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Mr. Steve Zappe, WIPP Project Leader
Hazardous Waste Permits Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 E. Rodeo Park Dr. Bldg. 1
Santa Fe, New Mexico 87505-6303

Subject: Transmittal of WIPP Annual Monitoring Reports

Dear Mr. Zappe:

The purpose of this letter is to provide you with the annual monitoring reports required by the WIPP Hazardous Waste Facility Permit (HWFP) No. NM4890139088—TSDF. The reports are listed below with the respective HWFP reporting requirement:

- Geotechnical Analysis Report for July 2001 – June 2002 (Volume I and II), HWFP Module IV.F.2b.
- Confirmatory Volatile Organic Compound and Mine Ventilation Rate Monitoring Annual Report, HWFP Modules IV.F.2.b and IV.F.3.b. respectively
- WIPP Site Environmental Report, calendar year 2002, Module V.J.2.c.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

If you have any questions regarding this data transmittal, please contact Mr. Jody Plum at (505) 234-7462.

Sincerely,

Inés Triay

Dr. Inés R. Triay, Manager
Carlsbad Field Office

S. D. Warren, General Manager
Washington TRU Solutions LLC

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DOE/WIPP 03-3177
Volume 1

Geotechnical Analysis Report for July 2001 – June 2002

March 2003

Waste Isolation Pilot Plant

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FOREWORD AND ACKNOWLEDGMENTS

This report contains an assessment of the geotechnical status of the Waste Isolation Pilot Plant (WIPP). During the excavation of the principal underground access and experimental areas, the status was reported quarterly. Since 1987, when the initial construction phase was completed, reports have been published annually. This report presents and analyzes data collected from July 1, 2001, to June 30, 2002.

This Geotechnical Analysis Report was written to meet the needs of several audiences. This report satisfies the requirements presented in the WIPP Hazardous Waste Permit[1] and the certification of compliance[2] with Title 40 *Code of Federal Regulations(CFR)* Parts 191, "Environmental Radiation Protection for Management and Disposal of Spent Fuel, High-Level and Transuranic Radioactive Wastes," and 194, "Criteria for the Certification and Re-certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations." It focuses on the geotechnical performance of the various components of the underground facility, including the shafts, shaft stations, access drifts, and waste disposal areas. The results of investigations of excavation effects and other geologic studies are also included. The report compares the geotechnical performance of the repository to the design criteria. It describes the techniques that were used to acquire the data and the performance history of the instruments. The depth and breadth of the evaluation of the different components of the underground facility vary according to the types and quantities of data available and the complexity of the recorded geotechnical responses. Graphic documentation of data and tabular documentation of instrument history can be provided upon request.

This Geotechnical Analysis Report was prepared by Washington TRU Solutions (WTS) for the U.S. Department of Energy (DOE), Carlsbad Field Office (CBFO), Carlsbad, New Mexico. Work was supported by the DOE under Contract No. DE-AC04-01AL66444.

[1] New Mexico Environment Department (NMED), 1999, "Waste Isolation Pilot Plant Hazardous Waste Facility Permit," NM4890139088-TSDF, Santa Fe, New Mexico
[2] Federal Register, Vol. 63, No. 95, pp. 27354, May 18, 1998

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Acronyms and Abbreviations

b.p.	before present
bsc	below shaft collar
CAO	Carlsbad Area Office
CBFO	Carlsbad Field Office
CFI	Closure from initial
CFR	Code of Federal Regulations
CH	contact-handled
cm	centimeter(s)
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
GAR	Geotechnical Analysis Report
GIS	geomechanical instrumentation system
in.	inch(es)
KPa	kilopascal(s)
LANL	Los Alamos National Laboratory
lb	pound(s)
m	meter(s)
Ma	millions of years
MB	marker bed
NMED	New Mexico Environment Department
OMB	orange marker bed
psi	pound(s) per square inch
RH	remote handled
SDD	system design descriptions
SNL/NM	Sandia National Laboratories/New Mexico
SPDV	Site Preliminary Design Validation
TRU	transuranic
WID	Waste Isolation Division
WIPP	Waste Isolation Pilot Plant
WTS	Washington TRU Solutions LLC
Yr(s)	year(s)

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1.0 Introduction

This Geotechnical Analysis Report (GAR) presents and interprets the geotechnical data from the underground excavations at the Waste Isolation Pilot Plant (WIPP). The data, which are obtained as part of a regular monitoring program, are used to characterize conditions, to compare actual performance to the design assumptions, and to evaluate and forecast the performance of the underground excavations.

GARs have been available to the public since 1983. During the Site and Preliminary Design Validation (SPDV) Program, the architect/engineer for the project produced these reports on a quarterly basis to document the geomechanical performance during and immediately after excavation of the underground facility. Since the completion of the construction phase of the project in 1987, the management and operating contractor for the facility has prepared these reports annually. This report describes the performance and condition of selected areas from July 1, 2001, to June 30, 2002. It is divided into ten chapters. The remainder of Chapter 1 provides background information on WIPP, its mission, and the purpose and scope of the geomechanical monitoring program. Chapter 2 describes the local and regional geology of the WIPP site. Chapters 3 and 4 describe the geomechanical instrumentation located in the shafts and shaft stations, present the data collected by that instrumentation, and provide interpretation of these data. Chapters 5, 6, and 7 present the results of geomechanical monitoring in the three main portions of the WIPP underground facility (the access drifts, the Northern Experimental Area, and the Waste Disposal Area). Chapter 8 discusses the results of the Geoscience Program, which include fracture and stratigraphic mapping, borehole and core logging, and borehole observations. Chapter 9 summarizes the results of the geomechanical monitoring and compares the current excavation performance to the design requirements. Chapter 10 lists the References and Bibliography.

1.1 Location and Description

WIPP is located in southeastern New Mexico, 26 miles (42 km) east of Carlsbad (Figure 1-1). The surface facilities were built on the flat to gently rolling hills that are characteristic of the Los Medaños area. The underground facility is being excavated approximately 2,150 feet [ft] (655 m) beneath the surface in the Salado Formation. Figure 1-2 shows a plan view of the current underground configuration of WIPP.

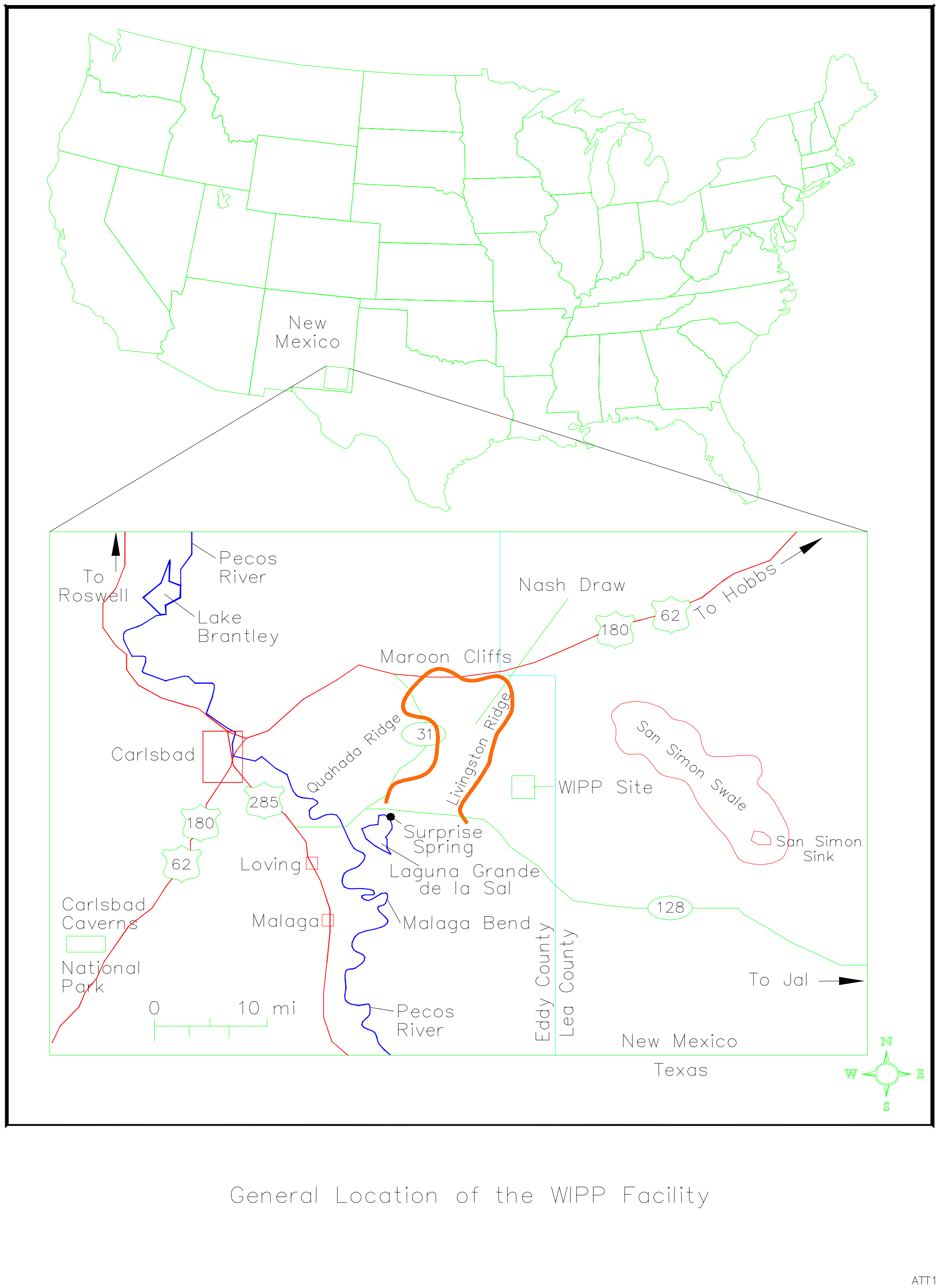


Figure 1-1
WIPP Location

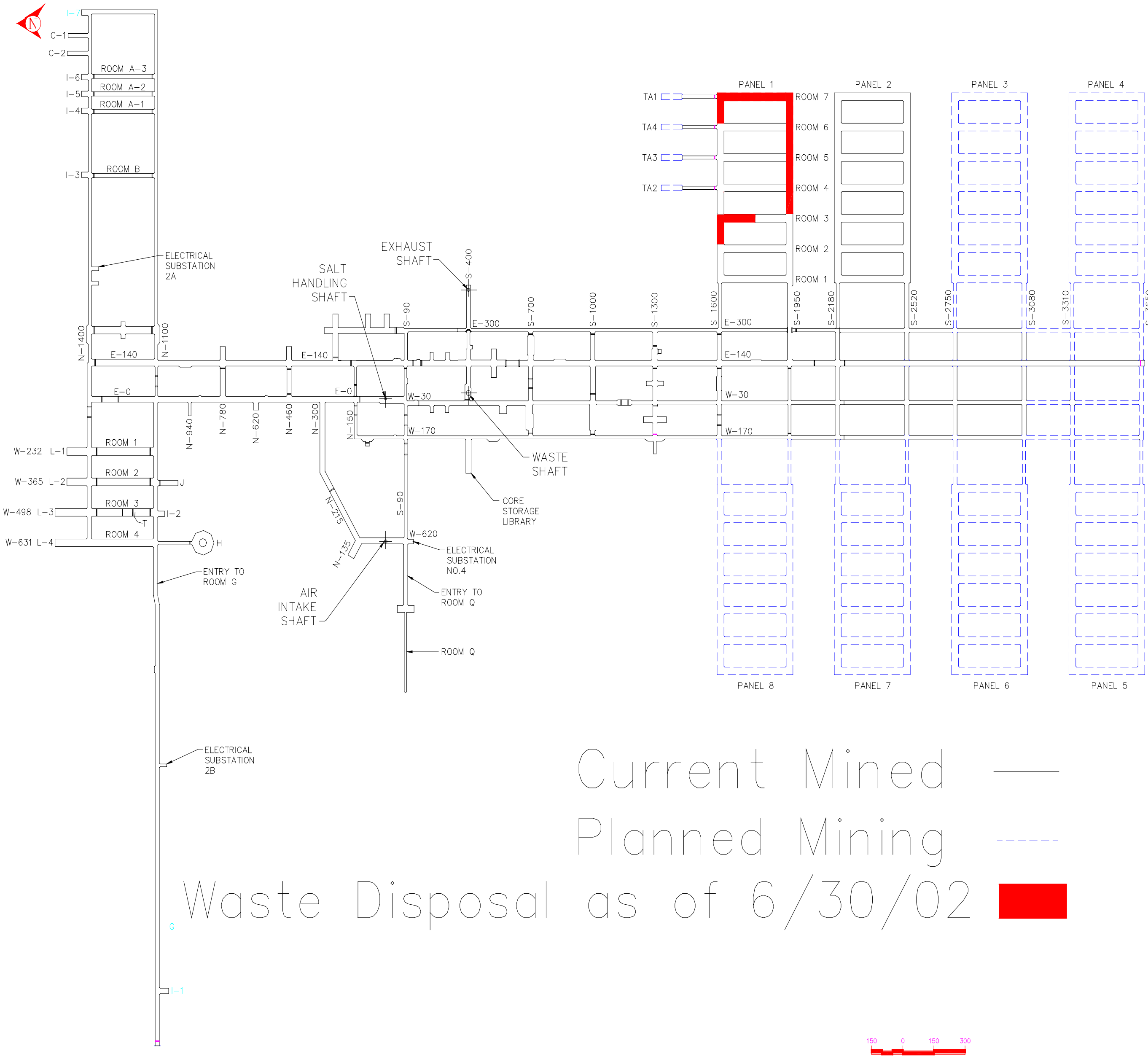


Figure 1-2
Current Underground Configuration

1.2 Mission

In 1979 Congress authorized WIPP (Public Law 96-164) to provide ". . . a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States exempted from regulation by the Nuclear Regulatory Commission." WIPP is intended to receive, handle, and permanently dispose of transuranic (TRU) waste and TRU mixed waste. To fulfill this mission, the U.S. Department of Energy (DOE) constructed a full-scale facility to demonstrate both technical and operational principles of the permanent disposal of TRU and TRU mixed wastes. Technical aspects are those concerned with the design, construction, and performance of the subsurface excavations. Operational aspects refer to the receiving, handling, and emplacement of TRU wastes in the facility. The facility was also used for in situ studies and experiments without the use of radioactive waste. These studies and experiments have been completed.

1.3 Development Status

To fulfill its mission, the DOE developed WIPP in a phased manner. The goal of the SPDV phase, begun in 1980, was to characterize the site and obtain in situ geotechnical data from underground excavations in order to determine whether site characteristics and the in situ conditions were suitable for a permanent disposal facility. During this phase, the Salt Handling Shaft, a ventilation shaft, a drift to the southernmost extent of the proposed waste disposal area, a four-room experimental panel, and access drifts were excavated. Surface-based geological and hydrological investigations were also conducted. The data obtained from the SPDV investigations were reported in the “Summary of the Results of the Evaluation of the WIPP Site and Preliminary Design Validation Program” (DOE, 1983).

Based upon the favorable results of the SPDV investigations, additional activities were initiated in 1983. These included the construction of surface structures, conversion of the ventilation shaft for use as the waste shaft, excavation of the exhaust shaft, development of additional access drifts to the Waste Disposal Area, excavation of the air intake shaft, and excavation of additional experimental rooms to support research and development activities. Geotechnical data acquired during this phase were used to evaluate the performance of the excavations in the context of established design criteria (DOE, 1984). Results of these evaluations were reported in Geotechnical Field Data and Analysis Reports

(DOE, 1985; DOE, 1986a) and were summarized in the Design Validation Final Report (DOE, 1986b).

The Design Validation Final Report concluded that the facility, including waste disposal areas, could be developed and operated to fulfill the long-term mission of WIPP (DOE, 1986b). However, some modifications to the reference design were proposed so that the requirements could be met for the anticipated life of the waste disposal rooms and the demonstration phase while the waste remained retrievable.

The original design for the waste disposal rooms allowed for a relatively short time in which to mine the salt and emplace waste. Each panel, consisting of seven disposal rooms, was scheduled to be mined, filled with waste containers, and closed in fewer than five years. Field studies, as part of the SPDV Program, proved that unsupported openings of a typical disposal room configuration at WIPP would remain stable and safe during the five-year period following excavation, and that closure from creep would not affect the operation of large equipment during that time. The information from these studies validated the design of underground openings to safely accommodate the permanent disposal of waste under routine operating conditions.

Panel 1 mining began in 1986 and was completed in 1988. Panel 1 was indented to receive waste for an initial operations demonstration and pilot plant phase that was scheduled to start in October 1988. This original plan was to place drums of contact-handled (CH) TRU waste in the disposal rooms for a period of up to 5 years. The waste in the disposal rooms would not be easily accessible, but the option to reenter would be maintained so that the waste could be removed, if required. Delays were encountered including obtaining a permit for waste disposal. To maintain roof stability, rock bolts were installed in the rooms.

In October 1996, the DOE submitted to the U.S. Environmental Protection Agency (EPA) a compliance certification application in accordance with Title 40 CFR Parts 191 and 194, which addressed the long-term (10,000-year) performance criterion for the disposal system. On May 18, 1998, the EPA published final certification that allows for the receipt of TRU waste at WIPP. Immediately prior to this certification, the DOE Carlsbad Area Office (CAO) completed the WIPP Operational Readiness Review, which was required before the startup of a nuclear waste repository. As a result of the review, the CAO notified the Energy Secretary on April 1, 1998, that WIPP was operationally ready to receive waste. On October 27, 1999, WIPP received the Hazardous Waste Facility Permit. On March 26, 1999, the first shipment of TRU waste was received from Los Alamos National Laboratory (LANL). By the end of June 2002, shipments of

TRU waste were being received at the WIPP site from LANL, Savannah River Site, Hanford Site, Rocky Flats Environmental Technology Site, and Idaho National Engineering and Environmental Laboratory.

Mining of Panel 2 began in September 1999 and was completed in August 2000. The South Mains for Panel 3 were completed in June of 2002. These drifts are mined to S3080 and consist of E300, E140, W30 and W170. Panels 3 through 8 have not been mined.

1.4 Purpose and Scope of Geomechanical Monitoring Program

As specified in the WIPP Hazardous Waste Facility Permit (NMED, 1999), the purpose of the geomechanical monitoring program is to obtain in situ data to support the continuous assessment of the design for underground facilities. Specifically, the program provides for:

- Early detection of conditions that could affect operational safety
- Evaluation of disposal room closure that ensures adequate access
- Guidance for design modifications and remedial actions
- Data for interpreting the behavior of underground openings, in comparison with established design criteria

Polling of the geomechanical instrumentation is performed at least monthly with higher frequency in some areas as deemed necessary. The data taken from the geomechanical instrumentation are evaluated and reported in this Geotechnical Analysis Report. This annual report fulfills the requirements set forth in Section IV.F.1 and Attachment M2, Section M2-5b(2) of the WIPP Hazardous Waste Facility Permit (NMED, 1999), and Title 40 CFR §191.14, "Assurance Requirements" implemented through the certification criteria, Title 40 CFR Part 194.

The geomechanical instrumentation system (GIS) provides data that are collected, processed, and stored for analysis. The following subsections briefly describe the major components of the GIS.

1.4.1 Instrumentation

Instruments installed for measuring the geomechanical response of the shafts, drifts, and other underground openings include convergence points, convergence meters, extensometers, rock bolt load cells, pressure cells, strain gauges, piezometers, and joint meters. Table 1-1 lists a summary of the geomechanical instrumentation specifications.

Table 1-1
Geomechanical Instrumentation System

Instrument Type	Measures	Range[a]	Resolution[a]
Sonic probe borehole extensometer	Cumulative deformation	0–2 in.	0.001 in.
Convergence points	Cumulative deformation	2–50 ft	0.001 in.
Wire convergence meters	Cumulative deformation	0–3.5 ft	0.001 in.
Sonic probe convergence meters	Cumulative deformation	0–25 ft	0.001 in.
Embedded strain gauges	Cumulative strain	0–3000 μin./in.	1 μin./in.
Spot-welded strain gauges	Cumulative strain	0–2500 μin./in.	1 μin./in.
Rock bolt load cells	Load	0–50 tons	40 lb
Earth pressure cells	Pressure	0–1000 psi	1 psi
Piezometers	Fluid pressure	0–500 psi	0.5 psi
Joint Meters	Cumulative deformation	0–4 in.	0.001 in.
Vibrating wire borehole extensometer	Cumulative deformation	0–4 in.	0.001 in.
Wire borehole extensometer	Cumulative deformation	0–3.5 in.	0.001 in.
Linear potentiometric borehole extensometer	Cumulative deformation	0–6 in.	0.001 in.

[a] Manual read out boxes for the instruments were manufactured to output measurements in English units. Range and resolution measurement units have not been converted to metric units. Measurements from these instruments have been converted for presentation elsewhere in this report.

ft = foot (feet).
in. = inch(es).
μin. = 10^{-6} inch(es).
psi = pound(s) per square inch.
lb = pound(s).

1.4.2 Data Acquisition

The individual geomechanical instruments are read either manually using portable devices or remotely by electronically polling the stations from the surface in accordance with approved operating procedures. Remotely read instruments are connected to one of the data loggers located underground and readings are collected by initiating the appropriate polling routine. Upon completion of a verification process, the data are transferred to a computer database. The manual readout devices are taken to the instrument locations underground. The data are recorded on a data sheet and later entered into a software database along with the remotely acquired data.

The underground data acquisition system consists of instruments, polling devices, and a communications network. One or more instruments are connected to a polling device. The polling devices are installed in electrical enclosures near the location of the instrument to facilitate queries of each individual instrument. The polling devices are connected by a datalink to a surface computer.

Whether acquired manually or remotely, geomechanical data are entered into the database files of the GIS data processing system. The data processing system consists of computer programs that are used to enter, reduce, and transfer the data to permanent storage files. Additional routines allow access to these permanent storage files for numerical analysis, tabular reporting, and graphical plotting. Copies of the instrumentation database and data plots are available upon request[3].

1.4.3 Data Evaluation

Closure measurements are acquired manually from convergence point anchors and remotely from convergence meters. The data are presented in plots as closure versus time.

Extensometers provide relative displacement data at various depths in the rock strata acquired from sensors installed in a borehole. Displacement is measured relative to a fixed point. Extensometers consist of rods that are anchored in a borehole at various depths. The deepest anchor is fixed in what is assumed to be undisturbed ground and is used as the reference point. Similar to convergence plots of displacement versus time and rate of

[3] Instrumentation data and data plots are available in "Geotechnical Analysis Report for July 2001–June 2002 Supporting Data." This document is available upon request from Washington TRU Solutions. See back side of cover sheet for details and addresses.

displacement versus time for individual anchors relative to the reference point are presented. Typically, the plots show greater relative ground movement near the collar (i.e., the opening of the hole).

The annualized closure rate is calculated as follows:

$$rate(inches / year) = (cfi_2 - cfi_1)/(date_2 - date_1) \times 365.25\, days / year$$
$$where\ cfi = the\ change\ from\ the\ initial\ reading\ (inches)$$
$$cfi_1 = cfi\ reading\ closest\ to\ the\ beginning\ of\ the\ reporting\ period$$
$$cfi_2 = cfi\ reading\ closest\ to\ the\ end\ of\ the\ reporting\ period$$

Rock bolt load cells are used to determine bolt loading. Plots show load versus time for each instrumented bolt.

Earth pressure cells and strain gauges are used to determine the stresses and deformations in and around the shaft liners, and data are depicted in time-based plots.

Piezometers used to measure the gauge pressure of groundwater are installed in the shafts at varying elevations to monitor the hydraulic head acting on the shaft liners. Data from piezometers are plotted as pressure versus time.

Joint meters, installed perpendicular to a crack, monitor the dilation of the crack with time. Data from these are typically presented as displacement versus time and rate of displacement versus time.

1.4.4 Data Errors

As described above, GIS data are processed through a comprehensive database management system. Whether acquired manually or remotely, GIS data are processed and permanently stored according to approved procedures. On occasion, erroneous readings can occur. There are several possible explanations for erroneous readings including the following:

- The measuring device was misread.
- The reading was recorded incorrectly.

- The measuring device was not functioning within specifications.

When a reading is believed to be erroneous, an immediate evaluation of the previous reading is performed, and a second reading is collected. If the second reading falls in line with the instrument trend, the first reading is discarded and the second reading is entered in the database. If the second reading and subsequent readings remain out of the instrument trend, the ground conditions in the vicinity of the instrument are assessed to determine the reason for the discrepancy. In addition, reading frequency may be increased. This process to correct erroneous readings is documented and filed for future reference.

2.0 Geology

This chapter provides a summary of the stratigraphy of the WIPP region and the facility stratigraphy. Readers desiring further geologic information may consult the "Geological Characterization Report, WIPP Site, Southeastern New Mexico" (Powers et al., 1978). This report was developed as a source document on the geology of the WIPP site for individuals, groups, or agencies seeking basic information on geologic history, hydrology, geochemistry, or detailed information, such as physical and chemical properties of repository rocks. A more recent survey of WIPP stratigraphy is included in Holt and Powers (1990).

2.1 Regional Stratigraphy

The stratigraphy in the vicinity of the WIPP site includes rocks and sediments of Permian (286 to 245 million years ago [Ma]), Triassic (245 to 208 Ma), and Quaternary (1.6 Ma to present) ages. The generalized descriptions of formations provided in this section are given in order of deposition (oldest to youngest), beginning with the Castile Formation (Figure 2-1).

The Permian system in the United States is divided into four series. The last of these, the Ochoan Series, contains the host rock in which the WIPP facility is located. The Ochoan Series is of mostly marine origin and consists of four formations: three evaporite formations (the Castile, the Salado, and the Rustler) and one redbed formation (the Dewey Lake). The Ochoan evaporites overlie marine limestones and sandstones of the Guadalupian Series (Delaware Mountain Group). The younger redbeds represent a transition from the lower evaporite deposition to fluvial deposition on a broad, low-relief, fluvial plain. Fluvial deposits of the Triassic and Quaternary periods complete the stratigraphic column.

2.1.1 Castile Formation

The Castile Formation, lowermost of the four Ochoan formations, is approximately 1,250-ft (380 m) thick in the WIPP vicinity. Lithologically, the Castile is the least complex of the evaporite formations and is composed chiefly of interbedded anhydrite and halite, with limestone present in minor amounts.

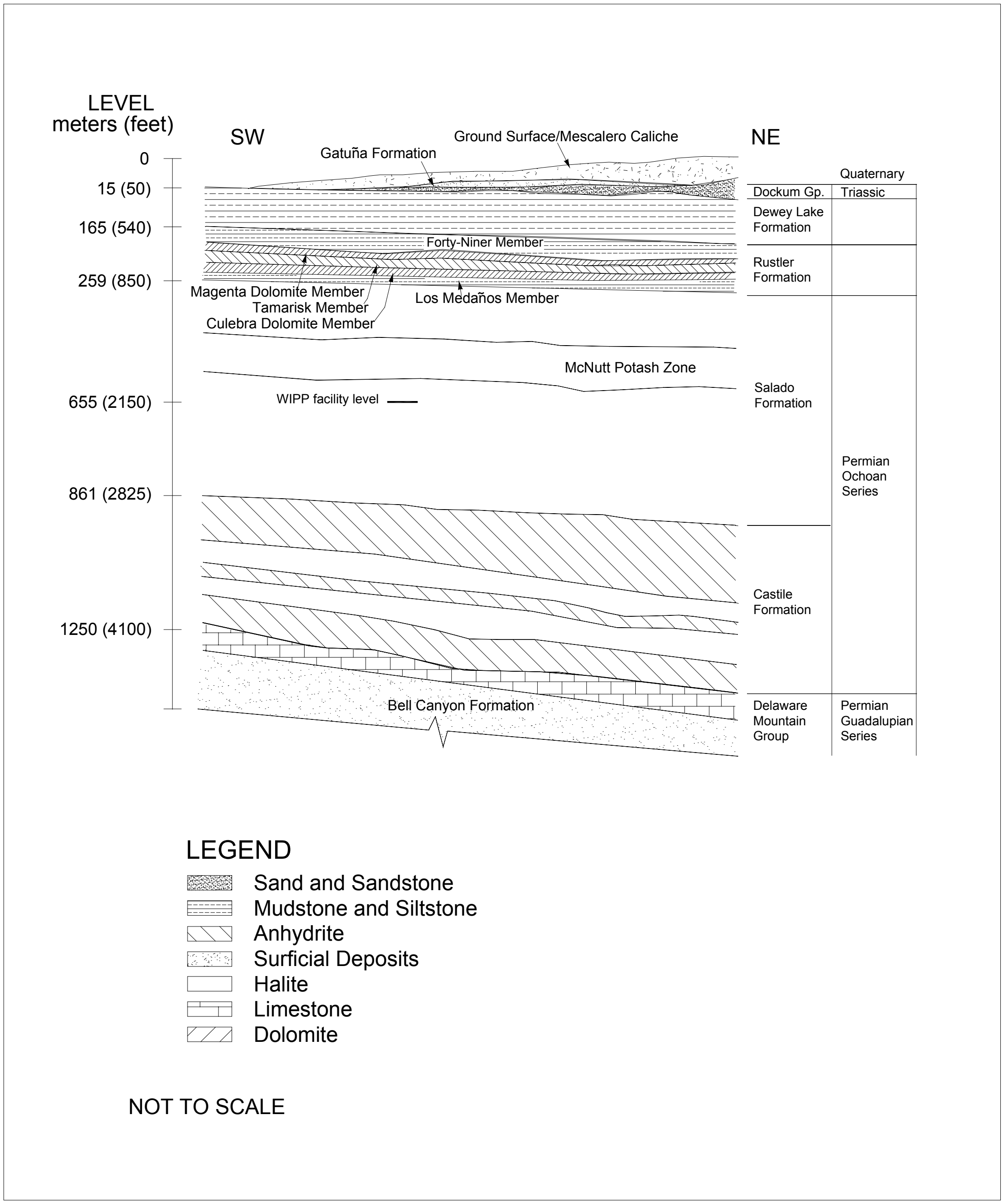


Figure 2-1
Regional Geology

2.1.2 Salado Formation

The Salado Formation comprises nearly 2,000-ft (610 m) of evaporites (primarily halite). The formation is subdivided into three informal members, the unnamed lower member, the McNutt potash zone, and the unnamed upper member. Each member contains similar amounts of halite, anhydrite, and polyhalite and is differentiated on the basis of soluble potassium and magnesium-bearing minerals. The WIPP disposal horizon is located within the unnamed lower member, 2,150-ft (655 m) below the surface.

2.1.3 Rustler Formation

The Rustler Formation is the uppermost of the three Ochoan evaporite formations and contains the largest proportion of clastic material of the three. The Rustler is subdivided into five members as follows (from the base): the Los Medaños Member, the Culebra Dolomite Member, the Tamarisk Member, the Magenta Dolomite Member, and the Forty-niner Member.

In the vicinity of the WIPP site the Rustler is about 310-ft (95 m) thick and thickens to the east. The lower portion (Los Medaños Member) contains primarily fine sandstone to mudstone with lesser amounts of anhydrite, polyhalite, and halite. Bedded and burrowed siliciclastic sedimentary rocks with cross-bedding and fossil remains signify the transition from the strongly evaporitic environments of the Salado to the brackish lagoonal environments of the Rustler (Holt and Powers, 1990).

The upper portion of the Rustler contains interbeds of anhydrite, dolomite, and mudstone. The Culebra Dolomite member is generally brown, finely crystalline and locally argillaceous. The Culebra contains rare to abundant vugs with variable gypsum and anhydrite filling and is the most transmissive hydrologic unit within the Rustler. The Tamarisk Member consists of lower and upper sulfate units separated by a unit that varies laterally from mudstone to mainly halite. The Magenta Dolomite Member is a gypsiferous dolomite with abundant primary sedimentary structures and well-developed algal features. The Forty-Niner Member is a mudstone that displays sedimentary features and bedding relationships indicating sedimentary transport and deposition on a mudflat. East of the site area, halite correlates with the mudstone. The Culebra and Magenta Dolomite members are persistent and serve as important marker units.

2.1.4 Dewey Lake Redbeds

The Dewey Lake Redbeds are the uppermost of the Ochoan Series formations in the WIPP vicinity. Within the series, the Dewey Lake represents a transition from the lower marine-influenced evaporite deposition to fluvial deposition on a broad, low-relief, fluvial plain. The redbeds, about 475-ft (145 m) thick, consist of predominantly reddish-brown interbedded fine-grained sandstone, siltstone, and claystone. The formation is differentiated from other formations by its lithology and distinctive color (both of which are remarkably uniform), and sedimentary structures, including horizontal- and cross-laminae and ripple marks. The redbeds also contain locally abundant greenish-gray reduction spots and gypsum-filled fractures. The formation thickens from west to east due to eastward dips and erosion to the west.

2.1.5 Dockum Group

The Dockum Group consists of fine-grained floodplain sediments and coarse alluvial debris of Triassic age. At the WIPP site, the Dockum Group pinches out near the center of the site and thickens eastward as an erosional wedge. Local subdivisions of the Dockum Group are the Santa Rosa Sandstone and the Chinle Formation; however, only the Santa Rosa occurs in the vicinity of the site. The Santa Rosa consists primarily of poorly sorted sandstone with conglomerate lenses and thin mudstone partings and contains impressions and remnants of fossils. These rocks have more variegated hues than the underlying uniformly colored Dewey Lake.

2.1.6 Gatuña Formation, Mescalero Caliche, and Surficial Sediments

Quaternary Period deposits include the Gatuña Formation, Mescalero Caliche, and surficial sediments. The Gatuña Formation (ranging in age from approximately 13 Ma to 600,000 years before present [b.p.] [Powers and Holt, 1993]) is a stream-laid deposit overlying the Dockum Group in the WIPP vicinity. At the site center the formation consists of about 13-ft (4 m) of poorly consolidated sand, gravel, and silty clay. The Gatuña Formation is light red and mottled with dark stains. The unit contains abundant calcium carbonate but is poorly cemented. Sedimentary structures are abundant (Powers and Holt, 1993, 1995).

The Mescalero Caliche (approximately 500,000 years b.p.) is about 4 ft (1.2 m) thick in the WIPP vicinity. The Mescalero is a hard, resistant soil horizon that lies beneath a cover of wind-blown sand. The horizon is petrocalcic, or very strongly cemented with calcium carbonate. Petrocalcic horizons form slowly beneath a stable landscape at the average depth of infiltration of soil moisture and are an indicator of stability and integrity of the

land surface. Many of the surface buildings at WIPP are founded on top of the Mescalero Caliche.

Surficial sediments include sandy soils developed from eolian material and active dune areas. The Berino Series (a soil type) covers about 50 percent of the site and consists of deep sandy soils that developed from wind-worked material of mixed origin. Based on sample analyses, the Berino soil from the WIPP site formed 330,000 ± 75,000 years ago.

2.2 Underground Facility Stratigraphy

The WIPP disposal horizon lies in the approximate center of the Salado Formation. The Salado was deposited in a shallow saline lagoon environment, which progressed through numerous inundation and desiccation cycles that are reflected in the formation. An "ideal" cycle progresses upward as follows: a basal layer consisting predominantly of claystone, followed by a layer of sulfate, which is in turn followed by a layer of halite. The entire sequence is capped by a bed of argillaceous (clay-rich) halite accumulated during a period of mainly subaerial exposure.

A regional system used for numbering the more significant sulfate beds within the Salado designates these beds as marker beds (MB) 100 (near the top of the formation) to MB144 (near the base). The repository is located between MB138 and MB139 (Figure 2-2) within a sequence of laterally continuous depositional cycles as described above. Within this sequence, layers of clay and anhydrite that are locally designated (as shown) can have a significant impact on the geomechanical performance of the excavations. Clay layers provide surfaces along which slip and separation can occur, whereas anhydrite acts as a brittle unit that does not deform plastically.

2.2.1 Disposal Horizon Stratigraphy (Panels 1, 2, 7, and 8)

Most underground excavations are located within this disposal horizon (see Figure 2-2). In this horizon, the Orange Marker Bed (OMB) typically occurs near mid-rib. The OMB is a laterally consistent unit of moderately to light reddish-orange halite, typically about 6 in. (15 cm) thick that is used as a point of reference for disposal area excavation.

MB139 typically lies about 5-ft (1.5 m) below the excavation floor. MB139 is a 20 to 32 in. (50- to 80-cm) thick layer of polyhalitic anhydrite. The top of the anhydrite undulates up to 15 in. (38 cm) while the bottom is subhorizontal and is underlain by clay "E." Above

MB139 is a unit of halite that terminates at the base of the OMB. Within this unit, polyhalite is locally abundant and decreases upward, while argillaceous material increases upward.

Above the OMB, a thin sequence of argillaceous halite gives way to a thick sequence of clear halite that becomes increasingly argillaceous upward and is capped by clay "F." Clay "F" occurs as a thin layer occasionally interrupted by partings and breaks and is readily visible in the upper ribs of disposal horizon excavations, usually about 24 in. (60 cm) below the roof.

Above clay "F," another sequence of halite begins that, as in lower sequences, becomes increasingly argillaceous upward. This sequence terminates at the clay "G"/Anhydrite "b" interface, about 6.5 ft (2 m) above the roof of most disposal horizon excavations forming the first roof beam. The roof of some disposal horizon excavations (e.g. E140 drift between S1000 and S1950), has been excavated to the upper contact of Anhydrite "b." Another depositional sequence begins with Anhydrite "b" and progresses upward to the clay "H"/Anhydrite "a" interface, typically about 13-ft (4 m) above the roof. Where disposal horizon excavations have been trimmed to the upper contact of Anhydrite "b." This sequence between the new roof and the clay "H"/Anhydrite "a" interface forms the first roof beam.

2.2.2 Disposal Horizon Stratigraphy (Panels 3, 4, 5, and 6)

In this horizon (See Figure 2-3), the OMB typically occurs at or below the floor. MB139 typically lies about 12 feet (3.7 m) below the excavation floor. At the floor level, a thin sequence of argillaceous halite gives way to a thick sequence of clear halite that becomes increasingly argillaceous upward and is capped by clay "F." Clay "F" occurs as a thin layer occasionally interrupted by partings and breaks and is readily visible in the ribs of disposal horizon excavations, usually about 9 ft. (2.7 m) below the roof.

Above clay "F," another sequence of halite begins that, as in lower sequences, becomes increasingly argillaceous upward. This sequence terminates at the clay "G"/Anhydrite "b" interface. The roof is immediately above Anhydrite "b." Clay "G"/Anhydrite "b" are used as the mining reference at this disposal horizon.

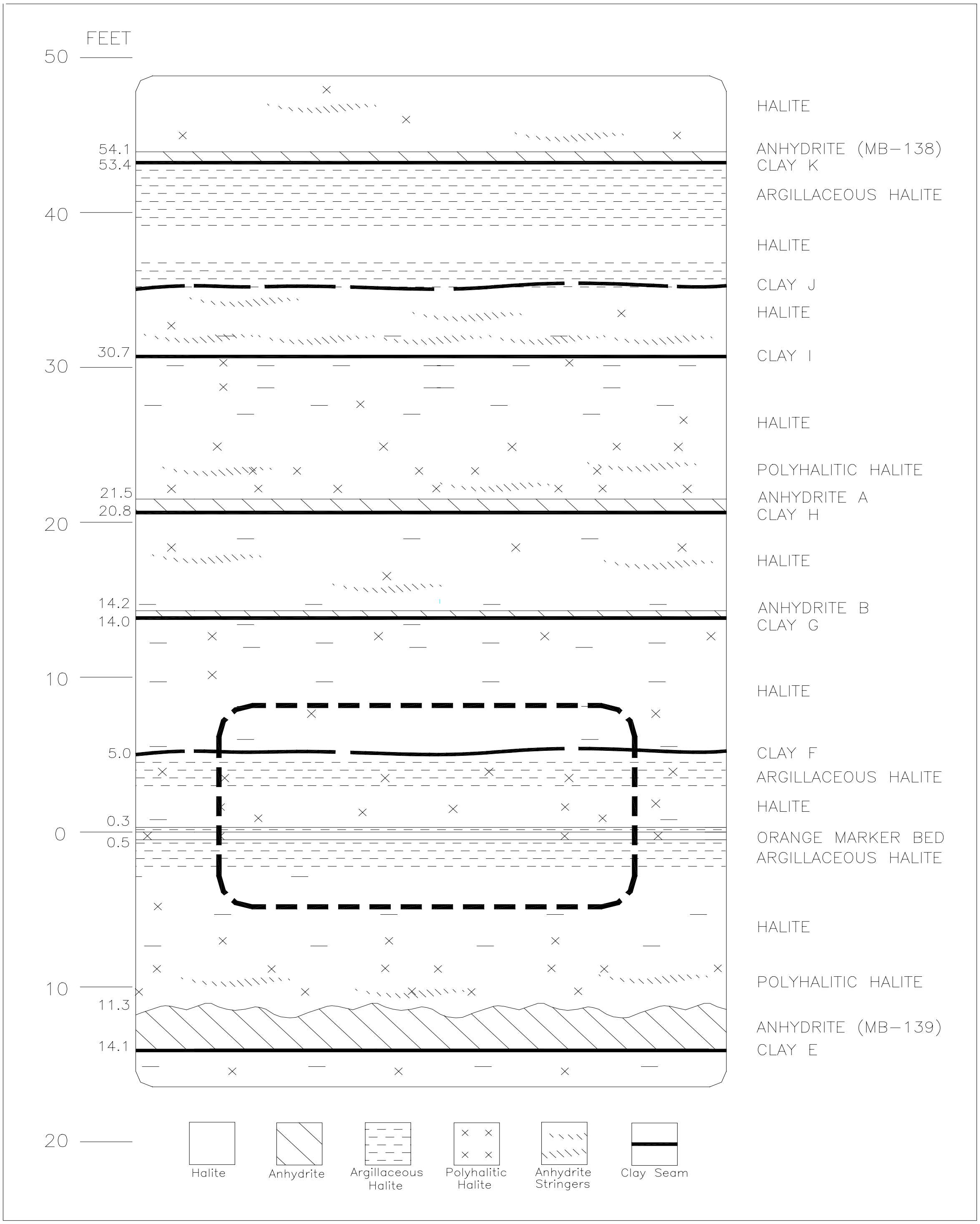


Figure 2-2
Repository Level Stratigraphy (Panels 1, 2, 7, and 8)

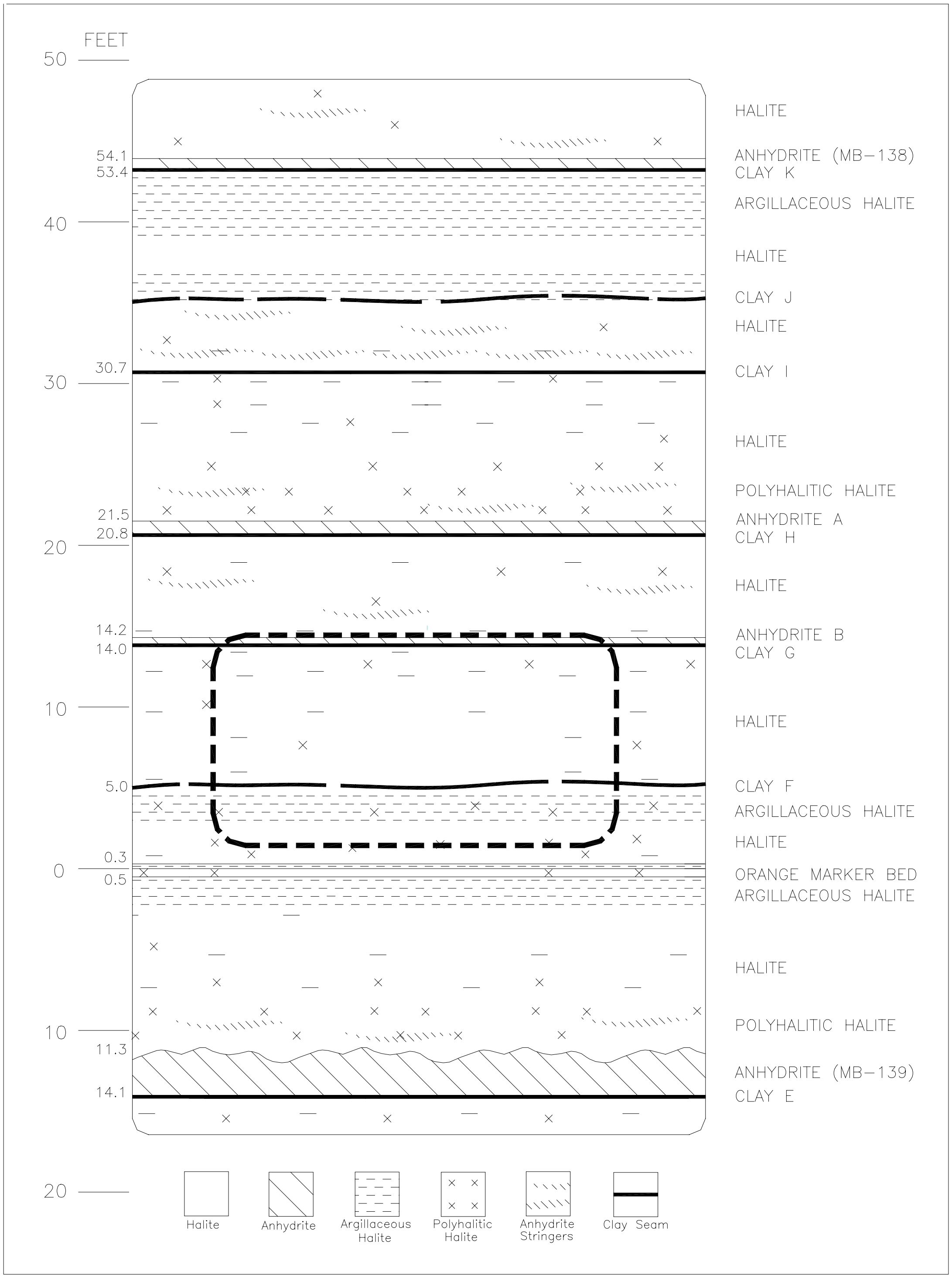


Figure 2-3
Repository Level Stratigraphy (Panels 3, 4, 5, and 6)

2.2.3 Experimental Area Stratigraphy

Some excavations located in the eastern wing of the Northern Experimental Area (deactivated and closed during this reporting period) lie at a higher stratigraphic level than the disposal excavations. These excavations typically have floors excavated at Anhydrite "B." As in the lower units, the halite intervals between the clay seams/anhydrite beds contain relatively pure halite that becomes increasingly argillaceous upward. Above clay "I," two more halite intervals complete the underground facility stratigraphy. Clay "J," at the top of the first of these intervals, may occur as a distinct seam or merely an argillaceous zone. Clay "K" tops the second interval and is overlain by anhydrite MB138.

3.0 Performance of Shafts and Keys

Four shafts connect the surface with the WIPP underground facility. The four shafts are the Salt Handling Shaft which is primarily used for removing excavated salt from the underground; the Waste Shaft which is the primary shaft for transporting men and materials between the surface and the underground and is used for transporting the TRU waste to the underground disposal area; the Exhaust Shaft used to exhaust the ventilation air from the underground; and the Air Intake Shaft which is the primary source of fresh air ventilation to the underground. This chapter describes the geomechanical performance of these shafts.

There are currently no plans to replace failed instrumentation installed in any of the shafts. The project currently has a good understanding of the expected movements in the shafts. The monitoring results, up to the point of instrument failure, did not indicate any unusual shaft movements or displacements. Continued periodic visual inspections confirm the expected shaft performance and provide necessary observations to evaluate shaft performance. It is anticipated that replacement of the failed instrumentation will not provide significant additional information.

3.1 Salt Handling Shaft

The first construction activity undertaken during the SPDV Program was the excavation of the Exploratory Shaft. This shaft was subsequently referred to as the Construction and Salt Handling Shaft and is currently designated the Salt Handling Shaft (see Figure 1-2). The shaft was drilled from July 4 to October 24, 1981, and geologic mapping was conducted in the spring of 1982 (DOE, 1983). Figure 3-1 presents the stratigraphy at the Salt Handling Shaft.

The Salt Handling Shaft is lined with steel casing and has a 10-ft (3-m) inside diameter from the ground surface to the shaft key at a depth of 846-ft (258 m). The steel liner has a thickness of 0.62 in. (1.6 cm) at the top, increasing with depth to a thickness of 1.5 in. (3.8 cm), including external stiffener rings, at the key. Cement grout is placed between the liner and rock face. The 10-ft (3-m) diameter extends through the concrete shaft key to a depth of 880-ft (268 m). The shaft key is a 37.5 ft - (11.4 m -) long reinforced-concrete structure at the base of the steel liner. The shaft from the key to the bottom of the shaft, at a depth of 2,298-ft (700 m), has a nominal diameter of 12-ft (4 m). Wire mesh anchored by rock bolts is installed in this portion as a safety screen to contain rock fragments that may

become detached. The shaft extends approximately 140-ft (43 m) below the facility horizon in order to accommodate the skip loading equipment and to act as a sump.

3.1.1 Shaft Observations

Underground operations personnel conduct weekly visual shaft inspections. These inspections are performed principally to assess the condition of the hoisting and mechanical systems, but they also include examining the shaft walls for water seepage, loose rock, or sloughing. The visual shaft inspections during this reporting period found that the Salt Handling Shaft was in satisfactory condition. Only routine ground control activities were required in the Salt Handling Shaft during this reporting period.

3.1.2 Instrumentation

Geomechanical instruments (extensometers, piezometers, and radial convergence points) were installed at various levels in the Salt Handling Shaft during April and July of 1982 (Figure 3-2). In the shaft key, instruments included strain gages, pressure cells, and piezometers (Figure 3-3). All of the extensometers in the Salt Handling Shaft are non-functional.

All 12 piezometers continue to provide data. The fluid pressures recorded at the end of this reporting period range from approximately 85 pounds per square inch (psi) (586 kilopascals [KPa]) at the 620-ft (188-m) level in the Magenta Dolomite Member to 145 psi (999 KPa) at the 726-ft (222-m) level in the Culebra Member. The recorded pressure of 85 psi (586 KPa) at the Magenta Dolomite Member represents a 35 percent decrease over the recorded pressure in the same location at the end of the previous reporting period. The pressure for the shaft liner will continue to be monitored on a regular basis.

Four earth pressure cells were installed in the key section of the Salt Handling Shaft during concrete emplacement at the 860-ft (262-m) level. These instruments measure the normal stress between the concrete key and the Salado Formation as the creep effects load on the key structure. Three of the four earth pressure cells continue to provide data, although all three indicate negative pressure. These instruments have essentially indicated no contact pressure since their installation (readings resemble instrument drift at a zero pressure). The contact pressures recorded by the instruments for this reporting period ranged from –9.5 to –30.2 psi (-65 to -208 KPa). Sixteen spot-welded and twenty-four embedment strain gages were installed on and in the shaft key concrete at both the 856.3-ft (261-m) level and at the

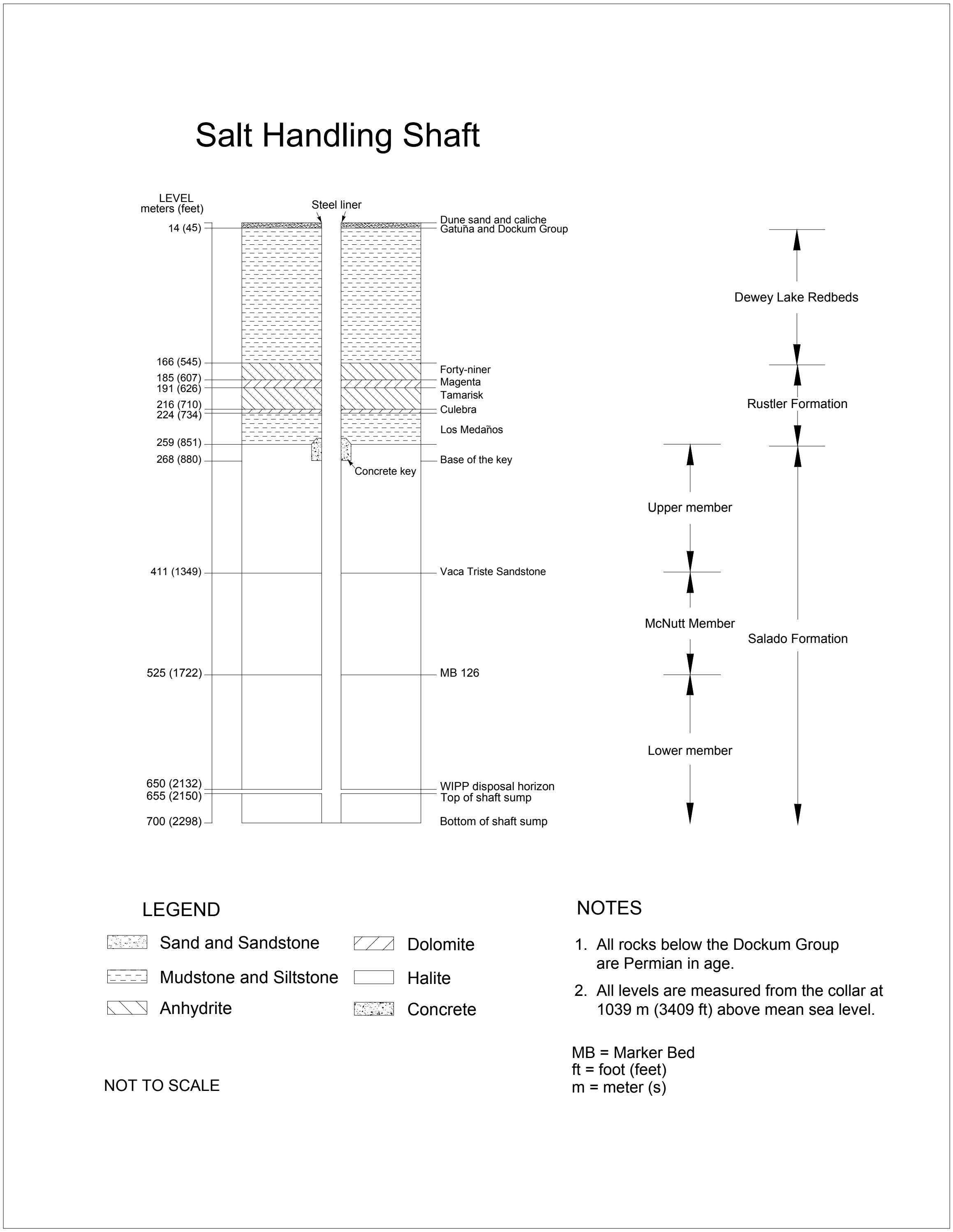


Figure 3-1
Salt Handling Shaft Stratigraphy

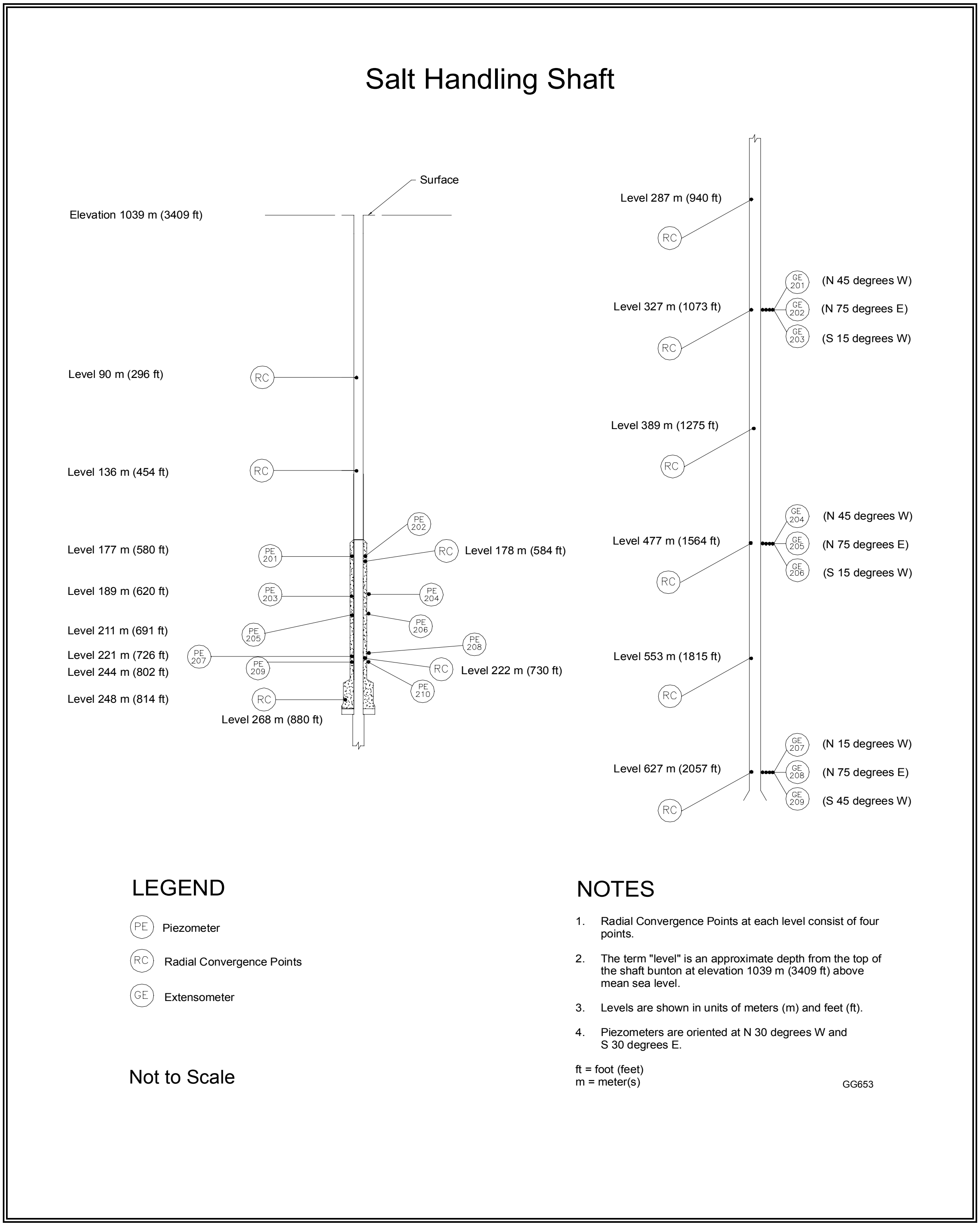


Figure 3-2
Salt Handling Shaft Instrumentation (Without Shaft Key)

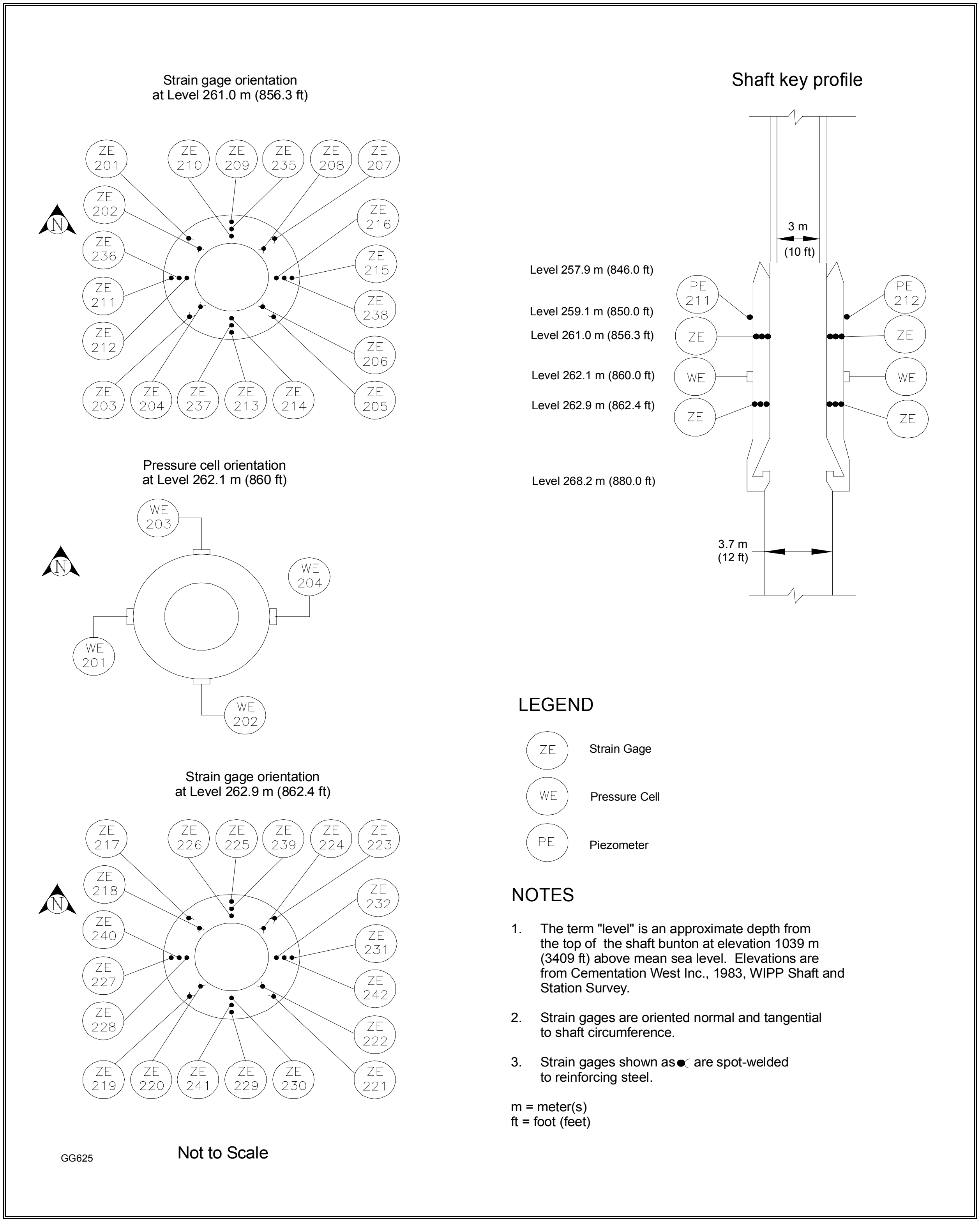


Figure 3-3
Salt Handling Shaft Key Instrumentation

862.4-ft (262.9-m) level. There are four functioning spot-welded strain gages located at these levels. The reported strains at the 856.3-ft (261-m) level were 589 and 727 microstrain. The reported strains at the 862.4-ft (262.9-m) level were 440 and 807 microstrain. The strains reported for this reporting period from the 12 embedment strain gages located at the 856.3-ft (261-m) level range from -914 microstrain to 950 microstrain. The strains reported for this reporting period from the 2 embedment strain gages located at the 862.4-ft (262.9-m) level range from -386 microstrain to 391 microstrain. The strains recorded from the spot-welded strain gages and the embedment strain gages are very similar to the recorded strains from these instruments at the end of the previous reporting period.

3.2 Waste Shaft

As part of the SPDV Program, a 6-ft (2-m) diameter ventilation shaft, now referred to as the Waste Shaft, was excavated from December 1981 through February 1982. This shaft, in combination with the Salt Handling Shaft, provided a two-shaft underground air circulation system. From October 11, 1983, to June 11, 1984, the shaft was enlarged to a diameter of 20 to 23 ft (6 to 7 m) and lined. Stratigraphic mapping (Figure 3-4) was conducted during shaft enlargement from December 9, 1983, to June 5, 1984 (Holt and Powers, 1984).

The Waste Shaft is lined with nonreinforced concrete and has a 19-ft (6-m) inside diameter from the ground surface to the top of the Waste Shaft key at 837-ft (255 m). Liner thickness increases with depth from 10 in. (25 cm) at the surface to 20 in. (51 cm) at the key. The Waste Shaft key is 63-ft (19 m) long and 4.25-ft (1.3 m) thick and is constructed of reinforced concrete. The bottom of the key is 900-ft (274 m) below the surface. The diameter of the shaft is 20-ft (6 m) at the point below the key and increases to 23-ft (7 m) just above the shaft station. The shaft below the key is lined with wire mesh anchored by rock bolts. The diameter of 23-ft (7 m) extends to a depth of approximately 2,286-ft (697 m) with the shaft sump comprising the lower 128-ft (39 m) of that interval.

3.2.1 Shaft Observations

Underground operations personnel conduct weekly visual shaft inspections. These inspections are performed principally to assess the condition of the hoisting and mechanical systems, but also include observation of the shaft walls for water seepage, loose rock, or sloughing. The visual shaft inspections during this reporting period found that the Waste Shaft was in satisfactory condition. No ground control activities other than routine maintenance were required in the Waste Shaft during this reporting period.

3.2.2 Instrumentation

Extensometers, piezometers, earth pressure cells, and radial convergence points were installed in the Waste Shaft between August 27 and September 10, 1984. Figures 3-5 and 3-6 illustrate the instrumentation configurations in the shaft and shaft key.

Nine multiposition borehole extensometers were installed in arrays at 1,071-ft (326 m), 1,566-ft (477 m), and 2,059-ft (628 m) below the surface as shown in Figure 3-5. Each array consists of three extensometers. Currently, seven out of nine extensometers remain functional. Table 3-1 summarizes information regarding collar displacement measurements from these extensometers.

Table 3-1
Collar Displacement at Waste Shaft Extensometers

Field Tag	Location Shaft Level	Date of Last Reading	Collar Relative to Deepest Anchor (inches)	Displacement 2001-2002 inches/year	Displacement Rate 2000-2001 inches/year	Rate Change Percent	Comments
31X-GE-00203	1071	06/05/02	0.202	0.002	0.010	-80%	
31X-GE-00204	1566	05/03/02	0.755	0.018	0.031	-42%	
31X-GE-00205	1566	05/03/02	0.638	0.016	0.029	-45%	
31X-GE-00206	1566	06/05/02	0.767	0.021	0.030	-30%	
31X-GE-00207	2059	06/05/02	1.923	0.060	0.064	-6%	
31X-GE-00208	2059	05/03/02	1.787	0.047	0.069	-32%	
31X-GE-00209	2059	06/05/02	2.036	0.067	0.080	-16%	

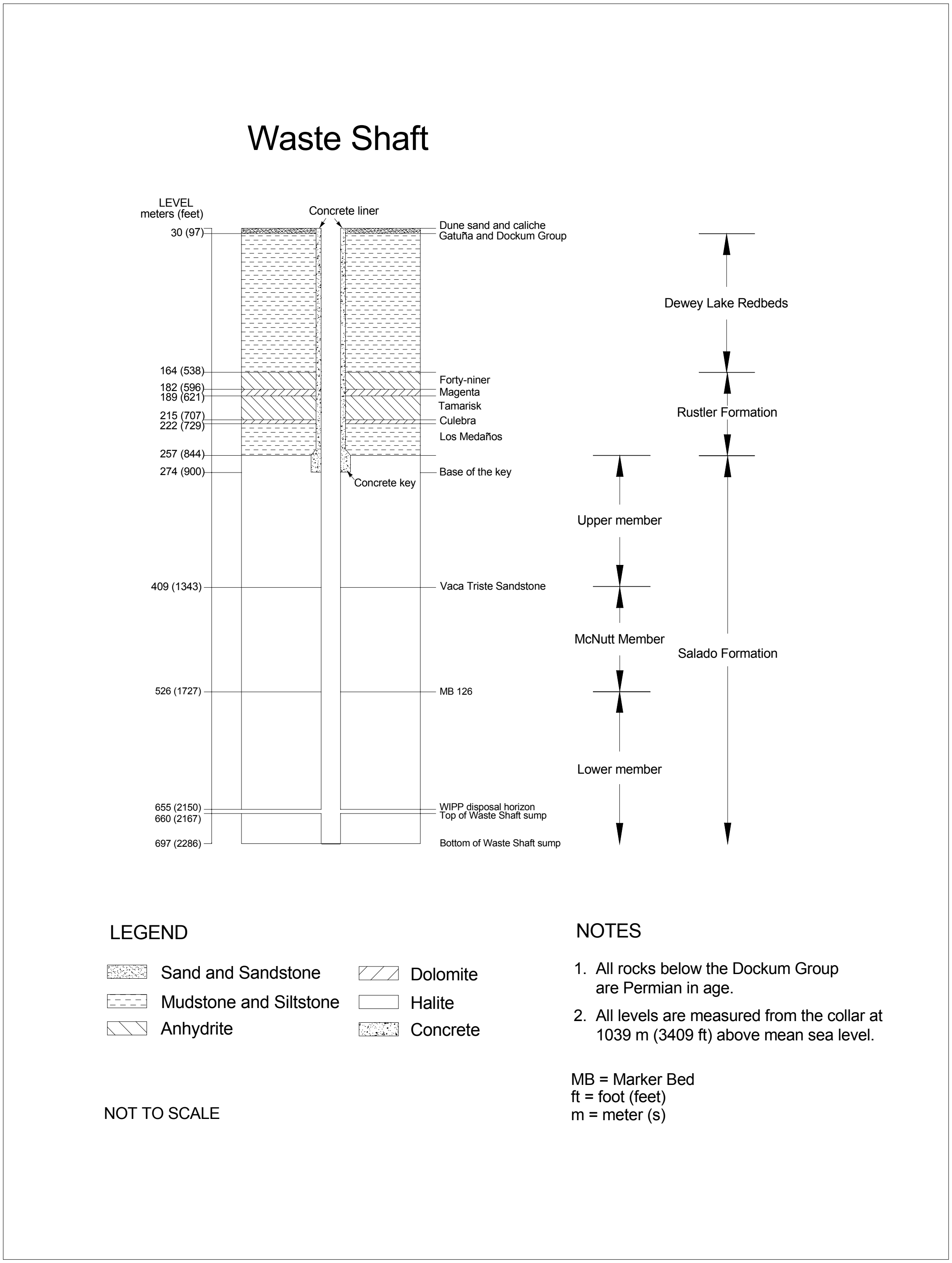


Figure 3-4
Waste Shaft Stratigraphy

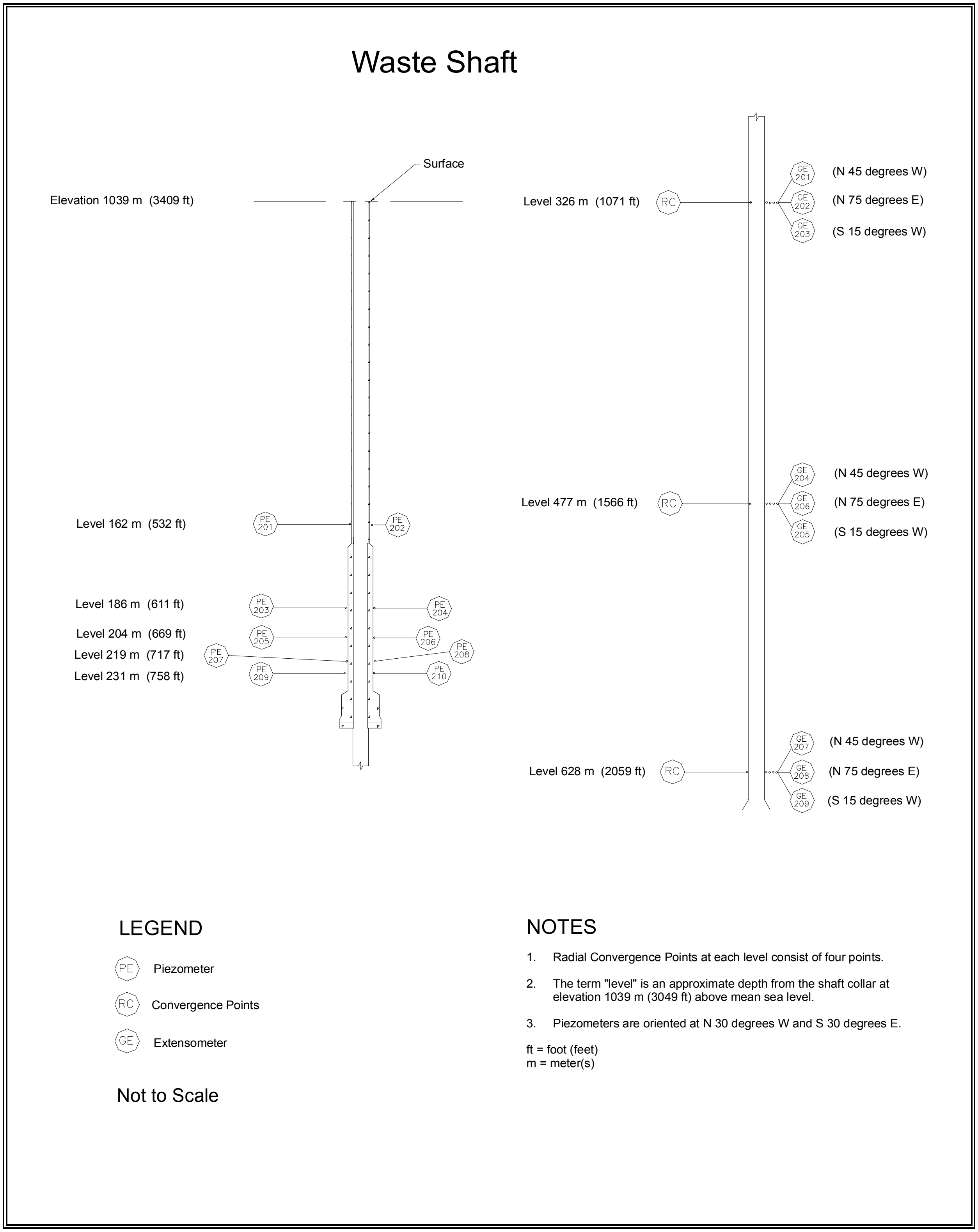


Figure 3-5
Waste Shaft Instrumentation (Without Shaft Key)

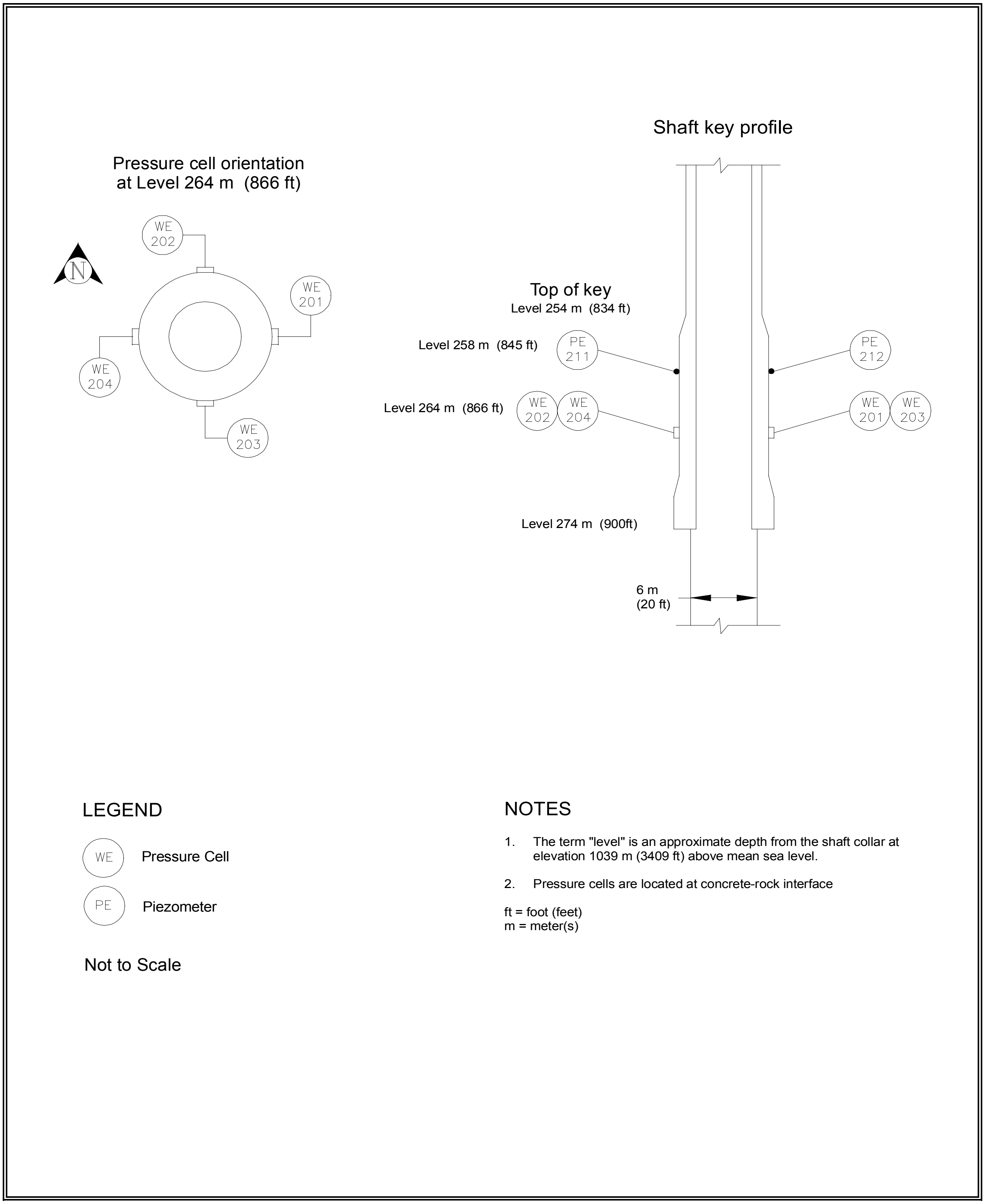


Figure 3-6
Waste Shaft Key Instrumentation

The collar displacement at the level 1,071-ft (326-meter) indicate an annual displacement rate[4] of 0.002 in./yr. (0.005 cm/yr.). This is a relatively slow displacement rate and represents a rate decrease of 80 percent when compared to the negligible annual collar displacement rate of 0.010 in./yr. (0.025 cm/yr.) from the previous reporting period. Overall, this displacement rate shows a decrease over the previous reporting period.

The collar displacement rates at the level 1,566-ft (477-meter) have remained similar relative to the rates from the previous reporting period. The annualized displacement rate for the three extensometers has decreased by approximately –30, -42, and -45 percent. At the 2,059-ft level (628 m) the collar displacement rate varied from a decrease of -6 percent for 31X-GE-00207 to a decrease of -16 and -32 percent at the other two installations. Again these rates are considered acceptable. There is no indication of shaft instability from routine inspections.

Twelve piezometers were installed in the lined section of the Waste Shaft on September 7 and 8, 1984, to monitor pressure behind the shaft liner and key section in the shaft. Data continue to be received from all 12 piezometers, although 5 of the 12 report zero or near zero fluid pressure. The recorded positive fluid pressures from the remaining 7 piezometers at the end of the reporting period range from 33 psi (227 KPa) at the Magenta Dolomite Member (611-ft [186 m] depth) up to greater than 146 psi (1,004 KPa) at the level where the shaft intersects the Culebra Dolomite Member (717-ft [218.5-m] depth).

Four earth pressure cells were installed in the key section of the Waste Shaft during concrete emplacement between March 23 and April 3, 1984. These instruments measure the normal stress between the concrete key and the Salado Formation as the salt creep loads the key structure. The contact pressure recorded by these four instruments has remained fairly constant over the past five years. The pressures of record during this reporting period are between 78 and 104 psi (536 and 715 KPa).

[4] Annual displacement rates are calculated as the difference in collar displacement readings from the first reading of the previous reporting period to the final reading of this reporting period divided by the time between those two readings, usually approximately one year.

3.3 Exhaust Shaft

The Exhaust Shaft was drilled from September 22, 1983, to November 29, 1984, to establish a route from the underground facility to the surface for exhaust air. Stratigraphic mapping was conducted from July 16, 1984, to January 18, 1985 (DOE, 1986c). Figure 3-7 illustrates the Exhaust Shaft Stratigraphy.

The Exhaust Shaft is lined with nonreinforced concrete from the surface to the top of the shaft key at a depth of 844-ft (257 m). The liner thickness increases from 10 to 16 in. (25 to 41 cm) over that interval. The Exhaust Shaft key is 63-ft (19 m) long and 3.5-ft (1 m) thick. The shaft diameter below the key is 15-ft (5 m) and the interval below the key is lined with wire mesh anchored by rock bolts. The shaft terminates at the facility horizon, at a depth of approximately 2,150-ft (655 m). There is no excavated shaft sump.

3.3.1 Exhaust Shaft Observations

Quarterly Exhaust Shaft video inspections are conducted following approved WIPP procedures. Inspections are performed to evaluate the condition and to verify the integrity of the shaft. The shaft is examined for cracks, corrosion, salt buildup, leaks and debris. In addition, inspections examine the condition of anchors, brackets, and down hole equipment. Between June 2001 and June 2002 four shaft inspections were conducted. Inspections were conducted on August 22, 2001, November 13, 2001, February 20, 2002 and May 9, 2002.

3.3.1.1 Video Camera

Video inspections of the Exhaust Shaft were conducted by the WTS Geotechnical Engineering Section using a custom designed vertical drop camera. The system consists of a color camera with pan, tilt and zoom capability. The camera is housed in an aerodynamic housing and suspended by a dual-armored cable. The cable consists of five copper conductors and two multi-mode optical fibers. The cable is reeled out by a winch mounted in a control van. The video inspections are recorded on VHS tape. Additionally, “still” pictures can also be taken of features both during and after the inspection.

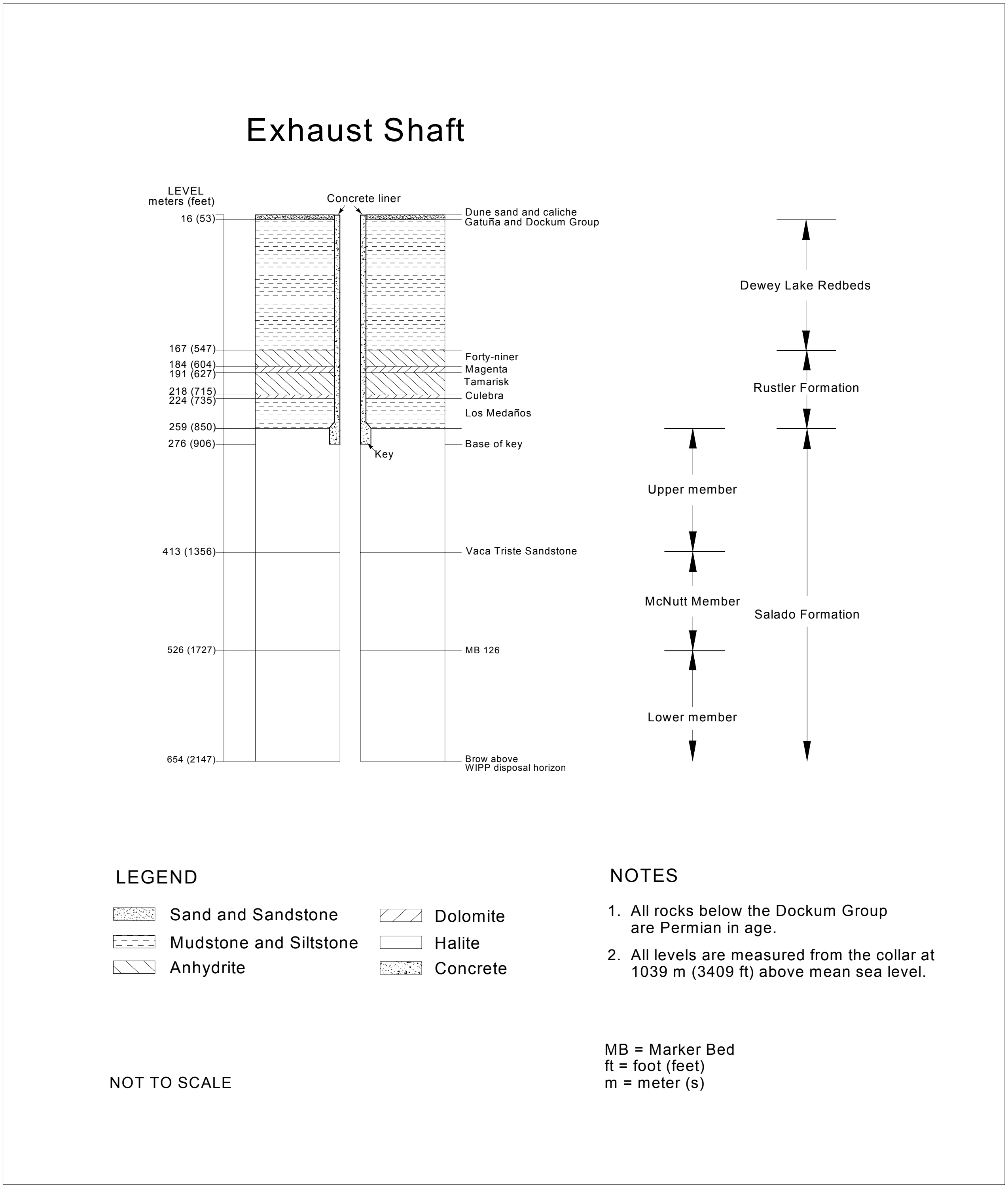


Figure 3-7
Exhaust Shaft Stratigraphy

3.3.1.2 Shaft Inspection Observations

Quarterly video inspection observations concentrate on four major areas; air monitoring systems, shaft liner, shaft walls, and equipment support and cabling. The air monitoring components consist of one air-velocity and three air-monitoring devices in the Exhaust Shaft, as shown in Figure 3-8. The video inspection includes examination of each device including the transport assembly, guide tubes, the sample intake and the support brackets which extends from Station A, located at the top of the Exhaust Shaft, to about 50 feet into the shaft, as shown in Figure 3-8. Video inspections indicate that the air-sampling components typically can accumulate salt buildup of-up-to several inches.

The Exhaust Shaft liner was examined for cracks, seepage and general shaft stability. Currently, there are two principal zones of seepage located in the shaft. The first is located at a depth of about 50-to-55 feet below the shaft collar (bsc). The second is located at a depth of about 80-to-85 feet bsc, as shown in Figure 3-9. Monitoring of these seepage horizons dates back prior to 1995. Water entering the shaft through these cracks is believed to originate from a perched anthropogenic water-bearing horizon located at the base of the Santa-Rosa Formation. The fluid level in the Santa Rosa near the shaft is at about 42 feet below ground surface. Based on examination of the inspection videos the flow rate into the shaft is estimated at about 1-to-3 gallons per minute.

Conditions in the shaft change as a function of several variables including, airflow, humidity, temperature, and underground mining activities (dust). The seepage cracks noted above are confined primarily to the eastern side of the shaft wall. During this reporting period, there does not appear to be any significant change in the quantity of fluid entering the shaft. This is confirmed by comparing annual records of the volume of fluid accumulating in the Exhaust Shaft catch basin located at the bottom of the Exhaust Shaft.

When fluid was detected seeping into the Exhaust Shaft in 1995, a catch basin was designed and installed at the base of the Exhaust Shaft to intercept and prevent water from draining into the Waste Shaft Sump. Fluid has been removed on an as-needed basis from the catch basin since March 1996. Table 3-2 presents the volume of fluid removal from the catch basin from July 1997 through June 2002. Over the past three years the volume

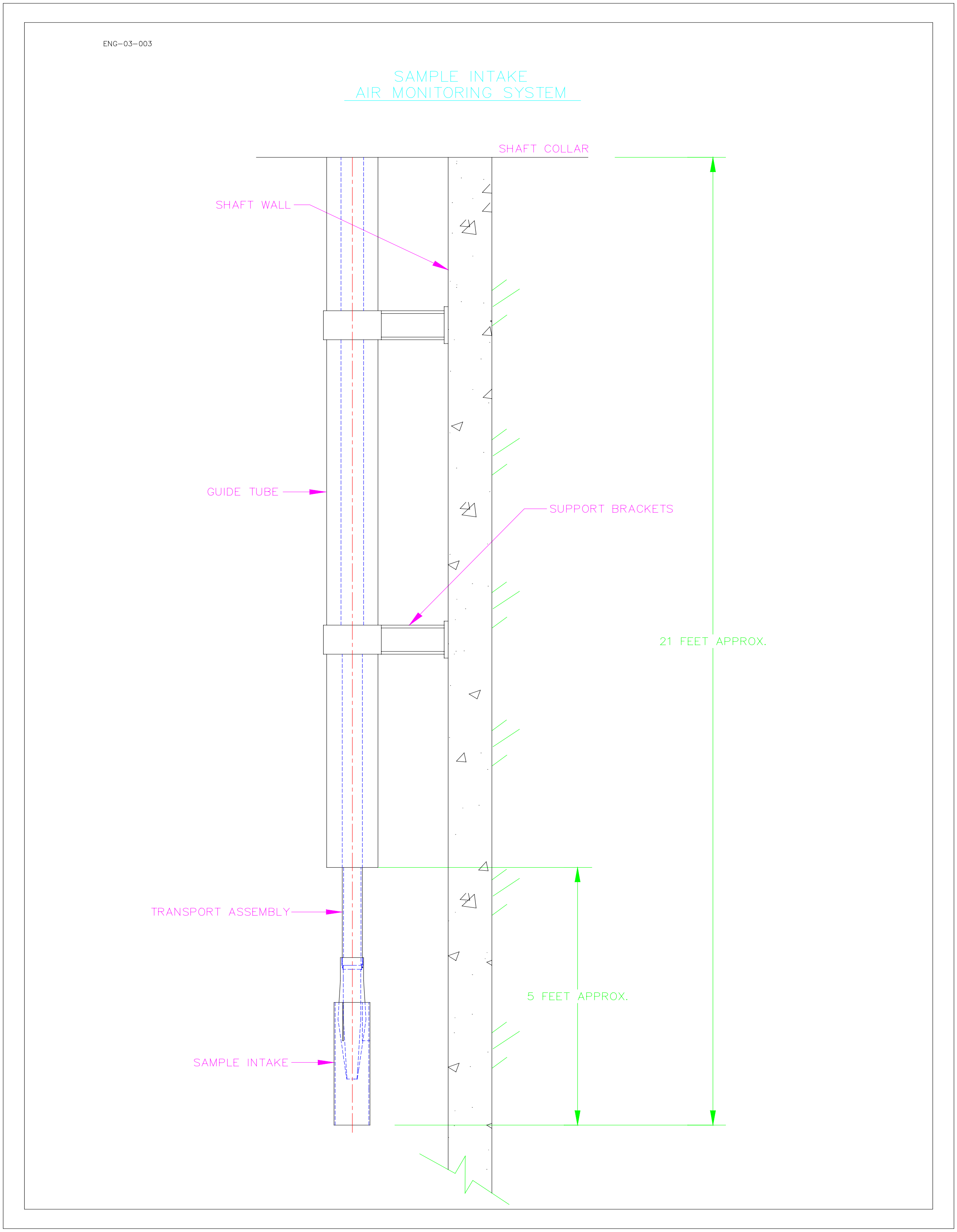


Figure 3-8
Sample Intake Air Monitoring System

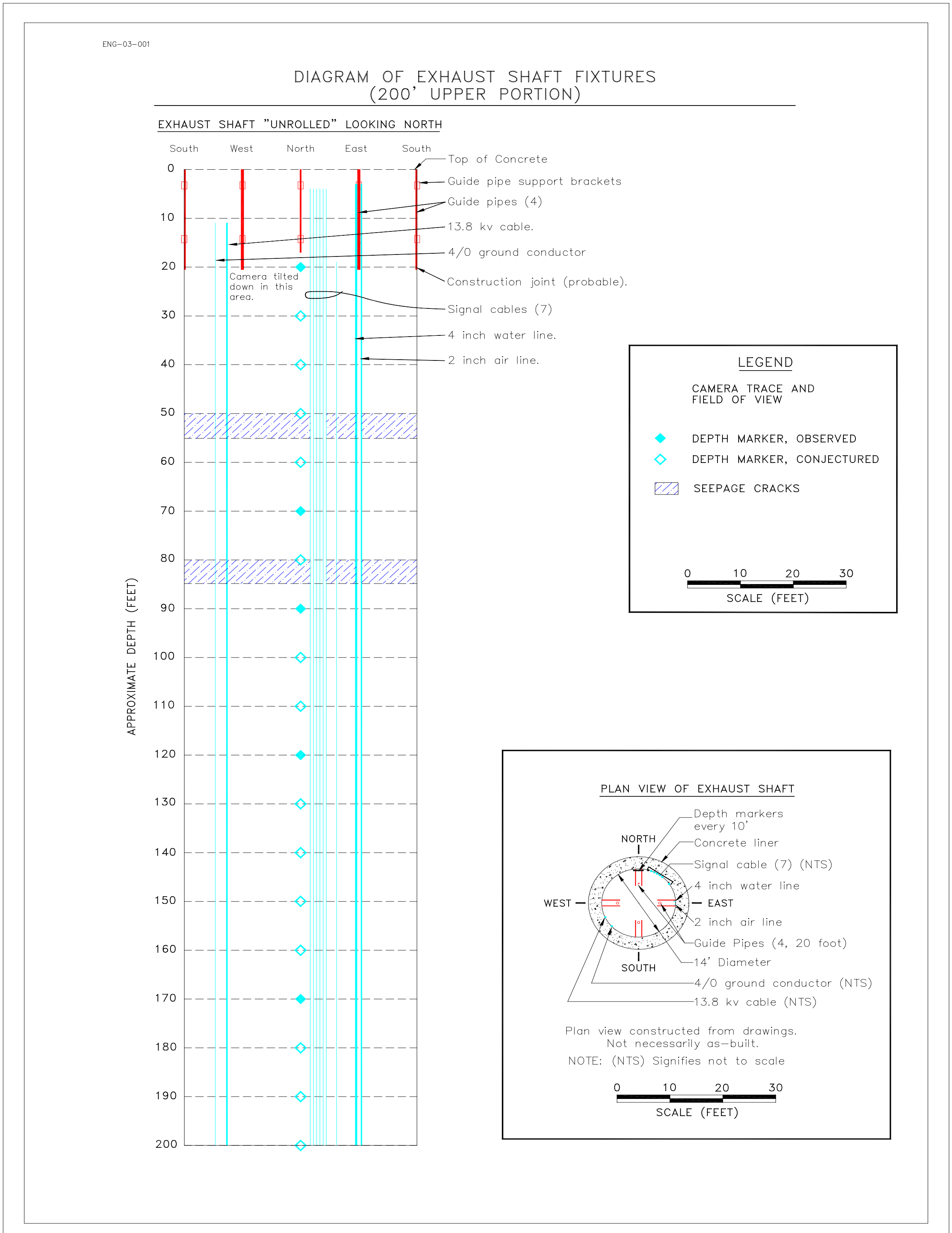


Figure 3-9
Diagram of Exhaust Shaft Fixtures (200' Upper Portion)

reporting to the catch basin has varied from 2475 to 4235 gallons. The 1595 gallons reported in August 21, 2001 was associated with maintenance activities and reduced airflow conditions in the shaft maintained over a weekend. For a discussion of the factors affecting the quantity of fluid entering the Exhaust Shaft catch basin, refer to DOE/WIPP 00-2000, "Brine Generation Study."

The shaft walls were examined for cracks, moisture, and encrustation with particular attention paid to three water rings located at the base of the Magenta and Culebra members of the Rustler Formation and the bottom of the shaft key. As noted earlier the condition of the shaft wall vary depending on the airflow, humidity, temperature, and underground mining activities. During this reporting period, there has been significant mining activity in the south main drifts. The only areas in the shaft with significant salt build up were the three water rings located at the Magenta, the Culebra, and the key. Though the Magenta and Culebra water rings are encrusted with salt buildup, there does not appear to be any water emanating from the liner or water rings. Most of the seepage is observed along the east face of the shaft wall near the instrumentation cables and the air and waterlines in the upper section of the shaft. Though the presence of water is an inconvenience requiring periodic disposal. At this time, it does not appear to have created any hazard or has compromised the structural integrity of the shaft. There were no visible signs of dissolution of the salt below the key.

The video inspection also concentrated on the installed utilities and support brackets. This includes the 13.8 KVA power cable and the grounding cable located on the west wall of the shaft, the instrumentation cables located on the northeast wall of the shaft, and the 4-inch airline and the 2-inch water line located on the east wall of the shaft. Video inspection of the 13.8 KVA cable and the grounding cable indicates that the cables are in good condition with no visible signs of damage. There is sporadic salt buildup on the cables. It is not clear as to the long-term implications of salt buildup on the cables. The 4-inch compressed airline and the 2-inch water line extend from the ground surface to the bottom of the shaft. At present, neither line is being used. Inspection of the integrity of the brackets holding the air line and water line is difficult to assess because of salt buildup. However, there does not appear to be any indication that the brackets, which hold the airline and water line in place, are broken. At present, there are two broken instrumentation cables. The cable breaks are located about 905 feet bsc and about 1095 feet bsc. The instrumentation cables were not in use and have no impact on shaft monitoring nor do they impact shaft operations.

Table 3-2
Water Removed from the Exhaust Shaft Catch Basin

July 1997 – June 1998		July 1998 – June 1999		July 1999 – June 2000		July 2000 – June 2001		July 2001 – June 2002	
Date	**Gallons**	**Date**	**Gallons**	**Date**	**Gallons**	**Date**	**Gallons**	**Date**	**Gallons**
7/18/97	275	7/1/98	770	7/19/99	110	7/3/00	220	7/31/01	165
7/28/97	660	7/7/98	330	12/13/99	165	7/15/00	110	8/21/01	1595
8/1//97	550	7/14/98	220	2/21/00	110	9/18/00	330	9/13/01	330
8/4/97	715	7/16/98	275	5/16/00	715	10/24/00	110	10/15/01	770
8/8/97	770	7/23/98	165	6/7/00	165	3/7/01	110	10/30/01	220
8/11/97	660	7/24/98	220	6/12/00	275	3/21/01	165	4/29/02	275
8/15/97	475	7/27/98	825	6/19/00	440	4/10/01	220	6/11/02	550
8/18/97	330	7/28/98	330	6/22/00	330	4/17/01	220	6/22/02	330
8/22/97	330	8/3/98	495	6/30/00	165	4/24/01	110	**Total**	**4235**
8/25/97	1045	8/10/98	1265	**Total**	**2475**	5/22/01	110		
Sludge	110	8/21/98	330			Sludge	440		
9/2/97	220	8/24/98	990			6/12/01	1100		
9/15/97	605	8/27/98	1155			6/13/01	110		
9/22/97	550	9/1/98	330			Sludge	110		
10/13/97	825	10/5/98	385			**Total**	**3465**		
10/20/97	220	10/26/98	660						
11/3/97	275	11/23/98	110						
11/10/97	385	2/1/99	385						
11/17/97	385	2/10/99	110						
11/24/97	330	5/4/99	330						
12/10/97	440	5/11/99	110						
12/12/97	550	5/24/99	605						
1/2/98	220	5/26/99	165						
1/12/98	605	6/1/99	165						
2/2/98	660	6/4/99	165						
2/16/98	605	6/10/99	165						
3/16/98	605	Sludge	165						
5/4/98	660	6/16/99	165						
5/11/98	550	6/21/99	1705						
5/18/98	495	6/23/99	275						
5/20/98	110	6/30/99	605						
6/1/98	330	**Total**	**14135**						
6/10/98	90								
6/15/98	385								
6/22/98	165								
Total	**16185**								

3.3.1.3 Conclusion

Four quarterly shaft video inspections were conducted between July 1, 2001 and June 30, 2002. Inspections focused on the condition of the shaft liner, the shaft walls and water rings, and the condition of shaft utilities and support brackets. There is no indication at this time that any of the support brackets for the cables, water lines and airlines are damaged, although, due to salt buildup, it is often difficult to discern actual conditions of these items.

3.3.2 Instrumentation

The Exhaust Shaft was equipped with geomechanical instrumentation in two stages. Earth pressure cells were installed behind the liner key in November 1984. Piezometers and nine multiposition borehole extensometers were installed during November and December 1985. Figures 3-10 and 3-11 illustrate the instrumentation configuration.

The extensometers at the 1,573-ft (480 m) level indicate annual collar displacement rates ranging from 0.344 to 0.373 in/yr. (0.873 to 0.947 cm/yr.) These rates have not significantly changed from the previous reporting periods. At the 2,066-ft (630 m) level, the annualized collar displacement rates range from 1.232 in/yr. to 1.669 in/yr. (3.129 to 4.239 cm/yr.) These displacements indicate continued deformation into the shaft; however, there is no indication of accelerated movement. Table 3-3 summarizes information regarding collar displacement measurements from these extensometers.

Table 3-3
Collar Displacement at the Exhaust Shaft Extensometers

Field Tag	Location Shaft Level	Date Last Reading	Collar Displacement Relative to Deepest Anchor (in.)	Displacement Rate 2001 to 2002 in/yr	Displacement Rate 2000 to 2001 in/yr	Rate Change Percent	Comments
35X-GE-00204	1573	06/05/02	0.344	0.019	0.020	-5%	
35X-GE-00205	1573	06/05/02	0.360	0.023	0.022	5%	
35X-GE-00206	1573	06/05/02	0.373	0.024	0.021	14%	
35X-GE-00207	2066	06/05/02	1.669	0.080	0.083	-4%	
35X-GE-00209	2066	06/05/02	1.232	0.059	0.059	0%	

Thirteen of the twenty-one piezometers installed remain in working condition. The fluid pressure readings from the working piezometers at the end of the reporting period range

from -3.1 psi (-21.3 KPa) at the 544-ft (165-m) level to 140 psi (963 KPa) at the 721-ft. Maximum pressure readings from the working piezometers during this reporting period were consistent with maximum readings from the previous reporting period with some of the recorded pressures having decreased slightly.

Two earth pressure cells were installed in the key section of the Exhaust Shaft during concrete emplacement. During this reporting period, the pressure cells have indicated a gradual decreasing trend. The maximum-recorded pressures during this period are 52.8 and 43.9 psi (363 and 302 KPa).

3.4 Air Intake Shaft

The Air Intake Shaft was drilled from December 4, 1987, to August 31, 1988, to establish a primary route for surface air to enter the repository. Stratigraphic mapping was conducted from September 14, 1988, to November 14, 1989 (Holt and Powers, 1990). Figure 3-12 illustrates the Air Intake Shaft stratigraphy.

The Air Intake Shaft is lined with nonreinforced concrete from the surface to the bottom of the shaft key at a depth of 903-ft (275 m). The Air Intake Shaft key is 81-ft (25 m) long with an inside diameter of 16-ft (5 m). The diameter below the shaft key is 20-ft (6 m), and the shaft is unlined below the key to the facility horizon at a depth of 2,150-ft (655 m). The Air Intake Shaft has no sump.

3.4.1 Shaft Performance

Weekly visual inspections were performed on the Air Intake Shaft during this reporting period and the shaft was found to be in satisfactory condition.

3.4.2 Instrumentation

Sandia National Laboratories/New Mexico (SNL/NM) installed geomechanical instruments in the Air Intake Shaft in 1988. WTS maintains responsibility for the operation of all of the instruments located in the Air Intake Shaft as well as for data acquisition and instrument maintenance. WTS provides the data to SNL/NM for analysis. Data from these instruments are available from SNL/NM by request.

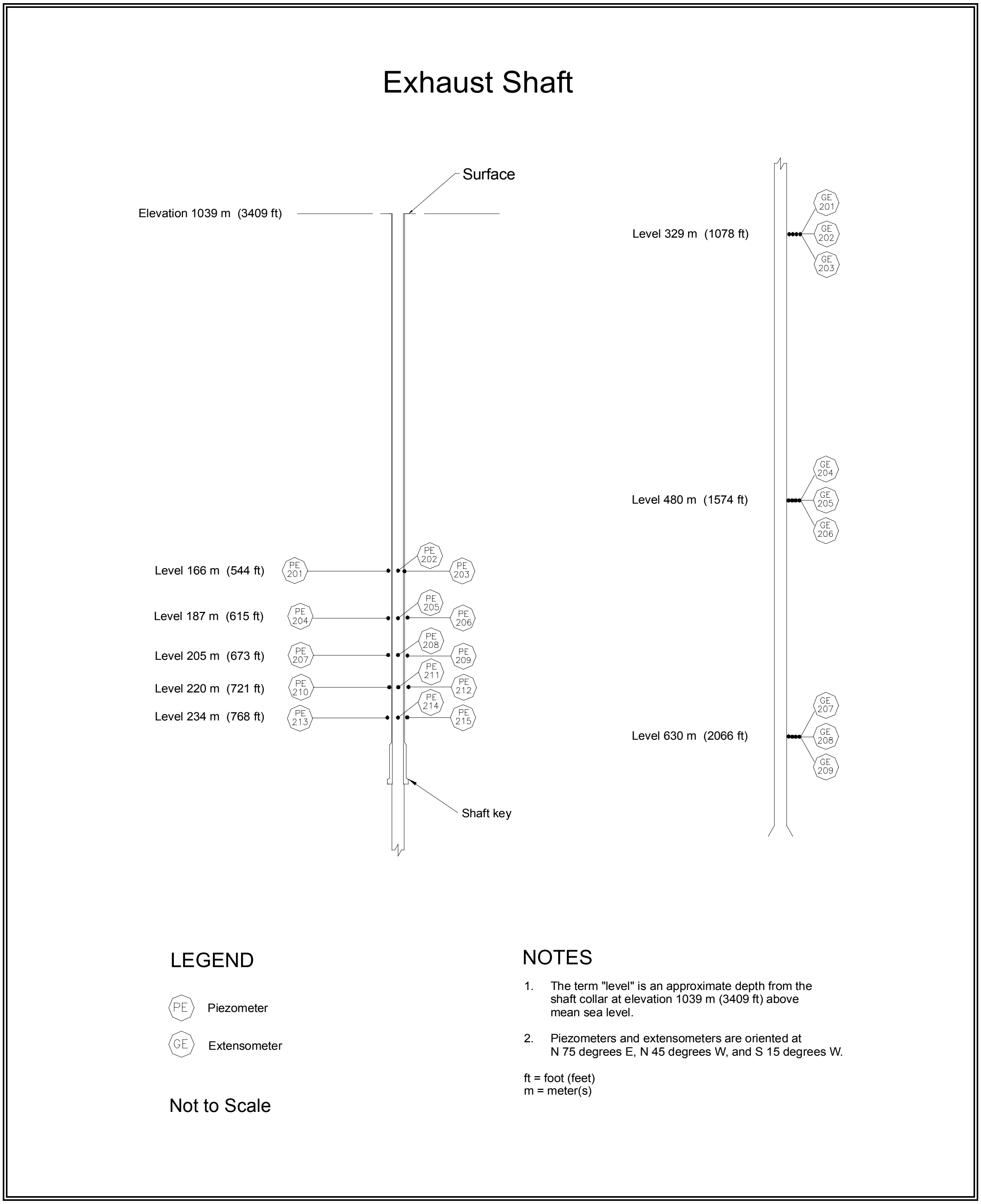
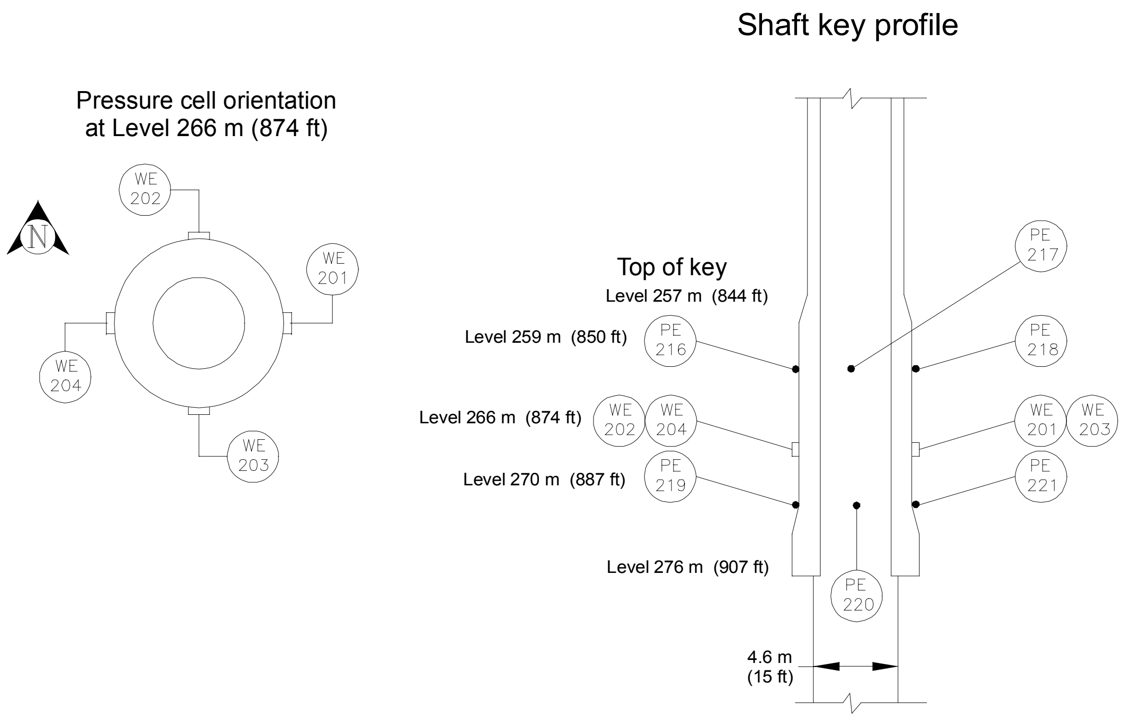


Figure 3-10
Exhaust Shaft Instrumentation (Without Shaft Key)



LEGEND

WE Pressure Cell

PE Piezometer

Not to Scale

NOTES

1. The term "level" is an approximate depth from the shaft collar at elevation 1039 m (3049 ft) above mean sea level.
2. Pressure cells are located at concrete-rock interface and oriented at azimuths of 0 degrees, 90 degrees, 180 degrees, and 270 degrees.
3. Piezometers are oriented at N 75 degrees E, N 45 degrees W, and S 15 degrees W.

ft = foot (feet)
m = meter(s)

Figure 3-11
Exhaust Shaft Key Instrumentation

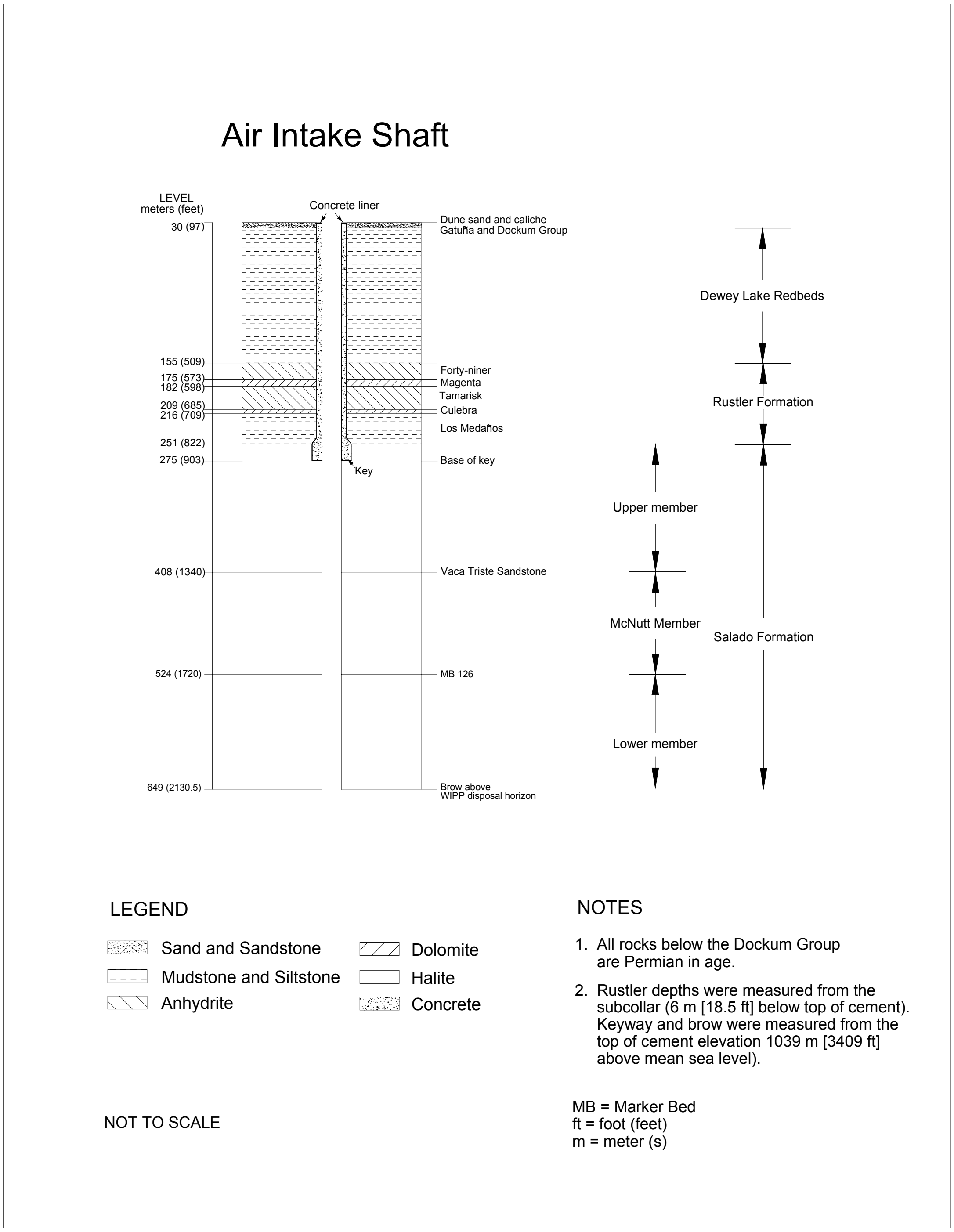


Figure 3-12
Air Intake Shaft Stratigraphy

4.0 Performance of Shaft Stations

This chapter describes the instrumentation and geomechanical performance of the shaft stations at the base of the Salt Handling Shaft, Waste Shaft, and the Air Intake Shaft. The Exhaust Shaft does not have an enlarged shaft station and therefore, is not included in this chapter.

4.1 Salt Handling Shaft Station

The Salt Handling Shaft Station was excavated between May 2 and June 3, 1982, by drilling and blasting. In 1987 the station was enlarged, removing the roof beam up through Anhydrite "b" between S90 and N20 using a mechanical scaler. In 1995 the remaining roof beam at the north end of the station was also removed up through Anhydrite "B." The station area south of the shaft is 90 ft (27.5 m) long and 32 to 38 ft (10 to 12 m) wide. The height of the station south of the shaft is 18-ft (5.5 m). The station dimensions north of the shaft are approximately 30 ft (9 m) long, 32 to 35 ft (10 to 11 m) wide, and 18 ft (5.5 m) high. The shaft extends approximately 140-ft (43 m) below the facility horizon in order to accommodate the skip loading equipment and to act as a sump. Figure 4-1 shows a generalized cross section of the station.

4.1.1 Modifications to Excavation and Ground Control Activities

No major modifications were performed in the Salt Handling Station during this reporting period. Removal of the roof beam immediately north of the station is addressed in Section 5, Performance of Access Drifts. Ground control was performed as routine maintenance.

4.1.2 Instrumentation

Geomechanical instrumentation was installed in the Salt Handling Shaft Station between June 1982 and February 1983, with subsequent reinstallation of extensometers and convergence points as necessary. Figure 4-2 shows the instrument locations after the roof beam was taken down.

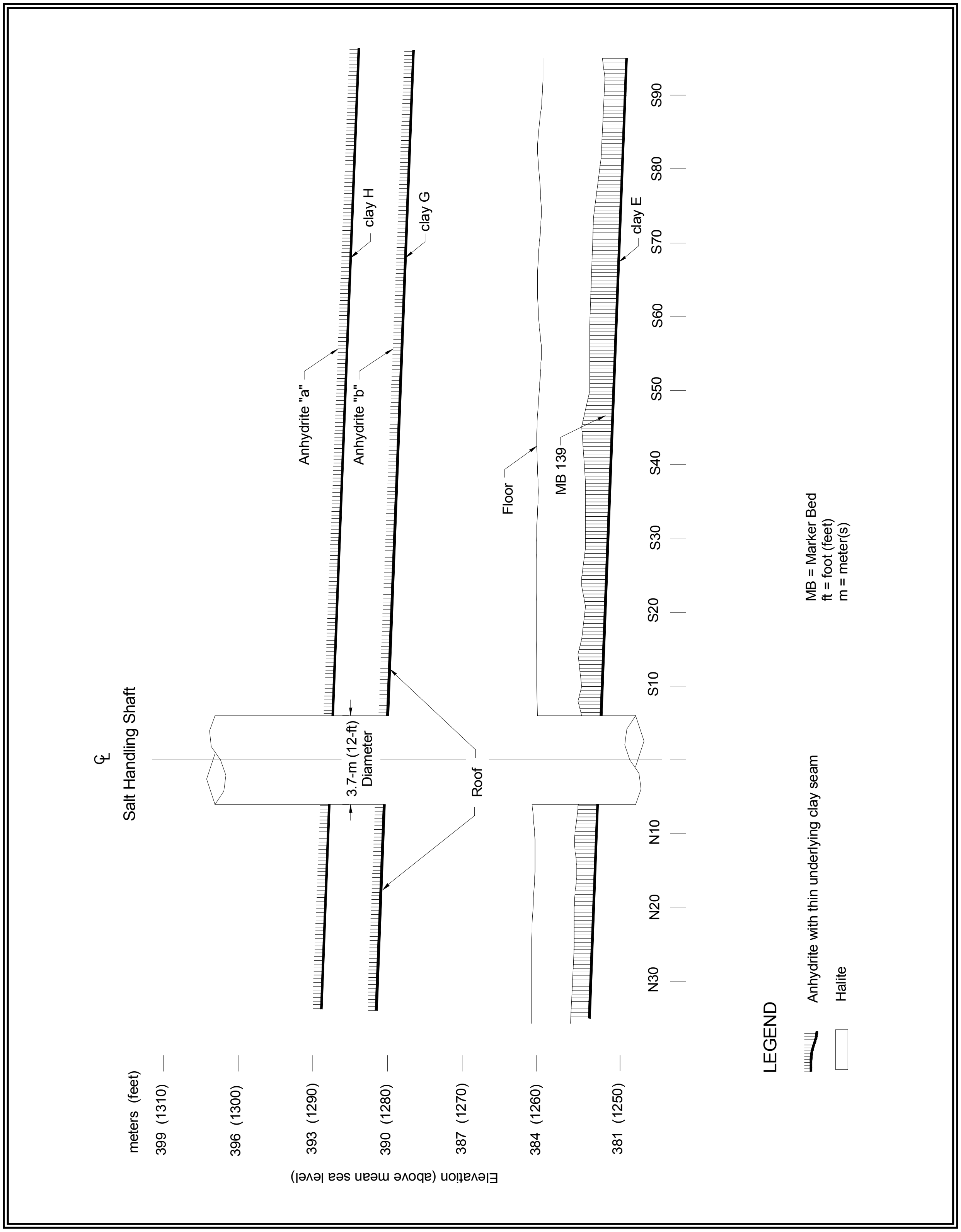


Figure 4-1
Salt Handling Shaft Station Stratigraphy

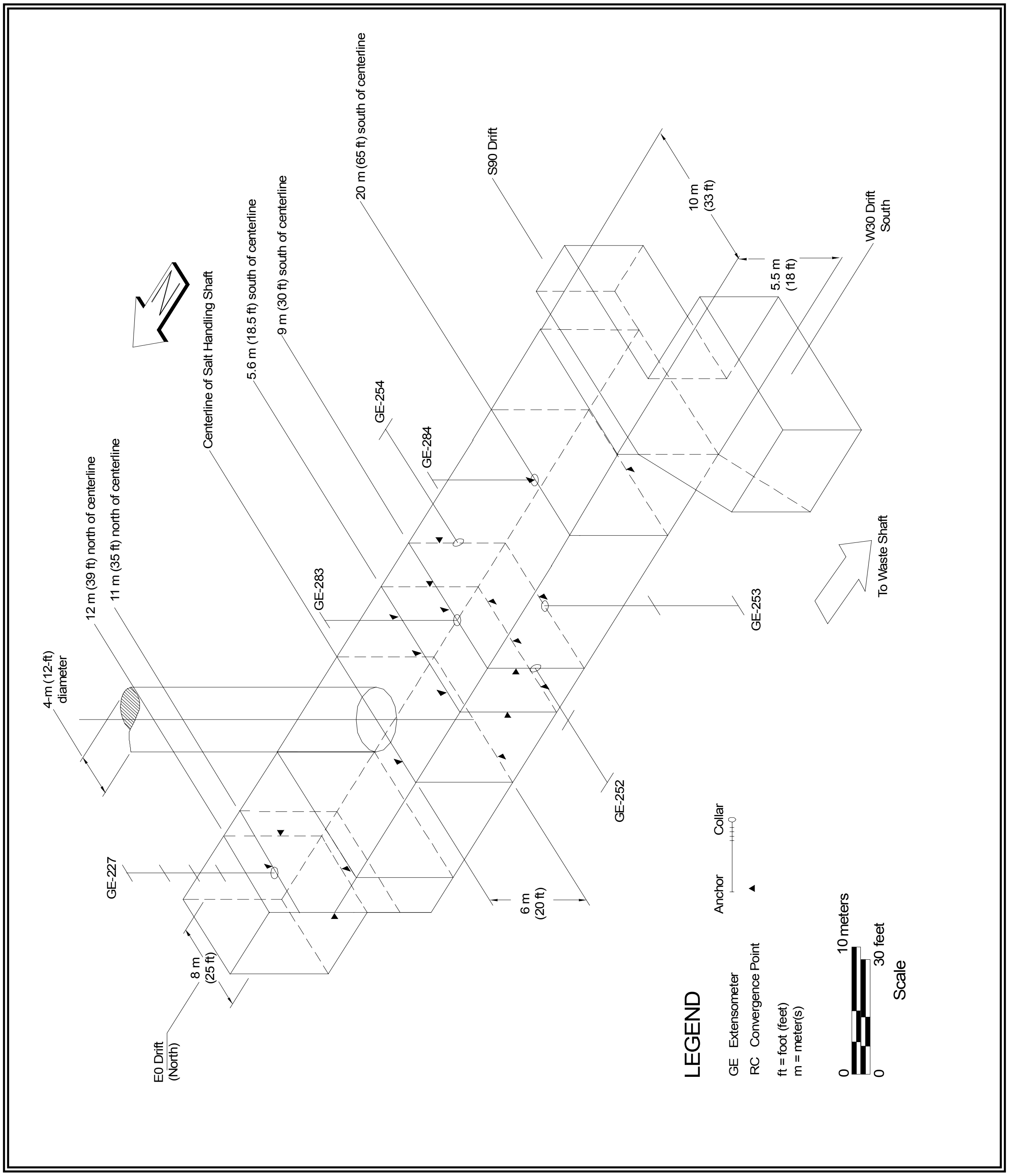


Figure 4-2
Salt Handling Shaft Station Instrumentation After Roof Beam Excavation

There are three extensometers located in the Salt Handling Shaft Station. Due to instrument malfunctions there are no extensometer data for the Salt Handling Shaft Station for this reporting period, however, historical data are maintained for comparative purposes. Five vertical convergence point arrays and one horizontal convergence chord are currently monitored. Table 4-1 summarizes the vertical closure rates in the Salt Handling Shaft Station from July 2001 through June 2002. Salt Handling Shaft Station vertical closure rates have remained relatively consistent compared to previous reporting periods.

Table 4-1
Vertical Closure Rates in the Salt Handling Shaft Station

Field Tag	Location	Last Reading Date	Last Reading (Inches	Cumulative Displacement (Inches)	2001-2002 Closure Rate in./yr. (cm/yr.)	2000-2001 Closure Rate in./yr. (cm/yr.)	Percent Rate Change
E0-N39-5 A-C	E0 Drift-N39	02/18/02	5.632	37.528	1.590 (4.039)	1.480 (3.759)	7%
E0-N39-2 B-D	E0 Drift-N39	02/18/02	11.434	23.967	0.991 (2.517)	1.033 (2.624)	-4%
E0-W12-5 A-C	Salt Shaft-W12	05/31/02	2.863	16.032	0.765 (1.943)	0.729 (1.852)	5%
E0-S18-6 A-E	E0 Drift-S18	05/31/02	5.315	22.871	1.579 (4.011)	1.452 (3.688)	9%
E0-S18-4 B-D	E0 Drift-S18	05/31/02	5.721	22.779	1.596 (4.054)	1.554 (3.947)	3%
E0-S18-4 F-H	E0 Drift-S18	05/31/02	3.645	14.501	1.016 (2.581)	0.974 (2.474)	4%
E0-S30-5 A-C	E0 Drift-S30	05/31/02	5.592	37.199	1.533 (3.894)	1.542 (3.917)	-1%
E0-S65-3 A-C	E0 Drift-S65	05/31/02	4.193	34.544	1.201 (3.051)	1.194 (3.033)	1%

in./yr. = inch(es) per year.
cm/yr. = centimeter(s) per year.

4.2 Waste Shaft Station

The Waste Shaft Station was initially excavated with a continuous miner as a ventilation connection to a 6-ft (2-m) diameter exhaust shaft in November 1982. In 1984, the station was enlarged to a height of 15 to 20 ft (4.5 to 6 m) and a width of 20 to 30 ft (6 to 9 m). The station is approximately 150-ft (46 m) long. In 1988 the station walls were trimmed and concrete was placed on the floor. Since 1988, the Waste Shaft Station has undergone three major floor renovations. A 53-ft (16 m) long section of the reinforced concrete was removed in February 1991 and in 1995 an additional 30-ft (9 m) section was removed. The most recent floor maintenance included removal of the remaining reinforced concrete section, trimming of the floor, and reinstallation of the rails supported by segmented concrete panels on a crushed rock backfill. Figure 4-3 shows a cross section of the Waste Shaft Station.

4.2.1 Modifications to Excavation and Ground Control Activities

Cable slings on the East brow of the Waste Shaft were pinned with 10' mechanical rock bolts. Ground control activities performed in the Waste Shaft Station during this reporting period consisted of routine rib maintenance and the routine replacement of failed rock bolts.

4.2.2 Instrumentation

Instruments were initially installed in the Waste Shaft Station between November 12 and December 2, 1982. Figure 4-4 illustrates the locations after enlargement. There are three extensometers in the roof of the Waste Shaft Station (located at W30, E35, E90, and E140) that are currently being monitored. In addition, horizontal convergence is being monitored at E30 and E90.

Table 4-2 summarizes the history of the roof extensometers in the Waste Shaft Station. The extensometers, 51X-GE-00268 (W30) and 51X-GE-00279 (E140), remain in good working condition and the data indicate a relatively steady displacement rate. Extensometers 51X-GE-00277 (E35) and 51X-GE-00278 (E90), are no longer functional due to damage. The annual displacement rate calculated for extensometer 51X-GE-00279, located in S400 drift at E140 is 16.0 percent higher than the rate calculated for the previous reporting period. However, the data trend at this installation is consistent with historic displacement rates for this instrument.

Table 4-3 summarizes the annual horizontal closure rates calculated from convergence point data for this reporting period. The data indicate a slight increase in horizontal closure rates at E30 and E90 of 6.0 and 2.0 percent, respectively, relative to the previous annual closure rates.

Sixteen rock bolt load cells are installed in the roof and brow of the Waste Shaft Station. The loads on these rock bolts are monitored regularly.

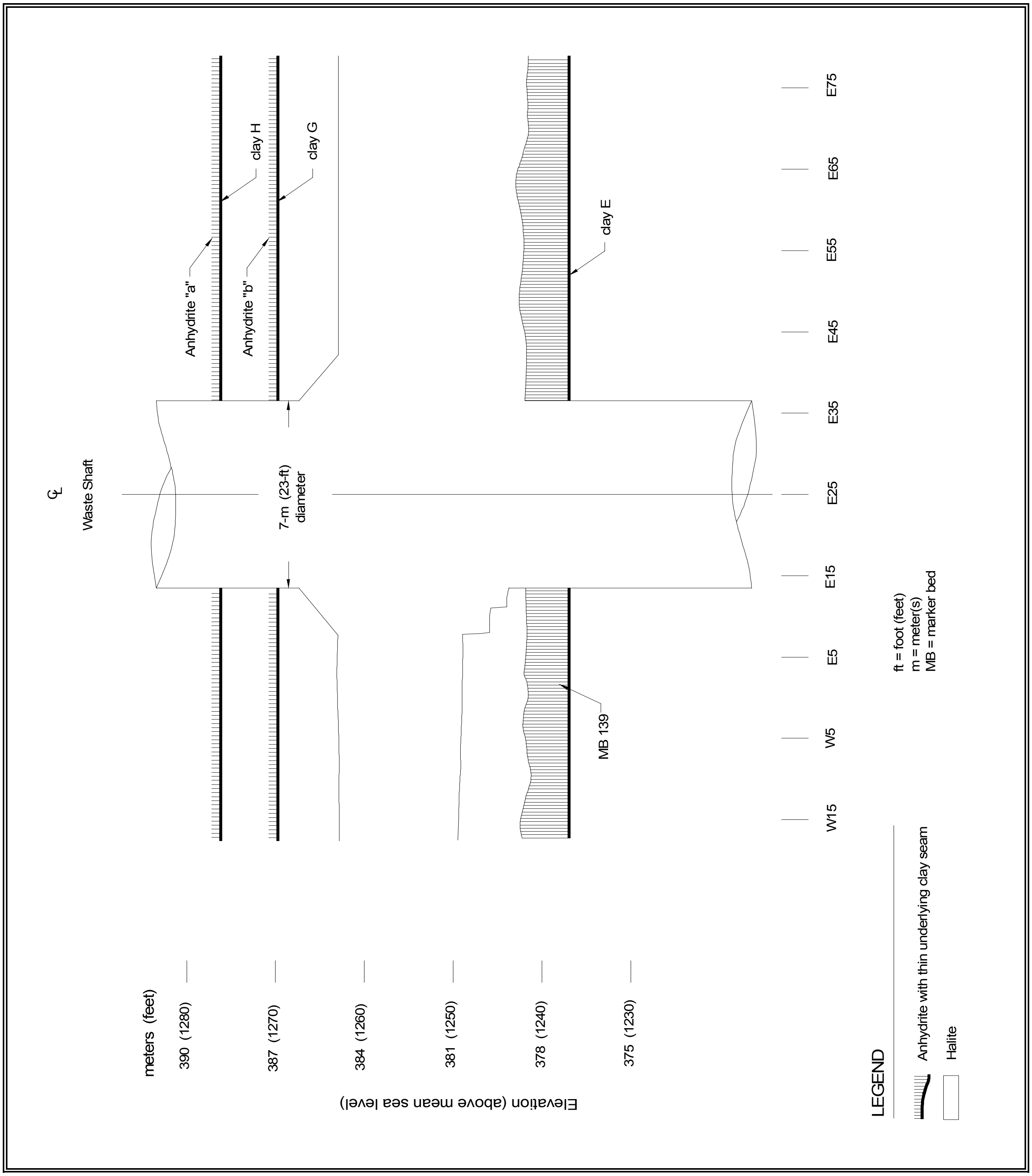


Figure 4-3
Waste Shaft Station Stratigraphy

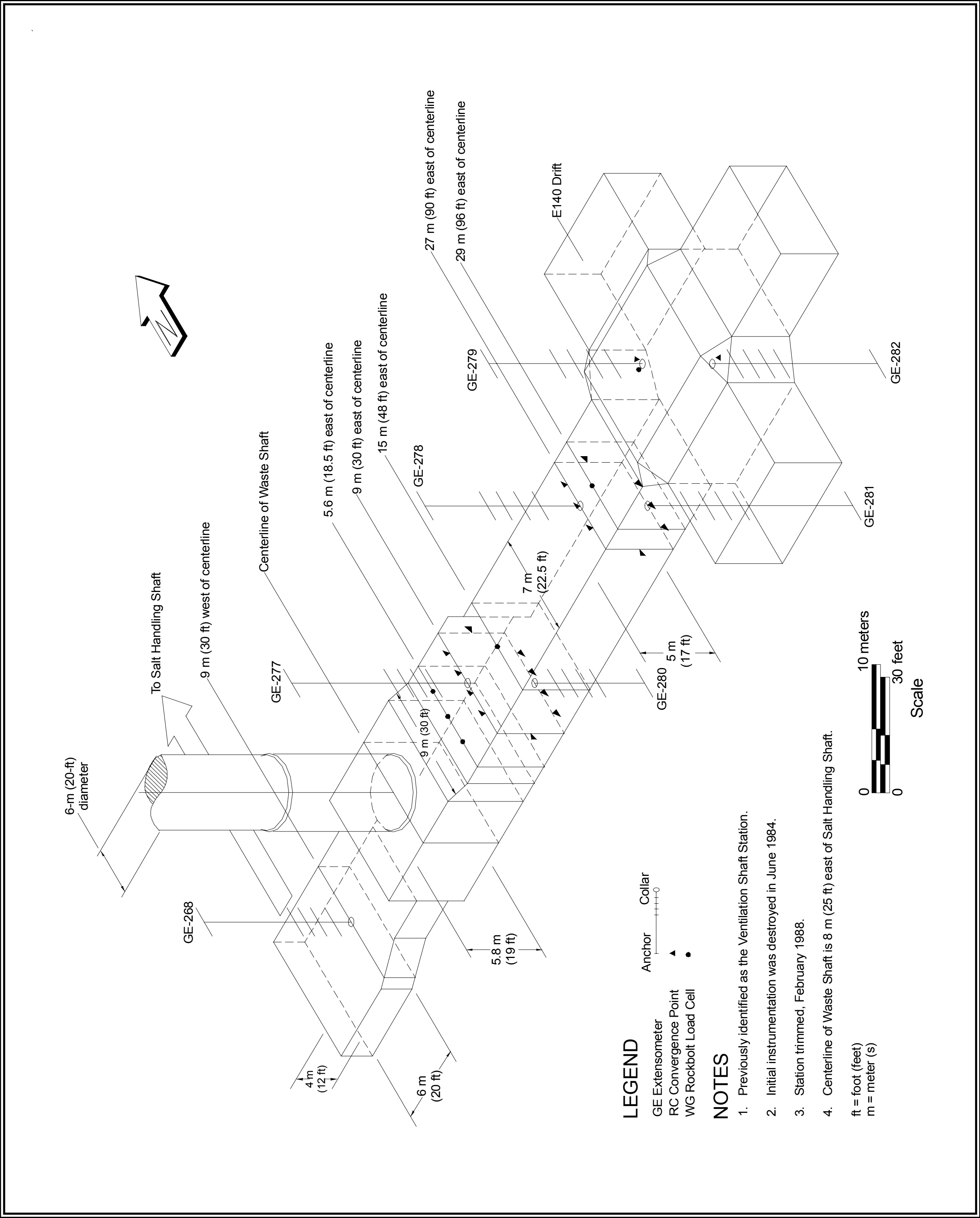


Figure 4-4
Waste Shaft Station Instrumentation After Wall Trimming

Table 4-2
Historical Summary of Roof Extensometers in Waste Shaft Station

Instrument	Location	Date Installed	Date of Last Reading	Collar Displacement Relative to Deepest Anchor Inches (cm)	Displacement Rate 2001 to 2002 in./yr. (cm/yr.)	Displacement Rate 2000 to 2001 in./yr.(cm/yr.)	Rate Change Percent
51X-GE-00268	S400-W30	10/24/1984	6/04/2002	7.596 (19.294)	0.243 (0.617)	0.235 (0.597)	3%
51X-GE-00279	S400-E140	11/29/1988	6/24/2002	9.602 (24.389)	0.820 (2.083)	0.707 (1.796)	16%

cm = centimeter(s)
in = inch(es)

Table 4-3
Horizontal Closure Rates in the Waste Shaft Station

Location Date of Last	Date of Last Reading	Last Reading	Cumulative Displacement Inches (cm)	2001 to 2002 Closure Rate in./yr. (cm/yr.)	2000 to 2001 Closure Rate in./yr. (cm/yr.)	Percent Rate Change
S400-E30	6/04/2002	14.854 (37.729)	14.927 (37.915)	0.920 (2.337)	0.865 (2.197)	6%
S400-E90	6/04/2002	16.941 (43.030)	17.132 (43.515)	0.968 (2.459)	0.952 (2.418)	2%

cm/yr. = centimeter(s) per year.
in./yr = inch(es) per year.

4.3 Air Intake Shaft Station

The Air Intake Shaft Station was excavated in late 1987 and early 1988 using a continuous miner. The Air Intake Shaft is not typically used to transport personnel or materials between the surface and the underground, but does have a work platform that can be raised and lowered in the shaft to perform routine ground maintenance. There is minimal operational activity at the Air Intake Shaft Station.

4.3.1 Modifications to Excavation and Ground Control Activities

No modifications or ground control activities, other than routine maintenance, were performed in the Air Intake Shaft Station during this reporting period.

4.3.2 Instrumentation

Convergence point and extensometer instrumentation located near the Air Intake Shaft Station is presented in Chapter 5.0 as part of the discussion on the performance of the access drifts. Twenty rock bolt load cells installed in the Air Intake Shaft Station area are monitored regularly.

5.0 Performance of Access Drifts

This chapter describes the geomechanical performance of the central underground access drifts. The Northern Experimental Area and the Waste Disposal Area are discussed later in Chapters 6.0 and 7.0, respectively. There are four major north-south drifts in the WIPP underground, intersected by shorter east-west cross-drifts. These drift dimensions range from 8 ft (2.4 m) to 21 ft (6.4 m) in height and from 14 ft (4.3 m) to 33 ft (9.2 m) in width.

5.1 Modifications to Excavation and Ground Control Activities

The four major north-south access drifts were extended towards the south during this reporting period. Trimming, scaling, and floor milling activities were performed as necessary in many areas throughout the WIPP underground. Table 5-1 summarizes these activities. Table 5-1 also summarizes ground control activities (e.g., rock bolting and installing wire mesh) performed in various locations in the access drifts. The roof was removed to above Anhydrite “b” in the two major north-south access drifts, E0 and E140, north to N1100.

5.2 Instrumentation

Figure 5-1 shows typical convergence point array configurations. This section discusses instrumentation details and locations for each instrumentation type.

5.2.1 Borehole Extensometers

There were no new extensometers installed during this reporting period. All operating underground extensometers continue to be monitored. Twelve borehole extensometers were damaged or mined out during this reporting period, 54 extensometers continue to be monitored. Some extensometers were removed due to mining up to clay “G” in E140 and E0 drifts.

5.2.2 Convergence Points

Instrumentation installed during this reporting period was limited to the installation and replacement of convergence point arrays and the installation of new monitoring arrays in the newly mined areas. Convergence points were reinstalled in various locations throughout the WIPP underground where rib, roof, or floor trimming activities had been performed during this and the previous reporting periods. Horizontal and vertical convergence point arrays were installed at various locations in the W170, W30, E140, and E300 drifts. Convergence points within the access drifts are read manually at least every

two months, with more frequent monitoring in some areas. Table 5-2 lists the new and replacement convergence points that were installed during this reporting period.

Table 5-1
Summary of Modifications and Ground Control Activities in the Access Drifts
July 1, 2001, through June 30, 2002

Date	Location	Work Performed
7/01-6/02	W-170/S2807-S3141	Rough cut.
7/01-6/02	W-170/S2559-S2758	Cut to final.
7/01-6/02	W-30/S2962-S3140	Rough cut.
7/01-6/02	W-30/S2562-2758	Cut to final.
7/01-6/02	E-140/S2597-S2758	Rough cut & cut to final.
7/01-6/02	E-140/S2758-S3122	Rough cut.
7/01-6/02	E-300/S2601-S2738	Cut to final.
7/01-6/02	E-300/S2758-S3177	Rough cut & partial cut to final.
7/01-6/02	S-2750/W170-E300	Cut to final.
7/01-6/02	S-3080/W170-E300	Rough cut.
7/01-6/02	E-140/N254-460	Roof removal cut to final.
7/01-6/02	E-140/N460-N780	Roof removal rough cut.
7/01-6/02	E-0/N50-N150	Roof removal rough cut & cut to final.
7/01-6/02	E-0/N620-N910	Roof removal rough cut.
7/01-6/02	E-0/N460-N780	Roof removal cut to final.
7/01-6/02	N-780/E0-E140	Roof removal rough cut & cut to final.
7/01-6/02	S-400 at E-300 SW Miter	Complete trimming of ribs for Station D installation.
7/01-6/02	S-90/E-0-E-140 south rib	Trim south rib for Switch Station #1 modification.
7/01	E140 - N460 to N1100 & N215 drift	Spot bolted 48 each, 10-foot mechanical rock bolts.
7/01	S90 - W30 to E140 & W170 west for 100', Station D (E300-S400)	Installed mechanical bolts and chainlink mesh.
10/01	E300 drift from S2180-S2520	Completed installation of chainlink mesh.
10/01	E140 drift between S1500 and S1620.	Installed 60 ea. 4' mechanical rock bolts & chainlink mesh.
10/01	Entire accessible underground	Annual ground survey.
10/01	E140 from N780 to N1100, West Rib	Installed 12' rock bolts.
12/01	E140 drift high roof area from S1050 to S1900	Installed rock bolts and Chainlink mesh.
½	Waste Shaft Station Area.	Replaced broken mechanical rock bolts.
2/02	S2750 Drift	Drilled Air Relief Holes.
5/02	E140, N460 - N780, E0 drift from the N80 to the N150 overcast.	Installed chainlink mesh and 4' mechanical bolts on the roof.

Table 5-2
New and Replaced Convergence Points Installed in the Access Drifts
July 1, 2001 through June 30, 2002

Instrument Type	N/R	Field Tag	*Chord	Location	Date Installed
Convergence Point	N	E0-N225	A-C	E0 DRIFT-N225	07/25/2001
Convergence Point	N	E0-N225	B-D	E0 DRIFT-N225	07/25/2001
Convergence Point	R	E0-N300-4	A-C	E0 DRIFT-N290	07/25/2001
Convergence Point	R	E0-N460-2	A-C	E0 DRIFT-N460	07/25/2001
Convergence Point	N	E140-N355	A-C	E140 DRIFT-N355	07/25/2001
Convergence Point	N	E140-N355	B-D	E140 DRIFT-N355	07/25/2001
Convergence Point	R	E140-N460-2	A-C	E140 DRIFT-N460	07/25/2001
Convergence Point	R	N460-E70-2	B-D	N460 DRIFT-E70	07/25/2001
Convergence Point	R	N460-E70-2	A-C	N460 DRIFT-E70	07/25/2001
Convergence Point	R	S90-W920-2	A-C	S90 DRIFT-W920	08/10/2001
Convergence Point	R	N460-E70-3	A-C	N460 DRIFT-E70	09/07/2001
Convergence Point	R	E0-N140-6	A-C	E0 DRIFT-N140	10/10/2001
Convergence Point	R	E0-N225-2	A-C	E0 DRIFT-N225	11/08/2001
Convergence Point	R	E0-N460-3	A-C	E0 DRIFT-N460	11/08/2001
Convergence Point	R	E140-N460-3	A-C	E140 DRIFT-N460	11/08/2001
Convergence Point	R	E140-S1862-3	C-G	E140 DRIFT-S1862	11/14/2001
Convergence Point	R	W170-S2685-2	B-D	W170 DRIFT-S2685	12/27/2001
Convergence Point	R	W30-S2685-2	B-D	W30 DRIFT-S2685	12/27/2001
Convergence Point	R	W170-S2685-2	A-C	W170 DRIFT-S2685	01/08/2002
Convergence Point	R	W30-S2685-2	A-C	W30 DRIFT-S2685	01/08/2002
Convergence Point	R	E520-S1717-2	C-G	E520 DRIFT-S1717	03/06/2002
Convergence Point	N	E0-N75	A-C	E0 DRIFT-N80	05/21/2002
Convergence Point	N	E0-N75	B-D	E0 DRIFT-N80	05/21/2002
Convergence Point	R	S1000-E120-2	A-C	S1000 DRIFT-E120	06/13/2002

N = New installation.
R = Replacement installation (i.e., instrument replaces older instrument that has failed or has been mined out).
*Chord configuration is defined in "Geotechnical Analysis Report for July 2001–June 2002 Supporting Data."

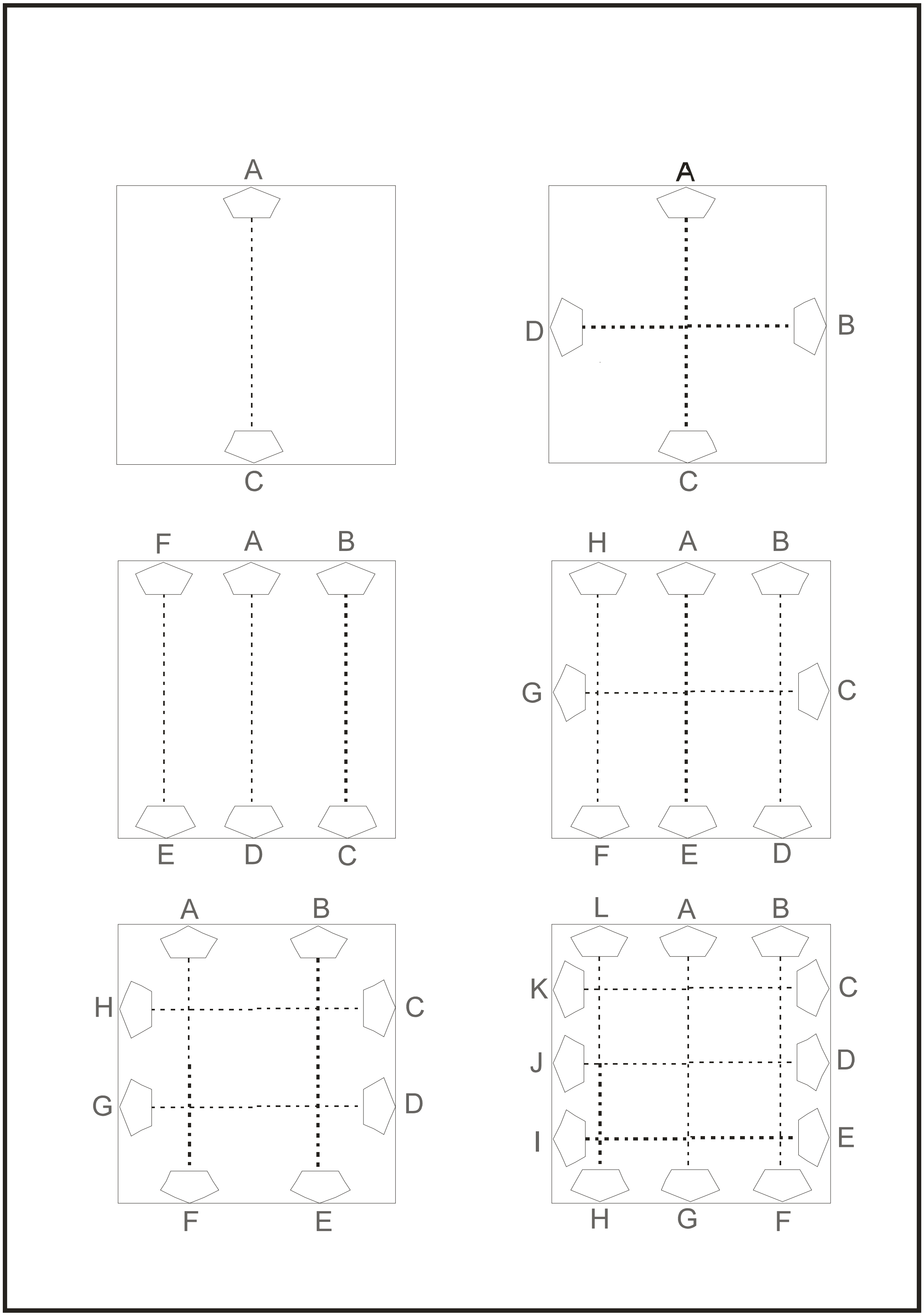


Figure 5-1
Typical Convergence Point Array Configurations

5.3 Analysis of Extensometer and Convergence Point Data

Extensometer data are obtained by measuring the displacement from the reference head anchor (collar) to each fixed anchor of the extensometer. Convergence point data are obtained by measuring the change in distance between fixed points anchored into the rock across an opening, either from rib to rib or from roof to floor. Convergence measurements are a primary means of identifying areas where conditions may be becoming unstable. These measurements are made, at a minimum, every two months throughout the WIPP underground, with the exception of when convergence points are not accessible. Extensometer displacement rates and convergence rates indicate how an excavation is performing; rates that decrease or are relatively constant typify stable excavations, whereas increasing rates may indicate some type of developing instability.

Routinely, extensometer displacement rates and convergence rates are plotted against time, and comparisons are made between consecutive rates to identify any acceleration. Annual convergence rates are calculated by determining the difference between the first and last readings of the reporting period and dividing that difference by the time between the two readings (in years). Instruments that indicate acceleration are then analyzed to determine the significance of the acceleration. Factors that are considered during the analysis include the magnitude of the respective rates, percentage increase, convergence history, and any recent excavation in the vicinity.

There are 54 active borehole extensometers being monitored at various locations in the access drifts. There are 27 of these instruments located in the southern E140 drift to monitor the waste transport route. Where data are available, annual displacement rates were calculated for each of the active extensometers and compared to the annual displacement rates from the previous reporting period. Significant percentage increases in displacement rates were observed in the E140 drift between S1375 and S1865. Displacement rates in this area range from -15% at E140 S1685 to 120% at E140 S1775. The increased movement in the E140 roof rates can be attributed to a clay stringer separation approximately 12" to 18" above the roof.

Where possible, annual closure rates were calculated from convergence point array data from the access drifts. A complete tabulation of these convergence point data and calculated closure rates are presented in the supporting data document for this report[5].

[5]Instrumentation data and data plots are available in "Geotechnical Analysis Report for July 2001-June 2002 Supporting Data." This document is available upon request from Washington TRU Solutions. See backside of cover sheet for details and addresses.

Locations with increases in annual vertical and horizontal closure rates of greater than 10 percent are listed in Table 5-3.

Further analysis of these accelerations has shown many of them to be relatively insignificant. Others, such as the southern areas of the access drifts had closure rate increases that can be directly attributed to the mining of Panel 2 and Panel 2 access drifts. These rates are expected to decrease with time as the Panel 2 and Panel 2 access drifts stress effects are redistributed.

The rates in E0 and E140, where the roof has been mined to Clay "G," show an increase in the closure rates. These rates are expected to decrease over time as the mining effect subsides. The convergence point pairs in E140 between S1375 and S1865, show a trend of increasing convergence rates over the long-term median convergence rate. This is due to a separation caused by a clay stringer approximately 12" to 18" above the roof. A supplemental ground control system was installed in this area to address the separation.

5.4 Excavation Performance

Bi-monthly assessments of underground excavations continue to indicate that convergence rates vary with seasonal temperature variations; typically increasing during the warmer summer months and decreasing during the cooler winter months. Over 490 readings are collected and assessed from convergence point pairs located throughout the WIPP underground on a regular basis.

The performance of the access drift excavations during this reporting period was within acceptable criteria. "Acceptable criteria" is when the drift remains accessible and the ground can be controlled by routine maintenance. Only standard remedial ground control maintenance was required to maintain the performance of the excavations.

Table 5-3
Increases in Annual Vertical Convergence Rates Greater than 10 Percent Access Drifts

Location	*Chord	Last Reading 2001 to 2002 Date	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent [a]	Comments
E0-N1110-3	A-C	05/31/02	1.48	1.29	14.73	Nearby mining.
E0-N1266-3	A-C	05/31/02	2.14	1.94	10.31	Nearby mining.
E0-N940-3	A-C	05/31/02	2.27	1.81	25.41	Nearby mining.
E140-N220	A-C	05/31/02	1.72	1.40	22.86	Nearby mining.
E140-N562	A-E	12/11/01	2.01	1.72	16.86	Nearby mining.
E140-N562	H-F	12/11/01	2.42	2.17	11.52	Nearby mining.
E140-N626	E-F	12/11/01	1.85	1.66	11.45	Nearby mining.
E140-N626-2	A-C	12/11/01	2.48	2.21	12.22	Nearby mining.
E140-N686	A-E	12/11/01	2.13	1.90	12.11	Nearby mining.
E140-N686	B-D	12/11/01	1.88	1.64	14.63	Nearby mining.
E140-N780	A-C	12/11/01	2.90	2.54	14.17	Nearby mining.
E140-S1534-2	A-E	06/05/02	4.94	4.29	15.15	Clay stringer separation.
E140-S1534-2	B-D	06/05/02	2.88	2.26	27.43	Clay stringer separation.
E140-S1687-2	A-E	06/05/02	2.46	2.22	10.81	Clay stringer separation.
E140-S1775-2	A-G	06/27/02	6.19	3.42	80.99	Clay stringer separation.
E140-S1775-2	B-F	06/27/02	4.85	3.43	41.40	Clay stringer separation.
E140-S1775-2	L-H	06/27/02	2.44	1.69	44.38	Clay stringer separation.
E140-S1862-2	A-E	06/05/02	2.49	2.07	20.29	Clay stringer separation.
E140-S2122-2	A-C	06/05/02	3.03	2.72	11.40	Nearby mining.
E300-N170	A-E	05/31/02	1.43	1.26	13.49	Nearby mining.
E300-N170	H-F	05/31/02	1.27	1.13	12.39	Nearby mining.
E300-N45	A-E	05/31/02	1.51	1.37	10.22	Nearby mining.
E300-N45	H-F	04/03/02	1.35	1.21	11.57	Nearby mining.
E300-S1000	A-C	06/06/02	0.59	0.51	15.69	
E300-S1150-3	A-E	06/06/02	0.57	0.51	11.76	
E300-S1150-3	H-F	06/06/02	0.42	0.35	20.00	
E300-S1450	A-C	06/06/02	0.68	0.61	11.48	
E300-S2065	A-C	06/17/02	0.96	0.84	14.29	
E300-S45-2	A-E	05/31/02	1.27	1.11	14.41	
E300-S45-2	H-F	05/31/02	1.15	0.93	23.66	
E300-S850	A-E	06/06/02	0.48	0.41	17.07	
E300-S850	B-D	06/06/02	0.37	0.31	19.35	
E300-S850	H-F	06/06/02	0.37	0.33	12.12	
N140-E90	A-C	05/31/02	0.75	0.68	10.29	Nearby mining.
N1420-W258	A-E	04/03/02	0.99	0.87	13.79	Nearby mining.
N1420-W258-2	H-F	04/03/02	0.59	0.52	13.46	Nearby mining.
N1420-W258-4	C-G	04/03/02	0.79	0.67	17.91	
N1420-W391-2	B-D	04/03/02	0.61	0.54	12.96	
N1420-W391-3	C-G	04/03/02	0.79	0.70	12.86	
S1300-W100-2	A-C	06/03/02	1.54	1.34	14.93	
S90-W770	A-C	06/06/02	0.89	0.76	17.11	
S90-W770-2	B-D	06/06/02	0.69	0.62	11.29	
TR4	H-F	12/11/01	2.62	2.29	14.41	
TR4-N1175	A-E	12/11/01	1.86	1.68	10.71	
TR4-N1175	B-D	04/03/02	1.60	1.42	12.68	

Table 5-3
Increases in Annual Vertical Convergence Rates Greater than 10 Percent Access Drifts-Continued

Location	*Chord	Last Reading 2001 to 2002 Date	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent [a]	Comments
TR4-N1175	F-H	12/11/01	1.45	1.26	15.08	
TR4-N1325	F-H	12/11/01	1.84	1.62	13.58	
W170-S1000-2	A-C	06/03/02	0.72	0.58	24.14	
W170-S1150-3	A-E	06/03/02	0.74	0.67	10.45	
W170-S1600-2	A-C	06/03/02	0.82	0.71	15.49	
W170-S232-2	A-C	06/03/02	0.63	0.45	40.00	
W170-S560-3	A-C	06/03/02	0.65	0.57	14.04	
W170-S850-6	A-E	06/03/02	0.63	0.49	28.57	
W30-S120	A-C	06/03/02	1.16	0.92	26.09	
W30-S1775-2	B-D	06/03/02	0.73	0.60	21.67	

[a] Increase in convergence rate is calculated from the difference between the 2000–2001 rate and the 2001–2002 rate.

*Chord is defined in "Geotechnical Analysis Report for July 2001–June 2002 Supporting Data."

in./year. = inch(es) per year.

6.0 Performance of Northern Experimental Area

This chapter describes the geomechanical performance of the rooms and access drifts located in the Northern Experimental Area. This area includes all excavations north of the N1100 drift including the SPDV rooms, the N1400 and N1100 drifts, the E0 and E140 drifts between N1100 and N1400, and the E300 shop. Sections of this area have been deactivated. Restricted access to some of this area precludes direct observation of instruments or the installation of new instruments; therefore, only data from remotely read instruments are available in deactivated areas.

6.1 Modifications to Excavation and Ground Control Activities

The Experimental Area was spot bolted, replacing failed bolts. Muck disposal/backfilling operations have filled almost all areas west of the E0 drift. Roof removal in E0 and E140 from the N1100 to N1400 was performed during this reporting period. Table 6-1 summarizes these activities. Table 6-1 also summarizes ground control activities (e.g., rock bolting and installing wire mesh) performed in various locations in the Experimental Area drifts. Initiated re-mining of rooms in some sections of the Experimental Area.

Table 6-1
Summary of Modifications and Ground Control Activities in the Northern Experimental Area July 1, 2001 through June 30, 2002

Date	Location	Work Performed
7/01-6/02	Room G – SPDV Room 4	Completely backfilled with mined salt.
7/01-6/02	SPDV Room 4	Completely backfilled with mined salt.
7/01-6/02	Rooms L-1, L-2, L-3 & L-4	Completely backfilled with mined salt.
7/01-6/02	N-1100/SPDV Room 4 – W-536	Completely backfilled with mined salt.
7/01-6/02	E-140/N1100-N1400	Completely backfilled with mined salt.
10/01	E140 from N1100 to N1420, West Rib	Installed 12’ rock bolts.
12/01	N1420 drift from E140 to SPDV Room 4	Torque tested mechanical rock bolts. Suspected broken rock bolts were identified and replaced.

6.2 Entry into Deactivated Area

Access to this area was blocked by the construction of barriers in the E0 and E140 drifts at N800 from August 1996 to November 1999. In October and November 1999 a re-entry was made into portions of the deactivated Northern Experimental Area. Areas that remain deactivated are Room H, SPDV Rooms 1, 2, and 3, and N1100 and N1420 drifts east of the E300 drift.

6.3 Instrumentation

Active, remotely read, geotechnical instrumentation located in the Northern Experimental Area consists of borehole extensometers and wire convergence meters. Monitoring of accessible manually read instrumentation was re-established during the re-entry. There was only one replacement convergence point was installed during this reporting period. It was located at N1400-W232-3.

6.3.1 Borehole Extensometers

Data were collected remotely from seven extensometers located in the Northern Experimental Area from July 2001 to May 2002. Table 6-2 presents a comparison of the last reporting period to this reporting period. A comparison of calculated displacement rates between the current and previous reporting periods range from –52% in Room L-4 to an increase of 26% in SPDV Room 4, N1250.

6.3.2 Wire Convergence Meters

Manual convergence measurements continue in accessible areas. Wire convergence meters are monitored in the N1100 and N1420 drifts. Table 6-3 presents the data from these convergence meters. A comparison of calculated displacement rates between the current and previous reporting periods range from –1% in E300 Drift-N1275 to an increase of 16% in Room D, N1187.

6.4 Excavation Performance

Based on the extensometer and convergence data, the annual closure rates within many of these monitored rooms and drifts continue to be relatively constant. One exception includes the roof extensometer installation in SPDV Room L4. The roof displacement data indicates that lateral displacement at the clay seam may be influencing the results.

6.5 Analysis of Convergence Data

As described previously, convergence measurements are a primary means of identifying areas where conditions may be becoming unstable. Due to the roof removal in the northern experimental area, comparisons from the previous reporting period to this reporting period are hard to interpret. The remotely read extensometers show an overall decrease in the rate change percent.

Table 6-2
Results of Remotely Read Extensometers in the Northern Experimental Area

Location		Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in./yr	Displacement Rate 2000 to 2001 in./yr	Rate Change Percent %
E140 Drift-N1266	E Rib	04/05/02	8.390	0.607	0.599	1%
E140 Drift-N1266	W Rib	04/05/02	6.142	0.448	0.464	-3%
Room L4	Roof	04/05/02	2.637	0.264	0.549	-52%
SPDV Room 4-N1325	Roof	05/02/02	5.763	1.011	1.102	-8%
SPDV Room 4-N1250	East 1/4 Pt	05/02/02	2.910	0.597	0.474	26%
SPDV Room 4-N1250	Roof	05/02/02	4.095	0.508	0.592	-14%
SPDV Room 4-N1250	West 1/4 Pt	05/02/02	7.014	1.090	1.138	-4%
SPDV Room 4-Center	E Rib	04/05/02	13.470	0.597	0.613	-3%
SPDV Room 4-Center	W Rib	12/10/01	10.390	0.461	0.410	12%
SPDV Room 4-N1175	Roof	05/02/02	3.205	0.487	0.673	-28%

SPDV = Site Preliminary Design Validation Program
in./yr. = inch(es) per year.

Table 6-3
Convergence Readings in the Northern Experimental Area
Wire Convergence Meters

Location		Date of Last Reading	Cumulative Displacement Inches	2001 to 2002 in/yr	2000 to 2001 in/yr	Rate Change Percent
N1420 DRIFT-E1551		05/29/02	6.441	0.834	0.824	1%
N1420 DRIFT-E1451		05/29/02	6.093	0.881	0.858	3%
ROOM D-N1342	Center	05/29/02	8.455	1.204	1.134	6%
ROOM D-N1266	Center	05/29/02	7.793	0.887	0.858	3%
ROOM D-N1187	Center	05/29/02	7.775	0.990	0.855	16%
N1100 DRIFT-E1620		05/07/02	4.280	0.447	0.434	3%
N1100 DRIFT-E1530		05/29/02	2.083	0.580	0.543	7%
E300 DRIFT-N1275	Center	05/29/02	20.753	3.069	3.087	-1%

in/yr. = inch(es)/year

7.0 Performance of Waste Disposal Area

Excavation of the Panel 1 waste disposal area began in May 1986 with the mining of access entries to Panel 1. Initially, the disposal rooms and drifts were developed as pilot drifts that were later excavated to nominal operational dimensions of 13 ft (4 m) high, 33 ft (10 m) wide, and 300 ft (91 m) long. Room 1 was completed to these dimensions in August 1986, and pilot drifts for Rooms 2 and 3 were excavated in January and February 1987. Rooms 2 and 3 were completed in February and March 1988 and Rooms 4 through 7 were completed in May 1988. Short access drifts designed to lead to smaller test alcoves were excavated north off of the S1600 drift in June 1989. Only the access drifts to the alcoves were completed; the alcoves were not excavated.

Excavation of the Panel 2 waste disposal area began in September 1999 with the mining of access entries to Panel 2. Initially, the disposal rooms and drifts were developed as pilot drifts that were trimmed to finished dimensions. Room 1 was completed in January 2000, and pilot drifts for Rooms 2 and 3 were excavated in February 2000. Pilot drifts were completed for rooms 4 through 6 in April 2000. The pilot drift for Room 7 was excavated in May 2000. All the rooms were excavated to final dimensions by August 2000.

7.1 Modifications to Excavations and Ground Control Activities

No new excavations were mined in Panels 1 and 2 during the reporting period of July 2001 through June 2002. Routine maintenance and ground control activities in the form of trimming, scaling, rock bolt replacement, and installing wire mesh was performed on ribs, floor, and roof throughout accessible areas in Panels 1 and 2. During this reporting period, Panel 2 Rooms 2, 6, 7, and S2180 were fully wire meshed and bolted. The remaining rooms were not bolted, with the exception of some spot bolting in drummy areas.
Table 7-1 summarizes the ground control activities performed in Panel 1 and Panel 2 during this reporting period.

7.2 Instrumentation

No extensometers were installed or replaced in Panel 1 during this reporting period. Twelve convergence points were replaced in Panel 1, Room 1 during this reporting period and an additional 13 convergence points were re-installed in the rest of Panel 1. Table 7-2 lists the convergence points installed or replaced in Panels 1 and 2. Figure 7-1 shows the location of the various types of geotechnical instruments in Panel 1 of the Waste Disposal

Area. During this reporting period, Rooms 4, 5, and 6 closed. The convergence points are no longer accessible in these rooms. The 286 rock bolt load cells

Table 7-1
Summary of Modifications and Ground Control Activities in the Waste Disposal Area July 1, 2001 through June 30, 2002

Date Completed	Location	Work Performed
7/01-6/02	Panel 1 – Rooms 1, 2 & 3	Floor trimming.
7/01-6/02	S1600	Floor trimming.
7/01-6/02	S-1950/Room 1 – Room 2	Floor trimming.
7/01-6/02	Panel 1, Rooms 5, 6, and 7	Waste disposal complete. Room closed.
8/01	S1950 from Rooms 1 to 4	Completed the installation of roof mats and 12’ rock bolts.
8/01	Panel 1, Rooms 6 & 7	Installed chainlink and brattice cloth room closures.
10/01	Panel 1, Rooms 2 & 3	Installed roof mats.
12/01	S2520/Room 6 intersection	Installed mechanical rock bolts and mesh.
1/02	S1950 between Room 1 and E140	Installed a supplemental ground support system (12’ rock bolts).
1/02	Entrance to Room 1, Panel 1	Installed roof mats.
5/02	Panel 2, S2180 drift & Room 7	Installed chainlink mesh and 4’ mechanical bolts on the roof.
6/02	Panel 2, Rooms 2 & 6	Installed mechanical bolts and mesh on the roof and ribs.

of the yielding roof support system in Room 1 are monitored regularly. As the roof beam expands, the tension in the rock bolts increases. Detensioning of the rock bolts was performed approximately every five weeks to maintain a specified load range during previous reporting periods. However, during this reporting period, the loads were allowed to increase until failure of the rock bolt. The failed rock bolts are replaced with a similar installation. These installations also include a Titan load indicator. The load indicators provide additional yield capacity thus extending the useful life of the bolt. Figure 7-2 shows the location of the various types of geotechnical instruments in Panel 2 of the Waste Disposal Area.

7.3 Excavation Performance

Horizontal and vertical convergence rates have been calculated at the center of each of the rooms in Panel 1 for this and the previous reporting period. Tables 7-3 and 7-4 present these convergence rates. The vertical convergence rates at the center of each of the rooms in Panel 1 have all increased with the exception of Room 2, which decreased during the

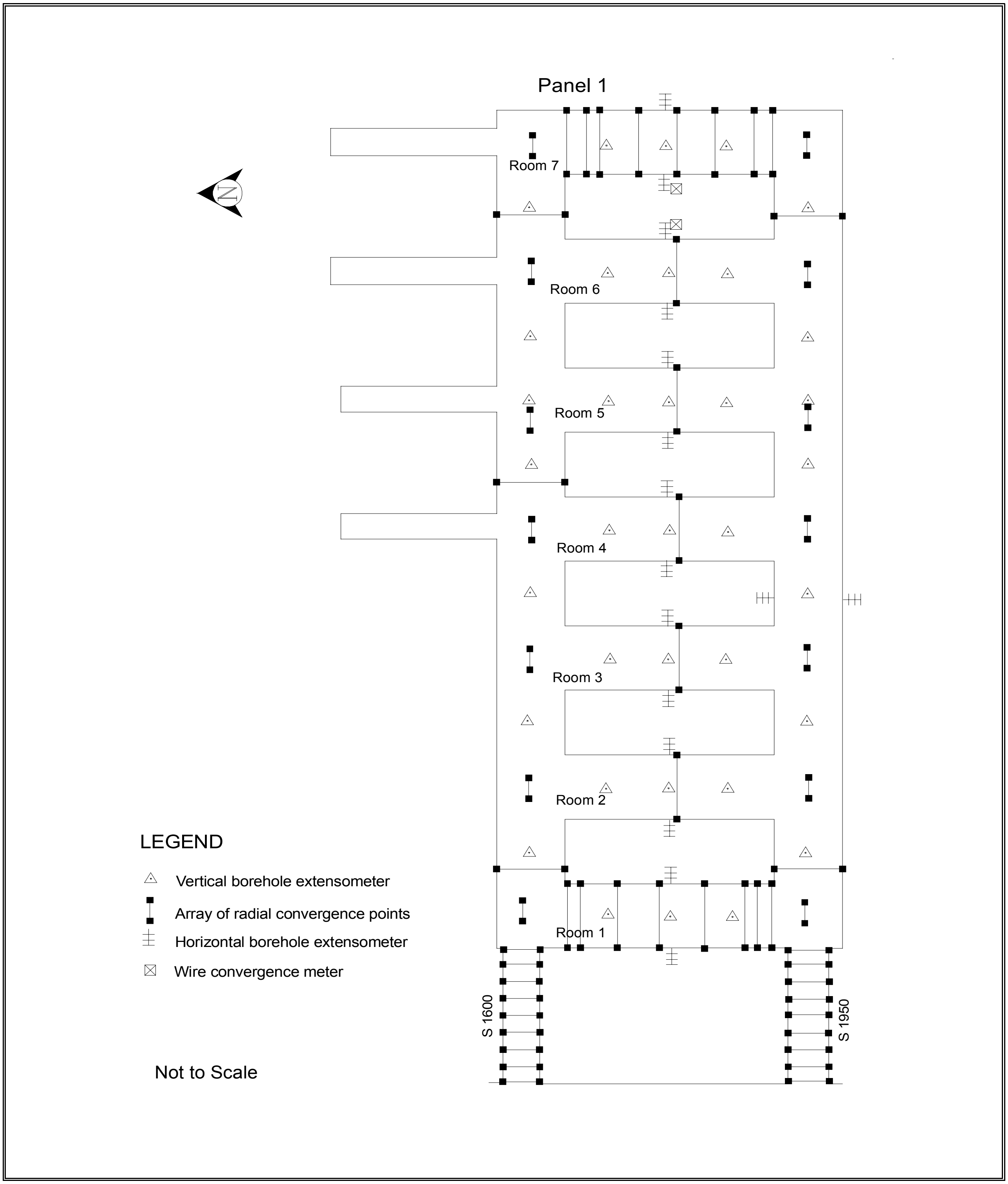


Figure 7-1
Location of Panel 1 Geotechnical Instruments

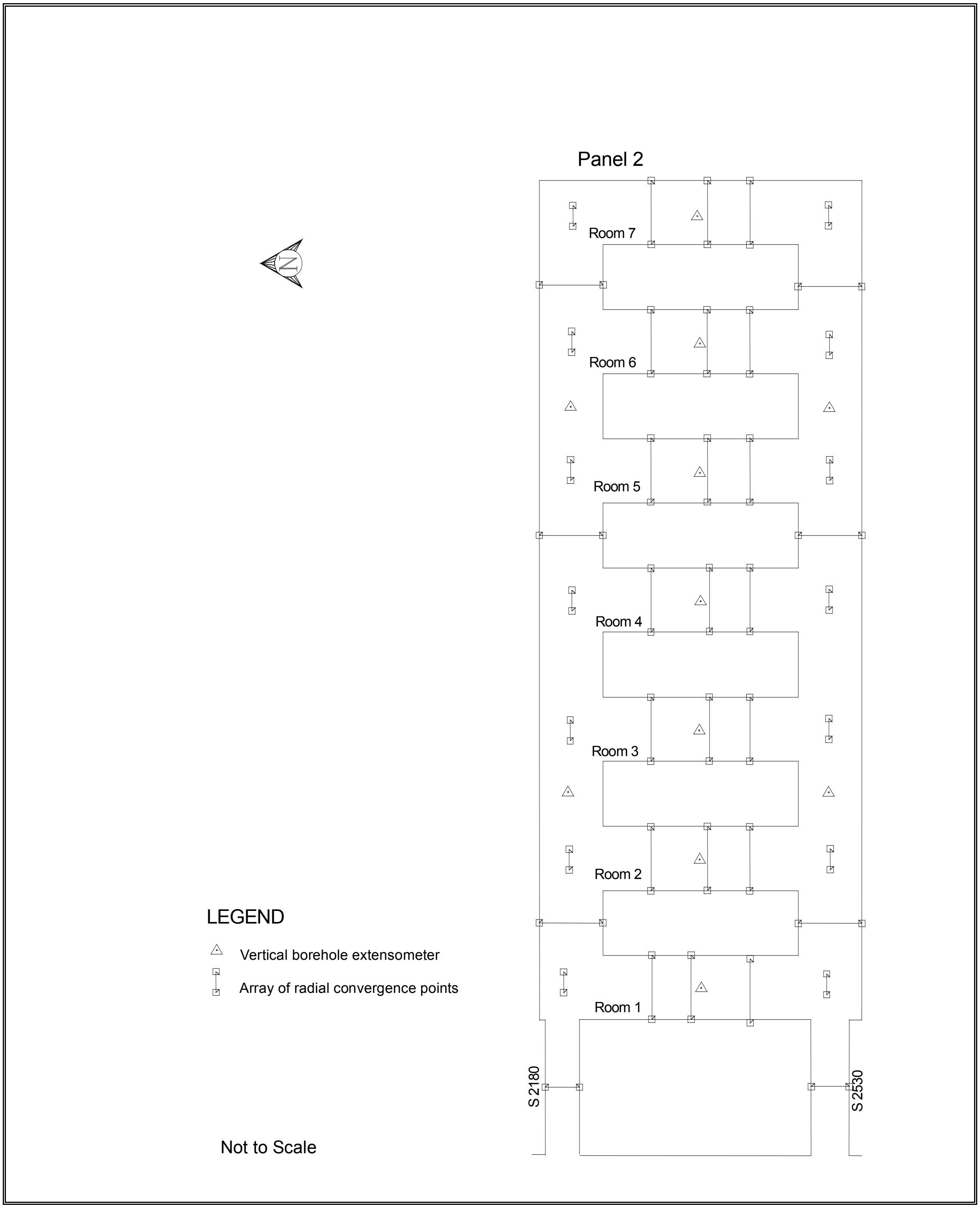


Figure 7-2
Location of Panel 2 Geotechnical Instruments

Table 7-2
New and Replaced Instruments in the Waste Disposal Area
July 1, 2001 through June 30, 2002

Instrument Type	N/R	Field Tag*	Chord	Location	Date Installed
Convergence Point	R	E1050-S1775-5	B-E	E1050 DRIFT-S1775	07/26/2001
Convergence Point	R	S1950-E586-8	A-C	S1950 DRIFT-E586	08/30/2001
Convergence Point	R	E660-S2275-2	A-C	E660 DRIFT-S2275	09/06/2001
Convergence Point	R	E790-S1775-4	A-C	E790 DRIFT-S1775	09/12/2001
Convergence Point	R	S1600-E482-3	A-C	S1600 DRIFT-E482	11/07/2001
Convergence Point	R	S1600-E507-3	A-C	S1600 DRIFT-E507	11/07/2001
Convergence Point	R	S1600-E520-4	A-C	S1600 DRIFT-E520	11/07/2001
Convergence Point	R	S1600-E586-4	A-C	S1600 DRIFT-E586	11/07/2001
Convergence Point	R	S1600-E660-3	A-C	S1600 DRIFT-E660	11/07/2001
Convergence Point	R	S1600-E790-3	A-C	S1600 DRIFT-E790	11/07/2001
Convergence Point	R	E660-S1775-6	A-C	E660 DRIFT-S1775	11/08/2001
Convergence Point	R	E520-S1639-2	A-D	E520 DRIFT-S1639	11/14/2001
Convergence Point	R	E520-S1639-2	B-C	E520 DRIFT-S1639	11/14/2001
Convergence Point	R	E520-S1639-2	F-E	E520 DRIFT-S1639	11/14/2001
Convergence Point	R	S2180-E586-2	B-D	S2180 DRIFT-E586	12/27/2001
Convergence Point	R	E520-S1717-2	C-G	E520 DRIFT-S1717	03/06/2002
Convergence Point	R	E520-S1717-2	B-D	E520 DRIFT-S1717	03/06/2002
Convergence Point	R	E520-S1717-2	H-F	E520 DRIFT-S1717	03/06/2002
Convergence Point	R	E520-S1802-7	A-E	E520 DRIFT-S1802	03/06/2002
Convergence Point	R	E520-S1802-2	B-D	E520 DRIFT-S1802	03/06/2002
Convergence Point	R	E520-S1802-2	H-F	E520 DRIFT-S1802	03/06/2002
Convergence Point	R	E520-S1884-2	A-E	E520 DRIFT-S1884	03/06/2002
Convergence Point	R	E520-S1884-2	B-D	E520 DRIFT-S1884	03/06/2002
Convergence Point	R	E520-S1884-2	H-F	E520 DRIFT-S1884	03/06/2002
Convergence Point	R	S1950-E503-7	A-C	S1950 DRIFT-E503	03/06/2002
Convergence Point	R	S1950-E586-9	A-C	S1950 DRIFT-E586	03/06/2002

*Field tag chords is defined in "Geotechnical Analysis Report for July 2001–June 2002 Supporting Data.

current reporting period relative to each of the three previous reporting periods. All the horizontal convergence rates at the center of each room have increased during the current reporting period relative to the previous period. Horizontal and vertical convergence rates have been calculated at the center of each of the rooms in Panel 2 for this and the previous reporting period. Tables 7-5 and 7-6 present these convergence rates. The vertical convergence rates at the center of each room in Panel 2 have all decreased. All the horizontal convergence rates at each room center have decreased.

Fracturing within the immediate roof beam contributes to high convergence rates seen in some areas of Panel 1, especially portions of Room 1. The ground support systems in Rooms 1 and 2, Panel 1 were designed specifically to yield in response to deformation, however, when the detensioning was stopped, the support system no longer functioned as a

Table 7-3

Annual Vertical Convergence Rates at the Center of Panel 1 Disposal Rooms

Location		Fieldtag	Total Cumulative Displacement Inches (cm)	Convergence Rate 2001-2002 in./yr. (cm/yr.)	Convergence Rate 2000-2001 in./yr. (cm/yr.)	Rate Change Percent %	Comments
	Centerline	E520-S1802-7 A-E	54.266 (137.836)	3.047 (7.739)	2.972 (7.759)	3%	
Room 2	Centerline	E660-S1775-6 A-C	39.644 (100.696)	2.214 (5.624)	2.388 (6.066)	-7%	
Room 3	Centerline	E790-S1775-4 A-C	44.653 (113.419)	2.848 (7.234)	2.665 (6.769)	7%	
Room 4	Centerline	E920-S1775-5 A-F	39.450 (100.203)	2.658 (6.751)	2.648 (6.726)	0%	Closed during this period.
Room 5	Centerline	E1050-S1775-4 A-F	38.229 (97.102)	2.908 (7.386)	2.663 (6.764)	9%	Closed during this period.
Room 6	Centerline	E1190-S1775-4 A-F	38.482 (97.744)	3.044 (7.732)	2.636 (6.695)	15%	Closed during this period.
Room 7	Centerline	E1320-S1775 A-E	NA*	NA*	NA*	NA*	Not Accessible.

*Room closed – unable to obtain readings.
cm/yr = centimeter(s) per year
in./yr = inch(es) per year

Table 7-4
Annual Horizontal Convergence Rates at the Center of Panel 1 Disposal Rooms

Location		Fieldtag	Total Cumulative Displacement Inches (cm)	Convergence Rate 2001-2002 in./yr. (cm/yr.)	Convergence Rate 2000-2001 in./yr. (cm/yr.)	Rate Change Percent %	Comments
	Rib center	E520-S1802-3 C-G	23.389 (59.408)	1.650 (4.191)	1.511 (3.383)	9%	
Room 2	Rib center	E660-S1775-5 B-D	25.595 (65.011)	1.790 (4.547	1.616 (4.105)	11%	
Room 3	Rib center	E790-S1775-5 B-D	27.970 (71.044)	2.126 (5.400)	1.954 (4.963)	9%	
Room 4	Rib center	E920-S1775-5 C-H	25.148 (63.876)	1.886 (4.790)	1.814 (4.608)	4%	Closed during this period.
Room 5	Rib center	E1050-S1775-5 C-H	26.635 (67.653)	1.881 (4.778)	1.827 (4.641)	3%	Closed during this period.
Room 6	Rib center	E1190-S1775-4 C-H	22.609 (57.427)	1.684 (4.277)	1.415 (3.594)	19%	Closed during this period.
Room 7	Rib center	E1320-S1775 C-G	NA*	NA*	NA*	NA*	Not Accessible.

*Room closed – unable to obtain readings.
cm/yr = centimeter(s) per year
in./yr = inch(es) per year

Table 7-5
Annual Vertical Convergence Rates at the Center of Panel 2 Disposal Rooms

Location		Fieldtag	Total Cumulative Displacement Inches (cm)	Convergence Rate 2001-2002 in./yr. (cm/yr.)	Convergence Rate 2000-2001 in./yr. (cm/yr.)	Rate Change Percent %	Comments
Room 1	Centerline	E520-S2350-2 A-C	9.893 (25.128)	3.579 (9.091)	5.297 (13.454)	-32%	
Room 2	Centerline	E660-S2350-3 A-C	10.286 (26.126)	3.656 (9.286)	4.252 (10.800)	-14%	
Room 3	Centerline	E790-S2350-2 A-C	9.783 (24.849)	3.167 (8.044)	5.196 (13.198)	-39%	
Room 4	Centerline	E920-S2350-2 A-C	12.300 (31.242)	3.591 (9.121)	6.060 (15.392)	-41%	
Room 5	Centerline	E1050-S2350-2 A-C	12.028 (30.551)	3.279 (8.329)	5.884 (13.945)	-44%	
Room 6	Centerline	E1190-S2350-3 A-C	10.536 (26.761)	3.322 (8.438)	5.077 (12.896)	-35%	
Room 7	Centerline	E1320-S2350-3 A-C	8.975 (22.797)	3.802 (9.657)	5.369 (13.637)	-29%	

cm/yr = centimeter(s) per year
in./yr = inch(es) per year

Table 7-6
Annual Horizontal Convergence Rates at the Center of Panel 2 Disposal Rooms

Location		Fieldtag	Total Cumulative Displacement Inches	Convergence Rate 2001-2002 in./yr. (cm/yr.)	Convergence Rate 2000-2001 in./yr. (cm/yr.)	Rate Change Percent %	Comments
Room 1	Rib center	E520-S2350 B-D	6.354 (16.139)	2.377 (6.038)	3.549 (9.014)	-33%	
Room 2	Rib center	E660-S2350 B-D	6.602 (16.602)	2.268 (5.761)	3.787 (9.619)	-40%	
Room 3	Rib center	E790-S2350 B-D	5.853 (14.867)	2.176 (5.527)	3.778 (9.596)	-42%	
Room 4	Rib center	E920-S2350 B-D	5.982 (15.194)	NA*	5.792 (14.712)	NA*	Temporarily Blocked.
Room 5	Rib center	E1050-S2350 B-D	5.535 (14.059)	2.031 (5.159)	3.769 (9.573)	-46%	
Room 6	Rib center	E1190-S2350 B-D	5.494 (13.955)	1.960 (4.978)	3.798 (9.647)	-48%	
Room 7	Rib center	E1320-S2425 B-D	5.177 (13.150)	1.748 (4.440)	3.390 (8.611)	-48%	

*Indicates insufficient data to calculate.
cm/yr = centimeter(s) per year
in./yr = inch(es) per year3.778

yielded system, but continued to function as a normal load bearing system. If the roof fracturing increases to the point at which a large section of the rock is detached, the yielding support systems are designed to support the weight of the roof beam (Westinghouse WID, 1999). Initially, in Panel 2, the convergence rates were high which can be attributed to the recent excavation of this panel. During this reporting period, the convergence rates have slowed down, as indicated by the rate change percent for both horizontal and vertical convergence points. During this reporting period, Rooms 4, 5, and 6 of Panel 1 were closed.

7.4 Analysis of Extensometer and Convergence Point Data

As discussed previously, extensometer data are obtained by measuring the displacement from the reference anchor (collar) to each fixed anchor of the extensometer. Convergence point data are obtained by measuring the change in distance between fixed points anchored into the rock across an opening, either from rib to rib or from roof to floor. Extensometer displacement rates and convergence rates are plotted against time, and comparisons are made between consecutive rates to identify any acceleration. Points that indicate acceleration are then analyzed to determine the significance of the acceleration. Factors that are considered during the analysis include the magnitude of the respective rates, percentage increase, convergence history, and any recent excavation in the vicinity.

There are 35 active extensometers installed in the roofs and ribs of Panel 1 with most being located in the disposal rooms. The majority of the extensometers show a displacement rate increase. The extensometers with the greatest rate increases are generally located in the southern half of the panel closest to Panel 2. The instrument data indicate a definite response to the mining of Panel 2.

Vertical convergence rates within Panel 1 increased slightly during this reporting period in the disposal rooms and in S1950 Access Drift. The areas closest to Panel 2 continue to have elevated deformation rates. These observations confirm the effect of the stress changes associated with mining the new panel. The greatest convergence rate increase (15%) within the disposal rooms themselves is located in Panel 1, Room 6. All of these areas will continue to be monitored closely.

The high closure rates in Panel 2 are generally associated with the initial response of the rock to mining. The convergence rates are expected to be higher immediately after mining and then taper off to a lower steady state rate. This is confirmed by the consistent drop in displacement rates over time.

8.0 Geoscience Program

The Geoscience Program confirms the suitability of the site through the collection of geologic data from the underground facility, including documentation of the stratigraphy and excavation characteristics. Geologic data are gathered through the mapping of excavation surfaces and the logging of new boreholes. Excavation characteristics are determined from fracture mapping and the logging of fractures and offsets (lateral displacements) in open boreholes. Data collected through these activities support the design and evaluation of ground support systems (Westinghouse WID, 1999).

During this reporting period, the following activities were performed:

- Borehole Inspections
- New Borehole Logging
- Fracture Mapping

8.1 Borehole Inspections

Geotechnical observation boreholes are drilled at various locations throughout the underground facility. A location may contain one or several boreholes arranged in an array. These holes are drilled to depths that allow the monitoring of fracture development and offsetting and are inspected for the development of those features.

Roof observation holes usually intersect clays "G" and "H" (Figure 8-1). Floor observation holes are no longer monitored due to infilling of the holes with crushed salt. There are no separation or offset data for floor observation holes for this reporting period.

The clay seams nearest the excavation surfaces define the immediate roof beam. Clay "G" defines the roof beam in most of the access drifts and Panels 1 and 2. Some areas, such as the Salt Handling Shaft Station, portions of the E140 drift, and some of the south mains are excavated to clay "G" and so have roof beams bounded by clay "H."

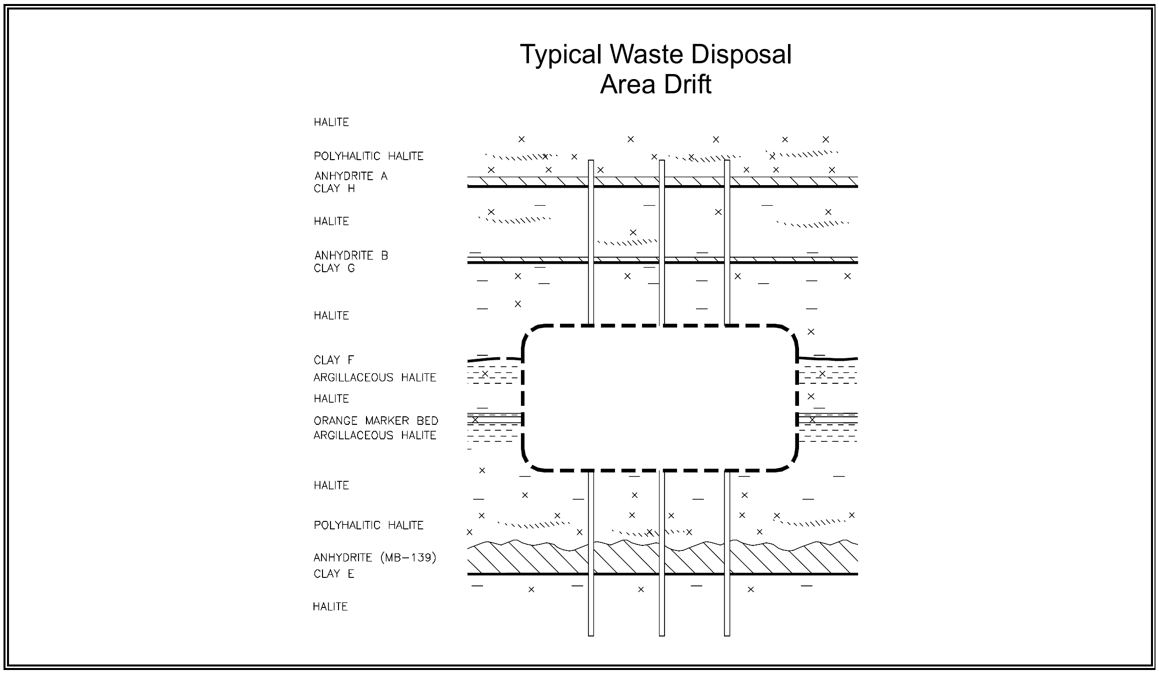


Figure 8-1
Examples of Observation Borehole Layouts

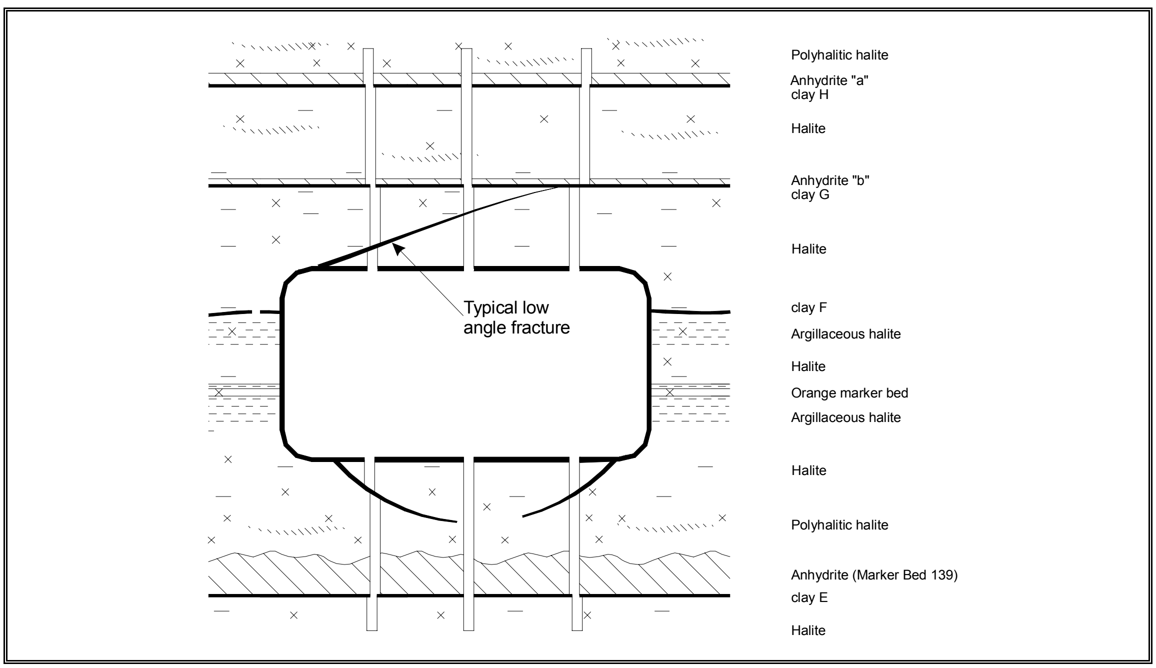


Figure 8-2
Generalized Fracture Pattern

The offset in a borehole is determined by visually estimating the degree of borehole occlusion. The direction of offset along clay seams is observed as the movement of the strata nearer to the observer relative to the strata farther away. Typically the nearer strata moves toward the center of the excavation (Figure 8-2). Based on previous observations in the underground, the magnitude of offset is usually greater in boreholes located near ribs than in those located along excavation centerlines. Offsetting along the clay layers is observable until the total borehole offset is reached or visibility is obstructed by intervening offsets at other clay seams or fractures. Boreholes are inspected for fractures using an aluminum rod with a flattened steel wire probe attached to one end perpendicular to the rod (referred to as a “scratcher rod”). Fractures and clay seams are located by moving the probe along the sides of the borehole until it is snagged in one of these features. Depth to each feature is recorded, as is the magnitude of separations encountered.

The separation and offset data observed at clay “G” and clay “H” in accessible boreholes during this reporting period are presented in Table 7-1 of the supporting data document for this report.[6]

8.2 New Borehole Logging

New boreholes are drilled to determine geologic features in selected areas. During this reporting period five observation holes were drilled in N1400 drift. Table 7-2 of the supporting data document presents a summary of these holes.

8.3 Fracture Mapping

Routine mapping documents the progression of fractures in the roof exposed on the excavation surfaces of the drifts and rooms in the underground repository. The fracture surveys are generally performed on an annual basis, and the fracture maps are recorded on Mylar sheets or updated as AutoCAD files. The fracture maps facilitate the analysis of strain in the immediate roof-beam as they document the propagation of fractures through time. Figures 7-1 through 7-19 of the supporting data document contain fracture maps for Panels 1 and 2.

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[6] Instrumentation data and data plots are available in “Geotechnical Analysis Report for July 2001-June 2002 Supporting Data.” This document is available upon request from Washington TRU Solutions. Refer to Foreword and Acknowledgments for details and address.

9.0 Summary

At the inception of the WIPP project, criteria were developed that address the requirements for the design of WIPP (DOE, 1984). These criteria, in the form of design requirements, pertain to all aspects of the mined facility and its operation as a pilot plant for the demonstration of technical and operational methods for permanent disposal of CH and remote handled (RH) TRU waste. In 1994, as WIPP developed and the focus moved toward the permanent disposal of TRU waste, these design requirements were reassessed and replaced by a new set of requirements called system design descriptions (SDD). Table 9-1 shows the comparison of these design requirements with conditions actually observed in the underground from July 2001 through June 2002.

Fracture development in the roof is primarily caused by the concentration of compressive stresses in the roof beam and is influenced by the size and shape of the excavation and the stratigraphy in the immediate vicinity of the opening. Pillar deformations induce lateral compressive stresses into the immediate roof and floor. With time the buildup of stress causes differential movement along stratigraphic boundaries. This differential movement is identified as offsets in observation boreholes and is indicated by the bends in failed rock bolts. Large strains associated with lateral movements can induce fracturing in the roof, which is frequently seen near the ribs. This scenario of roof deterioration, combining compressive stresses, horizontal offsetting, and large strains associated with lateral movements, is substantiated by field observations.

Normal drift and room maintenance continued during this reporting period with rib, roof, and floor scaling and trimming in various locations, and rock bolting and wire mesh installation as needed. Supplemental ground support systems consisting of cable slings and welded wire mesh were installed in S1600 drift within Panel 1.

New convergence point pairs were installed in the access drifts to Panel 2, and in various locations throughout the repository to replace mined out instruments. During a prior reporting period, entry was made into the deactivated Northern Experimental Area to assess the ground conditions to use the area for salt disposal. Remote convergence monitoring continues at selected locations east of E140 Drift. All accessible areas of the underground are connected to data loggers or are monitored manually.

Table 9-1
Comparison of Excavation Performance to System Design Requirements

Requirement	Comments
"The lining shall be designed for a hydrostatic pressure. . . ."	Water pressure observed on piezometers located behind the shaft keys in the Waste Shaft and the Exhaust Shaft remains below design levels.
"The key shall be designed to resist the lateral pressure generated by salt creep."	Geomechanical data from the Waste Shaft indicate that the shaft is structurally stable. Visual inspections of the shaft keys do not indicate any deterioration due to creep loading.
"The key shall be designed to retain the rock formation and will be provided with chemical seal rings and a water collection ring with drains to prevent water from flowing down the unlined shaft from the lining above."	The small amount of groundwater inflow into the shafts is effectively controlled. Seepage into the Exhaust Shaft is manageable. There is no indication of shaft instability due to salt dissolution.
"The underground waste disposal facilities shall be designed to provide space and adequate access for the underground equipment and temporary storage space to support underground operations."	Geomechanical instrument data and visual observations indicate that the current design provides adequate access and storage space. Ground control maintenance is performed as necessary to maintain access.
"The underground waste disposal facilities shall be designed to provide the capability of retrieving the emplaced CH and RH TRU waste."	(Retrievability is not presently a requirement in the waste disposal program.)
"Entries and sub-entries to the underground disposal area and the experimental areas shall be provided and sized for personnel safety, adequate air flow, and space for equipment."	Deformation of excavation remains within the required limits. Normal periodic maintenance consisting of rock bolting, wire meshing, trimming, and scaling continue throughout the repository.
"Geomechanical instrumentation shall be provided to measure the cumulative deformation of the rock mass surrounding mined drifts. . . ."	Geotechnical instrumentation is operated and maintained to meet this requirement. This annual report acts to provide a summary and analysis of the geomechanical data.

The in situ performance of the excavations generally continues to satisfy the appropriate design criteria, although specific areas are being identified where deterioration resulting

from aging must be addressed through routine maintenance and implementation of engineered systems. This deterioration has been identified through the analysis of data acquired from geomechanical instrumentation and the Geoscience Program. If the planned life of some of the openings needs to be extended, redesigning the geometry of the access drifts (e.g., changing the horizontal and vertical dimensions) or additional ground control (e.g., installing bolts, mesh, or straps) may be necessary. The ground conditions in the Waste Disposal Area and associated waste transport routes continue to slowly deteriorate; however, routine ground control installations and maintenance continues to allow safe access in the underground facility.

In addition to underground instrumentation, qualitative assessments of fracture development are documented through mapping the underground repository and inspecting the observation boreholes. The information acquired from these programs provides early detection of ground deterioration, contributes to the understanding of the dynamic geomechanical processes in the WIPP underground, and aids in the design of effective ground control and support systems.

10.0 References and Bibliography

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DOE/WIPP-03-3177
Volume 2

Geotechnical Analysis Report for July 2001 - June 2002

Supporting Data

March 2003

Waste Isolation Pilot Plant

FOREWORD AND ACKNOWLEDGMENTS

This Supporting Data Document to the Geotechnical Analysis Report (GAR) presents the data that were used to assess the geotechnical status of the Waste Isolation Pilot Plant (WIPP). This report presents data for the underground facility including the shafts, shaft stations, access drifts, Northern Experimental Area, and the Waste Disposal Area. The data are presented in both tables and plots in order to meet the needs of several audiences. This report presents the data collected through June 30, 2002. This data can be provided in its original format upon written request to the U.S. Department of Energy (DOE) at the following address:

U.S. Department of Energy
Carlsbad Field Office
P.O. Box 3090
Carlsbad, NM 88221-3090

The Geotechnical Analysis Report is a multi-author report that was prepared by Washington TRU Solutions for the DOE, Carlsbad Field Office, Carlsbad, New Mexico. Work was supported by the DOE under Contract No. DE-AC04-01AL66444.

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Geosciences Program

1.0 Introduction

This report is a compilation of geotechnical data presented as plots for each active instrument installed in the underground at the Waste Isolation Pilot Plant (WIPP) through June 30, 2002. A summary of the geotechnical analyses that were performed using the enclosed data is provided in Volume 1 of the Geotechnical Analysis Report.

1.1 Instrumentation

Geomechanical data included in this report reflect the measurements of the geomechanical response from instruments installed in the underground and shafts. These instruments consist of convergence points, wire convergence meters, borehole extensometers, rockbolt load cells, pressure cells, strain gages, piezometers, and joint meters.

Closure measurements are taken at convergence points and by wire convergence meters. Rock displacement is calculated by measuring the distance between two opposing points. Displacement is monitored over time and is plotted as closure versus time. Annual rates of closure are calculated for the convergence data and are compared with annual closure rates from previous reporting periods.

Borehole extensometers are used to determine the absolute movements of the ground around the openings. With these instruments, rods or wires are placed into a hole and anchored at various depths. The displacement at the extensometer head (located near the excavation face) is measured relative to each of the fixed anchors. These data are used in the extensometer *displacement* plots presented here. As part of the post-processing of acquired extensometer data a *relative displacement* value is calculated. The deepest anchor is assumed to be fixed in undisturbed ground and a displacement for the remaining anchors relative to the deepest anchor is calculated. Annual rates of collar displacement are calculated for each extensometer and are compared with the annual displacement rate reported during the previous reporting period.

Rockbolt load cells are used to determine the ground loading and the effectiveness of rockbolts. Plots consist of load versus time for each instrumented bolt.

Earth pressure cells and strain gages are used in and around the shaft liners to determine their loads. These are also depicted in time-based plots. Monitoring of these instruments indicates whether there is any stress buildup in the shaft lining systems.

Piezometers are used to measure the gage pressure of groundwater. They have been installed in the shafts at varying elevations to monitor the hydraulic head acting on the shaft liners. Plots from piezometers are presented as pressure versus time.

Joint meters are installed perpendicular to a crack and monitor any changes in separation of the crack which may occur over time.

1.2 Data Plot Explanation

Data are presented in graphical form for ease in interpretation. Time-based plots are used in this report. Each plot generally consists of a legend in the upper right-hand corner that gives the array name and specific location of the instrument or point evaluated. The legend ties the graphical cross-sectional representation of the drift or shaft typically presented in the lower right-hand corner to the symbols on the curve in the graph. For extensometers, each anchor is designated with an alpha character "A" closest to the collar and "C," "D," or "E" for the furthest point from the collar (the deepest anchor). For convergence points, the horizontal and vertical sections of the drift are referred to as chords. Breaks in the graph for convergence data and a numeric designator added to the legend indicate that the convergence point was lost due to normal mine maintenance activities and later reinstalled.

1.3 Report Organization

Chapter 1.0 provides an introduction to this Supporting Data volume of the GAR. Chapter 2.0 provides instrument data analysis for the Salt Handling Shaft, Waste Shaft, and Exhaust Shaft followed by data plots for the extensometers, piezometers, earth pressure cells, spot welded strain gages, and embedment strain gages installed in the shafts. Chapter 3.0 provides instrument data analysis for the Salt Handling Shaft Station and Waste Shaft Station, an instrument data summary only for the area immediately surrounding the Air Intake Shaft, and data plots for extensometers, convergence points, and rockbolt load cells for all three locations. Chapter 4.0 provides instrument data analysis for the access drifts followed by data plots for the extensometers, convergence points and joint meters. Chapter 5.0 provides instrument data analysis for the Northern Experimental Area including the SPDV rooms and associated access drifts, followed by data plots for the extensometers, convergence points, and wire convergence meters. Chapter 6.0 provides instrument data analysis for the Waste Disposal Area followed by data plots for the extensometers and convergence points.

Chapter 7.0 provides geologic data collected through the mapping of fractures and stratigraphic features on excavation surfaces, the observation of clay seam displacements in vertical boreholes, and the logging of new core and boreholes.

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2.0 Instrumentation Summary for Shafts

Instrumentation data analysis for three of the four shafts at the WIPP follows. Table 2-1 presents data and analysis of the Salt Shaft. Plots of the instrument data are presented as Figures 2-1 through 2-13. Table 2-2 presents data and analysis of the Waste Shaft. Plots of the instrument data are presented as Figures 2-14 through 2-27. Table 2-3 presents data and analysis of the Exhaust Shaft. Plots of the instrument data are presented as Figures 2-28 through 2-40. Instrumentation and measurements for the Air Intake Shaft are collected by Washington TRU Solutions and then provided to Sandia National Laboratories/New Mexico for analysis and reporting. The data are not presented here.

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Table 2-1
Salt Handling Shaft Data Analysis

PIEZOMETERS

Field Tag	Level feet	Figure Number	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Date of 2000-2001 Max. Reading	2000-2001 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
37X-PE-00201	580	2-1	12/12/01	64.2	07/03/00	80.5	-16.3	
37X-PE-00202	580	2-1	12/12/01	67.0	07/03/00	85.0	-18.0	
37X-PE-00203	620	2-2	12/12/01	44.0	07/03/00	128.8	-84.8	
37X-PE-00204	620	2-2	12/12/01	90.4	07/03/00	138.3	-47.9	
37X-PE-00205	691	2-3	11/07/01	108.9	09/05/00	150.3	-41.4	
37X-PE-00206	691	2-3	02/11/02	108.3	09/05/00	144.7	-36.4	
37X-PE-00207	726	2-4	02/11/02	144.9	01/02/01	144.3	0.6	
37X-PE-00208	726	2-4	12/12/01	142.5	01/02/01	141.7	0.8	
37X-PE-00209	802	2-5	11/07/01	115.0	09/05/00	134.2	-19.2	
37X-PE-00210	802	2-5	11/07/01	113.9	09/05/00	131.0	-17.1	
37X-PE-00211	850	2-6	11/07/01	78.7	09/05/00	109.4	-30.7	
37X-PE-00212	850	2-6	11/07/01	79.0	09/05/00	111.8	-32.8	

EARTH PRESSURE CELLS

Field Tag	Level feet	Figure Number	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Date of 2000-2001 Max. Reading	2000-2001 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
37X- WE-00201	860	2-7	11/07/01	-9.5	09/05/00	0.5	-10.0	
37X- WE-00202	860	2-7	02/11/02	-25.2	08/01/00	-23.3	-1.9	
37X- WE-00203	860	2-7	11/07/01	-30.2	07/03/00	-28.3	-1.9	

Table 2-1 (Continued)
Salt Handling Shaft Data Analysis

SPOT WELDED STRAIN GAGES

Field Tag	Level feet	Figure Number	Date of 2001-2002 Max. Reading	2001-2002 Maximum Total microstrain	Date of 2000-2001 Max. Reading	2000-2001 Maximum Total microstrain	Change in Maximum Strain From Previous Year	Comments
37X-ZE-00201	856.3	2-8	11/07/01	727	08/01/00	754	-27	
37X-ZE-00206	856.3	2-8	11/07/01	589	09/05/00	660	-71	
37X-ZE-00220	862.4	2-9	11/07/01	807	12/04/00	819	-12	
37X-ZE-00221 [B]	862.4	2-9	02/11/02	204	07/03/00	-99	303	High reading fluctuations.
37X-ZE-00223	862.4	2-9	02/11/02	440	09/05/00	384	56	

[B] Probable Instrument Failure.

EMBEDMENT STRAIN GAGES

Field Tag	Level feet	Figure Number	Date of 2001-2002 Max. Reading	2001-2002 Maximum Total microstrain	Date of 2000-2001 Max. Reading	2000-2001 Maximum Total microstrain	Change in Maximum Strain From Previous Year	Comments
37X-ZE-00209	856.3	2-10	12/12/01	-549	01/02/01	-550	1	
37X-ZE-00210	856.3	2-10	11/07/01	950	09/05/00	983	-33	
37X-ZE-00211	856.3	2-10	11/07/01	298	08/01/00	331	-33	
37X-ZE-00212	856.3	2-10	02/11/02	-914	12/04/00	-933	19	
37X-ZE-00213	856.3	2-10	11/07/01	240	08/01/00	223	17	
37X-ZE-00214	856.3	2-10	02/11/02	-189	01/02/01	-199	10	
37X-ZE-00215	856.3	2-10	11/07/01	46	08/01/00	64	-18	
37X-ZE-00216	856.3	2-10	11/07/01	497	09/05/00	549	-52	
37X-ZE-00225	862.4	2-11	11/07/01	391	09/05/00	421	-30	
37X-ZE-00235	856.3	2-12	02/11/02	-424	01/02/01	-424	0	
37X-ZE-00236	856.3	2-12	02/11/02	-146	12/04/00	-161	15	
37X-ZE-00237	856.3	2-12	02/11/02	-47	12/04/00	-75	28	
37X-ZE-00238	856.3	2-12	11/07/01	422	09/05/00	464	-42	
37X-ZE-00239	862.4	2-13	02/11/02	-386	01/02/01	-383	-3	

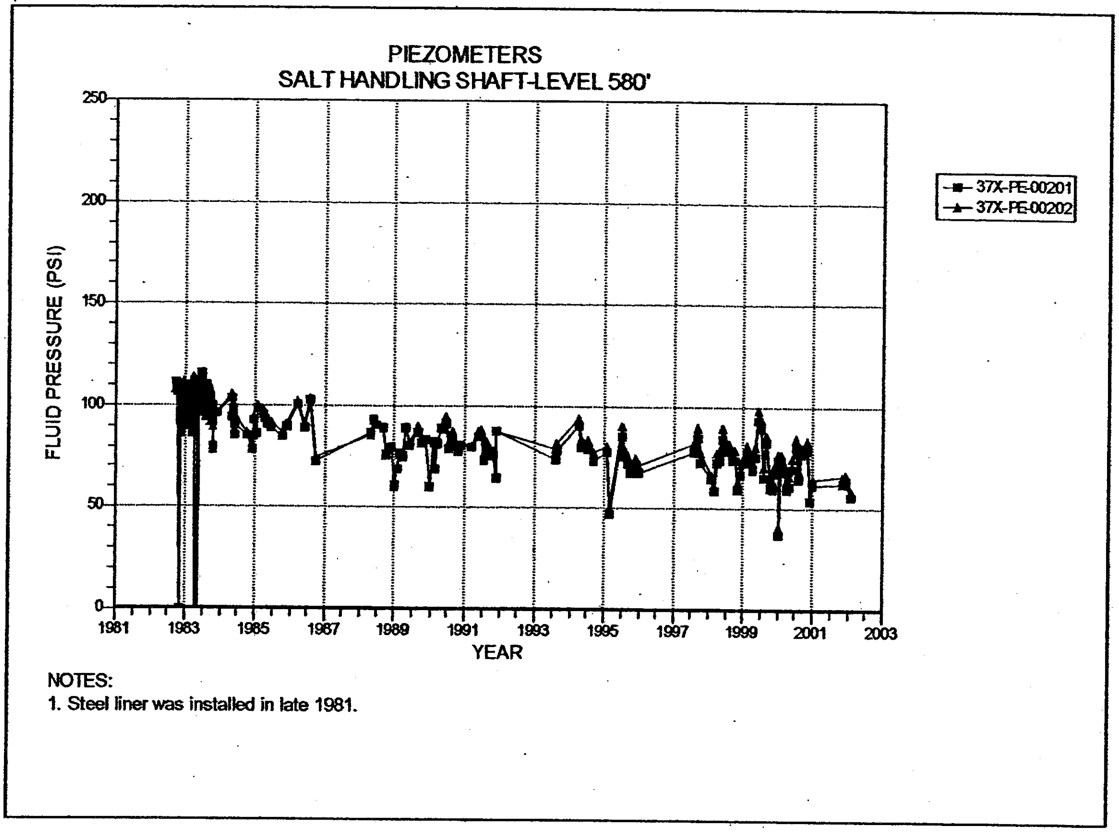


Figure 2-1 Piezometers 37X-PE-00201 and 37X-PE-00202
Salt Handling Shaft – Level 580 at the Forty-niner Member

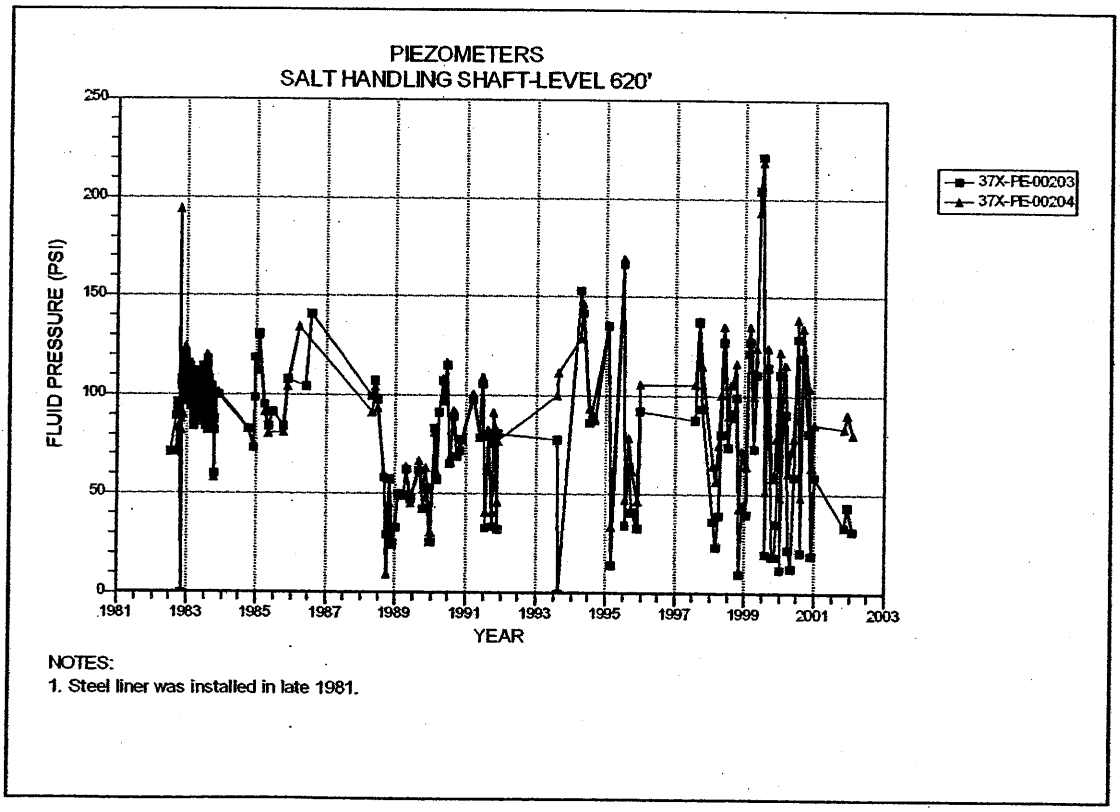


Figure 2-2 Piezometers 37X-PE-00203 and 37X-PE-00204
Salt Handling Shaft – Level 620 at the Magenta Dolomite Member

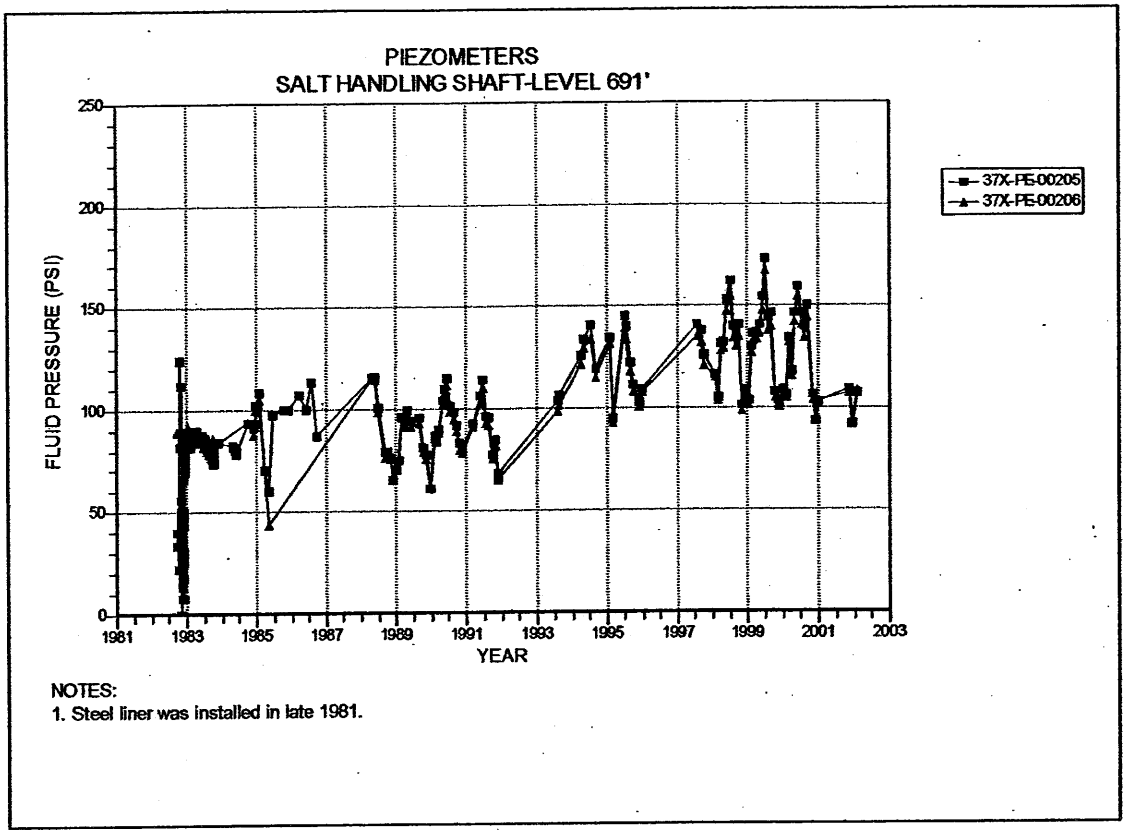


Figure 2-3 Piezometers 37X-PE-00205 and 37X-PE-00206
Salt Handling Shaft – Level 691 at the Tamarisk Member

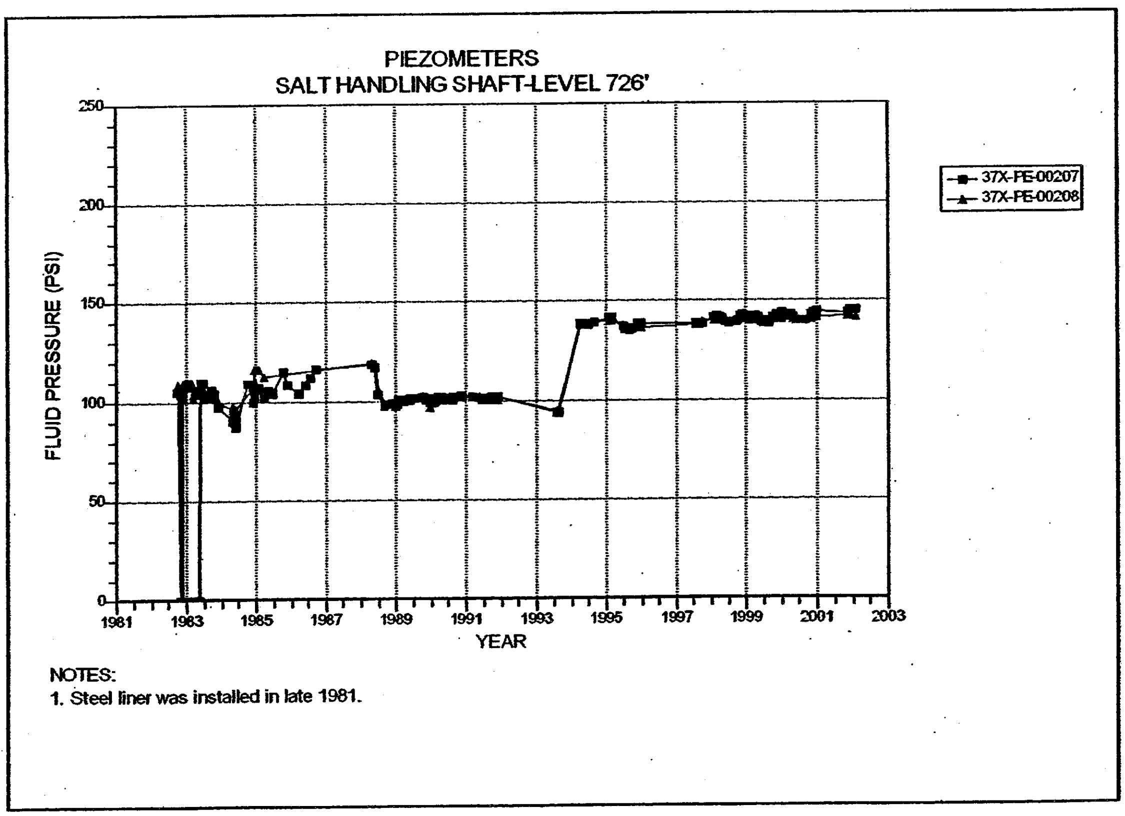
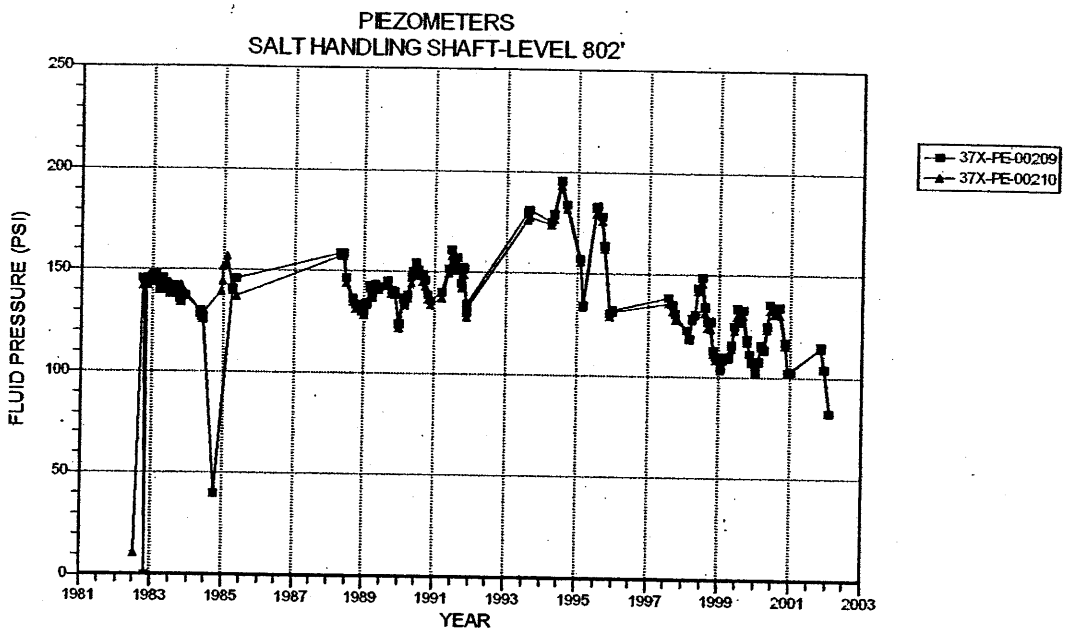
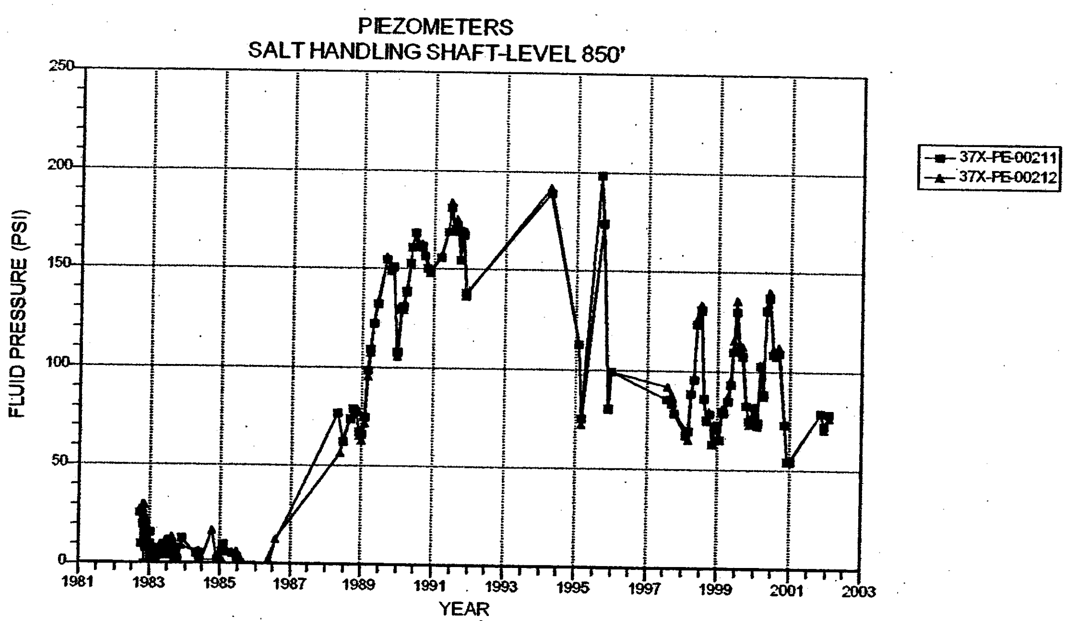


Figure 2-4 Piezometers 37X-PE-00207 and 37X-PE-00208
Salt Handling Shaft – Level 726 at the Culebra Dolomite Member



NOTES:
1. Steel liner was installed in late 1981.

Figure 2-5 Piezometers 37X-PE-00209 and 37X-PE-00210
Salt Handling Shaft – Level 802 at the Los Medaños Member



NOTES:
1. Concrete for key was placed in April 1982.

Figure 2-6 Piezometers 37X-PE-00211 and 37X-PE-00212
Salt Handling Shaft – Level 850 at the Rustler-Salado Contact

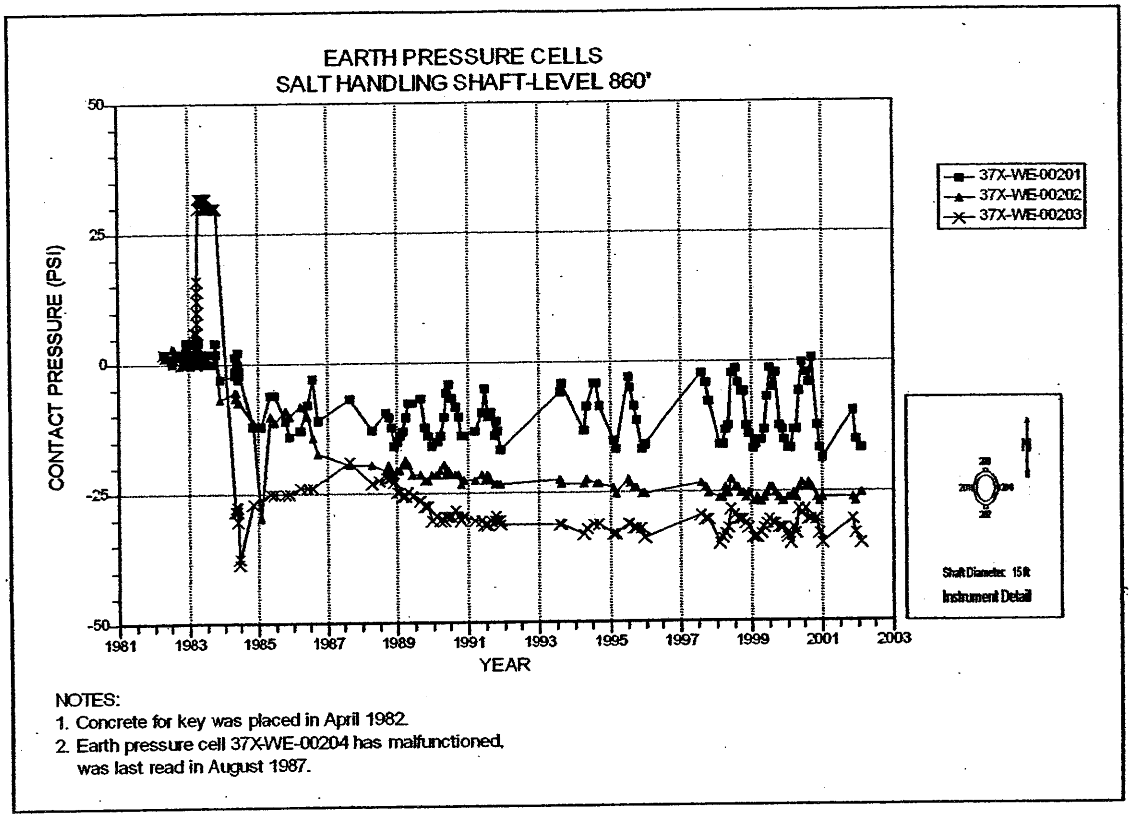


Figure 2-7 Earth Pressure Cells Behind Shaft Key
Salt Handling Shaft Key – Level 860

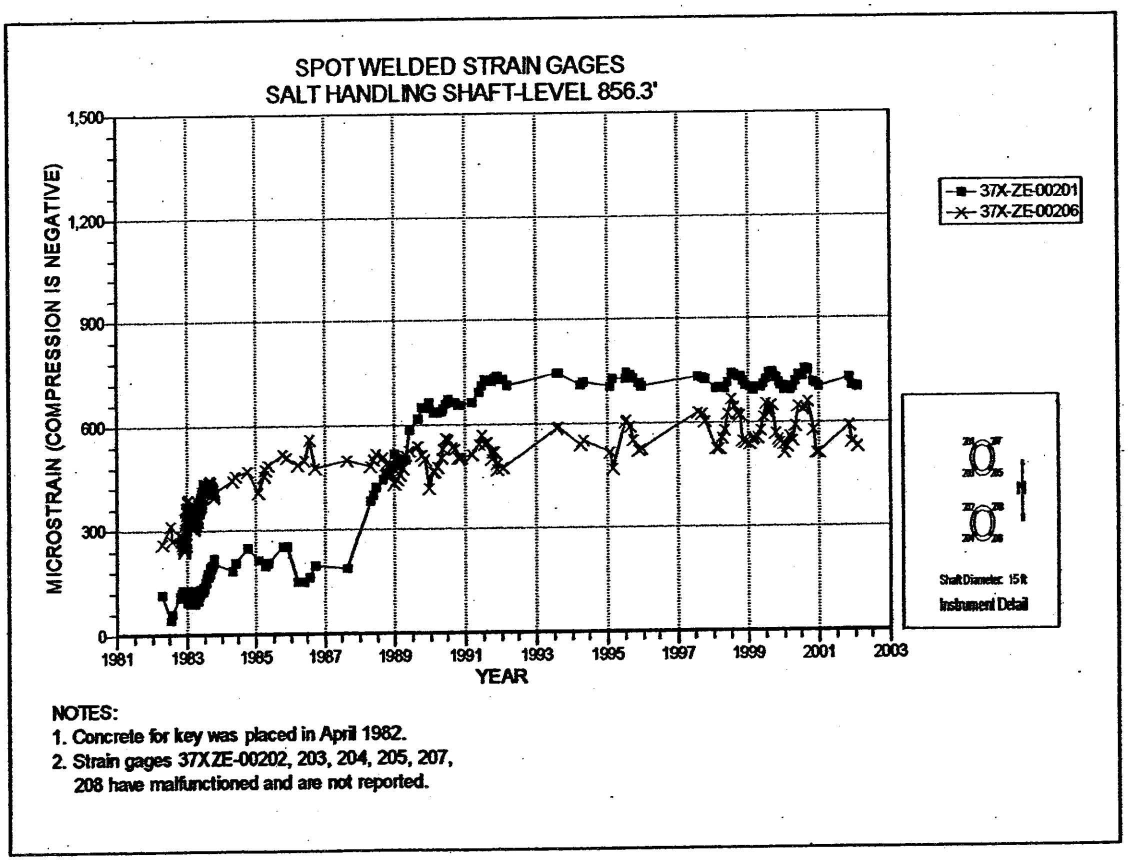
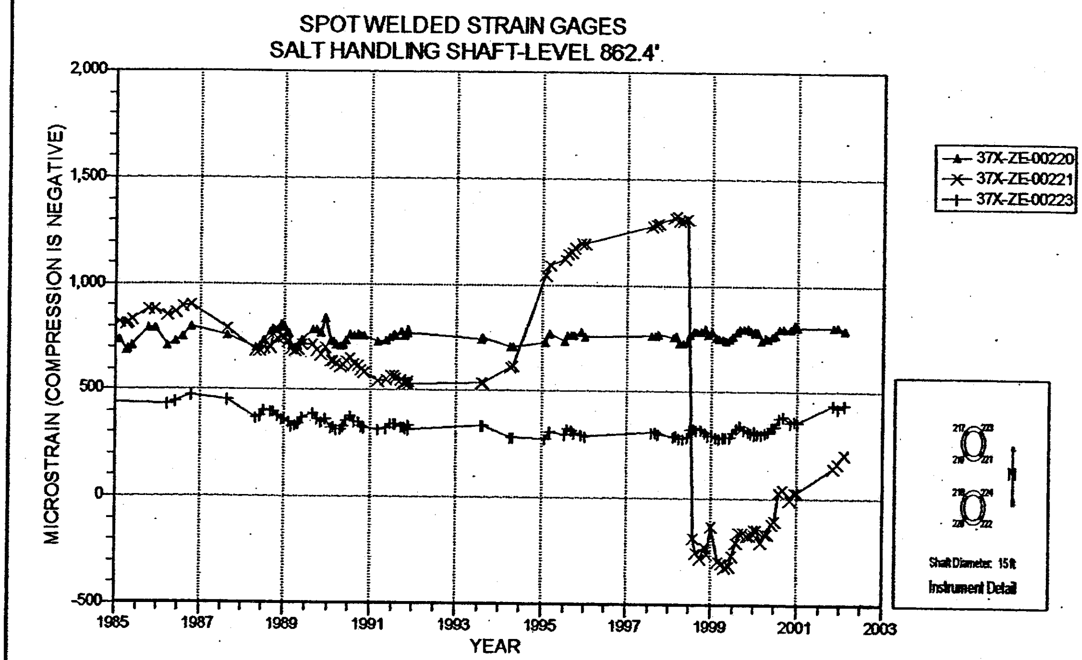
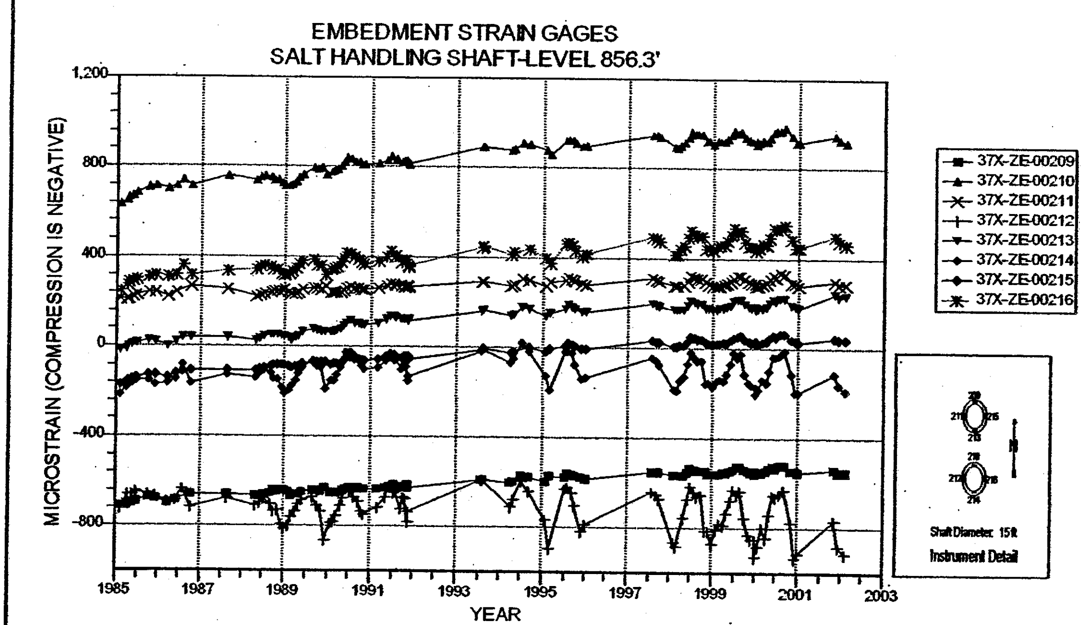


Figure 2-8 Spot Welded Strain Gages
Salt Handling Shaft Key – Level 856.3



NOTES:
1. Concrete for key was placed in April 1982.
2. Strain gages 37X ZE-00217, 218, 219, 222, and 224 have malfunctioned and are not reported.

Figure 2-9 Spot Welded Strain Gages
Salt Handling Shaft Key – Level 862.4



NOTES:
1. Concrete for key was placed in April 1982.

Figure 2-10 Embedment Strain Gages
Salt Handling Shaft Key – Level 856.3

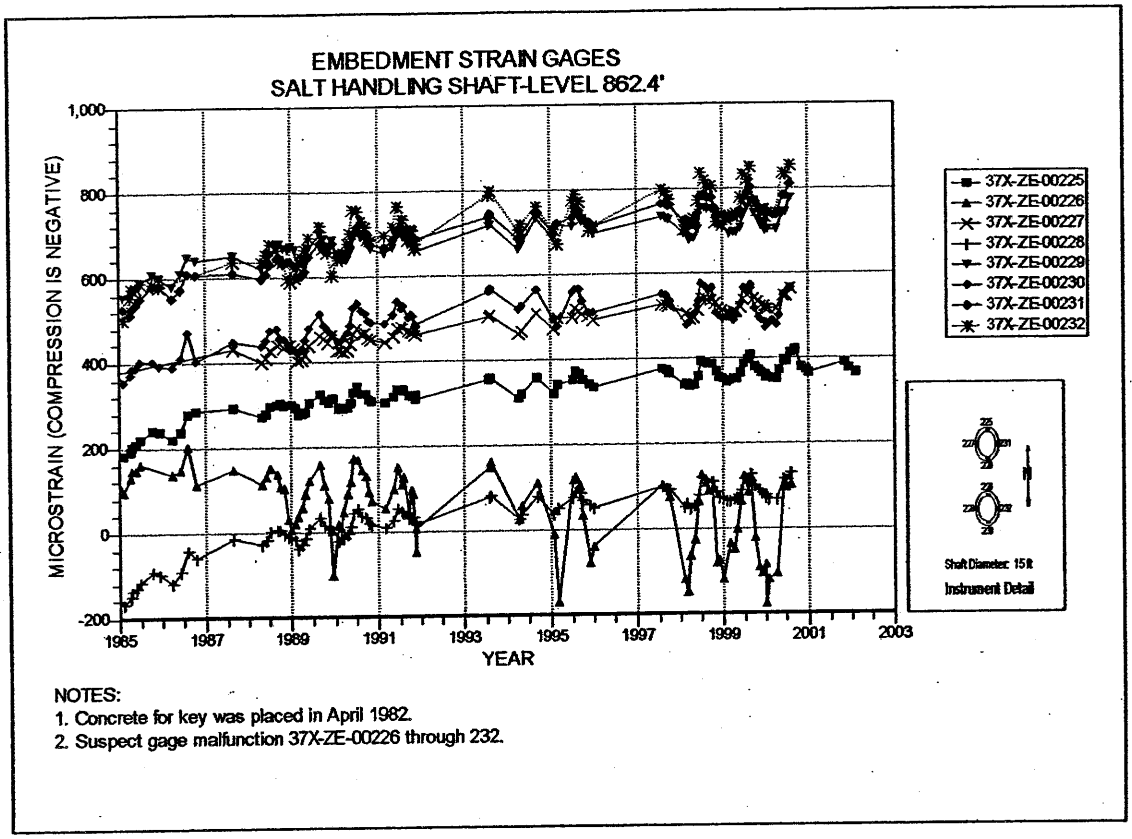


Figure 2-11 Embedment Strain Gages
Salt Handling Shaft Key Level 862.4

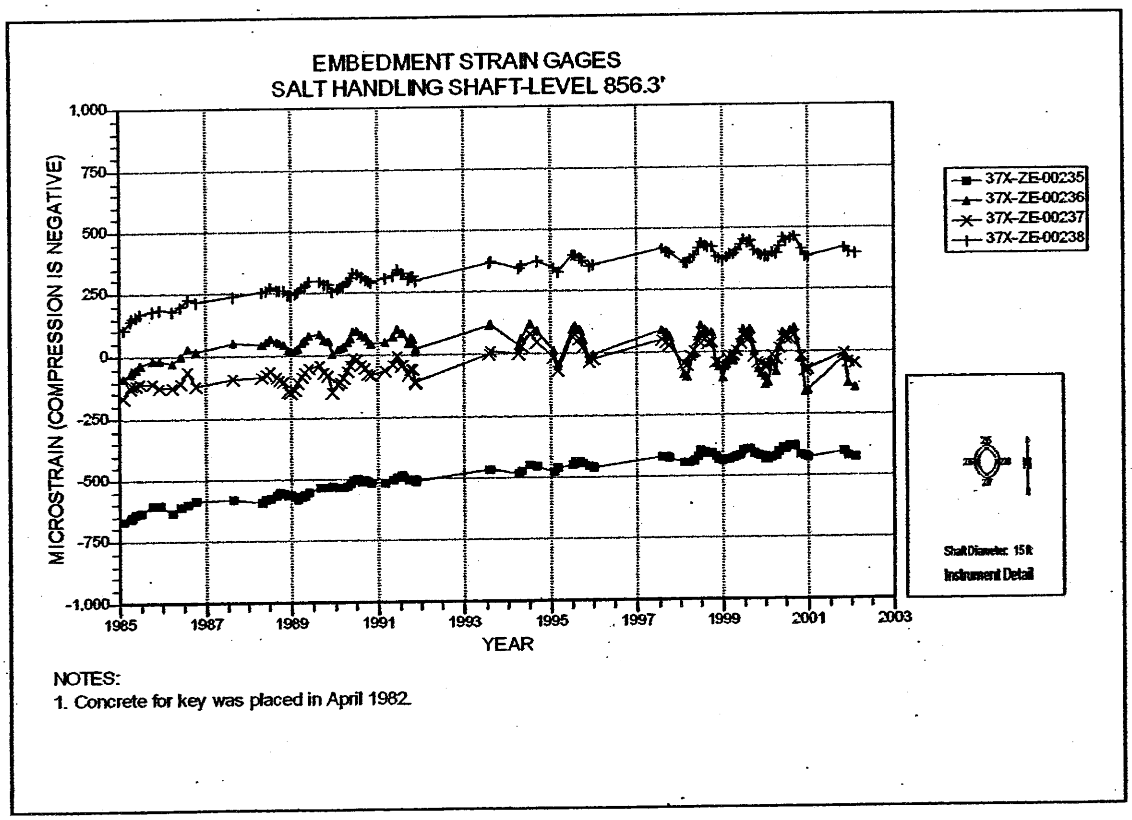
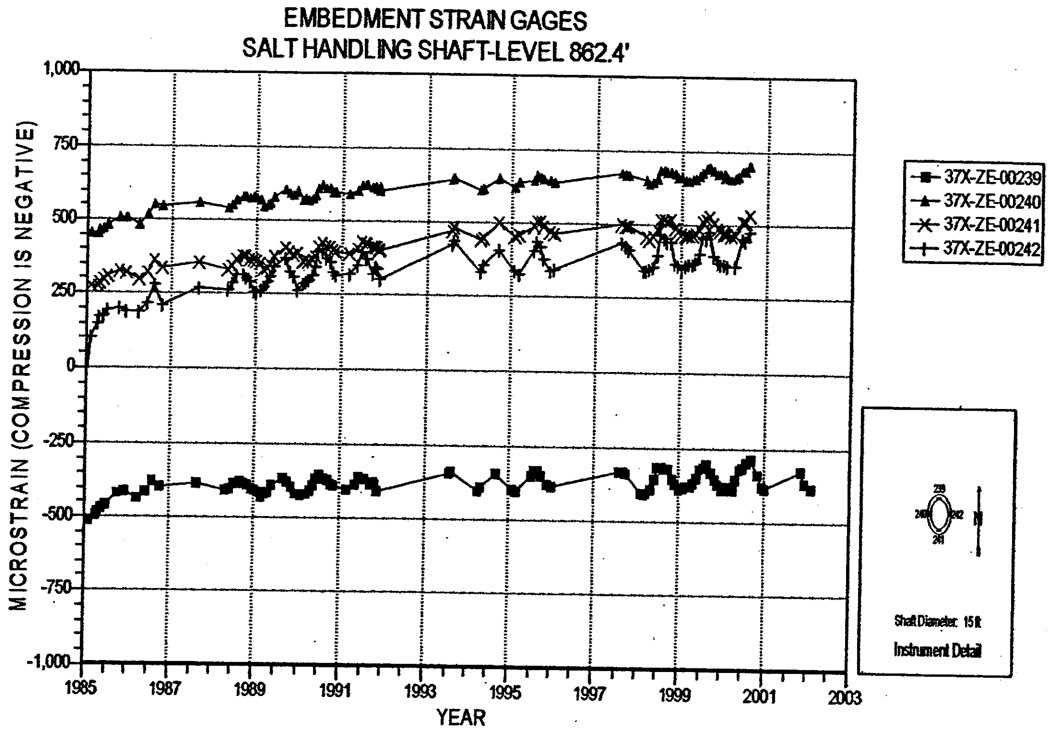


Figure 2-12 Embedment Strain Gages
Salt Handling Shaft Key Level 856.3



NOTES:
1. Concrete for key was placed in April 1982.
2. Suspect malfunction 37X-ZE-00240, 241, and 242

Figure 2-13 Embedment Strain Gages
Salt Handling Shaft Key – Level 862.4

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Table 2-2
Waste Shaft Data Analysis

EXTENSOMETERS

Field Tag	Location	Level feet	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent	Comments
31X-GE-00203	WASTE SHAFT	1071	2-14	06/05/02	0.202	0.002	0.010	-80%	
31X-GE-00204	WASTE SHAFT	1566	2-15	05/03/02	0.755	0.018	0.031	-42%	
31X-GE-00205	WASTE SHAFT	1566	2-16	05/03/02	0.638	0.016	0.029	-45%	
31X-GE-00206	WASTE SHAFT	1566	2-17	06/05/02	0.767	0.021	0.030	-30%	
31X-GE-00207	WASTE SHAFT	2059	2-18	06/05/02	1.923	0.060	0.064	-6%	
31X-GE-00208	WASTE SHAFT	2059	2-19	05/03/02	1.787	0.047	0.069	-32%	
31X-GE-00209	WASTE SHAFT	2059	2-20	06/05/02	2.036	0.067	0.080	-16%	

PIEZOMETERS

Field Tag	Level feet	Figure Number	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Date of 2000-2001 Max. Reading	2000-2001 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
31X-PE-00201	532	2-21	03/04/02	-3.2	08/01/00	0.7	-3.9	
31X-PE-00202	532	2-21	10/01/01	-3.6	10/02/00	-3.6	0	
31X-PE-00203	611	2-22	09/04/01	41.8	09/05/00	47.6	-5.8	
31X-PE-00204	611	2-22	08/09/01	33.2	09/05/00	35.0	-1.8	
31X-PE-00205	669	2-23	03/04/02	0.0	03/05/01	0.0	0	
31X-PE-00206	669	2-23	06/05/02	-0.7	11/02/00	-0.7	0	
31X-PE-00208	717	2-24	08/09/01	146.3	09/05/00	147.3	-1	
31X-PE-00209	758	2-25	06/05/02	42.5	05/29/01	40.6	1.9	
31X-PE-00210 [B]	758	2-25	05/03/02	0.0	04/30/01	0.0	0	
31X-PE-00211	845	2-26	10/01/01	79.3	09/05/00	87.1	-7.8	
31X-PE-00212	845	2-26	06/05/02	75.6	09/05/00	92.7	-17.1	

[B] Probable Instrument Failure.

Table 2-2 (Continued)
Waste Shaft Data Analysis

EARTH PRESSURE CELLS

Field Tag	Level feet	Figure Number	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Date of 2000-2001 Max. Reading	2000-2001 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
31X- WE-00201	866	2-27	11/06/01	77.5	10/02/00	96	-18.5	
31X- WE-00202	866	2-27	09/04/01	88.4	10/02/00	101.3	-12.9	
31X- WE-00203	866	2-27	08/09/01	102.9	09/05/00	113.8	-10.9	
31X- WE-00204	866	2-27	08/09/01	104.2	09/05/00	113.9	-9.7	

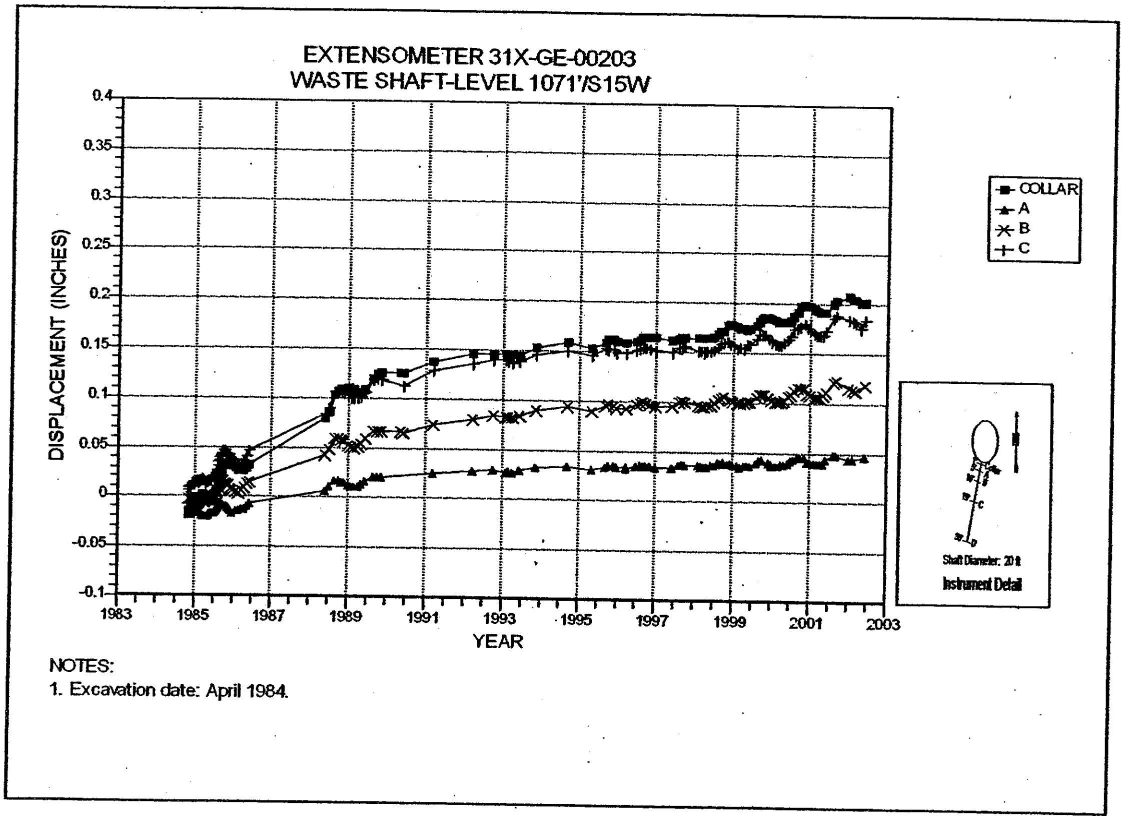


Figure 2-14 Extensometer 31X-GE-00203
Waste Shaft – Level 1071 / S15W

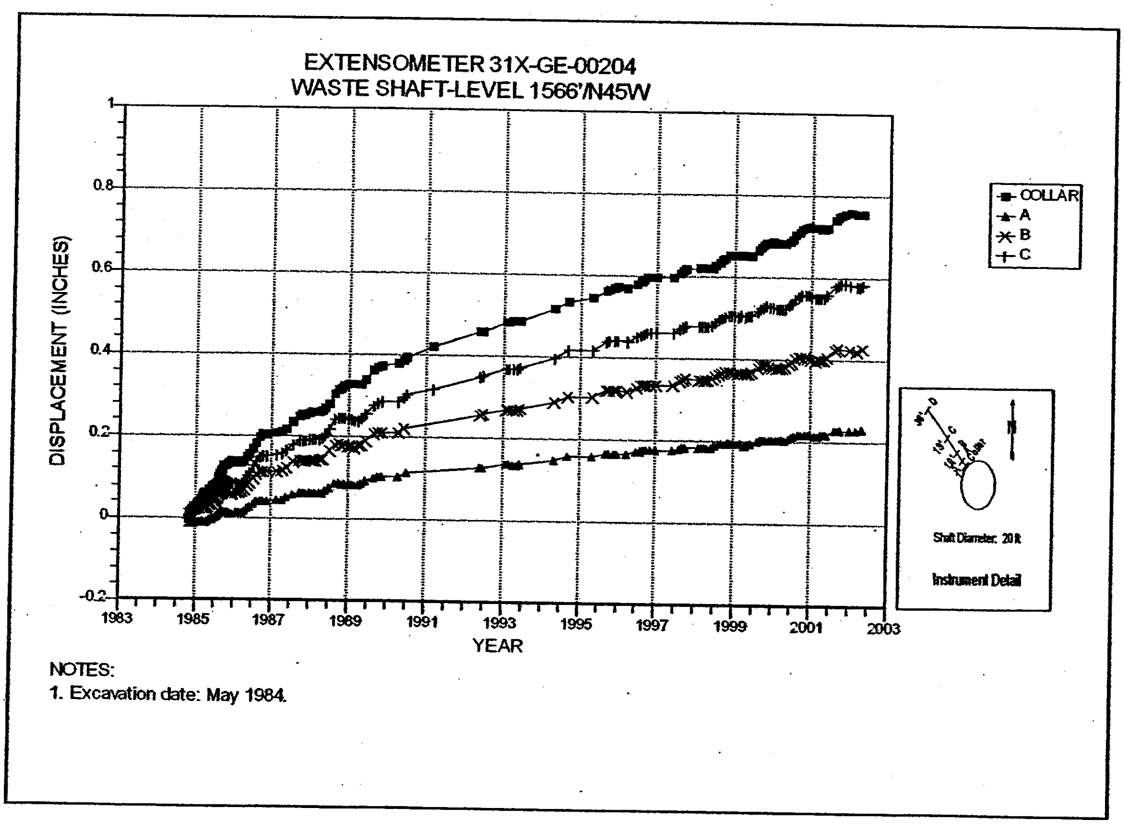
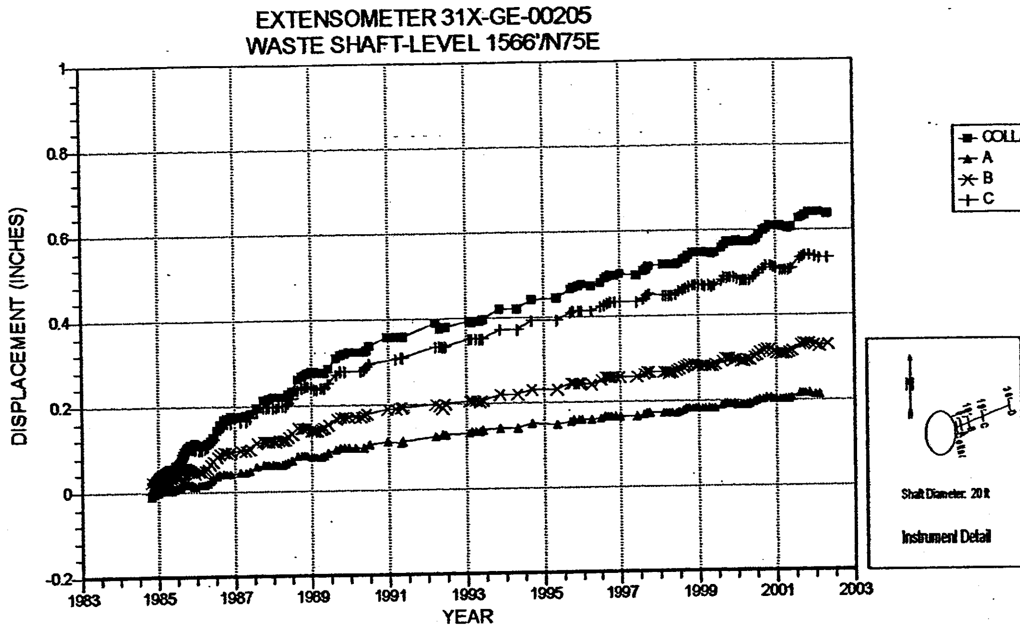
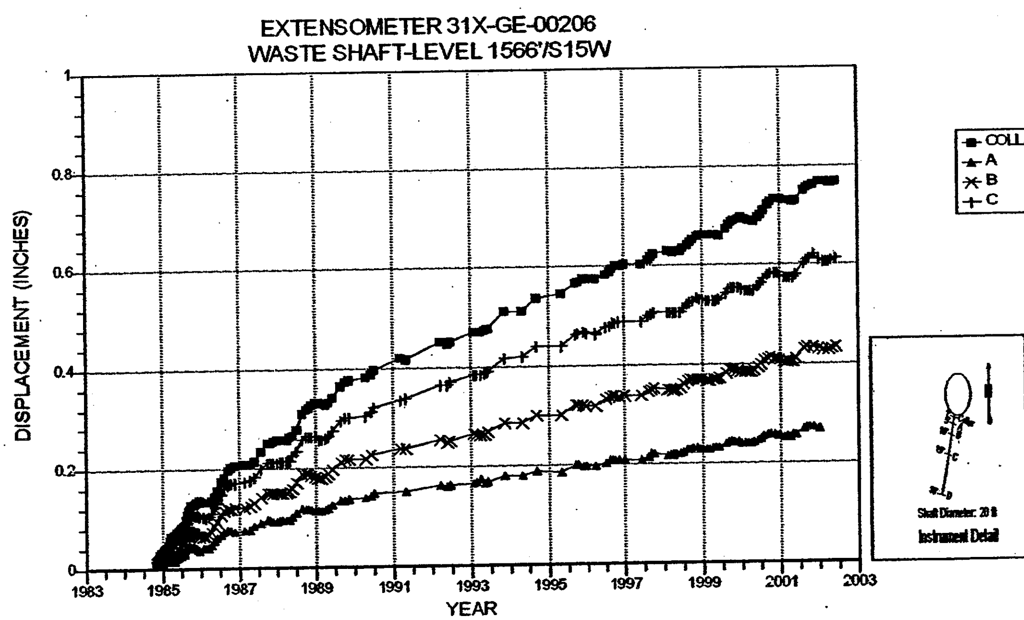


Figure 2-15 Extensometer 31X-GE-00204
Waste Shaft – Level 1566 / N45W



NOTES:
1. Excavation date: May 1984.

Figure 2-16 Extensometer 31X-GE-00205
Waste Shaft – Level 1566 / N75E



NOTES:
1. Excavation date: May 1984.

Figure 2-17 Extensometer 31X-GE-00206
Waste Shaft – Level 1566 / S15W

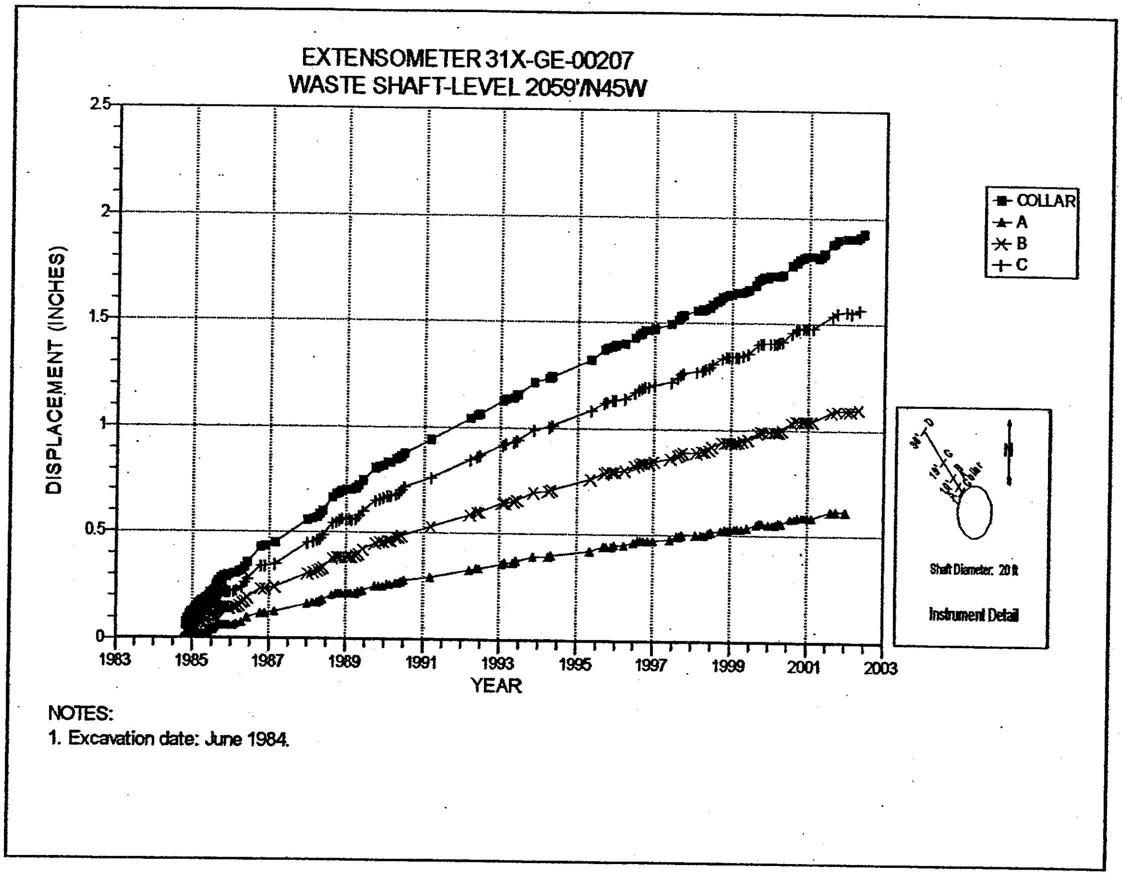


Figure 2-18 Extensometer 31X-GE-00207
Waste Shaft – Level 2059 / N45W

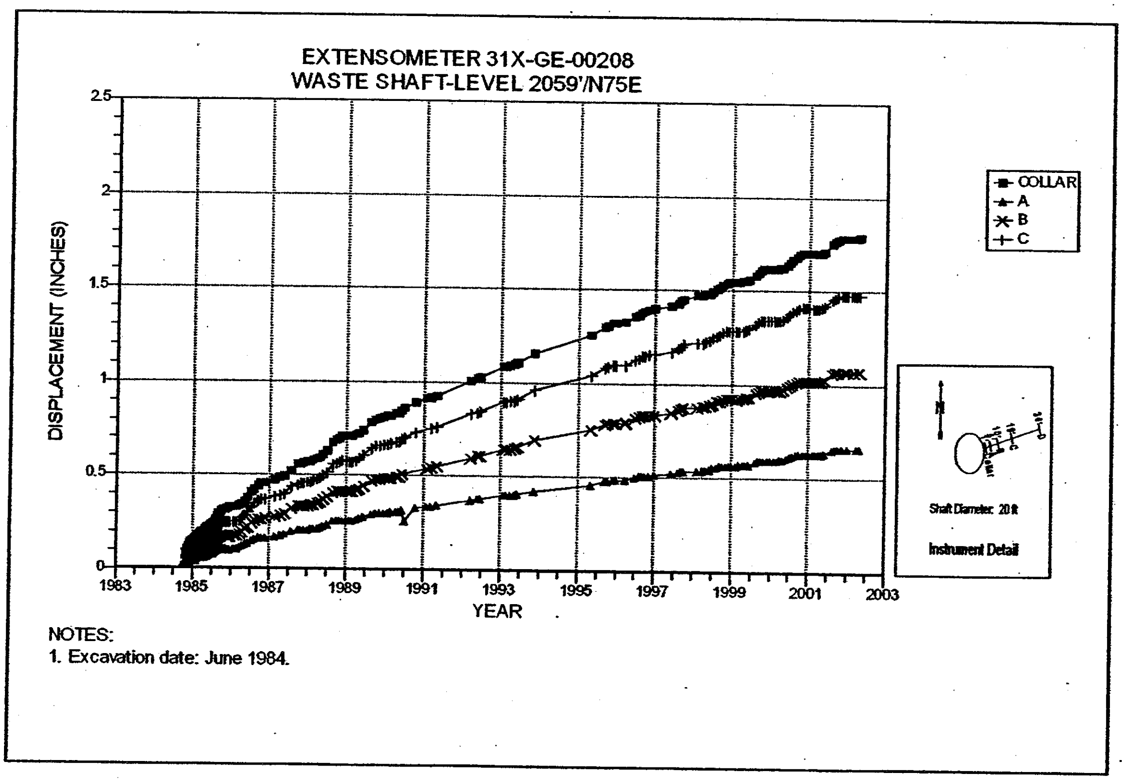


Figure 2-19 Extensometer 31X-GE-00208
Waste Shaft – Level 2059 / N75E

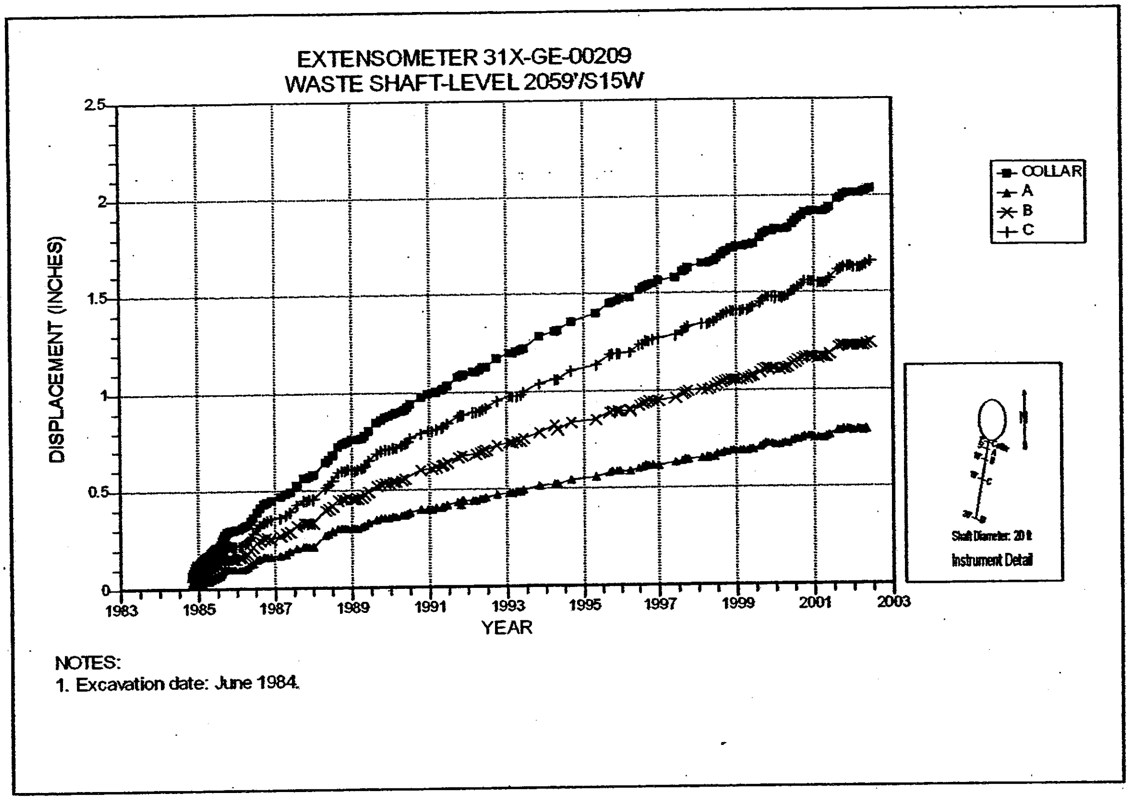


Figure 2-20 Extensometer 31X-GE-00209
Waste Shaft – Level 2059 / S15W

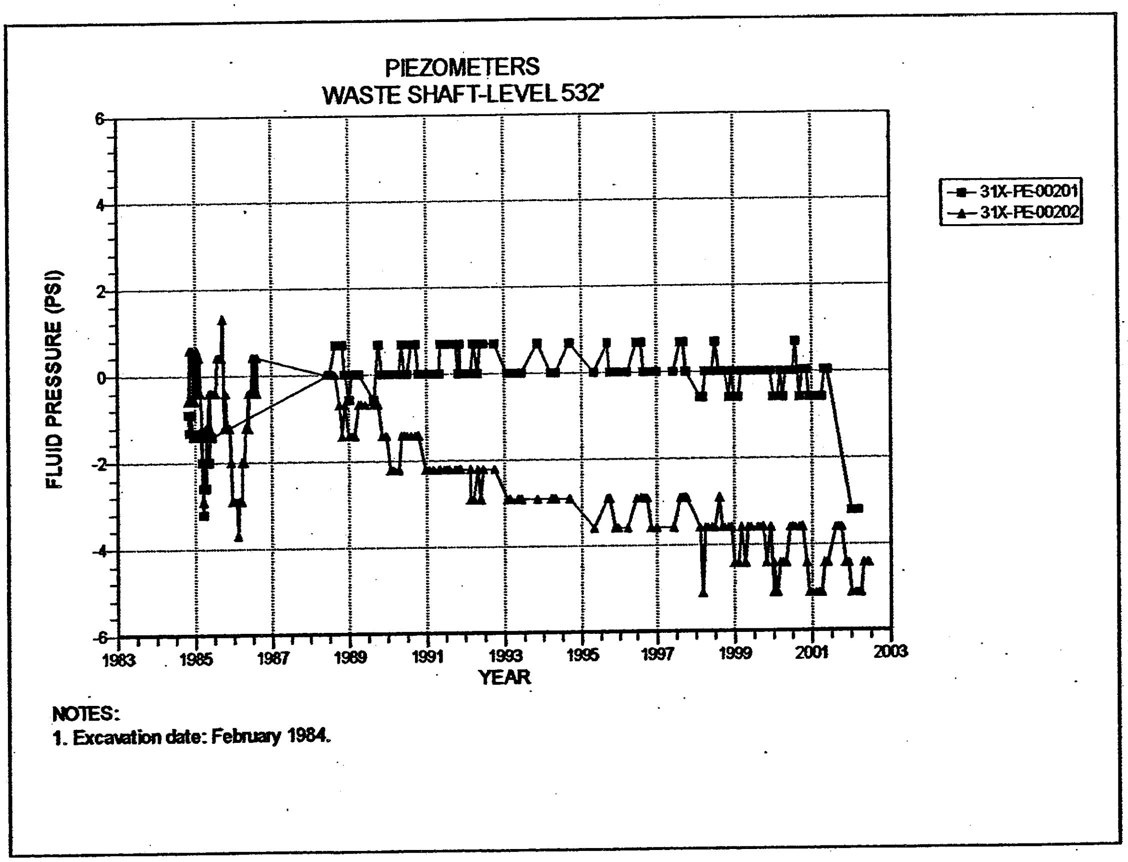


Figure 2-21 Piezometers 31X-PE-00201 and 31X-PE-00202
Waste Shaft – Level 532 at the Base of Dewey Lake Redbeds

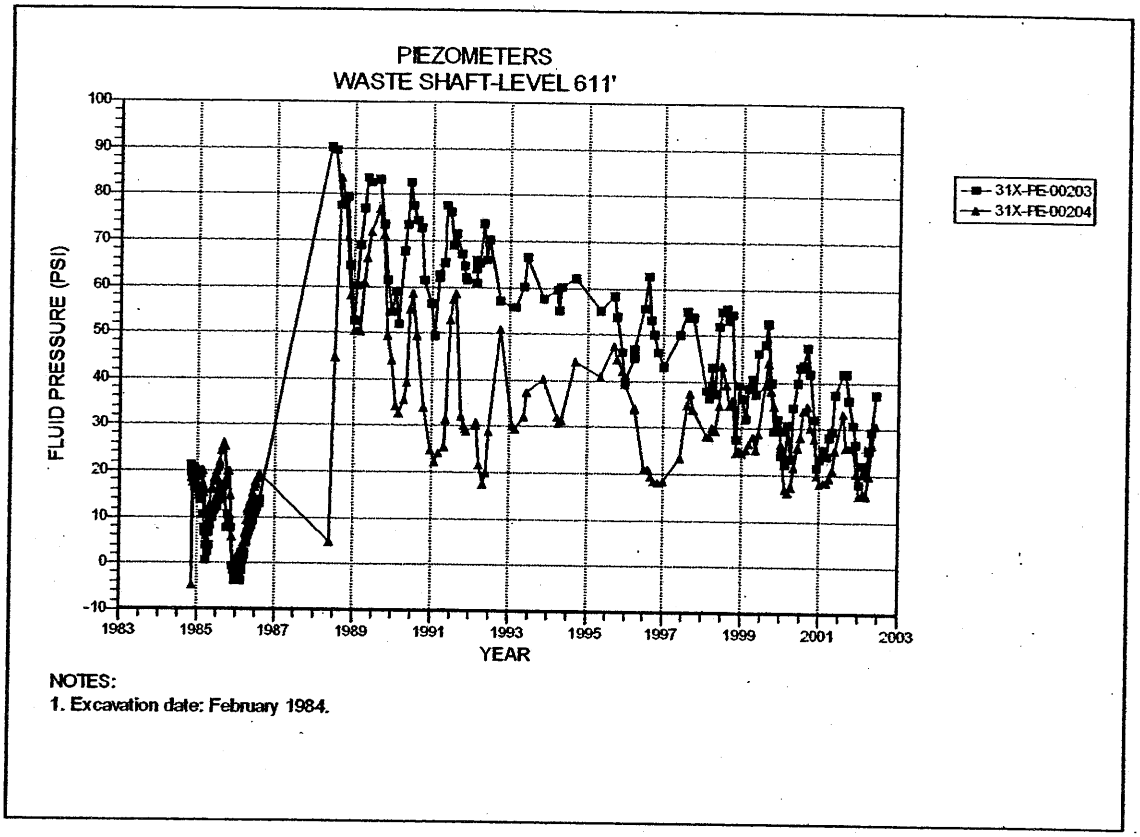


Figure 2-22 Piezometers 31X-PE-00203 and 31X-PE-00204
Waste Shaft – Level 611 at the Magenta Dolomite Member

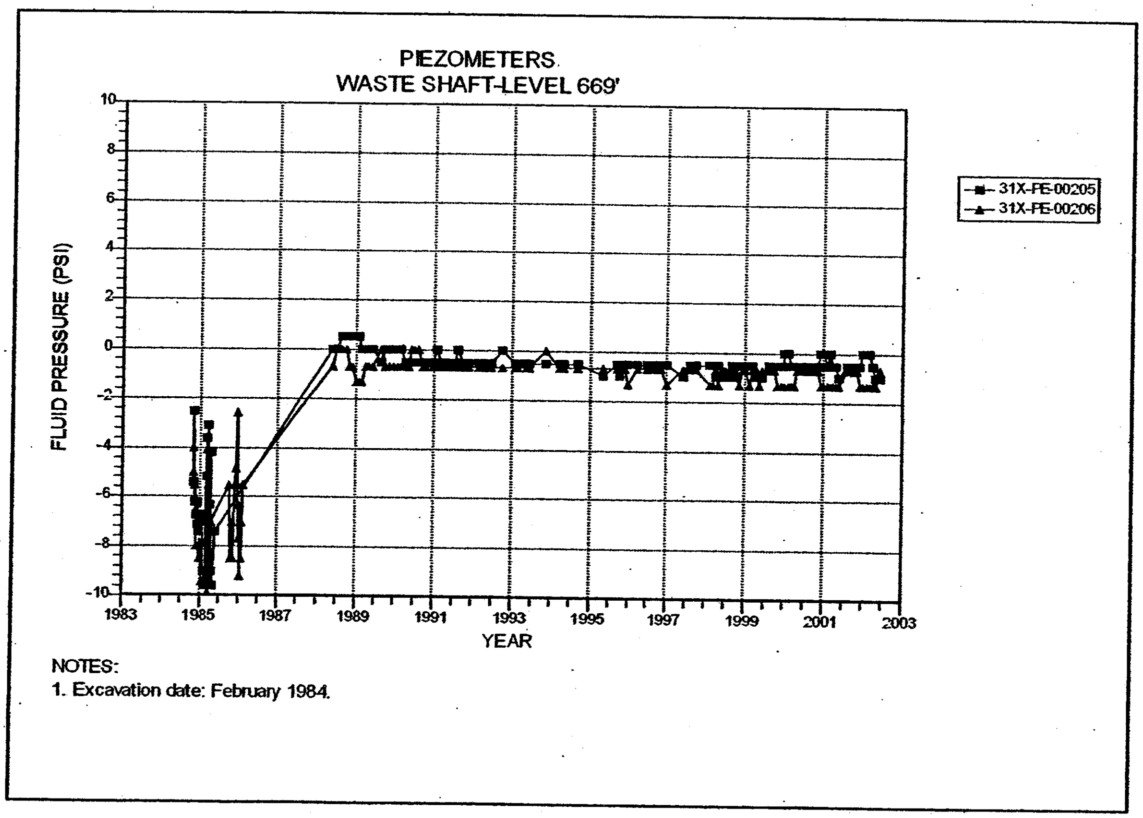
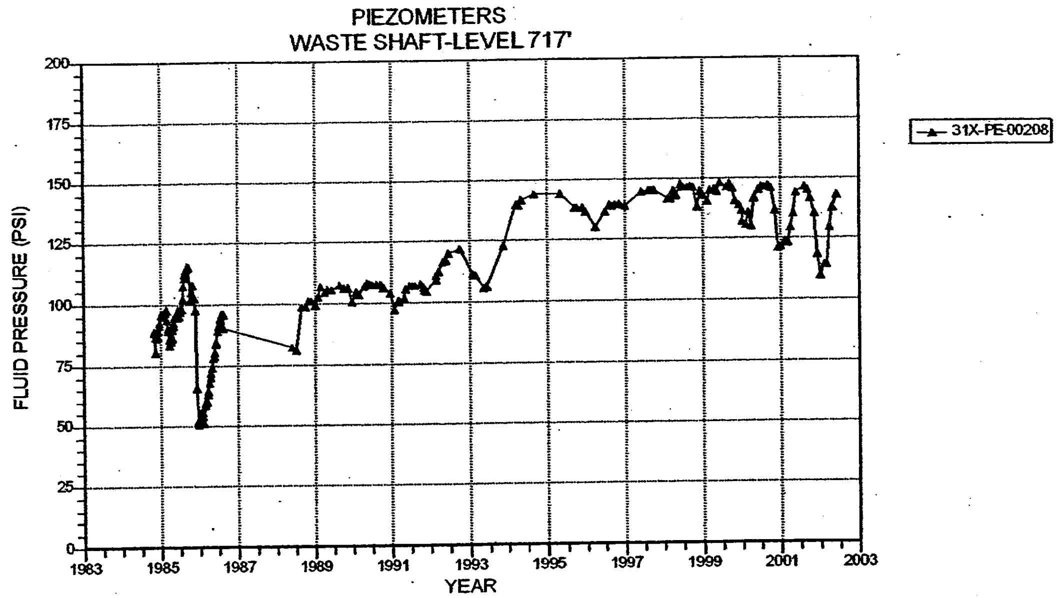
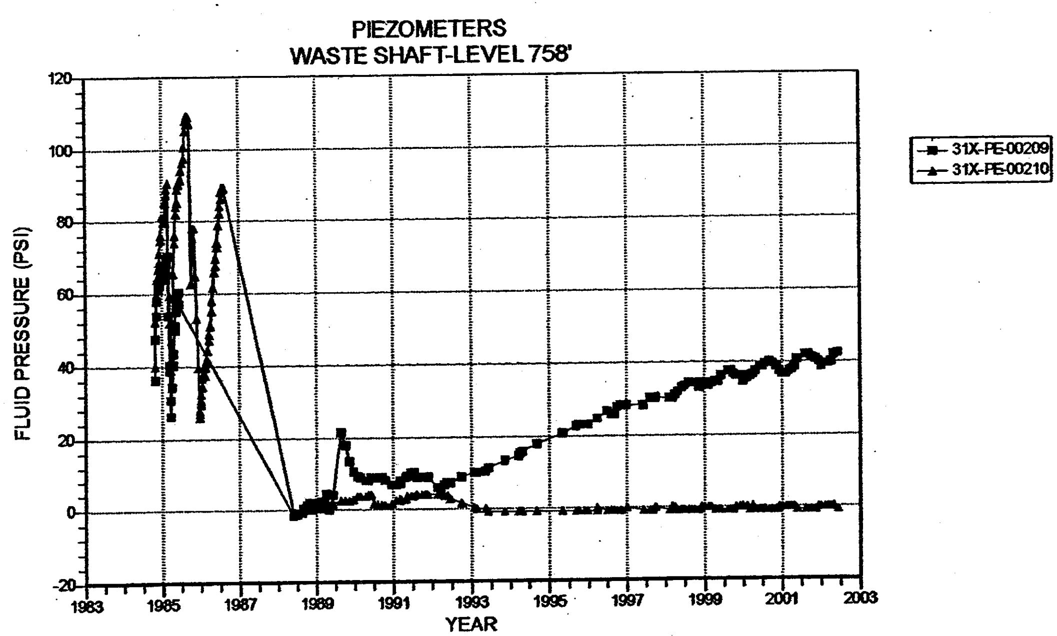


Figure 2-23 Piezometers 31X-PE-00205 and 31X-PE-00206
Waste Shaft – Level 669 at the Tamarisk Member



NOTES:
1. Excavation date: February 1984.

Figure 2-24 Piezometers 31X-PE-00208
Waste Shaft – Level 717 at the Culebra Dolomite Member



NOTES:
1. Excavation date: March 1984.
2. Suspected malfunction 31X-PE-00210.

Figure 2-25 Piezometers 31X-PE-00209 and 31X-PE-00210
Waste Shaft – Level 758 at the Los Medaños Member

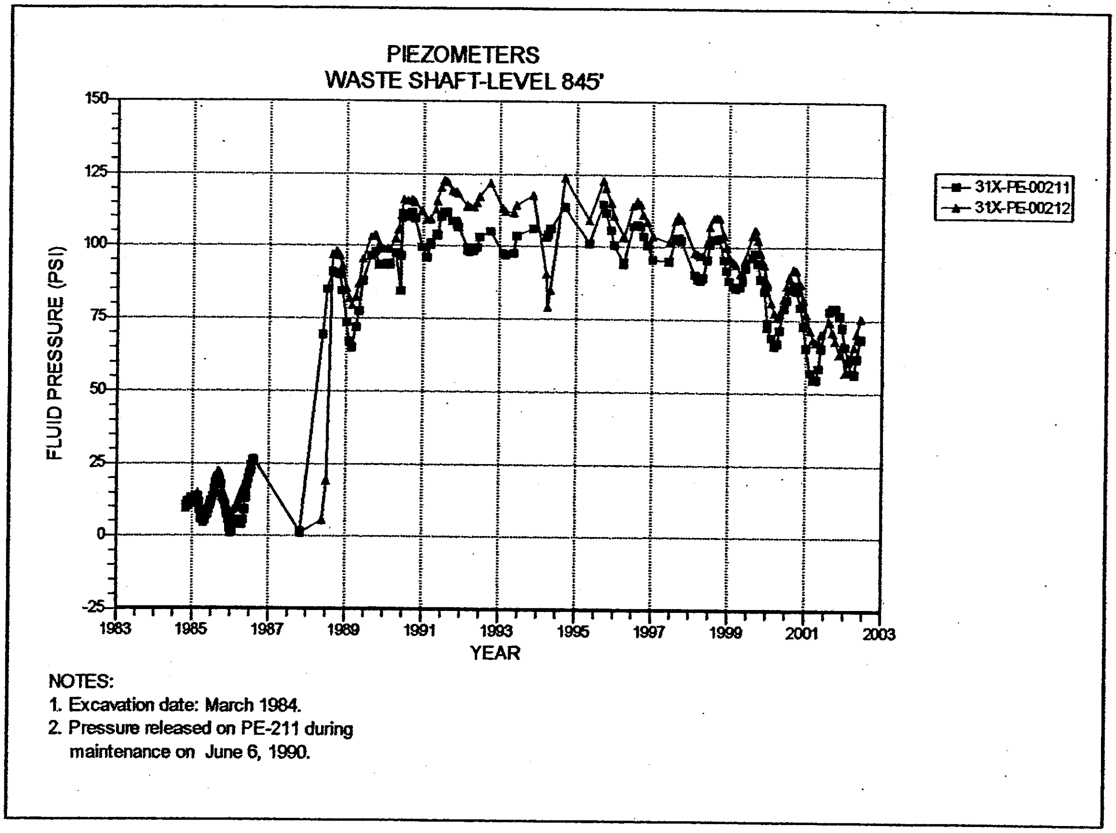


Figure 2-26 Piezometers 31X-PE-00211 and 31X-PE-00212
Waste Shaft – Level 845 at the Rustler-Salado Contact

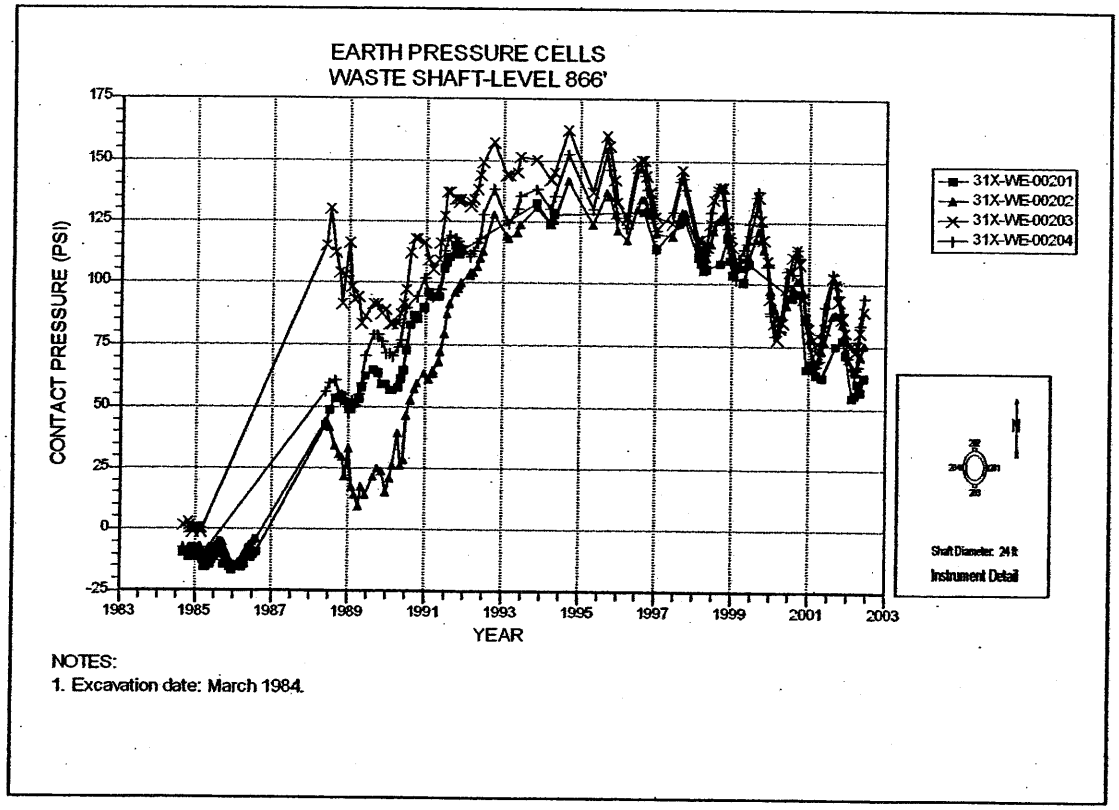


Figure 2-27 Earth Pressure Cells
Waste Shaft Key – Level 866

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Table 2-3
Exhaust Shaft Data Analysis

EXTENSOMETERS

Field Tag	Location	Level feet	Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent	Comments
35X-GE-00204	EXHAUST SHAFT	1573	2-28	06/05/02	0.344	0.019	0.020	-5%	
35X-GE-00205	EXHAUST SHAFT	1573	2-29	06/05/02	0.360	0.023	0.022	5%	
35X-GE-00206	EXHAUST SHAFT	1573	2-30	06/05/02	0.373	0.024	0.021	14%	
35X-GE-00207	EXHAUST SHAFT	2066	2-31	06/05/02	1.669	0.080	0.083	-4%	
35X-GE-00209	EXHAUST SHAFT	2066	2-32	06/05/02	1.232	0.059	0.059	0%	

PIEZOMETERS

Field Tag	Level feet	Figure Number	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Date of 2000-2001 Max. Reading	2000-2001 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
35X-PE-00201	544	2-33	09/04/01	-3.1	10/03/00	-3.7	0.6	
35X-PE-00202	544	2-33	09/04/01	-1.9	10/03/00	-1.9	0	
35X-PE-00204	615	2-34	09/04/01	126.7	10/03/00	127.8	-1.1	
35X-PE-00205	615	2-34	09/04/01	138	10/03/00	139.4	-1.4	
35X-PE-00208	673	2-35	09/04/01	6.7	10/03/00	8.2	-1.5	
35X-PE-00210	721	2-36	10/01/01	140.4	10/03/00	140.4	0	
35X-PE-00211	721	2-36	02/04/02	132.1	12/04/00	132	0.1	
35X-PE-00213	768	2-37	07/30/01	11.9	09/08/00	13.4	-1.5	
35X-PE-00214	768	2-37	09/04/01	9.5	09/08/00	9.1	0.4	
35X-PE-00216	850	2-38	09/04/01	93.4	09/08/00	98.9	-5.5	
35X-PE-00218	850	2-38	09/04/01	15.6	09/08/00	15.6	0	
35X-PE-00219	887	2-39	12/04/01	23.6	11/01/00	28.3	-4.7	
35X-PE-00220	887	2-39	10/01/01	26.9	10/03/00	29.7	-2.8	

Table 2-3 (Continued)
Exhaust Shaft Data Analysis

EARTH PRESSURE CELLS

Field Tag	Level feet	Figure Number	Date of 2001-2002 Max. Reading	2001-2002 Maximum Pressure Readings (psi)	Date of 2000-2001 Max. Reading	2000-2001 Maximum Pressure Readings (psi)	Change in Maximum Pressure From Previous Year (psi)	Comments
35X-WE-00201	874	2-40	12/04/01	43.9	10/03/00	45.9	-2	
35X-WE-00202	874	2-40	09/04/01	52.8	09/08/00	57.9	-5.1	

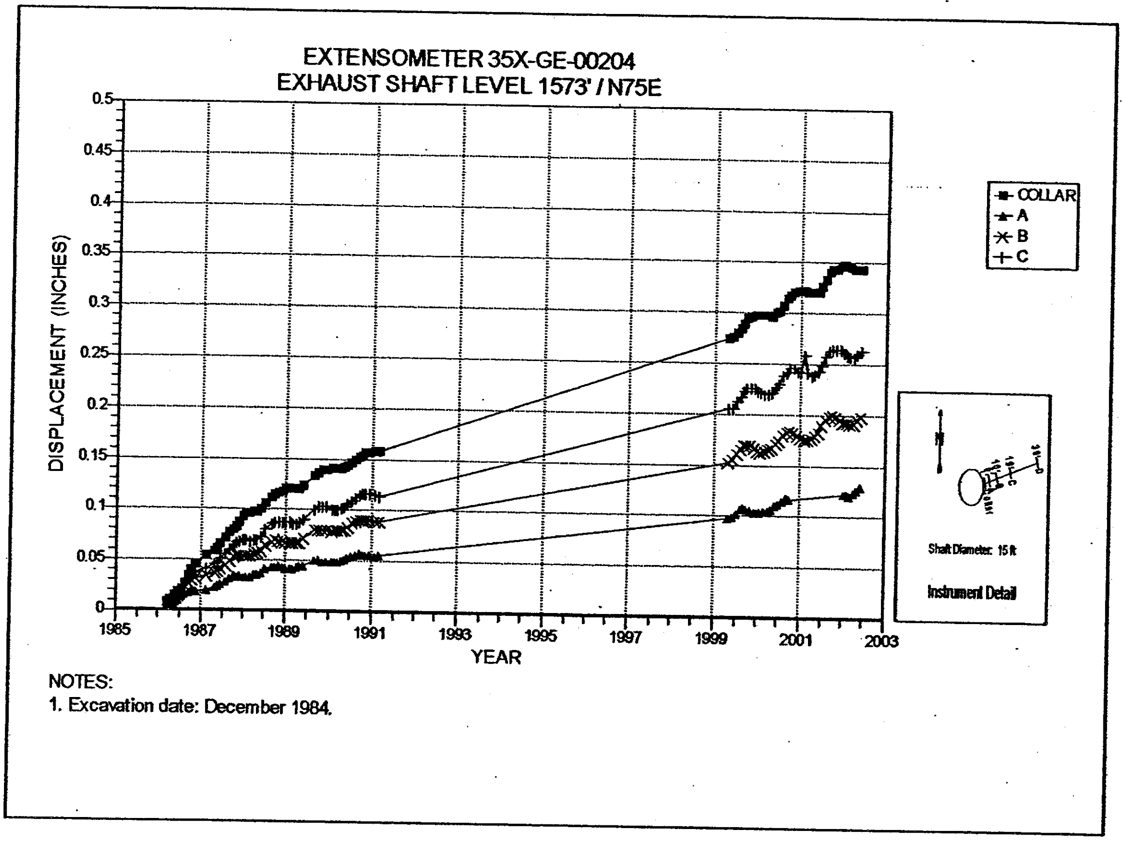


Figure 2-28 Extensometer 35X-GE-00204
Exhaust Shaft – Level 1573 / N75E

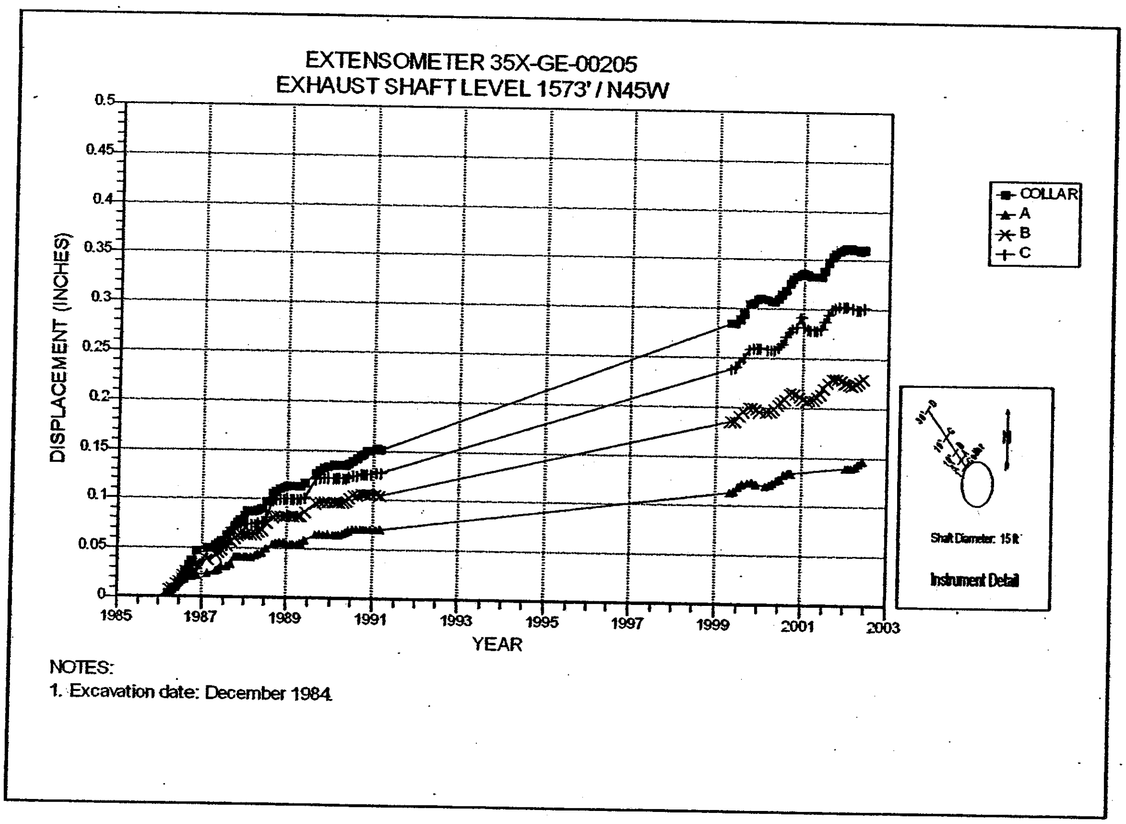


Figure 2-29 Extensometer 35X-GE-00205
Exhaust Shaft – Level 1573 / N45W

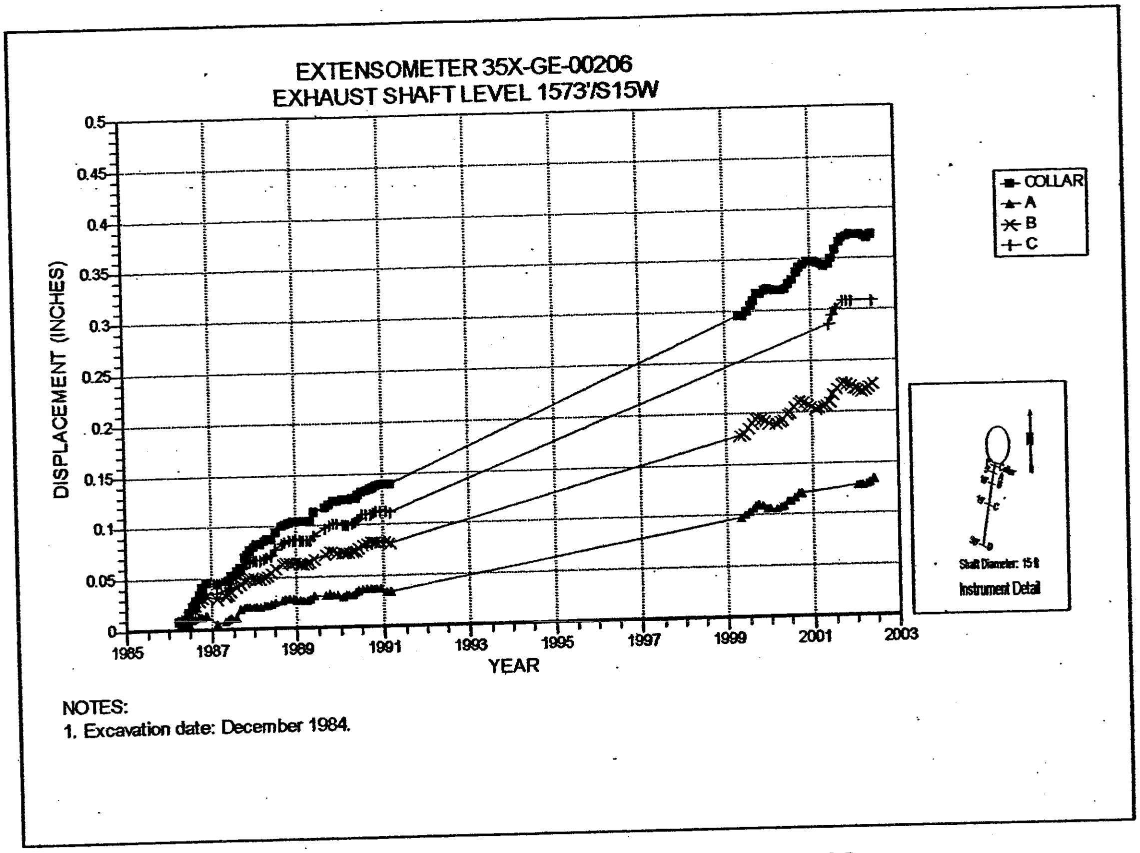


Figure 2-30 Extensometer 35X-GE-00206
Exhaust Shaft – Level 1573 / S15W

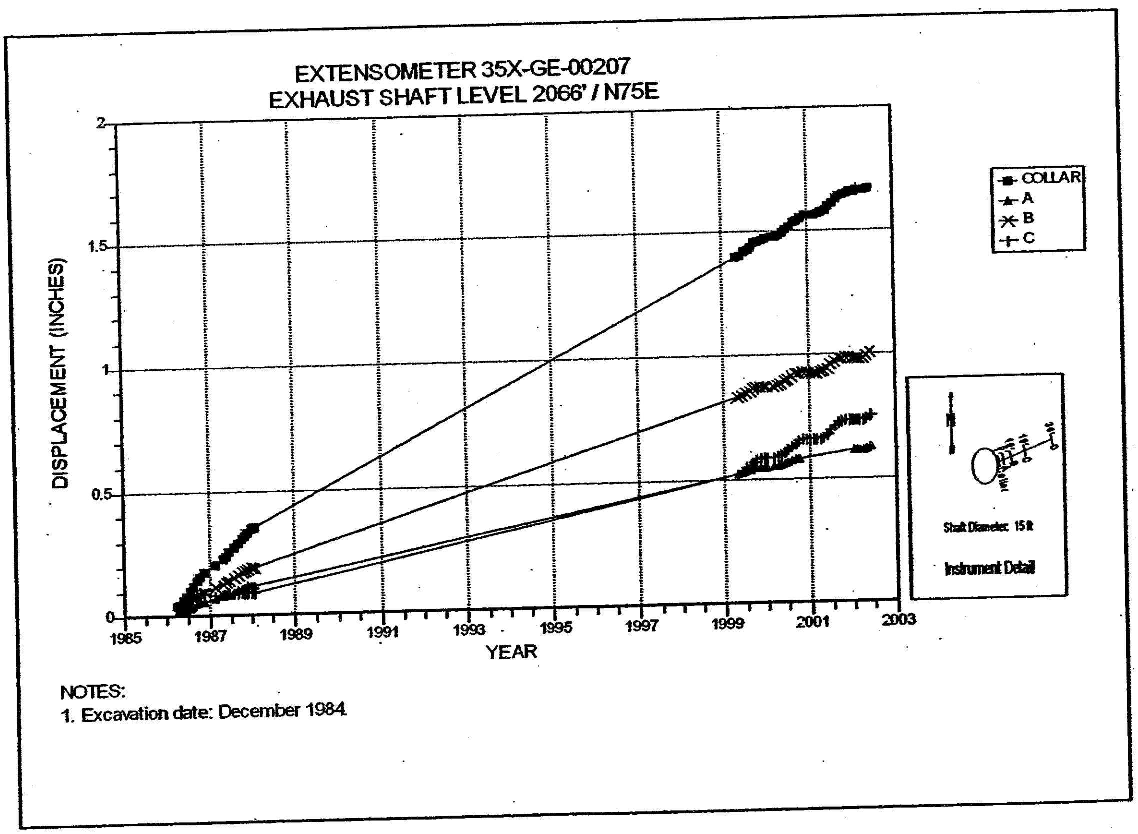


Figure 2-31 Extensometer 35X-GE-00207
Exhaust Shaft – Level 2066 / N75E

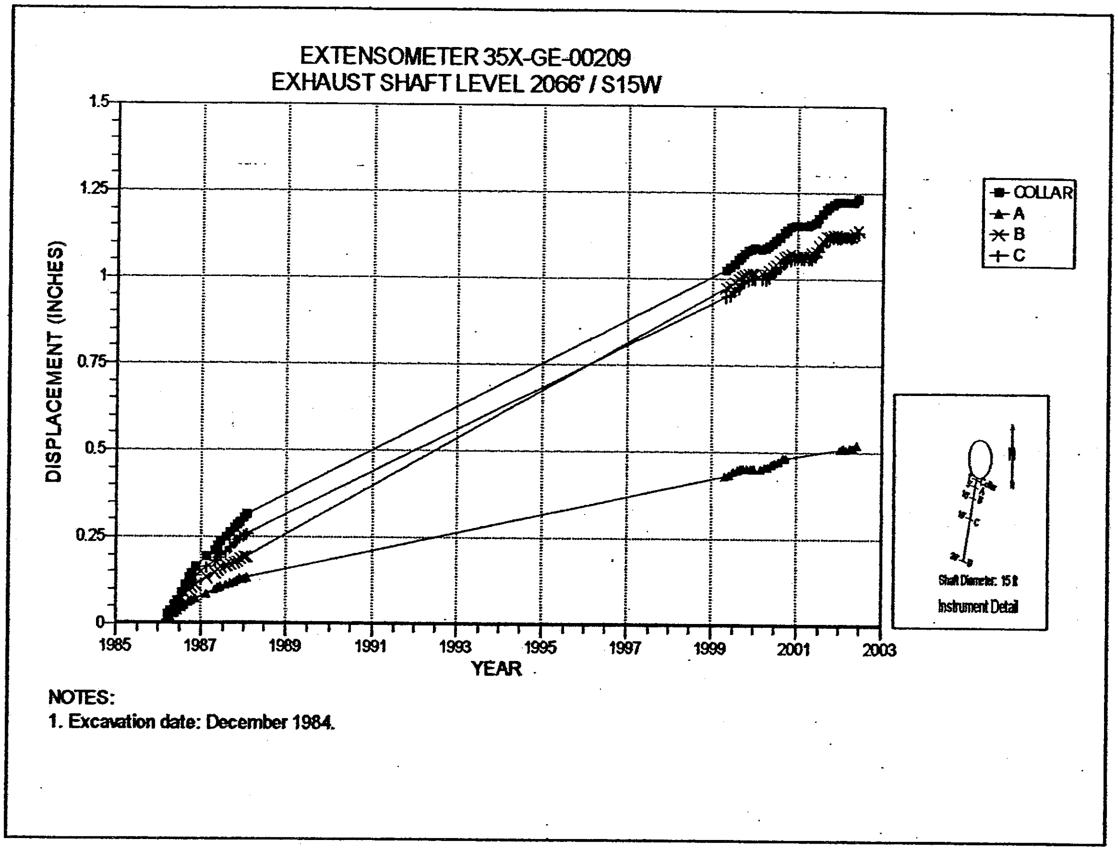


Figure 2-32 Extensometer 35X-GE-00209
Exhaust Shaft – Level 2066 / S15W

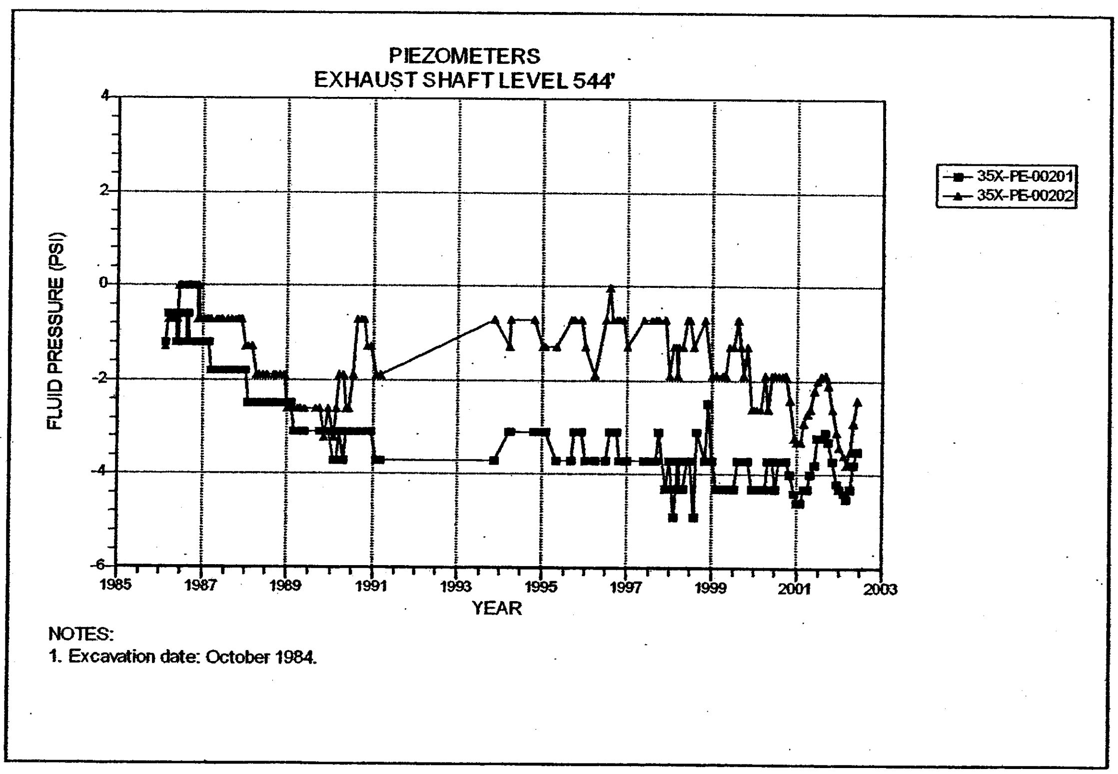


Figure 2-33 Piezometers 35X-PE-00201and 35X-PE-00202
Exhaust Shaft – Level 544 at the Base of Dewey Lake Redbeds

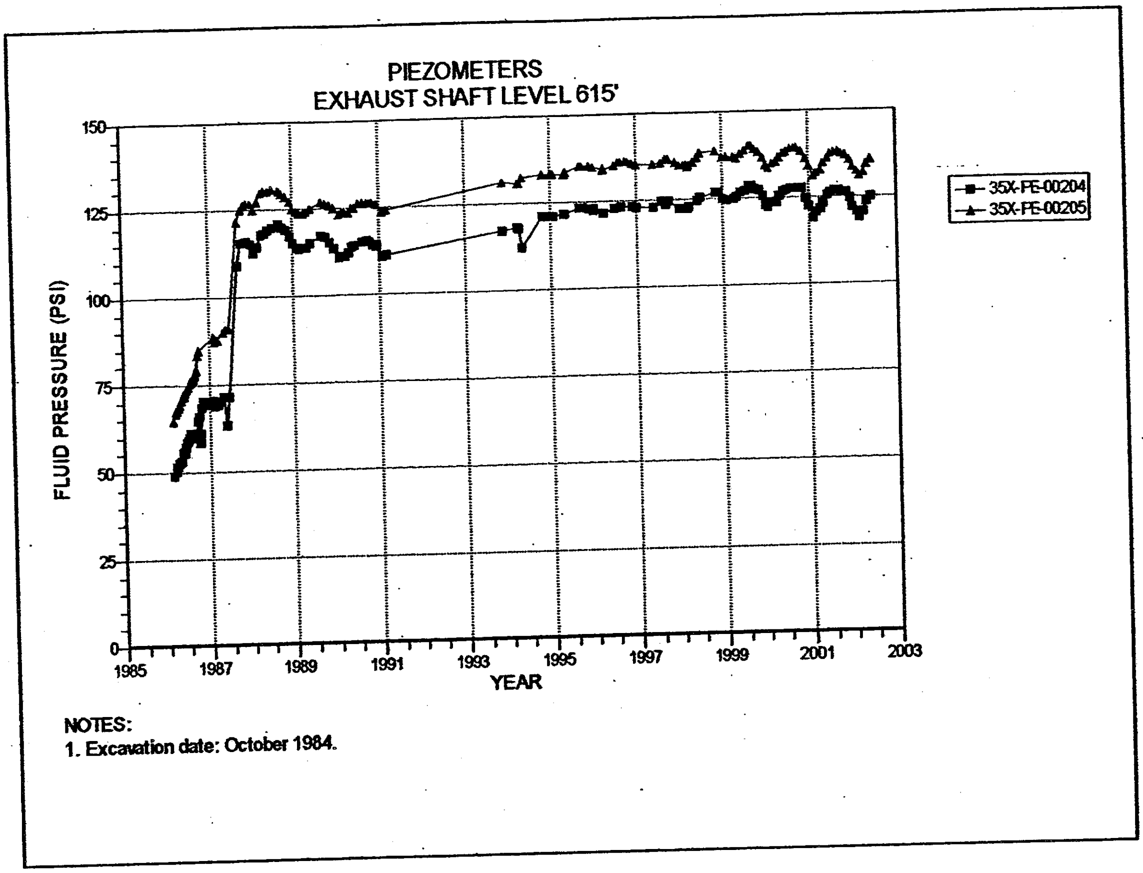


Figure 2-34 Piezometers 35X-PE-00204 and 35X-PE-00205
Exhaust Shaft – Level 615 at the Magenta Dolomite Member

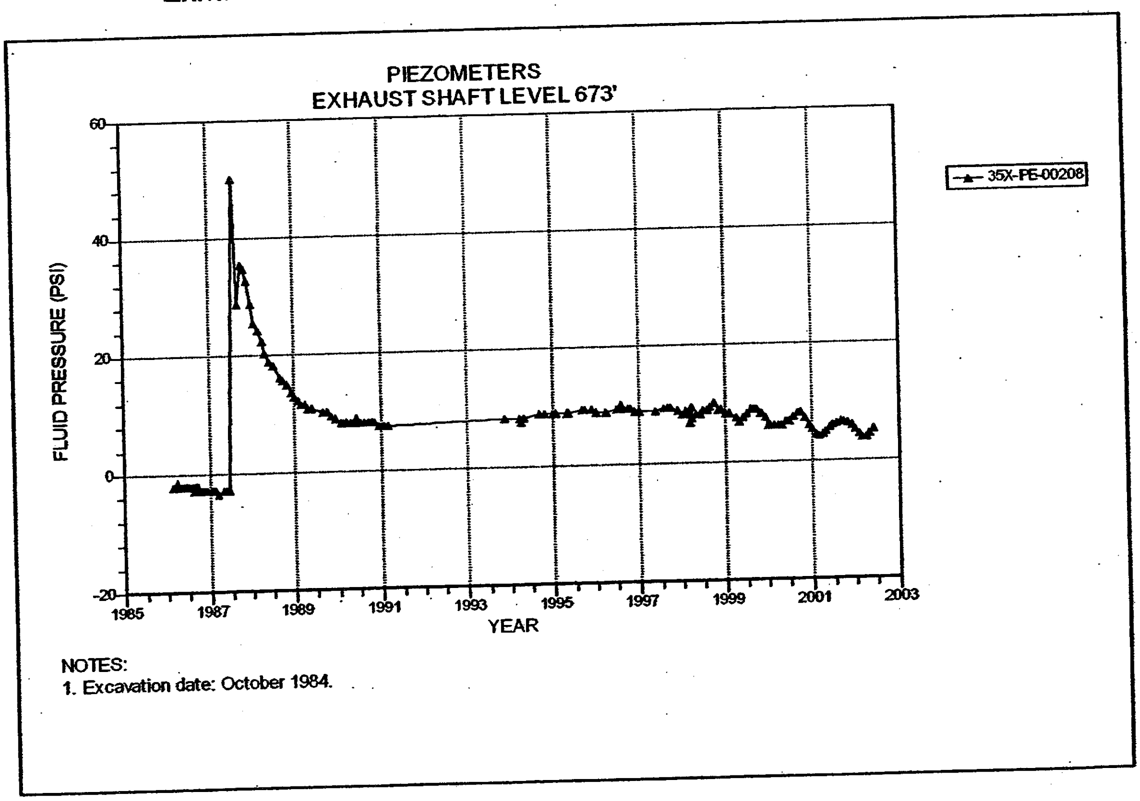


Figure 2-35 Piezometers 35X-PE-00208
Exhaust Shaft – Level 673 at the Tamarisk Member

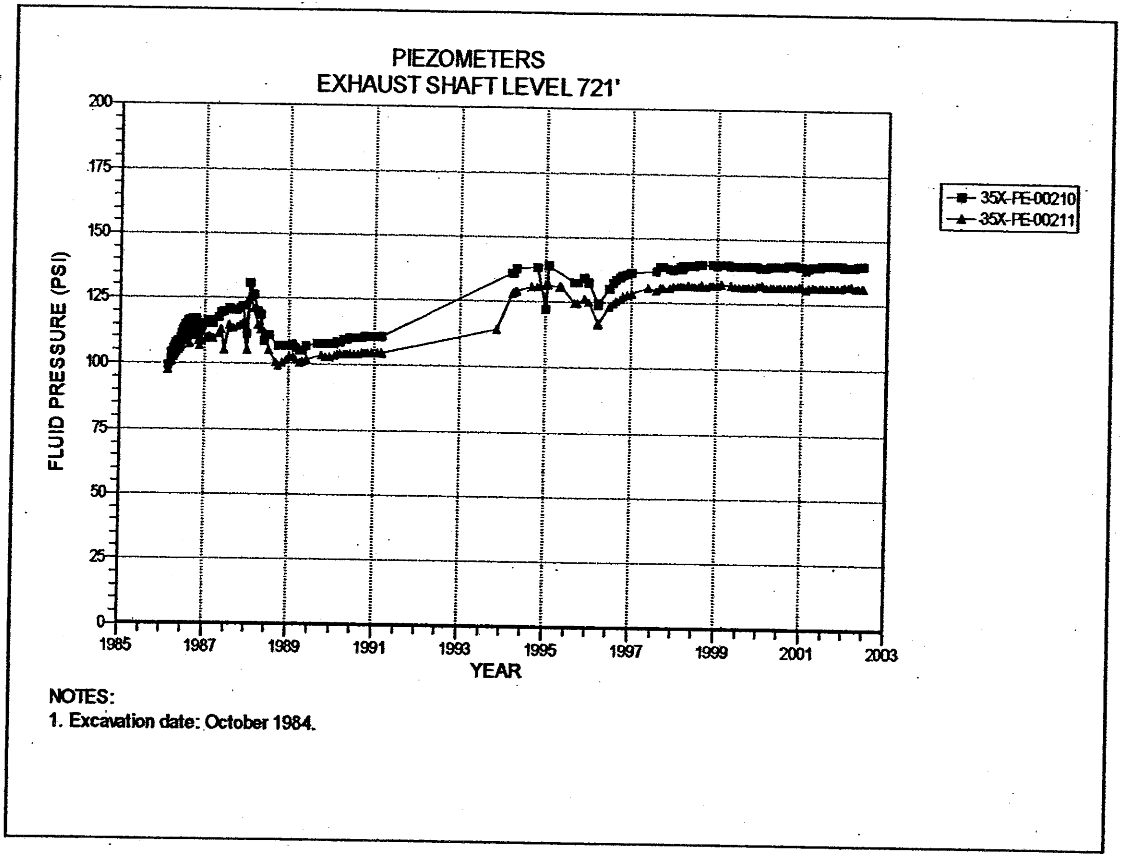


Figure 2-36 Piezometers 35X-PE-00210 and 35X-PE-00211
Exhaust Shaft – Level 721 at the Culebra Dolomite Member

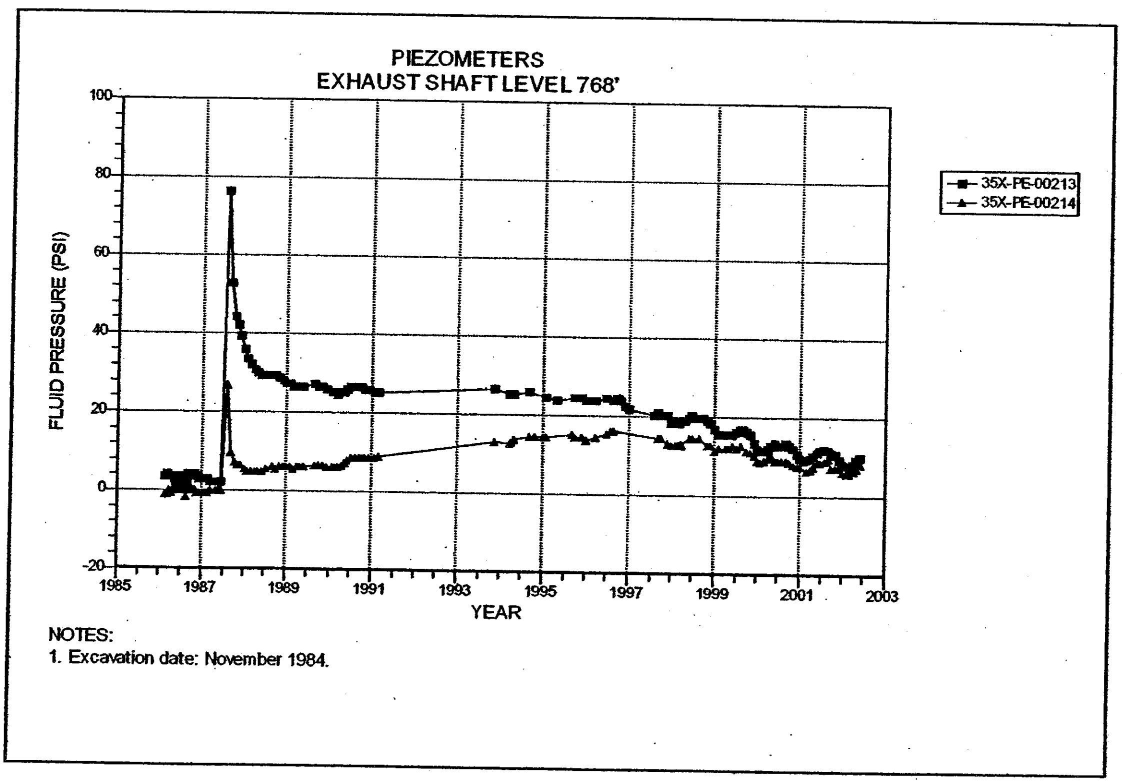


Figure 2-37 Piezometers 35X-PE-00213 and 35X-PE-00214
Exhaust Shaft – Level 768 at the Los Medaños Member

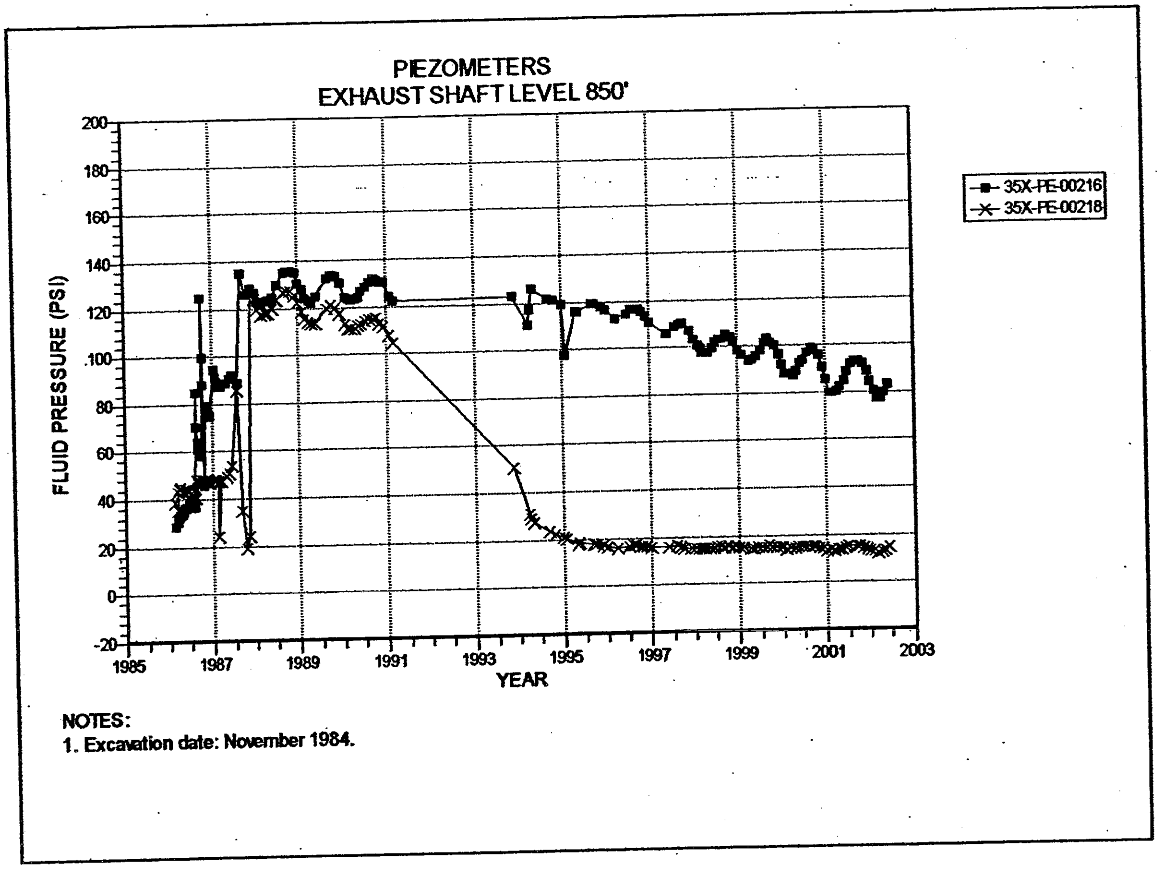


Figure 2-38 Piezometers 35X-PE-00216 and 35X-PE-00218
Exhaust Shaft – Level 850 at the Rustler-Salado Contact

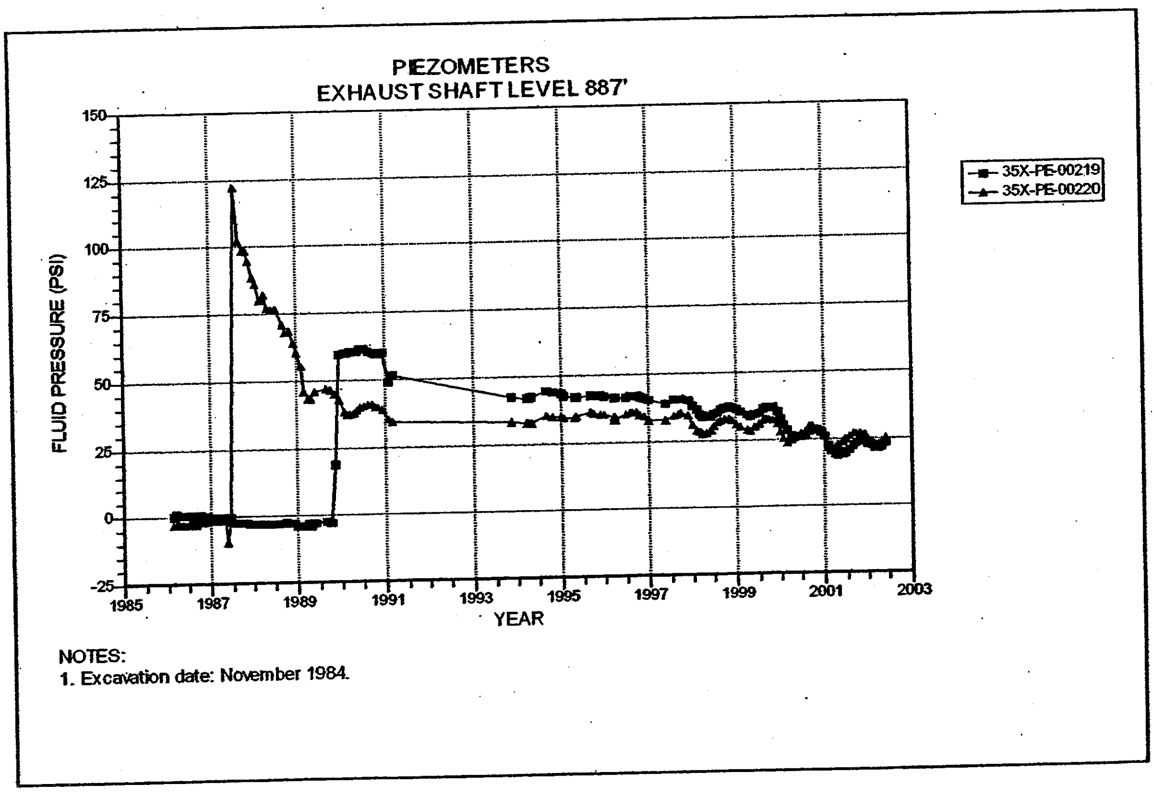
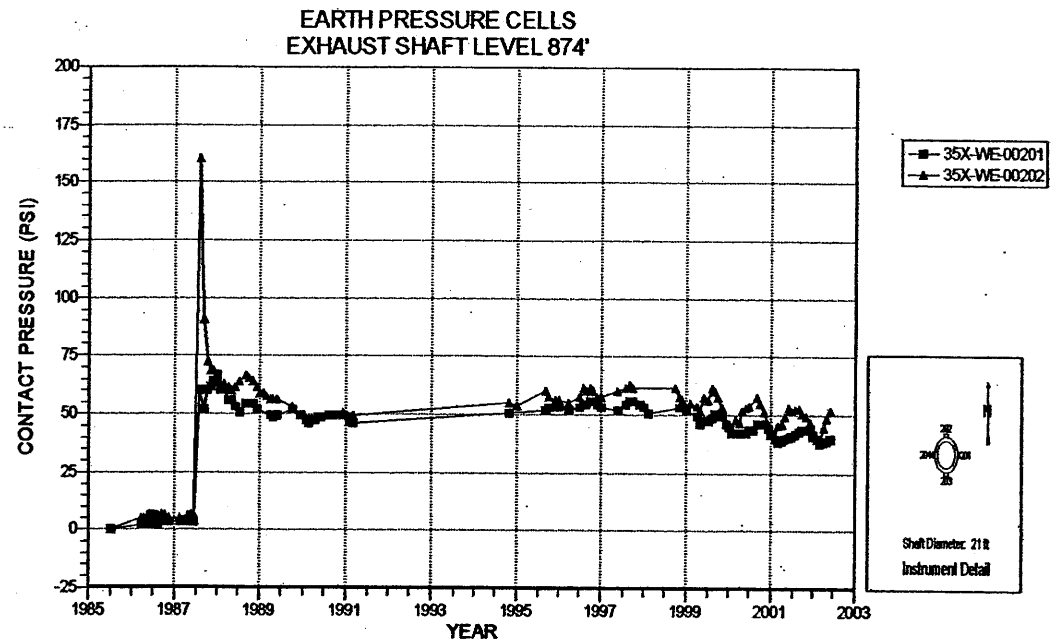


Figure 2-39 Piezometers 35X-PE-00219 and 35X-PE-00220
Exhaust Shaft – Level 887 below the Lower Chemical Seal



NOTES:
1. Excavation date: November 1984.

Figure 2-40 Earth Pressure Cells 35X-WE-00201 and 35X-WE-00202
Exhaust Shaft Key – Level 874

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3.0 Instrumentation Summary for Shaft Stations

Instrumentation data analysis for the Salt Handling Shaft Station, Waste Shaft Station, and the area around the Air Intake Shaft follow. Table 3-1 presents data analyses for each of the Salt Handling Shaft Station instruments. Figures 3-1 through 3-5 present plots of the instrumentation data for the Salt Handling Shaft Station. Tables 3-2 presents data and analysis for the Waste Shaft Station. Plots from the instrumentation in the Waste Shaft Station are presented as Figures 3-6 through 3-12. Table 3-3 and Figures 3-13 through 3-16 present the data from rock bolt load cells located in the immediate area around the Air Intake Shaft.

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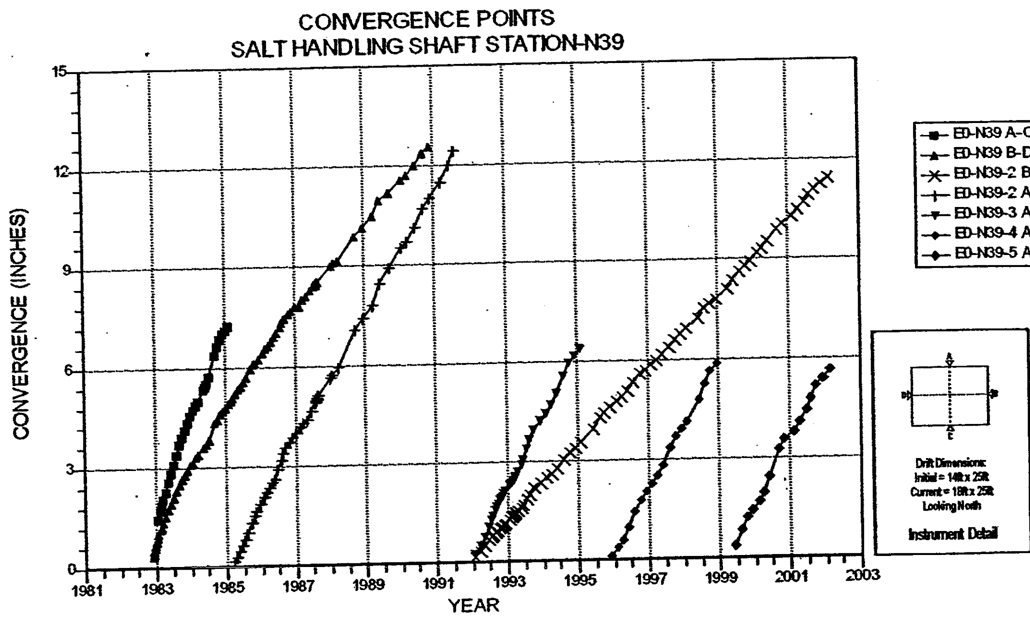
Table 3-1
Salt Handling Shaft Station Data Analysis

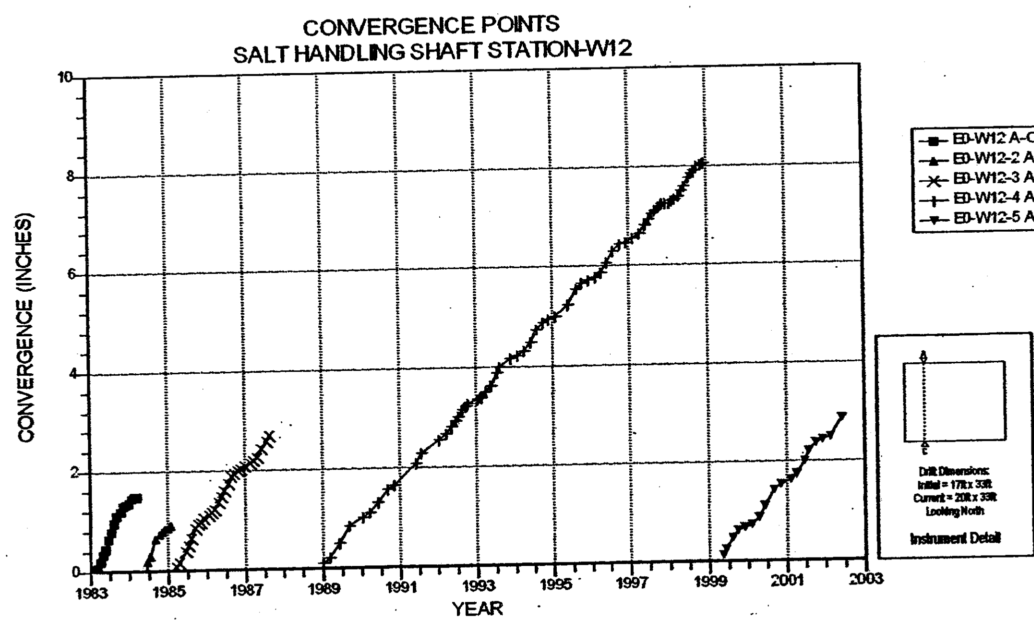
CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent	Comments
			Date	Inches					
E0-N39-5 A-C	E0 Drift-N39	3-1	02/18/02	5.632	37.528	1.590	1.480	7%	Mined out.
E0-N39-2 B-D	E0 Drift-N39	3-1	02/18/02	11.434	23.967	0.991	1.033	-4%	
E0-W12-5 A-C	Salt Shaft-W12	3-2	05/31/02	2.863	16.032	0.765	0.729	5%	
E0-S18-6 A-E	E0 Drift-S18	3-3	05/31/02	5.315	22.871	1.579	1.452	9%	
E0-S18-4 B-D	E0 Drift-S18	3-3	05/31/02	5.721	22.779	1.596	1.554	3%	
E0-S18-4 F-H	E0 Drift-S18	3-3	05/31/02	3.645	14.501	1.016	0.974	4%	
E0-S30-5 A-C	E0 Drift-S30	3-4	05/31/02	5.592	37.199	1.533	1.542	-1%	
E0-S65-3 A-C	E0 Drift-S65	3-5	05/31/02	4.193	34.544	1.201	1.194	1%	



NOTES:
1. Excavation date: October 1982.
2. Mined out.

Figure 3-1 Convergence Point Array
Salt Handling Shaft Station at North 39 – All Chords



NOTES:
1. Excavation date: May 1982.

Figure 3-2 Convergence Point Array
Salt Handling Shaft Station 12 Feet West of Shaft – Roof to Floor

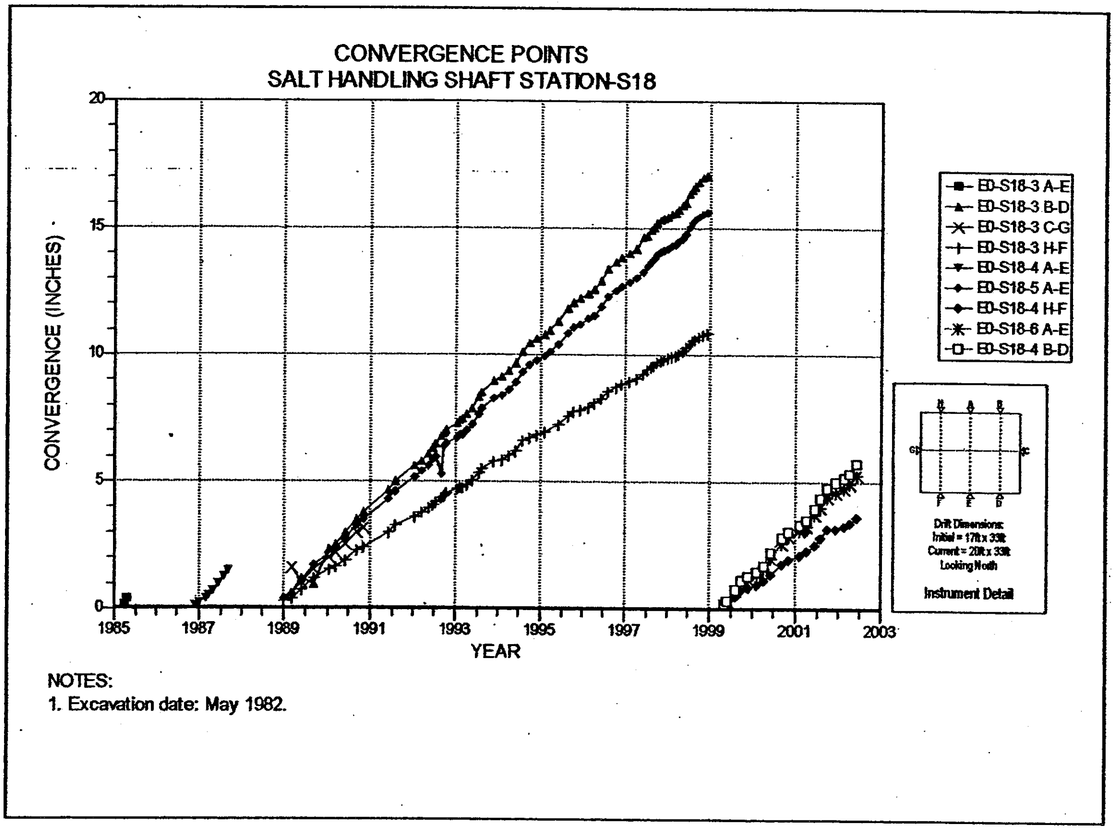


Figure 3-3 Convergence Point Array
Salt Handling Shaft Station at South 18 – All Chords

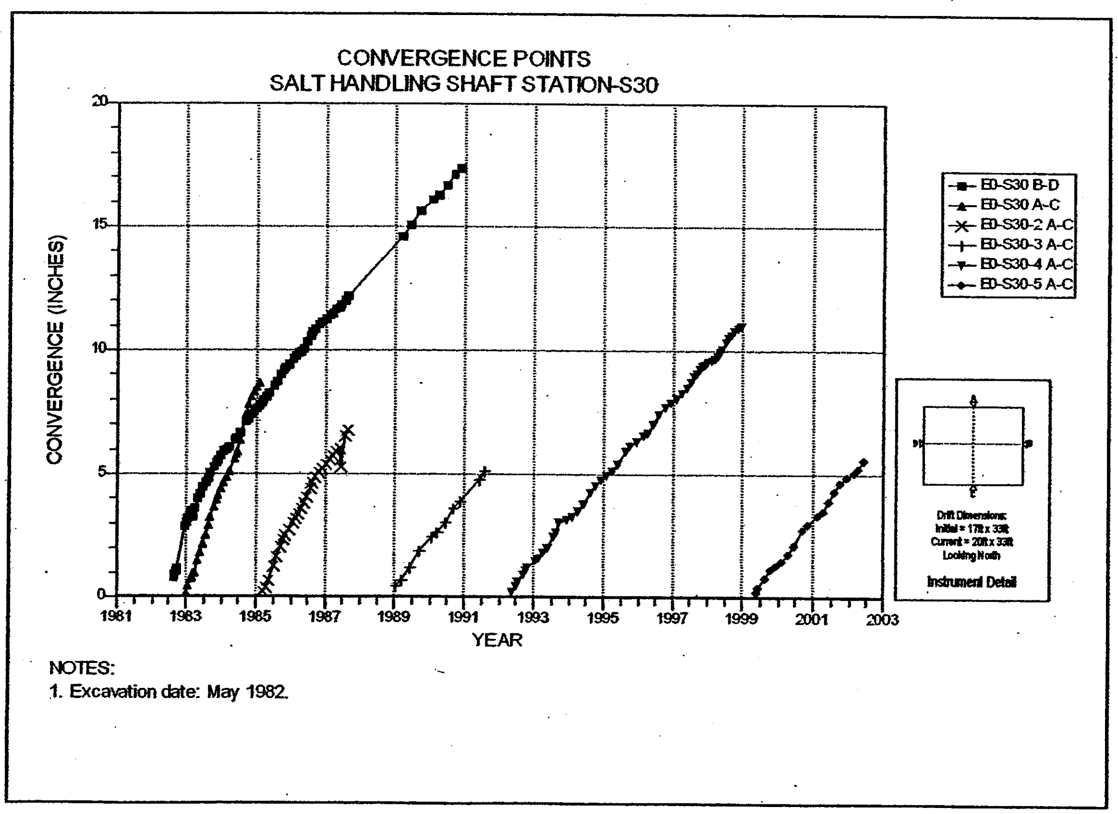


Figure 3-4 Convergence Point Array
Salt Handling Shaft Station at South 30 – All Chords

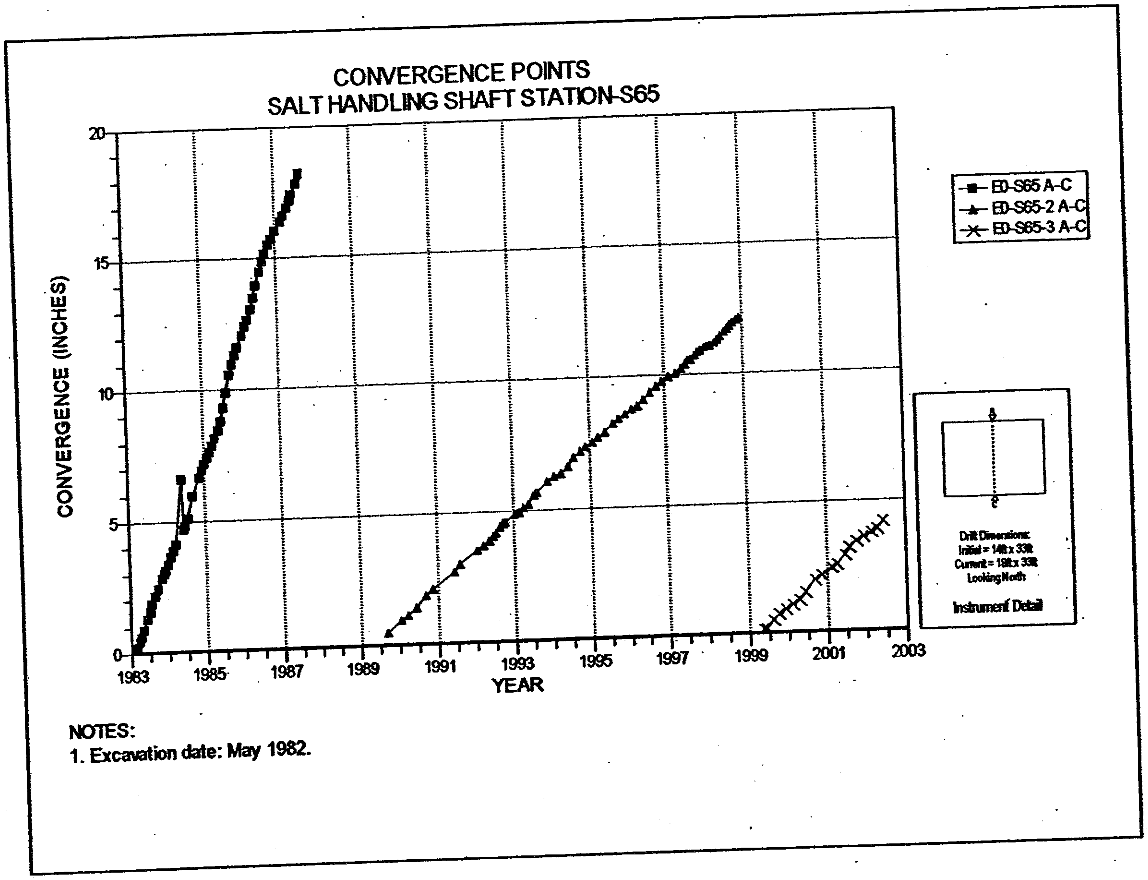


Figure 3-5 Convergence Point Array
Salt Handling Shaft Station at South 65 – Roof to Floor

Table 3-2
Waste Shaft Station Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (Inches)	Displacement Rate 2001 to 2002 In/year	Displacement Rate 2000 to 2001 In/year	Rate Change Percent	Comments
51X-GE-00268	W30 Drift-S400	Roof	3-6	06/04/02	7.596	0.243	0.235	3%	
51X-GE-00279	S400 Drift-E140	Roof	3-7	06/24/02	9.602	0.820	0.707	16%	

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading		Cumulative Displacement Inches	Closure Rate 2001 to 2002 In/year	Closure Rate 2000 to 2001 In/year	Rate Change Percent	Comments
			Date	Inches					
S400-E30-2 C-H	S400 Drift-E30	3-8	06/04/02	14.854	14.927	0.920	0.865	6%	
S400-E90-2 C-G	S400 Drift-E90	3-9	06/04/02	16.941	17.132	0.968	0.952	2%	

Table 3-2 (Continued)
Waste Shaft Station Data Analysis

ROCKBOLT LOAD CELLS

Field Tag	Location	Figure Number	Date of Initial Reading	Date of Last Reading	Load (kips)	Comments
51X-WG-00208	S400 Drift-E41 North	3-10	02/19/88	07/26/01	8.914	
51X-WG-00209	S400 Drift-E41 Center	3-10	02/19/88	07/26/01	19.950	
51X-WG-00211	S400 Drift-E73 Center	3-10	02/19/88	07/26/01	11.072	Probable broken bolt.
51X-WG-00212	S400 Drift-E122 Center	3-10	02/19/88	07/26/01	37.483	
51X WG-00213	S400 Drift-E140 Intersection	3-10	02/19/88	07/26/01	25.633	
51X WG-00226	Waste Shaft Station Brow	3-11	07/15/92	06/24/02	41.870	
51X WG-00227	Waste Shaft Station Brow	3-11	07/15/92	06/24/02	30.940	
51X WG-00228	Waste Shaft Station Brow	3-11	03/20/96	06/24/02	43.327	
51X WG-00229	Waste Shaft Station Brow	3-11	03/20/96	06/24/02	35.615	
51X WG-00230	Waste Shaft Station Brow	3-11	03/20/96	06/24/02	46.927	
51X WG-00231	Waste Shaft Station Brow	3-12	03/20/96	06/24/02	27.114	
51X WG-00232	Waste Shaft Station Brow	3-12	07/15/92	06/24/02	18.874	
51X WG-00233	Waste Shaft Station Brow	3-12	07/15/92	06/24/02	3.187	Probable broken bolt.
51X WG-00234	Waste Shaft Station Brow	3-12	07/15/92	06/24/02	60.051	
51X WG-00235	Waste Shaft Station Brow	3-12	03/20/96	06/24/02	16.883	

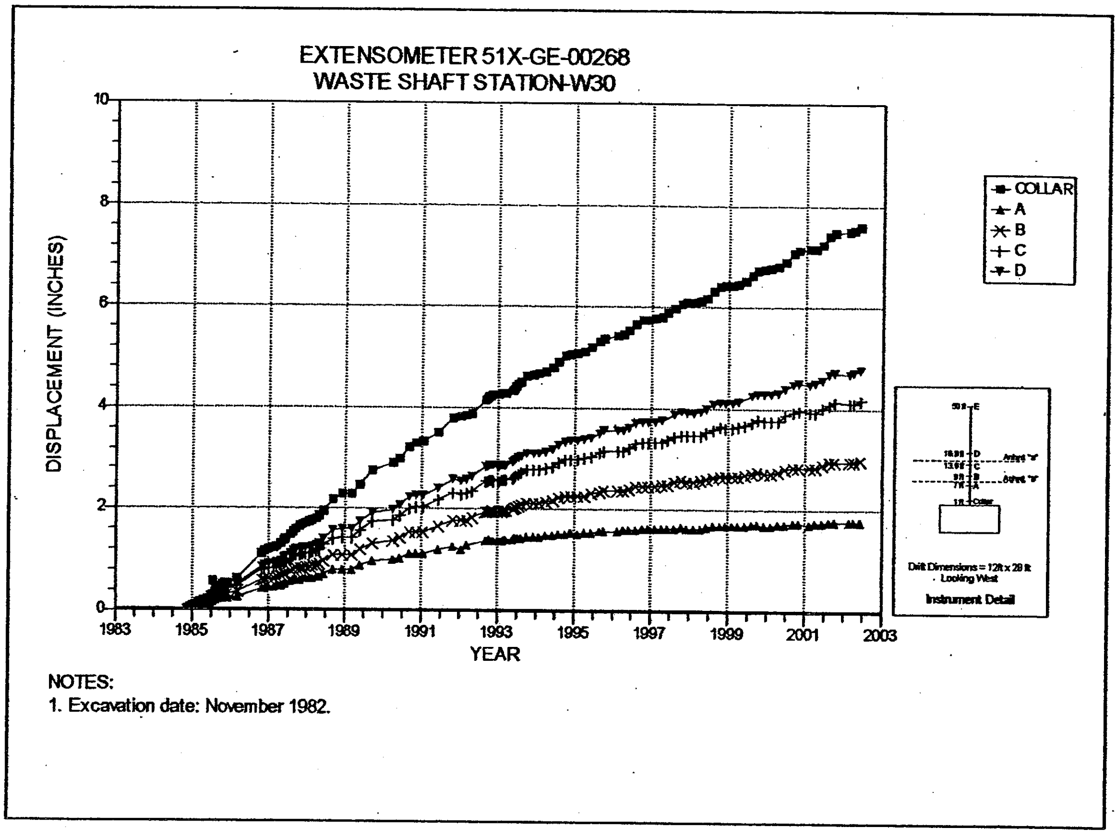


**Figure 3-6 Extensometer 51X-GE-00268
Waste Shaft Station at West 30 – Roof**

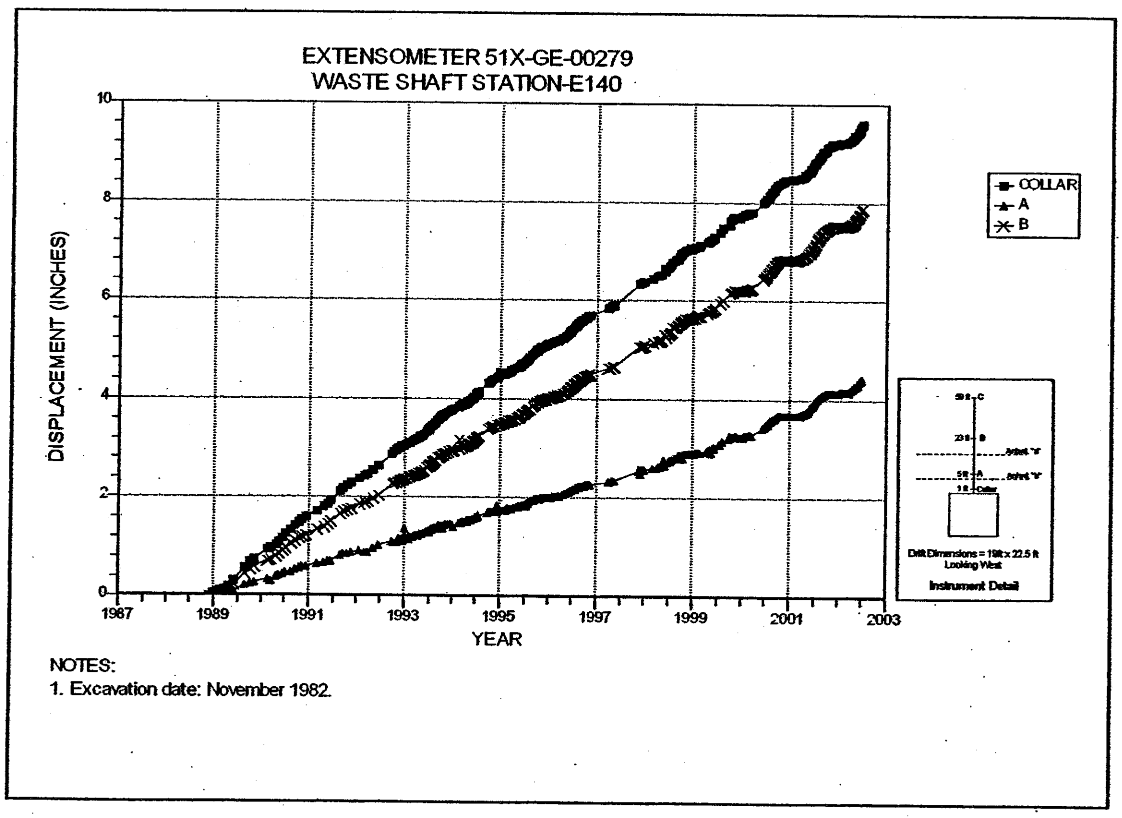
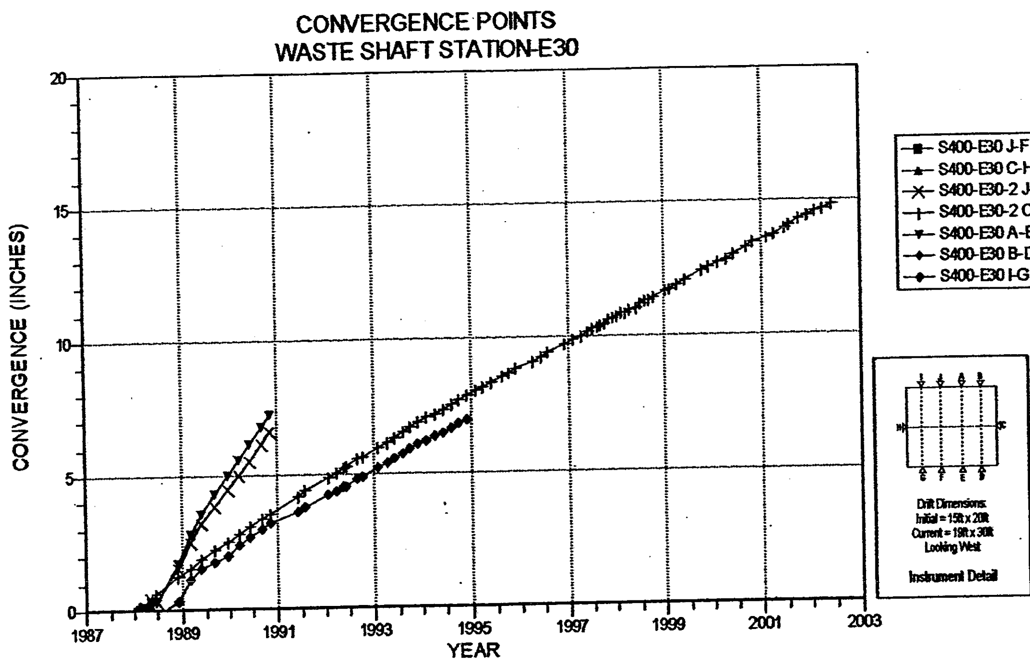
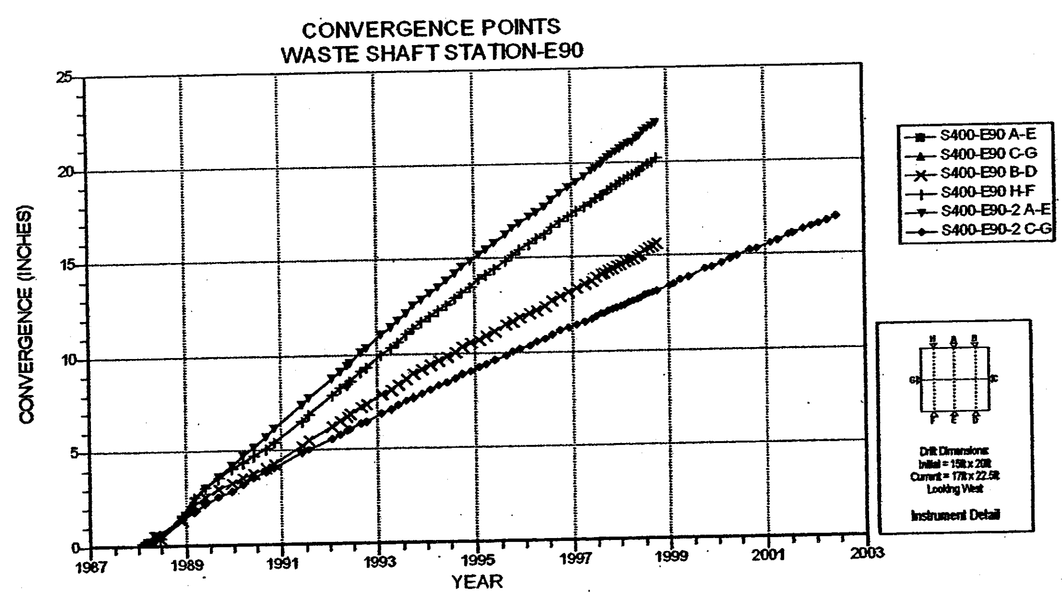


**Figure 3-7 Extensometer 51X-GE-00279
Waste Shaft Station at East 140 – Roof**



NOTES:
1. Excavation date: November 1982.

Figure 3-8 Convergence Point Array
Waste Shaft Station at East 30 – All Chords



NOTES:
1. Excavation date: November 1982.

Figure 3-9 Convergence Point Array
Waste Shaft Station at East 90 – All Chords

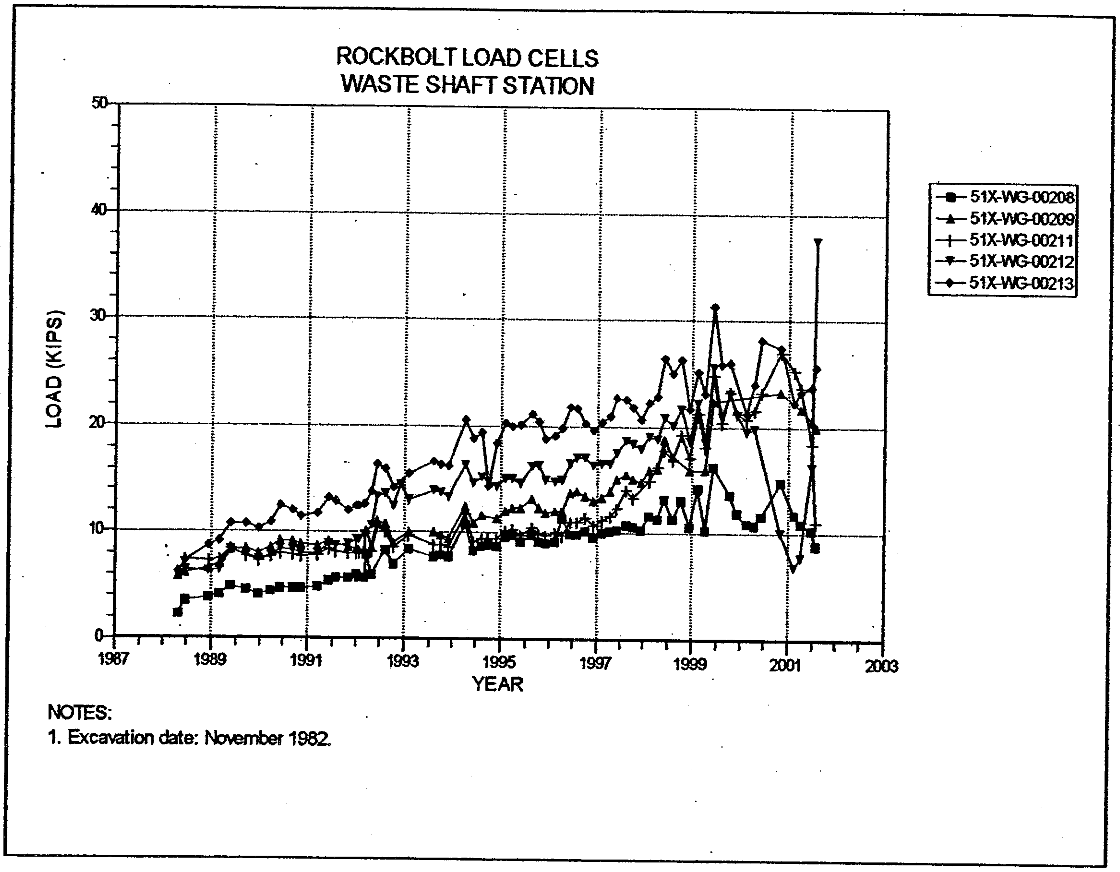


Figure 3-10 Rock Bolt Load Cells
Waste Shaft Station – Roof Bolts

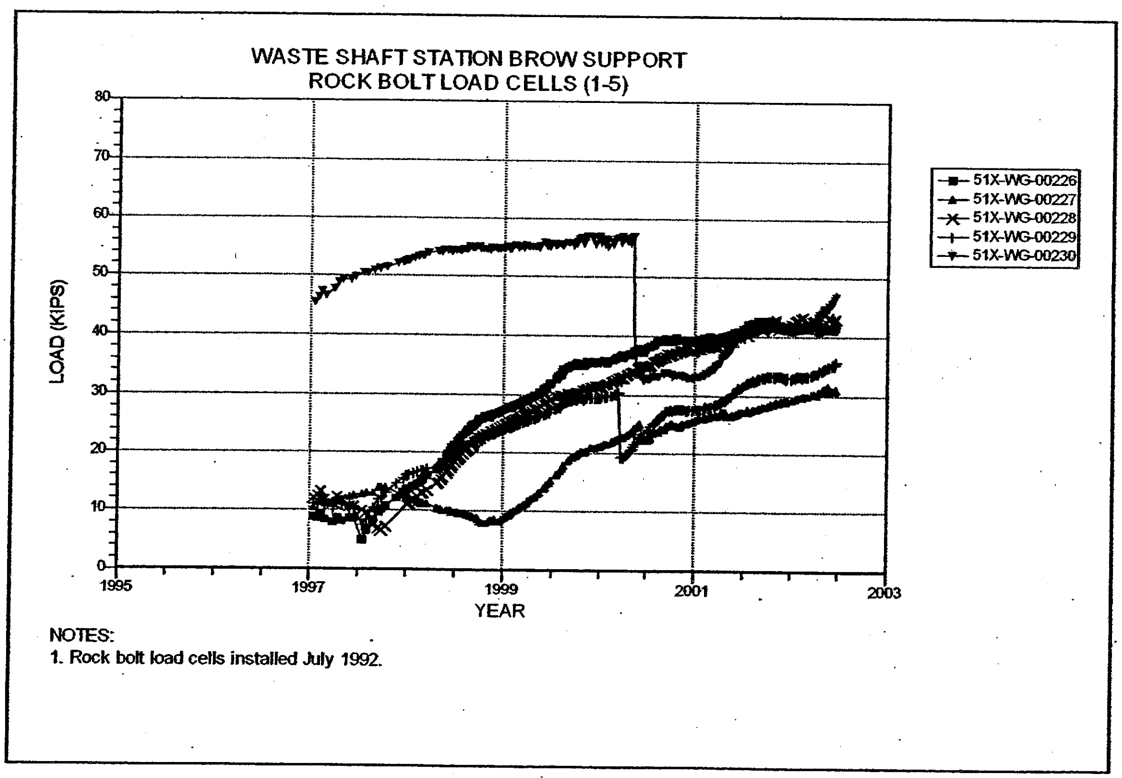
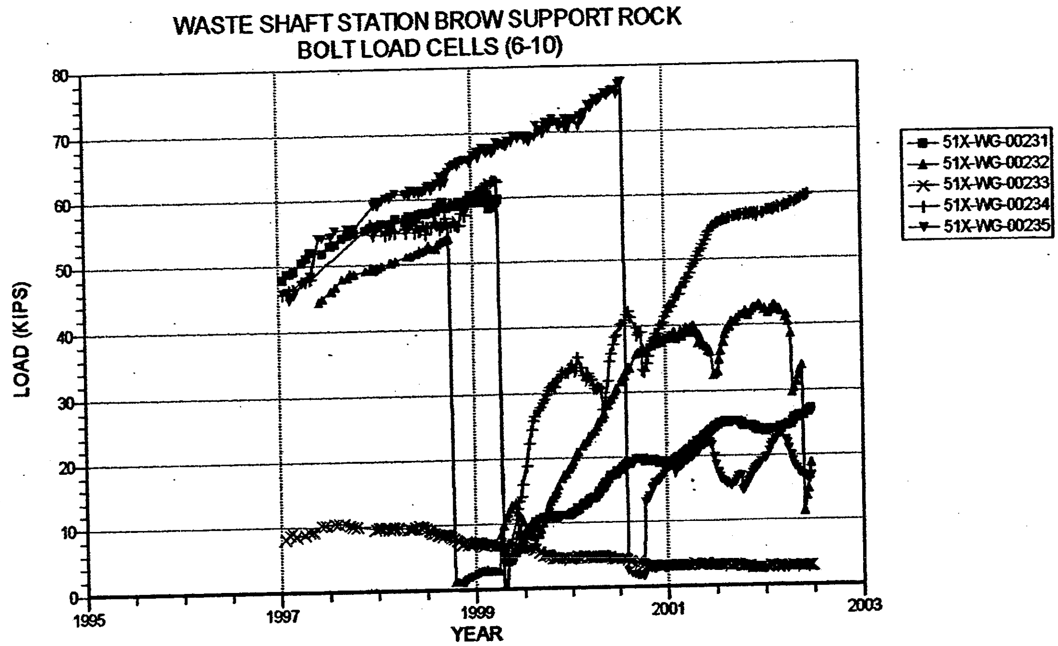


Figure 3-11 Rock Bolt Load Cells
Waste Shaft Station Brow – Roof Bolts Set 1



NOTES:
1. Rock bolt load cells installed July 1992.

Figure 3-12 Rock Bolt Load Cells
Waste Shaft Station Brow – Roof Bolts Set 2

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Table 3-3
Air Intake Shaft Station Data Analysis

ROCKBOLT LOAD CELLS

Field Tag	Location	Figure Number	Date of Initial Reading	Date of Last Reading	Load (kips)	Comments
51X-WG-00236	AIS Station Brow - South	3-13	01/19/93	06/24/02	47.222	
51X-WG-00237	AIS Station Brow - South	3-13	01/19/93	06/24/02	45.984	
51X-WG-00238	AIS Station Brow - South	3-13	01/19/93	06/24/02	7.855	
51X-WG-00239	AIS Station Brow - South	3-13	01/19/93	06/24/02	45.473	
51X-WG-00240	AIS Station Brow - South	3-13	01/19/93	06/25/02	13.036	
51X-WG-00241	AIS Station Brow - South	3-14	01/19/93	06/24/02	44.669	
51X-WG-00242	AIS Station Brow - South	3-14	01/19/93	06/24/02	44.588	
51X-WG-00243	AIS Station Brow - South	3-14	01/19/93	06/24/02	45.694	
51X-WG-00244	AIS Station Brow - South	3-14	12/24/94	06/24/02	42.743	
51X-WG-00245	AIS Station Brow - South	3-14	01/19/93	06/24/02	41.950	
51X-WG-00246	AIS Station Brow - North	3-15	01/19/93	06/24/02	36.145	
51X-WG-00247	AIS Station Brow - North	3-15	01/19/93	06/24/02	36.911	
51X-WG-00248	AIS Station Brow - North	3-15	01/19/93	06/24/02	41.088	
51X-WG-00249	AIS Station Brow - North	3-15	01/19/93	06/24/02	0.032	Broken bolt.
51X-WG-00250	AIS Station Brow - North	3-15	12/24/94	06/24/02	18.807	
51X-WG-00251	AIS Station Brow - North	3-16	01/19/93	06/24/02	26.336	
51X-WG-00252	AIS Station Brow - North	3-16	01/19/93	06/24/02	3.277	
51X-WG-00253	AIS Station Brow - North	3-16	01/19/93	06/24/02	40.239	
51X-WG-00254	AIS Station Brow - North	3-16	01/19/93	06/24/02	16.566	
51X-WG-00255	AIS Station Brow - North	3-16	01/19/93	06/24/02	17.425	

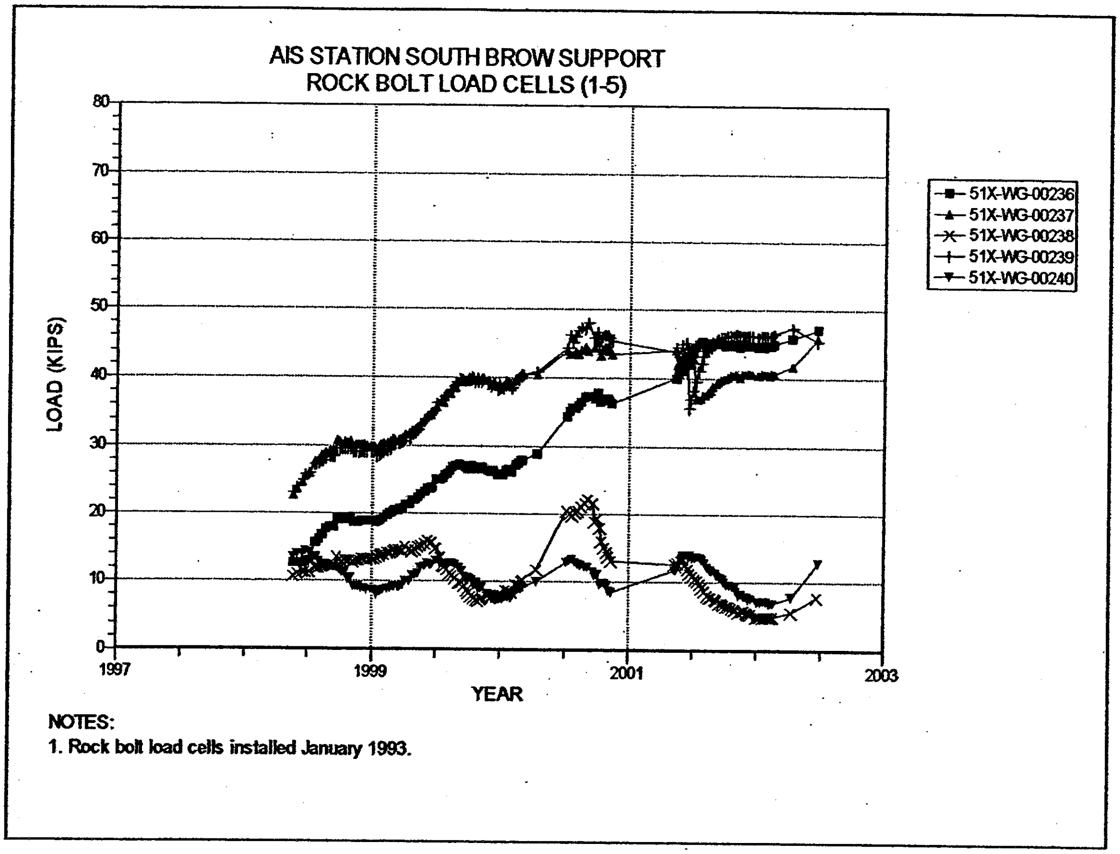

Figure 3-13 Rock Bolt Load Cells
Air Intake Shaft Station Brow – South Side Roof Bolts Set 1

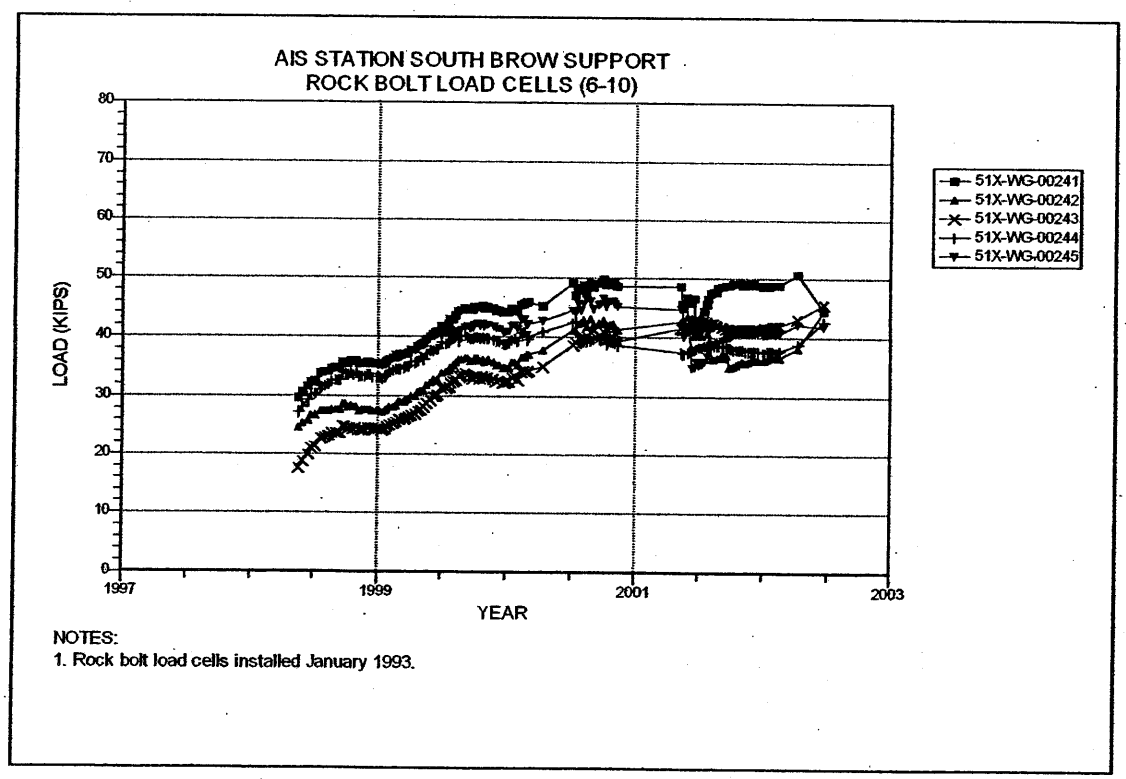

Figure 3-14 Rock Bolt Load Cells
Air Intake Shaft Station Brow – South Side Roof Bolts Set 2

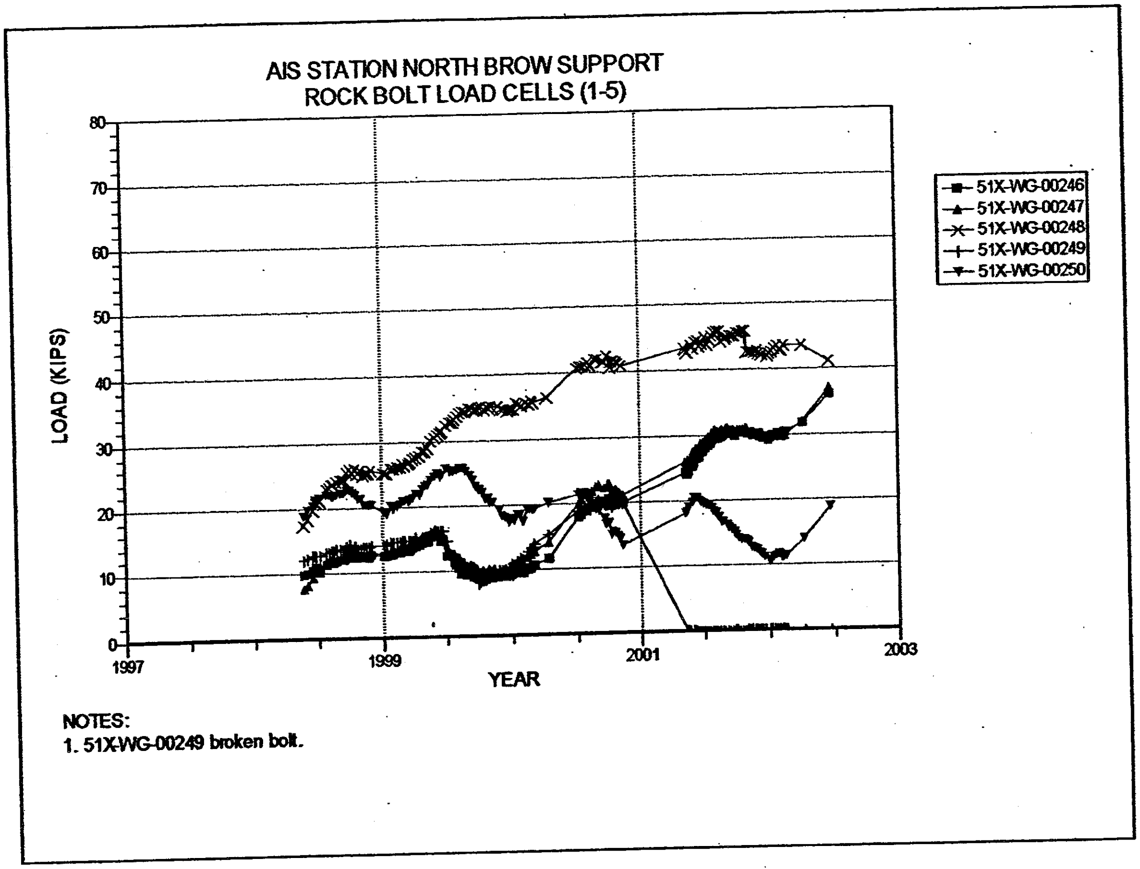

Figure 3-15 Rock Bolt Load Cells
Air Intake Shaft Station Brow – North Side Roof Bolts Set 1

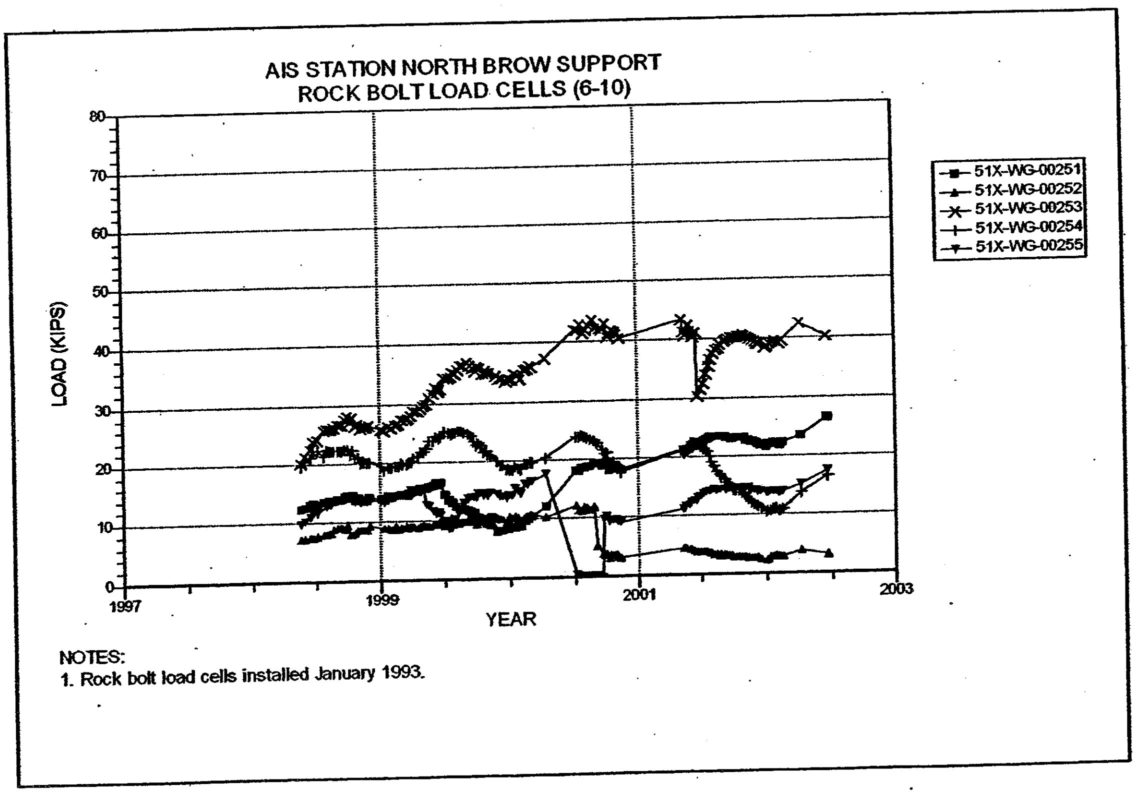

Figure 3-16 Rock Bolt Load Cells
Air Intake Shaft Station Brow – North Side Roof Bolts Set 2

4.0 Instrumentation Summary for the Access Drifts

This chapter presents the instrumentation data and data analyses for the access drifts throughout the WIPP underground. Table 4-1 provides the results of analyses performed on the instrument data including calculated annual displacement and convergence rates. Figures 4-1 through 4-57 present data from borehole extensometers installed in the access drifts while Figures 4-58 through 4-213 present the convergence point data. Figure 4-214 presents data from joint meters installed in the S1950/E300 overcast.

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Table 4-1
Access Drifts Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
51X-GE-00265	S700 Drift-E220	Roof	4-1	06/24/02	10.360	0.523	0.505	4%	
51X-GE-00406	E140 Drift-N686	East Roof	4-2	12/11/01	2.378	0.423	0.337	26%	Mined out.
51X-GE-00403	E140 Drift-N686	Center Roof	4-3	12/11/01	3.327	0.220	0.357	-38%	Mined out.
41X-GE-00109	E140 Drift-N675	Roof	4-4	01/28/02	4.098	1.377	1.302	6%	Mined out.
51X-GE-00407	E140 Drift-N626	East Roof	4-5	12/11/01	2.680	0.652	0.468	39%	Mined out.
51X-GE-00404	E140 Drift-N626	Center Roof	4-6	12/11/01	4.819	1.142	0.876	30%	Mined out.
41X-GE-00108	E140 Drift-N566	Roof	4-7	01/28/02	3.493	1.018	0.937	9%	Mined out.
51X-GE-00408	E140 Drift-N562	East Roof	4-8	12/11/01	2.621	0.458	0.347	32%	Mined out.
51X-GE-00405	E140 Drift-N562	Center Roof	4-9	12/11/01	4.011	0.609	0.672	-9%	Mined out.
41X-GE-00106	E140 Drift-N250	Roof	4-10	05/31/02	2.347	0.357	0.386	-8%	
51X-GE-00105-3	E140 Drift-N150	Roof	4-11	05/31/02	0.177	0.425	N/A	N/A	Reference anchor replaced 10/18/01.
51X-GE-00276	E140 Drift-S700	Roof	4-12	06/24/02	8.227	0.563	0.557	1%	
51X-GE-00299	E140 Drift-S800	Roof	4-13	06/24/02	4.929	0.230	0.202	14%	
51X-GE-00300	E140 Drift-S900	Roof	4-14	06/24/02	7.667	0.363	1.564	-77%	Reference anchor malfunction.
51X-GE-00474	E120/S1000	Roof	4-15	06/04/02	0.547	0.066	0.078	-15%	
51X-GE-00472	E140 Drift-S1000	Roof	4-16	06/04/02	2.493	0.280	0.295	-5%	
51X-GE-00473	E160/S1000	Roof	4-17	06/04/02	0.474	0.051	0.129	-60%	
51X-GE-00464	E140 Drift-S1025	Roof	4-18	06/04/02	2.791	0.263	0.224	17%	
51X-GE-00459	E140 Drift-S1075	Roof	4-19	06/05/02	1.405	0.225	0.226	0%	
51X-GE-00333	E140 Drift-S1075	Roof	4-20	06/24/02	1.953	0.450	0.462	-3%	
51X-GE-00460	E140 Drift-S1150	Roof	4-21	06/05/02	1.910	0.372	0.337	10%	
41X-GE-00103	E140 Drift-S1150	Roof	4-22	06/24/02	2.512	0.622	0.604	3%	
51X-GE-00461	E140 Drift-S1225	Roof	4-23	06/05/02	1.451	0.252	0.258	-2%	
51X-GE-00334	E140 Drift-S1225	Roof	4-24	06/24/02	2.044	0.479	0.489	-2%	
51X-GE-00462	E120/S1300	Roof	4-25	06/04/02	0.285	0.032	0.023	39%	
51X-GE-00465	E140 Drift-S1300	Roof	4-26	06/05/02	1.042	0.129	0.267	-52%	
51X-GE-00335	E140 Drift-S1300	Roof	4-27	06/24/02	1.533	0.334	0.342	-2%	
51X-GE-00463	E160/S1300	Roof	4-28	06/04/02	1.370	0.234	0.214	9%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

EXTENSOMETERS (Continued)

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
51X-GE-00409	E140 Drift-S1375	Roof	4-29	06/05/02	1.619	0.232	0.233	0%	
51X-GE-00336	E140 Drift-S1375	Roof	4-30	05/22/02	2.493	1.042	0.489	113%	Localized roof fracturing.
51X-GE-00410	E140 Drift-S1450	Roof	4-31	06/05/02	3.077	0.770	0.897	-14%	
41X-GE-00102	E140 Drift-S1450	Roof	4-32	10/22/01	3.063	1.353	1.055	28%	Reference anchor replaced 11/01.
41X-GE-00102-2	E140 Drift-S1450	Roof	4-32	06/24/02	0.763	1.262	N/A	N/A	
51X-GE-00411	E140 Drift-S1525	Roof	4-33	12/04/01	8.187	2.374	2.185	9%	
51X-GE-00337	E140 Drift-S1525	Roof	4-34	07/23/01	8.313	4.035	3.985	1%	Reference anchor replaced 10/01.
51X-GE-00337-2	E140 Drift-S1525	Roof	4-34	06/24/02	2.810	3.819	N/A	N/A	
51X-GE-00442	E120/S1600	Roof	4-35	06/04/02	0.472	0.070	0.049	43%	
51X-GE-00446	E140 Drift-S1600	Roof	4-36	06/05/02	1.393	0.201	0.180	12%	
51X-GE-00338	E140 Drift-S1600	Roof	4-37	10/22/01	1.649	0.802	0.591	36%	Reference anchor replaced 1/02.
51X-GE-00338-2	E140 Drift-S1600	Roof	4-37	06/24/02	0.172	0.381	N/A	N/A	
51X-GE-00441	E160/S1600	Roof	4-38	06/04/02	1.189	0.223	0.155	44%	
51X-GE-00443	E140 Drift-S1685	Roof	4-39	06/05/02	2.135	0.275	0.322	-15%	
51X-GE-00339	E140 Drift-S1685	Roof	4-40	11/05/01	2.543	1.183	0.805	47%	Reference anchor replaced 1/02.
51X-GE-00339-2	E140 Drift-S1685	Roof	4-40	06/24/02	0.468	1.016	N/A	N/A	
51X-GE-00444	E140 Drift-S1775	Roof	4-41	06/05/02	5.239	2.356	1.072	120%	Localized roof fracturing.
41X-GE-00101	E140 Drift-S1775	Roof	4-42	11/05/01	3.406	1.974	1.102	79%	Reference anchor replaced 1/02.
41X-GE-00101-2	E140 Drift-S1775	Roof	4-42	06/24/02	1.435	3.139	N/A	N/A	
51X-GE-00445	E140 Drift-S1863	Roof	4-43	12/05/01	3.680	1.214	0.879	38%	
51X-GE-00340	E140 Drift-S1865	Roof	4-44	11/05/01	4.482	2.197	1.771	24%	Reference anchor replaced 1/02.
51X-GE-00340-2	E140 Drift-S1865	Roof	4-44	06/24/02	1.315	2.974	N/A	N/A	
51X-GE-00128	E140 Drift-S1917	Roof	4-45	06/24/02	4.338	0.756	0.753	0%	
51X-GE-00272	E140 Drift-S1950	Roof	4-46	04/22/02	13.810	0.952	1.542	-38%	
41X-GE-00114	E0 Drift-N675	Roof	4-47	09/26/01	3.142	0.777	0.742	5%	Mined out.
51X-GE-00448	E0 Drift-N626	Roof	4-48	08/07/01	4.062	N/A	0.816	N/A	Mined out.
51X-GE-00481	N300 Drift-W10	Roof	4-49	06/24/02	0.209	0.189	N/A	N/A	Installed 6/5/01.
41X-GE-00127	N300 Drift-W110	Roof	4-50	02/18/02	3.259	0.640	0.702	-9%	Off line due to mining activities.

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

EXTENSOMETERS (Continued)

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent	Comments
41X-GE-00126	N300 Drift-W212	Roof	4-51	02/18/02	3.891	0.613	0.795	-23%	Off line due to mining activities.
41X-GE-00125	N215 Drift-W417	Roof	4-52	02/18/02	2.222	0.353	0.496	-29%	Off line due to mining activities.
41X-GE-00124	N215 Drift-W519	Roof	4-53	02/18/02	2.131	0.354	0.487	-27%	Off line due to mining activities.
41X-GE-00123	W620 Drift-N93	Roof	4-54	06/24/02	2.052	0.400	0.404	-1%	
41X-GE-00122	W620 Drift-S65	Roof	4-55	06/24/02	1.568	0.295	0.339	-13%	
51X-GE-00476	W30 Drift-S2685	Roof	4-56	09/26/01	0.718	0.815	1.148	-29%	Mined out.
51X-GE-00477	W170 Drift-S2685	Roof	4-57	10/01/01	0.638	0.466	1.118	-58%	Mined out.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent	Comments
			Date	Inches					
E300-N250-2 A-C	E300 Drift-N250	4-58	05/31/02	7.929	22.282	1.779	1.653	8%	
E300-N170 A-E	E300 Drift-N170	4-59	05/31/02	16.410	16.410	1.428	1.259	13%	
E300-N170 H-F	E300 Drift-N170	4-59	05/31/02	14.467	14.467	1.271	1.128	13%	Temporarily blocked.
E300-N170 C-G	E300 Drift-N170	4-59	05/31/02	13.088	13.088	1.183	0.851	39%	Temporarily blocked.
E300-N45 A-E	E300 Drift-N45	4-60	05/31/02	16.834	16.834	1.512	1.367	11%	
E300-N45 H-F	E300 Drift-N45	4-60	04/03/02	13.636	13.636	1.349	1.206	12%	Temporarily blocked.
E300-N45 C-G	E300 Drift-N45	4-60	05/31/02	12.317	12.317	1.167	0.897	30%	
E300-S45-2 A-E	E300 Drift-S45	4-61	05/31/02	13.713	13.713	1.272	1.113	14%	
E300-S45-2 B-D	E300 Drift-S45	4-61	05/31/02	10.934	10.934	0.914	0.928	-2%	
E300-S45-2 H-F	E300 Drift-S45	4-61	05/31/02	11.700	11.700	1.149	0.928	24%	
E300-S45 C-G	E300 Drift-S45	4-61	05/31/02	10.943	10.943	0.885	0.813	9%	
E300-S90 A-C	E300 Drift-S90	4-62	06/06/02	11.220	11.220	0.765	0.734	4%	
E300-S250-2 A-C	E300 Drift-S250	4-63	06/06/02	2.903	7.313	0.648	0.640	1%	
E300-S250-2 B-D	E300 Drift-S250	4-63	06/06/02	3.290	7.363	0.629	0.637	-1%	
E300-S700 A-C	E300 Drift-S700	4-64	06/06/02	14.470	14.470	0.616	0.576	7%	
E300-S850 A-E	E300 Drift-S850	4-65	06/06/02	11.193	11.193	0.475	0.408	16%	
E300-S850 B-D	E300 Drift-S850	4-65	06/06/02	8.378	8.378	0.369	0.313	18%	
E300-S850 H-F	E300 Drift-S850	4-65	06/06/02	7.624	7.624	0.366	0.334	10%	
E300-S850-2 C-G	E300 Drift-S850	4-65	06/06/02	3.120	12.398	0.548	0.490	12%	
E300-S1000 A-C	E300 Drift-S1000	4-66	06/06/02	14.570	14.570	0.585	0.508	15%	
E300-S1150-3 A-E	E300 Drift-S1150	4-67	06/06/02	6.862	12.352	0.570	0.513	11%	
E300-S1150-3 B-D	E300 Drift-S1150	4-67	06/06/02	4.782	8.841	0.398	0.381	4%	
E300-S1150-3 H-F	E300 Drift-S1150	4-67	06/06/02	4.734	8.354	0.416	0.354	18%	
E300-S1150-2 C-G	E300 Drift-S1150	4-68	06/06/02	3.660	14.116	0.661	0.547	21%	
E300-S1300 A-C	E300 Drift-S1300	4-69	06/06/02	7.549	7.549	0.574	0.633	-9%	

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change Percent [A]	Comments
			Date	Inches	Inches	In/year	In/year		
E300-S1450 A-C	E300 Drift-S1450	4-70	06/06/02	3.210	3.210	0.682	0.614	11%	
E300-S1450 B-D	E300 Drift-S1450	4-70	06/06/02	3.605	3.605	0.798	0.699	14%	
E300-S1687 A-C	E300 Drift-S1687	4-71	06/06/02	3.102	3.102	0.693	0.662	5%	
E300-S1687 B-D	E300 Drift-S1687	4-71	06/06/02	3.490	3.490	0.797	0.729	9%	
E300-S1775 A-C	E300 Drift-S1775	4-72	06/06/02	2.952	2.952	0.707	0.680	4%	
E300-S1775 B-D	E300 Drift-S1775	4-72	06/06/02	3.517	3.517	0.798	0.771	4%	
E300-S1862 A-C	E300 Drift-S1862	4-73	06/06/02	2.976	2.976	0.730	0.679	8%	
E300-S1862 B-D	E300 Drift-S1862	4-73	06/06/02	3.724	3.724	0.843	0.835	1%	
E300-S2065 A-C	E300 Drift-S2065	4-74	06/17/02	3.567	3.567	0.956	0.843	13%	
E300-S2065 B-D	E300 Drift-S2065	4-74	06/17/02	4.538	4.538	1.114	1.130	-1%	
E300-S2180-1 A-C	E300 Drift-S2180	4-75	06/17/02	4.053	9.403	1.366	1.668	-18%	
E300-S2275 A-C	E300 Drift-S2275	4-76	06/17/02	3.696	3.696	1.255	1.794	-30%	
E300-S2275 B-D	E300 Drift-S2275	4-76	06/17/02	4.335	4.335	1.620	2.084	-22%	
E300-S2350 A-C	E300 Drift-S2350	4-77	06/17/02	4.306	4.306	1.463	2.057	-29%	
E300-S2350 B-D	E300 Drift-S2350	4-77	06/17/02	4.612	4.612	1.613	2.224	-27%	
E300-S2425 A-C	E300 Drift-S2425	4-78	06/17/02	4.310	4.310	1.593	2.019	-21%	
E300-S2425 B-D	E300 Drift-S2425	4-78	06/17/02	4.686	4.686	1.617	2.187	-26%	
E140-N952 A-C	E140 Drift-N952	4-79	05/31/02	29.416	29.416	2.521	2.434	4%	
E140-N952 B-D	E140 Drift-N952	4-79	02/13/02	15.281	15.281	1.540	N/A	N/A	Temporarily blocked.
E140-N780 A-C	E140 Drift-N780	4-80	12/11/01	31.778	31.778	2.905	2.538	14%	Mined out.
E140-N686 A-E	E140 Drift-N686	4-81	12/11/01	13.162	13.162	2.131	1.903	12%	Mined out.
E140-N686 B-D	E140 Drift-N686	4-81	12/11/01	11.043	11.043	1.878	1.642	14%	Mined out.
E140-N686 H-F	E140 Drift-N686	4-81	10/05/01	14.716	14.716	2.272	2.171	5%	Mined out.
E140-N686 C-G	E140 Drift-N686	4-81	12/11/01	8.884	8.884	1.455	1.284	13%	Mined out.
E140-N626-2 A-C	E140 Drift-N626	4-82	12/11/01	25.869	32.594	2.478	2.213	12%	Mined out.
E140-N626-3 B-D	E140 Drift-N626	4-82	12/11/01	10.201	21.360	1.458	1.308	11%	Mined out.

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002 Date	Last Reading 2001 to 2002 Inches	Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
E140-N626 E-F	E140 Drift-N626	4-82	12/11/01	11.136	11.136	1.849	1.656	12%	Mined out.
E140-N626 H-G	E140 Drift-N626	4-82	12/11/01	17.053	17.053	2.889	2.666	8%	Mined out.
E140-N562 A-E	E140 Drift-N562	4-83	12/11/01	11.841	11.841	2.012	1.721	17%	Mined out.
E140-N562 B-D	E140 Drift-N562	4-83	12/11/01	8.302	8.302	1.307	1.197	9%	Mined out.
E140-N562 H-F	E140 Drift-N562	4-83	12/11/01	14.687	14.687	2.423	2.167	12%	Mined out.
E140-N562 C-G	E140 Drift-N562	4-83	12/11/01	8.249	8.249	1.379	1.218	13%	Mined out.
E140-N460-3 A-C	E140 Drift-N460	4-84	05/31/02	1.054	21.950	1.845	1.510	22%	Mined out. Reinstalled 11/01.
E140-N355 A-C	E140 Drift-N355	4-85	05/31/02	1.749	1.749	1.998	N/A	N/A	New installation 7/01.
E140-N355 B-D	E140 Drift-N355	4-85	05/31/02	1.493	1.493	1.672	N/A	N/A	New installation 7/01.
E140-N220 A-C	E140 Drift-N220	4-86	05/31/02	19.365	19.365	1.722	1.398	23%	
E140-N150 A-C	E140 Drift-N150	4-87	05/31/02	14.714	14.714	1.098	1.155	-5%	
E140-N5-4 A-C	E140 Drift-N5	4-88	05/31/02	5.256	26.962	1.187	1.176	1%	
E140-N5-3 B-D	E140 Drift-N5	4-88	05/31/02	6.152	21.393	0.898	0.926	-3%	
E140-S90-3 A-C	E140 Drift-S90	4-89	05/31/02	5.117	12.497	1.082	1.081	0%	
E140-S262-3 A-C	E140 Drift-S262	4-90	05/31/02	13.832	16.848	1.579	1.528	3%	
E140-S262-3 B-D	E140 Drift-S262	4-90	05/31/02	9.659	11.012	0.989	0.953	4%	
E140-S460-4 A-C	E140 Drift-S460	4-91	06/04/02	8.898	34.609	1.977	2.069	-4%	
E140-S460-2 B-D	E140 Drift-S460	4-91	06/04/02	16.433	22.377	0.977	0.931	5%	
E140-S550-4 A-C	E140 Drift-S550	4-92	06/04/02	5.761	29.878	1.291	1.227	5%	
E140-S550-4 B-D	E140 Drift-S550	4-92	06/04/02	17.029	25.671	1.013	1.022	-1%	
E140-S700-5 A-D	E140 Drift-S700	4-93	06/04/02	1.768	17.951	1.253	1.550	-19%	Reinstalled 3/01.
E140-S700-4 B-C	E140 Drift-S700	4-94	06/04/02	5.530	17.491	1.225	1.162	5%	
E140-S700-4 E-F	E140 Drift-S700	4-94	06/04/02	4.050	12.866	0.929	0.886	5%	
E140-S850-7 A-C	E140 Drift-S850	4-95	06/04/02	7.702	34.222	1.702	1.807	-6%	
E140-S850-4 B-D	E140 Drift-S850	4-96	06/04/02	7.853	23.800	1.047	1.017	3%	
E140-S1000 A-C	E140 Drift-S1000	4-97	06/04/02	23.056	23.056	1.377	1.384	-1%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change	Comments
			Date	Inches	Inches	In/year	In/year	Percent	
E140-S1025-2 A-C	E140 Drift-S1025	4-98	06/04/02	6.641	9.187	1.371	1.364	1%	
E140-S1075-2 A-E	E140 Drift-S1075	4-99	06/05/02	6.650	8.397	1.675	1.548	8%	
E140-S1075-2 B-D	E140 Drift-S1075	4-99	06/05/02	6.410	8.072	1.520	1.512	1%	
E140-S1075-2 F-H	E140 Drift-S1075	4-99	06/05/02	5.569	7.149	1.258	1.357	-7%	
E140-S1075-2 C-G	E140 Drift-S1075	4-99	06/05/02	5.596	6.470	1.163	1.181	-2%	
E140-S1150-2 A-G	E140 Drift-S1150	4-100	06/05/02	7.489	36.636	1.838	1.787	3%	
E140-S1150-2 B-F	E140 Drift-S1150	4-100	06/05/02	7.614	9.126	1.848	1.811	2%	
E140-S1150-3 L-H	E140 Drift-S1150	4-100	06/05/02	5.889	7.532	1.407	1.389	1%	
E140-S1150 C-K	E140 Drift-S1150	4-101	06/05/02	6.558	6.558	1.142	1.171	-2%	
E140-S1150-2 D-J	E140 Drift-S1150	4-101	06/05/02	6.007	25.878	1.221	1.306	-7%	
E140-S1150-2 E-I	E140 Drift-S1150	4-101	06/05/02	5.510	6.420	1.182	1.118	6%	
E140-S1225-2 A-E	E140 Drift-S1225	4-102	06/05/02	7.497	9.522	1.928	1.868	3%	
E140-S1225-2 B-D	E140 Drift-S1225	4-102	06/05/02	8.076	10.186	1.975	1.928	2%	
E140-S1225-2 H-F	E140 Drift-S1225	4-102	06/05/02	5.719	7.318	1.337	1.350	-1%	
E140-S1225-2 C-G	E140 Drift-S1225	4-102	06/05/02	6.504	7.461	1.413	1.410	0%	
E140-S1300-4 A-C	E140 Drift-S1300	4-103	06/05/02	5.640	22.263	1.261	1.241	2%	
E140-S1378-2 A-E	E140 Drift-S1378	4-104	06/05/02	7.466	18.304	1.842	1.804	2%	
E140-S1378-2 B-D	E140 Drift-S1378	4-104	06/05/02	5.102	14.806	1.248	1.228	2%	
E140-S1378-2 H-F	E140 Drift-S1378	4-104	06/05/02	8.735	20.013	2.149	2.086	3%	
E140-S1378 C-G	E140 Drift-S1378	4-105	06/05/02	7.715	11.885	1.257	1.267	-1%	
E140-S1456-4 A-G	E140 Drift-S1456	4-106	06/05/02	6.895	41.964	2.520	2.302	9%	
E140-S1456-2 B-F	E140 Drift-S1456	4-107	06/05/02	9.122	19.290	2.307	2.186	6%	
E140-S1456-2 L-H	E140 Drift-S1456	4-107	06/05/02	6.608	15.378	1.708	1.606	6%	
E140-S1456-2 D-J	E140 Drift-S1456	4-108	06/05/02	6.806	28.154	1.475	1.444	2%	
E140-S1456 K-C	E140 Drift-S1456	4-109	06/05/02	7.464	7.464	1.181	1.220	-3%	
E140-S1456-2 I-E	E140 Drift-S1456	4-109	06/05/02	5.758	7.368	1.252	1.226	2%	

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change	Comments
			Date	Inches	Inches	in/year	in/year	Percent	
E140-S1534-2 A-E	E140 Drift-S1534	4-110	06/05/02	15.388	18.549	4.936	4.292	15%	
E140-S1534-2 B-D	E140 Drift-S1534	4-110	06/05/02	8.658	10.933	2.881	2.257	28%	
E140-S1534-2 H-F	E140 Drift-S1534	4-110	06/05/02	9.925	12.995	2.573	2.694	-4%	
E140-S1534-2 C-G	E140 Drift-S1534	4-110	06/05/02	6.116	7.639	1.359	1.327	2%	
E140-S1600-5 A-C	E140 Drift-S1600	4-111	06/05/02	6.264	23.109	1.482	1.415	5%	
E140-S1687-2 A-E	E140 Drift-S1687	4-112	06/05/02	8.866	11.824	2.465	2.219	11%	
E140-S1687-2 B-D	E140 Drift-S1687	4-112	06/05/02	8.113	10.997	2.124	2.001	6%	
E140-S1687-2 H-F	E140 Drift-S1687	4-112	06/05/02	7.065	9.661	1.831	1.714	7%	
E140-S1687 C-G	E140 Drift-S1687	4-112	06/05/02	7.424	7.424	1.319	1.250	6%	
E140-S1775-2 A-G	E140 Drift-S1775	4-113	06/27/02	14.805	18.032	6.195	3.415	81%	Localized roof fracturing.
E140-S1775-2 B-F	E140 Drift-S1775	4-113	06/27/02	13.877	17.327	4.853	3.433	41%	
E140-S1775-2 L-H	E140 Drift-S1775	4-113	06/27/02	7.278	9.464	2.436	1.692	44%	
E140-S1775 C-K	E140 Drift-S1775	4-114	06/05/02	7.389	7.389	1.318	1.242	6%	
E140-S1775-2 D-J	E140 Drift-S1775	4-114	06/05/02	6.180	7.490	1.402	1.366	3%	
E140-S1775-2 I-E	E140 Drift-S1775	4-114	06/05/02	6.022	7.563	1.417	1.357	4%	
E140-S1862-2 A-E	E140 Drift-S1862	4-115	06/05/02	8.311	10.917	2.493	2.074	20%	
E140-S1862-2 B-D	E140 Drift-S1862	4-115	06/05/02	8.606	11.522	2.281	2.176	5%	
E140-S1862-2 H-F	E140 Drift-S1862	4-115	06/05/02	5.306	7.137	1.430	1.329	8%	
E140-S1862-3 C-G	E140 Drift-S1862	4-115	06/05/02	0.748	7.153	1.240	1.351	-8%	Reinstalled 11/01.
E140-S1917-3 A-C	E140 Drift-S1917	4-116	06/04/02	7.876	11.771	1.597	1.687	-5%	
E140-S1950-4 A-C	E140 Drift-S1950	4-117	06/05/02	9.876	28.537	2.338	2.611	-10%	
E140-S2007-2 A-C	E140 Drift-S2007	4-118	06/05/02	4.457	11.802	2.567	2.579	0%	Reinstalled 9/00.
E140-S2065-2 A-C	E140 Drift-S2065	4-119	06/05/02	4.293	10.391	2.480	2.446	1%	Reinstalled 9/00.
E140-S2065 B-D	E140 Drift-S2065	4-119	06/05/02	5.798	5.798	1.377	1.422	-3%	
E140-S2122-2 A-C	E140 Drift-S2122	4-120	06/05/02	5.027	11.238	3.032	2.717	12%	Reinstalled 9/00.
E140-S2180-3 A-C	E140 Drift-S2180	4-121	06/05/02	3.581	16.587	2.072	1.909	9%	Reinstalled 9/00.
E140-S2275 A-C	E140 Drift-S2275	4-122	06/05/02	9.043	9.043	3.768	4.123	-9%	

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
			Date	Inches					
E140-S2275 B-D	E140 Drift-S2275	4-122	06/05/02	4.278	4.278	1.619	1.946	-17%	
E140-S2350-2 A-C	E140 Drift-S2350	4-123	06/05/02	7.209	24.160	2.994	3.259	-8%	
E140-S2350-2 B-D	E140 Drift-S2350	4-123	06/05/02	4.350	11.241	1.703	1.983	-14%	
E140-S2425 A-C	E140 Drift-S2425	4-124	06/05/02	6.883	6.883	2.791	3.152	-11%	
E140-S2425 B-D	E140 Drift-S2425	4-124	06/05/02	4.339	4.339	1.645	2.035	-19%	
E140-S2520 A-C	E140 Drift-S2520	4-125	06/05/02	6.784	6.784	2.674	3.073	-13%	
E0-N940-3 A-C	E0 Drift-N940	4-126	05/31/02	38.176	45.510	2.270	1.812	25%	
E0-N780 A-C	E0 Drift-N780	4-127	08/07/01	20.440	20.440	N/A	1.856	N/A	Mined out.
E0-N626-3 A-C	E0 Drift-N626	4-128	08/07/01	34.277	40.978	N/A	2.146	N/A	Mined out.
E0-N460-3 A-C	E0 Drift-N460	4-129	05/31/02	1.127	21.274	1.978	N/A	N/A	Mined out. Reinstalled 11/01.
E0-N300-4 A-C	E0 Drift-N300	4-130	05/31/02	1.732	36.459	1.944	N/A	N/A	Mined out. Reinstalled 7/01.
E0-N225-2 A-C	E0 Drift-N225	4-131	05/31/02	1.115	1.206	1.892	N/A	N/A	Mined out. Reinstalled 11/01.
E0-N225 B-D	E0 Drift-N225	4-131	05/31/02	1.476	1.476	1.682	N/A	N/A	Mined out. Reinstalled 11/01.
E0-N140-6 A-C	E0 Drift-N140	4-132	02/18/02	0.322	13.077	0.706	1.183	-40%	Mined out. Reinstalled 10/01.
E0-N75 A-C	E0 Drift-N75	4-133	05/31/02	0.145	17.165	N/A	1.602	N/A	Installed 5/02. Replaced E0-N80.
E0-N75 B-D	E0 Drift-S75	4-133	05/31/02	0.147	0.147	N/A	N/A	N/A	Installed 5/02. Replaced E0-N80.
W30-S120 A-C	W30 Drift-S120	4-134	06/03/02	15.382	15.382	1.161	0.922	26%	
W30-S250-3 A-C	W30 Drift-S250	4-135	06/03/02	12.347	21.859	1.085	1.093	-1%	
W30-S250-5 B-D	W30 Drift-S250	4-135	06/03/02	7.852	18.806	0.838	0.809	4%	
W30-S400 A-C	W30 Drift-S400	4-136	06/03/02	13.540	13.540	0.870	0.836	4%	
W30-S500 A-C	W30 Drift-S500	4-137	06/03/02	18.754	18.754	0.830	0.839	-1%	
W30-S500 B-D	W30 Drift-S500	4-137	06/03/02	17.722	17.722	0.751	0.813	-8%	
W30-S700-2 A-C	W30 Drift-S700	4-138	06/03/02	4.223	24.664	1.040	0.993	5%	
W30-S850-2 A-E	W30 Drift-S850	4-139	06/03/02	7.717	14.470	0.672	0.663	1%	
W30-S850-2 B-D	W30 Drift-S850	4-139	06/03/02	5.307	9.869	0.466	0.457	2%	
W30-S850 H-F	W30 Drift-S850	4-139	06/03/02	10.766	10.766	0.489	0.511	-4%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002 Date	Last Reading 2001 to 2002 Inches	Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
W30-S850 C-G	W30 Drift-S850	4-139	06/03/02	16.098	16.098	0.744	0.736	1%	
W30-S1000-3 A-C	W30 Drift-S1000	4-140	06/03/02	10.777	27.644	1.189	1.143	4%	
W30-S1100 A-C	W30 Drift-S1100	4-141	06/03/02	6.177	6.177	0.879	0.881	0%	
W30-S1200 A-C	W30 Drift-S1200	4-142	06/03/02	6.288	6.288	0.894	0.865	3%	
W30-S1300 A-C	W30 Drift-S1300	4-143	06/03/02	12.736	12.736	0.988	0.970	2%	
W30-S1453 A-C	W30 Drift-S1453	4-144	06/03/02	8.573	8.573	0.814	0.752	8%	
W30-S1453-2 B-D	W30 Drift-S1453	4-144	06/03/02	3.893	8.816	0.778	0.748	4%	
W30-S1600-1 A-C	W30 Drift-S1600	4-145	06/03/02	2.570	11.312	0.974	0.899	8%	
W30-S1775 A-C	W30 Drift-S1775	4-146	06/03/02	6.355	6.355	0.589	0.572	3%	
W30-S1775-2 B-D	W30 Drift-S1775	4-146	06/03/02	3.426	7.466	0.726	0.605	20%	
W30-S1950 A-C	W30 Drift-S1950	4-147	06/03/02	10.836	10.836	0.942	1.028	-8%	
W30-S2067 A-C	W30 Drift-S2067	4-148	06/03/02	8.165	8.165	0.838	0.866	-3%	
W30-S2067-2 B-D	W30 Drift-S2067	4-148	06/03/02	3.776	8.685	0.919	0.909	1%	
W30-S2180 A-C	W30 Drift-S2180	4-149	06/03/02	13.349	13.349	1.216	1.435	-15%	
W30-S2275-2 A-C	W30 Drift-S2275	4-150	06/03/02	1.727	2.566	1.004	1.032	-3%	Reinstalled 10/00.
W30-S2275 B-D	W30 Drift-S2275	4-150	06/03/02	3.071	3.071	1.172	1.405	-17%	
W30-S2350-2 A-C	W30 Drift-S2350	4-151	06/03/02	2.009	3.097	1.127	1.271	-11%	Reinstalled 10/00.
W30-S2350 B-D	W30 Drift-S2350	4-151	06/03/02	3.562	3.562	1.314	1.651	-20%	
W30-S2425-2 A-C	W30 Drift-S2425	4-152	06/03/02	2.249	3.238	1.246	1.428	-13%	Reinstalled 10/00.
W30-S2425 B-D	W30 Drift-S2425	4-152	06/03/02	3.640	3.640	1.405	1.579	11%	
W30-S2520-2 A-C	W30 Drift-S2520	4-153	06/03/02	3.380	5.301	1.755	2.286	-23%	Reinstalled 10/00.
W30-S2685-2 A-C	W30 Drift-S2685	4-154	06/26/02	1.006	3.140	2.122	N/A	N/A	Reinstalled 1/02.
W30-S2685-2 B-D	W30 Drift-S2685	4-154	06/26/02	1.013	3.193	1.940	N/A	N/A	Reinstalled 12/01.
W170-N150-2 A-C	W170 Drift-N150	4-155	06/03/02	4.474	5.920	0.502	0.481	4%	
W170-S5 A-C	W170 Drift-S5	4-156	06/03/02	9.513	9.513	0.561	0.601	-7%	
W170-S5-2 B-D	W170 Drift-S5	4-156	06/03/02	2.922	10.714	0.671	0.692	-3%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change Percent [A]	Comments
			Date	Inches	Inches	in/year	in/year		
W170-S90-2 A-C	W170 Drift-S90	4-157	07/30/01	1.560	7.270	N/A	0.879	N/A	Mined out.
W170-S232-2 A-C	W170 Drift-S232	4-158	06/03/02	0.948	6.560	0.626	0.447	40%	Reinstalled 11/00.
W170-S232-2 B-D	W170 Drift-S232	4-158	06/03/02	4.000	6.642	0.617	0.578	7%	
W170-S400 A-C	W170 Drift-S400	4-159	06/03/02	8.126	8.126	0.661	0.642	3%	
W170-S560-3 A-C	W170 Drift-S560	4-160	06/03/02	0.992	7.087	0.655	0.568	15%	Reinstalled 11/00.
W170-S560-2 B-D	W170 Drift-S560	4-160	06/03/02	4.539	7.671	0.693	0.627	11%	
W170-S700 A-C	W170 Drift-S700	4-161	06/03/02	15.779	15.779	0.675	0.636	6%	
W170-S850-6 A-E	W170 Drift-S850	4-162	06/03/02	0.856	13.345	0.634	0.489	30%	Reinstalled 2/01.
W170-S850-5 B-D	W170 Drift-S850	4-163	06/03/02	0.806	9.805	0.500	0.458	9%	Reinstalled 11/00.
W170-S850-6 H-F	W170 Drift-S850	4-163	06/03/02	0.720	9.100	0.460	0.430	7%	Reinstalled 11/00.
W170-S850-3 C-G	W170 Drift-S850	4-164	06/03/02	4.484	15.297	0.693	0.681	2%	
W170-S1000-2 A-C	W170 Drift-S1000	4-165	06/03/02	0.918	17.602	0.722	0.582	24%	Reinstalled 3/01.
W170-S1150-3 A-E	W170 Drift-S1150	4-166	06/03/02	2.596	15.868	0.741	0.675	10%	
W170-S1150-3 B-D	W170 Drift-S1150	4-166	06/03/02	1.871	11.109	0.521	0.529	-2%	
W170-S1150-2 C-G	W170 Drift-S1150	4-166	06/03/02	4.908	16.485	0.719	0.712	1%	
W170-S1150 H-F	W170 Drift-S1150	4-166	06/03/02	10.373	10.373	0.551	0.512	8%	
W170-S1300-3 A-C	W170 Drift-S1300	4-167	06/03/02	10.110	13.190	1.066	0.979	9%	
W170-S1445-3 A-C	W170 Drift-S1445	4-168	06/03/02	2.563	7.298	0.665	0.688	-3%	
W170-S1445-2 B-D	W170 Drift-S1445	4-168	06/03/02	4.380	7.038	0.665	0.628	6%	
W170-S1600-2 A-C	W170 Drift-S1600	4-169	06/03/02	3.144	8.942	0.819	0.715	15%	
W170-S1779-2 A-C	W170 Drift-S1779	4-170	06/03/02	3.235	9.466	0.883	0.880	0%	
W170-S1779-2 B-D	W170 Drift-S1779	4-170	06/03/02	5.073	8.208	0.778	0.727	7%	
W170-S1950-2 A-C	W170 Drift-S1950	4-171	06/03/02	2.967	8.390	0.772	0.850	-9%	
W170-S2060-2 A-C	W170 Drift-S2060	4-172	06/03/02	3.042	8.600	0.812	0.883	-8%	
W170-S2060-2 B-D	W170 Drift-S2060	4-172	06/03/02	5.241	8.565	0.853	0.866	-2%	
W170-S2180-2 A-C	W170 Drift-S2180	4-173	06/03/02	3.962	9.977	1.020	1.136	-10%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
			Date	Inches					
W170-S2275 A-C	W170 Drift-S2275	4-174	06/03/02	2.990	2.990	1.080	1.380	-22%	
W170-S2275 B-D	W170 Drift-S2275	4-174	06/03/02	3.085	3.085	1.135	1.409	-19%	
W170-S2350 A-C	W170 Drift-S2350	4-175	06/03/02	3.992	3.992	1.425	1.791	-20%	
W170-S2350 B-D	W170 Drift-S2350	4-175	06/03/02	3.397	3.397	1.197	1.545	-23%	
W170-S2425 A-C	W170 Drift-S2425	4-176	06/03/02	3.706	3.706	1.321	1.680	-21%	
W170-S2425 B-D	W170 Drift-S2425	4-176	06/03/02	3.717	3.717	1.379	1.687	-18%	
W170-S2520 A-C	W170 Drift-S2520	4-177	06/03/02	4.112	4.112	1.456	1.985	-27%	
W170-S2685-2 A-C	W170 Drift-S2685	4-178	06/26/02	0.943	2.809	1.973	N/A	N/A	Reinstalled 12/01.
W170-S2685-2 B-D	W170 Drift-S2685	4-178	06/26/02	0.972	2.868	1.893	N/A	N/A	Reinstalled 12/01.
N460-E70-3 A-C	N460 Drift-E70	4-179	05/31/02	1.130	17.642	1.485	N/A	N/A	Mined out. Reinstalled 9/01.
N460-E70-2 B-D	N460 Drift-E70	4-179	05/31/02	1.519	13.267	1.722	N/A	N/A	Mined out. Reinstalled 7/01.
N250-E220 A-E	N250 Drift-E220	4-180	05/31/02	17.283	17.283	1.533	1.443	6%	
N250-E220 B-D	N250 Drift-E220	4-180	05/31/02	17.717	17.717	1.613	1.711	-6%	
N250-E220 H-F	N250 Drift-E220	4-180	05/31/02	13.448	13.448	1.203	1.126	7%	
N250-E220 C-G	N250 Drift-E220	4-180	05/31/02	13.096	13.096	1.101	1.037	6%	
N300-W170 A-C	N300 Drift-W170	4-181	05/31/02	19.442	19.442	1.554	1.626	-4%	
N300-W170-1 B-D	N300 Drift-W170	4-181	05/31/02	4.022	12.267	1.036	0.976	6%	
N215-W500 A-C	N215 Drift-W500	4-182	05/31/02	15.897	15.897	1.356	1.396	-3%	
N215-W500-2 B-D	N215 Drift-W500	4-182	05/31/02	3.522	10.392	0.829	0.870	-5%	
N215-W620 A-C	N215 Drift-W620	4-183	05/31/02	14.101	14.101	1.044	1.092	-4%	
N140-E90 A-C	N140 Drift-E90	4-184	05/31/02	10.636	10.636	0.749	0.684	10%	
N140-E90 B-D	N140 Drift-E90	4-184	05/31/02	10.913	10.913	0.721	0.621	16%	
N140-W50-2 B-D	N140 Drift-W50	4-185	06/03/02	4.163	16.369	1.160	1.020	14%	
S90-W120 A-C	S90 Drift-W120	4-186	06/06/02	1.562	1.562	0.680	0.669	2%	
S90-W120 B-D	S90 Drift-W120	4-186	06/06/02	1.625	1.625	0.740	0.683	8%	
S90-W400 A-C	S90 Drift-W400	4-187	06/06/02	11.625	11.625	0.671	0.706	-5%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change Percent [A]	Comments
			Date	Inches	Inches	in/year	in/year		
S90-W400-2 B-D	S90 Drift-W400	4-187	06/06/02	3.266	11.189	0.632	0.657	-4%	
S90-W590 A-C	S90 Drift-W590	4-188	06/06/02	7.681	7.681	0.629	0.652	-4%	
S90-W590-2 B-D	S90 Drift-W590	4-188	06/06/02	3.191	7.028	0.561	0.567	-1%	
S90-W620 A-C	S90 Drift-W620	4-189	06/06/02	14.167	14.167	1.018	1.259	-19%	
S90-W770 A-C	S90 Drift-W770	4-190	06/06/02	9.515	9.515	0.895	0.757	18%	
S90-W770-2 B-D	S90 Drift-W770	4-190	06/06/02	2.837	8.524	0.689	N/A	N/A	Temporarily blocked.
S90-W920-2 A-C	S90 Drift-W920	4-191	06/06/02	1.020	14.676	1.073	0.961	12%	Reinstalled 8/01.
CORE-W10 A-C	Core Storage Room	4-192	06/03/02	14.040	14.040	0.827	0.784	5%	
CORE-W20 A-C	Core Storage Room	4-192	06/03/02	12.953	12.953	0.817	0.782	4%	
CORE-W30 A-C	Core Storage Room	4-192	06/03/02	13.466	13.466	0.878	0.837	5%	
CORE-W51 A-C	Core Storage Room	4-192	06/03/02	14.945	14.945	0.970	0.967	0%	
CORE-W62 A-C	Core Storage Room	4-192	06/03/02	15.503	15.503	1.040	0.985	6%	
CORE-W73 A-C	Core Storage Room	4-192	06/03/02	15.592	15.592	1.053	1.003	5%	
CORE-W101 A-C	Core Storage Room	4-192	06/03/02	15.393	15.393	0.991	0.933	6%	
CORE-W117 A-C	Core Storage Room	4-192	06/03/02	14.083	14.083	0.873	0.823	6%	
CORE-W133 A-C	Core Storage Room	4-192	06/03/02	12.161	12.161	0.721	0.707	2%	
S700-E205-2 A-C	S700 Drift-E205	4-193	06/04/02	11.651	14.593	1.347	1.346	0%	
S700-E205 B-D	S700 Drift-E205	4-193	06/04/02	23.280	23.280	0.969	1.063	-9%	
S700-E58 A-C	S700 Drift-E58	4-194	06/03/02	10.983	10.983	1.274	1.240	3%	
S1000-E160 A-C	S1000 Drift-E160	4-195	06/04/02	4.315	4.315	0.752	0.760	-1%	
S1000-E58-3 A-C	S1000 Drift-E58	4-196	06/04/02	9.591	12.553	1.122	1.290	-13%	
S1000-E58-2 B-D	S1000 Drift-E58	4-196	06/04/02	8.383	9.927	0.838	0.922	-9%	
S1000-W98 A-C	S1000 Drift-W98	4-197	06/03/02	16.162	16.162	1.480	1.448	2%	
S1000-W98 B-D	S1000 Drift-W98	4-197	06/03/02	11.238	11.238	1.035	1.059	-2%	
S1300-E160 A-C	S1300 Drift-E160	4-198	06/04/02	7.603	7.603	1.199	1.127	6%	
S1300-E120 A-C	S1300 Drift-E120	4-199	06/04/02	5.655	5.655	0.885	0.872	1%	

[A] NA indicates insufficient data to calculate.

Table 4-1 (Continued)
Access Drifts Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent	Comments
			Date	Inches					
S1300-E24 A-C	S1300 Drift-E24	4-200	06/03/02	11.545	11.545	0.956	0.995	-4%	
S1300-W55 A-C	S1300 Drift-W55	4-201	06/03/02	8.197	8.197	1.096	1.026	7%	
S1300-W100-2 A-C	S1300 Drift-W100	4-202	06/03/02	11.883	18.403	1.539	1.344	15%	Temporarily blocked.
S1600-E170 A-C	S1600 Drift-E170	4-203	06/04/02	6.838	6.838	1.027	0.940	9%	
S1600-E110 A-C	S1600 Drift-E110	4-204	06/04/02	6.166	6.166	0.882	0.859	3%	
S1950-E113-4 A-C	S1950 Drift-E113	4-205	06/05/02	1.112	5.039	0.642	0.628	2%	Reinstalled 9/00.
S1950-E281-3 A-C	S1950 Drift-E281	4-206	06/06/02	4.139	10.708	1.041	1.163	-10%	
S1950-E284-3 A-C	S1950 Drift-E284	4-207	06/06/02	4.132	10.771	1.047	1.132	-8%	
S2180-E55-2 A-C	S2180 Drift-E55	4-208	06/03/02	2.095	2.415	1.213	1.275	-5%	Reinstalled 10/00.
S2180-E55 B-D	S2180 Drift-E55	4-208	06/03/02	1.933	1.933	0.978	1.086	-10%	
S2180-E220 A-C	S2180 Drift-E220	4-209	06/05/02	2.341	2.341	1.254	1.315	-5%	
S2180-E220 B-D	S2180 Drift-E220	4-209	06/05/02	2.348	2.348	1.199	1.280	-6%	
S2180-W100-2 A-C	S2180 Drift-W100	4-210	06/03/02	2.936	3.085	1.516	1.658	-9%	
S2180-W100-2 B-D	S2180 Drift-W100	4-210	06/03/02	2.019	2.205	1.001	1.127	-11%	
S2520-E55 A-C	S2520 Drift-E55	4-211	06/03/02	4.996	4.996	1.744	2.274	-23%	
S2520-E55 B-D	S2520 Drift-E55	4-211	06/03/02	4.882	4.882	1.747	2.168	-19%	
S2520-E220 A-C	S2520 Drift-E220	4-212	06/05/02	4.684	4.684	1.733	2.307	-25%	
S2520-E220 B-D	S2520 Drift-E220	4-212	06/05/02	4.489	4.489	1.801	2.218	-19%	
S2520-W100 A-C	S2520 Drift-W100	4-213	04/02/02	4.419	4.419	1.452	2.260	-36%	Temporarily blocked.
S2520-W100 B-D	S2520 Drift-W100	4-213	04/02/02	4.160	4.160	1.315	2.138	-38%	Temporarily blocked.

Table 4-1 (Continued)
Access Drifts Data Analysis

JOINT METERS

Field Tag	Location	Figure Number	Date of Last Reading	Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent	Comments
51X-CG-02703	S1950-E300 Overcast-NE	4-214	6/24/02	0.494	0.029	0.029	0%	
51X-CG-02706	S1950-E300 Overcast-SW	4-214	6/24/02	0.923	0.062	0.063	-2%	
51X-CG-02707	S1950-E300 Overcast-NW	4-214	6/24/02	0.944	0.069	0.063	10%	
51X-CG-02708	S1950-E300 Overcast-SE	4-214	6/24/02	0.540	0.039	0.036	8%	

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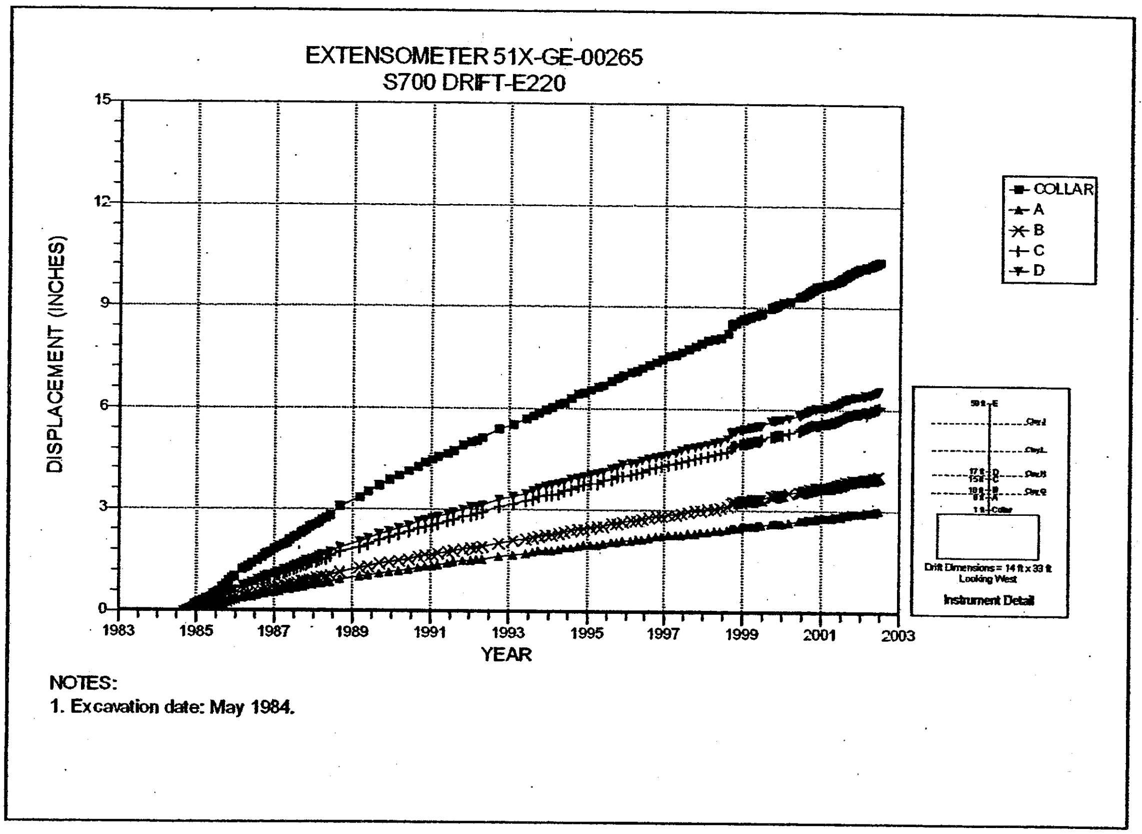


**Figure 4-1 Extensometer 51X-GE-00265
S700 Drift at E220 – Roof**

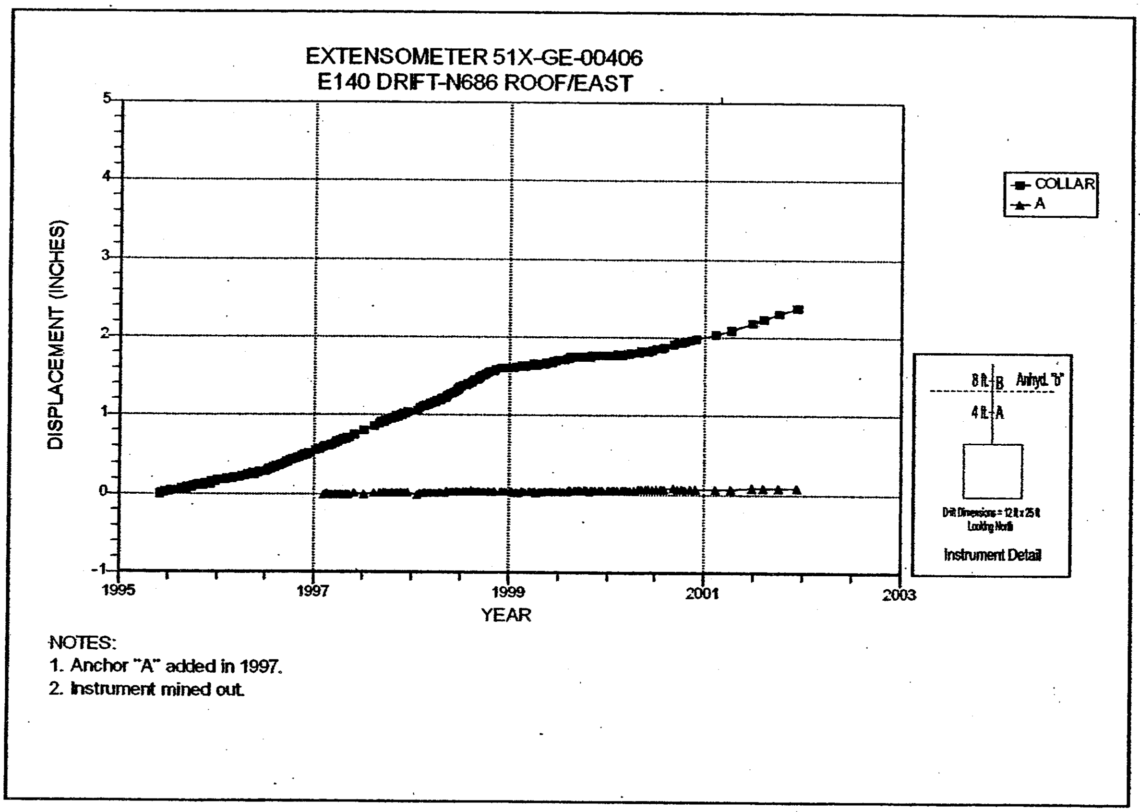
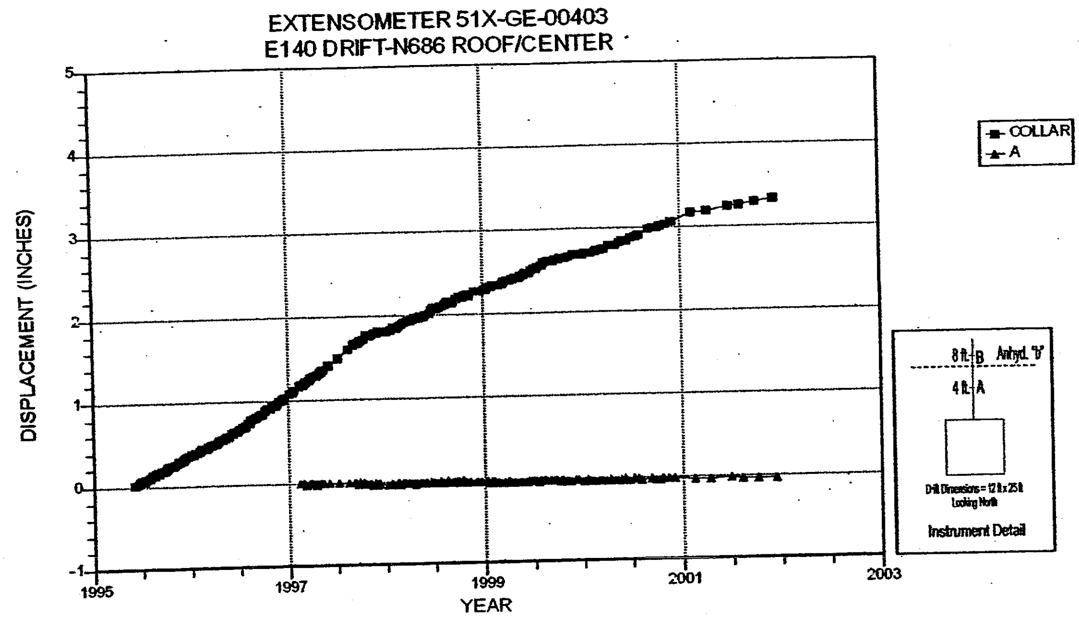
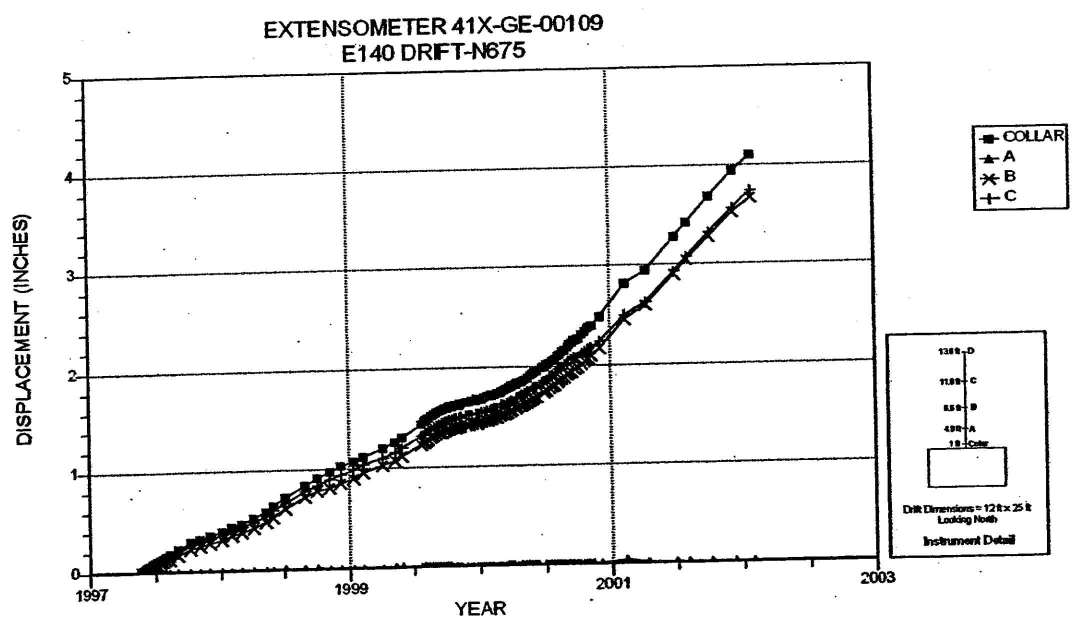


**Figure 4-2 Extensometer 51X-GE-00406
E140 Drift at N686 – Roof/East**



NOTES:
1. Anchor "A" added in 1997.
2. Instrument mined out.

Figure 4-3 Extensometer 51X-GE-00403
E140 Drift at N686 – Roof/Center



NOTES:
1. Excavation date: February 1983.
2. Instrument mined out.

Figure 4-4 Extensometer 41X-GE-00109
E140 Drift at N675 – Roof

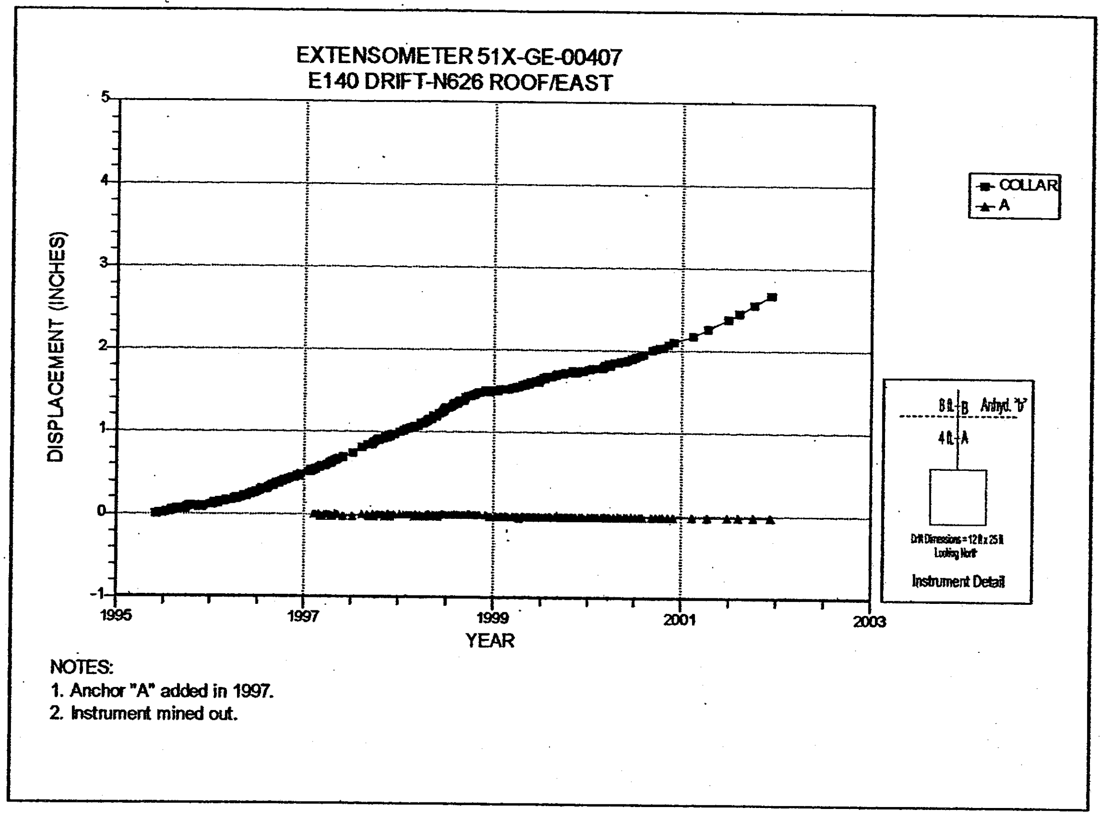


Figure 4-5 Extensometer 51X-GE-00407
E140 Drift at N626 – Roof/East

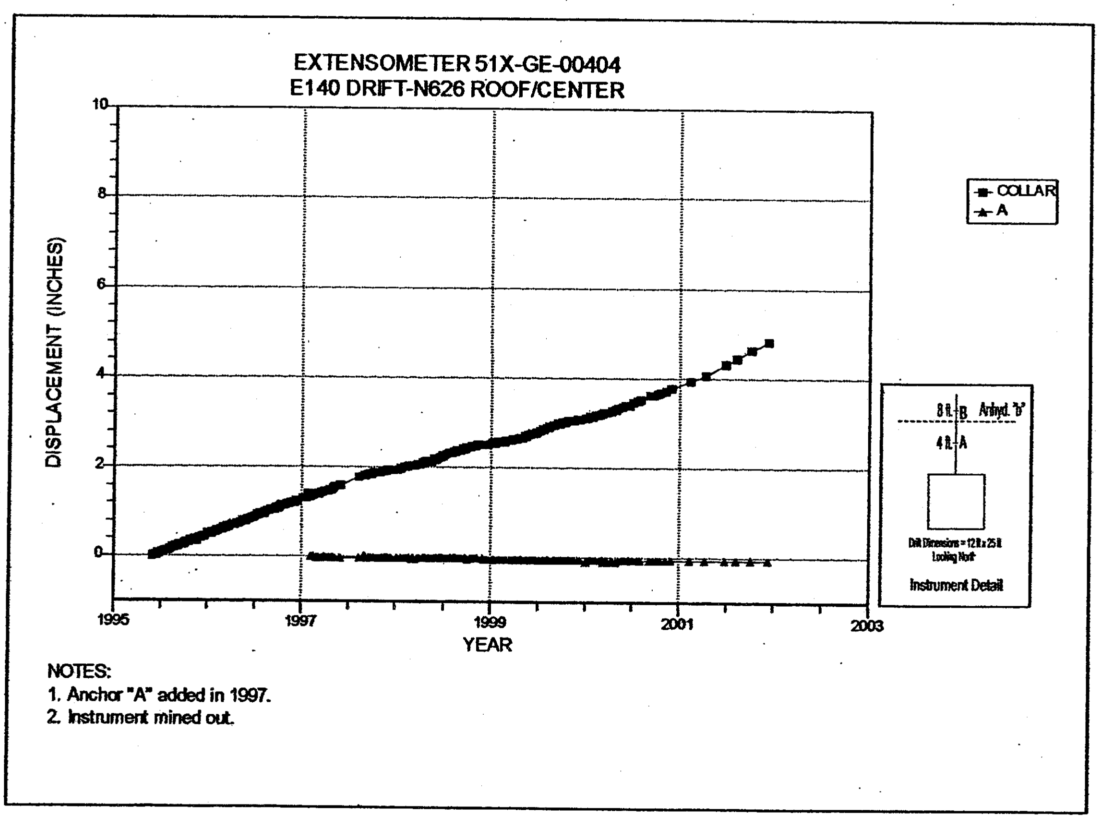
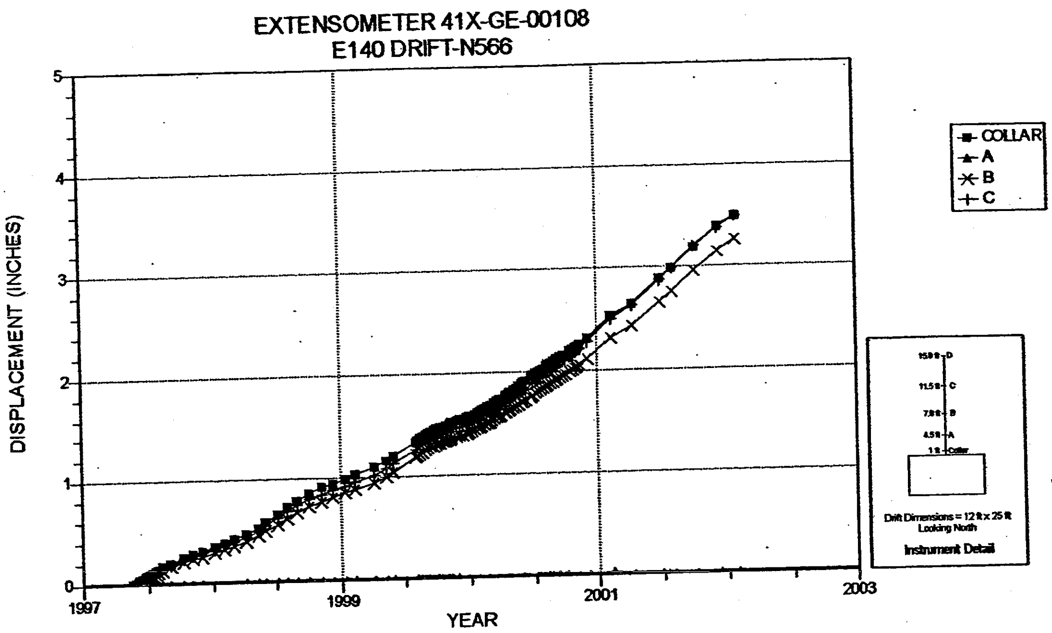
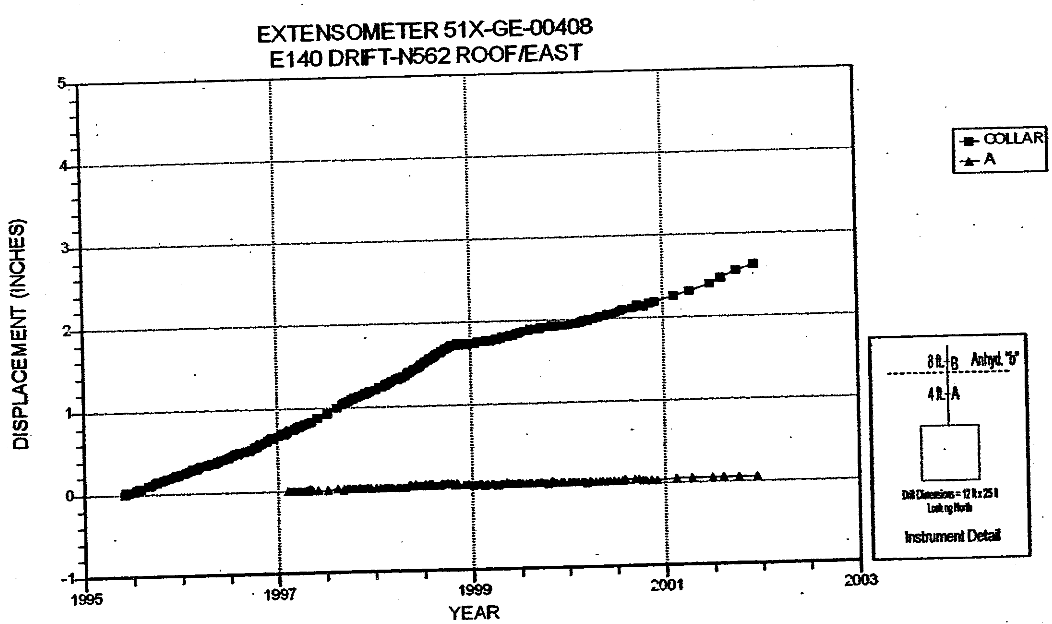


Figure 4-6 Extensometer 51X-GE-00404
E140 Drift at N626 – Roof/Center



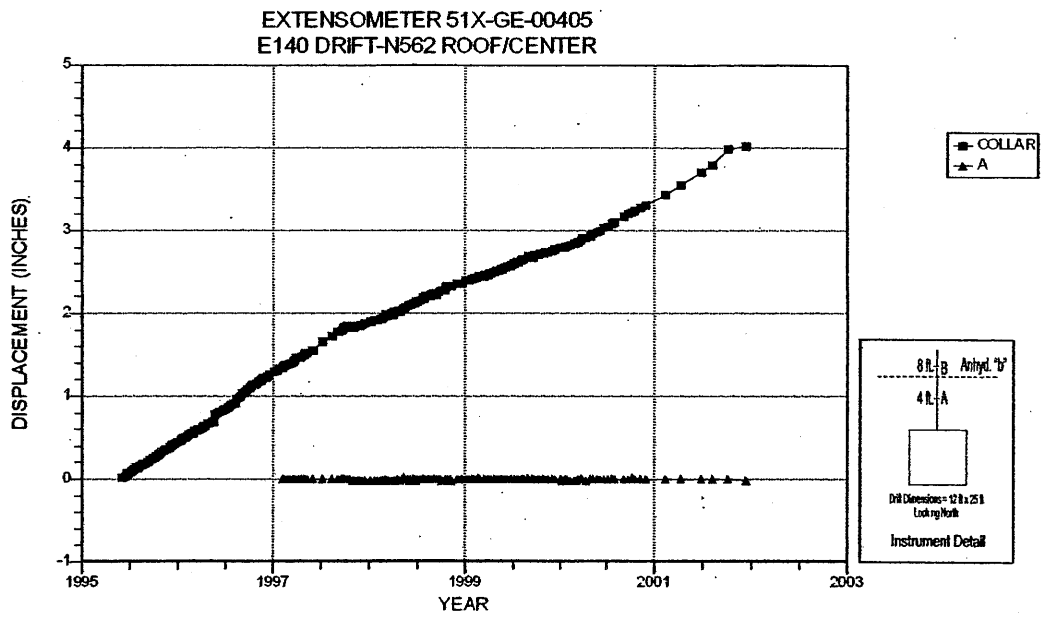
NOTES:
1. Excavation date: February 1983.
2. Instrument mined out.

Figure 4-7 Extensometer 41X-GE-00108
E140 Drift at N566 – Roof



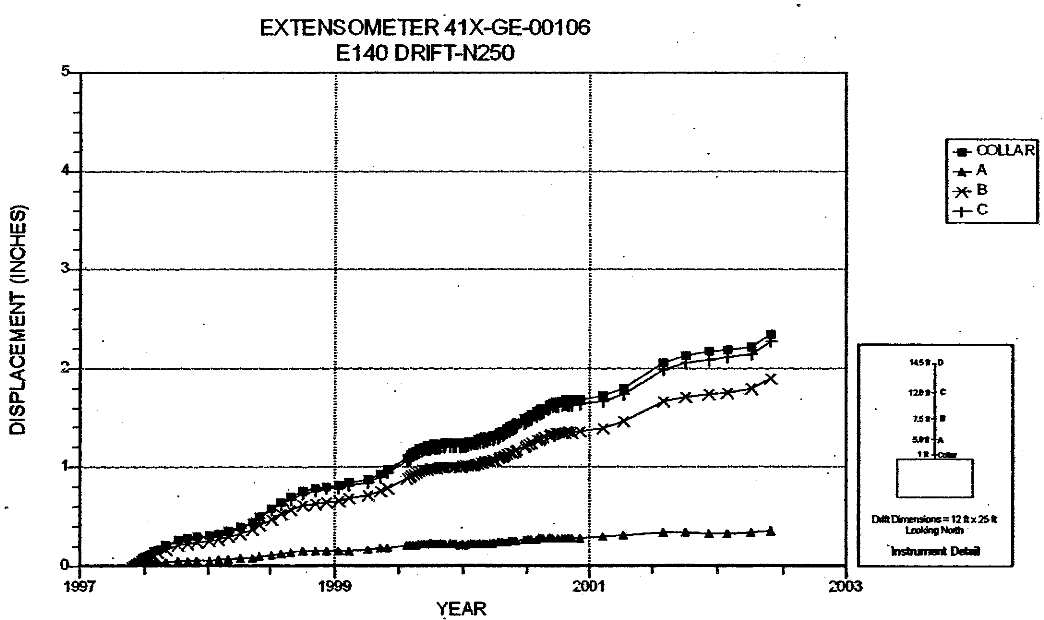
NOTES:
1. Anchor "A" added in 1997.
2. Instrument mined out.

Figure 4-8 Extensometer 51X-GE-00408
E140 Drift at N562 – Roof/East



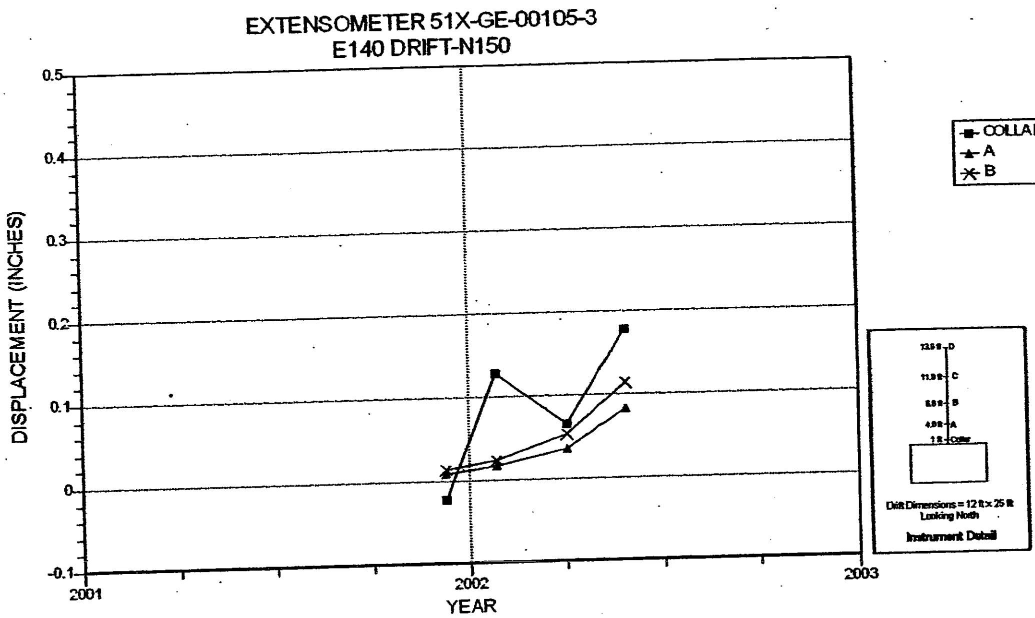
NOTES:
1. Anchor "A" added in 1997.
2. Instrument mined out.

Figure 4-9 Extensometer 51X-GE-00405
E140 Drift at N562 – Roof/Center



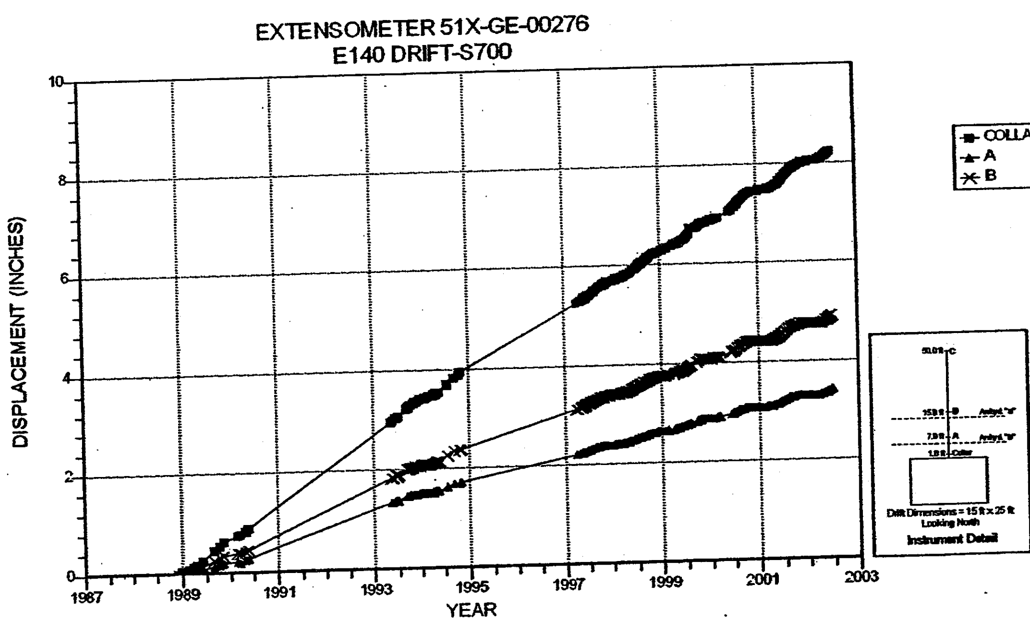
NOTES:
1. Excavation date: November 1982.

Figure 4-10 Extensometer 41X-GE-00106
E140 Drift at N250 – Roof



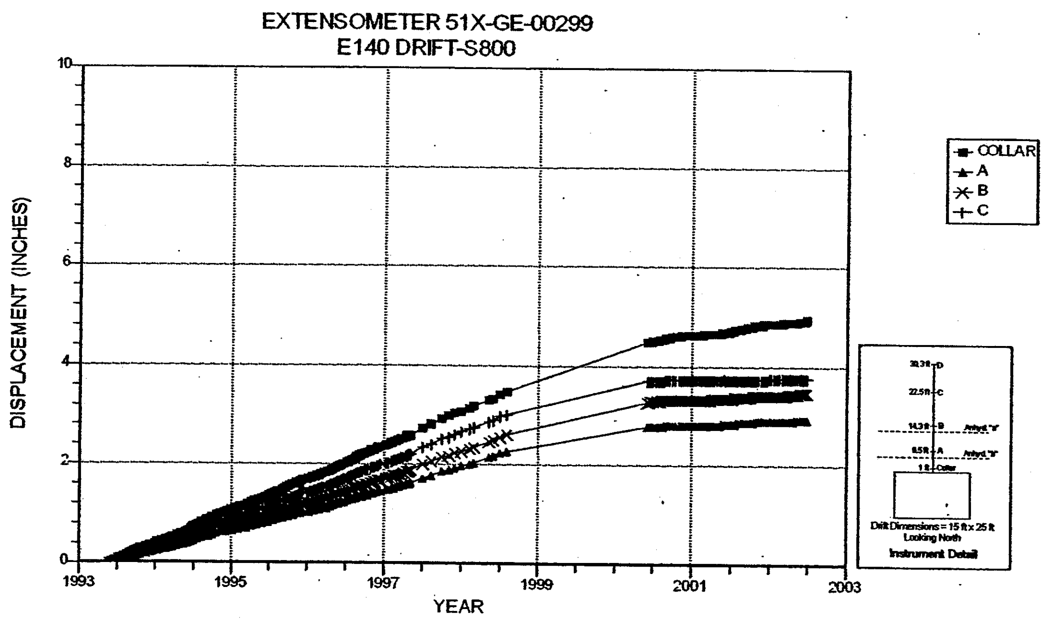
NOTES:
1. Excavation date: November 1982
2. Replaced head July. 26, 1999
3. Replaced head October. 18, 2001

Figure 4-11 Extensometer 51X-GE-00105-3
E140 Drift at N150 – Roof



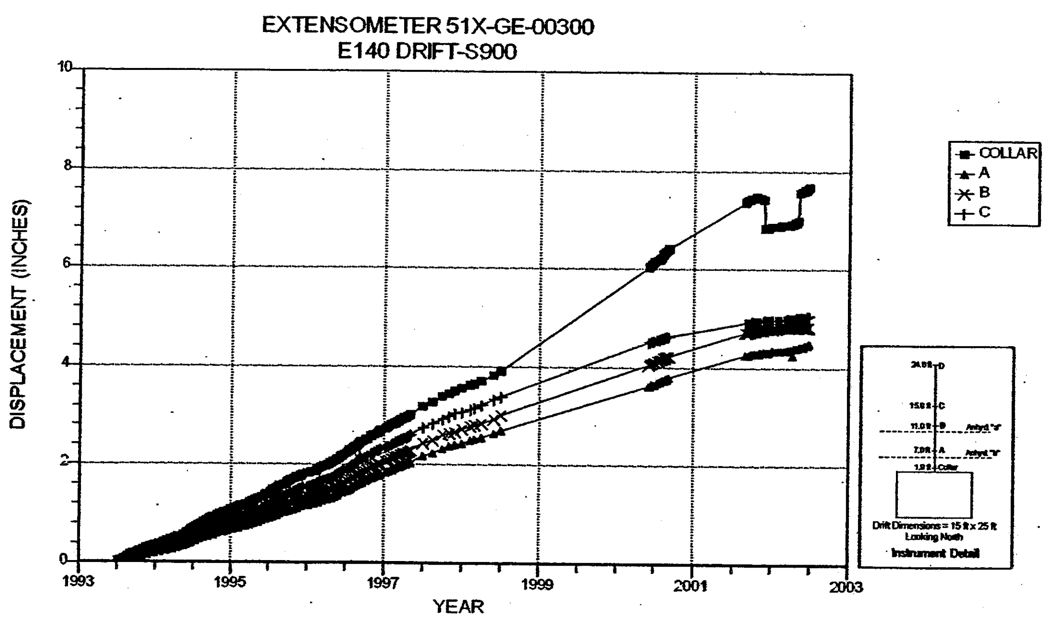
NOTES:
1. Excavation date: December 1982

Figure 4-12 Extensometer 51X-GE-00276
E140 Drift at S700 Drift Intersection – Roof



NOTES:
1. Excavation date: December 1982

Figure 4-13 Extensometer 51X-GE-00299
E140 Drift at S800 – Roof



NOTES:
1. Excavation date: December 1982
2. Probable instrument malfunction.

Figure 4-14 Extensometer 51X-GE-00300
E140 Drift at S900 – Roof

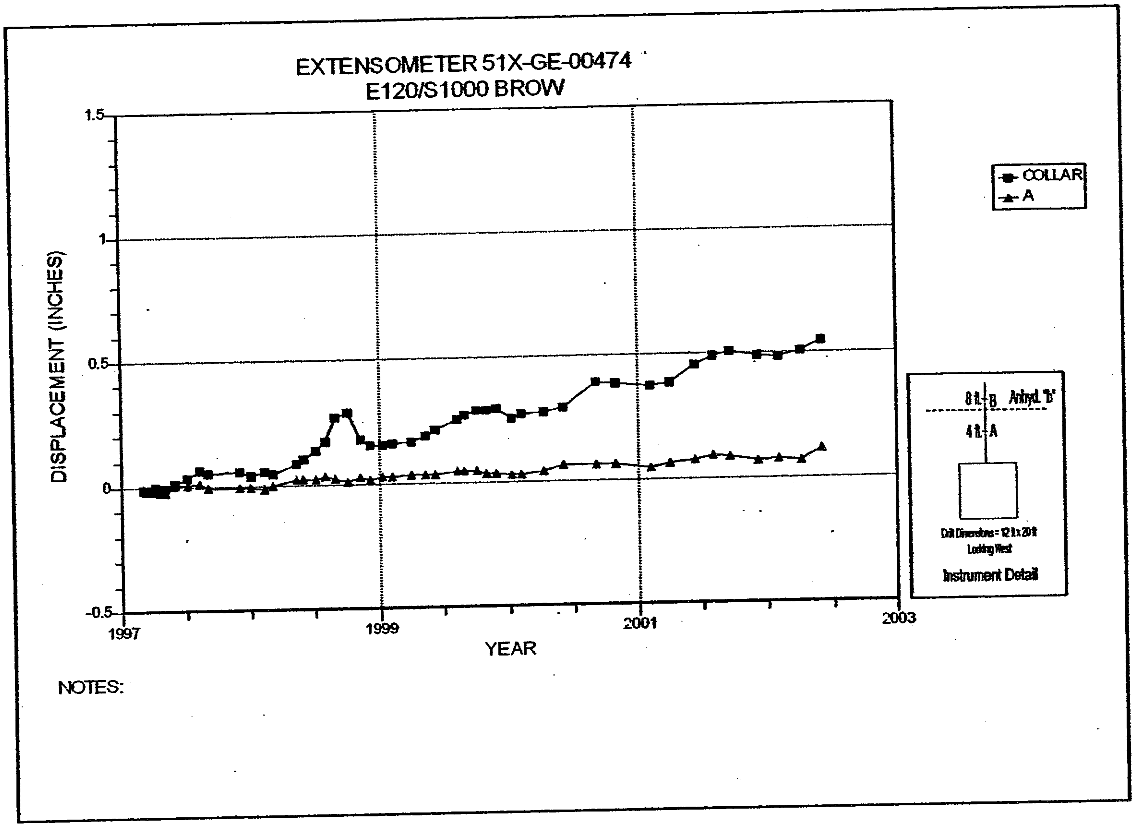


Figure 4-15 Extensometer 51X-GE-00474
E120 at S1000 – Roof

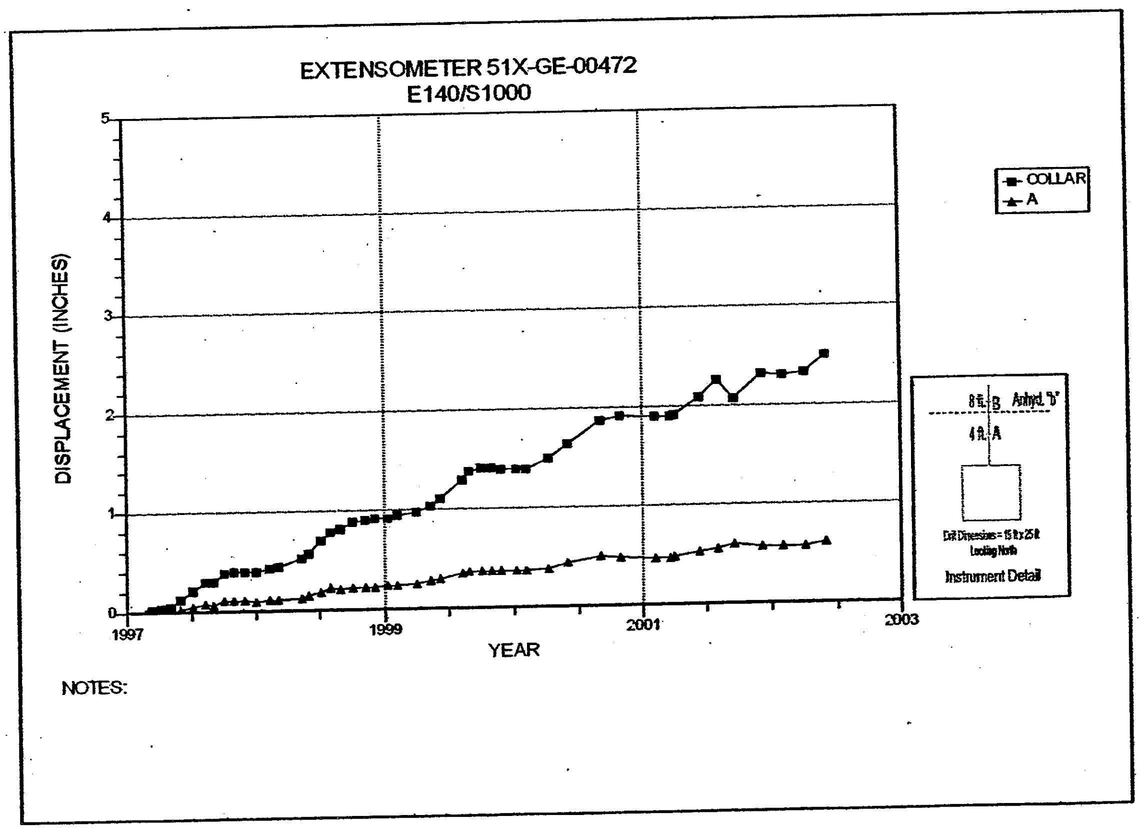


Figure 4-16 Extensometer 51X-GE-00472
E140 Drift at S1000 – Roof

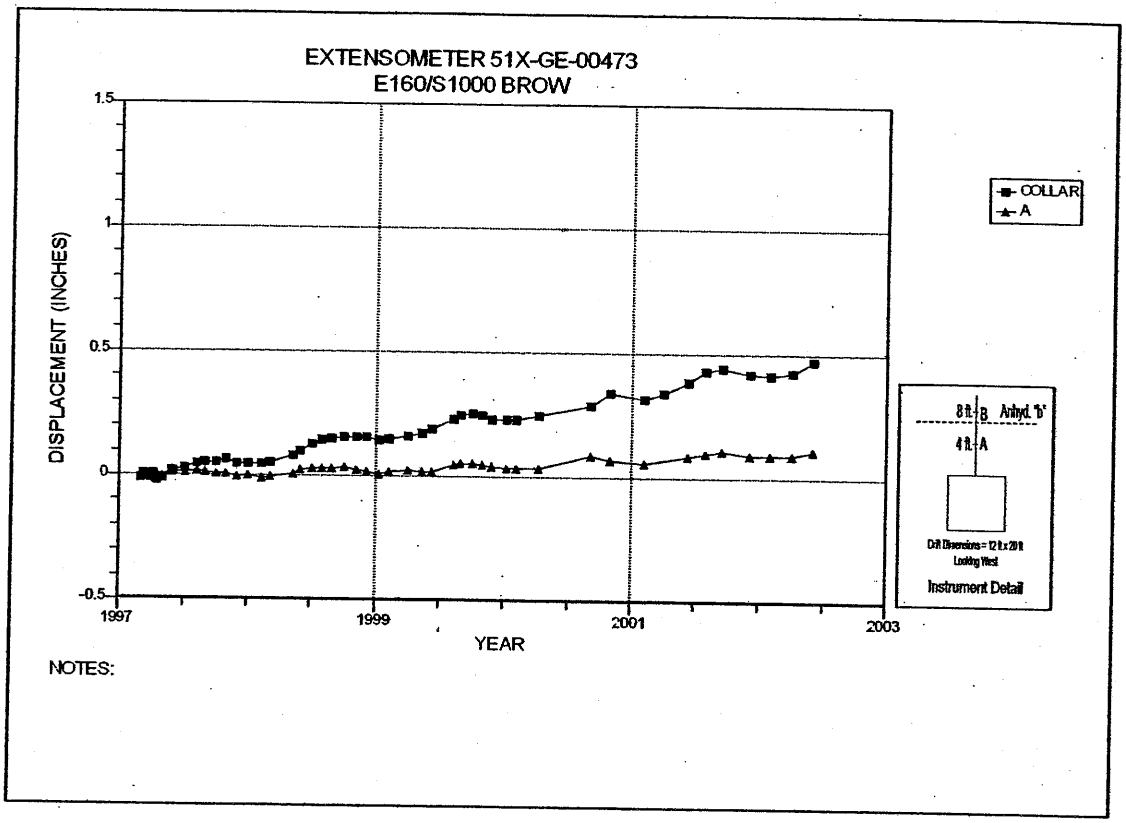


**Figure 4-17 Extensometer 51X-GE-00473
E160 at S1000 – Roof**

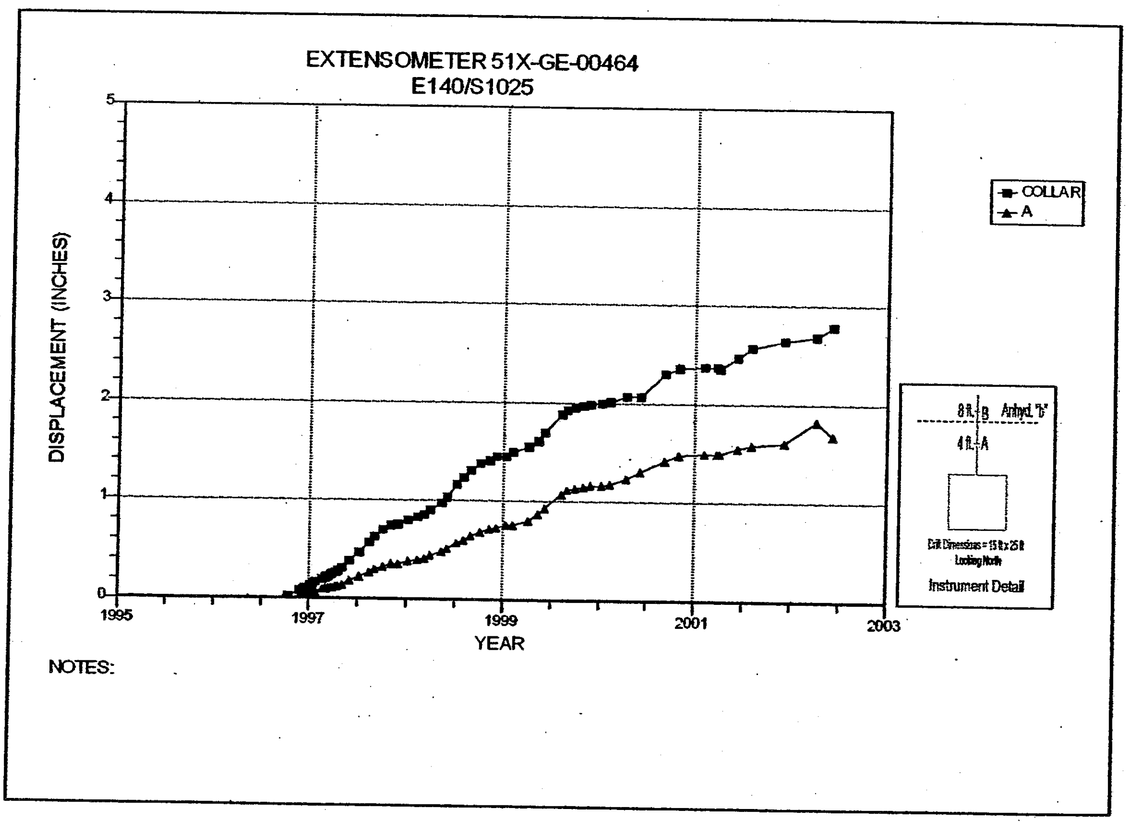
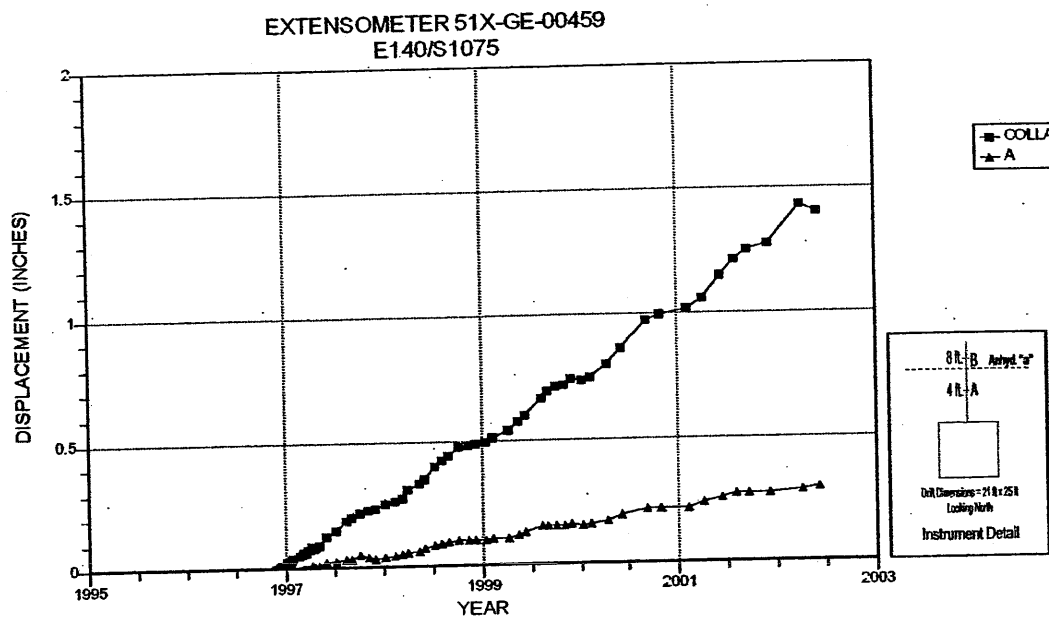
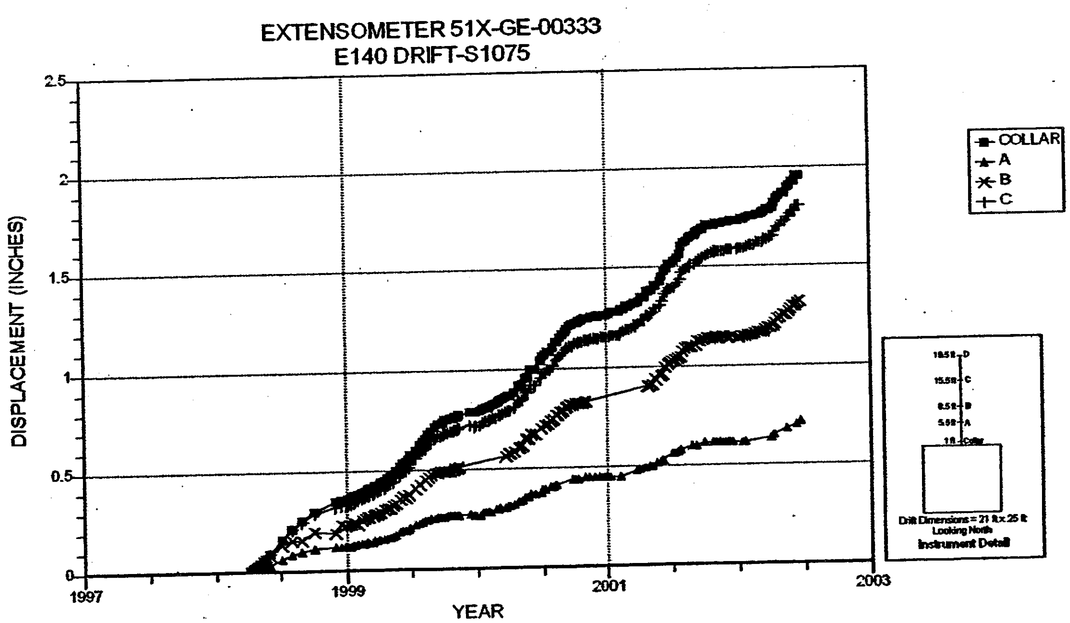


**Figure 4-18 Extensometer 51X-GE-00464
E140 Drift at S1025 – Roof**



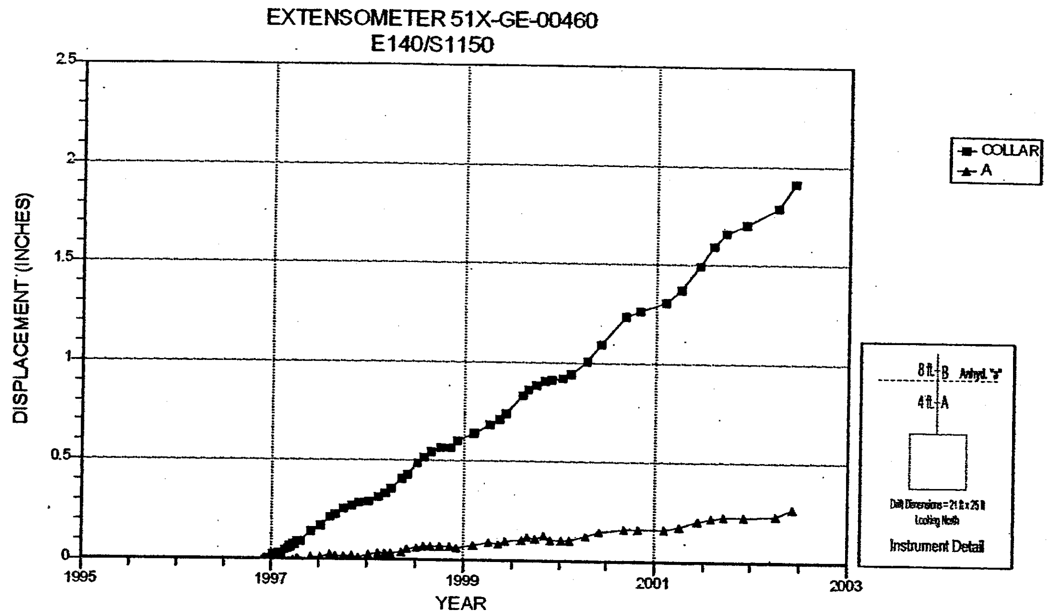
NOTES:

Figure 4-19 Extensometer 51X-GE-00459
E140 Drift at S1075 – Roof



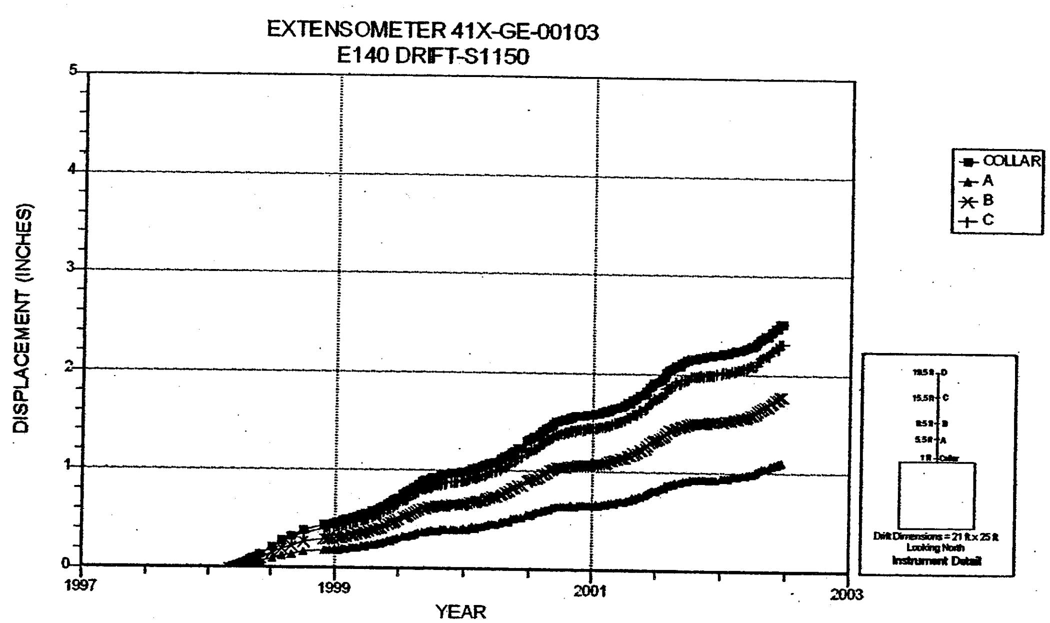
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-20 Extensometer 51X-GE-00333
E140 Drift at S1075 – Roof



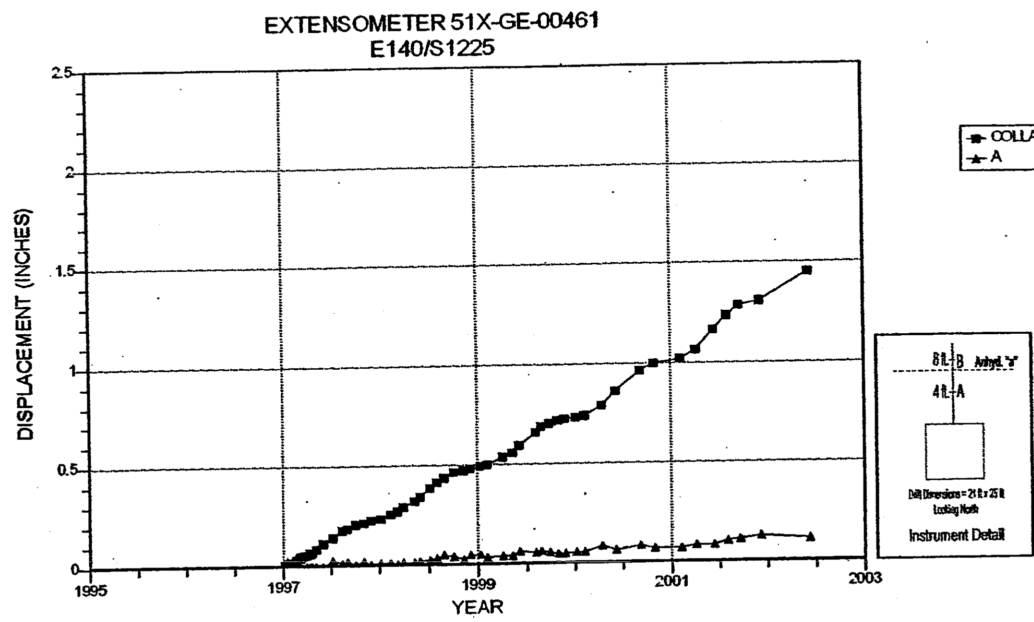
NOTES:

Figure 4-21 Extensometer 51X-GE-00460
E140 Drift at S1150 – Roof



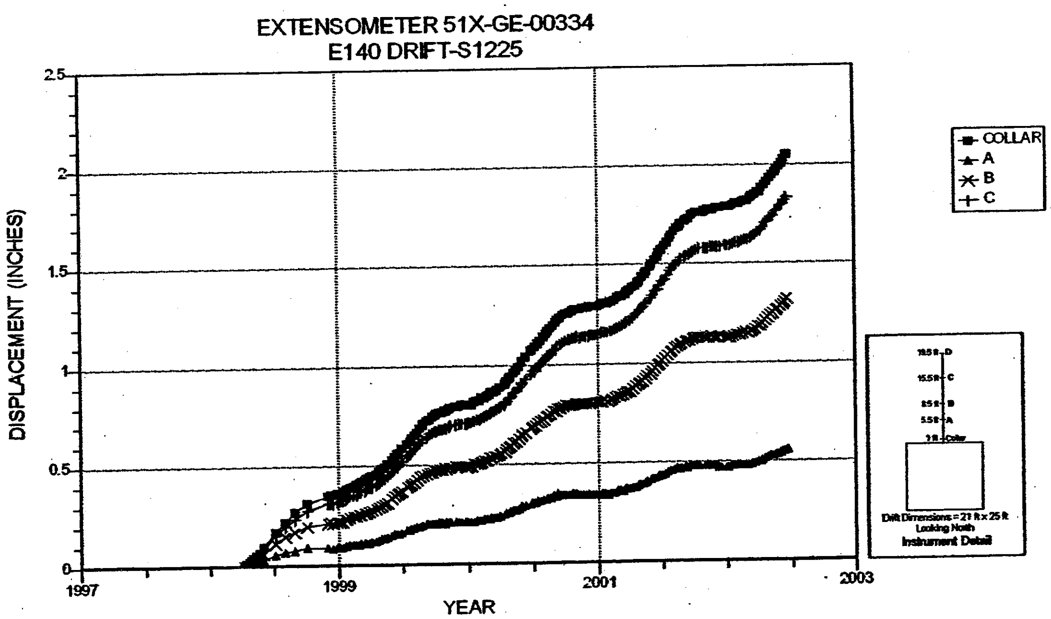
NOTES:
1. Excavation date: December 1982
2. Roof excavated to Anhydrite "b".

Figure 4-22 Extensometer 41X-GE-00103
E140 Drift at S1150 – Roof



NOTES:

Figure 4-23 Extensometer 51X-GE-00461
E140 Drift at S1225 – Roof



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-24 Extensometer 51X-GE-00334
E140 Drift at S1225 – Roof

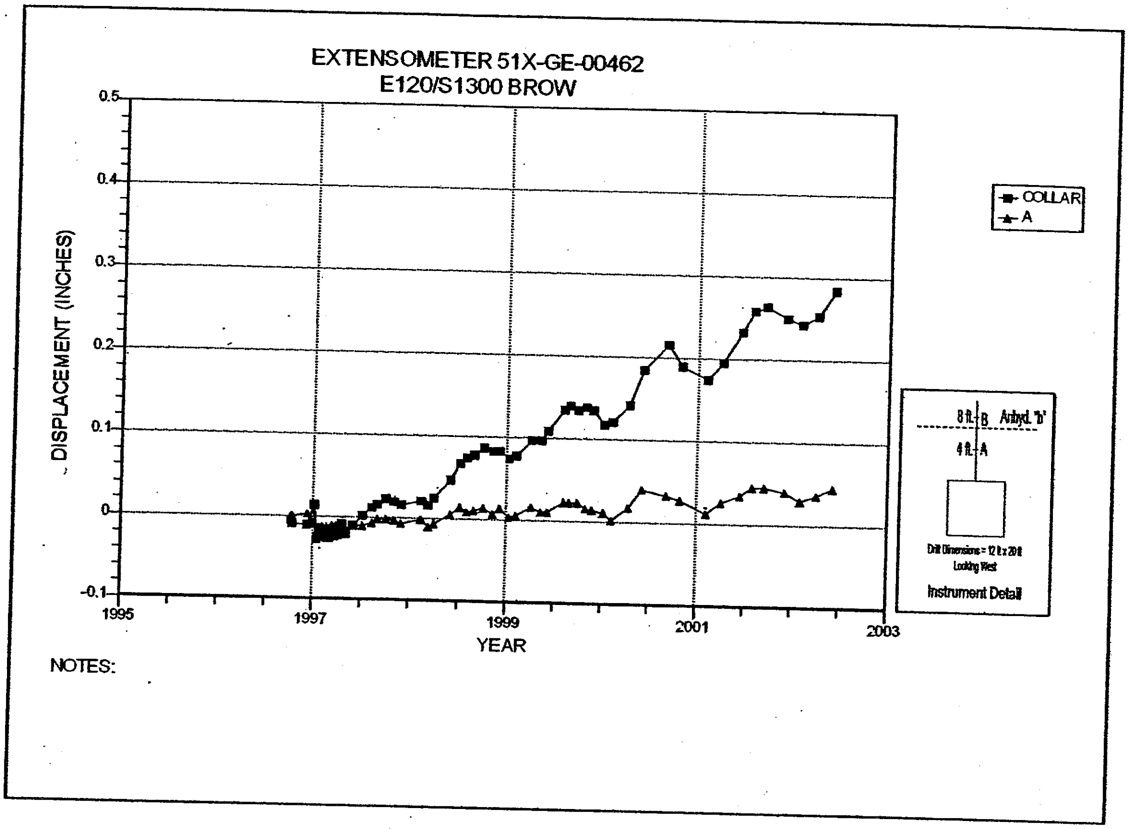


Figure 4-25 Extensometer 51X-GE-00462 E120 at S1300 – Roof

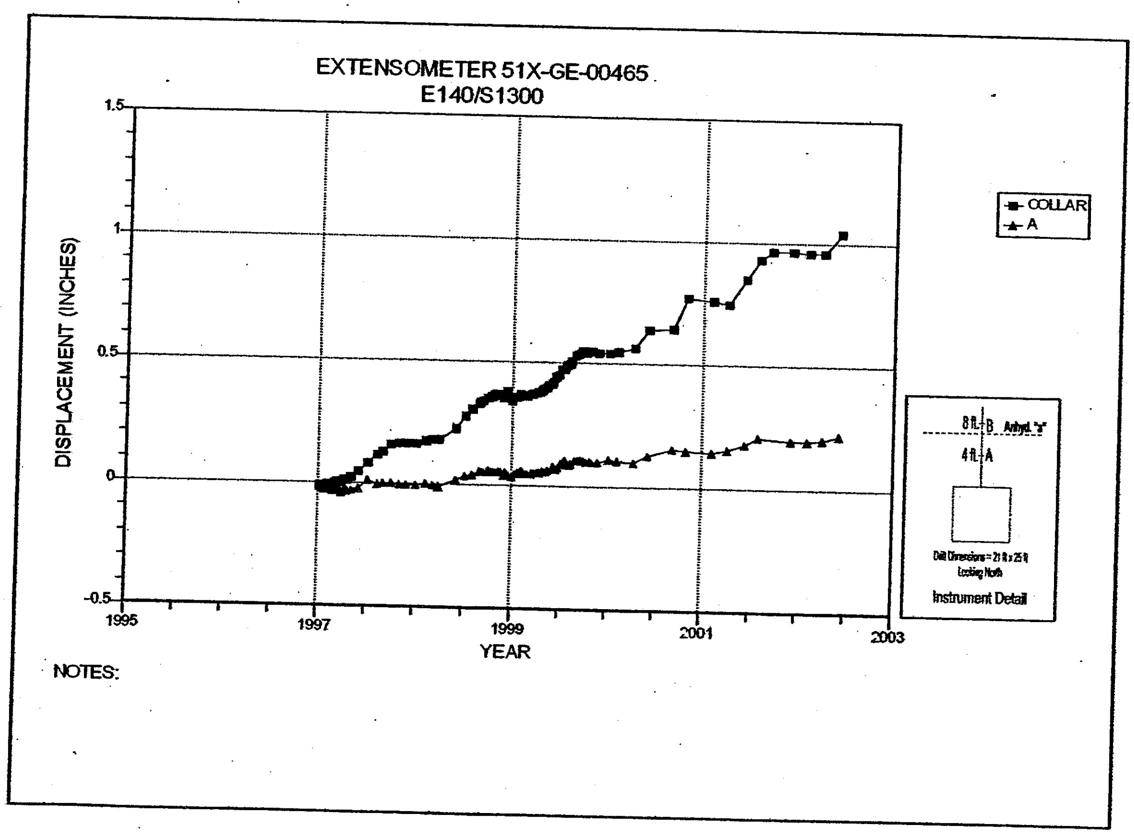
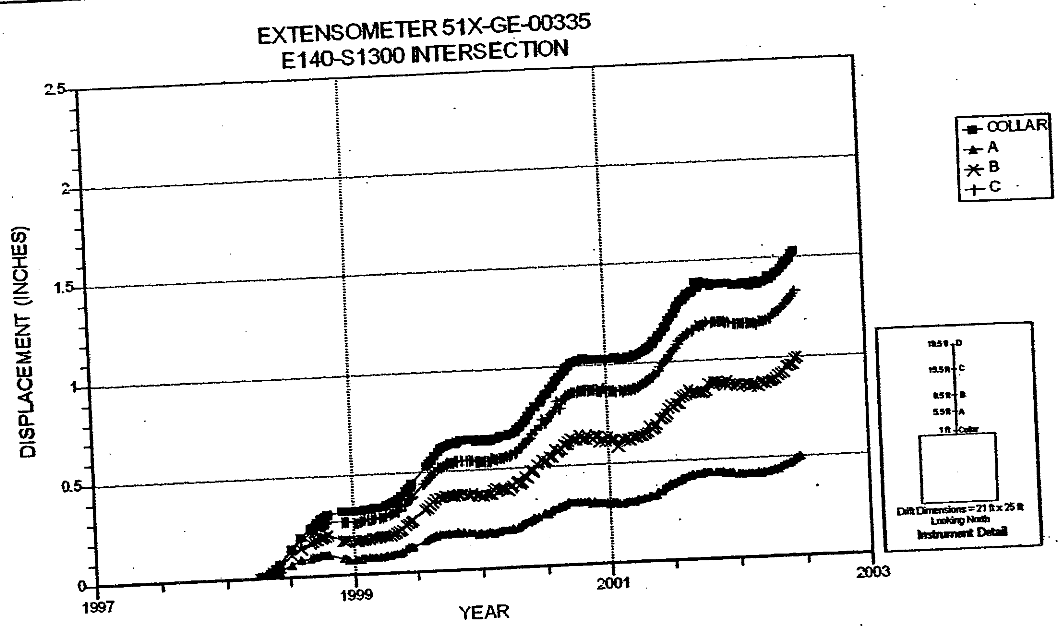
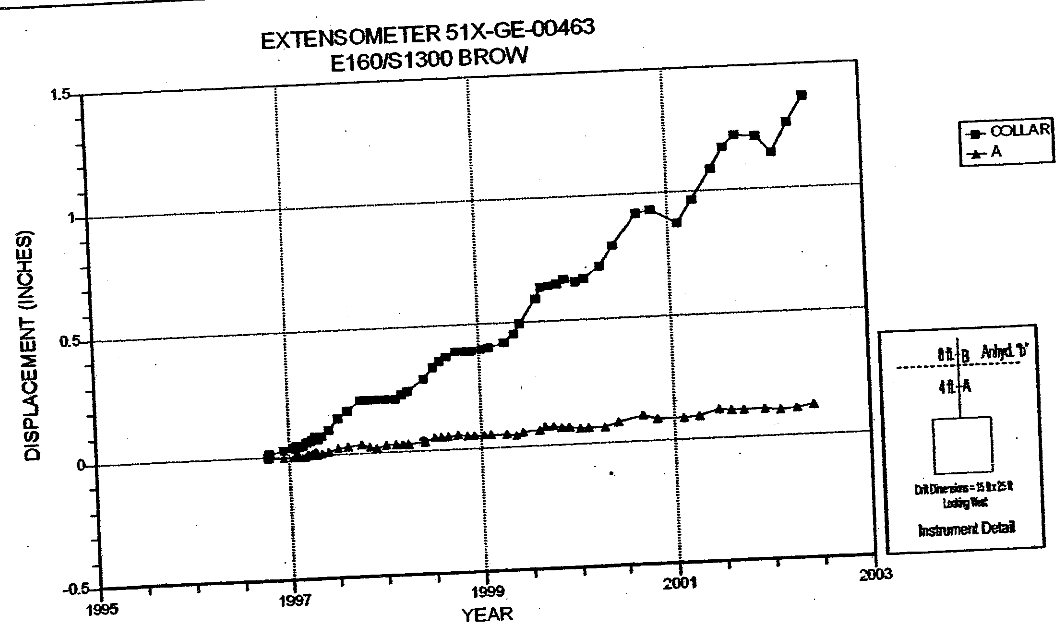


Figure 4-26 Extensometer 51X-GE-00465 E140 Drift at S1300 – Roof



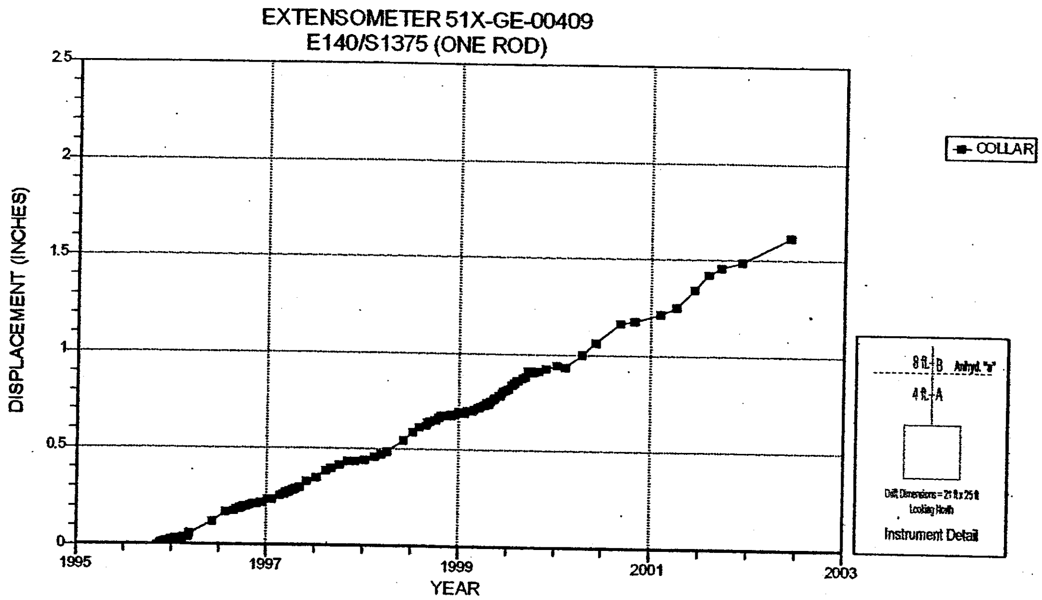
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-27 Extensometer 51X-GE-00335
E140 Drift at S1300 Drift Intersection – Roof



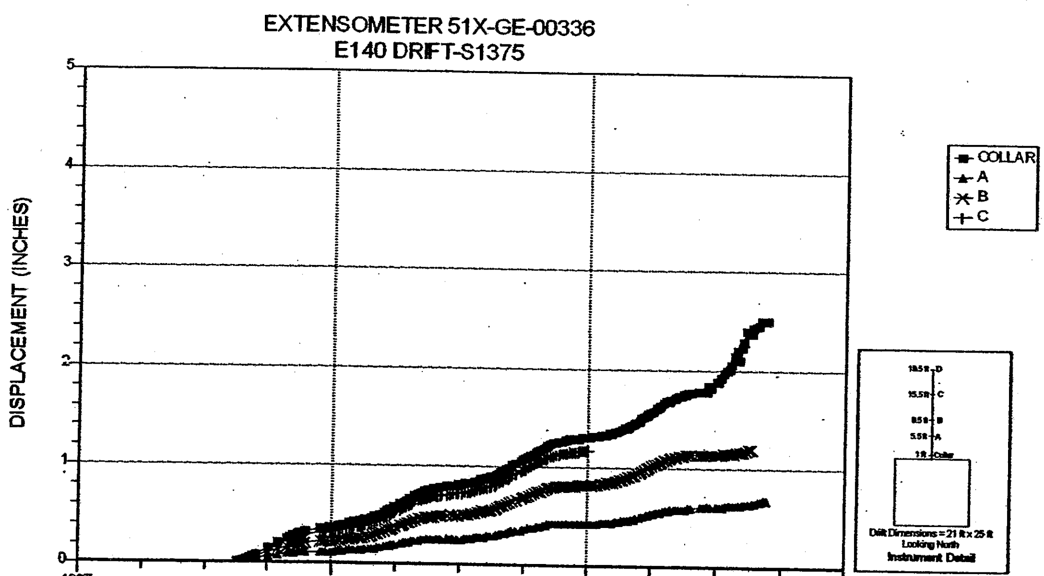
NOTES:

Figure 4-28 Extensometer 51X-GE-00463
E160 at S1300 – Roof



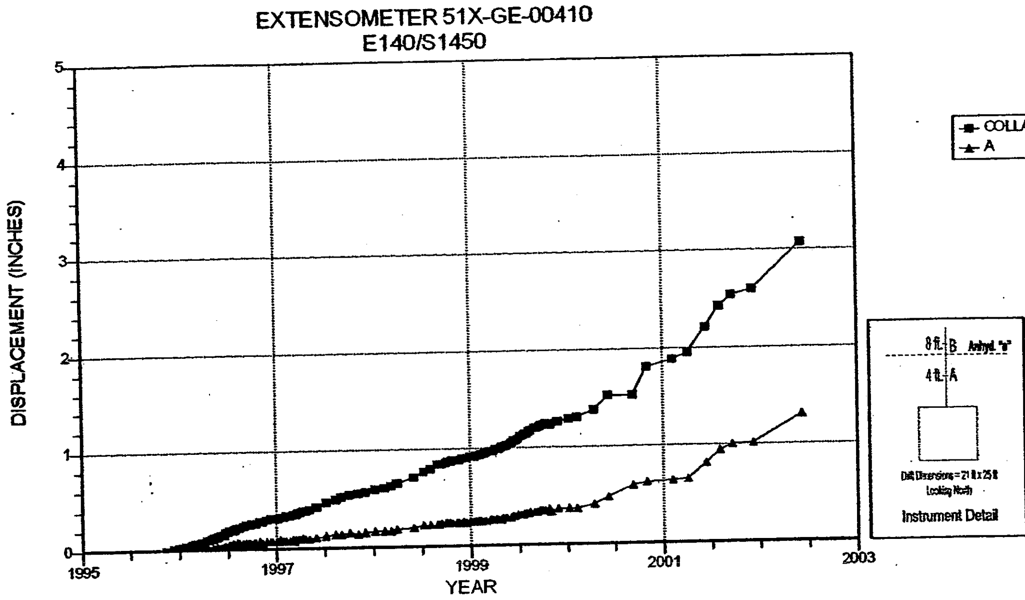
NOTES:

Figure 4-29 Extensometer 51X-GE-00409
E140 Drift at S1375 – Roof



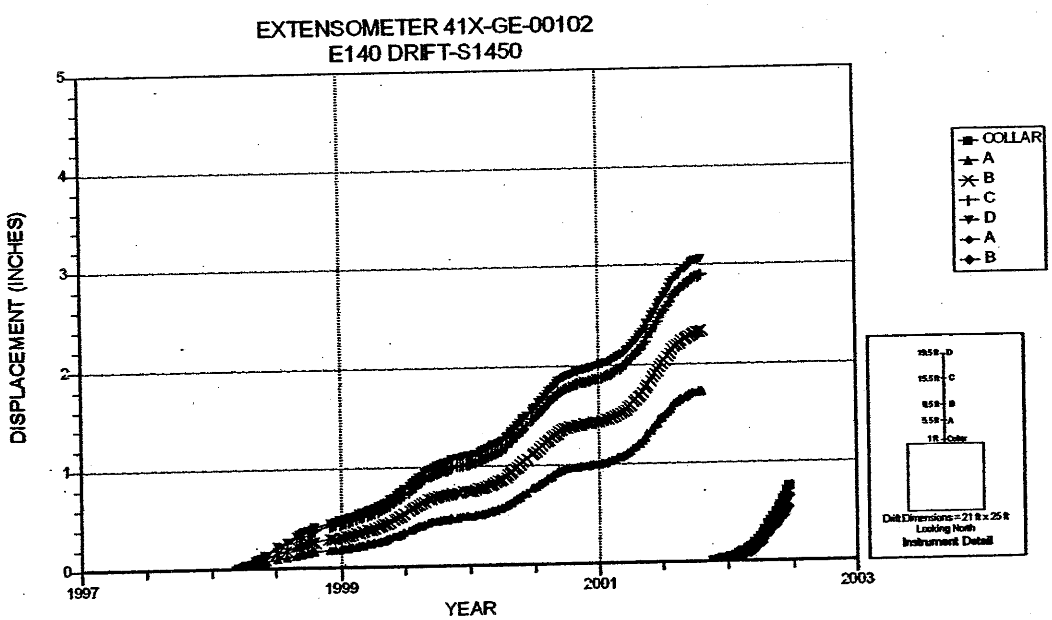
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Malfunction with Anchor "C".

Figure 4-30 Extensometer 51X-GE-00336
E140 Drift at S1375 – Roof



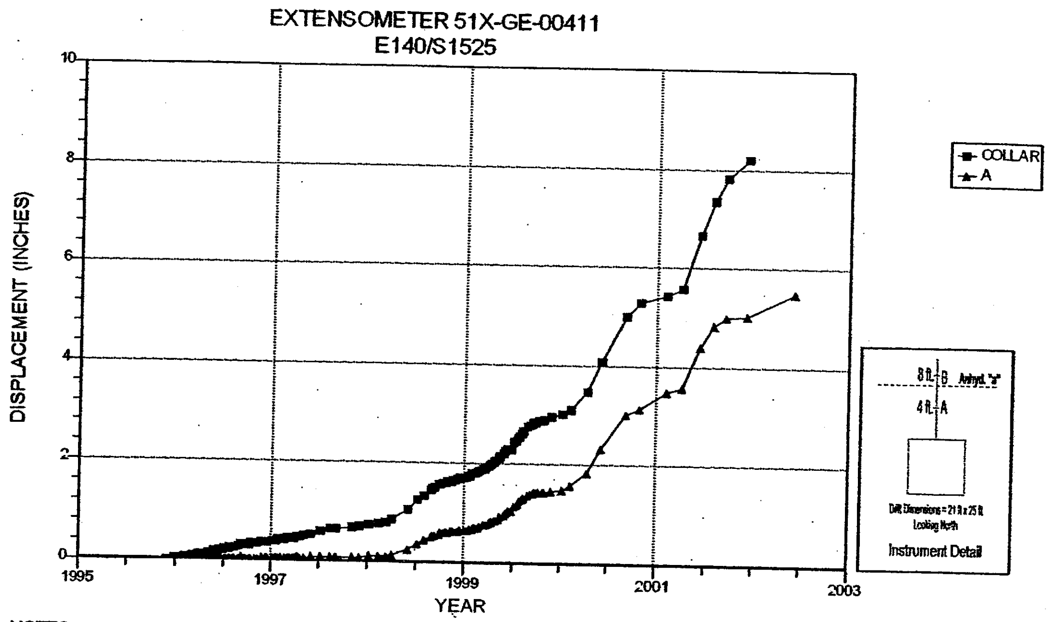
NOTES:

Figure 4-31 Extensometer 51X-GE-00410
E140 Drift at S1450 – Roof



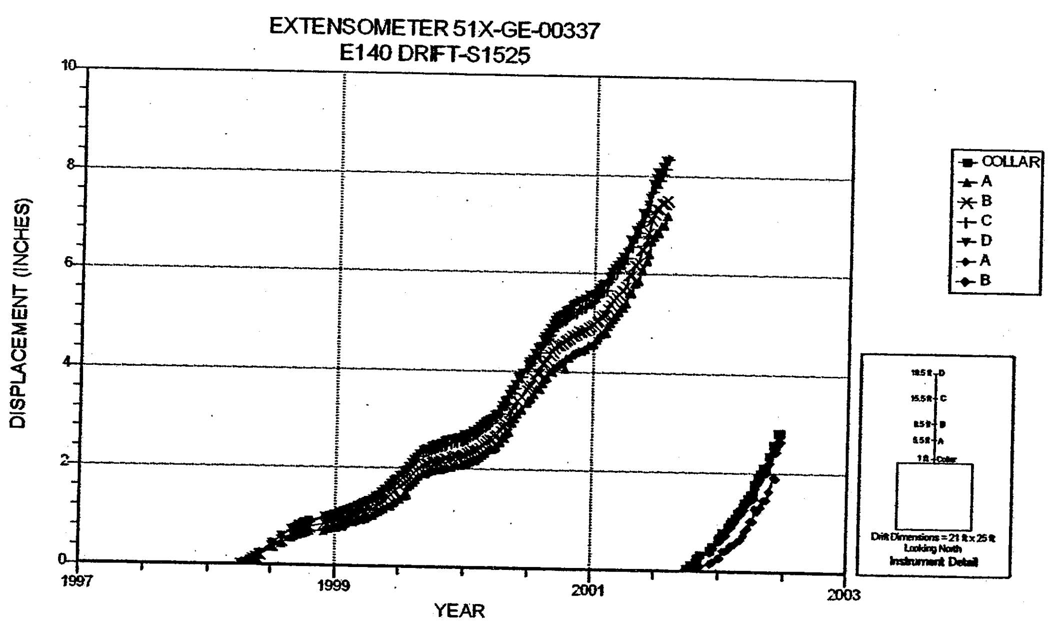
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Instrument repaired November 2001.
4. Rod C broken.

Figure 4-32 Extensometer 41X-GE-00102
E140 Drift at S1450 – Roof



NOTES:

Figure 4-33 Extensometer 51X-GE-00411
E140 Drift at S1525 – Roof



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Instrument repaired October 2001.
4. Rod C broken.

Figure 4-34 Extensometer 51X-GE-00337
E140 Drift at S1525 – Roof

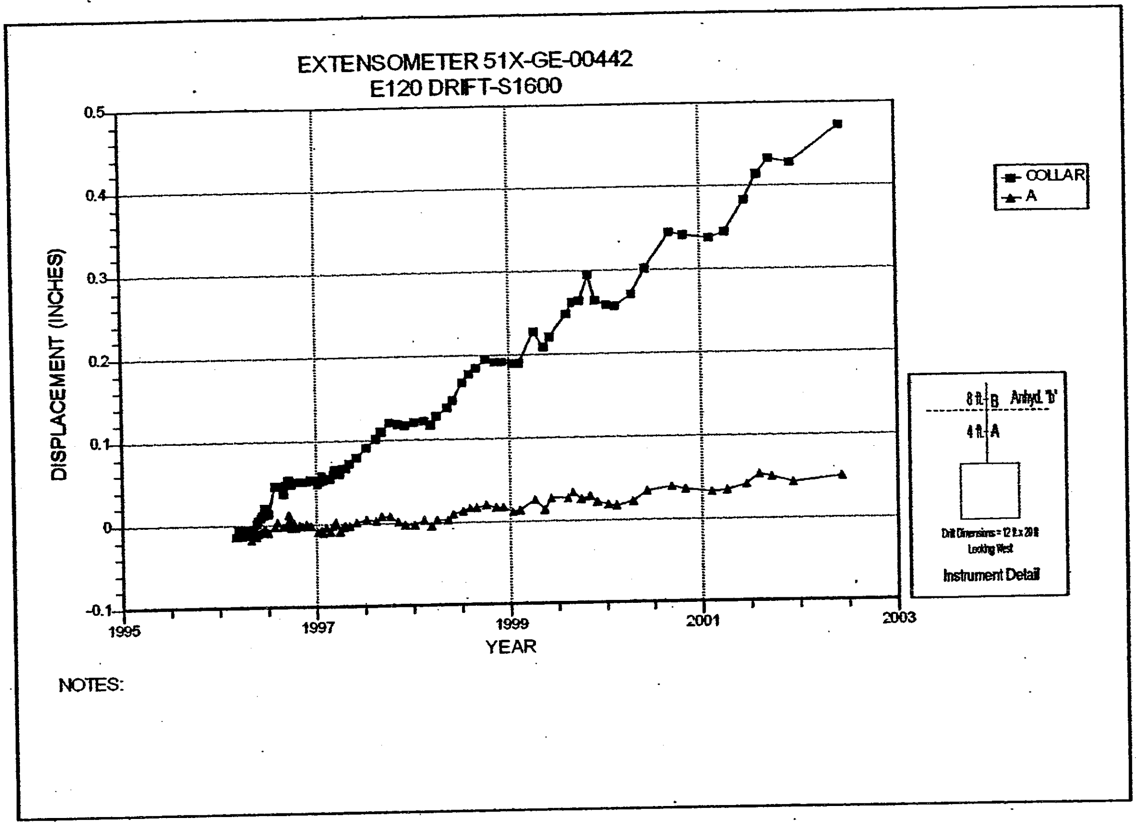


Figure 4-35 Extensometer 51X-GE-00442
E120 at S1600 – Roof

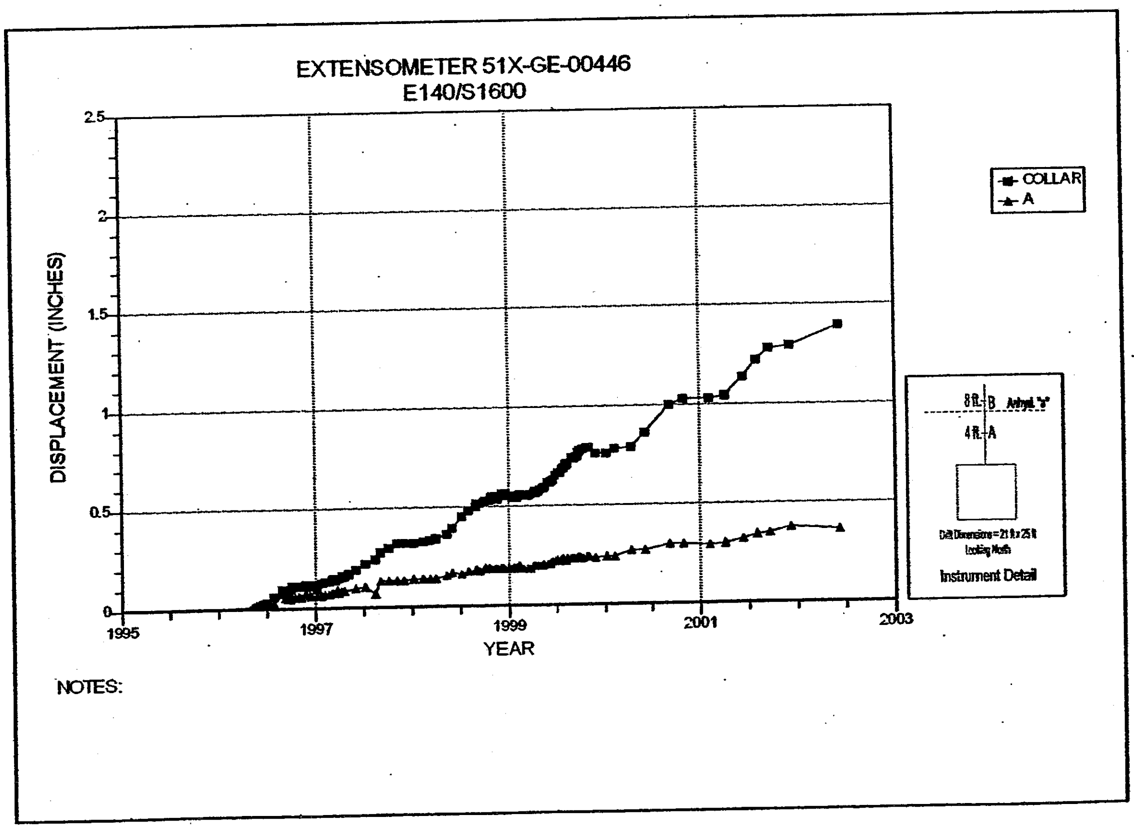
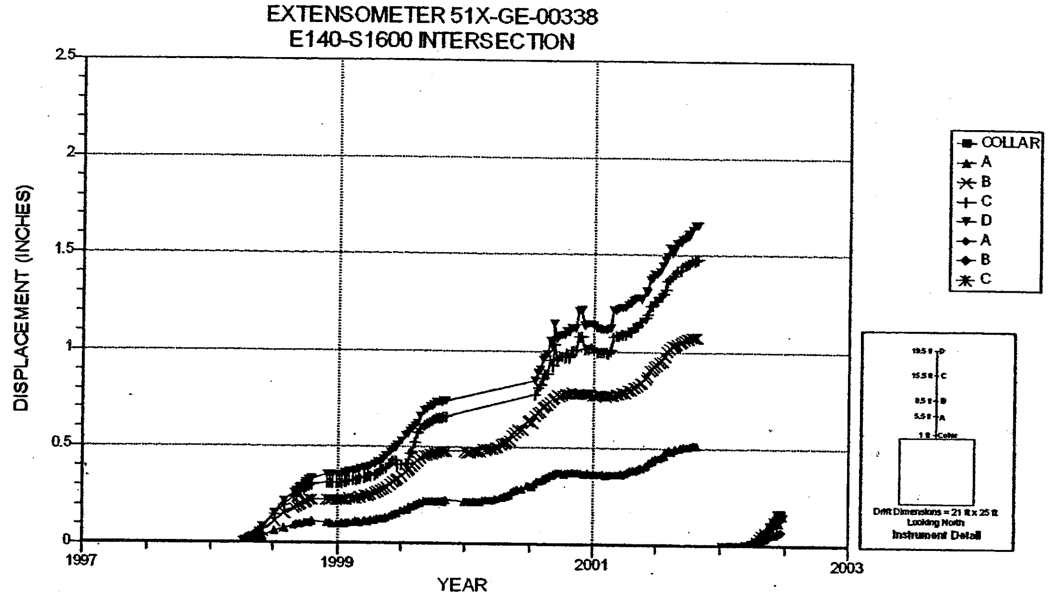
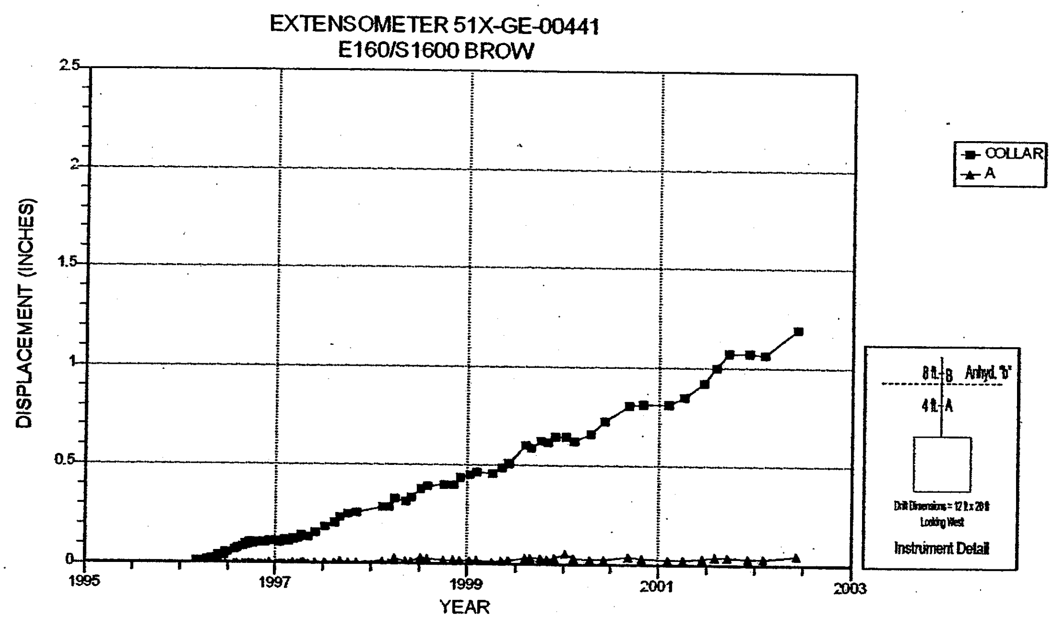


Figure 4-36 Extensometer 51X-GE-00446
E140 Drift at S1600 – Roof



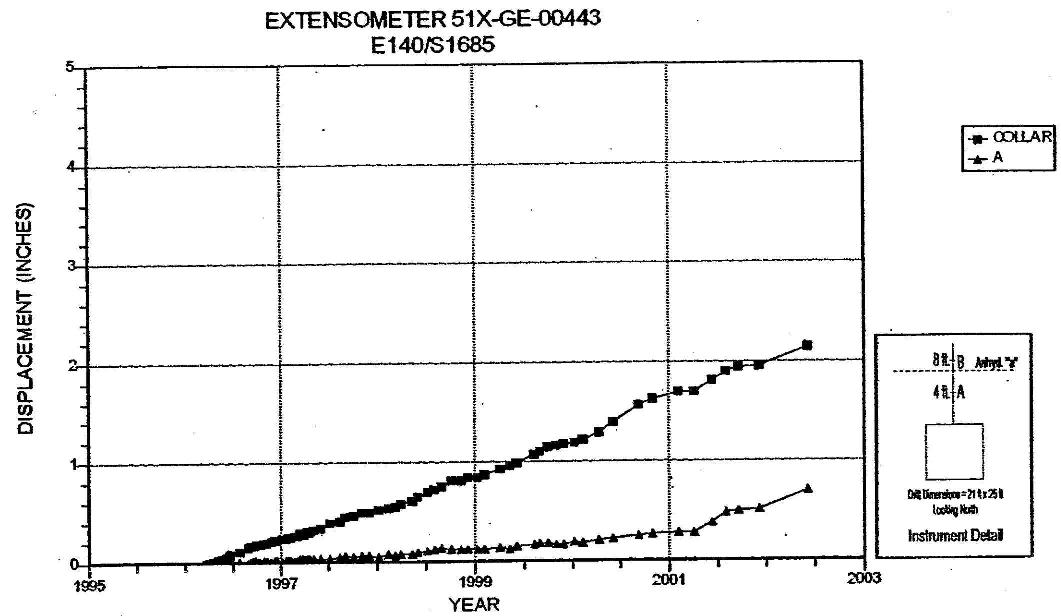
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Instrument repaired January 2002.

Figure 4-37 Extensometer 51X-GE-00338
E140 Drift at S1600 Drift Intersection – Roof



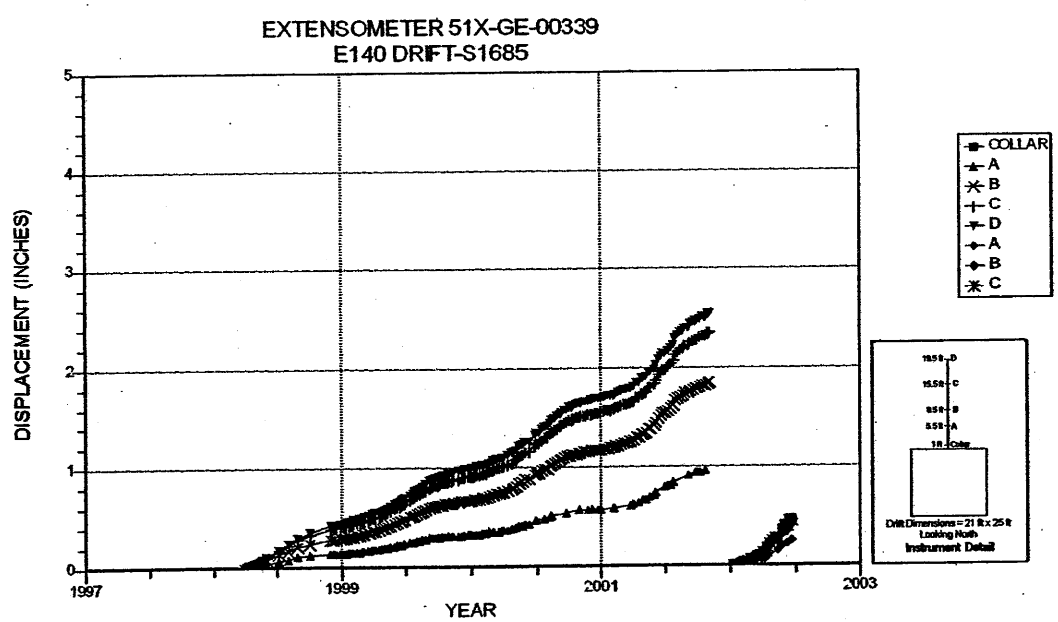
NOTES:

Figure 4-38 Extensometer 51X-GE-00441
E160 at S1600 – Roof



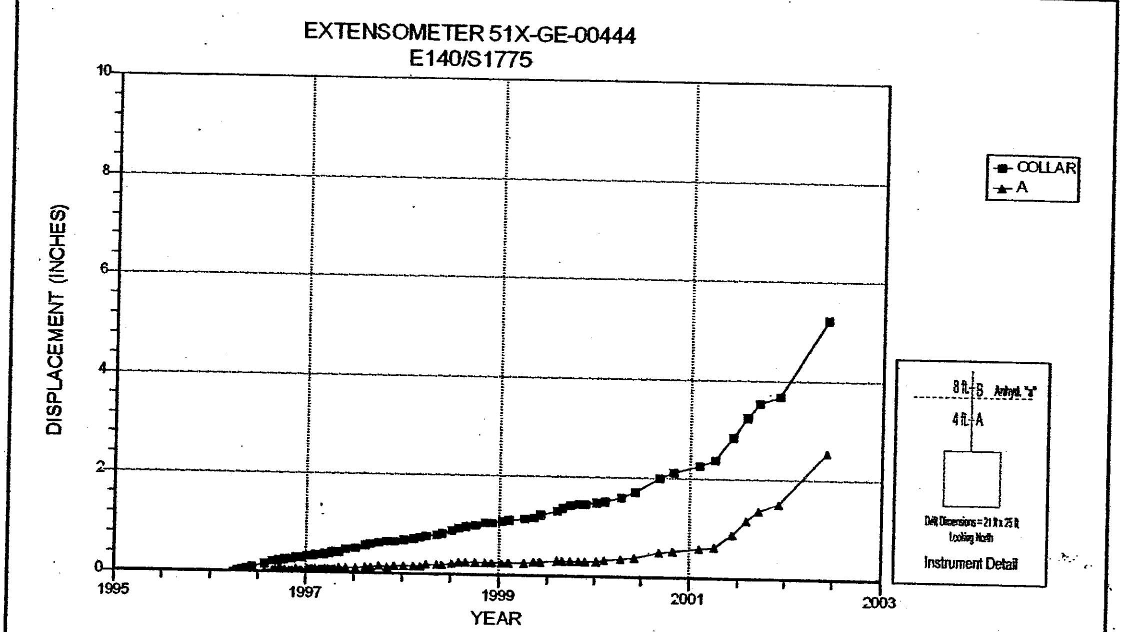
NOTES:

Figure 4-39 Extensometer 51X-GE-00443
E140 Drift at S1685 – Roof



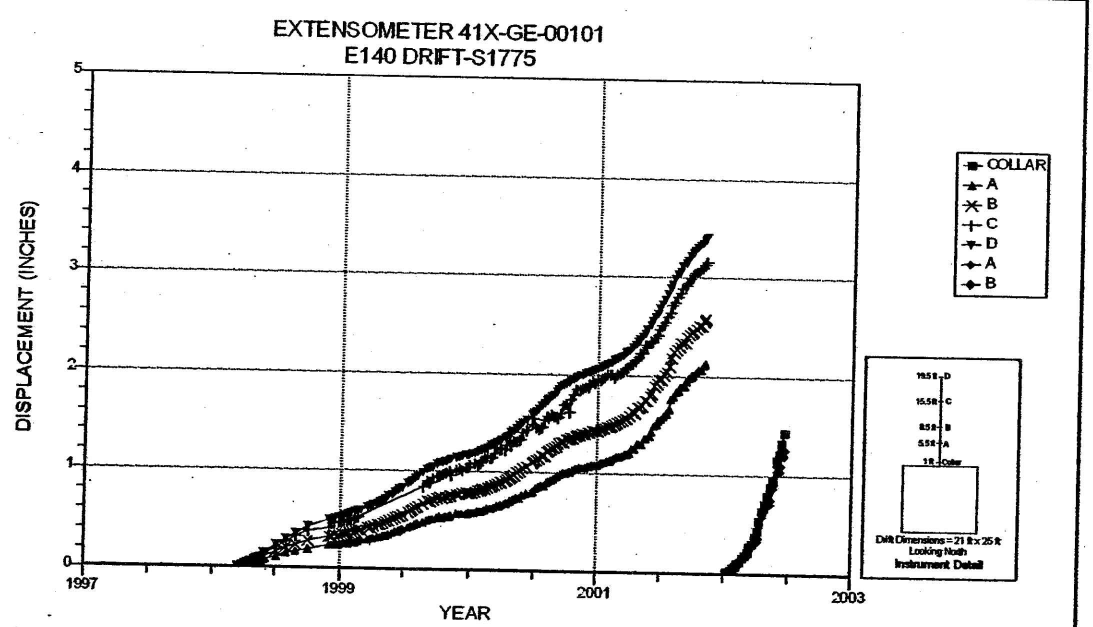
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Instrument repaired January 2002.

Figure 4-40 Extensometer 51X-GE-00339
E140 Drift at S1685 – Roof



NOTES:

Figure 4-41 Extensometer 51X-GE-00444
E140 Drift at S1775 – Roof



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".
3. Instrument repaired January 2002.
4. Rod C broken.

Figure 4-42 Extensometer 41X-GE-00101
E140 Drift at S1775 – Roof

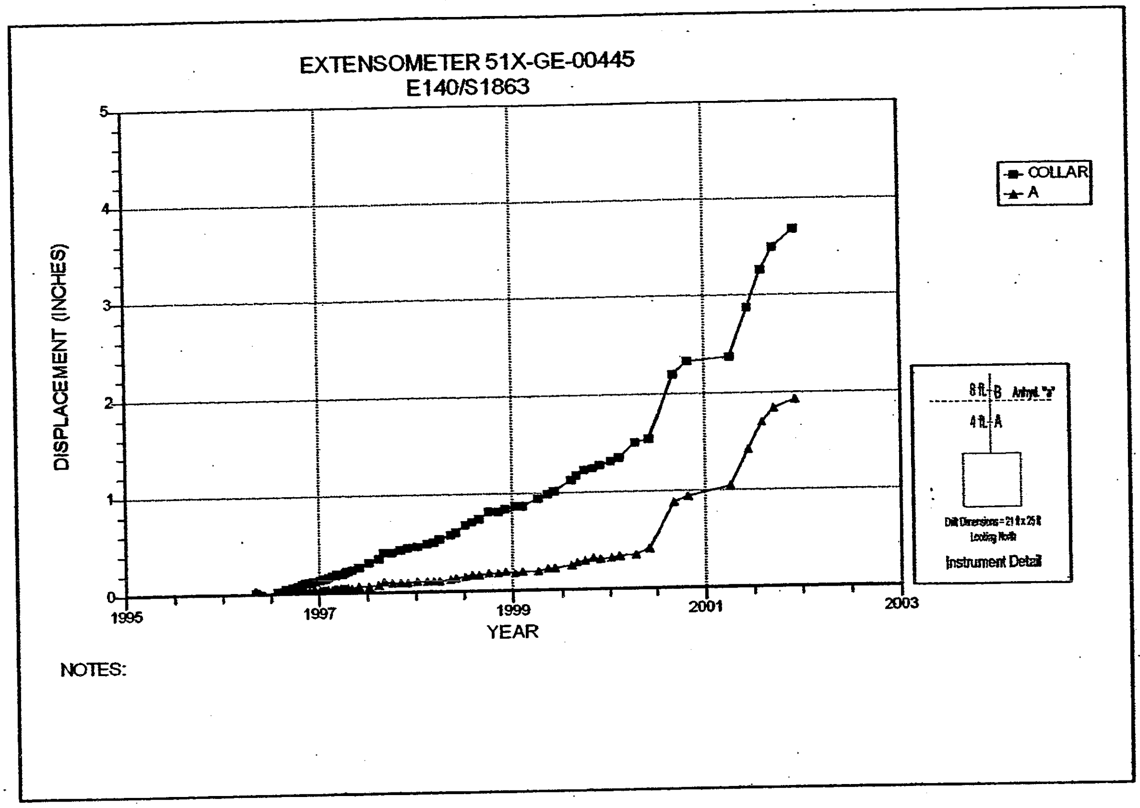


**Figure 4-43 Extensometer 51X-GE-00445
E140 Drift at S1863 – Roof**

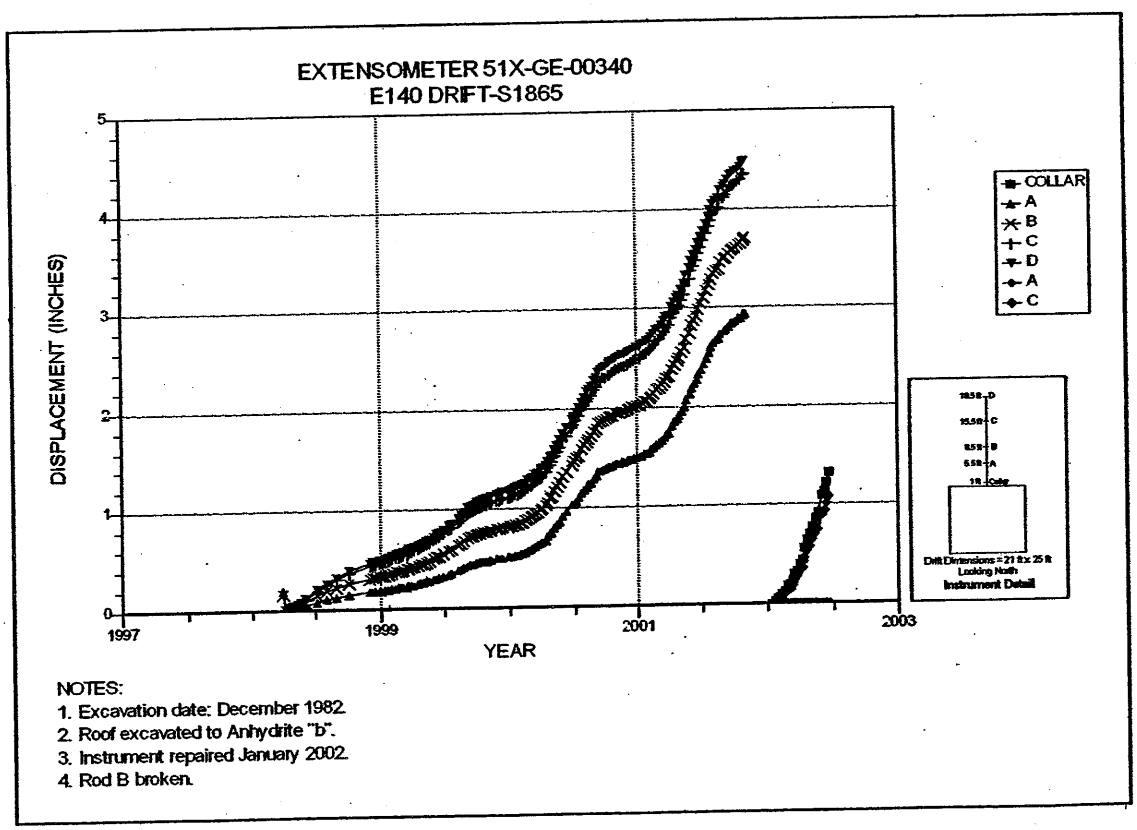
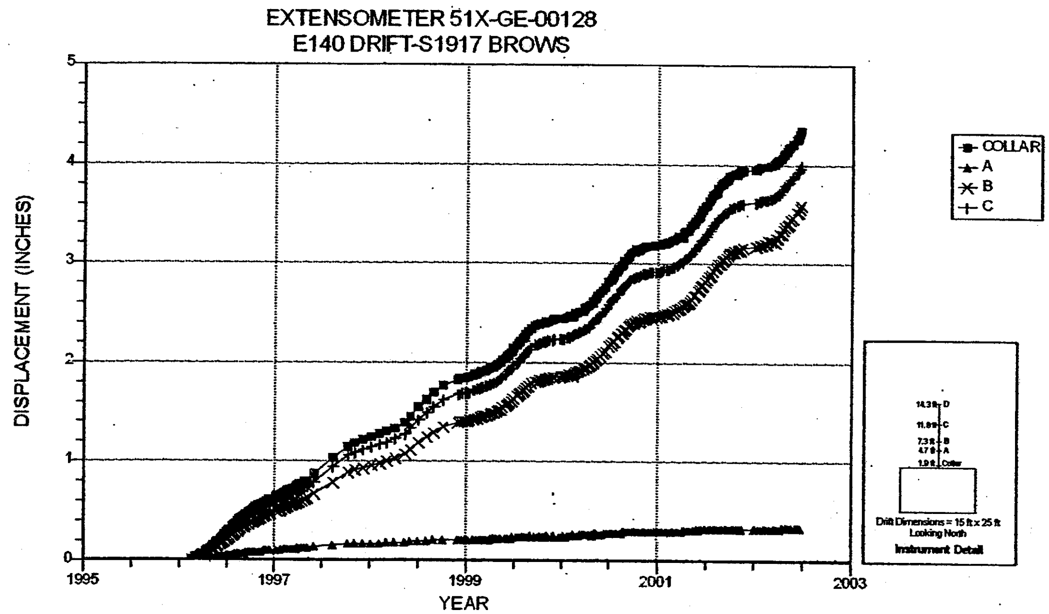
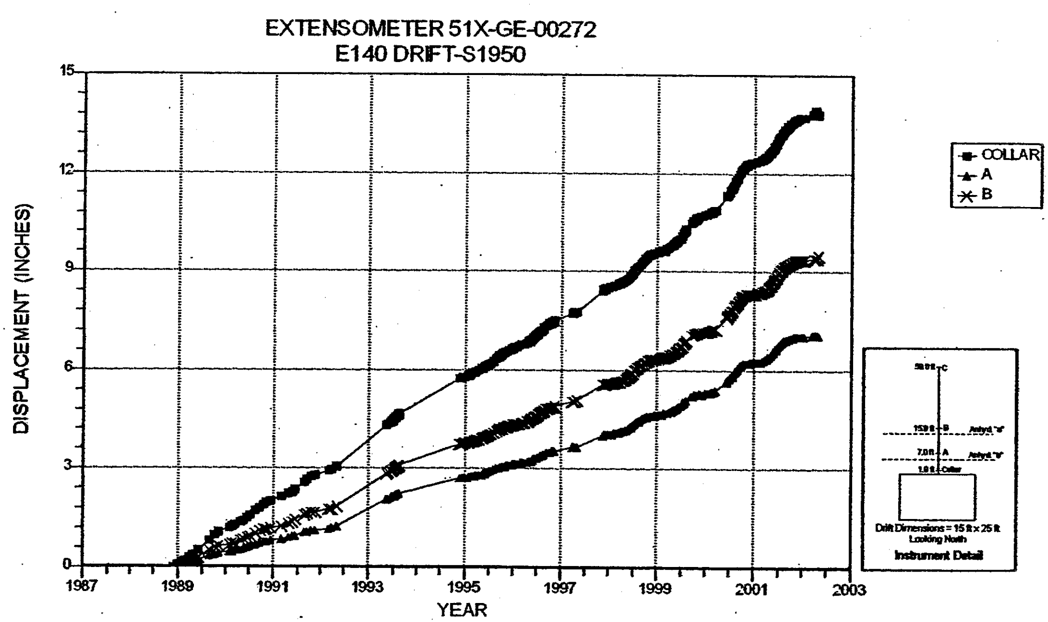


**Figure 4-44 Extensometer 51X-GE-00340
E140 Drift at S1865 – Roof**



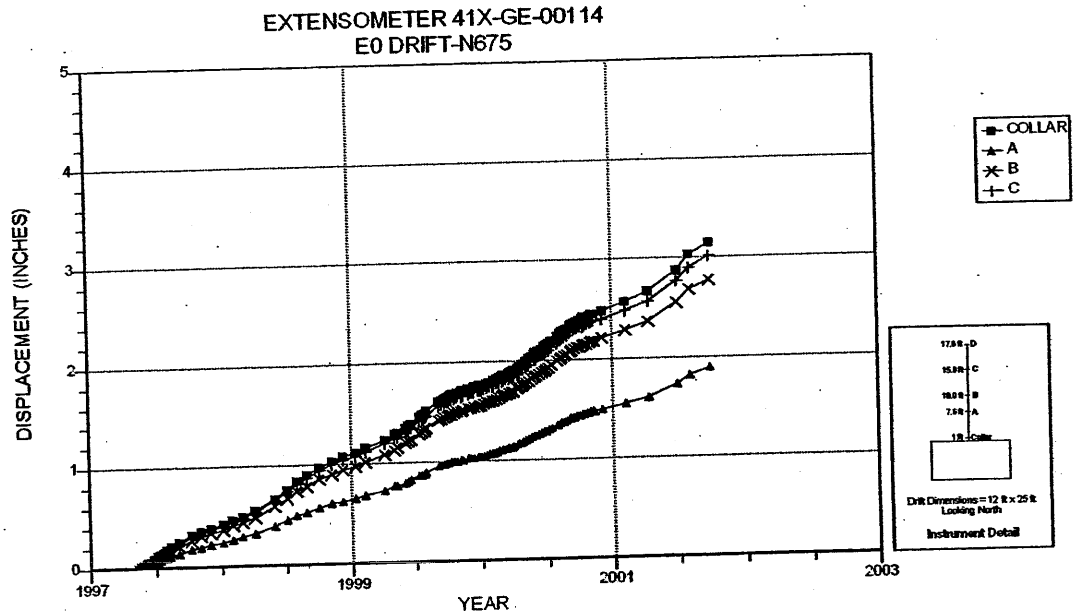
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b".

Figure 4-45 Extensometer 51X-GE-00128
E140 Drift at S1917 Brows – Roof



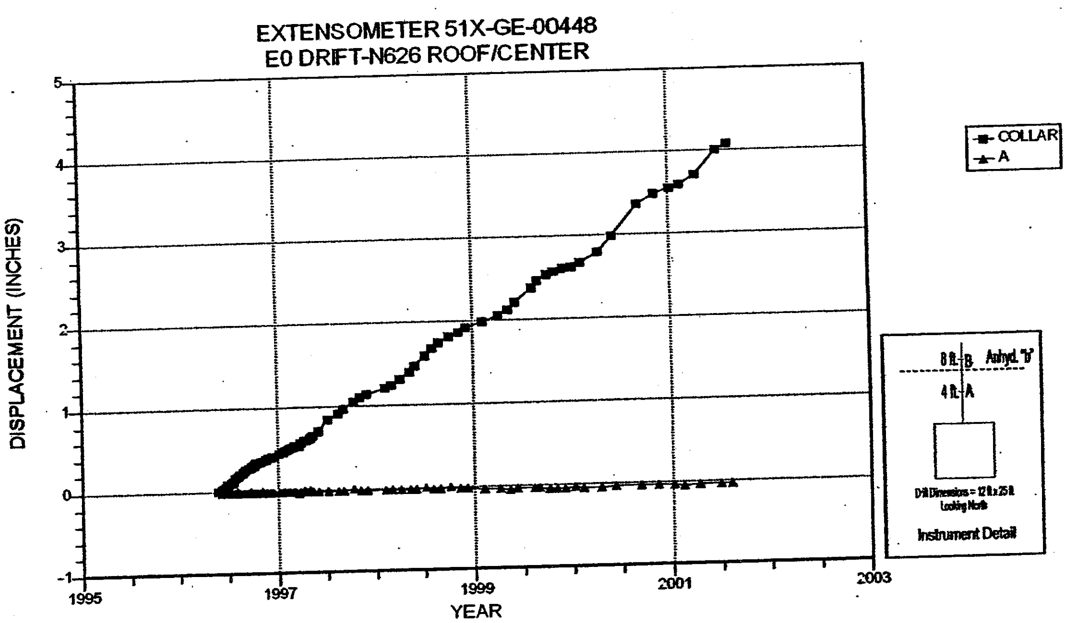
NOTES:
1. Excavation date: January 1983.

Figure 4-46 Extensometer 51X-GE-00272
E140 Drift at S1950 Drift Intersection – Roof



NOTES:
1. Excavation date: February 1983.
2. Instrument mined out.

Figure 4-47 Extensometer 41X-GE-00114
E0 Drift at N675 – Roof



NOTES:
1. Instrument mined out.

Figure 4-48 Extensometer 51X-GE-00448
E0 Drift at N626 – Roof/Center

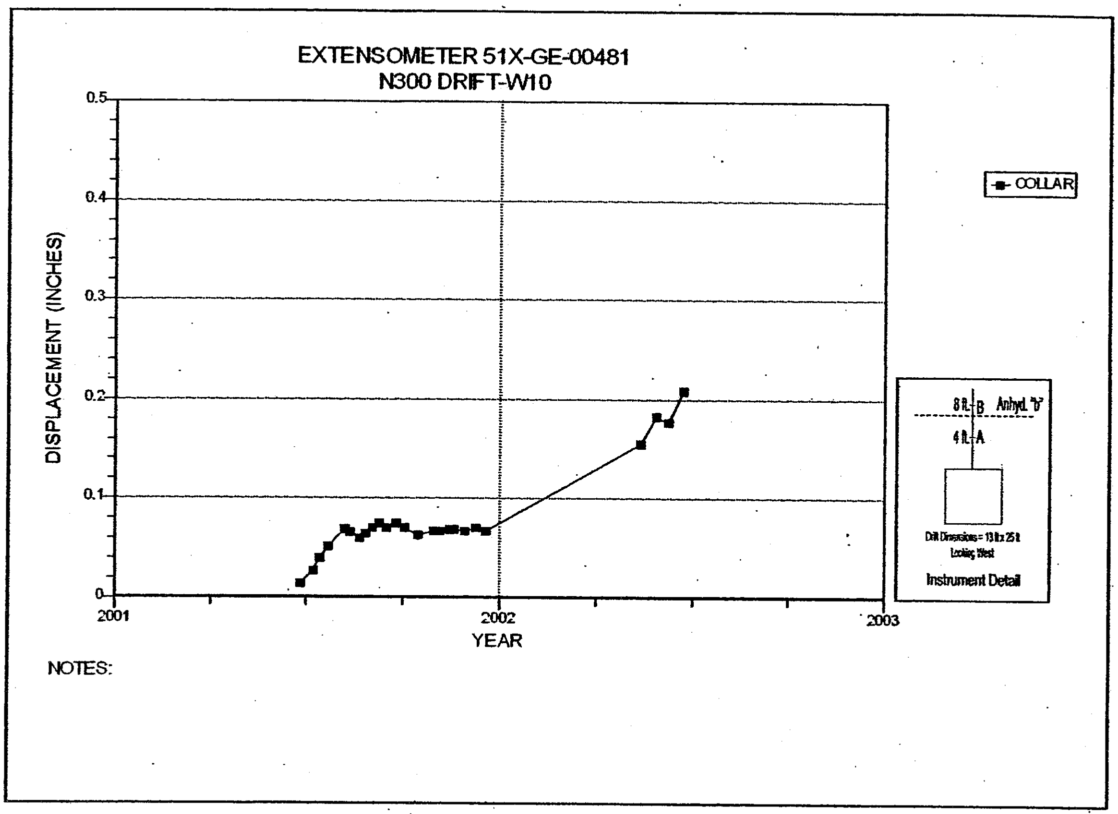


Figure 4-49 Extensometer 51X-GE-00481
N300 Drift at W10 – Roof

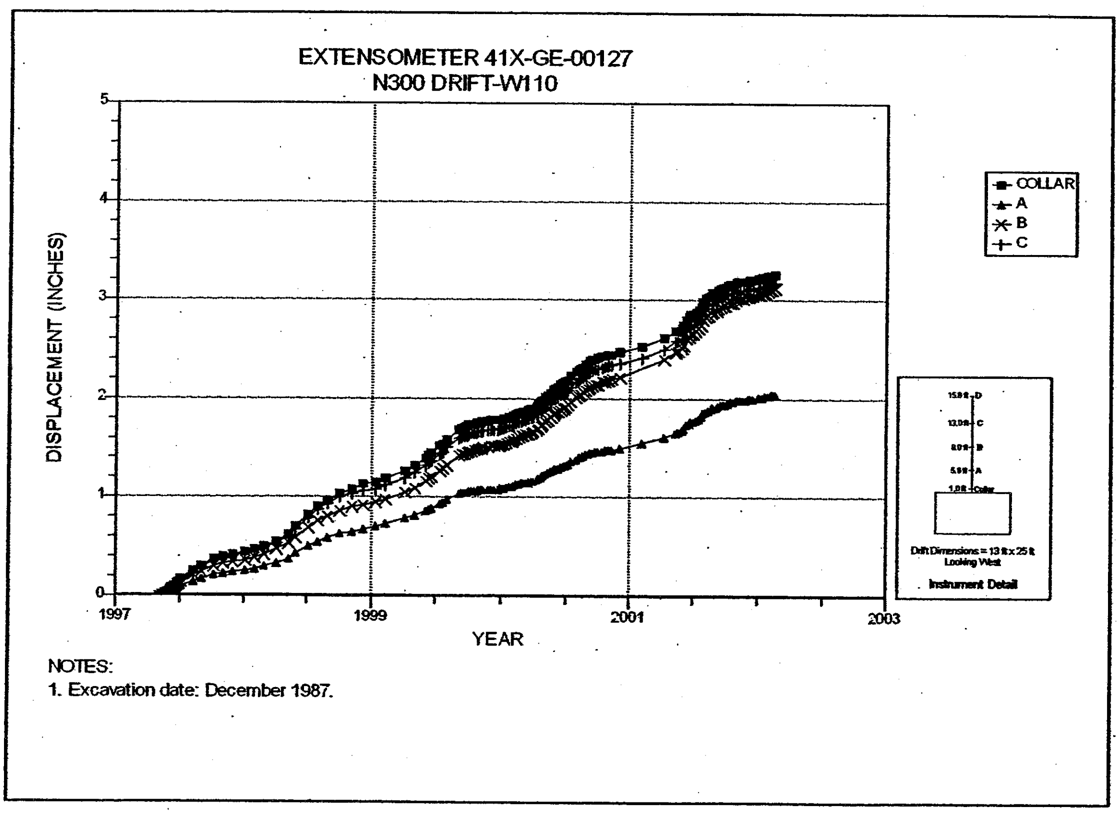


Figure 4-50 Extensometer 41X-GE-00127
N300 Drift at W110 – Roof

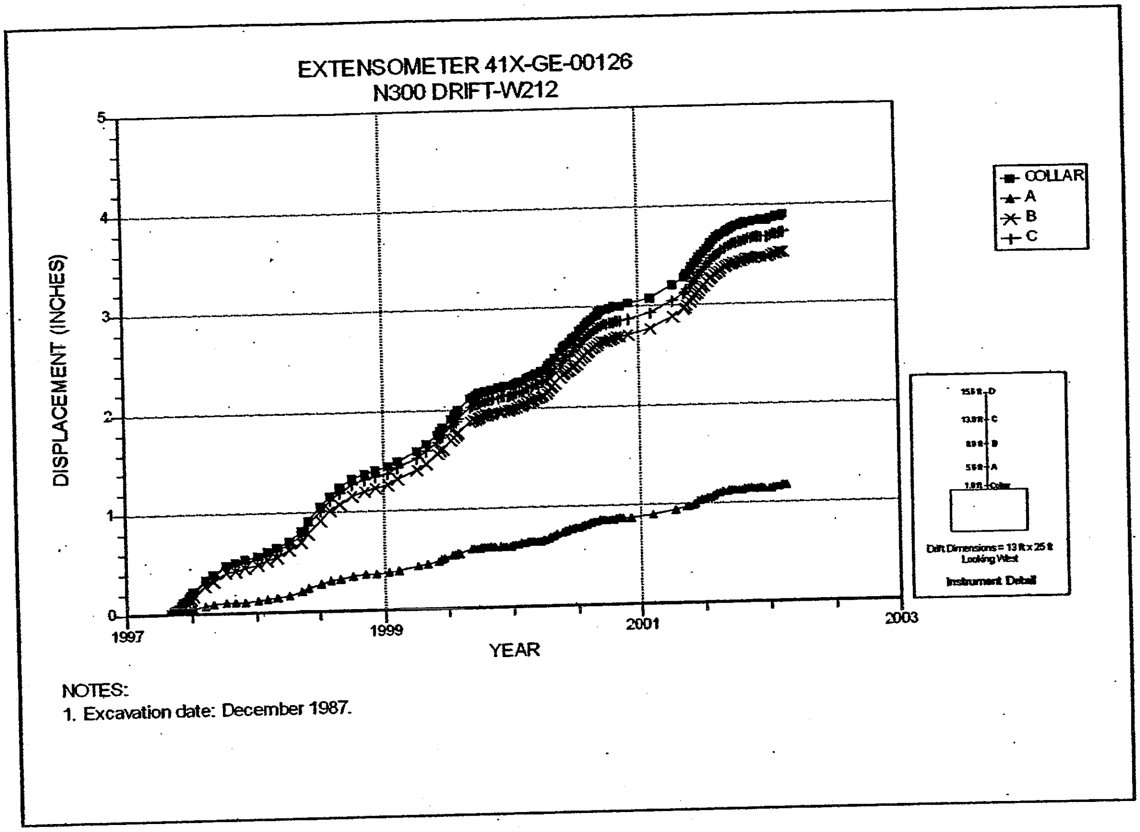


Figure 4-51 Extensometer 41X-GE-00126
N300 Drift at W212 – Roof

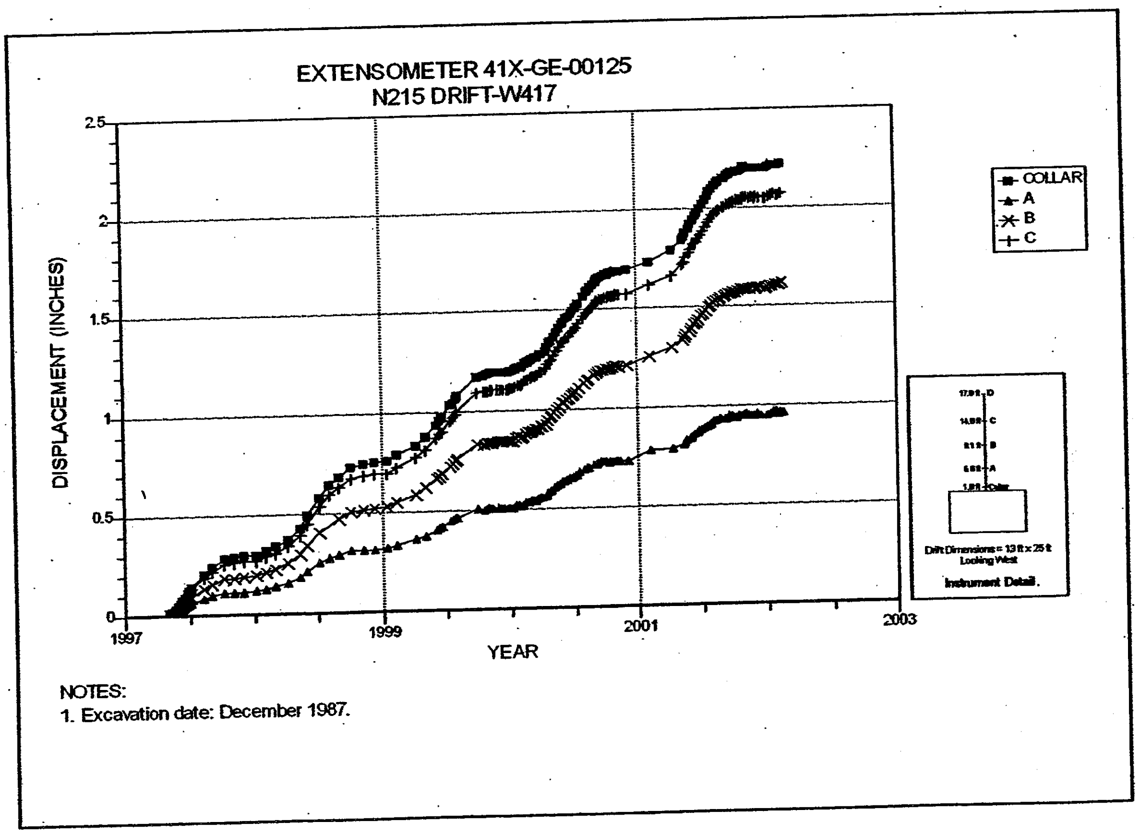


Figure 4-52 Extensometer 41X-GE-00125
N215 Drift at W417 – Roof

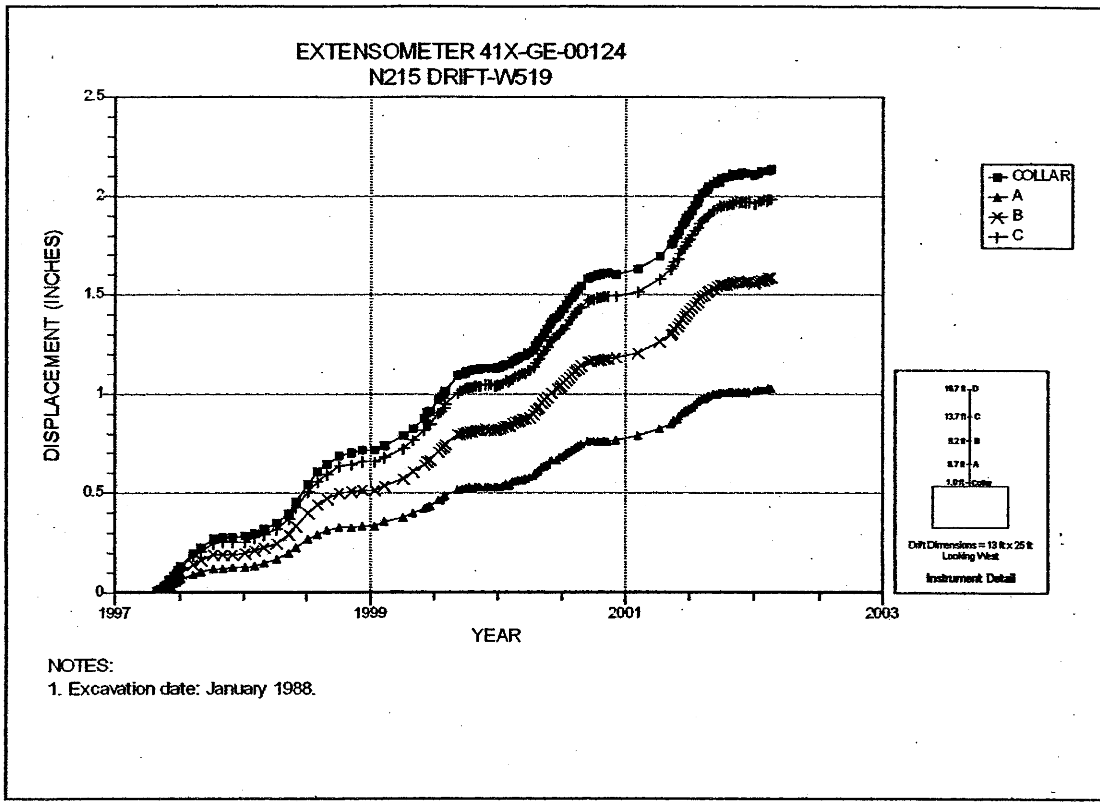


Figure 4-53 Extensometer 41X-GE-00124
N215 Drift at W519 – Roof

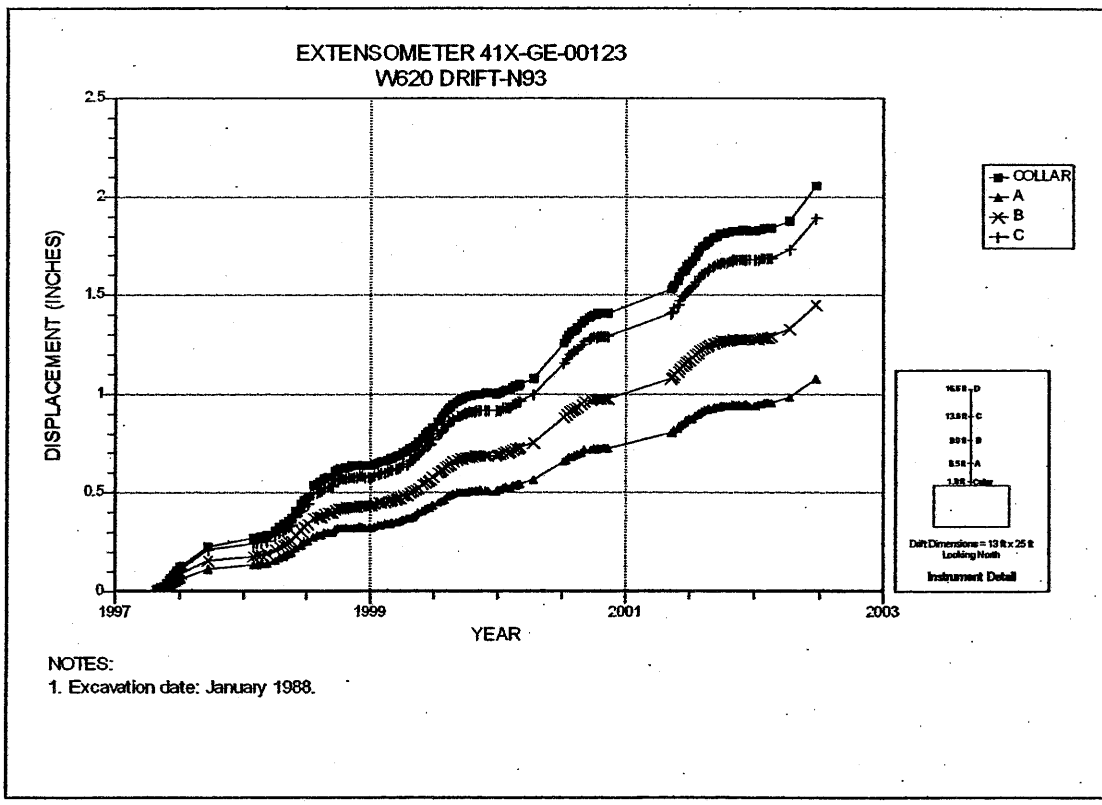
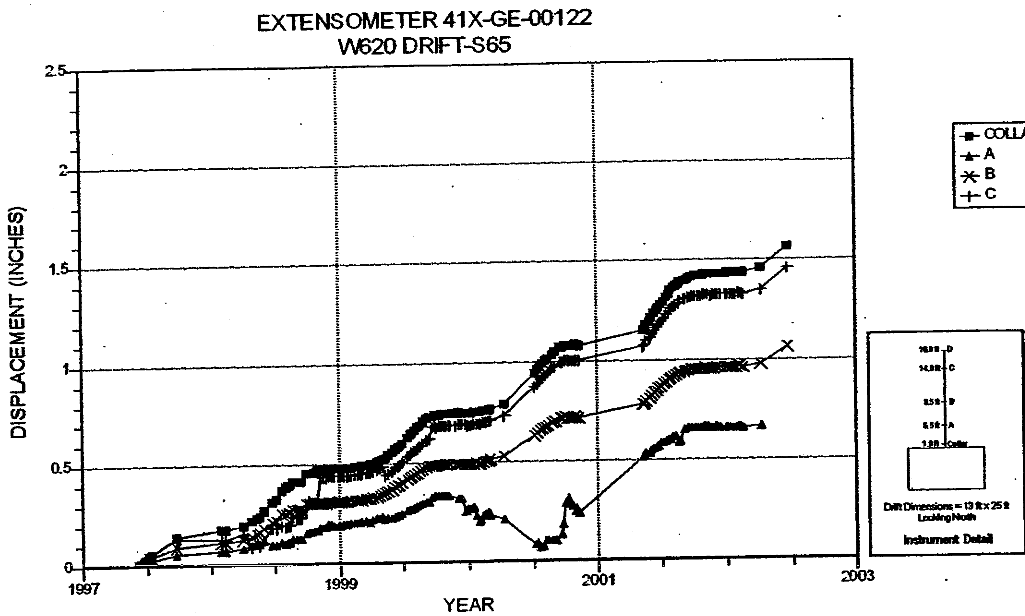
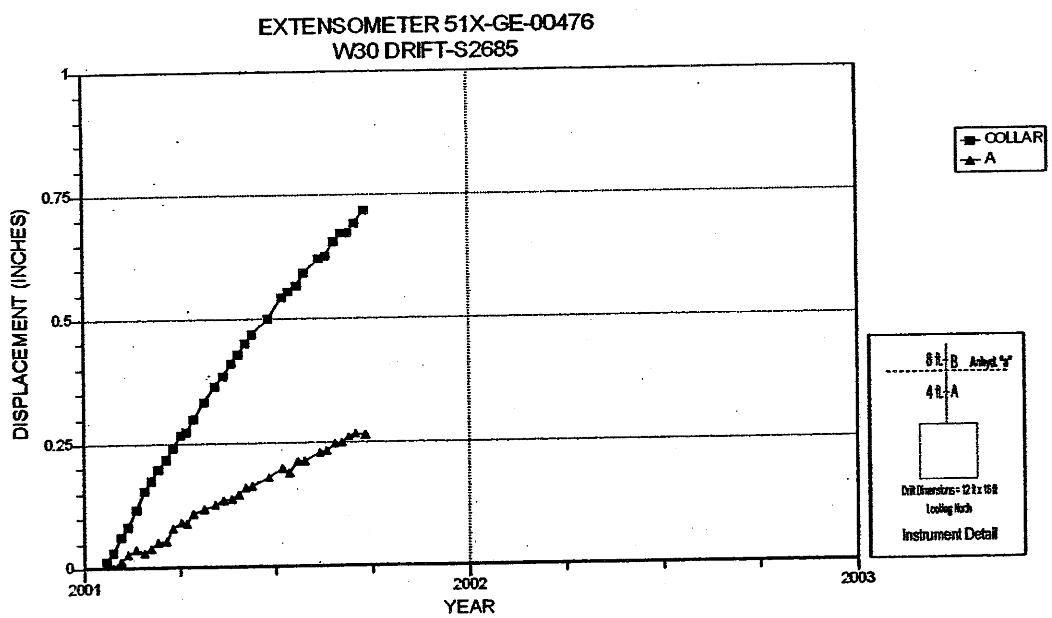


Figure 4-54 Extensometer 41X-GE-00123
W620 Drift at N93 – Roof



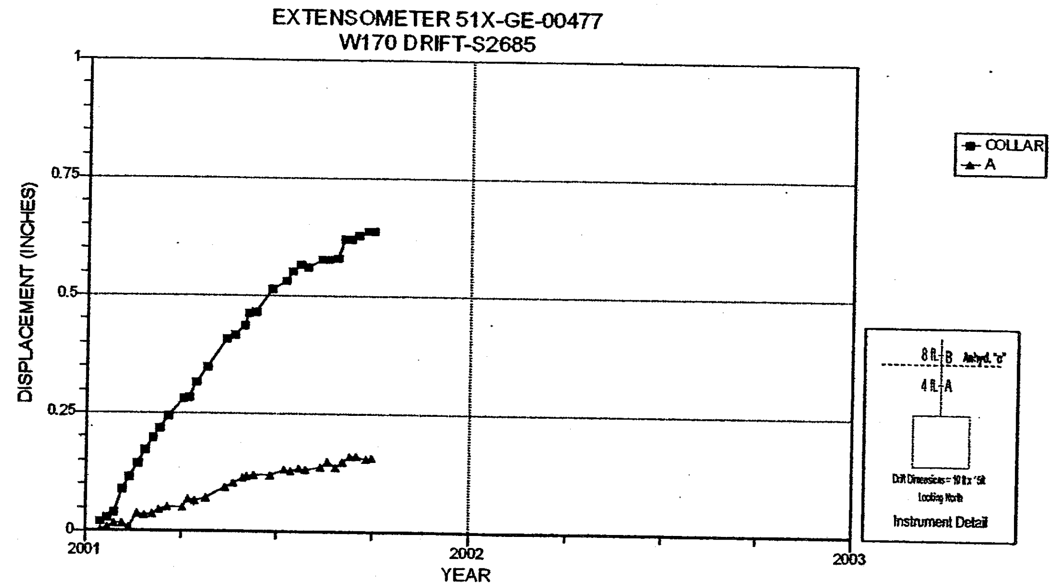
NOTES:
1. Excavation date: January 1988.
2. Anchor "A" noisy.

Figure 4-55 Extensometer 41X-GE-00122
W620 Drift at S65 – Roof



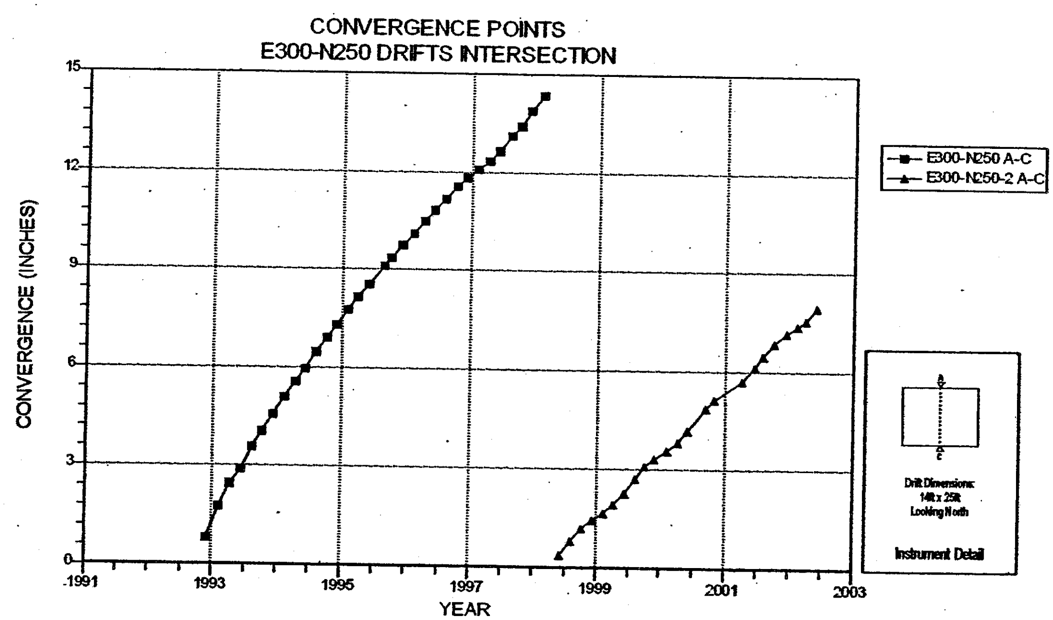
NOTES:
1. Instrument mined out.

Figure 4-56 Extensometer 51X-GE-00476
W30 Drift at S2685 – Roof



NOTES:
1. Instrument mined out.

Figure 4-57 Extensometer 51X-GE-00477
W170 Drift at S2685 – Roof



NOTES:
1. Excavation date: October 1992

Figure 4-58 Convergence Point Array
E300 Shop – E300 Drift at N250 – Roof to Floor

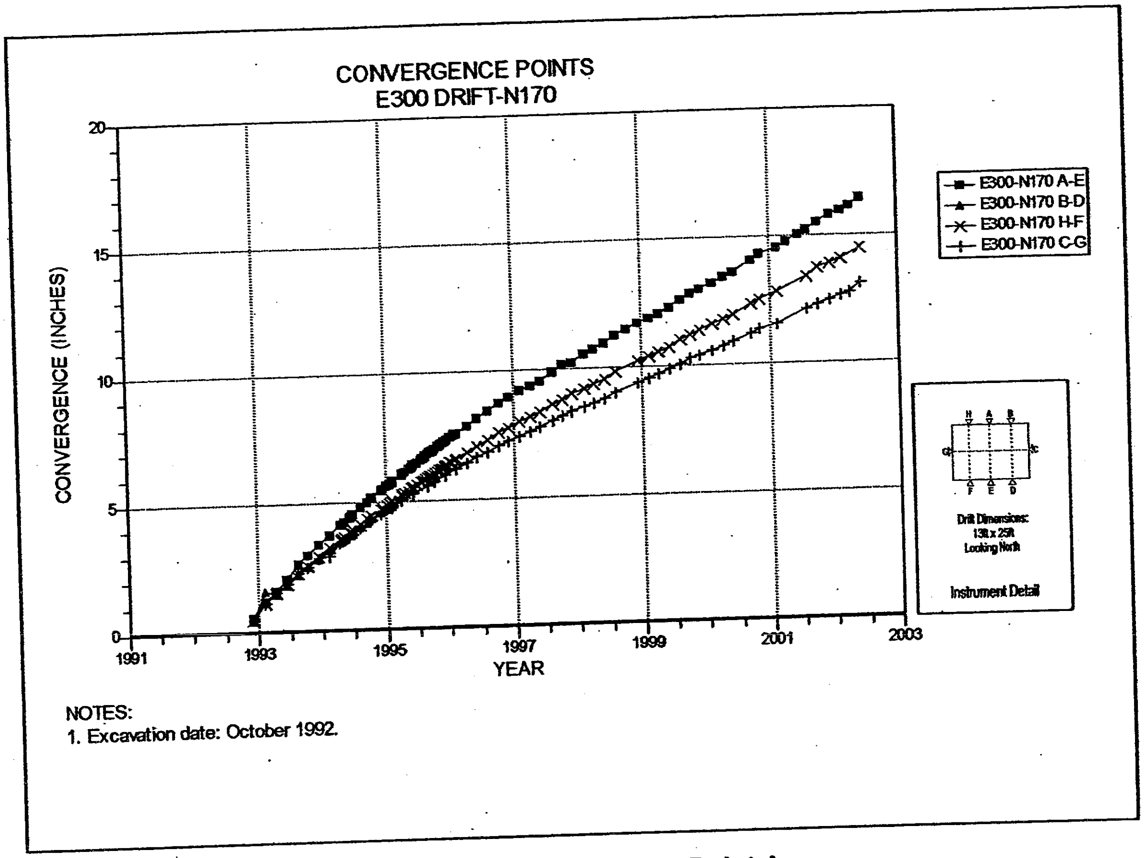


Figure 4-59 Convergence Point Array
E300 Shop – E300 Drift at N170 – All Chords

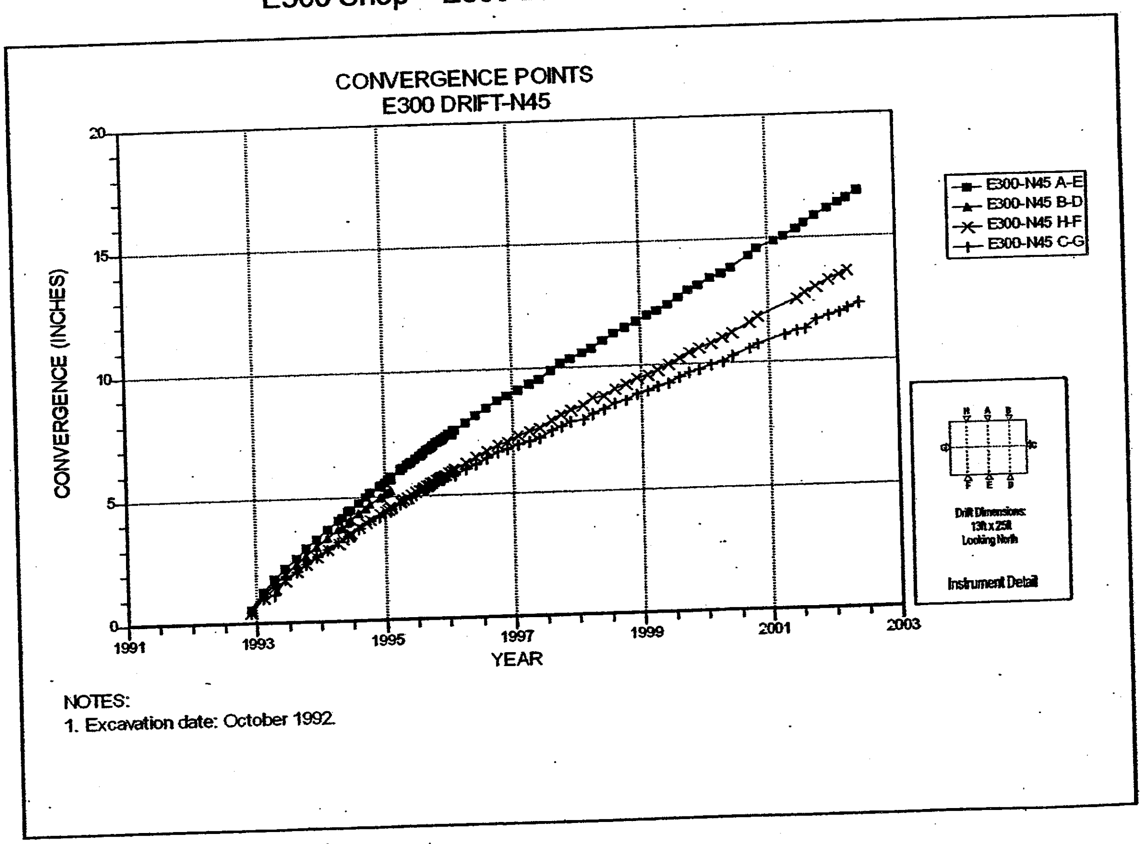


Figure 4-60 Convergence Point Array
E300 Shop – E300 Drift at N45 – All Chords

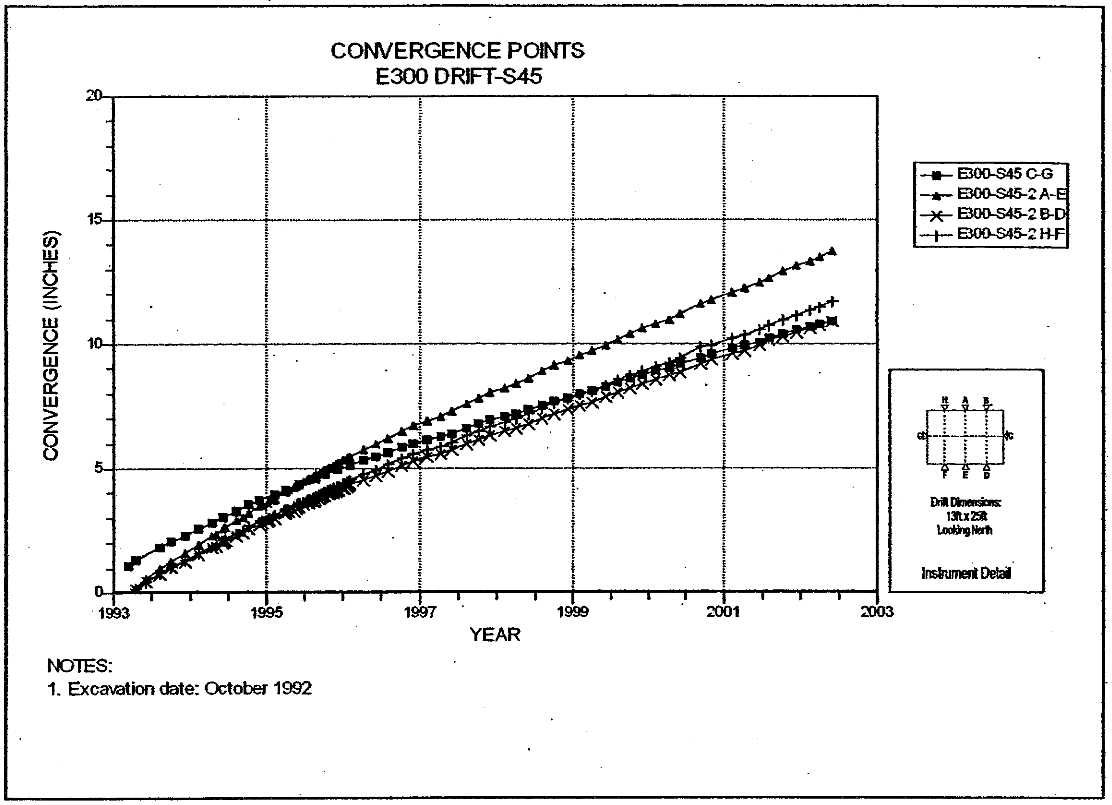


Figure 4-61 Convergence Point Array
E300 Shop – E300 Drift at S45 – All Chords

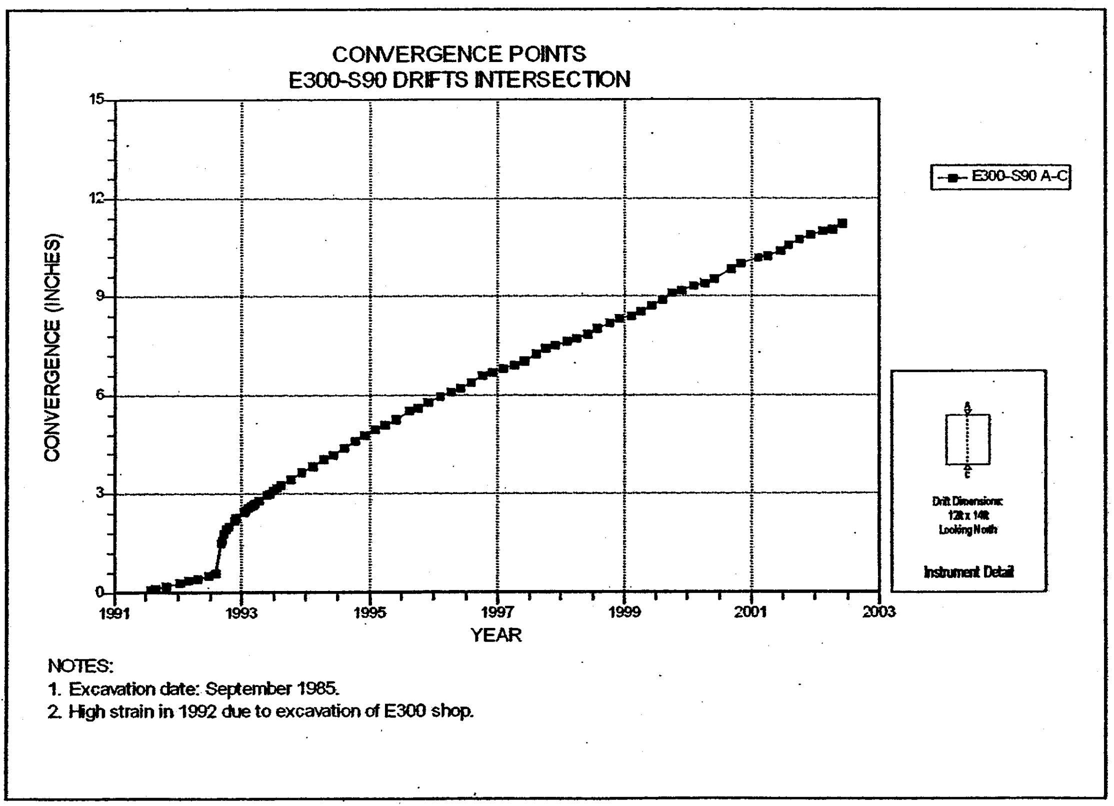
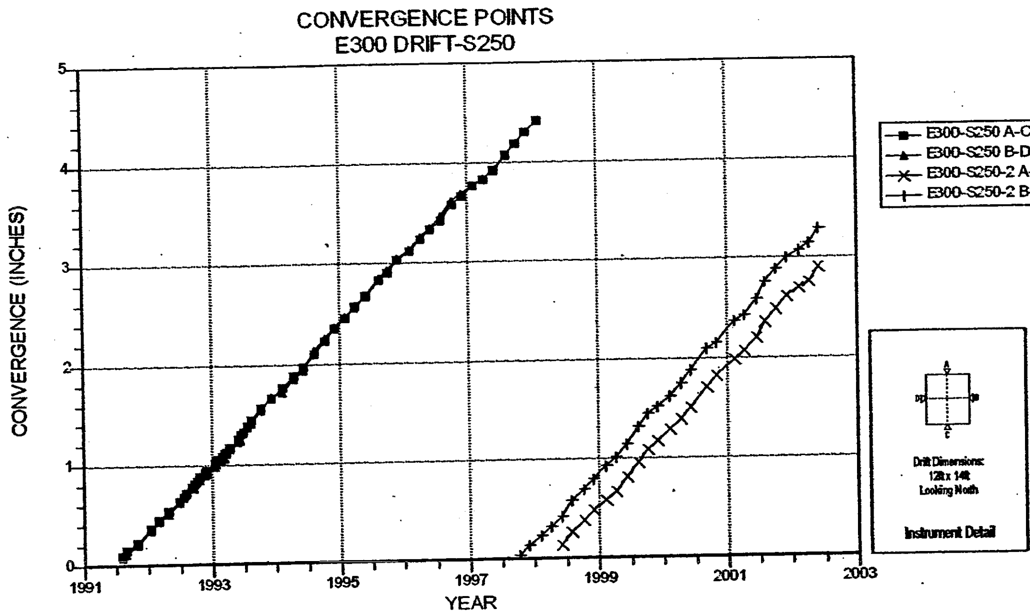
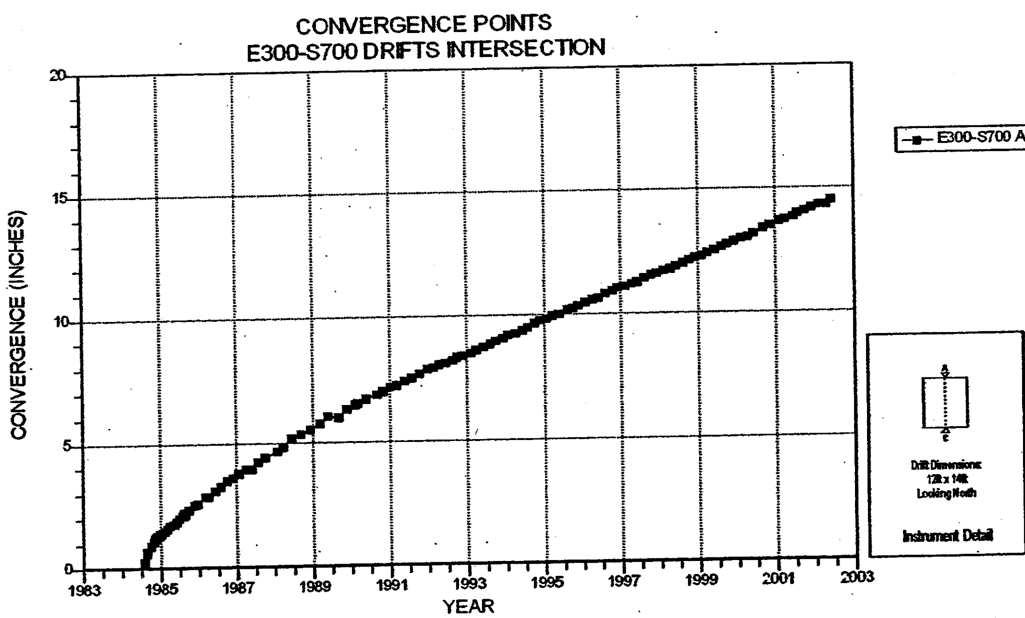


Figure 4-62 Convergence Point Array
E300 Drift at S90 Drift Intersection – Roof to Floor



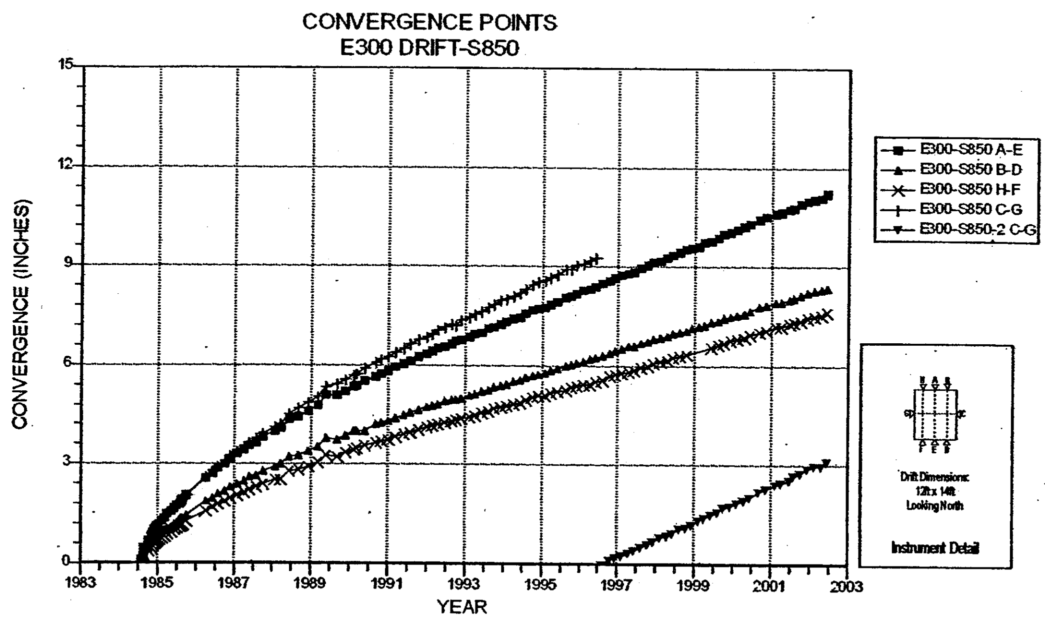
NOTES:
1. Excavation date: September 1985.

Figure 4-63 Convergence Point Array
E300 Drift at S250 – All Chords



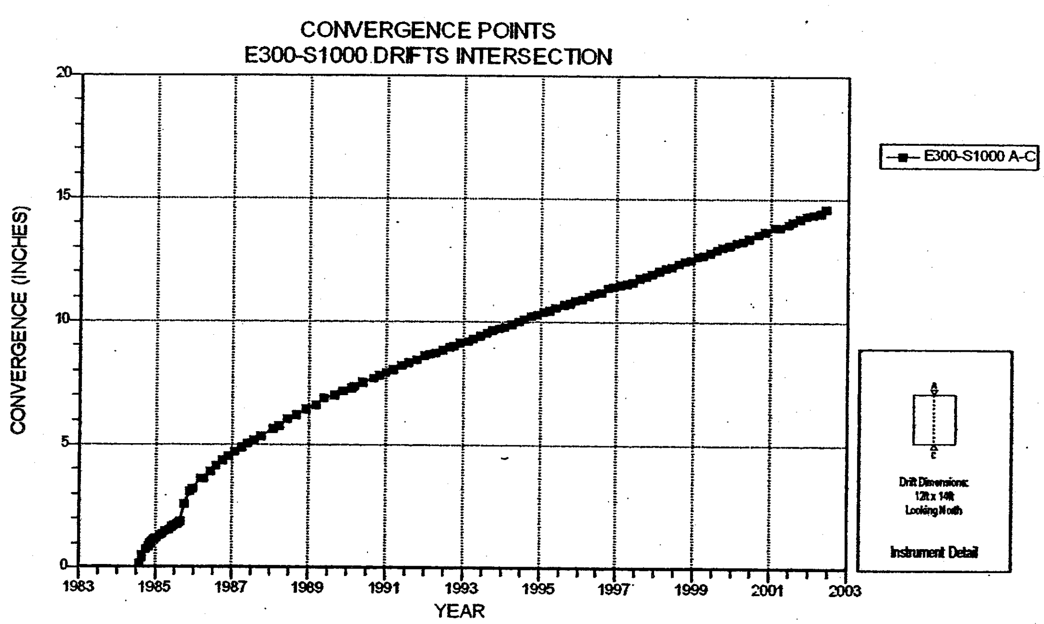
NOTES:
1. Excavation date: May 1984.

Figure 4-64 Convergence Point Array
E300 Drift at S700 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: July 1984.

Figure 4-65 Convergence Point Array
E300 Drift at S850 – All Chords



NOTES:
1. Excavation date: July 1984.

Figure 4-66 Convergence Point Array
E300 Drift at S1000 Drift Intersection – Roof to Floor

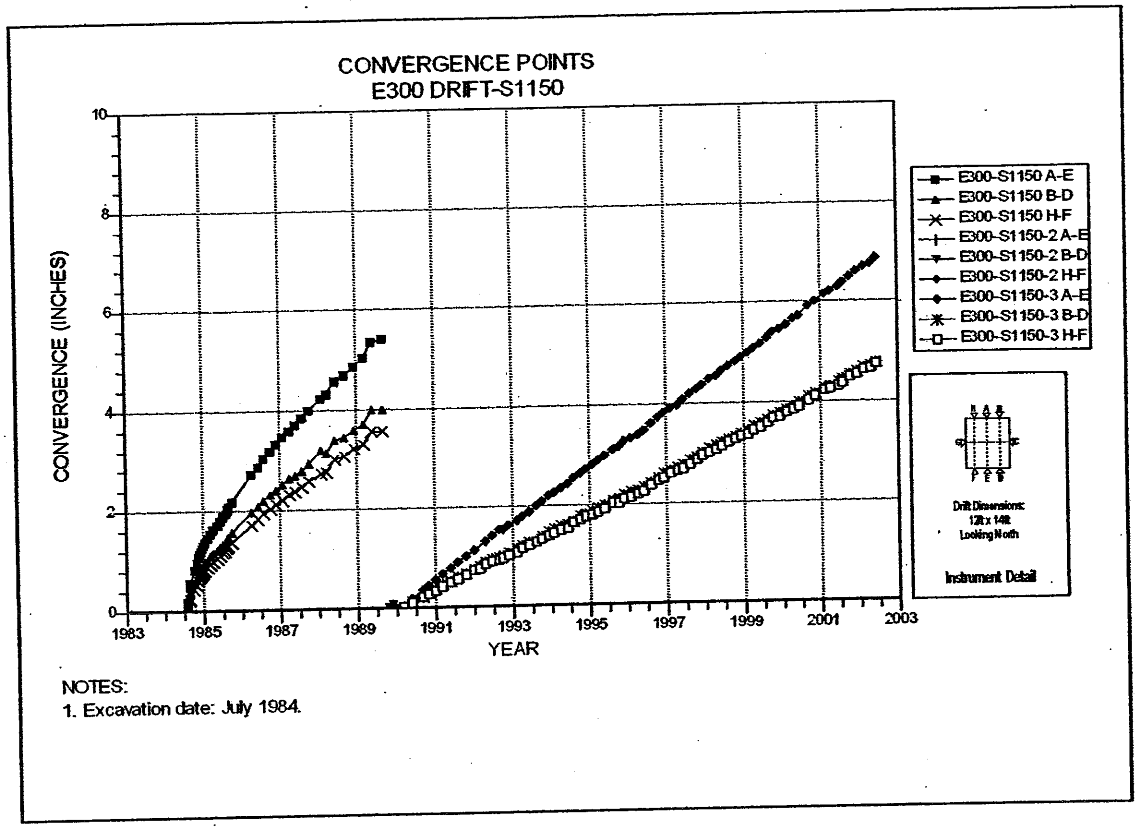


Figure 4-67 Convergence Point Array
E300 Drift at S1150 – Roof to Floor

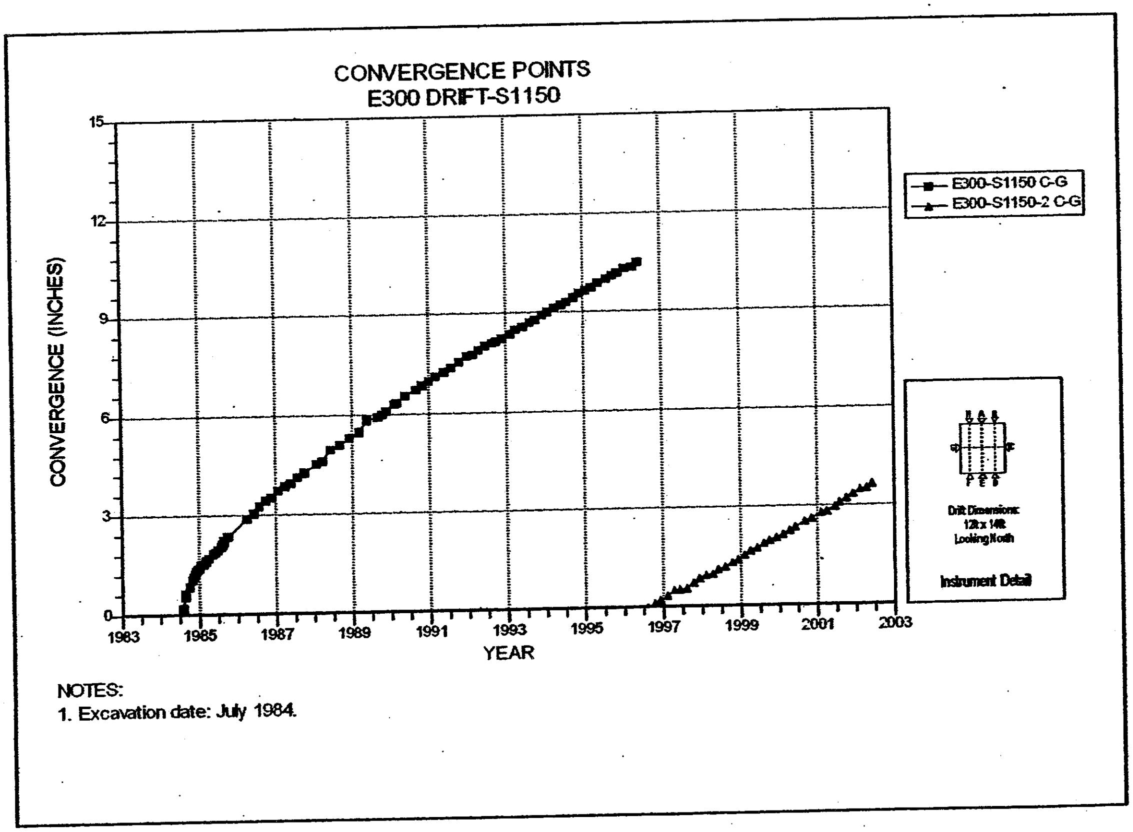


Figure 4-68 Convergence Point Array
E300 Drift at S1150 – Rib to Rib

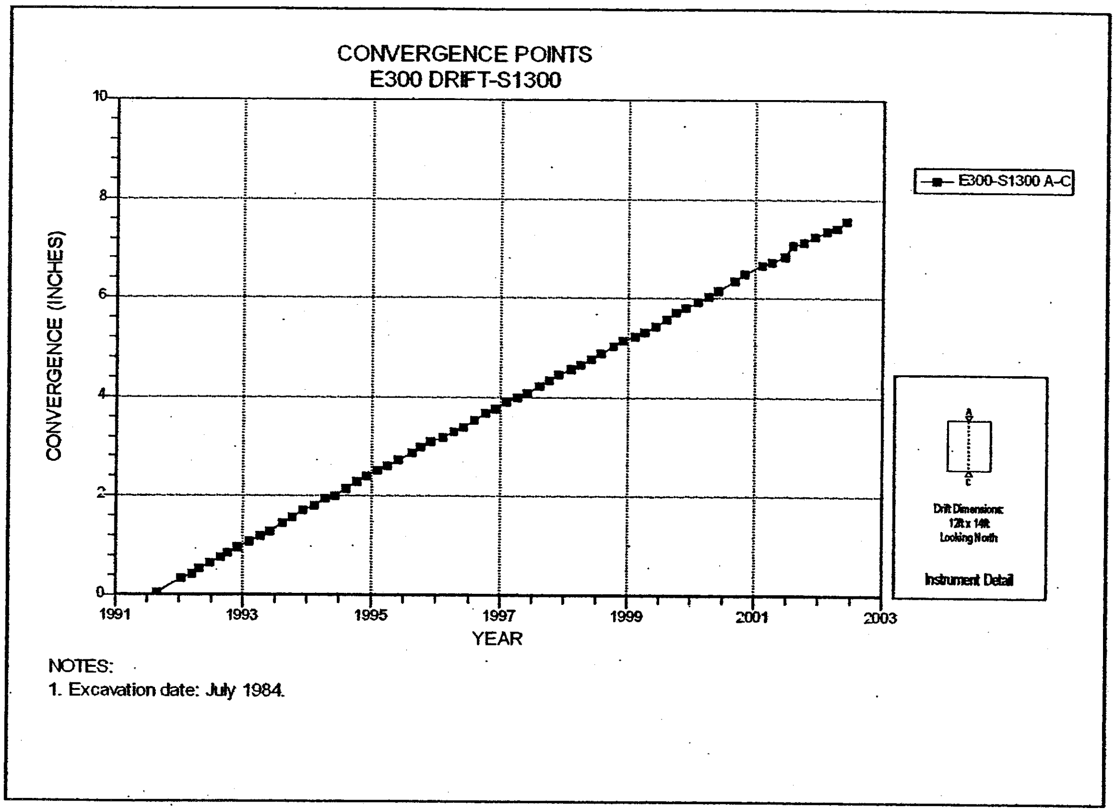


Figure 4-69 Convergence Point Array
E300 Drift at S1300 Drift Intersection – Roof to Floor

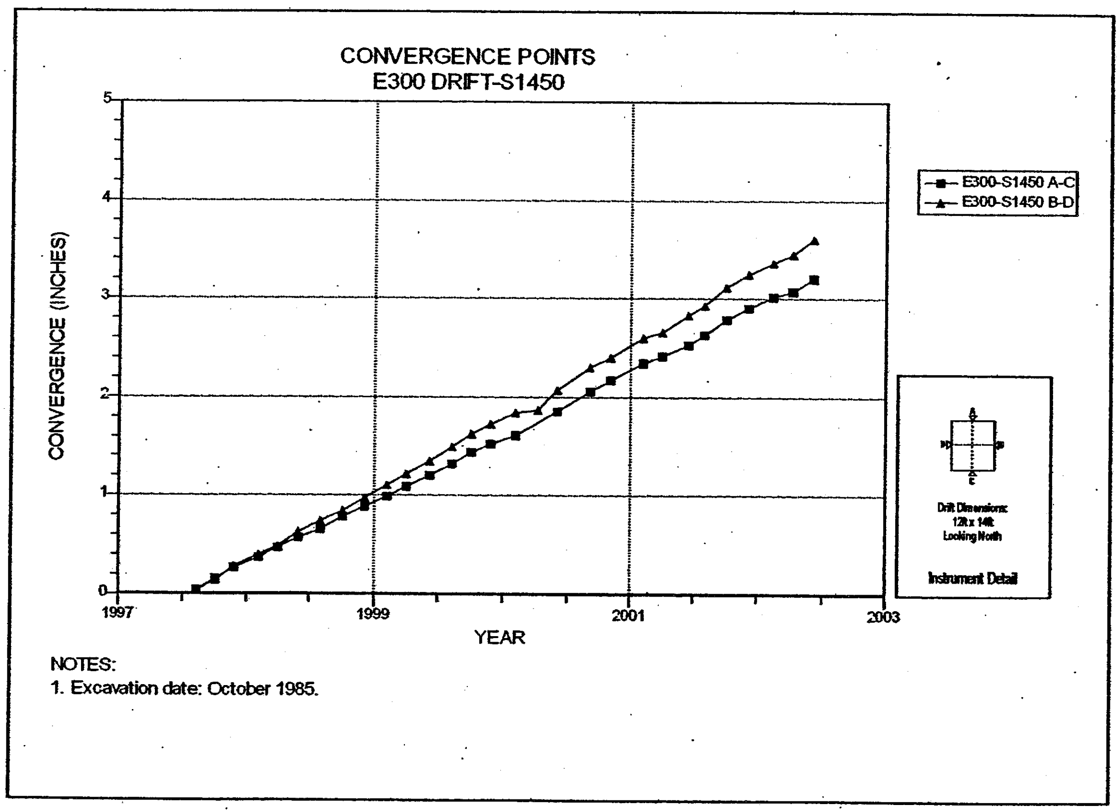
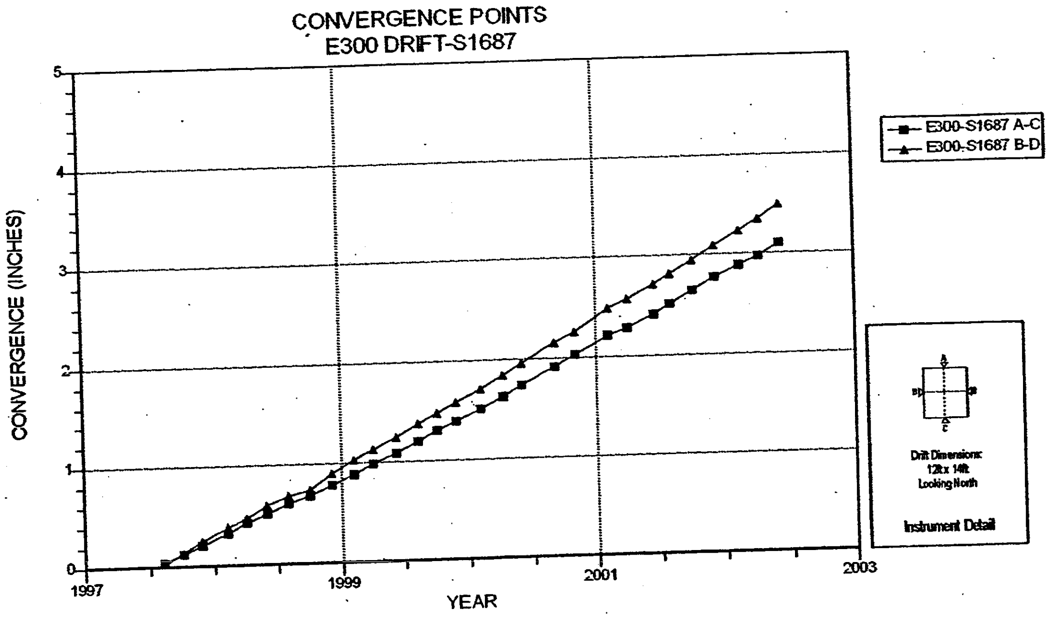
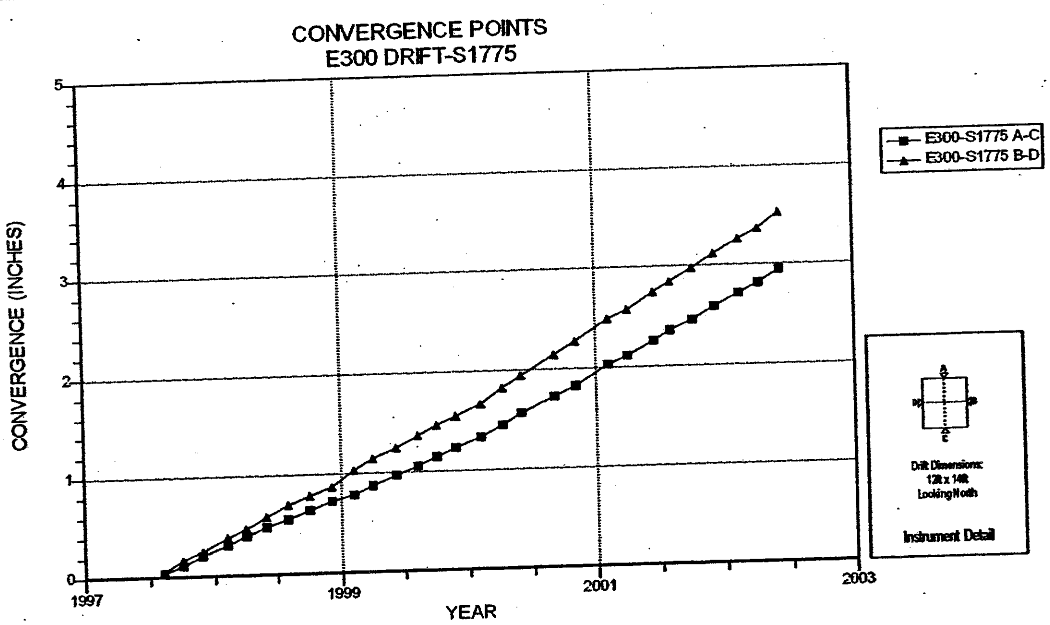


Figure 4-70 Convergence Point Array
E300 Drift at S1450 – All Chords



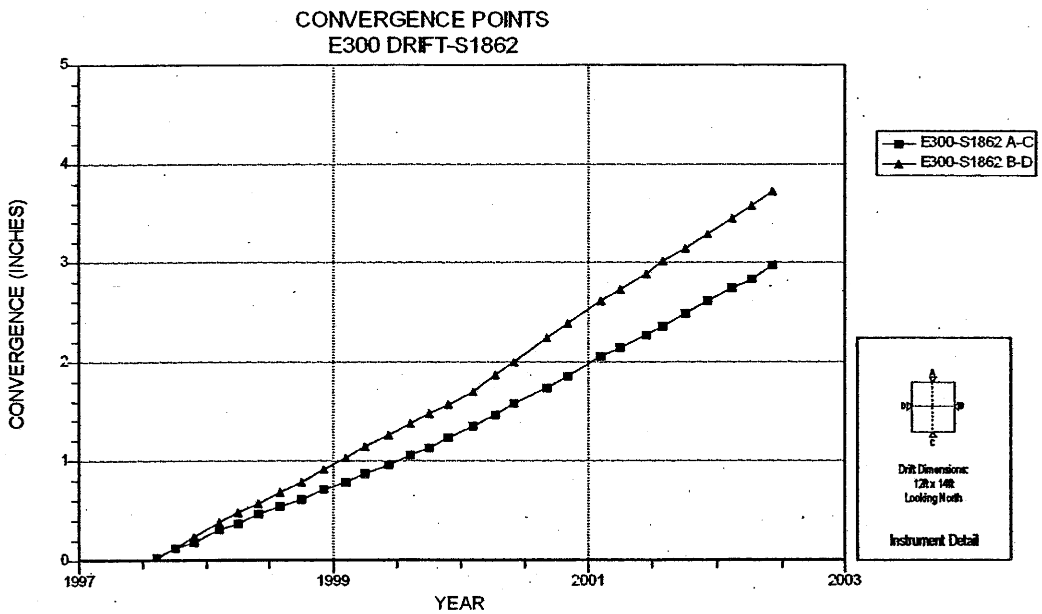
NOTES:
1. Excavation date: October 1985.

Figure 4-71 Convergence Point Array
E300 Drift at S1687 – All Chords



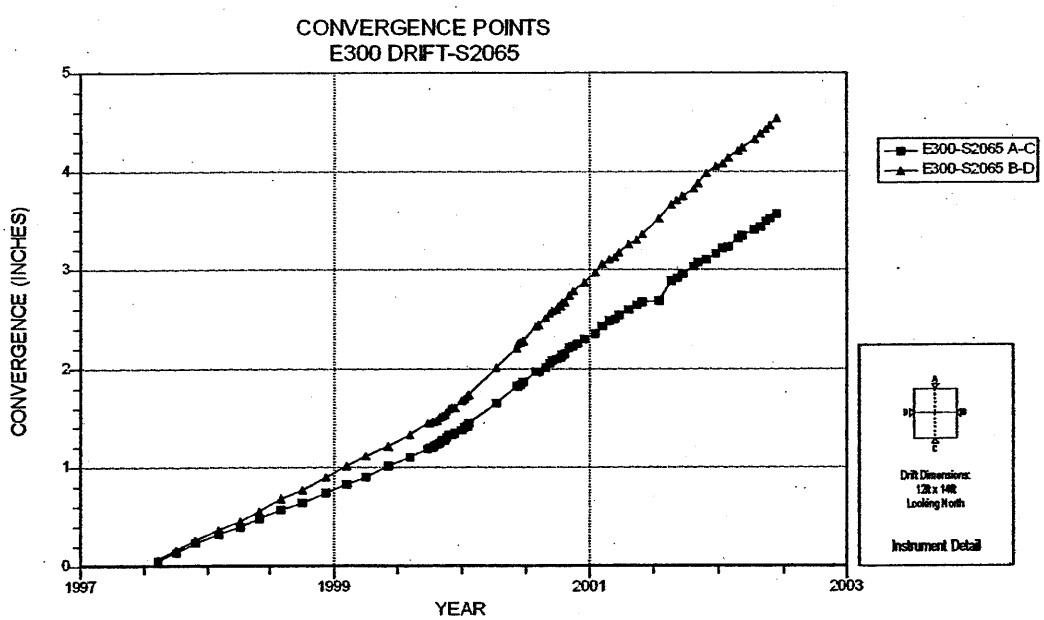
NOTES:
1. Excavation date: October 1985.

Figure 4-72 Convergence Point Array
E300 Drift at S1775 – All Chords



NOTES:
1. Excavation date: October 1985.

Figure 4-73 Convergence Point Array
E300 Drift at S1862 – All Chords



NOTES:
1. Excavation date: April 1986.

Figure 4-74 Convergence Point Array
E300 Drift at S2065 – All Chords

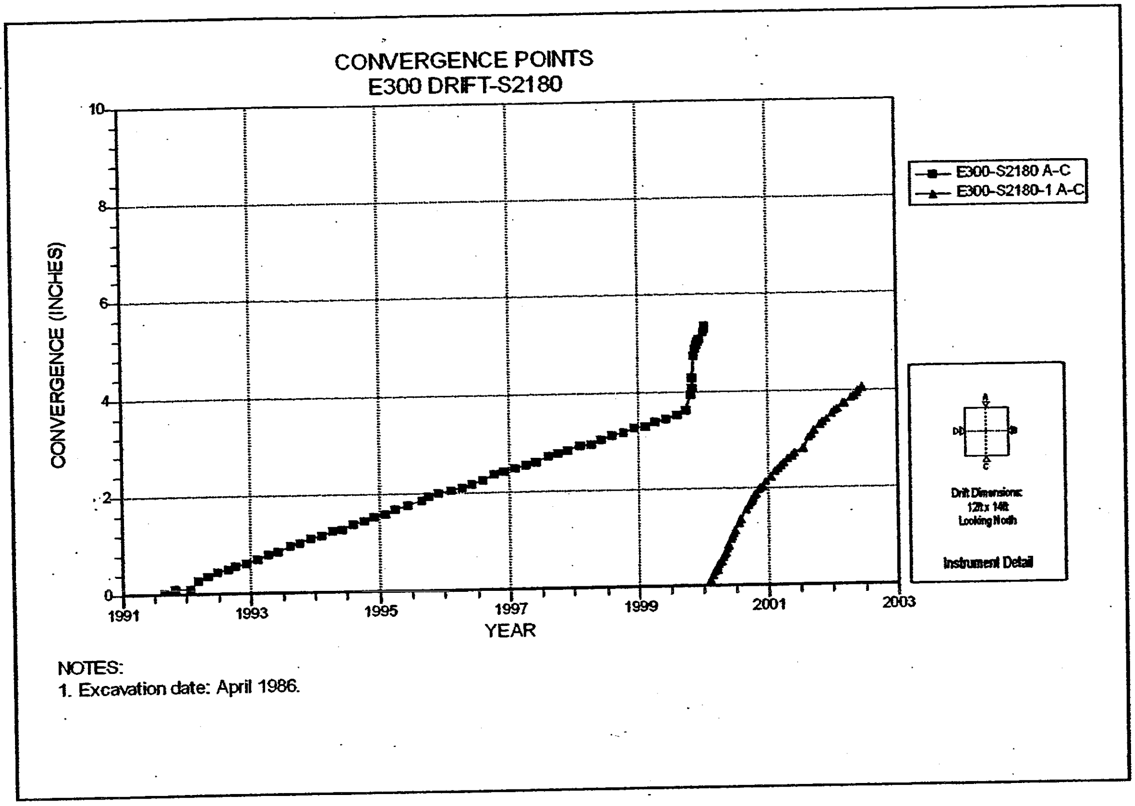


**Figure 4-75 Convergence Point Array
E300 Drift at S2180 Drift Intersection – Roof to Floor**

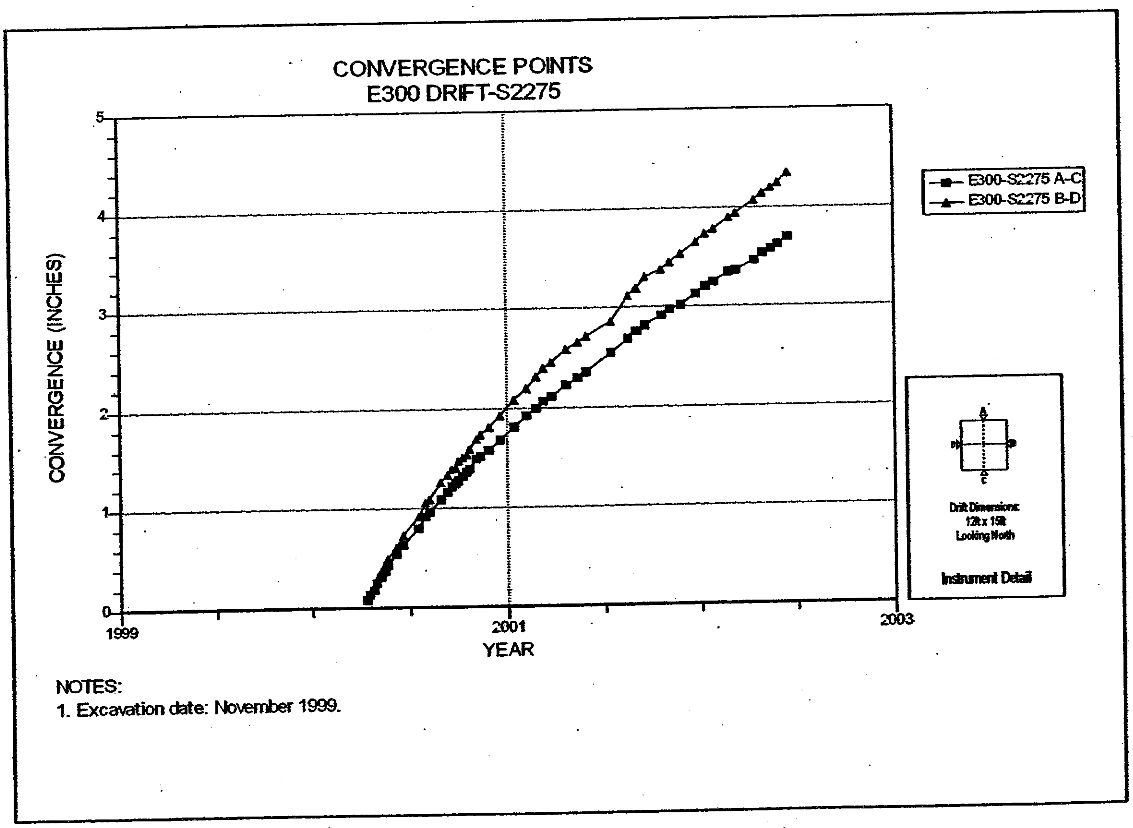


**Figure 4-76 Convergence Point Array
E300 Drift at S2275 – All Chords**

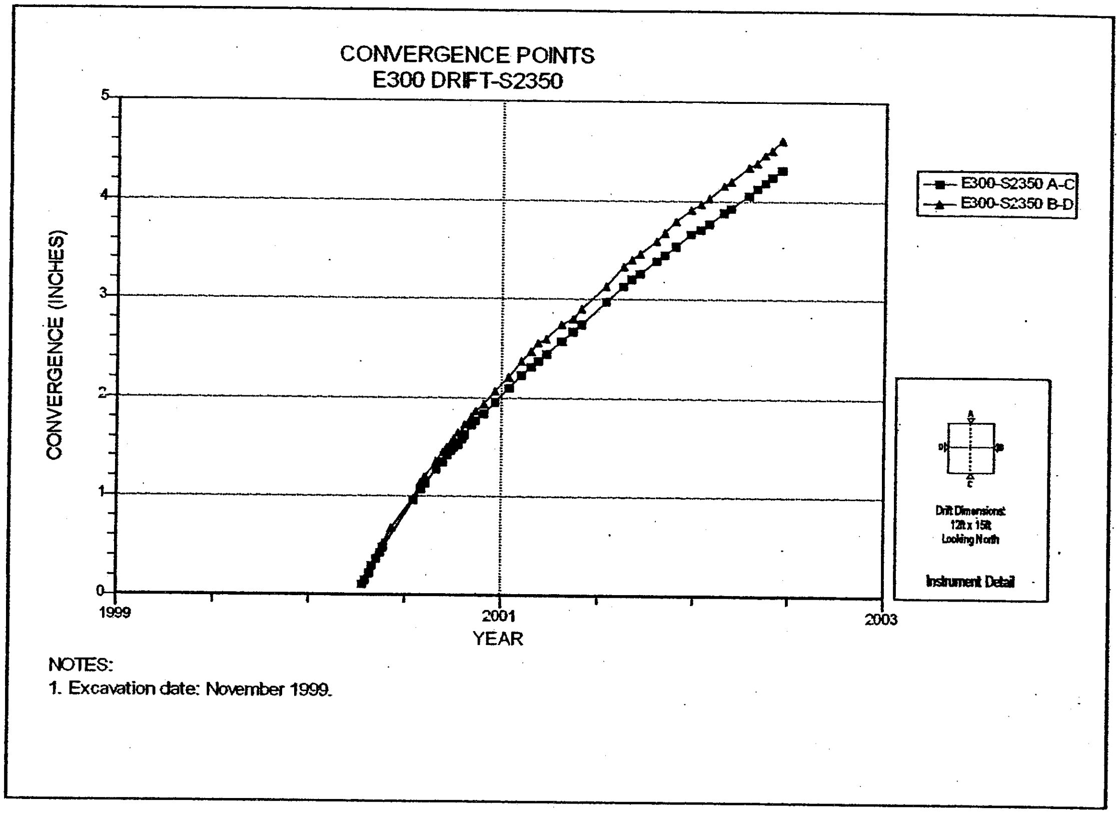


Figure 4-77 Convergence Point Array
E300 Drift at S2350 – All Chords

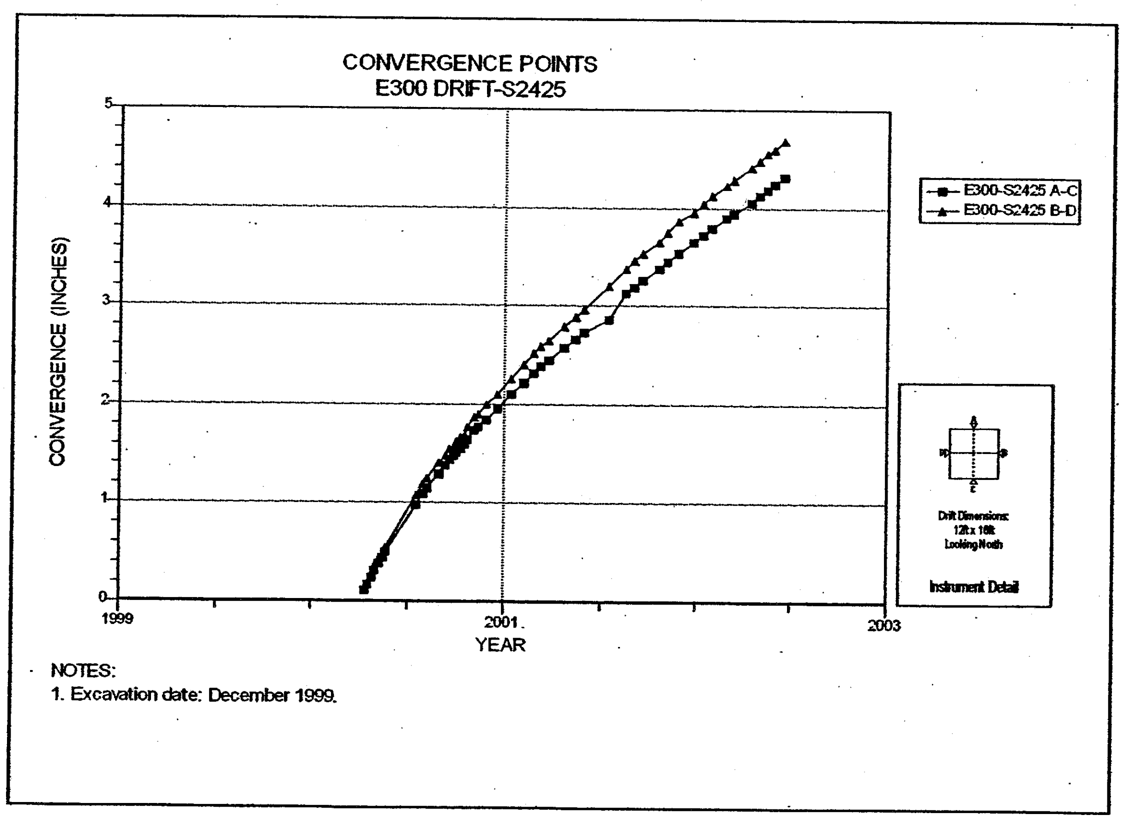
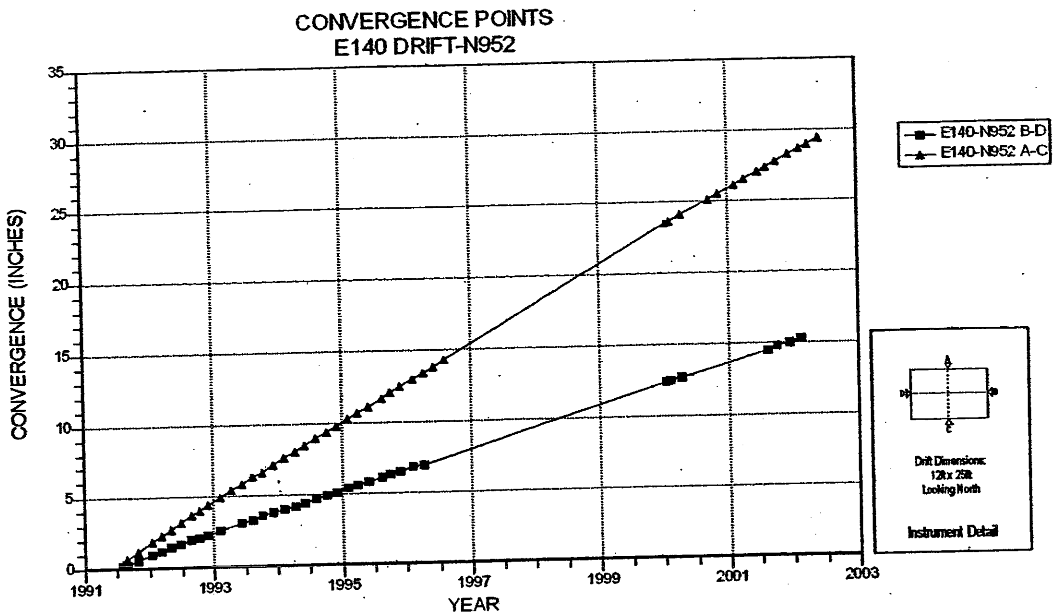
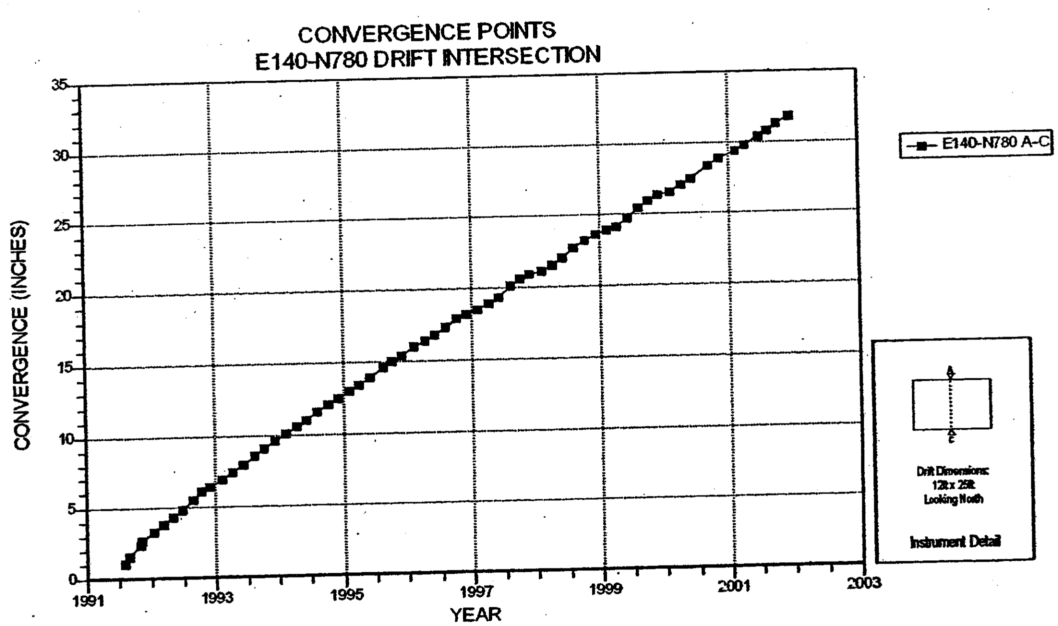


Figure 4-78 Convergence Point Array
E300 Drift at S2425 – All Chords



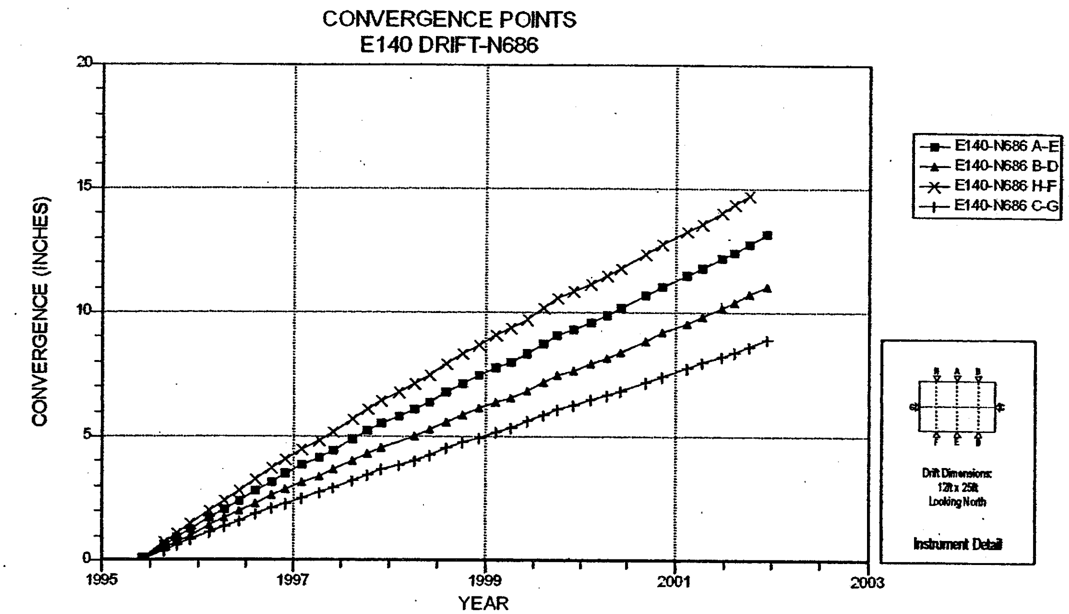
NOTES:
1. Excavation date: February 1983.
2. Not accessible from 8/96 to 1/00.

Figure 4-79 Convergence Point Array
E140 Drift at N952 – All Chords



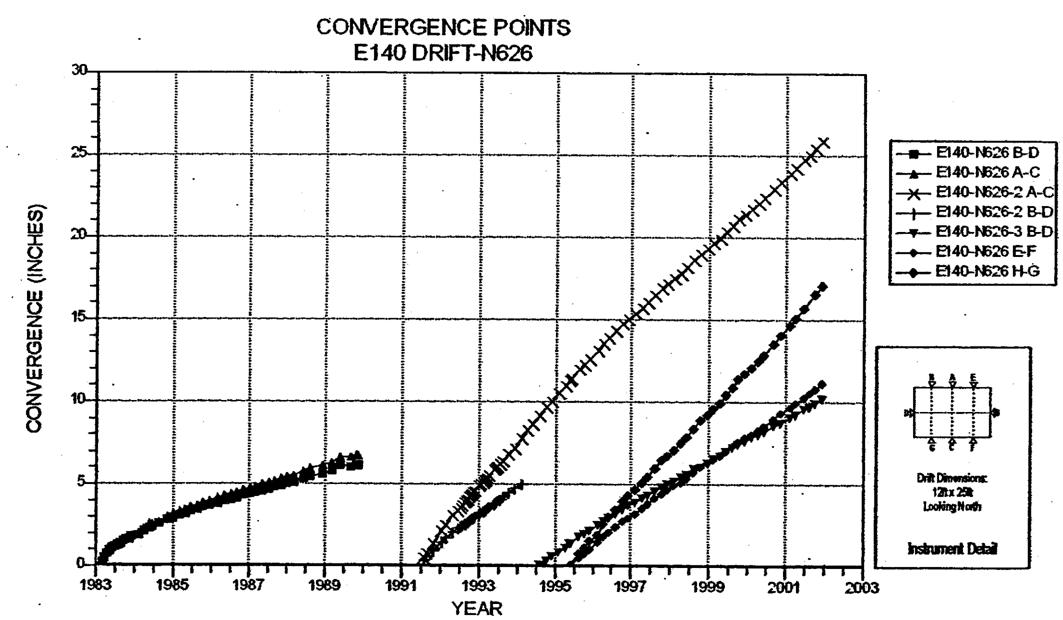
NOTES:
1. Excavation date: February 1983.
2. Mined out first quarter 2002.

Figure 4-80 Convergence Point Array
E140 Drift at N780 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: February 1983.
2. Enlarged from 8ft x 14ft in February 1990.
3. Current drift dimensions are 12ft x 25ft.
4. Mined out first quarter 2002.

**Figure 4-81 Convergence Point Array
E140 Drift at N686 – All Chords**



NOTES:
1. Excavation date: February 1983.
2. Enlarged from 8ft x 14ft in January 1990.
3. Current drift dimensions are 14ft x 25ft.
4. Mined out first quarter 2002.

**Figure 4-82 Convergence Point Array
E140 Drift at N626 – All Chords**

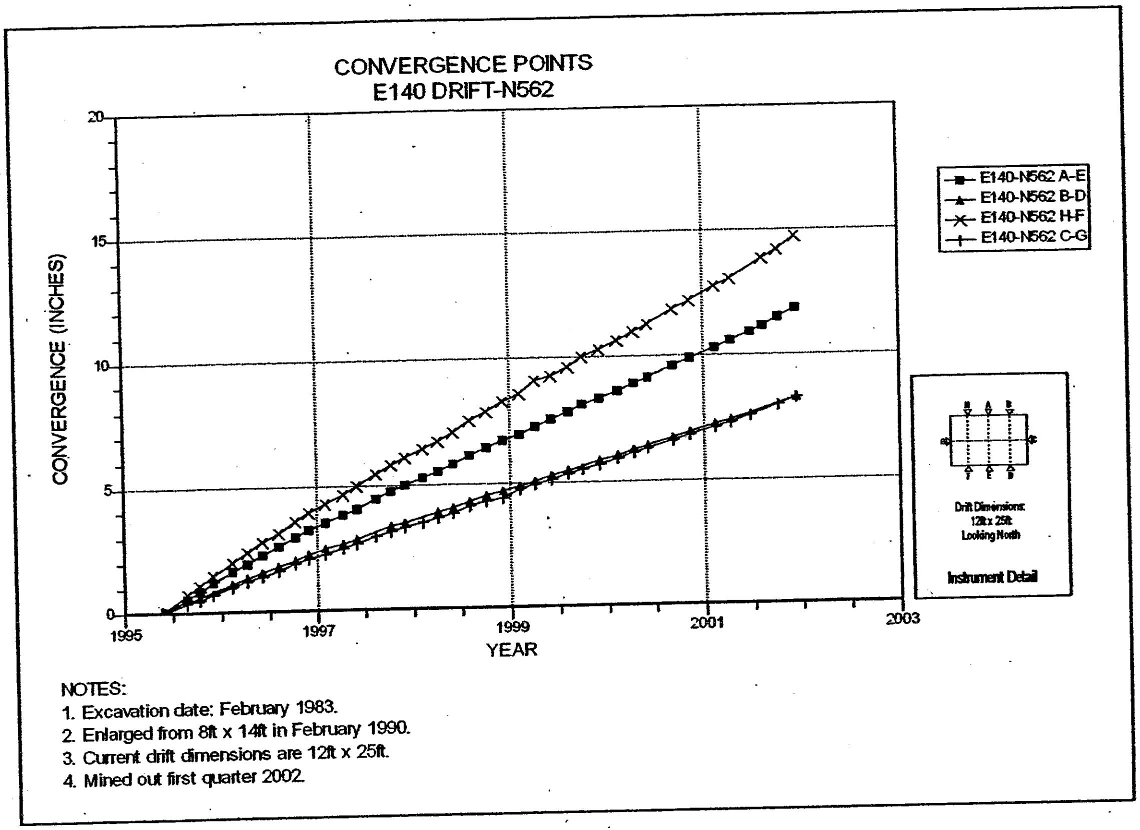


Figure 4-83 Convergence Point Array E140 Drift at N562 – All Chords

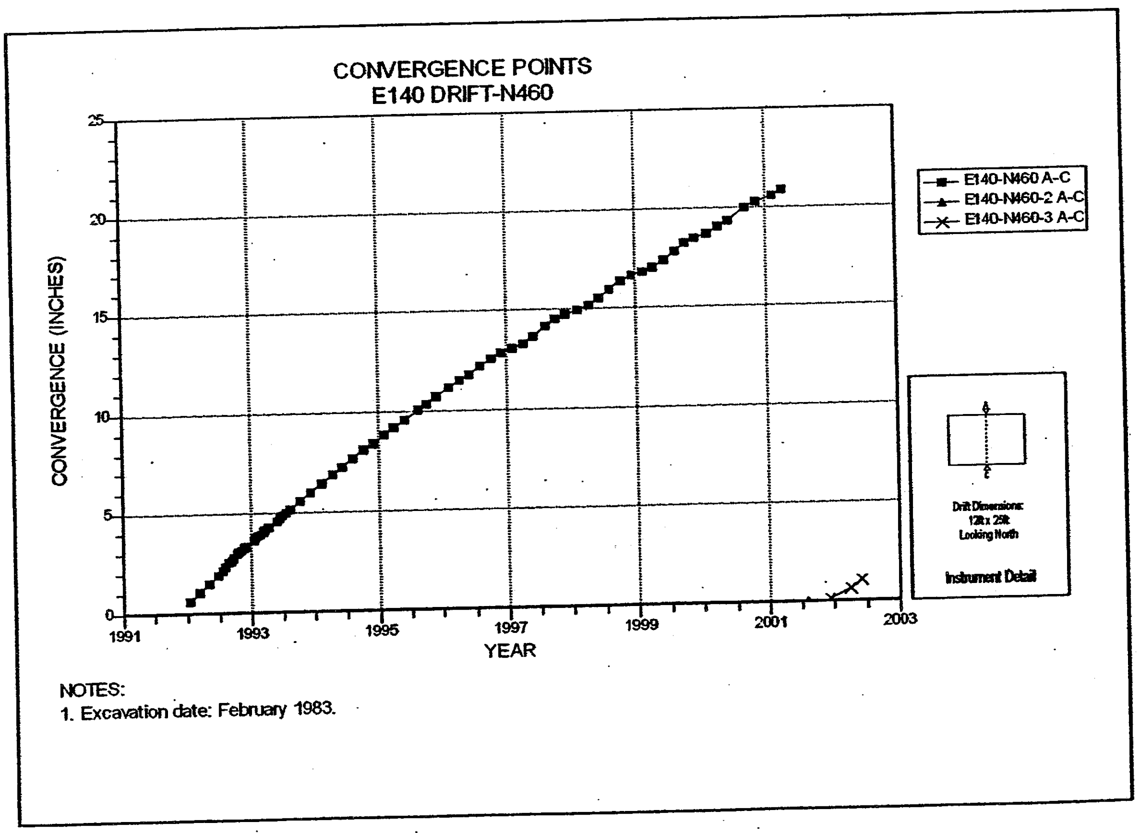


Figure 4-84 Convergence Point Array E140 Drift at N460 Drift Intersection – Roof to Floor

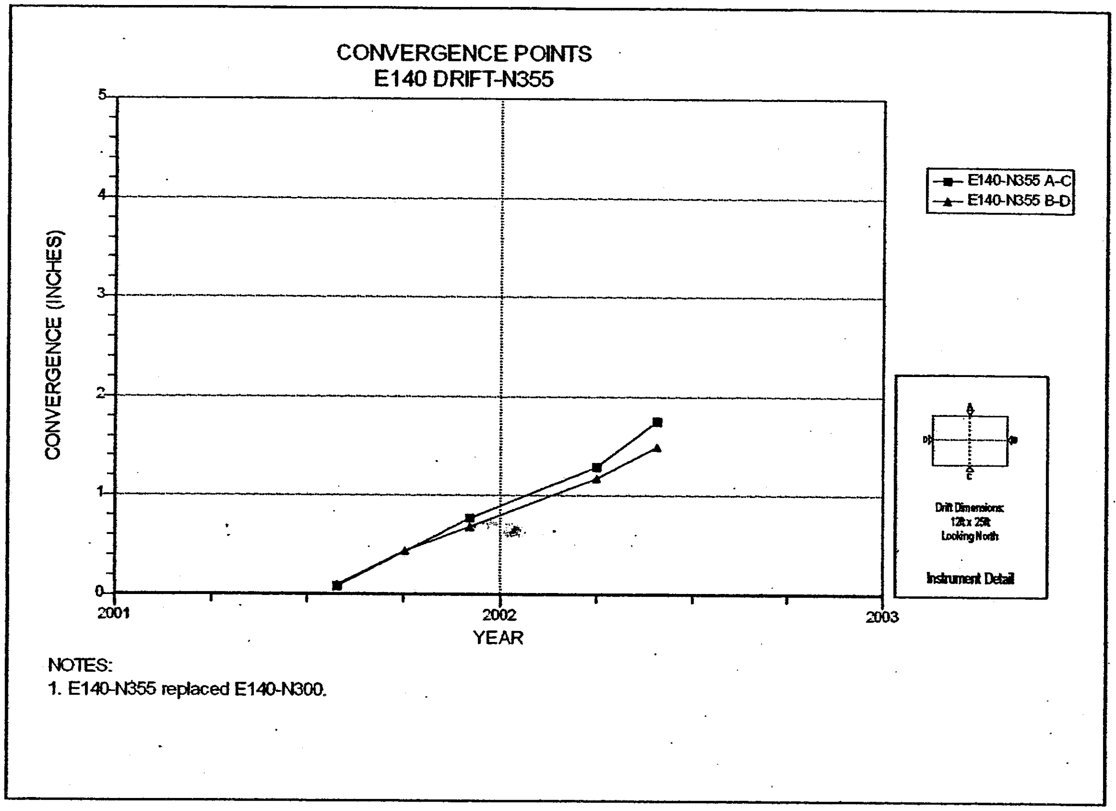


Figure 4-85 Convergence Point Array E140 Drift at N355 – All Chords

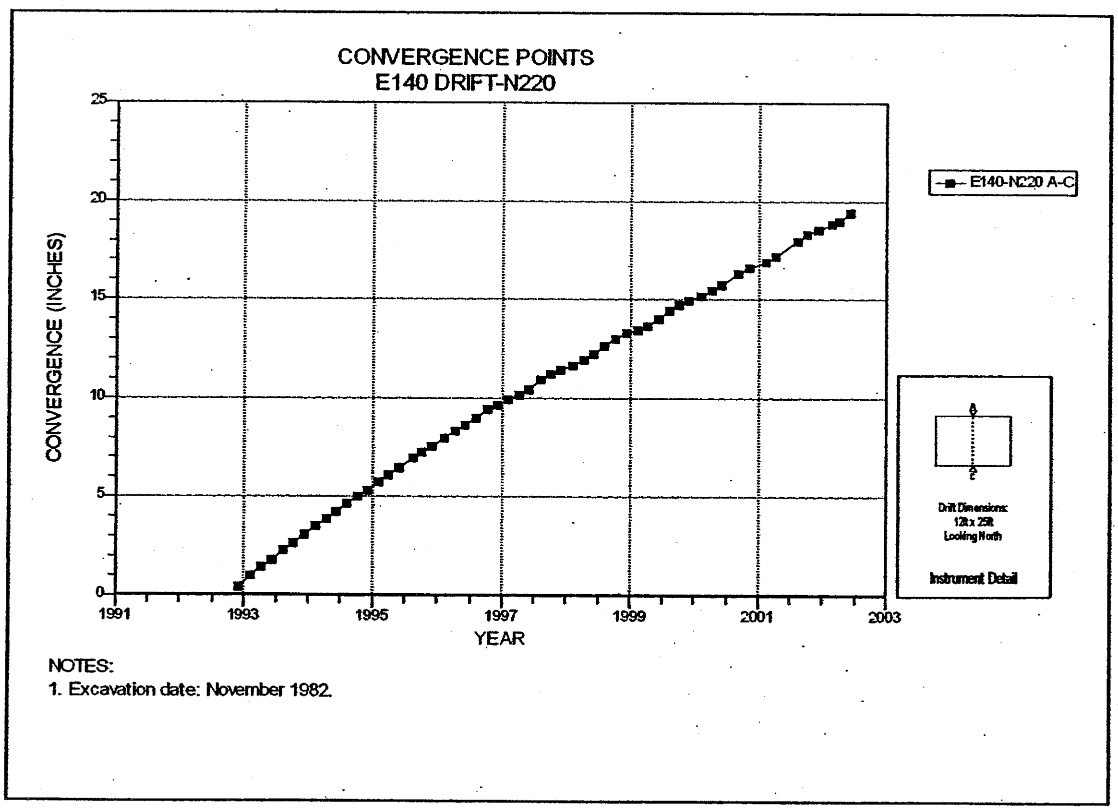


Figure 4-86 Convergence Point Array E140 Drift at N220 – Roof to Floor

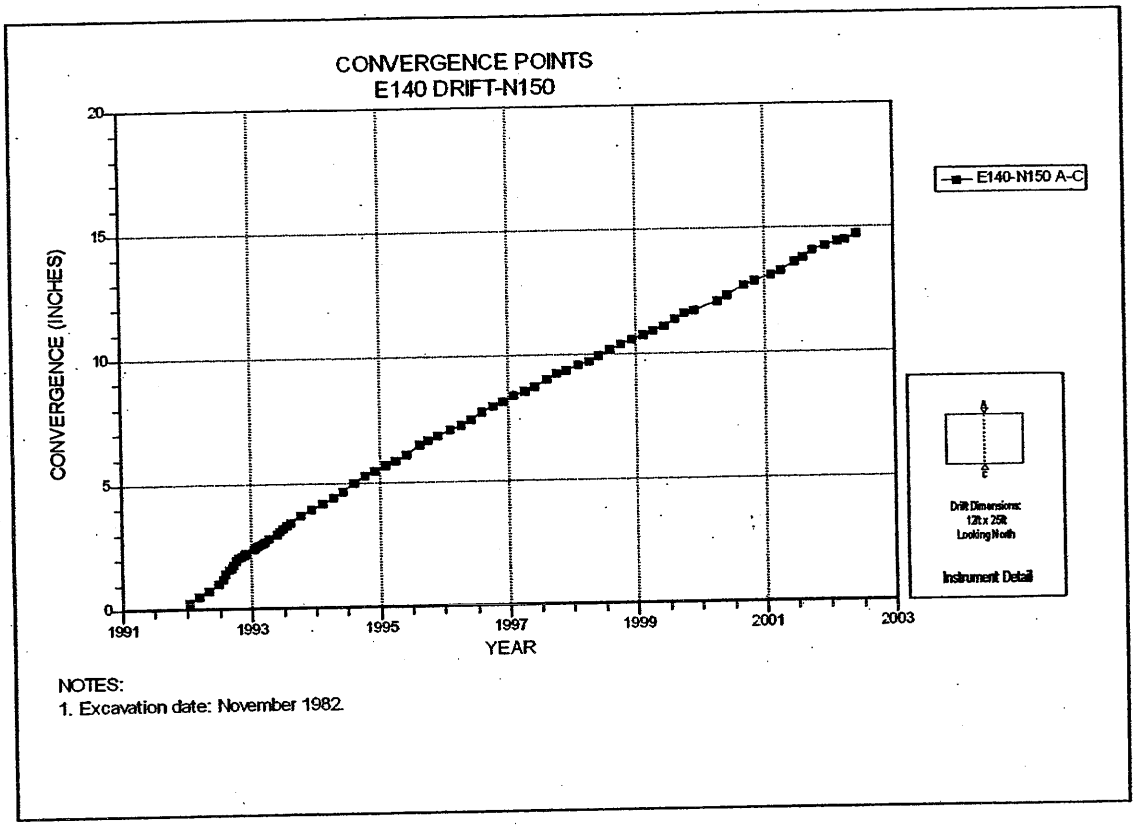


Figure 4-87 Convergence Point Array
E140 Drift at N150 Drift Intersection – Roof to Floor

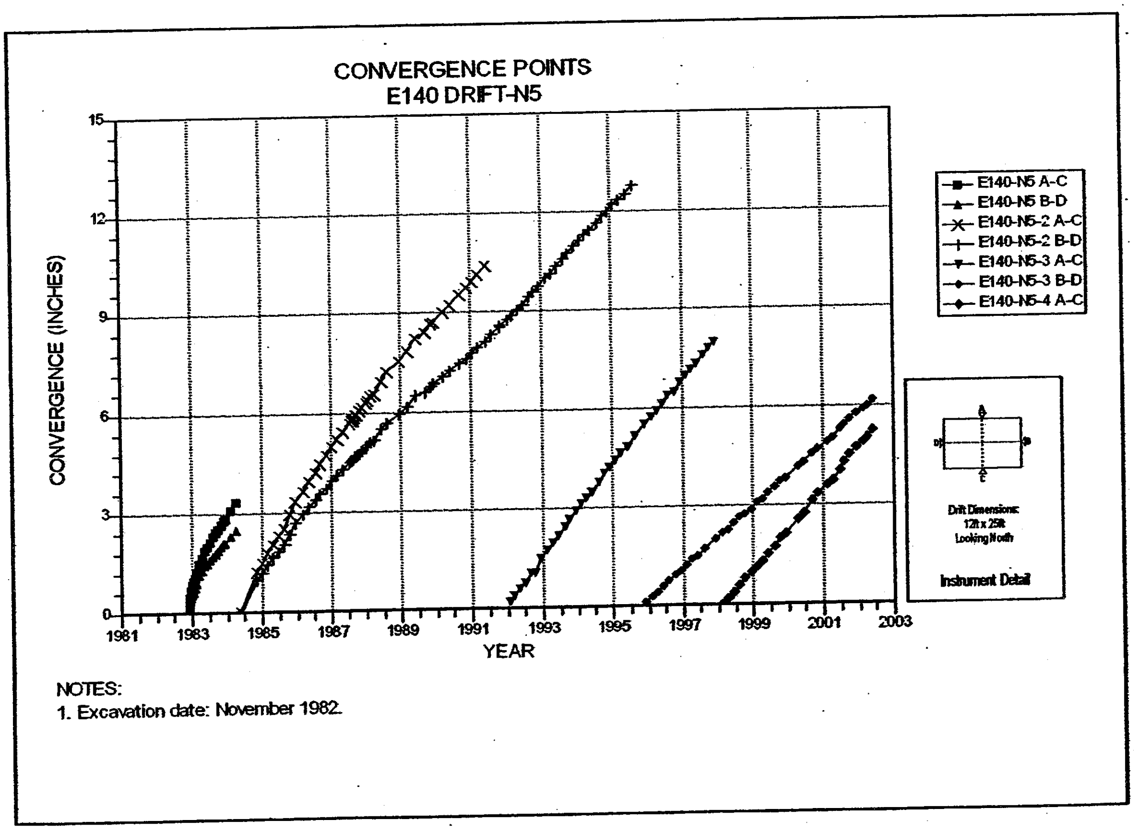


Figure 4-88 Convergence Point Array
E140 Drift at N5 – All Chords

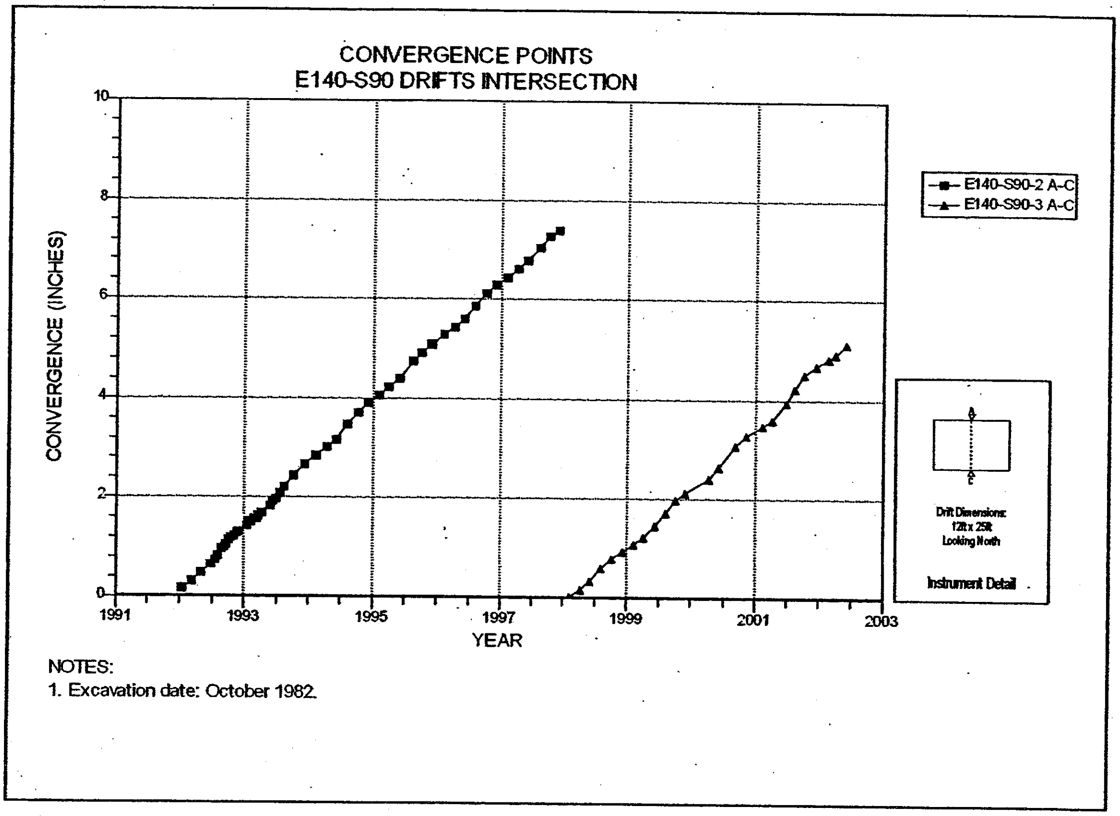


Figure 4-89 Convergence Point Array
E140 Drift at S90 Drift Intersection – Roof to Floor

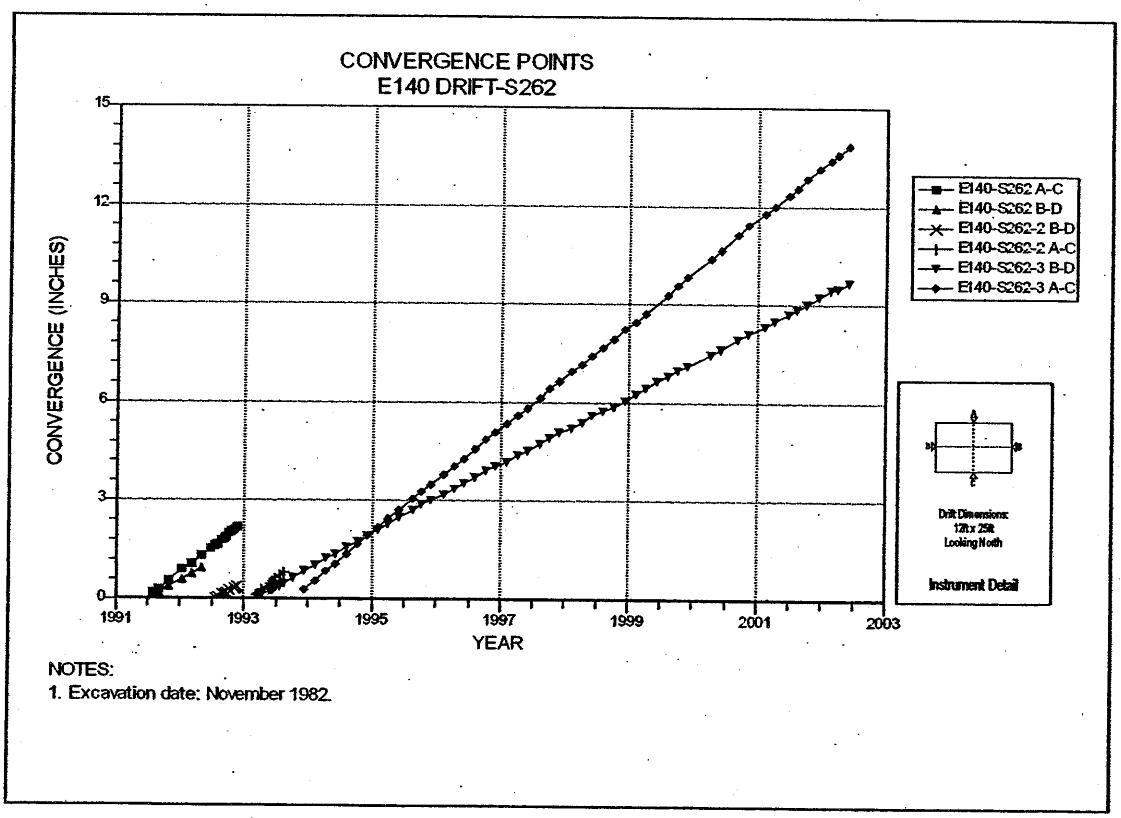
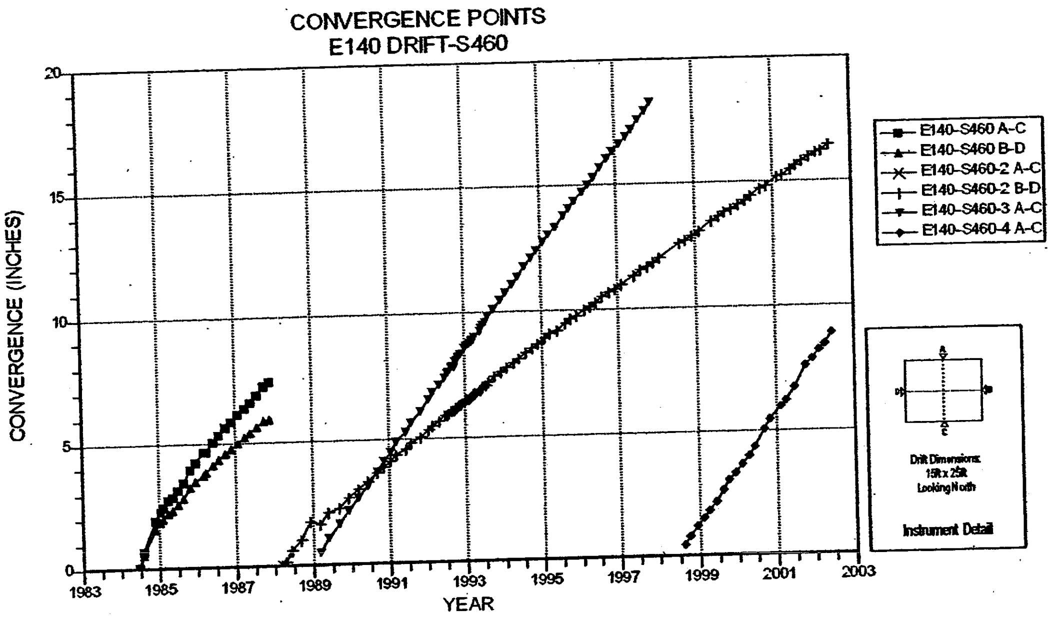
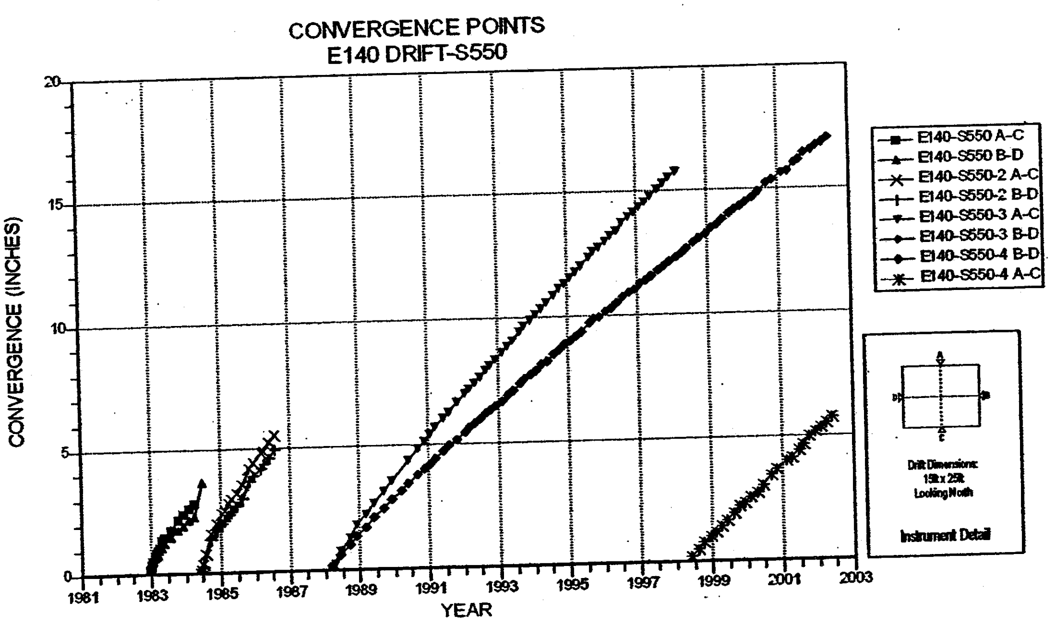


Figure 4-90 Convergence Point Array
E140 Drift at S262 – All Chords



NOTES:
1. Excavation date: December 1982

Figure 4-91 Convergence Point Array
E140 Drift at S460 – All Chords



NOTES:
1. Excavation date: December 1982

Figure 4-92 Convergence Point Array
E140 Drift at S550 – All Chords

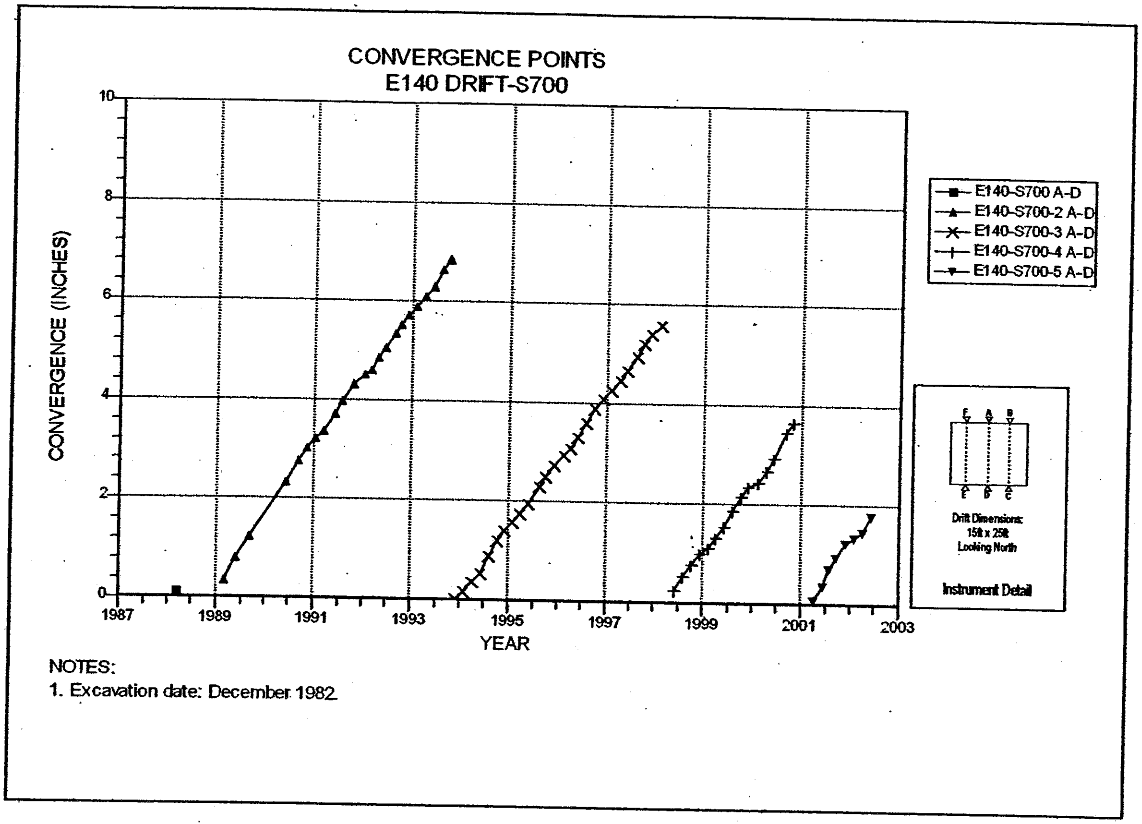


Figure 4-93 Convergence Point Array
E140 Drift at S700 Drift Intersection – Roof to Floor Centerline

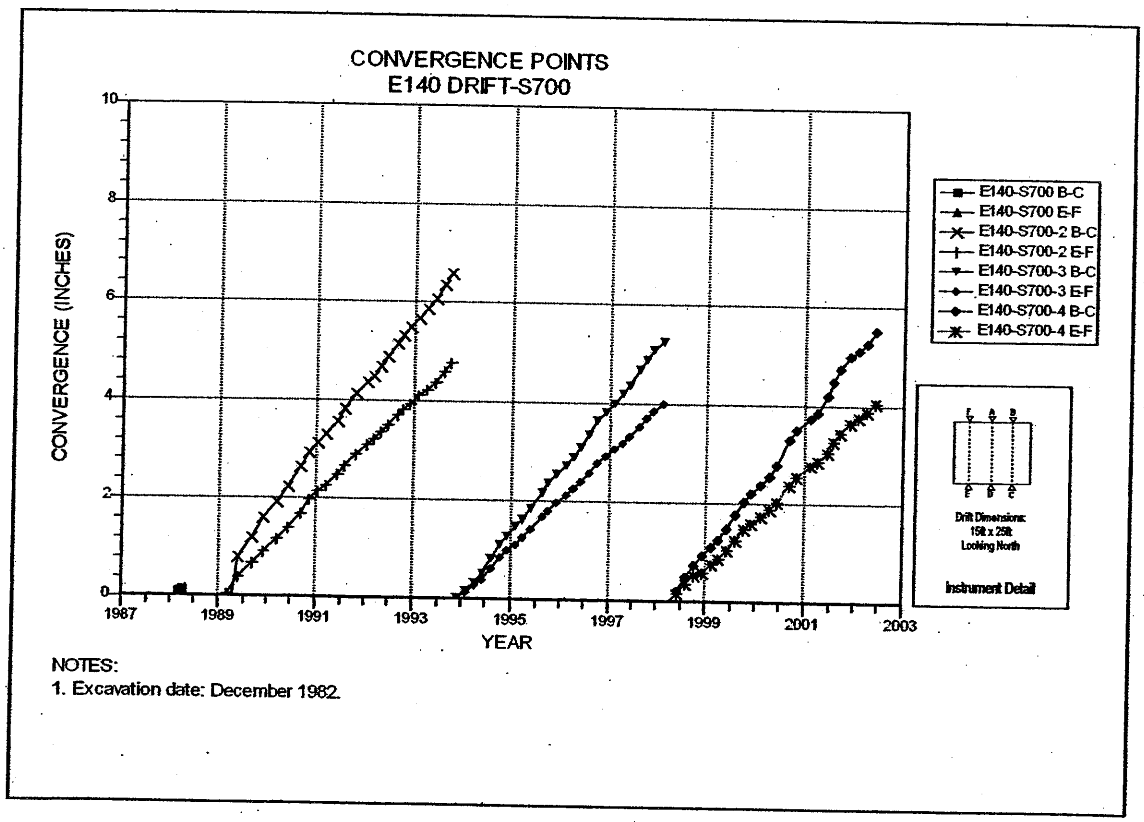


Figure 4-94 Convergence Point Array
E140 Drift at S700 Drift Intersection – Roof to Floor Quarter Points

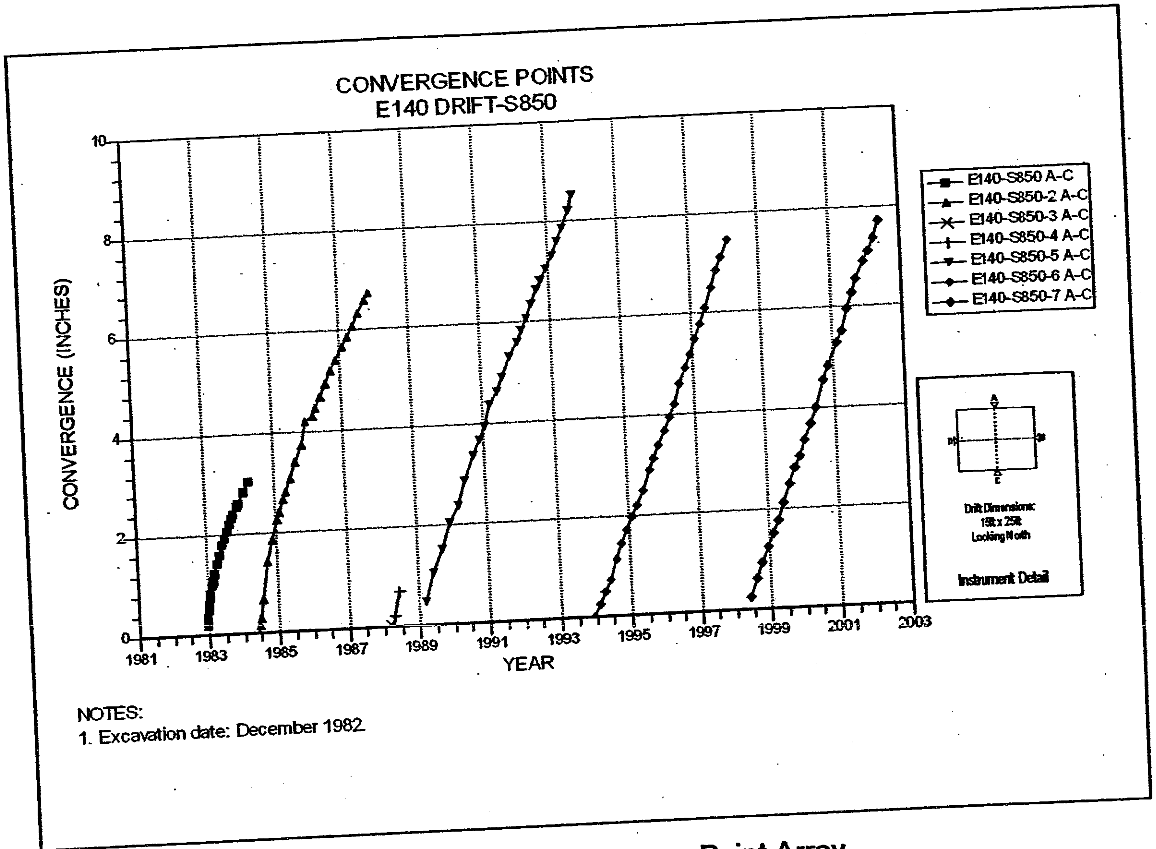


**Figure 4-95 Convergence Point Array
E140 Drift at S850 – Roof to Floor**

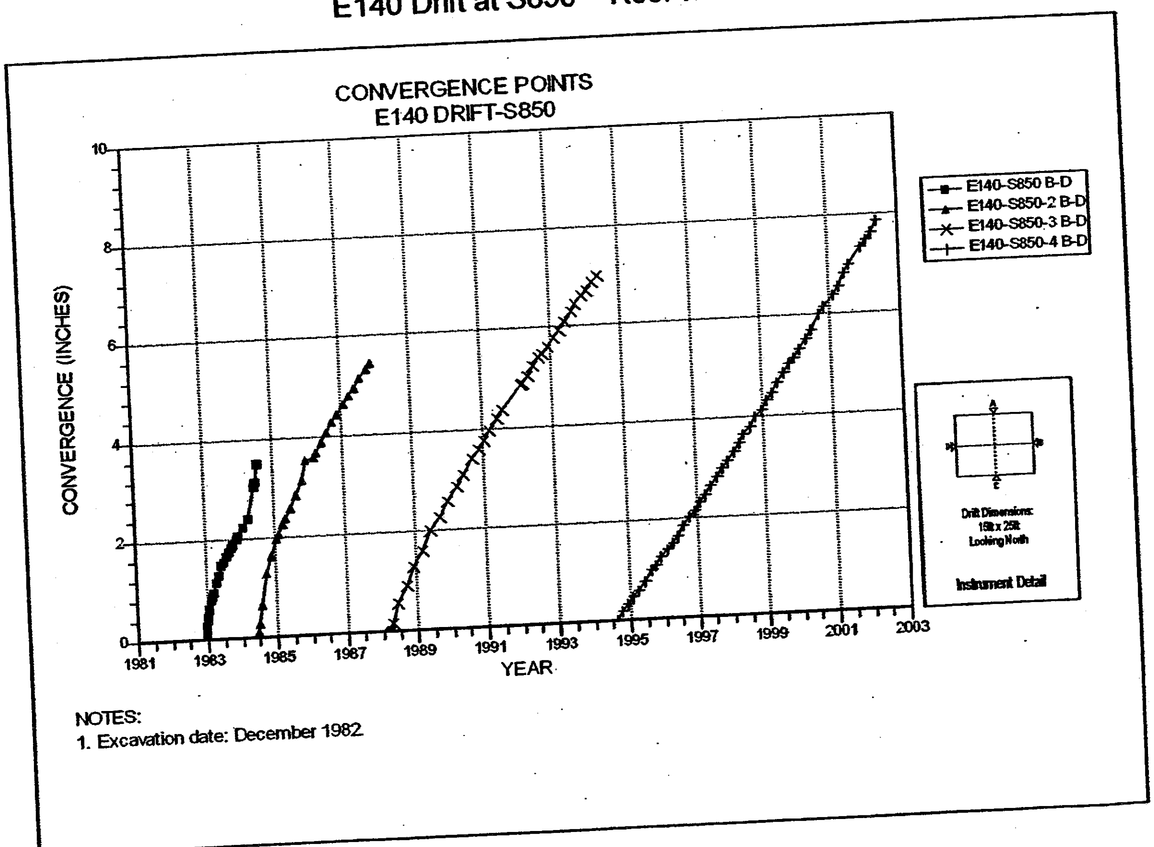
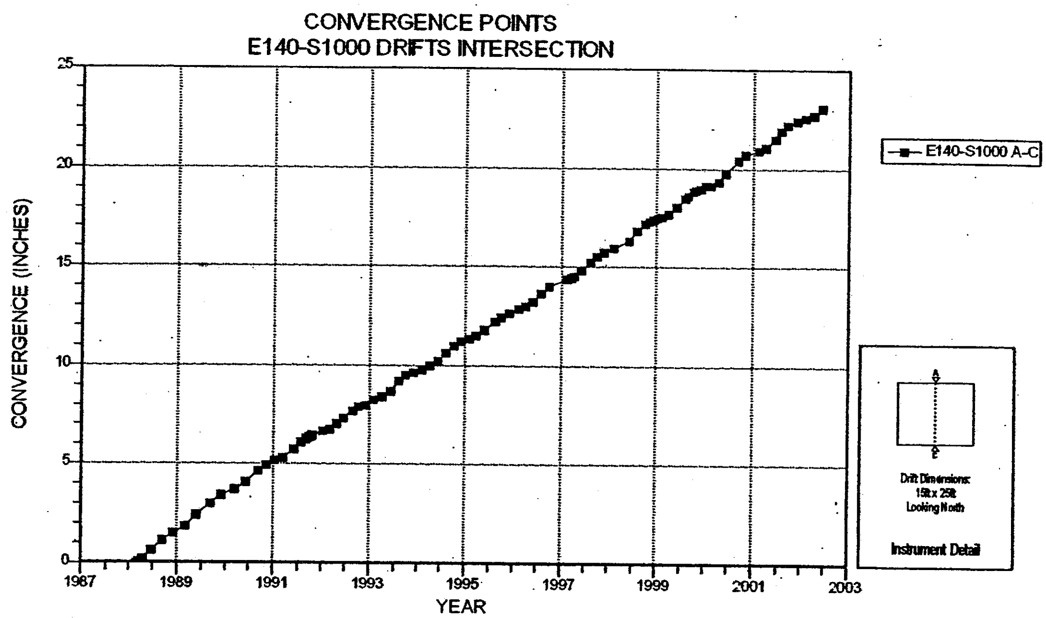
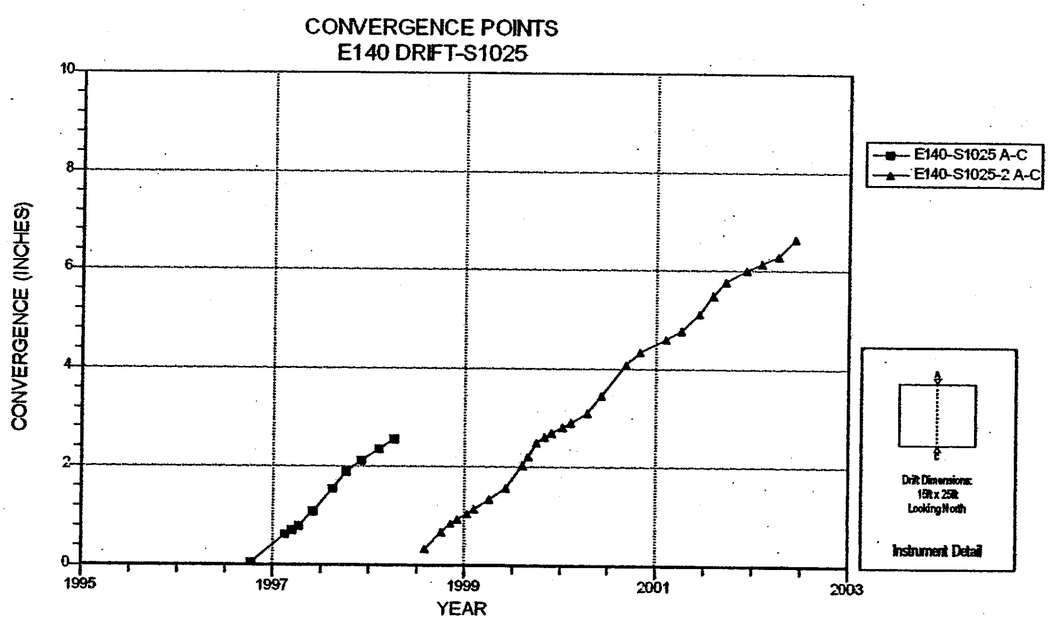


**Figure 4-96 Convergence Point Array
E140 Drift at S850 – Rib to Rib**



NOTES:
1. Excavation date: December 1982.

Figure 4-97 Convergence Point Array
E140 Drift at S1000 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: December 1982.

Figure 4-98 Convergence Point Array
E140 Drift at S1025 – Roof to Floor

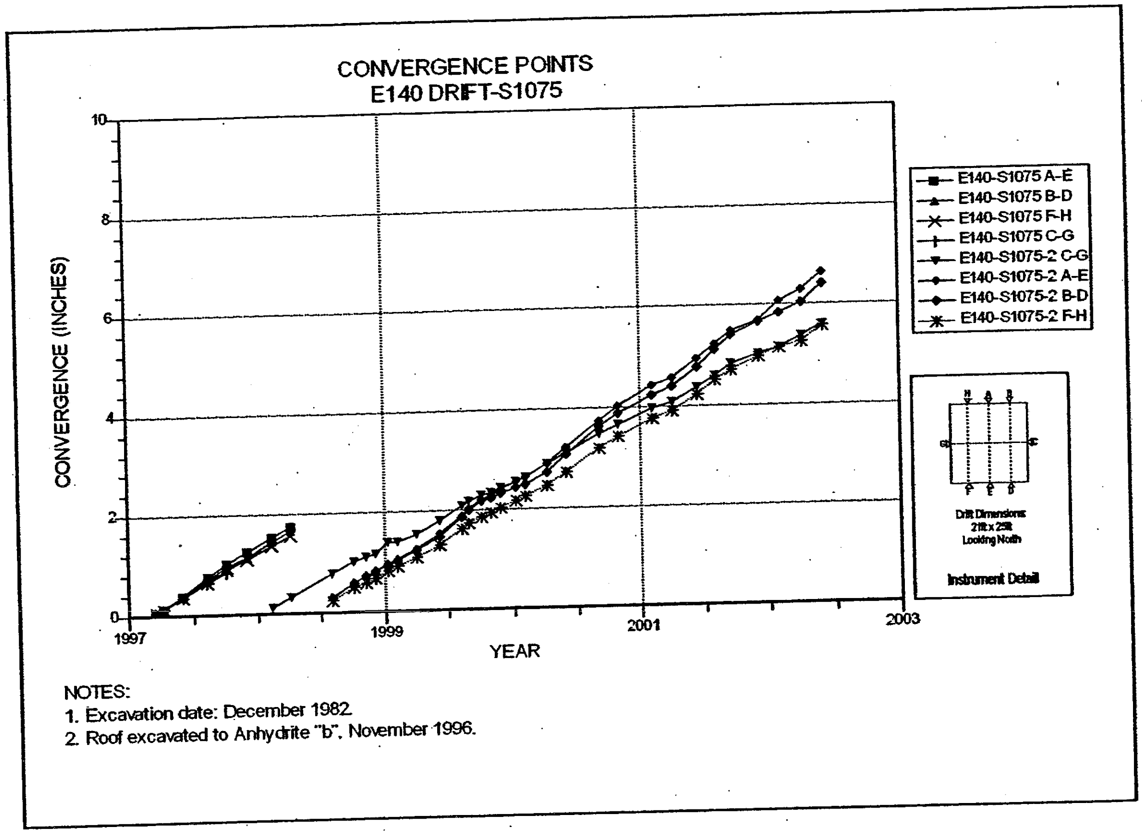


Figure 4-99 Convergence Point Array
E140 Drift at S1075 – All Chords

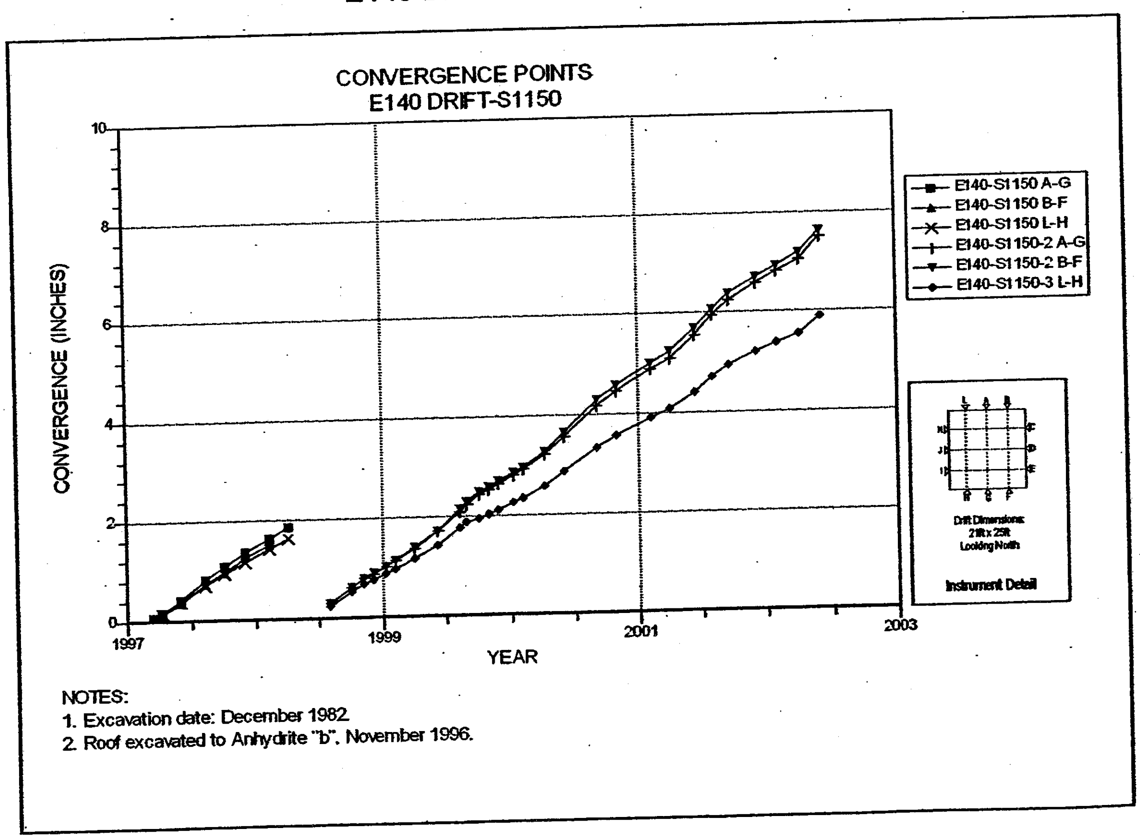


Figure 4-100 Convergence Point Array
E140 Drift at S1150 – Roof to Floor – Replacement Array

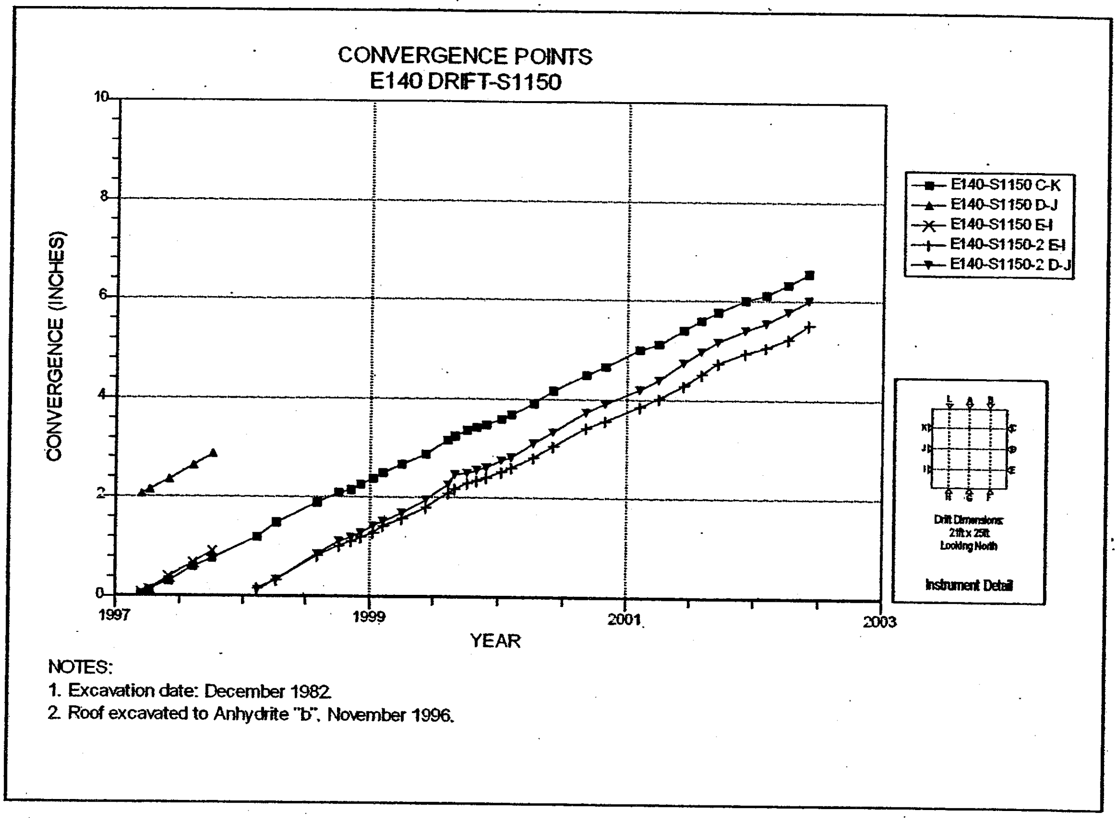


Figure 4-101 Convergence Point Array
E140 Drift at S1150 – Rib to Rib – Replacement Array

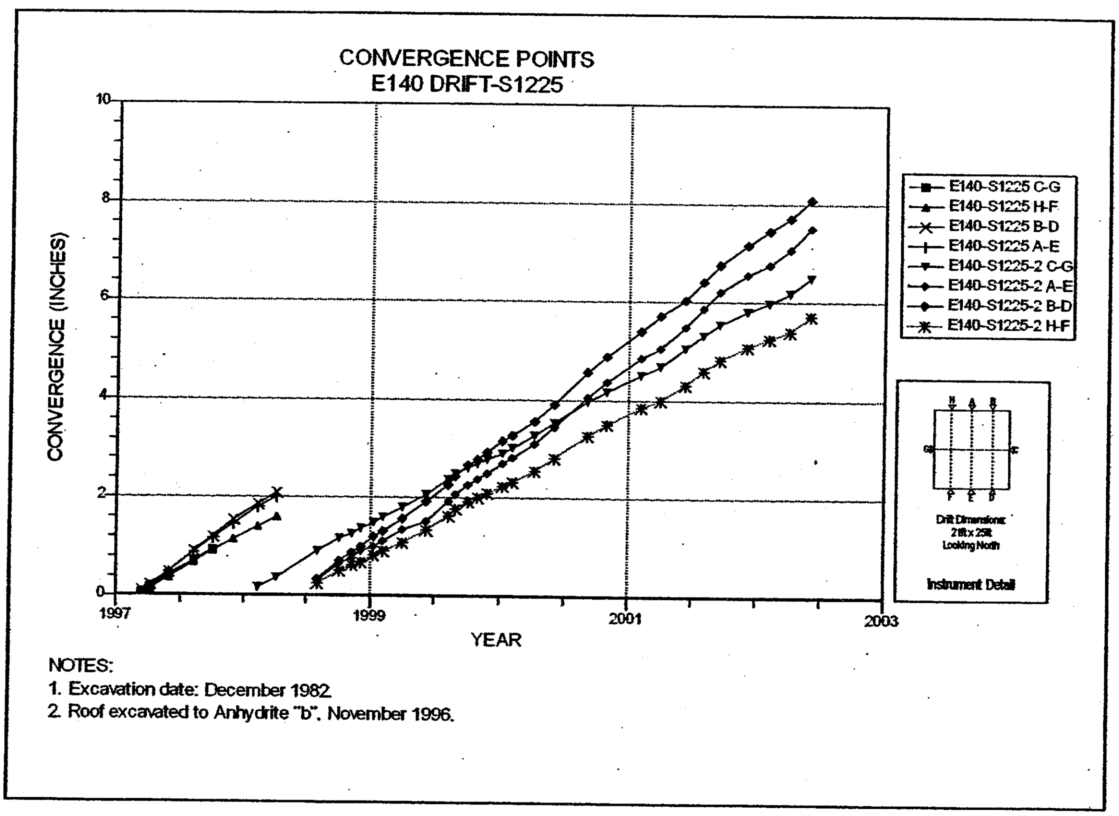
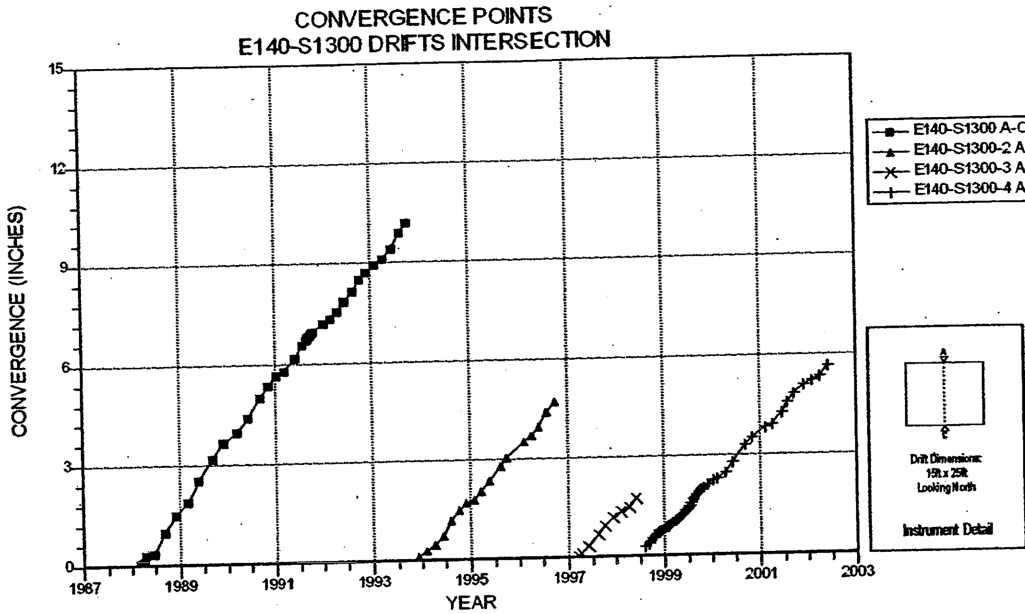
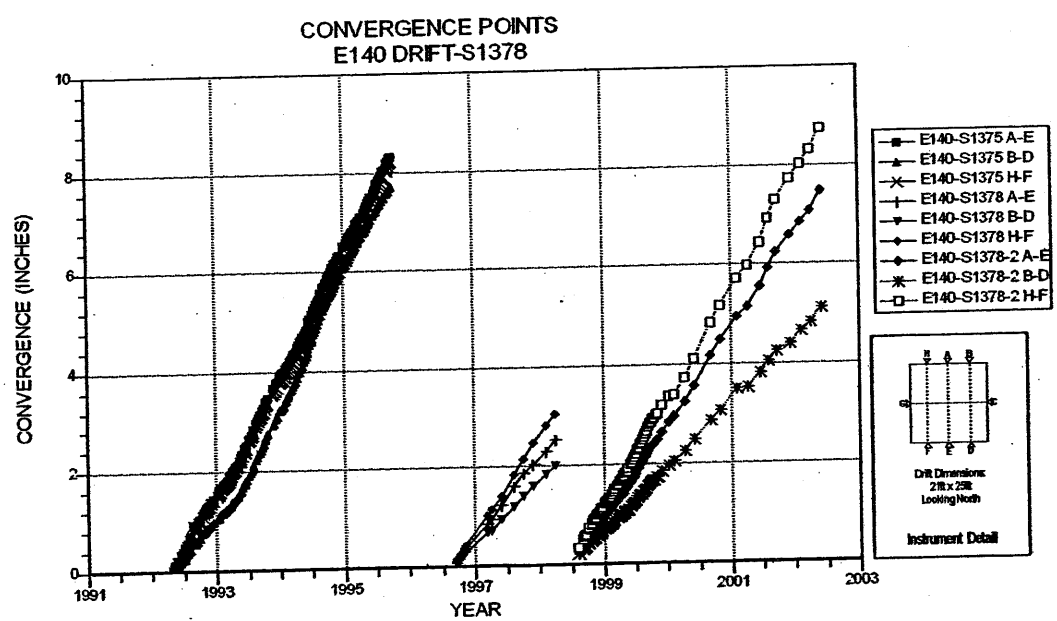


Figure 4-102 Convergence Point Array
E140 Drift at S1225 – All Chords



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1996.
3. Current drift dimensions are 21ft x 25ft.

Figure 4-103 Convergence Point Array
E140 Drift at S1300 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1995.
3. Current drift dimensions are 21ft x 25ft.

Figure 4-104 Convergence Point Array
E140 Drift at S1378 – Roof to Floor

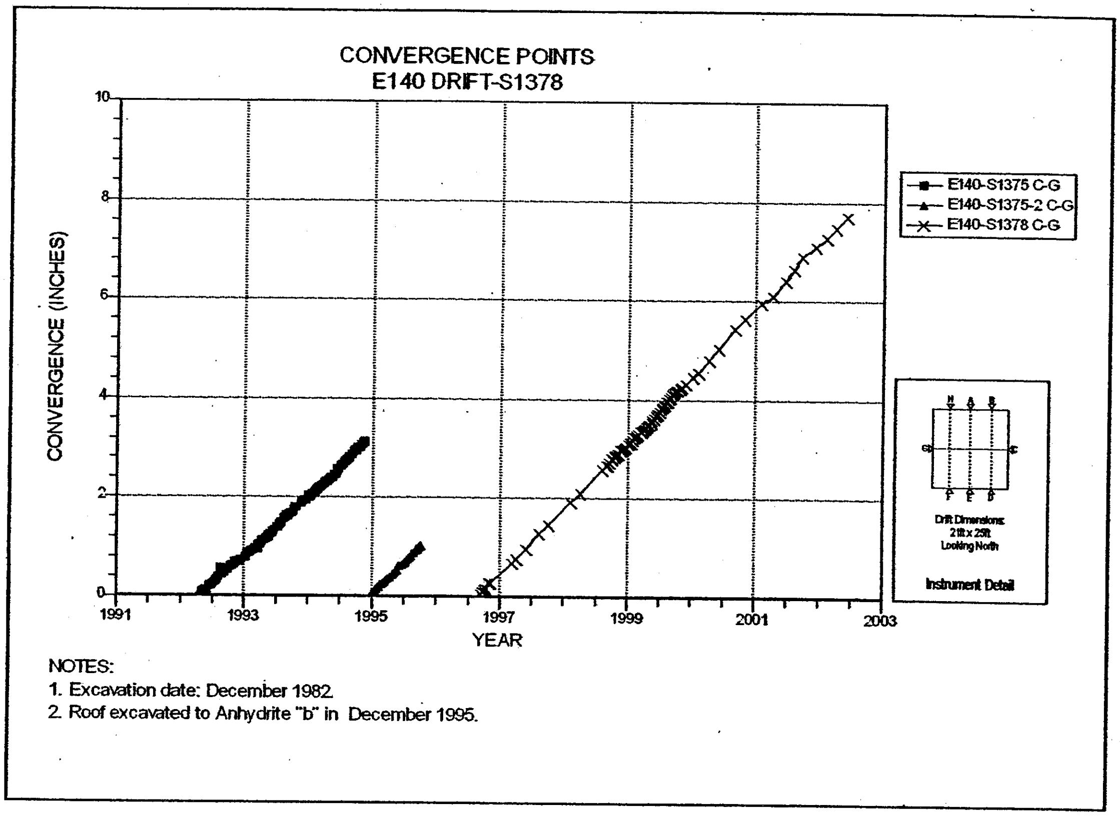


**Figure 4-105 Convergence Point Array
E140 Drift at S1378 – Rib to Rib**

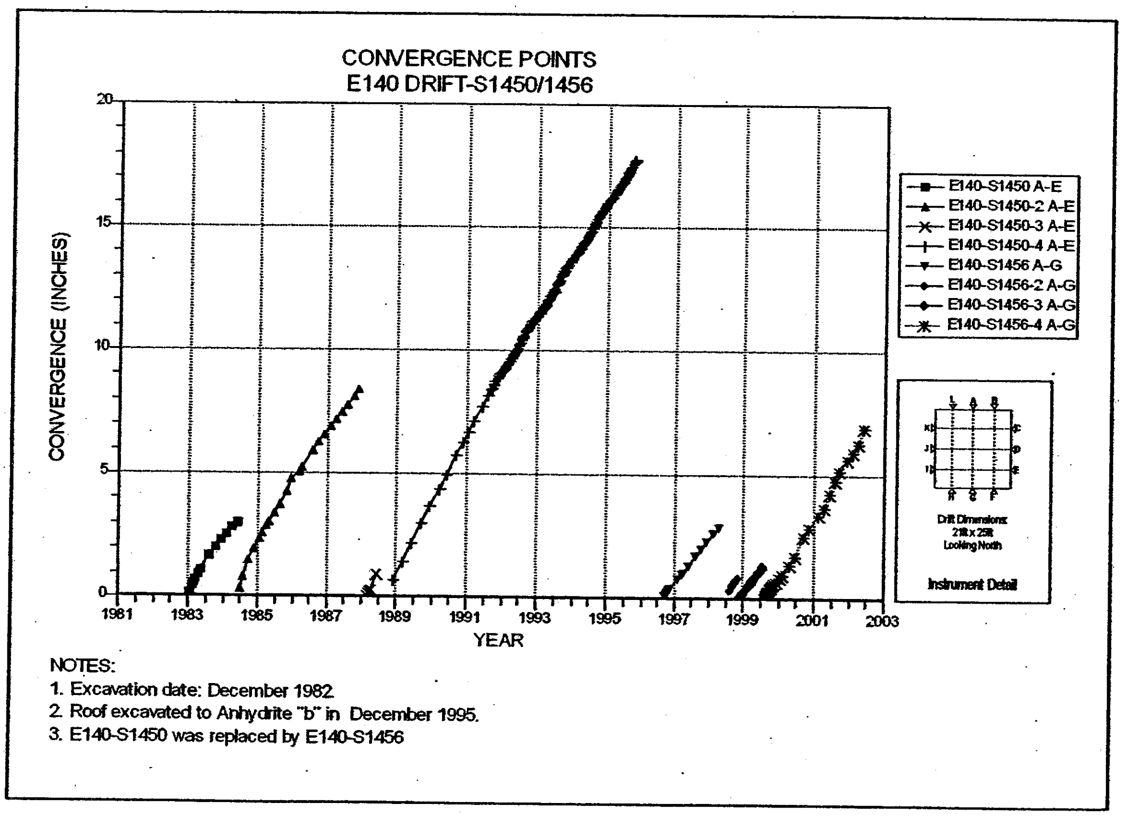


**Figure 4-106 Convergence Point Array
E140 Drift at S1450/S1456 – Roof to Floor – Centerline**

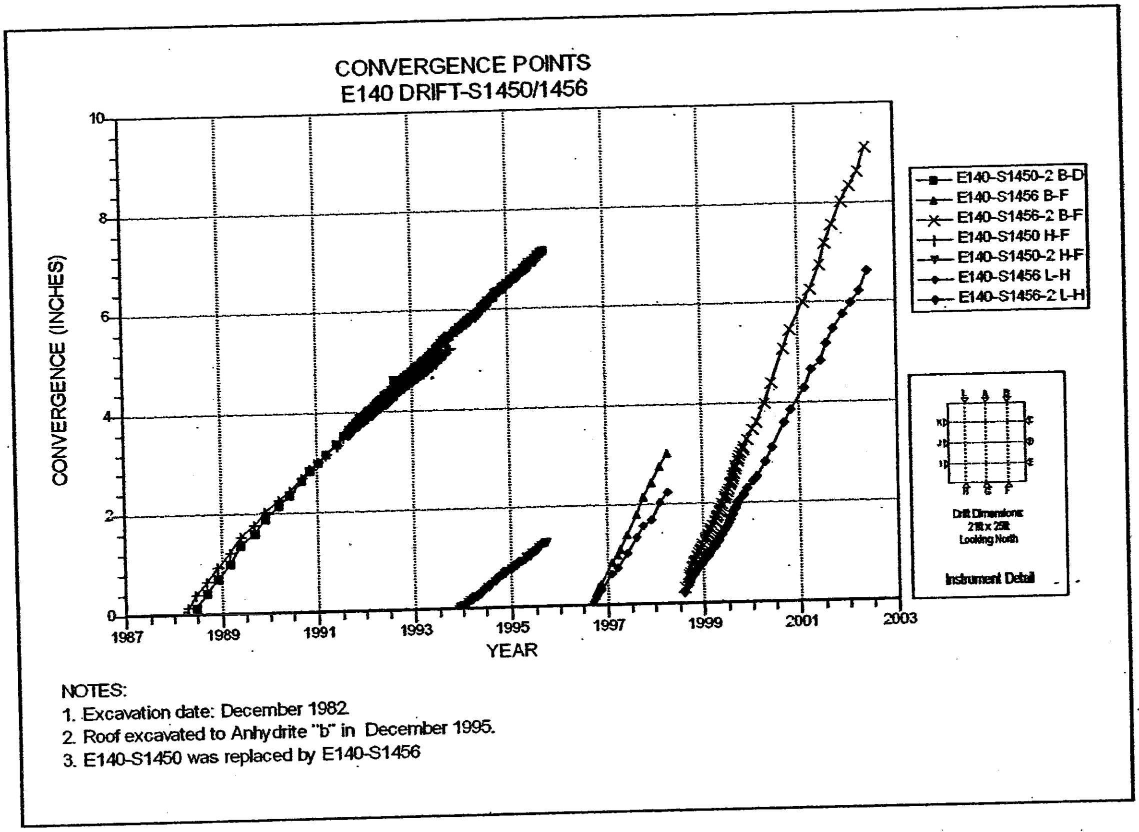


Figure 4-107 Convergence Point Array
E140 Drift at S1450/S1456 – Roof to Floor – Quarter Points

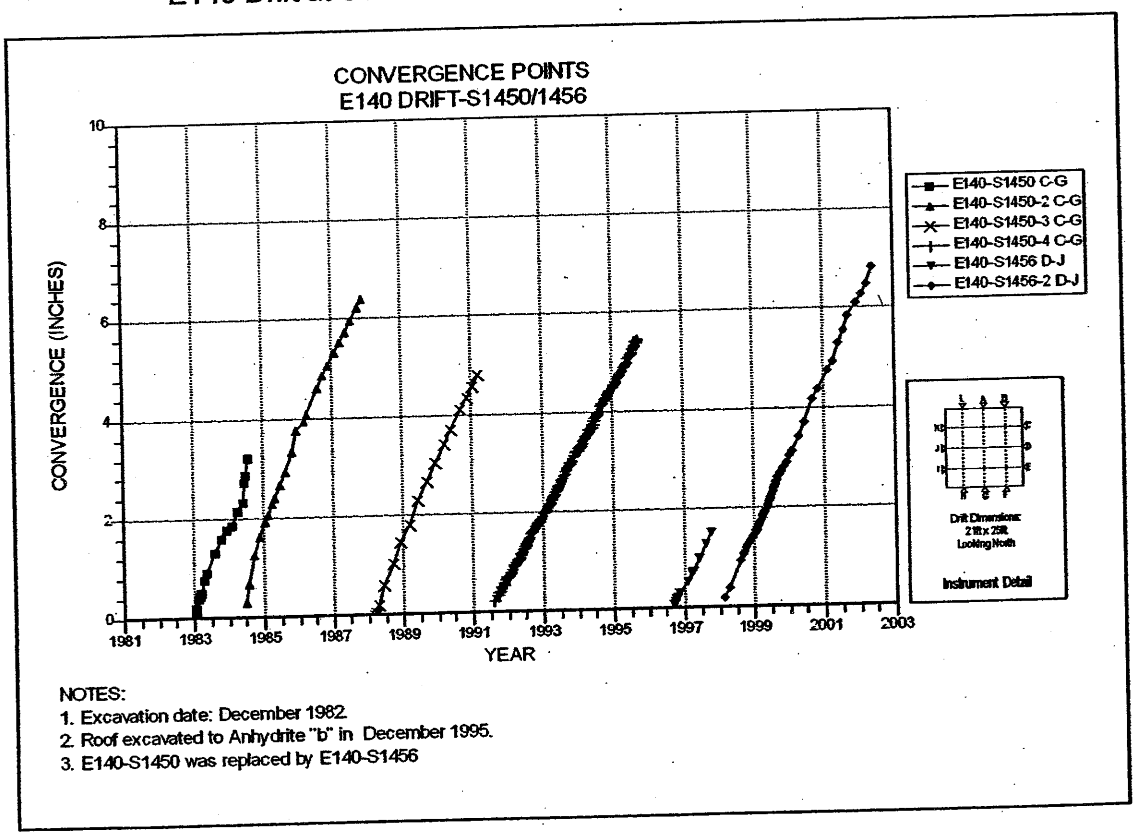
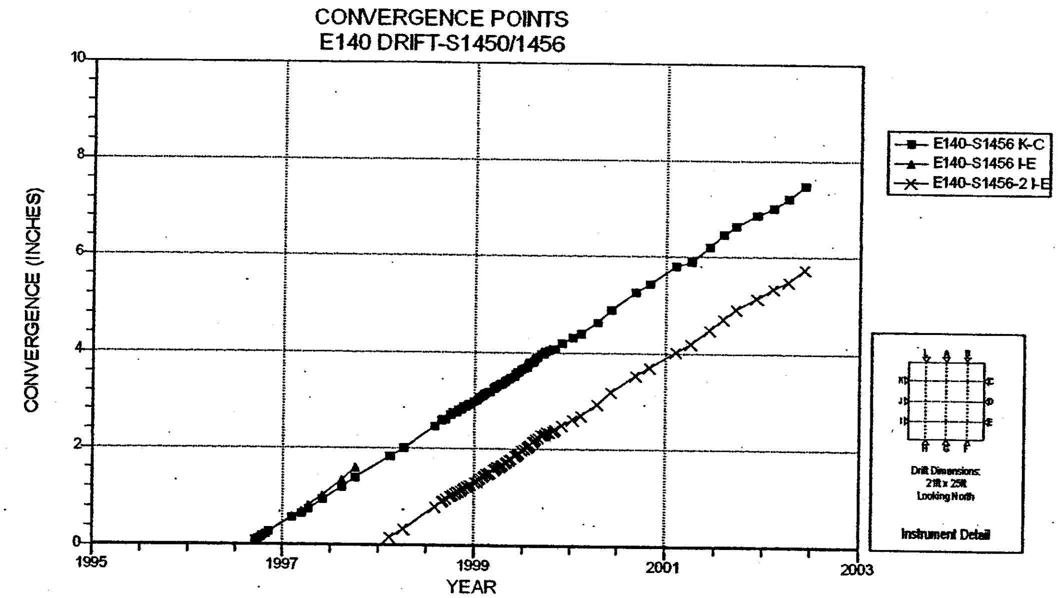
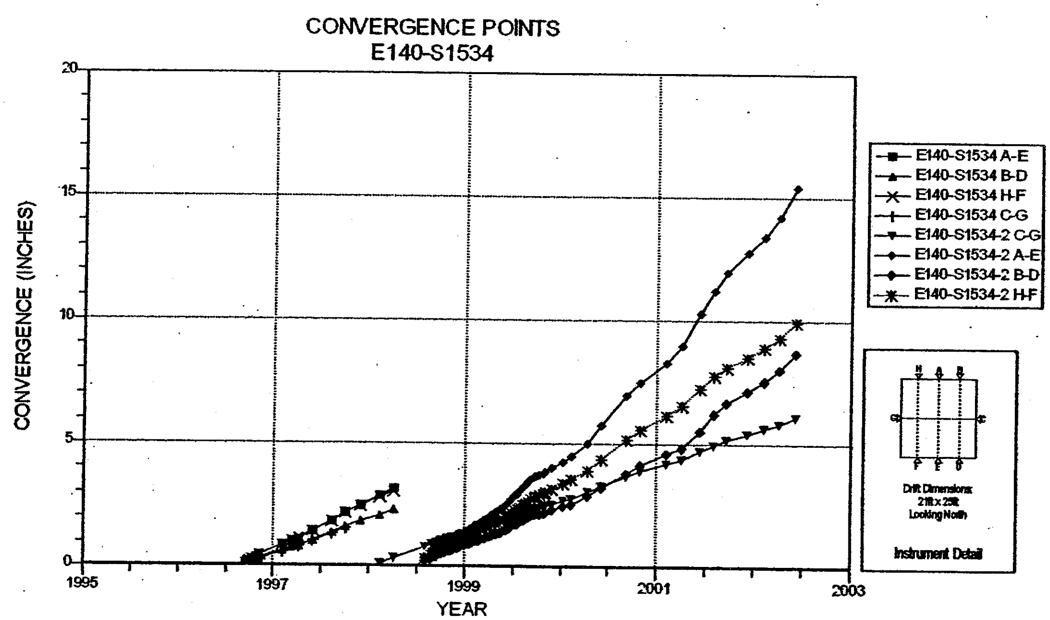


Figure 4-108 Convergence Point Array
E140 Drift at S1450/S1456 – Rib to Rib – Midheight



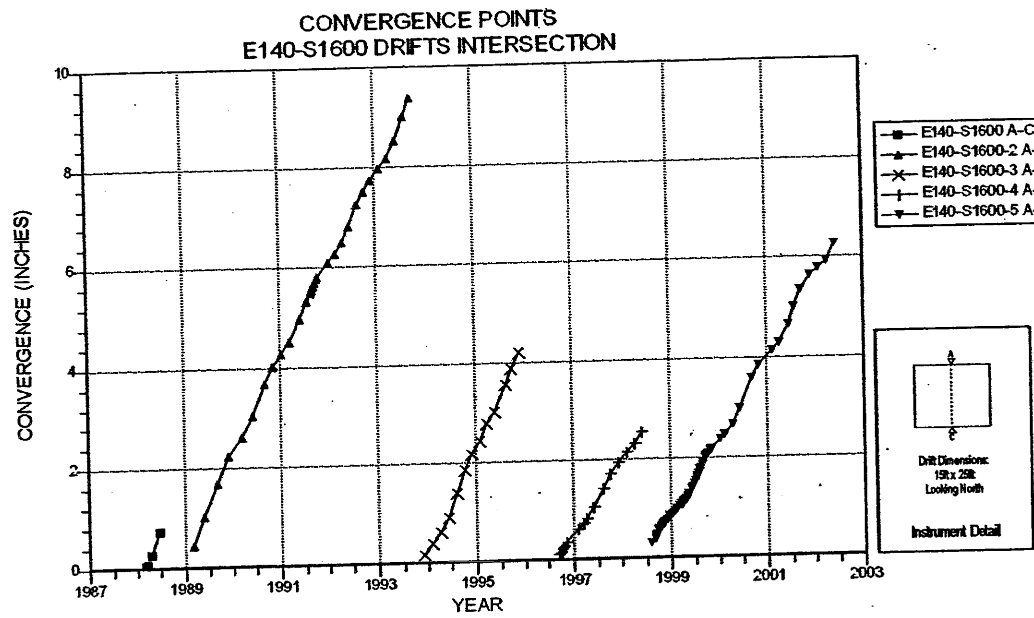
NOTES:
1. Excavation date: December 1982
2. Roof excavated to Anhydrite "b" in December 1995.
3. E140-S1450 was replaced by E140-S1456

Figure 4-109 Convergence Point Array
E140 Drift at S1450/S1456 – Rib to Rib – Quarter Points



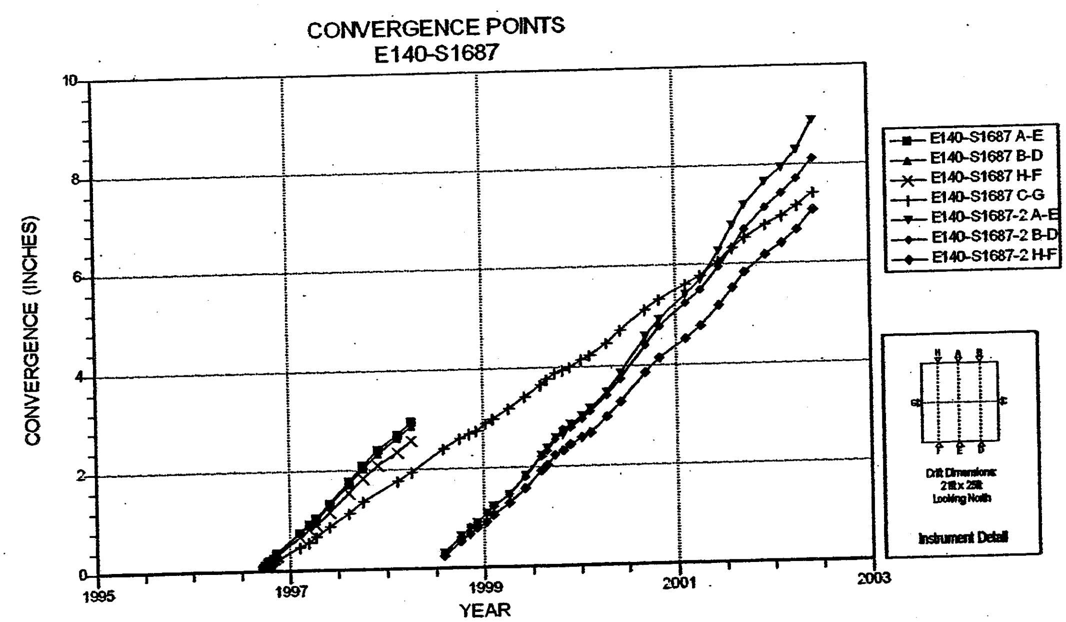
NOTES:
1. Excavation date: December 1982
2. Roof excavated to Anhydrite "b" in late 1995.

Figure 4-110 Convergence Point Array
E140 Drift at S1534 – All Chords



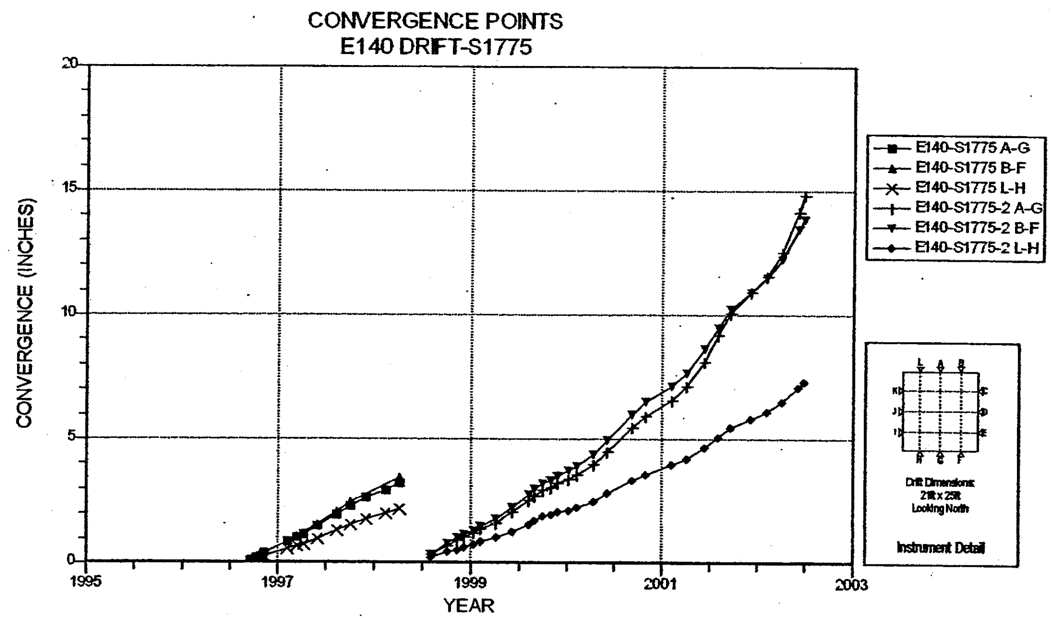
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in December 1996.
3. Current drift dimensions are 21ft x 25ft.

Figure 4-111 Convergence Point Array
E140 Drift at S1600 Drift Intersection – Roof to Floor



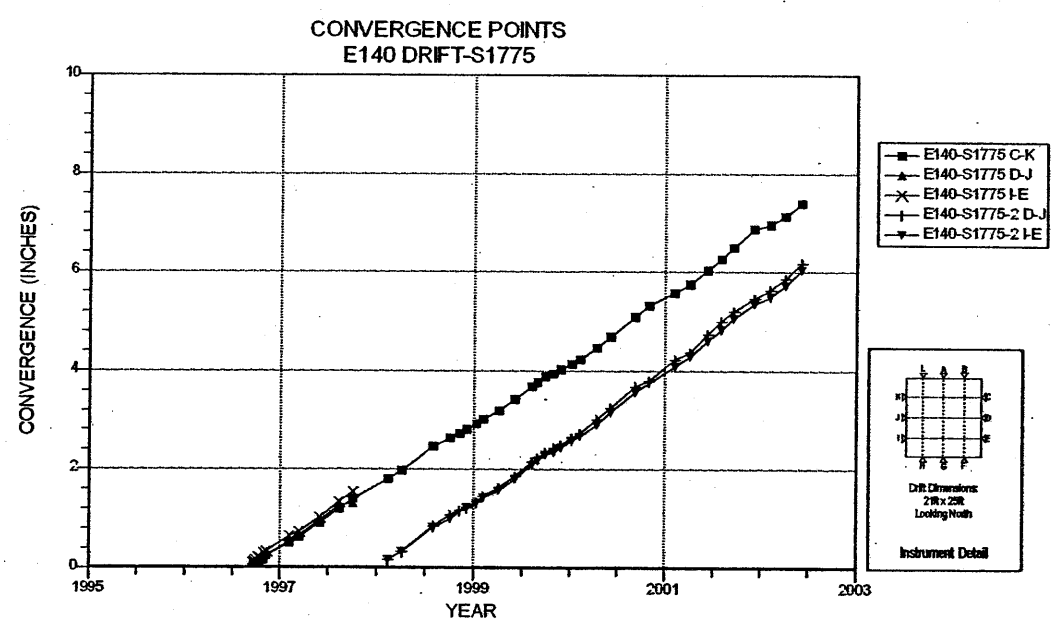
NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in early 1996.

Figure 4-112 Convergence Point Array
E140 Drift at S1687 – All Chords



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in early 1996.

Figure 4-113 Convergence Point Array
E140 Drift at S1775 – Roof to Floor



NOTES:
1. Excavation date: December 1982.
2. Roof excavated to Anhydrite "b" in early 1996.

Figure 4-114 Convergence Point Array
E140 Drift at S1775 – Rib to Rib

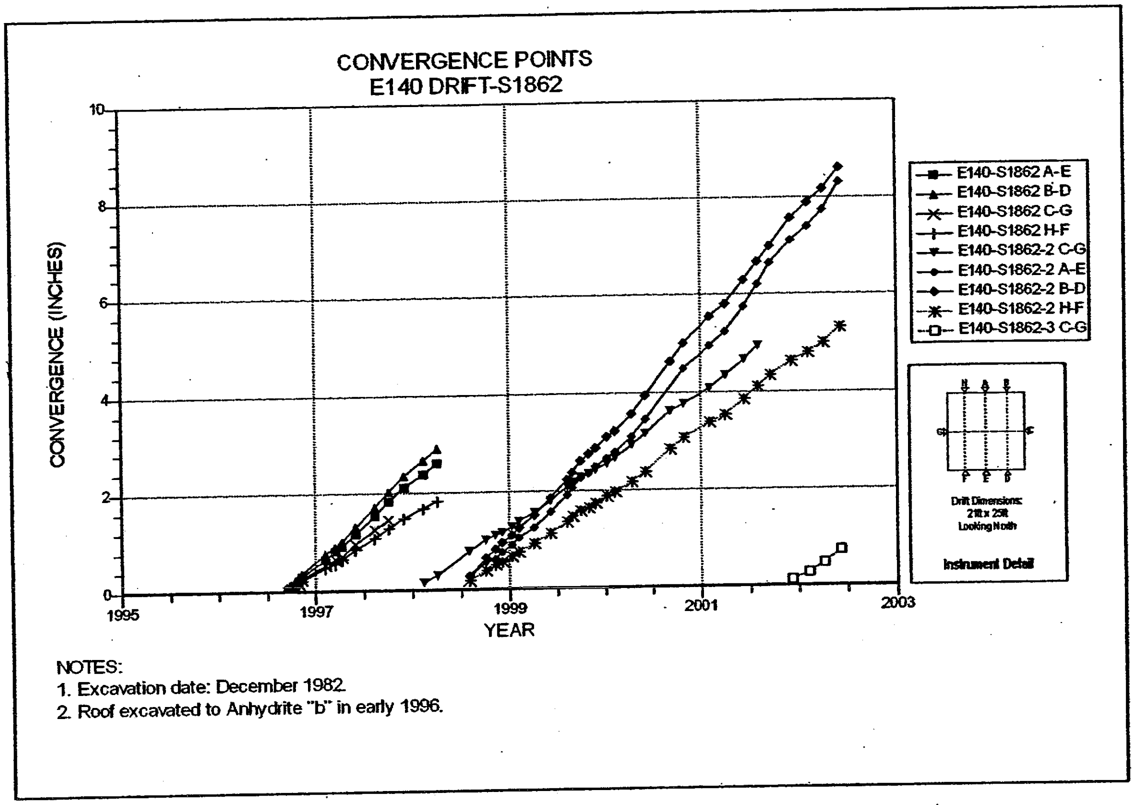


Figure 4-115 Convergence Point Array
E140 Drift at S1862 – All Chords

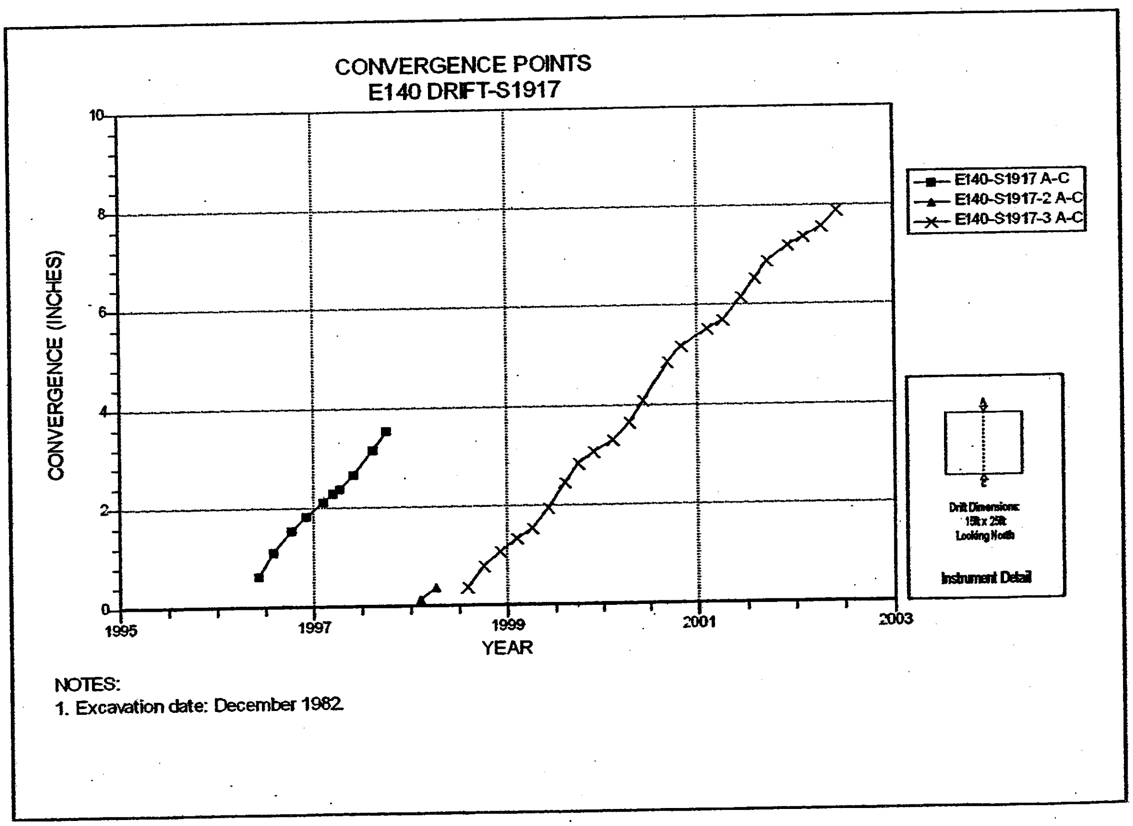


Figure 4-116 Convergence Point Array
E140 Drift at S1917 – Roof to Floor

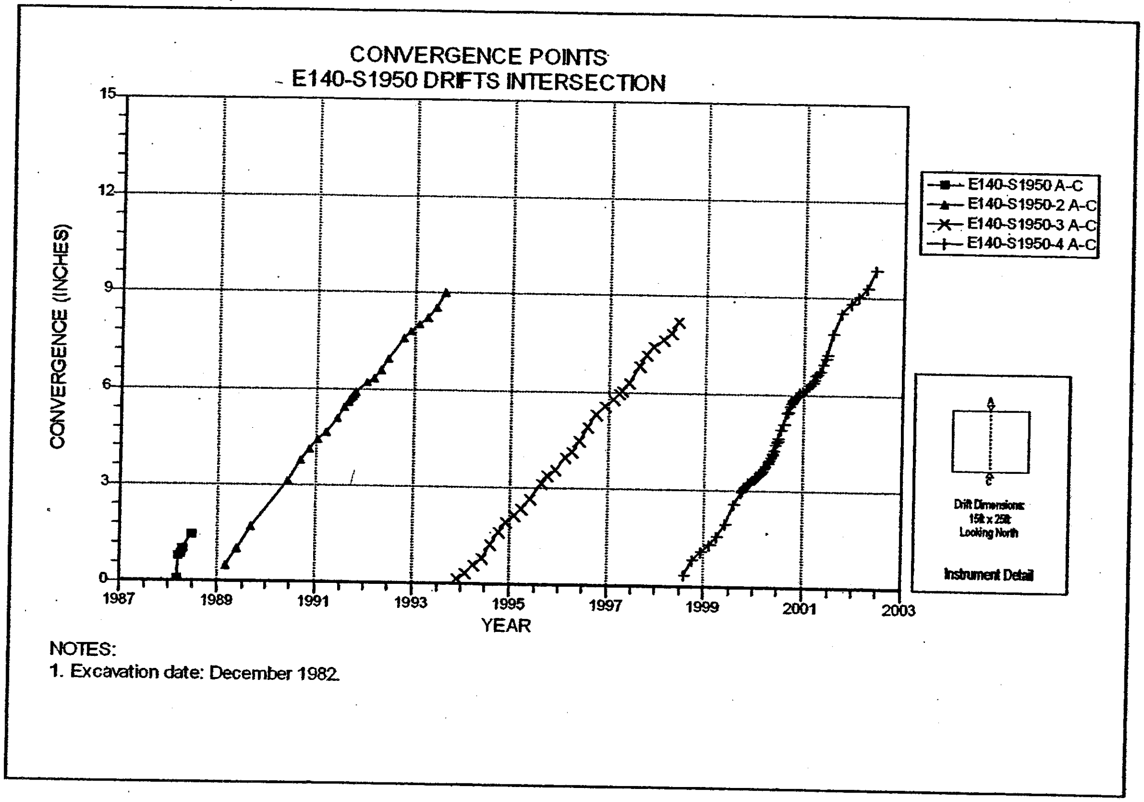


Figure 4-117 Convergence Point Array
E140 Drift at S1950 Drift Intersection – Roof to Floor

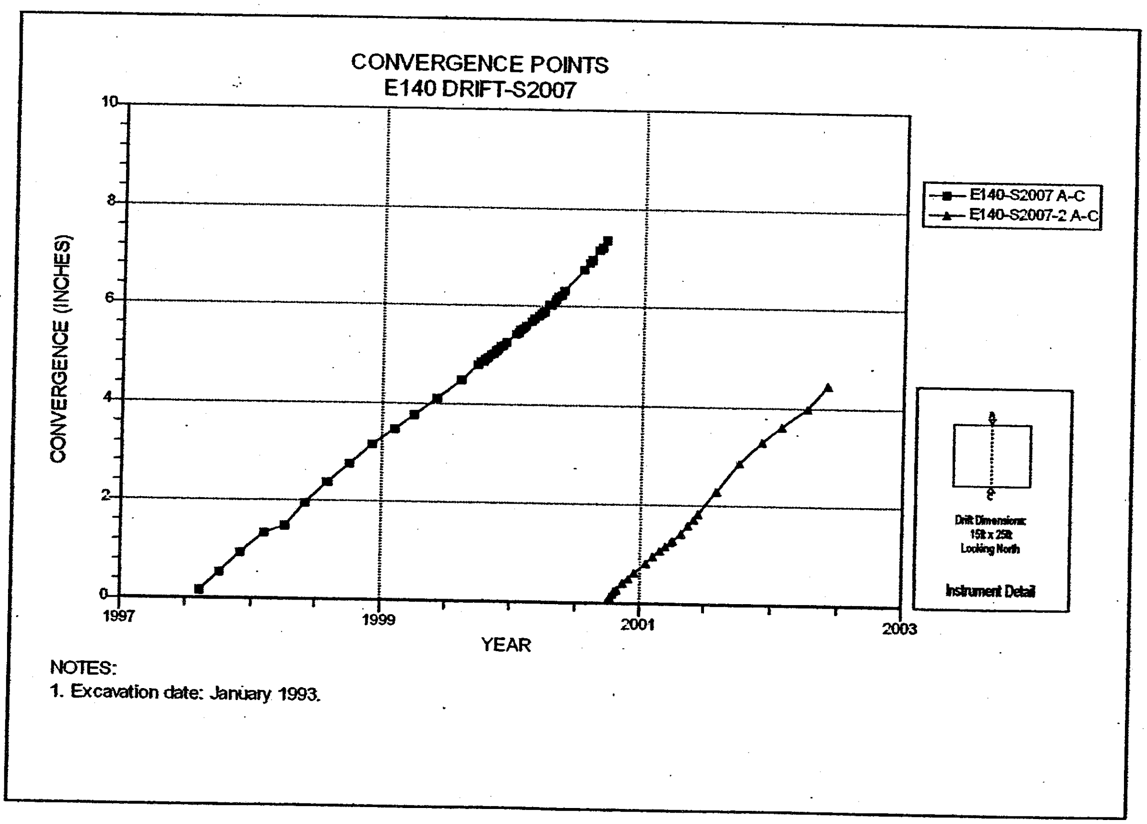
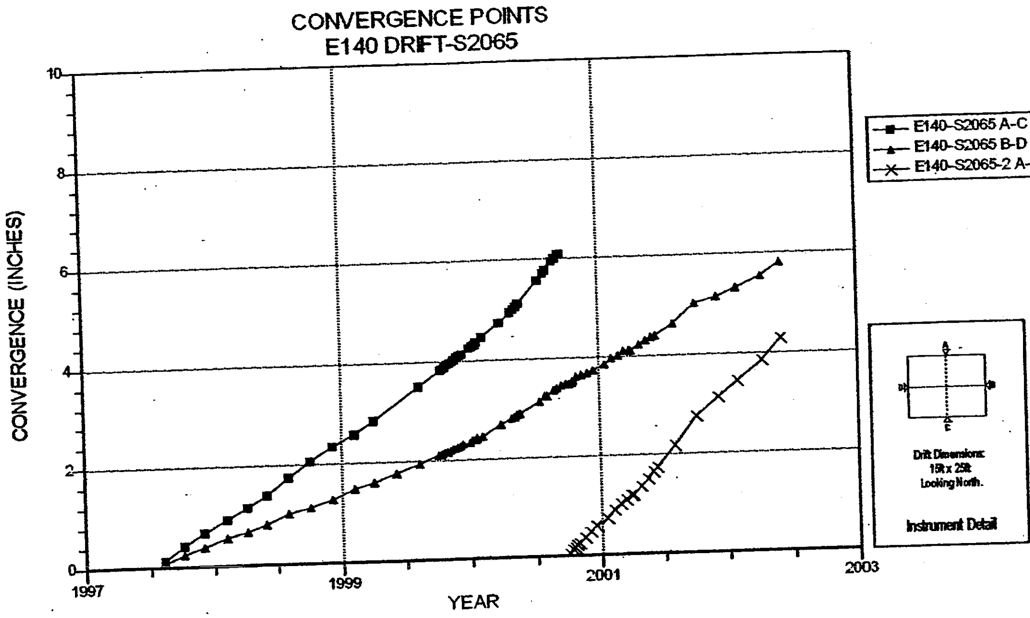
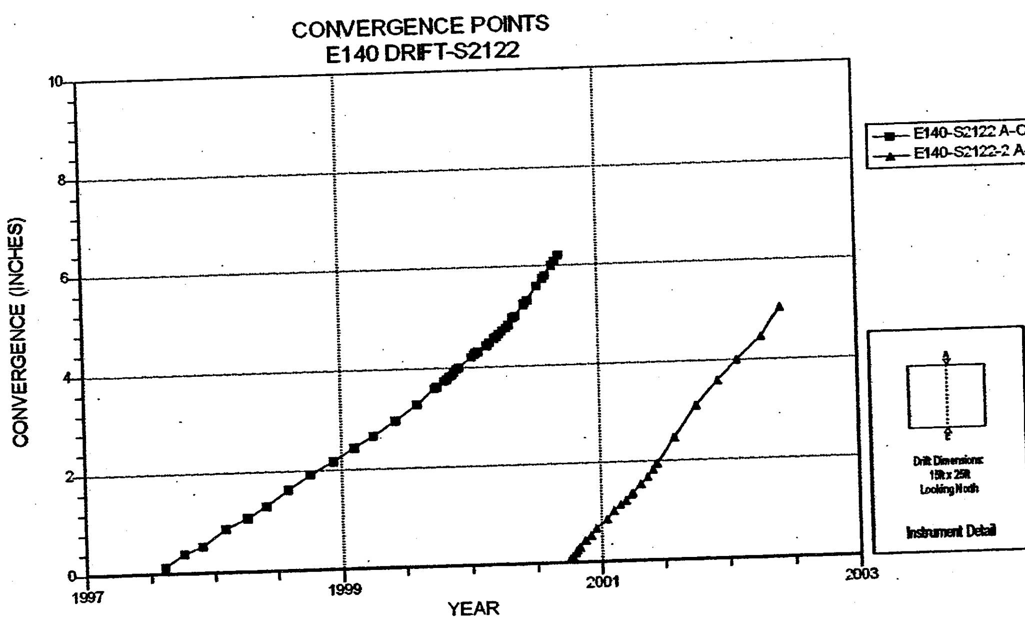


Figure 4-118 Convergence Point Array
E140 Drift at S2007 – Roof to Floor



NOTES:
1. Excavation date: January 1993.

Figure 4-119 Convergence Point Array
E140 Drift at S2065 – All Chords



NOTES:
1. Excavation date: January 1993.

Figure 4-120 Convergence Point Array
E140 Drift at S2122 – Roof to Floor

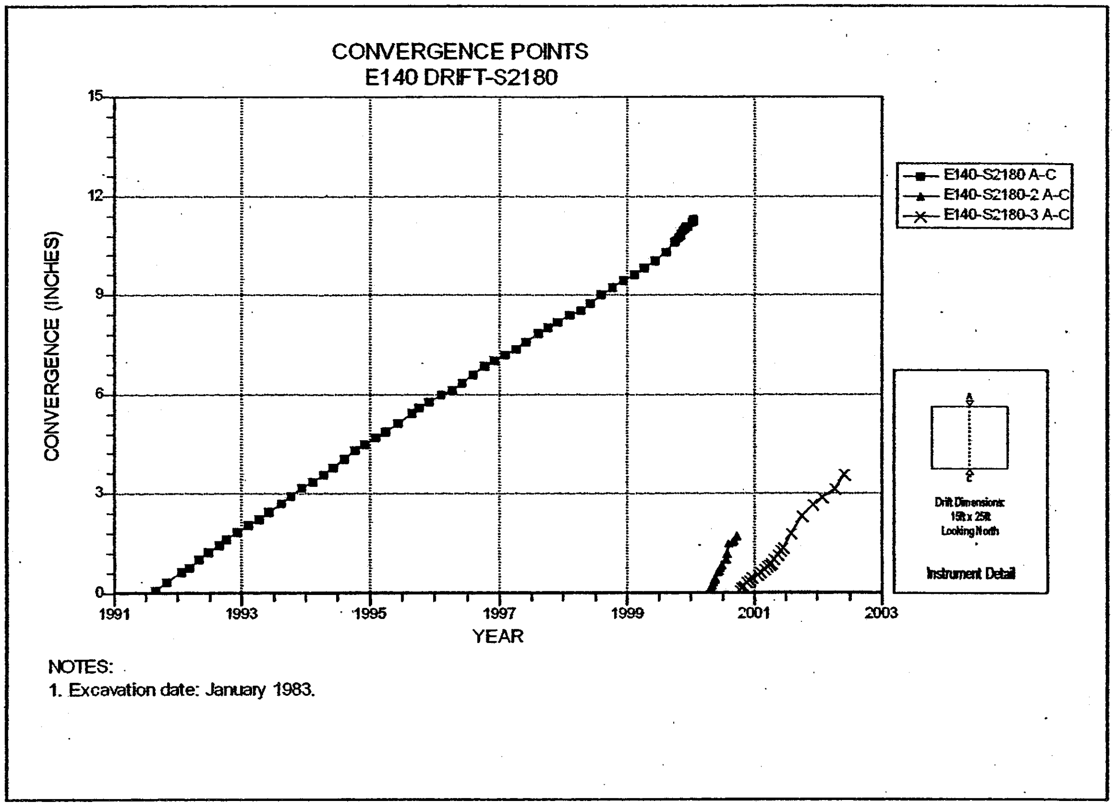


Figure 4-121 Convergence Point Array
E140 Drift at S2180 Drift Intersection – Roof to Floor

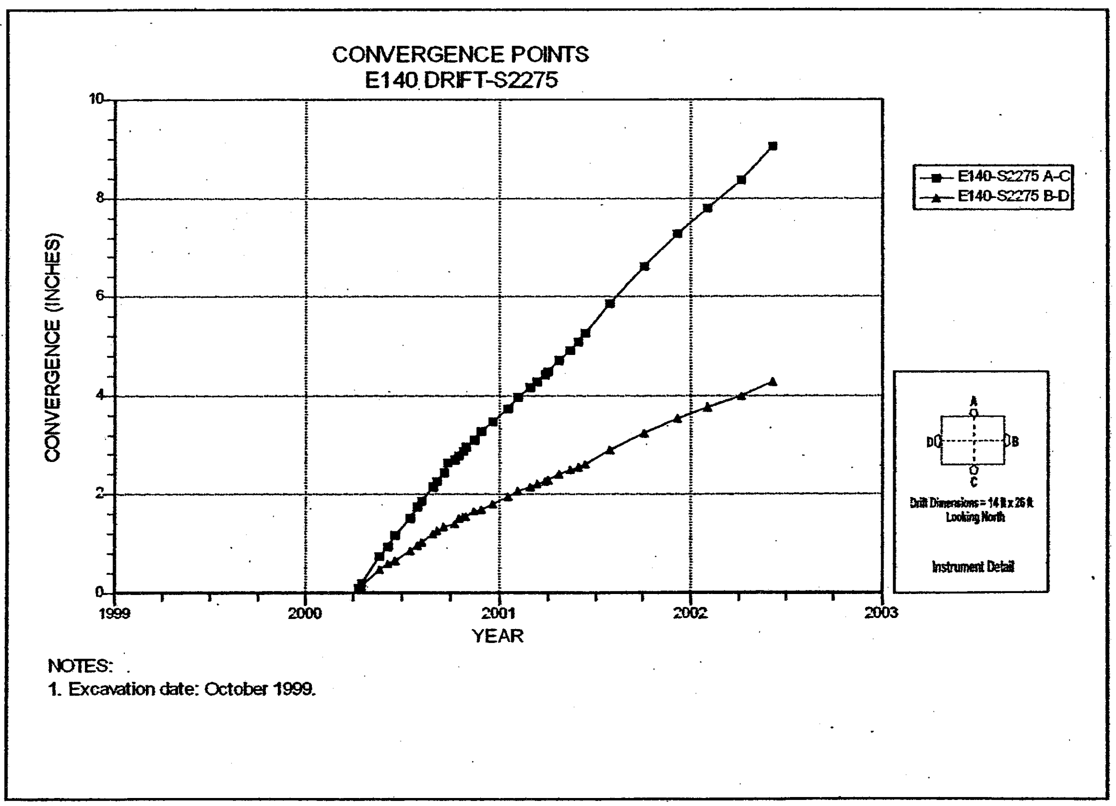
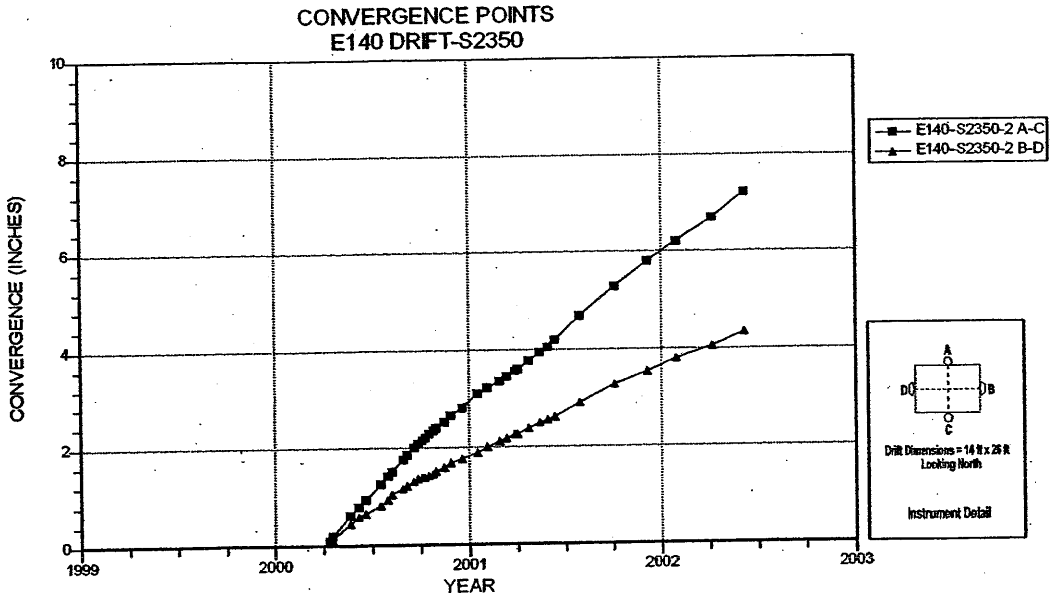
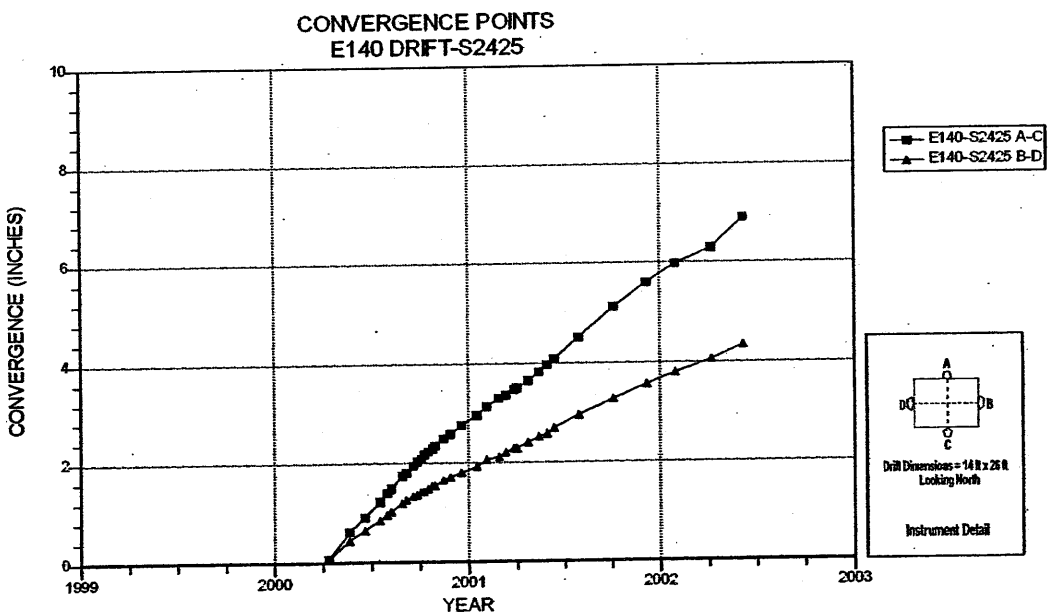


Figure 4-122 Convergence Point Array
E140 Drift at S2275 – All Chords



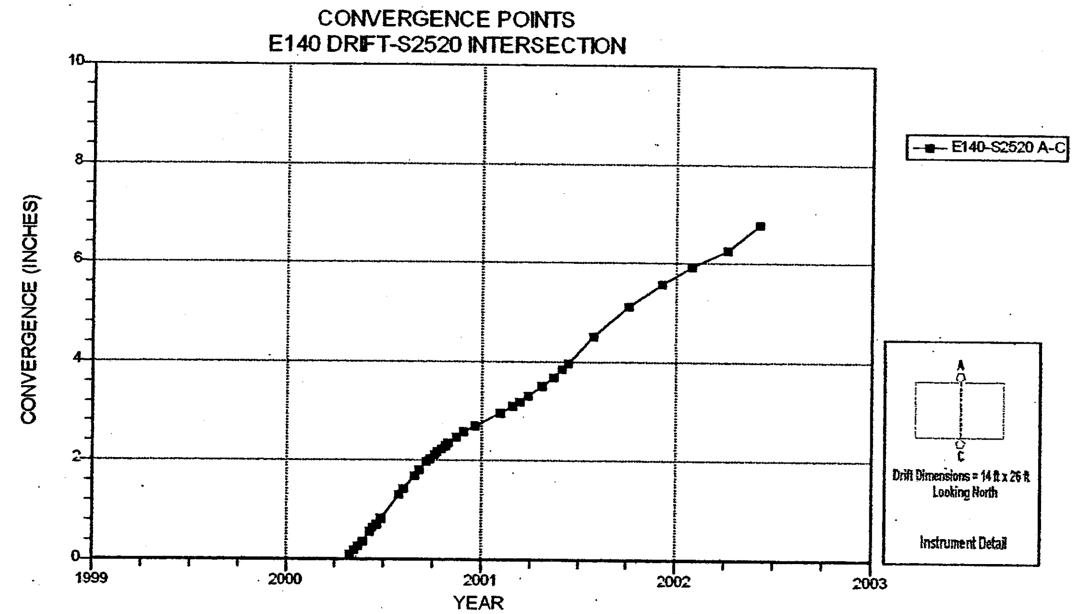
NOTES:
1. Excavation date: October 1999.

Figure 4-123 Convergence Point Array
E140 Drift at S2350 – All Chords



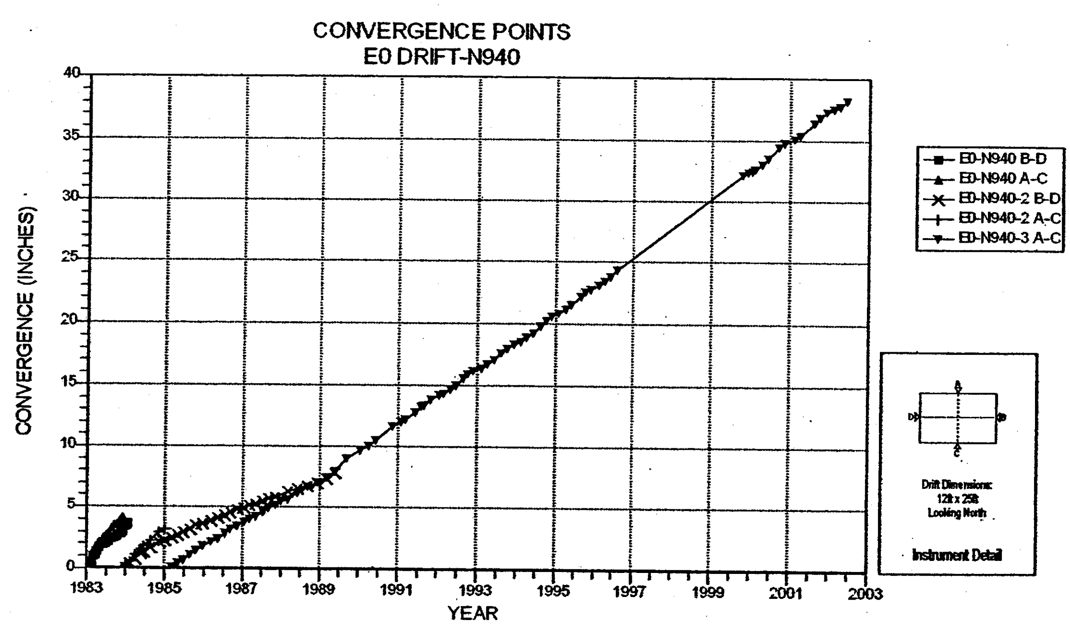
NOTES:
1. Excavation date: October 1999.

Figure 4-124 Convergence Point Array
E140 Drift at S2425 – All Chords



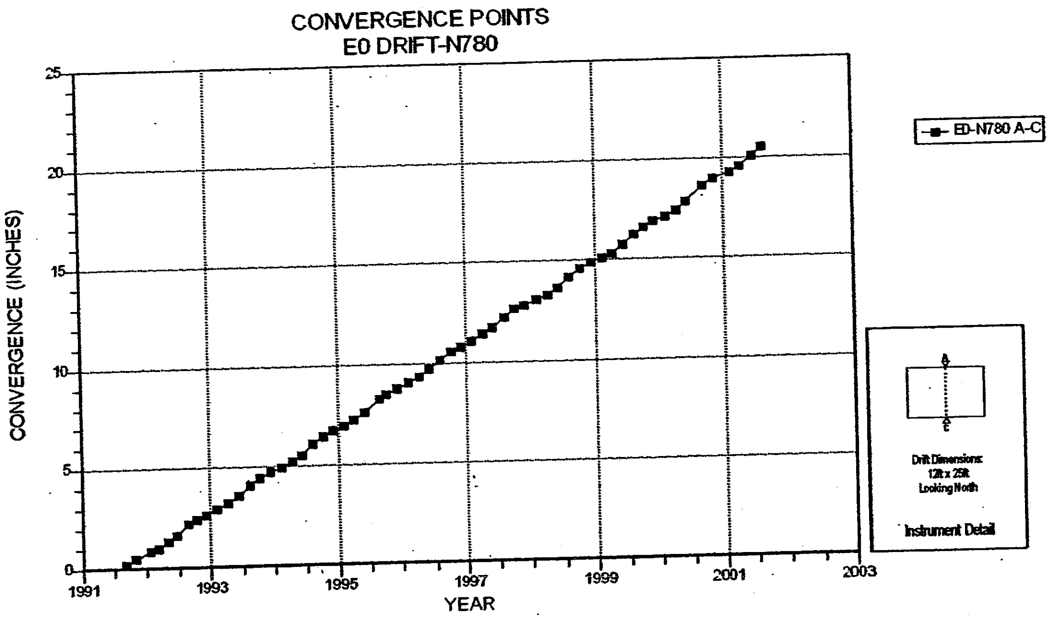
NOTES:
1. Excavation date: November 1999.

Figure 4-125 Convergence Point Array
E140 Drift at S2520 Drift Intersection – Roof to Floor



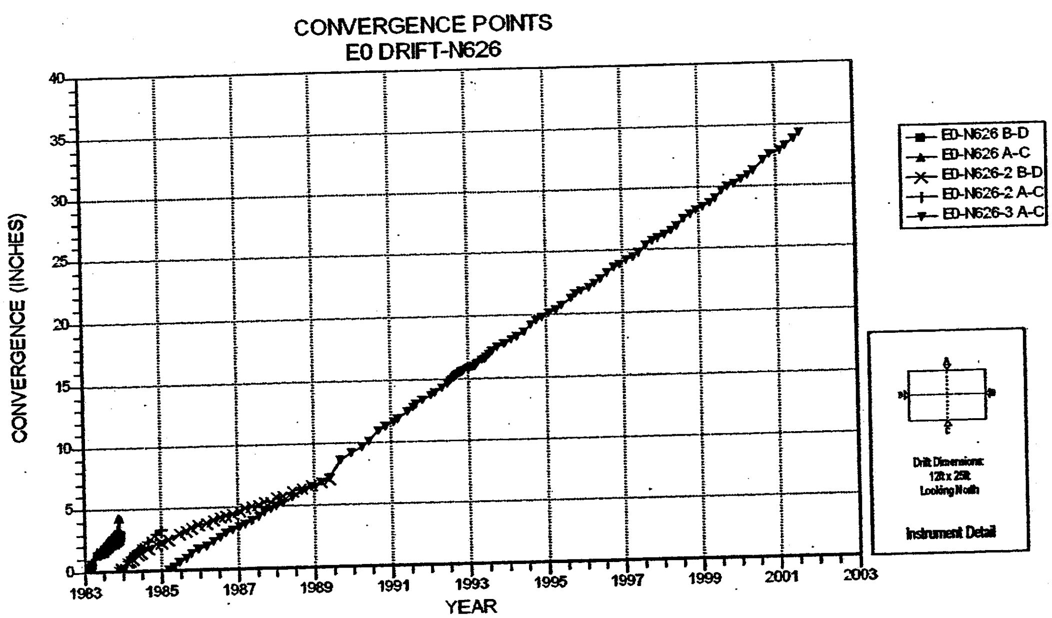
NOTES:
1. Excavation date: February 1983.

Figure 4-126 Convergence Point Array
E0 Drift at N940 – All Chords



NOTES:
1. Excavation date: February 1983.
2. Mined out third quarter 2001.

**Figure 4-127 Convergence Point Array
E0 Drift at N780 – Roof to Floor**



NOTES:
1. Excavation date: February 1983.
2. Mined out third quarter 2001.

**Figure 4-128 Convergence Point Array
E0 Drift at N626 – All Chords**

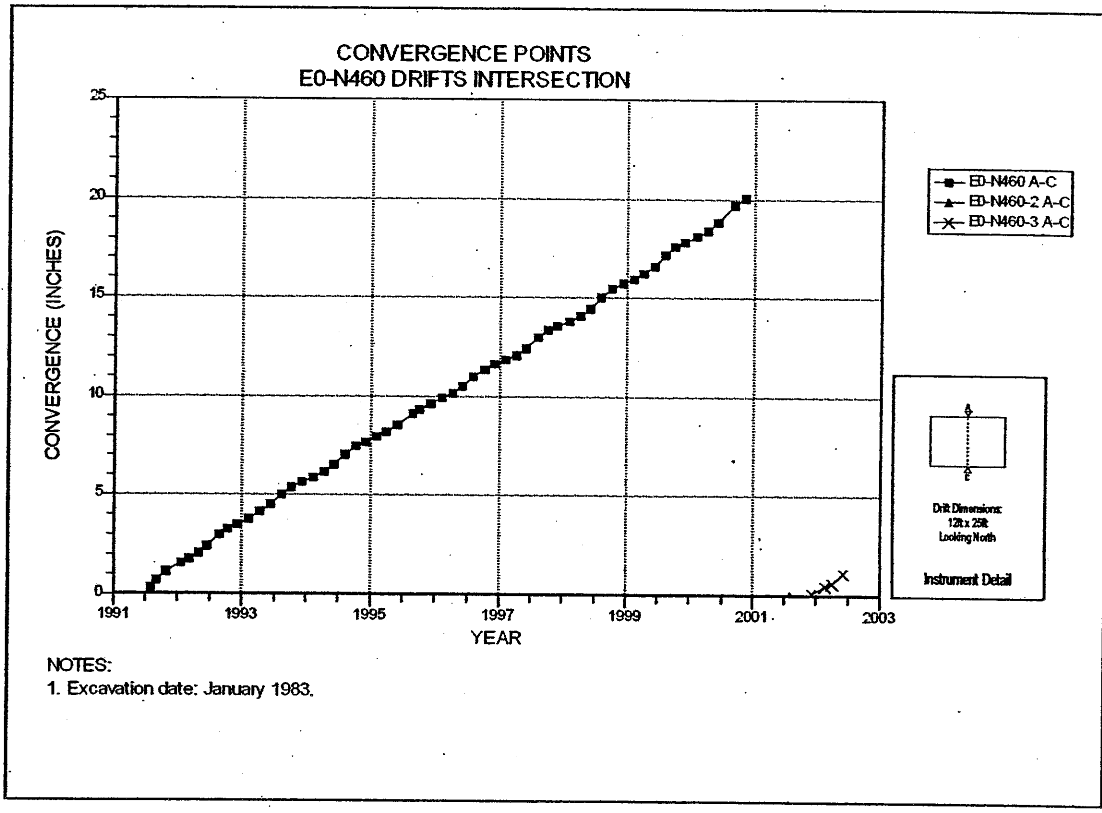


Figure 4-129 Convergence Point Array
E0 Drift at N460 Drift Intersection – Roof to Floor

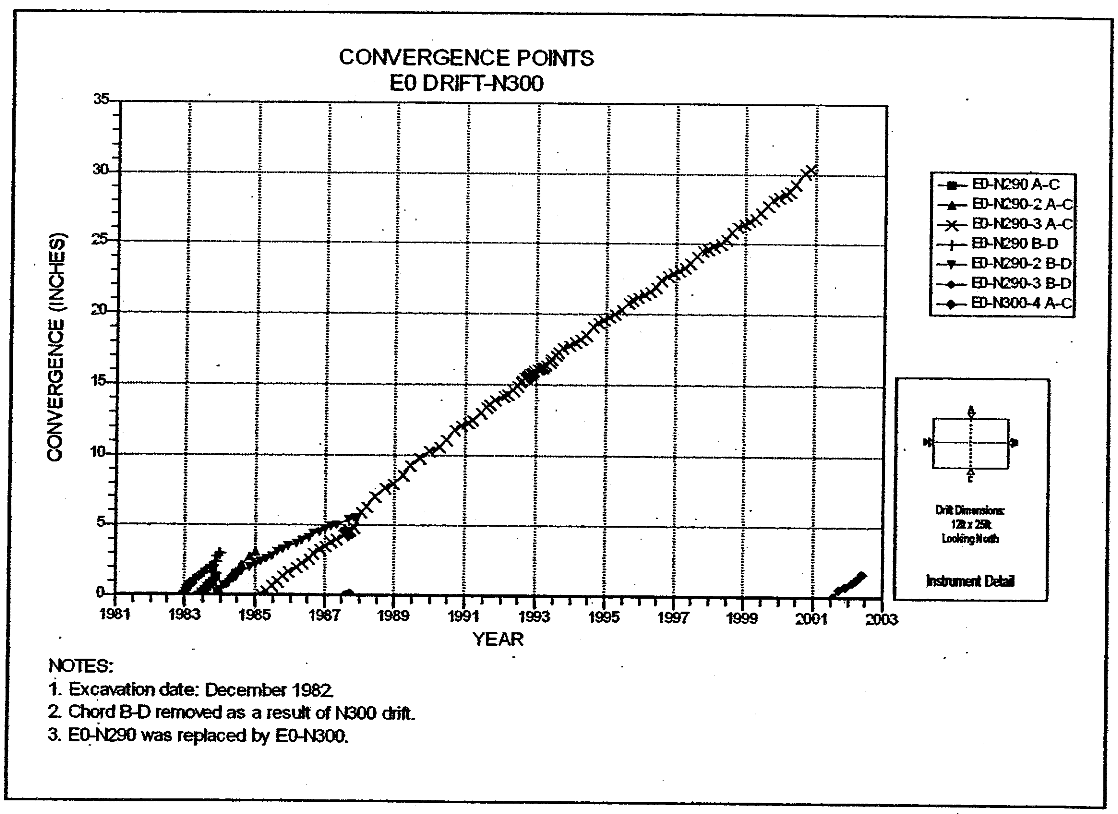


Figure 4-130 Convergence Point Array
E0 Drift at N300 – All Chords

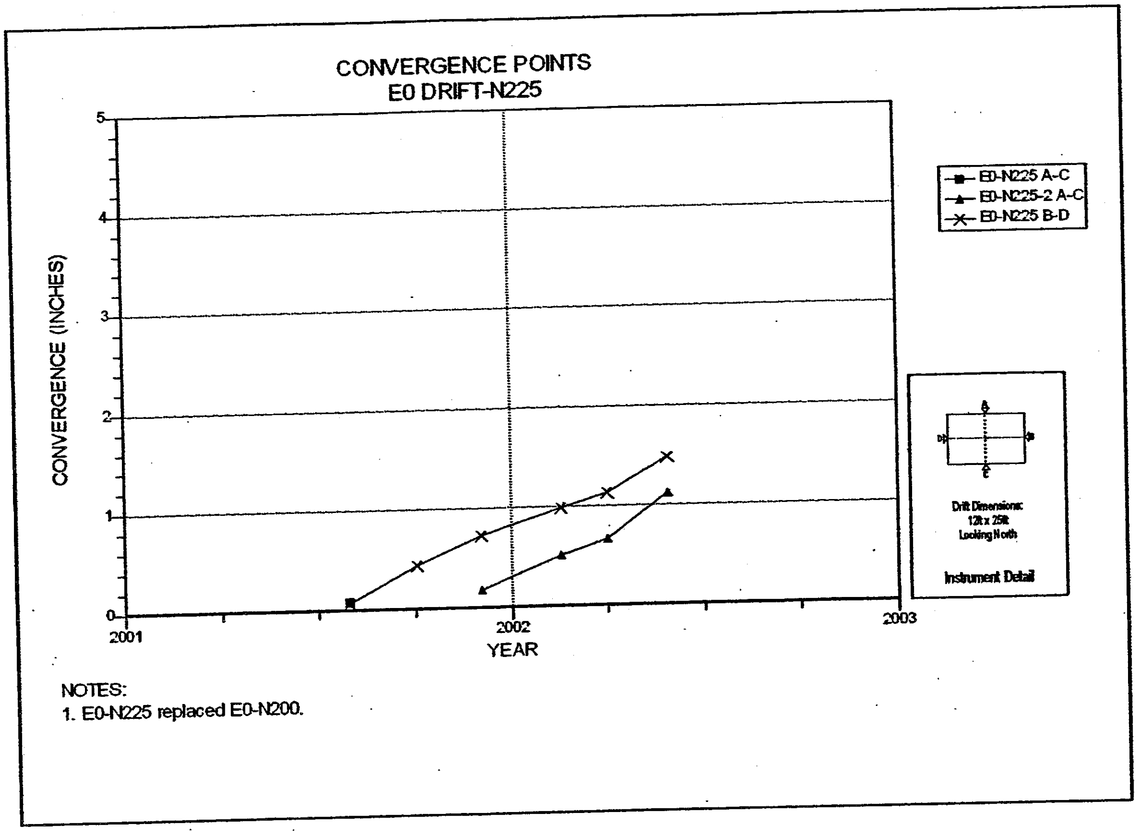


Figure 4-131 Convergence Point Array
E0 Drift at N225 – Roof to Floor

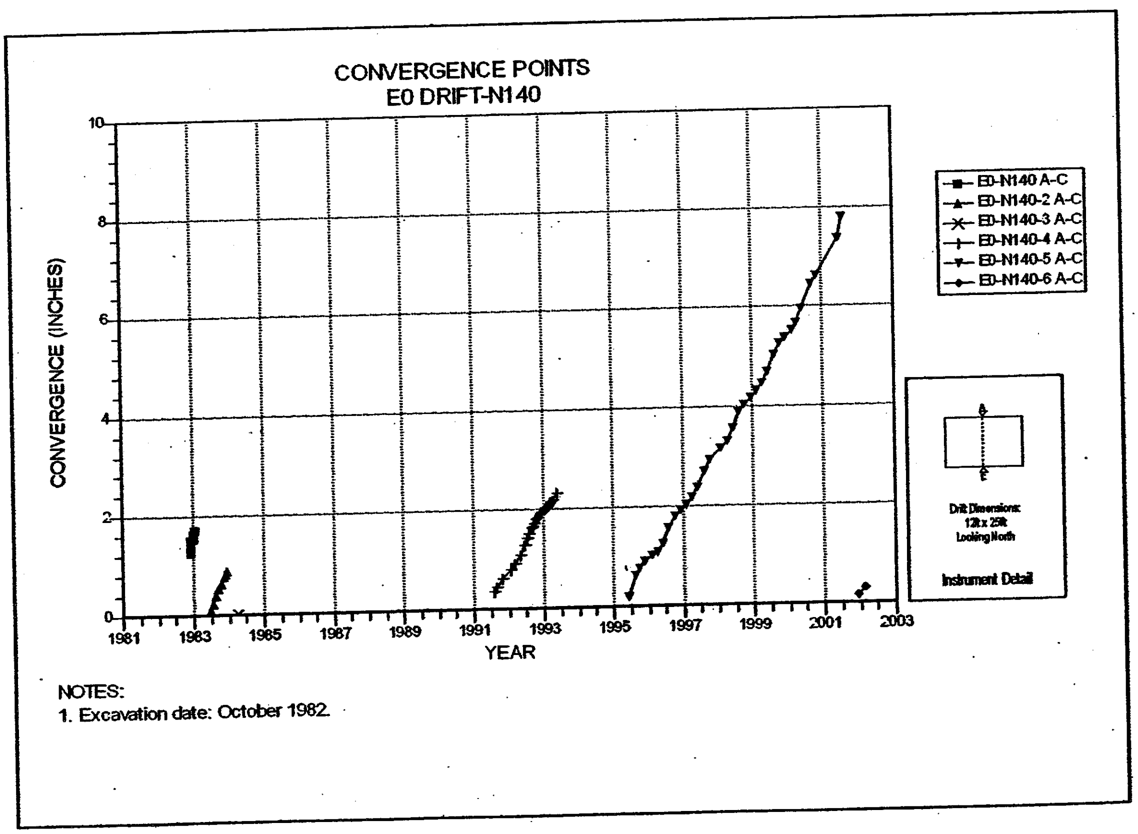


Figure 4-132 Convergence Point Array
E0 Drift at N140 – Roof to Floor

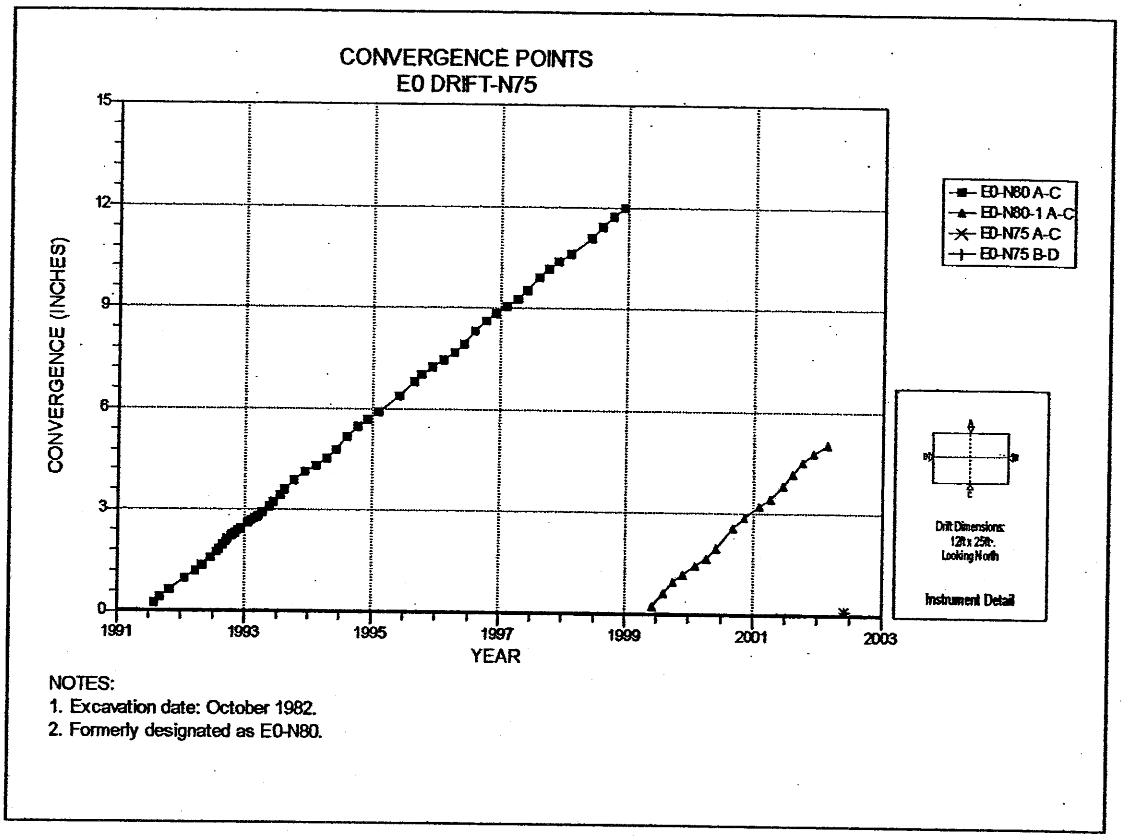


Figure 4-133 Convergence Point Array
E0 Drift at N75 – Roof to Floor

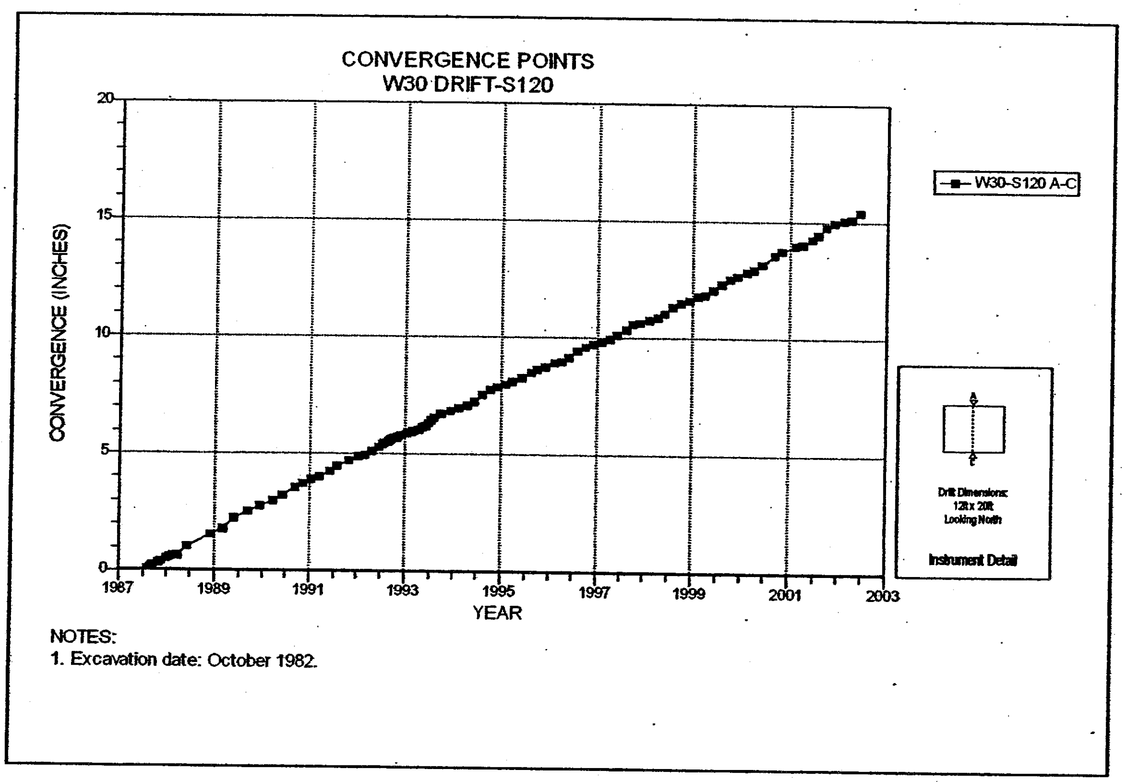
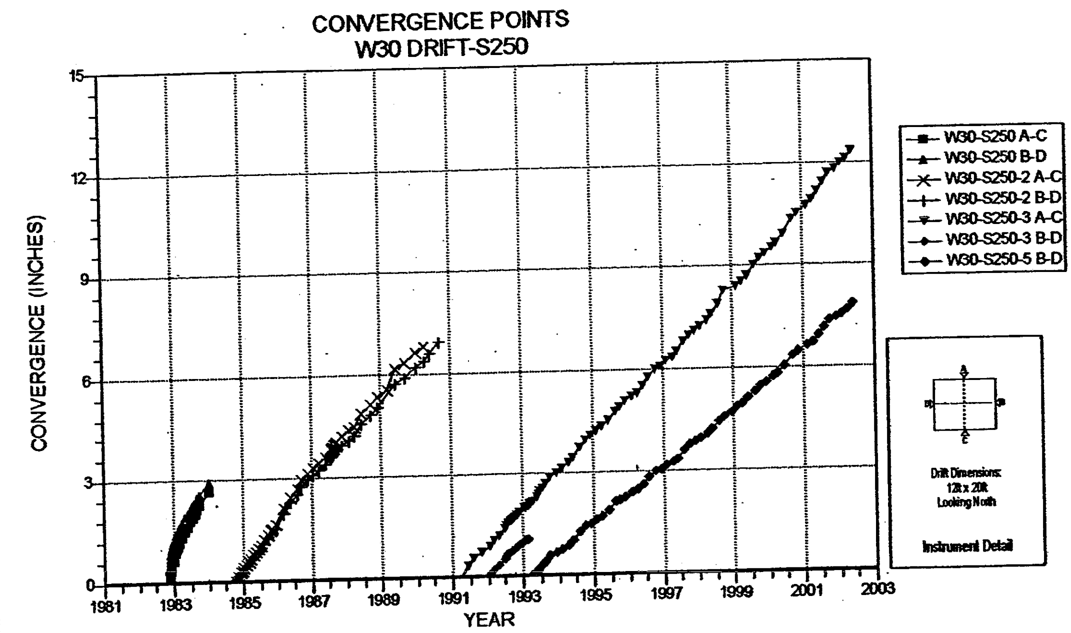
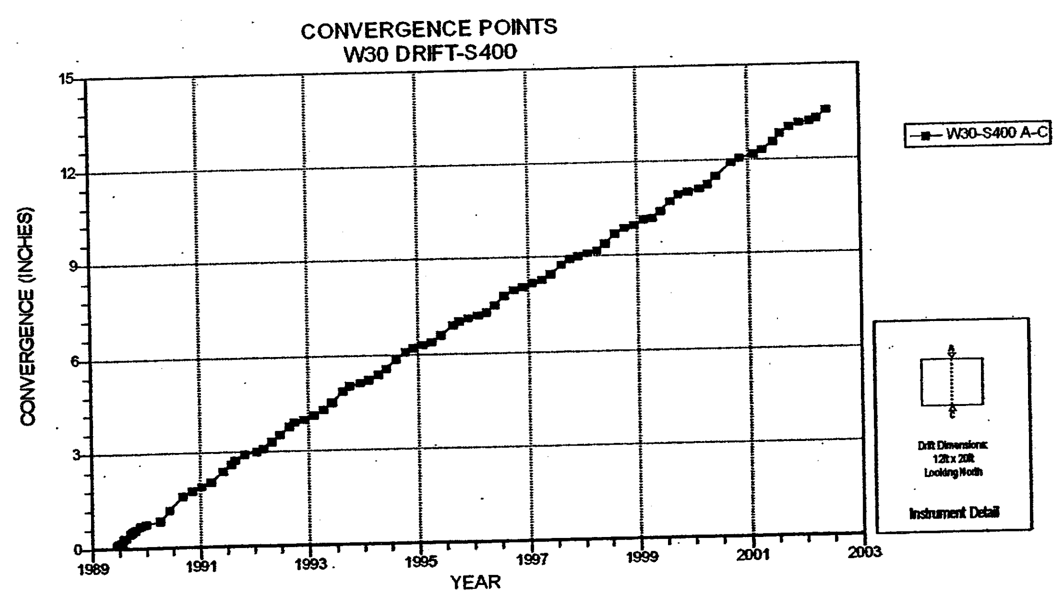


Figure 4-134 Convergence Point Array
W30 Drift at S120 – Roof to Floor



NOTES:
1. Excavation date: October 1982.

Figure 4-135 Convergence Point Array
W30 Drift at S250 – All Chords



NOTES:
1. Excavation date: October 1982.

Figure 4-136 Convergence Point Array
W30 Drift at S400 Drift Intersection – Roof to Floor

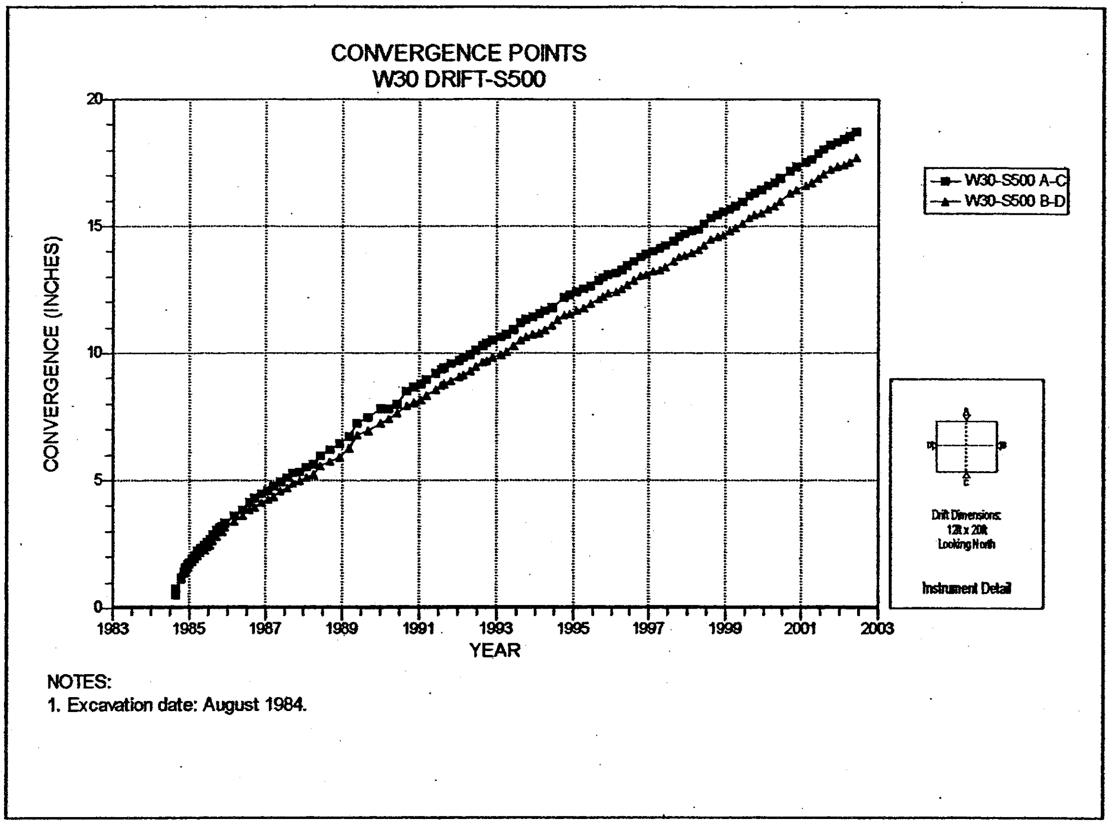


Figure 4-137 Convergence Point Array
W30 Drift at S500 – All Chords

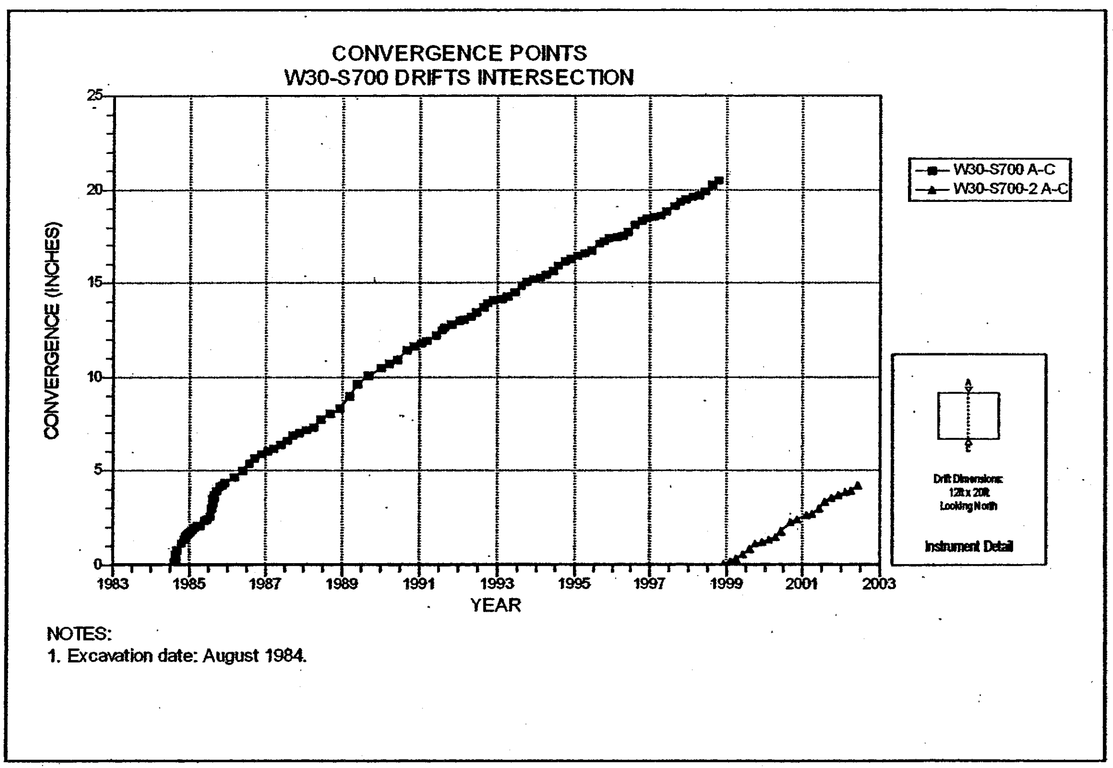
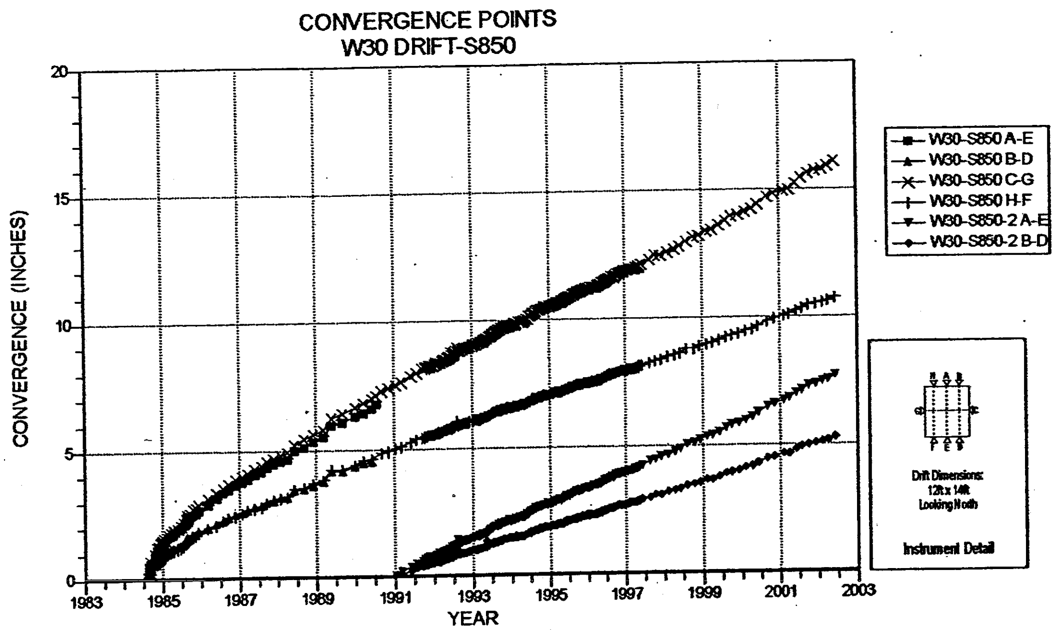
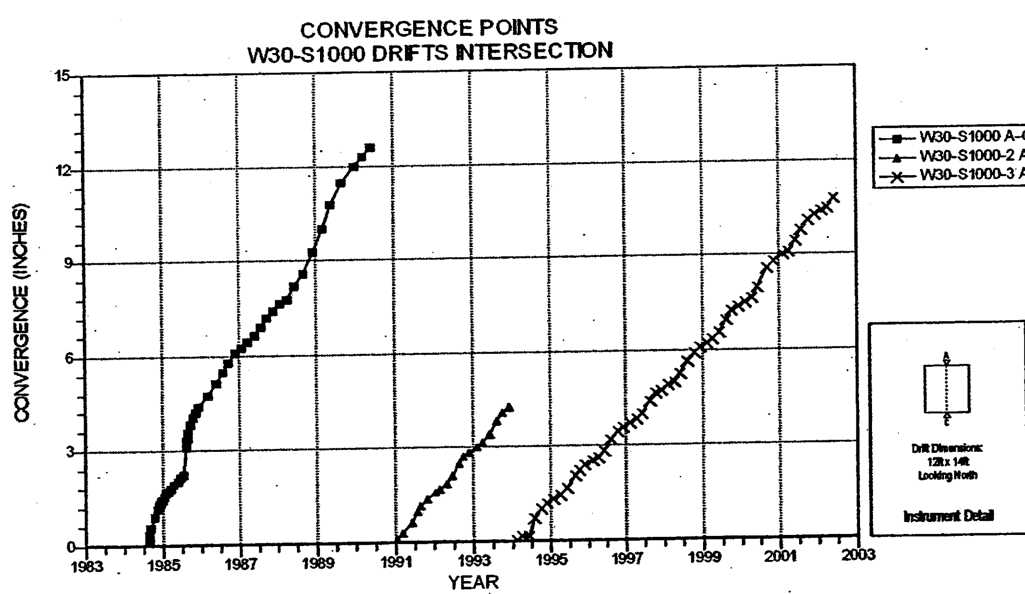


Figure 4-138 Convergence Point Array
W30 Drift at S700 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: August 1984.

Figure 4-139 Convergence Point Array
W30 Drift at S850 – All Chords



NOTES:
1. Excavation date: August 1984.

Figure 4-140 Convergence Point Array
W30 Drift at S1000 Drift Intersection – Roof to Floor

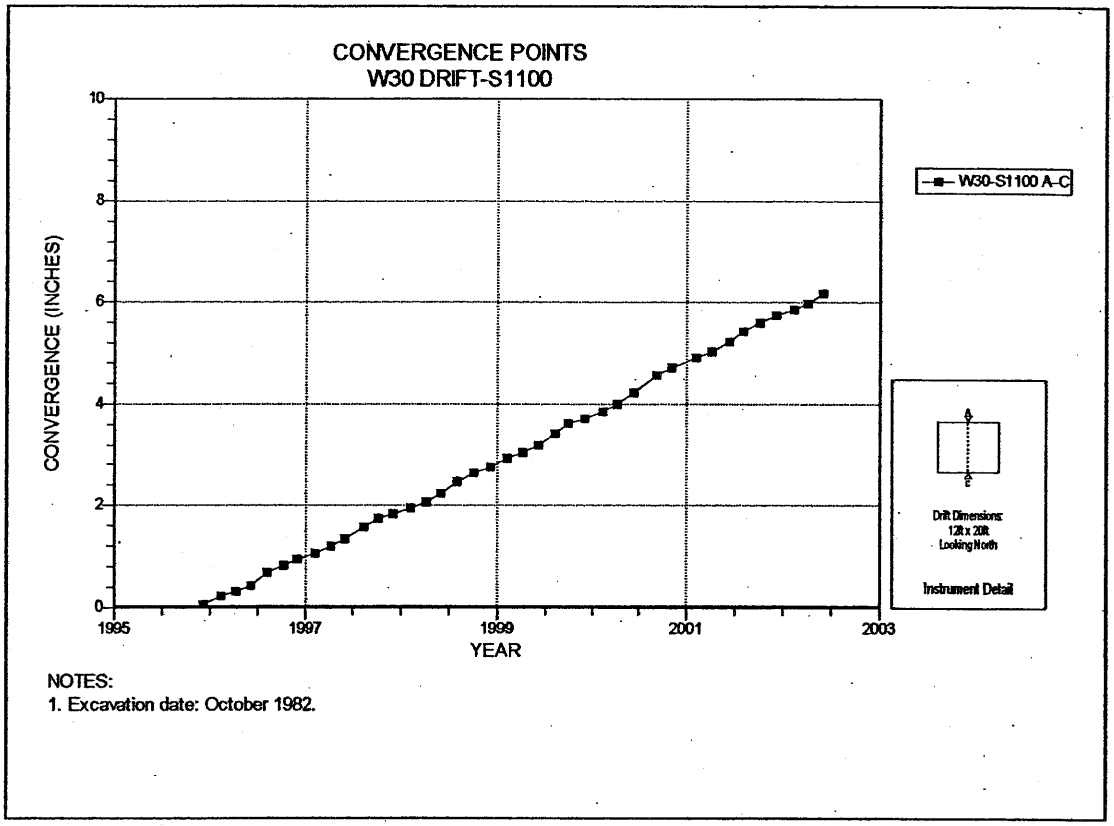


Figure 4-141 Convergence Point Array
W30 Drift at S1100 – Roof to Floor

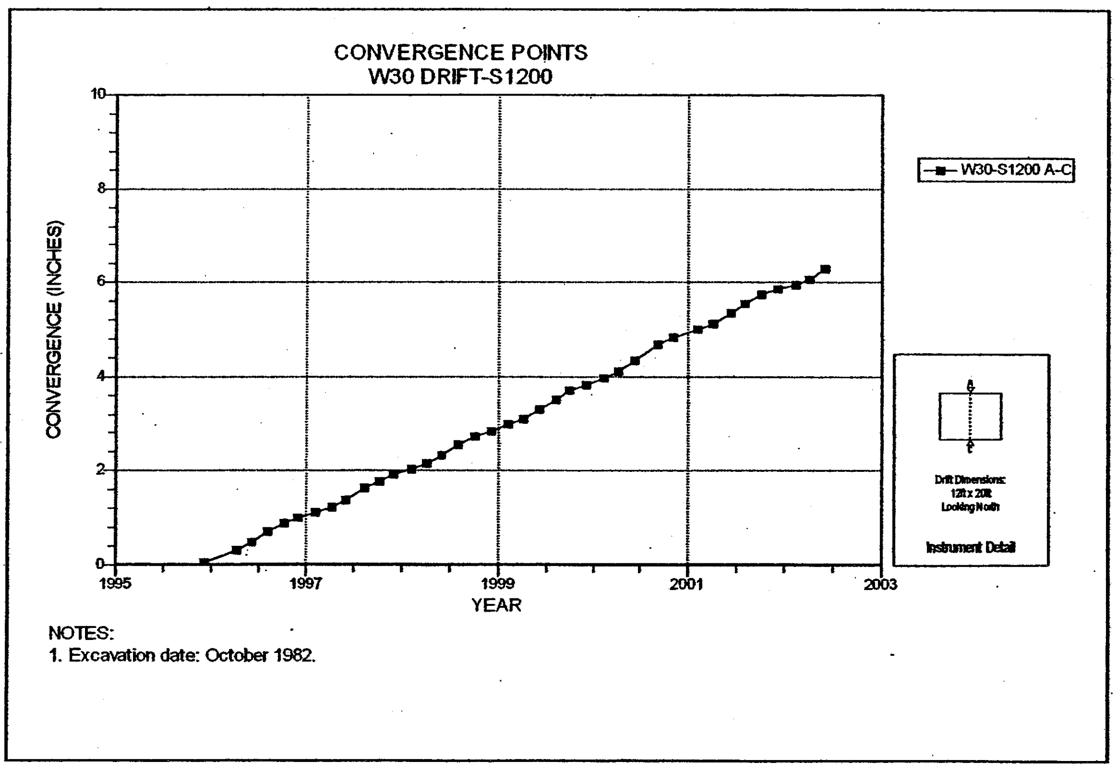


Figure 4-142 Convergence Point Array
W30 Drift at S1200 – Roof to Floor

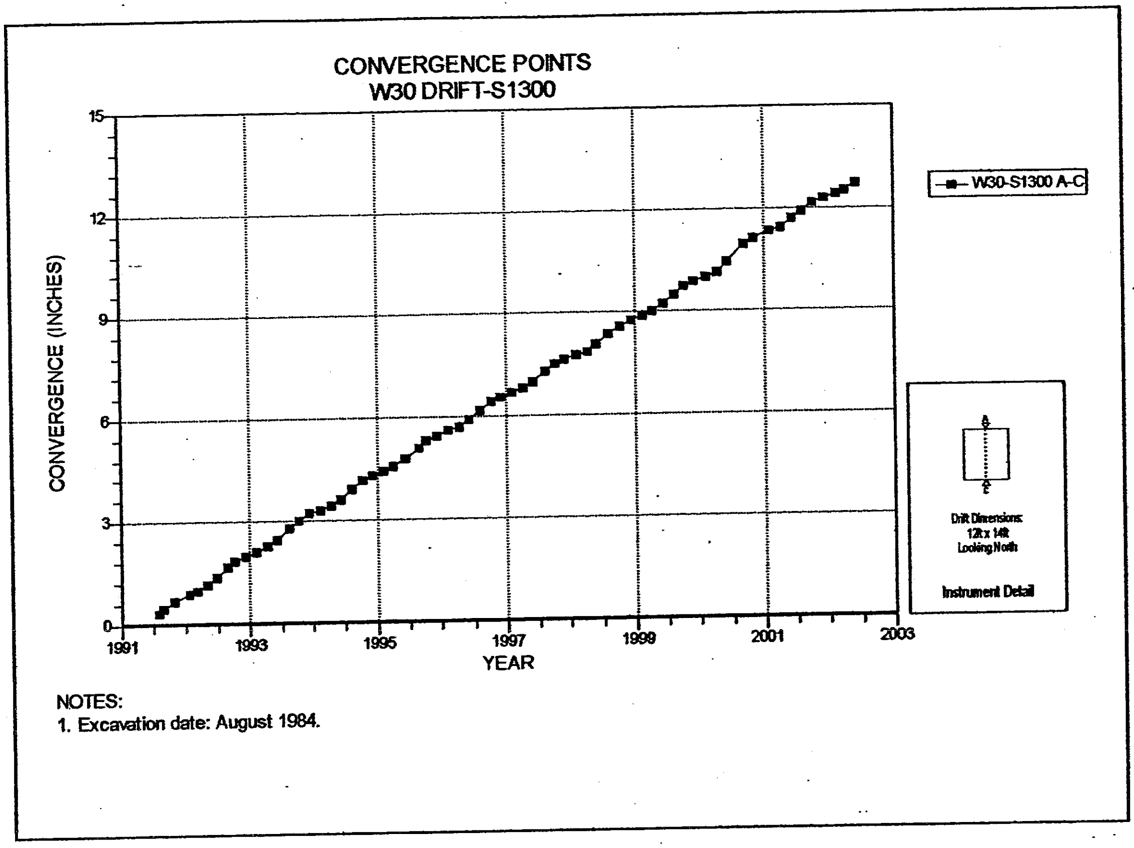


Figure 4-143 Convergence Point Array
W30 Drift at S1300 Drift Intersection – Roof to Floor

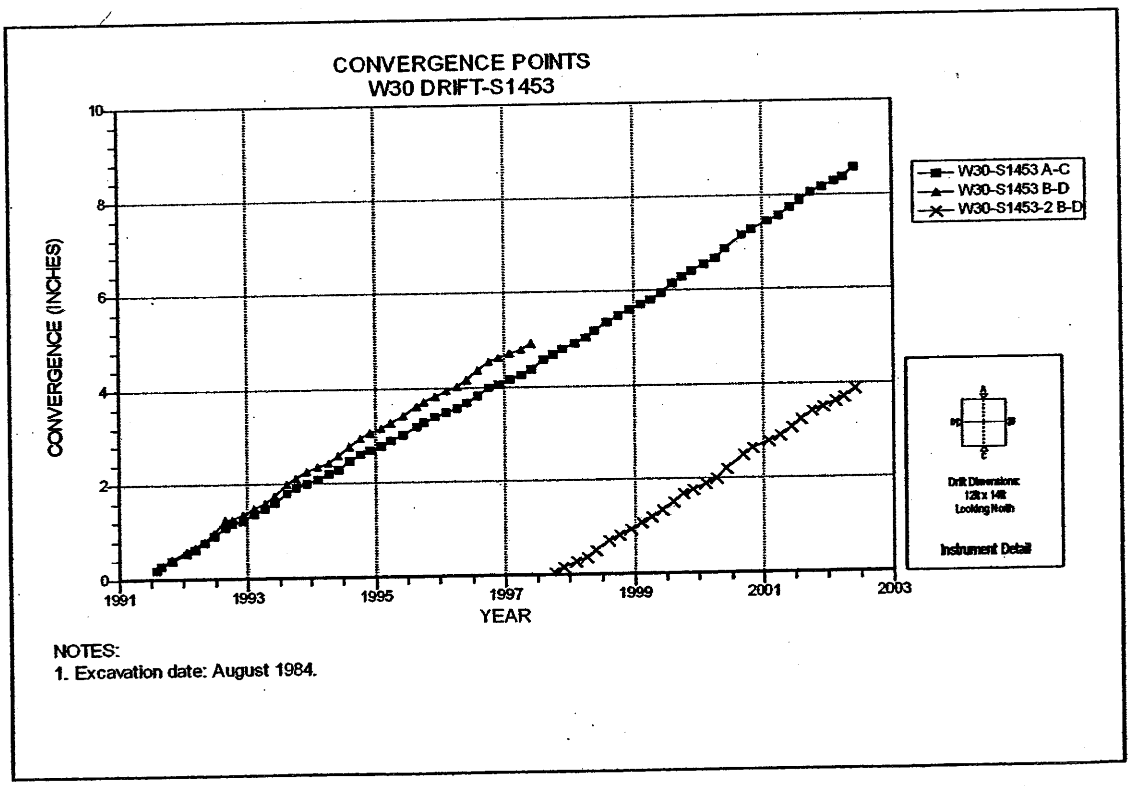
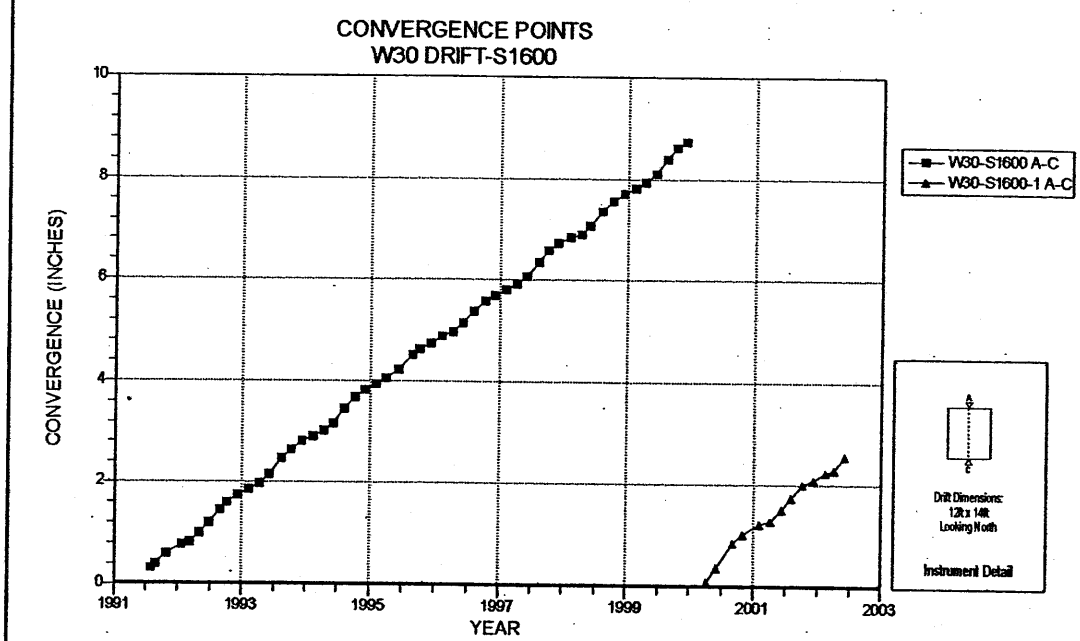
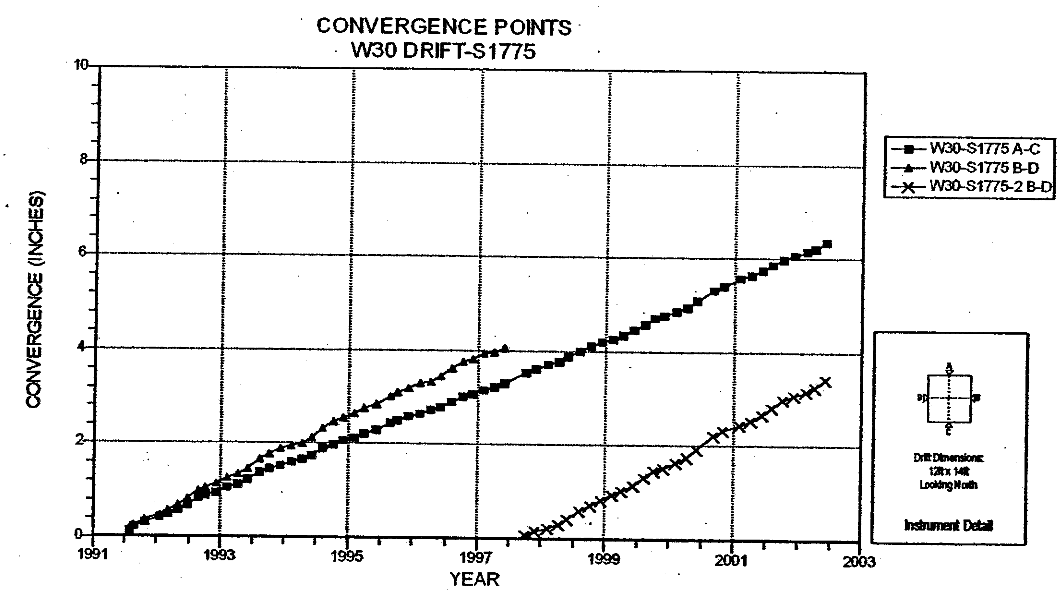


Figure 4-144 Convergence Point Array
W30 Drift at S1453 – All Chords



NOTES:
1. Excavation date: September 1984.

Figure 4-145 Convergence Point Array
W30 Drift at S1600 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: February 1986.

Figure 4-146 Convergence Point Array
W30 Drift at S1775 – All Chords

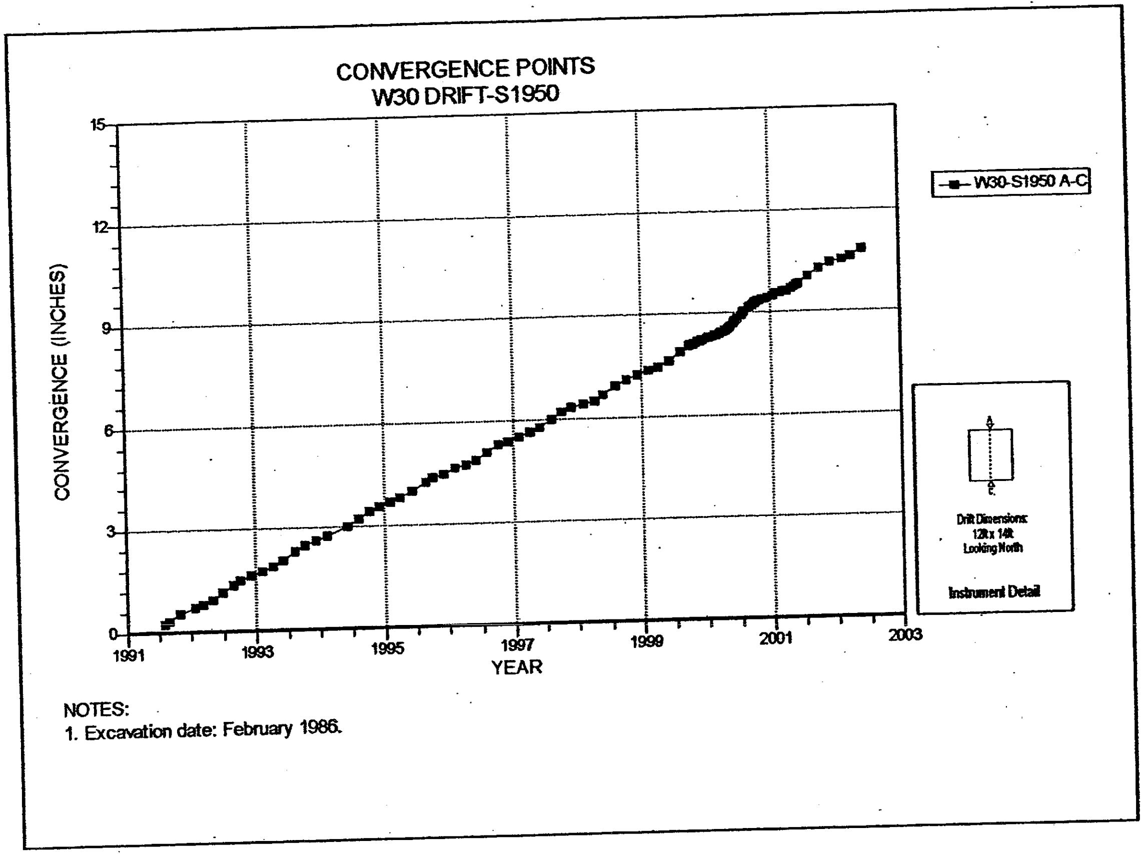


Figure 4-147 Convergence Point Array
W30 Drift at S1950 Drift Intersection – Roof to Floor

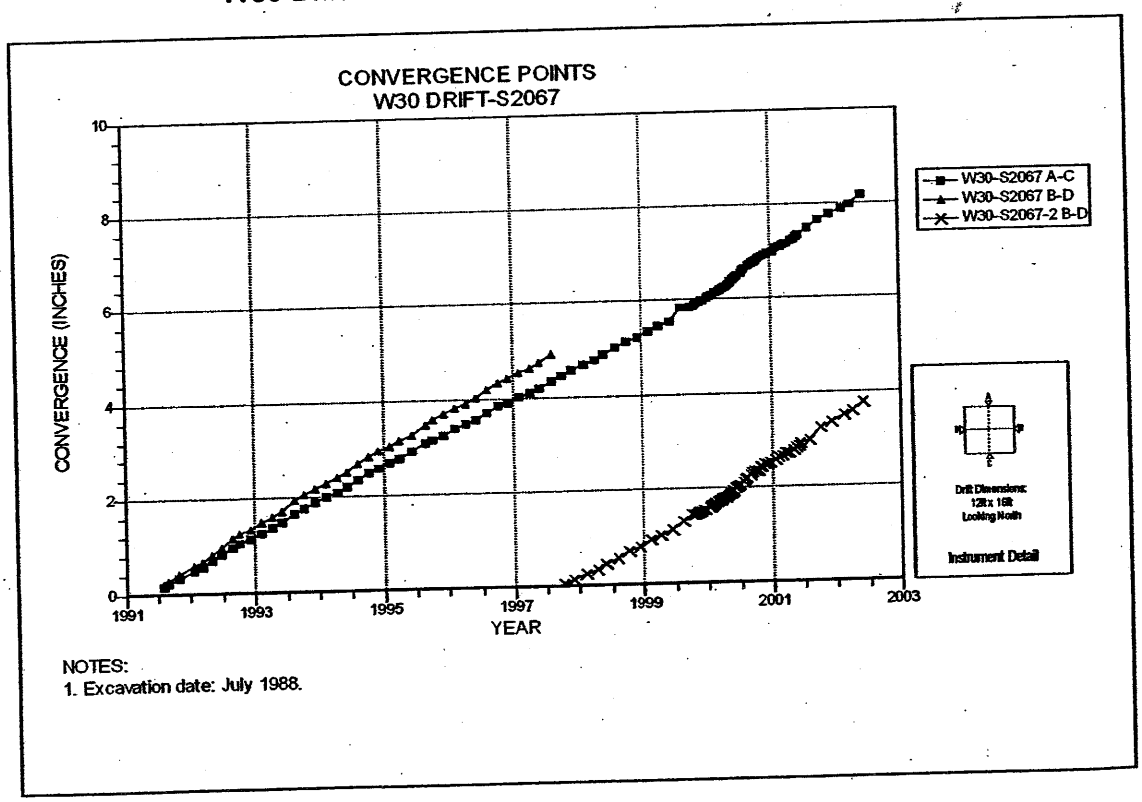
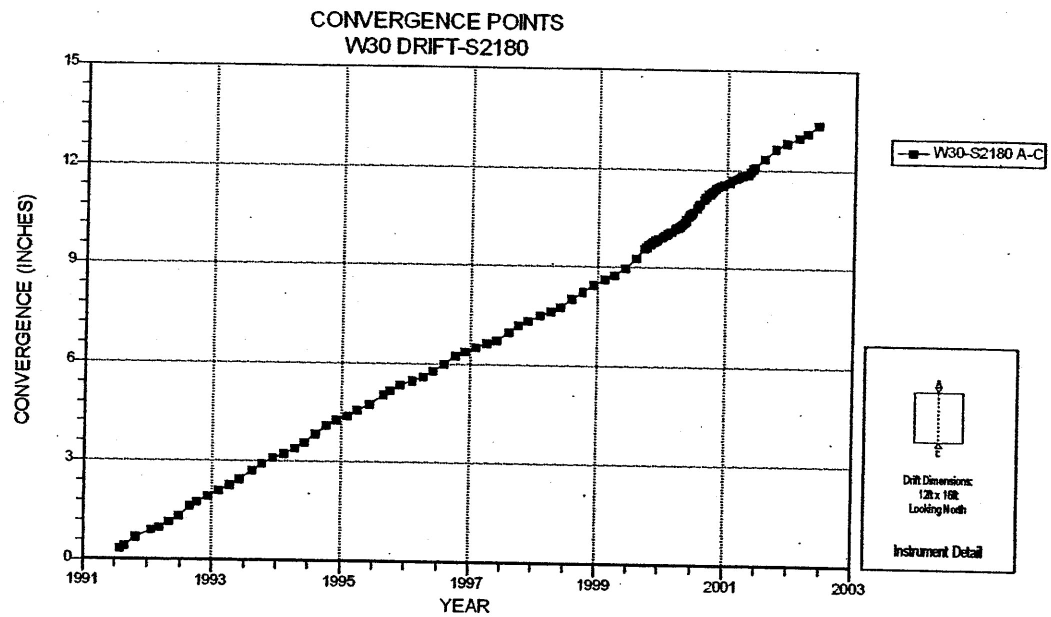
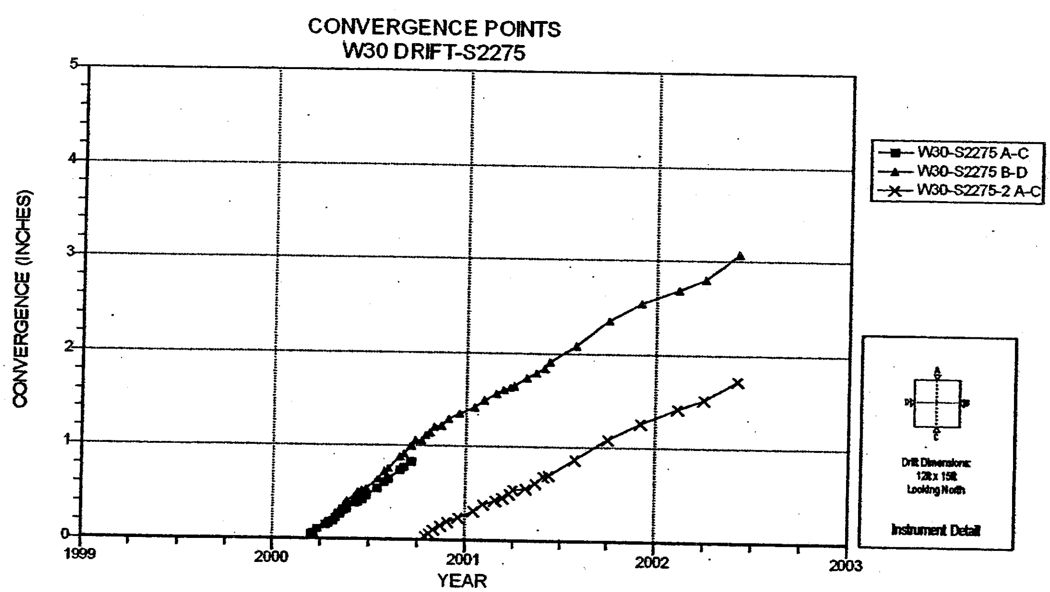


Figure 4-148 Convergence Point Array
W30 Drift at S2067 – All Chords



NOTES:
1. Excavation date: July 1988.

Figure 4-149 Convergence Point Array
W30 Drift at S2180 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: November 1999.

Figure 4-150 Convergence Point Array
W30 Drift at S2275 – All Chords

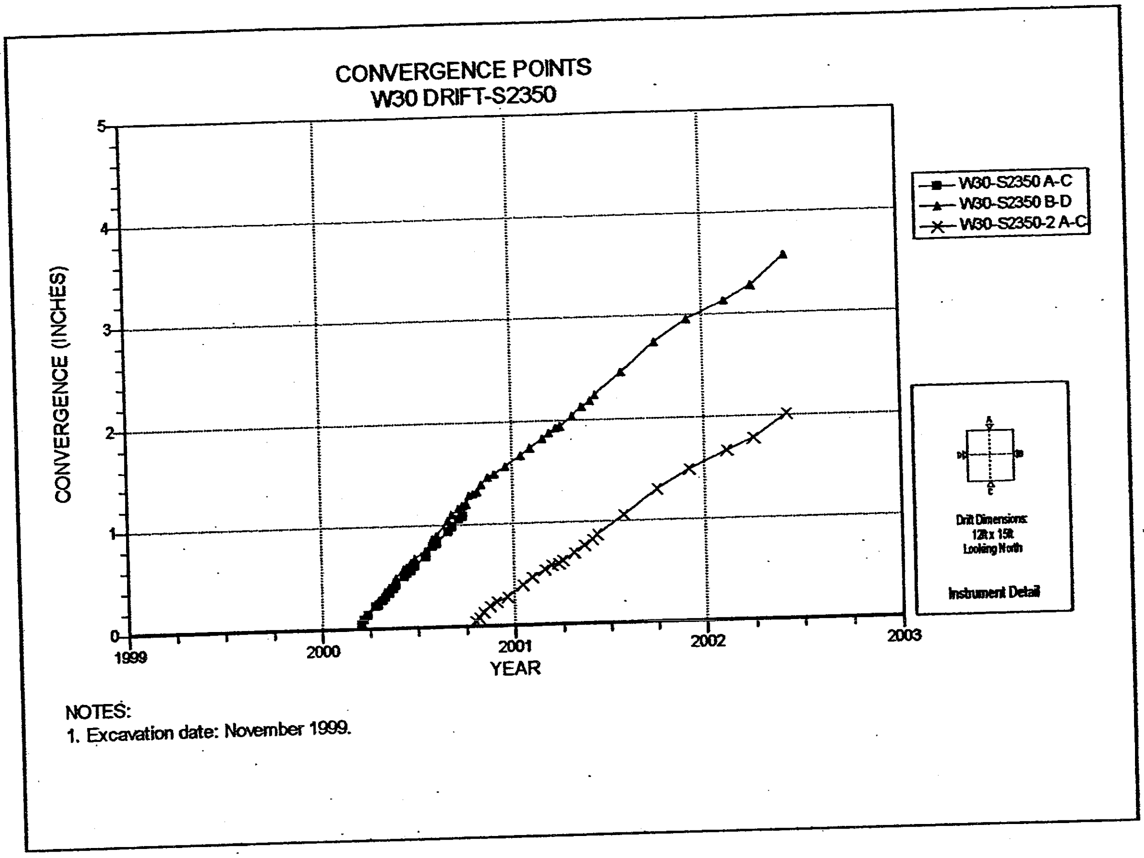


Figure 4-151 Convergence Point Array W30 Drift at S2350 – All Chords

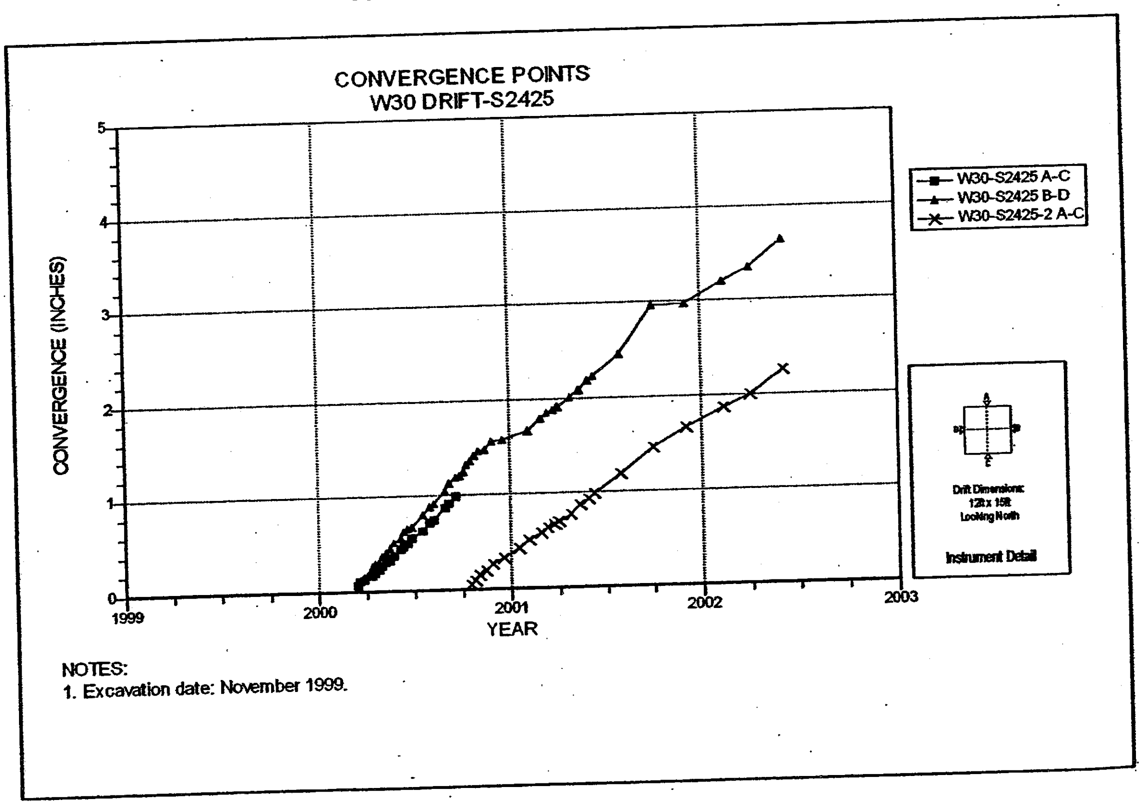


Figure 4-152 Convergence Point Array W30 Drift at S2425 – All Chords

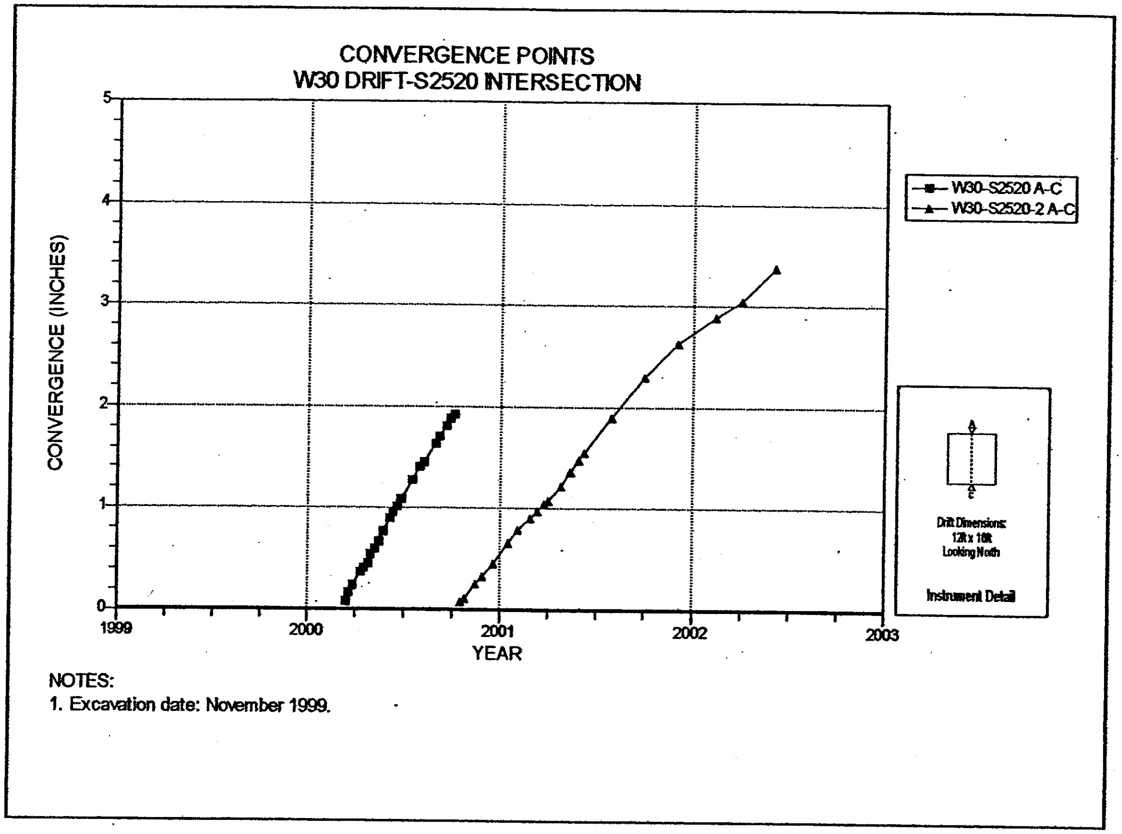


Figure 4-153 Convergence Point Array
W30 Drift at S2520 Drift Intersection – Roof to Floor

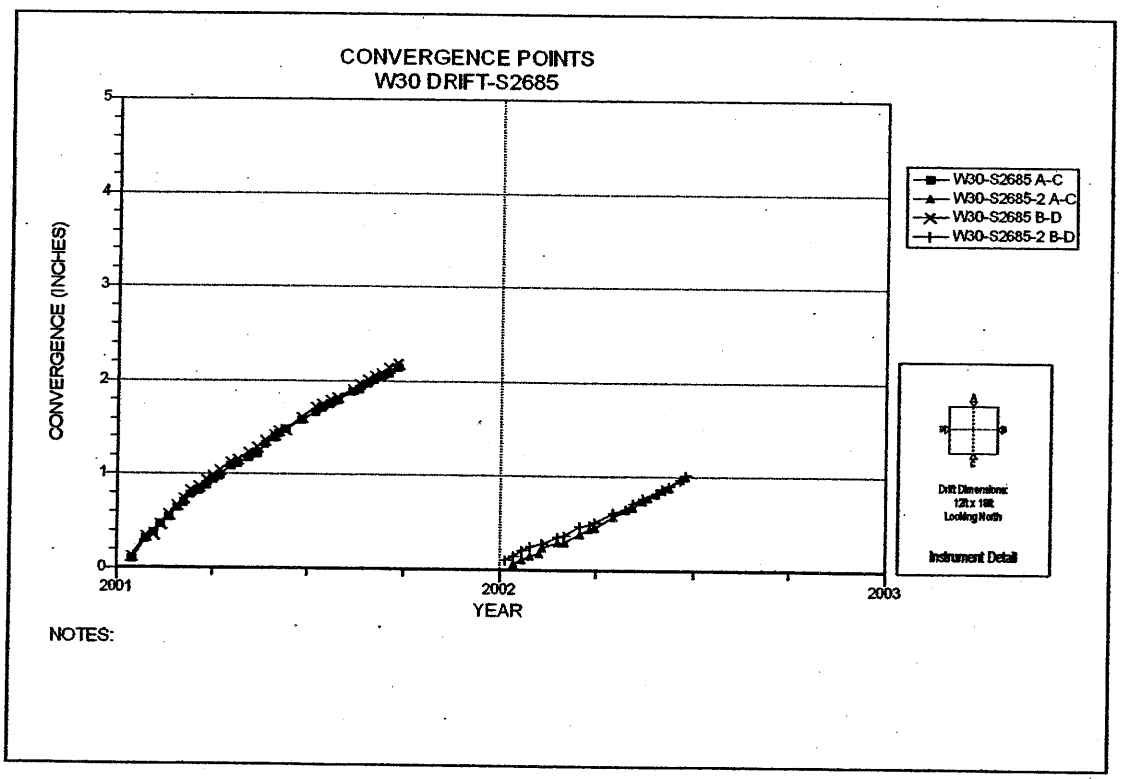
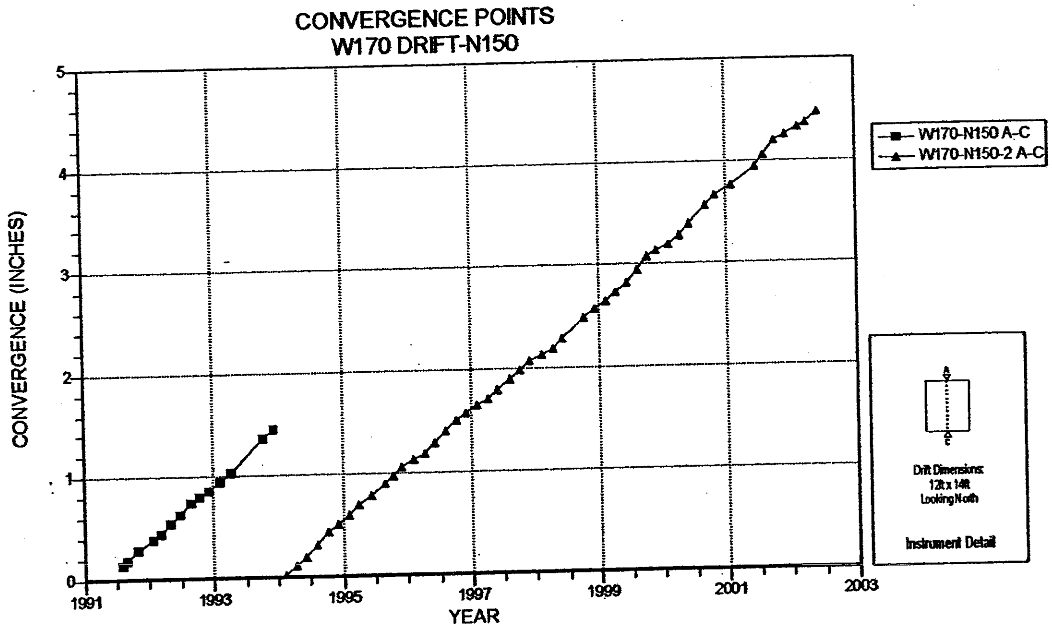
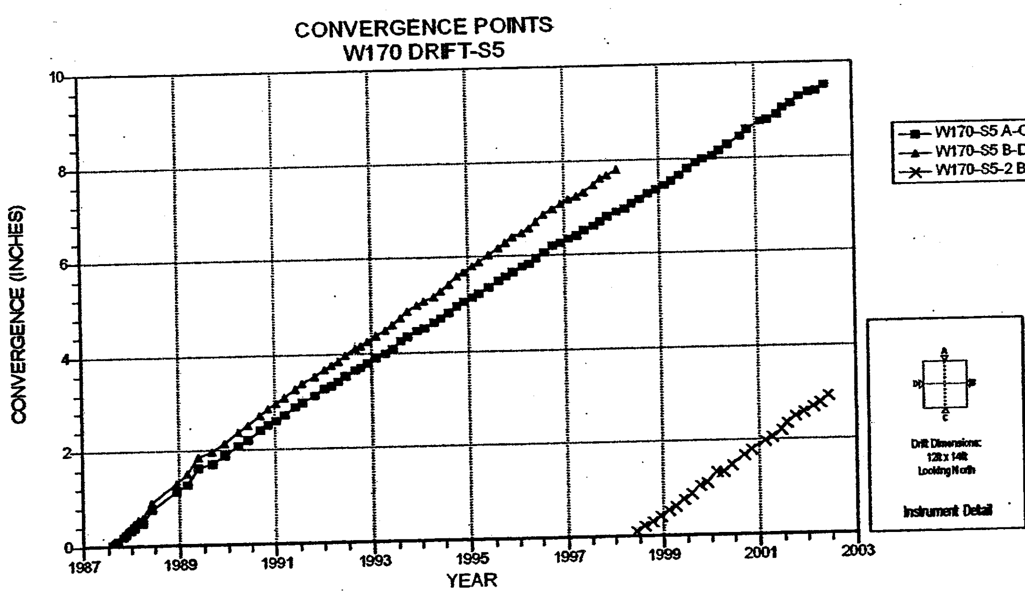


Figure 4-154 Convergence Point Array
W30 Drift at S2685 – All Chords



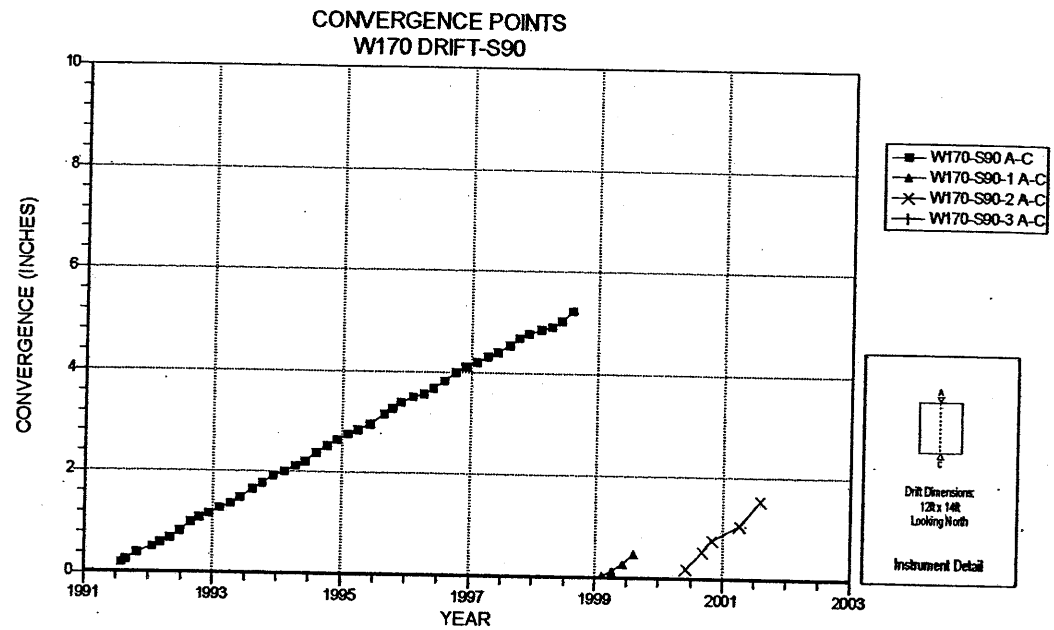
NOTES:
1. Excavation date: July 1984.

Figure 4-155 Convergence Point Array
W170 Drift at N150 Drift Intersection – Roof to Floor



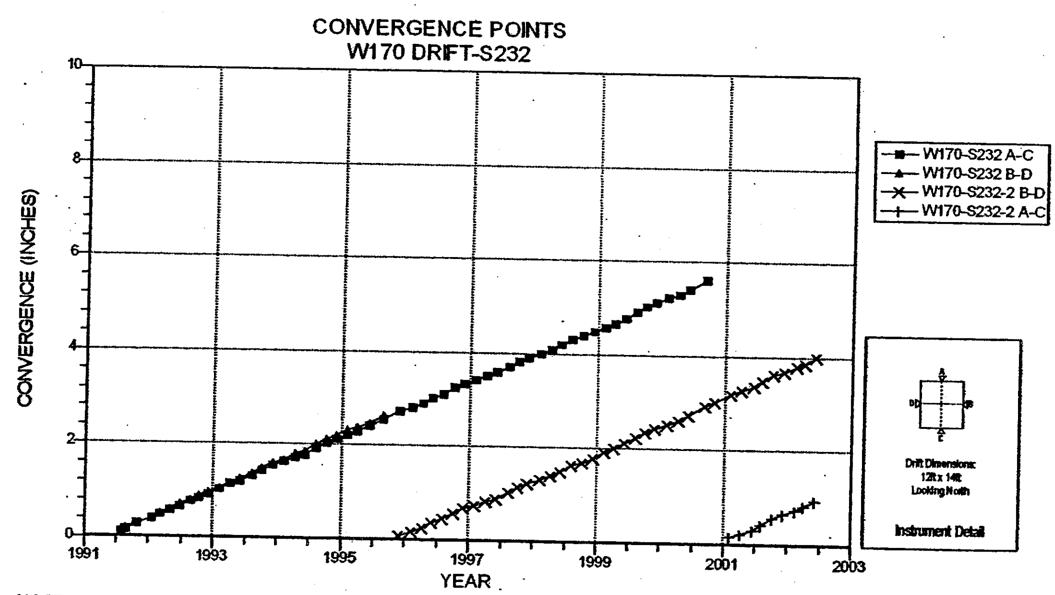
NOTES:
1. Excavation date: August 1984.

Figure 4-156 Convergence Point Array
W170 Drift at S5 – All Chords



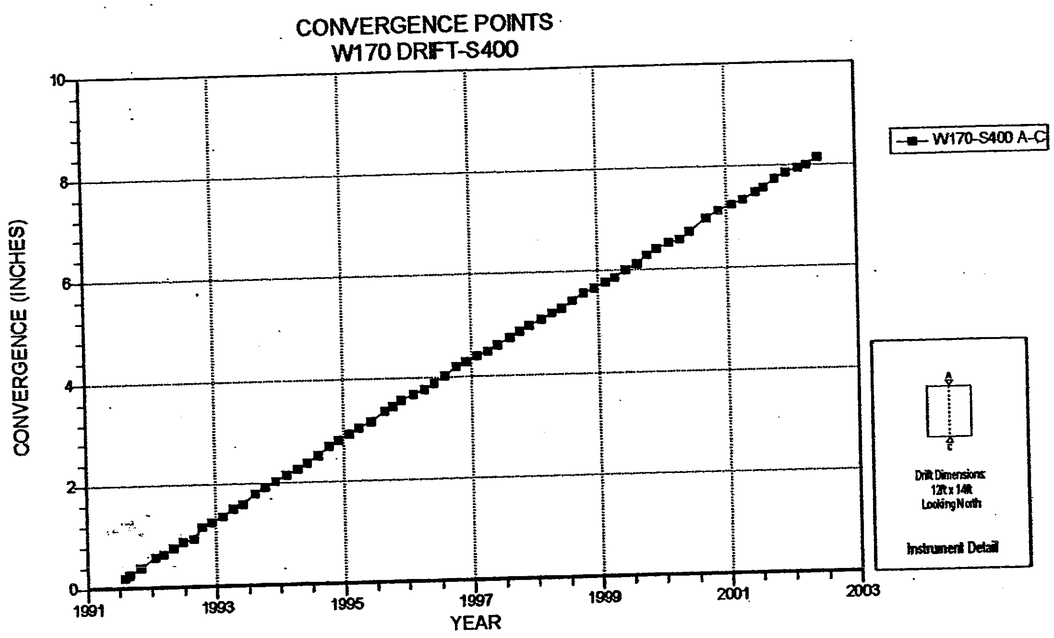
NOTES:
1. Excavation date: August 1984.
2. Mined out third quarter 2001.

Figure 4-157 Convergence Point Array
W170 Drift at S90 – Roof to Floor



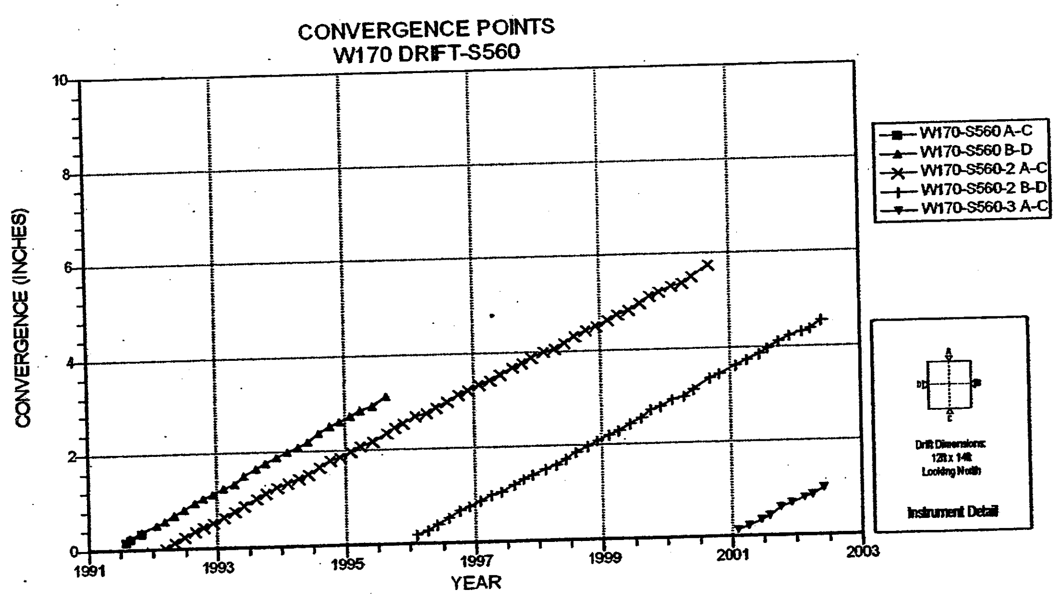
NOTES:
1. Excavation date: August 1984.

Figure 4-158 Convergence Point Array
W170 Drift at S232 – All Chords



NOTES:
1. Excavation date: August 1984.

Figure 4-159 Convergence Point Array
W170 Drift at S400 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: August 1984.

Figure 4-160 Convergence Point Array
W170 Drift at S560 – All Chords

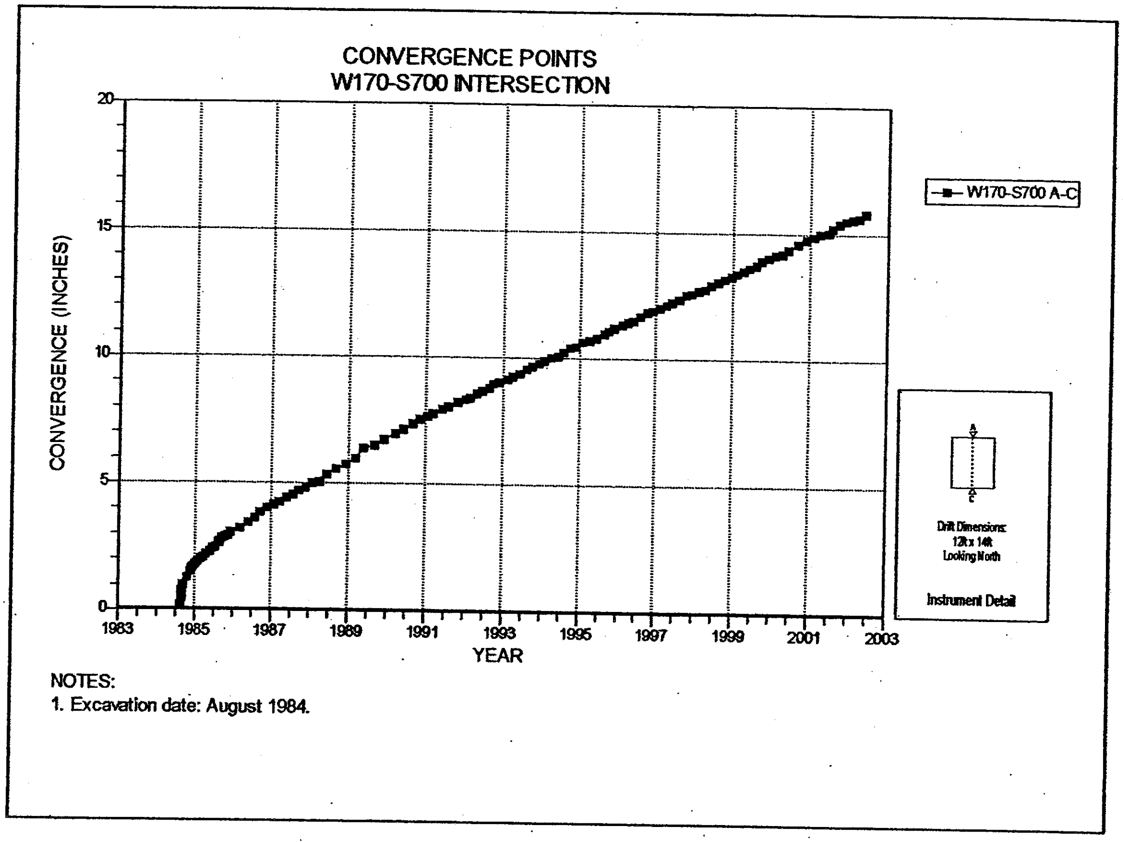


Figure 4-161 Convergence Point Array
W170 Drift at S700 Drift Intersection – Roof to Floor

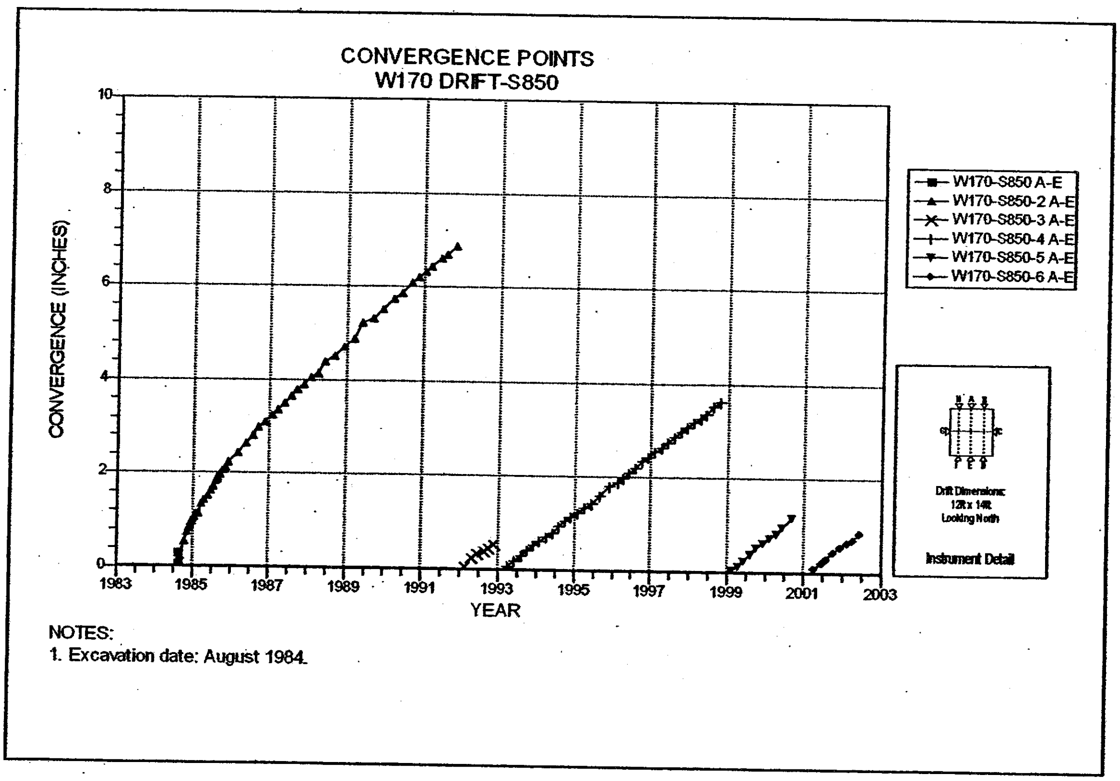


Figure 4-162 Convergence Point Array
W170 Drift at S850 – Roof to Floor – Centerline

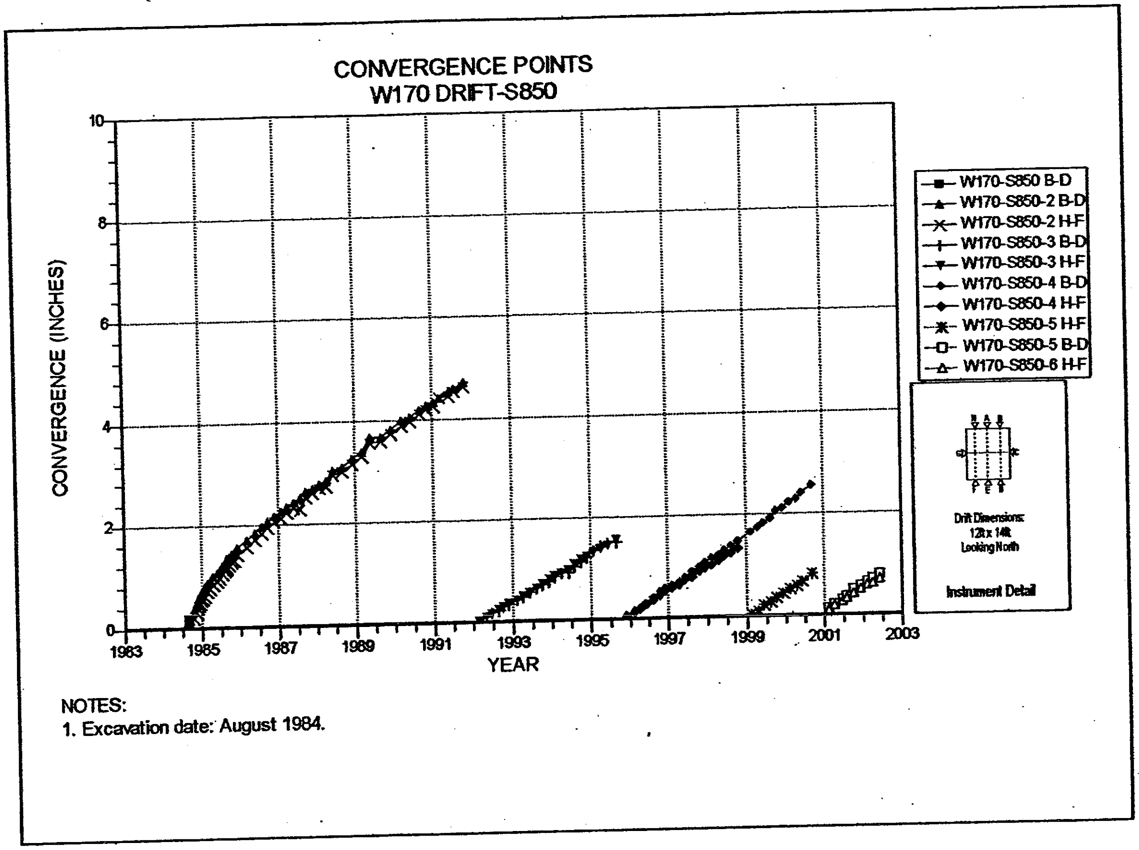


Figure 4-163 Convergence Point Array
W170 Drift at S850 – Roof to Floor – Quarter Points

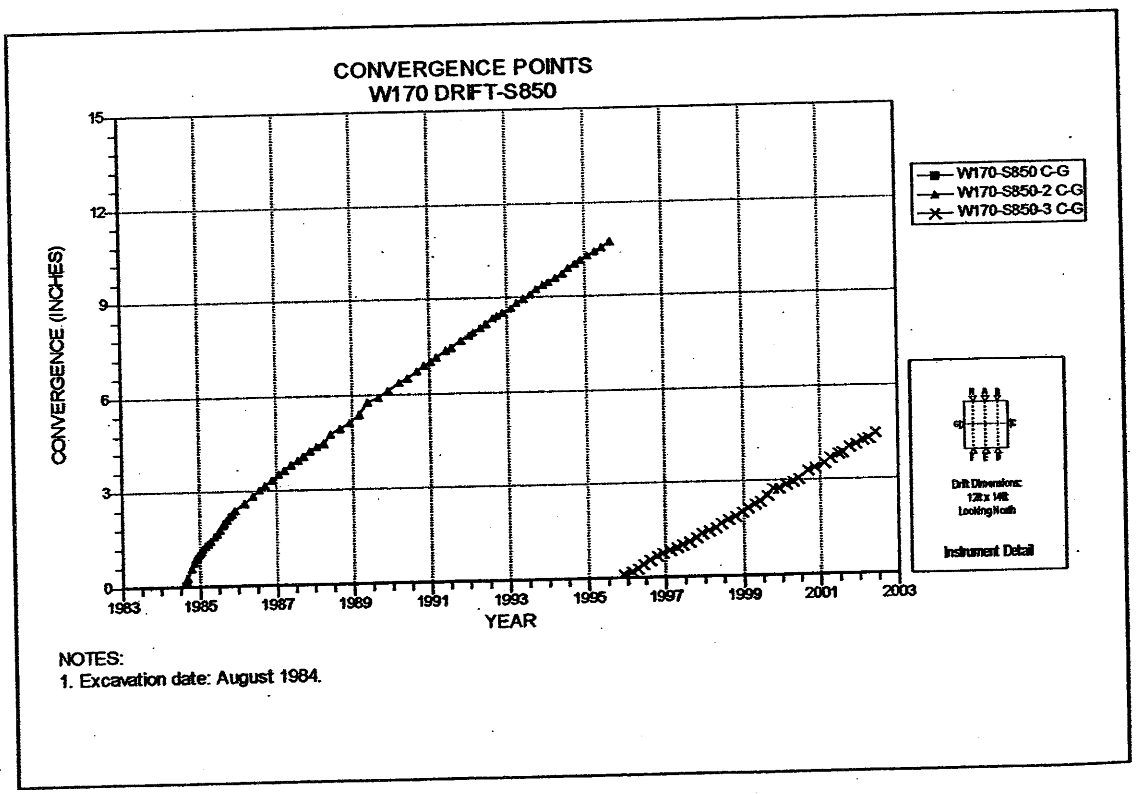


Figure 4-164 Convergence Point Array
W170 Drift at S850 – Rib to Rib

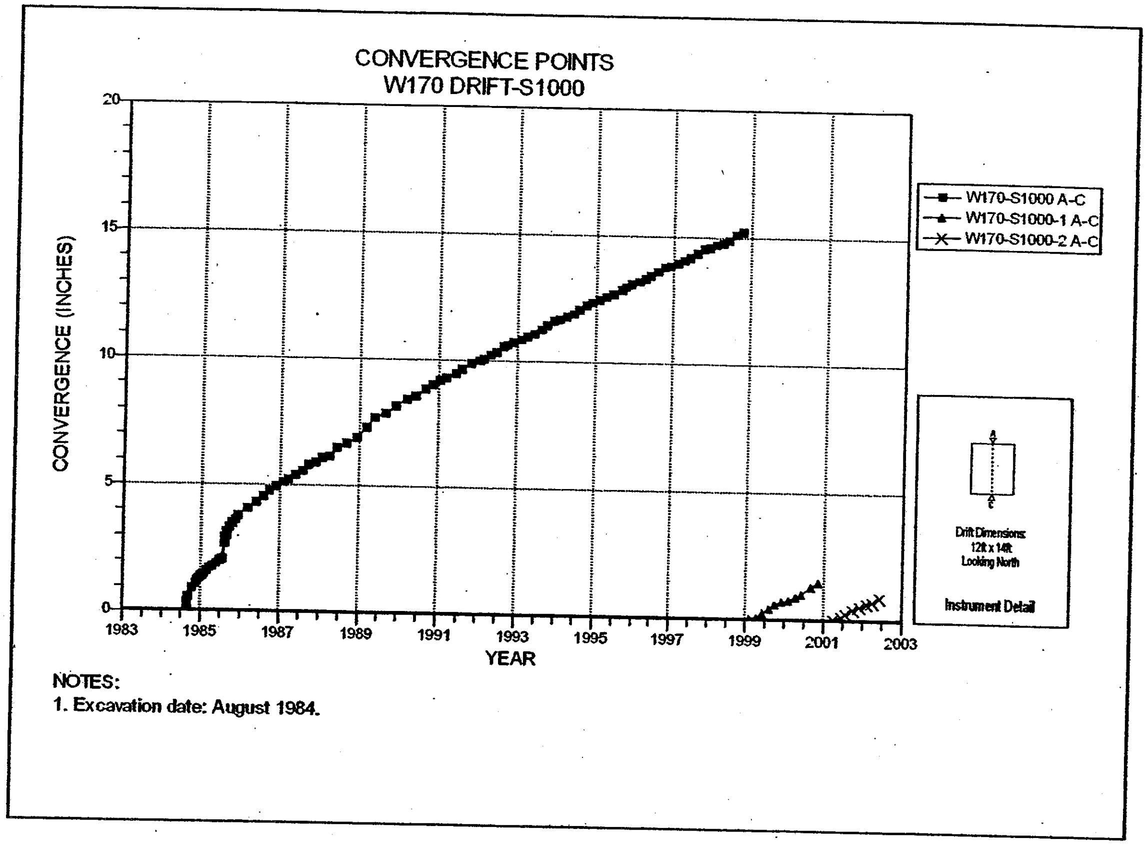


Figure 4-165 Convergence Point Array
W170 Drift at S1000 – Roof to Floor

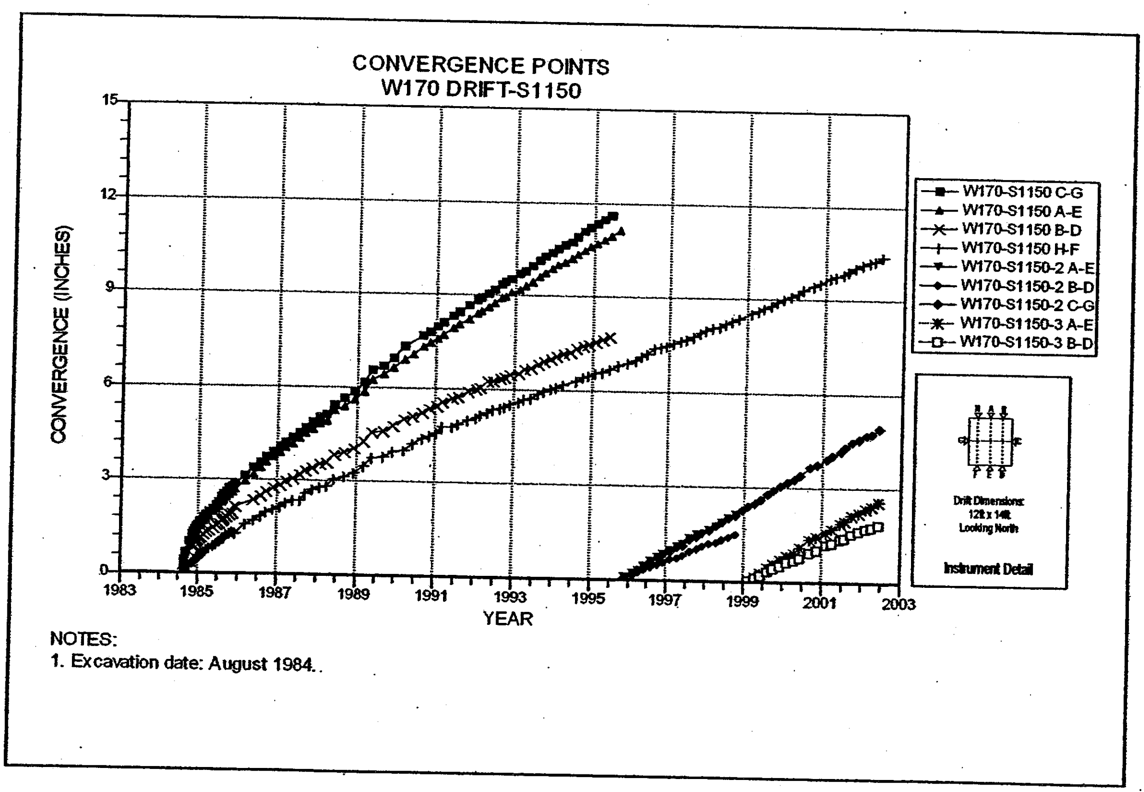


Figure 4-166 Convergence Point Array
W170 Drift at S1150 – All Chords

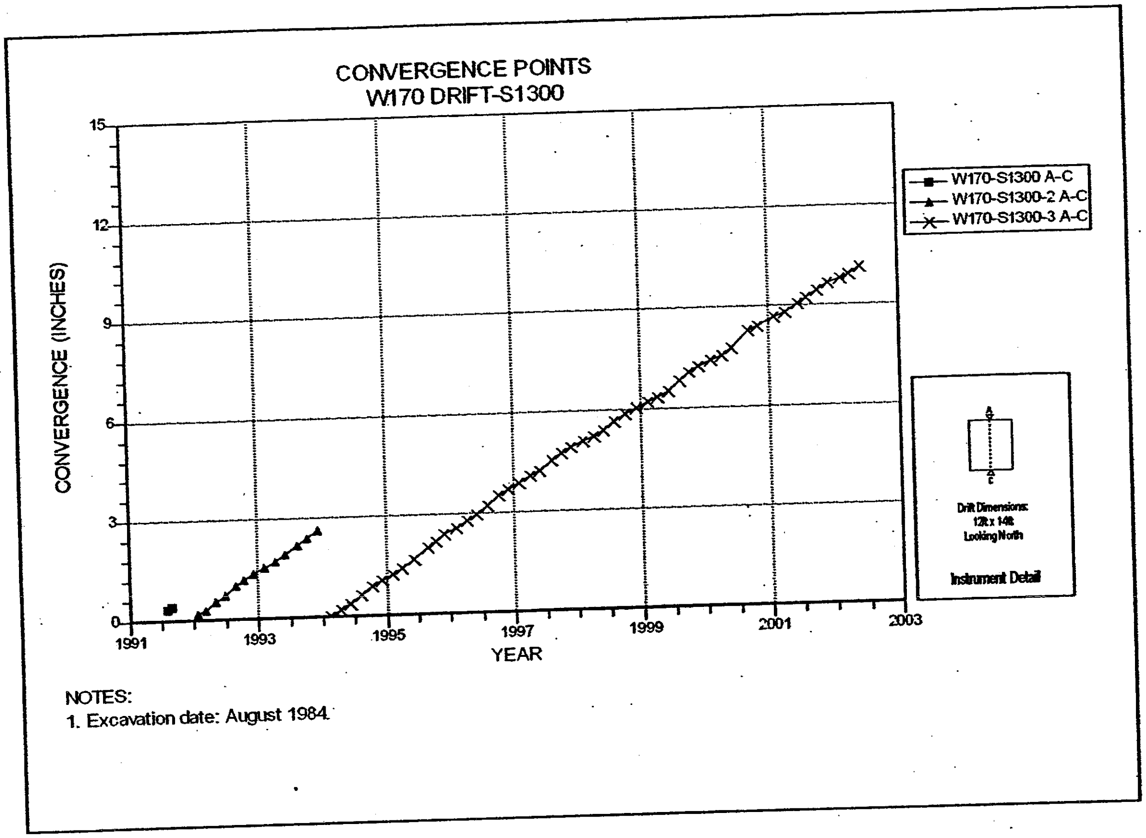


Figure 4-167 Convergence Point Array
W170 Drift at S1300 Drift Intersection – Roof to Floor

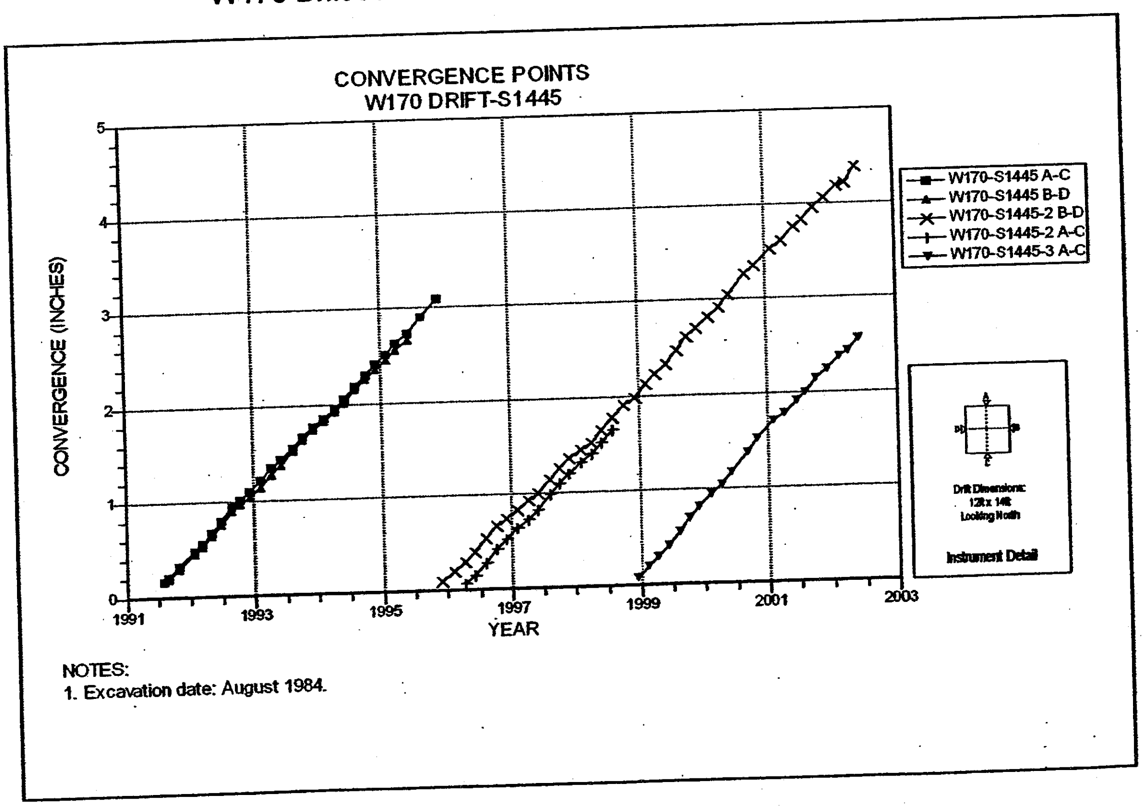


Figure 4-168 Convergence Point Array
W170 Drift at S1445 – All Chords

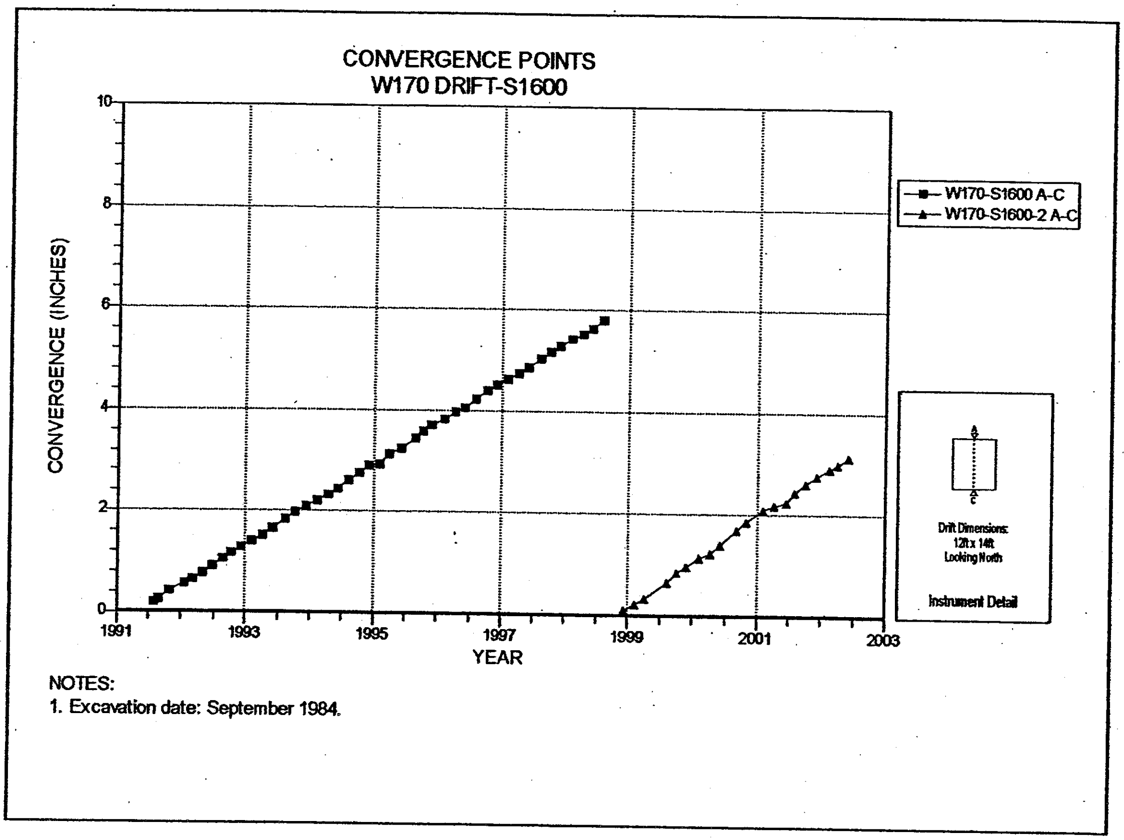


Figure 4-169 Convergence Point Array
W170 Drift at S1600 Drift Intersection – Roof to Floor

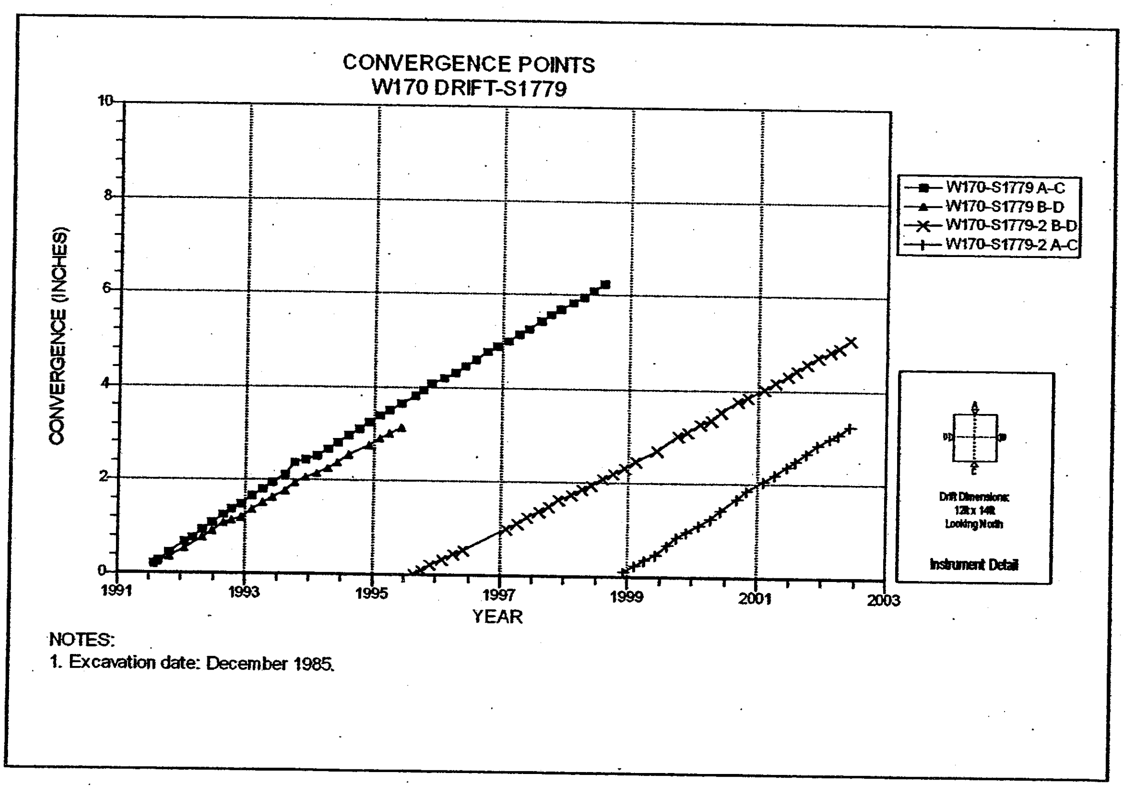


Figure 4-170 Convergence Point Array
W170 Drift at S1779 – All Chords

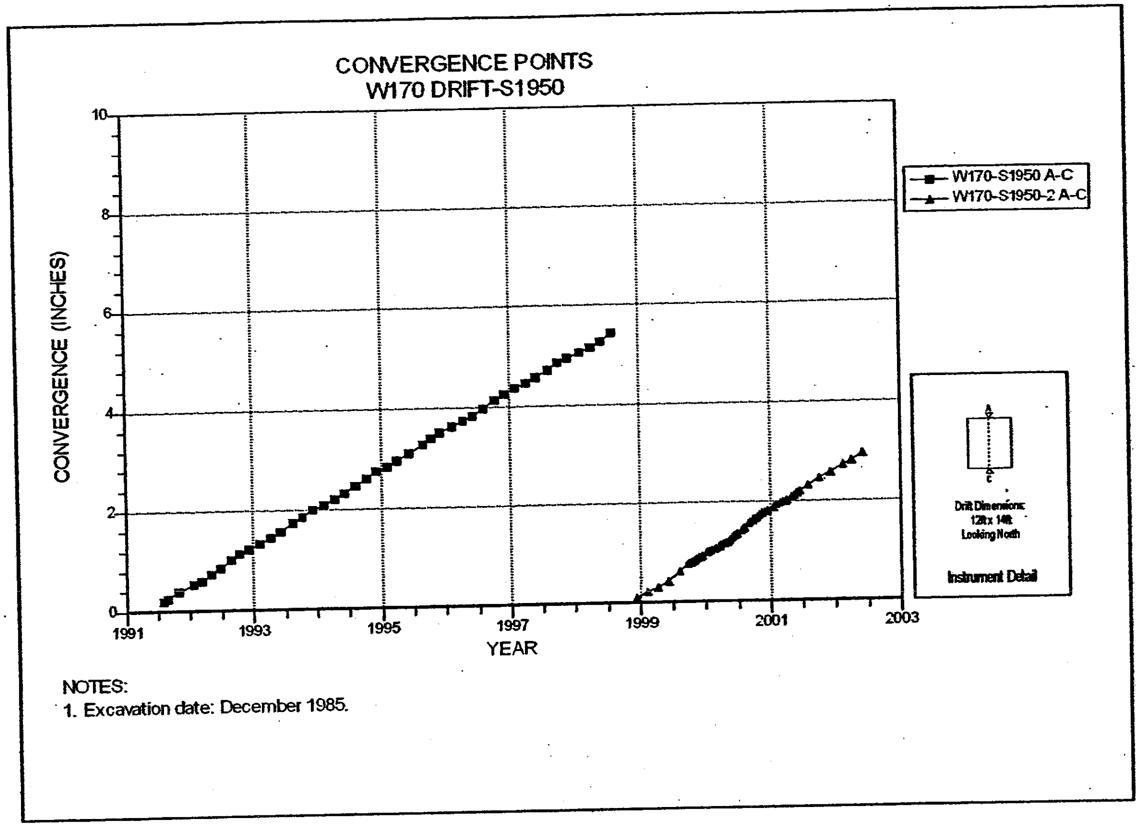


Figure 4-171 Convergence Point Array
W170 Drift at S1950 Drift Intersection – Roof to Floor

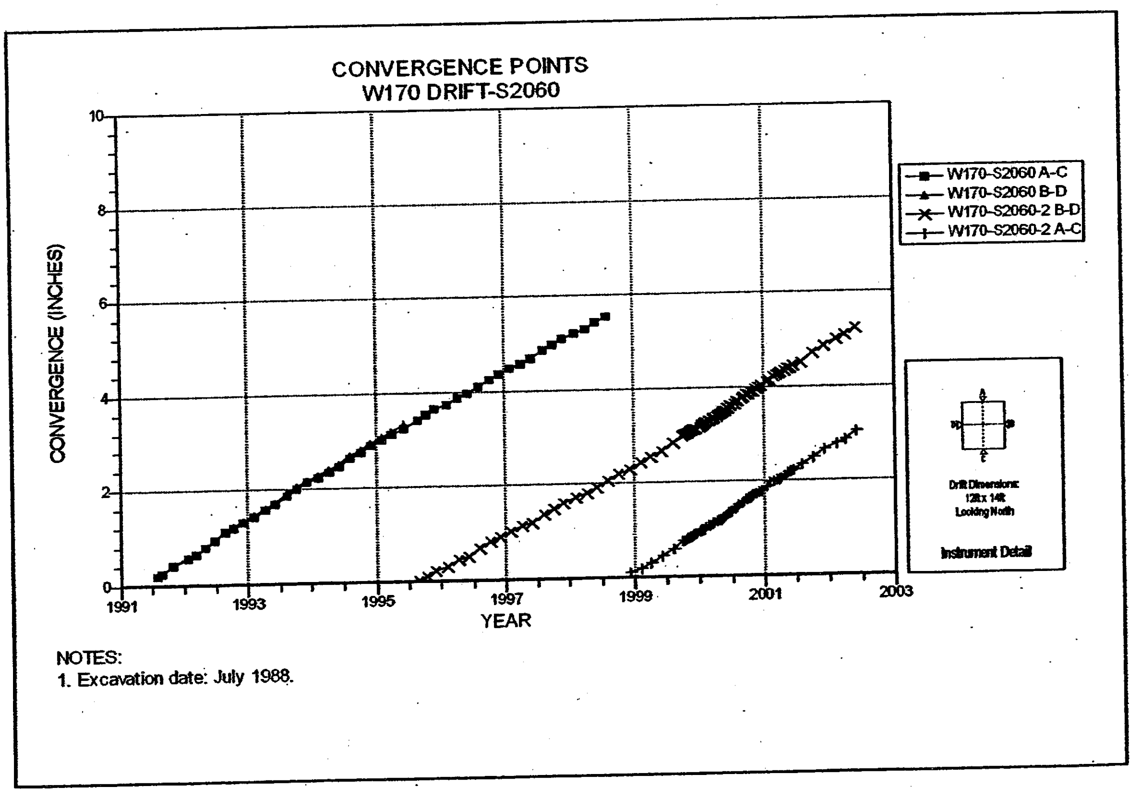


Figure 4-172 Convergence Point Array
W170 Drift at S2060 – All Chords

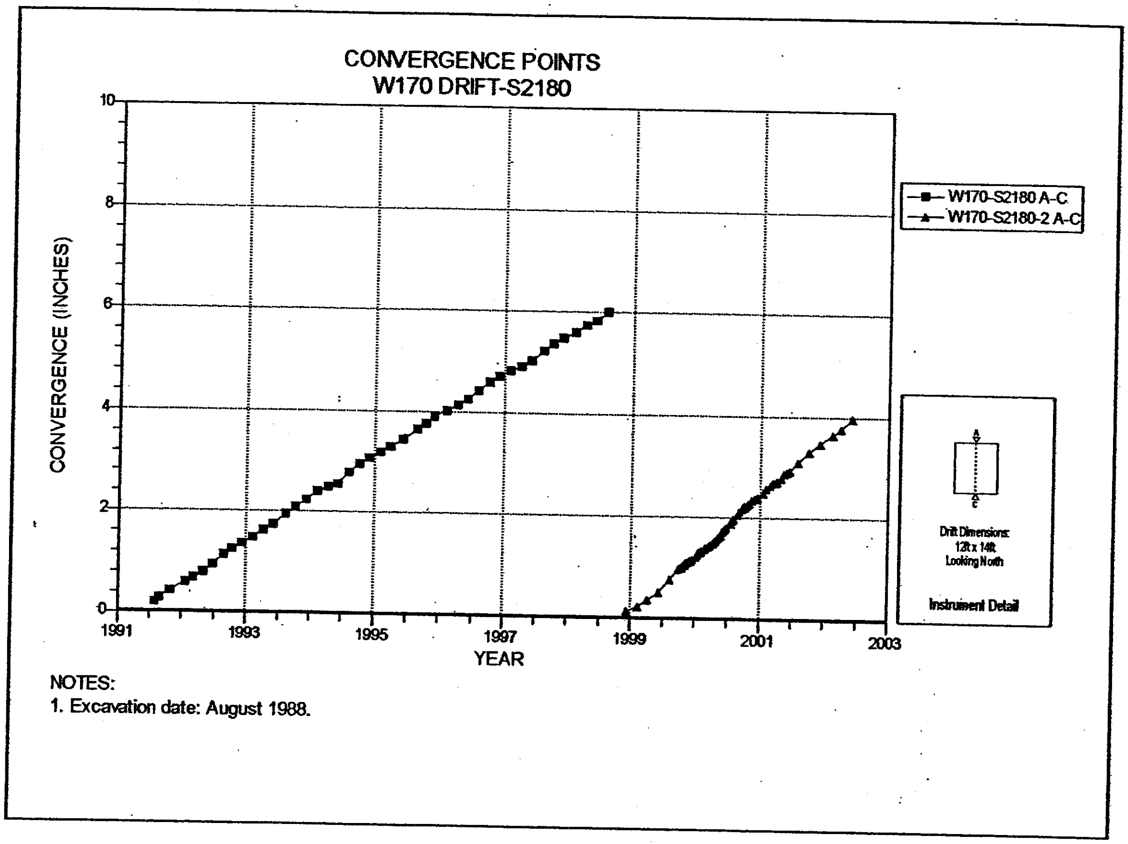


Figure 4-173 Convergence Point Array
W170 Drift at S2180 Drift Intersection – Roof to Floor

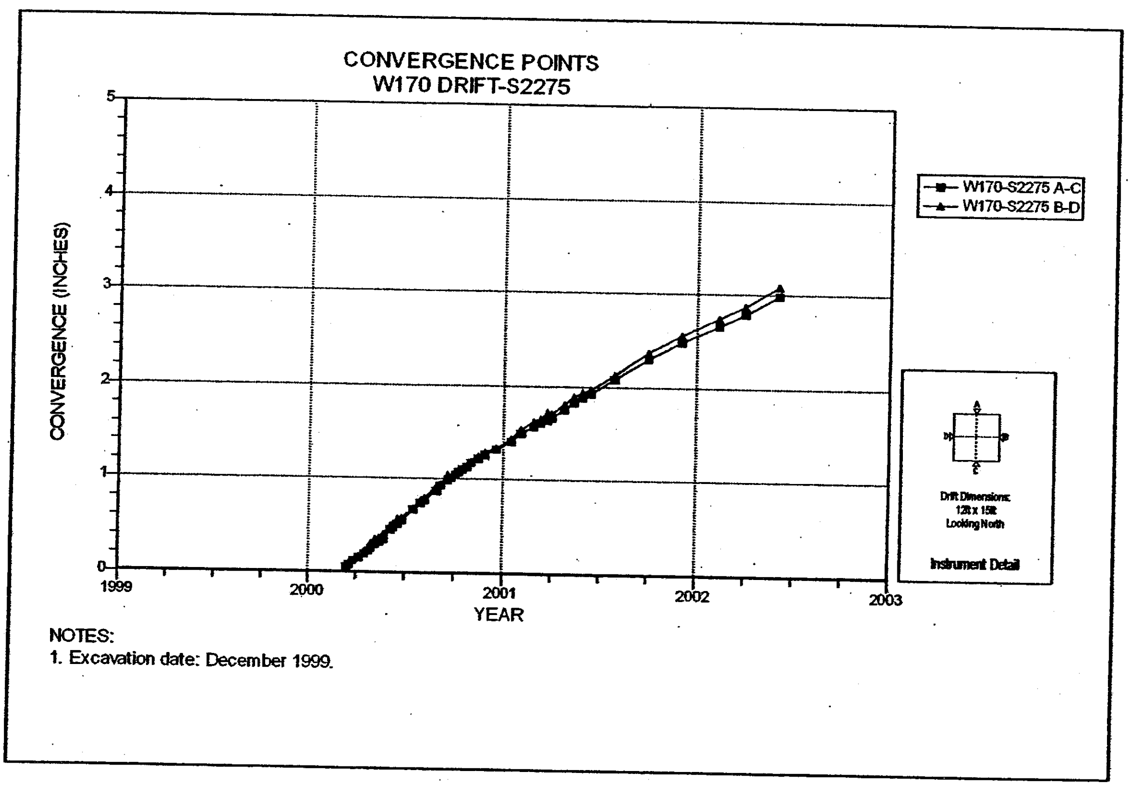


Figure 4-174 Convergence Point Array
W170 Drift at S2275 – All Chords

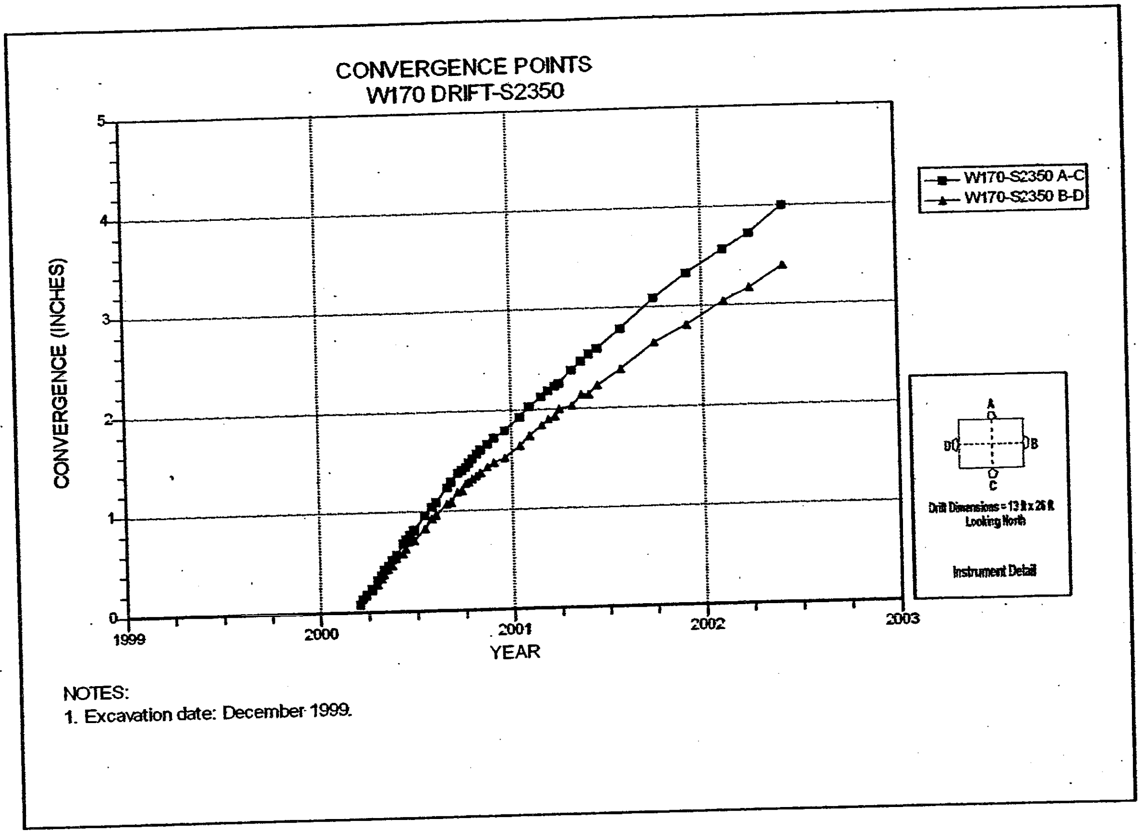


Figure 4-175 Convergence Point Array
W170 Drift at S2350 – All Chords

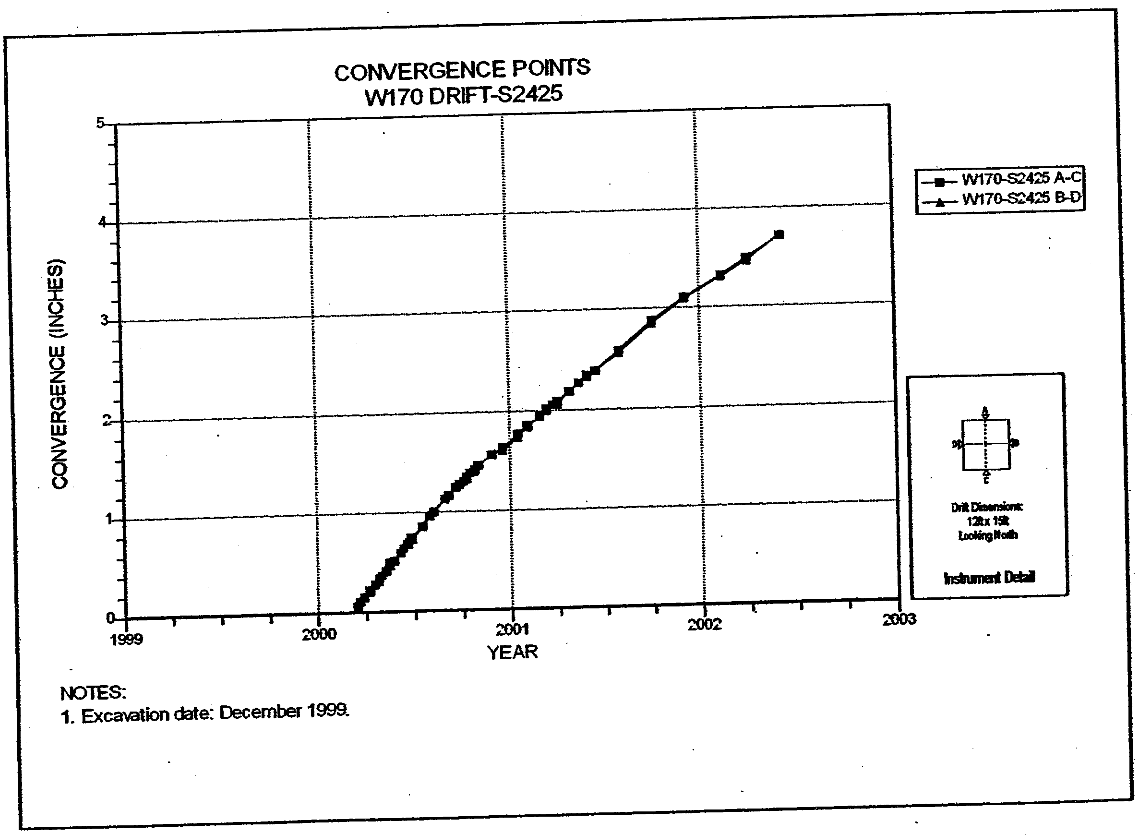
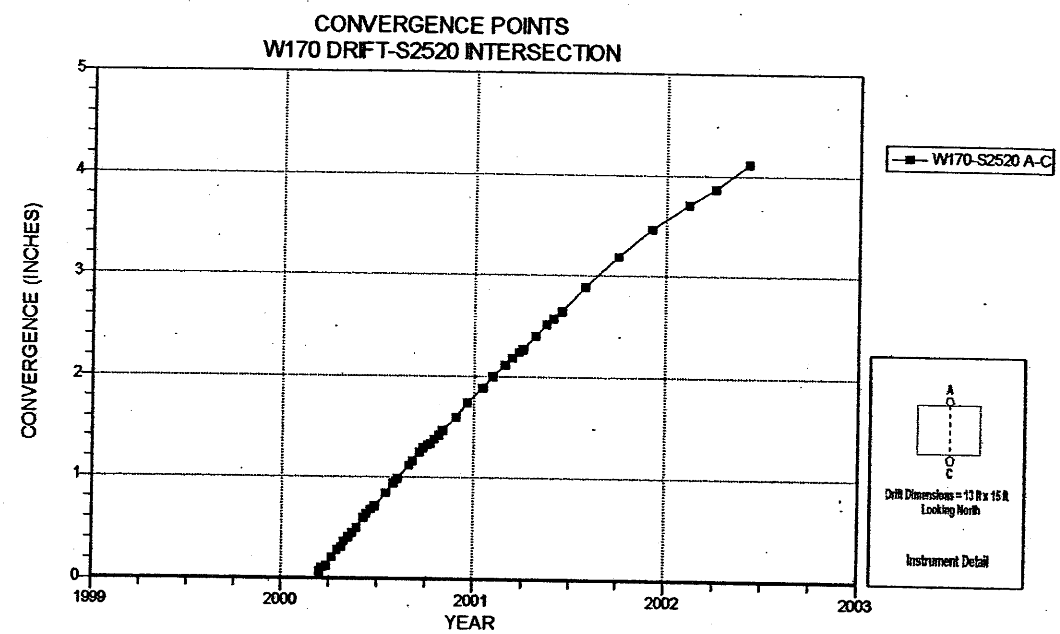
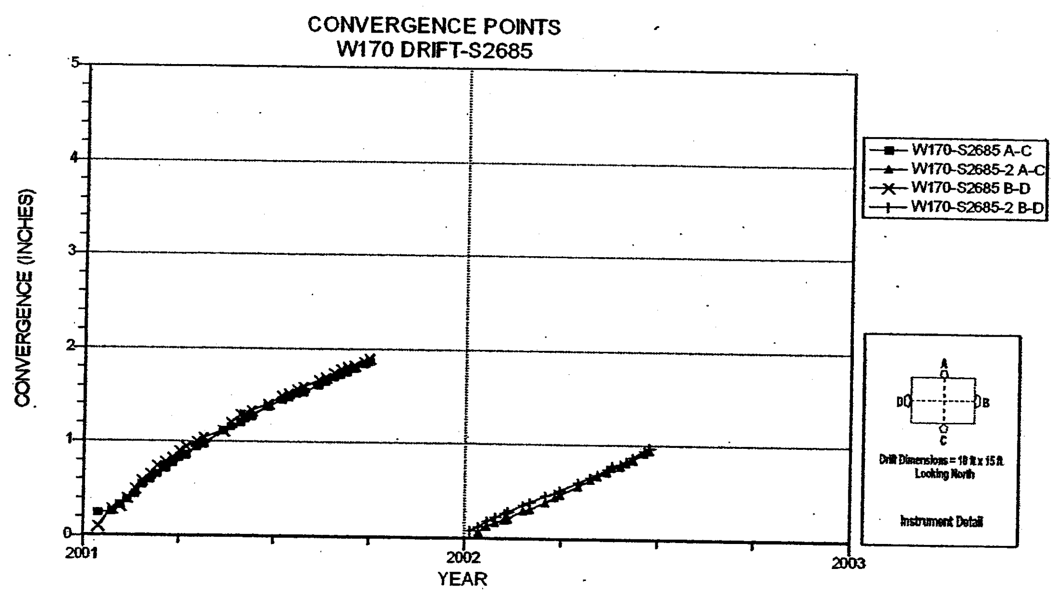


Figure 4-176 Convergence Point Array
W170 Drift at S2425 – All Chords



NOTES:
1. Excavation date: December 1999.

Figure 4-177 Convergence Point Array
W170 Drift at S2520 Drift Intersection – Roof to Floor



NOTES:

Figure 4-178 Convergence Point Array
W170 Drift at S2685 – All Chords

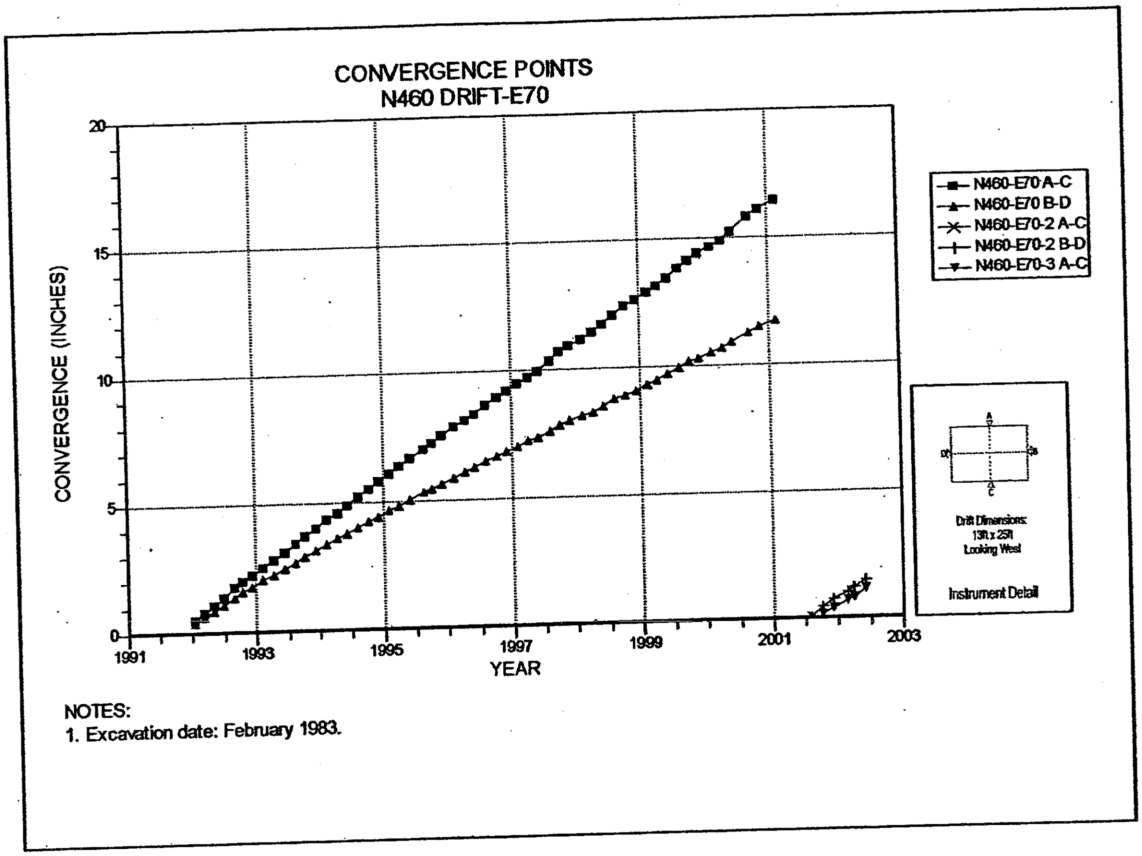


Figure 4-179 Convergence Point Array N460 Drift at E70 – All Chords

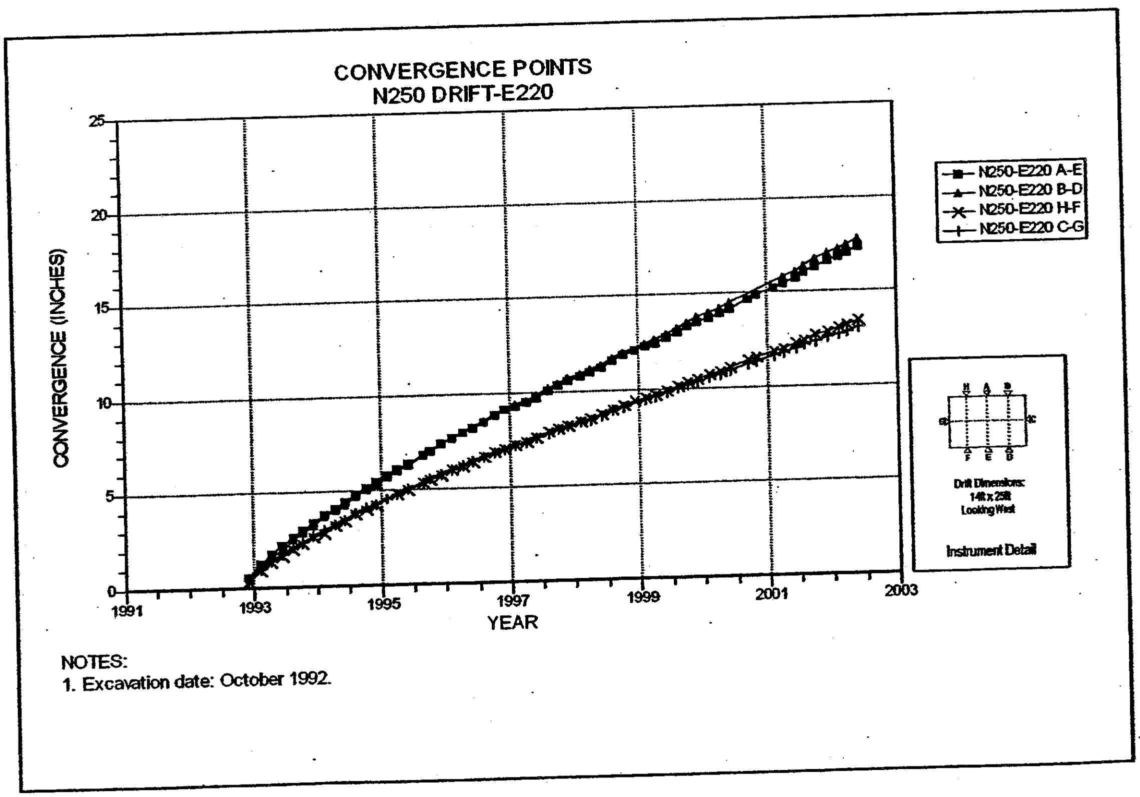
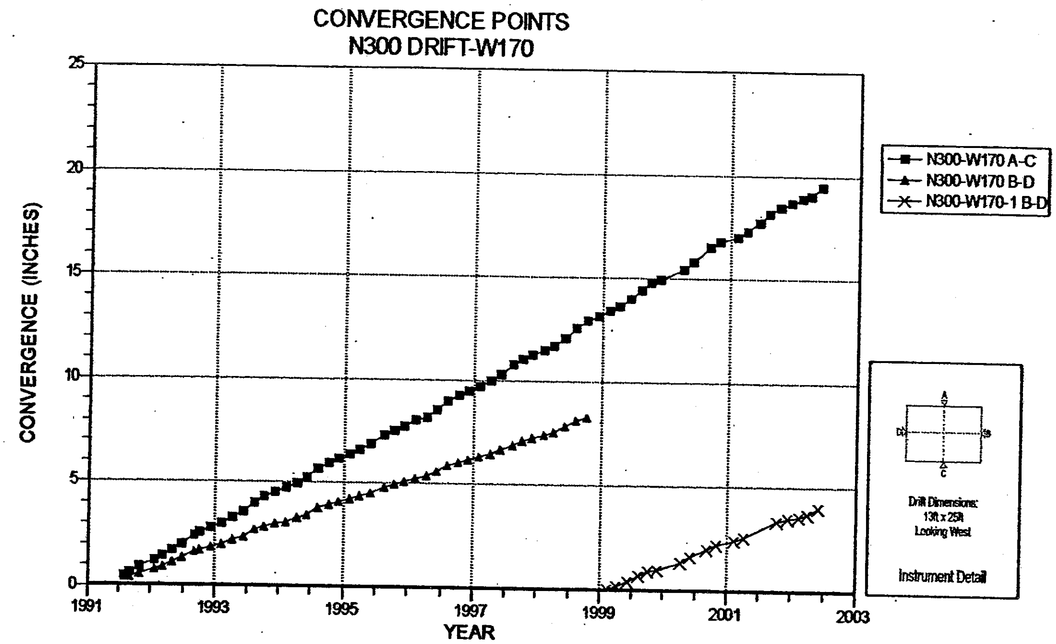
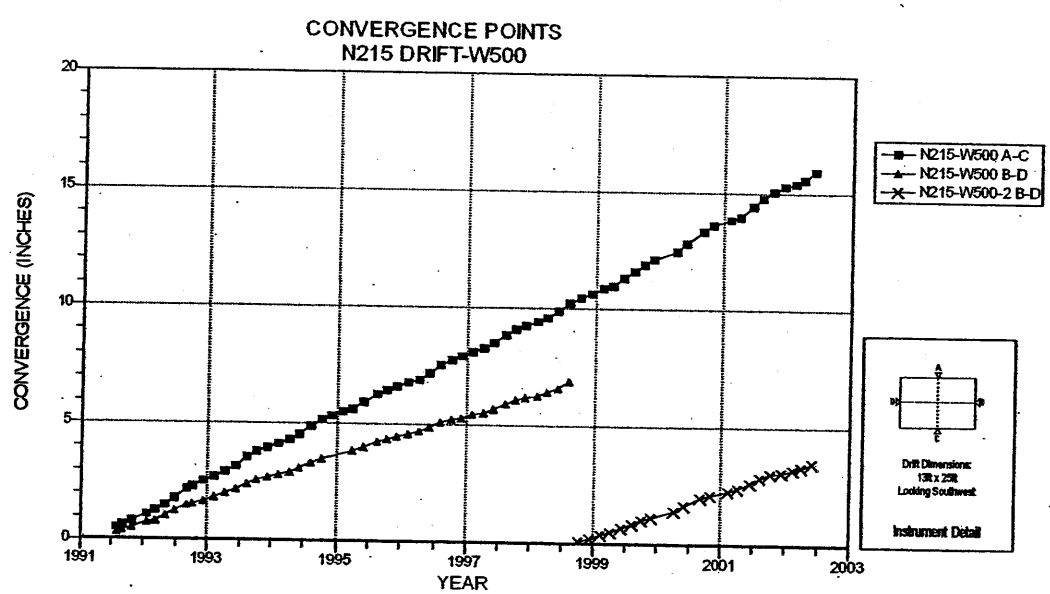


Figure 4-180 Convergence Point Array N250 Drift at E220 – All Chords



NOTES:
1. Excavation date: October 1988.

Figure 4-181 Convergence Point Array
N300 Drift at W170 – All Chords



NOTES:
1. Excavation date: December 1987.

Figure 4-182 Convergence Point Array
N215 Drift at W500 – All Chords

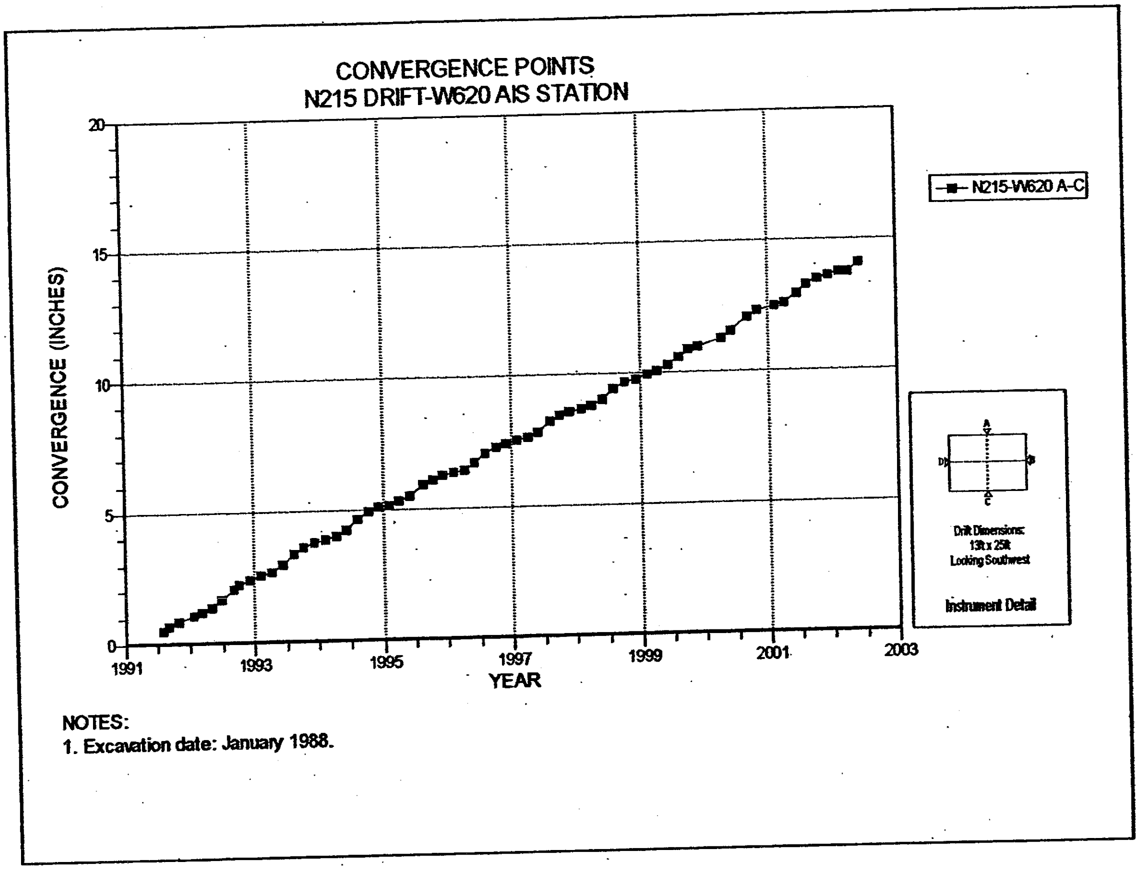


Figure 4-183 Convergence Point Array
N215 Drift at W620 at Air Intake Shaft – Roof to Floor

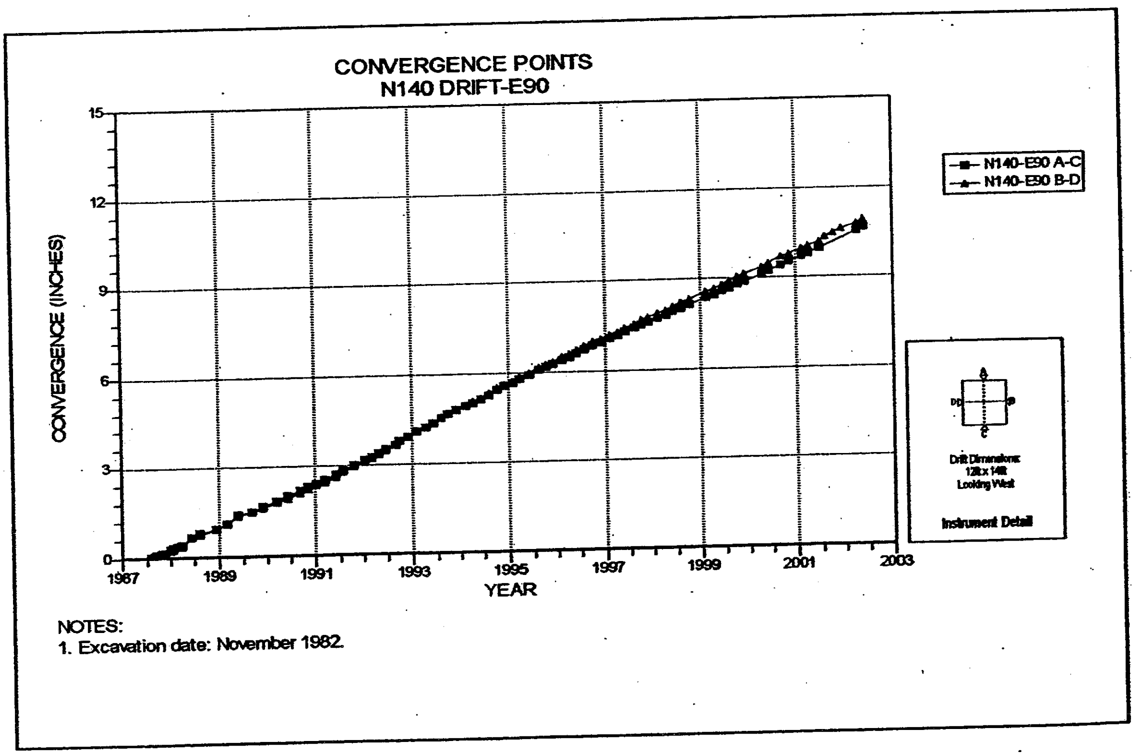
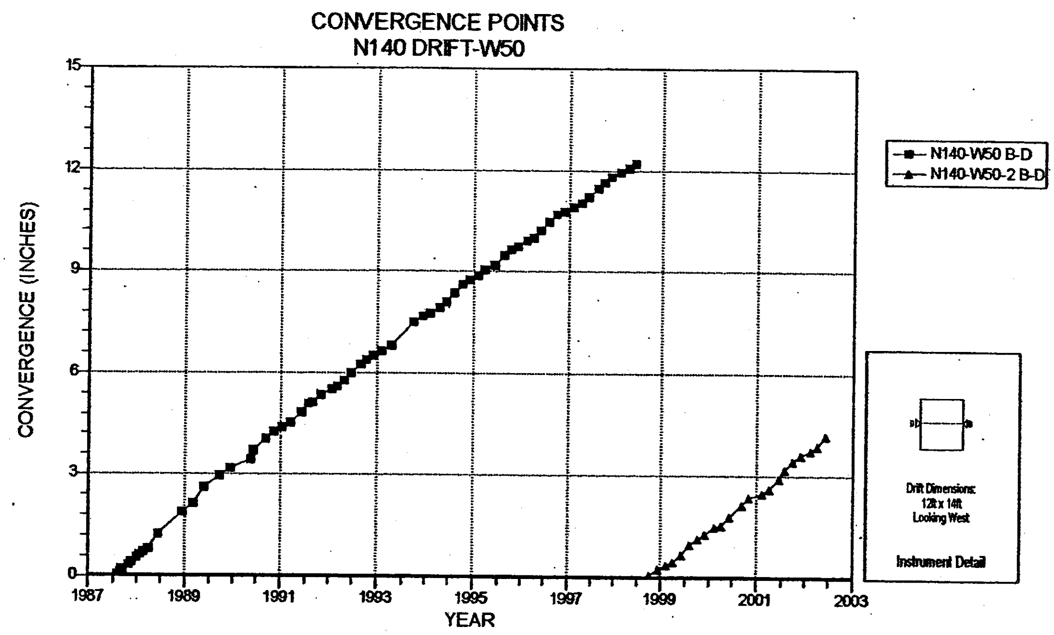
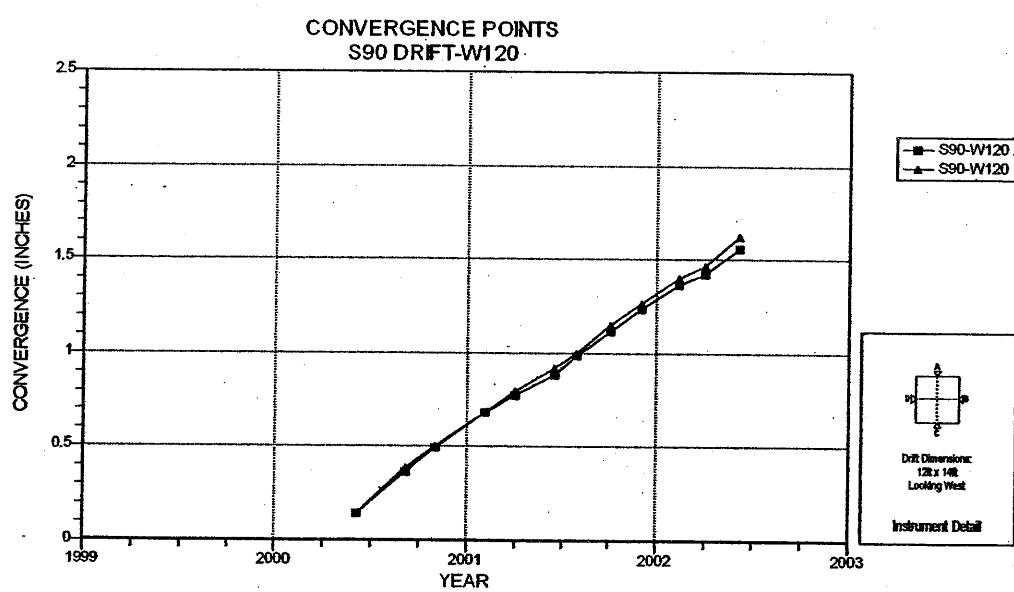


Figure 4-184 Convergence Point Array
N140 Drift at E90 – All Chords



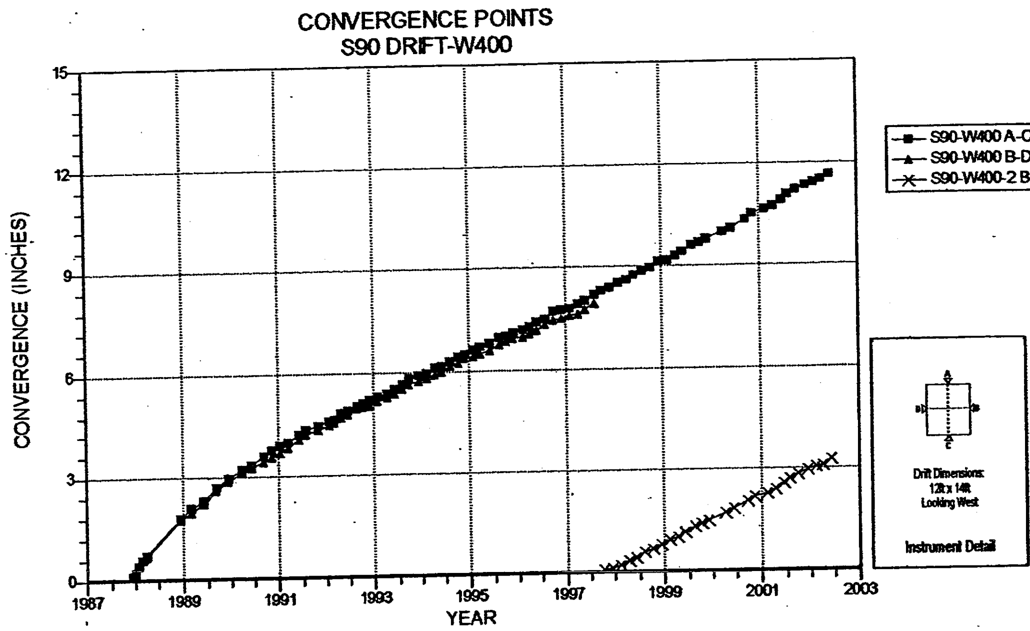
NOTES:
1. Excavation date: July 1984.

Figure 4-185 Convergence Point Array
N140 Drift at W50 – Rib to Rib



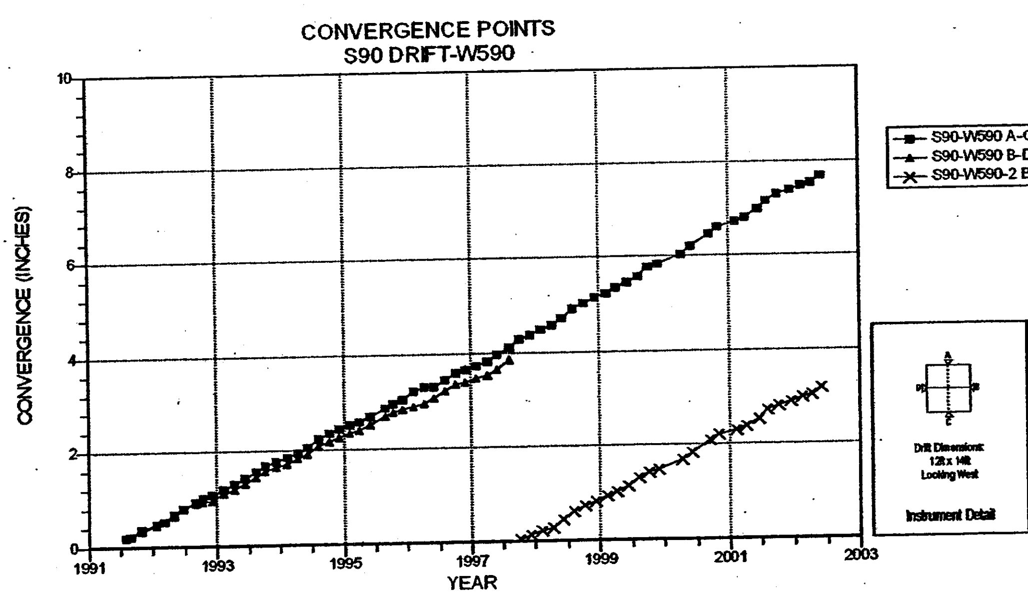
NOTES:

Figure 4-186 Convergence Point Array
S90 Drift at W120 – All Chords



NOTES:
1. Installation date: December 1987.

Figure 4-187 Convergence Point Array
S90 Drift at W400 – All Chords



NOTES:
1. Excavation date: November 1987.

Figure 4-188 Convergence Point Array
S90 Drift at W590 – All Chords

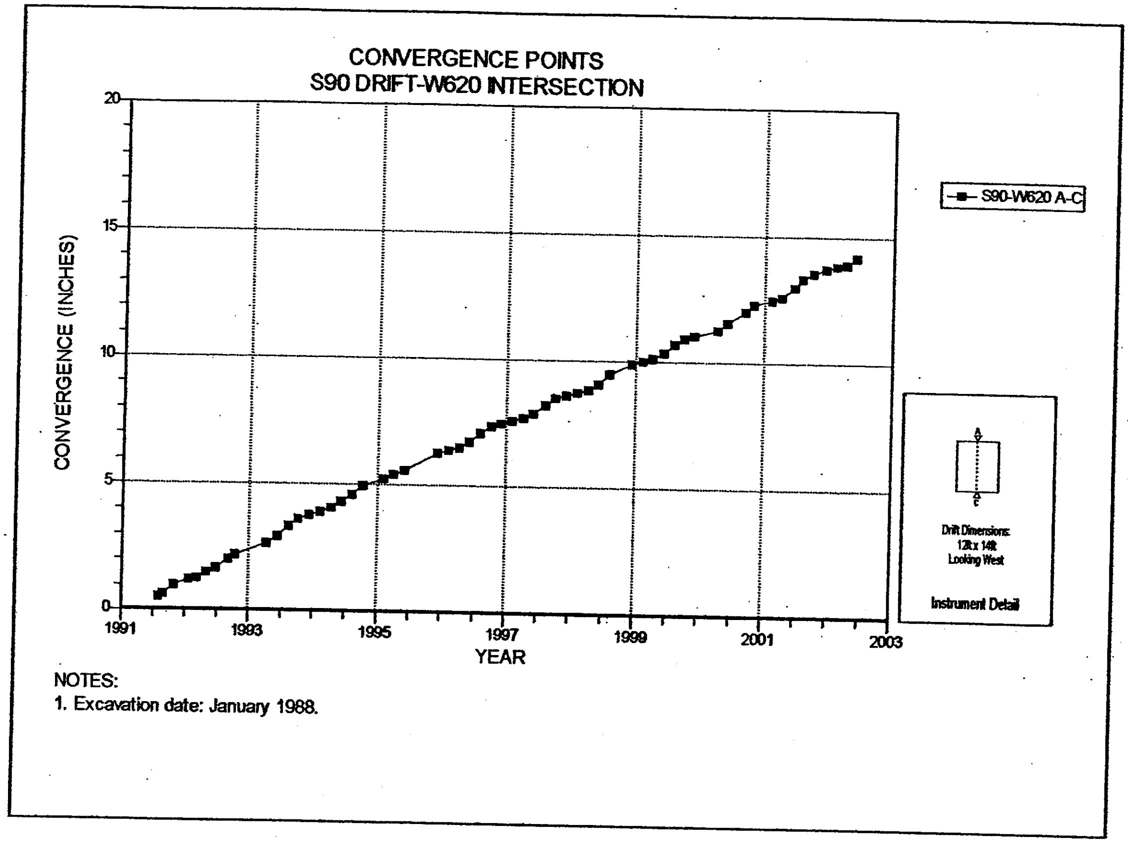


Figure 4-189 Convergence Point Array
S90 Drift at W620 – Roof to Floor

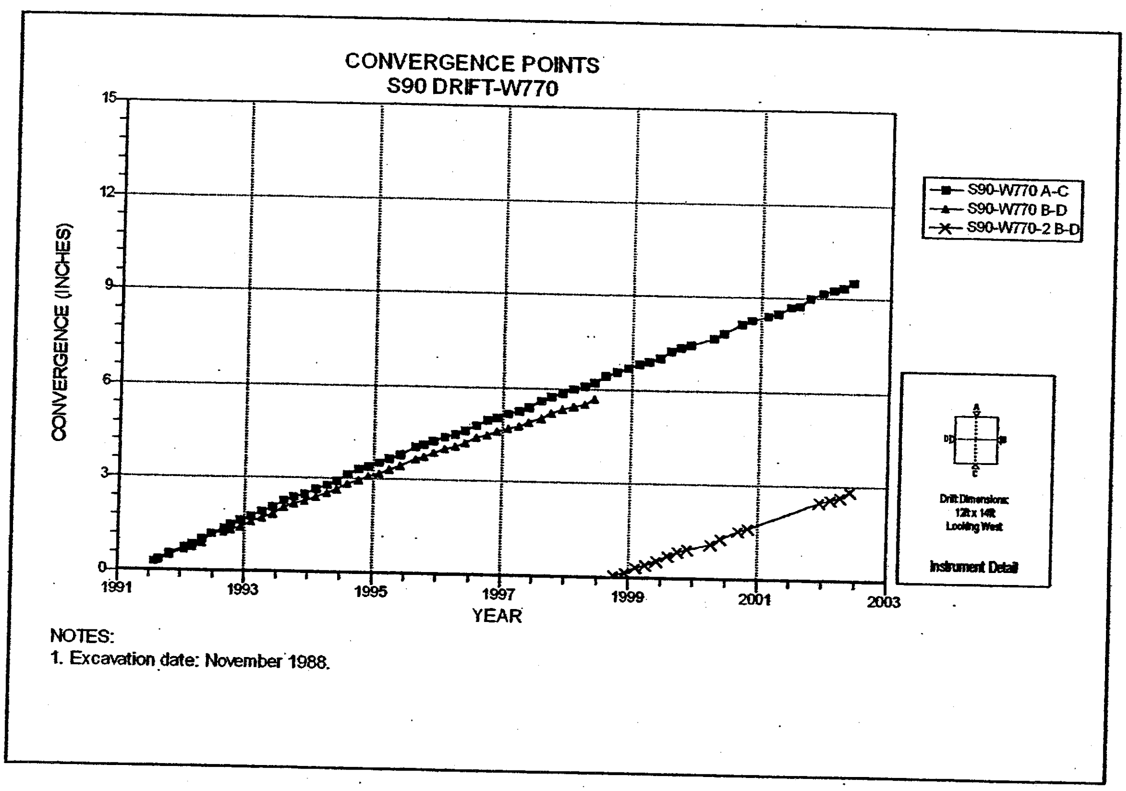


Figure 4-190 Convergence Point Array
S90 Drift at W770 – All Chords

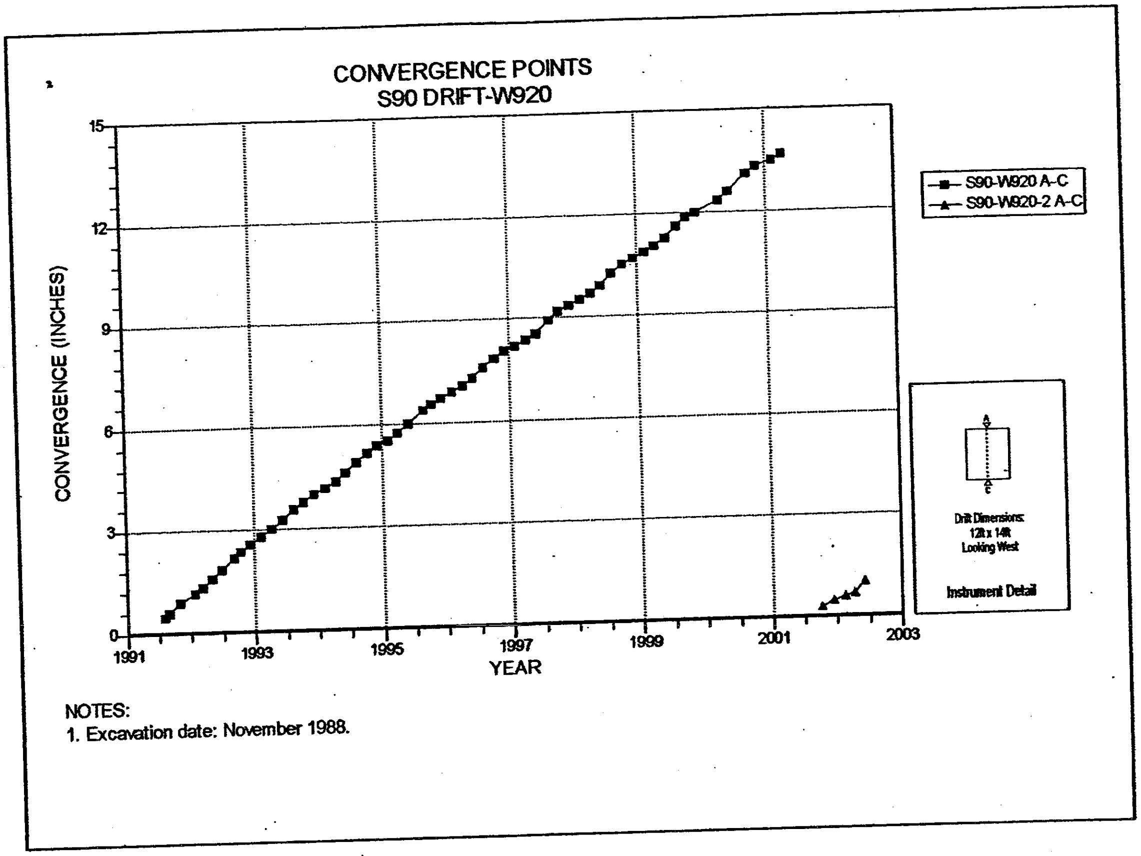


Figure 4-191 Convergence Point Array
S90 Drift at W920 – Roof to Floor

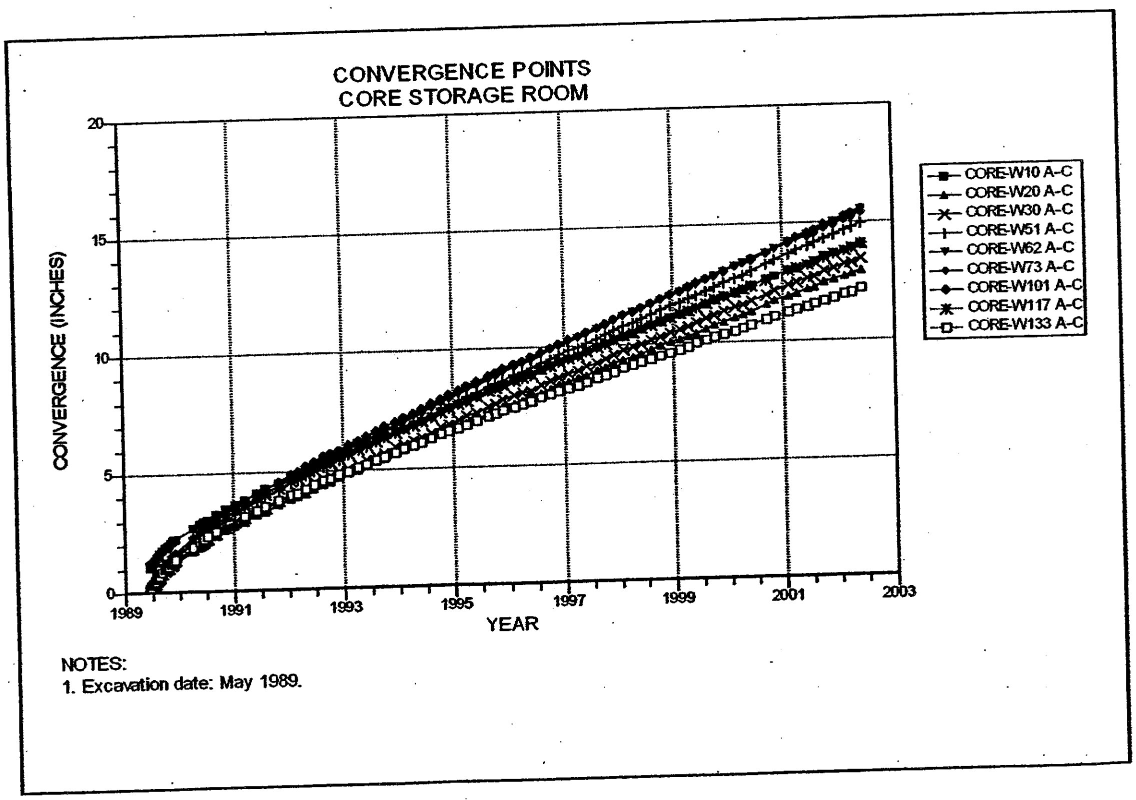


Figure 4-192 Convergence Point Array
S400 Core Storage Library – All Chords

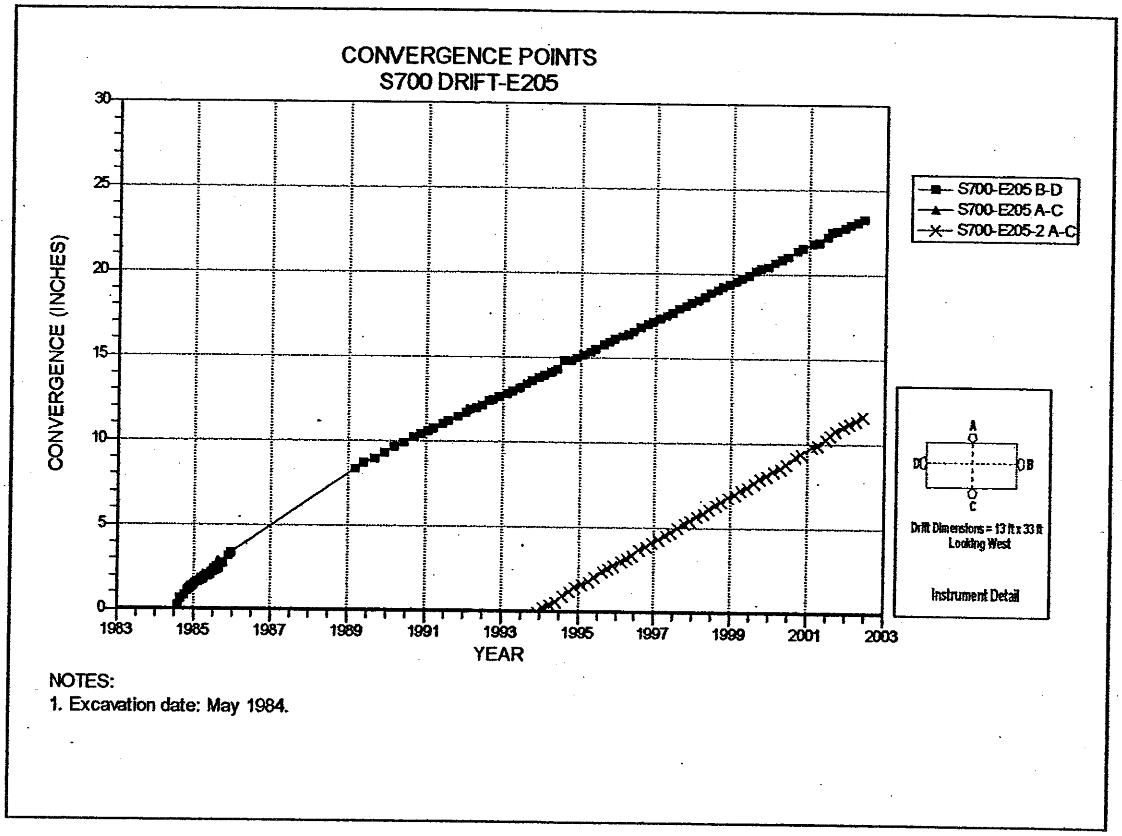


Figure 4-193 Convergence Point Array
S700 Drift at E205 – All Chords

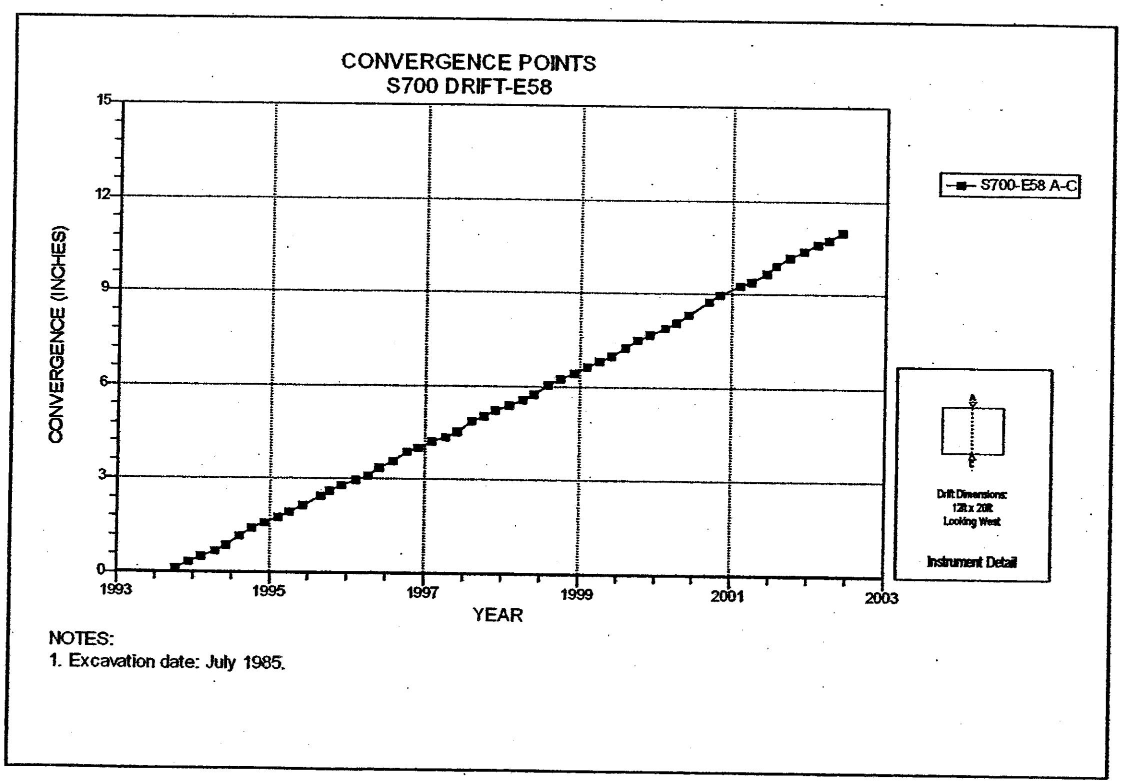


Figure 4-194 Convergence Point Array
S700 Drift at E58 – Roof to Floor

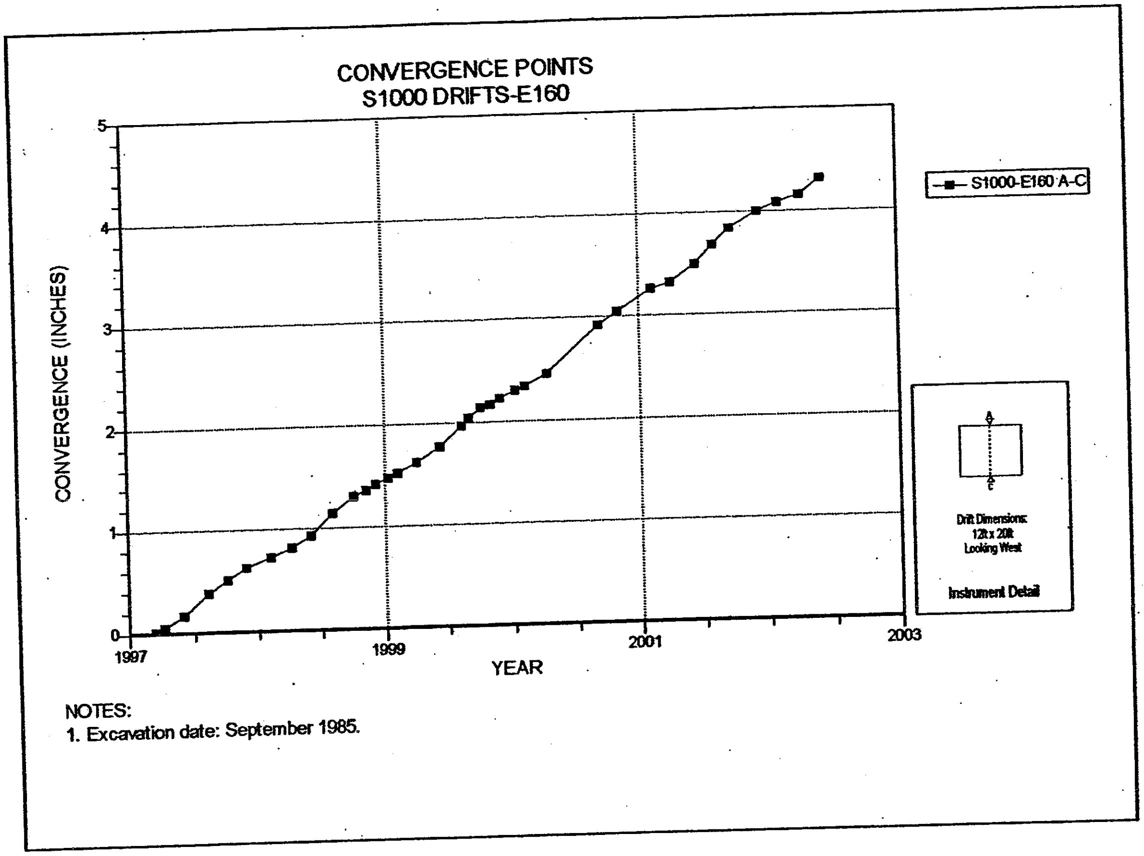


Figure 4-195 Convergence Point Array
S1000 Drift at E160 – Roof to Floor

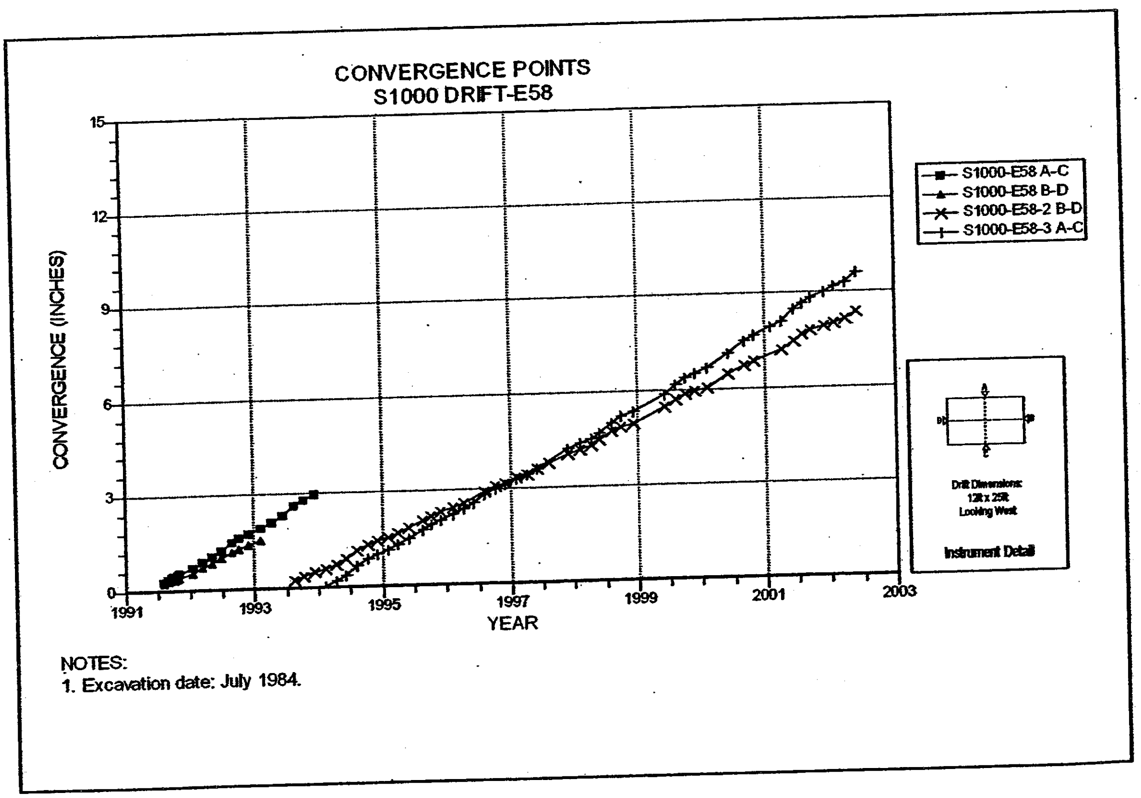
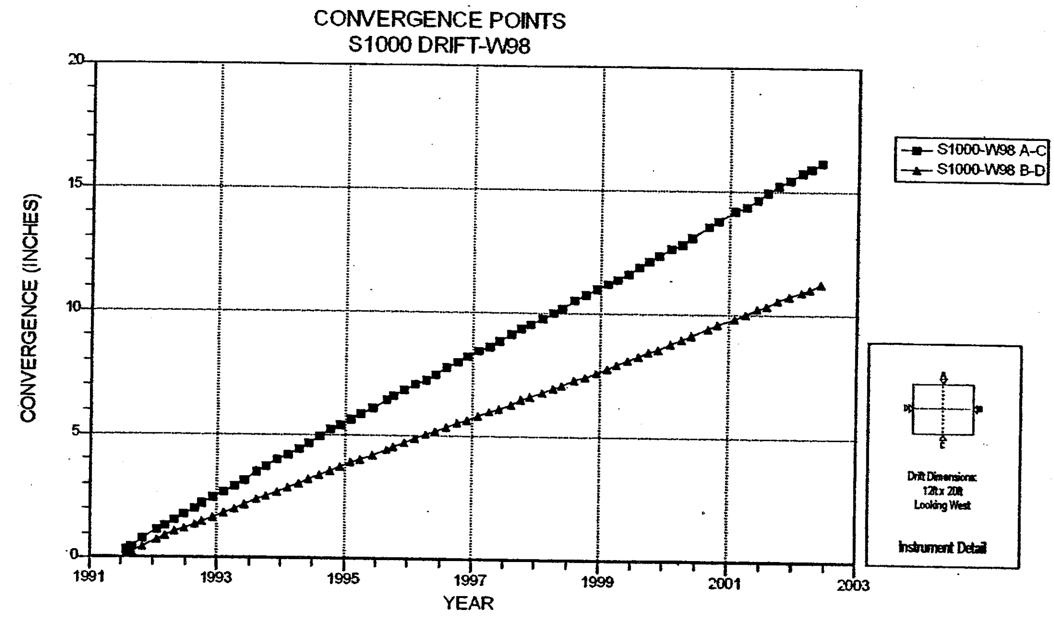
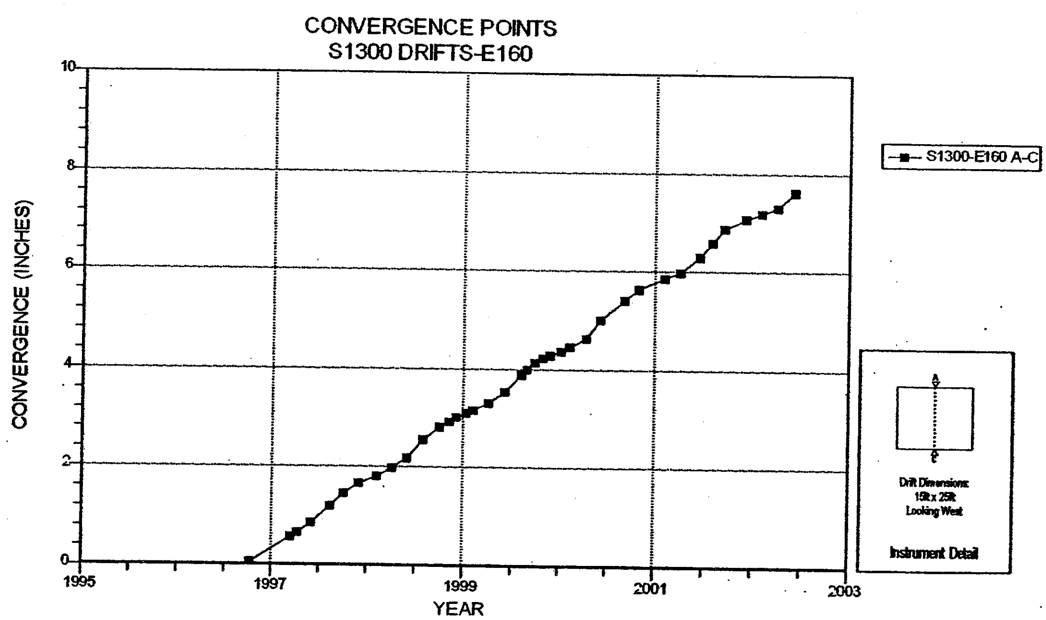


Figure 4-196 Convergence Point Array
S1000 Drift at E58 – All Chords



NOTES:
1. Excavation date: August 1985.

Figure 4-197 Convergence Point Array S1000 Drift at W98 – All Chords



NOTES:
1. Excavation date: June 1984.

Figure 4-198 Convergence Point Array S1300 Drift at E160 – Roof to Floor

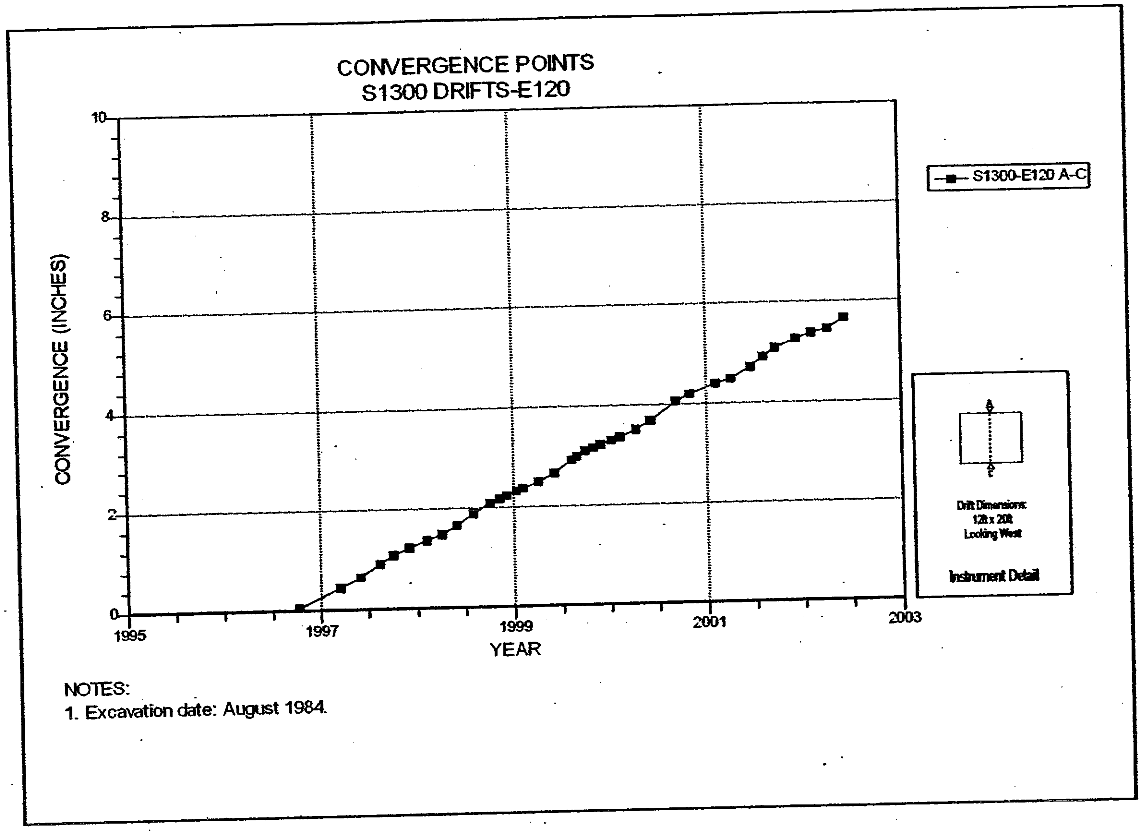


Figure 4-199 Convergence Point Array
S1300 Drift at E120 – Roof to Floor

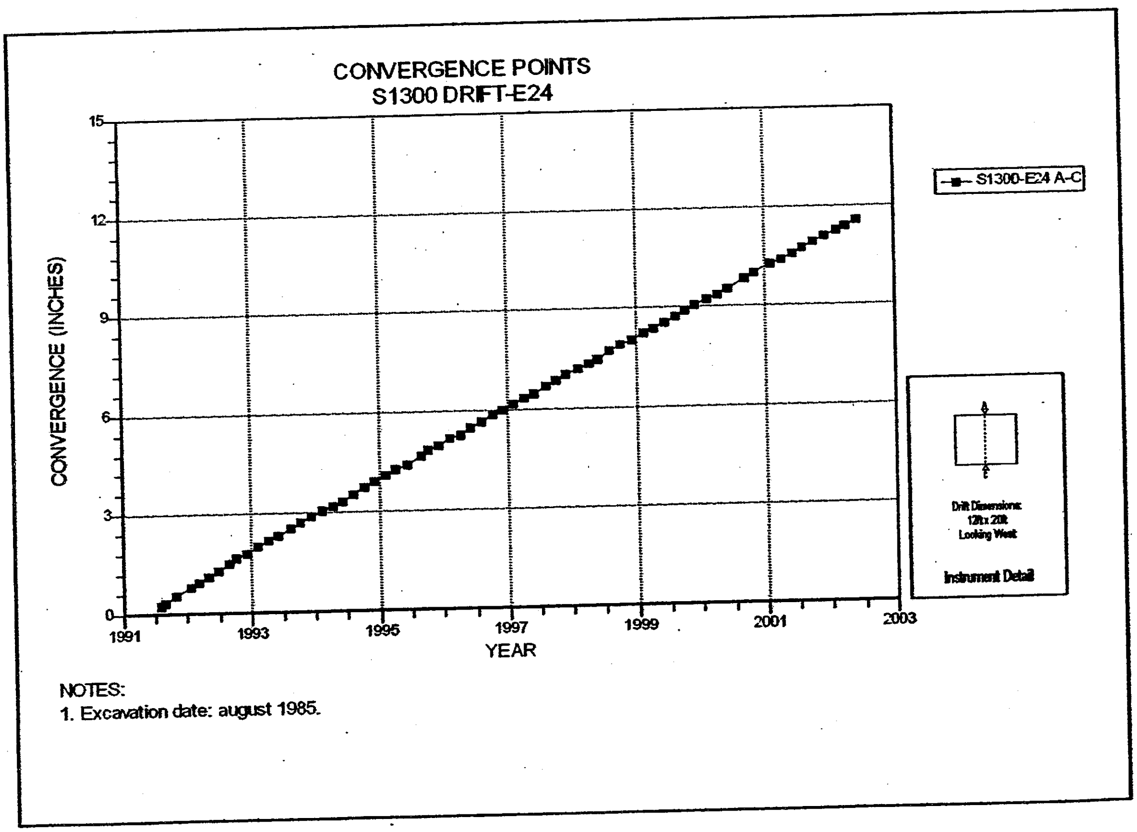


Figure 4-200 Convergence Point Array
S1300 Drift at E24 – Roof to Floor

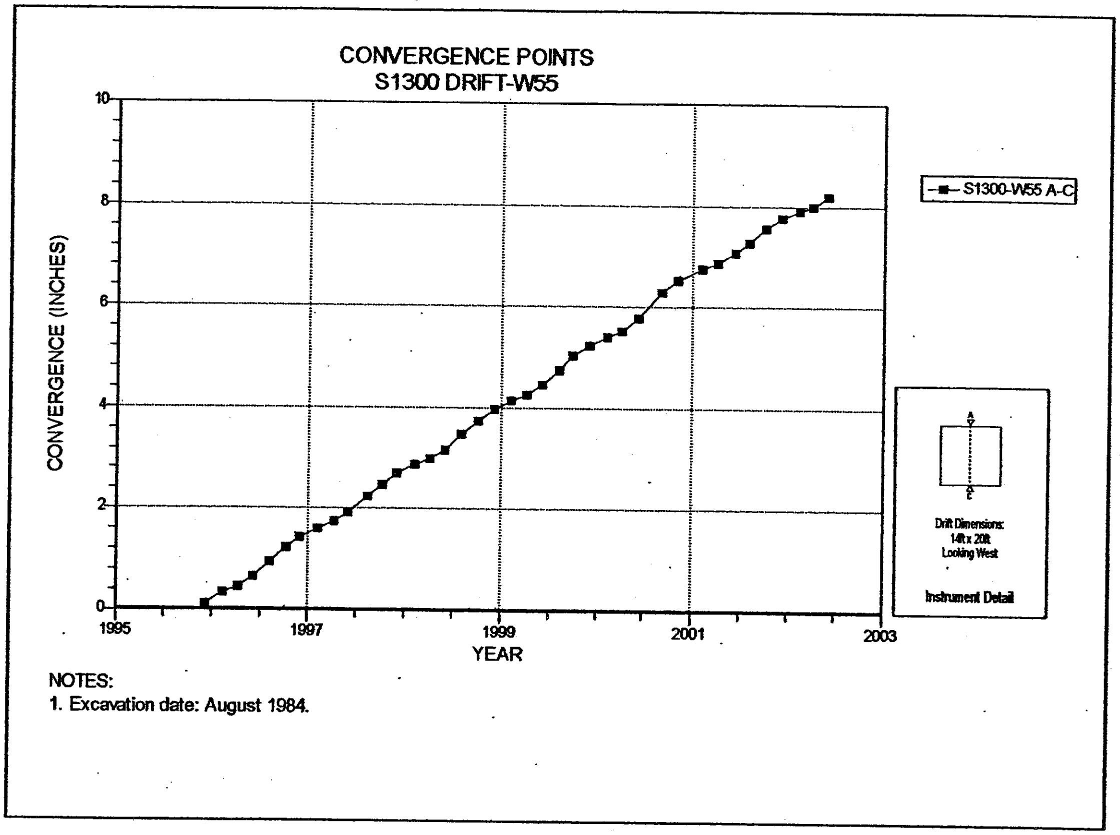


Figure 4-201 Convergence Point Array
S1300 Drift at W55 – Roof to Floor

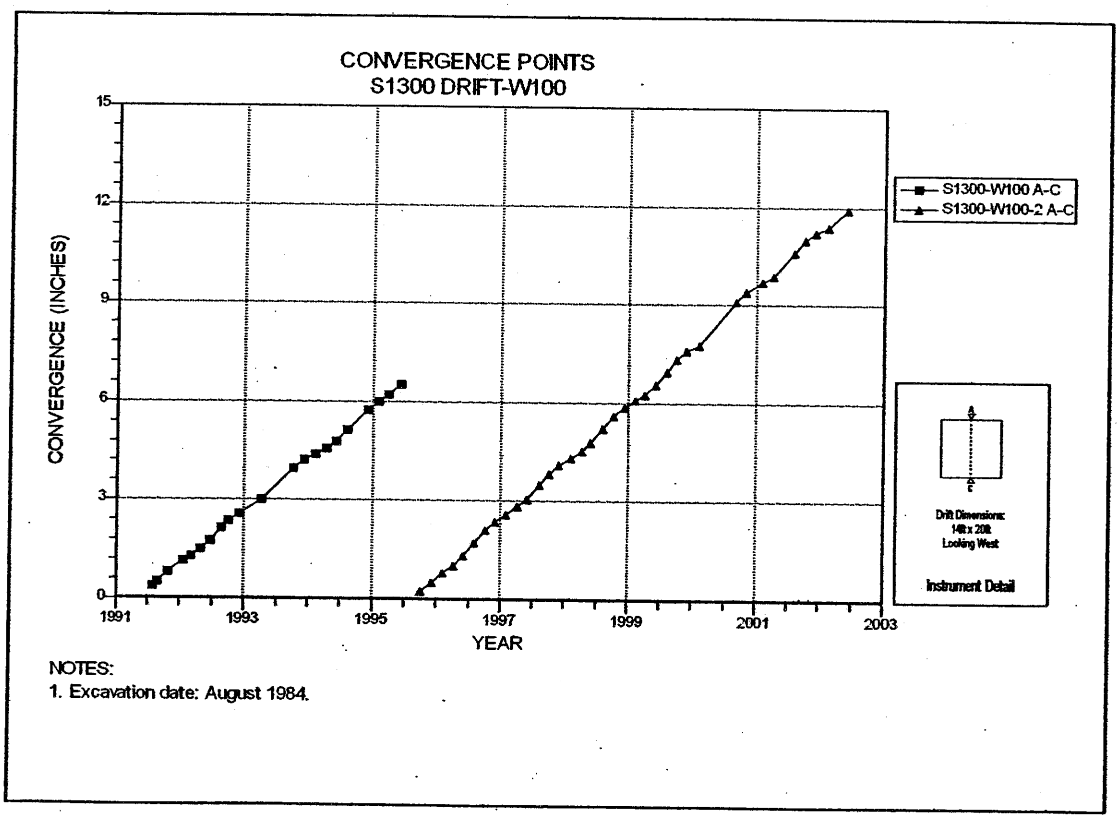
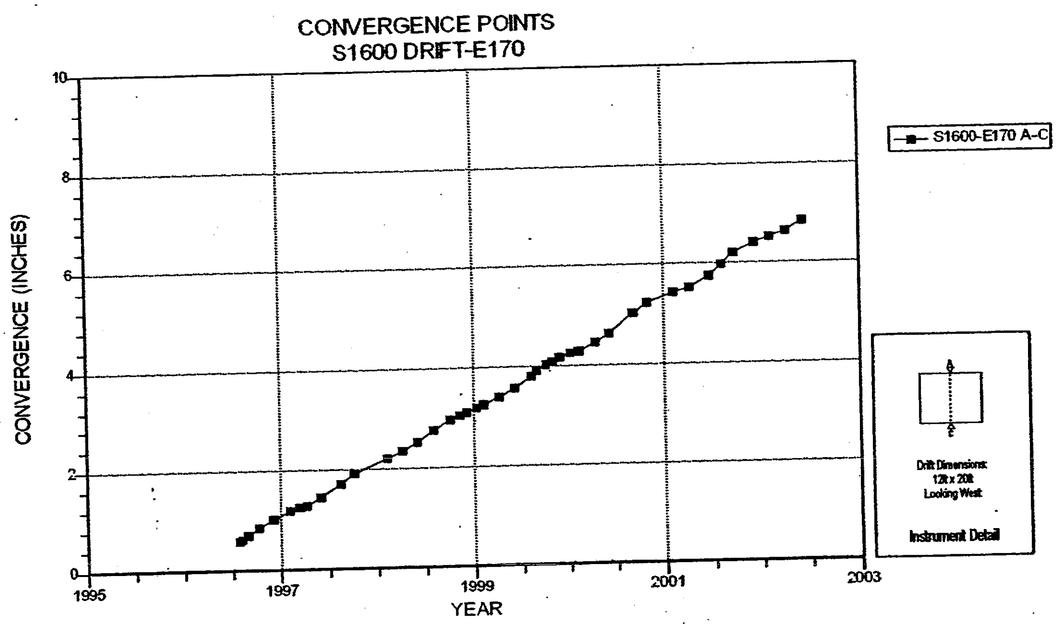
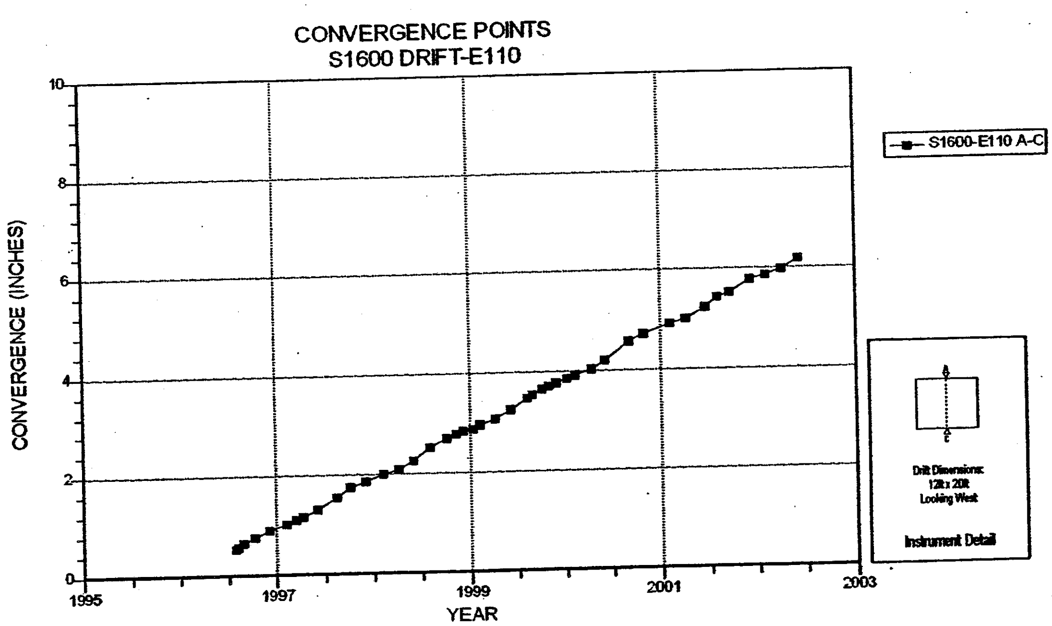


Figure 4-202 Convergence Point Array
S1300 Drift at W100 – Roof to Floor



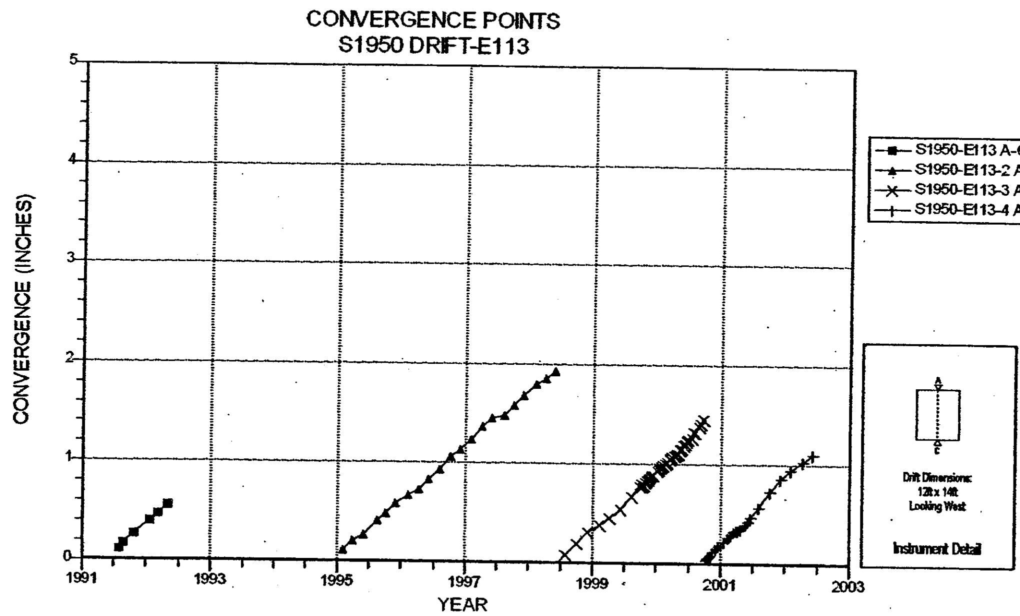
NOTES:
1. Excavation date: September 1985.

Figure 4-203 Convergence Point Array
S1600 Drift at E170 – Roof to Floor



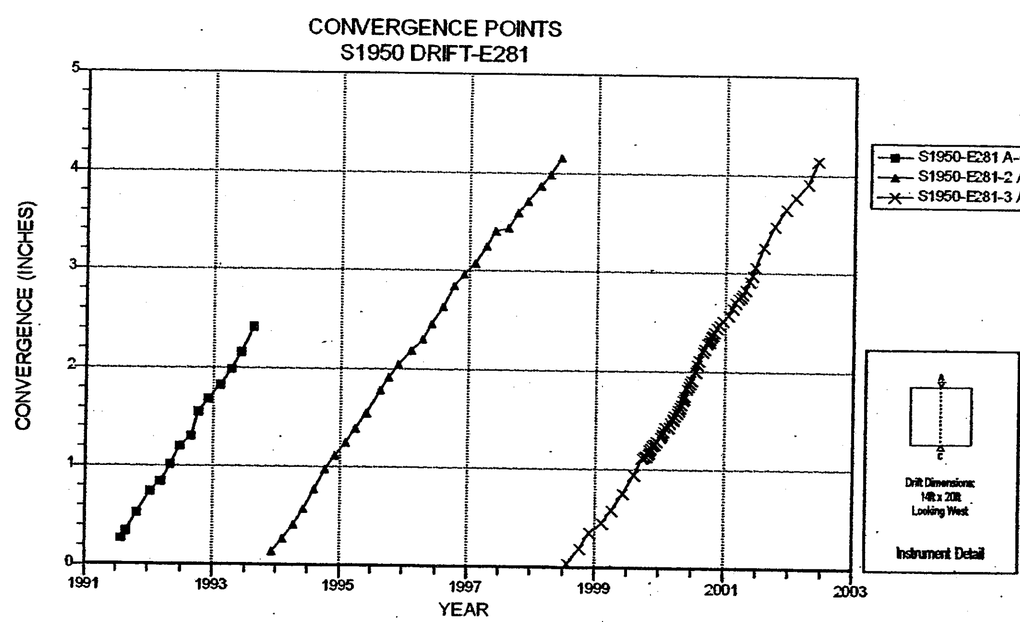
NOTES:
1. Excavation date: June 1984.

Figure 4-204 Convergence Point Array
S1600 Drift at E110 – Roof to Floor



NOTES:
1. Excavation date: January 1986.

Figure 4-205 Convergence Point Array
S1950 Drift at E113 – Roof to Floor



NOTES:
1. Excavation date: November 1985.

Figure 4-206 Convergence Point Array
S1950 Drift at E281 – Roof to Floor

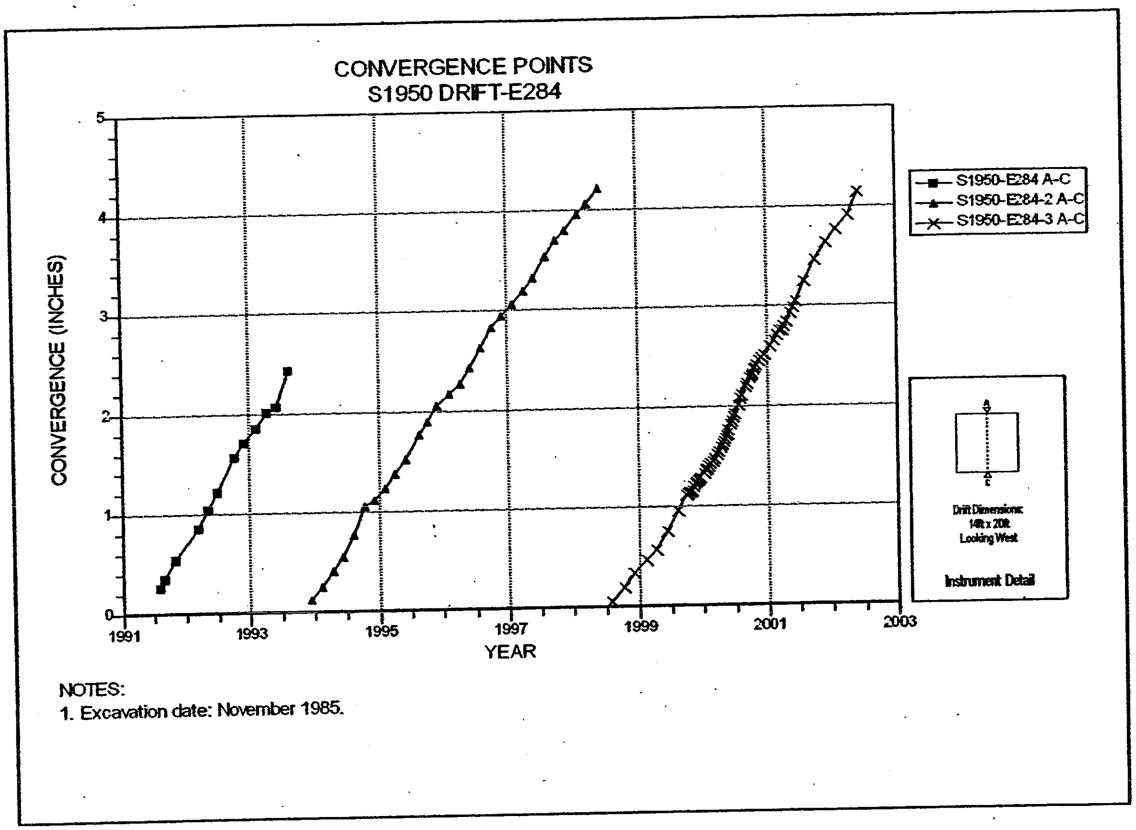


**Figure 4-207 Convergence Point Array
S1950 Drift at E284 – Roof to Floor**

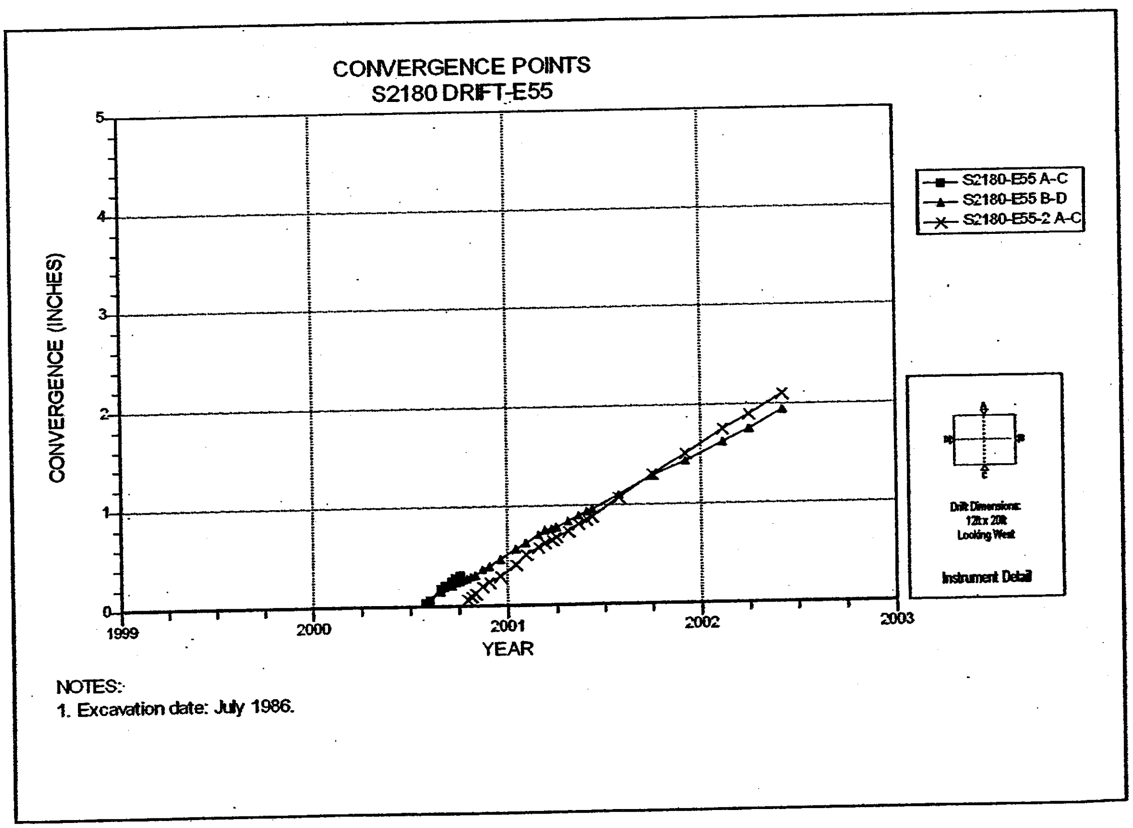


**Figure 4-208 Convergence Point Array
S2180 Drift at E55 – All Chords**

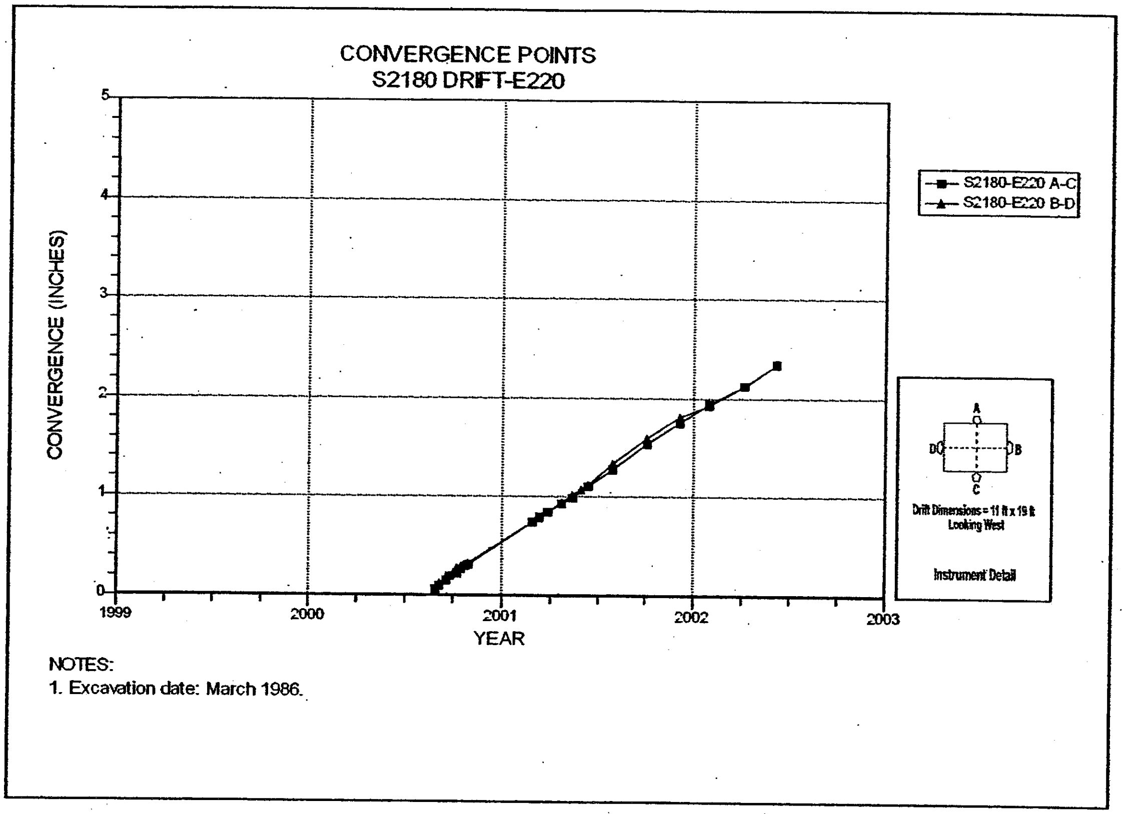


Figure 4-209 Convergence Point Array
S2180 Drift at E220 – All Chords

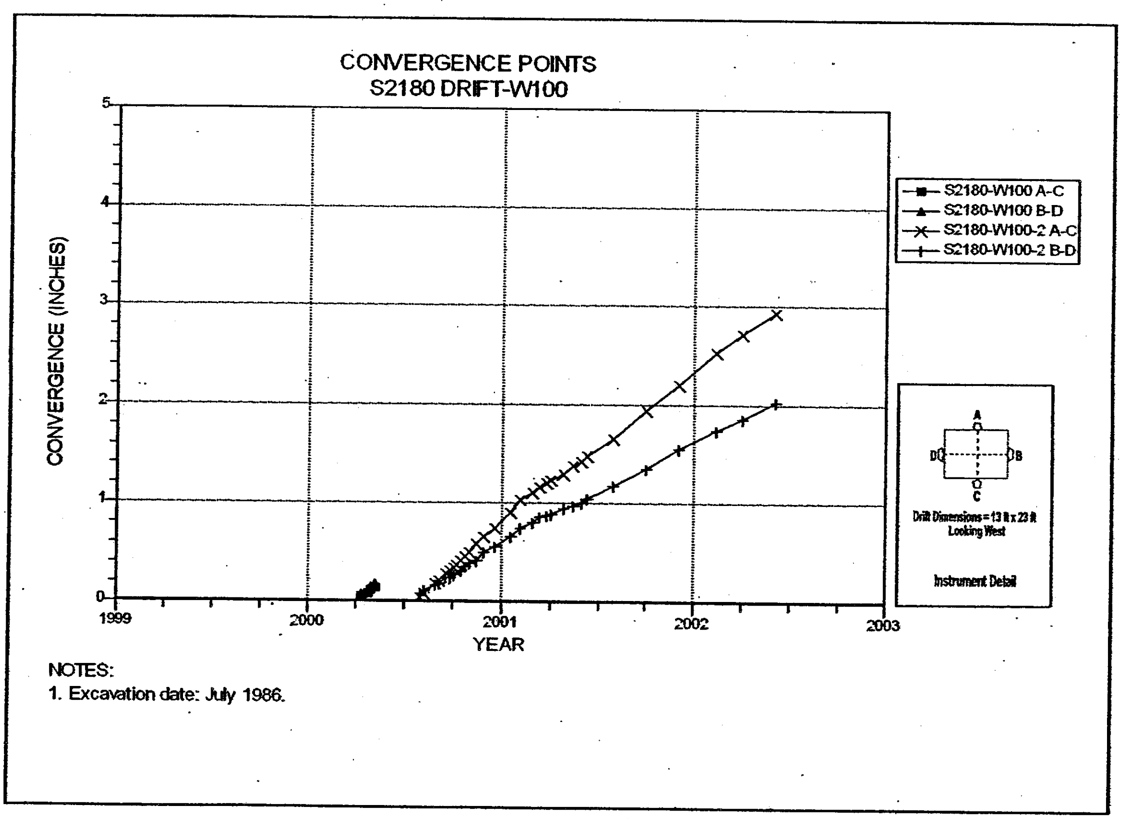


Figure 4-210 Convergence Point Array
S2180 Drift at W100 – All Chords

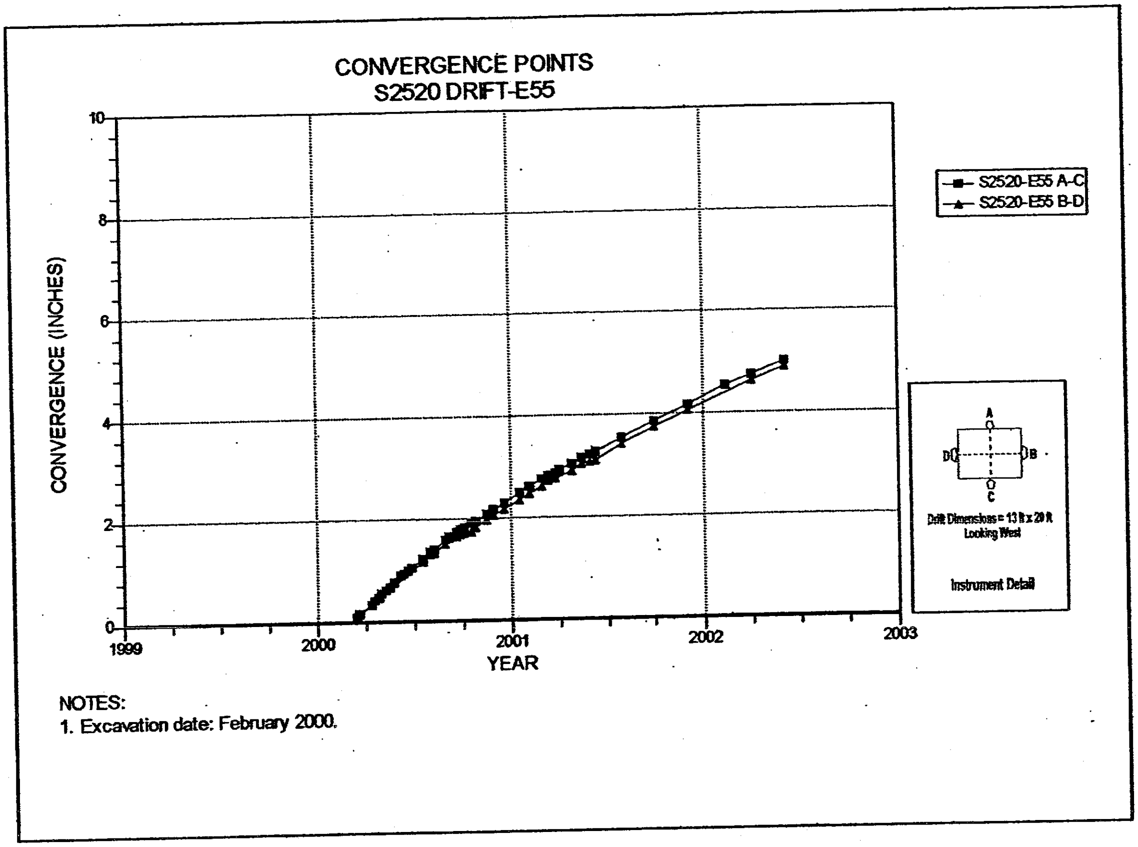


Figure 4-211 Convergence Point Array S2520 Drift at E55 – All Chords

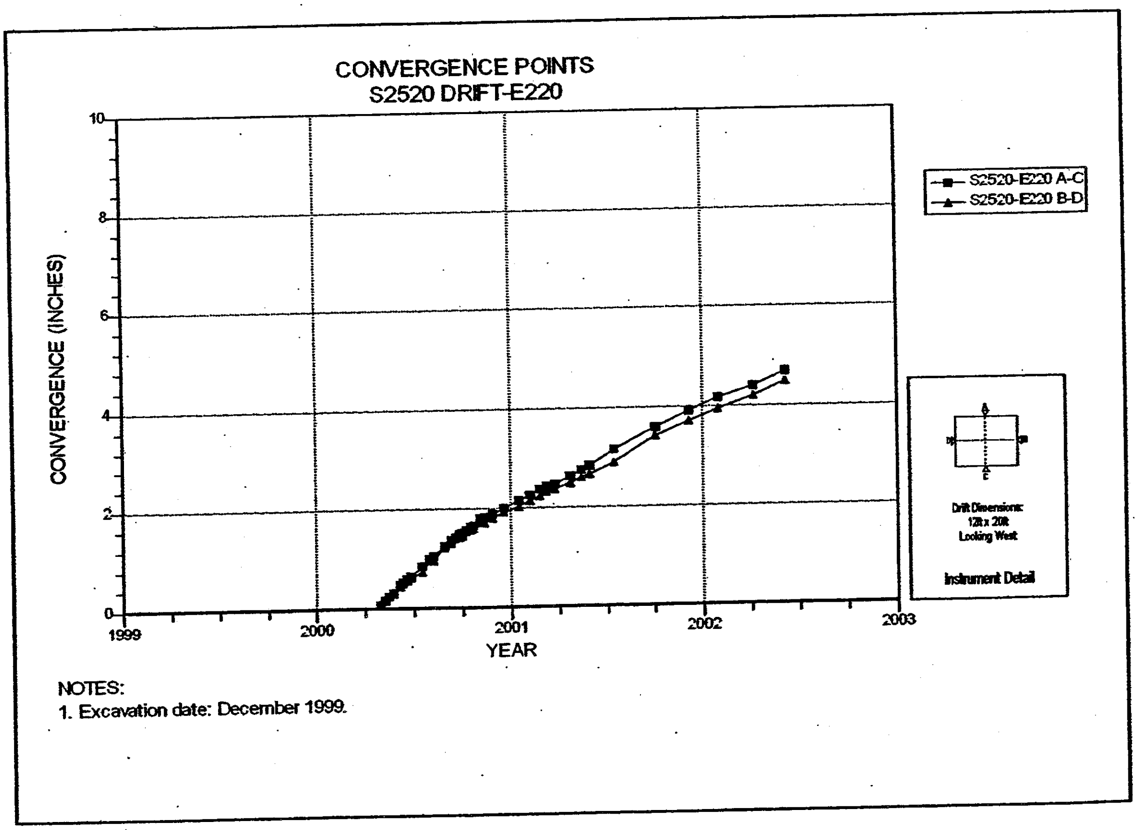


Figure 4-212 Convergence Point Array S2520 Drift at E220 – All Chords

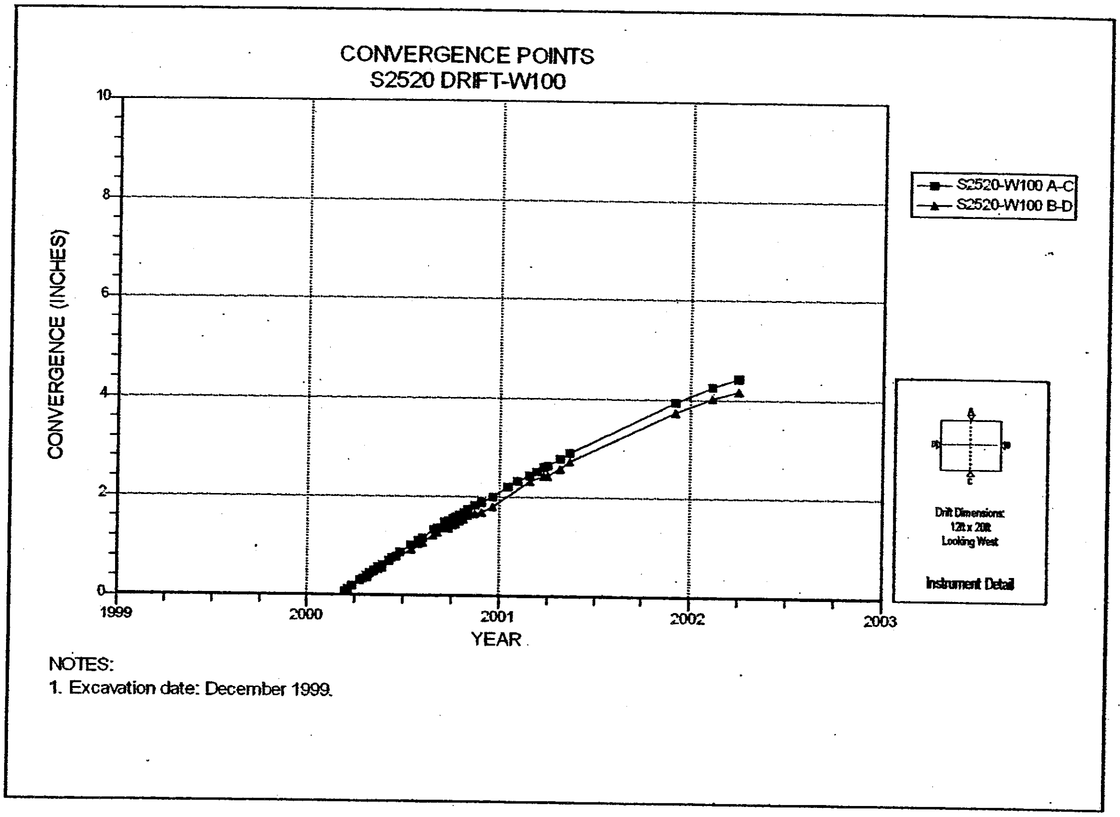


**Figure 4-213 Convergence Point Array
S2520 Drift at W100 – All Chords**

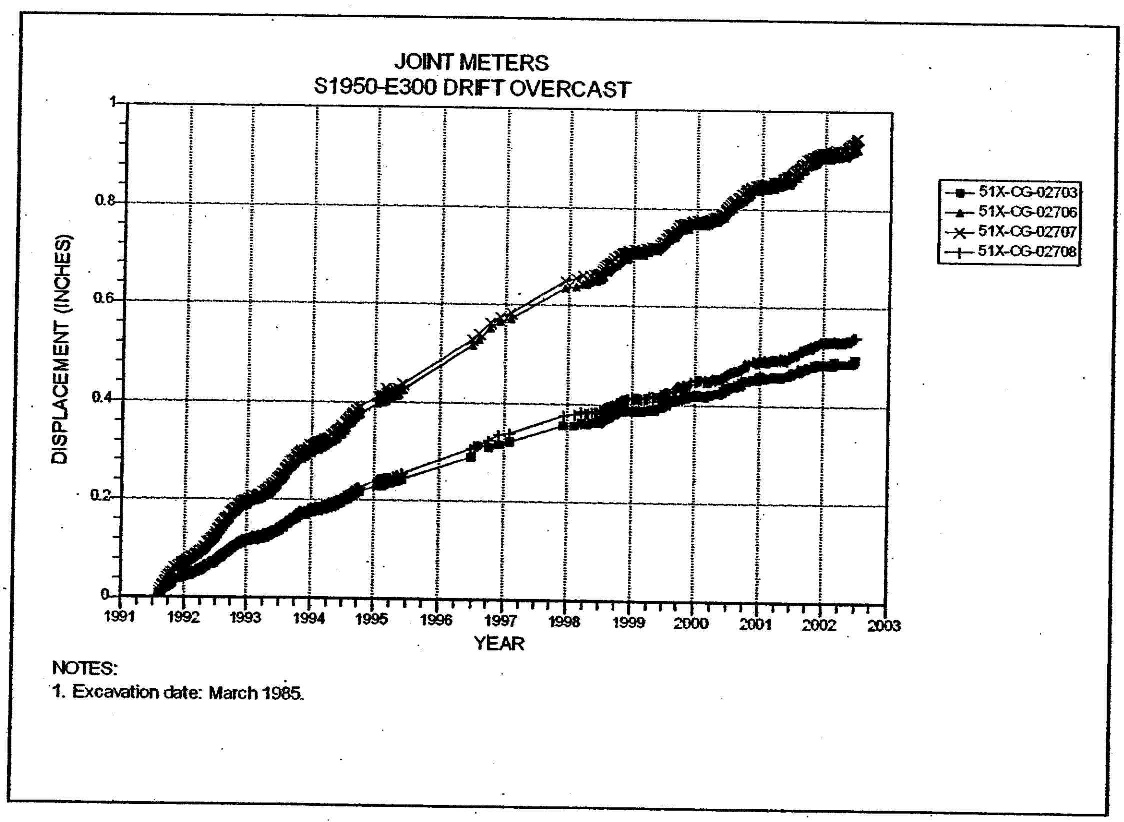


**Figure 4-214 Joint Meters
S1950 Drift at E300 – Drift Overcast**

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5.0 Instrumentation Summary for the Northern Experimental Area

This chapter presents the geotechnical instrumentation data and data analyses for the Site Preliminary Design and Validation (SPDV) rooms, the experimental rooms, and the access drifts located in the Northern Experimental Area. Table 5-1 presents the results of analyses performed on the instrumentation data including annual convergence rates and displacement rates. Figures 5-1 through 5-10 present plots of the borehole extensometer data, Figures 5-11 through 5-33 present plots of historical convergence point data, and Figures 5-34 through 5-41 present plots of wire convergence meter data. The Northern Experimental Area was initially deactivated in August 1996; subsequently, portions of this area were re-opened for salt storage and disposal.

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Table 5-1
Northern Experimental Area Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent	Comments
51X-GE-00285	E140 Drift-N1266	E Rib	5-1	04/05/02	8.390	0.607	0.599	1%	
51X-GE-00287	E140 Drift-N1266	W Rib	5-2	04/05/02	6.142	0.448	0.464	-3%	
51X-GE-00305	Room L4	Roof	5-3	04/05/02	2.637	0.264	0.549	-52%	
41X-GE-00121	SPDV Room 4-N1325	Roof	5-4	05/02/02	5.763	1.011	1.102	-8%	No longer accessible.
41X-GE-00110	SPDV Room 4-N1250	East 1/4 Pt	5-5	05/02/02	2.910	0.597	0.474	26%	No longer accessible.
41X-GE-00120	SPDV Room 4-N1250	Roof	5-6	05/02/02	4.095	0.508	0.592	-14%	No longer accessible.
41X-GE-00111	SPDV Room 4-N1250	West 1/4 Pt	5-7	05/02/02	7.014	1.090	1.138	-4%	No longer accessible.
51X-GE-00206	SPDV Room 4-Center	E Rib	5-8	04/05/02	13.470	0.597	0.613	-3%	No longer accessible.
51X-GE-00208	SPDV Room 4-Center	W Rib	5-9	12/10/01	10.390	0.461	0.410	12%	No longer accessible.
41X-GE-00119	SPDV Room 4-N1175	Roof	5-10	05/02/02	3.205	0.487	0.673	-28%	No longer accessible.

Table 5-1 (Continued)
Northern Experimental Area Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change	Comments
			Date	Inches	Inches	in/year	in/year	Percent	
N1420-E140 A-C	N1420 Drift-E140	5-11	04/03/02	16.490	16.490	1.447	1.334	8%	
E140-N1266-2 A-C	E140 Drift-N1266	5-12	04/03/02	29.037	37.777	2.224	2.100	6%	
E140-N1266-3 B-D	E140 Drift-N1266	5-12	04/03/02	13.952	22.067	1.301	1.271	2%	
N1110-E140 A-C	N1100 Drift-E140	5-13	05/31/02	19.740	19.740	1.696	1.610	5%	
N1110-E80-3 A-C	N1100 Drift-E80	5-14	05/31/02	17.042	18.528	0.781	0.794	-2%	
N1110-E80-4 B-D	N1100 Drift-E80	5-14	05/31/02	8.304	18.564	0.791	0.763	4%	
N1420-E0 A-C	N1420 Drift-E0	5-15	04/03/02	14.484	14.484	1.345	1.261	7%	
E0-N1266-3 A-C	E0 Drift-N1266	5-16	04/03/02	32.234	36.926	2.140	1.938	10%	
E0-N1266-4 B-D	E0 Drift-N1266	5-16	04/03/02	11.383	25.640	1.139	1.089	5%	
E0-N1110-3 A-C	E0 Drift-N1100	5-17	05/31/02	27.341	34.432	1.482	1.295	14%	
N1420-W232-3 A-C	N1420-Test Room 1	5-18	04/03/02	1.057	41.394	1.737	1.829	-5%	
TR1-N1110 A-C	N1100-Test Room 1	5-19	05/31/02	18.361	18.361	1.452	1.402	4%	
N1420-W258 A-E	N1420 Drift-W258	5-20	04/03/02	22.803	22.803	0.995	0.874	14%	No longer accessible.
N1420-W258-2 B-D	N1420 Drift-W258	5-20	04/03/02	5.947	14.073	0.562	0.522	8%	No longer accessible.
N1420-W258-2 H-F	N1420 Drift-W258	5-20	04/03/02	5.826	13.553	0.585	0.518	13%	No longer accessible.
N1420-W258-4 C-G	N1420 Drift-W258	5-20	04/03/02	7.821	19.694	0.787	0.670	17%	No longer accessible.
N1420-W365-3 A-C	N1420-Test Room 2	5-21	04/03/02	18.398	42.760	1.747	1.671	5%	No longer accessible.
TR2-N1110-2 A-C	N1100-Test Room 2	5-22	05/31/02	30.629	34.301	1.291	1.207	7%	No longer accessible.
N1420-W391 A-E	N1420 Drift-W391	5-23	04/03/02	22.685	22.685	0.888	0.870	2%	No longer accessible.
N1420-W391-2 B-D	N1420 Drift-W391	5-23	04/03/02	6.332	14.990	0.608	0.536	13%	No longer accessible.
N1420-W391-2 H-F	N1420 Drift-W391	5-23	04/03/02	6.117	14.054	0.569	0.547	4%	No longer accessible.
N1420-W391-3 C-G	N1420 Drift-W391	5-23	04/03/02	8.674	19.891	0.789	0.703	12%	No longer accessible.
TR3-N1420-2 A-C	N1420-Test Room 3	5-24	04/03/02	14.651	17.511	1.307	1.327	-2%	No longer accessible.
TR3-N1110 A-C	N1100-Test Room 3	5-25	05/31/02	14.538	14.538	1.098	1.028	7%	No longer accessible.
TR4-N1420 A-C	N1420-Test Room 4	5-26	04/03/02	21.964	21.964	1.919	1.798	7%	No longer accessible.
TR4-N1325 A-E	SPDV Room 4 N1325	5-27	02/13/02	27.434	27.434	1.832	1.726	6%	No longer accessible.
TR4-N1325 B-D	SPDV Room 4 N1325	5-27	04/03/02	28.381	28.381	1.805	1.791	1%	No longer accessible.

Table 5-1 (Continued)
Northern Experimental Area Data Analysis

CONVERGENCE POINTS (Continued)

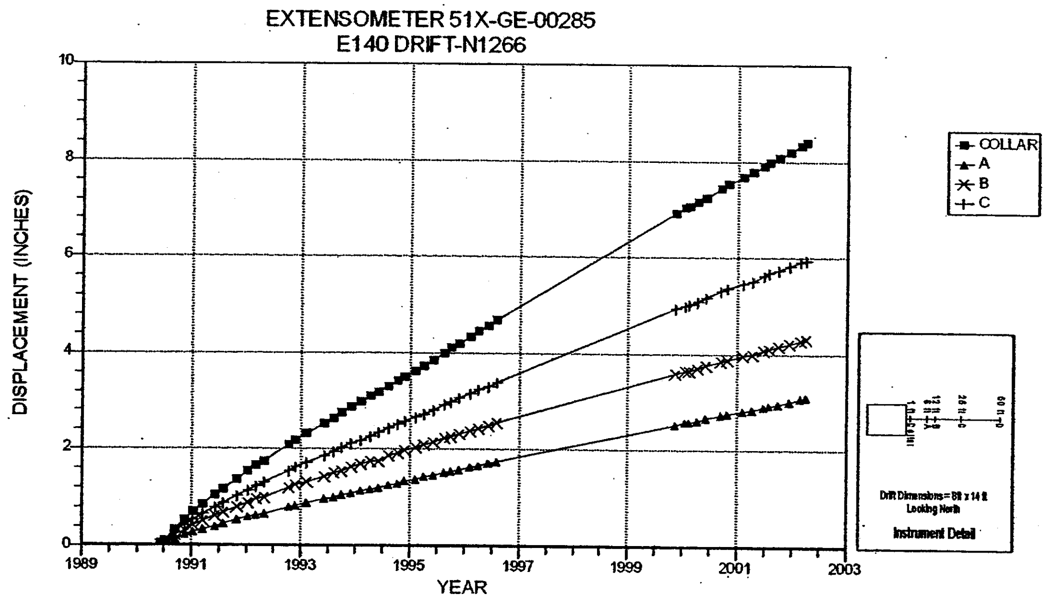
Field Tag	Location	Figure Number	Last Reading		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change Percent [A]	Comments
			Date	Inches	Inches	in/year	in/year		
TR4 N1325 H-F	SPDV Room 4 N1325	5-27	12/11/01	23.698	23.698	1.838	1.619	14%	Not accessible.
TR4 N1325-2 C-G	SPDV Room 4 N1325	5-27	12/11/01	9.478	17.633	1.313	1.297	1%	Not accessible.
TR4 A-E	SPDV Room 4 Center	5-28	02/13/02	45.729	45.729	1.899	1.756	8%	Not accessible.
TR4 B-D	SPDV Room 4 Center	5-28	04/03/02	28.808	28.808	1.819	1.791	2%	Not accessible.
TR4 H-F	SPDV Room 4 Center	5-28	12/11/01	32.679	32.679	2.618	2.288	14%	Not accessible.
TR4-2 C-G	SPDV Room 4 Center	5-28	12/11/01	12.805	25.586	1.215	1.203	1%	Not accessible.
TR4 N1175 A-E	SPDV Room 4 N1175	5-29	02/13/02	24.858	24.858	1.857	1.679	11%	Not accessible.
TR4 N1175 B-D	SPDV Room 4 N1175	5-29	04/03/02	26.566	26.566	1.599	1.418	13%	Not accessible.
TR4 N1175 H-F	SPDV Room 4 N1175	5-29	12/11/01	18.557	18.557	1.449	1.256	15%	Not accessible.
TR4 N1175-2 C-G	SPDV Room 4 N1175	5-29	12/11/01	11.742	14.719	0.991	1.076	-8%	Not accessible.
TR4-N1110 A-C	N1100 TR4 Intersection	5-30	04/03/02	14.334	14.334	1.035	1.015	2%	Not accessible.
N1110-W783-2 A-C	N1100 Drift-W783	5-31	12/11/01	12.640	15.301	0.702	0.550	28%	Not accessible.
N1110-W783-2 B-D	N1100 Drift-W783	5-31	12/11/01	9.776	12.112	N/A	N/A	N/A	Not accessible.
N1110-W951-2 A-C	N1100 Drift-W951	5-32	10/05/01	11.027	13.133	0.700	0.481	46%	Not accessible.
N1110-W1159-2 A-C	N1100 Drift-W1159	5-33	08/07/01	12.273	15.147	N/A	0.505	N/A	Not accessible.

[A] NA indicates insufficient data to calculate.

Table 5-1 (Continued)
Northern Experimental Area Data Analysis

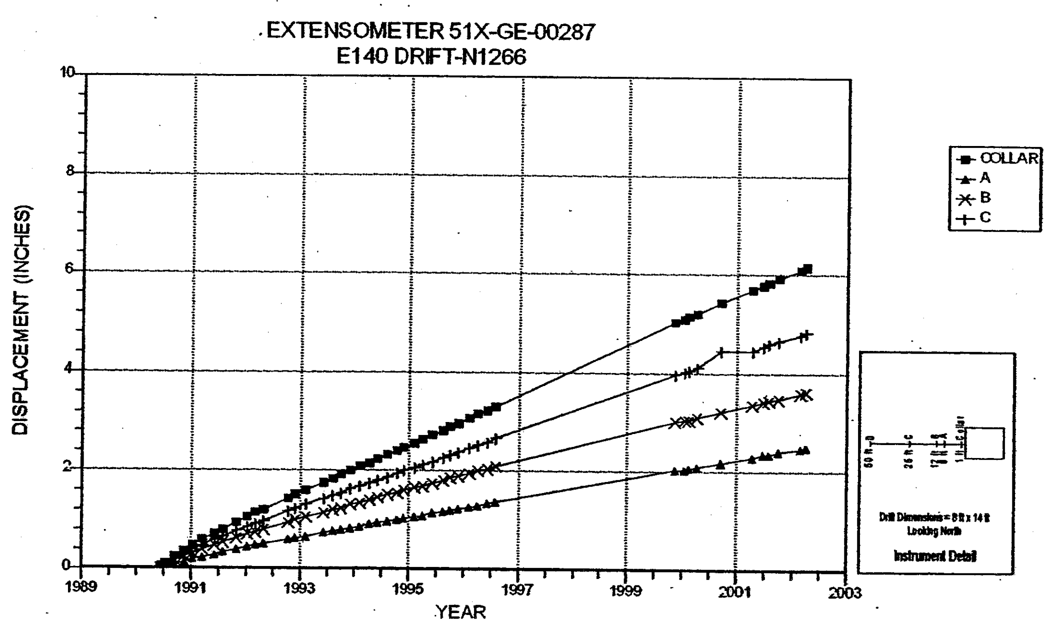
WIRE CONVERGENCE METERS

Field Tag	Location	Figure Number	Last Reading		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change Percent	Comments
			Date	Inches	Inches	in/year	in/year		
51X-CW-00033	N1420 DRIFT-E1551	5-34	05/29/02	6.441	6.441	0.834	0.824	1%	
51X-CW-00032	N1420 DRIFT-E1451	5-35	05/29/02	6.093	6.093	0.881	0.858	3%	
51X-CW-00034	ROOM D-N1342/CENTER	5-36	05/29/02	8.455	8.455	1.204	1.134	6%	
51X-CW-00035	ROOM D-N1266/CENTER	5-37	05/29/02	7.793	7.793	0.887	0.858	3%	
51X-CW-00036	ROOM D-N1187/CENTER	5-38	05/29/02	7.775	7.775	0.990	0.855	16%	
51X-CW-00037	N1100 DRIFT-E1620	5-39	05/07/02	4.280	4.280	0.447	0.434	3%	
51X-CW-00038	N1100 DRIFT-E1530	5-40	05/29/02	2.083	2.083	0.580	0.543	7%	
51X-CW-00039	E300 DRIFT-N1275/CENTER	5-41	05/29/02	20.753	20.753	3.069	3.087	-1%	



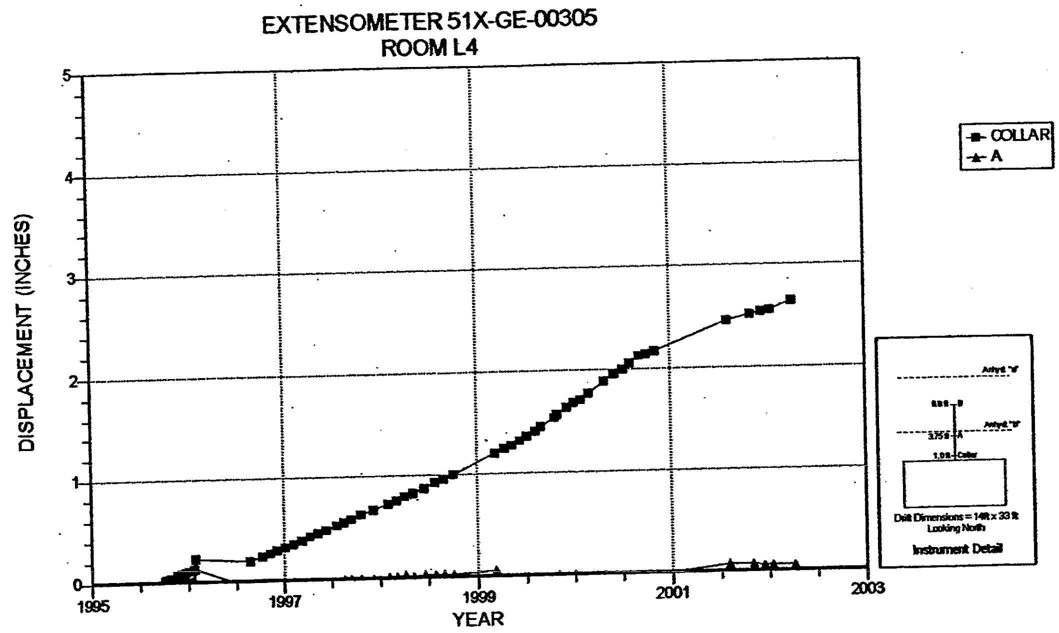
NOTES:
1. Excavation date: February 1983.
2. Drift enlarged January 1990.
3. Replaced 51X GE-00222.
4. Inaccessible from 8/ 96 to 11/99.

Figure 5-1 Extensometer 51X-GE-00285
E140 Drift at N1266 – East Rib



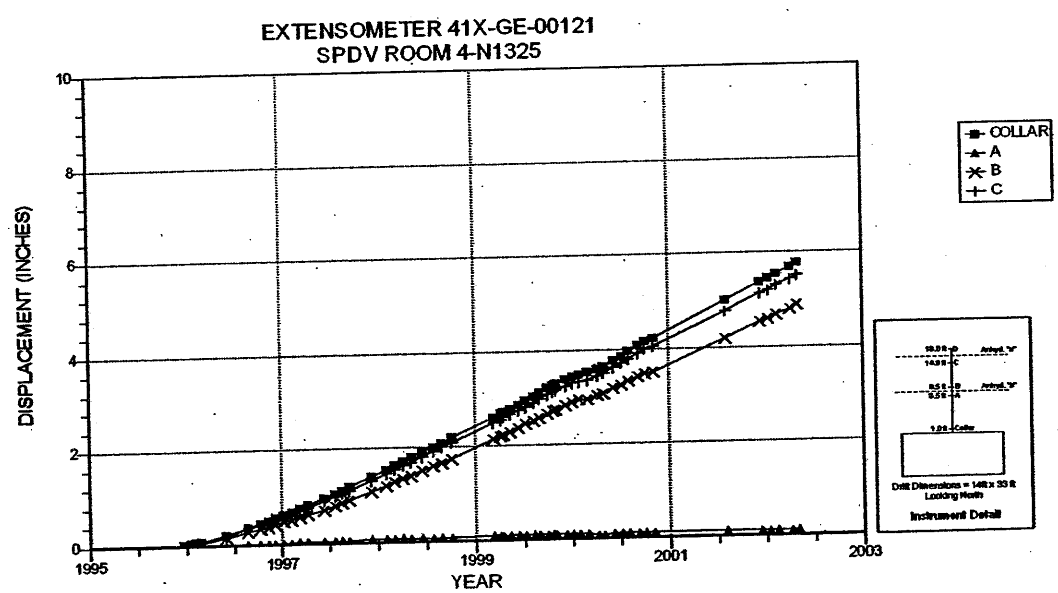
NOTES:
1. Excavation date: February 1983.
2. Drift enlarged January 1990.
3. Replaced 51X GE-00225.
4. Inaccessible from 8/ 96 to 11/99.

Figure 5-2 Extensometer 51X-GE-00287
E140 Drift at N1266 – West Rib



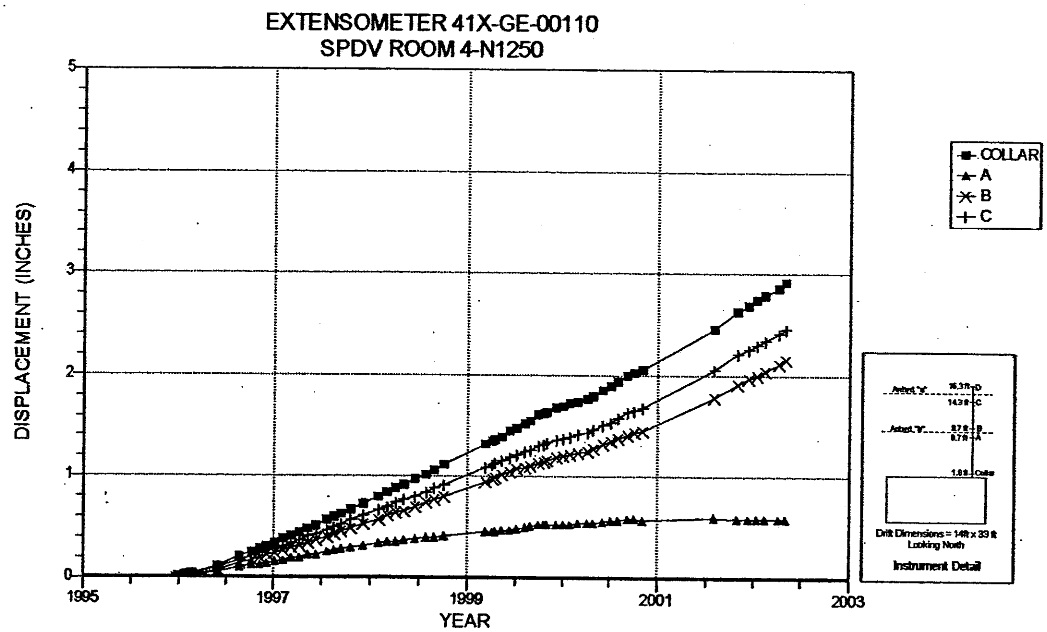
NOTES:
1. Excavation date: February 1989.

Figure 5-3 Extensometer 51X-GE-00305
Room L4 at N1514 – Roof



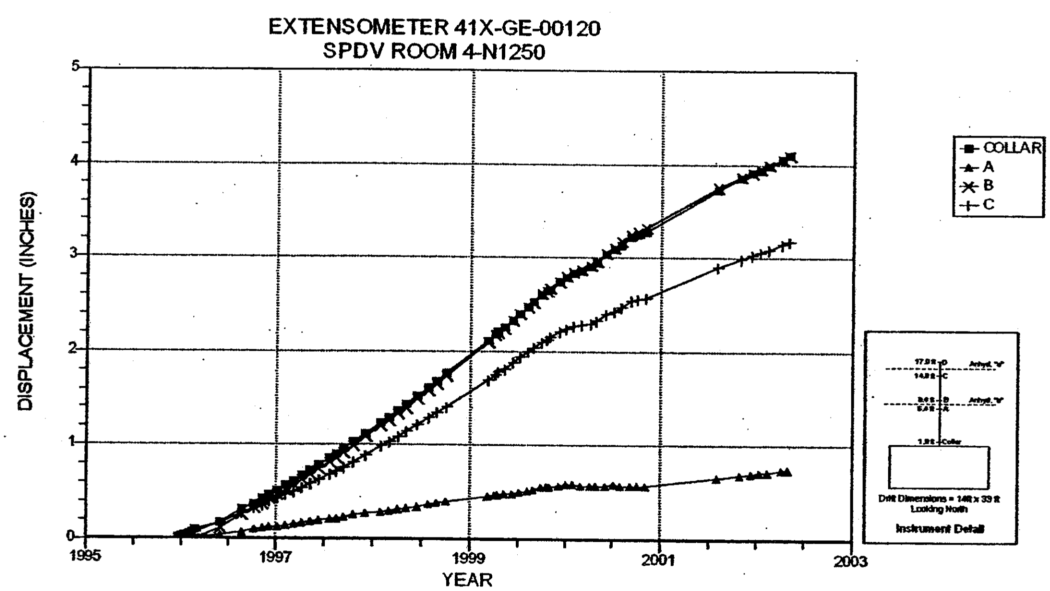
NOTES:
1. Excavation date: April 1983.

Figure 5-4 Extensometer 41X-GE-00121
SPDV Room 4 at N1325 – Roof



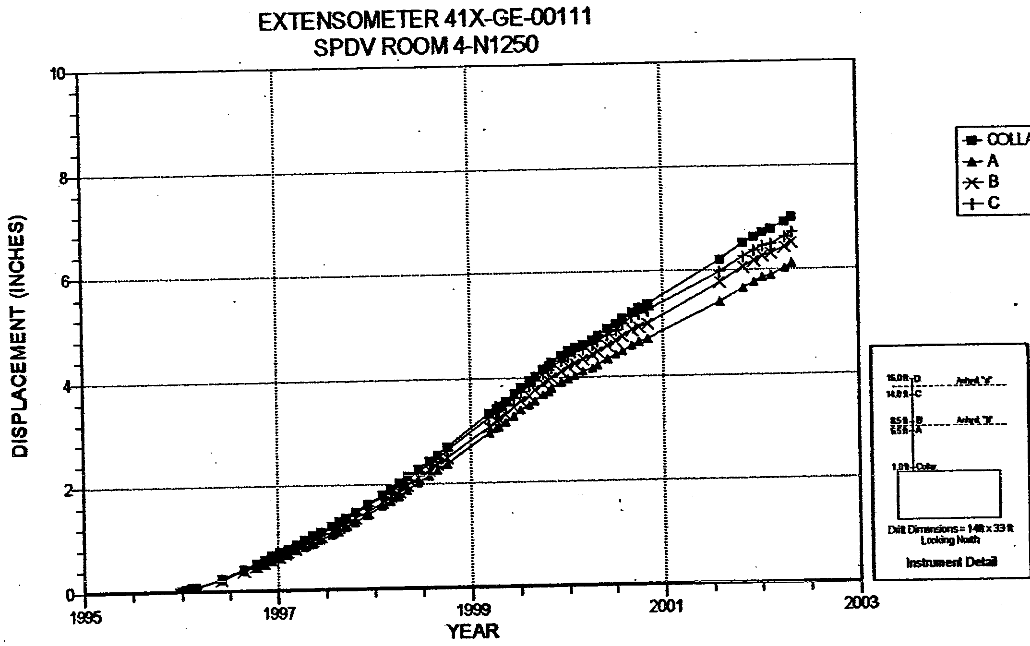
NOTES:
1. Excavation date: April 1983.

Figure 5-5 Extensometer 41X-GE-00110
SPDV Room 4 at N1250 – East Quarter Point – Roof



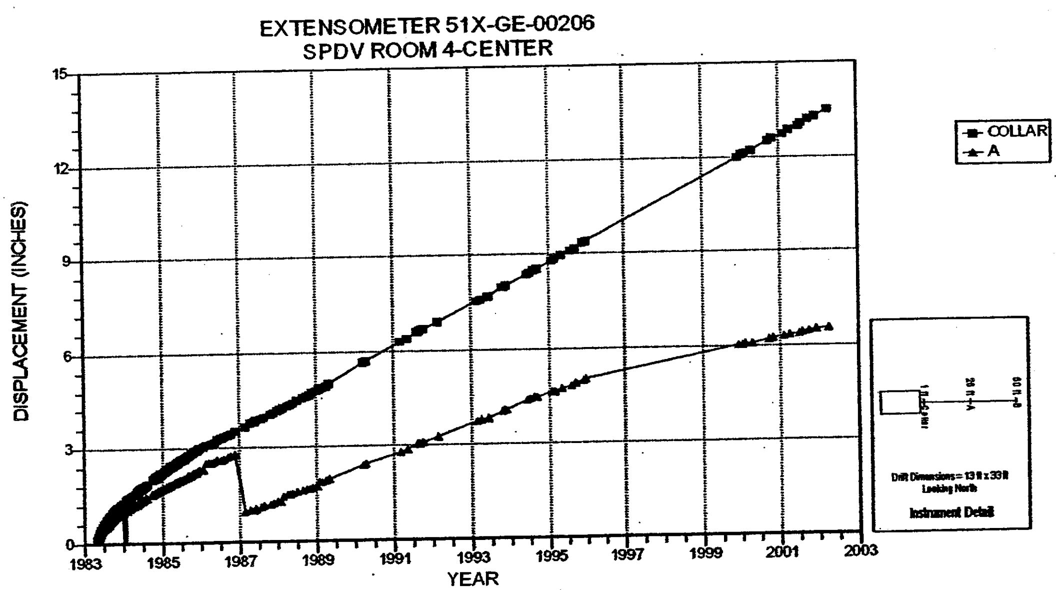
NOTES:
1. Excavation date: April 1983.
2. Anchor B has malfunctioned.

Figure 5-6 Extensometer 41X-GE-00120
SPDV Room 4 at N1250 – Centerline – Roof



NOTES:
1. Excavation date: April 1983.

Figure 5-7 Extensometer 41X-GE-00111
SPDV Room 4 at N1250 – West Quarter Point – Roof



NOTES:
1. Excavation date: April 1983.
2. Inaccessible from 1/96 to 12/99.

Figure 5-8 Extensometer 51X-GE-00206
SPDV Room 4 at N1250 – East Rib

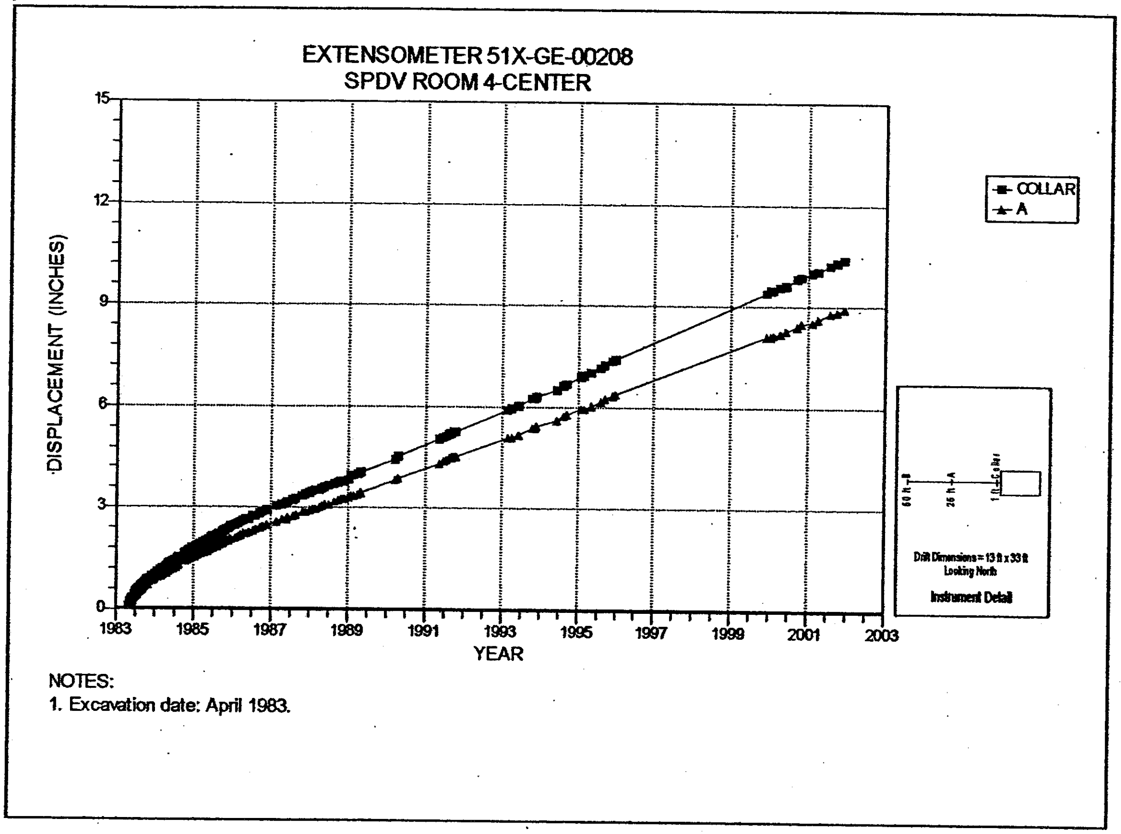


Figure 5-9 Extensometer 51X-GE-00208
SPDV Room 4 at N1250 – West Rib

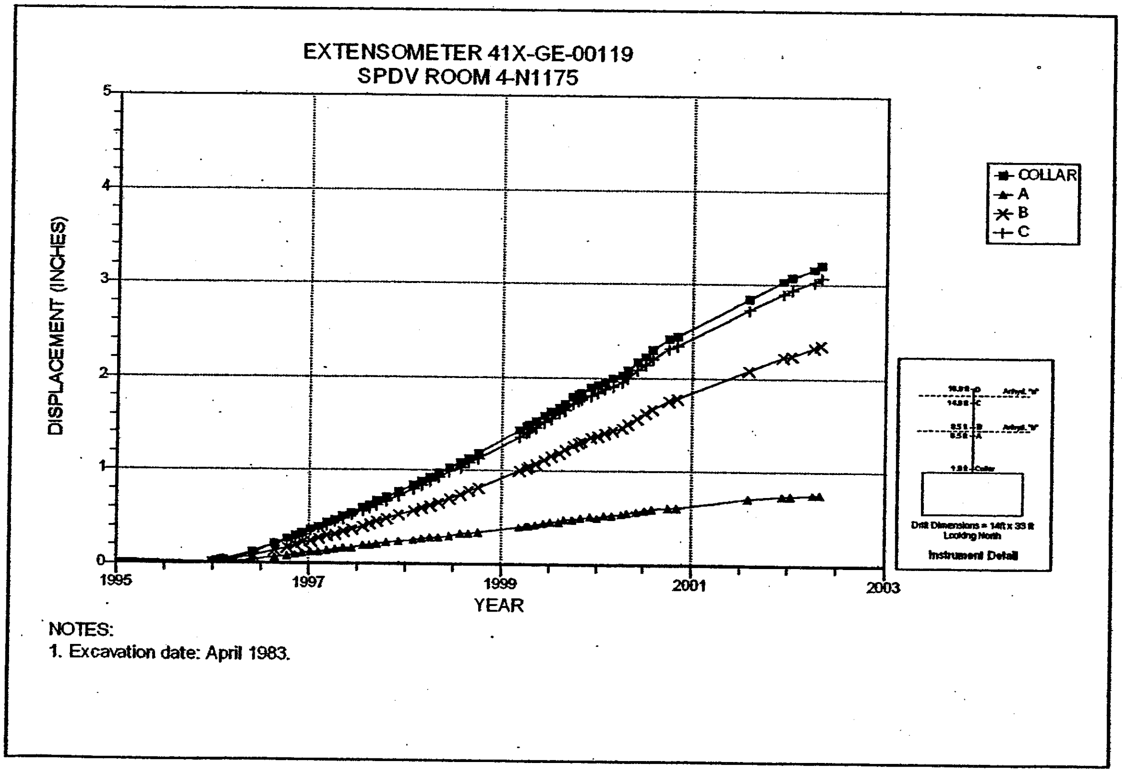


Figure 5-10 Extensometer 41X-GE-00119
SPDV Room 4 at N1175 – Roof

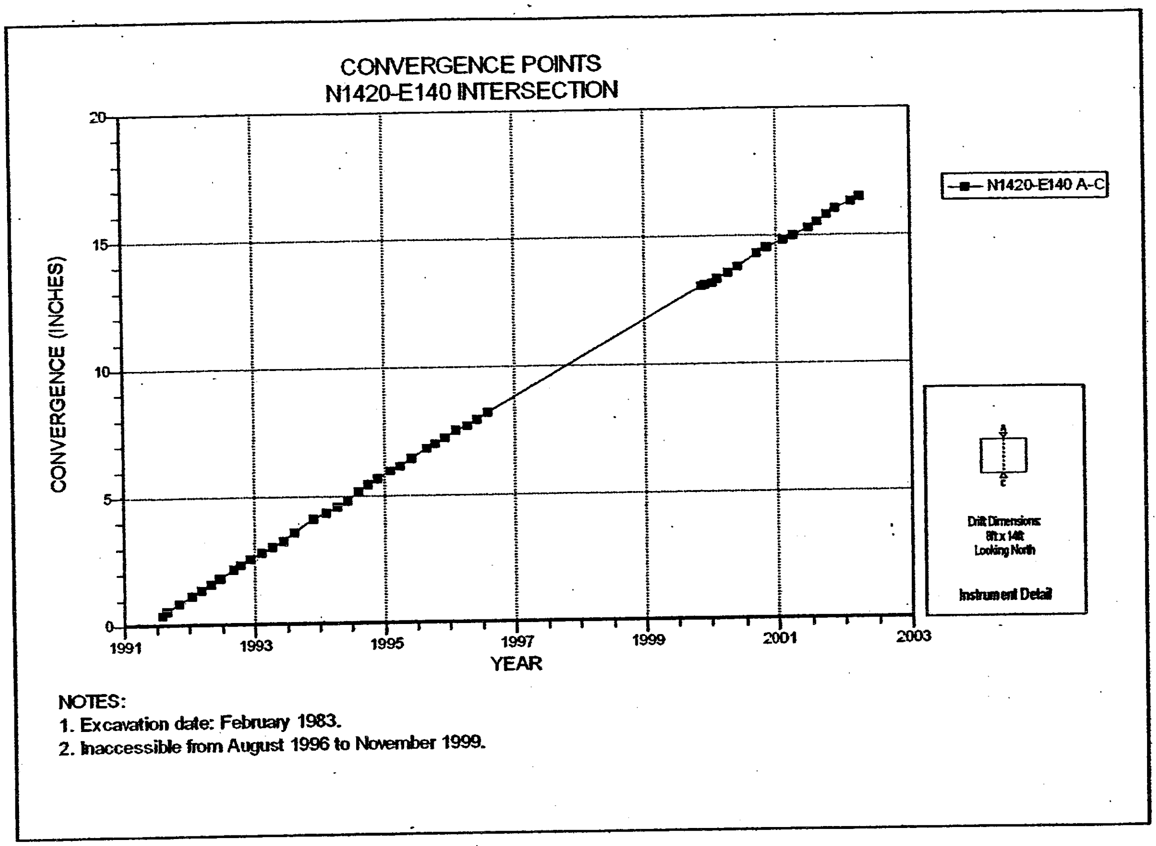


Figure 5-11 Convergence Point Array
N1420 Drift at E140 Drift Intersection – Roof to Floor

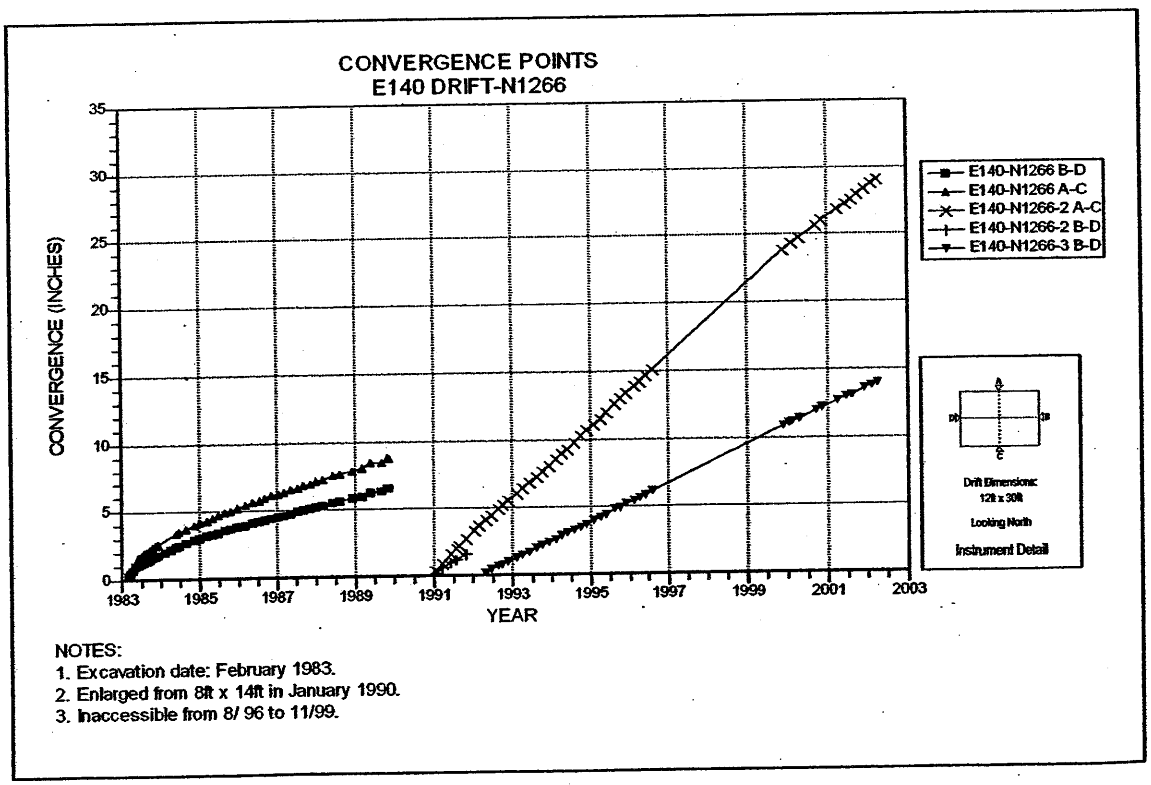
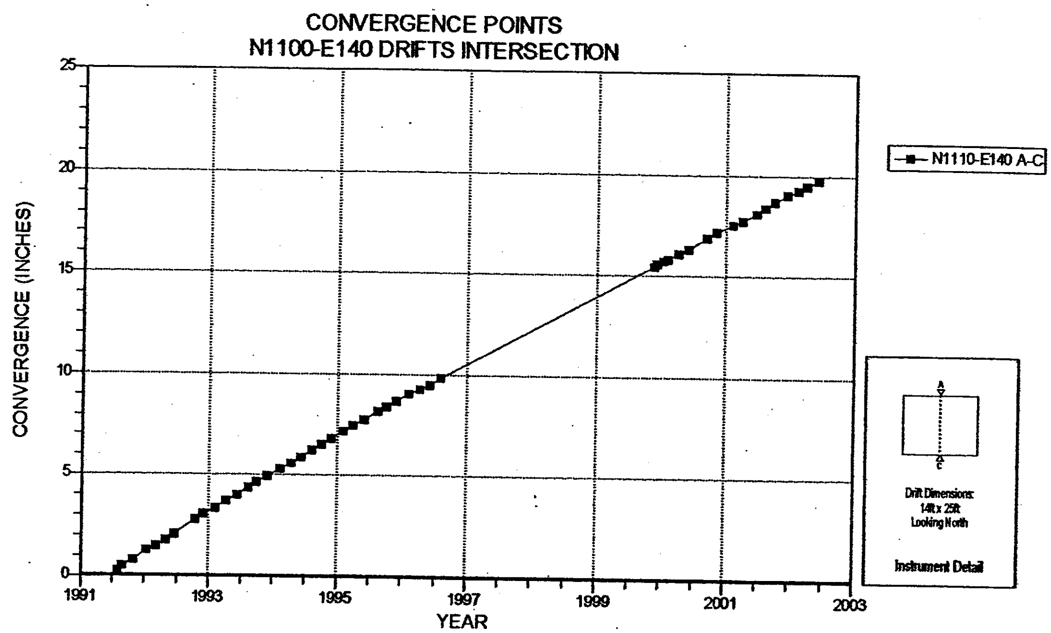
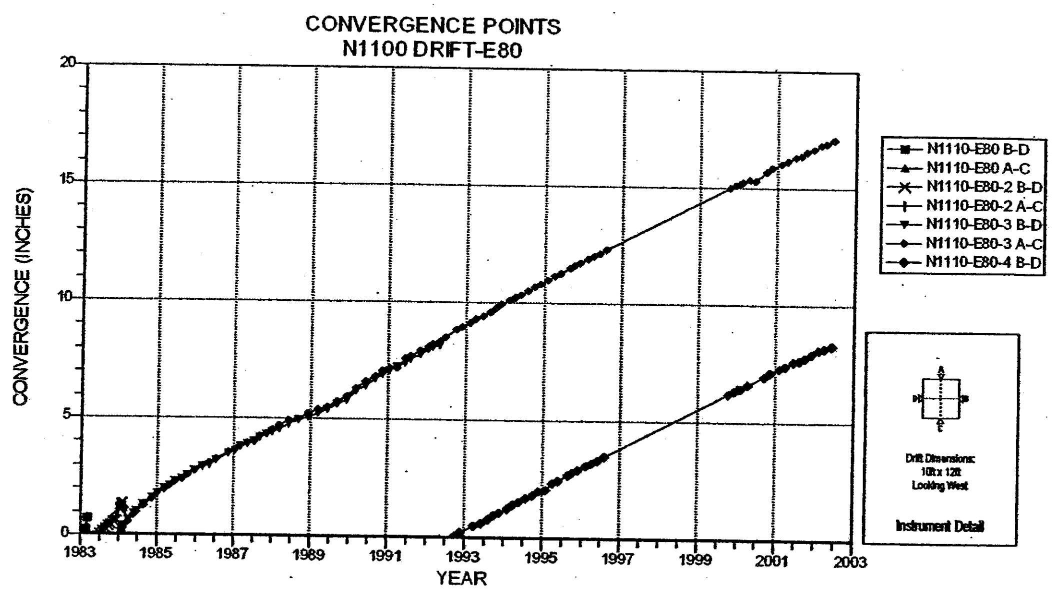


Figure 5-12 Convergence Point Array
E140 Drift at N1266 – All Chords



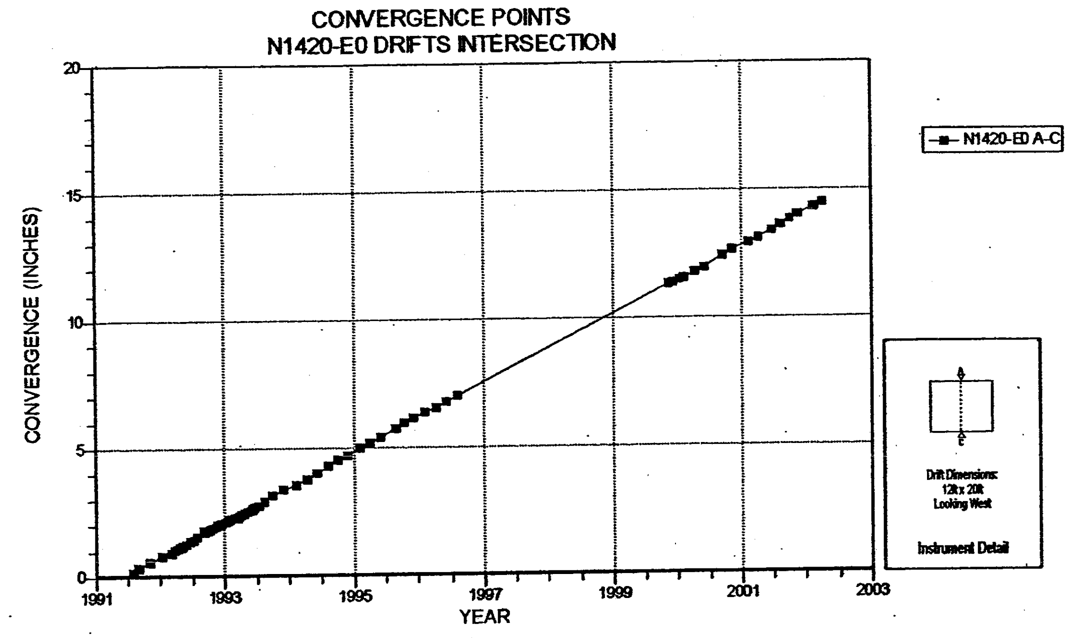
NOTES:
1. Excavation date: February 1983.
2. Inaccessible from 08/96 to 11/99.

Figure 5-13 Convergence Point Array
N1100 Drift at E140 Intersection – Roof to Floor



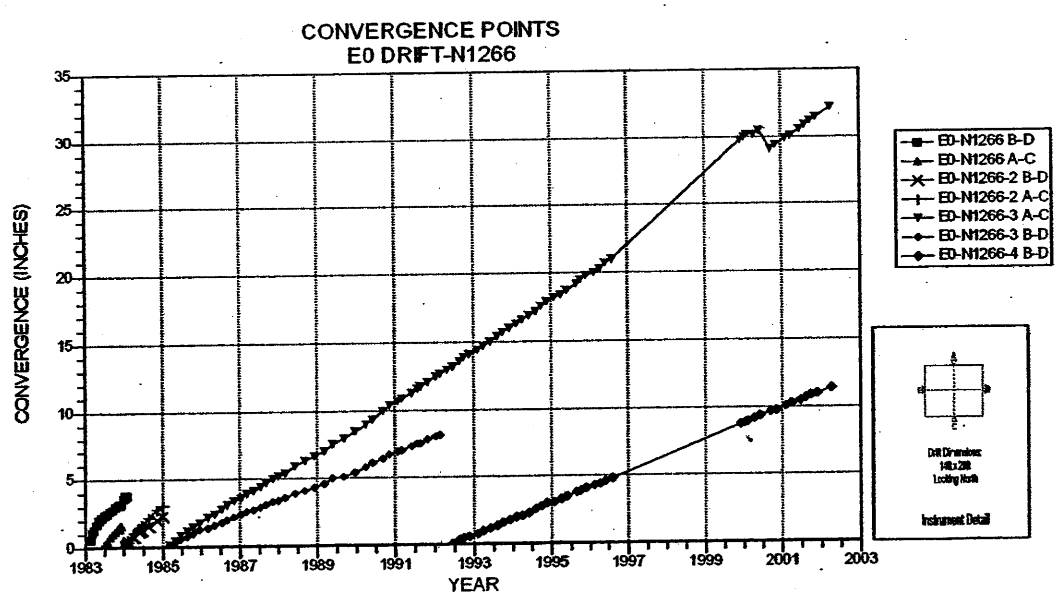
NOTES:
1. Excavation date: February 1983.
2. Inaccessible from 08/96 to 11/99.
3. Current drift dimensions are 11ft x 11ft.

Figure 5-14 Convergence Point Array
N1100 Drift at E80 – All Chords



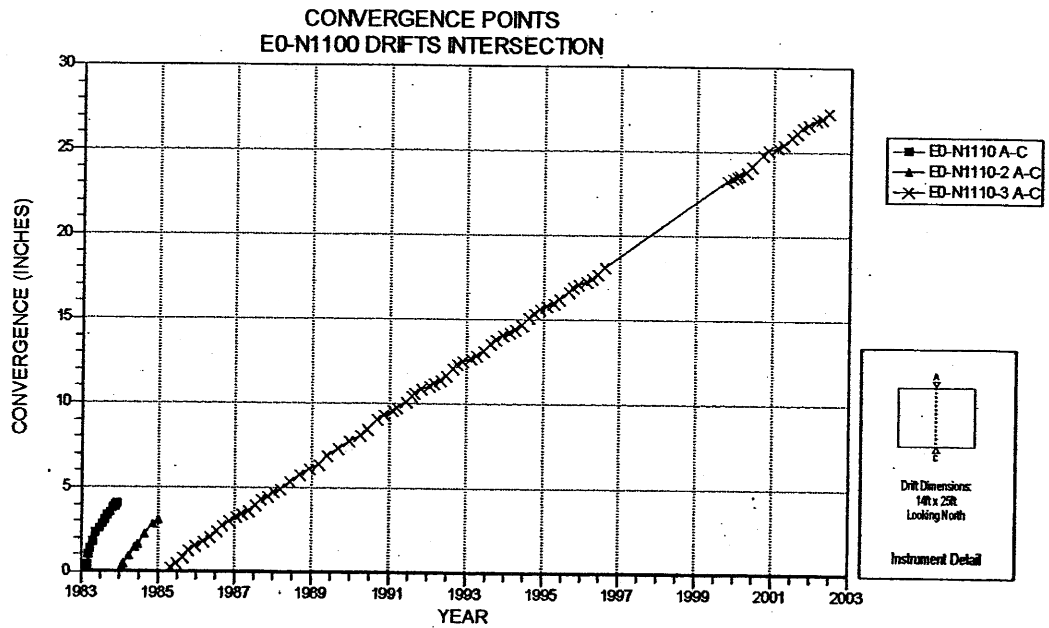
NOTES:
1. Excavation date: February 1983.
2. Inaccessible from 08/96 to 11/99.

Figure 5-15 Convergence Point Array N1420 Drift at E0 Drift Intersection – Roof to Floor



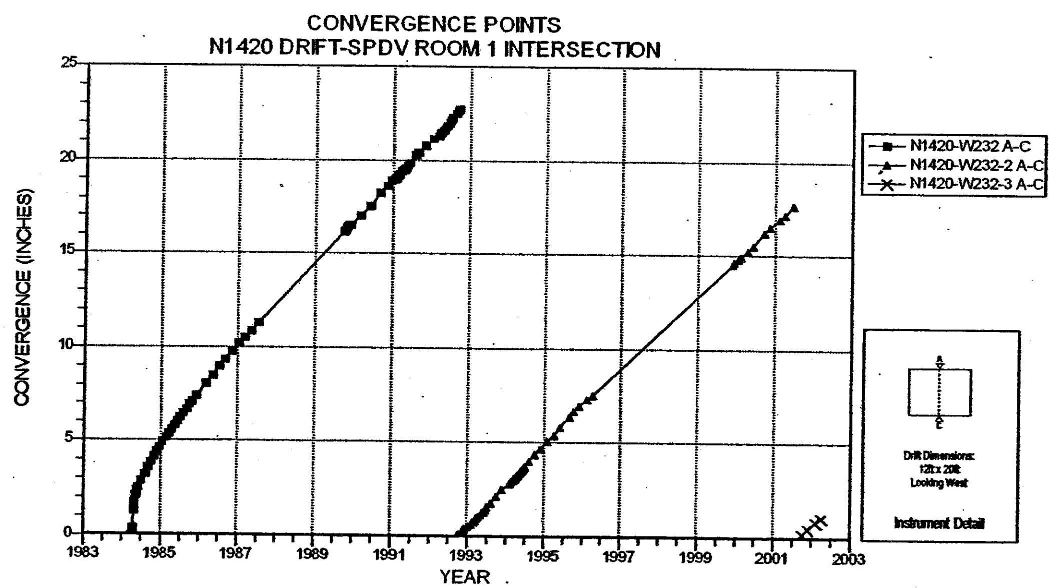
NOTES:
1. Excavation date: February 1983.
2. Possible slippage of chord A-C.
3. Inaccessible from 8/ 96 to 11/99.

Figure 5-16 Convergence Point Array E0 Drift at N1266 – All Chords



NOTES:
1. Excavation date: February 1983.
2. Inaccessible from 8/96 to 11/99.

Figure 5-17 Convergence Point Array
E0 Drift at N1100 Drift Intersection – Roof to Floor



NOTES:
1. Excavation date: March 1983.
2. Inaccessible from 08/96 to 11/99.

Figure 5-18 Convergence Point Array
N1420 Drift at SPDV Room 1 Intersection – Roof to Floor

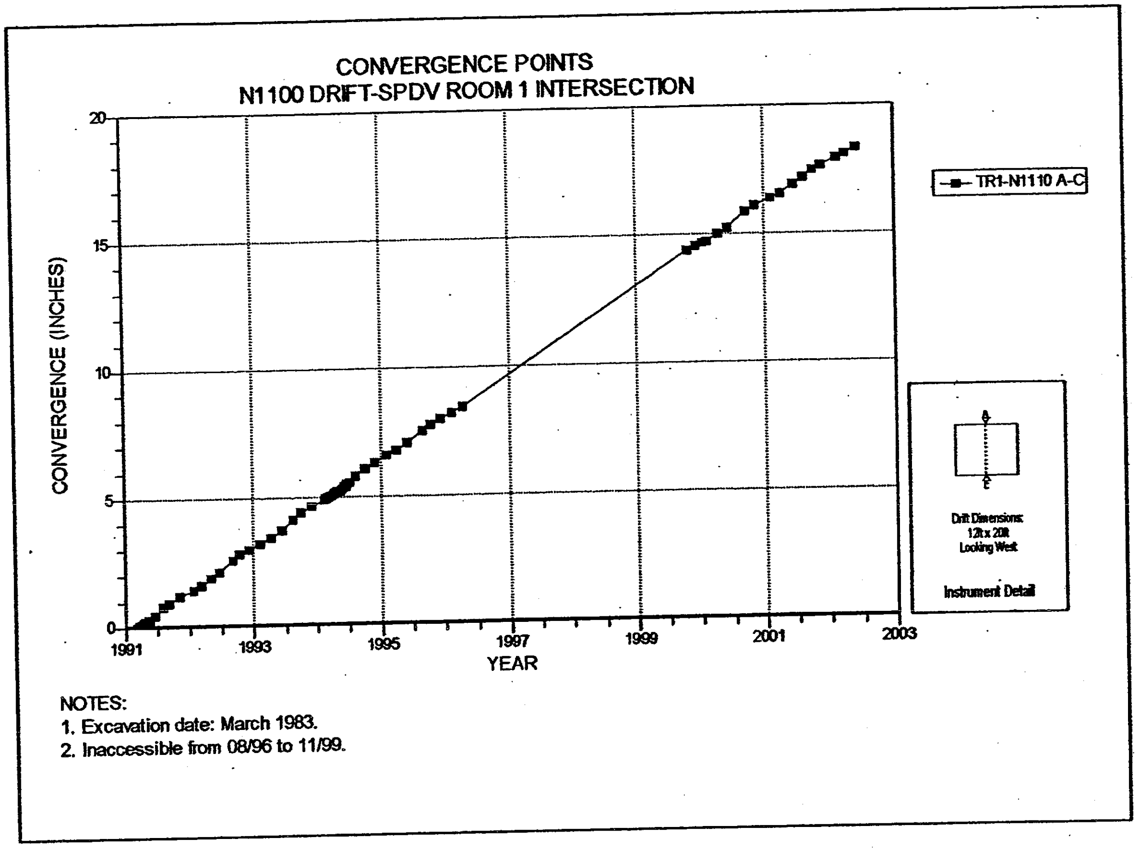


Figure 5-19 Convergence Point Array
N1100 Drift at SPDV Room 1 Intersection – Roof to Floor

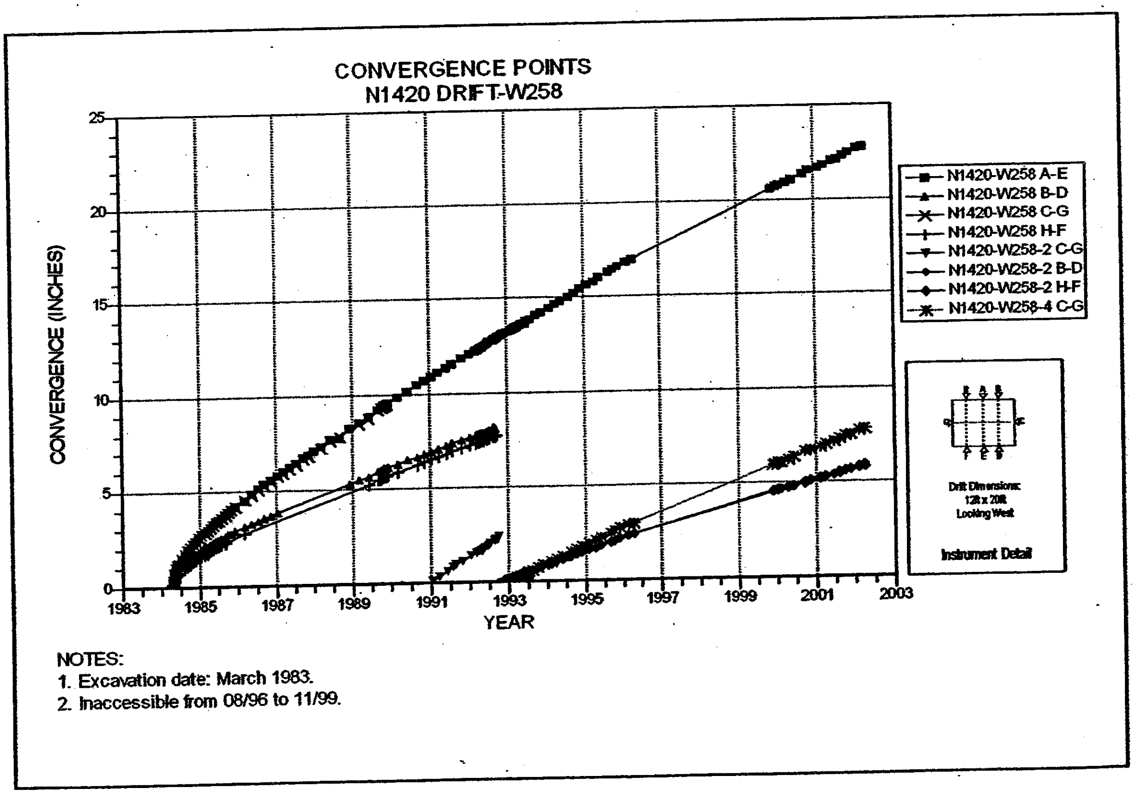


Figure 5-20 Convergence Point Array
N1420 Drift at W258 – All Chords

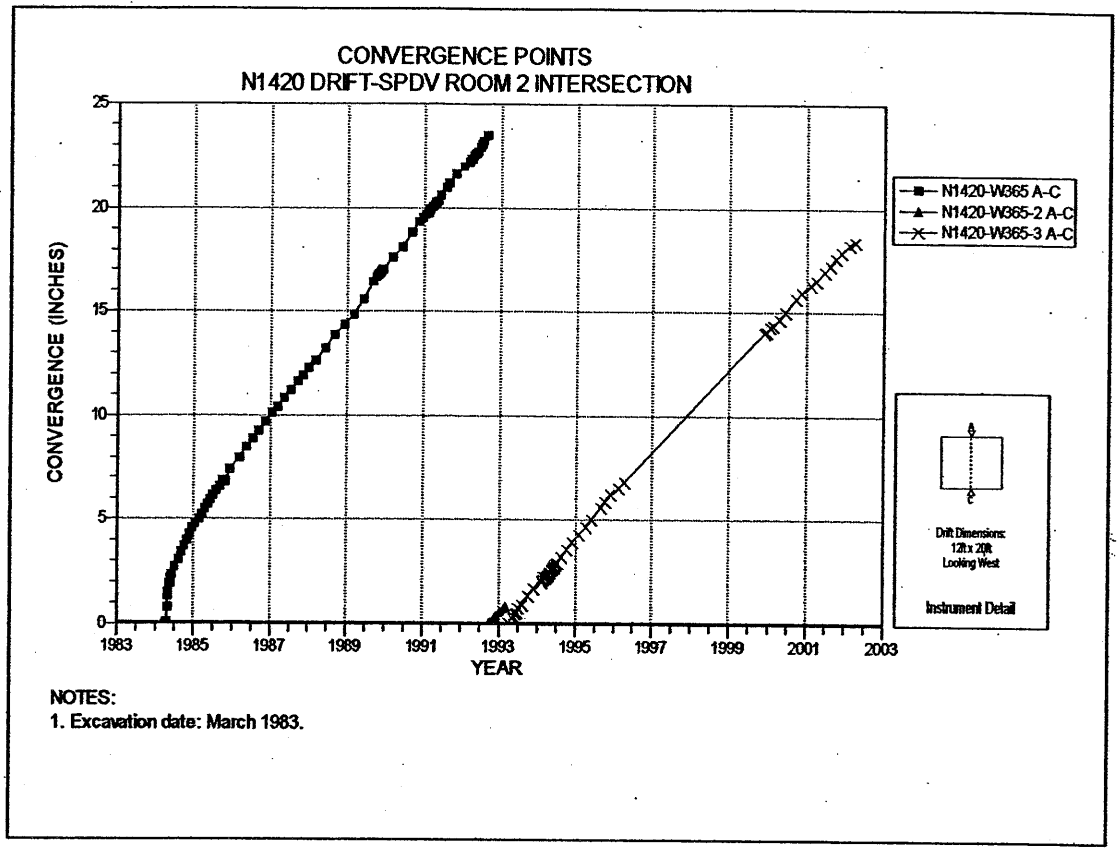


Figure 5-21 Convergence Point Array
N1420 Drift at SPDV Room 2 Intersection – Roof to Floor

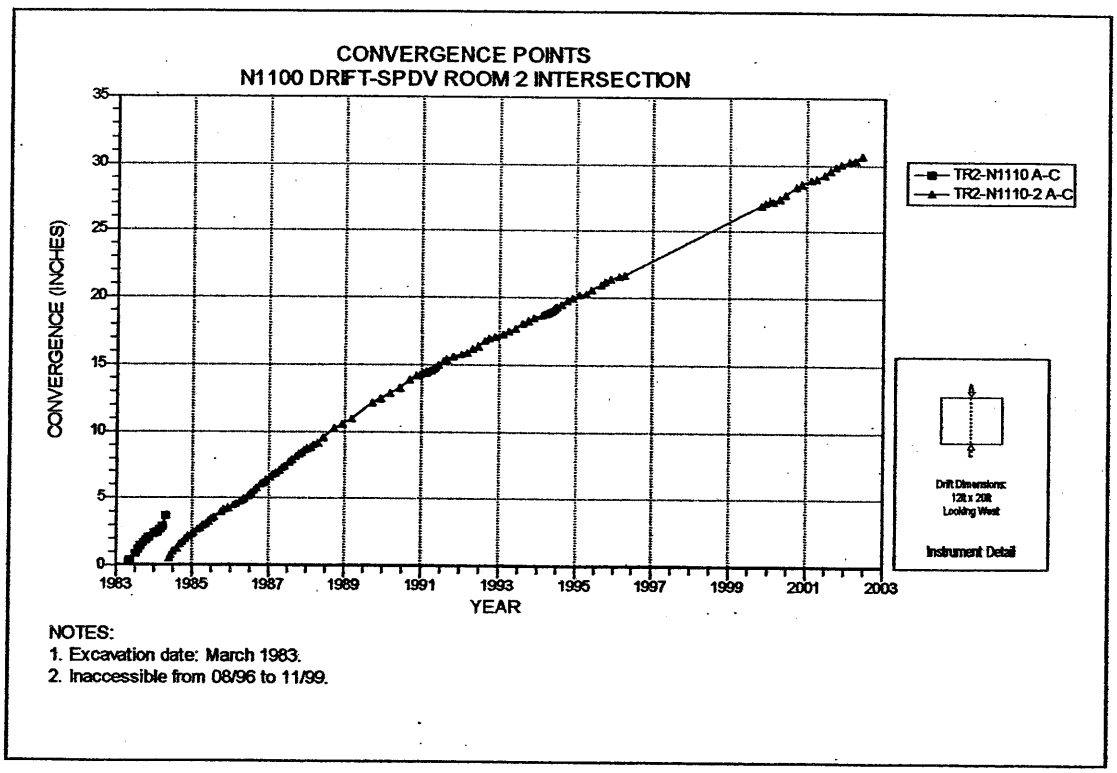


Figure 5-22 Convergence Point Array
N1100 Drift at SPDV Room 2 Intersection – Roof to Floor

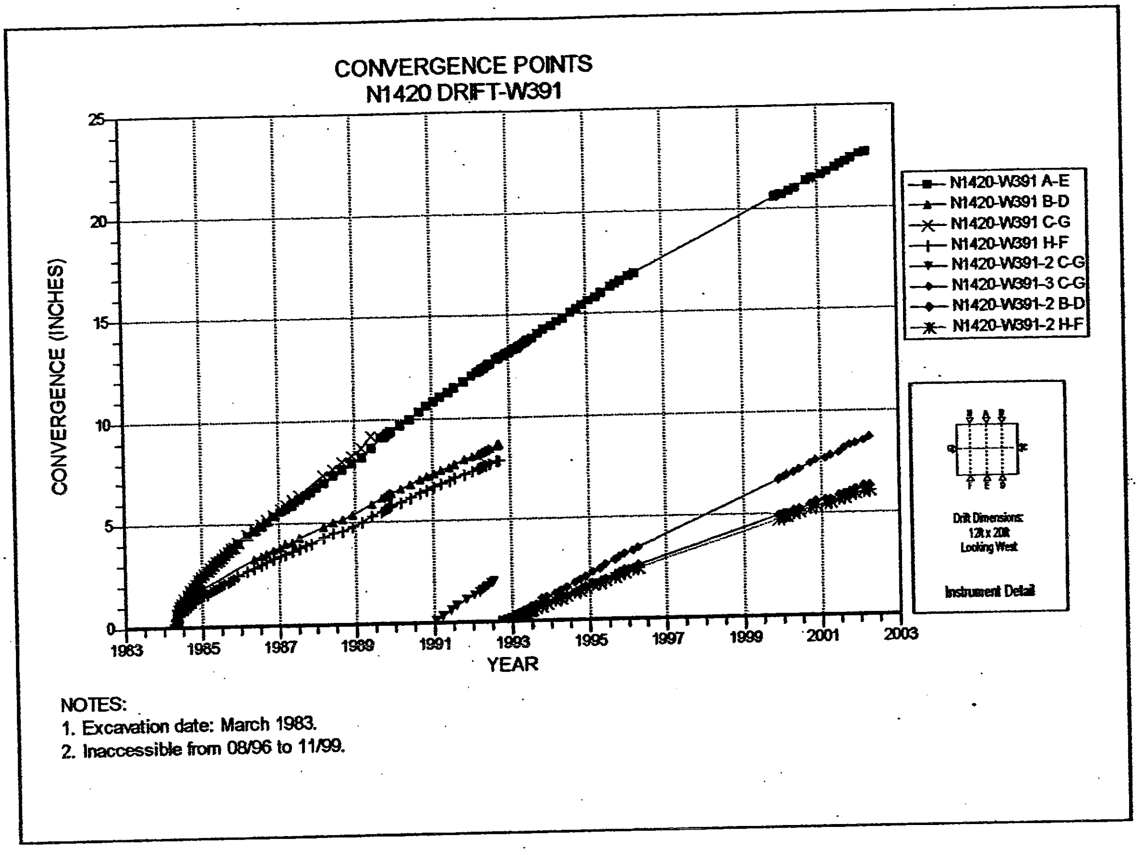


Figure 5-23 Convergence Point Array
N1420 Drift at W391 – All Chords

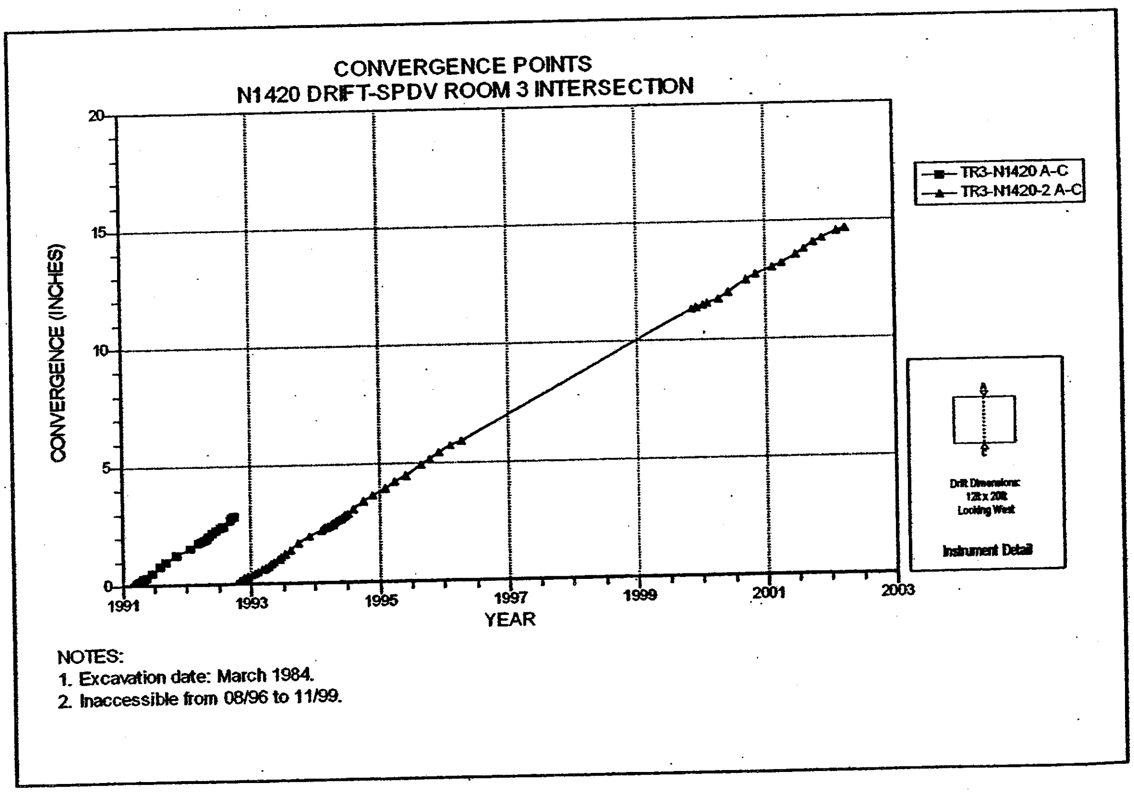
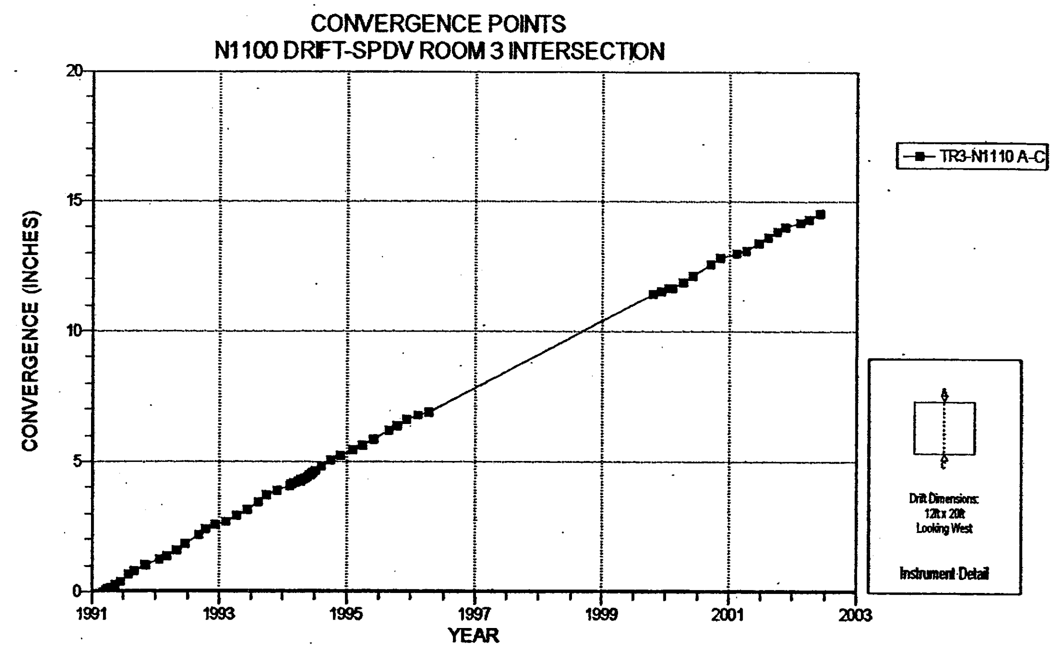
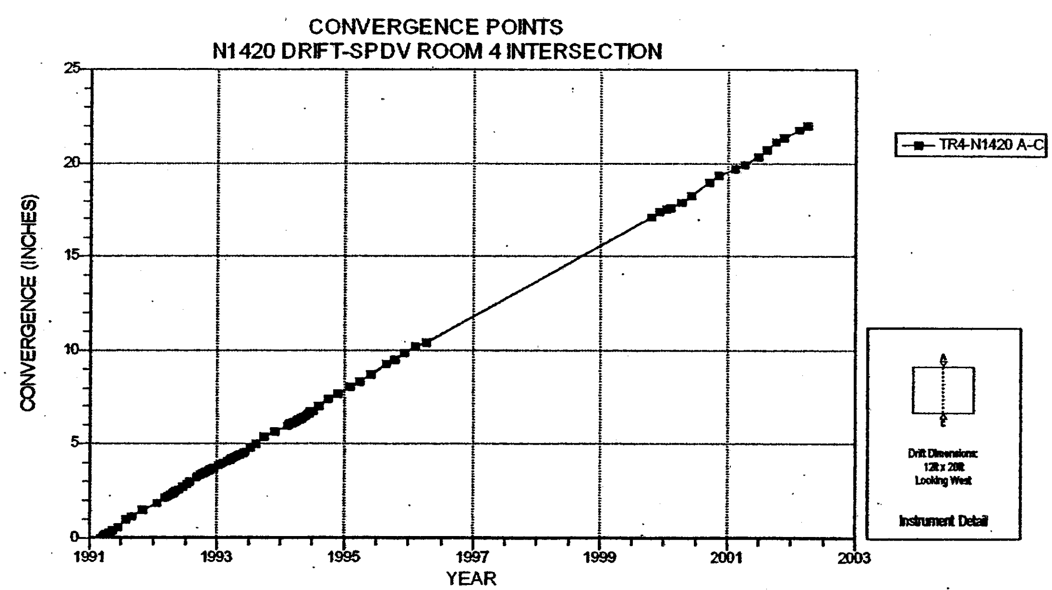


Figure 5-24 Convergence Point Array
N1420 Drift at SPDV Room 3 Intersection – Roof to Floor



NOTES:
1. Excavation date: March 1983.
2. Inaccessible from 08/96 to 11/99.

Figure 5-25 Convergence Point Array
N1100 Drift at SPDV Room 3 Intersection – Roof to Floor



NOTES:
1. Excavation date: March 1984.
2. Inaccessible from 08/96 to 11/99.

Figure 5-26 Convergence Point Array
N1420 Drift at SPDV Room 4 Intersection – Roof to Floor

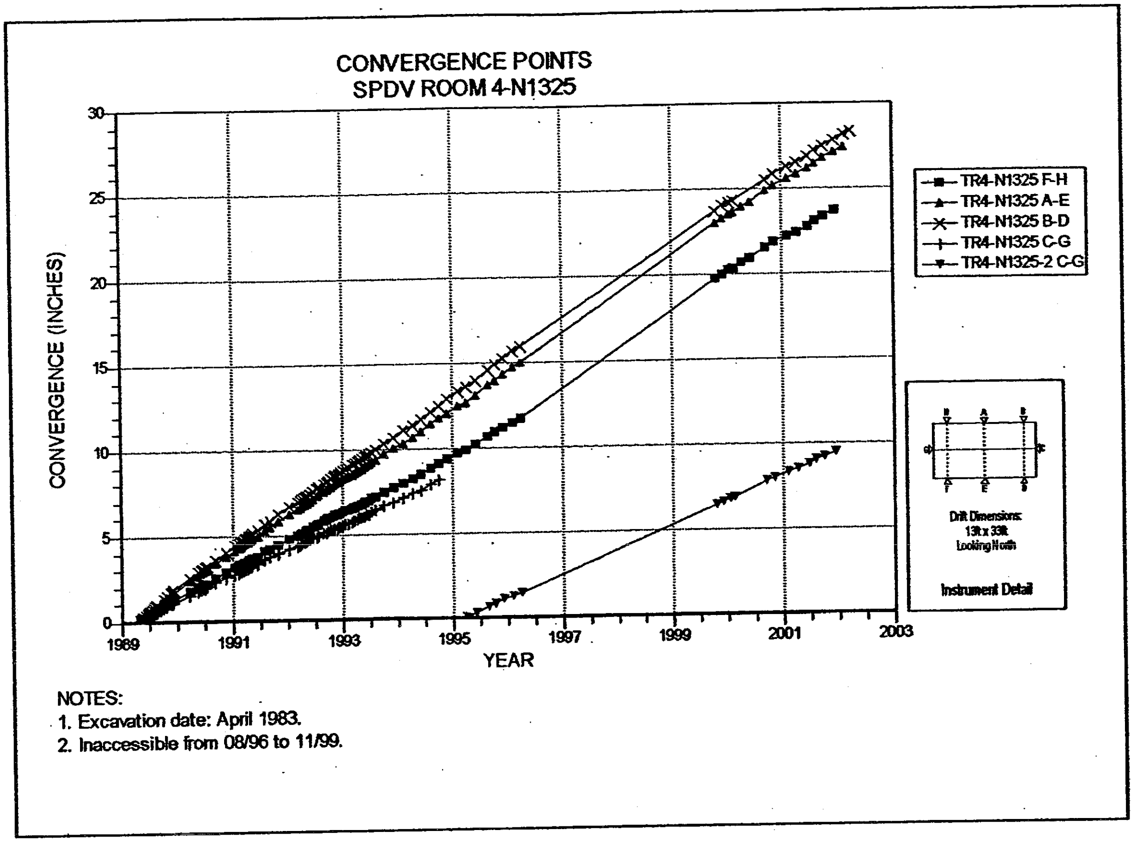


Figure 5-27 Convergence Point Array
SPDV Room 4 at N1325 – All Chords

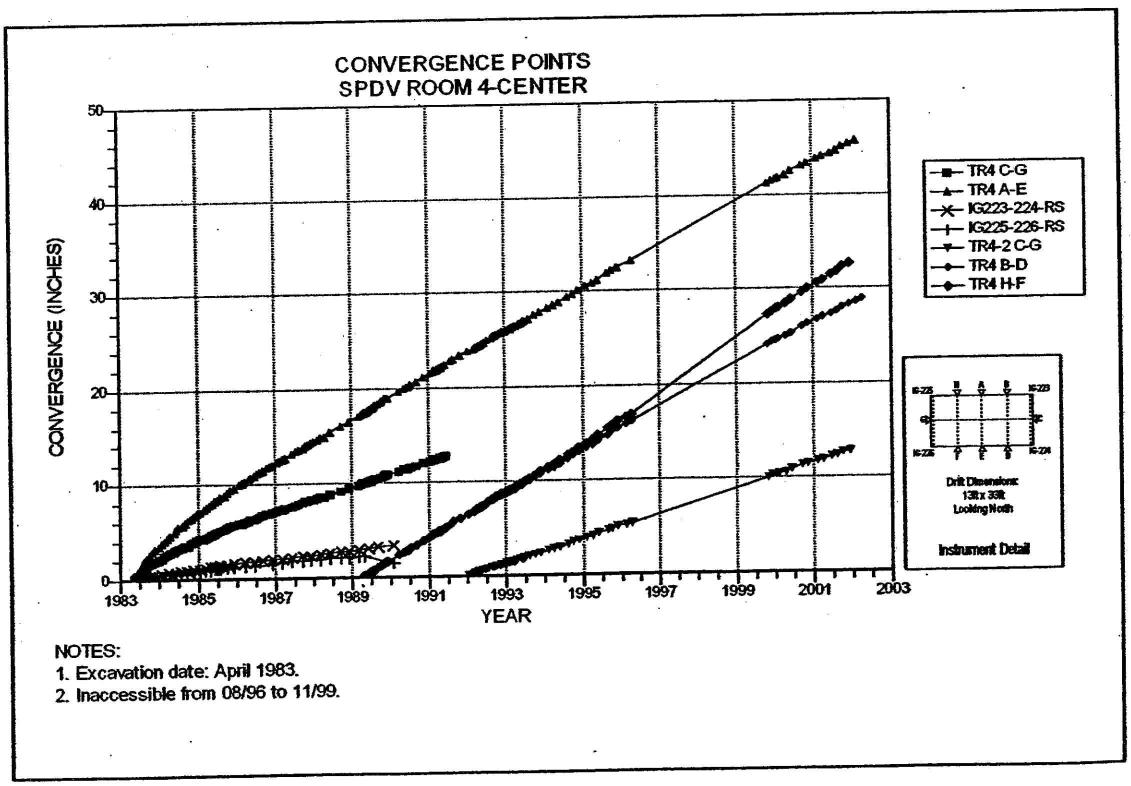
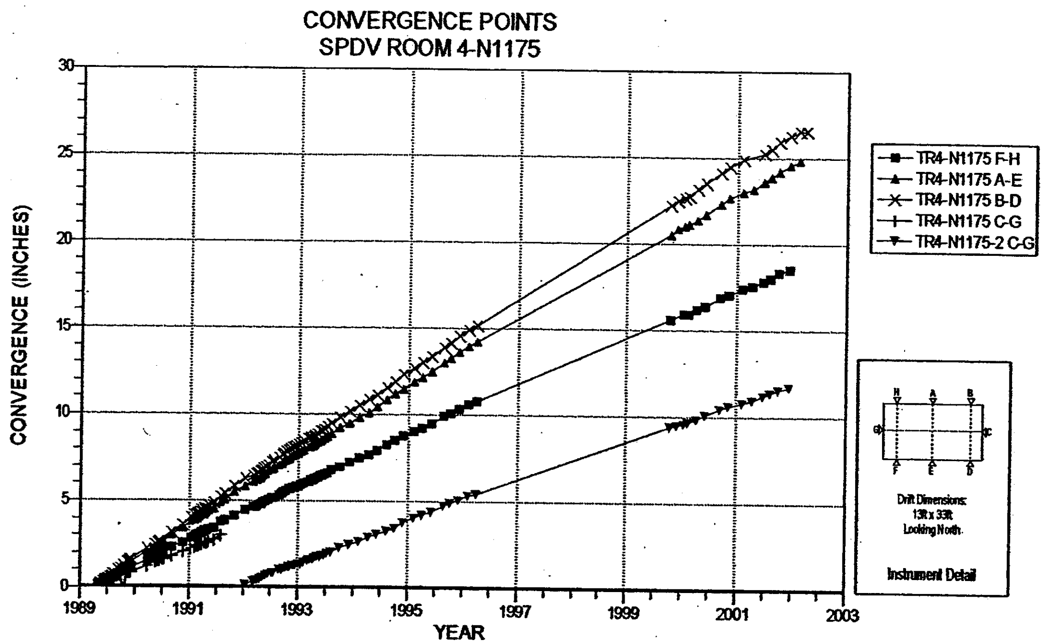
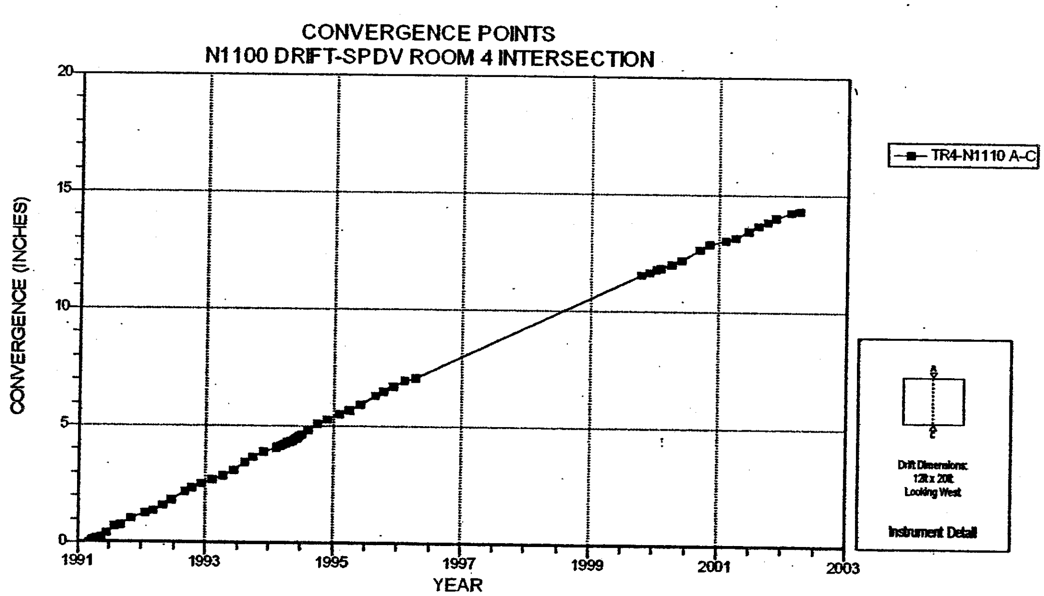


Figure 5-28 Convergence Point Array
SPDV Room 4 at N1250 – All Chords



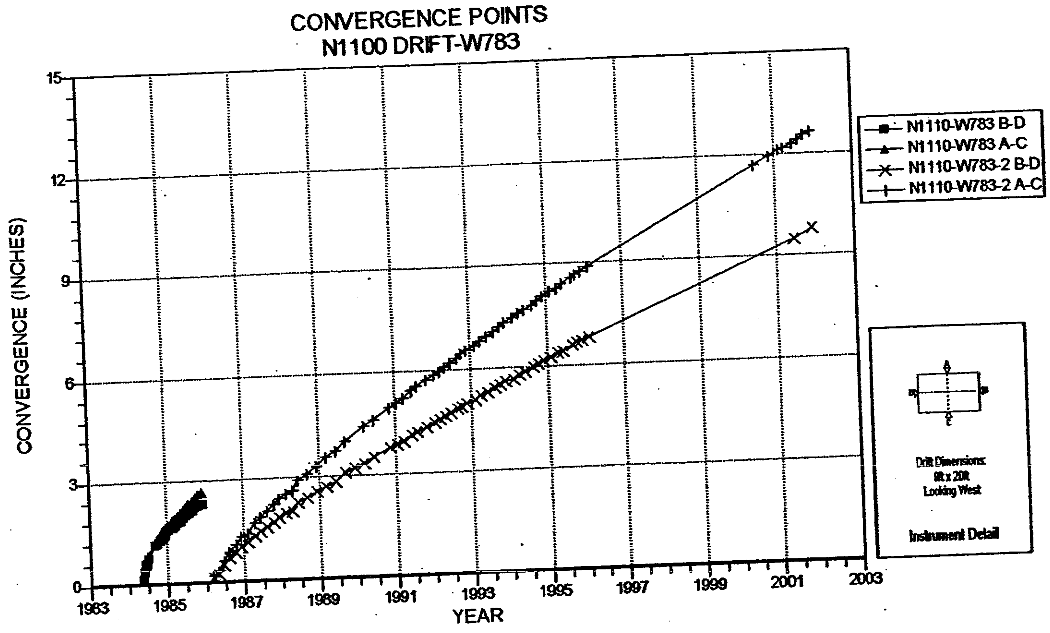
NOTES:
1. Excavation date: April 1983.
2. Inaccessible from 08/96 to 11/99.

Figure 5-29 Convergence Point Array
SPDV Room 4 at N1175 – All Chords



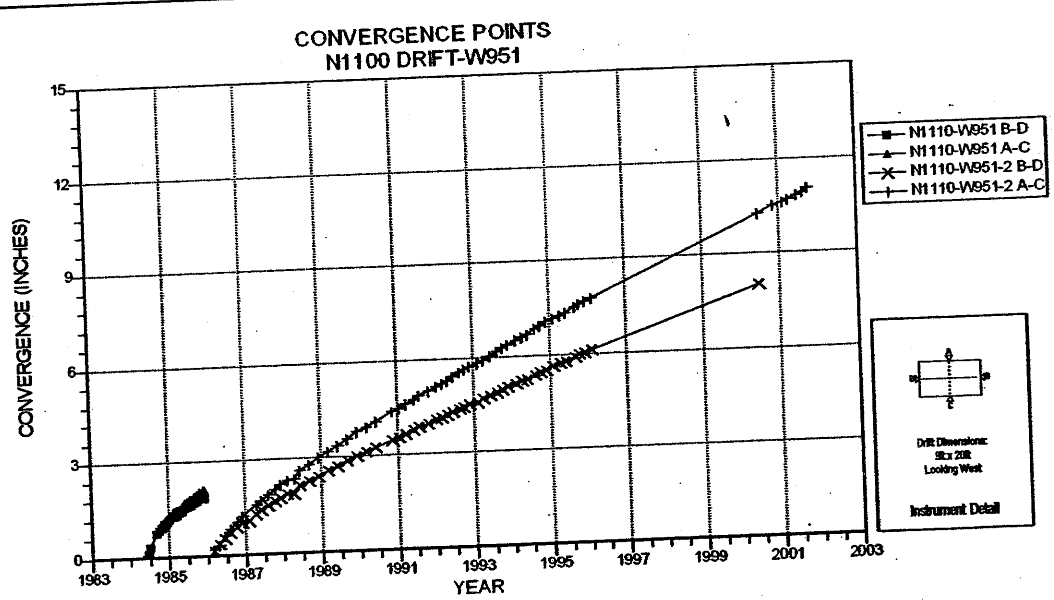
NOTES:
1. Excavation date: April 1983.
2. Inaccessible from 08/96 to 11/99.

Figure 5-30 Convergence Point Array
N1100 Drift at SPDV Room 4 Intersection – Roof to Floor



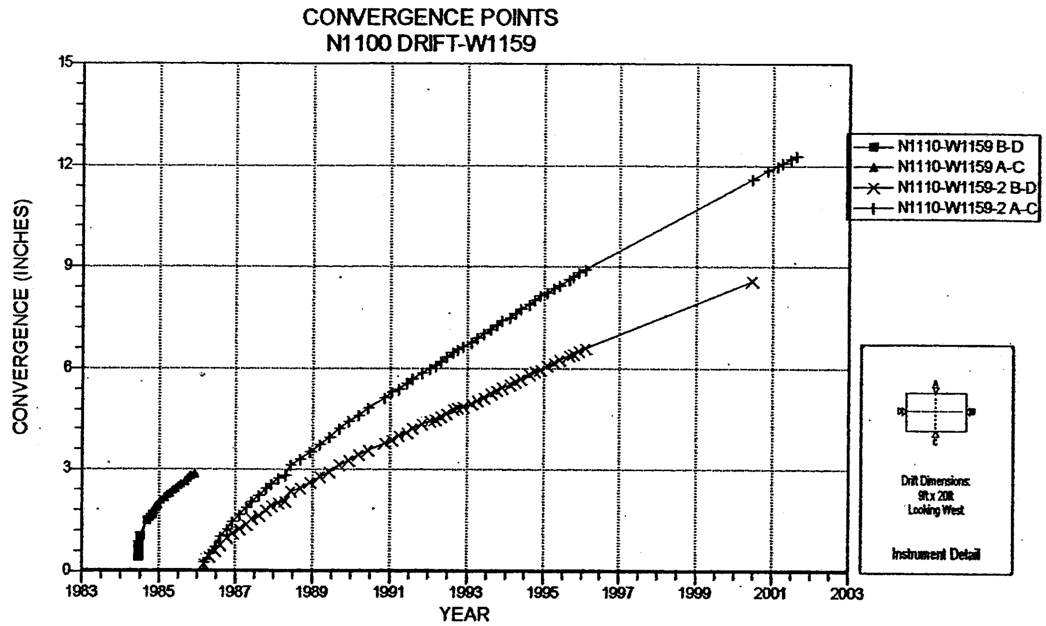
NOTES:
1. Excavation date: May 1984.
2. Inaccessible from 08/96 to 11/99.
3. Access restored, drift subsequently mucked in.

Figure 5-31 Convergence Point Array
N1100 Drift at W783 – All Chords



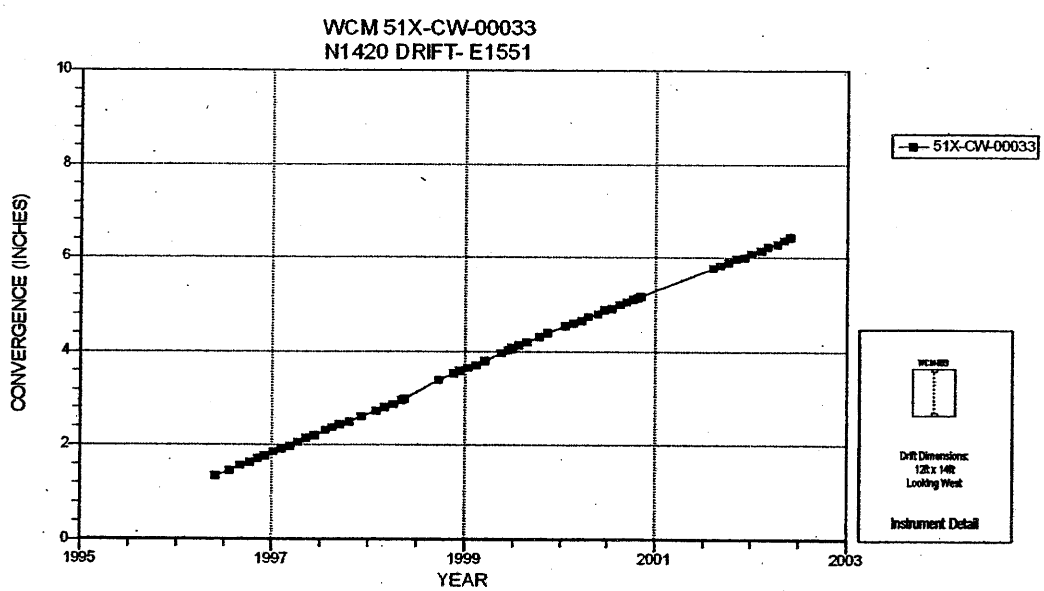
NOTES:
1. Excavation date: June 1984.
2. Inaccessible from 08/96 to 11/99.
3. Access restored, drift subsequently mucked in.

Figure 5-32 Convergence Point Array
N1100 Drift at W951 – All Chords



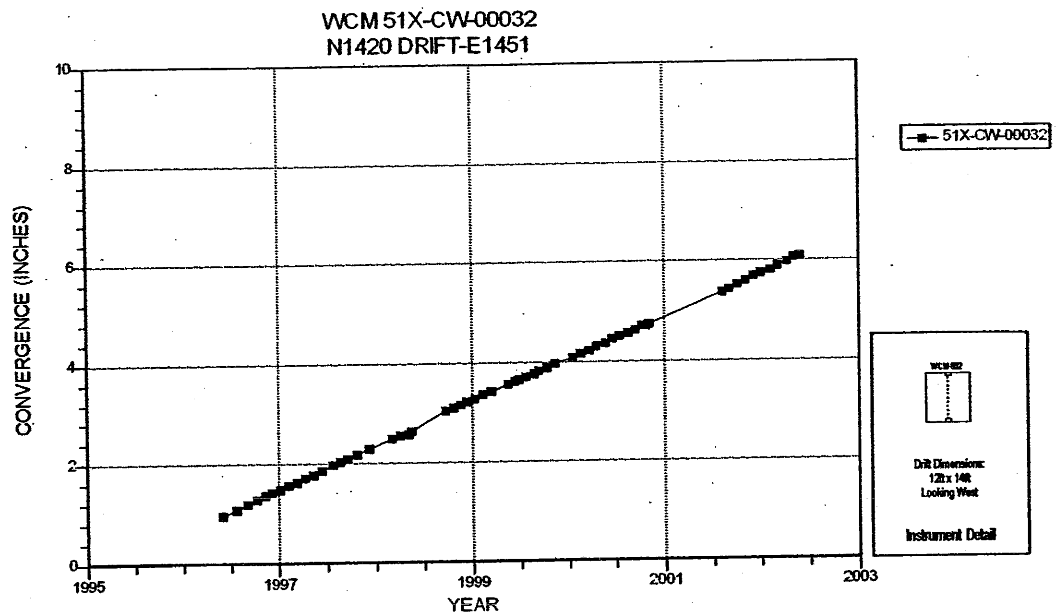
NOTES:
1. Excavation date: June 1984.
2. Inaccessible from 08/96 to 11/99.
3. Access restored, drift subsequently mucked in.

Figure 5-33 Convergence Point Array N1100 Drift at W1159 – All Chords



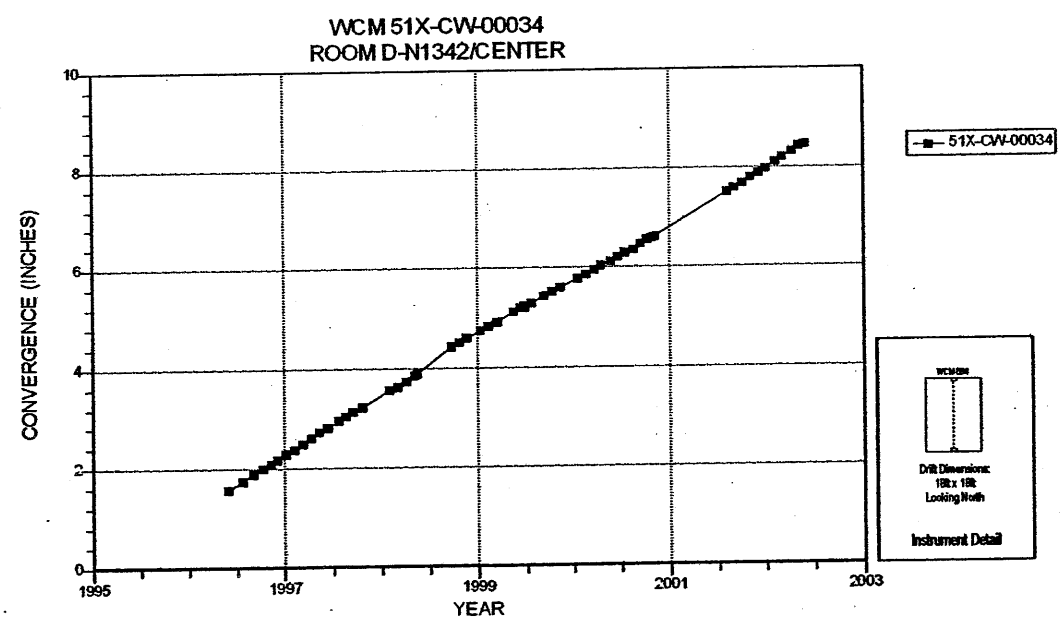
NOTES:
1. Excavation date: March 1984.
2. Area deactivated August 14, 1996.

Figure 5-34 Wire Convergence Meter N1420 Drift at E1551 – Roof to Floor



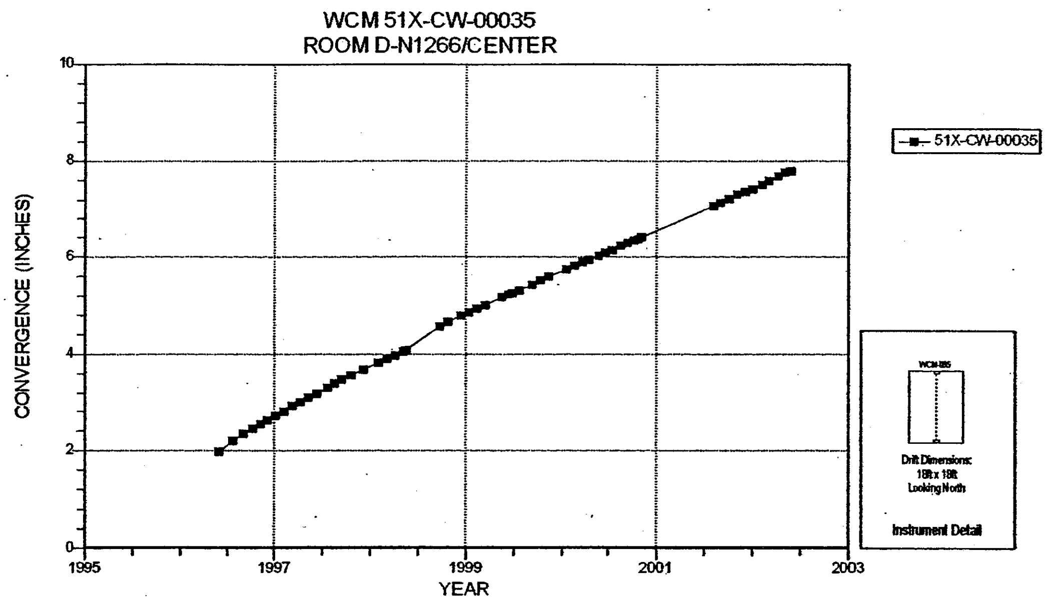
NOTES:
1. Excavation date: March 1984.
2. Area deactivated August 14, 1996.

Figure 5-35 Wire Convergence Meter
N1420 Drift at E1451 – Roof to Floor



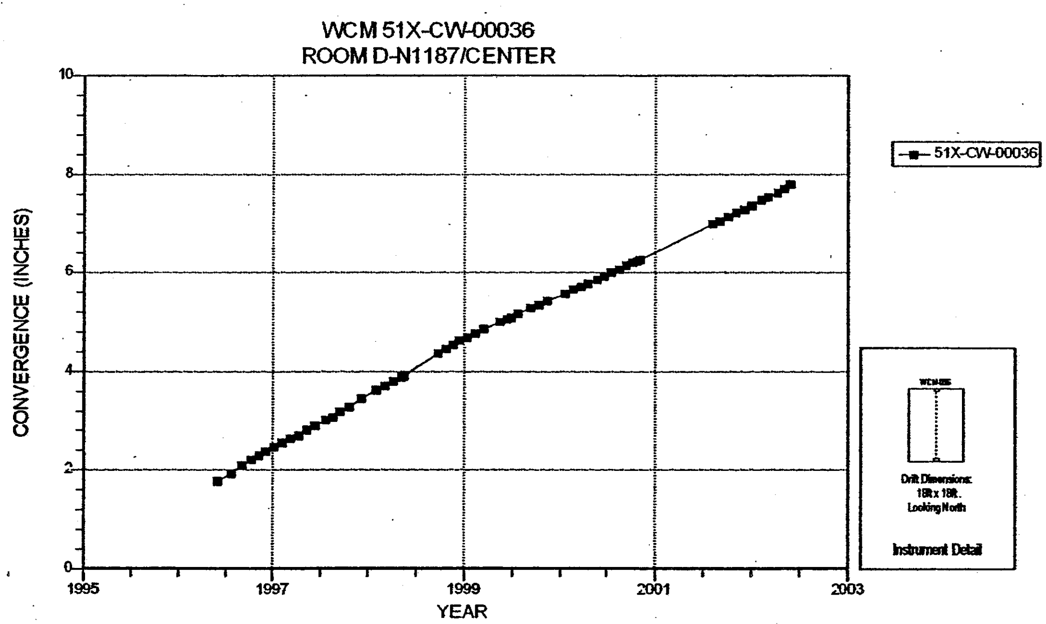
NOTES:
1. Excavation date: March 1984.
2. Area deactivated August 14, 1996.

Figure 5-36 Wire Convergence Meter
Room D at N1342 – Roof to Floor



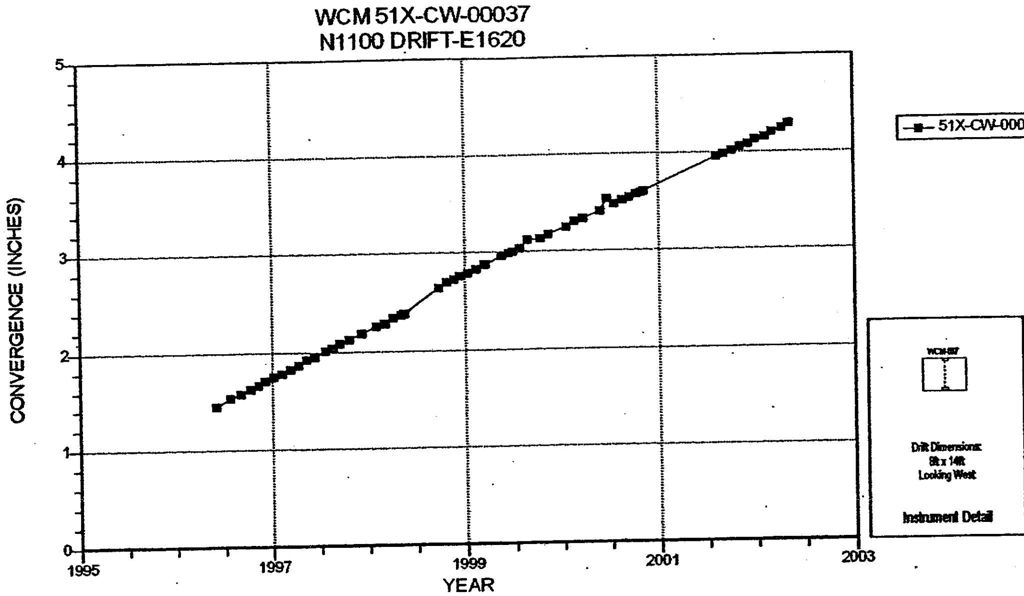
NOTES:
1. Excavation date: March 1984.
2. Area deactivated August 14, 1996.

Figure 5-37 Wire Convergence Meter Room D at N1266 – Roof to Floor



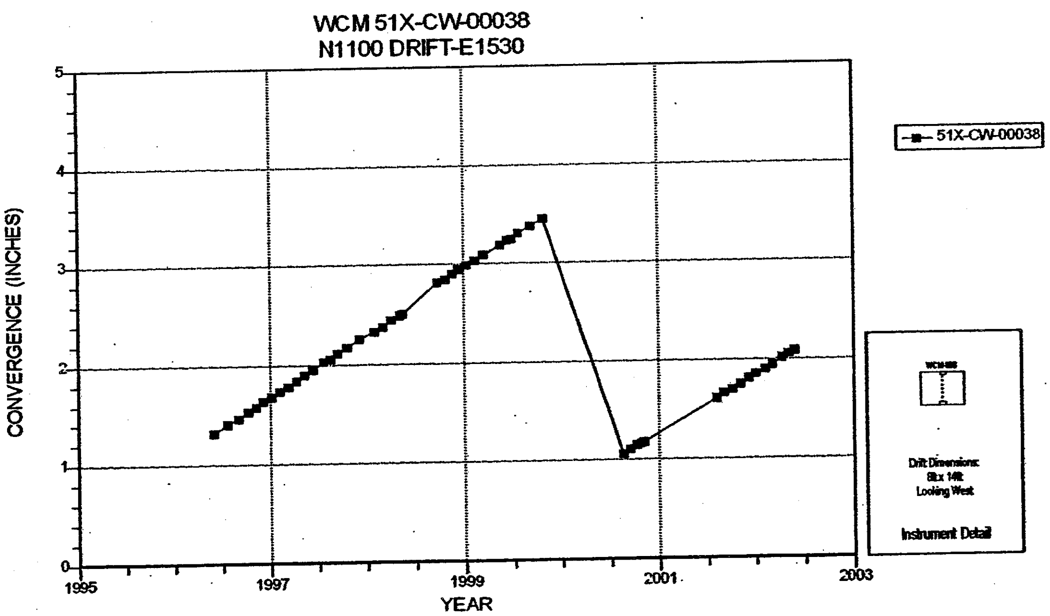
NOTES:
1. Excavation date: March 1984.
2. Area deactivated August 14, 1996.

Figure 5-38 Wire Convergence Meter Room D at N1187 – Roof to Floor



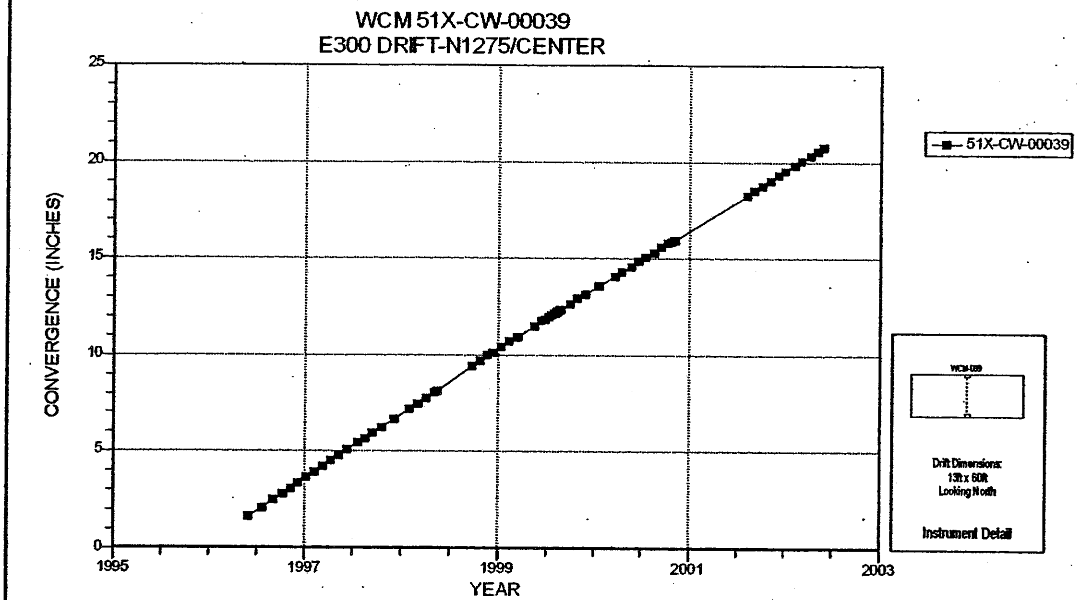
NOTES:
1. Excavation date: March 1984.
2. Area deactivated August 14, 1996.

Figure 5-39 Wire Convergence Meter N1100 Drift at E1620 – Roof to Floor



NOTES:
1. Excavation date: March 1984.
2. Area deactivated August 14, 1996.
3. Offset due to instrument being disturbed during reentry.

Figure 5-40 Wire Convergence Meter N1100 Drift at E1530 – Roof to Floor



NOTES:
1. Excavation date: September 1989.
2. Area deactivated August 14, 1996.

Figure 5-41 Wire Convergence Meter
E300 Drift at N1275 – Roof to Floor

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6.0 Instrumentation Summary for the Waste Disposal Area

This chapter presents a summary of the data collected from instruments located in Panel 1 and Panel 2 of the Waste Disposal Area. Table 6-1 and Table 6-2 presents the results of analyses performed on the instrument data including extensometer displacement rates and convergence rates compared to previous reporting period rates. Figures 6-1 through 6-68 present plots of the data from borehole extensometers located in Panel 1. Convergence point data plots are presented as Figures 6-69 through 6-119. Figures 6-120 through 6-130 present plots of the data from borehole extensometers located in Panel 2. Convergence point data plots are presented as Figures 6-131 through 6-173.

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Table 6-1
Panel 1 Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
51X-GE-01001	Room 1, Panel 1	E Rib	6-1	06/24/02	8.746	0.747	0.671	11%	
51X-GE-01002	Room 1, Panel 1	W Rib	6-2	06/24/02	8.216	0.665	0.620	7%	
51X-GE-00312	Room 1, Panel 1	Roof	6-3	06/24/02	6.956	2.139	2.008	7%	
51X-GE-00458	Room 1, Panel 1	Roof	6-4	06/28/02	3.468	-0.061	0.303	-120%	Rod restrained at clay G.
51X-GE-00313	Room 1, Panel 1	Roof	6-5	06/24/02	4.768	0.653	1.700	-62%	Rod "D" broken.
51X-GE-00457	Room 1, Panel 1	Roof	6-6	06/28/02	4.940	0.984	0.798	23%	
51X-GE-00314	Room 1, Panel 1	Roof	6-7	06/24/02	3.416	0.749	0.915	-18%	Reference anchor bumped.
51X-GE-00456	Room 1, Panel 1	Roof	6-8	06/28/02	4.036	0.789	0.533	48%	
51X-GE-01003	Room 2, Panel 1	E Rib	6-9	06/24/02	8.277	0.370	0.569	-35%	
51X-GE-01004	Room 2, Panel 1	W Rib	6-10	06/24/02	8.260	0.790	0.727	9%	
51X-GE-00315	Room 2, Panel 1	Roof	6-11	06/24/02	5.416	1.854	1.535	21%	
51X-GE-00428	Room 2, Panel 1	Roof	6-12	05/20/02	4.898	0.919	1.166	-21%	
51X-GE-00316	Room 2, Panel 1	Roof	6-13	06/24/02	4.845	1.272	1.224	4%	
51X-GE-00427	Room 2, Panel 1	Roof	6-14	06/11/02	4.575	0.557	0.601	-7%	
51X-GE-00317	Room 2, Panel 1	Roof	6-15	06/24/02	3.785	0.889	0.835	6%	
51X-GE-00426	Room 2, Panel 1	Roof	6-16	06/11/02	5.168	0.562	0.710	-21%	
51X-GE-01005	Room 3, Panel 1	E Rib	6-17	04/19/02	10.330	0.742	N/A	N/A	Intermittent data.
51X-GE-01006	Room 3, Panel 1	W Rib	6-18	04/19/02	8.900	0.749	0.742	1%	
51X-GE-00318	Room 3, Panel 1	Roof	6-19	06/24/02	4.723	1.451	1.430	1%	
51X-GE-00431	Room 3, Panel 1	Roof	6-20	04/22/02	5.417	0.610	0.737	-17%	
51X-GE-00319	Room 3, Panel 1	Roof	6-21	06/24/02	4.181	1.102	1.075	3%	
51X-GE-00430	Room 3, Panel 1	Roof	6-22	04/22/02	6.600	0.763	0.784	-3%	
51X-GE-00320	Room 3, Panel 1	Roof	6-23	06/24/02	3.489	0.973	0.837	16%	
51X-GE-00429	Room 3, Panel 1	Roof	6-24	04/22/02	5.033	0.746	0.644	16%	
51X-GE-01007	Room 4, Panel 1	E Rib	6-25	06/24/02	10.170	0.864	0.887	-3%	
51X-GE-01008	Room 4, Panel 1	W Rib	6-26	06/24/02	10.200	0.880	0.875	1%	
51X-GE-00321	Room 4, Panel 1	Roof	6-27	06/24/02	3.231	0.923	0.833	11%	
51X-GE-00487	Room 4, Panel 1	Roof	6-28	01/02/02	1.808	0.462	0.436	6%	Not accessible.
51X-GE-00434	Room 4, Panel 1	Roof	6-29	01/02/02	5.029	0.591	0.693	-15%	Not accessible.

[A] NA indicates insufficient data to calculate.

Table 6-1 (Continued)
Panel 1 Data Analysis

EXTENSOMETERS (Continued)

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (Inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
51X-GE-00488	Room 4, Panel 1	Roof	6-30	01/02/02	0.671	0.410	0.292	40%	Not accessible.
51X-GE-00322	Room 4, Panel 1	Roof	6-31	06/24/02	5.767	1.776	1.614	10%	
51X-GE-00485	Room 4, Panel 1	Roof	6-32	01/02/02	0.878	0.453	0.311	46%	Not accessible.
51X-GE-00433	Room 4, Panel 1	Roof	6-33	01/02/02	5.941	0.765	0.766	0%	Not accessible.
51X-GE-00486	Room 4, Panel 1	Roof	6-34	01/02/02	3.420	1.493	1.397	7%	Not accessible.
51X-GE-00323	Room 4, Panel 1	Roof	6-35	06/24/02	2.673	0.559	0.614	-9%	
51X-GE-00483	Room 4, Panel 1	Roof	6-36	01/02/02	2.845	1.079	1.172	-8%	Not accessible.
51X-GE-00432	Room 4, Panel 1	Roof	6-37	01/02/02	6.535	0.395	0.391	1%	Not accessible.
51X-GE-00484	Room 4, Panel 1	Roof	6-38	01/02/02	0.711	0.318	0.276	15%	Not accessible.
51X-GE-01009	Room 5, Panel 1	E Rib	6-39	06/24/02	9.452	0.765	0.659	16%	
51X-GE-00437	Room 5, Panel 1	Roof	6-40	10/31/01	5.252	N/A	0.783	N/A	Not accessible.
51X-GE-00325	Room 5, Panel 1	Roof	6-41	06/24/02	5.788	1.283	1.504	-15%	
51X-GE-00436	Room 5, Panel 1	Roof	6-42	10/31/01	5.019	0.317	0.665	-52%	Not accessible.
51X-GE-00326	Room 5, Panel 1	Roof	6-43	06/24/02	3.825	0.958	0.849	13%	
51X-GE-00435	Room 5, Panel 1	Roof	6-44	08/13/01	5.371	0.678	0.779	-13%	Not accessible.
51X-GE-01011	Room 6, Panel 1	E Rib	6-45	06/24/02	7.800	0.607	0.629	-3%	
51X-GE-01012	Room 6, Panel 1	W Rib	6-46	06/24/02	8.044	0.662	0.666	-1%	
51X-GE-00327	Room 6, Panel 1	Roof	6-47	06/24/02	6.379	1.644	1.581	4%	
51X-GE-00440	Room 6, Panel 1	Roof	6-48	08/21/01	4.140	0.542	0.521	4%	Not accessible.
51X-GE-00328	Room 6, Panel 1	Roof	6-49	06/24/02	4.234	1.271	1.228	4%	
51X-GE-00439	Room 6, Panel 1	Roof	6-50	08/20/01	6.170	0.639	0.992	-36%	Not accessible.
51X-GE-00329	Room 6, Panel 1	Roof	6-51	06/24/02	4.324	1.148	1.120	2%	
51X-GE-01013	Room 7, Panel 1	E Rib	6-52	06/24/02	7.435	0.489	0.479	2%	
51X-GE-01023	Room 7, Panel 1	W Rib	6-53	06/24/02	2.380	0.443	0.420	5%	
51X-GE-00330	Room 7, Panel 1	Roof	6-54	06/24/02	4.569	0.854	1.068	-20%	
51X-GE-00331	Room 7, Panel 1	Roof	6-55	06/24/02	3.845	0.810	0.726	12%	
51X-GE-00332	Room 7, Panel 1	Roof	6-56	06/24/02	3.360	0.748	0.613	22%	
51X-GE-00425	S1600 Drift-E582	Roof	6-57	10/31/01	2.981	0.440	0.311	41%	Not accessible.
51X-GE-00424	S1600 Drift-E725	Roof	6-58	10/31/01	3.964	0.485	0.418	16%	Not accessible.

[A] NA indicates insufficient data to calculate.

Table 6-1 (Continued)
Panel 1 Data Analysis

EXTENSOMETERS (Continued)

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
51X-GE-00423	S1600 Drift-E855	Roof	6-59	10/31/01	5.001	0.567	0.505	12%	Not accessible.
51X-GE-00422	S1600 Drift-E990	Roof	6-60	10/31/01	5.230	0.396	0.472	-16%	Not accessible.
51X-GE-00412	S1950 Drift-E582	Roof	6-61	06/28/02	5.577	0.686	0.684	0%	Not accessible.
51X-GE-00413	S1950 Drift-E725	Roof	6-62	06/11/02	5.201	0.073	0.951	-92%	Rod restrained at Clay G.
51X-GE-00414	S1950 Drift-E855	Roof	6-63	01/07/02	5.197	0.726	0.970	-25%	Not accessible.
51X-GE-01015	S1950 Drift-E856	S Rib	6-64	06/24/02	10.080	1.247	0.991	26%	
51X-GE-01016	S1950 Drift-E856	N Rib	6-65	06/24/02	7.094	0.567	0.301	88%	
51X-GE-00415	S1950 Drift-E990	Roof	6-66	10/31/01	4.832	0.679	0.708	-4%	Not accessible.
51X-GE-00416	S1950 Drift-E1060	Roof	6-67	10/31/01	2.741	0.044	0.104	-58%	Not accessible.
51X-GE-00417	S1950 Drift-E1125	Roof	6-68	08/13/01	5.693	N/A	1.157	N/A	Not accessible.

[A] NA indicates insufficient data to calculate.

Table 6-1 (Continued)
Panel 1 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent[A]	Comments
			Date	Inches					
S1600-E311-2 A-C	S1600 Drift-E311	6-69	06/06/02	8.805	14.252	0.612	0.664	-8%	
S1600-E311-5 B-D	S1600 Drift-E311	6-69	06/06/02	3.435	12.678	0.684	0.572	20%	
S1600-E332-3 A-C	S1600 Drift-E332	6-70	06/06/02	7.708	12.135	0.739	0.637	16%	
S1600-E357-2 A-C	S1600 Drift-E357	6-71	06/06/02	8.903	14.301	0.779	0.677	15%	
S1600-E357-2 B-D	S1600 Drift-E357	6-71	06/06/02	7.276	16.023	0.830	0.719	15%	
S1600-E382-2 A-C	S1600 Drift-E382	6-72	06/06/02	9.050	14.430	0.752	0.675	11%	
S1600-E382 B-D	S1600 Drift-E382	6-72	06/06/02	15.401	15.401	0.794	0.680	17%	
S1600-E407-3 C-K	S1600 Drift-E407	6-73	06/06/02	5.403	17.417	0.991	0.834	19%	
S1600-E407-2 D-J	S1600 Drift-E407	6-73	06/06/02	7.955	16.910	0.918	0.821	12%	
S1600-E407-2 E-I	S1600 Drift-E407	6-73	06/06/02	7.342	15.944	0.810	0.712	14%	
S1600-E407-2 A-G	S1600 Drift-E407	6-74	06/06/02	9.688	15.130	0.833	0.747	12%	
S1600-E407-2 B-F	S1600 Drift-E407	6-74	06/06/02	8.814	13.820	0.751	0.680	10%	
S1600-E407-2 H-L	S1600 Drift-E407	6-74	06/06/02	9.380	14.445	0.785	0.706	11%	
S1600-E432-2 A-C	S1600 Drift-E432	6-75	06/06/02	11.014	17.773	0.989	1.004	-1%	
S1600-E432-2 B-D	S1600 Drift-E432	6-75	06/06/02	7.412	16.550	0.812	0.689	18%	
S1600-E457-2 A-C	S1600 Drift-E457	6-76	06/06/02	10.038	16.117	0.848	0.721	18%	
S1600-E457-3 B-D	S1600 Drift-E457	6-76	06/06/02	4.822	16.543	0.871	0.741	18%	
S1600-E482-3 A-C	S1600 Drift-E482	6-77	06/06/02	0.582	16.958	0.952	0.732	30%	Floor trim, reinstalled 11/01.
S1600-E482-2 B-D	S1600 Drift-E482	6-77	06/06/02	8.969	19.380	1.225	0.913	34%	
S1600-E507-3 A-C	S1600 Drift-E507	6-78	06/06/02	0.851	17.639	1.397	0.944	48%	Floor trim, reinstalled 11/01.
S1600-E520-4 A-C	S1600 Drift-E520	6-79	06/06/02	1.009	35.137	1.679	1.751	-4%	Floor trim, reinstalled 11/01.
S1600-E586-4 A-C	S1600 Drift-E586	6-80	06/06/02	1.448	37.202	2.431	2.149	13%	Floor trim, reinstalled 11/01.
S1600-E586-5 B-D	S1600 Drift-E586	6-80	06/06/02	8.258	22.966	1.570	1.338	17%	Floor trim, reinstalled 11/01.
S1600-E660-3 A-C	S1600 Drift-E660	6-81	06/06/02	1.427	25.020	2.372	2.329	2%	Floor trim, reinstalled 11/01.
S1600-E790-3 A-C	S1600 Drift-E790	6-82	12/19/01	0.272	24.812	1.972	2.388	-17%	Floor trim, reinstalled 11/01.
S1600-E920-6 A-C	S1600 Drift-E920	6-83	12/19/01	12.838	43.531	2.224	1.965	13%	Not accessible.
S1600-E986-5 A-C	S1600 Drift-E986	6-84	11/14/01	18.593	36.139	2.131	2.087	2%	Not accessible.
S1950-E311-5 A-C	S1950 Drift-E311	6-85	06/06/02	1.371	21.600	1.152	N/A	N/A	Reinstalled 5/01.

[A] NA indicates insufficient data to calculate.

Table 6-1 (Continued)
Panel 1 Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent[A]	Comments
			Date	Inches					
S1950-E311-3 B-D	S1950 Drift-E311	6-85	06/06/02	4.780	17.823	1.084	1.061	2%	
S1950-E332-4 A-C	S1950 Drift-E332	6-86	06/06/02	5.497	24.156	1.587	1.475	8%	
S1950-E332-4 B-D	S1950 Drift-E332	6-86	06/06/02	1.860	19.847	1.181	1.174	1%	Reinstalled 12/00.
S1950-E357-7 A-C	S1950 Drift-E357	6-87	06/06/02	6.923	27.165	2.089	2.227	-6%	
S1950-E357-4 B-D	S1950 Drift-E357	6-87	06/06/02	2.019	20.519	1.280	1.310	-2%	Reinstalled 12/00.
S1950-E382-5 A-C	S1950 Drift-E382	6-88	06/06/02	8.620	27.305	2.374	2.485	-4%	
S1950-E382-3 B-D	S1950 Drift-E382	6-88	06/06/02	7.889	22.271	1.420	1.392	2%	
S1950-E407-4 A-G	S1950 Drift-E407	6-89	06/06/02	7.637	29.513	2.608	2.458	6%	
S1950-E407-3 B-F	S1950 Drift-E407	6-89	06/06/02	7.625	25.010	2.330	2.194	6%	
S1950-E407-3 H-L	S1950 Drift-E407	6-89	06/06/02	9.097	29.854	2.463	2.650	-7%	
S1950-E407-3 C-K	S1950 Drift-E407	6-90	06/06/02	7.632	20.609	1.423	1.362	4%	
S1950-E407-3 D-J	S1950 Drift-E407	6-90	06/06/02	8.337	22.514	1.547	1.465	6%	
S1950-E407-4 E-I	S1950 Drift-E407	6-90	06/06/02	3.092	21.080	1.272	1.266	0%	
S1950-E432-3 A-C	S1950 Drift-E432	6-91	06/06/02	8.047	29.868	2.385	2.176	10%	
S1950-E432-3 B-D	S1950 Drift-E432	6-91	06/06/02	7.882	22.283	1.456	1.419	3%	
S1950-E457-4 A-C	S1950 Drift-E457	6-92	06/06/02	6.055	30.858	2.158	2.136	1%	
S1950-E457-4 B-D	S1950 Drift-E457	6-92	06/06/02	7.425	22.717	1.318	1.341	-2%	
S1950-E482-7 A-C	S1950 Drift-E482	6-93	06/06/02	6.468	29.084	2.240	2.267	-1%	
S1950-E482-3 B-D	S1950 Drift-E482	6-93	06/06/02	8.359	24.628	1.401	1.344	4%	
S1950-E503-7 A-C	S1950 Drift-E503	6-94	06/06/02	0.900	36.895	3.795	3.055	24%	Floor trim, reinstalled 3/02.
S1950-E523-4 A-C	S1950 Drift-E523	6-95	06/28/02	8.832	43.410	2.831	3.214	-12%	
S1950-E586-9 A-C	S1950 Drift-E586	6-96	06/28/02	1.188	35.444	3.785	N/A	N/A	Floor trim, various installations.
S1950-E586-3 B-D	S1950 Drift-E586	6-97	06/28/02	10.676	22.778	1.945	2.151	-10%	Floor trim.
S1950-E660-4 A-C	S1950 Drift-E660	6-98	06/26/02	4.909	26.934	4.110	N/A	N/A	Floor trim, reinstalled 5/01.
S1950-E790-4 A-C	S1950 Drift-E790	6-99	05/20/02	4.411	27.955	3.925	N/A	N/A	Floor trim, reinstalled 5/01.
S1950-E920-6 A-C	S1950 Drift-E920	6-100	12/19/01	2.784	45.122	4.367	N/A	N/A	Not accessible.
S1950-E1050-4 A-C	S1950 Drift-E1050	6-101	10/31/01	3.071	28.591	4.325	4.523	-4%	Not accessible.
S1950-E1190-4 A-C	S1950 Drift-E1190	6-102	08/13/01	1.489	27.027	N/A	2.875	N/A	Not accessible.

[A] NA indicates insufficient data to calculate.

Table 6-1 (Continued)
Panel 1 Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent[A]	Comments
			Date	Inches					
E520-S1639-2 A-D	E520 Drift-S1639	6-103	12/19/01	0.217	18.314	N/A	1.638	N/A	Floor trim, mined out.
E520-S1639-2 B-C	E520 Drift-S1639	6-103	12/19/01	0.161	19.791	N/A	1.747	N/A	Floor trim, mined out.
E520-S1639-2 F-E	E520 Drift-S1639	6-103	12/19/01	0.152	13.139	N/A	1.172	N/A	Floor trim, mined out.
E520-S1681-3 A-E	E520 Drift-S1681	6-104	01/07/02	1.995	25.647	2.181	1.606	36%	Floor trim, mined out.
E520-S1681 B-D	E520 Drift-S1681	6-104	01/07/02	28.736	28.736	2.655	2.353	13%	Floor trim, mined out.
E520-S1681 C-G	E520 Drift-S1681	6-104	02/25/02	13.924	13.924	1.489	1.313	13%	Floor trim, mined out.
E520-S1681 H-F	E520 Drift-S1681	6-104	01/07/02	17.059	17.059	1.536	1.362	13%	Floor trim, mined out.
E520-S1717-4 A-E	E520 Drift-S1717	6-105	01/07/02	30.822	42.179	2.701	2.316	17%	Floor trim, mined out.
E520-S1717-2 B-D	E520 Drift-S1717	6-105	06/28/02	0.694	39.122	2.145	2.912	-26%	Floor trim, reinstalled 3/02.
E520-S1717-2 C-G	E520 Drift-S1717	6-105	06/28/02	0.690	24.348	1.959	1.565	25%	Floor trim, reinstalled 3/02.
E520-S1717-2 H-F	E520 Drift-S1717	6-105	06/28/02	0.690	21.182	2.084	1.565	33%	Floor trim, reinstalled 3/02.
E520-S1758 A-E	E520 Drift-S1758	6-106	01/07/02	31.267	31.267	2.722	2.614	4%	Floor trim, mined out.
E520-S1758 B-D	E520 Drift-S1758	6-106	01/07/02	33.059	33.059	2.976	2.755	8%	Floor trim, mined out.
E520-S1758 C-G	E520 Drift-S1758	6-106	02/25/02	14.866	14.866	1.495	1.421	5%	Floor trim, mined out.
E520-S1758 H-F	E520 Drift-S1758	6-106	01/07/02	27.262	27.262	2.233	2.229	0%	Floor trim, mined out.
E520-S1802-7 A-E	E520 Drift-S1802	6-107	06/28/02	0.983	54.266	3.047	2.730	12%	Floor trim, reinstalled 3/02.
E520-S1802-2 B-D	E520 Drift-S1802	6-107	06/28/02	0.867	37.528	2.721	3.210	-15%	Floor trim, reinstalled 3/02.
E520-S1802-2 H-F	E520 Drift-S1802	6-107	06/28/02	0.853	23.428	2.700	2.104	28%	Floor trim, reinstalled 3/02.
E520-S1802-3 C-G	E520 Drift-S1802	6-108	06/28/02	23.389	23.389	1.650	1.511	9%	Floor trim, mined out.
E520-S1841 A-E	E520 Drift-S1841	6-109	01/07/02	28.628	28.628	2.770	2.874	-4%	Floor trim, mined out.
E520-S1841 B-D	E520 Drift-S1841	6-109	01/07/02	26.730	26.730	2.651	2.721	-3%	Floor trim, mined out.
E520-S1841 C-G	E520 Drift-S1841	6-109	02/25/02	15.787	15.787	1.740	1.707	2%	Floor trim, mined out.
E520-S1841 H-F	E520 Drift-S1841	6-109	01/07/02	28.408	28.408	2.722	2.752	-1%	Floor trim, mined out.
E520-S1853 A-C	E520 Drift-S1853	6-110	01/07/02	30.657	30.657	3.179	3.220	-1%	Floor trim, mined out.
E520-S1853-2 B-D	E520 Drift-S1853	6-110	02/25/02	2.061	15.198	1.613	1.639	-2%	Floor trim, mined out.
E520-S1884-2 A-E	E520 Drift-S1884	6-111	06/28/02	0.976	26.937	3.087	2.930	5%	Floor trim, reinstalled 3/02.
E520-S1884-2 B-D	E520 Drift-S1884	6-111	06/10/02	0.835	31.337	3.152	3.515	-10%	Floor trim, reinstalled 3/02.
E520-S1884-4 C-G	E520 Drift-S1884	6-111	06/28/02	2.553	14.493	1.617	1.475	10%	Floor trim, reinstalled 12/00.

[A] NA indicates insufficient data to calculate.

Table 6-1 (Continued)
Panel 1 Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change	Comments
			Date	Inches	Inches	in/year	in/year	Percent	
E520-S1884-2 H-F	E520 Drift-S1884	6-111	06/28/02	0.568	18.200	1.762	1.871	-6%	Floor trim, reinstalled 3/02.
E660-S1775-6 A-C	E660 Drift-S1775	6-112	06/11/02	1.346	39.644	2.214	2.346	-6%	Floor trim, reinstalled 11/01.
E660-S1775-5 B-D	E660 Drift-S1775	6-112	06/11/02	22.063	25.595	1.790	1.616	11%	Floor trim.
E790-S1775-4 A-C	E790 Drift-S1775	6-113	04/19/02	1.770	44.653	2.848	2.646	8%	Floor trim, reinstalled 9/01.
E790-S1775-5 B-D	E790 Drift-S1775	6-113	04/19/02	17.010	27.970	2.126	1.954	9%	Floor trim.
E920-S1775-4 B-E	E920 Drift-S1775	6-114	01/02/02	28.182	33.240	1.953	1.949	0%	Not accessible.
E920-S1775-5 A-F	E920 Drift-S1775	6-114	01/02/02	35.563	39.450	2.658	2.648	0%	Not accessible.
E920-S1775-5 C-H	E920 Drift-S1775	6-115	01/02/02	11.608	25.148	1.886	1.814	4%	Not accessible.
E920-S1775-5 D-G	E920 Drift-S1775	6-115	01/02/02	11.079	24.347	1.747	1.710	2%	Not accessible.
E1050-S1775-4 A-F	E1050 Drift-S1775	6-116	10/31/01	32.601	38.229	2.908	2.663	9%	Not accessible.
E1050-S1775-5 B-E	E1050 Drift-S1775	6-116	10/31/01	0.734	41.607	2.663	2.637	1%	Not accessible.
E1050-S1775-5 C-H	E1050 Drift-S1775	6-117	10/31/01	9.887	26.635	1.881	1.827	3%	Not accessible.
E1050-S1775-5 D-G	E1050 Drift-S1775	6-117	10/31/01	9.875	26.312	1.939	1.860	4%	Not accessible.
E1190-S1775-4 A-F	E1190 Drift-S1775	6-118	08/22/01	35.575	38.482	3.044	2.636	15%	Not accessible.
E1190-S1775-3 B-E	E1190 Drift-S1775	6-118	08/22/01	34.517	38.861	2.881	2.652	9%	Not accessible.
E1190-S1775-4 C-H	E1190 Drift-S1775	6-119	08/22/01	7.858	22.609	1.684	1.415	19%	Not accessible.
E1190-S1775-4 D-G	E1190 Drift-S1775	6-119	08/22/01	7.951	22.922	1.786	1.416	26%	Not accessible.

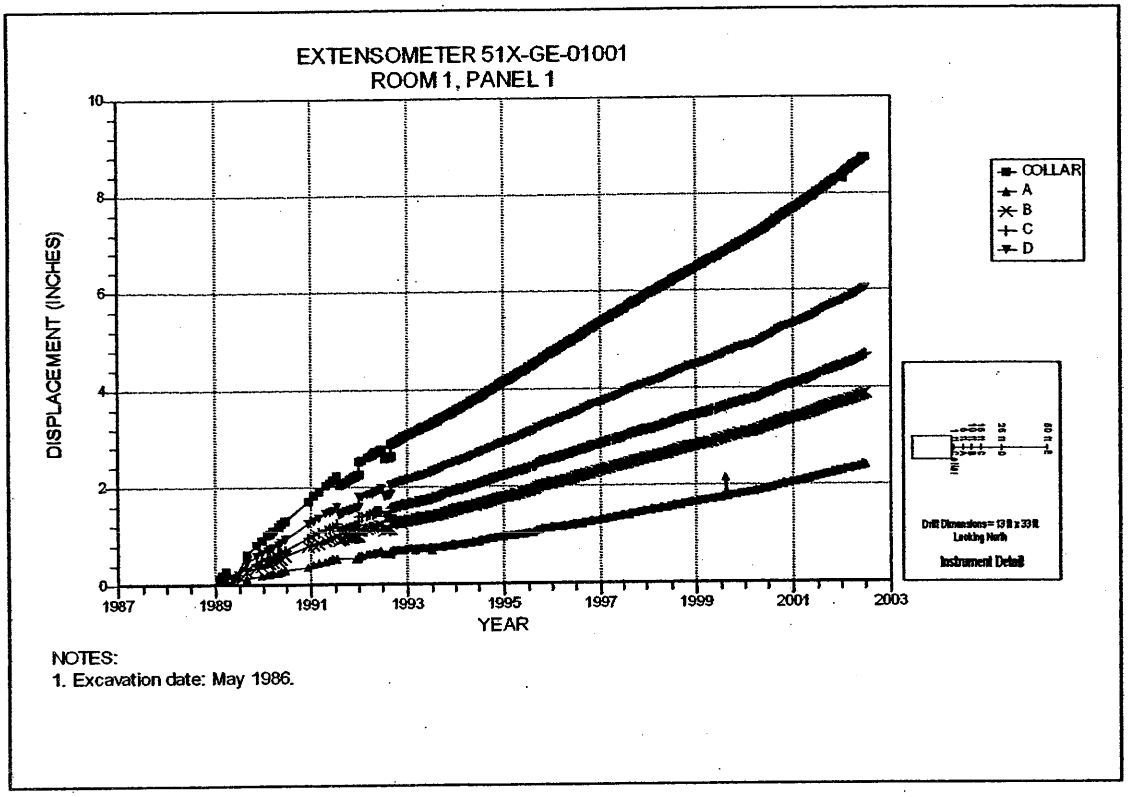


Figure 6-1 Extensometer 51X-GE-01001
Room 1, Panel 1 – Room Center – East Rib

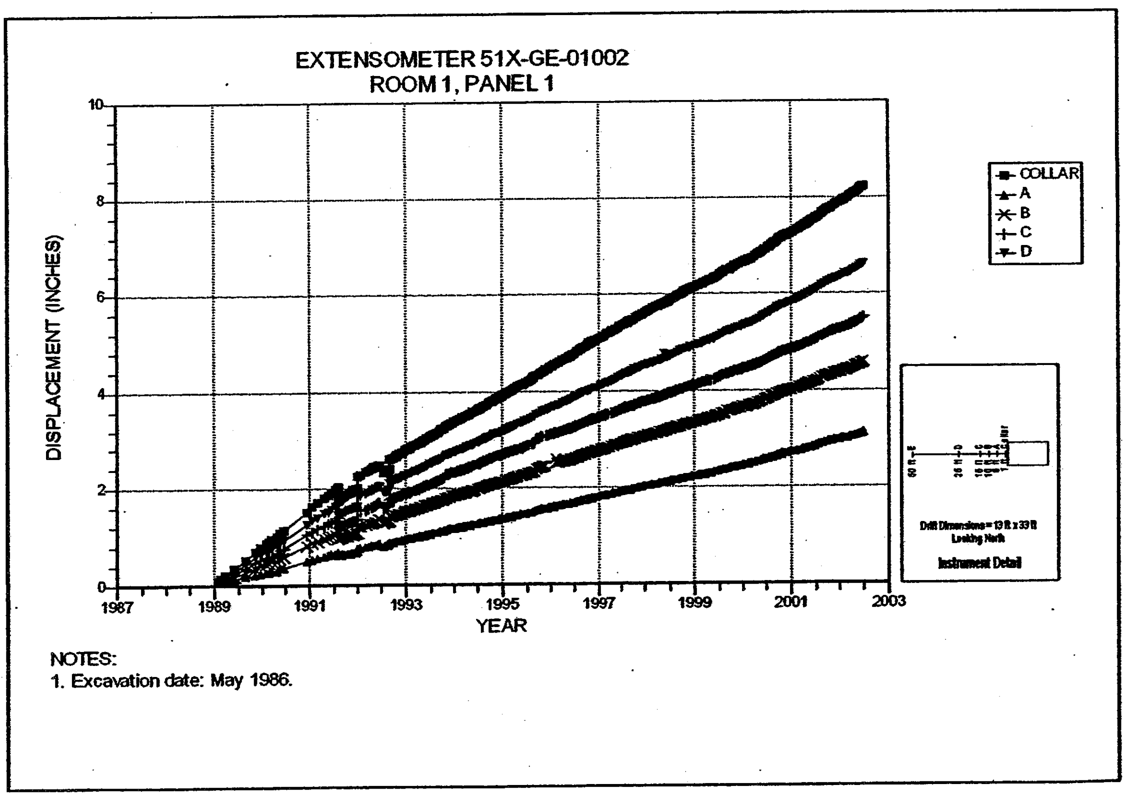
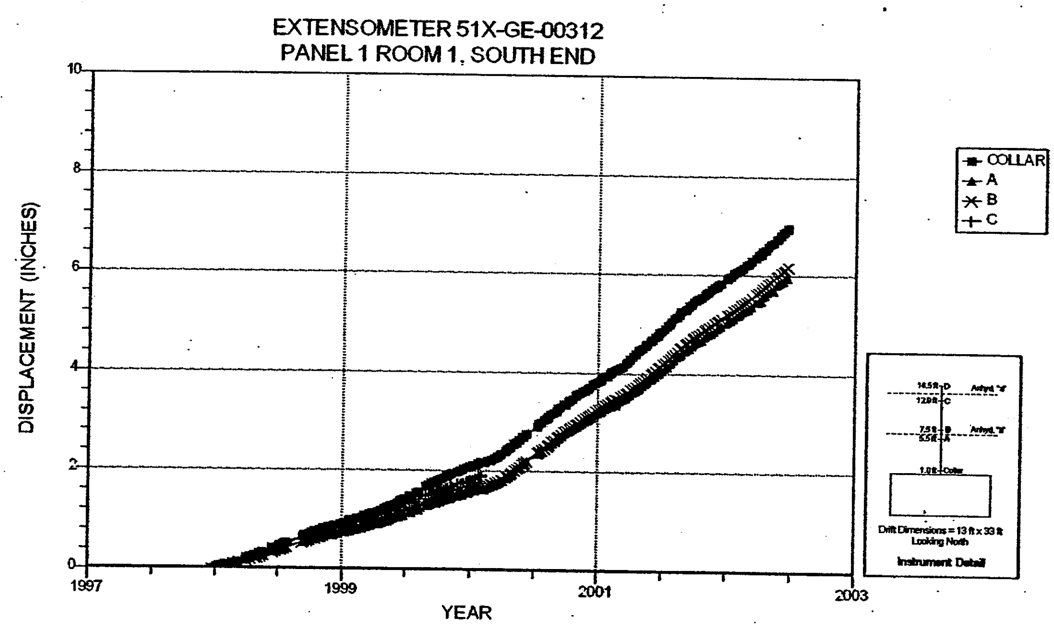
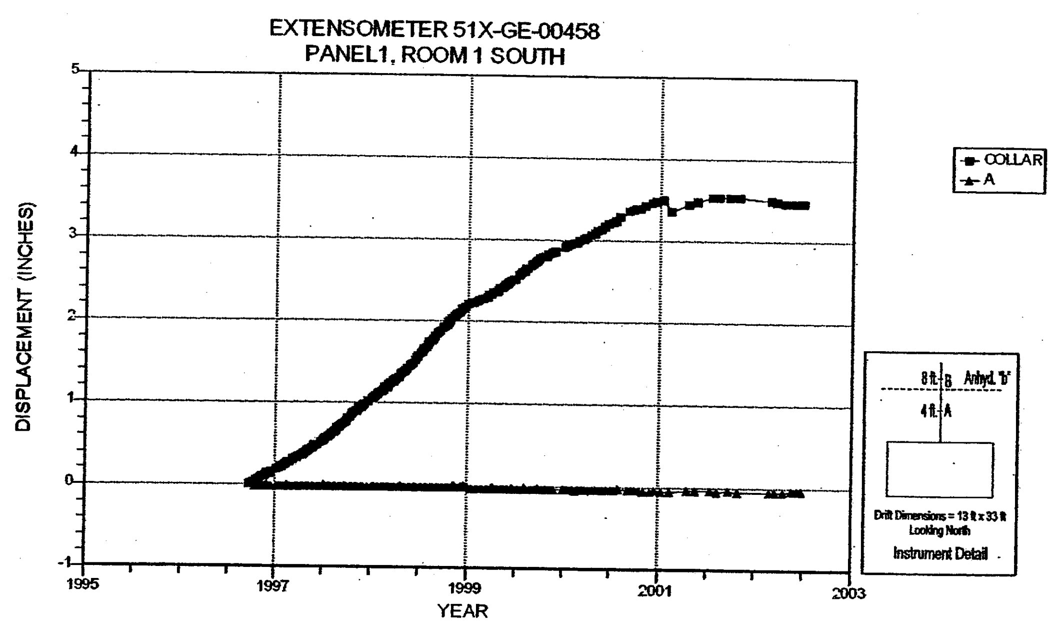


Figure 6-2 Extensometer 51X-GE-01002
Room 1, Panel 1 – Room Center – West Rib



NOTES:
1. Excavation date: May 1986.
2. Replaces 51X-GE-01017.
3. Anchor C defective after 2/2/00.

Figure 6-3 Extensometer 51X-GE-00312
Room 1, Panel 1 – South End – Roof



NOTES:

Figure 6-4 Extensometer 51X-GE-00458
Room 1, Panel 1 – South End – Roof

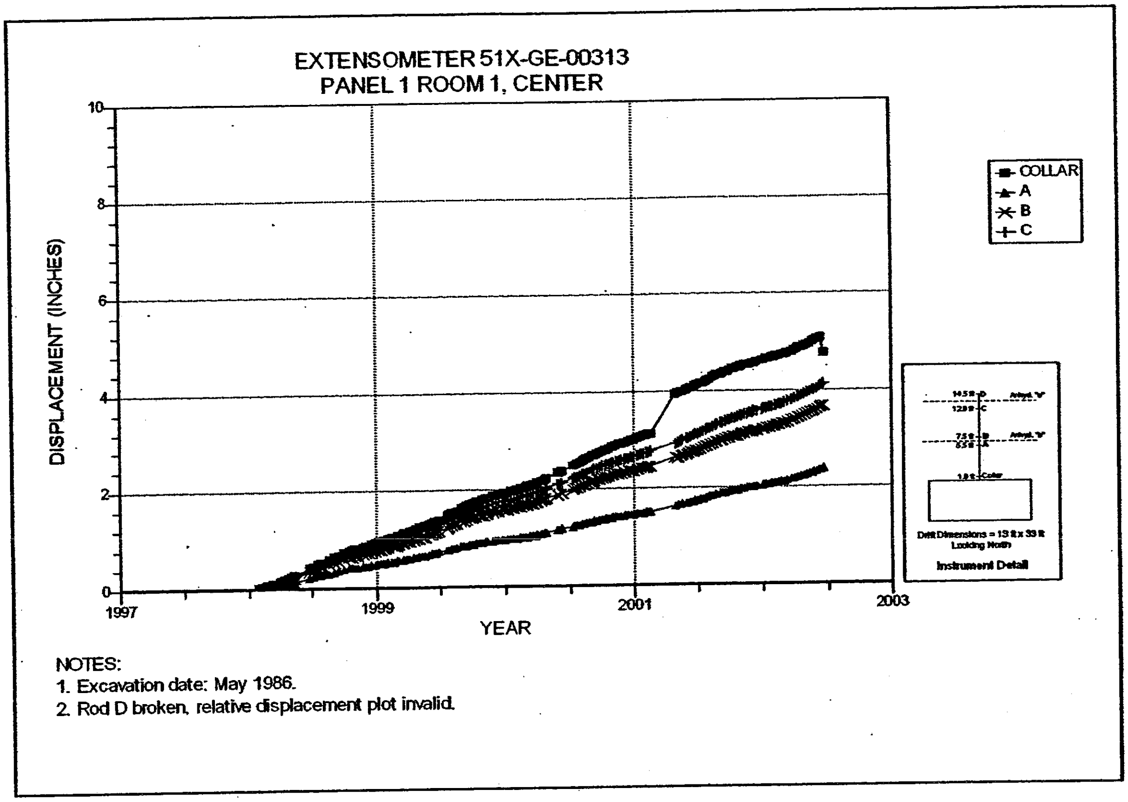


Figure 6-5 Extensometer 51X-GE-00313
Room 1, Panel 1 – Room Center – Roof

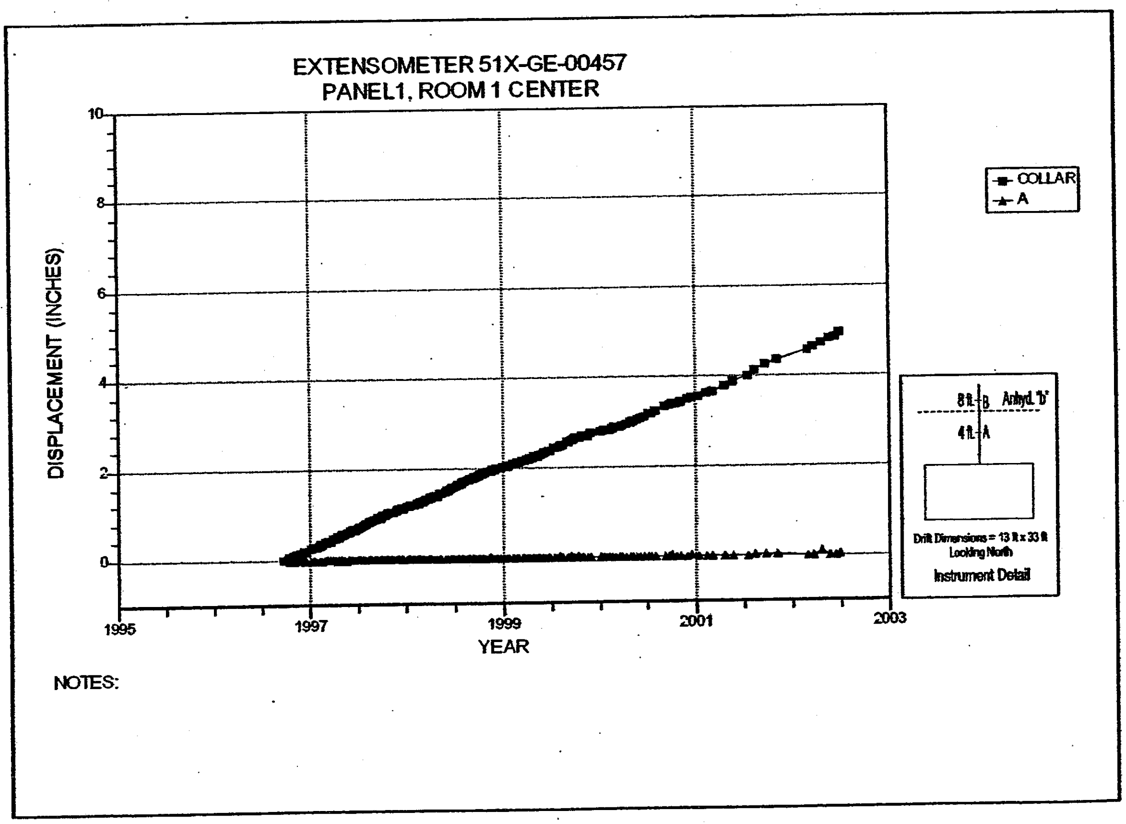
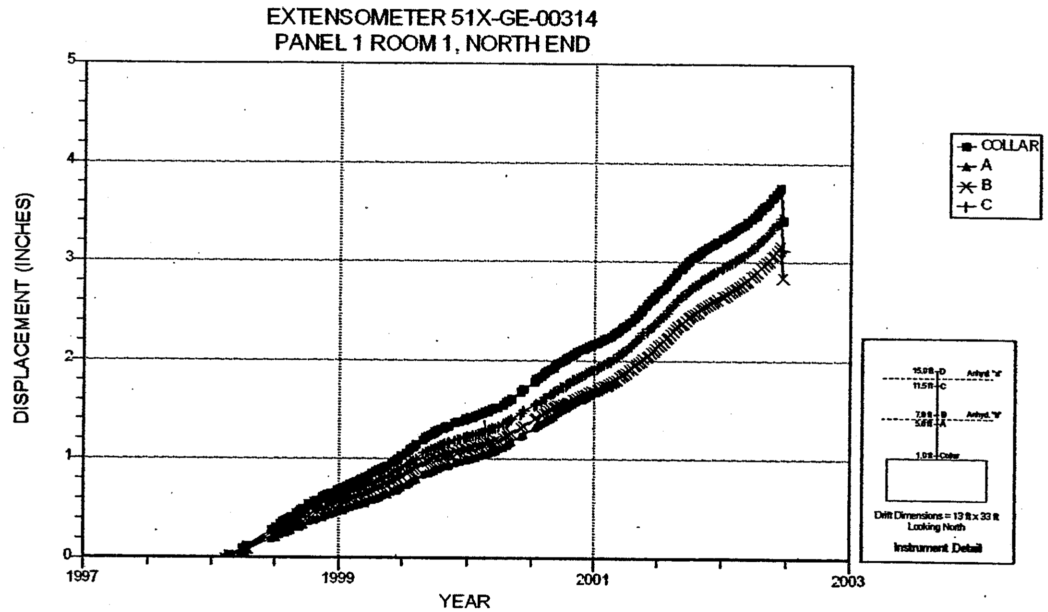
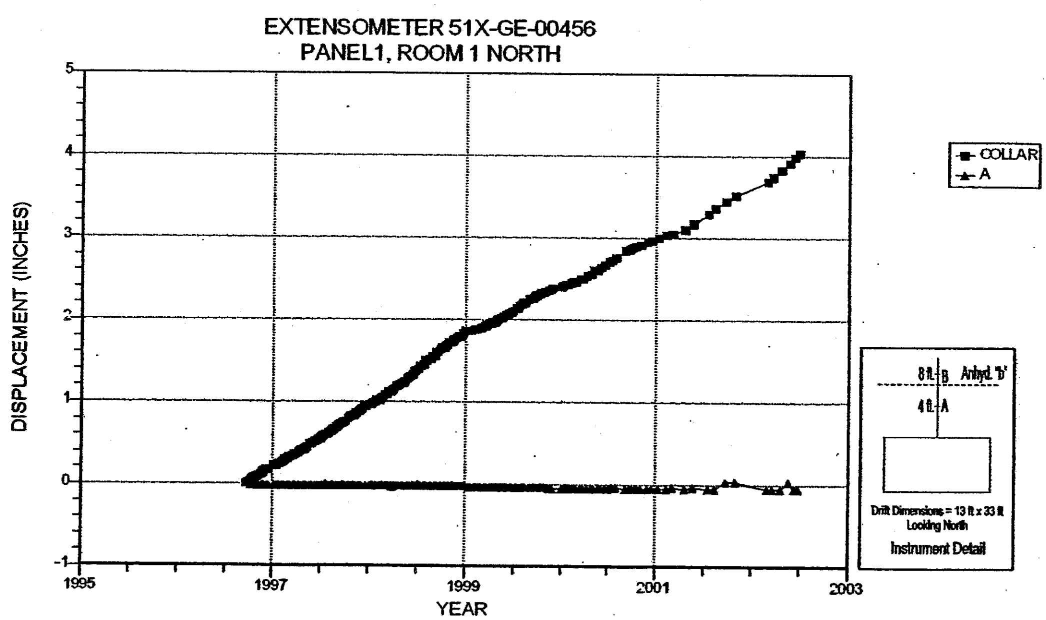


Figure 6-6 Extensometer 51X-GE-00457
Room 1, Panel 1 – Room Center – Roof



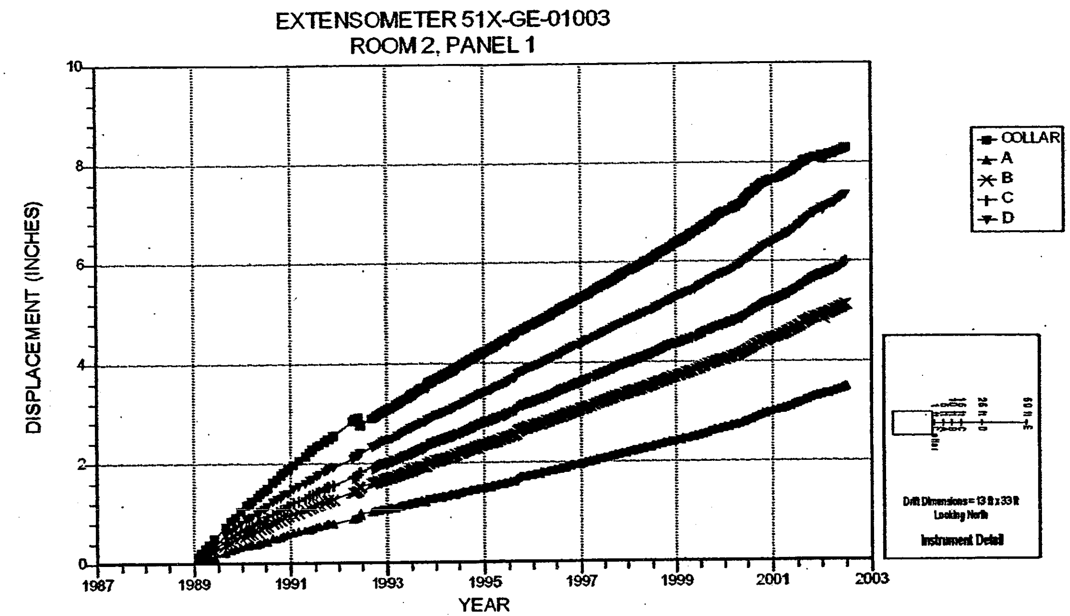
NOTES:
1. Excavation date: June 1986.
2. Replaces 51X-GE-01019.
3. Reference anchor bumped 06/02.

Figure 6-7 Extensometer 51X-GE-00314
Room 1, Panel 1 – North End – Roof



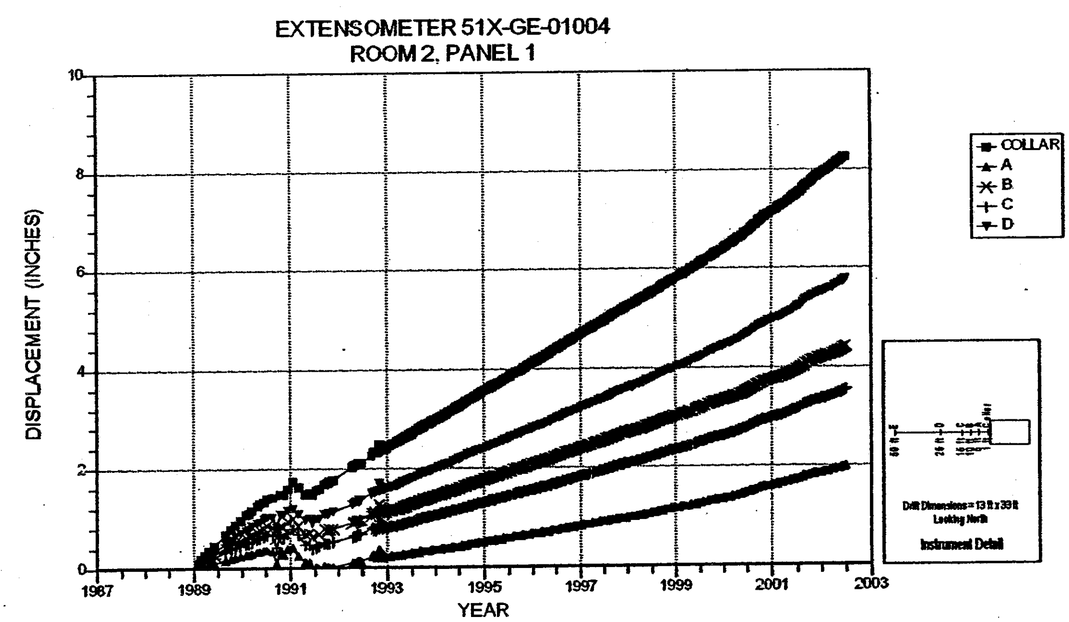
NOTES:

Figure 6-8 Extensometer 51X-GE-00456
Room 1, Panel 1 – North End – Roof



NOTES:
1. Excavation date: January 1987.

Figure 6-9 Extensometer 51X-GE-01003
Room 2, Panel 1 – Room Center – East Rib



NOTES:
1. Excavation date: January 1987.

Figure 6-10 Extensometer 51X-GE-01004
Room 2, Panel 1 – Room Center – West Rib

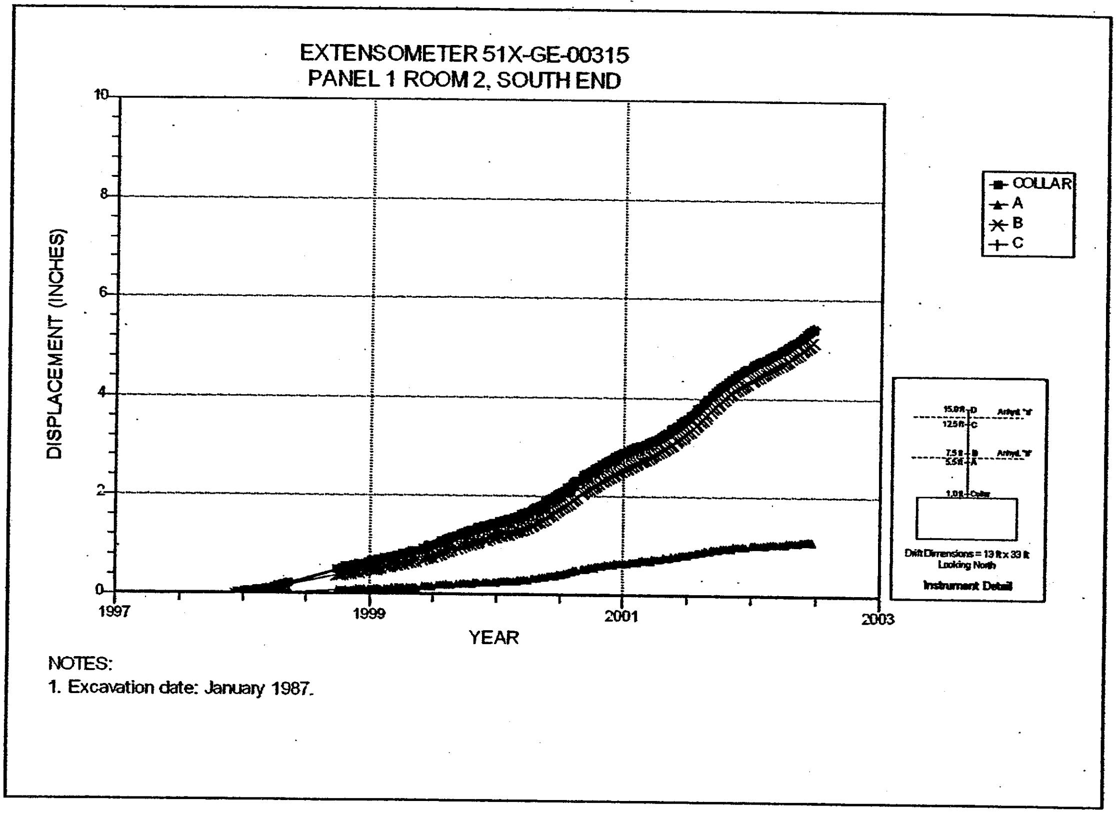


Figure 6-11 Extensometer 51X-GE-00315
Room 2, Panel 1 – South End –Roof

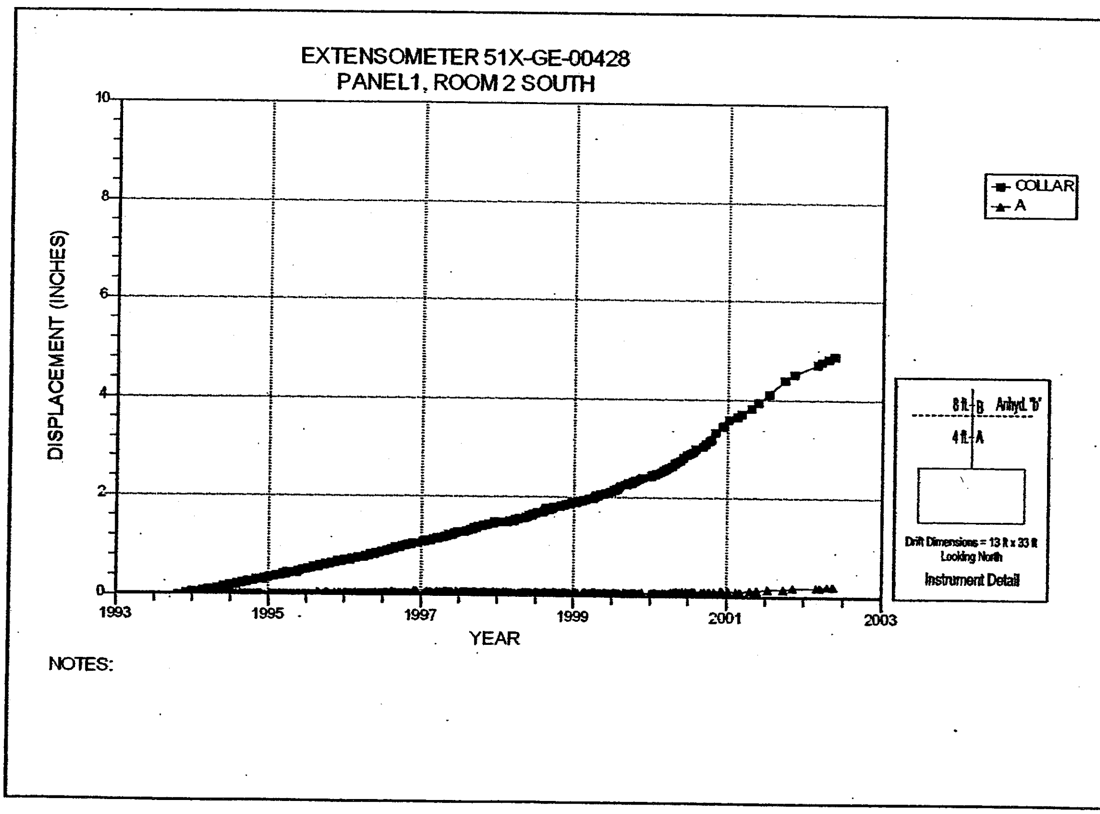
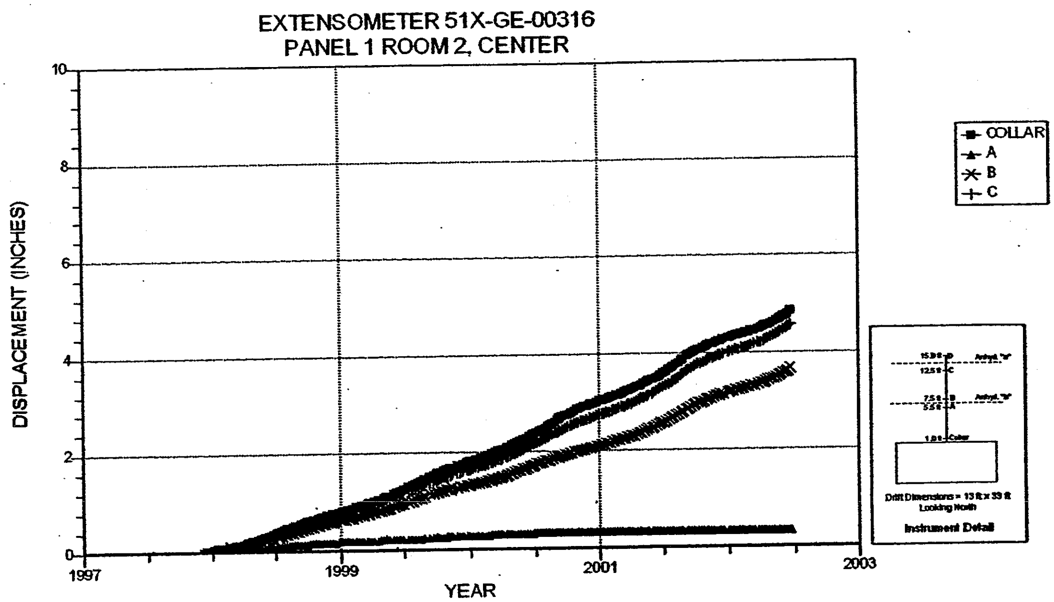
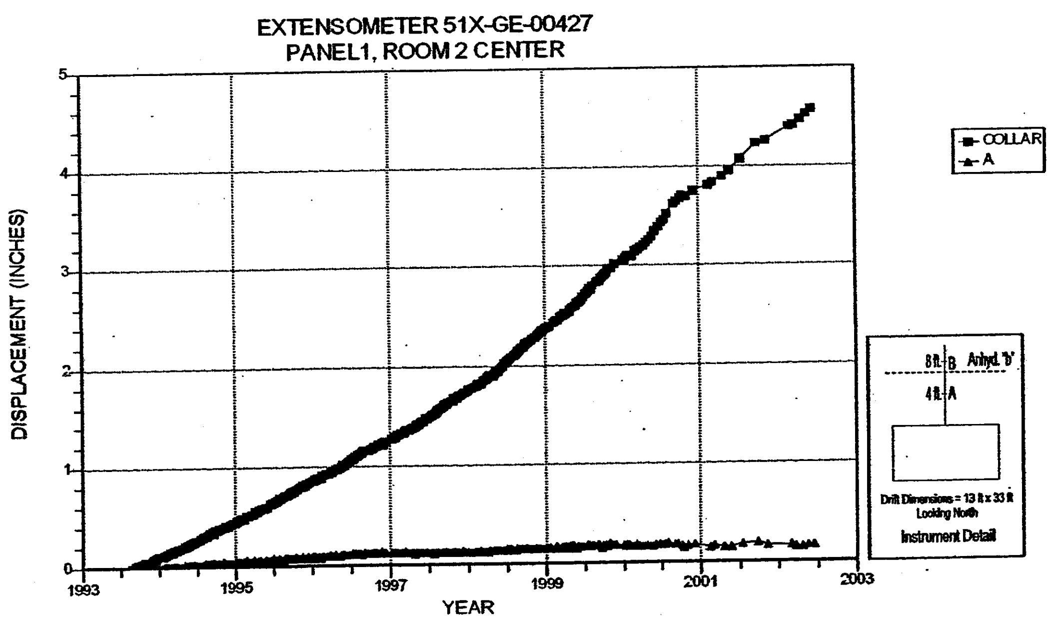


Figure 6-12 Extensometer 51X-GE-00428
Room 2, Panel 1 – South End – Roof



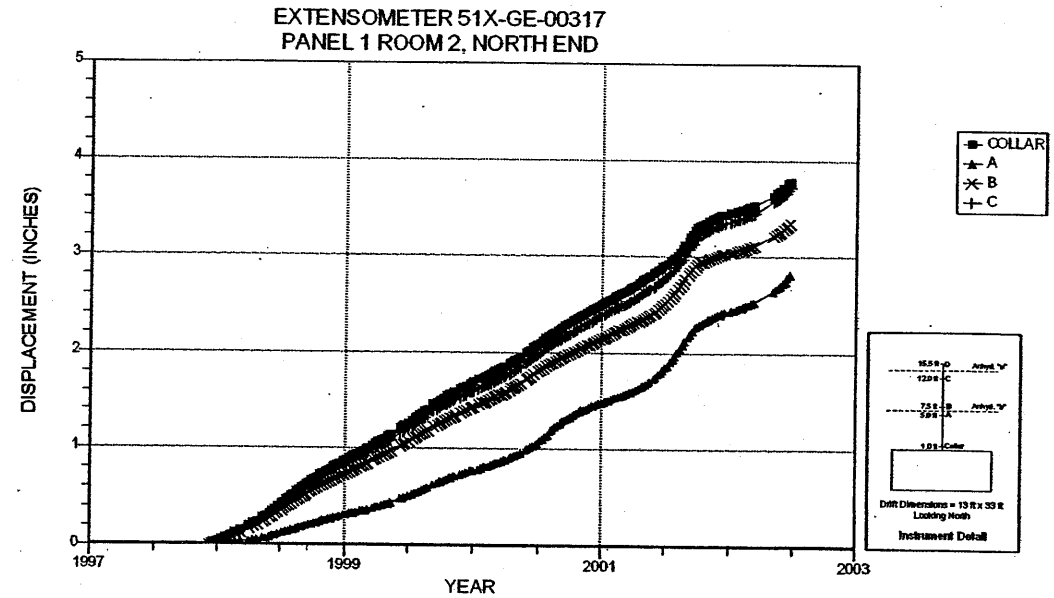
NOTES:
1. Excavation date: January 1987.

Figure 6-13 Extensometer 51X-GE-00316
Room 2, Panel 1 – Room Center – Roof



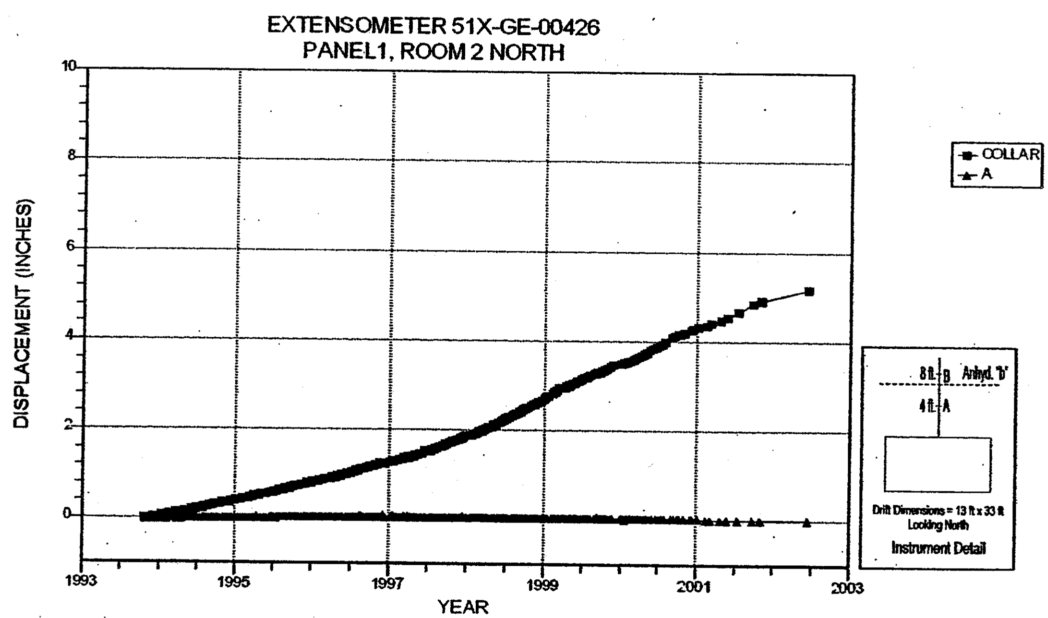
NOTES:

Figure 6-14 Extensometer 51X-GE-00427
Room 2, Panel 1 – Room Center – Roof



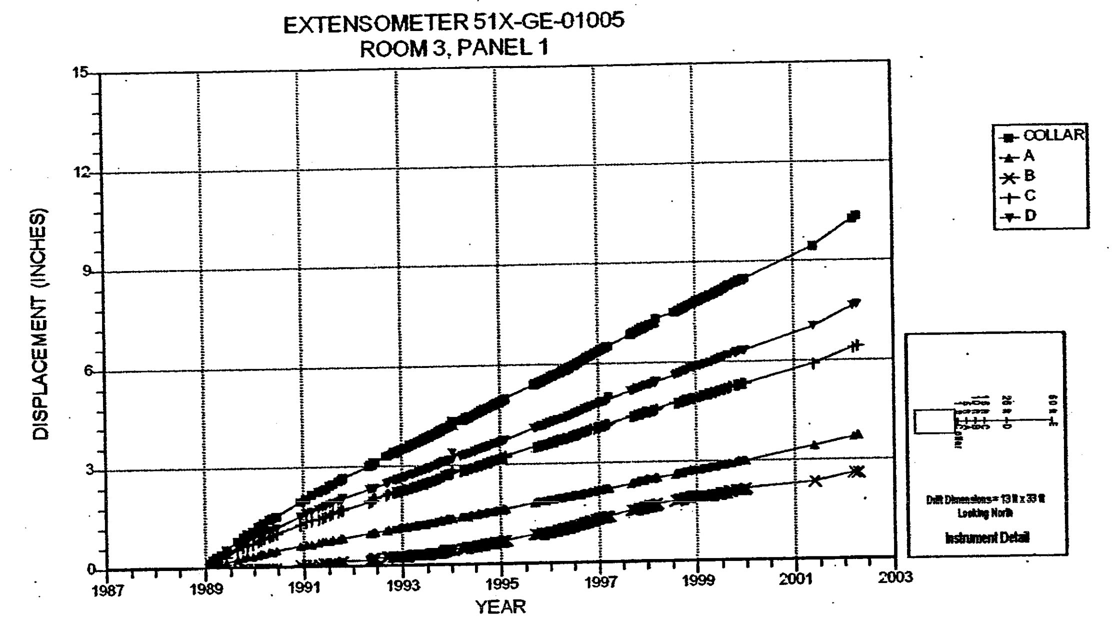
NOTES:
1. Excavation date: January 1987.

Figure 6-15 Extensometer 51X-GE-00317
Room 2, Panel 1 – North End – Roof



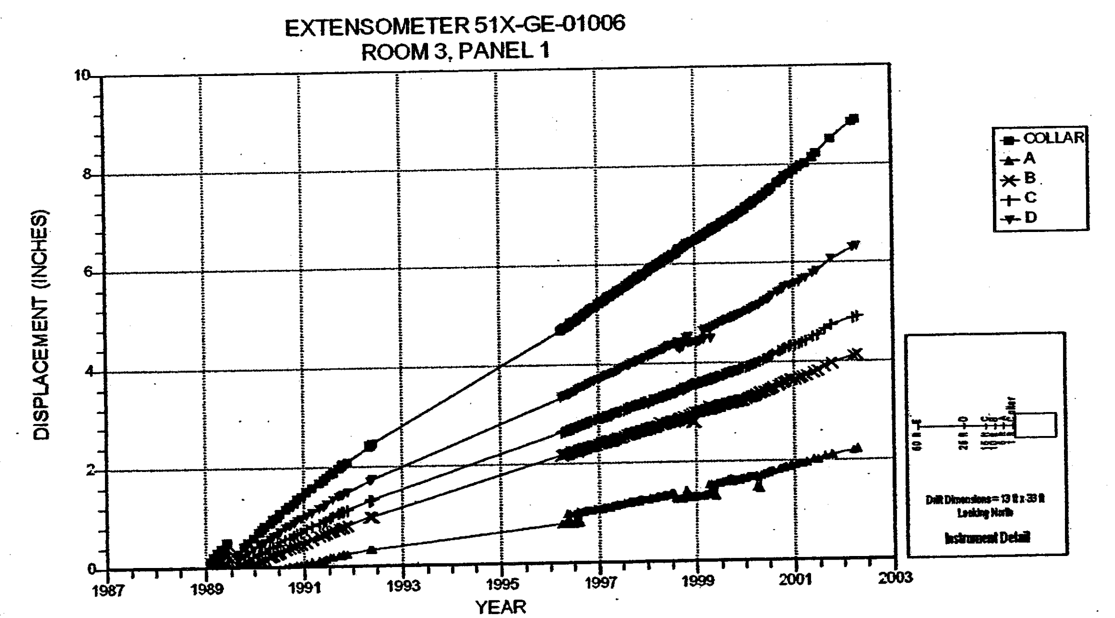
NOTES:

Figure 6-16 Extensometer 51X-GE-00426
Room 2, Panel 1 – North End – Roof



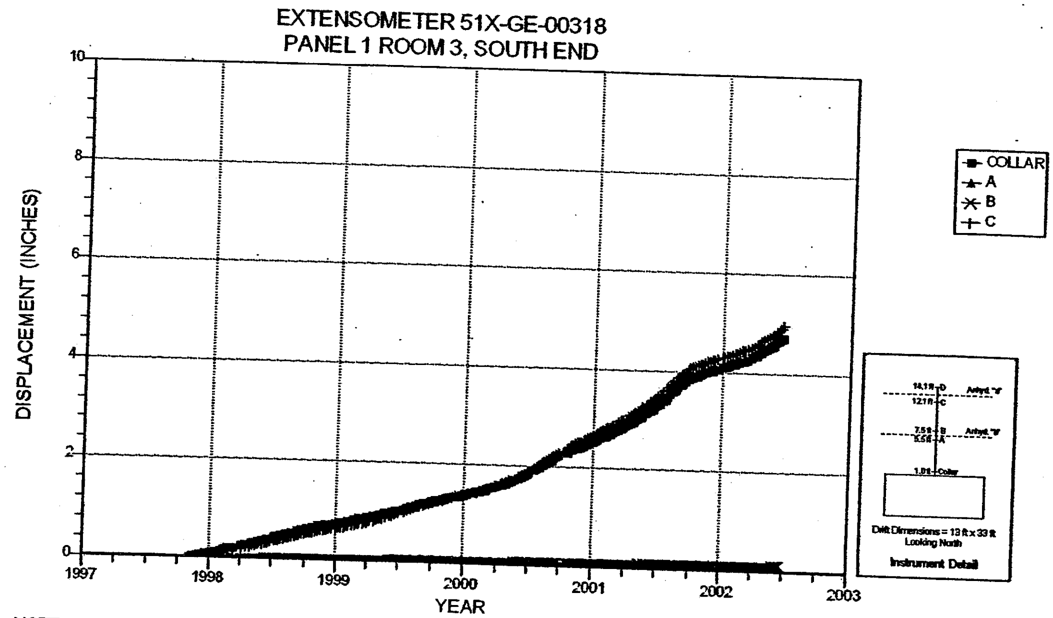
NOTES:
1. Excavation date: February 1987

Figure 6-17 Extensometer 51X-GE-01005
Room 3, Panel 1 – Room Center – East Rib



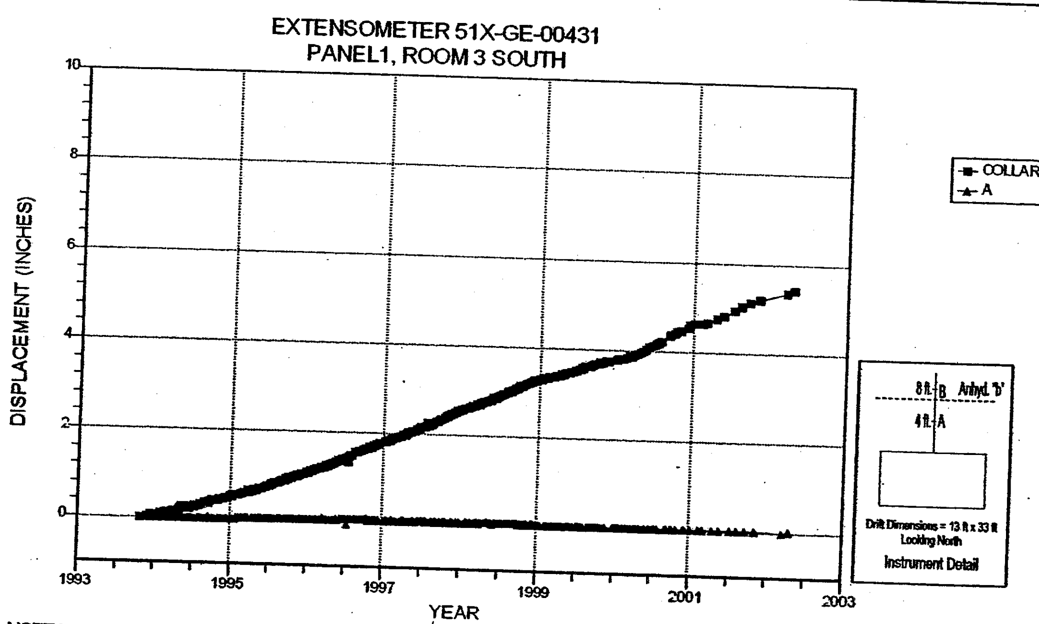
NOTES:
1. Excavation date: February 1987.

Figure 6-18 Extensometer 51X-GE-01006
Room 3, Panel 1 – Room Center – West Rib



NOTES:
1. Excavation date: February 1987.

Figure 6-19 Extensometer 51X-GE-00318
Room 3, Panel 1 – South End – Roof



NOTES:

Figure 6-20 Extensometer 51X-GE-00431
Room 3, Panel 1 – South End – Roof

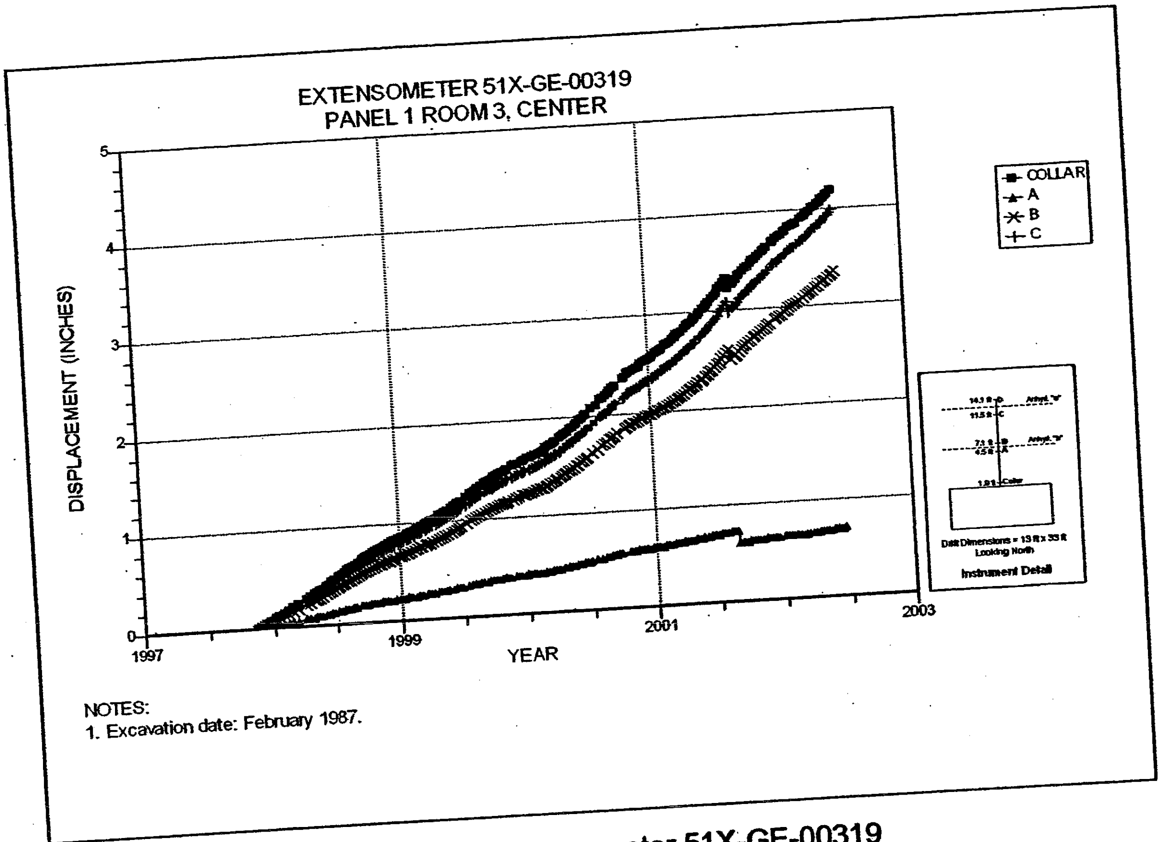


Figure 6-21 Extensometer 51X-GE-00319
Room 3, Panel 1 – Room Center – Roof

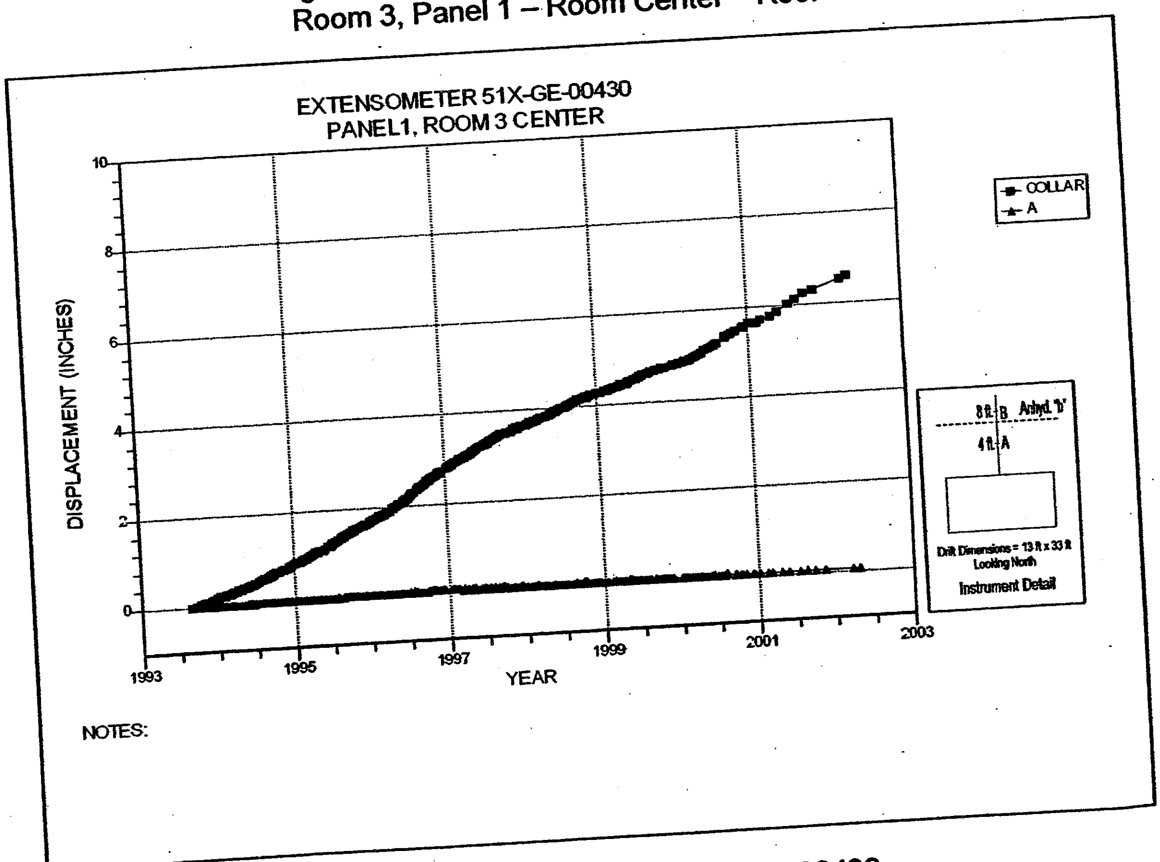


Figure 6-22 Extensometer 51X-GE-00430
Room 3, Panel 1 – Room Center – Roof

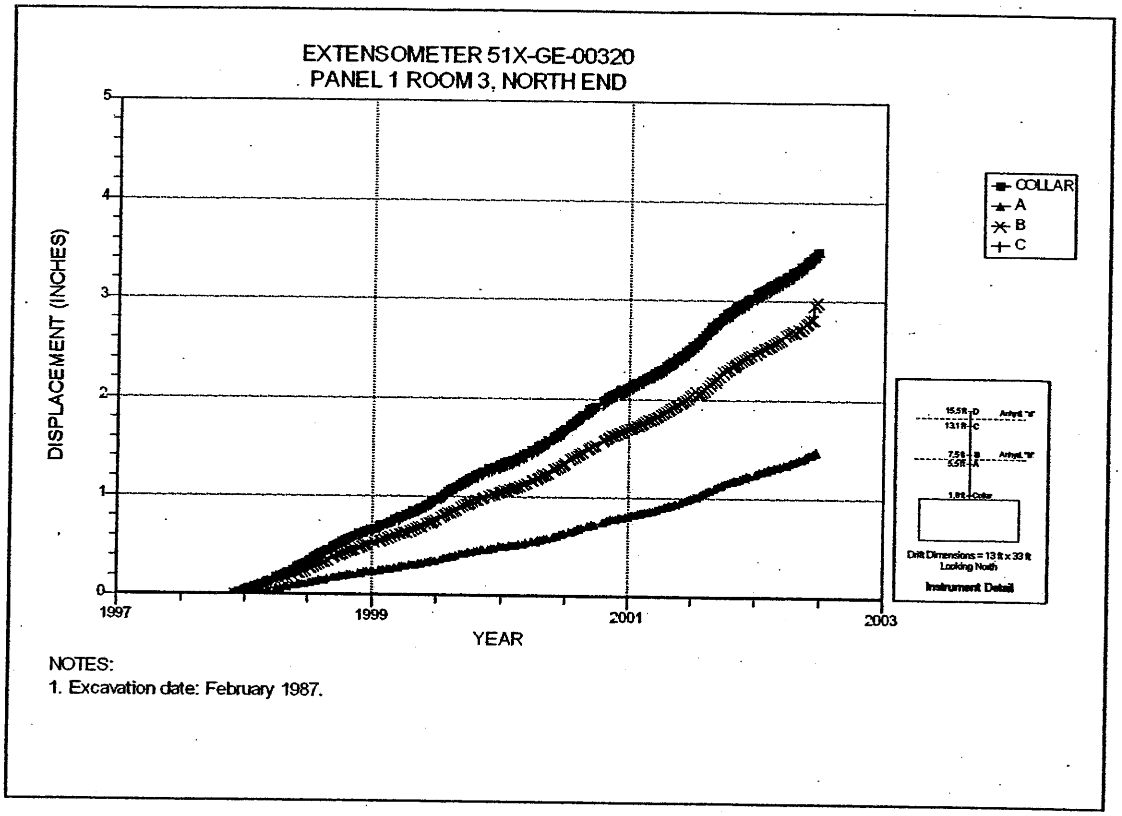


Figure 6-23 Extensometer 51X-GE-00320
Room 3, Panel 1 – North End – Roof

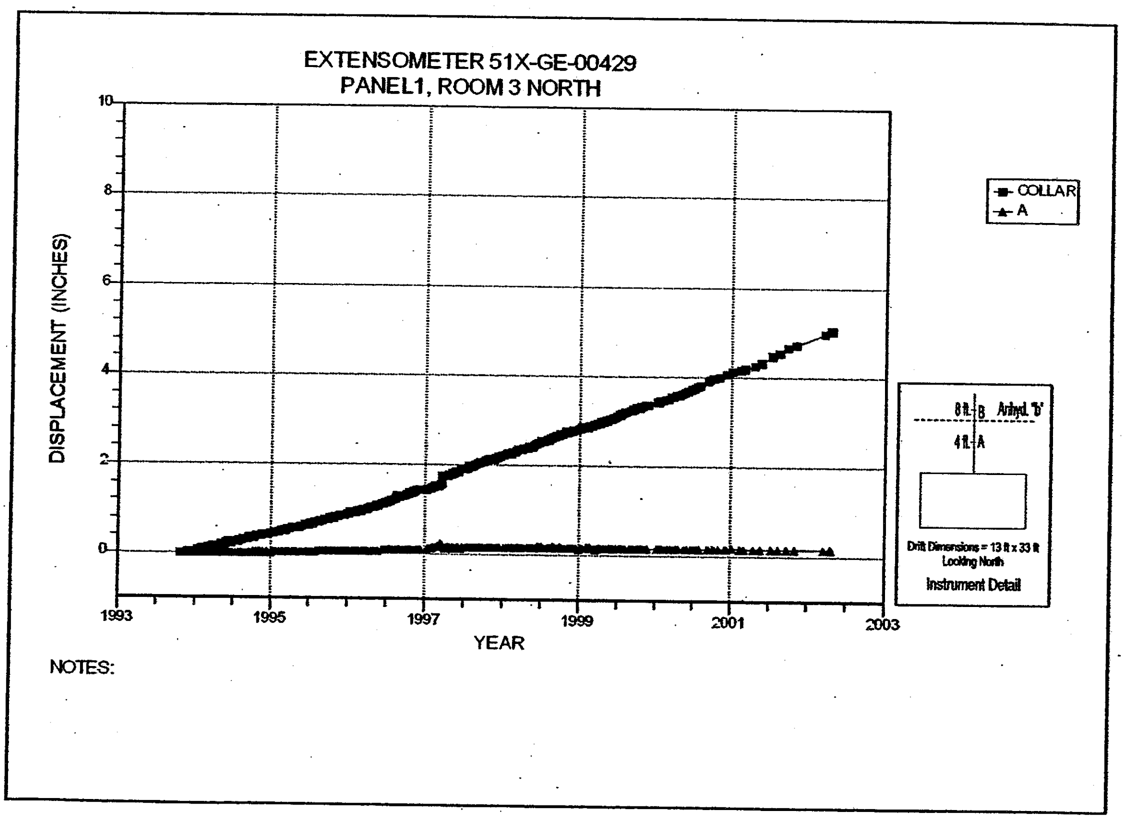
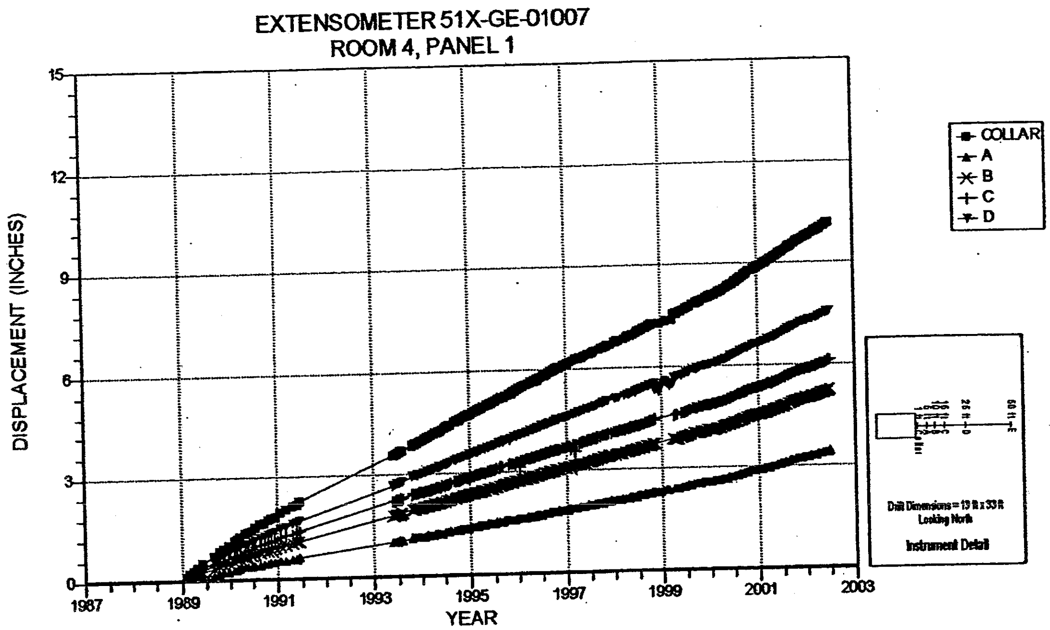
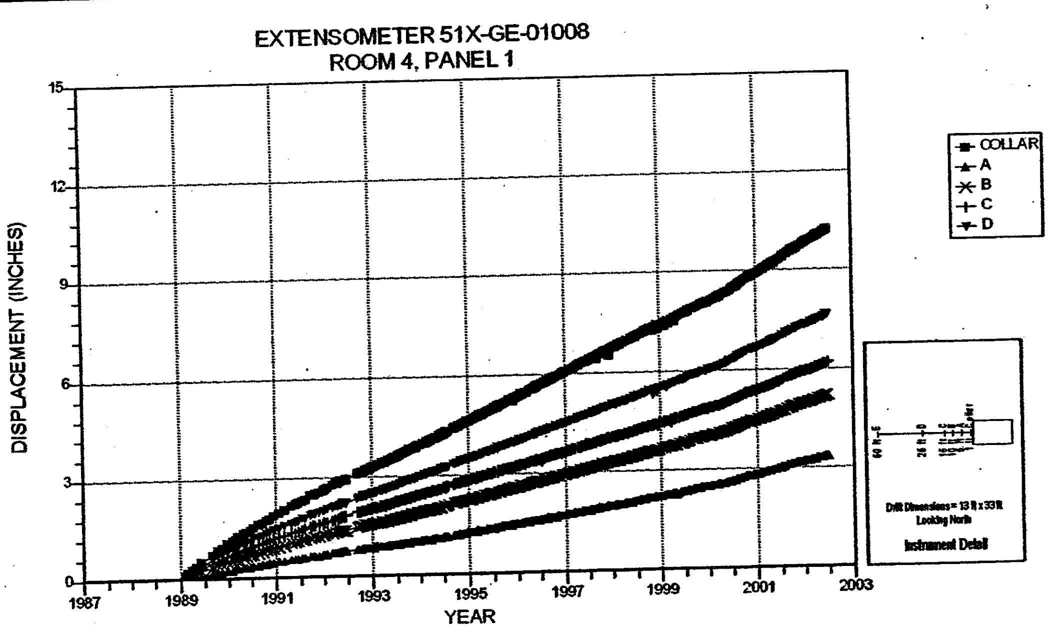


Figure 6-24 Extensometer 51X-GE-00429
Room 3, Panel 1 – North End – Roof



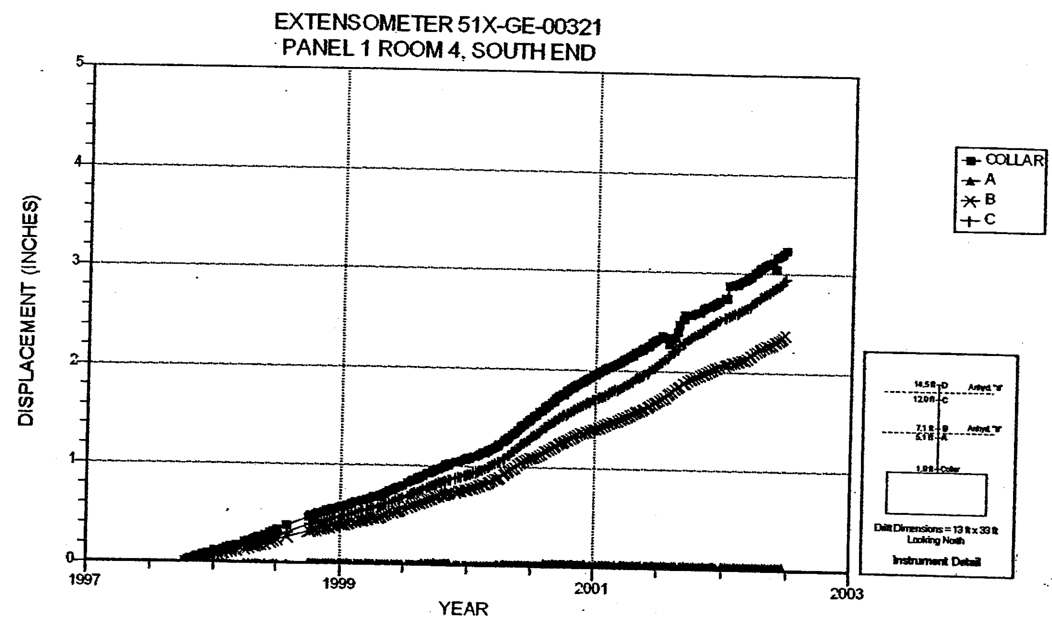
NOTES:
1. Excavation date: February 1988.

Figure 6-25 Extensometer 51X-GE-01007
Room 4, Panel 1 – Room Center – East Rib



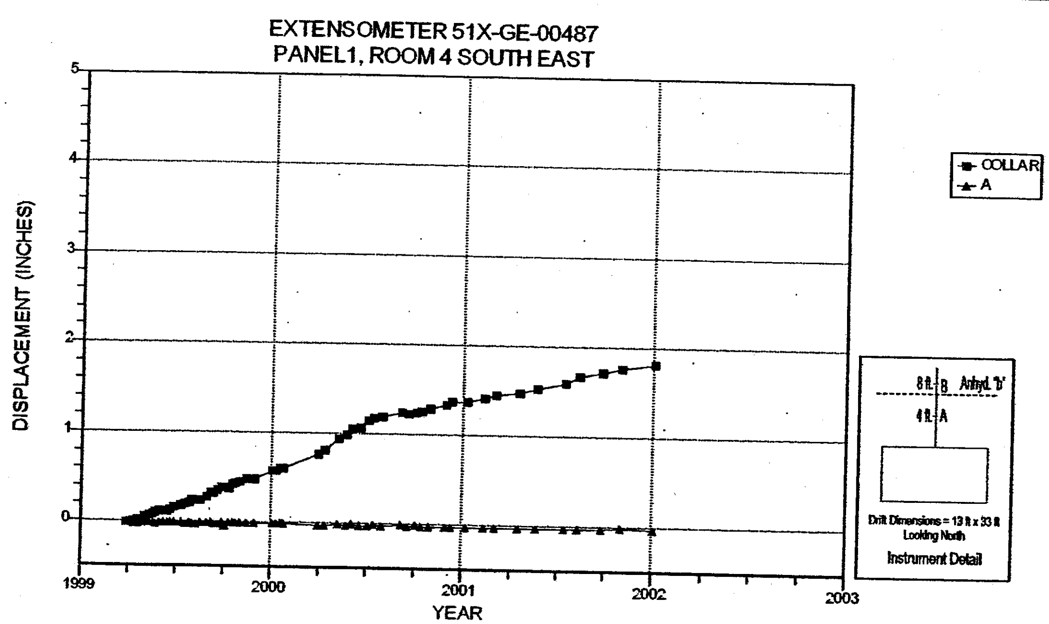
NOTES:
1. Excavation date: February 1988.

Figure 6-26 Extensometer 51X-GE-01008
Room 4, Panel 1 – Room Center – West Rib



NOTES:
1. Excavation date: February 1988.

Figure 6-27 Extensometer 51X-GE-00321
Room 4, Panel 1 – South End – Roof



NOTES:

Figure 6-28 Extensometer 51X-GE-00487
Room 4, Panel 1 – South End – East Roof

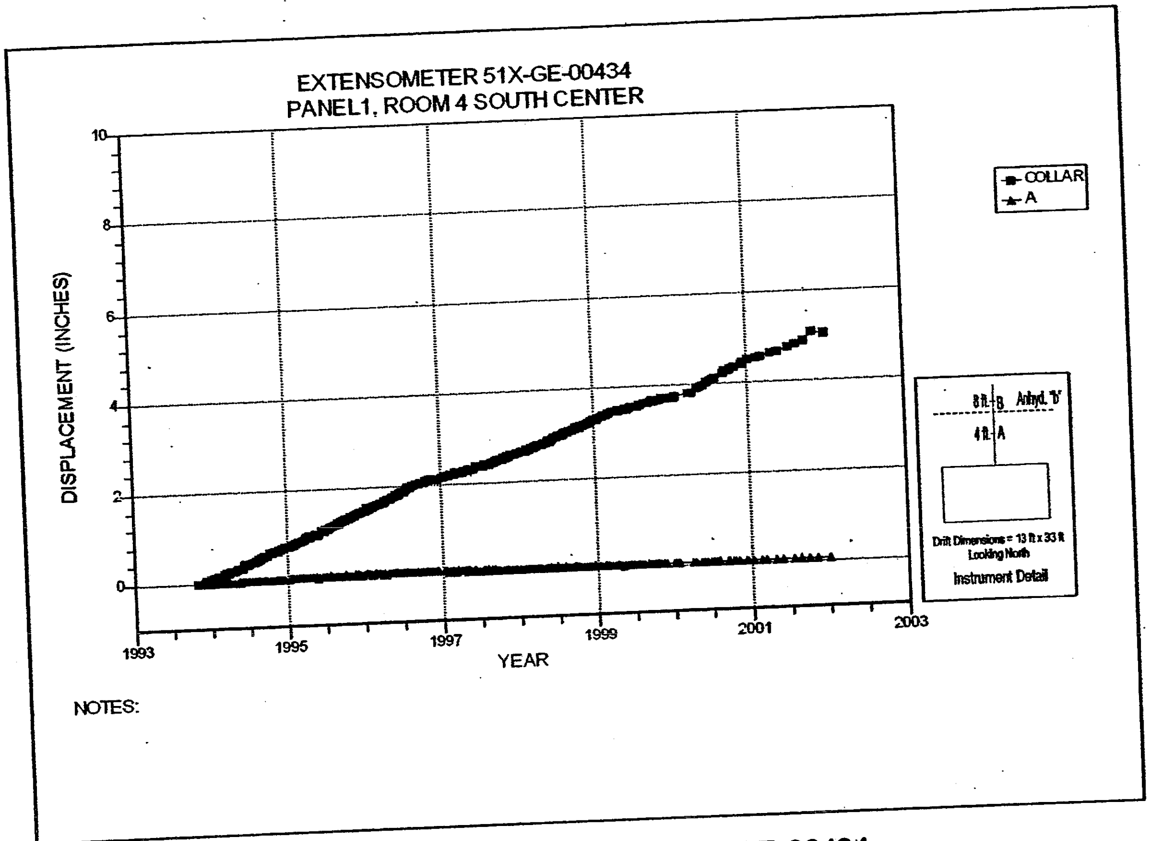


Figure 6-29 Extensometer 51X-GE-00434
Room 4, Panel 1 – South End – Center Roof

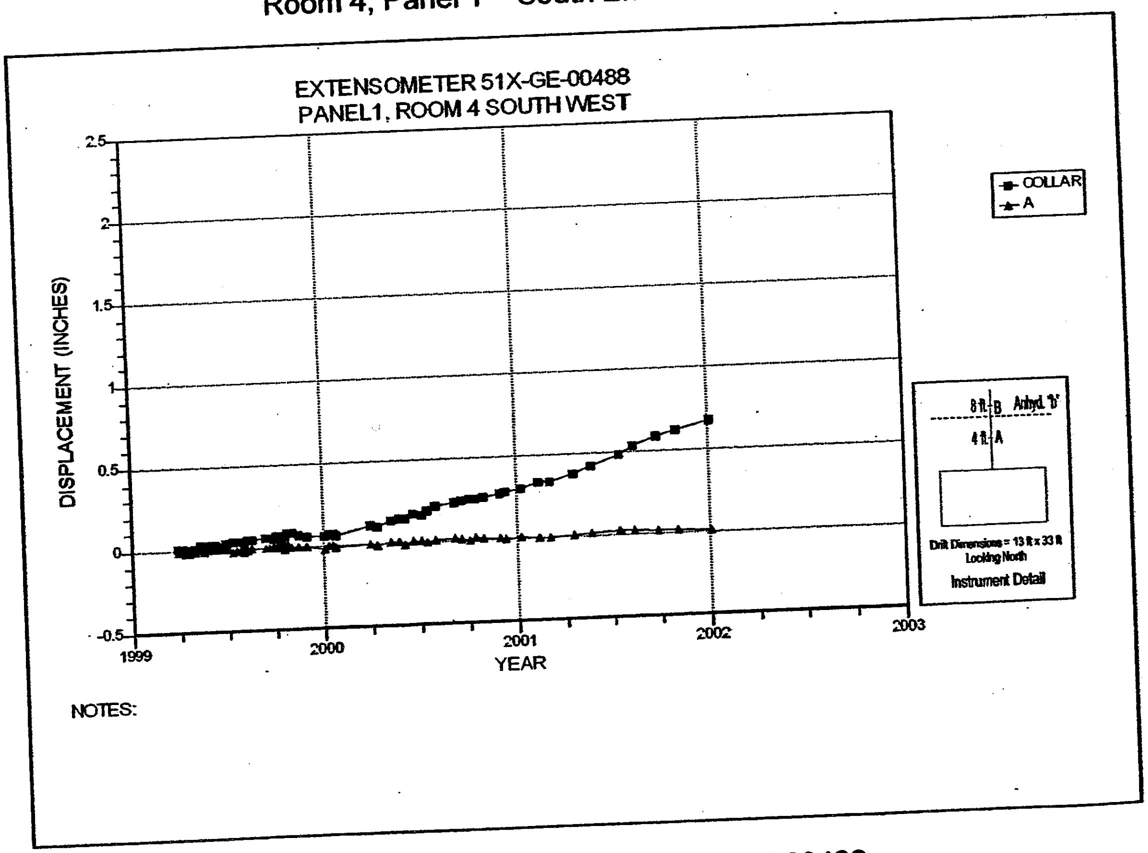


Figure 6-30 Extensometer 51X-GE-00488
Room 4, Panel 1 – South End – West Roof

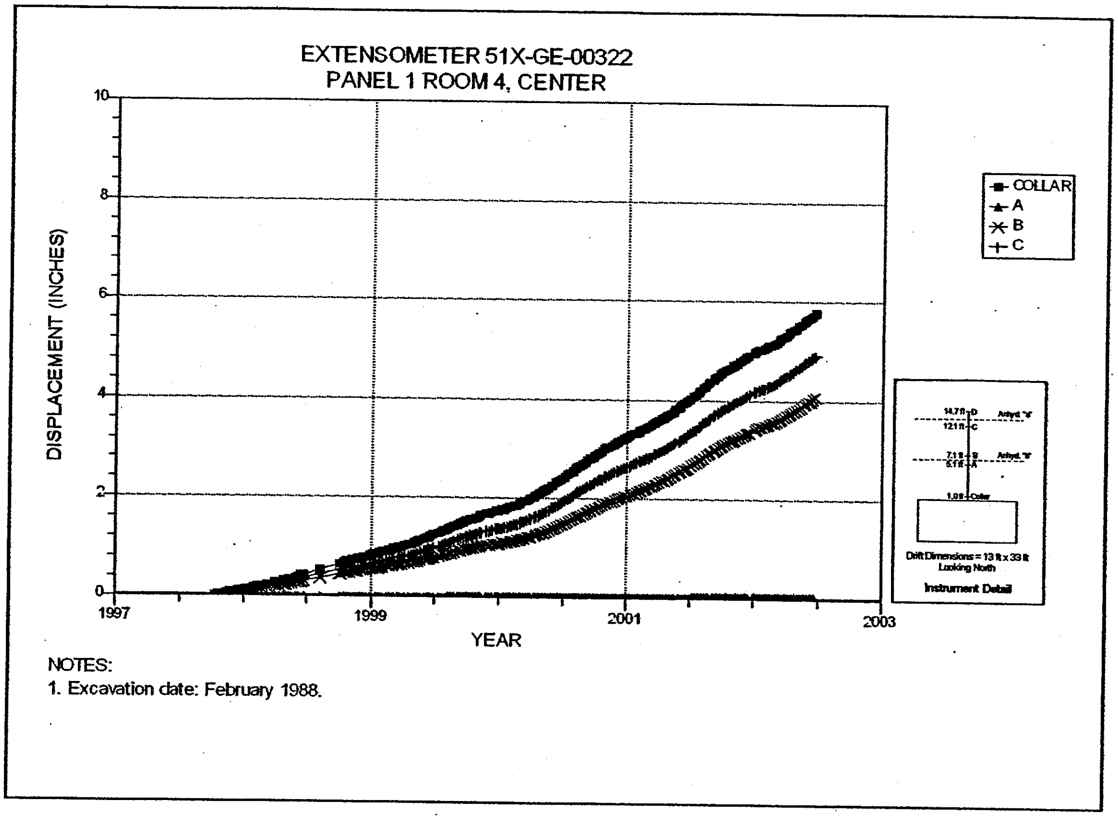


Figure 6-31 Extensometer 51X-GE-00322
Room 4, Panel 1 – Room Center – Roof

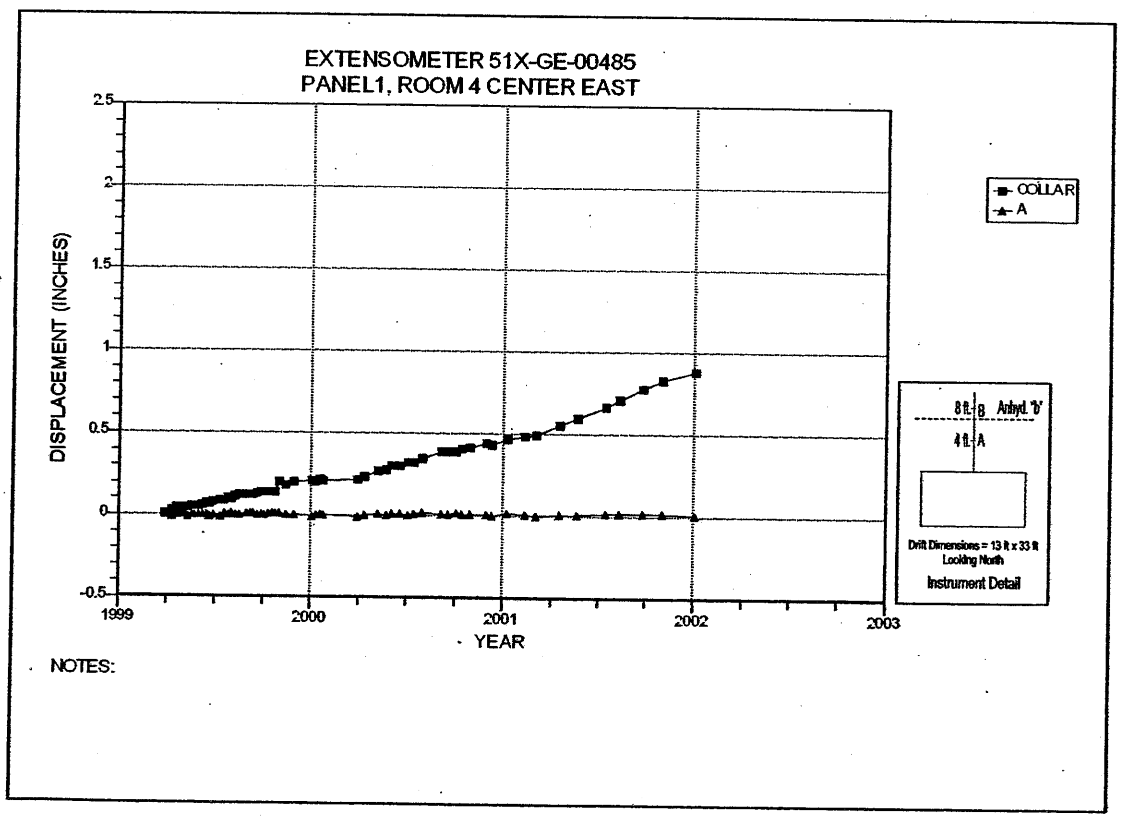


Figure 6-32 Extensometer 51X-GE-00485
Room 4, Panel 1 – Room Center – East Roof

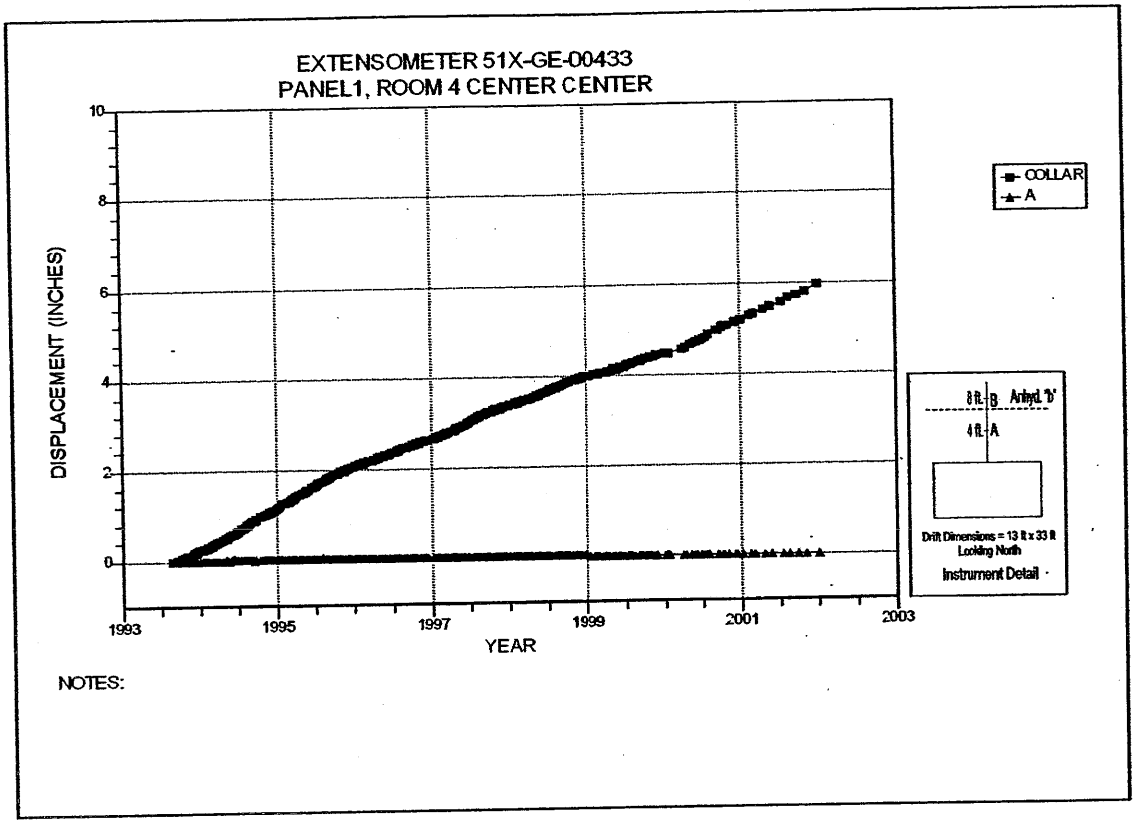


Figure 6-33 Extensometer 51X-GE-00433
Room 4, Panel 1 – Room Center – Center Roof

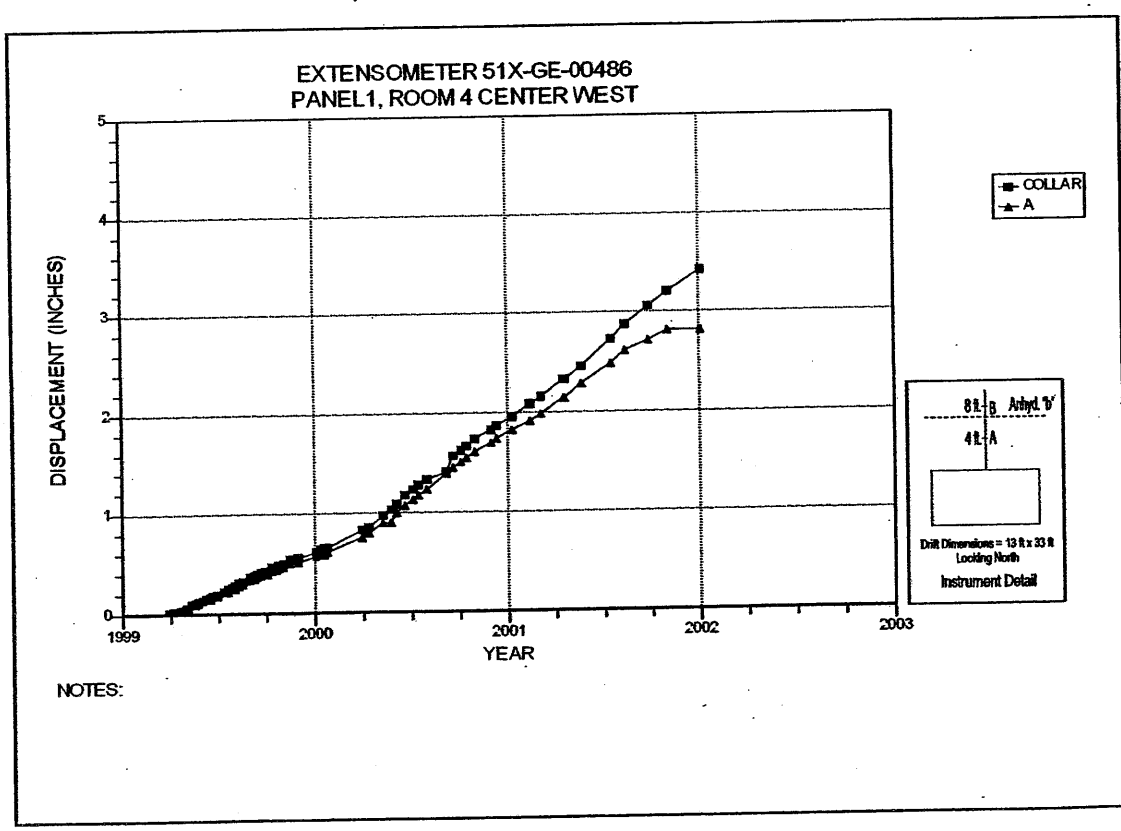
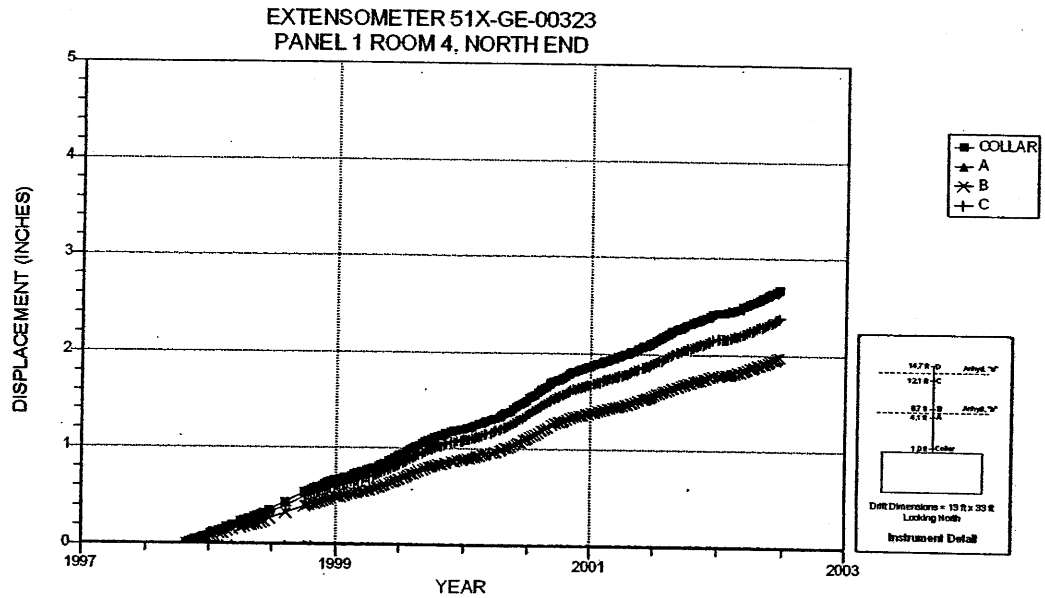
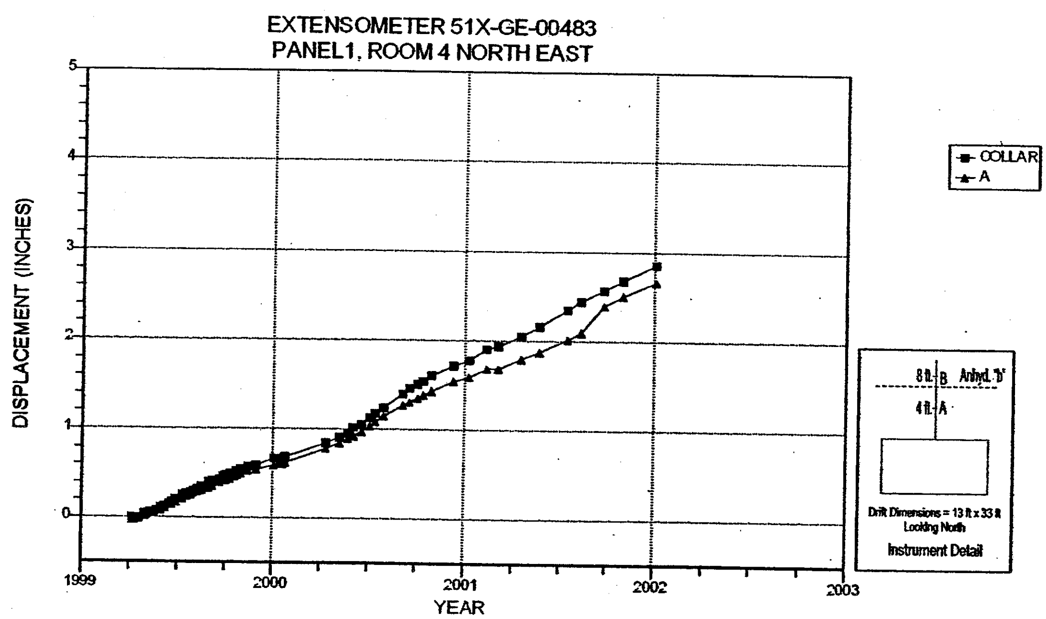


Figure 6-34 Extensometer 51X-GE-00486
Room 4, Panel 1 – Room Center – West Roof



NOTES:
1. Excavation date: February 1988.

Figure 6-35 Extensometer 51X-GE-00323
Room 4, Panel 1 – North End – Roof



NOTES:

Figure 6-36 Extensometer 51X-GE-00483
Room 4, Panel 1 – North End – East Roof

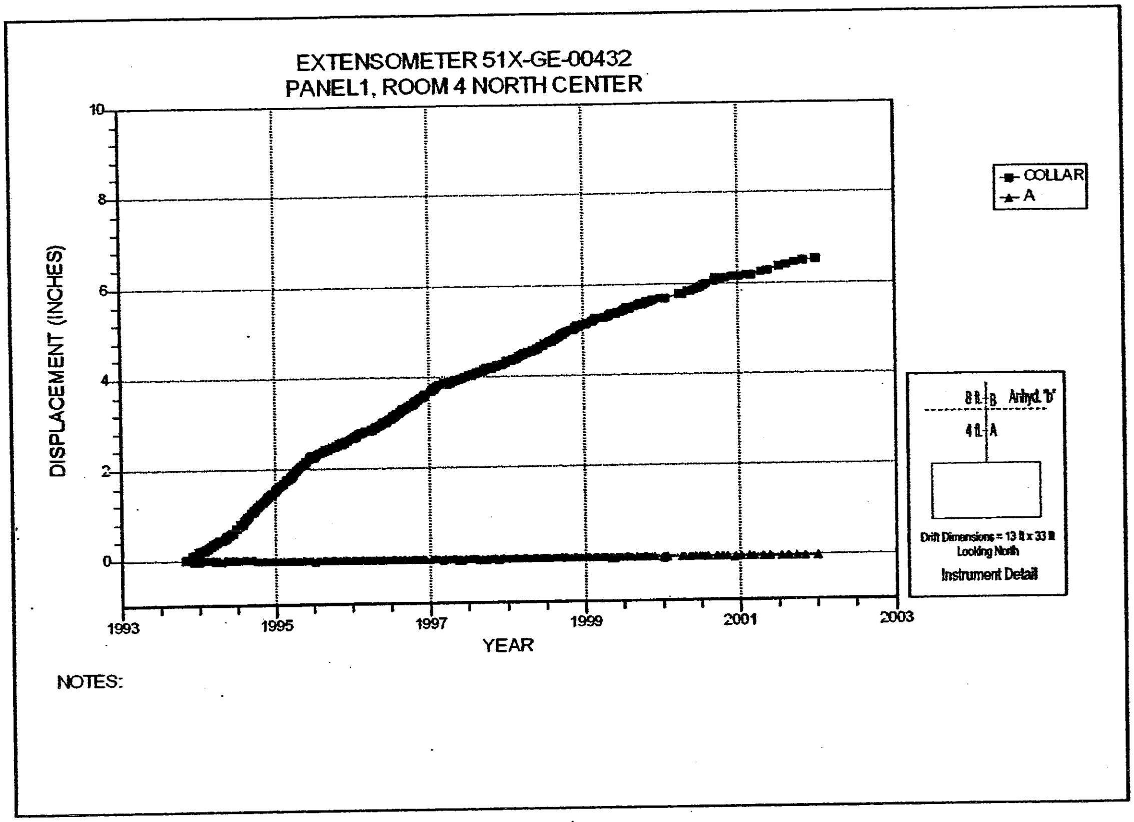


Figure 6-37 Extensometer 51X-GE-00432
Room 4, Panel 1 – North End – Center Roof

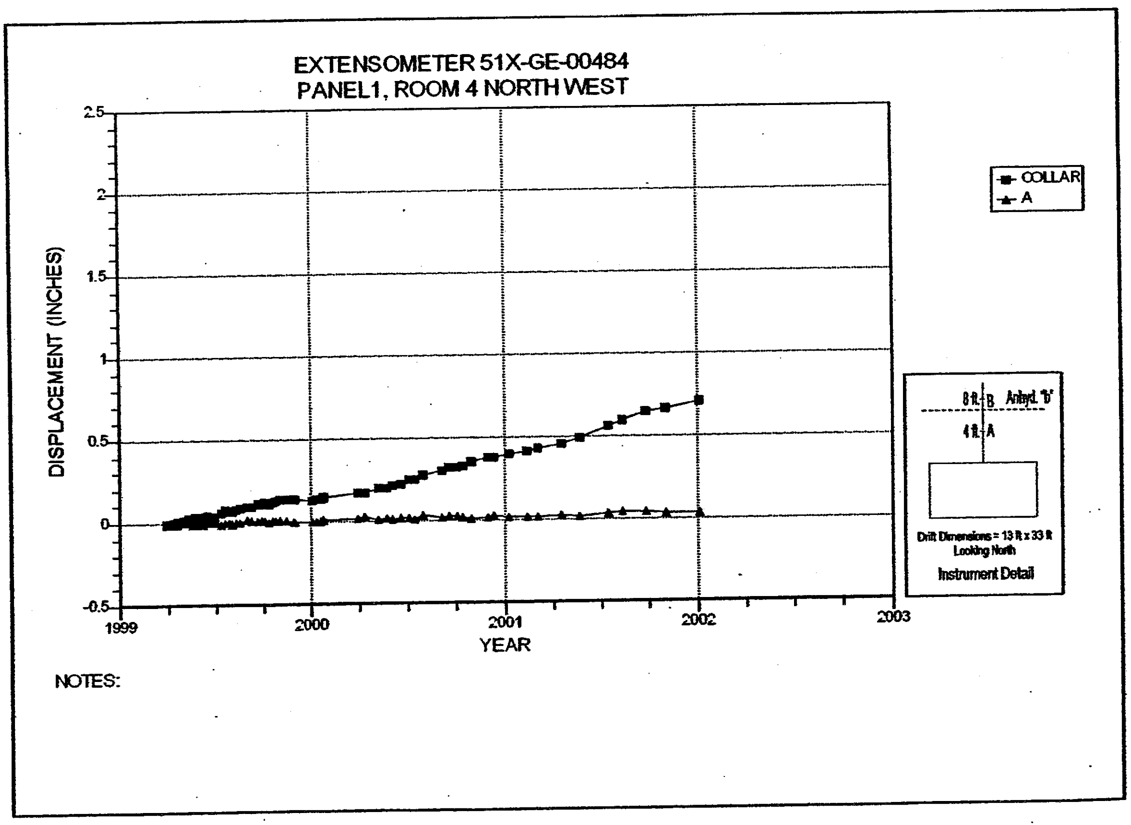
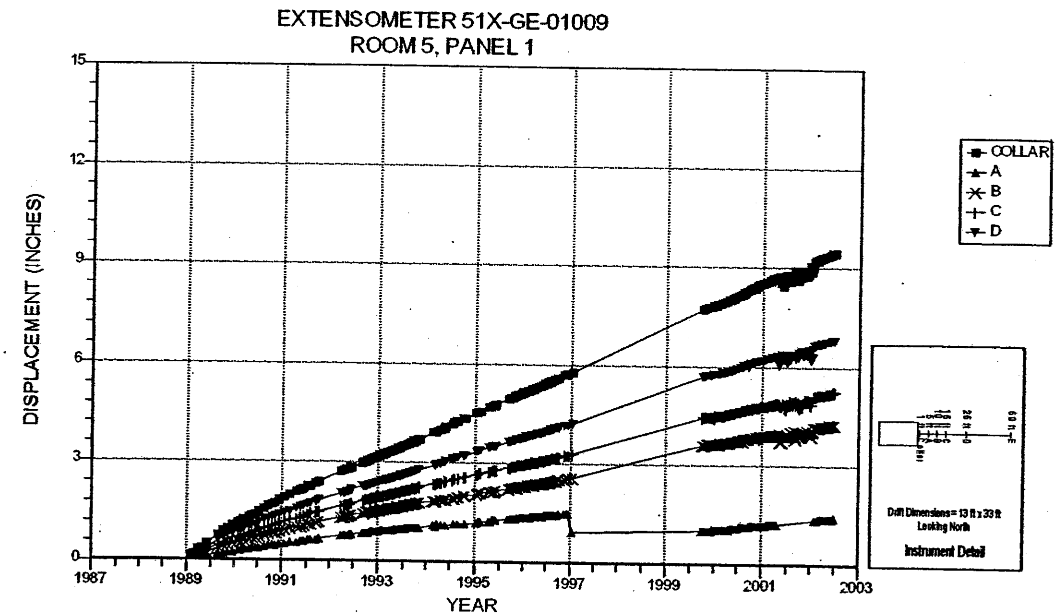
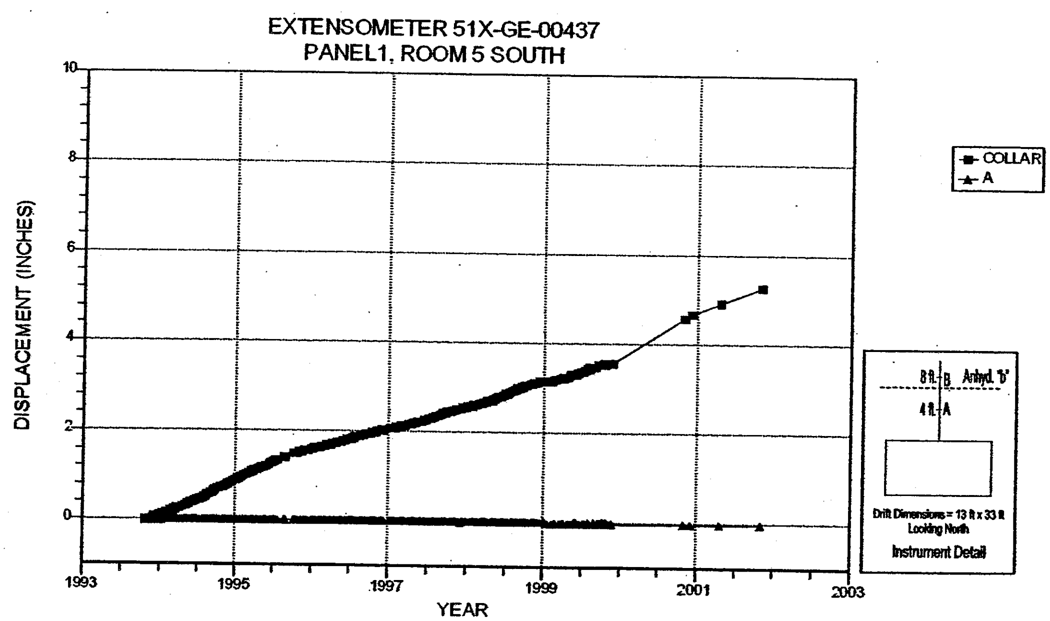


Figure 6-38 Extensometer 51X-GE-00484
Room 4, Panel 1 – North End – West Roof



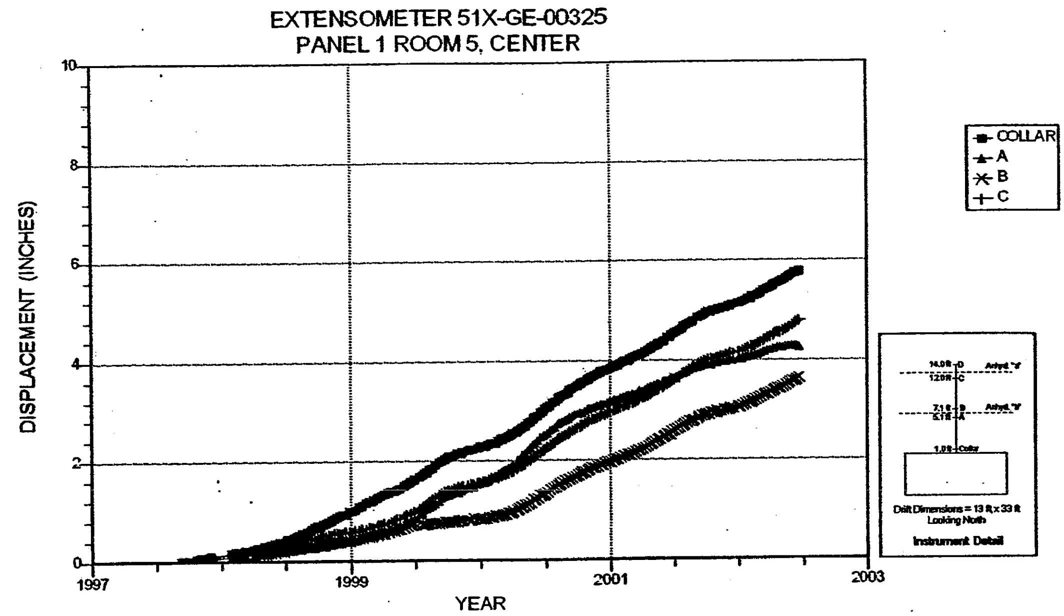
NOTES:
1. Excavation date: February 1988.
2. Electronic offset on rodr "A" after 1/97.

Figure 6-39 Extensometer 51X-GE-01009
Room 5, Panel 1 – Room Center – East Rib



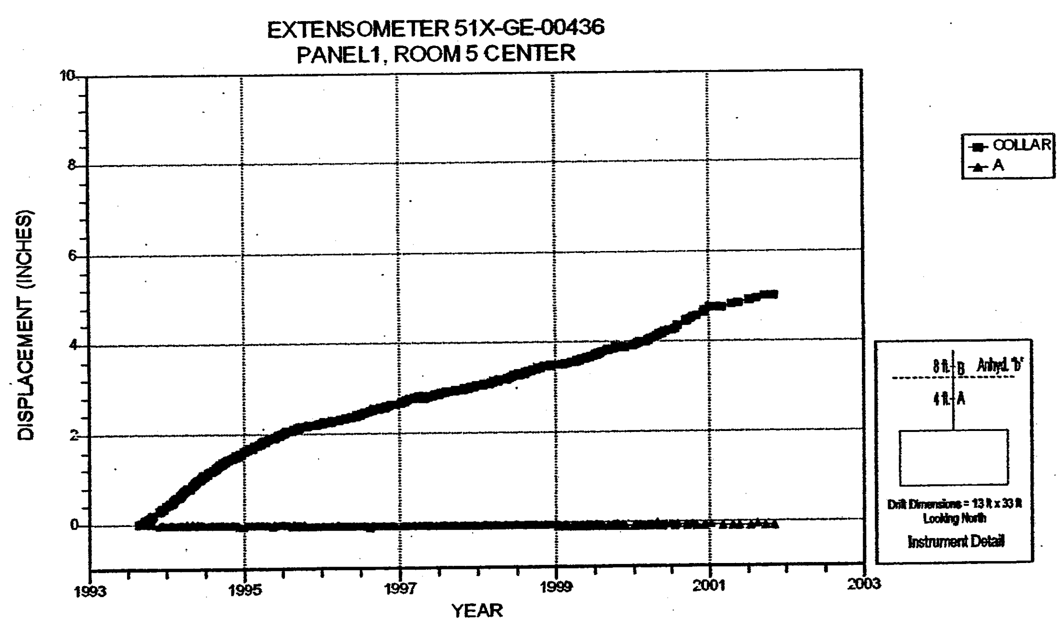
NOTES:

Figure 6-40 Extensometer 51X-GE-00437
Room 5, Panel 1 – South End – Roof



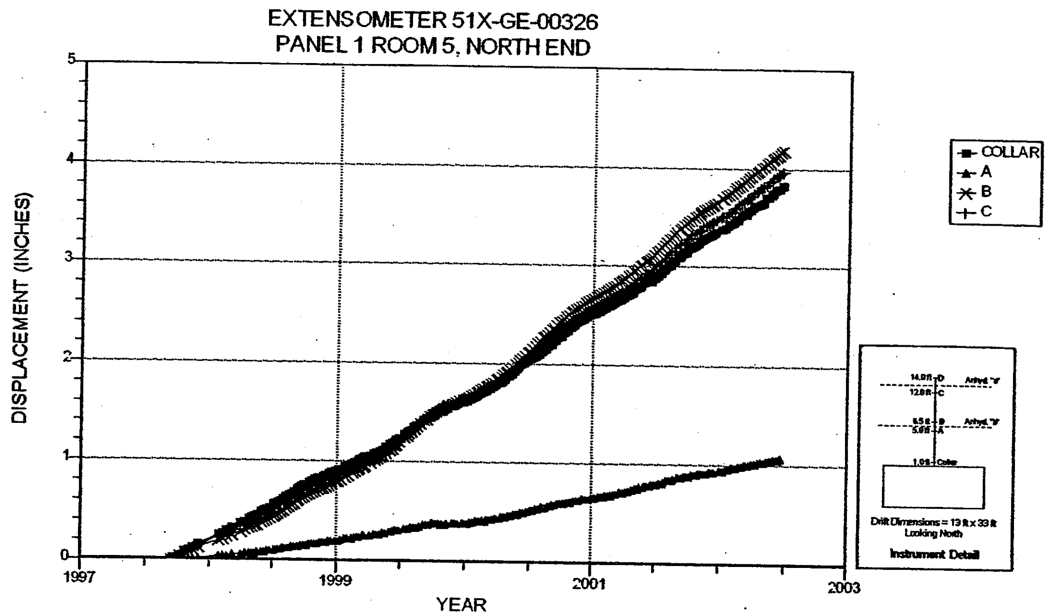
NOTES:
1. Excavation date: February 1988.

Figure 6-41 Extensometer 51X-GE-00325
Room 5, Panel 1 – Room Center – Roof



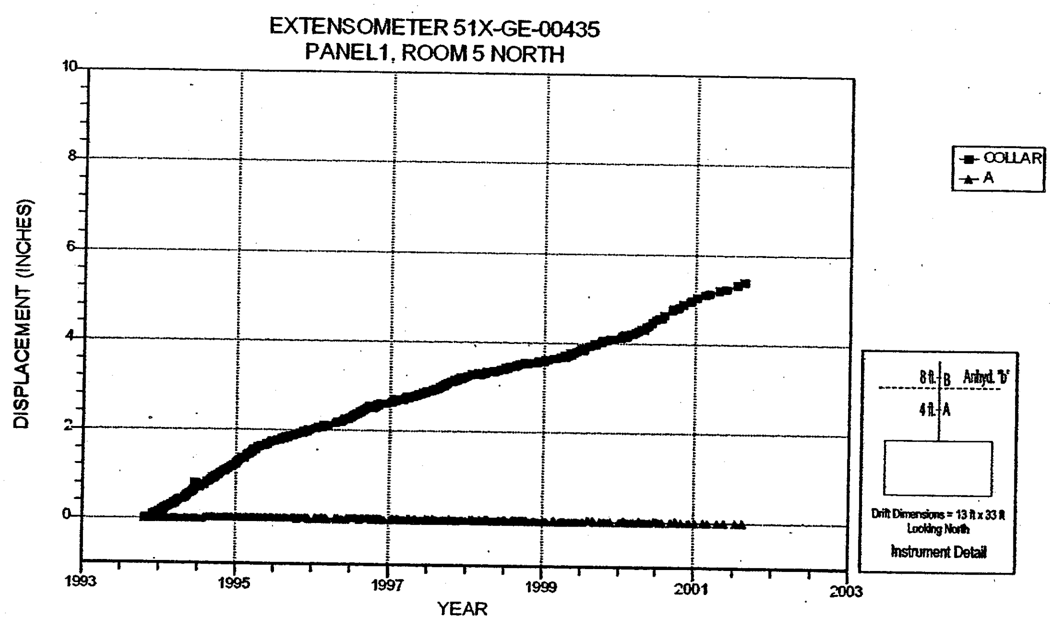
NOTES:

Figure 6-42 Extensometer 51X-GE-00436
Room 5, Panel 1 – Room Center – Roof



NOTES:
1. Excavation date: February 1988.

Figure 6-43 Extensometer 51X-GE-00326
Room 5, Panel 1 – North End – Roof



NOTES:

Figure 6-44 Extensometer 51X-GE-00435
Room 5, Panel 1 – North End – Roof

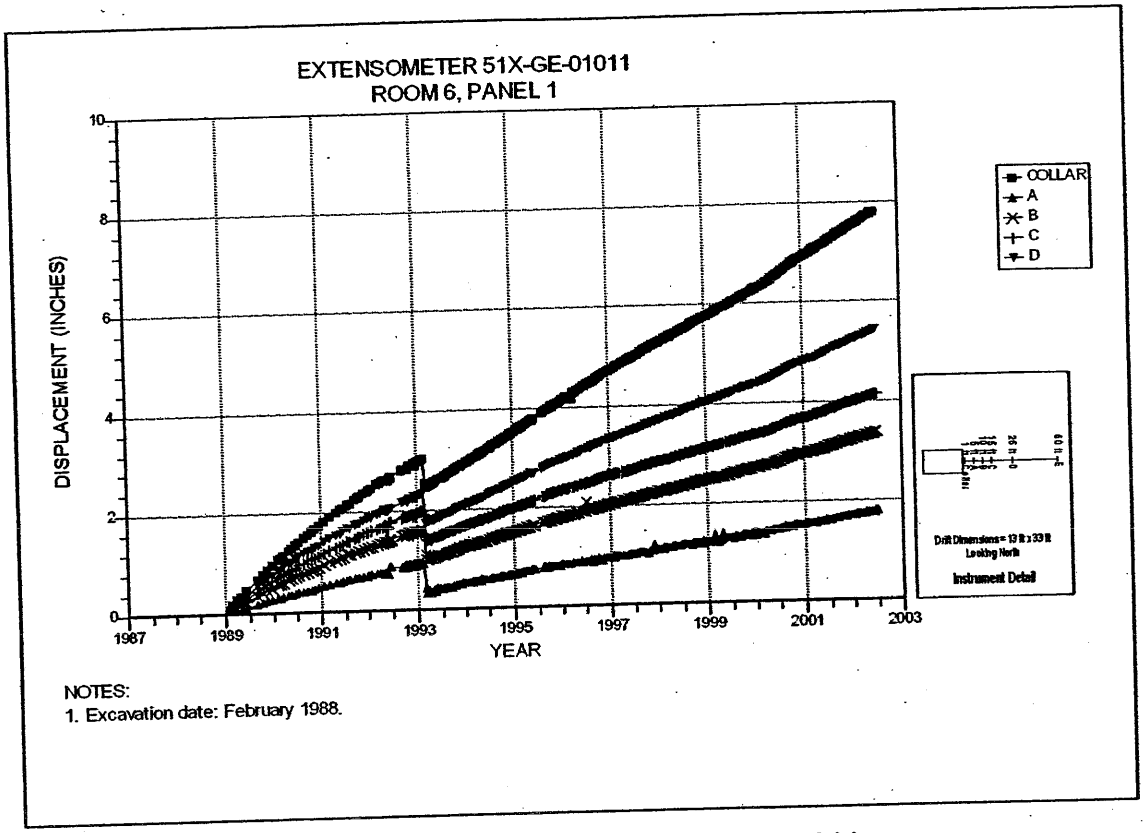


Figure 6-45 Extensometer 51X-GE-01011
Room 6, Panel 1 – Room Center – East Rib

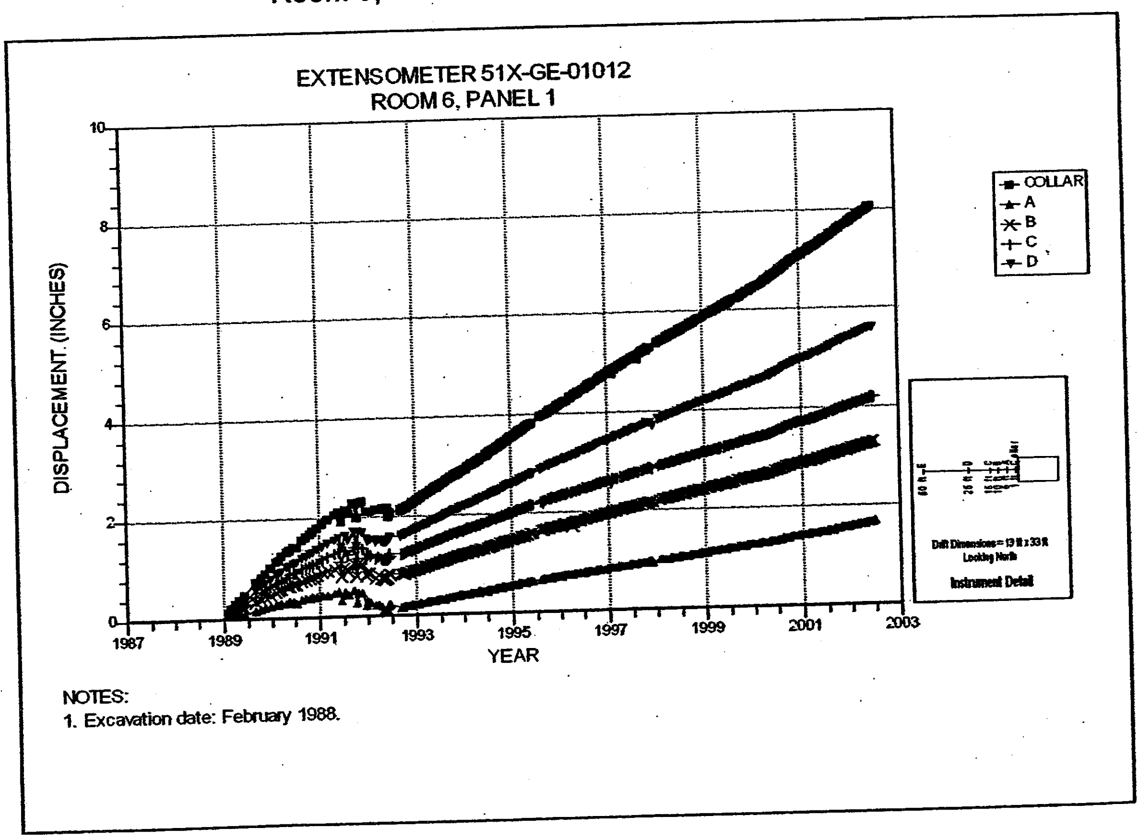
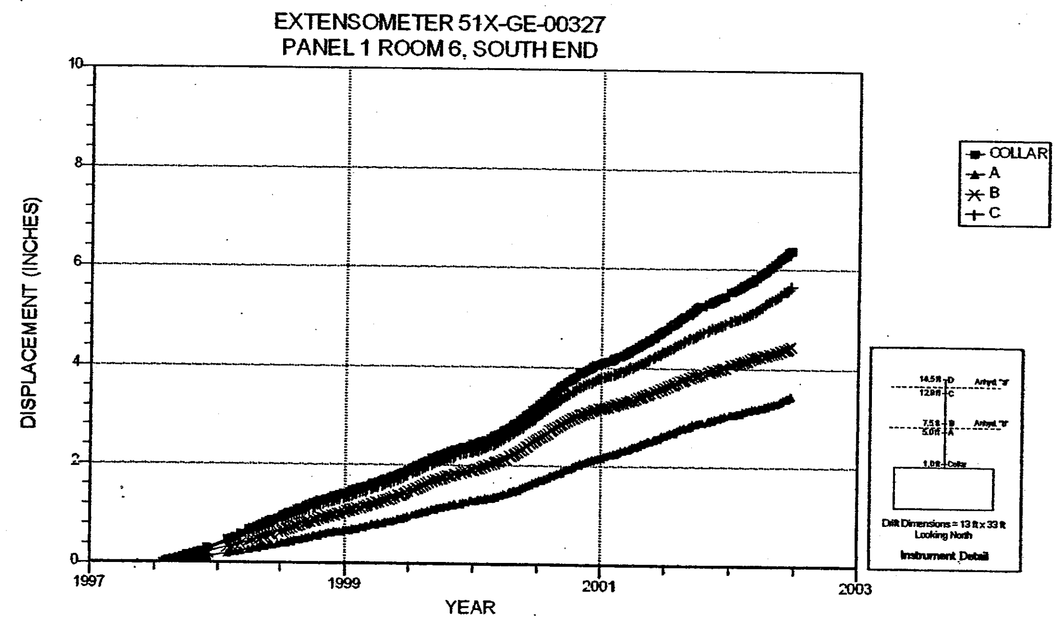
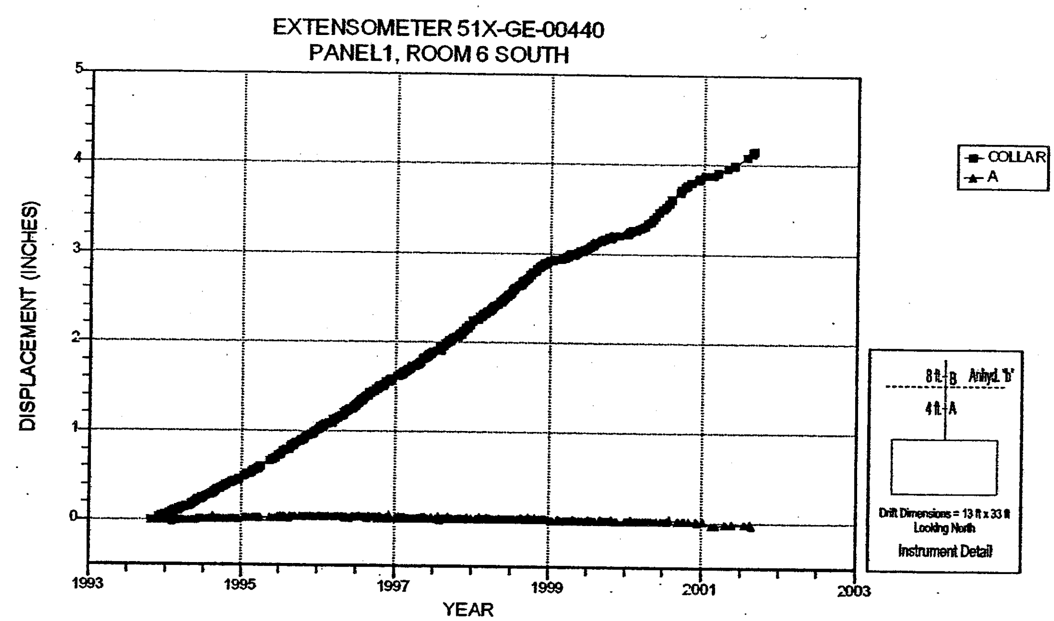


Figure 6-46 Extensometer 51X-GE-01012
Room 6, Panel 1 – Room Center – West Rib



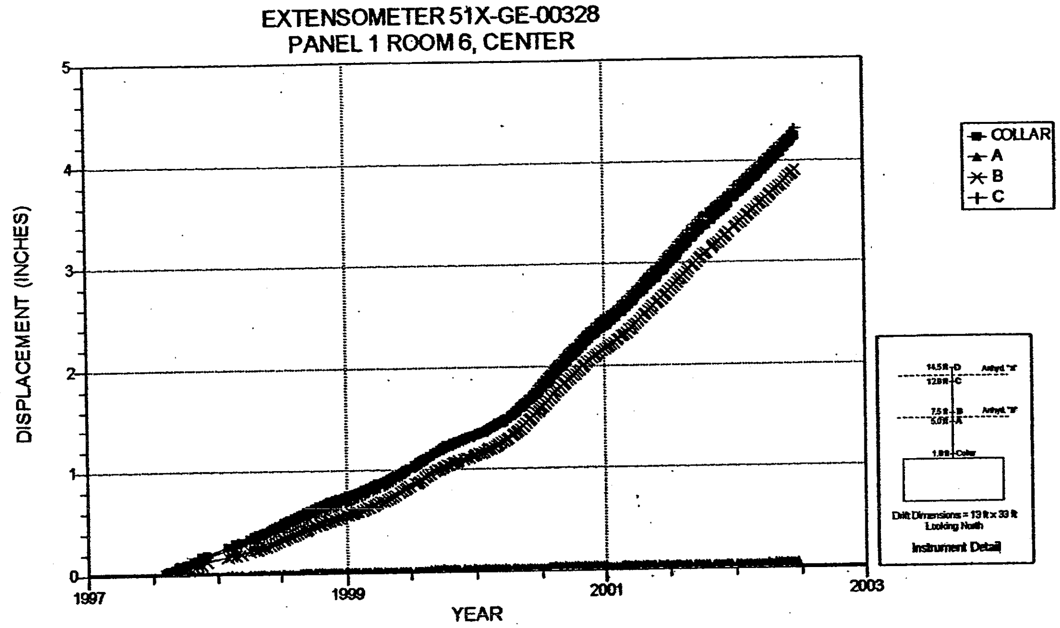
NOTES:
1. Excavation date: February 1988.

Figure 6-47 Extensometer 51X-GE-00327
Room 6, Panel 1 – South End – Roof



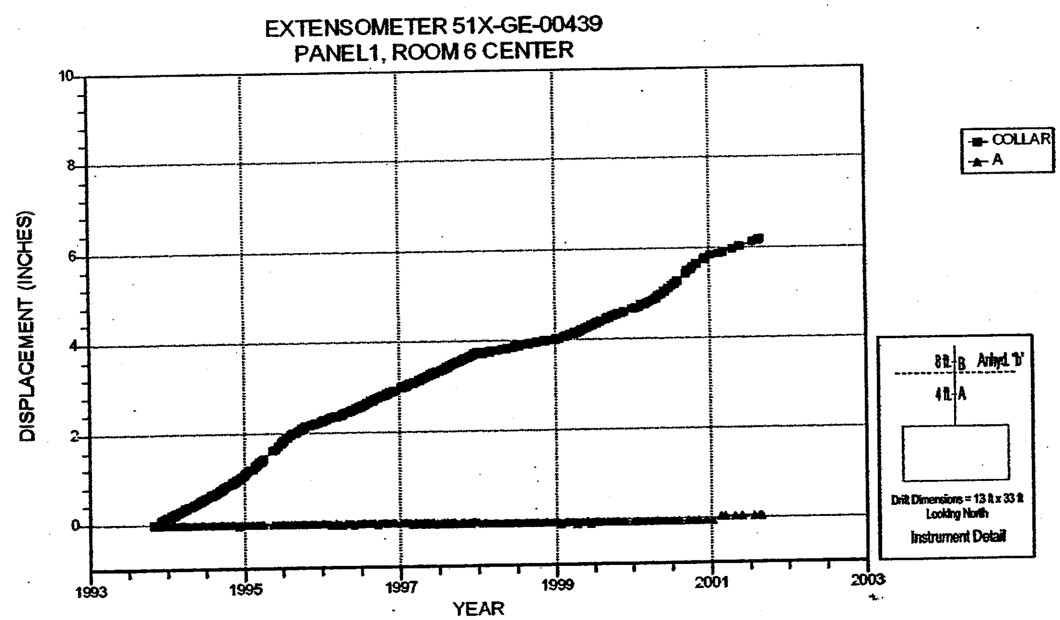
NOTES:

Figure 6-48 Extensometer 51X-GE-00440
Room 6, Panel 1 – South End – Roof



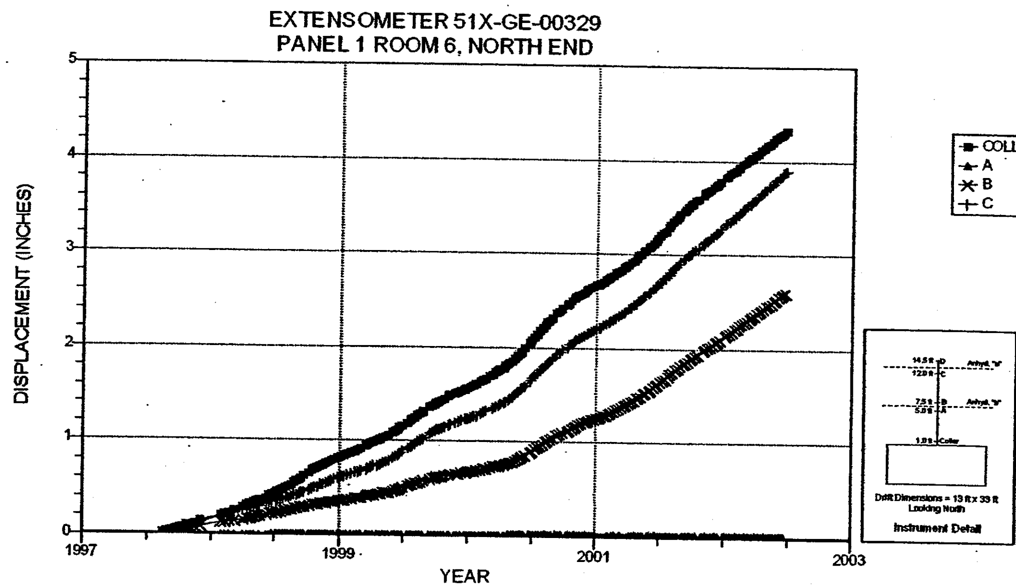
NOTES:
1. Excavation date: February 1988.

Figure 6-49 Extensometer 51X-GE-00328
Room 6, Panel 1 – Room Center – Roof



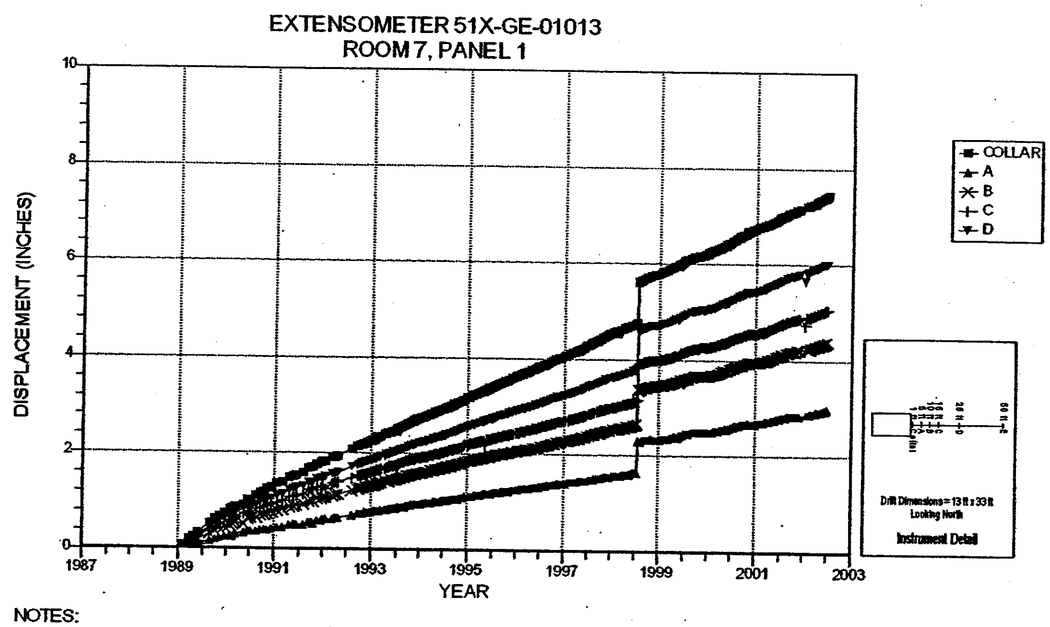
NOTES:

Figure 6-50 Extensometer 51X-GE-00439
Room 6, Panel 1 – Room Center – Roof



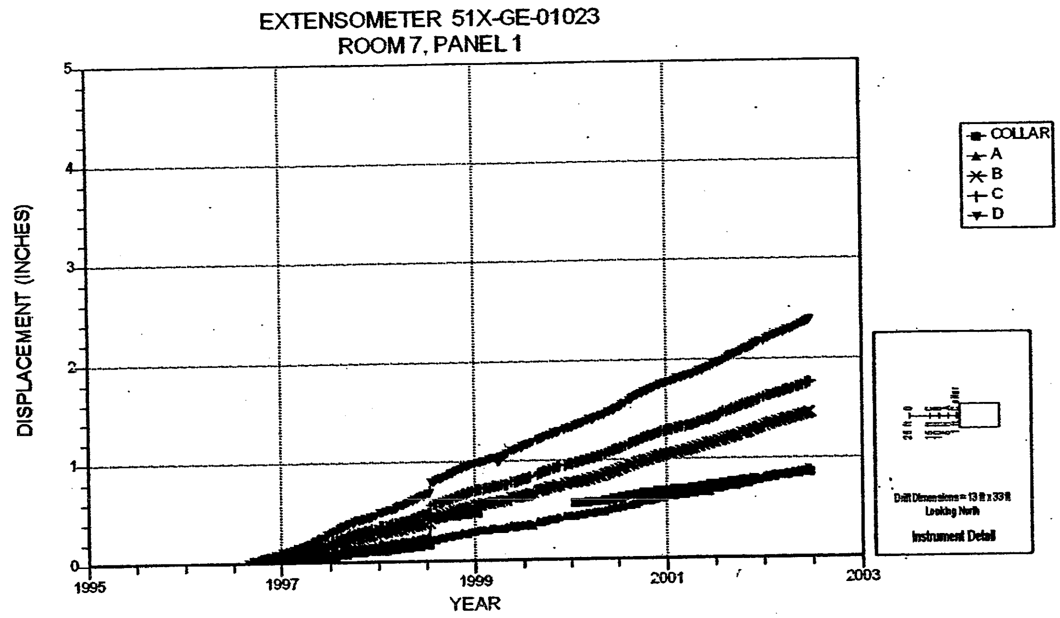
NOTES:
1. Excavation date: February 1988.

Figure 6-51 Extensometer 51X-GE-00329
Room 6, Panel 1 – North End – Roof



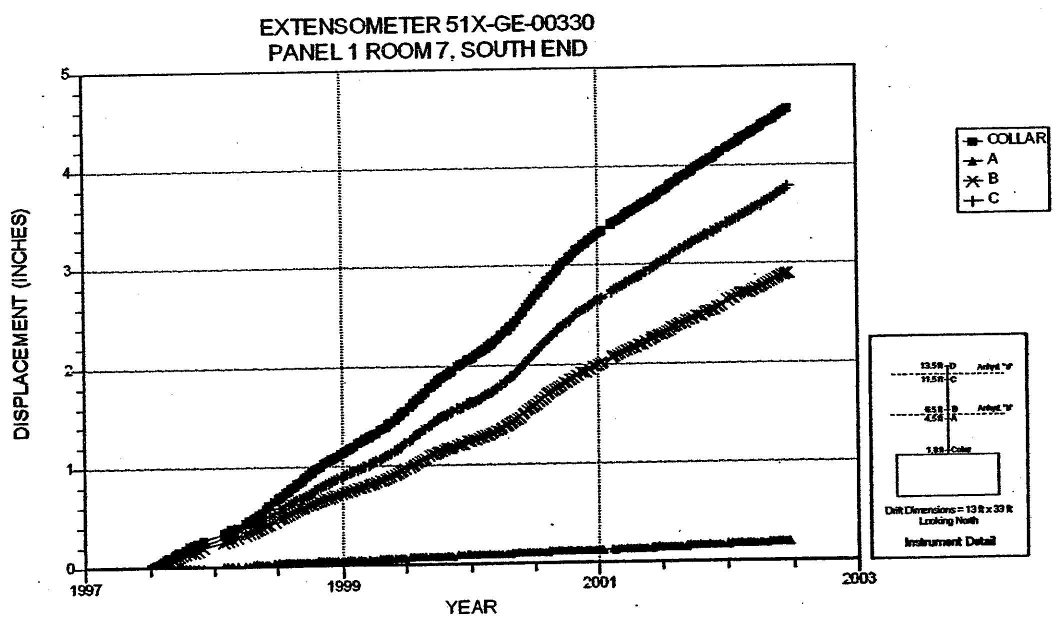
NOTES:
1. Excavation date: March 1988.
2. Offsets in the second half of 1998 due to electronic activities.

Figure 6-52 Extensometer 51X-GE-01013
Room 7, Panel 1 – Room Center – East Rib



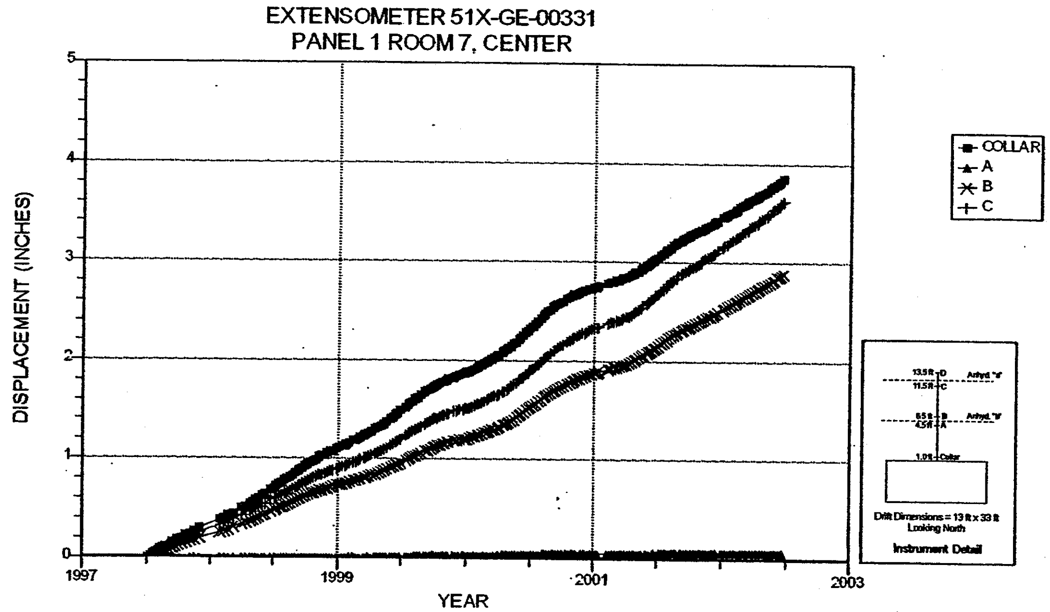
NOTES:
1. Excavation date: March 1988.
2. Replaces 51X-GE-01014.
3. Offsets in mid 1998 due to electronic activities.

Figure 6-53 Extensometer 51X-GE-01023
Room 7, Panel 1 – Room Center – West Rib



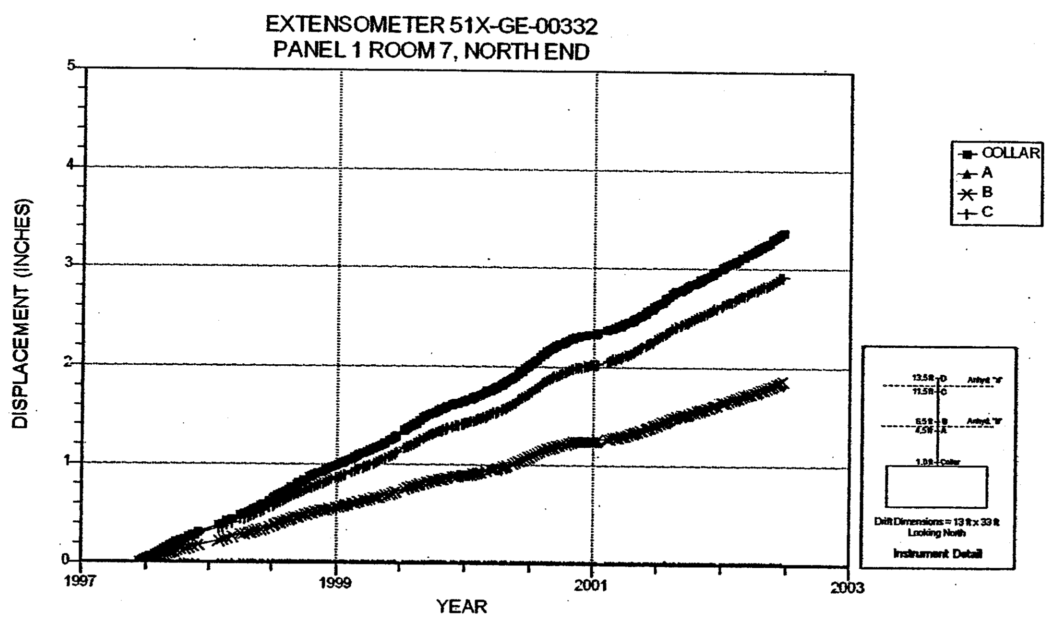
NOTES:
1. Excavation date: March 1988.

Figure 6-54 Extensometer 51X-GE-00330
Room 7, Panel 1 – South End – Roof



NOTES:
1. Excavation date: March 1988.

Figure 6-55 Extensometer 51X-GE-00331
Room 7, Panel 1 – Room Center – Roof



NOTES:
1. Excavation date: March 1988.
2. Replaces 51X-GE-01022.

Figure 6-56 Extensometer 51X-GE-00332
Room 7, Panel 1 – North End – Roof

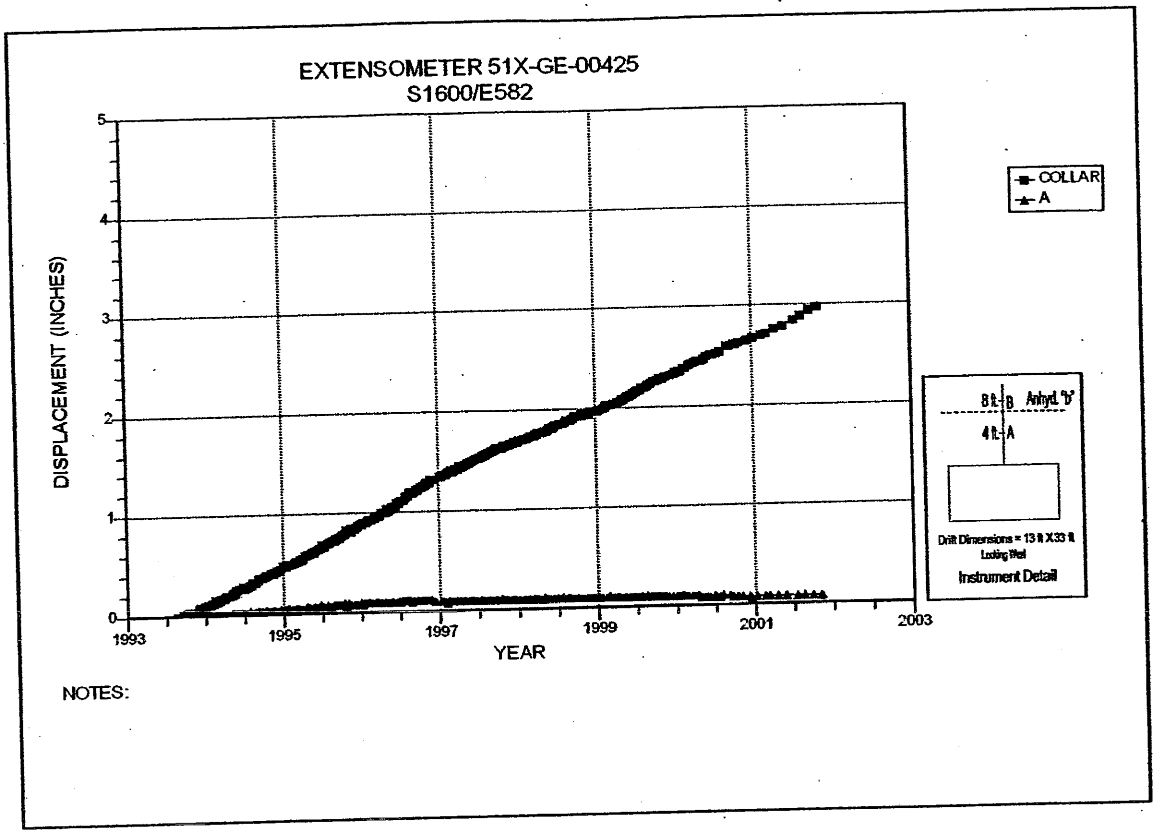


Figure 6-57 Extensometer 51X-GE-00425
S1600 Drift at E582 – Roof

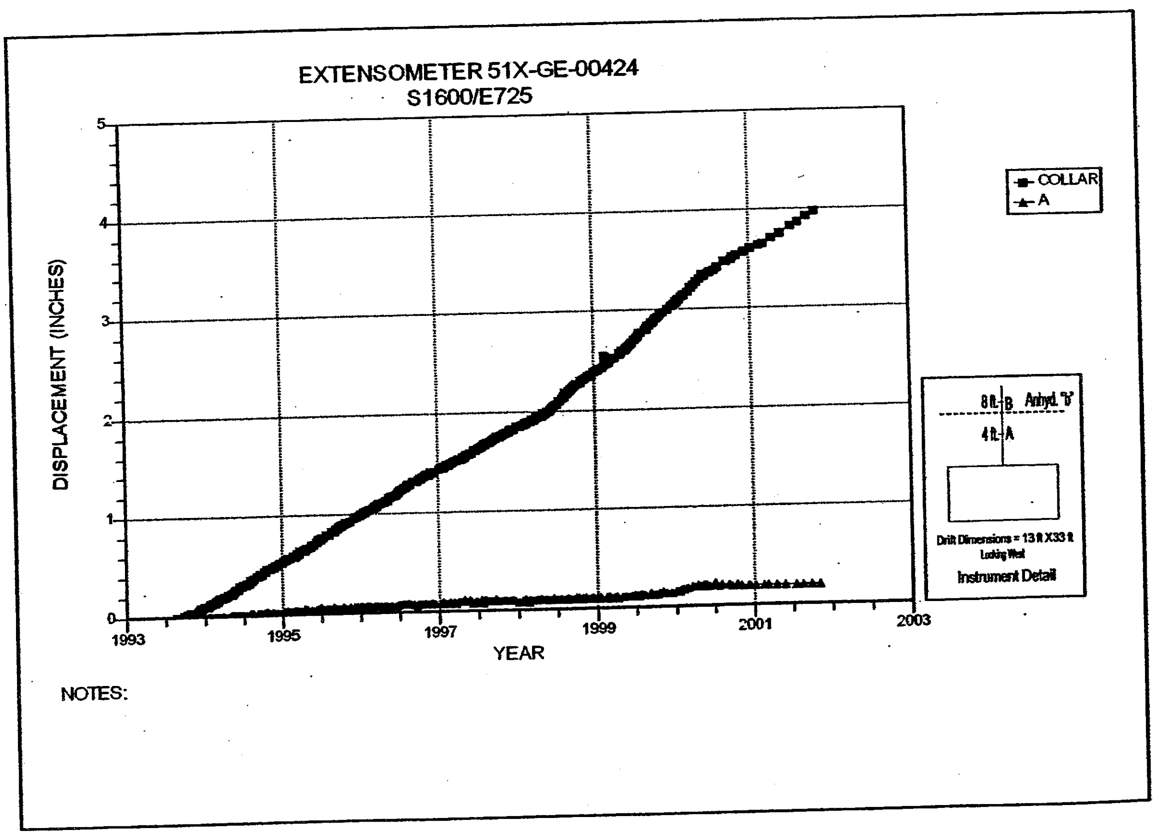


Figure 6-58 Extensometer 51X-GE-00424
S1600 Drift at E725 – Roof

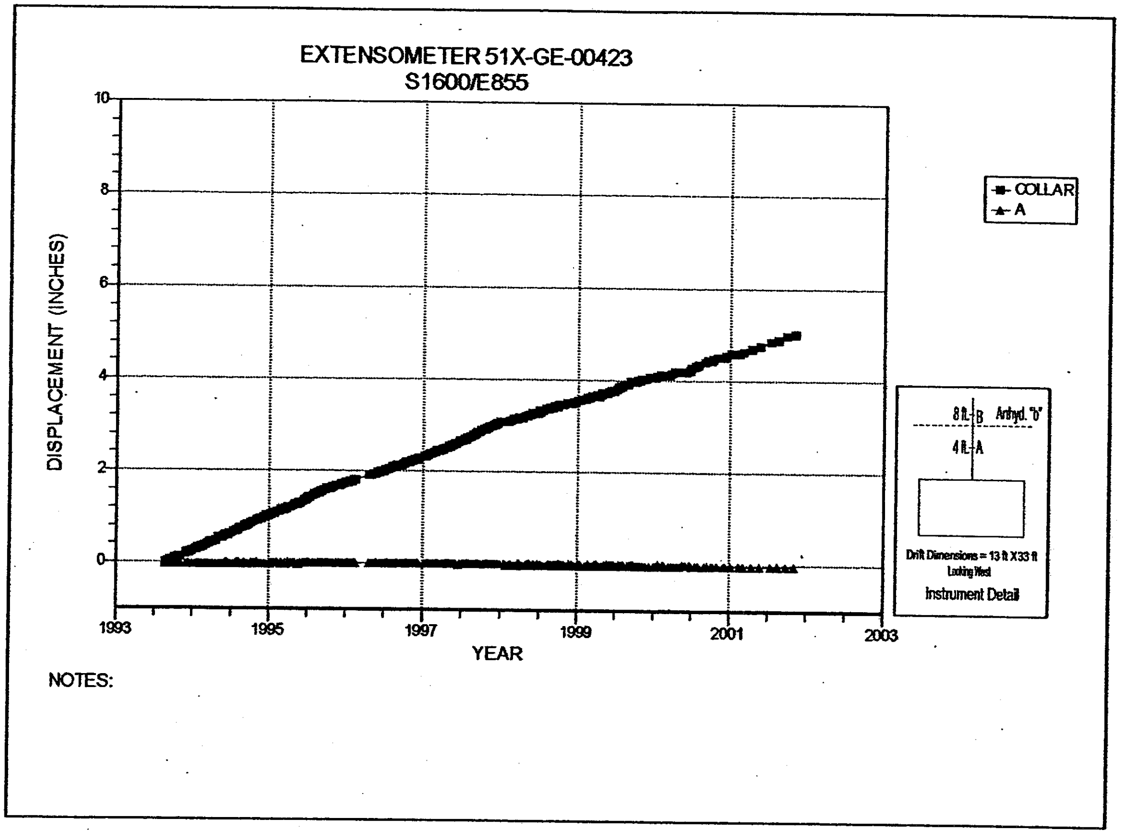


Figure 6-59 Extensometer 51X-GE-00423
S1600 Drift at E855 – East Roof

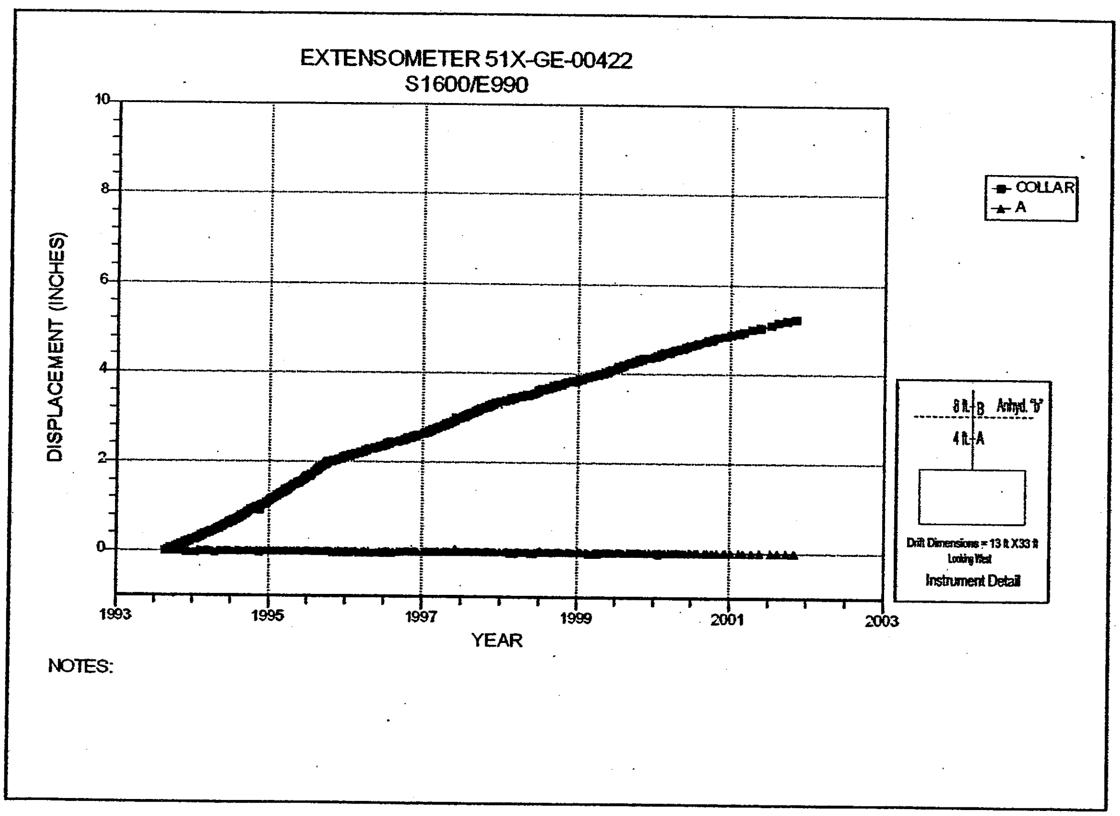


Figure 6-60 Extensometer 51X-GE-00422
S1600 Drift at E990 – Roof

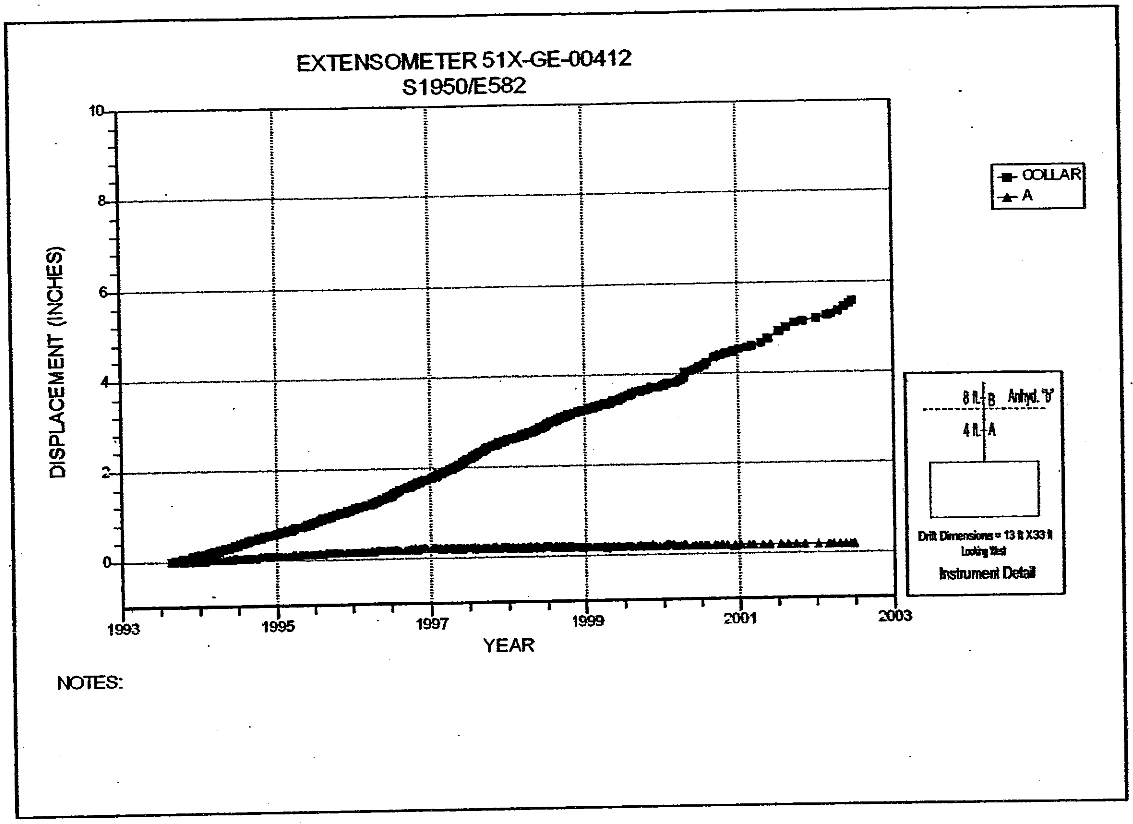


Figure 6-61 Extensometer 51X-GE-00412
S1950 Drift at E582 – Roof

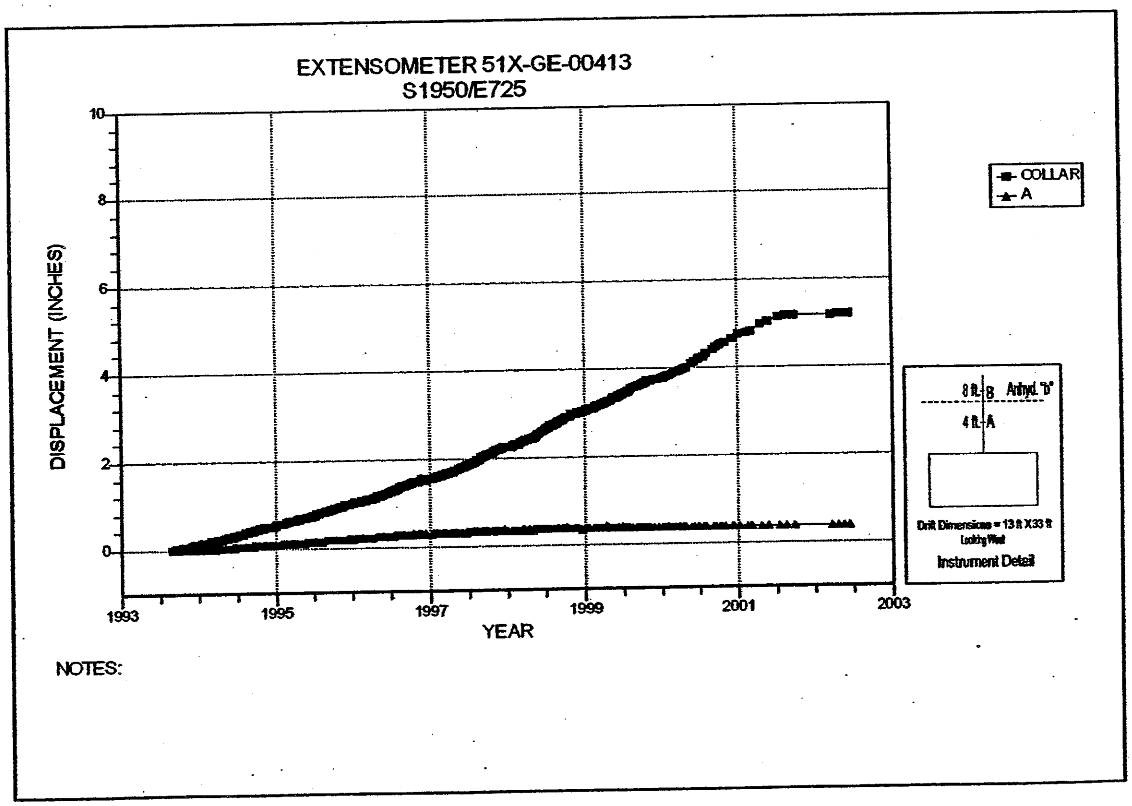


Figure 6-62 Extensometer 51X-GE-00413
S1950 Drift at E725 – Roof

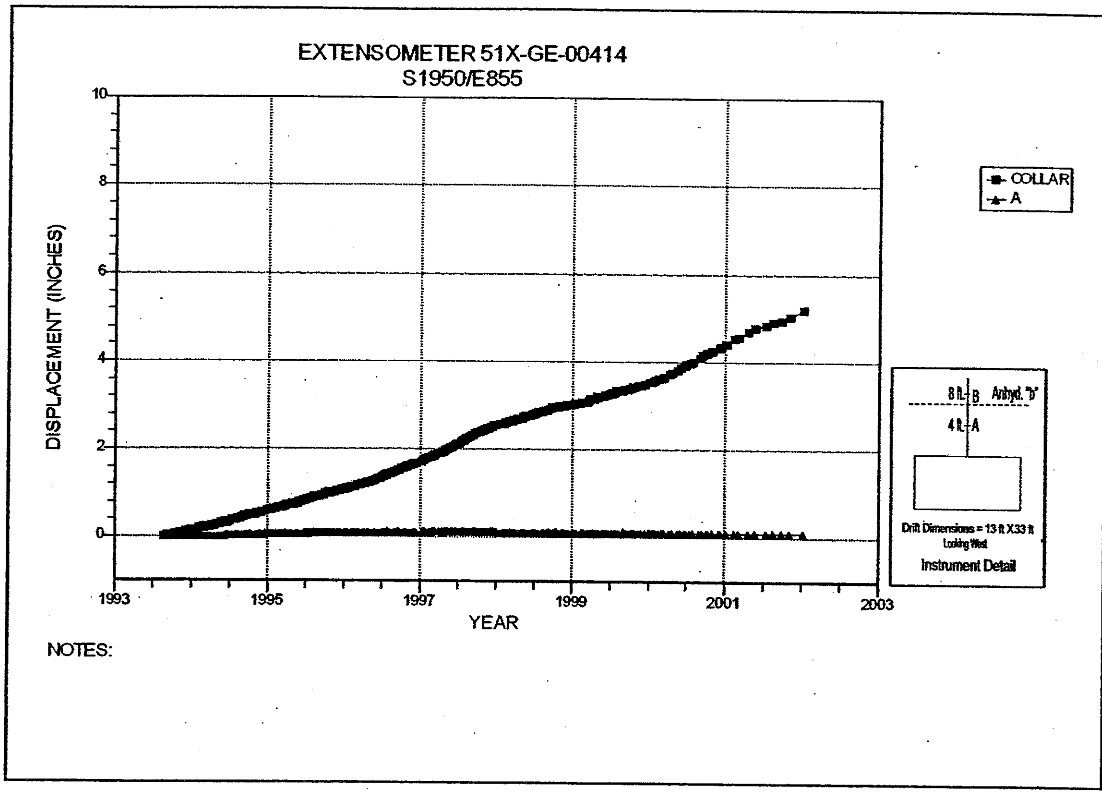


Figure 6-63 Extensometer 51X-GE-00414
S1950 Drift at E855 – Roof

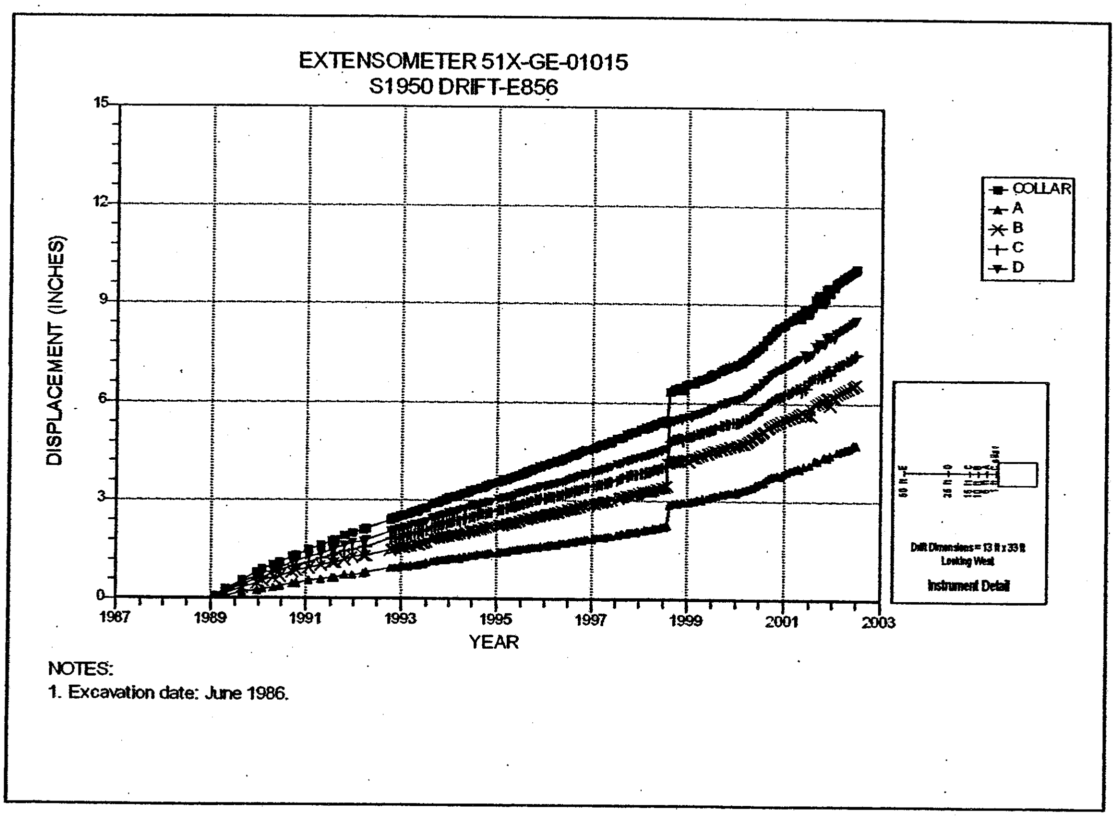
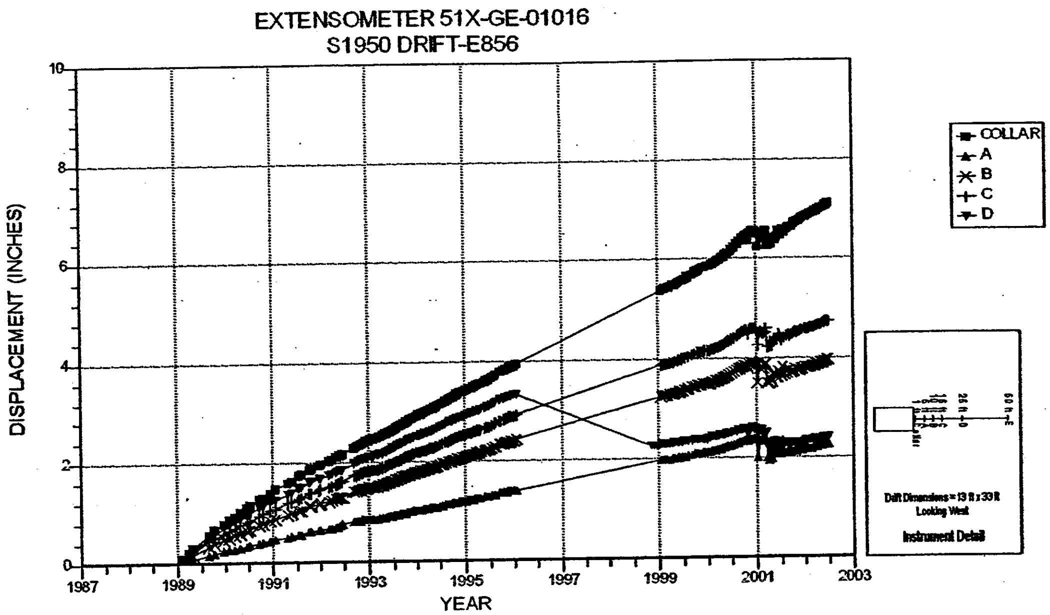
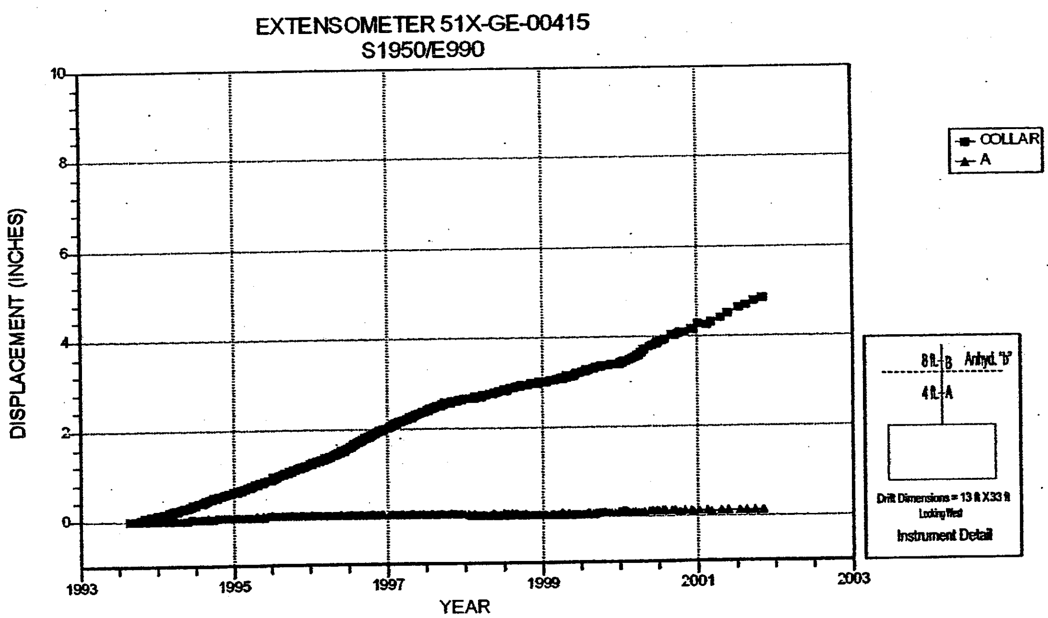


Figure 6-64 Extensometer 51X-GE-01015
South 1950 Drift at E856 – Mid Panel – South Rib



NOTES:
1. Excavation date: June 1986.

Figure 6-65 Extensometer 51X-GE-01016
South 1950 Drift at E856 – Mid Panel – North Rib



NOTES:

Figure 6-66 Extensometer 51X-GE-00415
S1950 Drift at E990 – Roof

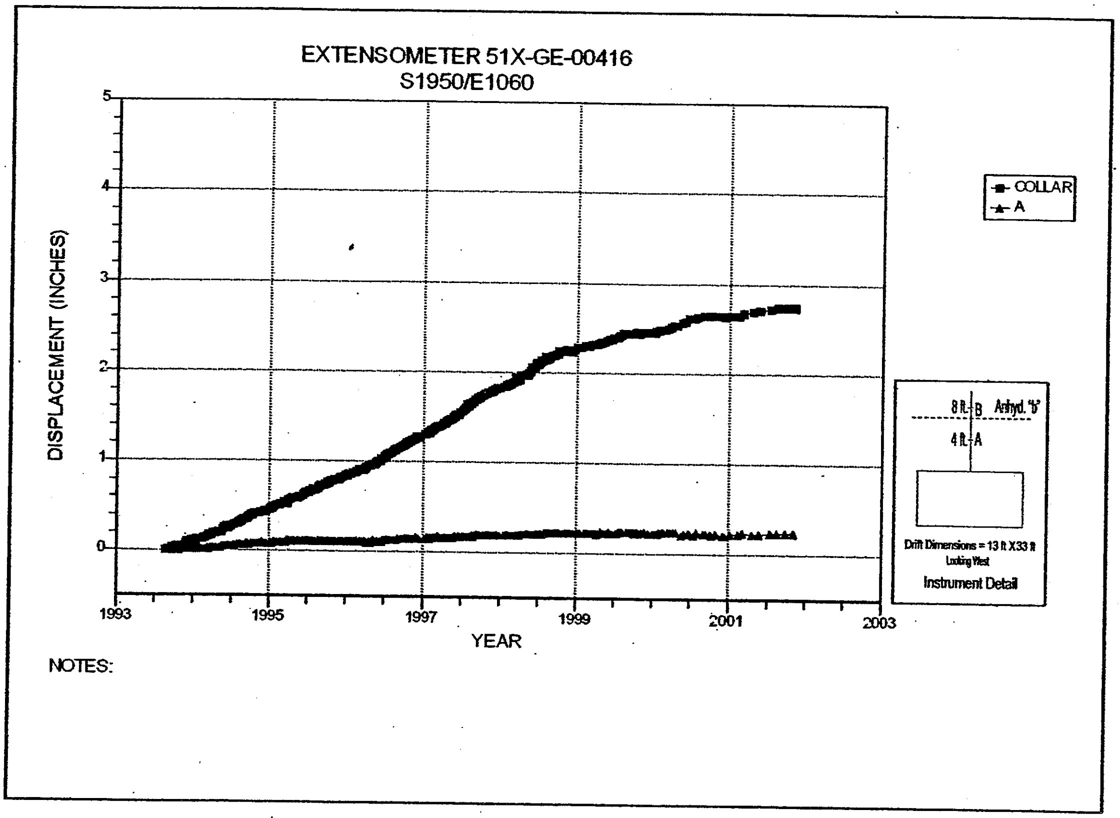


Figure 6-67 Extensometer 51X-GE-00416
S1950 Drift at E1060 – Roof

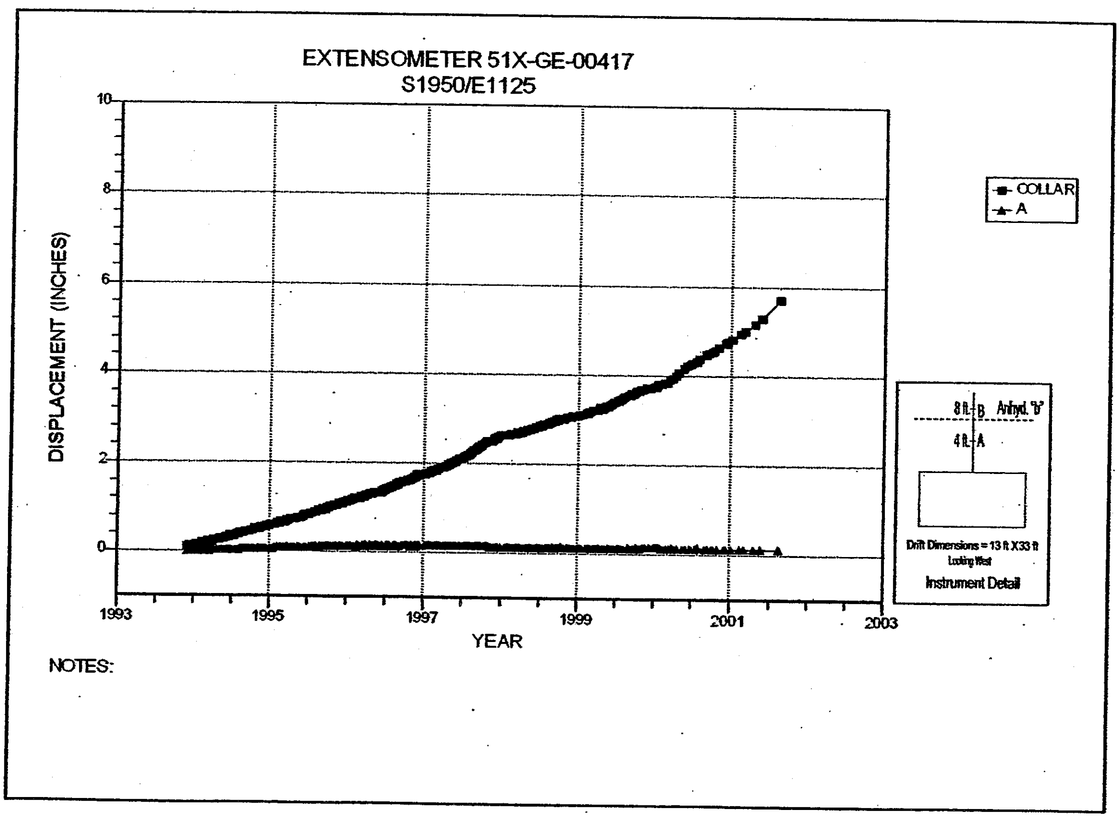
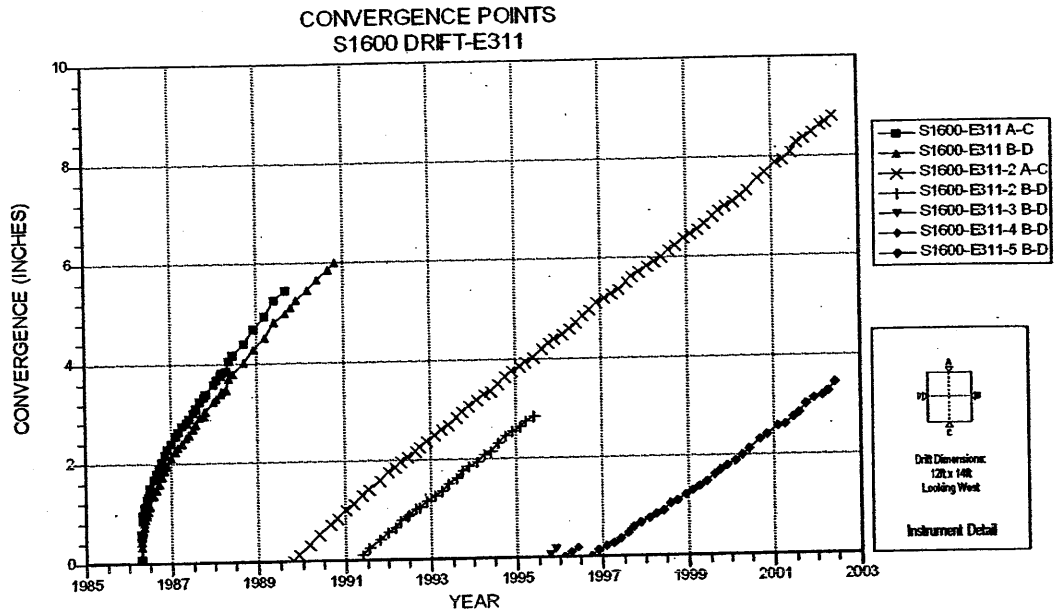
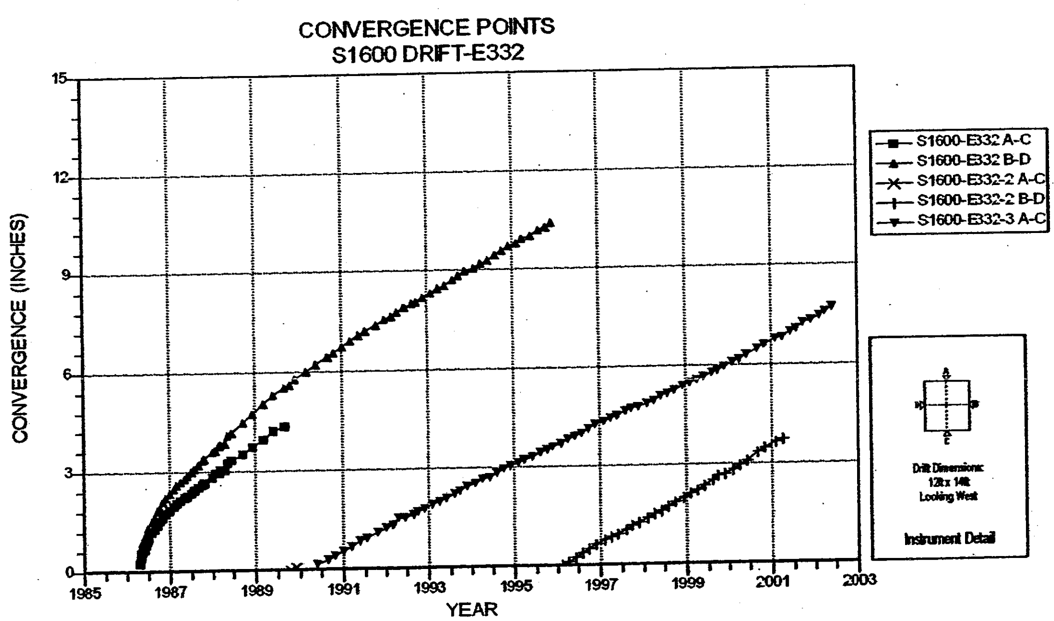


Figure 6-68 Extensometer 51X-GE-00417
S1950 Drift at E1125 – Roof



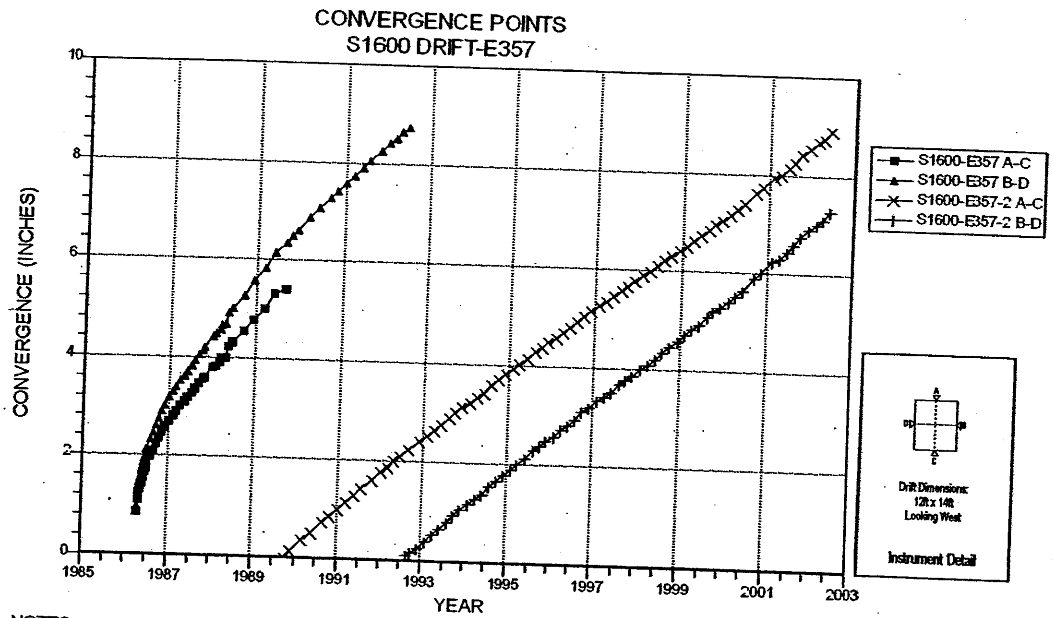
NOTES:
1. Excavation date: April 1986.

Figure 6-69 Convergence Point Array S1600 Drift at E311 – All Chords



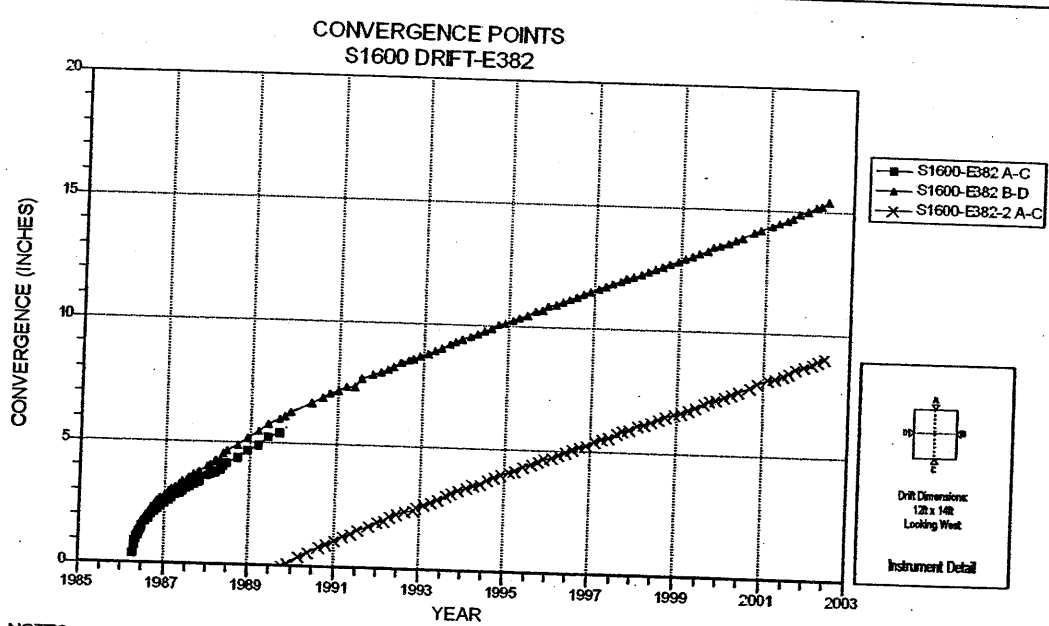
NOTES:
1. Excavation date: April 1986.
2. Chord B-D removed due to air monitoring equipment cutout.

Figure 6-70 Convergence Point Array S1600 Drift at E332 – All Chords



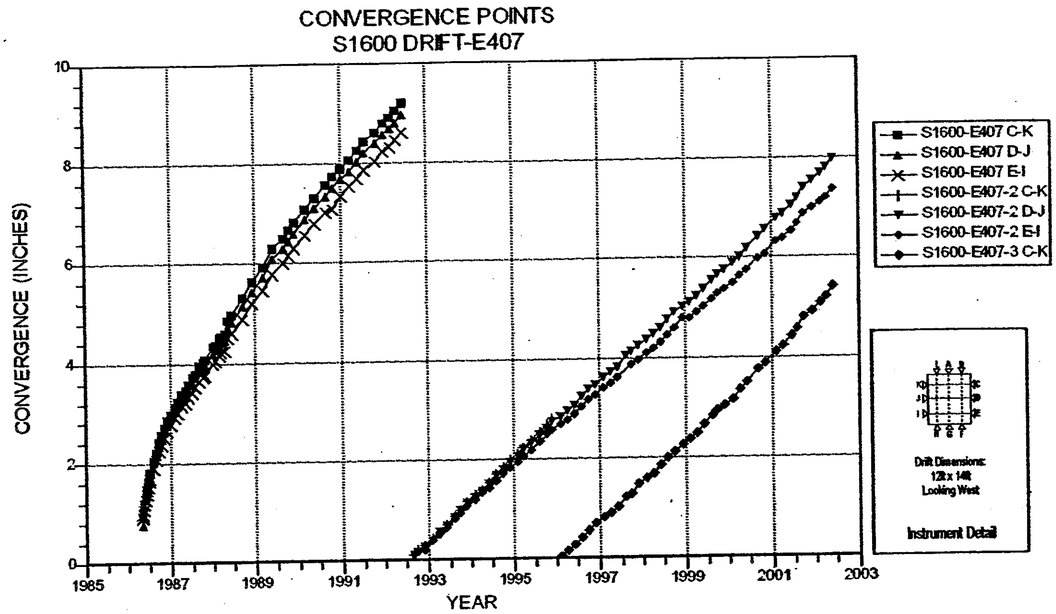
NOTES:
1. Excavation date: April 1986.

Figure 6-71 Convergence Point Array S1600 Drift at E357 – All Chords



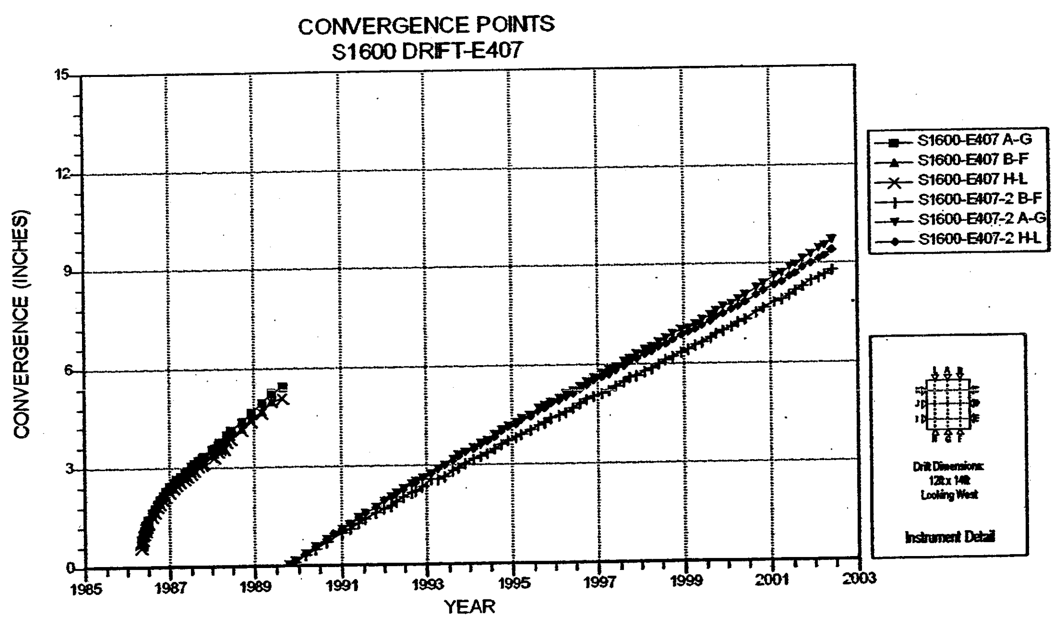
NOTES:
1. Excavation date: April 1986.

Figure 6-72 Convergence Point Array S1600 Drift at E382 – All Chords



NOTES:
1. Excavation date: April 1986.

Figure 6-73 Convergence Point Array
S1600 Drift at E407 – Rib to Rib



NOTES:
1. Excavation date: April 1986.

Figure 6-74 Convergence Point Array
S1600 Drift at E407 – Roof to Floor

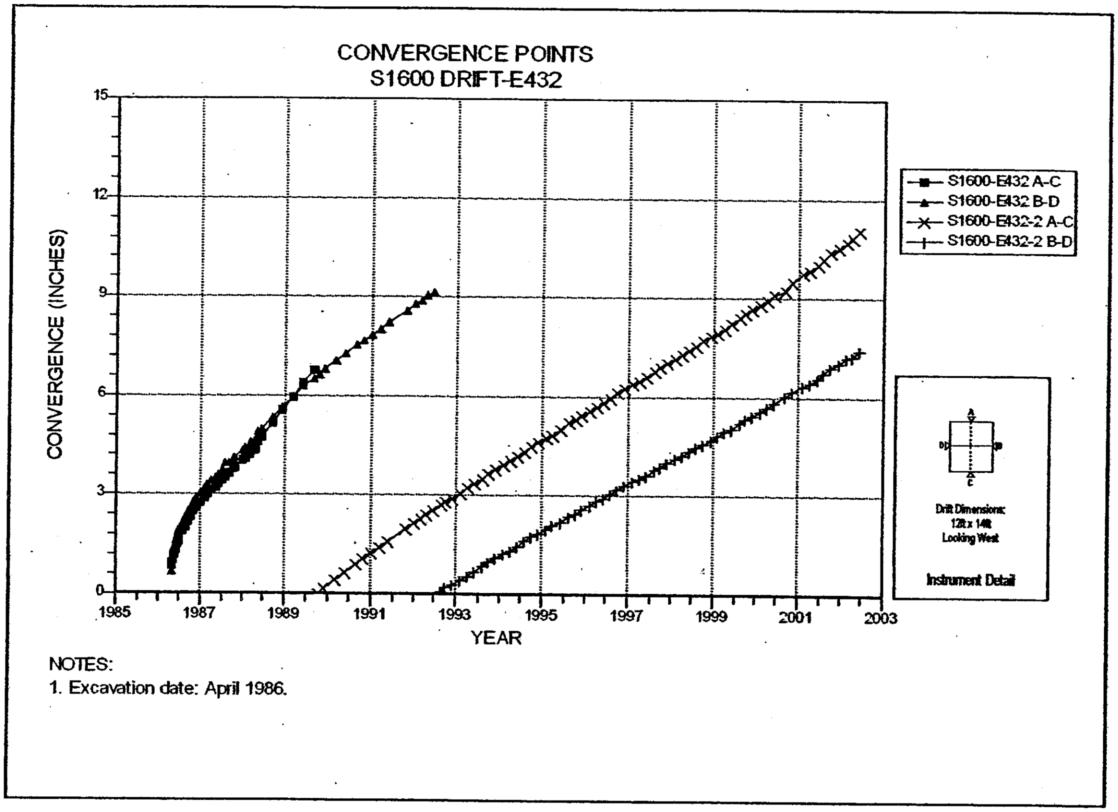


Figure 6-75 Convergence Point Array
S1600 Drift at E432 – All Chords

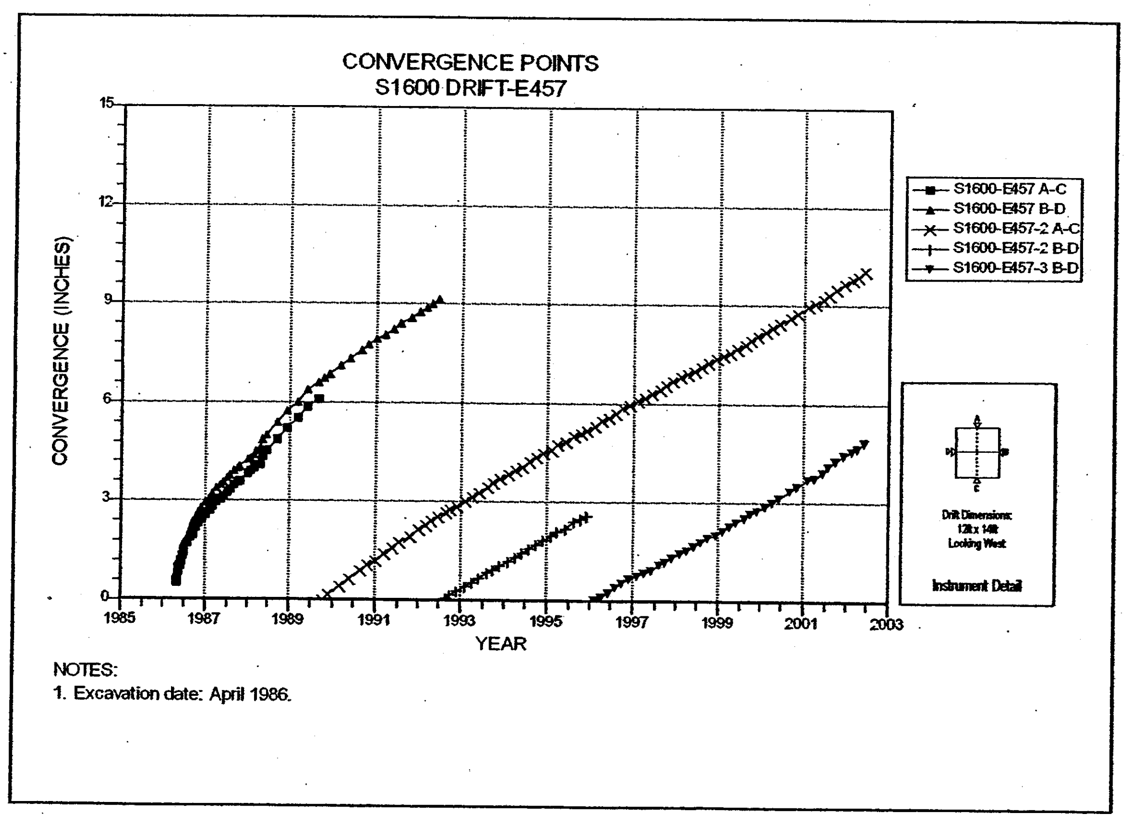
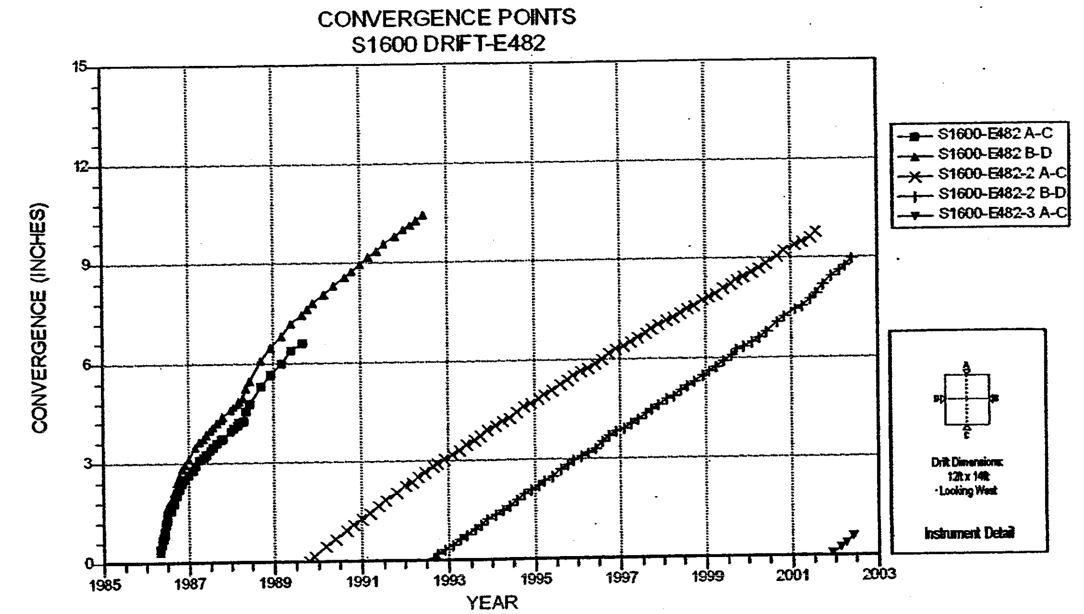
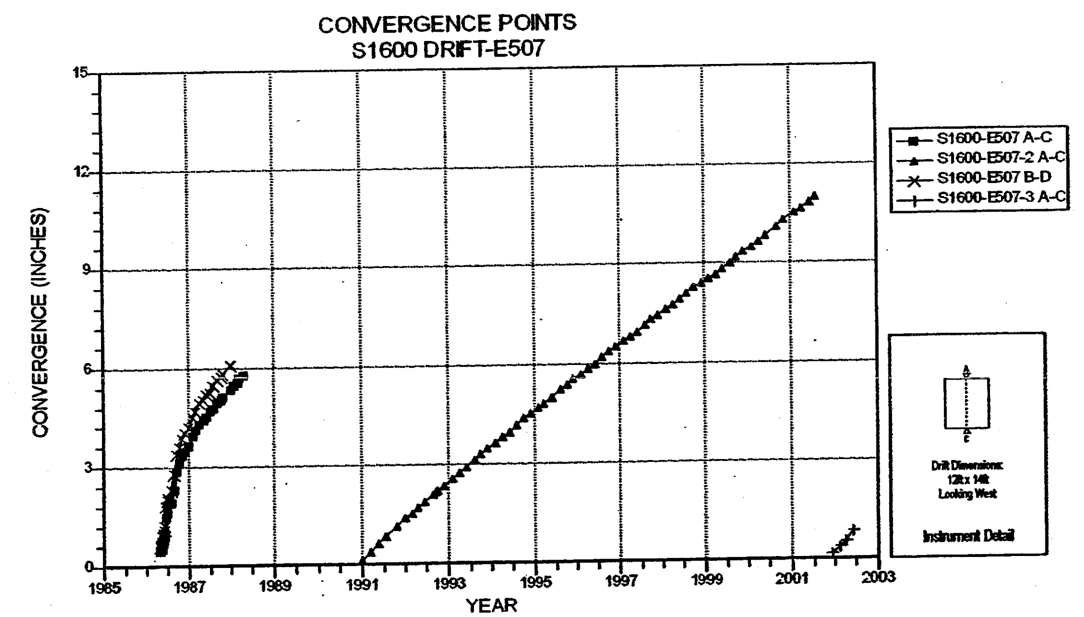


Figure 6-76 Convergence Point Array
S1600 Drift at E457 – All Chords



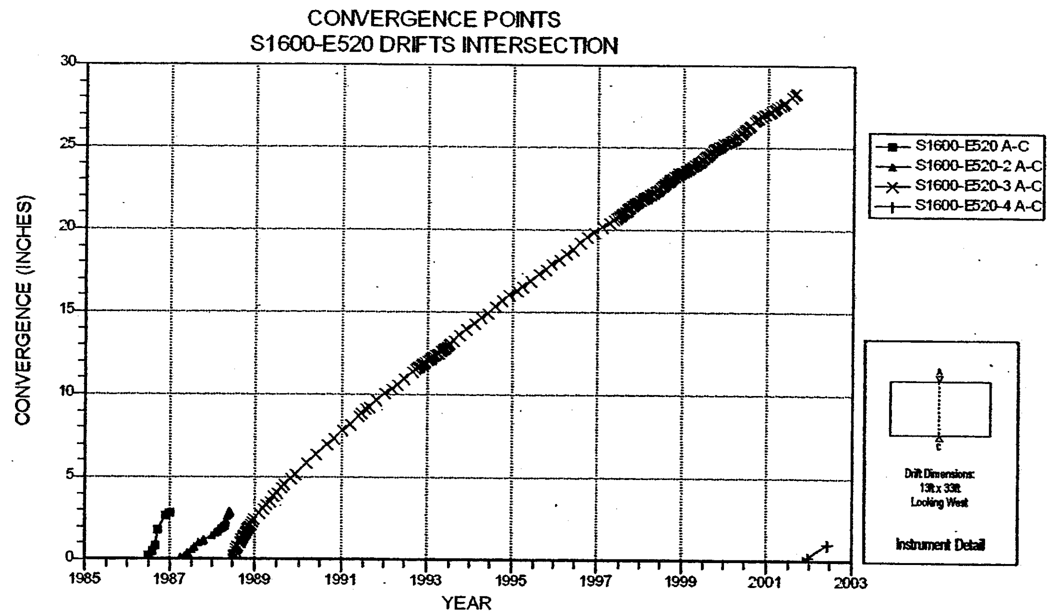
NOTES:
1. Excavation date: April 1986.

**Figure 6-77 Convergence Point Array
S1600 Drift at E482 – All Chords**



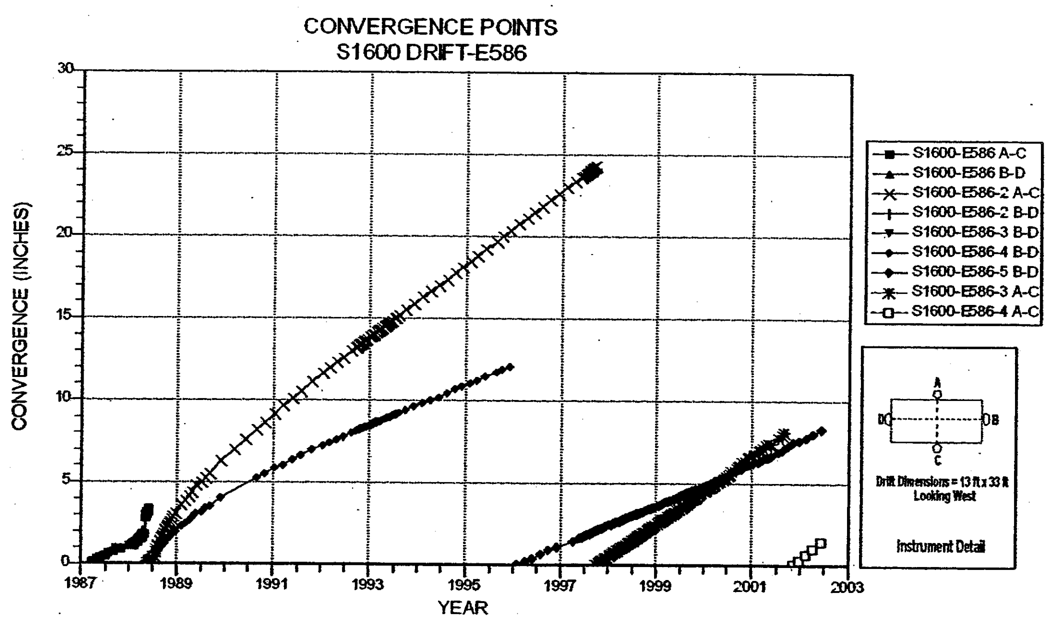
NOTES:
1. Excavation date: April 1986.
2. Chord B-D mined-out, area now an intersection.

**Figure 6-78 Convergence Point Array
S1600 Drift at E507 – Roof to Floor**



NOTES:
1. Excavation date: June 1986.

Figure 6-79 Convergence Point Array
S1600 Drift at E520 Drift Intersection (Room 1, Panel 1) – Roof to Floor



NOTES:
1. Excavation date: January 1986.

Figure 6-80 Convergence Point Array
S1600 Drift at E586 – All Chords

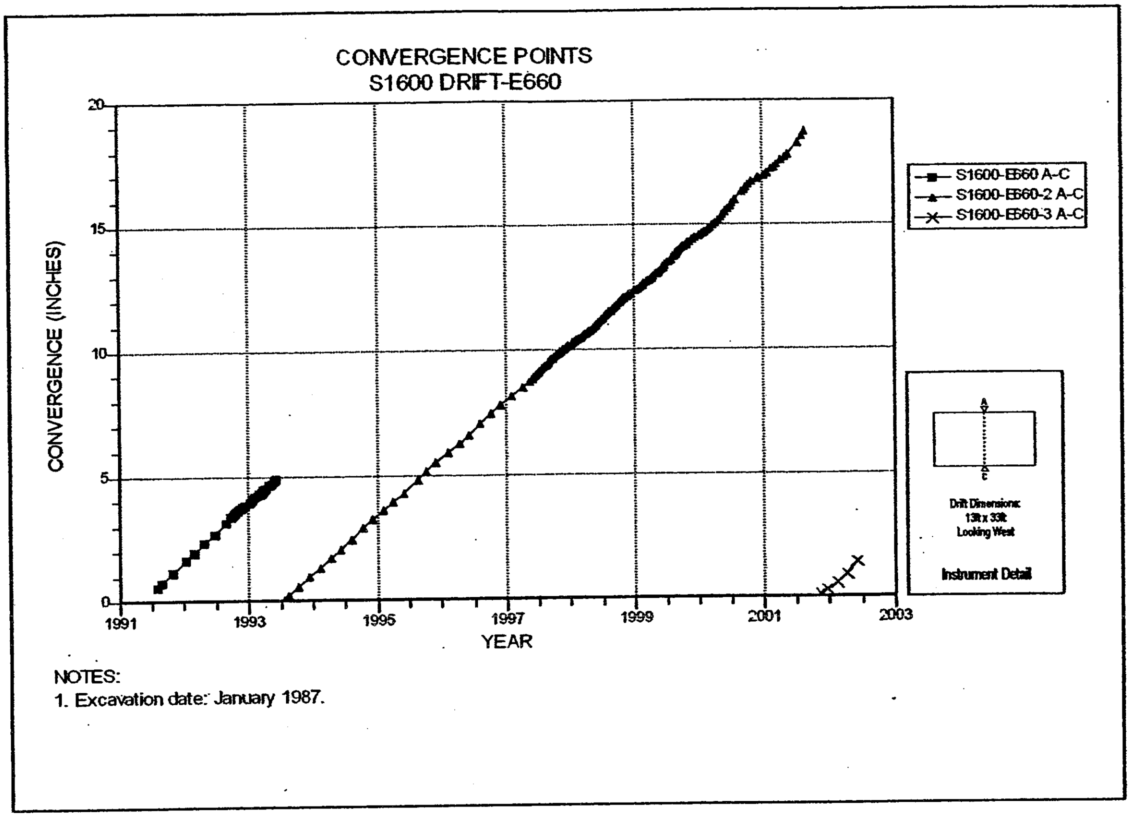


Figure 6-81 Convergence Point Array
S1600 Drift at E660 Drift Intersection (Room 2, Panel 1) – Roof to Floor

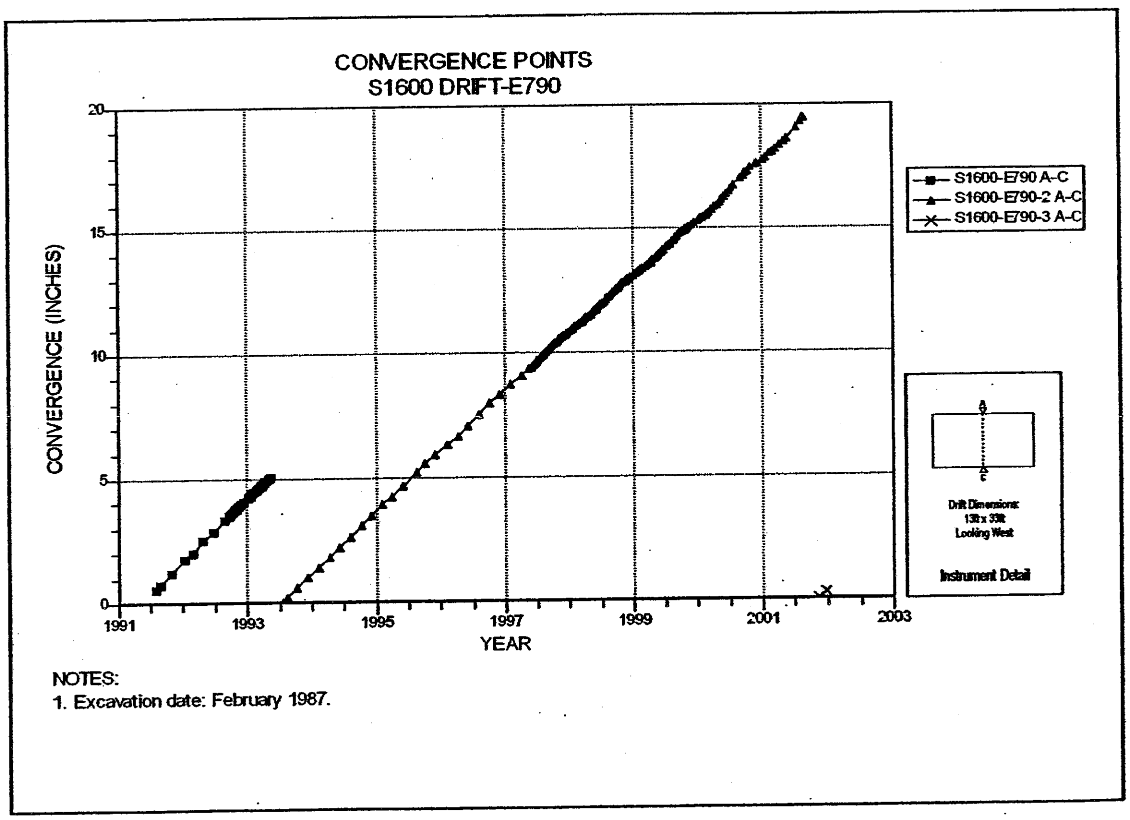


Figure 6-82 Convergence Point Array
S1600 Drift at E790 Drift Intersection (Room 3, Panel 1) – Roof to Floor

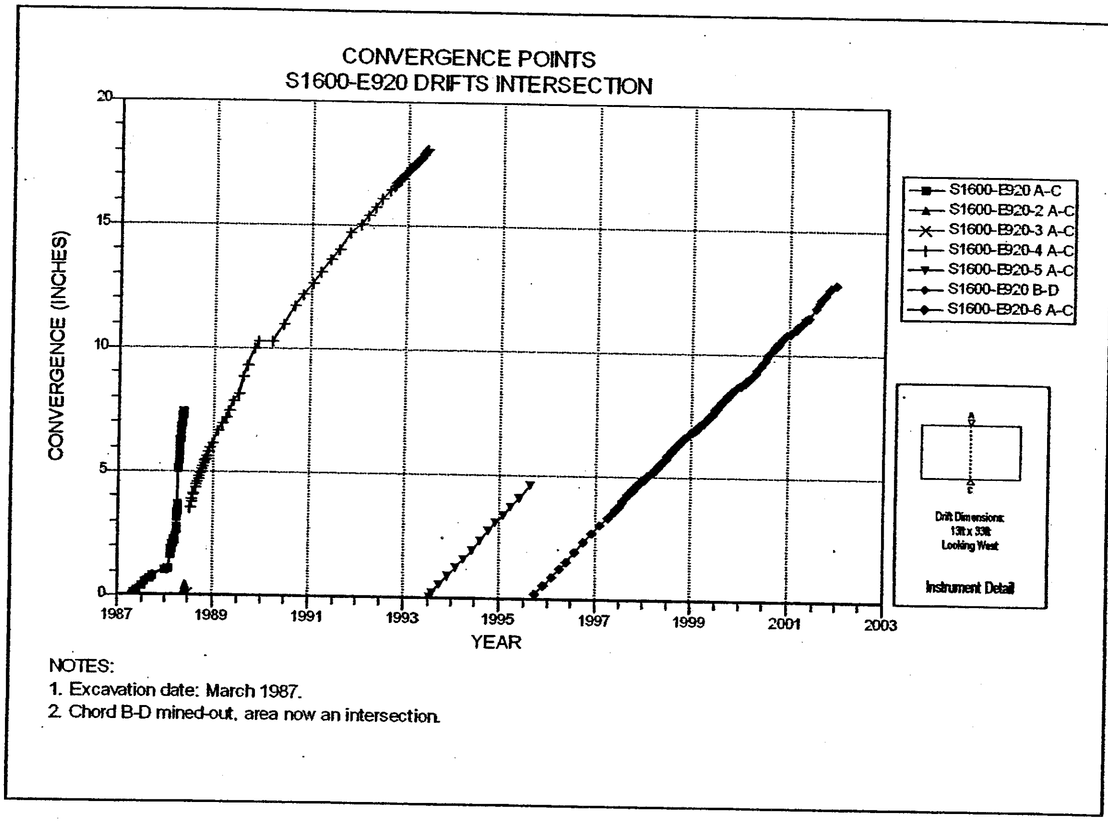


Figure 6-83 Convergence Point Array
S1600 Drift at E920 Drift Intersection (Room 4, Panel 1) – Roof to Floor

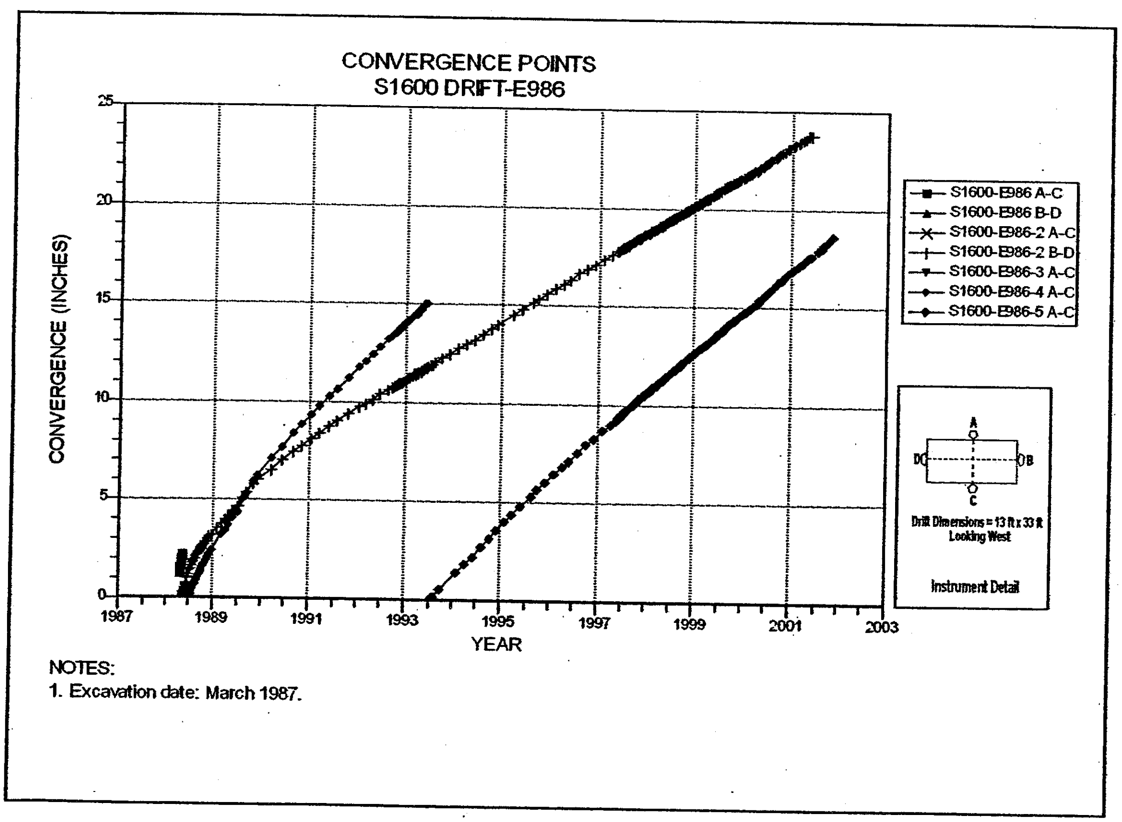


Figure 6-84 Convergence Point Array
S1600 Drift at E986 – All Chords

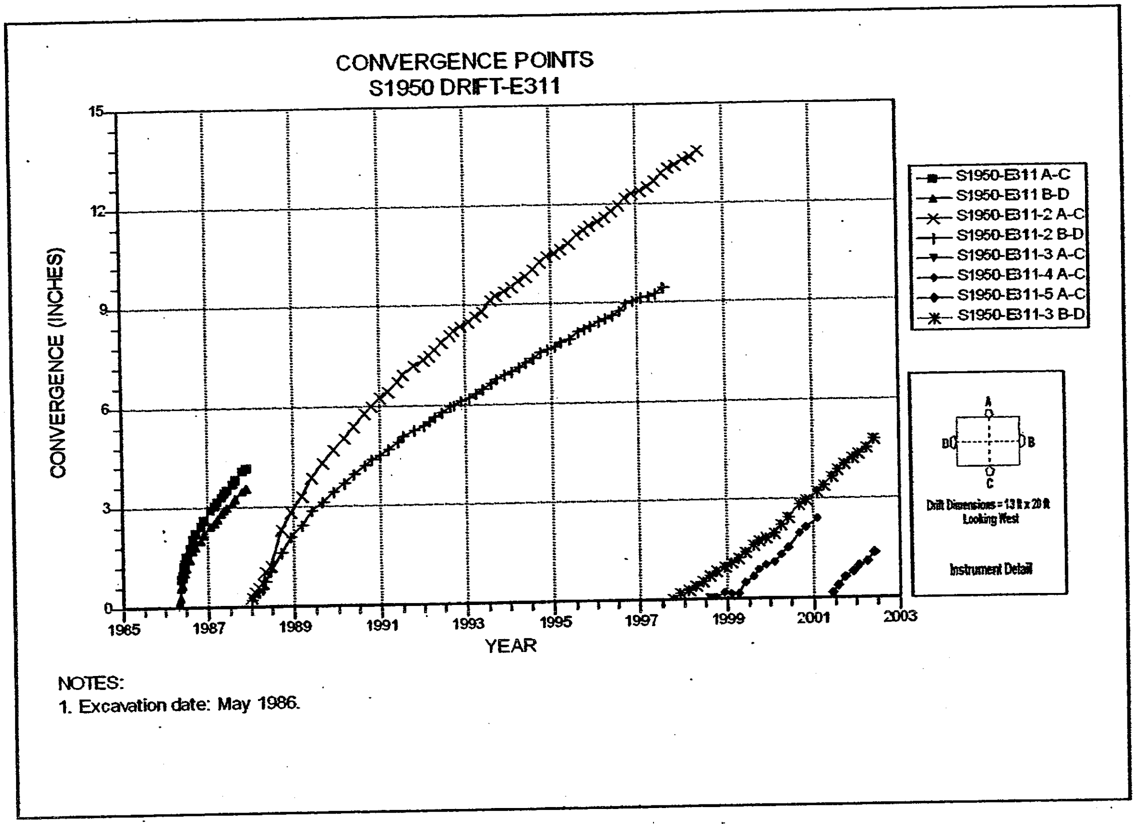


Figure 6-85 Convergence Point Array
S1950 Drift at E311 – All Chords

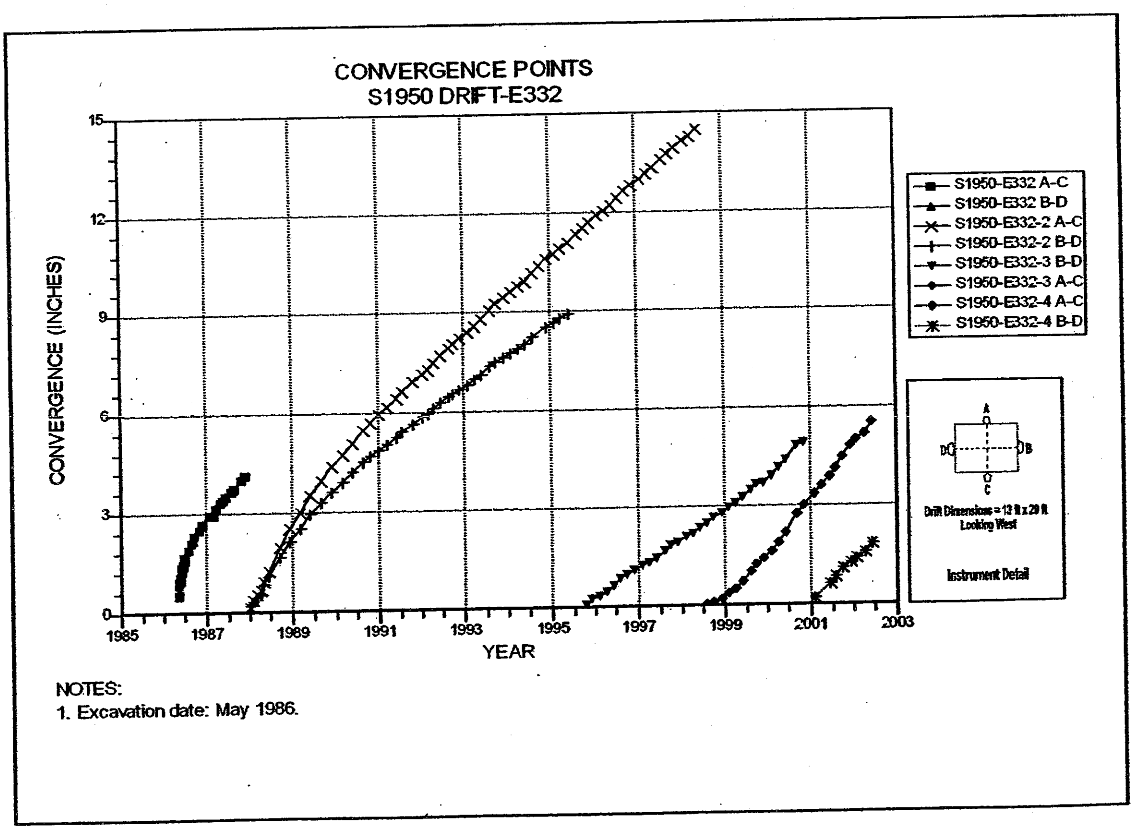
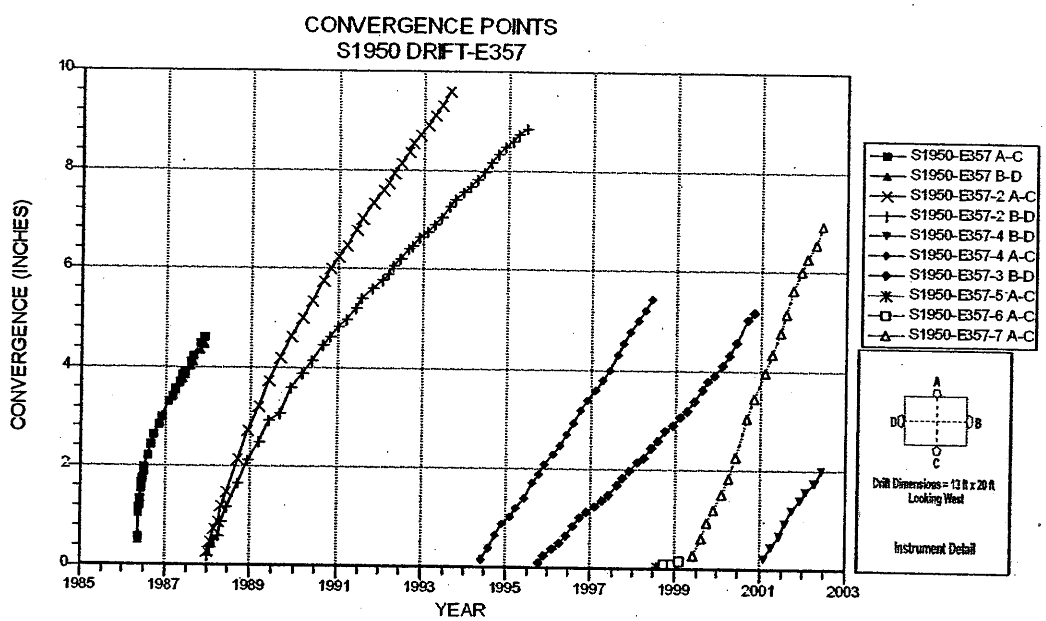
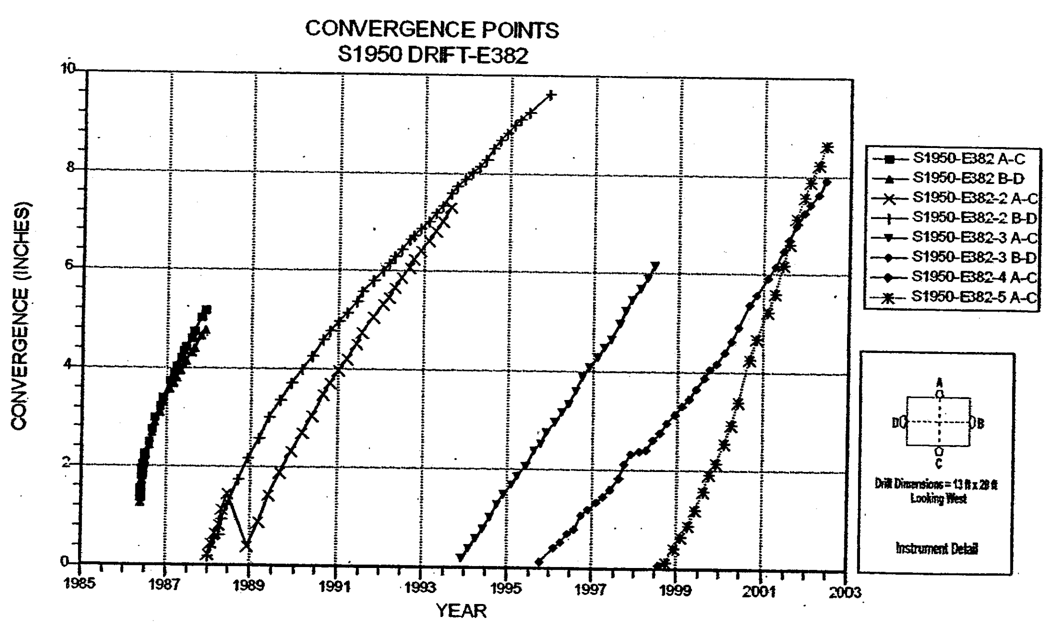


Figure 6-86 Convergence Point Array
S1950 Drift at E332 – All Chords



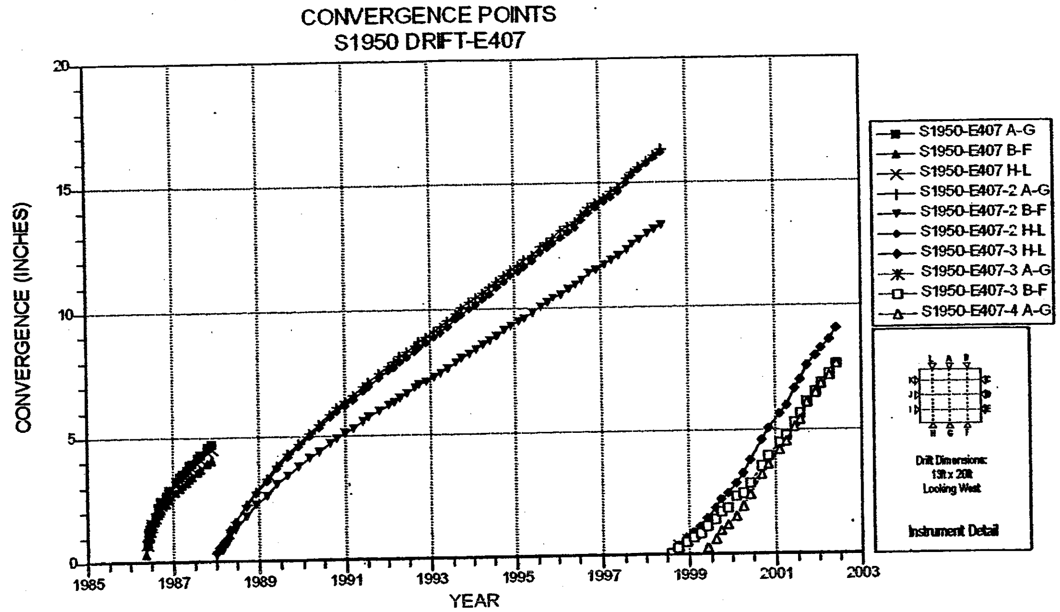
NOTES:
1. Excavation date: May 1986.

Figure 6-87 Convergence Point Array
S1950 Drift at E357 – All Chords



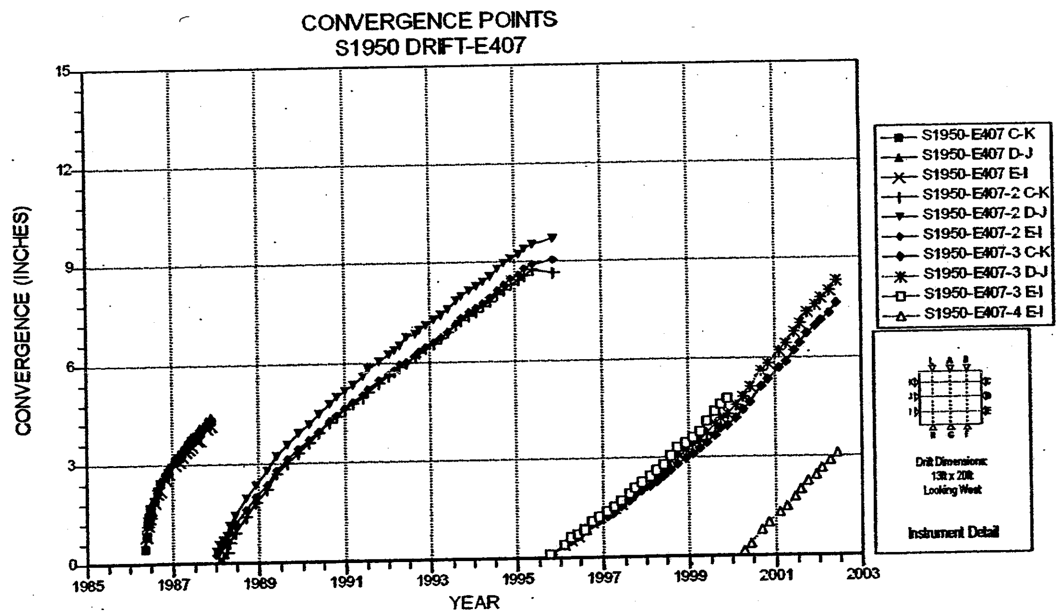
NOTES:
1. Excavation date: May 1986.

Figure 6-88 Convergence Point Array
S1950 Drift at E382 – All Chords



NOTES:
1. Excavation date: May 1986.

Figure 6-89 Convergence Point Array
S1950 Drift at E407 – Roof to Floor



NOTES:
1. Excavation date: May 1986.

Figure 6-90 Convergence Point Array
S1950 Drift at E407 – Rib to Rib

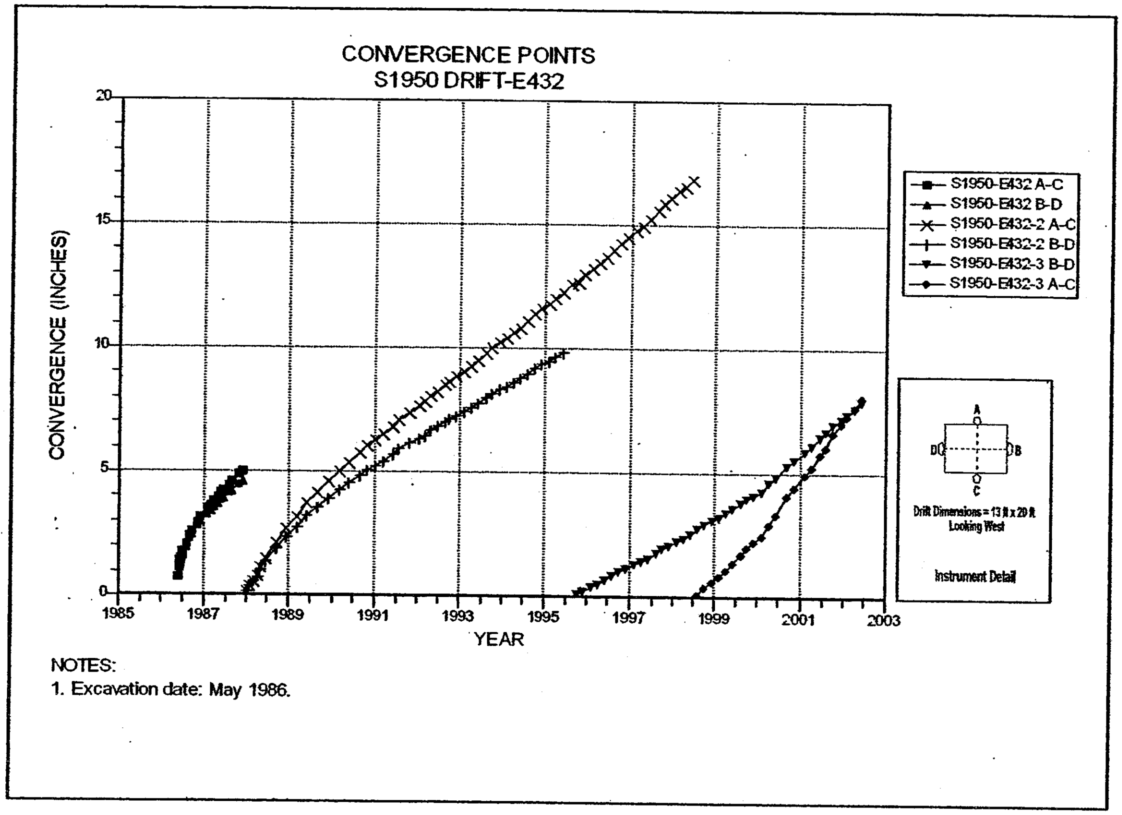


**Figure 6-91 Convergence Point Array
S1950 Drift at E432 – All Chords**

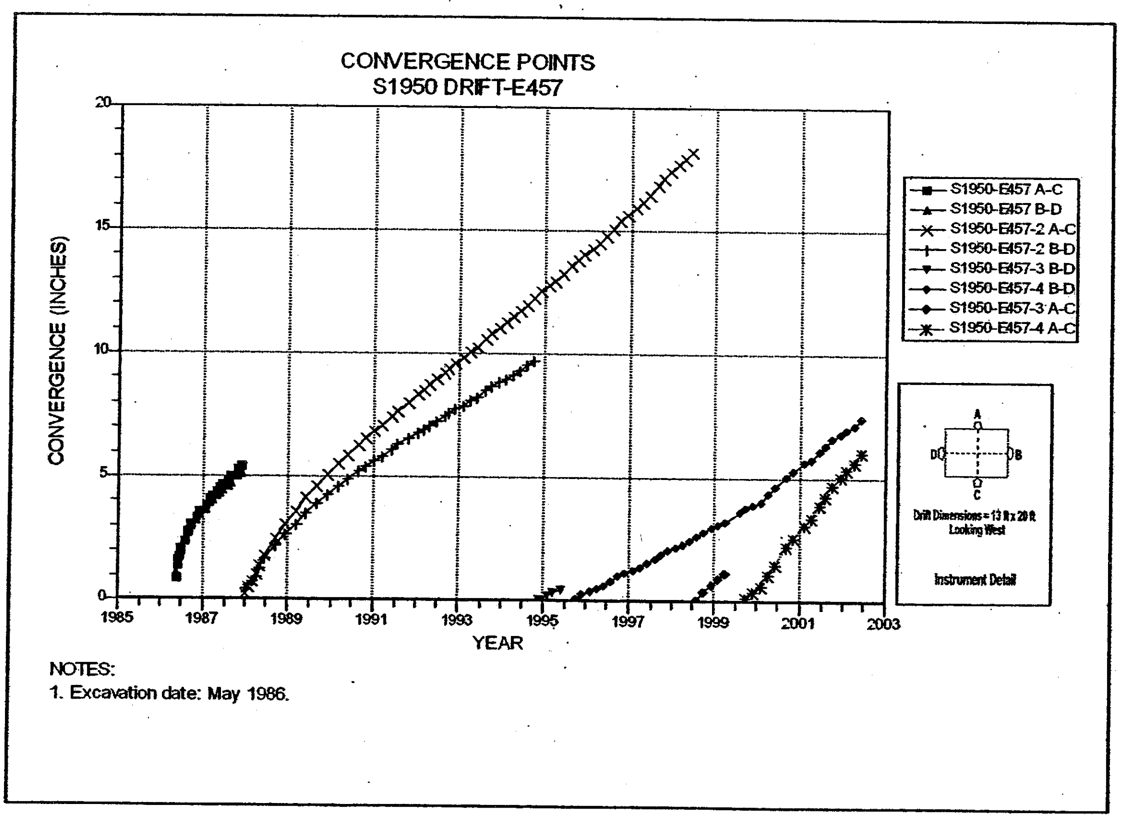
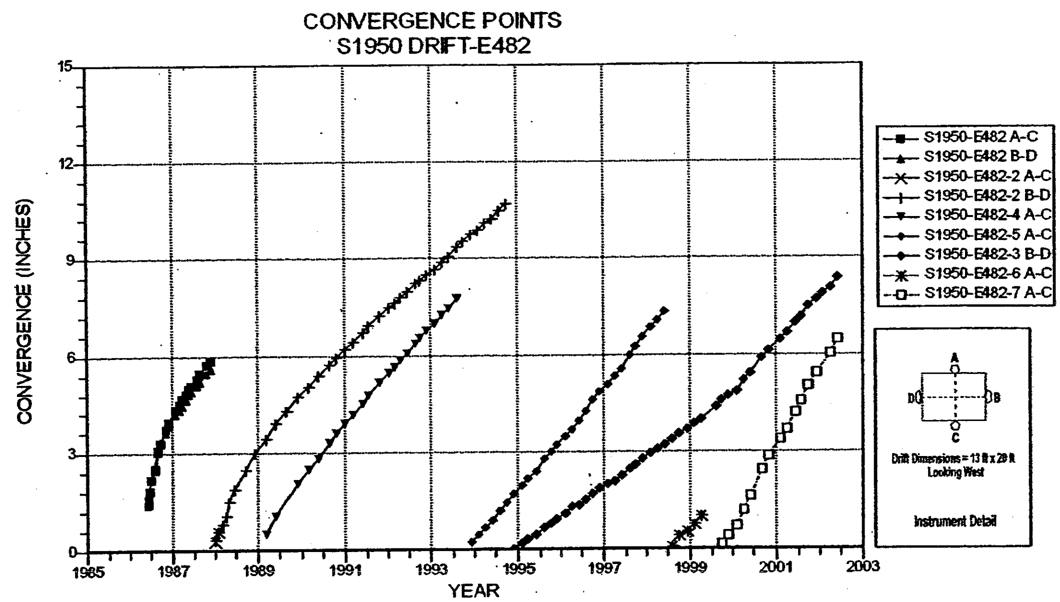
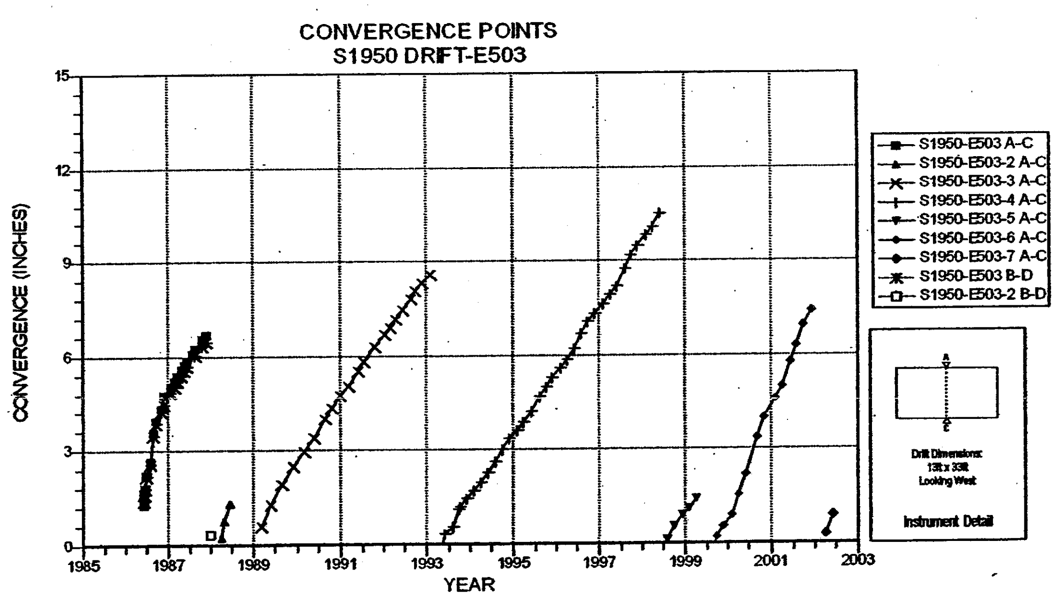


**Figure 6-92 Convergence Point Array
S1950 Drift at E457 – All Chords**



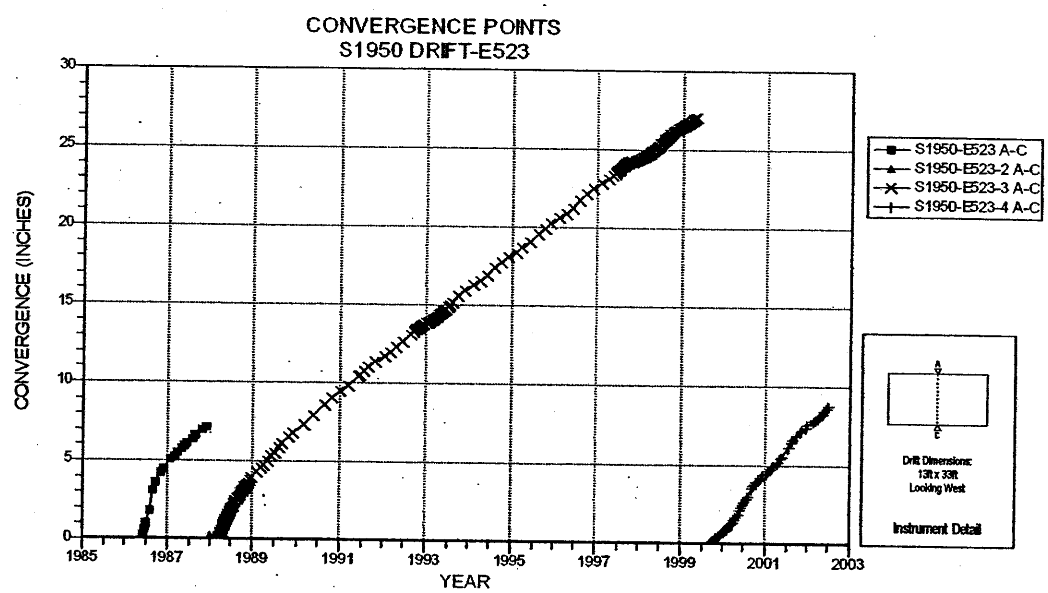
NOTES:
1. Excavation date: May 1986.

Figure 6-93 Convergence Point Array
S1950 Drift at E482 – All Chords



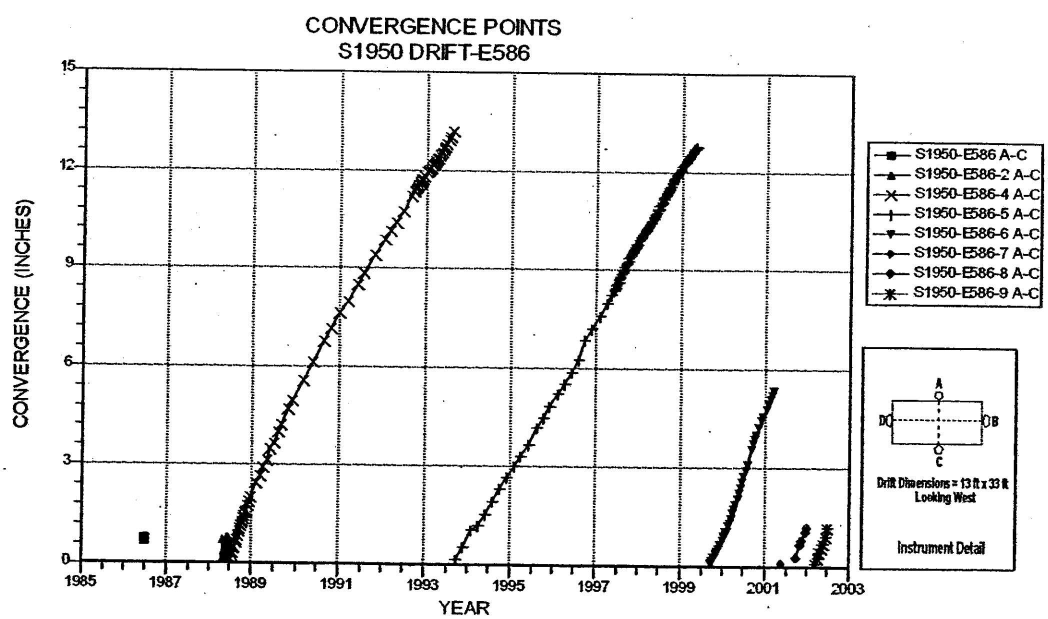
NOTES:
1. Excavation date: May 1986.
2. Chord B-D mined-out, area now an intersection.

Figure 6-94 Convergence Point Array
S1950 Drift at E503 – Roof to Floor



NOTES:
1. Excavation date: May 1986.

Figure 6-95 Convergence Point Array
S1950 Drift at E523 Drift Intersection (Room 1, Panel 1) – Roof to Floor



NOTES:
1. Excavation date: June 1986.

Figure 6-96 Convergence Point Array
S1950 Drift at E586 – Roof to Floor

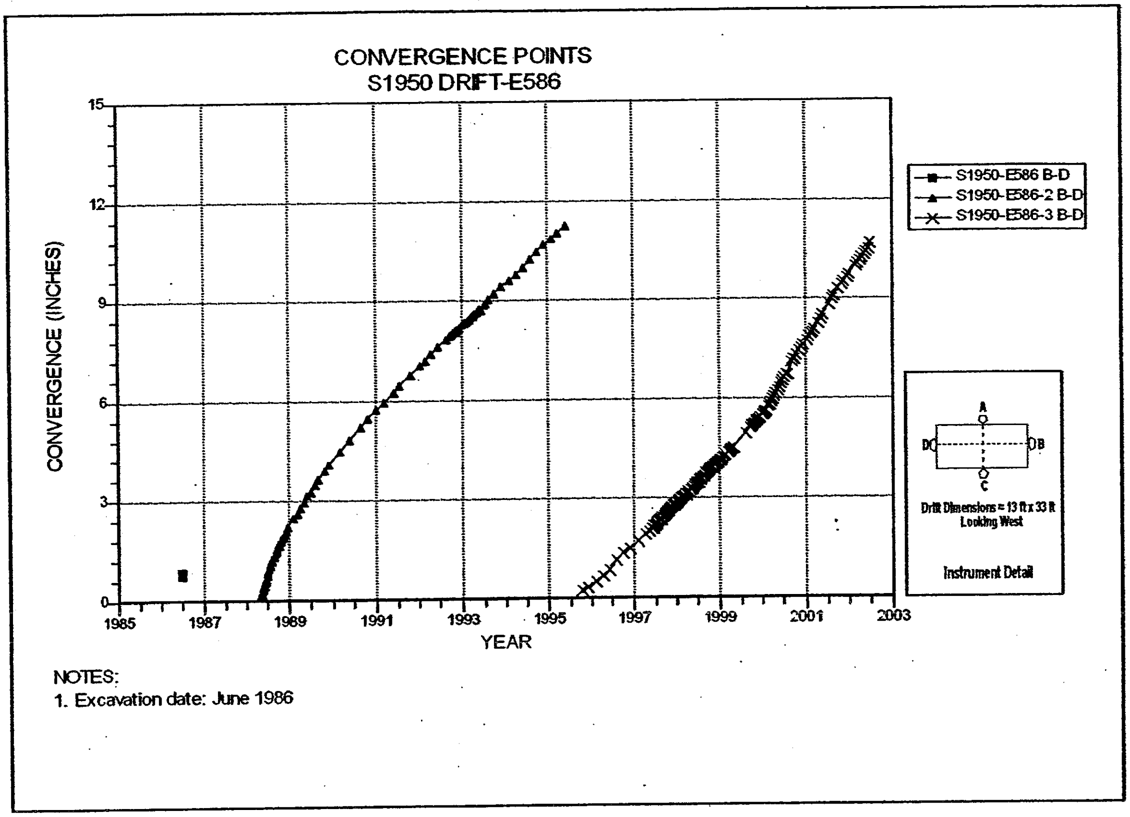


Figure 6-97 Convergence Point Array
S1950 Drift at E586 – Rib to Rib

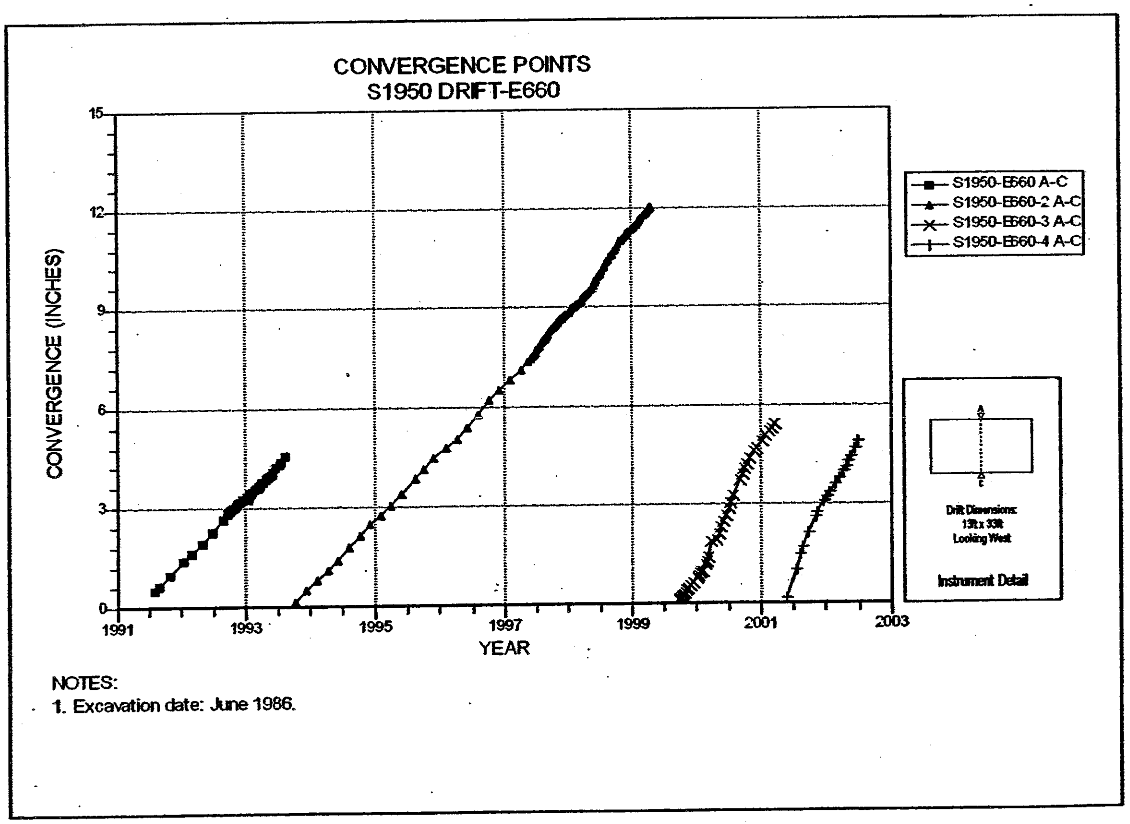


Figure 6-98 Convergence Point Array
S1950 Drift at E660 Drift Intersection (Room 2, Panel 1) – Roof to Floor

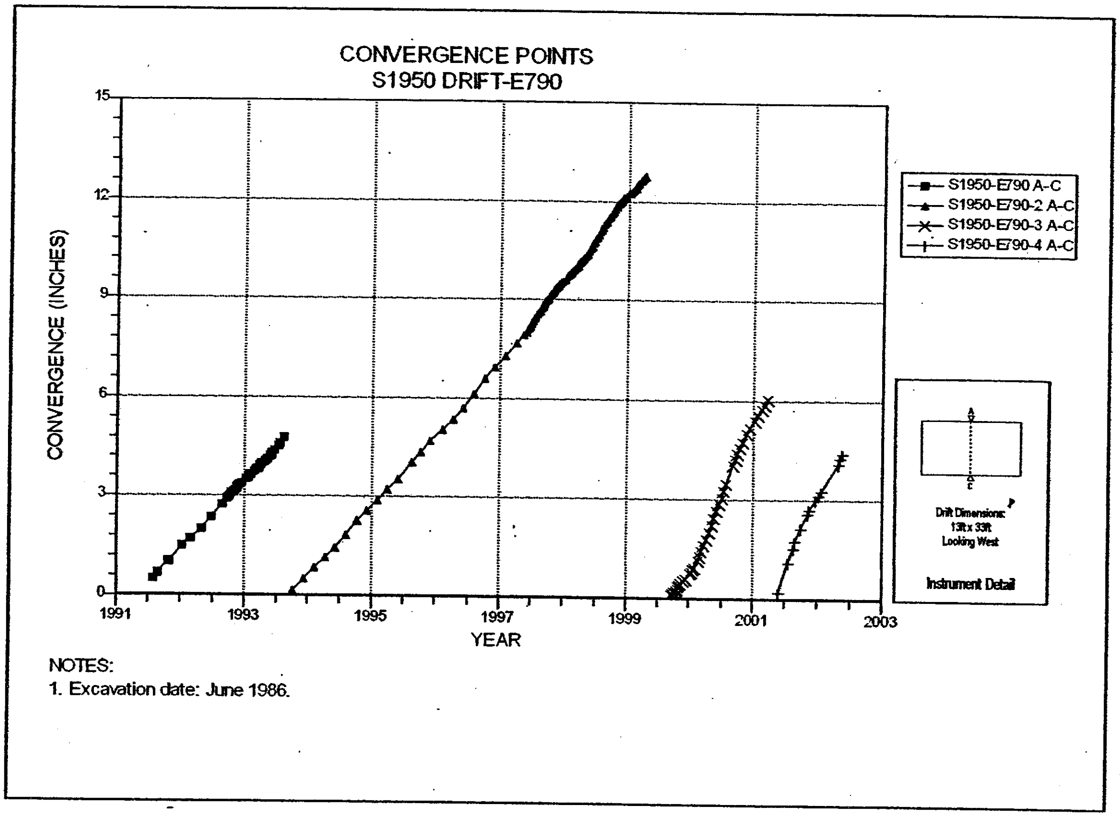


Figure 6-99 Convergence Point Array
S1950 Drift at E790 Drift Intersection (Room 3, Panel 1) – Roof to Floor

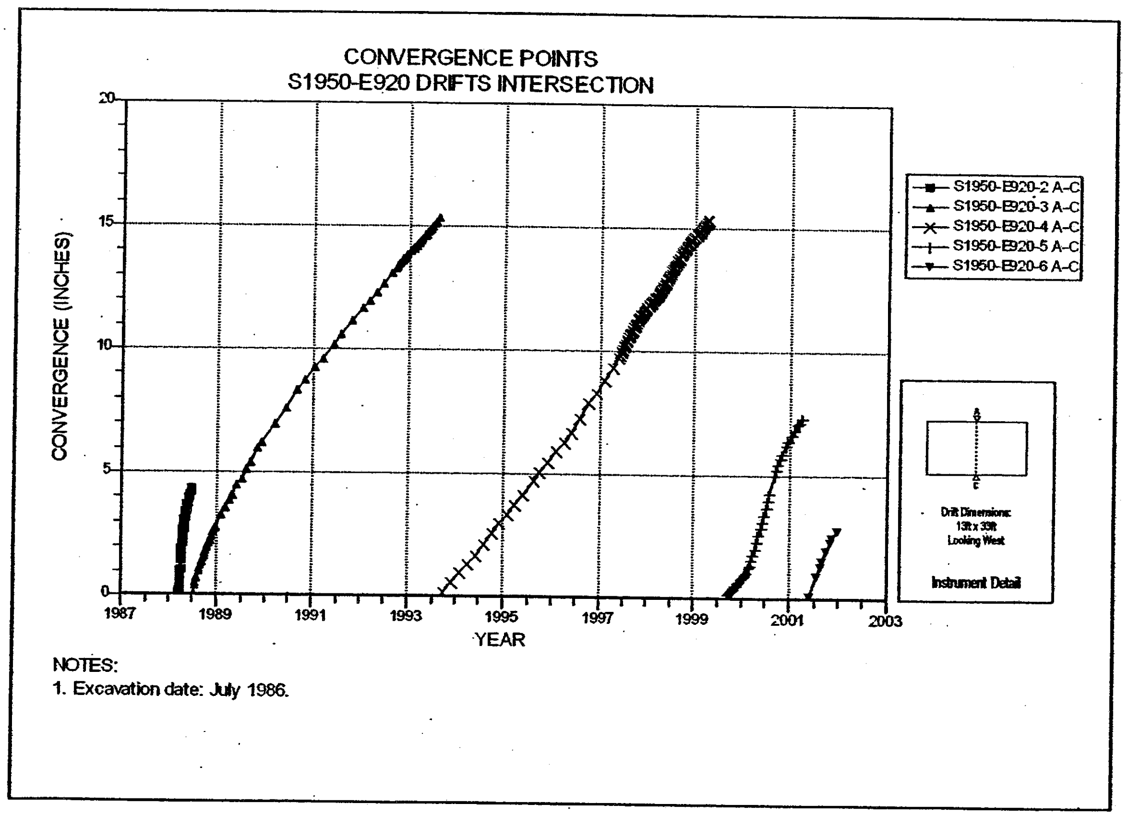


Figure 6-100 Convergence Point Array
S1950 Drift at E920 Drift Intersection (Room 4, Panel 1) – Roof to Floor

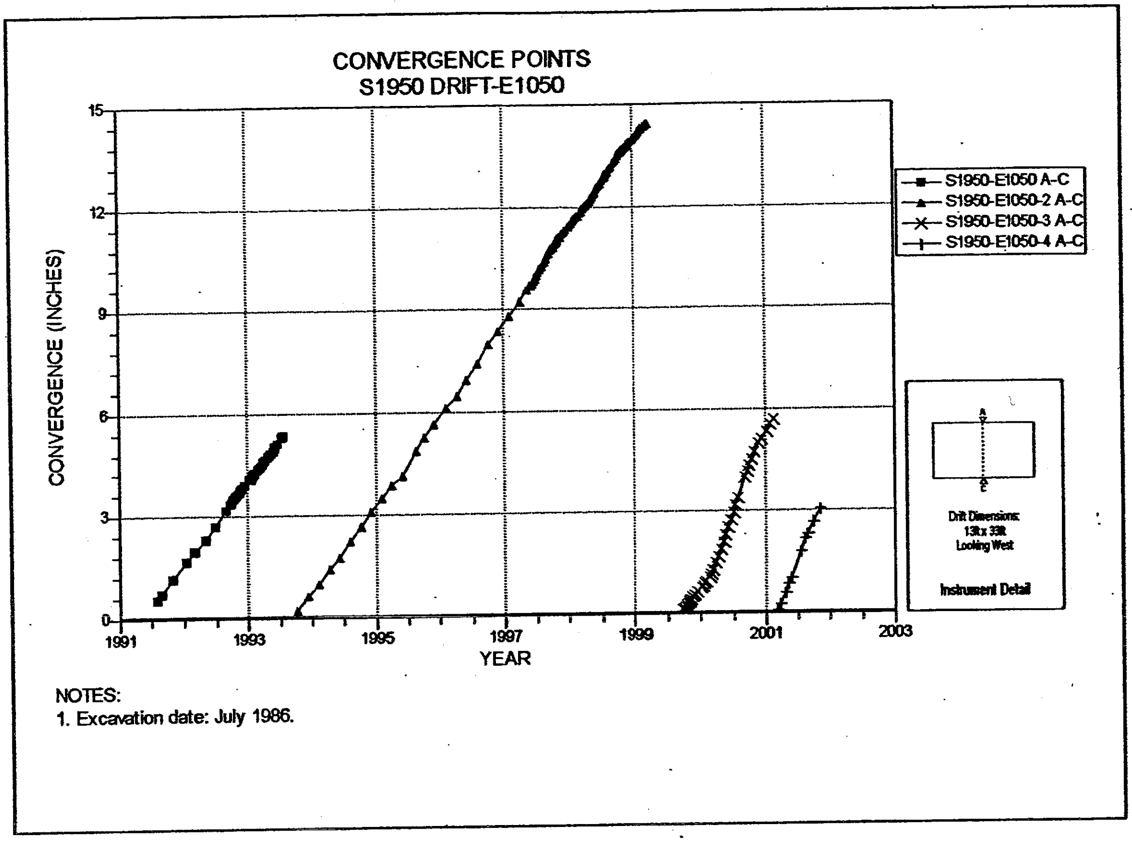


Figure 6-101 Convergence Point Array
S1950 Drift at E1050 Drift Intersection (Room 5, Panel 1) – Roof to Floor

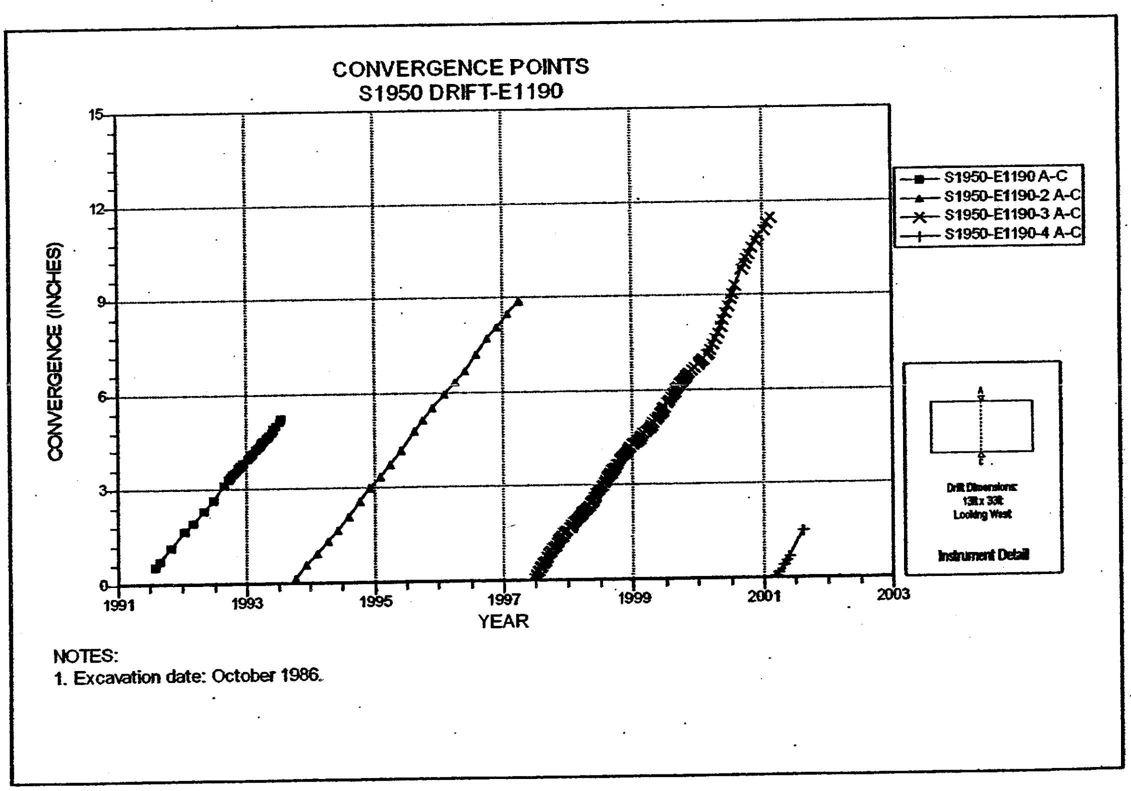


Figure 6-102 Convergence Point Array
S1950 Drift at E1190 Drift Intersection (Room 6, Panel 1) – Roof to Floor

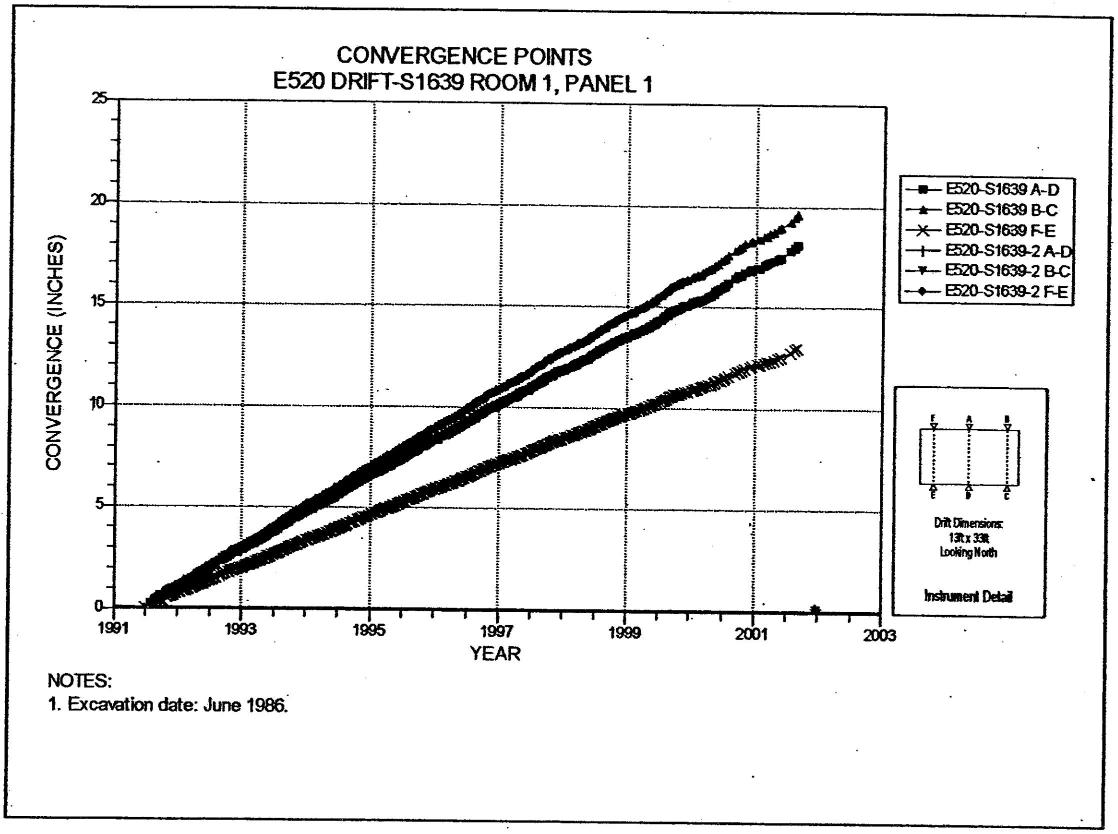


Figure 6-103 Convergence Point Array
Room 1, Panel 1 at S1639 – Roof to Floor

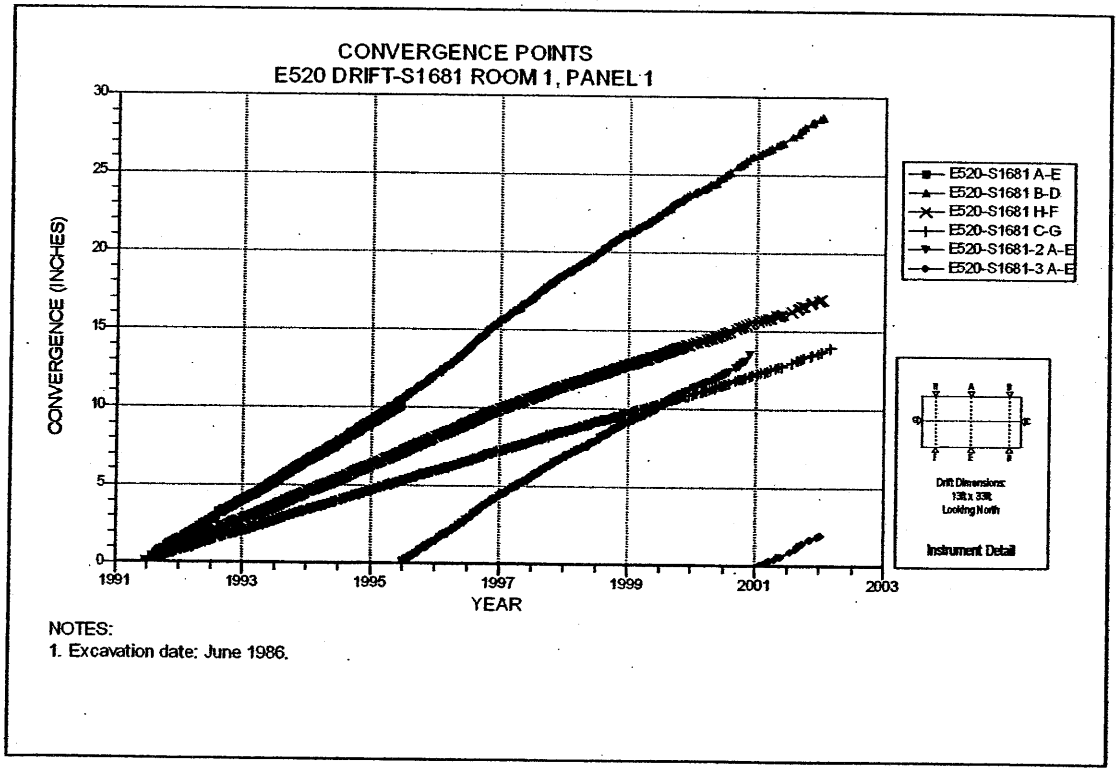


Figure 6-104 Convergence Point Array
Room 1, Panel 1 at S1681 – All Chords

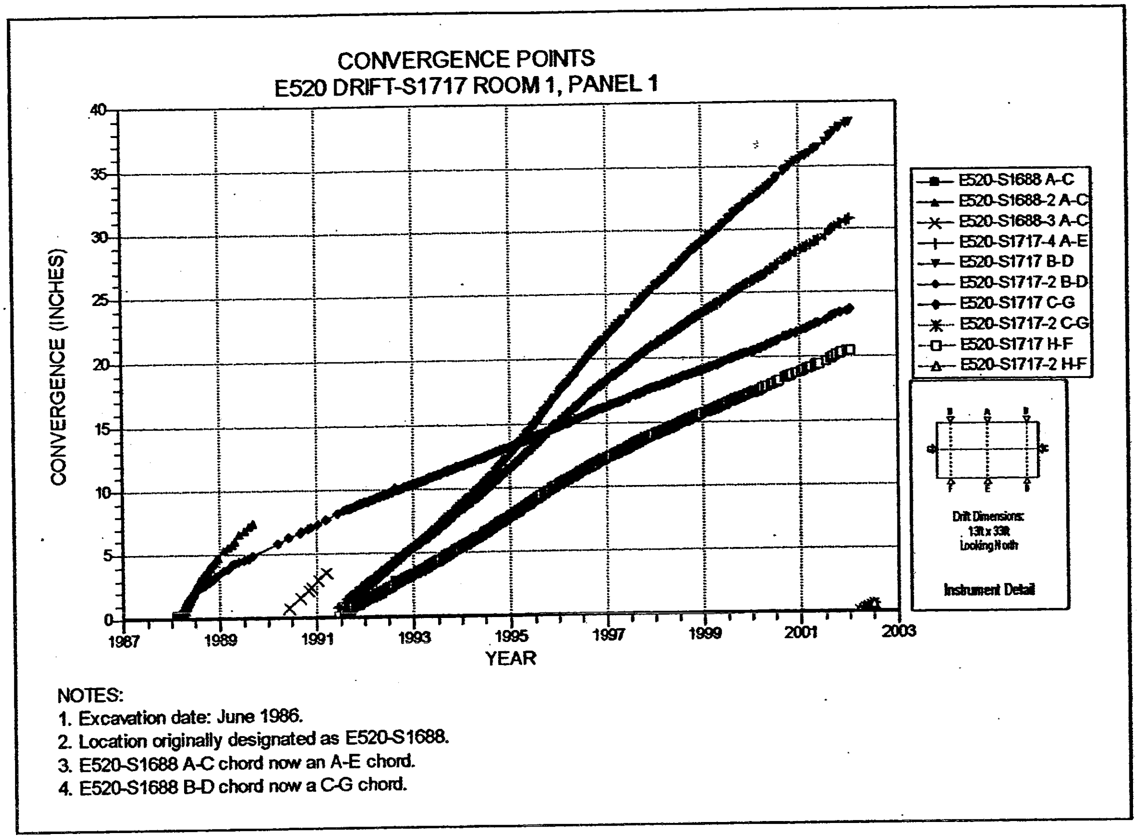


Figure 6-105 Convergence Point Array Room 1, Panel 1 at S1717 – All Chords

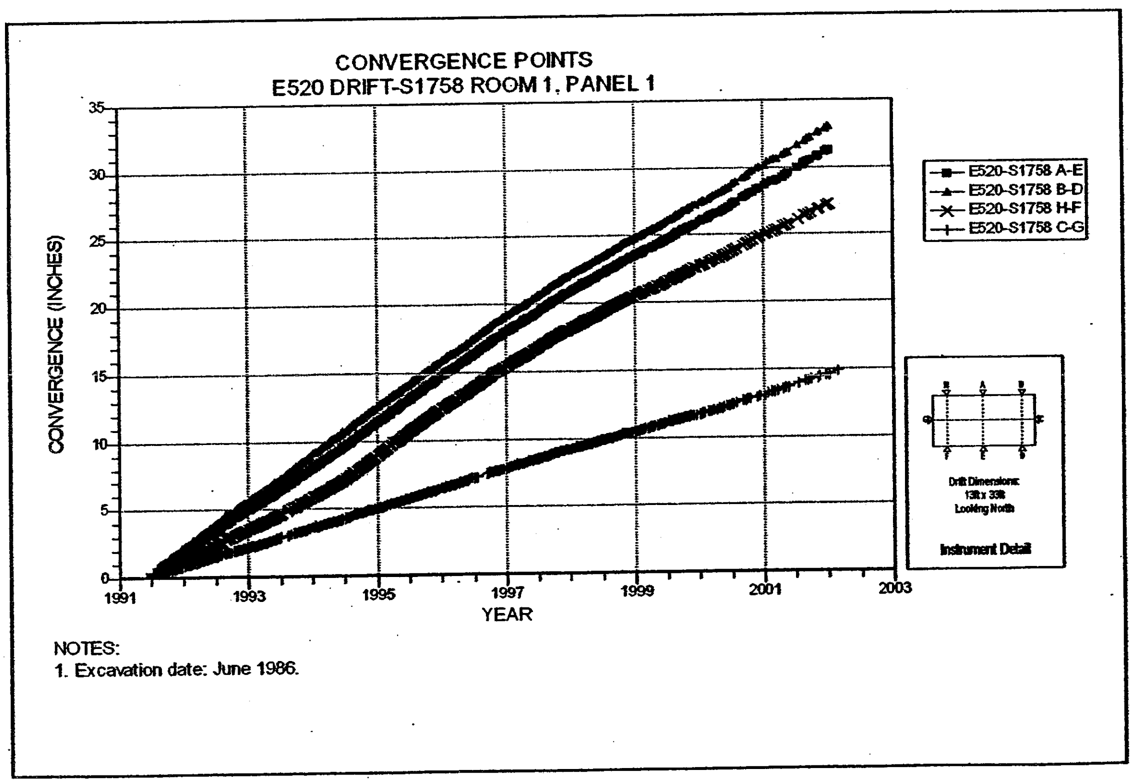
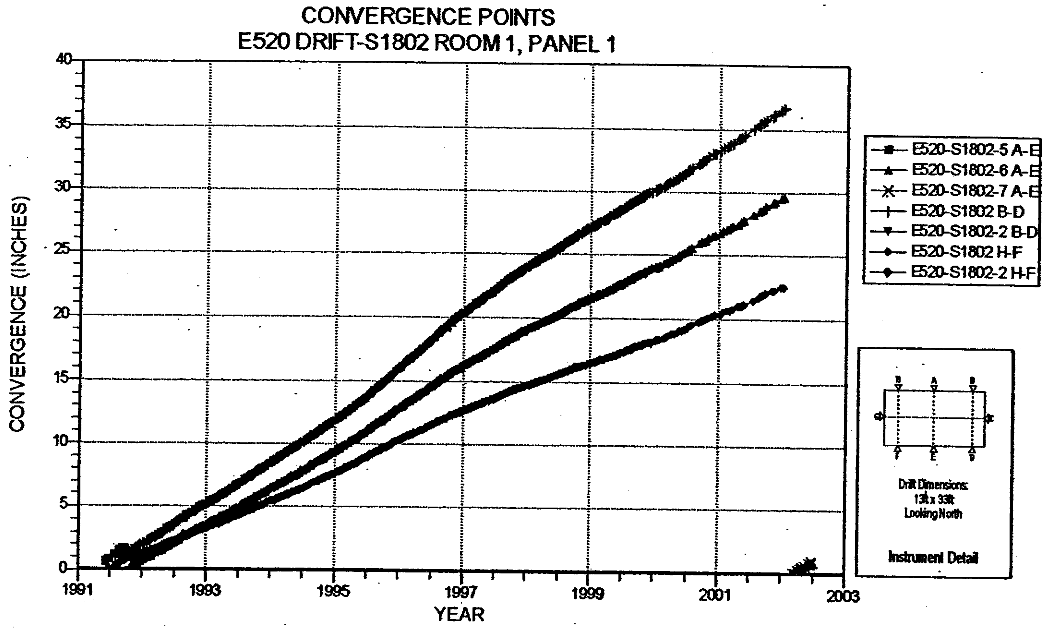
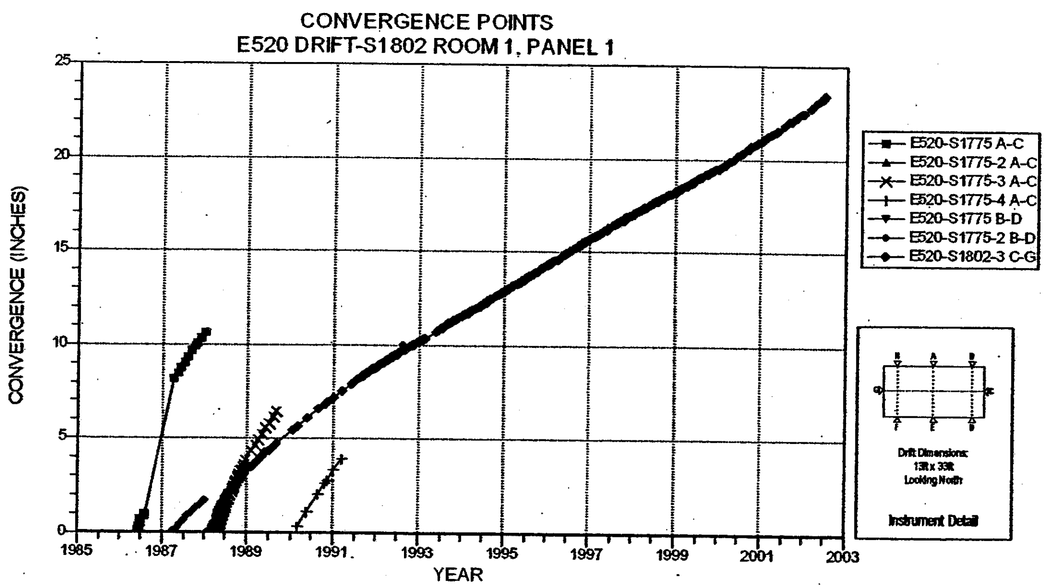


Figure 6-106 Convergence Point Array Room 1, Panel 1 at S1758 – All Chords



NOTES:
1. Excavation date: May 1986.
2. Location originally designated as E520-S1775.

Figure 6-107 Convergence Point Array Room 1, Panel 1 at S1802 – Roof to Floor



NOTES:
1. Excavation date: May 1986.
2. Location originally designated as E520-S1775.
3. E520-S1775 B-D chord now E520-S1802 C-G chord.

Figure 6-108 Convergence Point Array Room 1, Panel 1 at S1802 – Rib to Rib

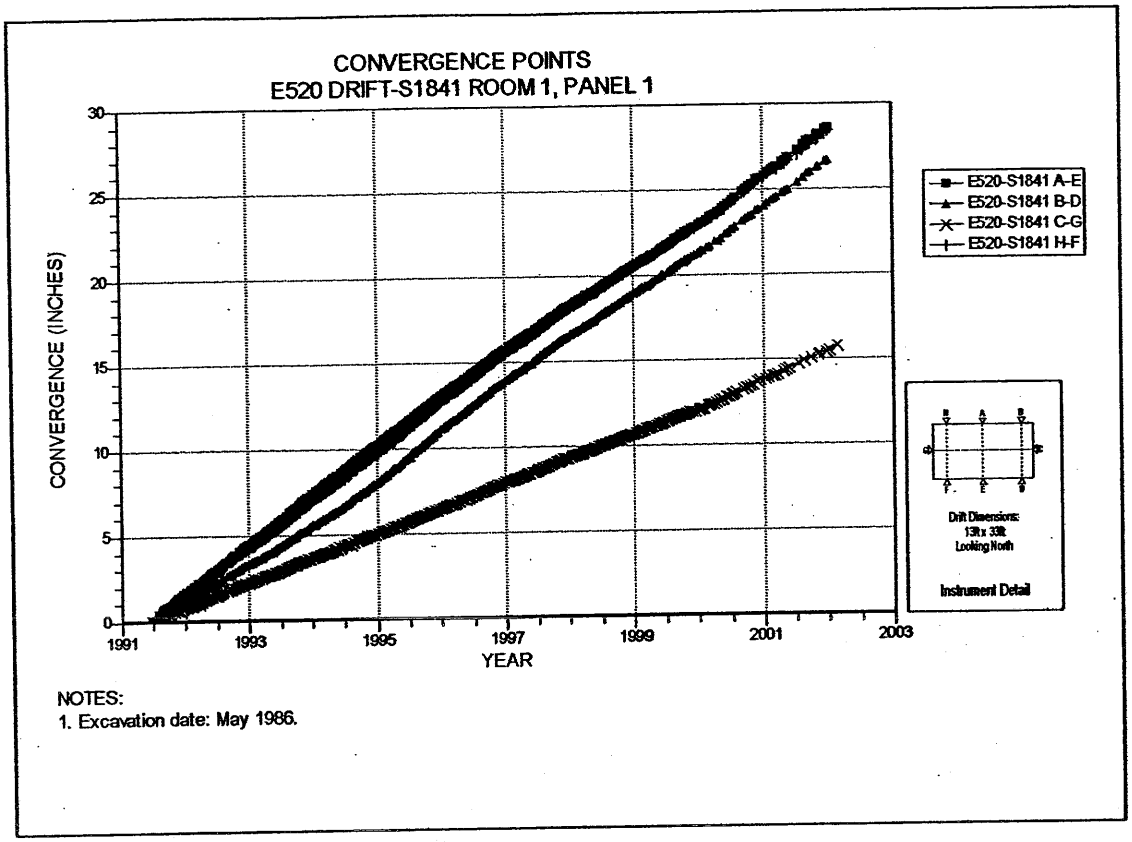


Figure 6-109 Convergence Point Array
Room 1, Panel 1 at S1841 – All Chords

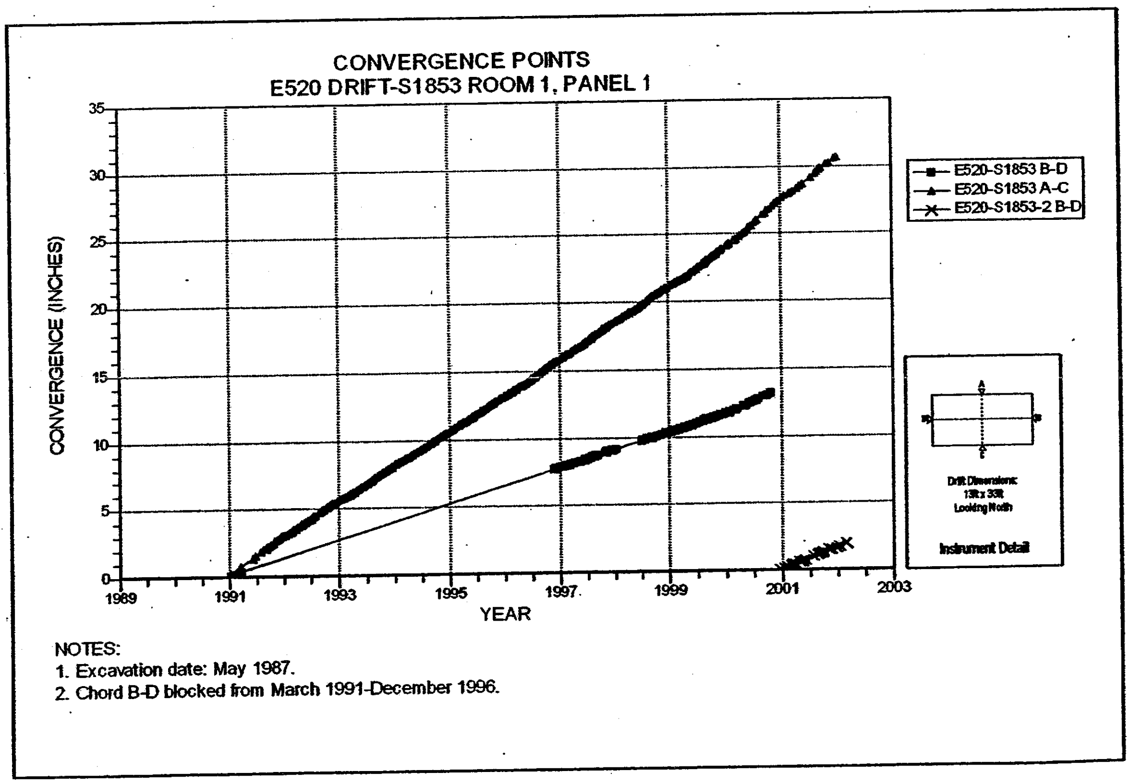


Figure 6-110 Convergence Point Array
Room 1, Panel 1 at S1853 – All Chords

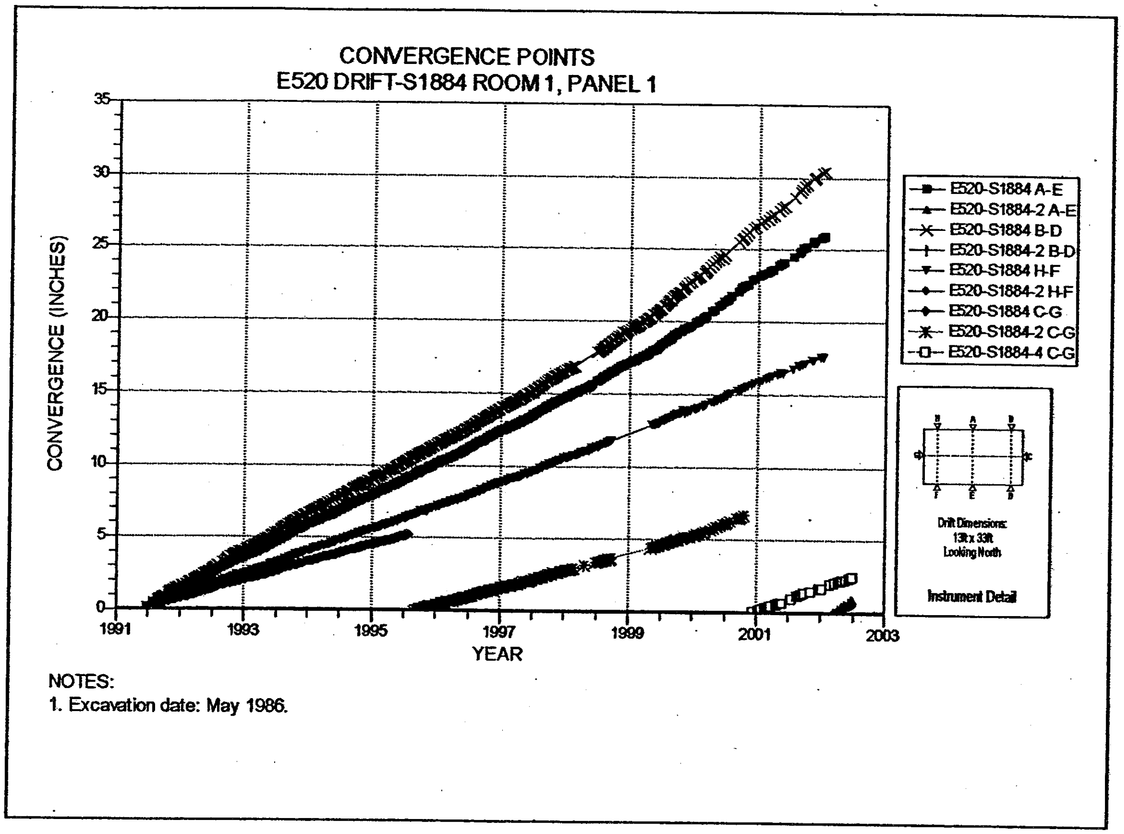


Figure 6-111 Convergence Point Array
Room 1, Panel 1 at S1884 – All Chords

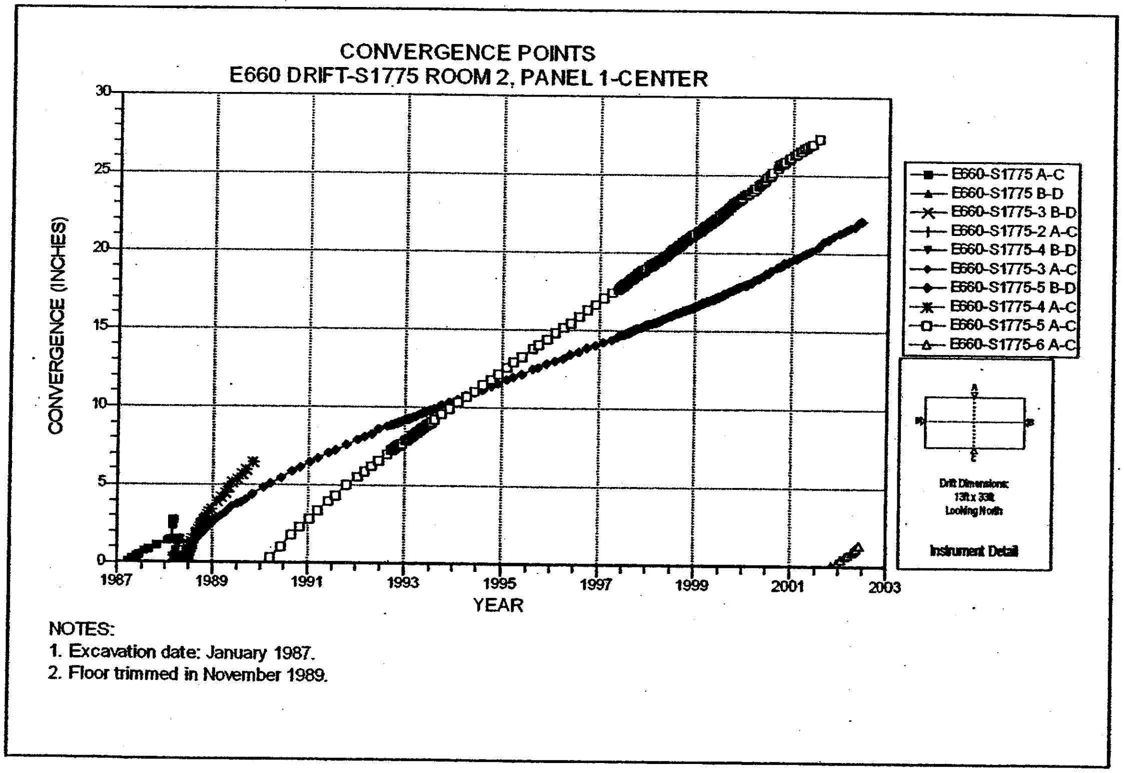
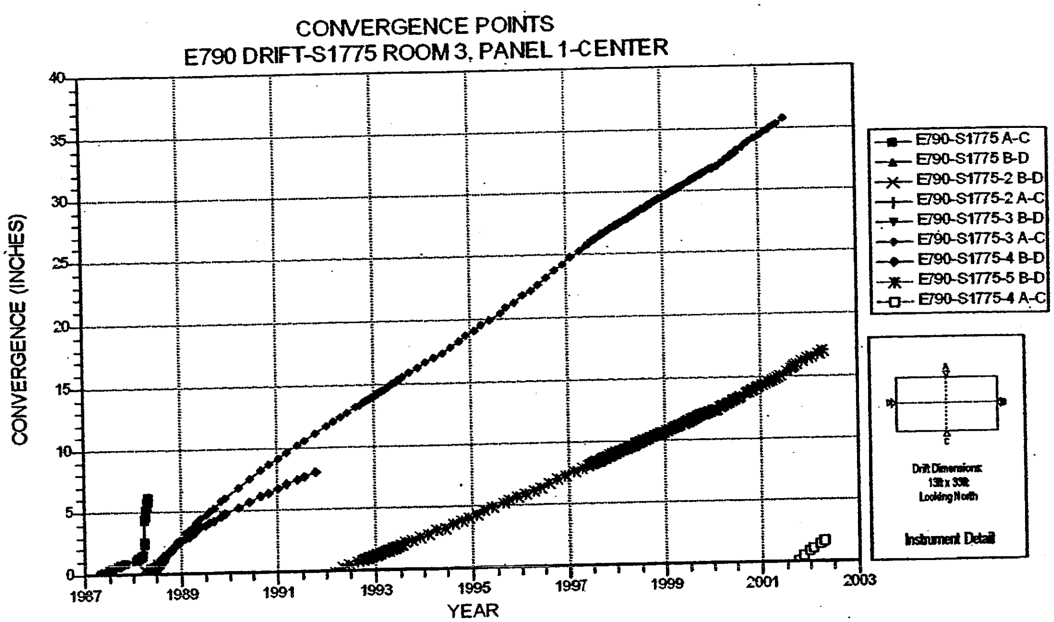
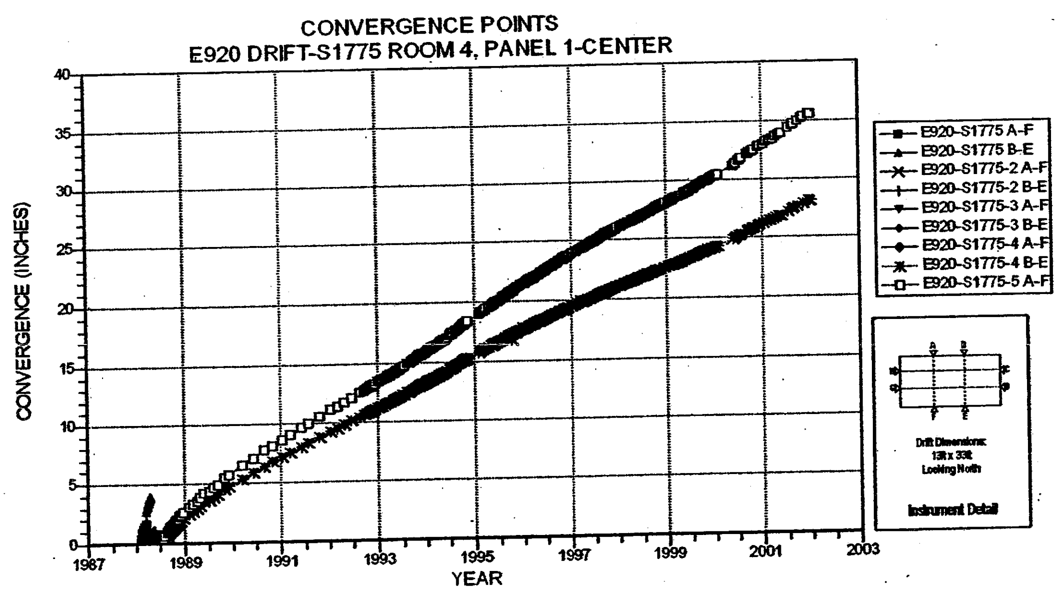


Figure 6-112 Convergence Point Array
Room 2, Panel 1 at S1775 – Room Center – All Chords



NOTES:
1. Excavation date: February 1987.

Figure 6-113 Convergence Point Array
Room 3, Panel 1 at S1775 – Room Center – All Chords



NOTES:
1. Excavation date: February 1988.

Figure 6-114 Convergence Point Array
Room 4, Panel 1 at S1775 – Room Center – Roof to Floor

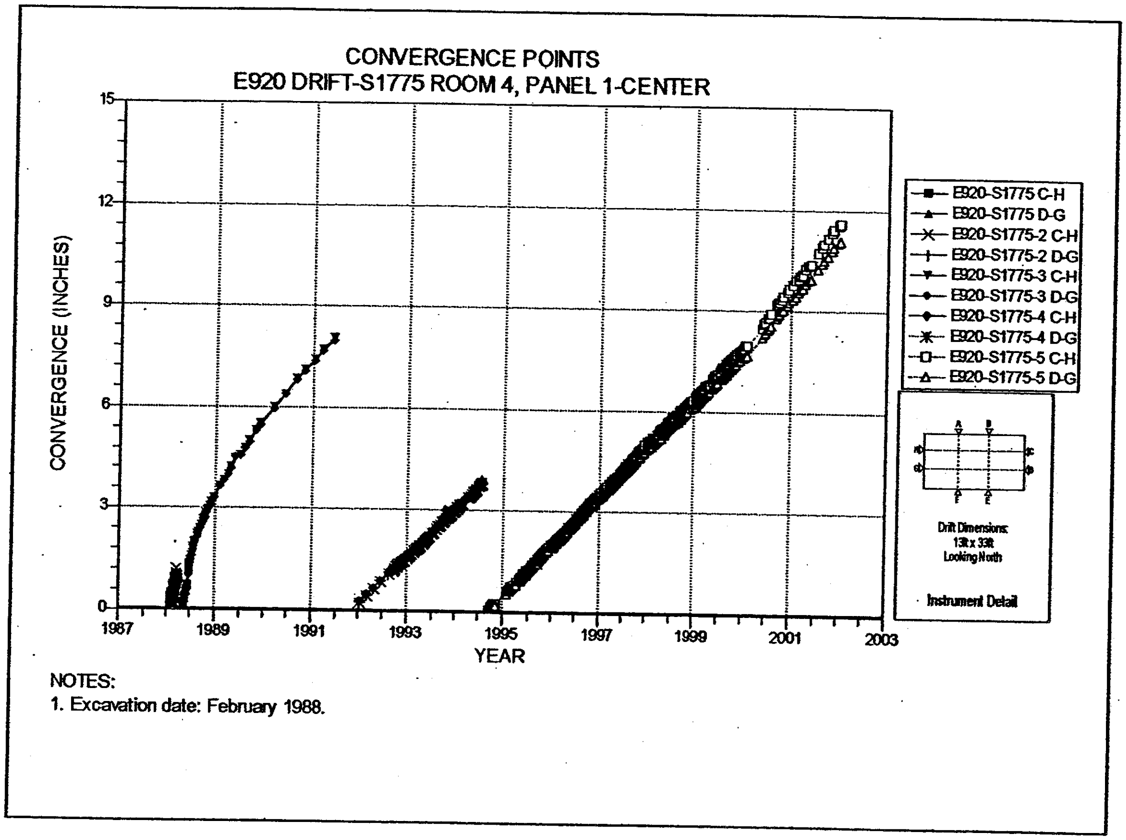


Figure 6-115 Convergence Point Array
Room 4, Panel 1 at S1775 – Room Center – Rib to Rib

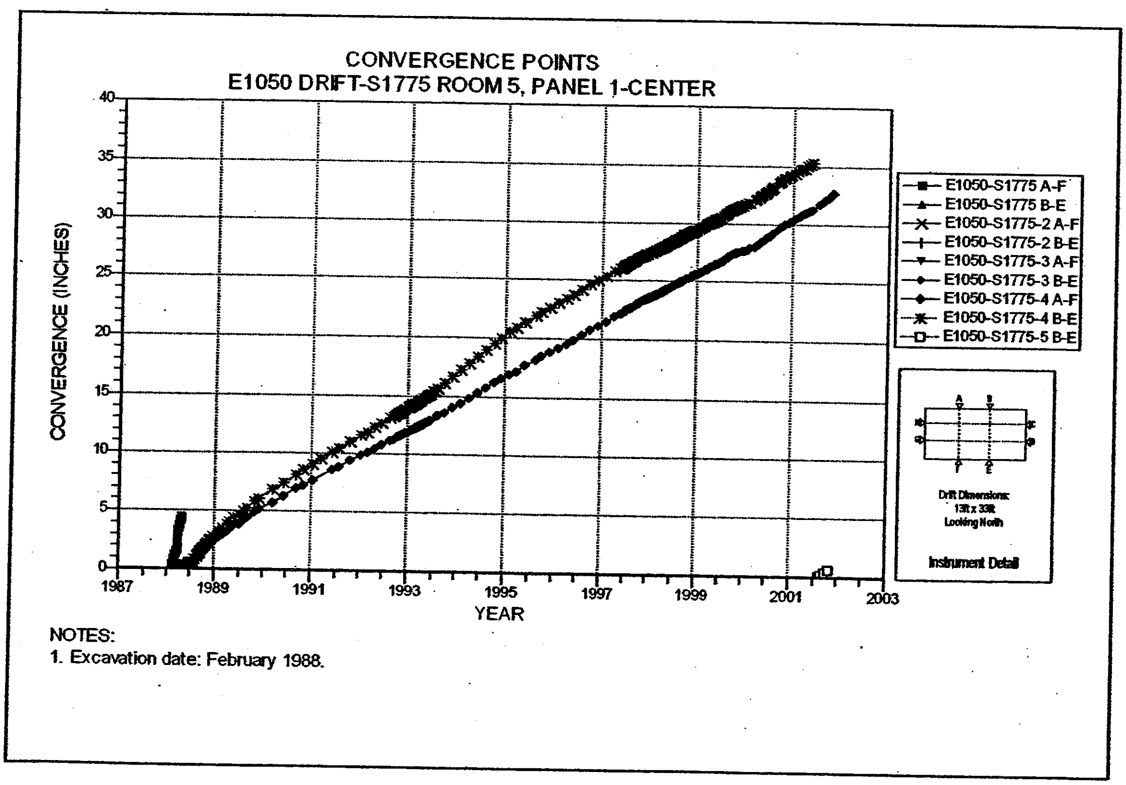


Figure 6-116 Convergence Point Array
Room 5, Panel 1 at S1775 – Room Center – Roof to Floor

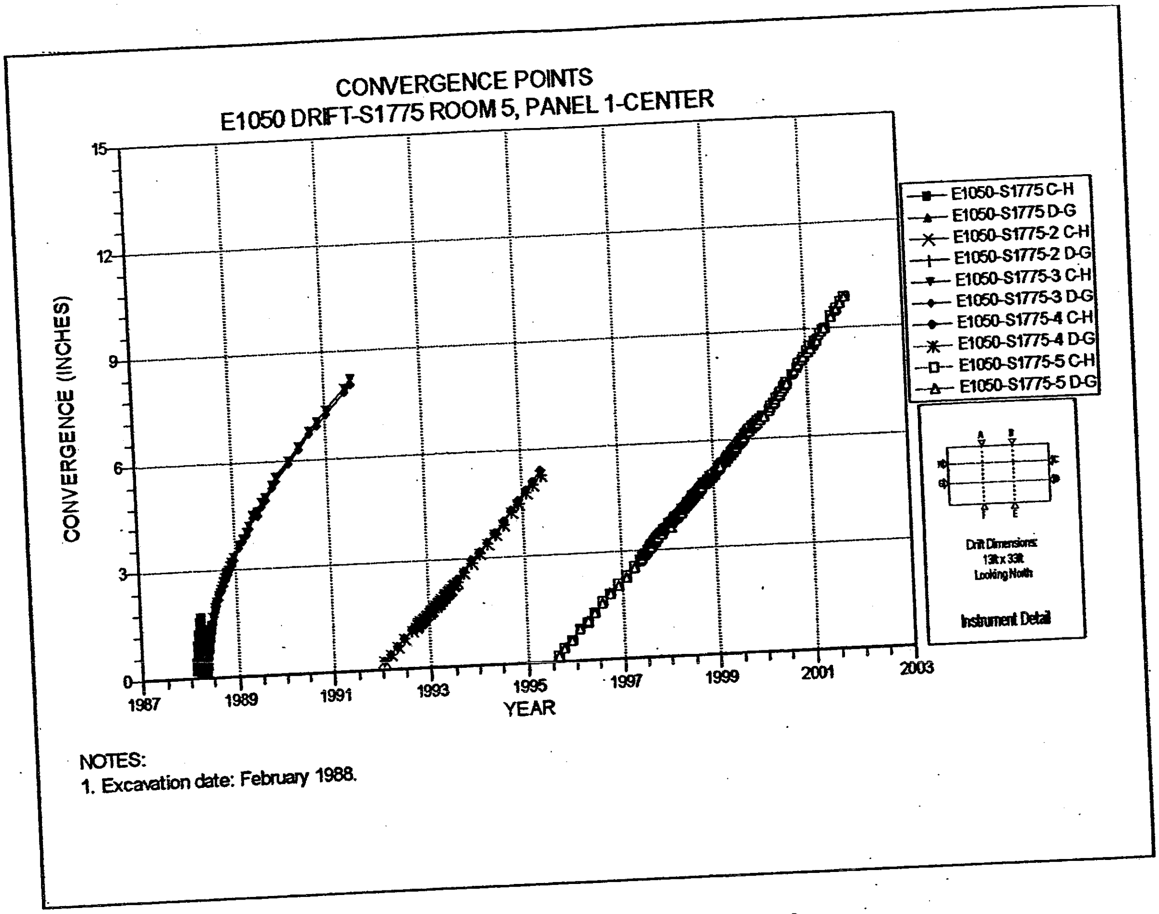


Figure 6-117 Convergence Point Array
Room 5, Panel 1 at S1775 – Room Center – Rib to Rib

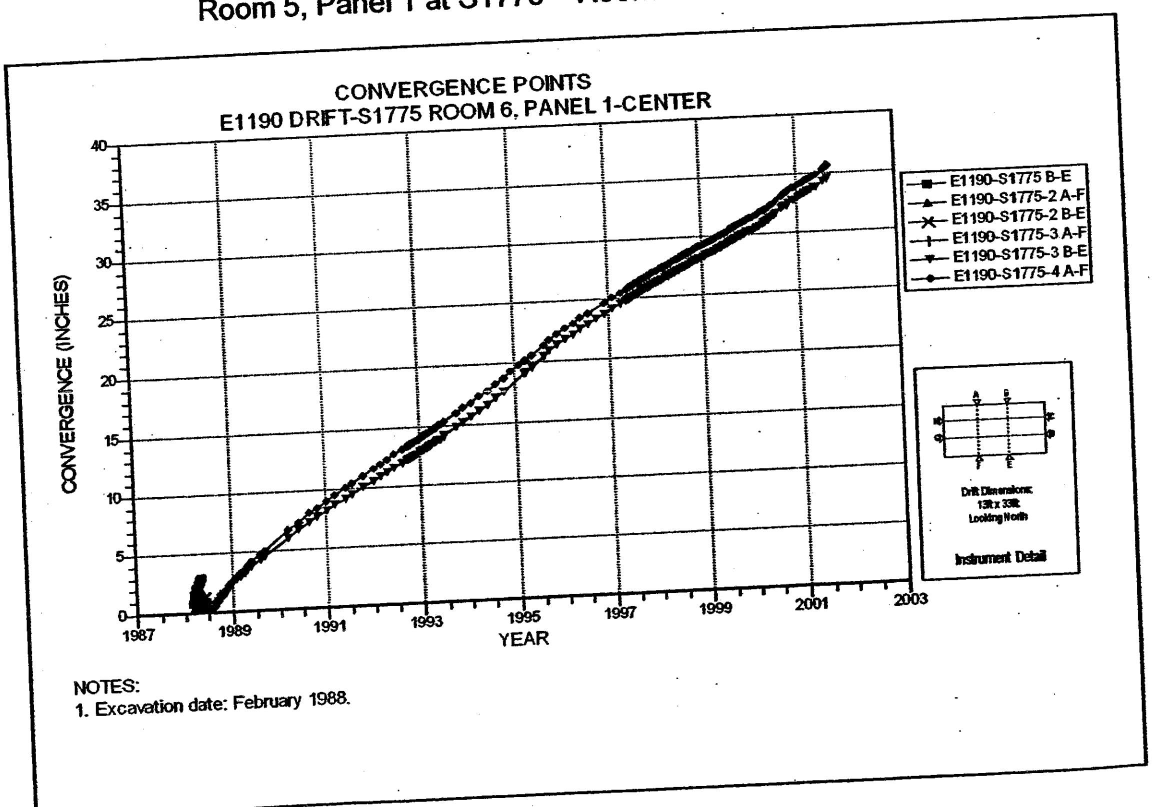
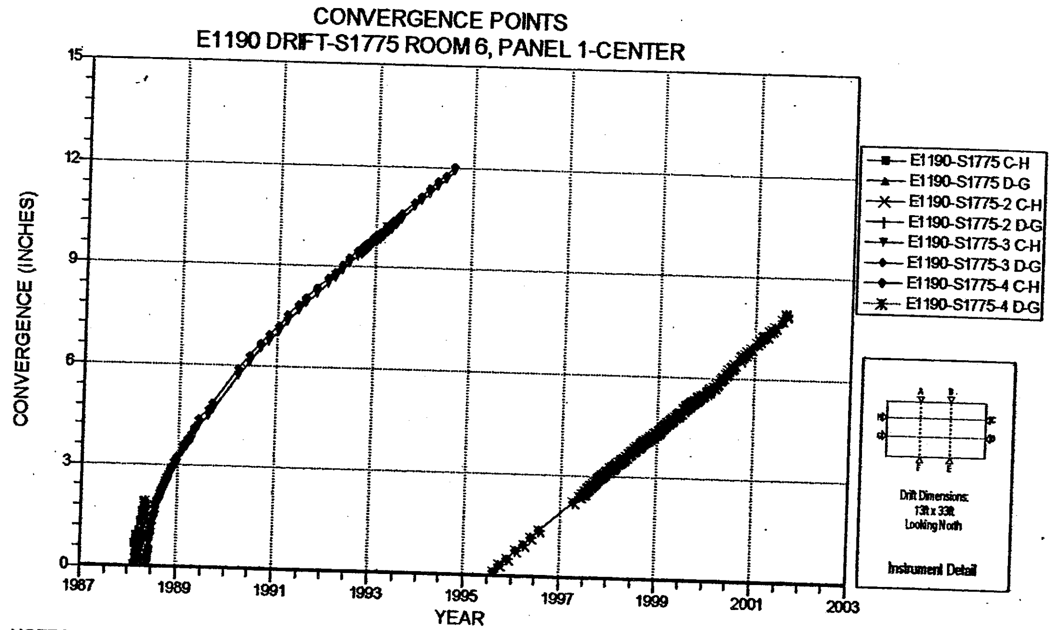


Figure 6-118 Convergence Point Array
Room 6, Panel 1 at S1775 – Room Center – Roof to Floor



NOTES:
1. Excavation date: February 1988.

Figure 6-119 Convergence Point Array
Room 6, Panel 1 at S1775 – Room Center – Rib to Rib

Table 6-2
Panel 2 Data Analysis

EXTENSOMETERS

Field Tag	Location		Figure Number	Date of Last Reading	Collar Displacement Relative to Deepest Anchor (inches)	Displacement Rate 2001 to 2002 in/year	Displacement Rate 2000 to 2001 in/year	Rate Change Percent	Comments
51X-GE-00341	PANEL 2 ROOM 1	CENTER ROOF	6-120	06/24/02	2.220	1.121	1.330	-16%	
51X-GE-00342	PANEL 2 ROOM 2	CENTER ROOF	6-121	06/24/02	1.720	0.712	1.216	-41%	Instrument bumped 06/02.
51X-GE-00343	PANEL 2 ROOM 3	CENTER ROOF	6-122	06/24/02	2.290	1.064	1.497	-29%	
51X-GE-00344	PANEL 2 ROOM 4	CENTER ROOF	6-123	06/17/02	2.112	0.975	1.383	-30%	
51X-GE-00345	PANEL 2 ROOM 5	CENTER ROOF	6-124	06/24/02	2.196	1.001	1.448	-31%	
51X-GE-00346	PANEL 2 ROOM 6	CENTER ROOF	6-125	06/24/02	1.832	0.851	1.221	-30%	
51X-GE-00347	PANEL 2 ROOM 7	CENTER ROOF	6-126	03/04/02	1.874	1.023	1.426	-28%	
51X-GE-00348	S2180 DRIFT - E725	ROOF	6-127	06/24/02	2.444	1.121	1.619	-31%	
51X-GE-00351	S2180 DRIFT - E1120	ROOF	6-128	06/24/02	1.831	0.810	1.245	-35%	
51X-GE-00350	S2520 DRIFT - E735	ROOF	6-129	06/24/02	2.196	1.054	1.382	-24%	
51X-GE-00349	S2520 DRIFT - E1120	ROOF	6-130	06/24/02	2.420	1.102	1.621	-32%	

Table 6-2 (Continued)
Panel 2 Data Analysis

CONVERGENCE POINTS

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change	Comments
			Date	Inches	Inches	in/year	in/year	Percent	
S2180-E410 A-C	S2180 Drift-E410	6-131	06/17/02	3.022	3.022	1.516	1.913	-21%	
S2180-E410 B-D	S2180 Drift-E410	6-131	06/17/02	3.177	3.177	1.616	2.004	-19%	
S2180-E520 A-C	S2180 Drift-E520	6-132	06/17/02	5.650	5.650	2.615	3.768	-31%	
S2180-E586 A-C	S2180 Drift-E586	6-133	06/17/02	7.283	7.283	3.335	4.887	-32%	
S2180-E586-2 B-D	S2180 Drift-E586	6-133	06/17/02	1.005	4.486	2.004	3.337	-40%	Reinstalled 12/01.
S2180-E660 A-C	S2180 Drift-E660	6-134	06/17/02	7.175	7.175	3.117	4.855	-36%	
S2180-E790 A-C	S2180 Drift-E790	6-135	06/17/02	8.022	8.022	3.591	5.452	-34%	
S2180-E920 A-C	S2180 Drift-E920	6-136	06/17/02	8.871	8.871	3.943	6.079	-35%	
S2180-E986 A-C	S2180 Drift-E986	6-137	06/17/02	8.114	8.114	3.636	5.517	-34%	
S2180-E986 B-D	S2180 Drift-E986	6-137	06/17/02	5.495	5.495	2.328	3.766	-38%	
S2180-E1050-2 A-C	S2180 Drift-E1050	6-138	06/17/02	6.987	6.987	3.394	4.935	-31%	
S2180-E1190 A-C	S2180 Drift-E1190	6-139	06/17/02	7.389	7.389	3.230	4.980	-35%	
S2180-E1265-2 A-C	S2180 Drift-E1265	6-140	06/17/02	6.266	7.850	3.055	4.389	-30%	
S2180-E1265 B-D	S2180 Drift-E1265	6-140	06/17/02	5.070	5.070	1.837	3.350	-45%	
S2180-E1320-2 A-C	S2180 Drift-E1320	6-141	06/17/02	4.689	5.483	2.173	3.289	-34%	
S2520-E410-2 A-C	S2520 Drift-E410	6-142	04/08/02	3.771	4.701	2.200	2.661	-17%	
S2520-E410 B-D	S2520 Drift-E410	6-142	04/08/02	4.834	4.834	1.980	2.794	-29%	
S2520-E520-2 A-C	S2520 Drift-E520	6-143	06/17/02	7.020	8.720	3.324	4.382	-24%	
S2520-E660 A-C	S2520 Drift-E660	6-144	06/17/02	10.216	10.216	3.534	5.536	-36%	
S2520-E586 A-C	S2520 Drift-E586	6-145	06/17/02	9.043	9.043	3.214	5.013	-36%	
S2520-E586 B-D	S2520 Drift-E586	6-145	06/17/02	5.753	5.753	1.940	3.148	-38%	
S2520-E790 A-C	S2520 Drift-E790	6-146	06/17/02	8.318	8.318	3.142	5.390	-42%	
S2520-E920 A-C	S2520 Drift-E920	6-147	06/17/02	7.683	7.683	3.016	5.109	-41%	
S2520-E985 A-C	S2520 Drift-E985	6-148	06/17/02	8.151	8.151	3.157	5.482	-42%	

Table 6-2 (Continued)
Panel 2 Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement Inches	Closure Rate 2001 to 2002 in/year	Closure Rate 2000 to 2001 in/year	Rate Change Percent [A]	Comments
			Date	Inches					
S2520-E985 B-D	S2520 Drift-E985	6-148	06/17/02	5.706	5.706	2.114	3.858	-45%	
S2520-E1050 A-C	S2520 Drift-E1050	6-149	06/17/02	8.025	8.025	3.066	5.450	-44%	
S2520-E1190-2 A-C	S2520 Drift-E1190	6-150	06/17/02	7.280	8.777	3.509	5.055	-31%	
S2520-E1265-2 A-C	S2520 Drift-E1265	6-151	06/17/02	5.628	6.923	2.702	4.010	-33%	
S2520-E1265 B-D	S2520 Drift-E1265	6-151	06/17/02	4.874	4.874	1.731	3.203	-46%	
S2520-E1320 A-C	E2520 Drift-E1320	6-152	06/17/02	6.450	6.450	2.510	4.130	-39%	
E520-S2275 A-C	E520 Drift-S2275	6-153	06/17/02	8.999	8.999	3.485	5.140	-32%	
E520-S2275 B-D	E520 Drift-S2275	6-153	06/17/02	5.555	5.555	2.046	3.196	-36%	
E520-S2350-2 A-C	E520 Drift-S2350	6-154	06/17/02	9.469	9.893	3.579	5.297	-32%	
E520-S2350 B-D	E520 Drift-S2350	6-154	06/17/02	6.354	6.354	2.377	3.549	-33%	
E520-S2425 A-C	E520 Drift-S2425	6-155	06/17/02	8.515	8.515	3.201	4.821	-34%	
E520-S2425 B-D	E520 Drift-S2425	6-155	06/17/02	5.859	5.859	2.188	3.261	-33%	
E660-S2275-2 A-C	E660 Drift-S2275	6-156	06/17/02	2.413	6.140	3.054	N/A	N/A	Reinstalled 9/01.
E660-S2275 B-D	E660 Drift-S2275	6-156	06/17/02	6.369	6.369	2.117	3.709	-43%	
E660-S2350-3 A-C	E660 Drift-S2350	6-157	06/17/02	4.764	10.286	3.656	4.252	-14%	Reinstalled 3/01.
E660-S2350 B-D	E660 Drift-S2350	6-157	06/17/02	6.602	6.602	2.268	3.787	-40%	
E660-S2425-2 A-C	E660 Drift-S2425	6-158	06/17/02	4.879	9.240	3.778	4.120	-8%	Reinstalled 3/01.
E660-S2425 B-D	E660 Drift-S2425	6-158	06/17/02	6.578	6.578	2.149	3.683	-42%	
E790-S2275 A-C	E790 Drift-S2275	6-159	06/17/02	7.401	7.401	2.779	4.886	-43%	
E790-S2275 B-D	E790 Drift-S2275	6-159	06/17/02	5.500	5.500	1.997	3.664	-45%	
E790-S2350-2 A-C	E790 Drift-S2350	6-160	06/17/02	8.063	9.783	3.167	5.196	-39%	
E790-S2350 B-D	E790 Drift-S2350	6-160	06/17/02	5.853	5.853	2.176	3.778	-42%	
E790-S2425 A-C	E790 Drift-S2425	6-161	06/17/02	8.041	8.041	3.102	5.184	-40%	
E790-S2425 B-D	E790 Drift-S2425	6-161	06/17/02	5.991	5.991	2.248	3.930	-43%	

[A] NA indicates insufficient data to calculate.

Table 6-2 (Continued)
Panel 2 Data Analysis

CONVERGENCE POINTS (Continued)

Field Tag	Location	Figure Number	Last Reading 2001 to 2002		Cumulative Displacement	Closure Rate 2001 to 2002	Closure Rate 2000 to 2001	Rate Change Percent [A]	Comments
			Date	Inches	Inches	in/year	in/year		
E920-S2275 A-C	E920 Drift-S2275	6-162	06/17/02	8.428	8.428	3.054	5.668	-46%	
E920-S2275 B-D	E920 Drift-S2275	6-162	06/17/02	6.184	6.184	2.205	4.104	-46%	
E920-S2350-2 A-C	E920 Drift-S2350	6-163	06/17/02	9.340	12.300	3.591	6.060	-41%	
E920-S2350 B-D	E920 Drift-S2350	6-163	06/17/02	6.479	6.479	2.360	4.267	-45%	
E920-S2425 A-C	E920 Drift-S2425	6-164	06/17/02	8.776	8.776	3.271	5.770	-43%	
E920-S2425 B-D	E920 Drift-S2425	6-164	06/17/02	5.982	5.982	N/A	5.792	N/A	Temporarily blocked.
E1050-S2275 A-C	E1050 Drift-S2275	6-165	06/17/02	7.483	7.483	2.865	5.097	-44%	
E1050-S2275 B-D	E1050 Drift-S2275	6-165	06/17/02	5.484	5.484	2.044	3.671	-44%	
E1050-S2350-2 A-C	E1050 Drift-S2350	6-166	06/17/02	8.611	12.028	3.279	5.884	-44%	
E1050-S2350 B-D	E1050 Drift-S2350	6-166	06/17/02	5.535	5.535	2.031	3.769	-46%	
E1050-S2425 A-C	E1050 Drift-S2425	6-167	04/30/02	7.135	7.135	2.852	5.169	-45%	
E1050-S2425 B-D	E1050 Drift-S2425	6-167	06/17/02	5.574	5.574	1.952	3.828	-49%	
E1190-S2275-2 A-C	E1190 Drift-S2275	6-168	06/17/02	6.137	7.563	2.921	4.440	-34%	
E1190-S2275 B-D	E1190 Drift-S2275	6-168	06/17/02	5.495	5.495	1.982	3.775	-47%	
E1190-S2350-3 A-C	E1190 Drift-S2350	6-169	06/17/02	7.113	10.536	3.322	5.077	-35%	
E1190-S2350 B-D	E1190 Drift-S2350	6-169	06/17/02	5.494	5.494	1.960	3.798	-48%	
E1190-S2425-2 A-C	E1190 Drift-S2425	6-170	06/17/02	6.997	8.126	3.271	5.084	-36%	
E1190-S2425 B-D	E1190 Drift-S2425	6-170	06/17/02	5.764	5.764	2.072	3.958	-48%	
E1320-S2275-2 A-C	E1320 Drift-S2275	6-171	06/17/02	6.976	8.085	3.435	4.871	-29%	
E1320-S2275 B-D	E1320 Drift-S2275	6-171	06/17/02	4.976	4.976	1.827	3.236	-44%	
E1320-S2350-3 A-C	E1320 Drift-S2350	6-172	06/17/02	7.291	9.139	3.550	5.146	-31%	
E1320-S2350 B-D	E1320 Drift-S2350	6-172	06/17/02	5.460	5.460	1.998	3.614	-45%	Temporarily blocked.
E1320-S2425-2 A-C	E1320 Drift-S2425	6-173	06/17/02	7.743	8.975	3.802	5.369	-29%	
E1320-S2425 B-D	E1320 Drift-S2425	6-173	06/17/02	5.177	5.177	1.748	3.390	-48%	

[A] NA indicates insufficient data to calculate.

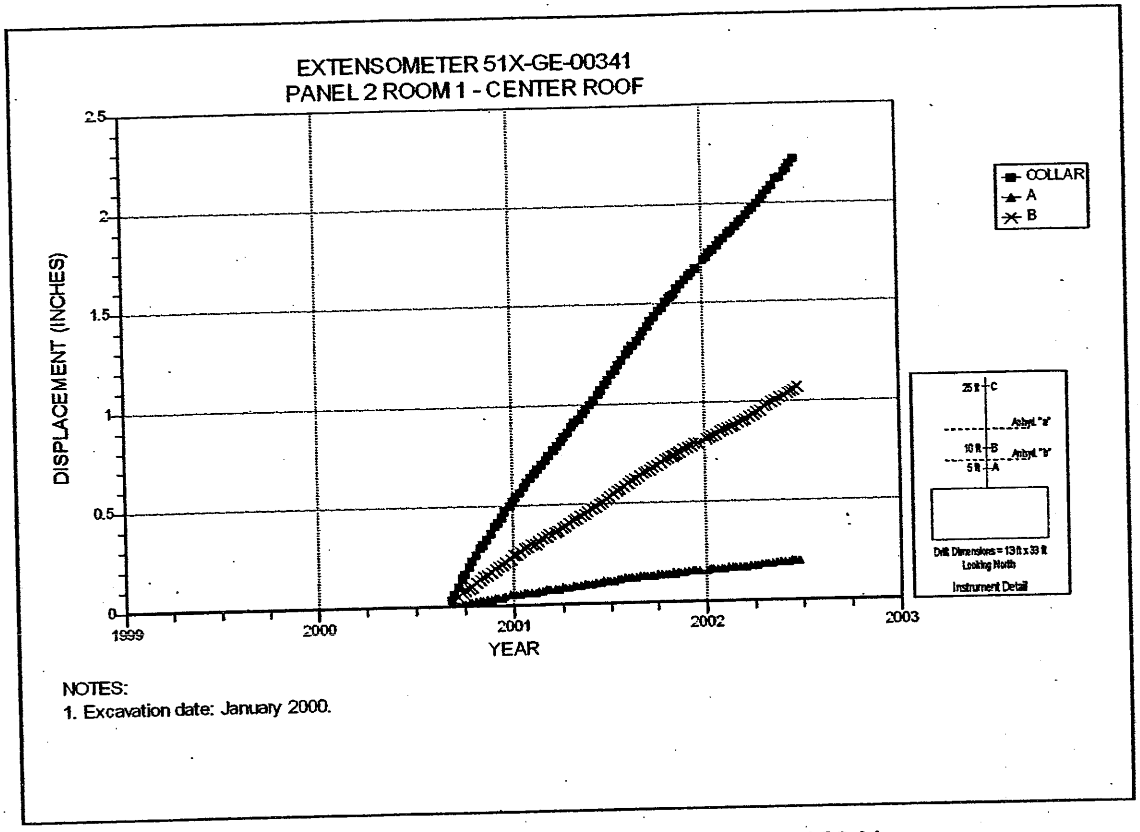


**Figure 6-120 Extensometer 51X-GE-00341
Room 1, Panel 2 – Room Center – Roof**

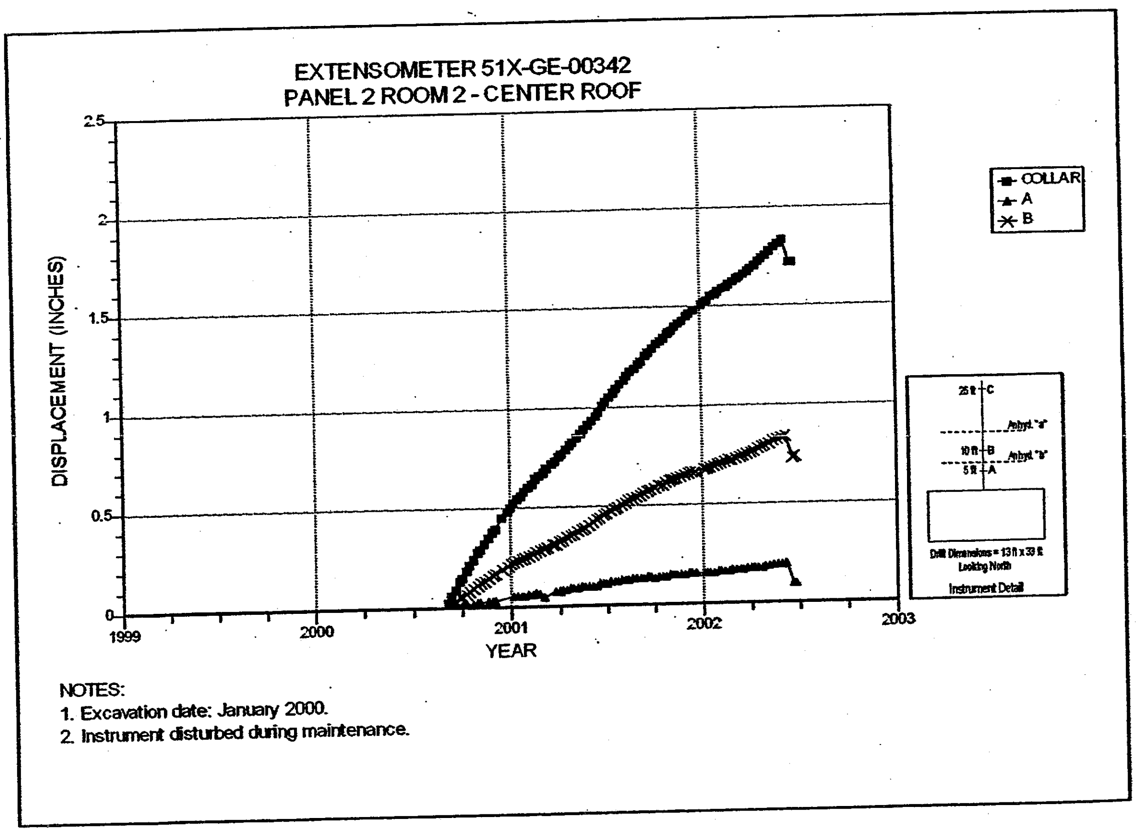


**Figure 6-121 Extensometer 51X-GE-00342
Room 2, Panel 2 – Room Center – Roof**

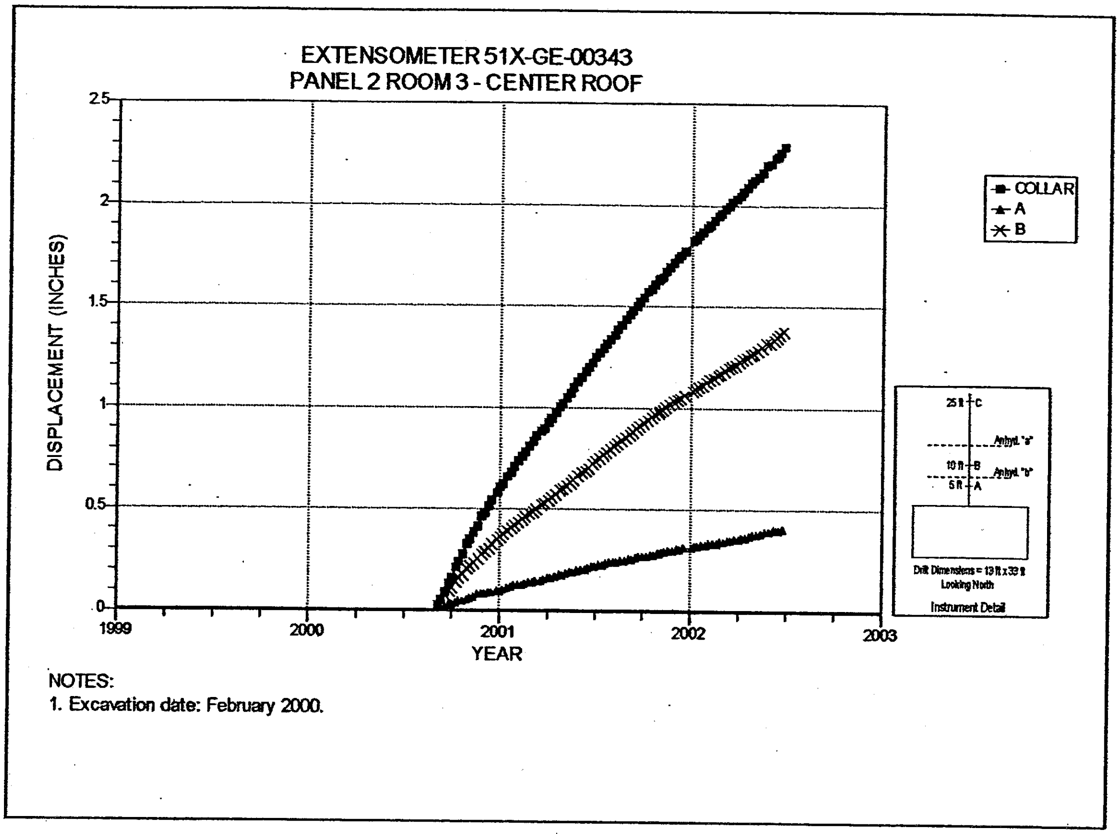


Figure 6-122 Extensometer 51X-GE-00343
Room 3, Panel 2 – Room Center – Roof

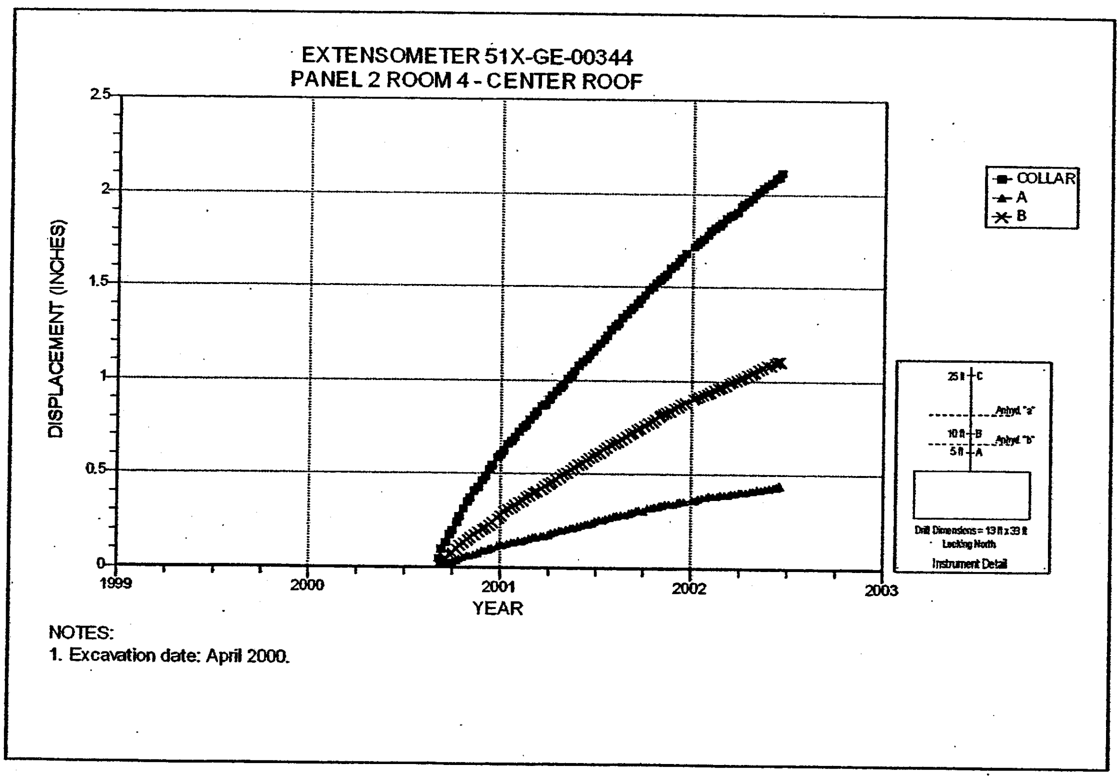


Figure 6-123 Extensometer 51X-GE-00344
Room 4, Panel 2 – Room Center – Roof

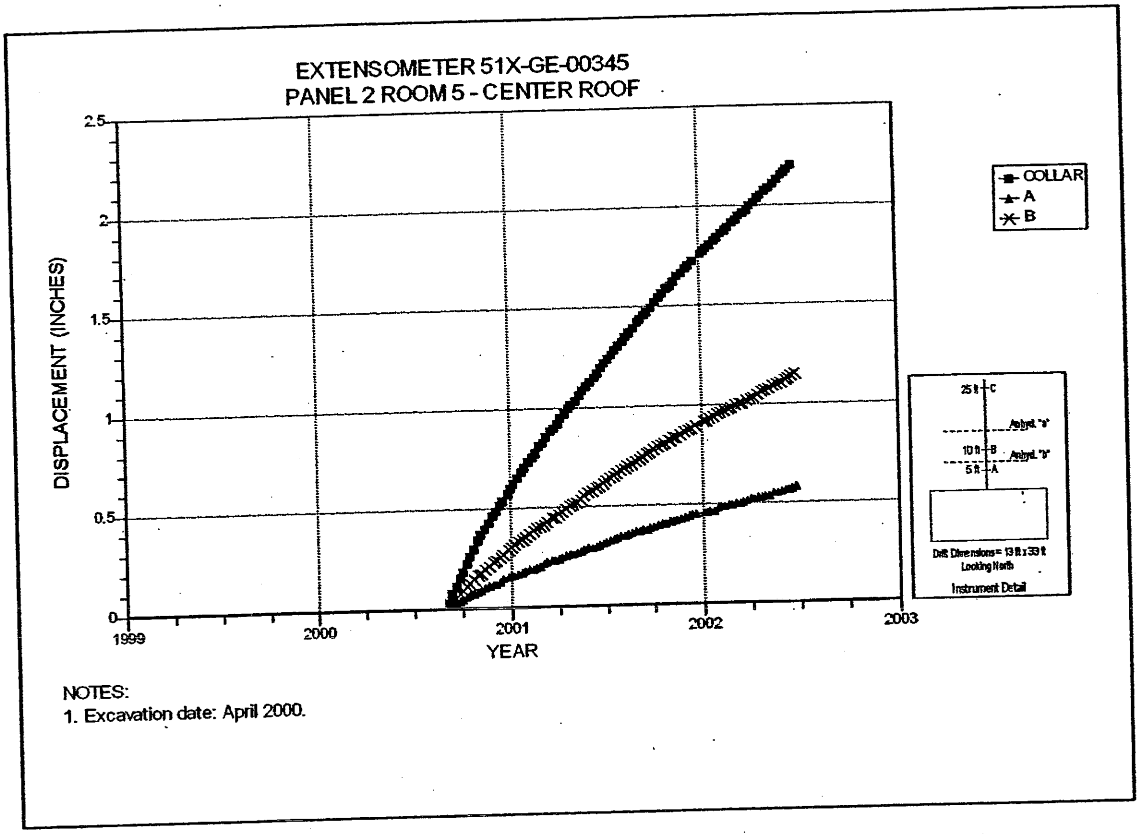


Figure 6-124 Extensometer 51X-GE-00345
Room 5, Panel 2 – Room Center – Roof

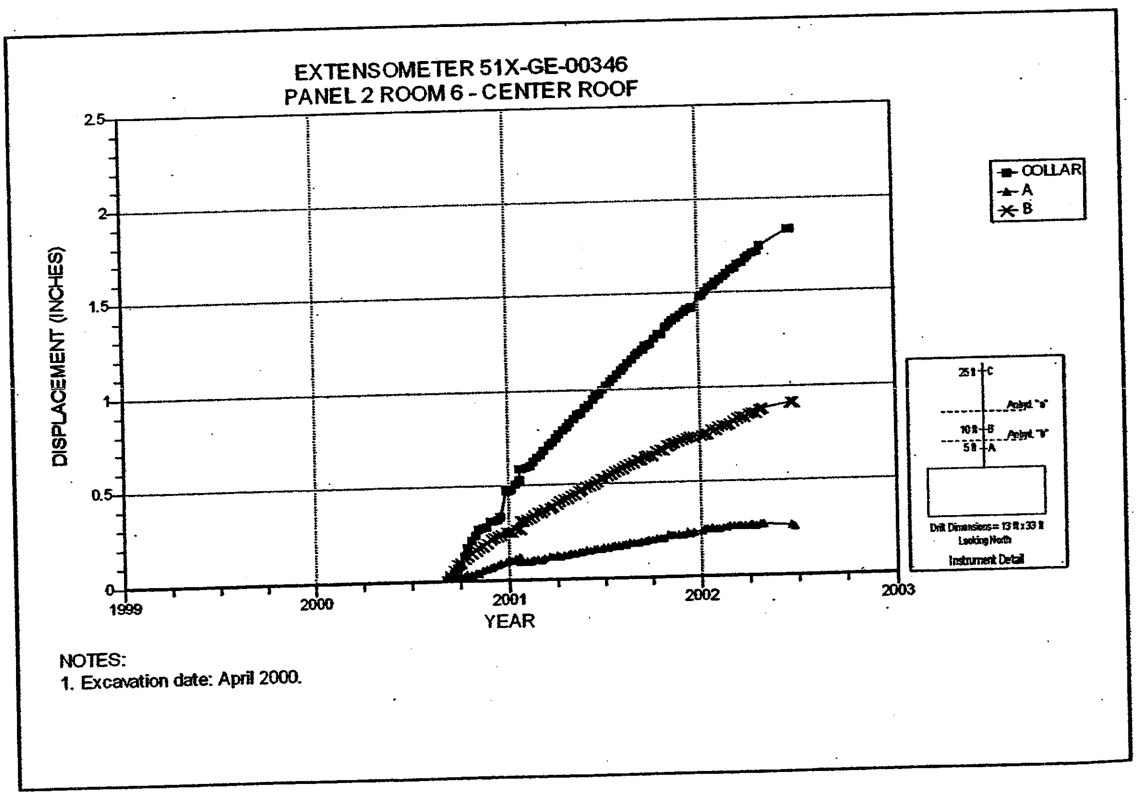


Figure 6-125 Extensometer 51X-GE-00346
Room 6, Panel 2 – Room Center – Roof

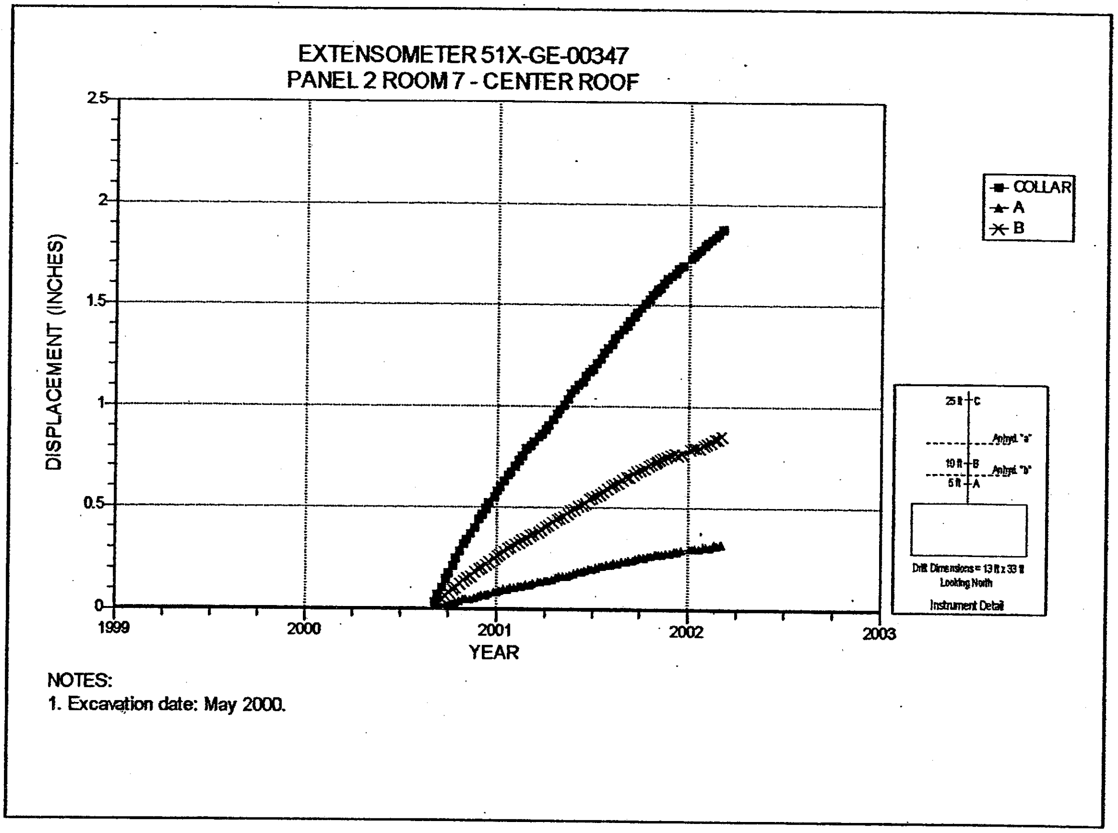


Figure 6-126 Extensometer 51X-GE-00347
Room 7, Panel 2 – Room Center – Roof

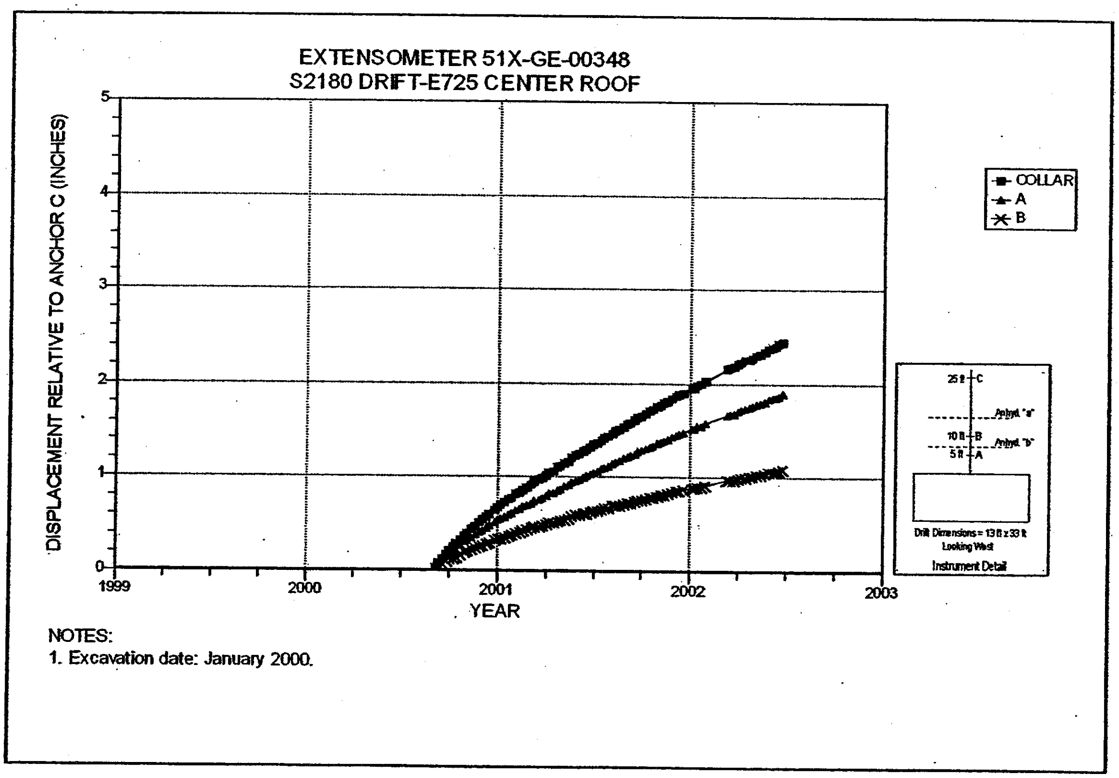


Figure 6-127 Extensometer 51X-GE-00348
S2180 Drift at E725 – Roof

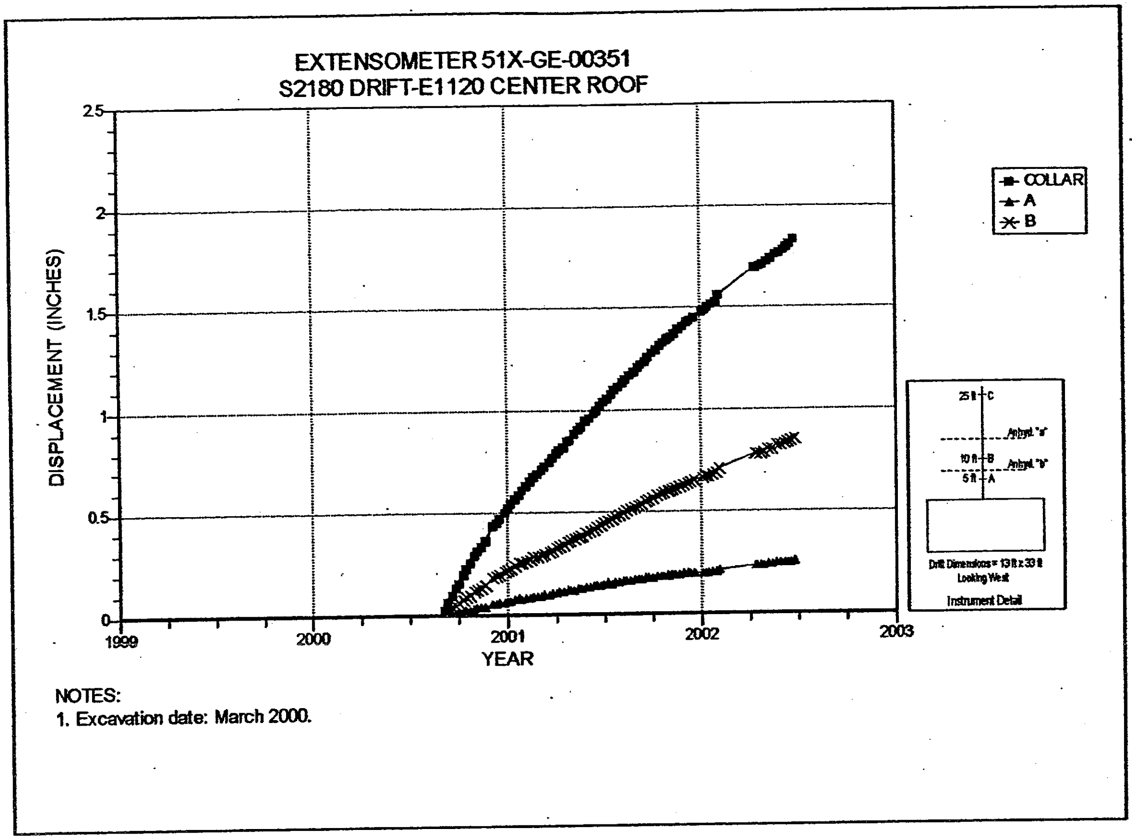


Figure 6-128 Extensometer 51X-GE-00351
S2180 Drift at E1120 – Roof

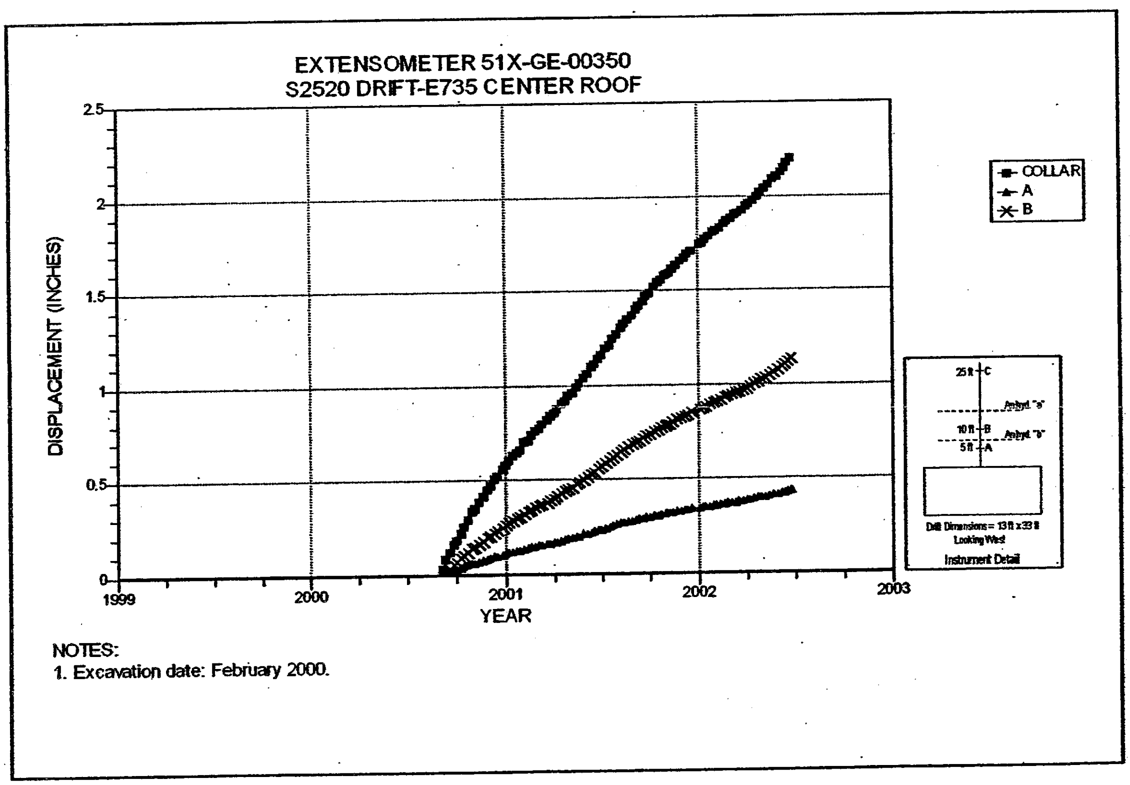


Figure 6-129 Extensometer 51X-GE-00350
S2520 Drift at E735 – Roof

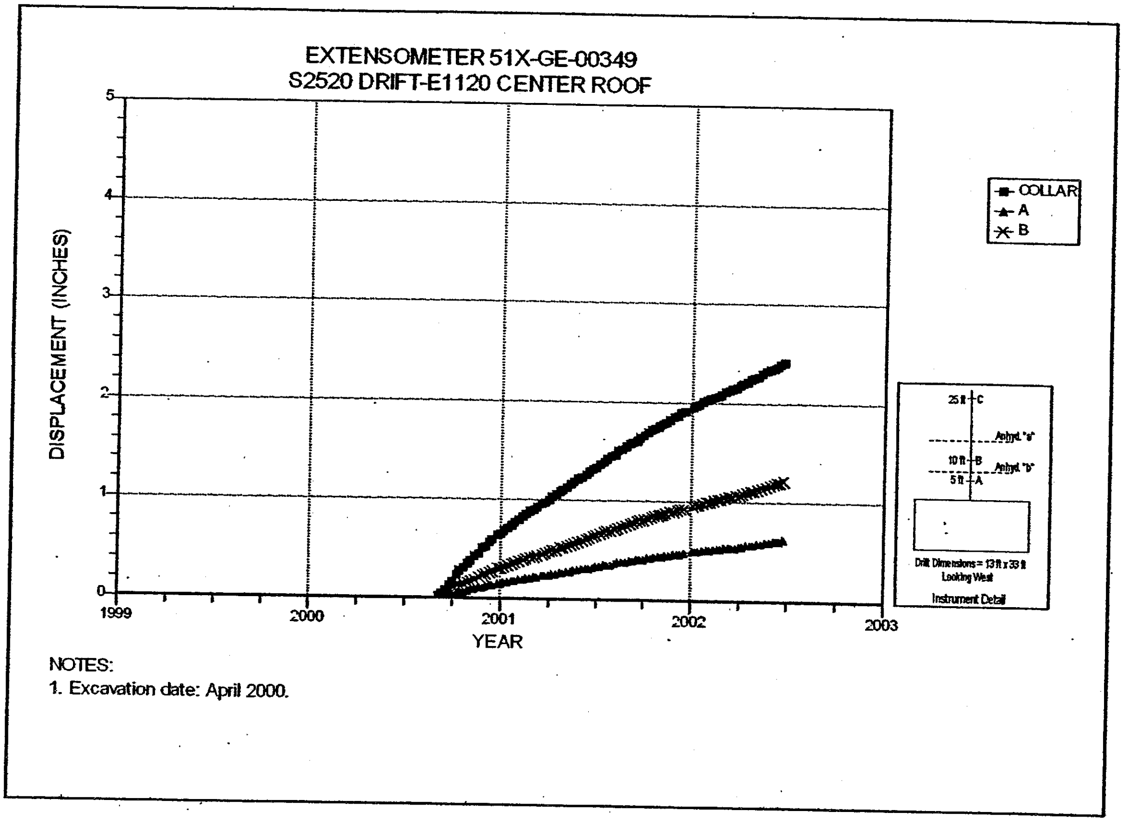


Figure 6-130 Extensometer 51X-GE-00349
S2520 Drift at E1120 – Roof

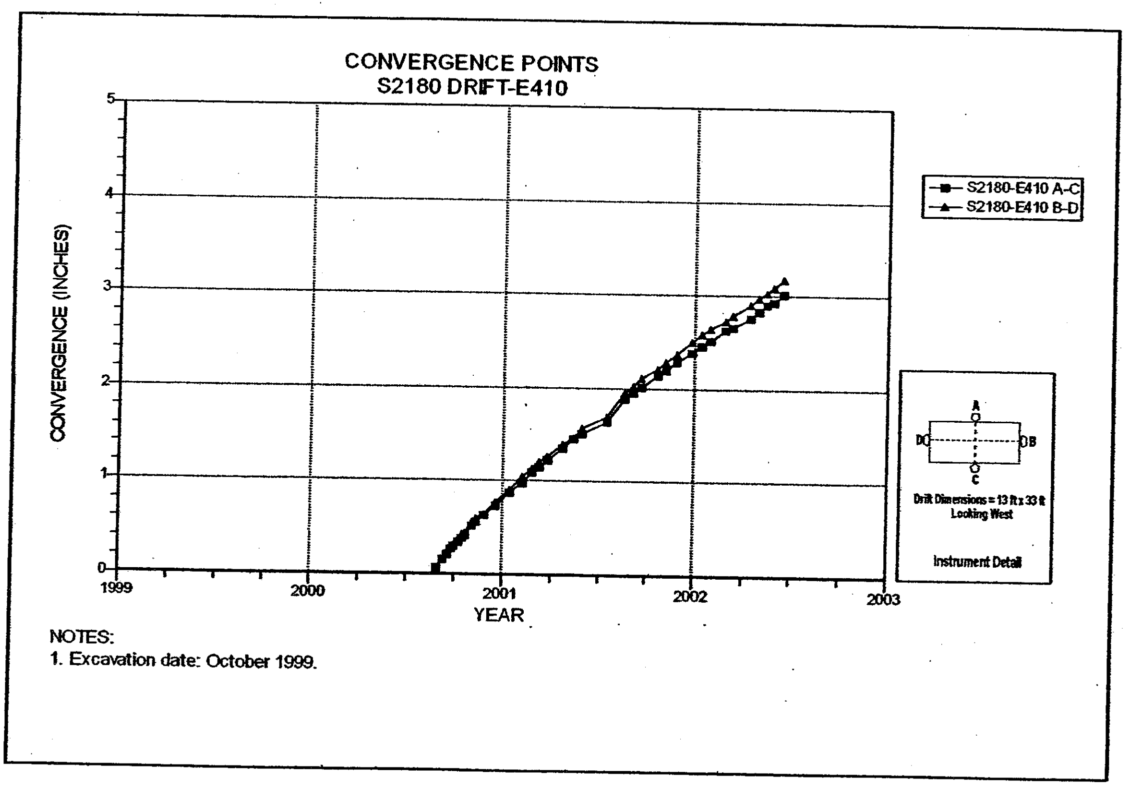


Figure 6-131 Convergence Point Array
S2180 Drift at E410 – All Chords

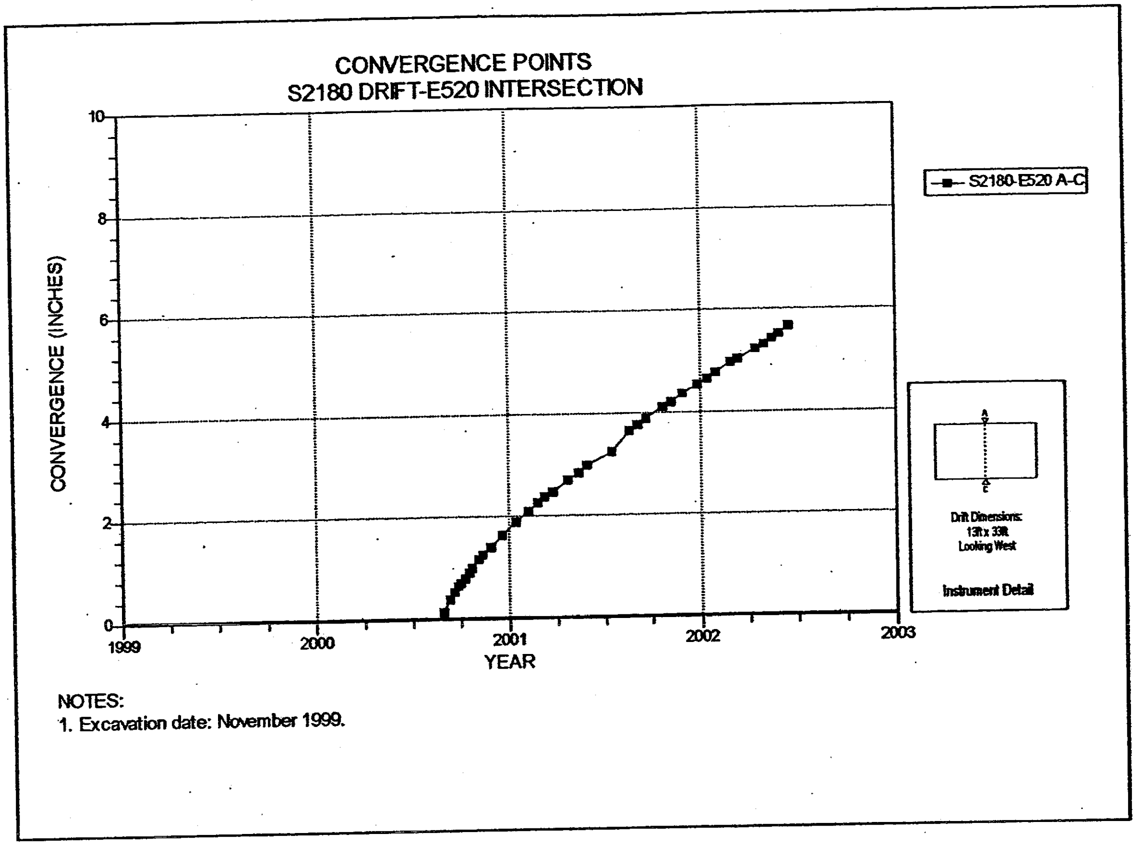


Figure 6-132 Convergence Point Array
S2180 Drift at E520 Drift Intersection (Room 1, Panel 2) – Roof to Floor

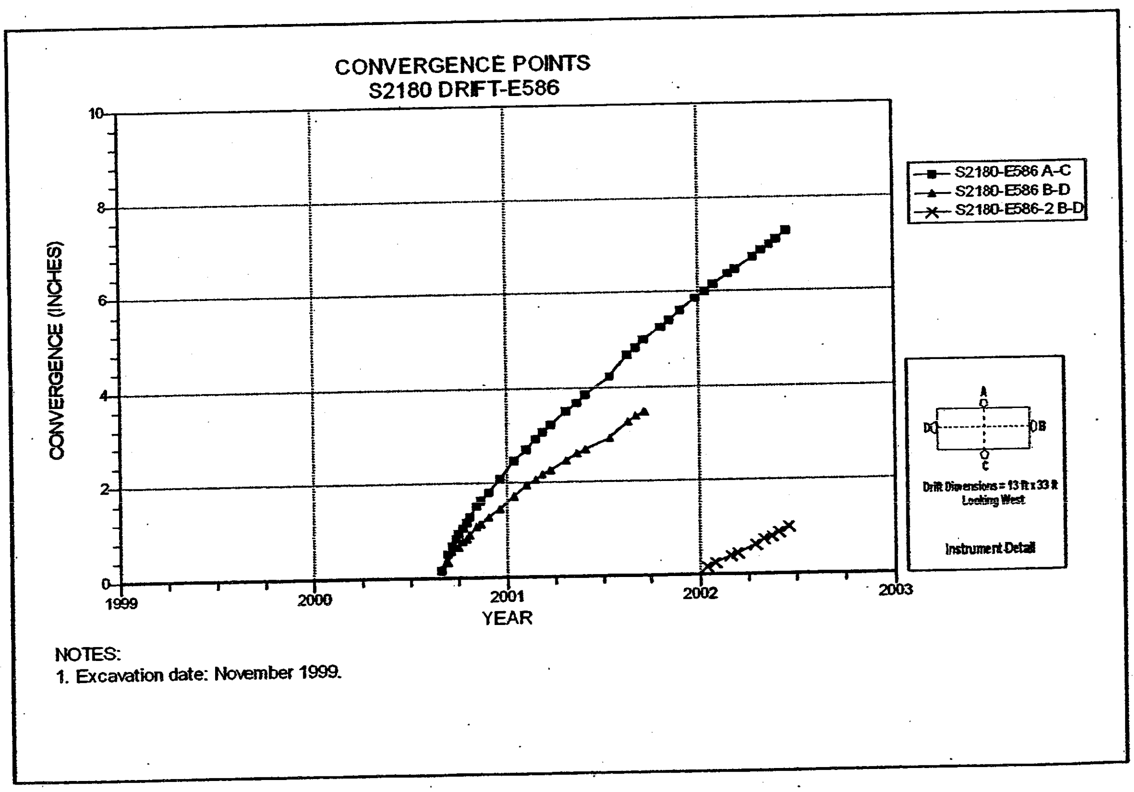


Figure 6-133 Convergence Point Array
S2180 Drift at E586 – All Chords

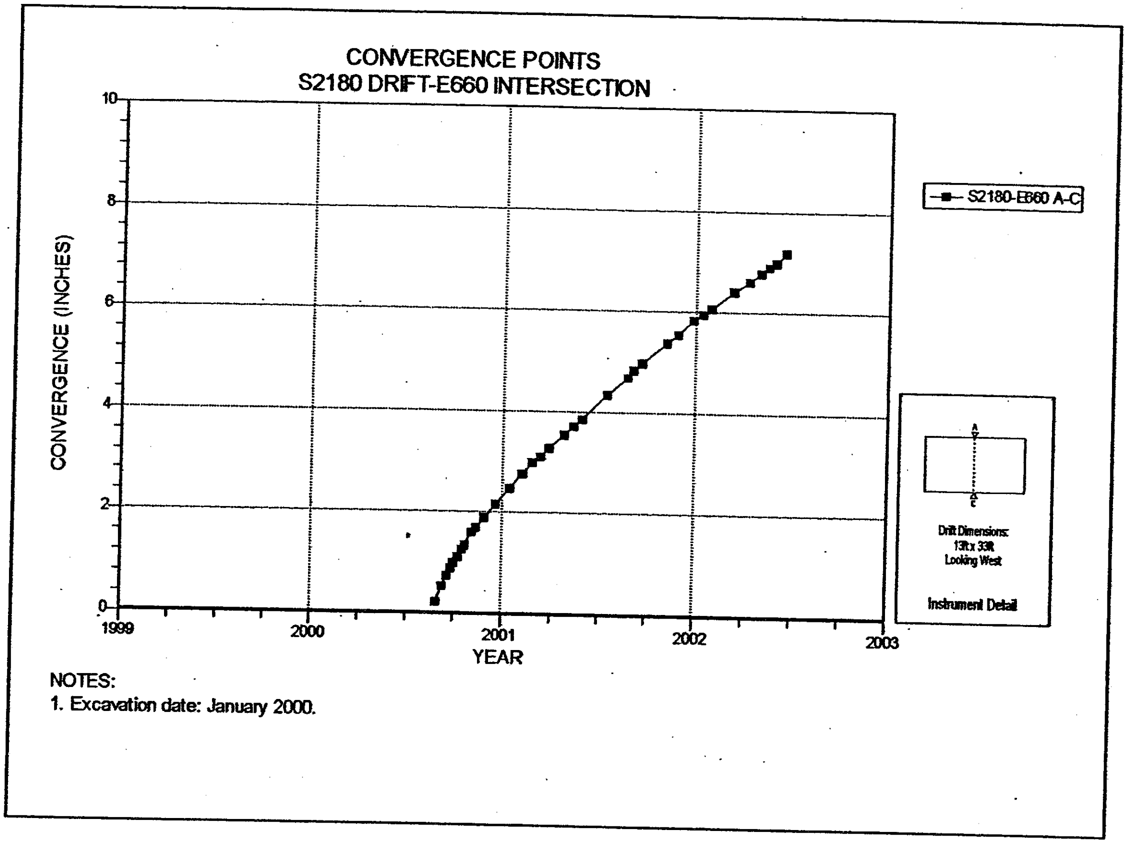


Figure 6-134 Convergence Point Array
S2180 Drift at E660 Drift Intersection (Room 2, Panel 2) – Roof to Floor

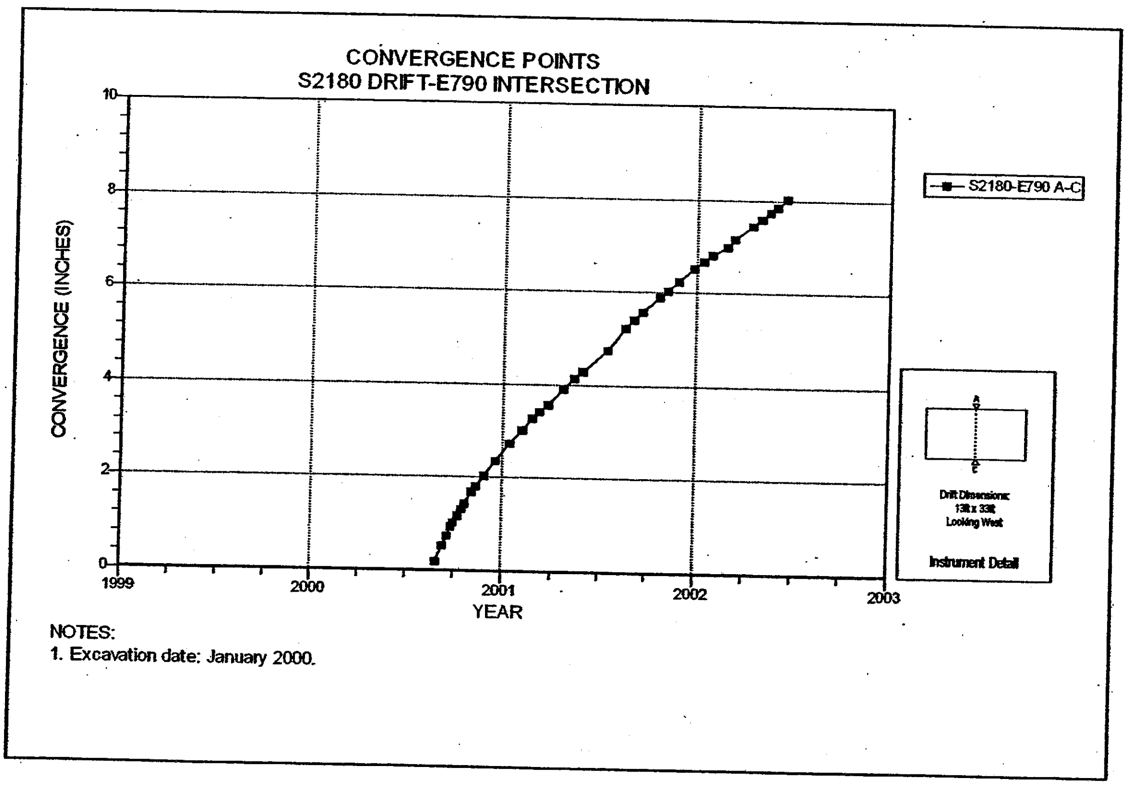


Figure 6-135 Convergence Point Array
S2180 Drift at E790 Drift Intersection (Room 3, Panel 2) – Roof to Floor

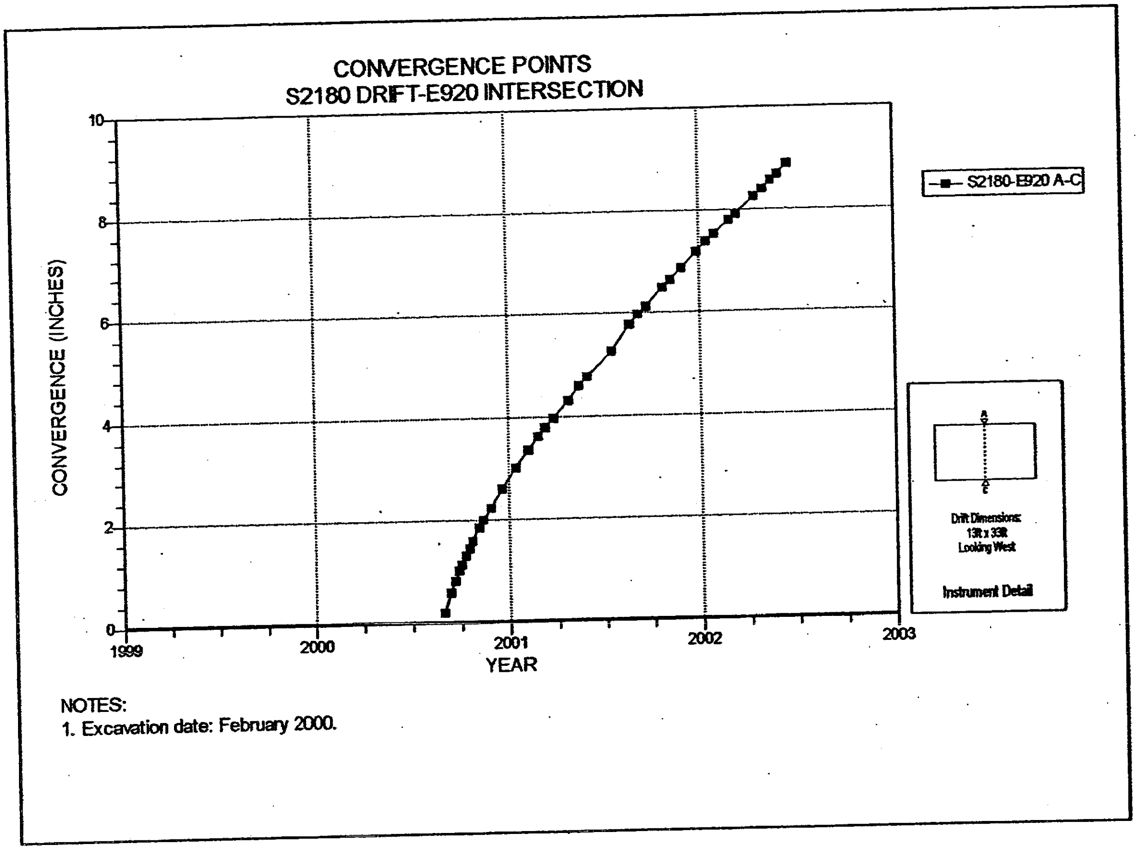


Figure 6-136 Convergence Point Array
S2180 Drift at E920 Drift Intersection (Room 4, Panel 2) – Roof to Floor

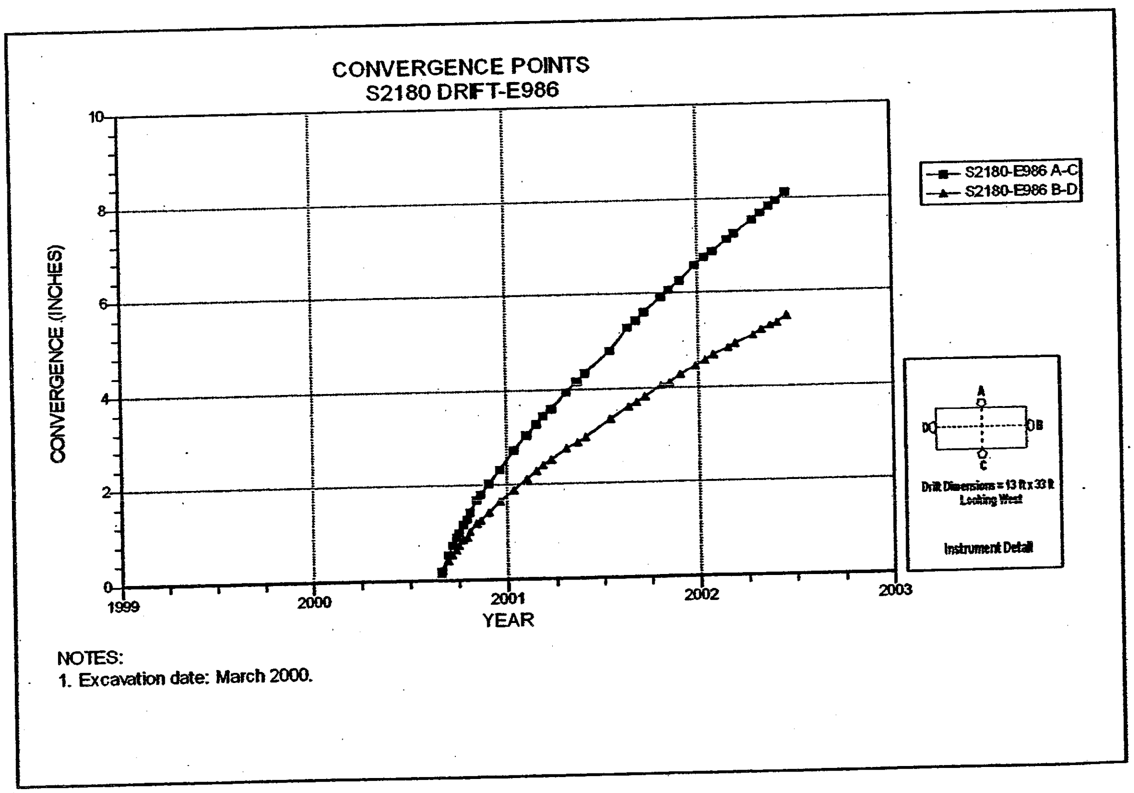


Figure 6-137 Convergence Point Array
S2180 Drift at E986 – All Chords

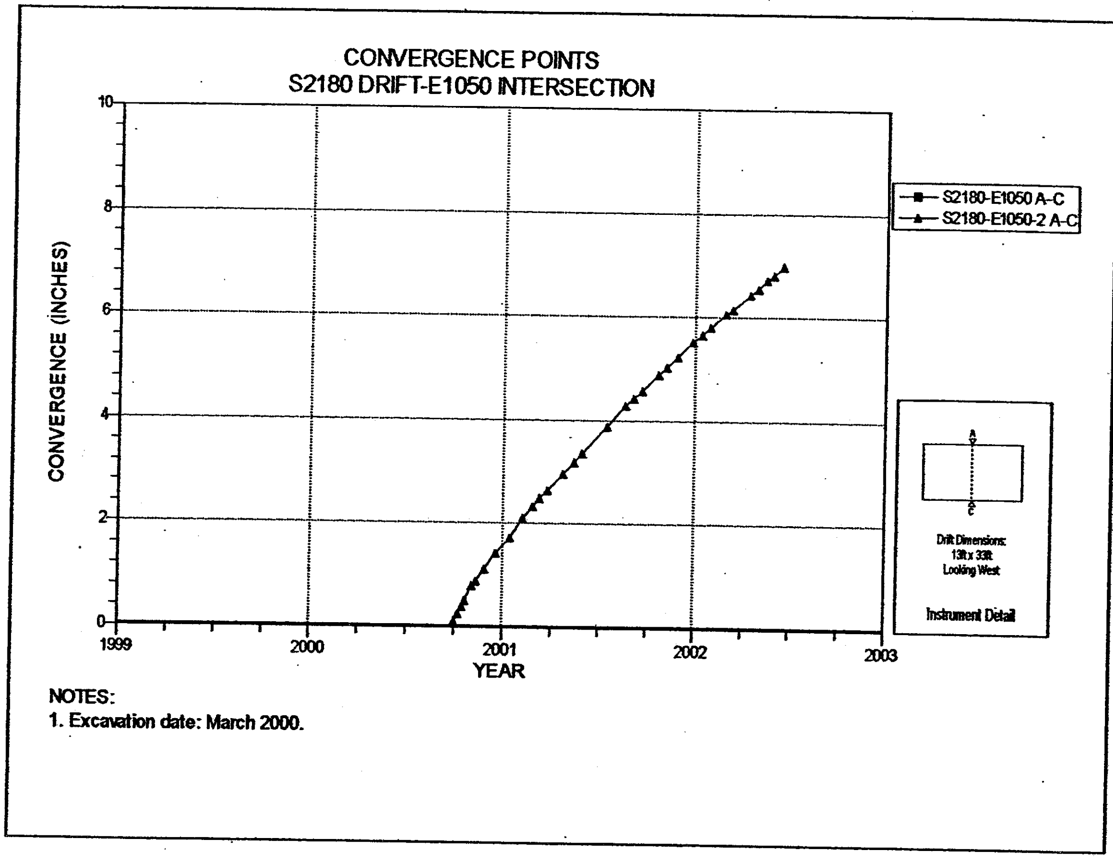


Figure 6-138 Convergence Point Array
S2180 Drift at E1050 Drift Intersection (Room 5, Panel 2) – Roof to Floor

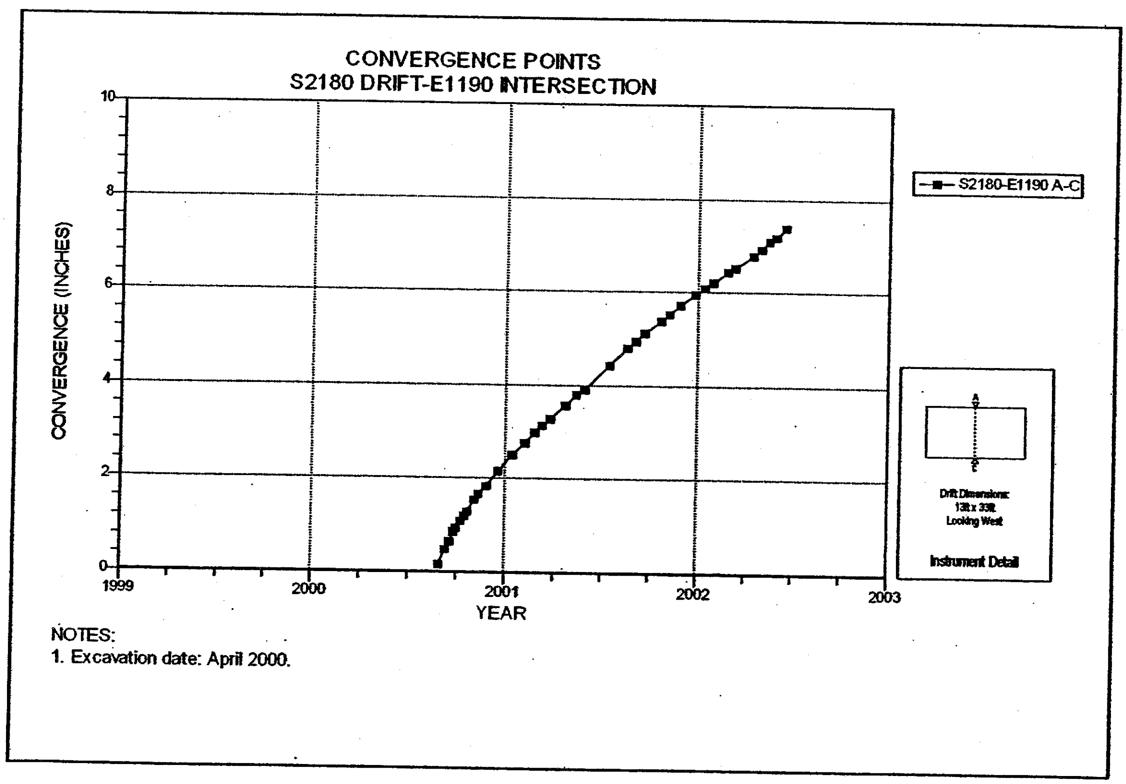


Figure 6-139 Convergence Point Array
S2180 Drift at E1190 Drift Intersection (Room 6, Panel 2) – Roof to Floor

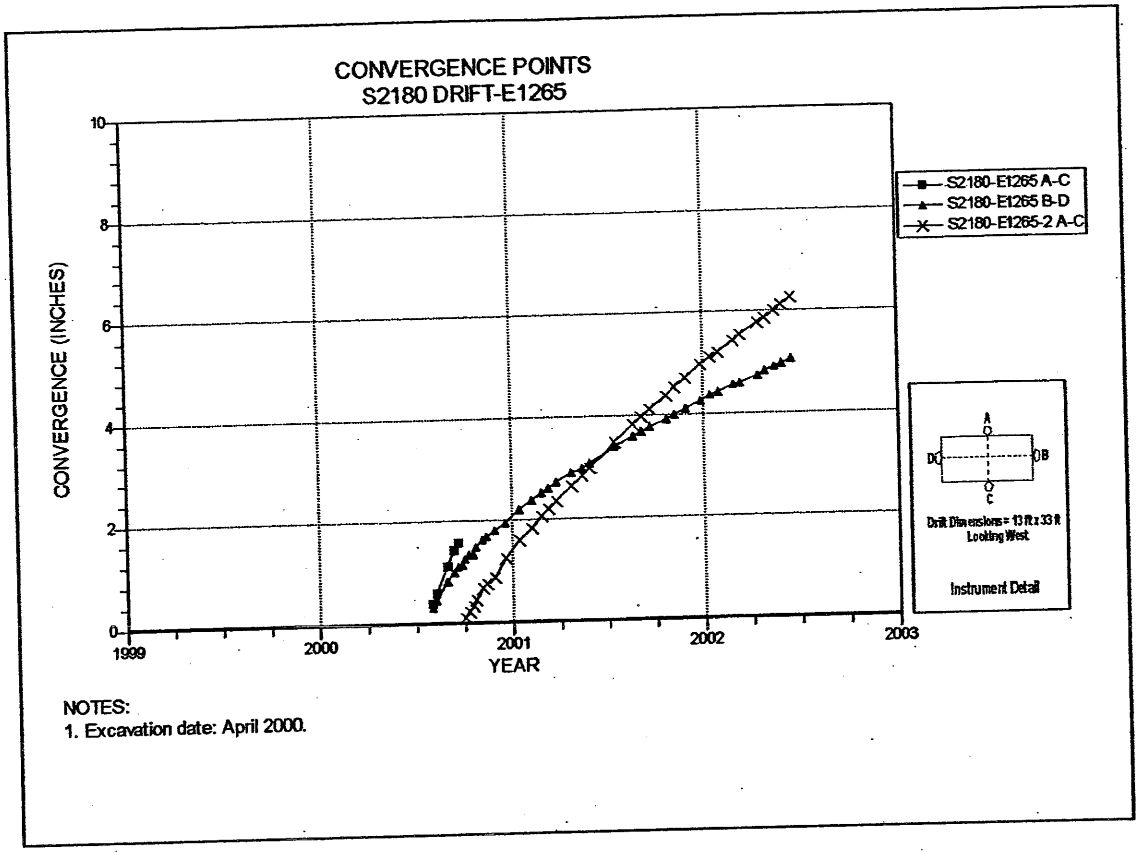


Figure 6-140 Convergence Point Array
S2180 Drift at E1265 – All Chords

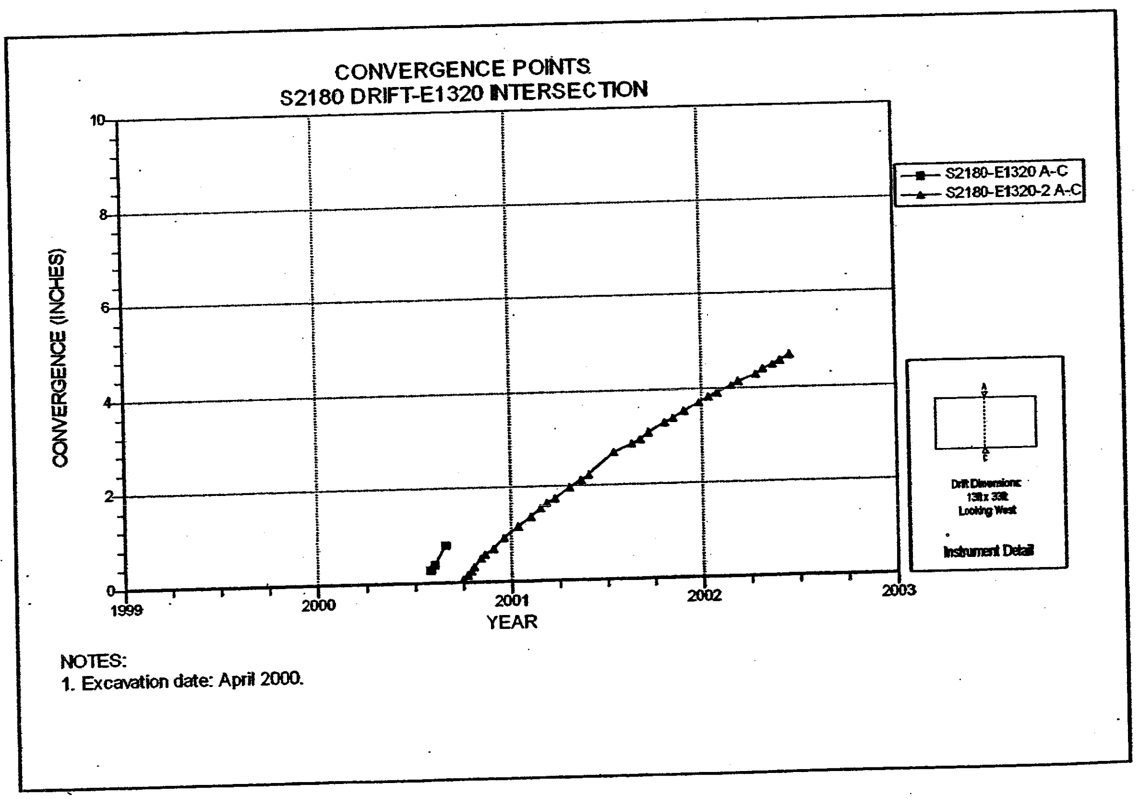


Figure 6-141 Convergence Point Array
S2180 Drift at E1320 Drift Intersection (Room 7, Panel 2) – Roof to Floor

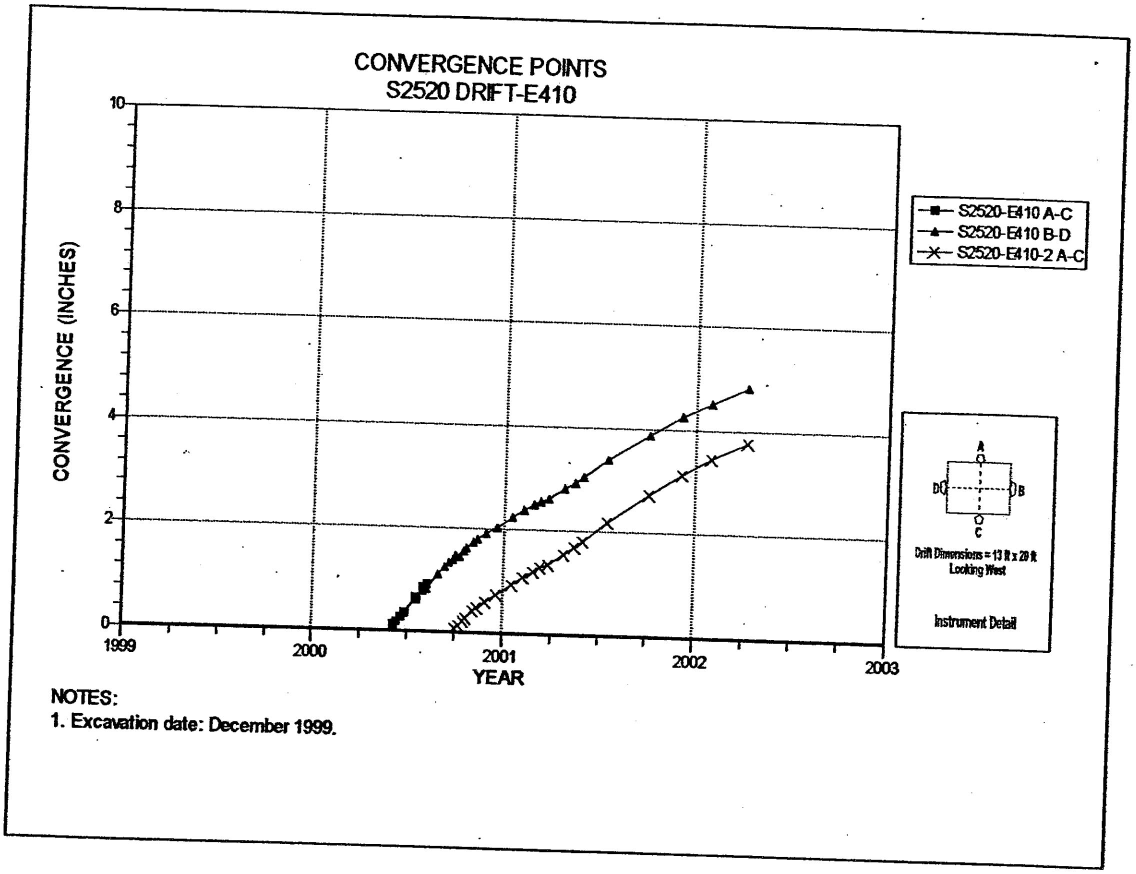


Figure 6-142 Convergence Point Array
S2520 Drift at E410 – All Chords

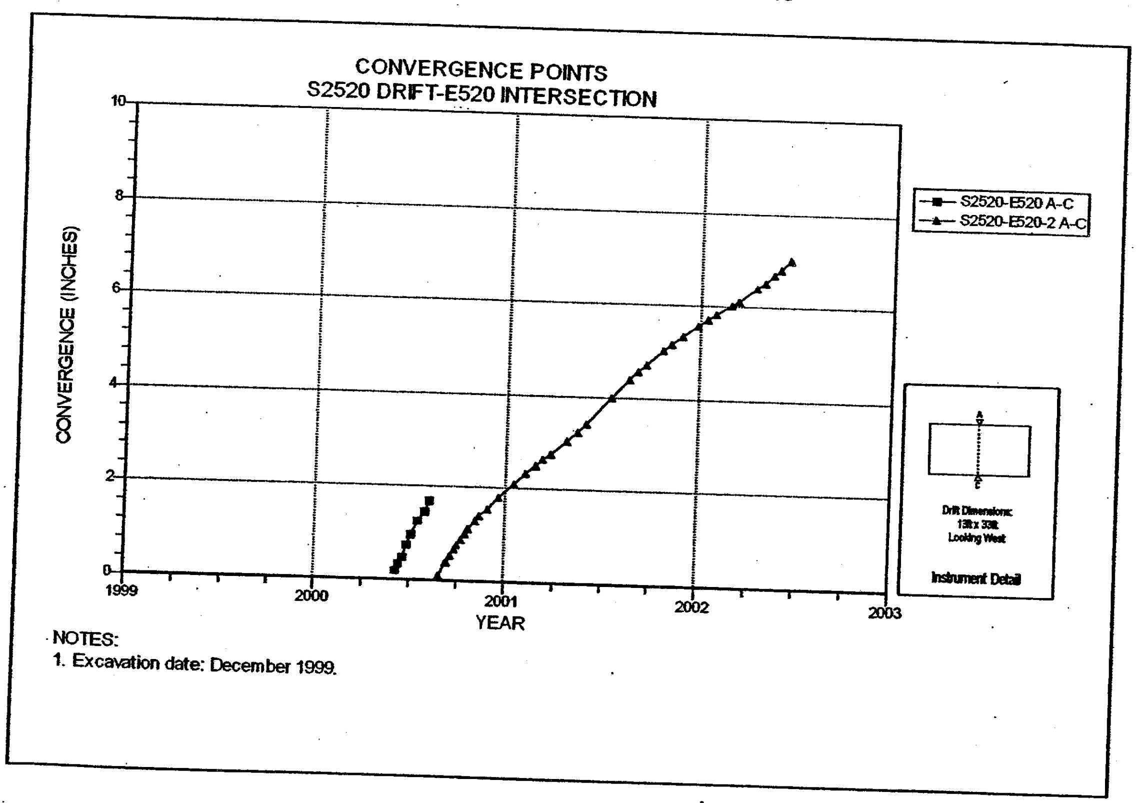
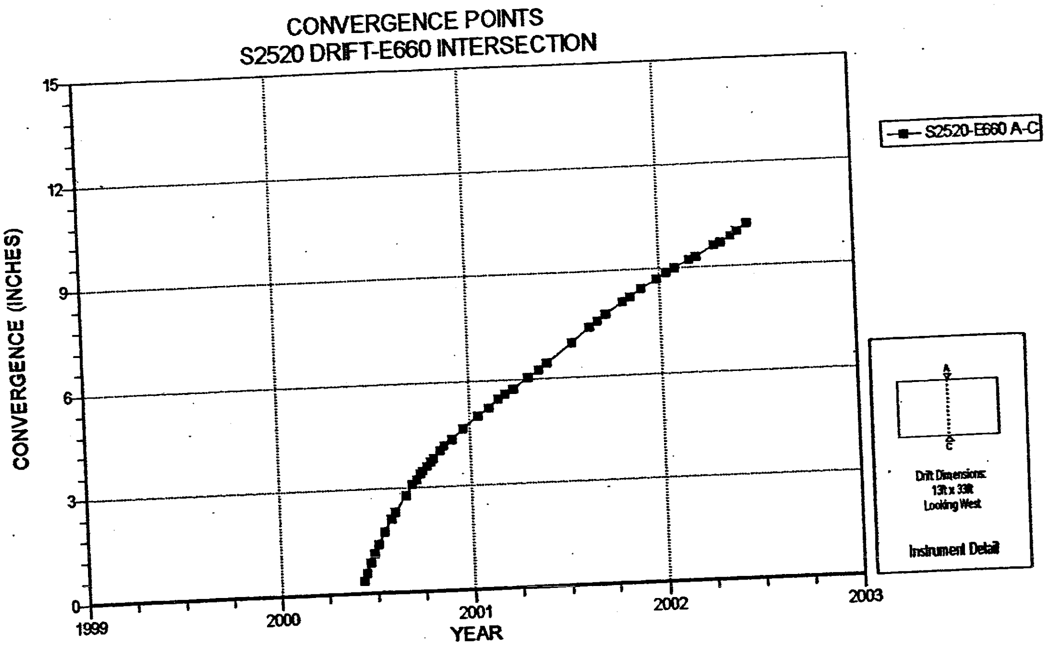
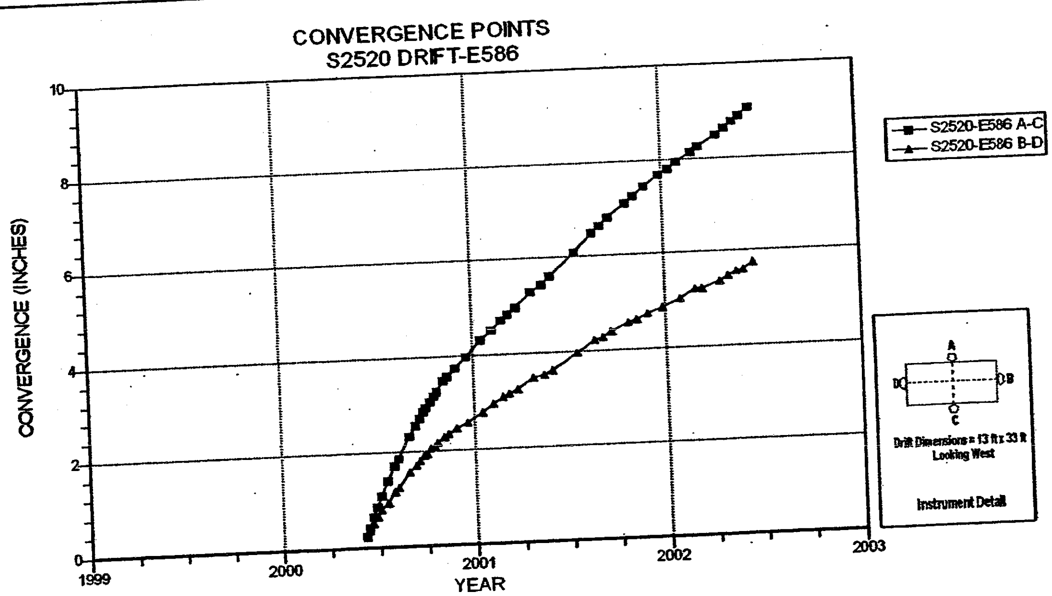


Figure 6-143 Convergence Point Array
S2520 Drift at E520 Drift Intersection (Room 1, Panel 2) – Roof to Floor



NOTES:
1. Excavation date: January 2000.

Figure 6-144 Convergence Point Array
S2520 Drift at E660 Drift Intersection (Room 2, Panel 2) – Roof to Floor



NOTES:
1. Excavation date: January 2000.

Figure 6-145 Convergence Point Array
S2520 Drift at E586 – All Chords

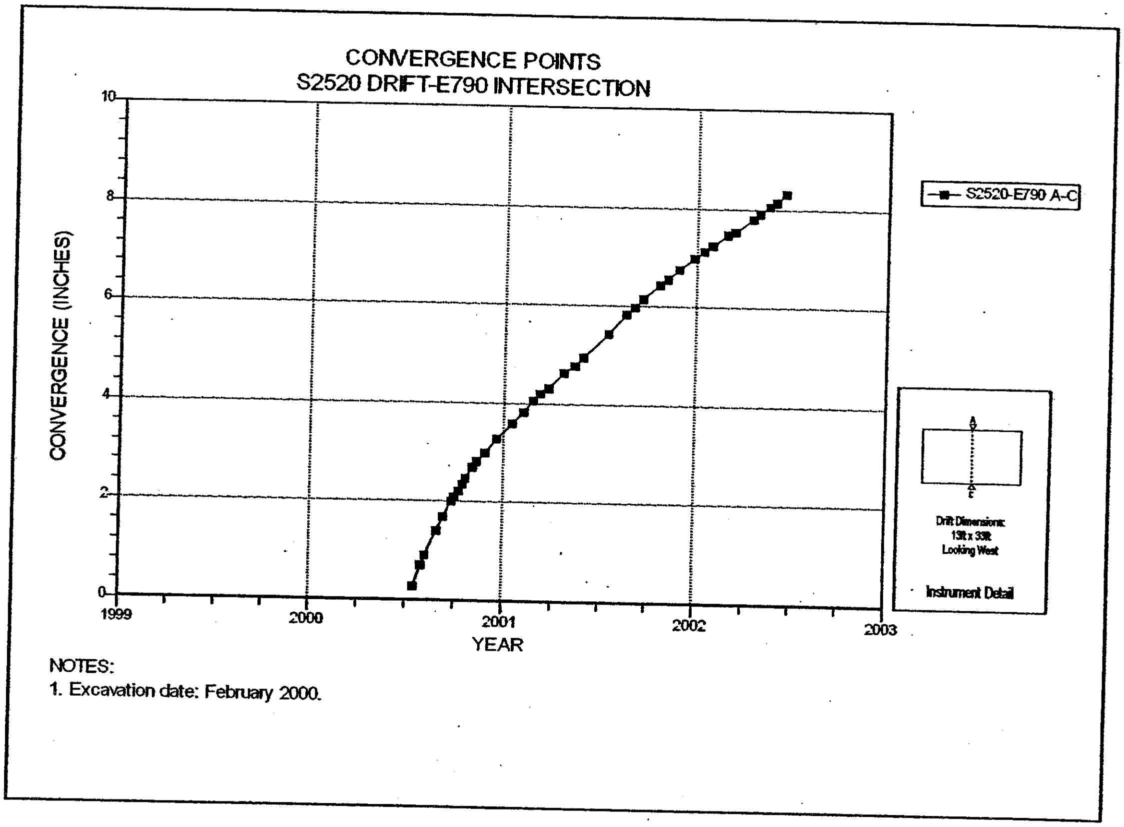


Figure 6-146 Convergence Point Array
S2520 Drift at E790 Drift Intersection (Room 3, Panel 2) – Roof to Floor

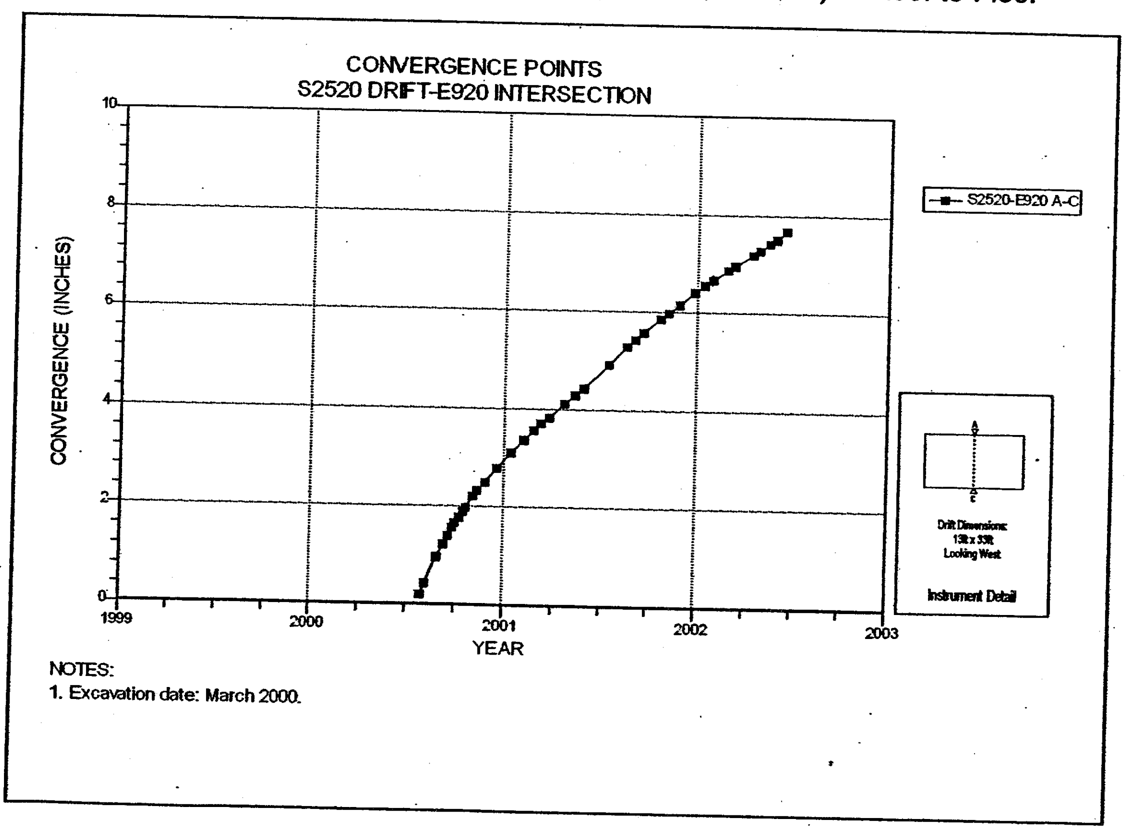
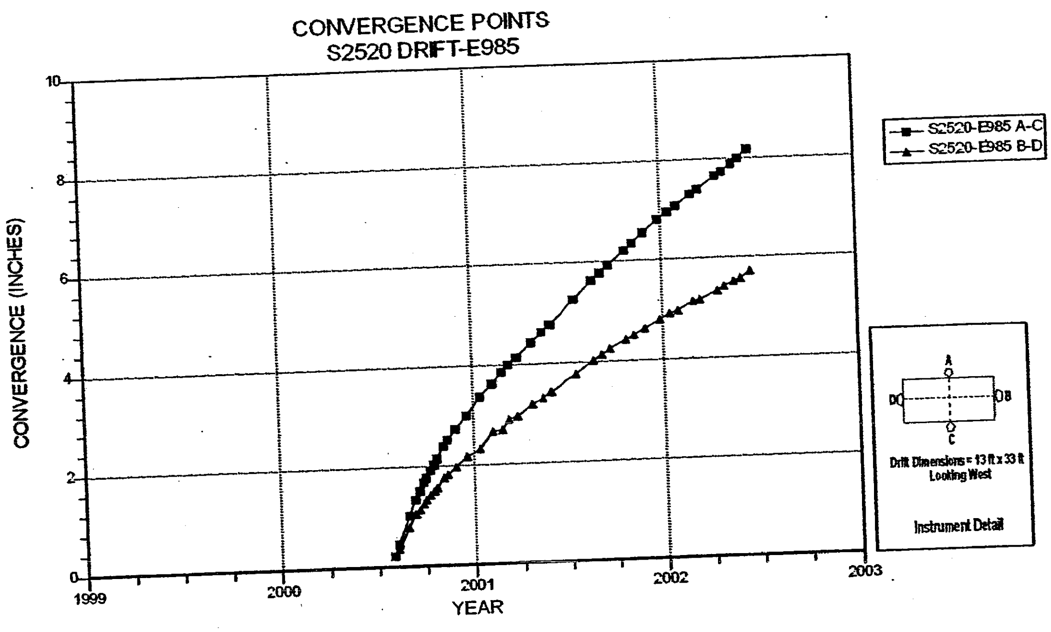
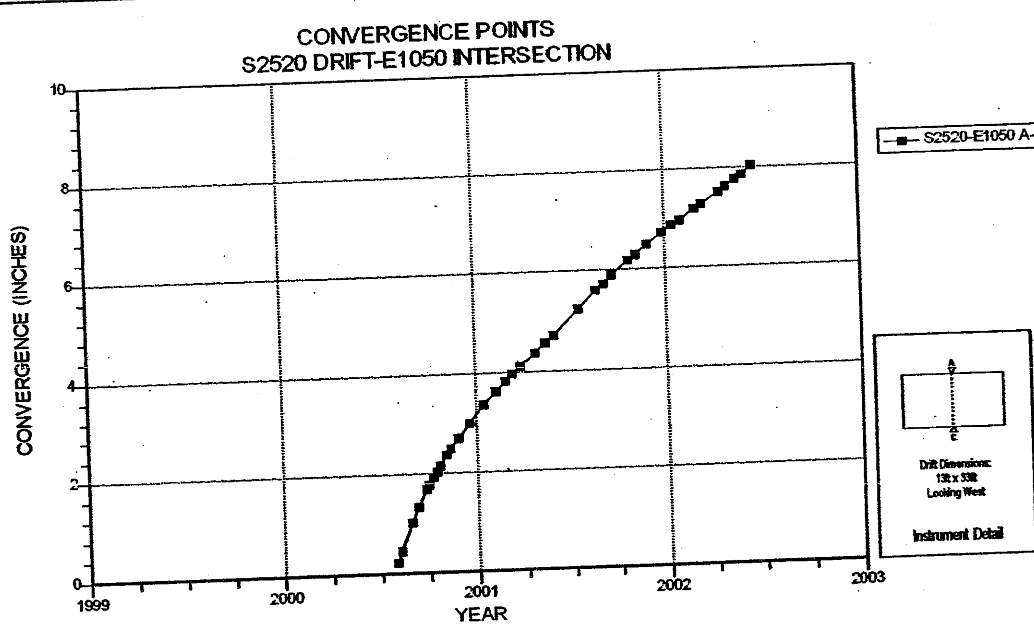


Figure 6-147 Convergence Point Array
S2520 Drift at E920 Drift Intersection (Room 4, Panel 2) – Roof to Floor



NOTES:
1. Excavation date: March 2000.

Figure 6-148 Convergence Point Array
S2520 Drift at E985 – All Chords



NOTES:
1. Excavation date: March 2000.

Figure 6-149 Convergence Point Array
S2520 Drift at E1050 Drift Intersection (Room 5, Panel 2) – Roof to Floor

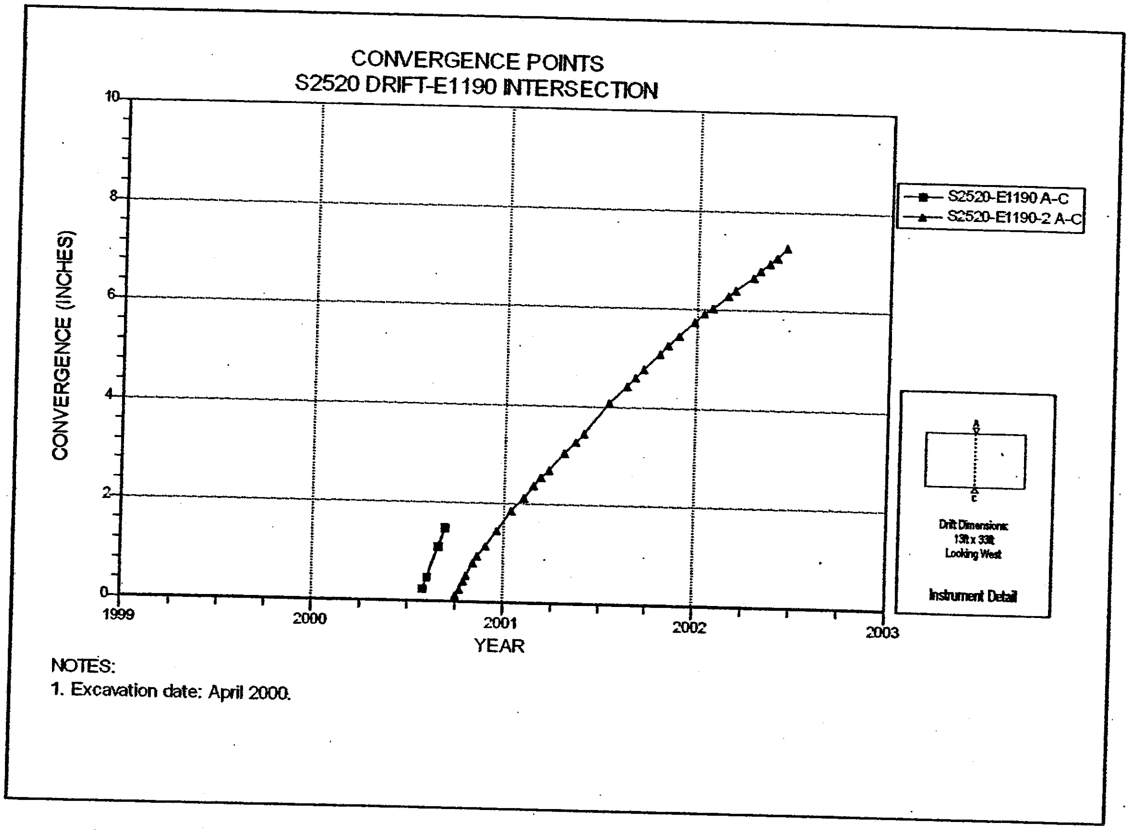


Figure 6-150 Convergence Point Array
S2520 Drift at E1190 Drift Intersection (Room 6, Panel 2) – Roof to Floor

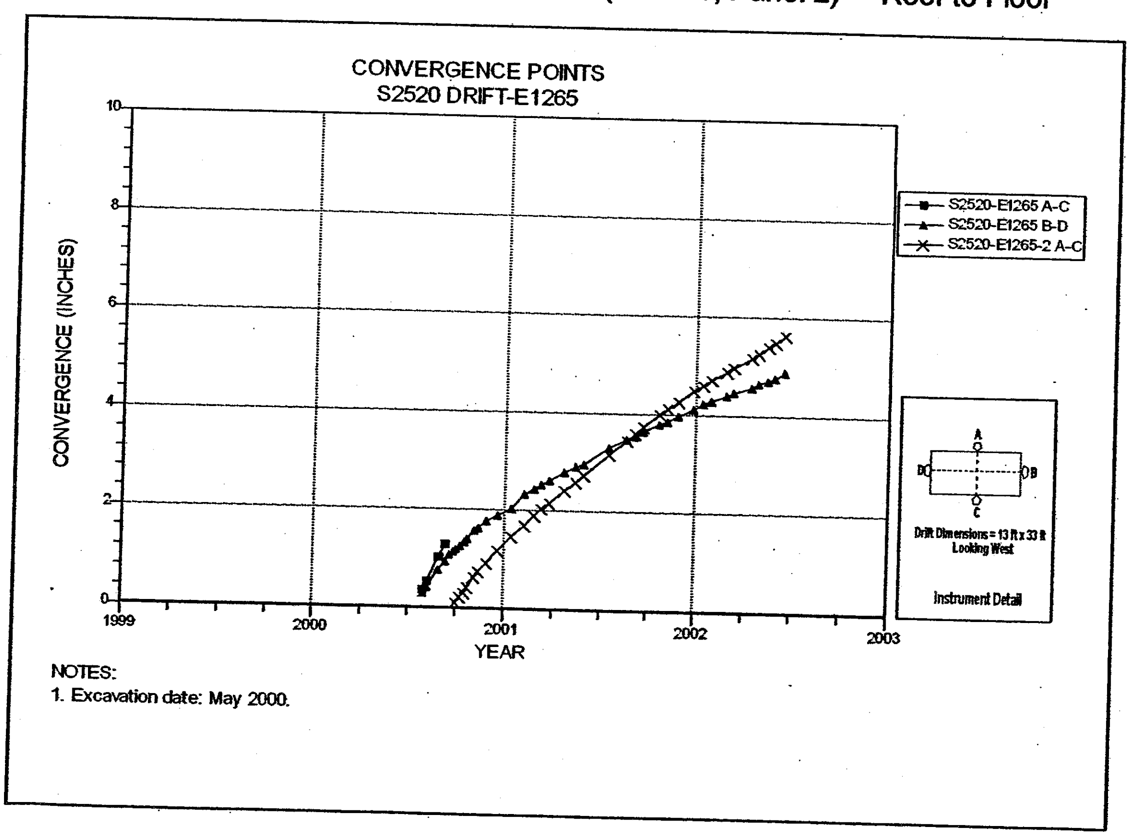
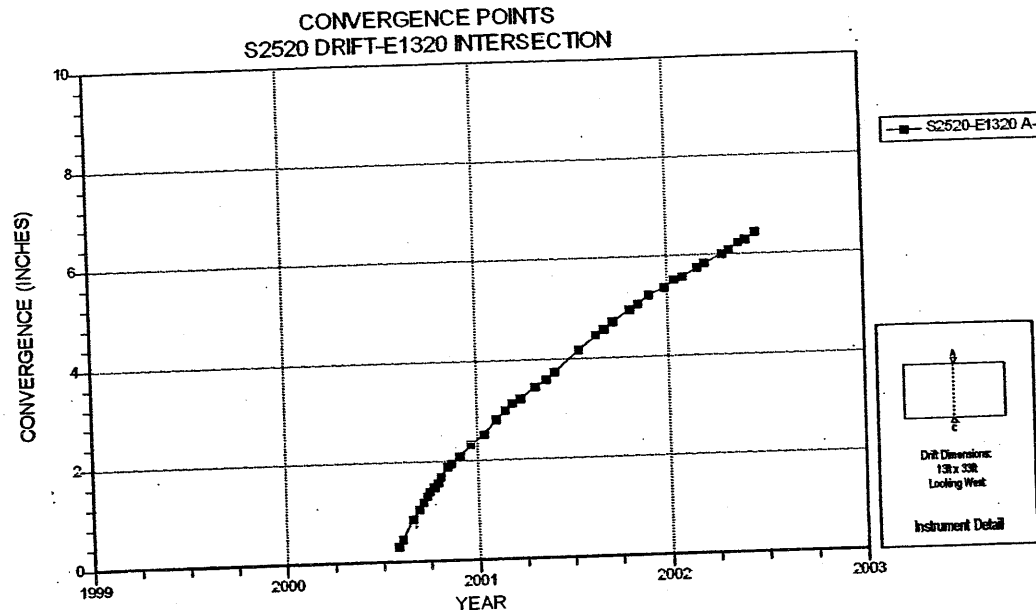
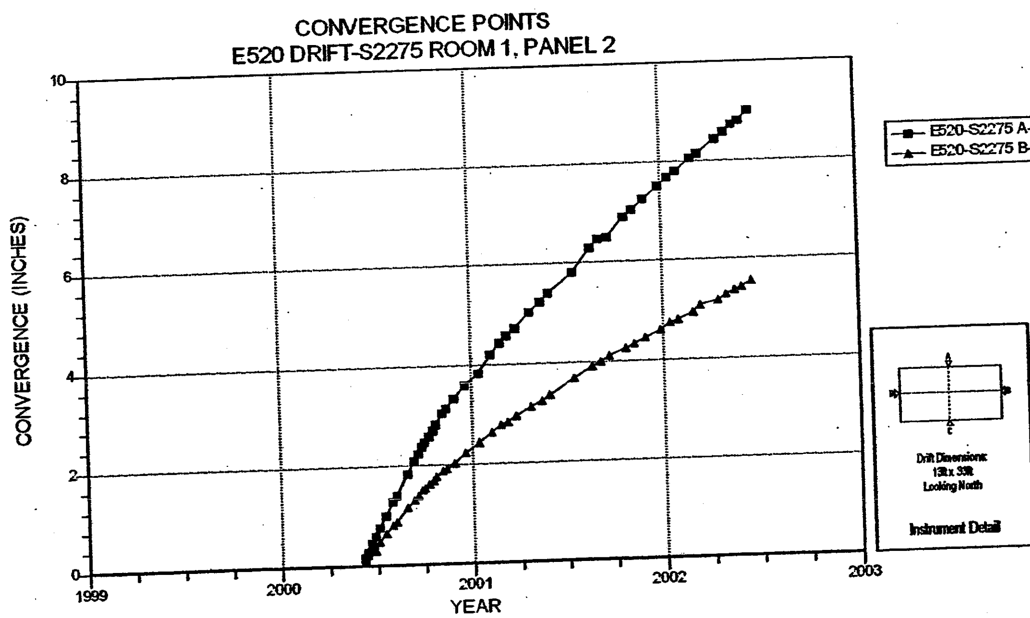


Figure 6-151 Convergence Point Array
S2520 Drift at E1265 – All Chords



NOTES:
1. Excavation date: May 2000.

Figure 6-152 Convergence Point Array
S2520 Drift at E1320 Drift Intersection (Room 7, Panel 2) – Roof to Floor



NOTES:
1. Excavation date: January 2000.

Figure 6-153 Convergence Point Array
Room 1, Panel 2 at S2275 – All Chords

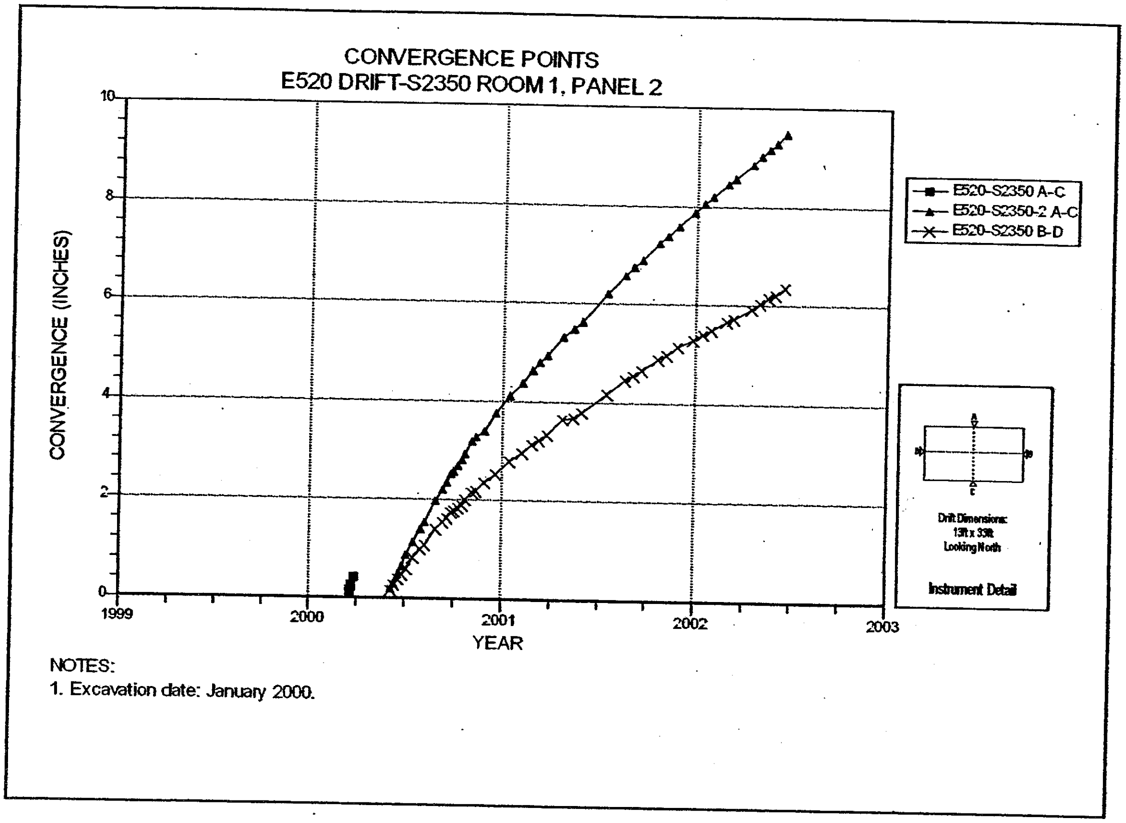


Figure 6-154 Convergence Point Array
Room 1, Panel 2 at S2350 – Room Center – All Chords

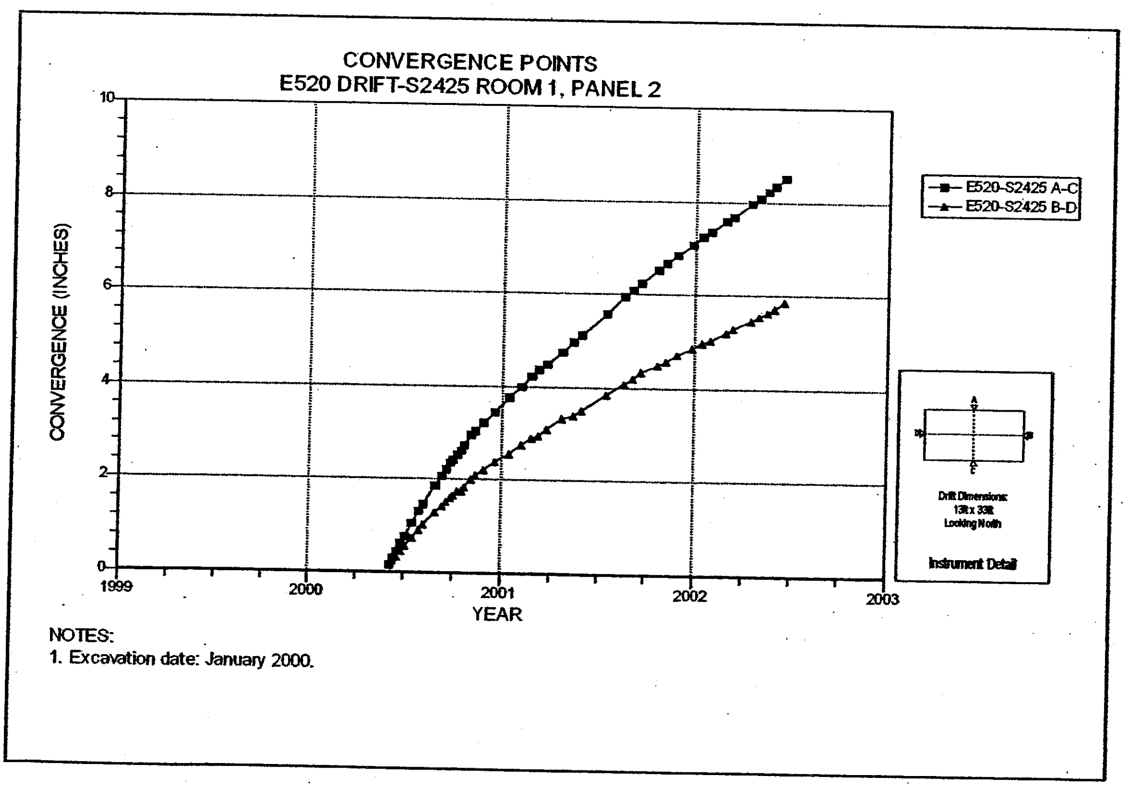
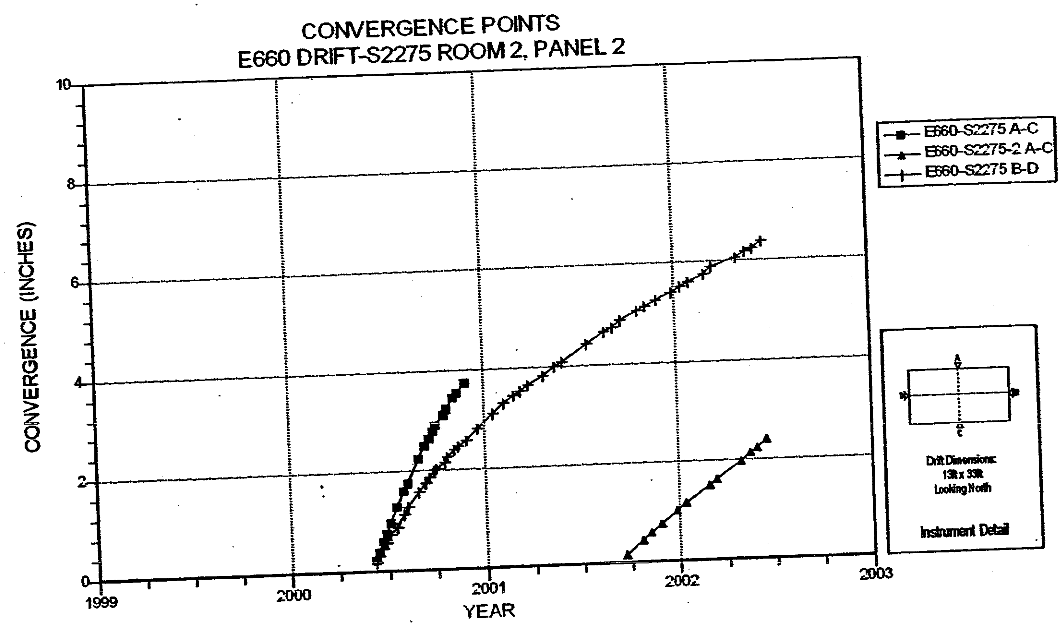
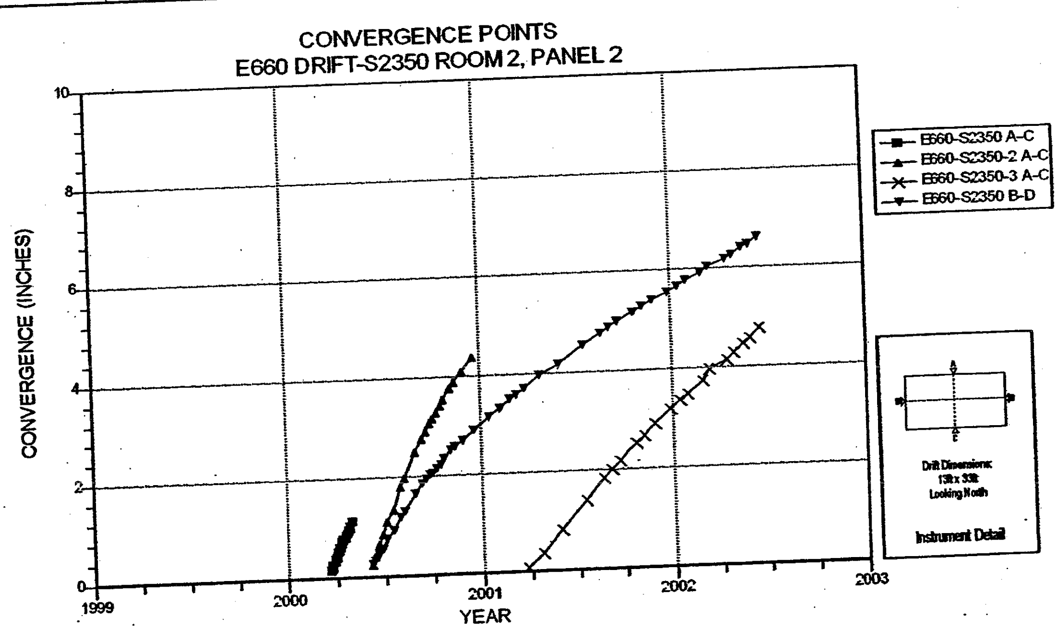


Figure 6-155 Convergence Point Array
Room 1, Panel 2 at S2425 – All Chords



NOTES:
1. Excavation date: February 2000.

Figure 6-156 Convergence Point Array
Room 2, Panel 2 at S2275 – All Chords



NOTES:
1. Excavation date: February 2000.

Figure 6-157 Convergence Point Array
Room 2, Panel 2 at S2350 – Room Center – All Chords

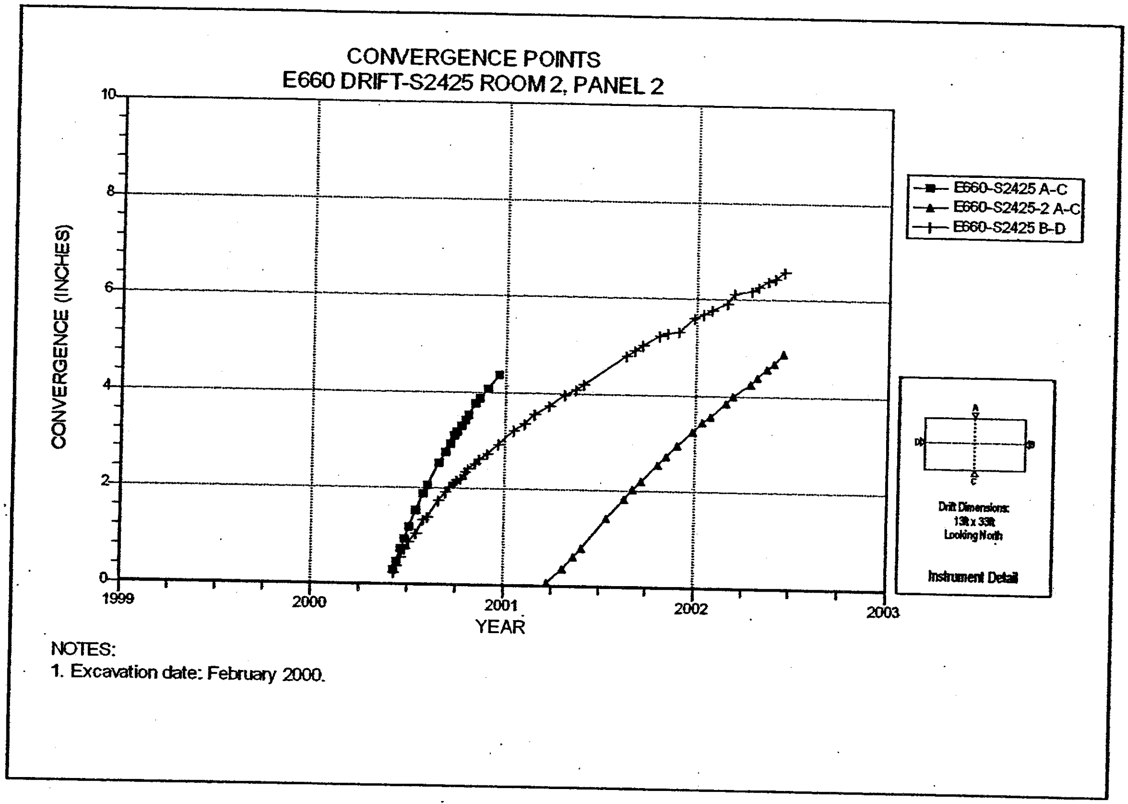


Figure 6-158 Convergence Point Array
Room 2, Panel 2 at S2425 – All Chords

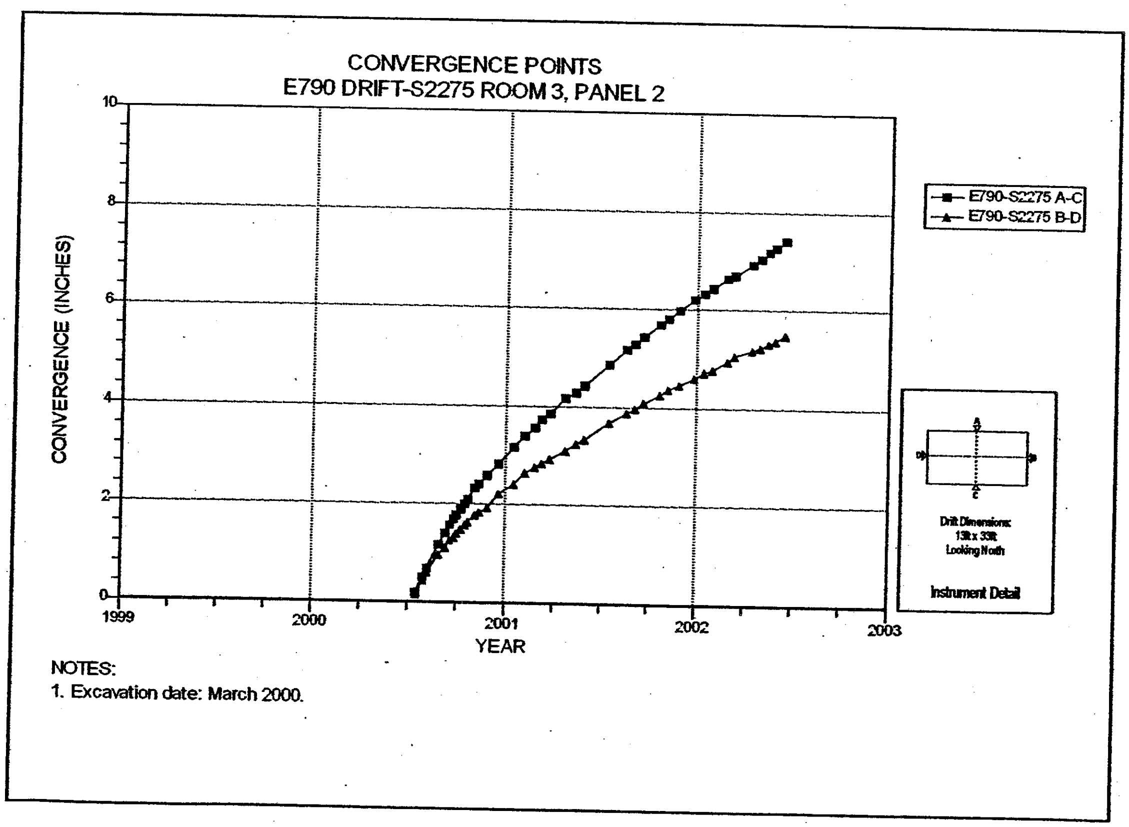


Figure 6-159 Convergence Point Array
Room 3, Panel 2 at S2275 – All Chords

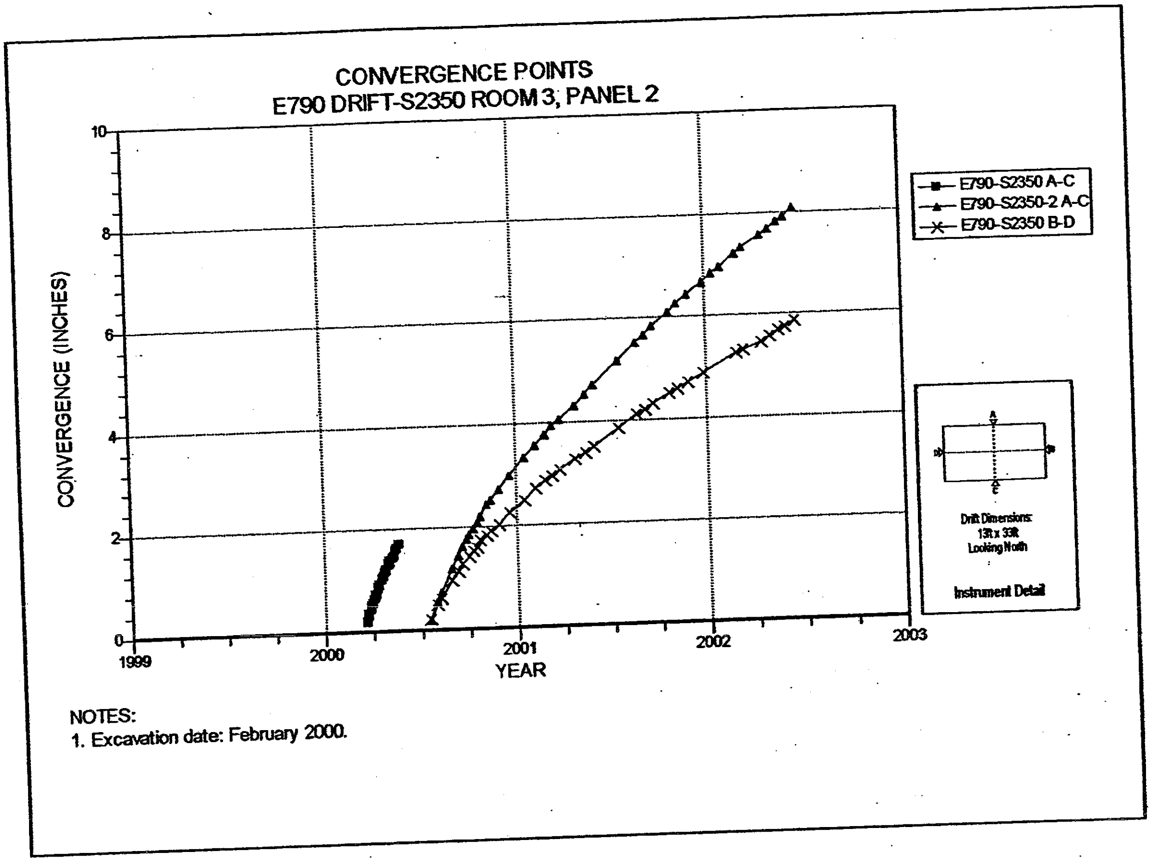


**Figure 6-160 Convergence Point Array
Room 3, Panel 2 at S2350 – Room Center – All Chords**

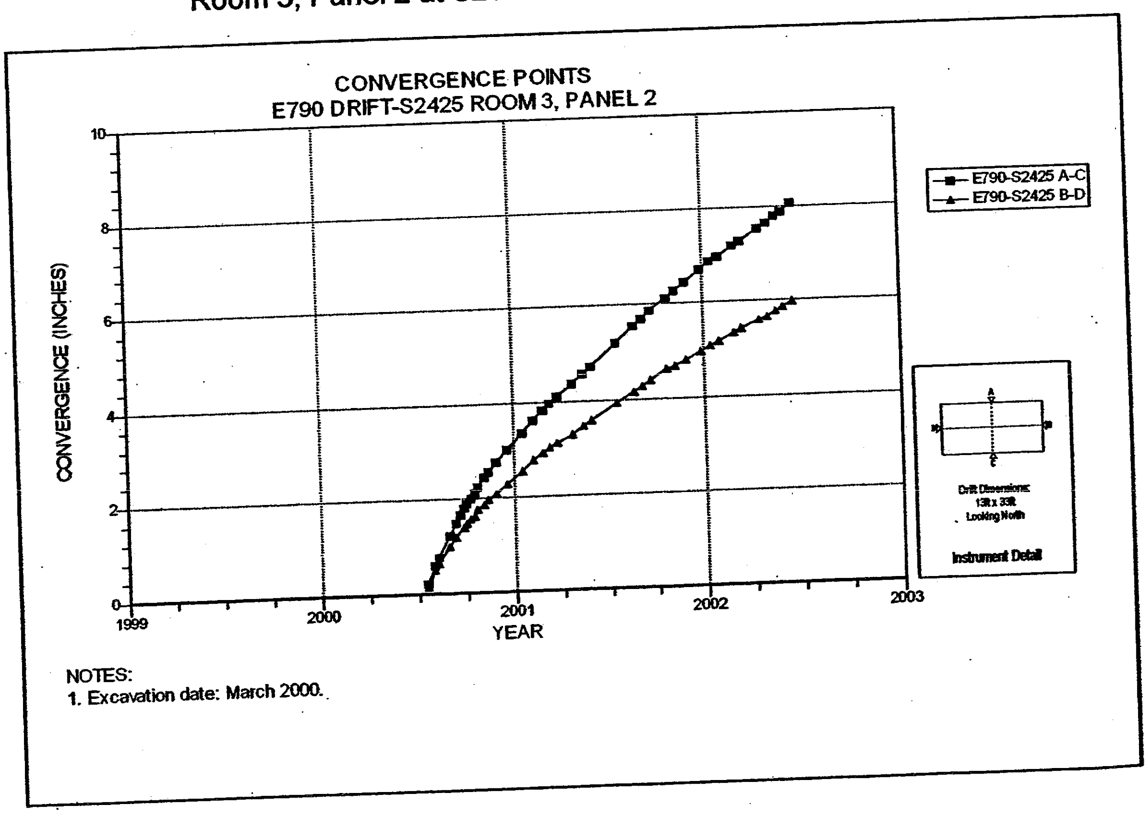


**Figure 6-161 Convergence Point Array
Room 3, Panel 2 at S2425 – All Chords**

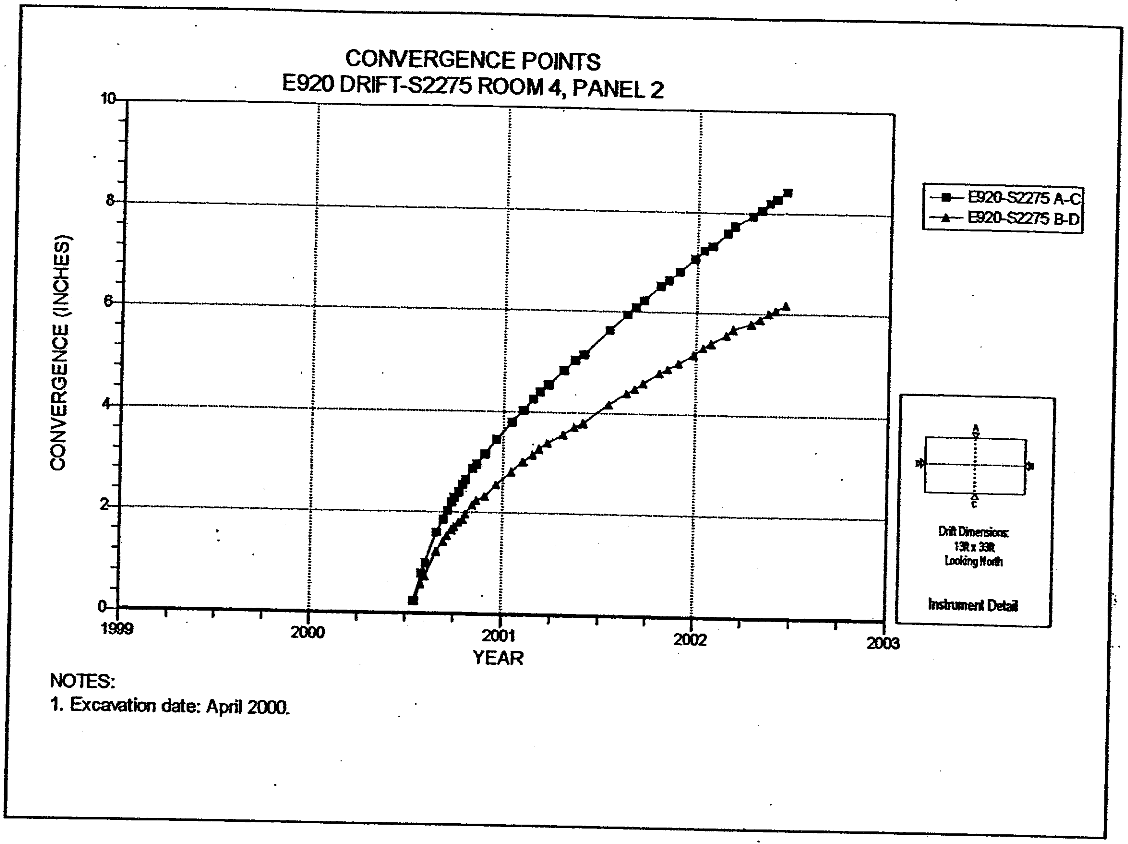


Figure 6-162 Convergence Point Array Room 4, Panel 2 at S2275 – All Chords

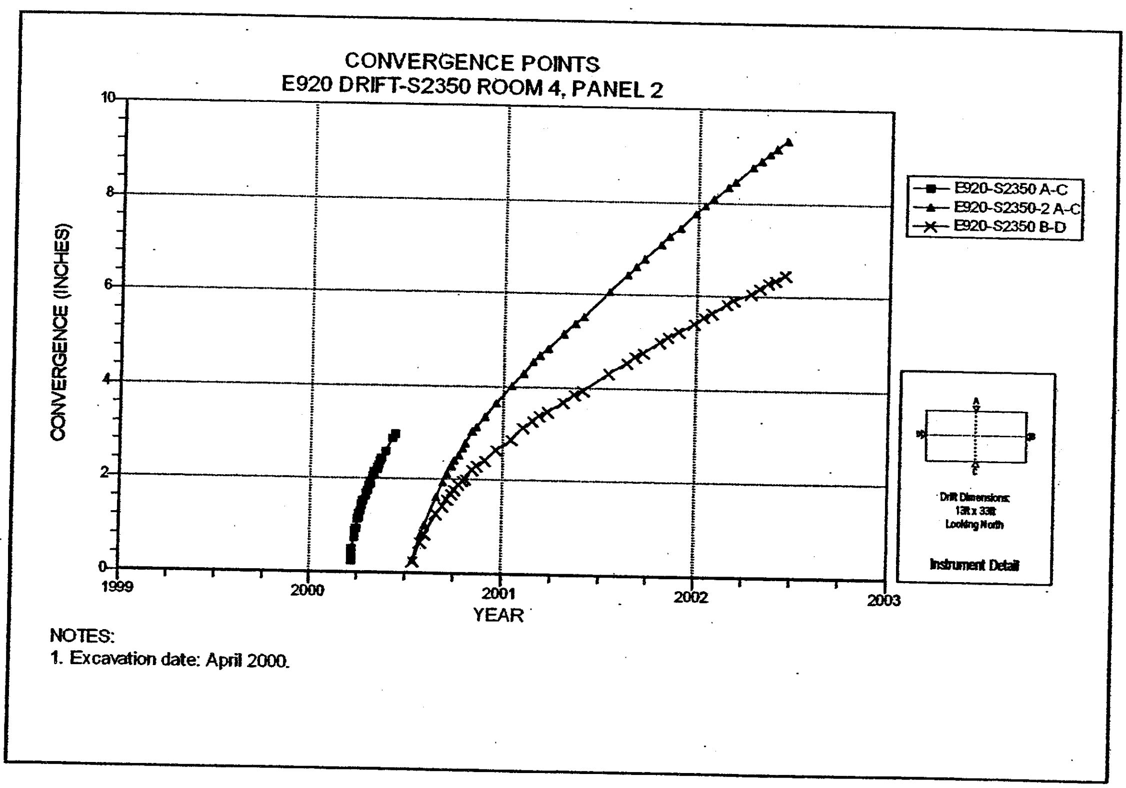


Figure 6-163 Convergence Point Array Room 4, Panel 2 at S2350 – Room Center – All Chords

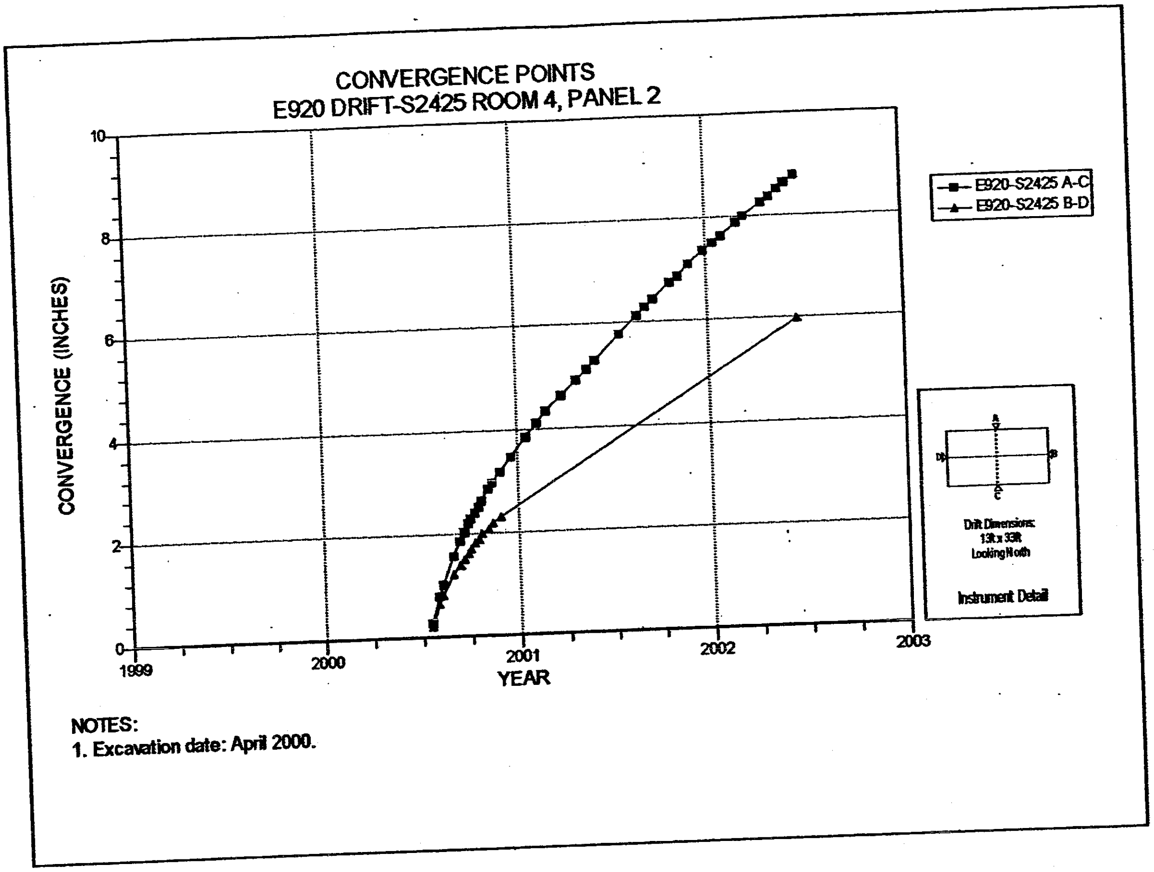


Figure 6-164 Convergence Point Array
Room 4, Panel 2 at S2425 – All Chords

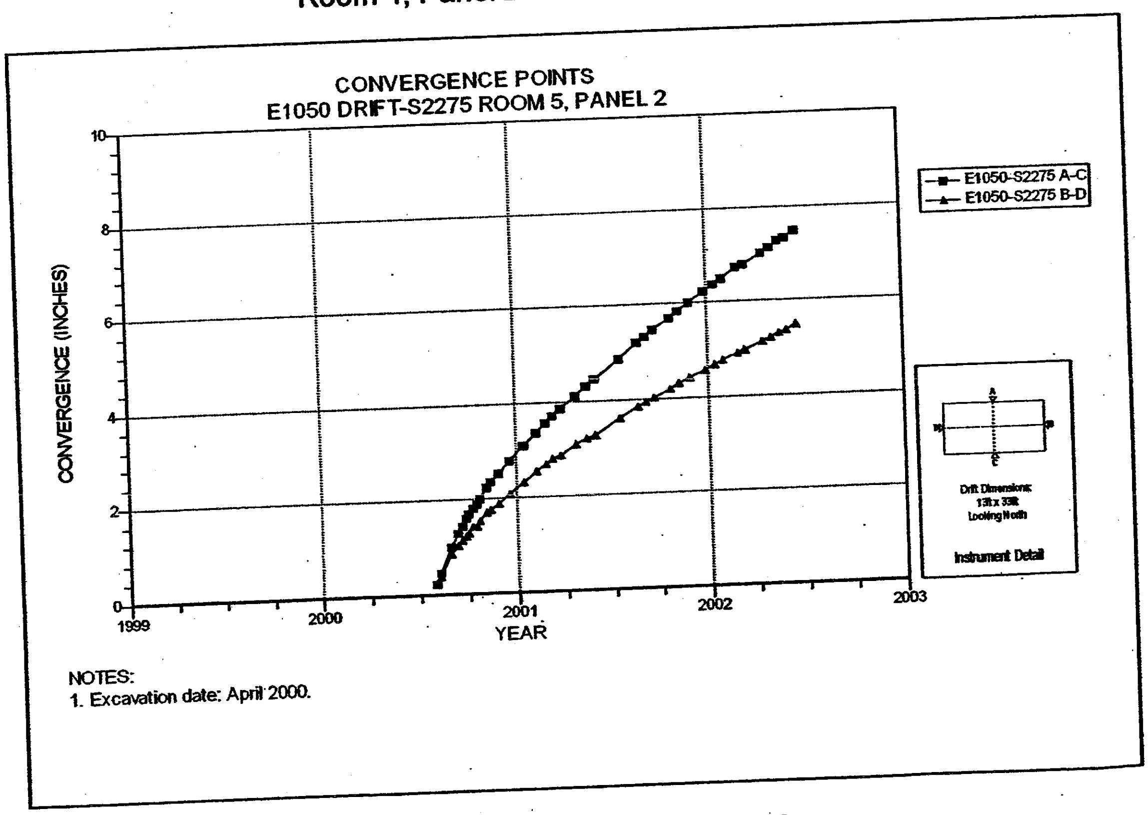


Figure 6-165 Convergence Point Array
Room 5, Panel 2 at S2275 – All Chords

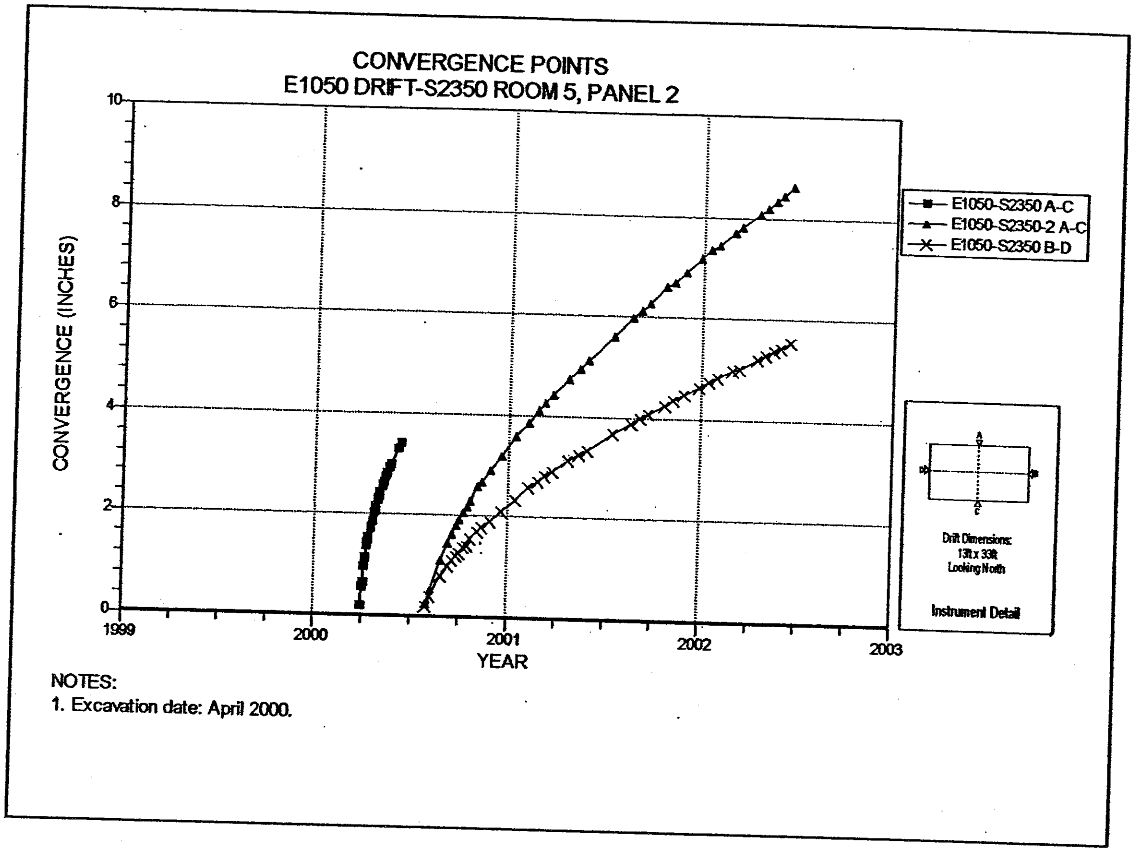


Figure 6-166 Convergence Point Array
Room 5, Panel 2 at S2350 – Room Center – All Chords

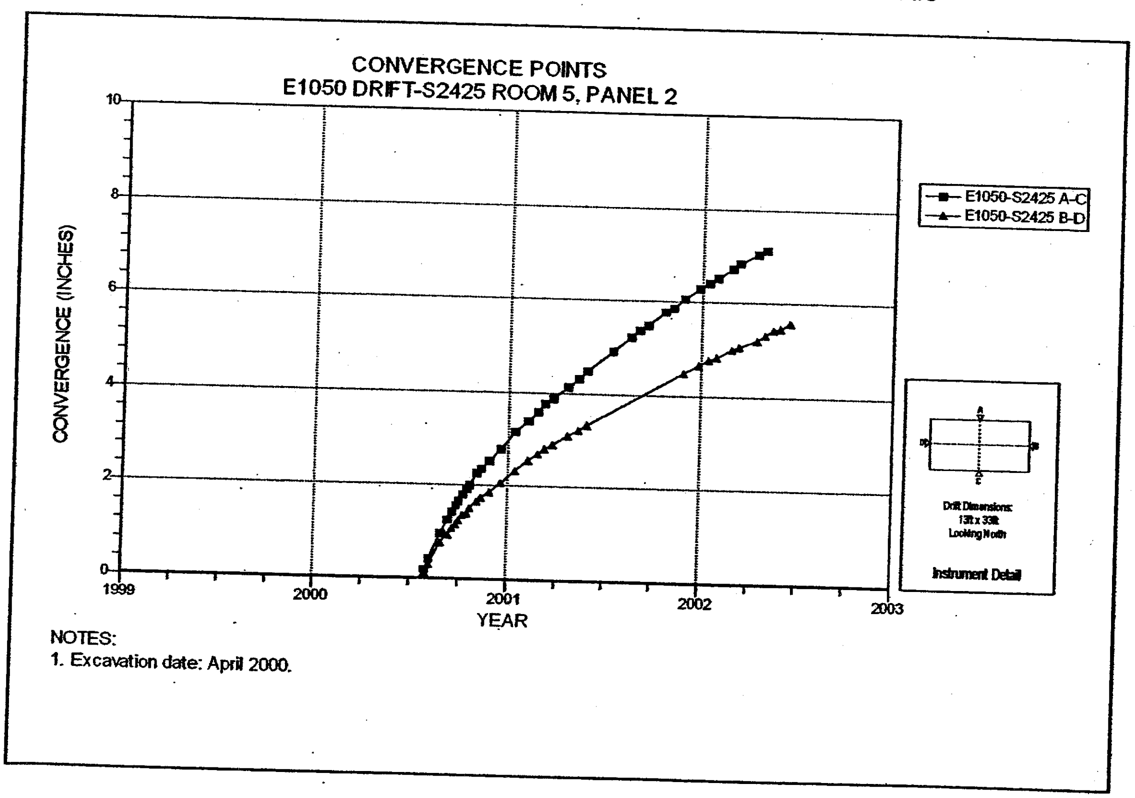


Figure 6-167 Convergence Point Array
Room 5, Panel 2 at S2425 – All Chords

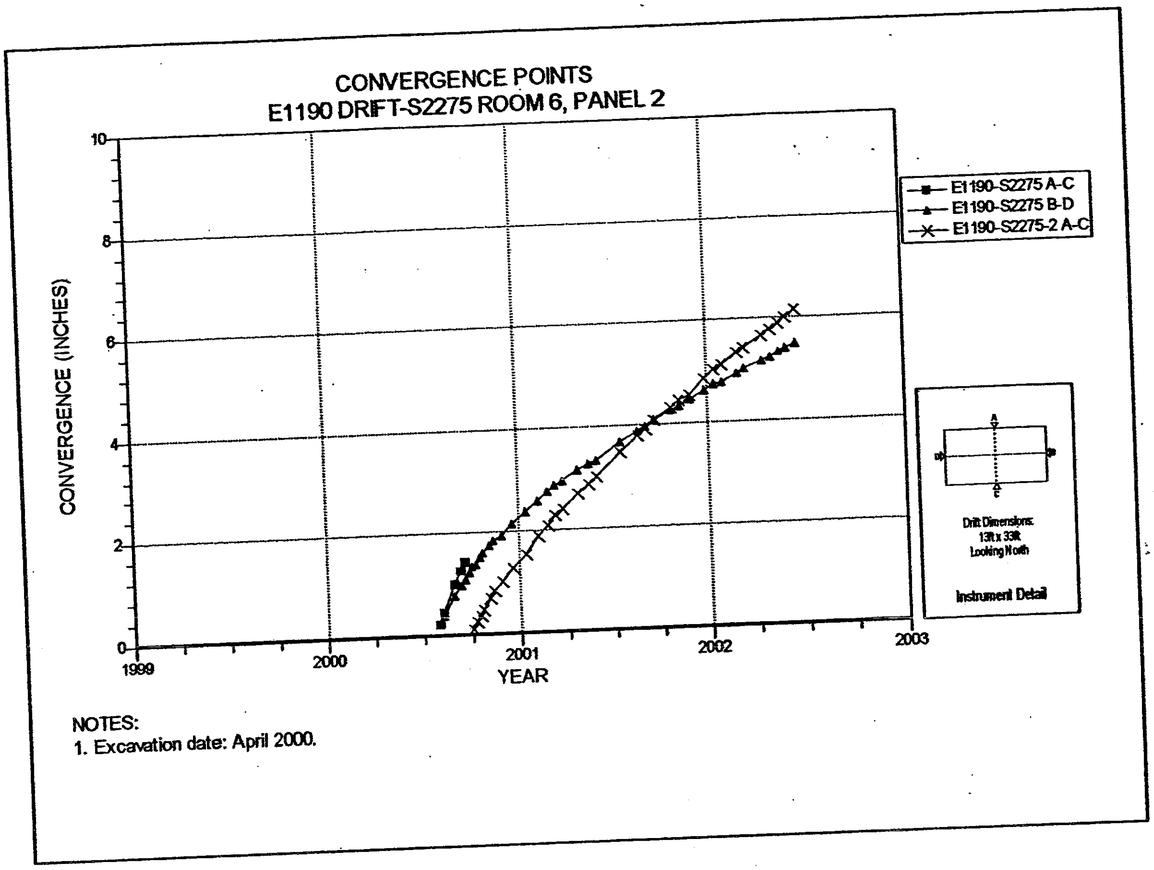


Figure 6-168 Convergence Point Array
Room 6, Panel 2 at S2275 – All Chords

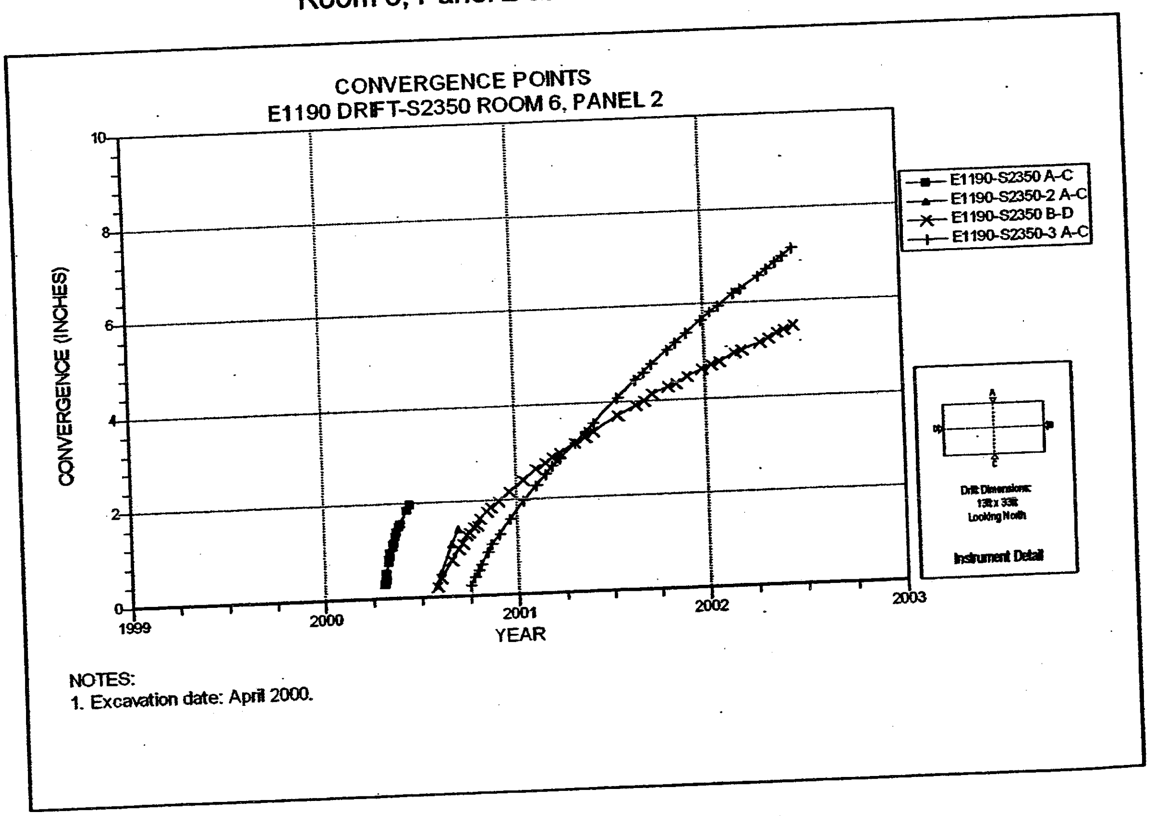


Figure 6-169 Convergence Point Array
Room 6, Panel 2 at S2350 – Room Center – All Chords

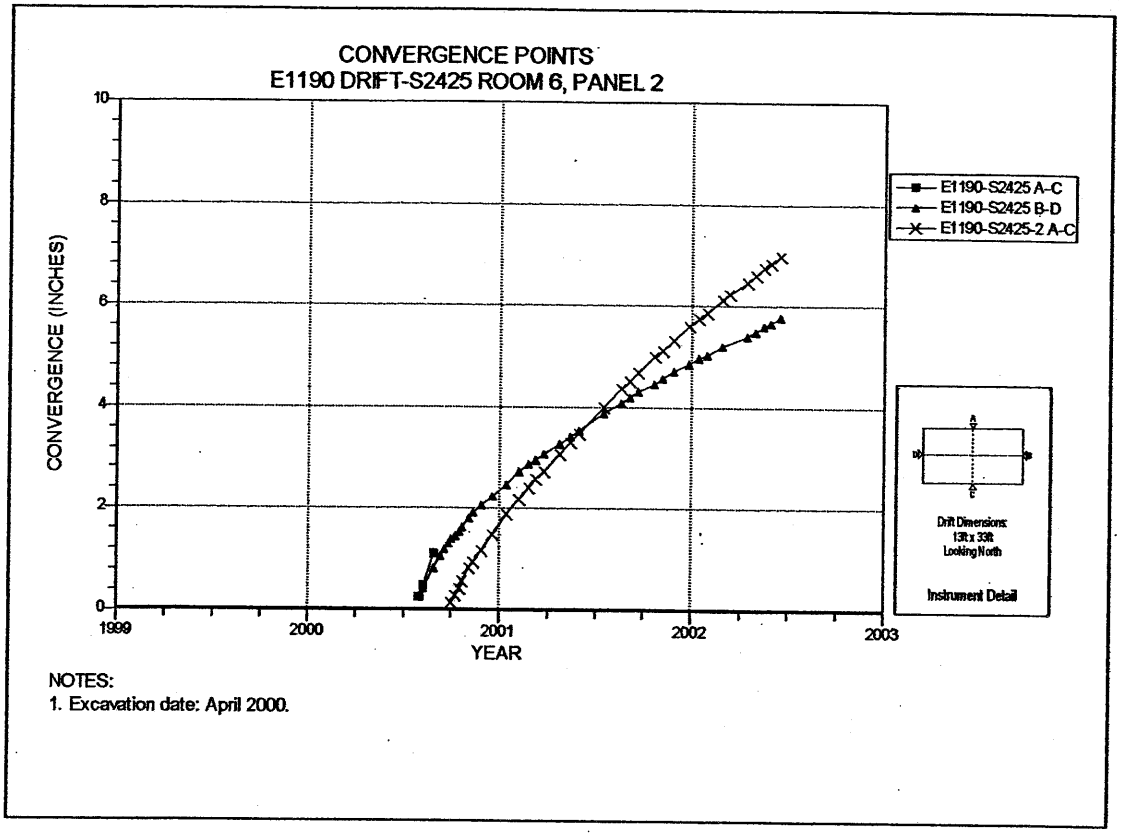


Figure 6-170 Convergence Point Array
Room 6, Panel 2 at S2425 – All Chords

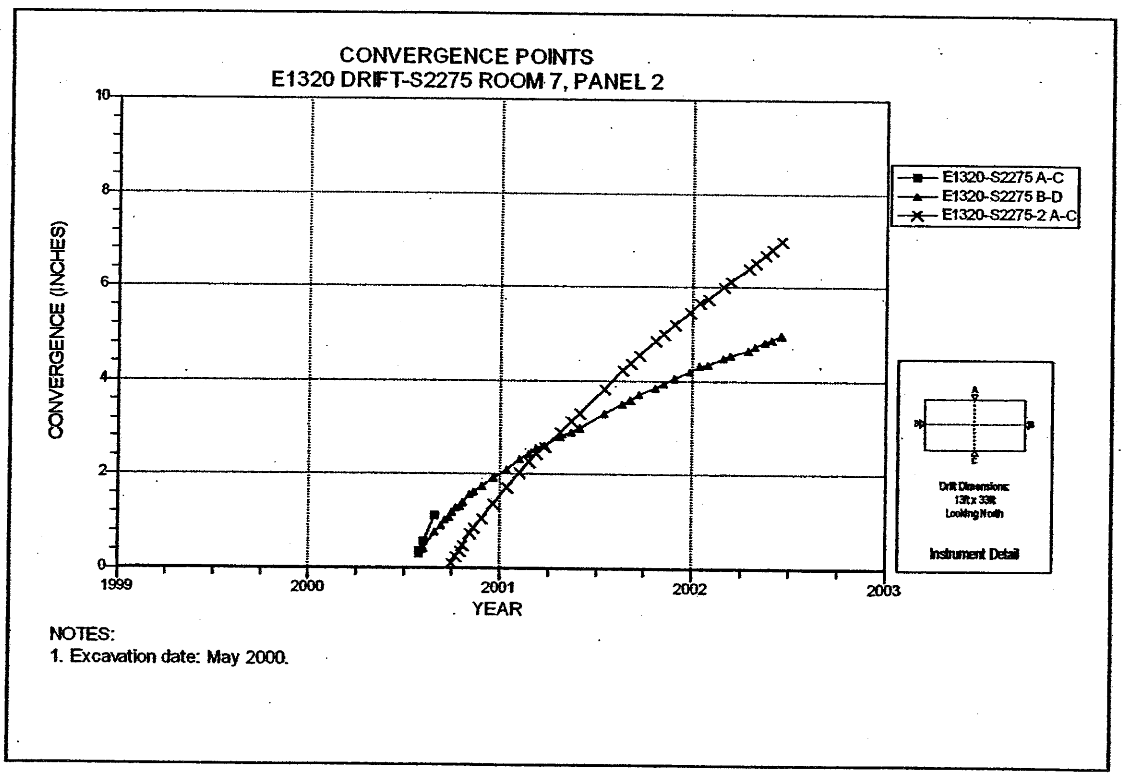


Figure 6-171 Convergence Point Array
Room 7, Panel 2 at S2275 – All Chords

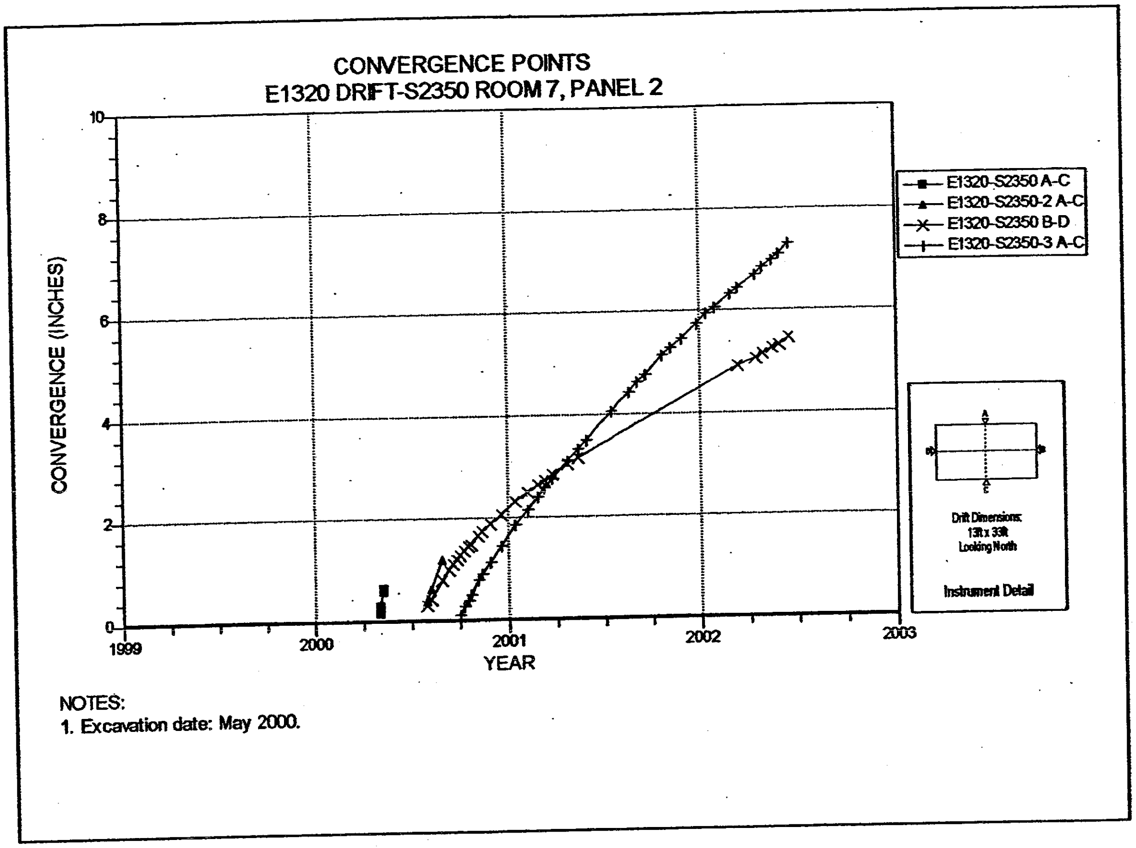


Figure 6-172 Convergence Point Array
Room 7, Panel 2 at S2350 – Room Center – All Chords

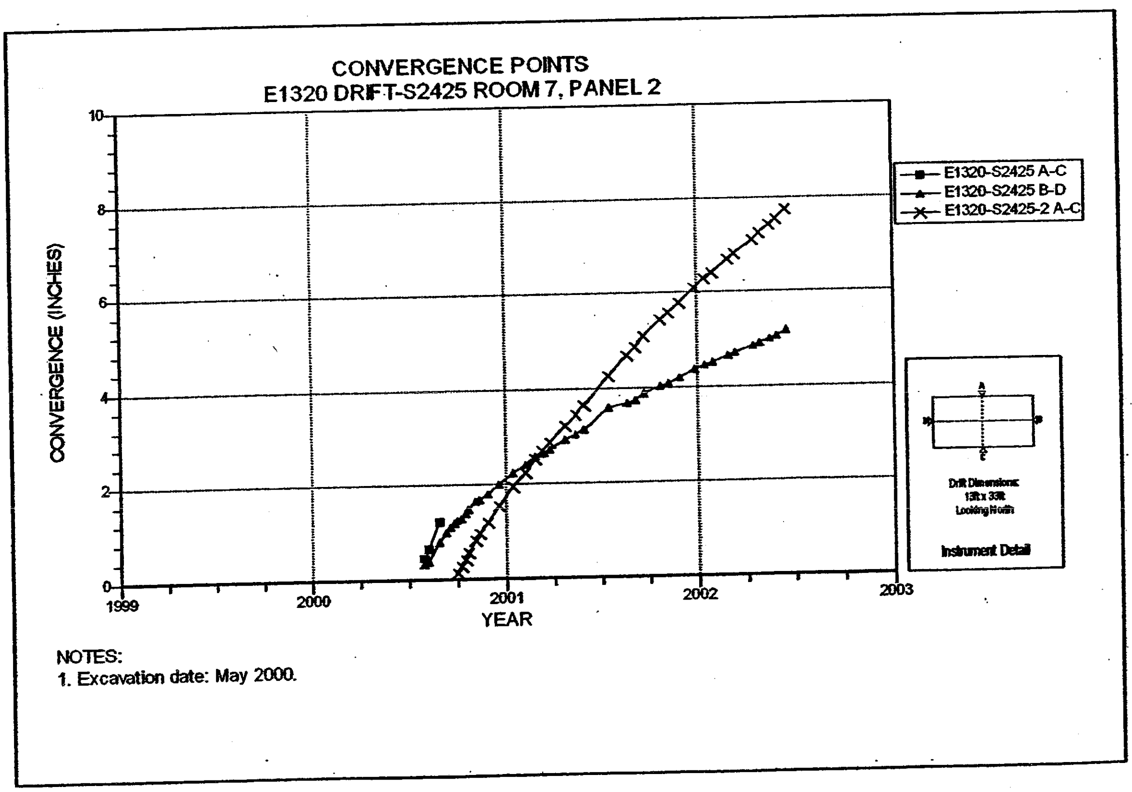


Figure 6-173 Convergence Point Array
Room 7, Panel 2 at S2425 – All Chords

7.0 Geoscience Program Supporting Data

This chapter presents supporting data acquired as part of the Geoscience Program. It includes observations of clay seam displacements in vertical boreholes, logs of new boreholes, stratigraphic core logs, fracture maps of excavation surfaces, and stratigraphic maps of excavation surfaces.

7.1 Bore Hole Inspections

This section presents a summary of the clay seam displacements (offsets) and fracture densities measured in observation boreholes located through the WIPP underground facility. Relative lateral displacement of rock strata above and below a clay layer is measured as offset within a borehole. Fracture density is a calculated parameter based on the number of fractures and fracture zones observed in an observation borehole. Fracture density is equal to the number of fractures plus twice the number of fracture zones in a roof beam divided by the thickness of the beam (in feet). Table 7-1 presents the observed offset data for boreholes intersecting Clay G and Clay H, the number of observed fractures and fracture zones, and the calculated fracture density.

7.2 New Borehole Logging

This section presents a summary of the boreholes drilled during this reporting period. Table 7-2 presents the location, drill date, size, total depth, and purpose of each new hole.

7.3 Fracture Mapping

This section presents graphical results of the fracture mapping done in Panels 1 and 2 of the Waste Disposal Area. Figures 7-1 through 7-19 are plan view fracture maps for the roof (back) in these panels.

Table 7-1
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Northing	Easting	Drill Date	Inspection Date	Fr[1]	FZ[2]	Beam Height (ft)	Beam Feature	Fracture Density[3]	Offset Depth (ft)	Offset Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offset Rate (in/yr)
Panel 2 Room 1														
OH 359	S 2271	E 523	6/2000	4/9/02	1	0	4.7	offset	0.21	4.7	0.12	3	4.0	0.06
OH 360	S 2350	E 523	6/2000	4/9/02	1	0	2.7	hangup	0.37	2.7	0.12	3	4.0	0.06
OH 361	S 2422	E 523	6/2000	4/9/02	0	0	7.1	fracture	0	7.1	0.12	3	4.0	0.06
Panel 2 Room 2														
OH 362	S 2275	E 655	6/2000	4/4/02	1	0	7.7	offset	0.13	7.7	0.12	3	4.0	0.07
OH 363	S 2347	E 656	6/2000	4/4/02	none	none	NA	no offsets	0	none	none	3	none	none
OH 364	S 2422	E 656	6/2000	4/4/02	none	none	NA	no offsets	0	none	none	3	none	none
Panel 2 Room 3														
OH 365	S 2277	E 789	6/2000	4/4/02	none	none	NA	no offsets	0	none	none	3	none	none
OH 366	S 2351	E 790	6/2000	4/4/02	1	0	7.0	offset	0.14	7.0	0.06	3	2.0	0.03
			6/2000	4/4/02	0	0	6.5	offset	0	6.5	0.06	3	2.0	0.03
OH 367	S 2421	E 789	6/2000	4/4/02	none	none	NA	no offsets	0	none	none	3	none	none
Panel 2 Room 4														
OH 368	S 2270	E 922	6/2000	4/4/02	none	none	NA	no offsets	0	none	none	3	none	none
OH 369	S 2344	E 922	6/2000	4/4/02	none	none	NA	no offsets	0	none	none	3	none	none
OH 370	S 2426	E 922	6/2000	4/4/02	2	0	14.0	offset/Clay H	0.14	14.0	0.06	3	2.0	0.03
			6/2000	4/4/02	1	0	7.2	offset/Clay G	0.14	7.2	0.05	3	1.7	0.03
Panel 2 Room 5														
OH 371	S 2276	E 1054	6/2000	3/19/02	none	none	NA	no offsets	0	none	none	3	none	none
OH 372	S 2351	E 1055	6/2000	3/19/02	0	0	6.5	hangup	0	6.5	0.12	3	4.0	0.07
OH 373	S 2426	E 1055	6/2000	3/19/02	0	0	6.8	offset	0	6.8	0.25	3	8.3	0.14
Panel 2 Room 6														
OH 374	S 2275	E 1188	6/2000	3/19/02	none	none	NA	no offsets	0	none	none	3	none	none
OH 375	S 2347	E 1189	6/2000	3/19/02	1	0	14.0	offset	0.07	14.0	0.12	3	4.0	0.07
			6/2000	3/19/02	0	0	7.3	offset	0	7.3	0.25	3	8.3	0.14
OH 376	S 2423	E 1189	6/2000	3/19/02	none	none	NA	no offsets	0	none	none	3	none	none
Panel 2 Room 7														
OH 379	S 2270	E 1321	6/2000	3/21/02	none	none	NA	no offsets	0	none	none	3	none	none
OH 378	S 2345	E 1321	6/2000	3/21/02	0	0	7.1	offset	0	7.1	0.12	3	4.0	0.07
OH 377	S 2421	E 1321	6/2000	3/21/02	1	0	7.1	offset	0.14	7.1	0.12	3	4.0	0.07

[1] Fr = Number of fractures in immediate roof beam

[2] Number of fracture zones in immediate roof beam

[3] Fracture Density = (Fr + 2 FZ) / Beam Height

Table 7-1 (Continued)
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Northing	Easting	Drill Date	Inspection Date	Fr [1]	FZ [2]	Beam Height (ft)	Beam Feature	Fracture Density [3]	Offset Depth (ft)	Offset Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offset Rate (in/yr)
South 2180 (Panel 2)														
OH 380	S 2180	E 726	6/2000	4/8/02	1	0	12.6	offset	0.08	12.6	1.6	3	53.3	0.86
			6/2000	4/8/02	0	0	6.3	offset	0	6.3	1.5	3	50.0	0.81
OH 381	S 2181	E 921	6/2000	4/8/02	1	0	14.4	hangup	0.07	14.4	1.6	3	53.3	0.86
			6/2000	4/8/02	0	0	7.5	hangup	0	7.5	1.5	3	50.0	0.81
OH 382	S 2183	E 1120	6/2000	4/8/02	0	0	7.7	hangup	0	7.7	0.12	3	4.0	0.06
South 2520 (Panel 2)														
OH 383	S 2515	E 718	6/2000	4/9/02	0	0	6.1	offset	0	6.1	0.12	3	4.0	0.06
OH 384	S 2517	E 921	6/2000	4/9/02	1	0	12.4	offset	0.08	12.4	1.4	3	46.7	0.75
			6/2000	4/9/02	0	0	6.5	offset	0	6.5	0.25	3	8.3	0.13
OH 385	S 2514	E 1133	6/2000	3/21/02	0	0	6.3	offset	0	6.3	0.25	3	8.3	0.14
OH 387	S 2517	E 1326	6/2000	3/21/02	1	0	12.6	offset	0.08	12.6	0.12	3	4.0	0.07
			6/2000	3/21/02	0	0	6.5	offset	0	6.5	0.25	3	8.3	0.14
Waste Shaft Station														
OH 005	S 400	E 45	11/13/91	10/24/01	2	1	4.7	offset	0.85	4.7	3.00	3	100.0	0.30
			11/13/91	10/24/01	1	0	4.6	FZ top	0.22	4.6	0	3	0	0
			11/13/91	10/24/01	1	0	2.5	FZ bottom	0.40	2.5	0	3	0	0
East 140														
OH 001	S 400	E 140	12/26/96	10/24/01	2	0	3.2	offset	0.63	3.2	2.50	3	83.3	0.52
OH 002	S 410	E 147	10/06/83	10/24/01	2	0	3.0	offset	0.67	3.0	2.00	3	66.7	0.11
OH103	S 500	E 149	07/12/94	10/24/01	2	0	5.5	offset	0.36	5.5	2.50	3	83.3	0.34
OH104	S 498	E 155	07/12/94	10/24/01	1	0	5.3	Clay G	0.19	5.3	0.12	3	4.0	0.02
OH108	S 550	E 161	07/12/94	10/24/01	3	0	6.0	offset	0.50	6.0	2.25	3	75.0	0.31
OH109	S 600	E 147	07/12/94	10/24/01	3	0	5.9	offset	0.51	5.9	3.00	3	100.0	0.41
OH110	S 599	E 154	07/12/94	10/24/01	2	1	6.1	offset	0.66	6.1	0.22	3	7.3	0.03
			07/12/94	10/24/01	0	0	4.8	FZ top	0	4.8	0	3	0	0
			07/12/94	10/24/01	0	0	4.5	FZ bottom	0	4.5	0.20	3	6.7	0.03
OH112	S 801	E 148	09/02/93	10/30/01	0	0	1.0	offset	0	1.0	0.50	3	16.7	0.06

[1] Fr = Number of fractures in immediate roof beam
[2] Number of fracture zones in immediate roof beam
[3] Fracture Density = (Fr + 2 FZ) / Beam Height

Table 7-1 (Continued)
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Northing		Easting		Drill Date	Inspection Date	Fr [1]	FZ [2]	Beam Height (ft)	Beam Feature	Fracture Density [3]	Offset Depth (ft)	Offset Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offset Rate (in/yr)
East 140 (continued)																
OH114	S	801	E	161	09/02/93	10/30/01	2	1	3.2	offset	1.25	3.2	2.90	3	96.7	0.36
					09/02/93	10/30/01	1	0	2.9	FZ top	0.34	2.9	0.30	3	10.0	0.04
					09/02/93	10/30/01	1	0	2.4	FZ bottom	0.42	2.4	0.30	3	10.0	0.04
					09/02/93	10/30/01	0	0	2.3	offset	0	2.3	0.25	3	8.3	0.03
OH115	S	851	E	149	09/02/93	10/31/01	1	0	2.5	offset	0.40	2.5	3.00	3	100.0	0.37
OH116	S	851	E	155	09/02/93	10/30/01	0	0	4.3	offset	0	4.3	3.00	3	100.0	0.37
OH118	S	900	E	149	09/02/93	10/30/01	0	0	1.7	fracture	0	1.7	3.00	3	100.0	0.37
OH119	S	900	E	155	09/02/93	10/30/01	2	1	5.5	offset	0.73	5.5	3.00	3	100.0	0.37
					09/02/93	10/30/01	1	0	5.0	FZ top	0.20	5.0	0	3	0.0	0
					09/02/93	10/30/01	1	0	4.7	FZ bottom	0.21	4.7	0	3	0.0	0
OH120	S	900	E	161	07/12/94	10/30/01	2	0	6.1	offset	0.33	6.1	3.00	3	100.0	0.41
OH229	S	1001	E	140	02/22/96	10/30/01	5	0	4.9	hangup	1.02	4.9	0.75	3	25.0	0.13
OH121-1	S	1100	E	148	11/08/96	10/30/01	0	0	6.4	Clay H	0	6.4	2.50	3	83.3	0.50
OH123-1	S	1100	E	161	11/08/96	10/30/01	0	0	6.5	Clay H	0	6.5	2.25	3	75.0	0.45
OH124-1	S	1151	E	149	11/18/96	10/30/01	2	0	6.5	Clay H	0.31	6.5	2.25	3	75.0	0.45
OH126-1	S	1150	E	161	11/18/96	10/30/01	2	0	6.5	Clay H	0.31	6.5	2.25	3	75.0	0.45
					11/18/96	10/30/01	0	0	1.3	offset	0	1.3	0.25	3	8.3	0.05
OH127-1	S	1200	E	148	11/20/96	10/30/01	2	0	6.4	offset	0.31	6.4	2.50	3	83.3	0.51
OH129-1	S	1200	E	160	11/22/96	10/30/01	2	0	6.3	Clay H	0.32	6.3	2.25	3	75.0	0.46
					11/22/96	10/30/01	0	0	1.4	fracture	0	1.4	0.25	3	8.3	0.05
OH216	S	1399	E	146	11/22/95	10/30/01	1	0	6.3	Clay H	0.16	6.3	1.50	3	50.0	0.25
					11/22/95	10/30/01	0	0	1.3	fracture	0	1.3	0.30	3	10.0	0.05
OH218	S	1399	E	161	10/08/96	10/30/01	1	0	6.4	Clay H	0.16	6.4	1.70	3	56.7	0.34
OH130-1	S	1405	E	148	12/16/97	10/30/01	2	0	6.2	Clay H	0.32	6.2	1.60	3	53.3	0.41
					12/16/97	10/30/01	0	0	1.4	offset	0	1.4	0.25	3	8.3	0.06
OH132-1	S	1345	E	161	11/08/95	10/30/01	2	0	6.5	Clay H	0.31	6.5	2.25	3	75.0	0.38
OH133-1	S	1455	E	148	11/22/95	10/30/01	1	0	6.4	Clay H	0.16	6.4	2.80	3	93.3	0.47
					11/22/95	10/30/01	0	0	1.4	offset	0	1.4	0.25	3	8.3	0.04

1 Fr = Number of fractures in immediate roof beam
2 Number of fracture zones in immediate roof beam
3 Fracture Density = (Fr + 2 FZ) / Beam Height

Table 7-1 (Continued)
Observation Borehole Fractures and Offset Data Summary

Observation Hole	Northing		Easting		Drill Date	Inspection Date	Fr [1]	FZ [2]	Beam Height (ft)	Beam Feature	Fracture Density [3]	Offset Depth (ft)	Offset Magnitude (in)	Hole Diameter (in)	Hole Closure (%)	Offse Rate (in/yr
East 140 (continued)																
OH134-1	S	1455	E	154	11/22/95	10/30/01	1	0	6.3	Clay H	0.16	6.3	0.25	3	8.3	0.04
OH135-1	S	1455	E	160	11/22/95	10/30/01	1	0	6.1	offset	0.16	6.1	2.30	3	76.7	0.39
OH136-1	S	1505	E	148	11/28/95	10/30/01	3	0	6.4	Clay H	0.47	6.4	3.00	3	100.0	0.51
					11/28/95	10/30/01	2	0	2.6	offset	0.77	2.6	1.70	3	56.7	0.29
					11/28/95	10/30/01	1	0	1.6	offset	0.63	1.6	1.60	3	53.3	0.27
					11/28/95	10/30/01	0	0	1.0	offset	0	1.0	1.50	3	50.0	0.25
OH137-1	S	1505	E	154	11/28/95	10/30/01	0	0	0.8	offset	0	0.8	0.75	3	25.0	0.13
OH138-1	S	1505	E	160	11/28/95	10/30/01	0	0	1.2	offset	0	1.2	1.70	3	56.7	0.29
OH227	S	1609	E	157	02/22/96	10/31/01	1	0	6.5	Clay H	0.15	6.5	0.50	3	16.7	0.09
OH228	S	1608	E	160	02/22/96	10/31/01	2	0	6.6	hangup	0.30	6.6	0.80	3	26.7	0.14
					11/22/95	10/31/01	1	0	6.3	Clay H	0.16	6.3	0.75	3	25.0	0.13
OH139-1	S	1731	E	147	03/15/96	10/31/01	1	0	6.1	offset	0.16	6.1	2.90	3	96.7	0.51
					03/15/96	10/31/01	0	0	1.5	offset	0	1.5	0.25	3	8.3	0.04
OH141-1	S	1731	E	159	03/18/96	10/31/01	1	0	6.4	offset	0.16	6.4	2.90	3	96.7	0.52
					03/18/96	10/31/01	0	0	1.0	offset	0	1.0	0.12	3	4.0	0.02
OH142-1	S	1781	E	147	03/28/96	10/31/01	4	0	6.2	offset	0.65	6.2	3.00	3	100.0	0.54
					03/28/96	10/31/01	2	0	2.5	hangup	0.80	2.5	0.40	3	13.3	0.07
					03/28/96	10/31/01	1	0	1.6	offset	0.63	1.6	0.30	3	10.0	0.05
					03/28/96	10/31/01	0	0	0.9	offset	0	0.9	0.20	3	6.7	0.04
OH144-1	S	1780	E	160	03/28/96	10/31/01	3	0	6.4	offset/FZ top	0.47	6.4	2.95	3	98.3	0.53
					03/28/96	10/31/01	3	0	6.2	FZ bottom	0.48	6.2	0	3	0	0
					03/28/96	10/31/01	2	0	2.8	offset	0.71	2.8	0.12	3	4.0	0.02
					03/28/96	10/31/01	1	0	1.8	offset	0.56	1.8	0.12	3	4.0	0.02
					03/28/96	10/31/01	0	0	1.3	offset	0	1.3	0.12	3	4.0	0.02
OH145-1	S	1831	E	146	04/25/96	10/31/01	1	0	6.0	Clay H	0.17	6.0	2.95	3	98.3	0.53
					04/25/96	10/31/01	0	0	0.9	offset	0	0.9	1.40	3	46.7	0.25
OH146-1	S	1830	E	152	04/25/96	10/31/01	1	0	1.3	offset	0.77	1.3	0.12	3	4.0	0.02
					04/25/96	10/31/01	0	0	0.9	offset	0	0.9	0.12	3	4.0	0.02
OH147-1	S	1830	E	160	04/25/96	10/31/01	2	0	6.0	offset	0.33	6.0	3.00	3	100.0	0.54

[1] Fr = Number of fractures in immediate roof beam
[2] Number of fracture zones in immediate roof beam
[3] Fracture Density = (Fr + 2 FZ) / Beam Height

Table 7-2
Summary of New Boreholes

Observation Hole	Northing	Easting	Location	Drill Date	Depth (ft)	Diameter (in)	Purpose of Hole
OH 391	N1429	W 003	North 1420 Drift - E 0	11/2001	11.0	3	Observation
OH 392	N1430	W 216	North 1420 Drift - W 216	11/2001	15.0	3	Observation
OH 393	N1431	W 306	North 1420 Drift - W 306	11/2001	15.0	3	Observation
OH 394	N1429	W 351	North 1420 Drift - W 351	11/2001	15.0	3	Observation
OH 394	N1431	W 633	North 1420 Drift - W 633	11/2001	15.0	3	Observation

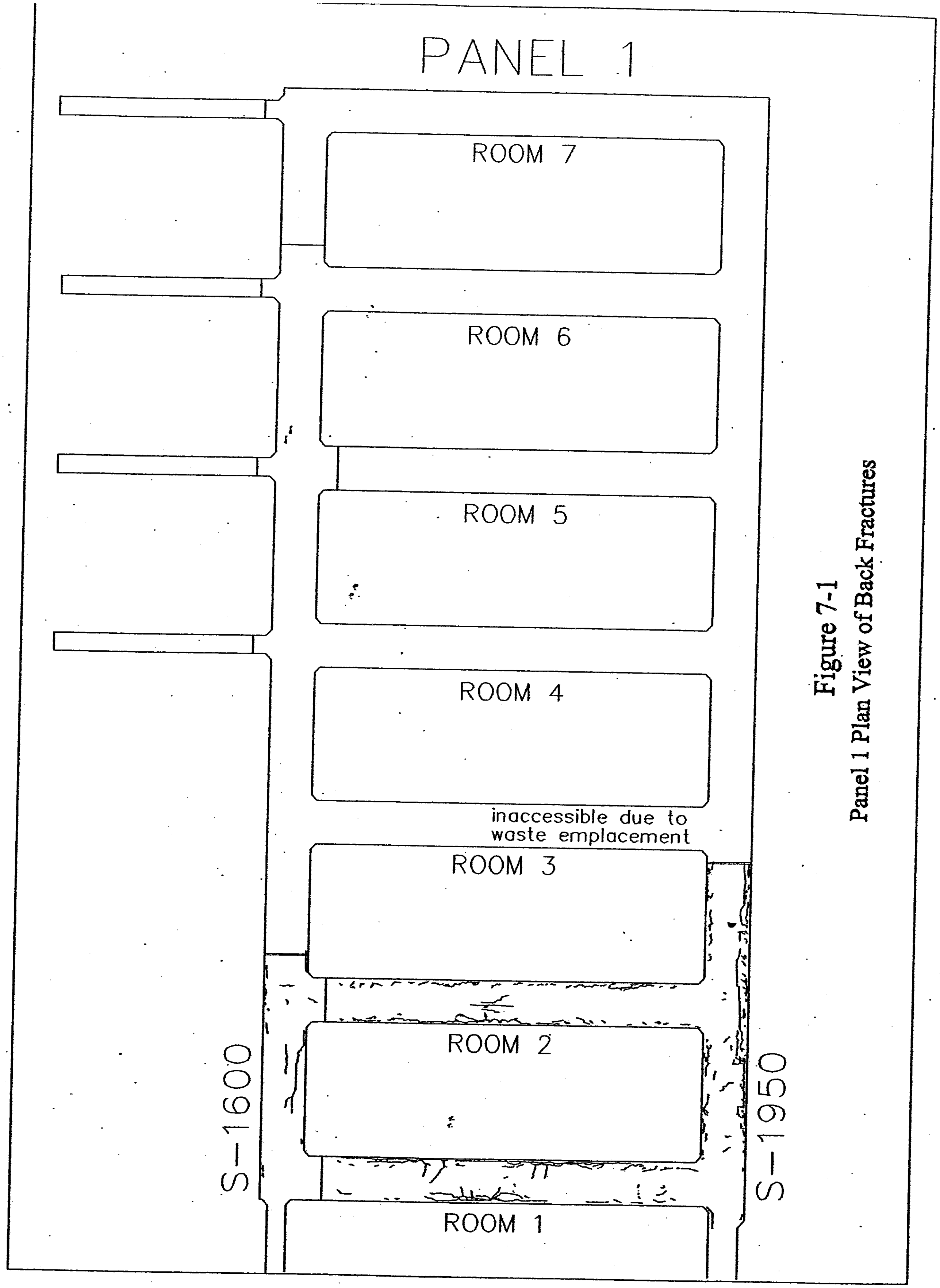


Figure 7-1
Panel 1 Plan View of Back Fractures

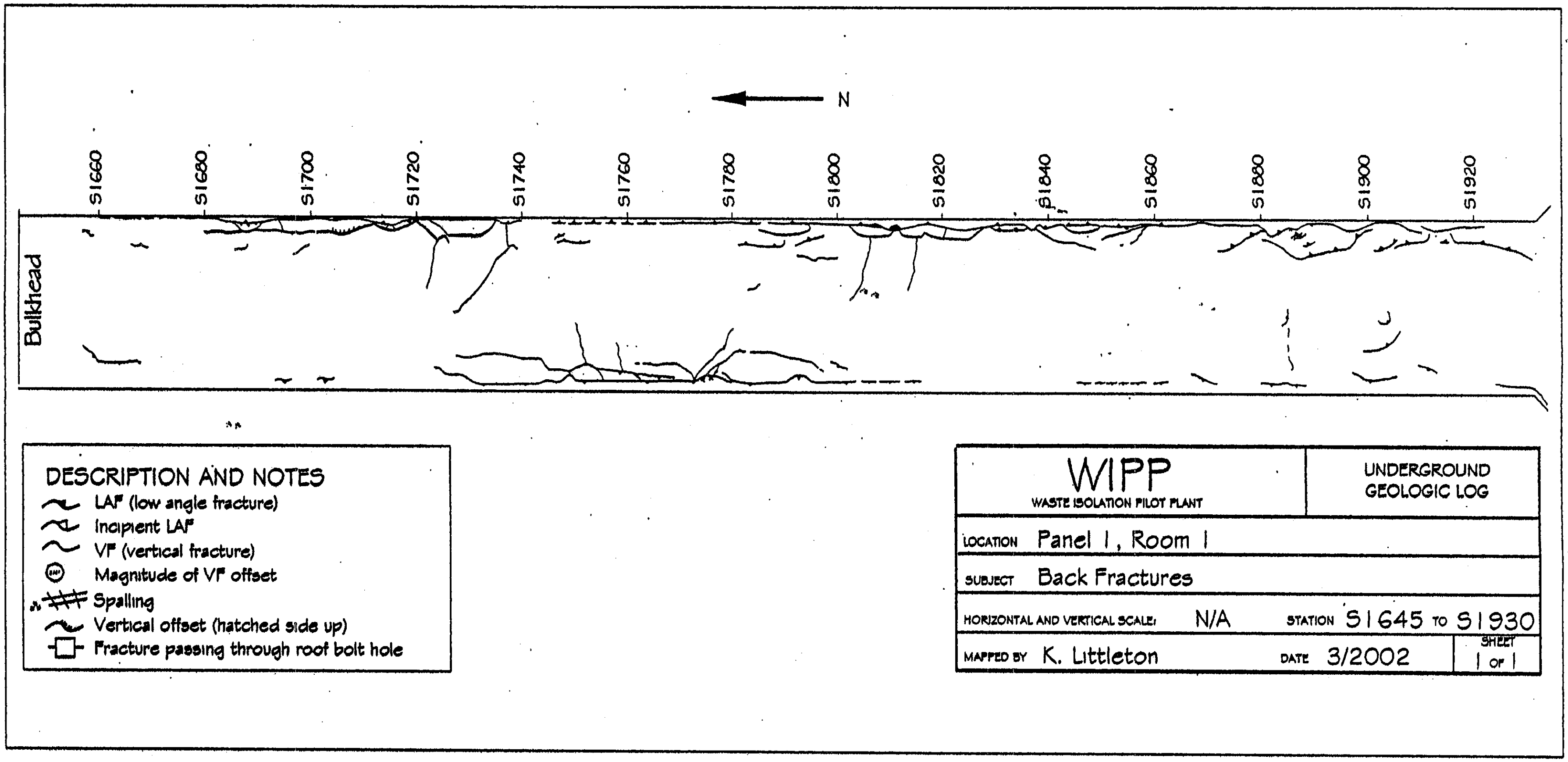


Figure 7-2
Panel 1, Room 1, Back Fractures

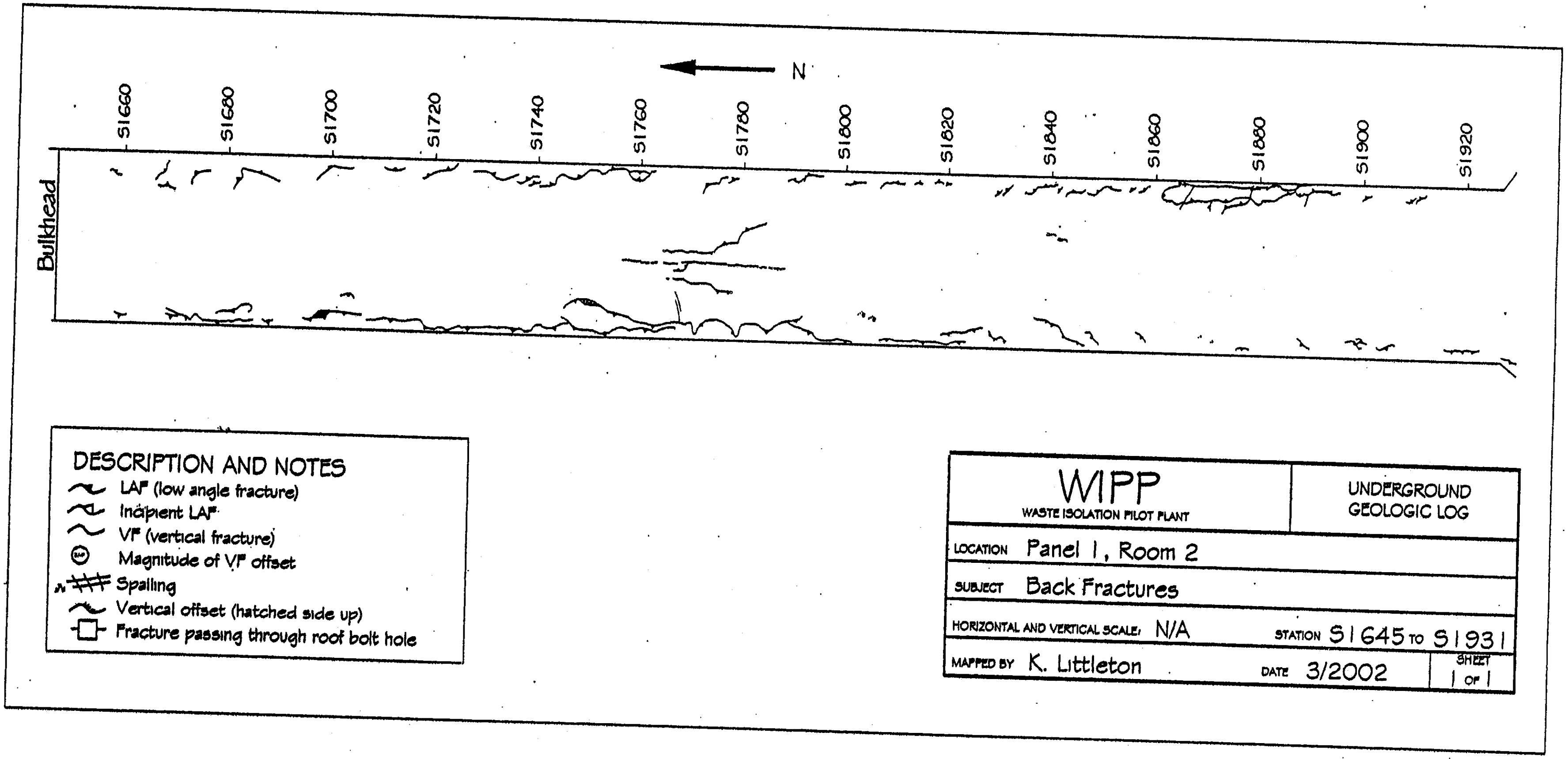


Figure 7-3
Panel 1, Room 2, Back Fractures

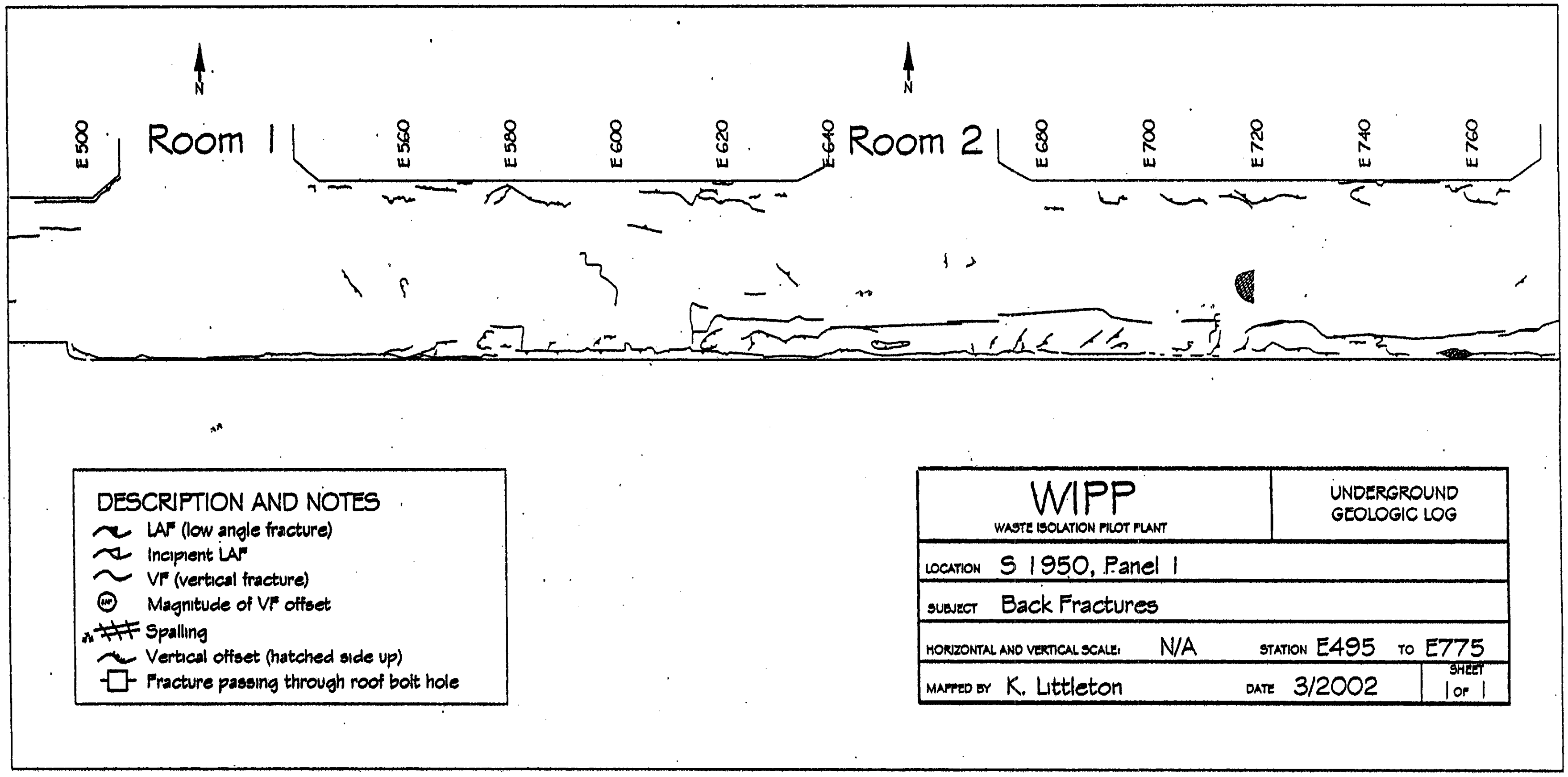


Figure 7-4
South 1950, E495-E775, Back Fractures

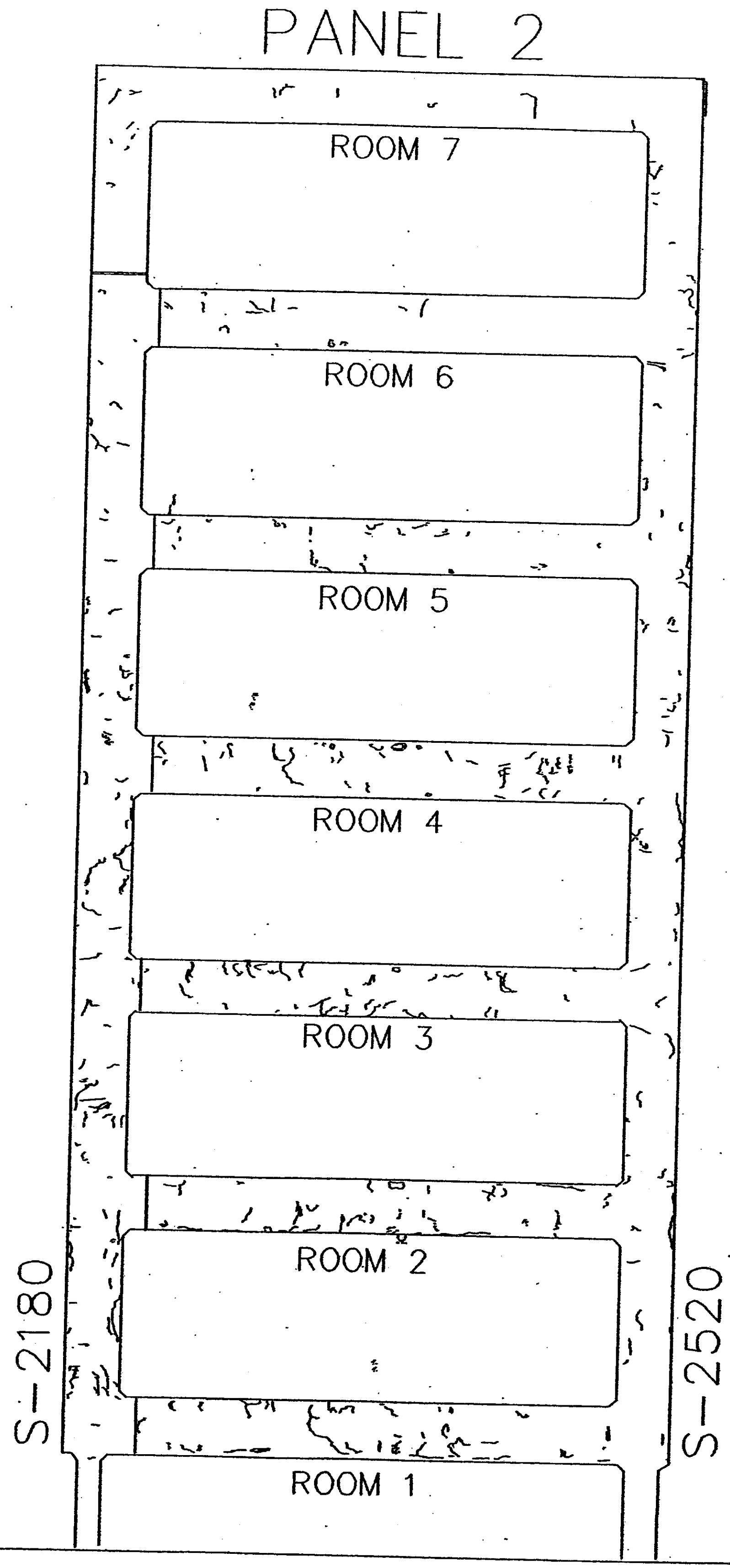


Figure 7-5
Panel 2 Plan View of Back Fractures

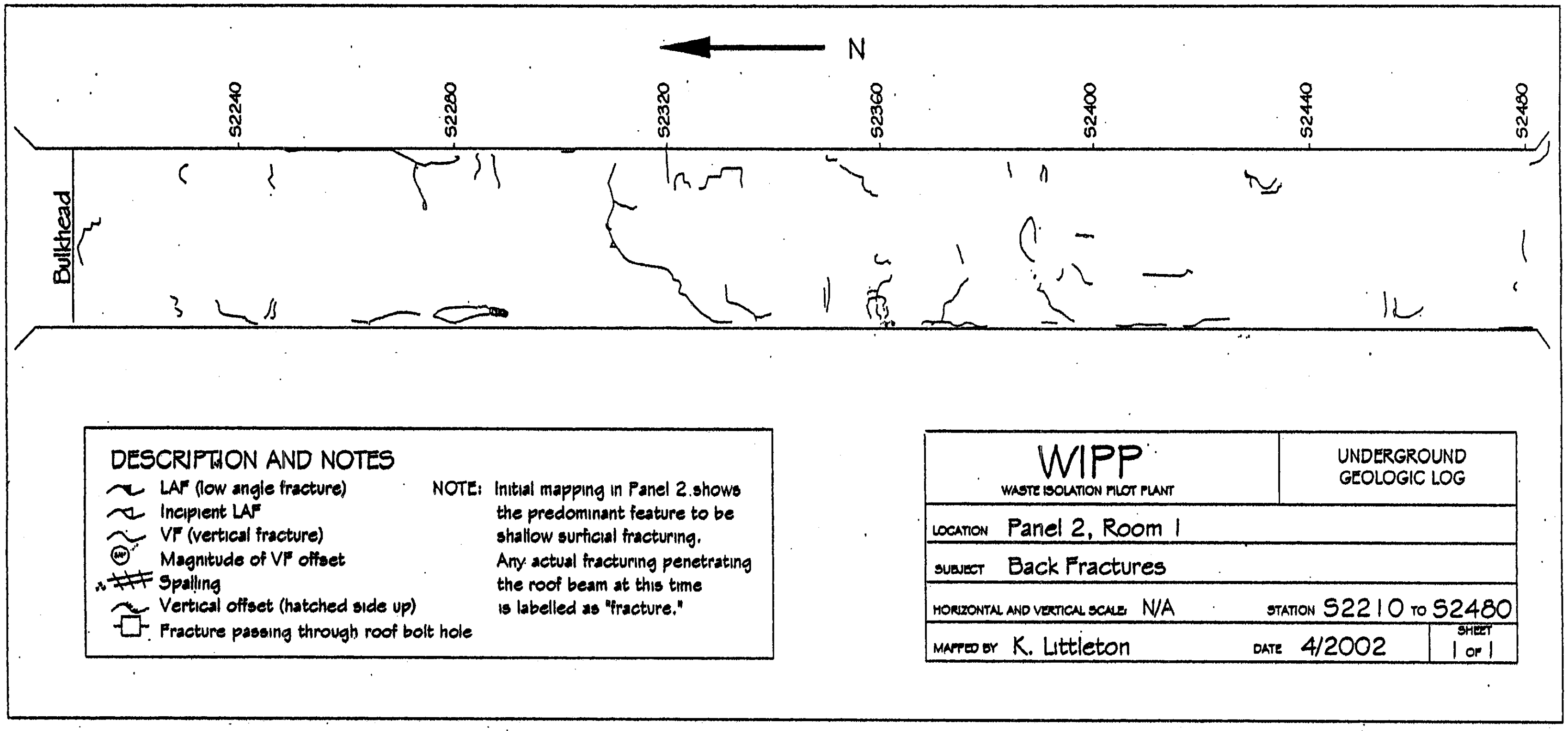


Figure 7-6
Panel 2, Room 1, Back Fractures

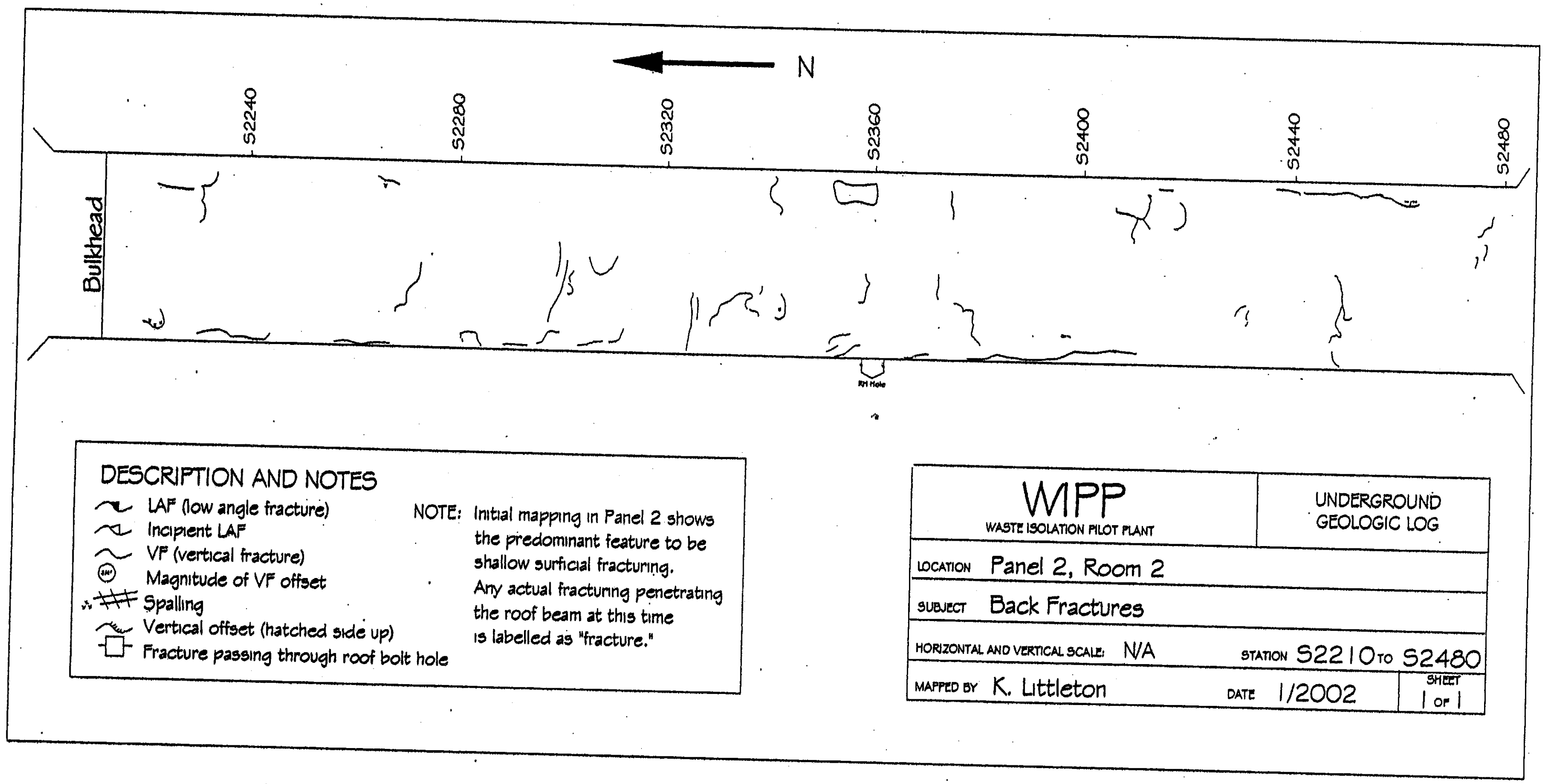


Figure 7-7
Panel 2, Room 2, Back Fractures

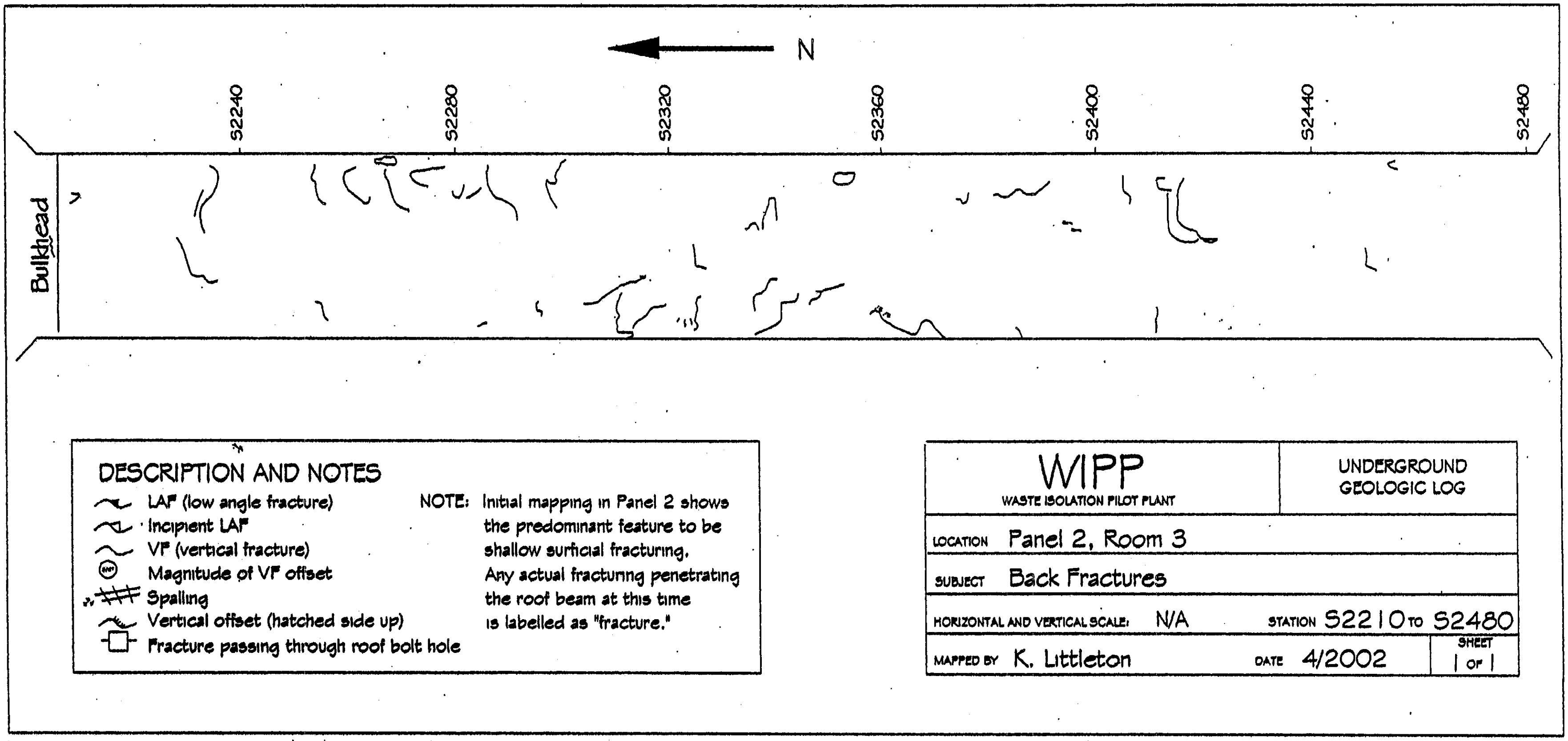


Figure 7-8
Panel 2, Room 3, Back Fractures

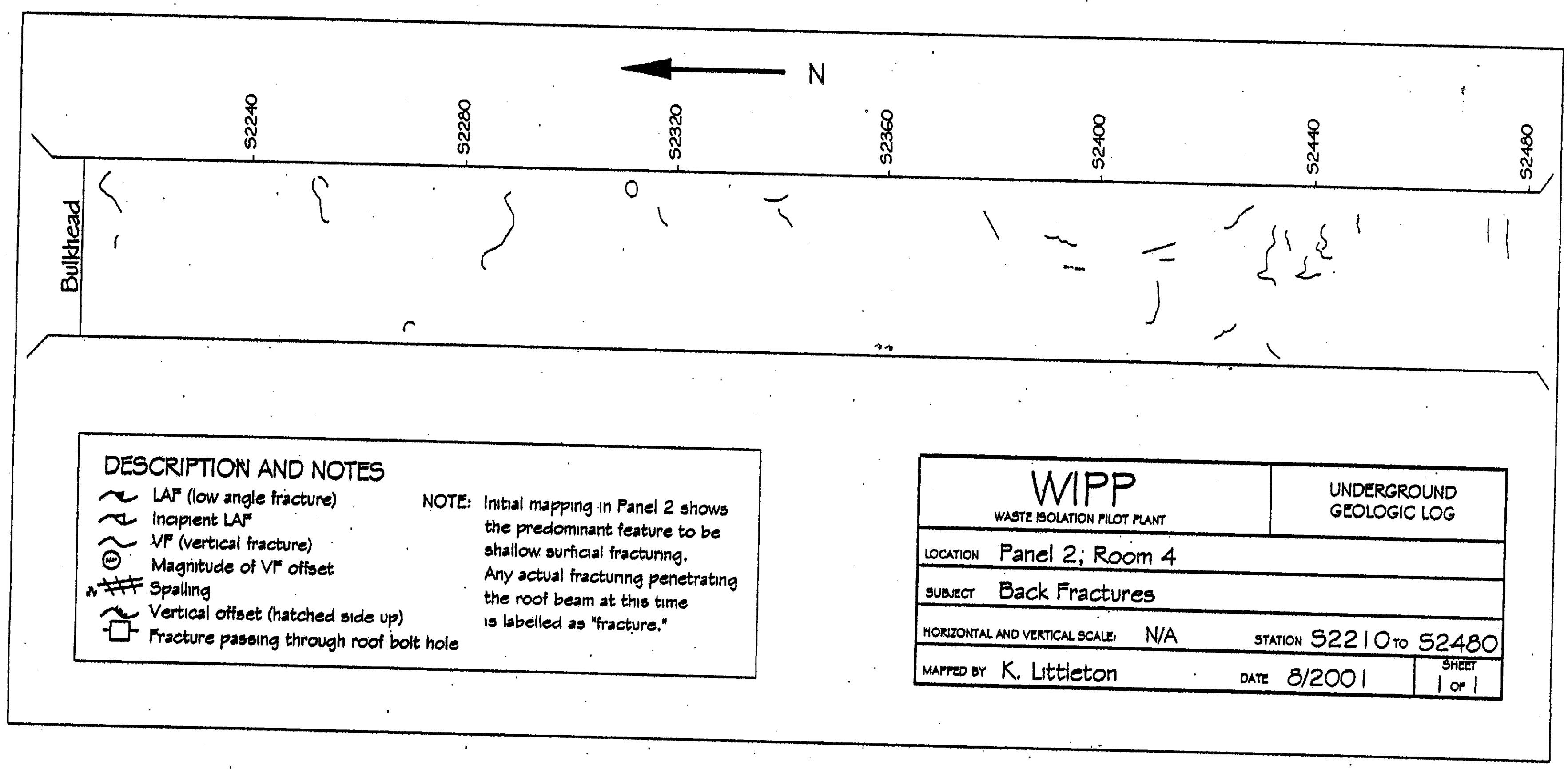


Figure 7-9
Panel 2, Room 4, Back Fractures

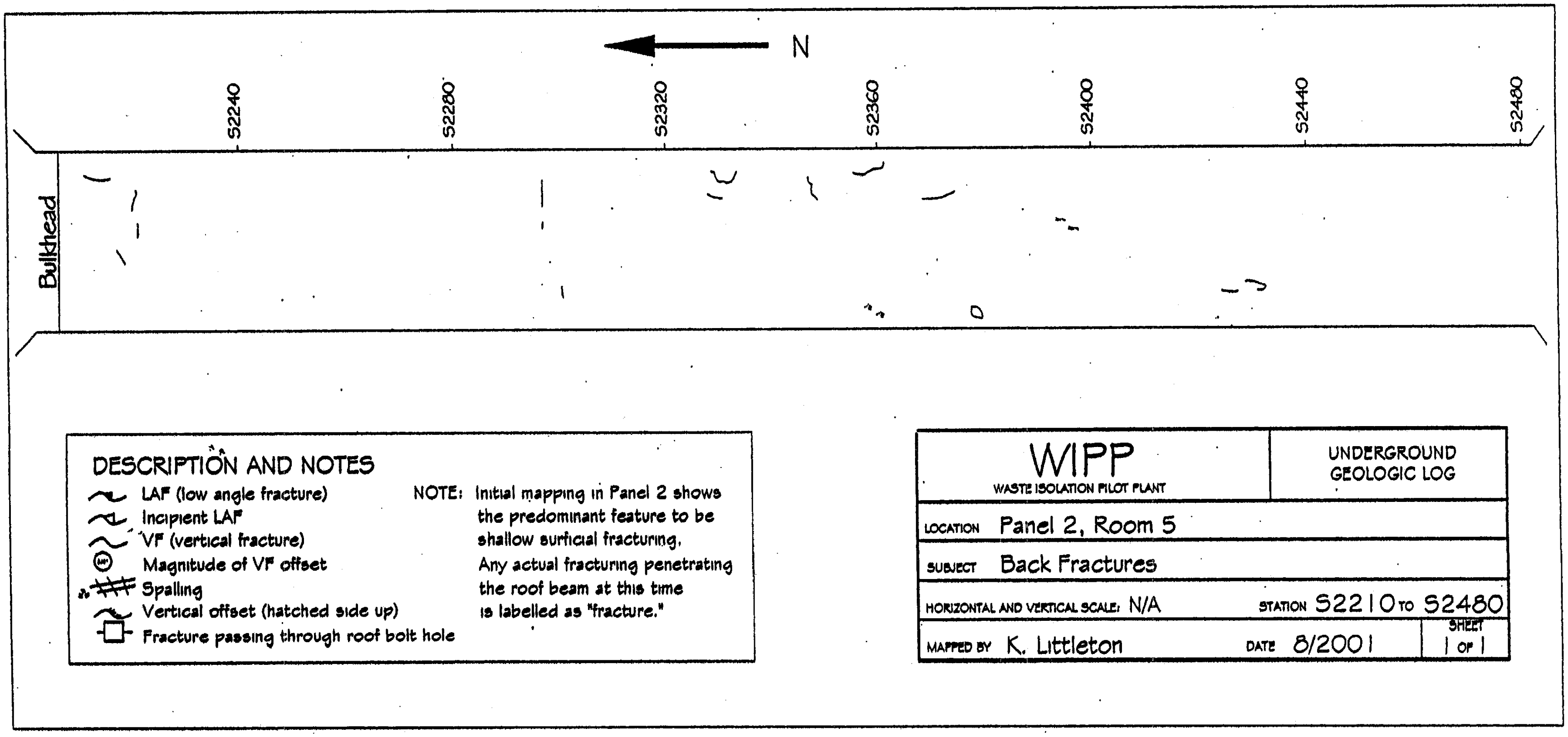


Figure 7-10
Panel 2, Room 5, Back Fractures

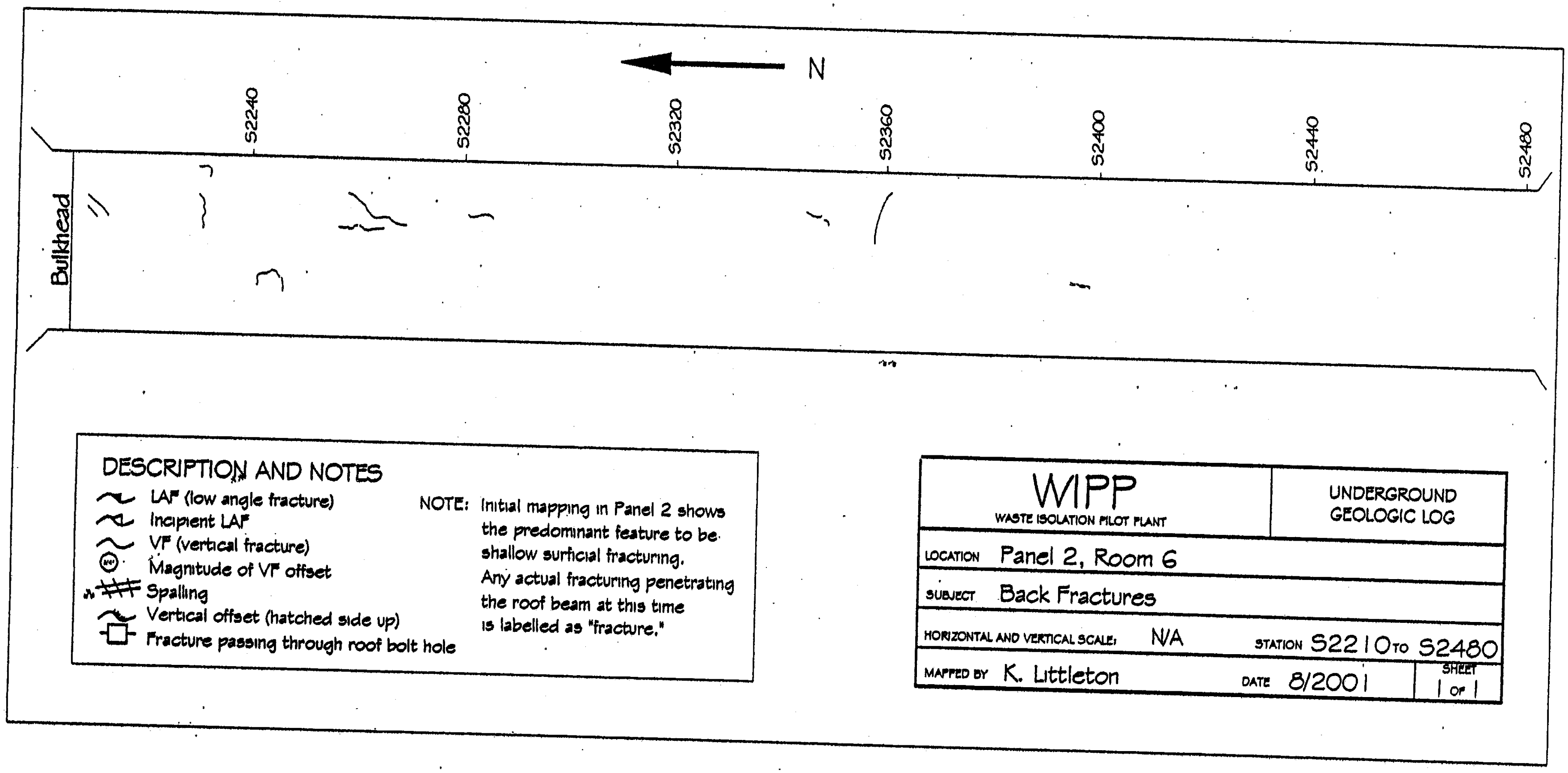


Figure 7-11
Panel 2, Room 6, Back Fractures

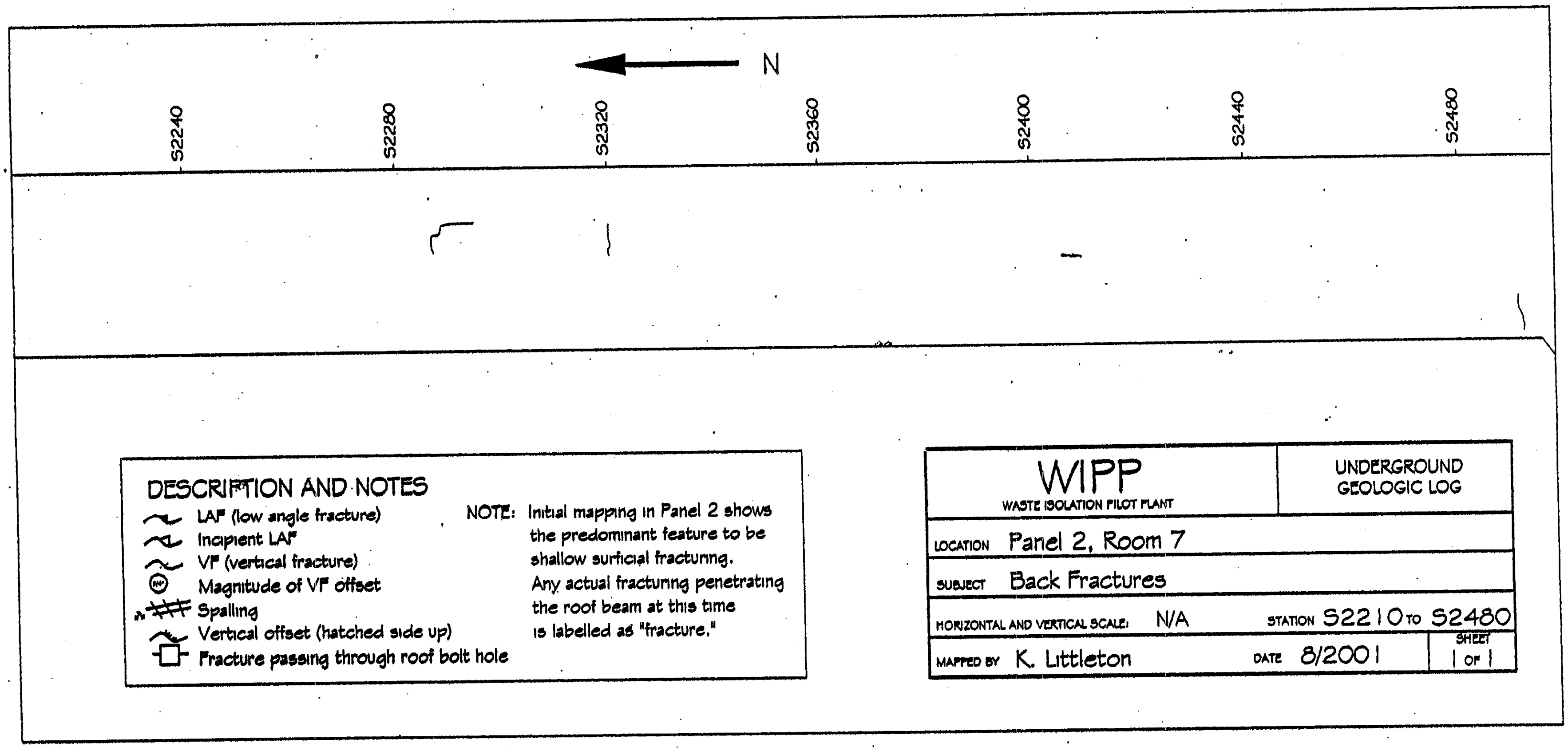


Figure 7-12
Panel 2, Room 7, Back Fractures

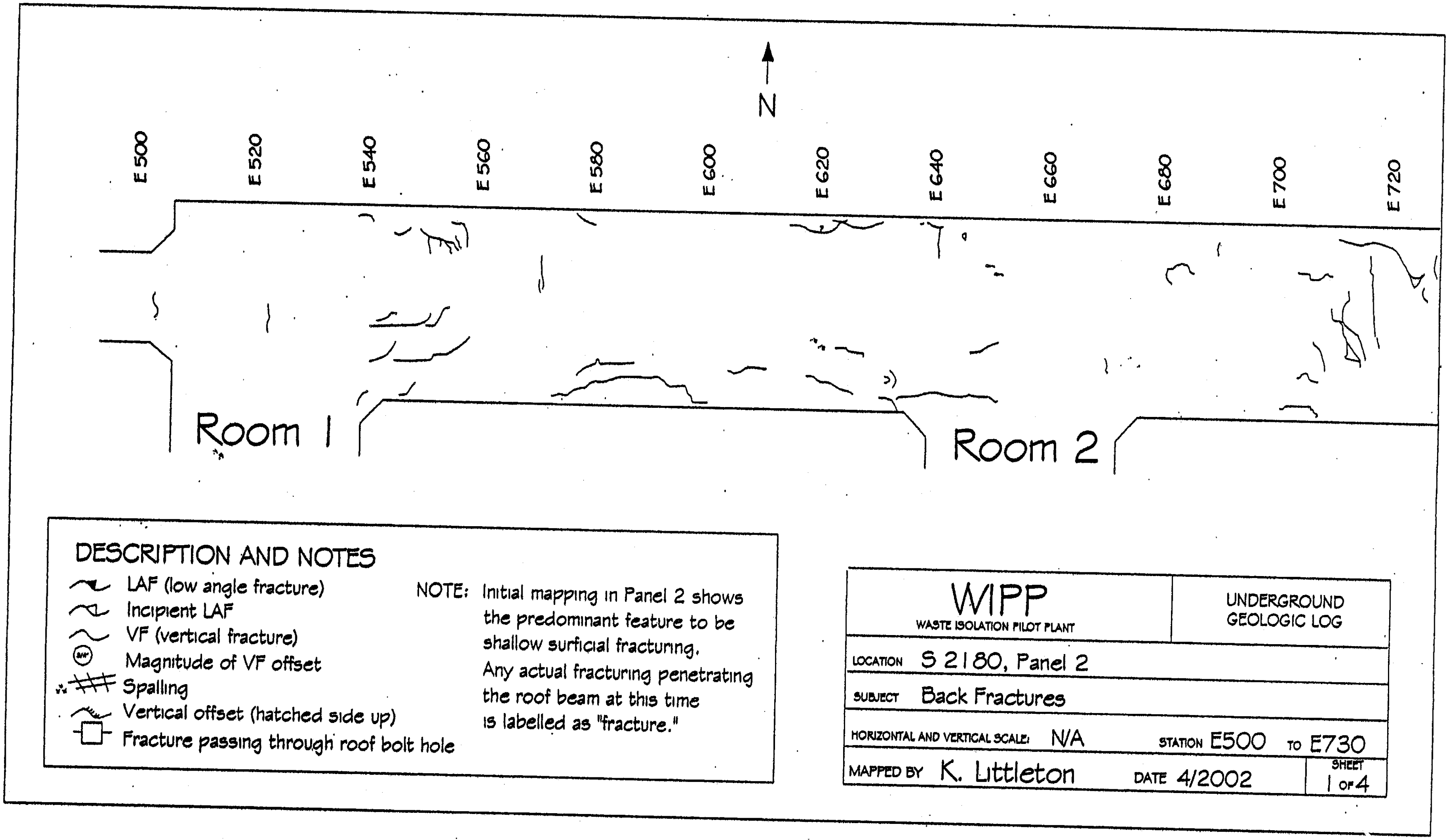


Figure 7-13
Panel 2, South 2180, E500-E730, Back Fractures

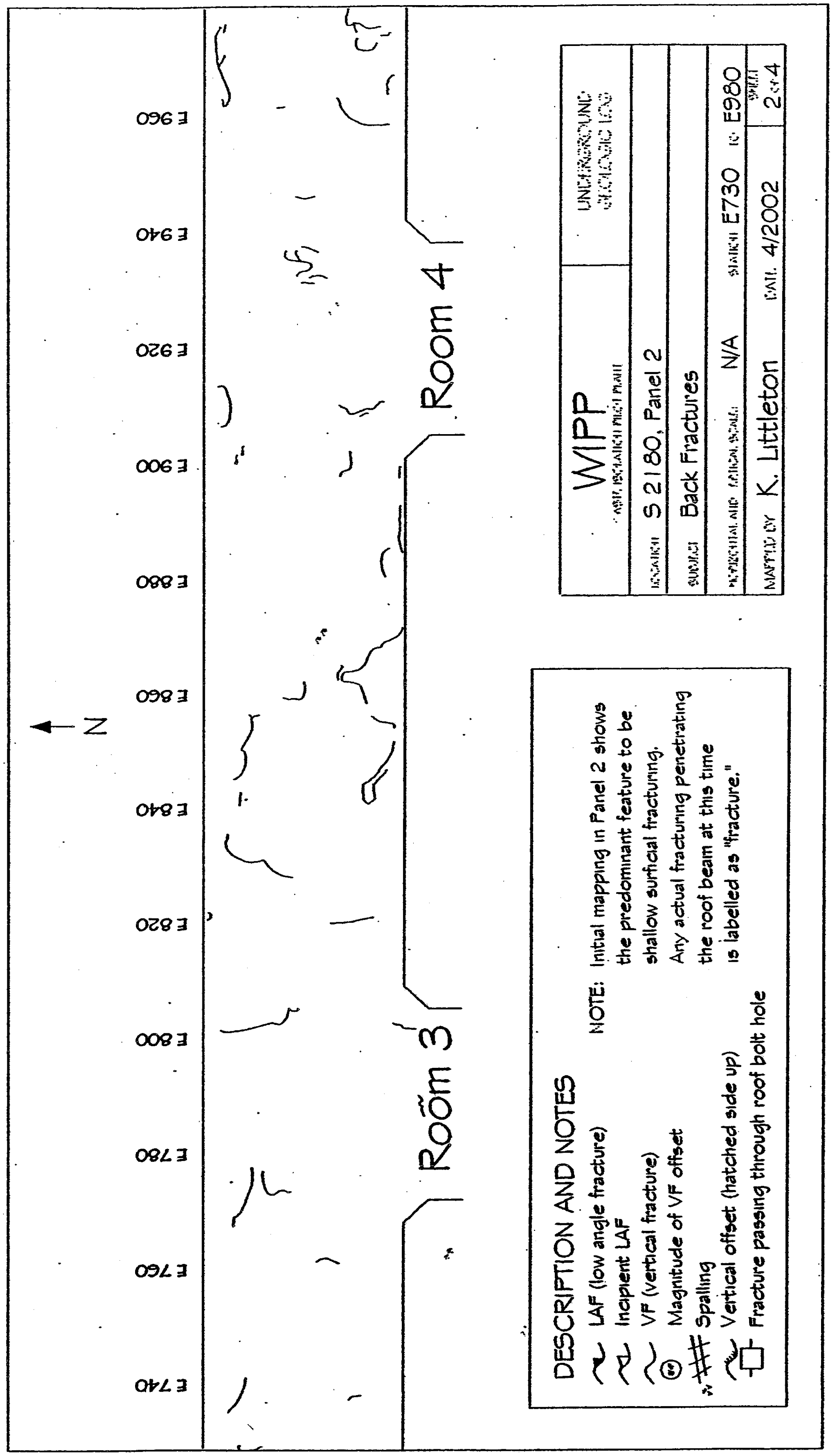


Figure 7-14
Panel 2. South 2180. E730-E980. Back Fractures

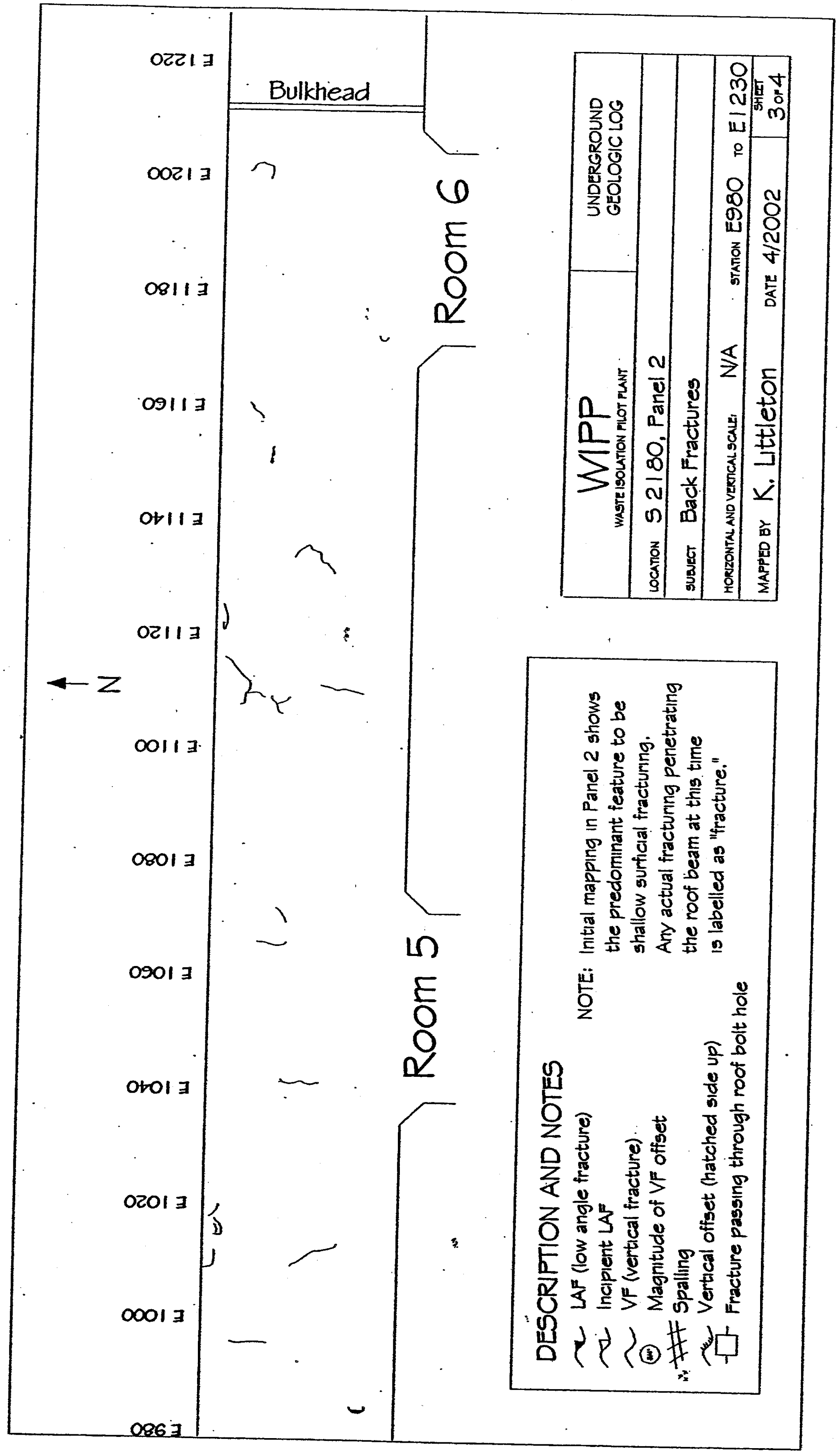


Figure 7-15
Panel 2, South 2180, E980-E1230, Back Fractures

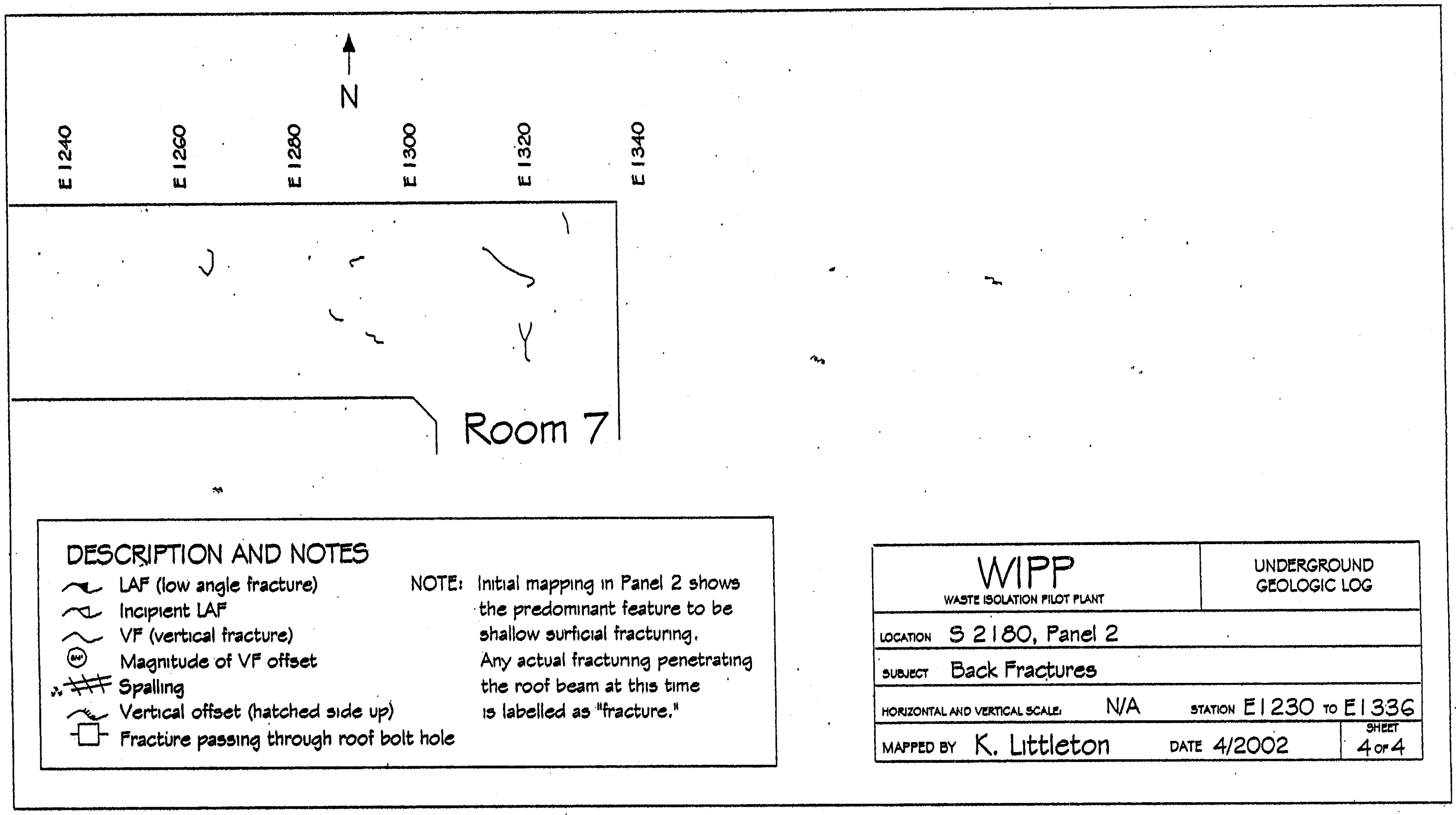


Figure 7-16
Panel 2, South 2180, E1230-E1336, Back Fractures

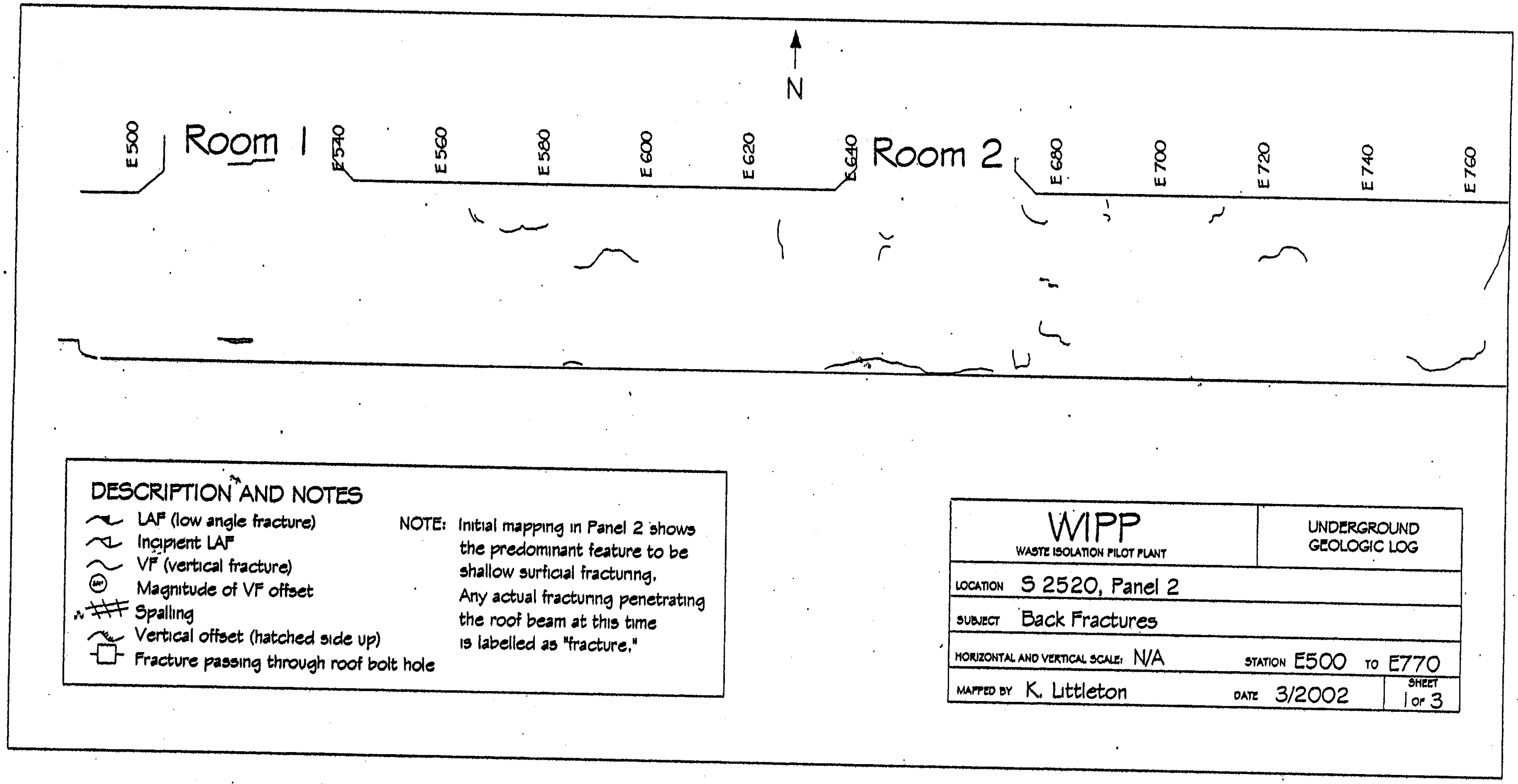


Figure 7-17
Panel 2, South 2520, E500-E770, Back Fractures

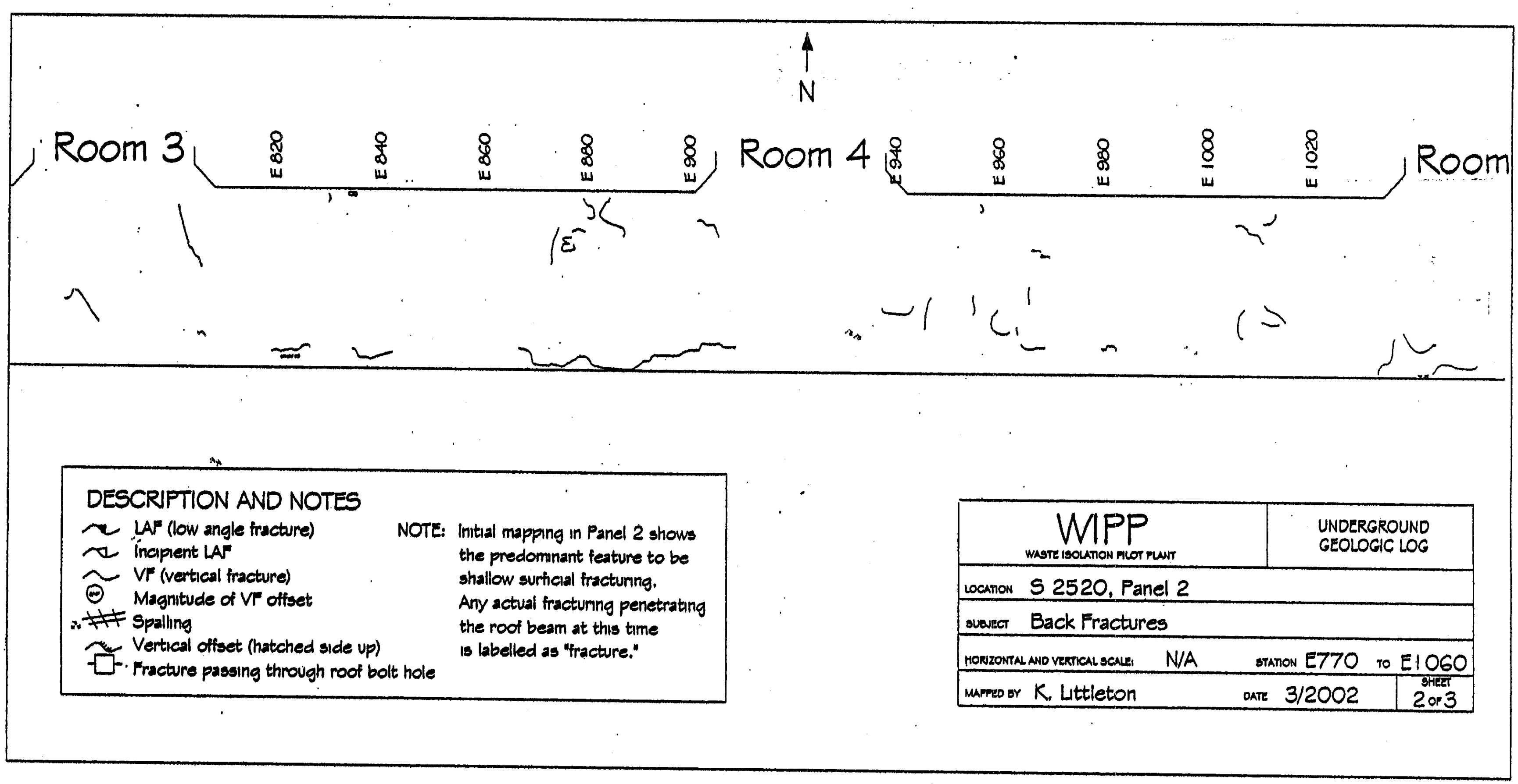


Figure 7-18
Panel 2, South 2520, E770-E1060, Back Fractures

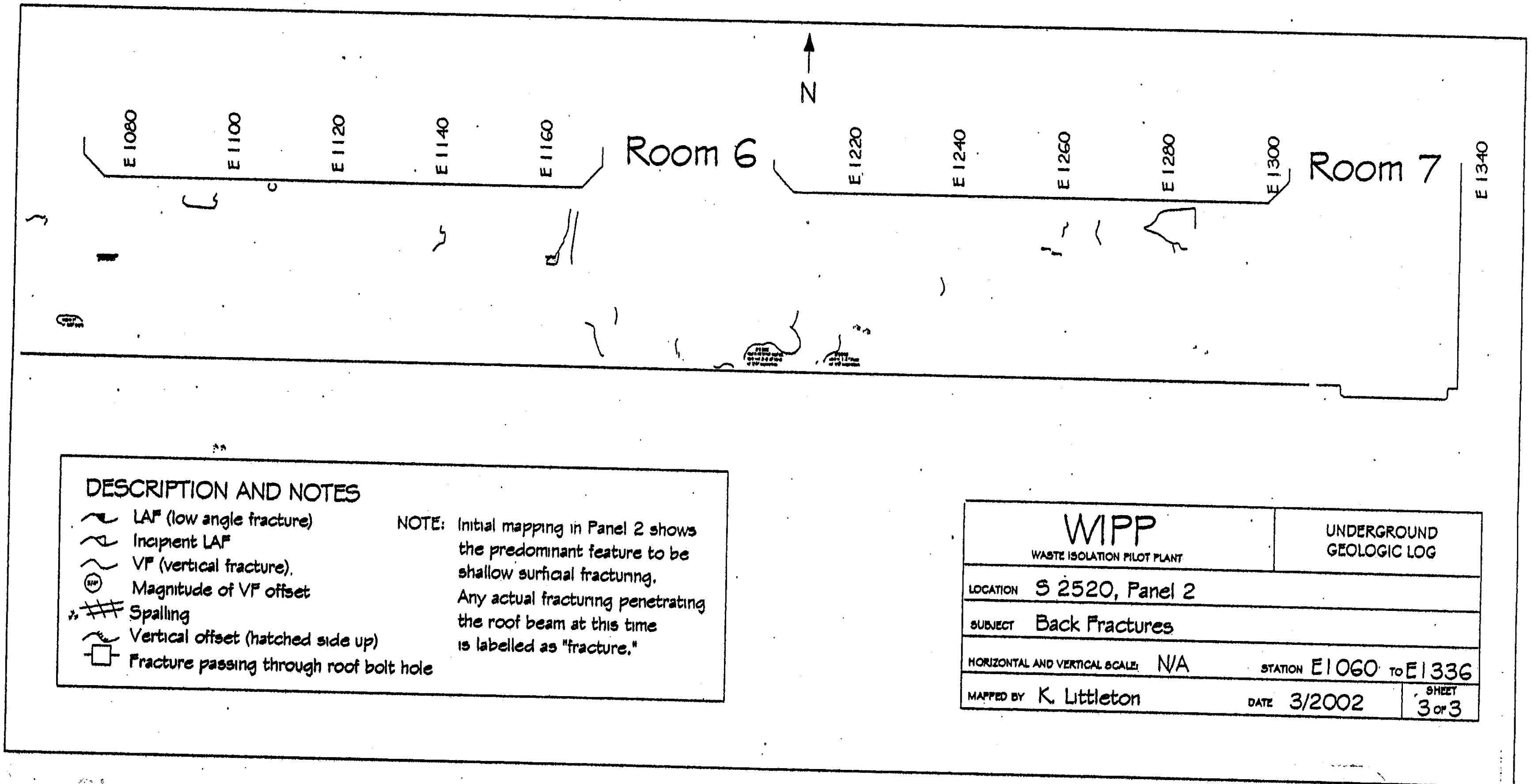


Figure 7-19
Panel 2, South 2520, E1060-E1336, Back Fractures

WIPP Library

Confirmatory VOC and Mine Ventilation Rate Monitoring Annual Report

Waste Isolation Pilot Plant
U.S. Department of Energy

Submitted to:

New Mexico Environment Department

Submitted by the:

Washington TRU Solutions, LLC

for the
U.S. Department of Energy
Carlsbad Field Office

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Executive Summary

Module IV of the Waste Isolation Pilot Plant (WIPP) Hazardous Waste Facility Permit (HWFP) require the Permittees (U.S. Department of Energy and Washington TRU Solutions LLC) to develop and implement programs for confirmatory volatile organic compound (VOC) monitoring and mine ventilation flow rate monitoring. The Confirmatory VOC Monitoring Program requires the concurrent collection of VOCs at two locations in the mine to determine net ambient air concentrations relative to Concentrations of Concern (COC) found in the HWFP, Attachment N, Table N-2. The Mine Ventilation Rate Monitoring Program (MVRMP) requires ventilation flow rate measurements for the total underground repository and each active disposal room to ensure the air flows meet HWFP conditions.

Permit Conditions IV.F.2.b and IV.F.3.b further requires WIPP to submit an annual report, beginning 12 months after issuance of the HWFP, describing the implementation and presenting data and analysis of the Confirmatory VOC MVRMP. The MVRMP is referred to as "draft" since approval of the plan and incorporation into Attachment Q of the WIPP HWFP is pending before the New Mexico Environment Department (See Section 4.0). This report covers the period from July 1, 2002 through June 30, 2003.

Under the Confirmatory VOC Monitoring Plan, the net concentrations for nine VOCs were determined by subtracting the upstream (background) sample concentration from a concurrent downstream sample result. If the net concentration of any of the selected compounds (either from a single sample pair and/or a running average) were to exceed the COC, the New Mexico Environment Department (NMED) would be notified and actions stipulated in the HWFP would be implemented.

A total of 105 VOC sample pairs were collected during this reporting period. The maximum concentration differences detected for each of the nine VOCs were below the COC levels as indicated in Table 1.

Table 1. VOC Summary Table

Compound of Interest	Maximum Concentration Differences Detected (ppbv)*	Concentration of Concern (ppbv)
1,1,-Dicholoroethene	0	100
Methylene Chloride	7.53	1930
Chloroform	0	180
1,1,1-Trichloroethane	3.09	590
Carbon Tetrachloride	0	165
1,2-Dicholorethane	0	45
Toluene	2.9	190
Chlorobenzene	0	220
1,1,2,2-Tetrachloroethane	0	50

*Parts per billion by volume

All samples were collected using Environmental Protection Agency (EPA) Method TO-14A and managed in accordance with a comprehensive quality assurance/quality control (QA/QC) program. The QA/QC results indicate the data set collected meets the program objectives and the data are both accurate and defensible.

The average ventilation flow rates were calculated for the total flow through the underground repository and the flow through the active disposal room in accordance with the draft MVRMP. During this report period the lowest monthly average total underground repository ventilation flow rate was 374,400 standard cubic feet per minute (scfm) which did not trigger any reporting requirements. Reporting would be required if the minimum monthly average total underground repository ventilation flow rate was less than 260,000 scfm.

During this report period, a of the mine ventilation system was performed. As required by the draft MVRMP, Section Q-4b, the Test and Balance is conducted every 12 to 18 months. The last Test and Balance was performed in October, 2002 and the next is due in March, 2004.

The draft MVRMP was submitted to the NMED on November 2, 1999 and revised on May 18, 2000. NMED issued a second Request for Supplemental Information on December 5, 2001, addressing several comments on the draft MVRMP. On February 1, 2002, the revised draft MVRMP was submitted to NMED. This revision provided additional details concerning the content of the Test and Balance reports; however, no changes were made to the manner in which mine ventilation rate monitoring data are collected.

The monthly average ventilation rate in the active disposal room was 66,395 actual cubic feet per minute (acfm). A minimum of 42,000 acfm is required to meet the 35,000 standard cubic feet per minute (scfm) flow rate stipulated in the HWFP.

Pursuant to Permit Condition I.E.14, instances of other noncompliance are required to be included at the time this annual monitoring report is submitted. As indicated in Section 8.0 of this report, there were three instances of other noncompliances during this reporting period.

1.0 Introduction

The New Mexico Environment Department (NMED) issued the Waste Isolation Pilot Plant (WIPP) Hazardous Waste Facility Permit (HWFP), NM4890139088-TSDF, on October 27, 1999. The HWFP, Condition IV.D.2.a, specifies that confirmatory monitoring for volatile organic compounds (VOCs) be performed in accordance with the HWFP, Attachment N, and be implemented within thirty calendar days of the issuance of the permit. The permit identifies nine compounds that are to be monitored and established a Concentration of Concern (COC) for each compound. These nine compounds represent the VOCs responsible for approximately 99 percent of the calculated human health risks. If any individual VOC measurement or the running annual average for a given VOC exceeds the applicable COC, notification requirements are triggered. The nine target compounds and the associated COCs are shown in Table 2.

Table 2. Target Compounds and Concentrations of Concern

Compound	Concentration of Concern	
	$\mu g/m^3$	ppbv
Carbon Tetrachloride	1,050	165
Chlorobenzene	1,015	220
Chloroform	890	180
1,1-Dichloroethene	410	100
1,2-Dichloroethane	175	45
Methylene Chloride	6,700	1,930
1,1,2,2-Tetrachloroethane	350	50
Toluene	715	190
1,1,1-Trichloroethane	3,200	590

In accordance with the HWFP, Permit Condition IV.F.3.a, a MVRMP was developed and submitted to the NMED within ninety calendar days of the issuance of the permit. The draft MVRMP documents compliance with the ventilation requirements described in the HWFP, Condition IV.E.3.b and Section M2-2a(3), for air flow rates for the total underground repository and the active disposal room.

The permit also specifies that an annual report be submitted, beginning 12 months after the issuance of the permit that describes the implementation of the Confirmatory VOC Monitoring Plan and the draft MVRMP, and present the results of the monitoring activities. This document was prepared to fulfill the annual reporting requirement for the period from July 1, 2002, to June 30, 2003.

The permit further specifies that the report include data on VOC levels in the headspace of transuranic (TRU) mixed waste containers from the WIPP Waste Information System (WWIS), and correlate the measured VOC levels in the mine air with the headspace VOC levels. During the reporting period, TRU mixed wastes were received and disposed, however, no significant levels of VOCs (i.e., measurable levels of VOC concentrations due to wastes emplaced in the repository) were measured. Therefore, it is not possible to correlate the measured VOC levels in the mine air with the measured VOC levels in the waste containers.

2.0 Implementation of VOC Monitoring Program

This section presents the sampling, chain-of-custody, analytical, and data management procedures that are performed for the VOC monitoring program.

2.1 Sampling Procedures

The monitoring program is designed to determine VOC concentrations attributed to open and closed panels using guidelines established in EPA Method TO-14A. During this reporting period, air samples were collected twice per week at two designated air monitoring stations. The stations are defined as VOC-A, located downstream from Panel 1 in the ventilation exhaust drift, and VOC-B, located upstream from the open panel. As waste is placed in new panels, the location of VOC-B will be moved so that it always represents the background ambient air. The location of VOC-A is not expected to change.

At each sampling station, ambient air is pumped into a 6-liter, passivated, stainless-steel canister over a six-hour sampling period until the canister is pressurized 8 to 15 pounds per square inch. Target compounds found in VOC-B represent the ambient air found in the mine before passing through the panels containing waste. Concentrations measured at this location consist of background concentrations entering the facility through the air intake shaft and concentrations attributed to upstream facility operations. Compounds found in VOC-A represent both the background mine air and any potential releases from open and closed panels. Concentrations found at VOC-B are subtracted from VOC-A to calculate the quantity of VOCs being released from the waste.

2.2 Chain-of-Custody Procedures

The chain-of-custody procedures used for this program follow EPA guidelines. Sampling information is recorded in blue or black ink on preformatted data sheets. Each sample is clearly labeled and assigned a unique sample identification number (ID) at the time of sample collection. A chain-of-custody form is prepared for each sample to document the location the sample was collected, the date and time the sample was collected, the person performing the sample collection, etc. The chain-of-custody form accompanies the sample from time of collection through transport and analysis.

2.3 Analytical Procedures

Samples are analyzed at the Air Toxics LTD laboratory located in Folsom, California. Samples are analyzed by gas chromatography/mass spectrometry (GC/MS) in accordance with the guidelines established in EPA Method TO-14. The laboratory operates under an established quality assurance/quality control (QA/QC) program. The nine target compounds and contract reporting limits are provided in Table 3.

2.4 Alternative Analytical Procedures

In accordance with the HWFP, Attachment N, alternative sampling methods were evaluated. After evaluation, it was determined that there have been no significant steps forward in the Fourier Transform Infrared Technology or other sampling methods. The current method offers the best detection levels and remains the most effective method for measuring VOCs in the WIPP environment.

2.5 Data Management Procedures

The analytical results for the samples collected at locations VOC-A and VOC-B are maintained in a computer database and in a record file. For each quantified target VOC, the concentration measured at VOC-B is subtracted from the concentration measured at VOC-A to assess the release of the target VOC from the panel. The net concentration difference between the two stations must be less than the COC listed in Table 2. Air samples not collected under typical mine ventilation rate operating conditions were normalized in relation to the ventilation flow rate.

3.0 VOC Monitoring Results

This section presents the results of the VOC monitoring program. This report covers monitoring from July 1, 2002 to June 30, 2003.

3.1 Operational Summary

The completeness of the data set is the percentage of valid data versus the total number of data obtained. The QA objective (i.e., goal) for the program is a completeness of 90 percent or greater. During this reporting period, a total of 210 samples were obtained and a total of 210 valid samples were generated. Therefore, the completeness for the reporting period was 100 percent.

3.2 Monitoring Data

The VOC monitoring results are summarized in Table 3. The individual monitoring results for all nine target analytes for each individual sample collected at location VOC-A and VOC-B are provided in Table 4. In some cases, the samples were diluted prior to analysis. Reporting limits are adjusted by the dilution factor; (i.e., the 5.0 parts per billion by volume [ppbv] and 2.0 ppbv value are multiplied by the dilution factor to calculate the laboratory reporting limit for the diluted sample).

Table 3. Summary of VOC Monitoring Results

Compound	No. of Samples	Samples ≥ MDL	Contract Reporting Limits (ppbv)	Maximum Detected Value (ppbv)	No. of Exceedances of COC
1,1-Dichloroethene	210	0	<5	0	0
Methylene Chloride	210	37	<5	7.53	0
Chloroform	210	0	<2	0	0
1,1,1-Trichloroethane	210	22	<5	3.09	0
Carbon Tetrachloride	210	0	<2	0	0
1,2-Dichloroethane	210	0	<2	0	0
Toluene	210	55	<5	7.17	0
Chlorobenzene	210	0	<2	0	0
1,1,2,2-Tetrachloroethane	210	0	<2	0	0

Running averages are calculated for each target compound in the VOC monitoring database. The average concentration for each target compound was less than the contract reporting limit. Therefore, no annual averages for each target compound are included in this report, because the majority of data points were below the method detection level (MDL). Similarly, the difference in concentration between VOC-A and VOC-B are calculated for each sample pair in the VOC monitoring database. These calculated values for the reporting period were not significant because of the frequency of sample values that were below the MDL. The data in Table 4 represent the comparison of analytical results from VOC-A and VOC-B during the current reporting period.

Table 4. Comparison between VOC-A, VOC-B, and COC
For Samples Collected Between 7/1/02 and 6/30/03 – Concentrations (ppbv)

Sample Pairs 105

Compound	**Average of Sample Pair Difference**	**Minimum of Sample Pair Difference**	**Maximum of Sample Pair Difference**	**COC**
1,1,1-Trichloroethane	0.23	-1.09	3.09	590
1,1,2,2-Tetrachloroethanee	0	0	0	50
1,1-Dichloroethene	0	0	0	100
1,2-Dichloroethane	0	0	0	45
Carbon Tetrachloride	0	0	0	165
Chlorobenzene	0	0	0	220
Chloroform	0	0	0	180
Methylene Chloride	0.10	-1.06	7.53	1930
Toluene	0.34	-1.52	2.9	190

Values preceded by "!!!" denote a concentration greater than the COC concentration.

Sample Date	**B Analysis Date**	**B Lab ID**	**B Sample ID**	**A Analysis Date**	**A Lab ID**	**A Sample ID**	**Compound**	**A**	**B**	**Difference****	**COC**
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	1,1,1-Trichloroethane	5 ND	5 ND	0	590
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	1,1-Dichloroethene	5 ND	5 ND	0	100
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	1,2-Dichloroethane	2 ND	2 ND	0	45
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	Carbon Tetrachloride	2 ND	2 ND	0	165

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	Chlorobenzene	2 ND	2 ND	0	220
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	Chloroform	2 ND	2 ND	0	180
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	Methylene Chloride	0.69* J	0.92* J	-0.23	1930
7/1/02	7/13/02	0207131-01	1110	7/13/02	0207131-02	1111	Toluene	0.56* J	5 ND	0.56	190
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	1,1,1-Trichloroethane	5.6 ND	5 ND	0	590
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	1,1,2,2-Tetrachloroethane	2.3 ND	2 ND	0	50
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	1,1-Dichloroethene	5.6 ND	5 ND	0	100
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	1,2-Dichloroethane	2.3 ND	2 ND	0	45
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	Carbon Tetrachloride	2.3 ND	2 ND	0	165
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	Chlorobenzene	2.3 ND	2 ND	0	220
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	Chloroform	2.3 ND	2 ND	0	180
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	Methylene Chloride	0.66* J	0.61* J	0.05	1930
7/2/02	7/13/02	0207131-03	1112	7/14/02	0207131-04	1113	Toluene	0.70* J	5 ND	0.7	190
7/8/02	7/14/02	0207267-01	1114	7/14/02	0207267-02	1115	1,1,1-Trichloroethane	5 ND	5 ND	0	590
7/8/02	7/14/02	0207267-01	1114	7/14/02	0207267-02	1115	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
7/8/02	7/14/02	0207267-01	1114	7/14/02	0207267-02	1115	1,1-Dichloroethene	5 ND	5 ND	0	100
7/8/02	7/14/02	0207267-01	1114	7/14/02	0207267-02	1115	1,2-Dichloroethane	2 ND	2 ND	0	45
7/8/02	7/14/02	0207267-	1114	7/14/02	0207267-	1115	Carbon	2 ND	2 ND	0	165

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02		Tetrachloride				
7/8/02	7/14/02	0207267-01	1114	7/14/02	0207267-02	1115	Chlorobenzene	2 ND	2 ND	0	220
7/8/02	7/14/02	0207267-01	1114	7/14/02	0207267-02	1115	Chloroform	2 ND	2 ND	0	180
7/8/02	7/14/02	0207267-01	1114	7/14/02	0207267-02	1115	Methylene Chloride	5 ND	5 ND	0	1930
7/8/02	7/14/02	0207267-01	1114	7/14/02	0207267-02	1115	Toluene	0.56* J	5 ND	0.56	190
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	1,1,1-Trichloroethane	5.8 ND	5 ND	0	590
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	1,1,2,2-Tetrachloroethane	2.3 ND	2 ND	0	50
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	1,1-Dichloroethene	5.8 ND	5 ND	0	100
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	1,2-Dichloroethane	2.3 ND	2 ND	0	45
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	Carbon Tetrachloride	2.3 ND	2 ND	0	165
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	Chlorobenzene	2.3 ND	2 ND	0	220
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	Chloroform	2.3 ND	2 ND	0	180
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	Methylene Chloride	5.8 ND	0.73* J	-0.73	1930
7/9/02	7/16/02	0207267-03	1116	7/16/02	0207267-04	1117	Toluene	0.78* J	5 ND	0.78	190
7/15/02	7/27/02	0207382-01	1118	7/27/02	0207382-02	1119	1,1,1-Trichloroethane	5 ND	5 ND	0	590
7/15/02	7/27/02	0207382-01	1118	7/27/02	0207382-02	1119	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
7/15/02	7/27/02	0207382-01	1118	7/27/02	0207382-02	1119	1,1-Dichloroethene	5 ND	5 ND	0	100
7/15/02	7/27/02	0207382-	1118	7/27/02	0207382-	1119	1,2-Dichloroethane	2 ND	2 ND	0	45

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Differenc e**	CO C
		01			02						
7/15/02	7/27/02	0207382-01	1118	7/27/02	0207382-02	1119	Carbon Tetrachloride	2 ND	2 ND	0	165
7/15/02	7/27/02	0207382-01	1118	7/27/02	0207382-02	1119	Chlorobenzene	2 ND	2 ND	0	220
7/15/02	7/27/02	0207382-01	1118	7/27/02	0207382-02	1119	Chloroform	2 ND	2 ND	0	180
7/15/02	7/27/02	0207382-01	1118	7/27/02	0207382-02	1119	Methylene Chloride	2.83* J	3.59* J	-0.76	193 0
7/15/02	7/27/02	0207382-01	1118	7/27/02	0207382-02	1119	Toluene	5 ND	5 ND	0	190
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	1,1,1-Trichloroethane	5 ND	5 ND	0	590
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	1,1-Dichloroethene	5 ND	5 ND	0	100
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	1,2-Dichloroethane	2 ND	2 ND	0	45
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	Carbon Tetrachloride	2 ND	2 ND	0	165
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	Chlorobenzene	2 ND	2 ND	0	220
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	Chloroform	2 ND	2 ND	0	180
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	Methylene Chloride	2.62* J	2.52* J	0.1	193 0
7/16/02	7/28/02	0207382-03	1120	7/28/02	0207382-04	1121	Toluene	5 ND	5 ND	0	190
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	1,1,1-Trichloroethane	5 ND	5 ND	0	590
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	1,1-Dichloroethene	5 ND	5 ND	0	100

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	1,2-Dichloroethane	2 ND	2 ND	0	45
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	Carbon Tetrachloride	2 ND	2 ND	0	165
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	Chlorobenzene	2 ND	2 ND	0	220
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	Chloroform	2 ND	2 ND	0	180
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	Methylene Chloride	0.59* J	5 ND	0.59	1930
7/22/02	8/4/02	0207543-01	1122	8/4/02	0207543-02	1123	Toluene	1.73* J	5 ND	1.73	190
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	1,1,1-Trichloroethane	5 ND	5 ND	0	590
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	1,1-Dichloroethene	5 ND	5 ND	0	100
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	1,2-Dichloroethane	2 ND	2 ND	0	45
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	Carbon Tetrachloride	2 ND	2 ND	0	165
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	Chlorobenzene	2 ND	2 ND	0	220
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	Chloroform	2 ND	2 ND	0	180
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	Methylene Chloride	5 ND	5 ND	0	1930
7/23/02	8/4/02	0207543-03	1124	8/4/02	0207543-04	1125	Toluene	5 ND	5 ND	0	190
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	1,1,1-Trichloroethane	5 ND	5 ND	0	590
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	1,1-Dichloroethene	5 ND	5 ND	0	100
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	1,2-Dichloroethane	2 ND	2 ND	0	45
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	Carbon Tetrachloride	2 ND	2 ND	0	165
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	Chlorobenzene	2 ND	2 ND	0	220
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	Chloroform	2 ND	2 ND	0	180
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	Methylene Chloride	0.59* J	0.56* J	0.03	1930
7/29/02	8/11/02	0208017-01	1126	8/11/02	0208017-02	1127	Toluene	5 ND	5 ND	0	190
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	1,1,1-Trichloroethane	5 ND	5 ND	0	590
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	1,1-Dichloroethene	5 ND	5 ND	0	100
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	1,2-Dichloroethane	2 ND	2 ND	0	45
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	Carbon Tetrachloride	2 ND	2 ND	0	165
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	Chlorobenzene	2 ND	2 ND	0	220
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	Chloroform	2 ND	2 ND	0	180
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	Methylene Chloride	0.84* J	0.73* J	0.11	1930
7/30/02	8/11/02	0208017-03	1128	8/11/02	0208017-04	1129	Toluene	2.90* J	2.28* J	0.62	190
8/5/02	8/19/02	0208189-01	1130	8/19/02	0208189-02	1131	1,1,1-Trichloroethane	5 ND	5 ND	0	590
8/5/02	8/19/02	0208189-	1130	8/19/02	0208189-	1131	1,1,2,2-	2 ND	2 ND	0	50

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02		Tetrachloroethane				
8/5/02	8/19/02	0208189-01	1130	8/19/02	0208189-02	1131	1,1-Dichloroethene	5 ND	5 ND	0	100
8/5/02	8/19/02	0208189-01	1130	8/19/02	0208189-02	1131	1,2-Dichloroethane	2 ND	2 ND	0	45
8/5/02	8/19/02	0208189-01	1130	8/19/02	0208189-02	1131	Carbon Tetrachloride	2 ND	2 ND	0	165
8/5/02	8/19/02	0208189-01	1130	8/19/02	0208189-02	1131	Chlorobenzene	2 ND	2 ND	0	220
8/5/02	8/19/02	0208189-01	1130	8/19/02	0208189-02	1131	Chloroform	2 ND	2 ND	0	180
8/5/02	8/19/02	0208189-01	1130	8/19/02	0208189-02	1131	Methylene Chloride	2.11* J	3.17* J	-1.06	1930
8/5/02	8/19/02	0208189-01	1130	8/19/02	0208189-02	1131	Toluene	2.90* J	5 ND	2.9	190
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	1,1,1-Trichloroethane	5 ND	5 ND	0	590
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	1,1-Dichloroethene	5 ND	5 ND	0	100
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	1,2-Dichloroethane	2 ND	2 ND	0	45
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	Carbon Tetrachloride	2 ND	2 ND	0	165
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	Chlorobenzene	2 ND	2 ND	0	220
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	Chloroform	2 ND	2 ND	0	180
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	Methylene Chloride	4.13* J	2.50* J	1.63	1930
8/6/02	8/19/02	0208189-03	1132	8/19/02	0208189-04	1133	Toluene	5 ND	5 ND	0	190
8/12/02	8/20/02	0208362-	1134	8/20/02	0208362-	1135	1,1,1-	5.6	5 ND	0	590

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02		Trichloroethane	ND			
8/12/02	8/20/02	0208362-01	1134	8/20/02	0208362-02	1135	1,1,2,2-Tetrachloroethane	2.2 ND	2 ND	0	50
8/12/02	8/20/02	0208362-01	1134	8/20/02	0208362-02	1135	1,1-Dichloroethene	5.6 ND	5 ND	0	100
8/12/02	8/20/02	0208362-01	1134	8/20/02	0208362-02	1135	1,2-Dichloroethane	2.2 ND	2 ND	0	45
8/12/02	8/20/02	0208362-01	1134	8/20/02	0208362-02	1135	Carbon Tetrachloride	2.2 ND	2 ND	0	165
8/12/02	8/20/02	0208362-01	1134	8/20/02	0208362-02	1135	Chlorobenzene	2.2 ND	2 ND	0	220
8/12/02	8/20/02	0208362-01	1134	8/20/02	0208362-02	1135	Chloroform	2.2 ND	2 ND	0	180
8/12/02	8/20/02	0208362-01	1134	8/20/02	0208362-02	1135	Methylene Chloride	2.81* J	2.34* J	0.47	1930
8/12/02	8/20/02	0208362-01	1134	8/20/02	0208362-02	1135	Toluene	5.6 ND	5 ND	0	190
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	1,1,1-Trichloroethane	5.3 ND	5.6 ND	0	590
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	1,1,2,2-Tetrachloroethane	2.1 ND	2.3 ND	0	50
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	1,1-Dichloroethene	5.3 ND	5.6 ND	0	100
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	1,2-Dichloroethane	2.1 ND	2.3 ND	0	45
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	Carbon Tetrachloride	2.1 ND	2.3 ND	0	165
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	Chlorobenzene	2.1 ND	2.3 ND	0	220
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	Chloroform	2.1 ND	2.3 ND	0	180
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	Methylene Chloride	2* J	2.44* J	-0.44	1930
8/14/02	8/20/02	0208362-03	1136	8/20/02	0208362-04	1137	Toluene	5.3 ND	5.6 ND	0	190

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Differenc e**	CO C
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	1,1,1-Trichloroethane	5 ND	5 ND	0	590
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	1,1-Dichloroethene	5 ND	5 ND	0	100
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	1,2-Dichloroethane	2 ND	2 ND	0	45
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	Carbon Tetrachloride	2 ND	2 ND	0	165
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	Chlorobenzene	2 ND	2 ND	0	220
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	Chloroform	2 ND	2 ND	0	180
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	Methylene Chloride	5 ND	5 ND	0	193 0
8/20/02	8/28/02	0208489-01	1138	8/28/02	0208489-02	1139	Toluene	5 ND	5 ND	0	190
8/21/02	8/28/02	0208489-03	1140	8/28/02	0208489-04	1141	1,1,1-Trichloroethane	5 ND	5 ND	0	590
8/21/02	8/28/02	0208489-03	1140	8/28/02	0208489-04	1141	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
8/21/02	8/28/02	0208489-03	1140	8/28/02	0208489-04	1141	1,1-Dichloroethene	5 ND	5 ND	0	100
8/21/02	8/28/02	0208489-03	1140	8/28/02	0208489-04	1141	1,2-Dichloroethane	2 ND	2 ND	0	45
8/21/02	8/28/02	0208489-03	1140	8/28/02	0208489-04	1141	Carbon Tetrachloride	2 ND	2 ND	0	165
8/21/02	8/28/02	0208489-03	1140	8/28/02	0208489-04	1141	Chlorobenzene	2 ND	2 ND	0	220
8/21/02	8/28/02	0208489-03	1140	8/28/02	0208489-04	1141	Chloroform	2 ND	2 ND	0	180
8/21/02	8/28/02	0208489-03	1140	8/28/02	0208489-04	1141	Methylene Chloride	5 ND	5 ND	0	193 0
8/21/02	8/28/02	0208489-	1140	8/28/02	0208489-	1141	Toluene	0.59*	0.63*	-0.04	190

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04			N	N		
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	1,1,1-Trichloroethane	5 ND	5 ND	0	590
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	1,1-Dichloroethene	5 ND	5 ND	0	100
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	1,2-Dichloroethane	2 ND	2 ND	0	45
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	Carbon Tetrachloride	2 ND	2 ND	0	165
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	Chlorobenzene	2 ND	2 ND	0	220
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	Chloroform	2 ND	2 ND	0	180
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	Methylene Chloride	0.79* J	0.88* J	-0.09	1930
8/27/02	9/4/02	0208636-01	1144	9/4/02	0208636-02	1145	Toluene	0.69* J	1.13* J	-0.44	190
8/28/02	9/4/02	0208636-03	1146	9/4/02	0208636-04	1147	1,1,1-Trichloroethane	5 ND	5 ND	0	590
8/28/02	9/4/02	0208636-03	1146	9/4/02	0208636-04	1147	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
8/28/02	9/4/02	0208636-03	1146	9/4/02	0208636-04	1147	1,1-Dichloroethene	5 ND	5 ND	0	100
8/28/02	9/4/02	0208636-03	1146	9/4/02	0208636-04	1147	1,2-Dichloroethane	2 ND	2 ND	0	45
8/28/02	9/4/02	0208636-03	1146	9/4/02	0208636-04	1147	Carbon Tetrachloride	2 ND	2 ND	0	165
8/28/02	9/4/02	0208636-03	1146	9/4/02	0208636-04	1147	Chlorobenzene	2 ND	2 ND	0	220
8/28/02	9/4/02	0208636-03	1146	9/4/02	0208636-04	1147	Chloroform	2 ND	2 ND	0	180
8/28/02	9/4/02	0208636-	1146	9/4/02	0208636-	1147	Methylene Chloride	1.05*	1.03*	0.02	193

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04			J	J		0
8/28/02	9/4/02	0208636-03	1146	9/4/02	0208636-04	1147	Toluene	6.96*	7.17*	-0.21	190
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	1,1,1-Trichloroethane	5 ND	5 ND	0	590
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	1,1-Dichloroethene	5 ND	5 ND	0	100
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	1,2-Dichloroethane	2 ND	2 ND	0	45
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	Carbon Tetrachloride	2 ND	2 ND	0	165
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	Chlorobenzene	2 ND	2 ND	0	220
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	Chloroform	2 ND	2 ND	0	180
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	Methylene Chloride	5 ND	0.61* J	-0.61	1930
9/4/02	9/10/02	0209140-01	1148	9/10/02	0209140-02	1149	Toluene	5 ND	5 ND	0	190
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	1,1,1-Trichloroethane	5 ND	5 ND	0	590
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	1,1-Dichloroethene	5 ND	5 ND	0	100
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	1,2-Dichloroethane	2 ND	2 ND	0	45
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	Carbon Tetrachloride	2 ND	2 ND	0	165
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	Chlorobenzene	2 ND	2 ND	0	220
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	Chloroform	2 ND	2 ND	0	180

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	Methylene Chloride	0.64* J	0.82* J	-0.18	1930
9/5/02	9/11/02	0209140-03	1150	9/11/02	0209140-04	1151	Toluene	5 ND	5 ND	0	190
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	1,1,1-Trichloroethane	5 ND	5 ND	0	590
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	1,1-Dichloroethene	5 ND	5 ND	0	100
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	1,2-Dichloroethane	2 ND	2 ND	0	45
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	Carbon Tetrachloride	2 ND	2 ND	0	165
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	Chlorobenzene	2 ND	2 ND	0	220
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	Chloroform	2 ND	2 ND	0	180
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	Methylene Chloride	0.62* J	0.92* J	-0.3	1930
9/9/02	9/17/02	0209217-01	1152	9/17/02	0209217-02	1153	Toluene	0.51* J	5 ND	0.51	190
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	1,1,1-Trichloroethane	5 ND	1.09* J	-1.09	590
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	1,1,2,2-Tetrachloroethane	2 ND	2.3 ND	0	50
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	1,1-Dichloroethene	5 ND	5.8 ND	0	100
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	1,2-Dichloroethane	2 ND	2.3 ND	0	45
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	Carbon Tetrachloride	2 ND	2.3 ND	0	165
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	Chlorobenzene	2 ND	2.3 ND	0	220

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	Chloroform	2 ND	2.3 ND	0	180
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	Methylene Chloride	5 ND	0.70* J	-0.7	1930
9/10/02	9/17/02	0209217-03	1154	9/17/02	0209217-04	1155	Toluene	5 ND	0.63* J	-0.63	190
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	1,1,1-Trichloroethane	5 ND	5 ND	0	590
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	1,1-Dichloroethene	5 ND	5 ND	0	100
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	1,2-Dichloroethane	2 ND	2 ND	0	45
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	Carbon Tetrachloride	2 ND	2 ND	0	165
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	Chlorobenzene	2 ND	2 ND	0	220
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	Chloroform	2 ND	2 ND	0	180
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	Methylene Chloride	0.45* J	0.42* J	0.03	1930
9/16/02	9/25/02	0209391-01	1156	9/25/02	0209391-02	1157	Toluene	5 ND	5 ND	0	190
9/17/02	9/25/02	0209391-03	1158	9/25/02	0209391-04	1159	1,1,1-Trichloroethane	5 ND	5 ND	0	590
9/17/02	9/25/02	0209391-03	1158	9/25/02	0209391-04	1159	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
9/17/02	9/25/02	0209391-03	1158	9/25/02	0209391-04	1159	1,1-Dichloroethene	5 ND	5 ND	0	100
9/17/02	9/25/02	0209391-03	1158	9/25/02	0209391-04	1159	1,2-Dichloroethane	2 ND	2 ND	0	45
9/17/02	9/25/02	0209391-03	1158	9/25/02	0209391-04	1159	Carbon Tetrachloride	2 ND	2 ND	0	165
9/17/02	9/25/02	0209391-	1158	9/25/02	0209391-	1159	Chlorobenzene	2 ND	2 ND	0	220

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04						
9/17/02	9/25/02	0209391-03	1158	9/25/02	0209391-04	1159	Chloroform	2 ND	2 ND	0	180
9/17/02	9/25/02	0209391-03	1158	9/25/02	0209391-04	1159	Methylene Chloride	5 ND	5 ND	0	1930
9/17/02	9/25/02	0209391-03	1158	9/25/02	0209391-04	1159	Toluene	5 ND	5 ND	0	190
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	1,1,1-Trichloroethane	5 ND	5 ND	0	590
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	1,1-Dichloroethene	5 ND	5 ND	0	100
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	1,2-Dichloroethane	2 ND	2 ND	0	45
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	Carbon Tetrachloride	2 ND	2 ND	0	165
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	Chlorobenzene	2 ND	2 ND	0	220
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	Chloroform	2 ND	2 ND	0	180
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	Methylene Chloride	5 ND	5 ND	0	1930
9/23/02	10/5/02	0209579-01	1160	10/5/02	0209579-02	1161	Toluene	5 ND	5 ND	0	190
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	1,1,1-Trichloroethane	5 ND	5.2 ND	0	590
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	1,1,2,2-Tetrachloroethane	2 ND	2.1 ND	0	50
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	1,1-Dichloroethene	5 ND	5.2 ND	0	100
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	1,2-Dichloroethane	2 ND	2.1 ND	0	45
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	Carbon Tetrachloride	2 ND	2.1 ND	0	165

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	Chlorobenzene	2 ND	2.1 ND	0	220
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	Chloroform	2 ND	2.1 ND	0	180
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	Methylene Chloride	7.53*	5.2 ND	7.53	1930
9/26/02	10/5/02	0209579-03	1162	10/10/02	0209579-04	1163	Toluene	0.63* J	5.2 ND	0.63	190
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	1,1,1-Trichloroethane	0.58* J	5 ND	0.58	590
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	1,1-Dichloroethene	5 ND	5 ND	0	100
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	1,2-Dichloroethane	2 ND	2 ND	0	45
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	Carbon Tetrachloride	2 ND	2 ND	0	165
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	Chlorobenzene	2 ND	2 ND	0	220
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	Chloroform	2 ND	2 ND	0	180
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	Methylene Chloride	2.65* J	2.76* J	-0.11	1930
9/30/02	10/13/02	0210115-01	1164	10/13/02	0210115-02	1165	Toluene	0.62* J	5 ND	0.62	190
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	1,1,1-Trichloroethane	5 ND	5 ND	0	590
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	1,1-Dichloroethene	5 ND	5 ND	0	100
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	1,2-Dichloroethane	2 ND	2 ND	0	45

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	Carbon Tetrachloride	2 ND	2 ND	0	165
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	Chlorobenzene	2 ND	2 ND	0	220
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	Chloroform	2 ND	2 ND	0	180
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	Methylene Chloride	2.10* J	2.20* J	-0.1	1930
10/2/02	10/13/02	0210115-03	1166	10/13/02	0210115-04	1167	Toluene	5 ND	5 ND	0	190
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	1,1,1-Trichloroethane	5.8 ND	5.8 ND	0	590
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	1,1,2,2-Tetrachloroethane	2.3 ND	2.3 ND	0	50
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	1,1-Dichloroethene	5.8 ND	5.8 ND	0	100
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	1,2-Dichloroethane	2.3 ND	2.3 ND	0	45
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	Carbon Tetrachloride	2.3 ND	2.3 ND	0	165
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	Chlorobenzene	2.3 ND	2.3 ND	0	220
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	Chloroform	2.3 ND	2.3 ND	0	180
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	Methylene Chloride	1.74* J	1.74* J	0	1930
10/7/02	10/17/02	0210291-01	1168	10/17/02	0210291-02	1169	Toluene	5.8 ND	5.8 ND	0	190
10/9/02	10/17/02	0210291-03	1170	10/17/02	0210291-04	1171	1,1,1-Trichloroethane	1.52* J	5 ND	1.52	590
10/9/02	10/17/02	0210291-03	1170	10/17/02	0210291-04	1171	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
10/9/02	10/17/02	0210291-03	1170	10/17/02	0210291-04	1171	1,1-Dichloroethene	5 ND	5 ND	0	100
10/9/02	10/17/02	0210291-	1170	10/17/02	0210291-	1171	1,2-Dichloroethane	2 ND	2 ND	0	45

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Differenc e**	CO C
		03			04						
10/9/02	10/17/02	0210291-03	1170	10/17/02	0210291-04	1171	Carbon Tetrachloride	2 ND	2 ND	0	165
10/9/02	10/17/02	0210291-03	1170	10/17/02	0210291-04	1171	Chlorobenzene	2 ND	2 ND	0	220
10/9/02	10/17/02	0210291-03	1170	10/17/02	0210291-04	1171	Chloroform	2 ND	2 ND	0	180
10/9/02	10/17/02	0210291-03	1170	10/17/02	0210291-04	1171	Methylene Chloride	3.60* J	3.73* J	-0.13	193 0
10/9/02	10/17/02	0210291-03	1170	10/17/02	0210291-04	1171	Toluene	1.19* J	0.69* J	0.5	190
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	1,1,1-Trichloroethane	0.95* J	5 ND	0.95	590
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	1,1-Dichloroethene	5 ND	5 ND	0	100
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	1,2-Dichloroethane	2 ND	2 ND	0	45
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	Carbon Tetrachloride	2 ND	2 ND	0	165
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	Chlorobenzene	2 ND	2 ND	0	220
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	Chloroform	2 ND	2 ND	0	180
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	Methylene Chloride	1.02* J	0.84* J	0.18	193 0
10/15/02	10/25/02	0210464-01	1172	10/25/02	0210464-02	1173	Toluene	0.88* J	5 ND	0.88	190
10/17/02	10/25/02	0210464-03	1174	10/25/02	0210464-04	1175	1,1,1-Trichloroethane	0.91* J	5 ND	0.91	590
10/17/02	10/25/02	0210464-03	1174	10/25/02	0210464-04	1175	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
10/17/02	10/25/02	0210464-	1174	10/25/02	0210464-	1175	1,1-Dichloroethene	5 ND	5 ND	0	100

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04						
10/17/02	10/25/02	0210464-03	1174	10/25/02	0210464-04	1175	1,2-Dichloroethane	2 ND	2 ND	0	45
10/17/02	10/25/02	0210464-03	1174	10/25/02	0210464-04	1175	Carbon Tetrachloride	2 ND	2 ND	0	165
10/17/02	10/25/02	0210464-03	1174	10/25/02	0210464-04	1175	Chlorobenzene	2 ND	2 ND	0	220
10/17/02	10/25/02	0210464-03	1174	10/25/02	0210464-04	1175	Chloroform	2 ND	2 ND	0	180
10/17/02	10/25/02	0210464-03	1174	10/25/02	0210464-04	1175	Methylene Chloride	5 ND	1.04* J	-1.04	1930
10/17/02	10/25/02	0210464-03	1174	10/25/02	0210464-04	1175	Toluene	0.85* J	5 ND	0.85	190
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	1,1,1-Trichloroethane	1.16* J	5 ND	1.16	590
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	1,1-Dichloroethene	5 ND	5 ND	0	100
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	1,2-Dichloroethane	2 ND	2 ND	0	45
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	Carbon Tetrachloride	2 ND	2 ND	0	165
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	Chlorobenzene	2 ND	2 ND	0	220
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	Chloroform	2 ND	2 ND	0	180
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	Methylene Chloride	0.89* J	1.00* J	-0.11	1930
10/21/02	10/28/02	0210608-01	1176	10/28/02	0210608-02	1177	Toluene	5 ND	5 ND	0	190
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	1,1,1-Trichloroethane	1.69* J	5 ND	1.69	590
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	1,1-Dichloroethene	5 ND	5 ND	0	100
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	1,2-Dichloroethane	2 ND	2 ND	0	45
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	Carbon Tetrachloride	2 ND	2 ND	0	165
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	Chlorobenzene	2 ND	2 ND	0	220
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	Chloroform	2 ND	2 ND	0	180
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	Methylene Chloride	0.86* J	0.75* J	0.11	1930
10/23/02	10/28/02	0210608-03	1178	10/28/02	0210608-04	1179	Toluene	0.73* J	5 ND	0.73	190
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	1,1,1-Trichloroethane	1.46* J	5 ND	1.46	590
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	1,1-Dichloroethene	5 ND	5 ND	0	100
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	1,2-Dichloroethane	2 ND	2 ND	0	45
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	Carbon Tetrachloride	2 ND	2 ND	0	165
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	Chlorobenzene	2 ND	2 ND	0	220
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	Chloroform	2 ND	2 ND	0	180
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	Methylene Chloride	0.76* J	5 ND	0.76	1930
10/28/02	11/8/02	0211063-01	1180	11/6/02	0211063-02	1181	Toluene	0.80* J	5 ND	0.8	190
10/31/02	11/6/02	0211063-03	1182	11/6/02	0211063-04	1183	1,1,1-Trichloroethane	5 ND	5 ND	0	590
10/31/02	11/6/02	0211063-	1182	11/6/02	0211063-	1183	1,1,2,2-	2 ND	2 ND	0	50

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04		Tetrachloroethane				
10/31/02	11/6/02	0211063-03	1182	11/6/02	0211063-04	1183	1,1-Dichloroethene	5 ND	5 ND	0	100
10/31/02	11/6/02	0211063-03	1182	11/6/02	0211063-04	1183	1,2-Dichloroethane	2 ND	2 ND	0	45
10/31/02	11/6/02	0211063-03	1182	11/6/02	0211063-04	1183	Carbon Tetrachloride	2 ND	2 ND	0	165
10/31/02	11/6/02	0211063-03	1182	11/6/02	0211063-04	1183	Chlorobenzene	2 ND	2 ND	0	220
10/31/02	11/6/02	0211063-03	1182	11/6/02	0211063-04	1183	Chloroform	2 ND	2 ND	0	180
10/31/02	11/6/02	0211063-03	1182	11/6/02	0211063-04	1183	Methylene Chloride	1.27* J	0.80* J	0.47	1930
10/31/02	11/6/02	0211063-03	1182	11/6/02	0211063-04	1183	Toluene	5 ND	5 ND	0	190
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	1,1,1-Trichloroethane	5 ND	5 ND	0	590
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	1,1-Dichloroethene	5 ND	5 ND	0	100
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	1,2-Dichloroethane	2 ND	2 ND	0	45
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	Carbon Tetrachloride	2 ND	2 ND	0	165
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	Chlorobenzene	2 ND	2 ND	0	220
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	Chloroform	2 ND	2 ND	0	180
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	Methylene Chloride	5 ND	5 ND	0	1930
11/4/02	11/11/02	0211149-01	1186	11/11/02	0211149-02	1187	Toluene	5 ND	5 ND	0	190
11/5/02	11/11/02	0211149-	1188	11/11/02	0211149-	1189	1,1,1-	1.65*	5 ND	1.65	590

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Differenc e**	CO C
		03			04		Trichloroethane	J			
11/5/02	11/11/02	0211149-03	1188	11/11/02	0211149-04	1189	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
11/5/02	11/11/02	0211149-03	1188	11/11/02	0211149-04	1189	1,1-Dichloroethene	5 ND	5 ND	0	100
11/5/02	11/11/02	0211149-03	1188	11/11/02	0211149-04	1189	1,2-Dichloroethane	2 ND	2 ND	0	45
11/5/02	11/11/02	0211149-03	1188	11/11/02	0211149-04	1189	Carbon Tetrachloride	2 ND	2 ND	0	165
11/5/02	11/11/02	0211149-03	1188	11/11/02	0211149-04	1189	Chlorobenzene	2 ND	2 ND	0	220
11/5/02	11/11/02	0211149-03	1188	11/11/02	0211149-04	1189	Chloroform	2 ND	2 ND	0	180
11/5/02	11/11/02	0211149-03	1188	11/11/02	0211149-04	1189	Methylene Chloride	0.62* J	1.06* J	-0.44	193 0
11/5/02	11/11/02	0211149-03	1188	11/11/02	0211149-04	1189	Toluene	0.79* J	5 ND	0.79	190
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	1,1,1-Trichloroethane	0.80* J	5 ND	0.8	590
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	1,1-Dichloroethene	5 ND	5 ND	0	100
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	1,2-Dichloroethane	2 ND	2 ND	0	45
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	Carbon Tetrachloride	2 ND	2 ND	0	165
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	Chlorobenzene	2 ND	2 ND	0	220
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	Chloroform	2 ND	2 ND	0	180
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	Methylene Chloride	5 ND	5 ND	0	193 0
11/12/02	11/17/02	0211369-01	1190	11/17/02	0211369-02	1191	Toluene	1.04* J	5 ND	1.04	190

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	1,1,1-Trichloroethane	0.67* J	5.7 ND	0.67	590
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	1,1,2,2-Tetrachloroethane	2.1 ND	2.3 ND	0	50
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	1,1-Dichloroethene	5.2 ND	5.7 ND	0	100
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	1,2-Dichloroethane	2.1 ND	2.3 ND	0	45
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	Carbon Tetrachloride	2.1 ND	2.3 ND	0	165
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	Chlorobenzene	2.1 ND	2.3 ND	0	220
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	Chloroform	2.1 ND	2.3 ND	0	180
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	Methylene Chloride	2.47* J	5.7 ND	2.47	1930
11/13/02	11/17/02	0211369-03	1192	11/20/02	0211369-04	1193	Toluene	2.47* J	5.7 ND	2.47	190
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	1,1,1-Trichloroethane	5 ND	5 ND	0	590
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	1,1-Dichloroethene	5 ND	5 ND	0	100
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	1,2-Dichloroethane	2 ND	2 ND	0	45
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	Carbon Tetrachloride	2 ND	2 ND	0	165
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	Chlorobenzene	2 ND	2 ND	0	220
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	Chloroform	2 ND	2 ND	0	180
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	Methylene Chloride	5 ND	5 ND	0	1930

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
11/19/02	11/29/02	0211515-01	1194	11/29/02	0211515-02	1195	Toluene	1.20* J	0.86* J	0.34	190
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	1,1,1-Trichloroethane	5 ND	5 ND	0	590
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	1,1-Dichloroethene	5 ND	5 ND	0	100
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	1,2-Dichloroethane	2 ND	2 ND	0	45
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	Carbon Tetrachloride	2 ND	2 ND	0	165
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	Chlorobenzene	2 ND	2 ND	0	220
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	Chloroform	2 ND	2 ND	0	180
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	Methylene Chloride	5 ND	5 ND	0	1930
11/20/02	11/29/02	0211515-03	1196	11/30/02	0211515-04	1197	Toluene	1.21* J	5 ND	1.21	190
11/25/02	12/7/02	0211691-01	1198	12/7/02	0211691-02	1199	1,1,1-Trichloroethane	5 ND	5 ND	0	590
11/25/02	12/7/02	0211691-01	1198	12/7/02	0211691-02	1199	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
11/25/02	12/7/02	0211691-01	1198	12/7/02	0211691-02	1199	1,1-Dichloroethene	5 ND	5 ND	0	100
11/25/02	12/7/02	0211691-01	1198	12/7/02	0211691-02	1199	1,2-Dichloroethane	2 ND	2 ND	0	45
11/25/02	12/7/02	0211691-01	1198	12/7/02	0211691-02	1199	Carbon Tetrachloride	2 ND	2 ND	0	165
11/25/02	12/7/02	0211691-01	1198	12/7/02	0211691-02	1199	Chlorobenzene	2 ND	2 ND	0	220
11/25/02	12/7/02	0211691-01	1198	12/7/02	0211691-02	1199	Chloroform	2 ND	2 ND	0	180
11/25/02	12/7/02	0211691-	1198	12/7/02	0211691-	1199	Methylene Chloride	5 ND	5 ND	0	193

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02						0
11/25/02	12/7/02	0211691-01	1198	12/7/02	0211691-02	1199	Toluene	5 ND	5 ND	0	190
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	1,1,1-Trichloroethane	5 ND	5 ND	0	590
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	1,1-Dichloroethene	5 ND	5 ND	0	100
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	1,2-Dichloroethane	2 ND	2 ND	0	45
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	Carbon Tetrachloride	2 ND	2 ND	0	165
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	Chlorobenzene	2 ND	2 ND	0	220
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	Chloroform	2 ND	2 ND	0	180
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	Methylene Chloride	1.32* J	5 ND	1.32	1930
11/26/02	12/7/02	0211691-03	1200	12/7/02	0211691-04	1201	Toluene	5 ND	5 ND	0	190
12/2/02	12/12/02	0212099-01	1202	12/12/02	0212099-02	1203	1,1,1-Trichloroethane	0.82* J	5 ND	0.82	590
12/2/02	12/12/02	0212099-01	1202	12/12/02	0212099-02	1203	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/2/02	12/12/02	0212099-01	1202	12/12/02	0212099-02	1203	1,1-Dichloroethene	5 ND	5 ND	0	100
12/2/02	12/12/02	0212099-01	1202	12/12/02	0212099-02	1203	1,2-Dichloroethane	2 ND	2 ND	0	45
12/2/02	12/12/02	0212099-01	1202	12/12/02	0212099-02	1203	Carbon Tetrachloride	2 ND	2 ND	0	165
12/2/02	12/12/02	0212099-01	1202	12/12/02	0212099-02	1203	Chlorobenzene	2 ND	2 ND	0	220
12/2/02	12/12/02	0212099-	1202	12/12/02	0212099-	1203	Chloroform	2 ND	2 ND	0	180

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02						
12/2/02	12/12/02	0212099-01	1202	12/12/02	0212099-02	1203	Methylene Chloride	0.70* JB	5 ND	0.7	1930
12/2/02	12/12/02	0212099-01	1202	12/12/02	0212099-02	1203	Toluene	0.79* J	5 ND	0.79	190
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	1,1,1-Trichloroethane	5 ND	5 ND	0	590
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	1,1-Dichloroethene	5 ND	5 ND	0	100
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	1,2-Dichloroethane	2 ND	2 ND	0	45
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	Carbon Tetrachloride	2 ND	2 ND	0	165
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	Chlorobenzene	2 ND	2 ND	0	220
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	Chloroform	2 ND	2 ND	0	180
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	Methylene Chloride	0.68* JB	1.09* JB	-0.41	1930
12/3/02	12/12/02	0212099-03	1204	12/12/02	0212099-04	1205	Toluene	5 ND	5 ND	0	190
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	1,1,1-Trichloroethane	5 ND	5 ND	0	590
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	1,1-Dichloroethene	5 ND	5 ND	0	100
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	1,2-Dichloroethane	2 ND	2 ND	0	45
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	Carbon Tetrachloride	2 ND	2 ND	0	165
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	Chlorobenzene	2 ND	2 ND	0	220

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	Chloroform	2 ND	2 ND	0	180
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	Methylene Chloride	5 ND	5 ND	0	1930
12/9/02	12/16/02	0212290-01	1206	12/16/02	0212290-02	1207	Toluene	5 ND	5 ND	0	190
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	1,1,1-Trichloroethane	1.93* J	5 ND	1.93	590
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	1,1-Dichloroethene	5 ND	5 ND	0	100
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	1,2-Dichloroethane	2 ND	2 ND	0	45
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	Carbon Tetrachloride	2 ND	2 ND	0	165
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	Chlorobenzene	2 ND	2 ND	0	220
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	Chloroform	2 ND	2 ND	0	180
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	Methylene Chloride	5 ND	5 ND	0	1930
12/10/02	12/16/02	0212290-03	1208	12/16/02	0212290-04	1209	Toluene	1.28* J	5 ND	1.28	190
12/17/02	12/22/02	0212489-01	1210	12/22/02	0212489-02	1211	1,1,1-Trichloroethane	0.88* J	5 ND	0.88	590
12/17/02	12/22/02	0212489-01	1210	12/22/02	0212489-02	1211	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/17/02	12/22/02	0212489-01	1210	12/22/02	0212489-02	1211	1,1-Dichloroethene	5 ND	5 ND	0	100
12/17/02	12/22/02	0212489-01	1210	12/22/02	0212489-02	1211	1,2-Dichloroethane	2 ND	2 ND	0	45
12/17/02	12/22/02	0212489-01	1210	12/22/02	0212489-02	1211	Carbon Tetrachloride	2 ND	2 ND	0	165
12/17/02	12/22/02	0212489-	1210	12/22/02	0212489-	1211	Chlorobenzene	2 ND	2 ND	0	220

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Differenc e**	CO C
		01			02						
12/17/02	12/22/02	0212489-01	1210	12/22/02	0212489-02	1211	Chloroform	2 ND	2 ND	0	180
12/17/02	12/22/02	0212489-01	1210	12/22/02	0212489-02	1211	Methylene Chloride	5 ND	5 ND	0	193 0
12/17/02	12/22/02	0212489-01	1210	12/22/02	0212489-02	1211	Toluene	0.50* J	5 ND	0.5	190
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	1,1,1-Trichloroethane	3.09* J	5 ND	3.09	590
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	1,1-Dichloroethene	5 ND	5 ND	0	100
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	1,2-Dichloroethane	2 ND	2 ND	0	45
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	Carbon Tetrachloride	2 ND	2 ND	0	165
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	Chlorobenzene	2 ND	2 ND	0	220
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	Chloroform	2 ND	2 ND	0	180
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	Methylene Chloride	0.43* J	5 ND	0.43	193 0
12/18/02	12/22/02	0212489-03	1212	12/23/02	0212489-04	1213	Toluene	0.92* J	5 ND	0.92	190
12/23/02	12/28/02	0212596-01	1214	12/28/02	0212596-02	1215	1,1,1-Trichloroethane	5 ND	5 ND	0	590
12/23/02	12/28/02	0212596-01	1214	12/28/02	0212596-02	1215	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/23/02	12/28/02	0212596-01	1214	12/28/02	0212596-02	1215	1,1-Dichloroethene	5 ND	5 ND	0	100
12/23/02	12/28/02	0212596-01	1214	12/28/02	0212596-02	1215	1,2-Dichloroethane	2 ND	2 ND	0	45
12/23/02	12/28/02	0212596-	1214	12/28/02	0212596-	1215	Carbon	2 ND	2 ND	0	165

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02		Tetrachloride				
12/23/02	12/28/02	0212596-01	1214	12/28/02	0212596-02	1215	Chlorobenzene	2 ND	2 ND	0	220
12/23/02	12/28/02	0212596-01	1214	12/28/02	0212596-02	1215	Chloroform	2 ND	2 ND	0	180
12/23/02	12/28/02	0212596-01	1214	12/28/02	0212596-02	1215	Methylene Chloride	5 ND	5 ND	0	1930
12/23/02	12/28/02	0212596-01	1214	12/28/02	0212596-02	1215	Toluene	0.55* J	5 ND	0.55	190
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	1,1,1-Trichloroethane	5 ND	5 ND	0	590
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	1,1-Dichloroethene	5 ND	5 ND	0	100
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	1,2-Dichloroethane	2 ND	2 ND	0	45
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	Carbon Tetrachloride	2 ND	2 ND	0	165
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	Chlorobenzene	2 ND	2 ND	0	220
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	Chloroform	2 ND	2 ND	0	180
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	Methylene Chloride	5 ND	5 ND	0	1930
12/26/02	12/28/02	0212596-03	1216	12/28/02	0212596-04	1217	Toluene	1.11* J	0.70* J	0.41	190
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	1,1,1-Trichloroethane	5 ND	5 ND	0	590
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	1,1-Dichloroethene	5 ND	5 ND	0	100
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	1,2-Dichloroethane	2 ND	2 ND	0	45

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	Carbon Tetrachloride	2 ND	2 ND	0	165
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	Chlorobenzene	2 ND	2 ND	0	220
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	Chloroform	2 ND	2 ND	0	180
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	Methylene Chloride	5 ND	5 ND	0	1930
12/30/02	1/8/03	0301002-01	1218	1/8/03	0301002-02	1219	Toluene	5 ND	5 ND	0	190
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	1,1,1-Trichloroethane	5 ND	5 ND	0	590
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	1,1-Dichloroethene	5 ND	5 ND	0	100
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	1,2-Dichloroethane	2 ND	2 ND	0	45
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	Carbon Tetrachloride	2 ND	2 ND	0	165
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	Chlorobenzene	2 ND	2 ND	0	220
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	Chloroform	2 ND	2 ND	0	180
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	Methylene Chloride	5 ND	5 ND	0	1930
12/31/02	1/8/03	0301002-03	1220	1/8/03	0301002-04	1221	Toluene	5 ND	5 ND	0	190
1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	1,1,1-Trichloroethane	1.64* J	5 ND	1.64	590
1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	1,1-Dichloroethene	5 ND	5 ND	0	100

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1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	1,2-Dichloroethane	2 ND	2 ND	0	45
1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	Carbon Tetrachloride	2 ND	2 ND	0	165
1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	Chlorobenzene	2 ND	2 ND	0	220
1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	Chloroform	2 ND	2 ND	0	180
1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	Methylene Chloride	5 ND	5 ND	0	1930
1/6/03	1/13/03	0301138-01	1222	1/13/03	0301138-02	1223	Toluene	0.82* J	5 ND	0.82	190
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	1,1,1-Trichloroethane	5 ND	5 ND	0	590
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	1,1-Dichloroethene	5 ND	5 ND	0	100
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	1,2-Dichloroethane	2 ND	2 ND	0	45
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	Carbon Tetrachloride	2 ND	2 ND	0	165
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	Chlorobenzene	2 ND	2 ND	0	220
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	Chloroform	2 ND	2 ND	0	180
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	Methylene Chloride	5 ND	5 ND	0	1930
1/7/03	1/13/03	0301138-03	1224	1/13/03	0301138-04	1225	Toluene	0.76* J	5 ND	0.76	190
1/13/03	1/24/03	0301282-01	1226	1/24/03	0301282-02	1227	1,1,1-Trichloroethane	0.65* J	5 ND	0.65	590
1/13/03	1/24/03	0301282-01	1226	1/24/03	0301282-02	1227	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
1/13/03	1/24/03	0301282-	1226	1/24/03	0301282-	1227	1,1-Dichloroethene	5 ND	5 ND	0	100

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02						
1/13/03	1/24/03	0301282-01	1226	1/24/03	0301282-02	1227	1,2-Dichloroethane	2 ND	2 ND	0	45
1/13/03	1/24/03	0301282-01	1226	1/24/03	0301282-02	1227	Carbon Tetrachloride	2 ND	2 ND	0	165
1/13/03	1/24/03	0301282-01	1226	1/24/03	0301282-02	1227	Chlorobenzene	2 ND	2 ND	0	220
1/13/03	1/24/03	0301282-01	1226	1/24/03	0301282-02	1227	Chloroform	2 ND	2 ND	0	180
1/13/03	1/24/03	0301282-01	1226	1/24/03	0301282-02	1227	Methylene Chloride	5 ND	5 ND	0	1930
1/13/03	1/24/03	0301282-01	1226	1/24/03	0301282-02	1227	Toluene	0.62* J	5 ND	0.62	190
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	1,1,1-Trichloroethane	0.66* J	5 ND	0.66	590
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	1,1-Dichloroethene	5 ND	5 ND	0	100
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	1,2-Dichloroethane	2 ND	2 ND	0	45
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	Carbon Tetrachloride	2 ND	2 ND	0	165
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	Chlorobenzene	2 ND	2 ND	0	220
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	Chloroform	2 ND	2 ND	0	180
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	Methylene Chloride	5 ND	5 ND	0	1930
1/14/03	1/24/03	0301282-05	1230	1/24/03	0301282-06	1231	Toluene	1.03* J	0.77* J	0.26	190
1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	1,1,1-Trichloroethane	5 ND	5 ND	0	590
1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50

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1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	1,1-Dichloroethene	5 ND	5 ND	0	100
1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	1,2-Dichloroethane	2 ND	2 ND	0	45
1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	Carbon Tetrachloride	2 ND	2 ND	0	165
1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	Chlorobenzene	2 ND	2 ND	0	220
1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	Chloroform	2 ND	2 ND	0	180
1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	Methylene Chloride	0.60* J	5 ND	0.6	1930
1/20/03	1/26/03	0301433-01	1232	1/26/03	0301433-02	1233	Toluene	1.68* J	5 ND	1.68	190
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	1,1,1-Trichloroethane	5 ND	5 ND	0	590
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	1,1-Dichloroethene	5 ND	5 ND	0	100
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	1,2-Dichloroethane	2 ND	2 ND	0	45
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	Carbon Tetrachloride	2 ND	2 ND	0	165
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	Chlorobenzene	2 ND	2 ND	0	220
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	Chloroform	2 ND	2 ND	0	180
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	Methylene Chloride	5 ND	5 ND	0	1930
1/21/03	1/26/03	0301433-03	1234	1/26/03	0301433-04	1235	Toluene	0.71* J	5 ND	0.71	190
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	1,1,1-Trichloroethane	5 ND	5 ND	0	590

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	1,1-Dichloroethene	5 ND	5 ND	0	100
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	1,2-Dichloroethane	2 ND	2 ND	0	45
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	Carbon Tetrachloride	2 ND	2 ND	0	165
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	Chlorobenzene	2 ND	2 ND	0	220
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	Chloroform	2 ND	2 ND	0	180
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	Methylene Chloride	5 ND	5 ND	0	1930
1/27/03	1/31/03	0301574-01	1236	1/31/03	0301574-02	1237	Toluene	5 ND	5 ND	0	190
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	1,1,1-Trichloroethane	5 ND	5 ND	0	590
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	1,1-Dichloroethene	5 ND	5 ND	0	100
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	1,2-Dichloroethane	2 ND	2 ND	0	45
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	Carbon Tetrachloride	2 ND	2 ND	0	165
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	Chlorobenzene	2 ND	2 ND	0	220
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	Chloroform	2 ND	2 ND	0	180
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	Methylene Chloride	5 ND	5 ND	0	1930
1/28/03	1/31/03	0301574-03	1238	1/31/03	0301574-04	1239	Toluene	5 ND	5 ND	0	190
2/4/03	2/11/03	0302193-	1240	2/11/03	0302193-	1241	1,1,1-	0.99*	5 ND	0.99	590

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02		Trichloroethane	J			
2/4/03	2/11/03	0302193-01	1240	2/11/03	0302193-02	1241	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
2/4/03	2/11/03	0302193-01	1240	2/11/03	0302193-02	1241	1,1-Dichloroethene	5 ND	5 ND	0	100
2/4/03	2/11/03	0302193-01	1240	2/11/03	0302193-02	1241	1,2-Dichloroethane	2 ND	2 ND	0	45
2/4/03	2/11/03	0302193-01	1240	2/11/03	0302193-02	1241	Carbon Tetrachloride	2 ND	2 ND	0	165
2/4/03	2/11/03	0302193-01	1240	2/11/03	0302193-02	1241	Chlorobenzene	2 ND	2 ND	0	220
2/4/03	2/11/03	0302193-01	1240	2/11/03	0302193-02	1241	Chloroform	2 ND	2 ND	0	180
2/4/03	2/11/03	0302193-01	1240	2/11/03	0302193-02	1241	Methylene Chloride	5 ND	5 ND	0	1930
2/4/03	2/11/03	0302193-01	1240	2/11/03	0302193-02	1241	Toluene	5 ND	5 ND	0	190
2/5/03	2/11/03	0302193-03	1242	2/11/03	0302193-04	1243	1,1,1-Trichloroethane	5 ND	5 ND	0	590
2/5/03	2/11/03	0302193-03	1242	2/11/03	0302193-04	1243	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
2/5/03	2/11/03	0302193-03	1242	2/11/03	0302193-04	1243	1,1-Dichloroethene	5 ND	5 ND	0	100
2/5/03	2/11/03	0302193-03	1242	2/11/03	0302193-04	1243	1,2-Dichloroethane	2 ND	2 ND	0	45
2/5/03	2/11/03	0302193-03	1242	2/11/03	0302193-04	1243	Carbon Tetrachloride	2 ND	2 ND	0	165
2/5/03	2/11/03	0302193-03	1242	2/11/03	0302193-04	1243	Chlorobenzene	2 ND	2 ND	0	220
2/5/03	2/11/03	0302193-03	1242	2/11/03	0302193-04	1243	Chloroform	2 ND	2 ND	0	180
2/5/03	2/11/03	0302193-03	1242	2/11/03	0302193-04	1243	Methylene Chloride	5 ND	5 ND	0	1930
2/5/03	2/11/03	0302193-	1242	2/11/03	0302193-	1243	Toluene	0.93*	0.73*	0.2	190

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Differenc e**	COC
		03			04			J	J		
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	1,1,1-Trichloroethane	1.13* J	5 ND	1.13	590
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	1,1-Dichloroethene	5 ND	5 ND	0	100
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	1,2-Dichloroethane	2 ND	2 ND	0	45
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	Carbon Tetrachloride	2 ND	2 ND	0	165
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	Chlorobenzene	2 ND	2 ND	0	220
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	Chloroform	2 ND	2 ND	0	180
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	Methylene Chloride	5 ND	5 ND	0	1930
2/10/03	2/19/03	0302269-01	1244	2/19/03	0302269-02	1245	Toluene	1.62* J	0.68* J	0.94	190
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	1,1,1-Trichloroethane	5 ND	5 ND	0	590
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	1,1-Dichloroethene	5 ND	5 ND	0	100
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	1,2-Dichloroethane	2 ND	2 ND	0	45
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	Carbon Tetrachloride	2 ND	2 ND	0	165
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	Chlorobenzene	2 ND	2 ND	0	220
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	Chloroform	2 ND	2 ND	0	180
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	Methylene Chloride	5 ND	5 ND	0	1930

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
2/11/03	2/19/03	0302269-03	1246	2/19/03	0302269-04	1247	Toluene	5 ND	5 ND	0	190
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	1,1,1-Trichloroethane	1.96* J	5 ND	1.96	590
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	1,1-Dichloroethene	5 ND	5 ND	0	100
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	1,2-Dichloroethane	2 ND	2 ND	0	45
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	Carbon Tetrachloride	2 ND	2 ND	0	165
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	Chlorobenzene	2 ND	2 ND	0	220
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	Chloroform	2 ND	2 ND	0	180
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	Methylene Chloride	5 ND	5 ND	0	1930
2/19/03	2/27/03	0302494-01	1248	2/27/03	0302494-02	1249	Toluene	1.52* J	1.52* J	0	190
2/20/03	2/27/03	0302494-03	1250	2/27/03	0302494-04	1251	1,1,1-Trichloroethane	5 ND	5 ND	0	590
2/20/03	2/27/03	0302494-03	1250	2/27/03	0302494-04	1251	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
2/20/03	2/27/03	0302494-03	1250	2/27/03	0302494-04	1251	1,1-Dichloroethene	5 ND	5 ND	0	100
2/20/03	2/27/03	0302494-03	1250	2/27/03	0302494-04	1251	1,2-Dichloroethane	2 ND	2 ND	0	45
2/20/03	2/27/03	0302494-03	1250	2/27/03	0302494-04	1251	Carbon Tetrachloride	2 ND	2 ND	0	165
2/20/03	2/27/03	0302494-03	1250	2/27/03	0302494-04	1251	Chlorobenzene	2 ND	2 ND	0	220
2/20/03	2/27/03	0302494-03	1250	2/27/03	0302494-04	1251	Chloroform	2 ND	2 ND	0	180
2/20/03	2/27/03	0302494-	1250	2/27/03	0302494-	1251	Methylene Chloride	5 ND	5 ND	0	193

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04						0
2/20/03	2/27/03	0302494-03	1250	2/27/03	0302494-04	1251	Toluene	0.70* J	0.77* J	-0.07	190
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	1,1,1-Trichloroethane	5 ND	5 ND	0	590
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	1,1-Dichloroethene	5 ND	5 ND	0	100
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	1,2-Dichloroethane	2 ND	2 ND	0	45
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	Carbon Tetrachloride	2 ND	2 ND	0	165
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	Chlorobenzene	2 ND	2 ND	0	220
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	Chloroform	2 ND	2 ND	0	180
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	Methylene Chloride	5 ND	5 ND	0	1930
2/24/03	2/28/03	0302579-01	1252	2/28/03	0302579-02	1253	Toluene	5 ND	5 ND	0	190
2/25/03	2/28/03	0302579-03	1254	3/3/03	0302579-04	1255	1,1,1-Trichloroethane	5 ND	5 ND	0	590
2/25/03	2/28/03	0302579-03	1254	3/3/03	0302579-04	1255	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
2/25/03	2/28/03	0302579-03	1254	3/3/03	0302579-04	1255	1,1-Dichloroethene	5 ND	5 ND	0	100
2/25/03	2/28/03	0302579-03	1254	3/3/03	0302579-04	1255	1,2-Dichloroethane	2 ND	2 ND	0	45
2/25/03	2/28/03	0302579-03	1254	3/3/03	0302579-04	1255	Carbon Tetrachloride	2 ND	2 ND	0	165
2/25/03	2/28/03	0302579-03	1254	3/3/03	0302579-04	1255	Chlorobenzene	2 ND	2 ND	0	220
2/25/03	2/28/03	0302579-	1254	3/3/03	0302579-	1255	Chloroform	2 ND	2 ND	0	180

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04						
2/25/03	2/28/03	0302579-03	1254	3/3/03	0302579-04	1255	Methylene Chloride	5 ND	5 ND	0	1930
2/25/03	2/28/03	0302579-03	1254	3/3/03	0302579-04	1255	Toluene	0.69* J	5 ND	0.69	190
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	1,1,1-Trichloroethane	0.77* J	5 ND	0.77	590
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	1,1-Dichloroethene	5 ND	5 ND	0	100
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	1,2-Dichloroethane	2 ND	2 ND	0	45
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	Carbon Tetrachloride	2 ND	2 ND	0	165
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	Chlorobenzene	2 ND	2 ND	0	220
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	Chloroform	2 ND	2 ND	0	180
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	Methylene Chloride	5 ND	5 ND	0	1930
3/3/03	3/10/03	0303123-01	1256	3/10/03	0303123-02	1257	Toluene	0.82* J	5 ND	0.82	190
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	1,1,1-Trichloroethane	5 ND	5 ND	0	590
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	1,1-Dichloroethene	5 ND	5 ND	0	100
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	1,2-Dichloroethane	2 ND	2 ND	0	45
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	Carbon Tetrachloride	2 ND	2 ND	0	165
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	Chlorobenzene	2 ND	2 ND	0	220

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	Chloroform	2 ND	2 ND	0	180
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	Methylene Chloride	5 ND	5 ND	0	1930
3/4/03	3/10/03	0303123-03	1258	3/10/03	0303123-04	1259	Toluene	0.65* J	5 ND	0.65	190
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	1,1,1-Trichloroethane	5 ND	5 ND	0	590
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	1,1-Dichloroethene	5 ND	5 ND	0	100
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	1,2-Dichloroethane	2 ND	2 ND	0	45
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	Carbon Tetrachloride	2 ND	2 ND	0	165
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	Chlorobenzene	2 ND	2 ND	0	220
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	Chloroform	2 ND	2 ND	0	180
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	Methylene Chloride	5 ND	5 ND	0	1930
3/11/03	3/19/03	0303290-01	1260	3/19/03	0303290-02	1261	Toluene	0.96* J	1.69* J	-0.73	190
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	1,1,1-Trichloroethane	5 ND	5 ND	0	590
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	1,1-Dichloroethene	5 ND	5 ND	0	100
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	1,2-Dichloroethane	2 ND	2 ND	0	45
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	Carbon Tetrachloride	2 ND	2 ND	0	165

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	Chlorobenzene	2 ND	2 ND	0	220
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	Chloroform	2 ND	2 ND	0	180
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	Methylene Chloride	5 ND	5 ND	0	1930
3/12/03	3/19/03	0303290-03	1262	3/19/03	0303290-04	1263	Toluene	5 ND	5 ND	0	190
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	1,1,1-Trichloroethane	5 ND	5 ND	0	590
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	1,1-Dichloroethene	5 ND	5 ND	0	100
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	1,2-Dichloroethane	2 ND	2 ND	0	45
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	Carbon Tetrachloride	2 ND	2 ND	0	165
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	Chlorobenzene	2 ND	2 ND	0	220
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	Chloroform	2 ND	2 ND	0	180
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	Methylene Chloride	5 ND	5 ND	0	1930
3/18/03	3/24/03	0303382-01	1264	3/24/03	0303382-02	1265	Toluene	0.99* J	5 ND	0.99	190
3/19/03	3/24/03	0303382-05	1268	3/24/03	0303382-06	1269	1,1,1-Trichloroethane	5 ND	5 ND	0	590
3/19/03	3/24/03	0303382-05	1268	3/24/03	0303382-06	1269	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/19/03	3/24/03	0303382-05	1268	3/24/03	0303382-06	1269	1,1-Dichloroethene	5 ND	5 ND	0	100
3/19/03	3/24/03	0303382-05	1268	3/24/03	0303382-06	1269	1,2-Dichloroethane	2 ND	2 ND	0	45
3/19/03	3/24/03	0303382-	1268	3/24/03	0303382-	1269	Carbon	2 ND	2 ND	0	165

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		05			06		Tetrachloride				
3/19/03	3/24/03	0303382-05	1268	3/24/03	0303382-06	1269	Chlorobenzene	2 ND	2 ND	0	220
3/19/03	3/24/03	0303382-05	1268	3/24/03	0303382-06	1269	Chloroform	2 ND	2 ND	0	180
3/19/03	3/24/03	0303382-05	1268	3/24/03	0303382-06	1269	Methylene Chloride	5 ND	5 ND	0	1930
3/19/03	3/24/03	0303382-05	1268	3/24/03	0303382-06	1269	Toluene	5 ND	5 ND	0	190
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	1,1,1-Trichloroethane	5 ND	5 ND	0	590
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	1,1-Dichloroethene	5 ND	5 ND	0	100
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	1,2-Dichloroethane	2 ND	2 ND	0	45
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	Carbon Tetrachloride	2 ND	2 ND	0	165
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	Chlorobenzene	2 ND	2 ND	0	220
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	Chloroform	2 ND	2 ND	0	180
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	Methylene Chloride	5 ND	5 ND	0	1930
3/24/03	3/28/03	0303528-01	1270	3/28/03	0303528-02	1271	Toluene	5 ND	5 ND	0	190
3/25/03	3/28/03	0303528-03	1272	3/28/03	0303528-04	1273	1,1,1-Trichloroethane	5 ND	5 ND	0	590
3/25/03	3/28/03	0303528-03	1272	3/28/03	0303528-04	1273	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/25/03	3/28/03	0303528-03	1272	3/28/03	0303528-04	1273	1,1-Dichloroethene	5 ND	5 ND	0	100
3/25/03	3/28/03	0303528-	1272	3/28/03	0303528-	1273	1,2-Dichloroethane	2 ND	2 ND	0	45

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04						
3/25/03	3/28/03	0303528-03	1272	3/28/03	0303528-04	1273	Carbon Tetrachloride	2 ND	2 ND	0	165
3/25/03	3/28/03	0303528-03	1272	3/28/03	0303528-04	1273	Chlorobenzene	2 ND	2 ND	0	220
3/25/03	3/28/03	0303528-03	1272	3/28/03	0303528-04	1273	Chloroform	2 ND	2 ND	0	180
3/25/03	3/28/03	0303528-03	1272	3/28/03	0303528-04	1273	Methylene Chloride	5 ND	5 ND	0	1930
3/25/03	3/28/03	0303528-03	1272	3/28/03	0303528-04	1273	Toluene	0.55* J	5 ND	0.55	190
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	1,1,1-Trichloroethane	5 ND	5 ND	0	590
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	1,1-Dichloroethene	5 ND	5 ND	0	100
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	1,2-Dichloroethane	2 ND	2 ND	0	45
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	Carbon Tetrachloride	2 ND	2 ND	0	165
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	Chlorobenzene	2 ND	2 ND	0	220
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	Chloroform	2 ND	2 ND	0	180
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	Methylene Chloride	5 ND	5 ND	0	1930
3/31/03	4/8/03	0304101-01	1274	4/9/03	0304101-02	1275	Toluene	1.07* J	5 ND	1.07	190
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	1,1,1-Trichloroethane	5 ND	5 ND	0	590
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	1,1-Dichloroethene	5 ND	5 ND	0	100

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	1,2-Dichloroethane	2 ND	2 ND	0	45
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	Carbon Tetrachloride	2 ND	2 ND	0	165
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	Chlorobenzene	2 ND	2 ND	0	220
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	Chloroform	2 ND	2 ND	0	180
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	Methylene Chloride	5 ND	5 ND	0	1930
4/1/03	4/9/03	0304101-03	1276	4/9/03	0304101-04	1277	Toluene	5 ND	5 ND	0	190
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	1,1,1-Trichloroethane	5 ND	5 ND	0	590
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	1,1-Dichloroethene	5 ND	5 ND	0	100
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	1,2-Dichloroethane	2 ND	2 ND	0	45
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	Carbon Tetrachloride	2 ND	2 ND	0	165
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	Chlorobenzene	2 ND	2 ND	0	220
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	Chloroform	2 ND	2 ND	0	180
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	Methylene Chloride	5 ND	5 ND	0	1930
4/7/03	4/11/03	0304242-01	1278	4/11/03	0304242-02	1279	Toluene	5 ND	5 ND	0	190
4/8/03	4/11/03	0304242-03	1280	4/11/03	0304242-04	1281	1,1,1-Trichloroethane	5 ND	5 ND	0	590
4/8/03	4/11/03	0304242-03	1280	4/11/03	0304242-04	1281	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
4/8/03	4/11/03	0304242-	1280	4/11/03	0304242-	1281	1,1-Dichloroethene	5 ND	5 ND	0	100

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04						
4/8/03	4/11/03	0304242-03	1280	4/11/03	0304242-04	1281	1,2-Dichloroethane	2 ND	2 ND	0	45
4/8/03	4/11/03	0304242-03	1280	4/11/03	0304242-04	1281	Carbon Tetrachloride	2 ND	2 ND	0	165
4/8/03	4/11/03	0304242-03	1280	4/11/03	0304242-04	1281	Chlorobenzene	2 ND	2 ND	0	220
4/8/03	4/11/03	0304242-03	1280	4/11/03	0304242-04	1281	Chloroform	2 ND	2 ND	0	180
4/8/03	4/11/03	0304242-03	1280	4/11/03	0304242-04	1281	Methylene Chloride	5 ND	5 ND	0	1930
4/8/03	4/11/03	0304242-03	1280	4/11/03	0304242-04	1281	Toluene	5 ND	1.52* J	-1.52	190
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	1,1,1-Trichloroethane	5 ND	5 ND	0	590
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	1,1-Dichloroethene	5 ND	5 ND	0	100
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	1,2-Dichloroethane	2 ND	2 ND	0	45
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	Carbon Tetrachloride	2 ND	2 ND	0	165
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	Chlorobenzene	2 ND	2 ND	0	220
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	Chloroform	2 ND	2 ND	0	180
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	Methylene Chloride	5 ND	5 ND	0	1930
4/14/03	4/22/03	0304381-01	1282	4/22/03	0304381-02	1283	Toluene	5 ND	5 ND	0	190
4/15/03	4/22/03	0304381-03	1284	4/22/03	0304381-04	1285	1,1,1-Trichloroethane	5 ND	5 ND	0	590
4/15/03	4/22/03	0304381-	1284	4/22/03	0304381-	1285	1,1,2,2-	2 ND	2 ND	0	50

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		03			04		Tetrachloroethane				
4/15/03	4/22/03	0304381-03	1284	4/22/03	0304381-04	1285	1,1-Dichloroethene	5 ND	5 ND	0	100
4/15/03	4/22/03	0304381-03	1284	4/22/03	0304381-04	1285	1,2-Dichloroethane	2 ND	2 ND	0	45
4/15/03	4/22/03	0304381-03	1284	4/22/03	0304381-04	1285	Carbon Tetrachloride	2 ND	2 ND	0	165
4/15/03	4/22/03	0304381-03	1284	4/22/03	0304381-04	1285	Chlorobenzene	2 ND	2 ND	0	220
4/15/03	4/22/03	0304381-03	1284	4/22/03	0304381-04	1285	Chloroform	2 ND	2 ND	0	180
4/15/03	4/22/03	0304381-03	1284	4/22/03	0304381-04	1285	Methylene Chloride	5 ND	5 ND	0	1930
4/15/03	4/22/03	0304381-03	1284	4/22/03	0304381-04	1285	Toluene	5 ND	5 ND	0	190
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	1,1,1-Trichloroethane	5 ND	5 ND	0	590
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	1,1-Dichloroethene	5 ND	5 ND	0	100
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	1,2-Dichloroethane	2 ND	2 ND	0	45
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	Carbon Tetrachloride	2 ND	2 ND	0	165
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	Chlorobenzene	2 ND	2 ND	0	220
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	Chloroform	2 ND	2 ND	0	180
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	Methylene Chloride	0.66* J	5 ND	0.66	1930
4/21/03	4/27/03	0304515-01	1286	4/27/03	0304515-02	1287	Toluene	0.77* J	5 ND	0.77	190
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	1,1,1-Trichloroethane	5 ND	5 ND	0	590

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	1,1-Dichloroethene	5 ND	5 ND	0	100
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	1,2-Dichloroethane	2 ND	2 ND	0	45
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	Carbon Tetrachloride	2 ND	2 ND	0	165
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	Chlorobenzene	2 ND	2 ND	0	220
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	Chloroform	2 ND	2 ND	0	180
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	Methylene Chloride	5 ND	5 ND	0	1930
4/22/03	4/27/03	0304515-03	1288	4/27/03	0304515-04	1289	Toluene	5 ND	5 ND	0	190
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	1,1,1-Trichloroethane	5 ND	5 ND	0	590
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	1,1-Dichloroethene	5 ND	5 ND	0	100
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	1,2-Dichloroethane	2 ND	2 ND	0	45
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	Carbon Tetrachloride	2 ND	2 ND	0	165
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	Chlorobenzene	2 ND	2 ND	0	220
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	Chloroform	2 ND	2 ND	0	180
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	Methylene Chloride	5 ND	5 ND	0	1930
4/28/03	5/2/03	0305006-01	1290	5/2/03	0305006-02	1291	Toluene	5 ND	5 ND	0	190

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	1,1,1-Trichloroethane	5 ND	5 ND	0	590
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	1,1-Dichloroethene	5 ND	5 ND	0	100
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	1,2-Dichloroethane	2 ND	2 ND	0	45
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	Carbon Tetrachloride	2 ND	2 ND	0	165
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	Chlorobenzene	2 ND	2 ND	0	220
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	Chloroform	2 ND	2 ND	0	180
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	Methylene Chloride	5 ND	5 ND	0	1930
4/29/03	5/2/03	0305006-03	1292	5/2/03	0305006-04	1293	Toluene	5 ND	5 ND	0	190
5/5/03	5/13/03	0305139-01	1294	5/13/03	0305139-02	1295	1,1,1-Trichloroethane	5 ND	5 ND	0	590
5/5/03	5/13/03	0305139-01	1294	5/13/03	0305139-02	1295	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
5/5/03	5/13/03	0305139-01	1294	5/13/03	0305139-02	1295	1,1-Dichloroethene	5 ND	5 ND	0	100
5/5/03	5/13/03	0305139-01	1294	5/13/03	0305139-02	1295	1,2-Dichloroethane	2 ND	2 ND	0	45
5/5/03	5/13/03	0305139-01	1294	5/13/03	0305139-02	1295	Carbon Tetrachloride	2 ND	2 ND	0	165
5/5/03	5/13/03	0305139-01	1294	5/13/03	0305139-02	1295	Chlorobenzene	2 ND	2 ND	0	220
5/5/03	5/13/03	0305139-01	1294	5/13/03	0305139-02	1295	Chloroform	2 ND	2 ND	0	180
5/5/03	5/13/03	0305139-01	1294	5/13/03	0305139-02	1295	Methylene Chloride	5 ND	5 ND	0	1930
5/5/03	5/13/03	0305139-	1294	5/13/03	0305139-	1295	Toluene	5 ND	5 ND	0	190

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02						
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	1,1,1-Trichloroethane	5 ND	5 ND	0	590
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	1,1-Dichloroethene	5 ND	5 ND	0	100
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	1,2-Dichloroethane	2 ND	2 ND	0	45
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	Carbon Tetrachloride	2 ND	2 ND	0	165
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	Chlorobenzene	2 ND	2 ND	0	220
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	Chloroform	2 ND	2 ND	0	180
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	Methylene Chloride	5 ND	5 ND	0	1930
5/6/03	5/13/03	0305139-03	1296	5/13/03	0305139-04	1297	Toluene	5 ND	5 ND	0	190
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	1,1,1-Trichloroethane	5 ND	5 ND	0	590
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	1,1-Dichloroethene	5 ND	5 ND	0	100
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	1,2-Dichloroethane	2 ND	2 ND	0	45
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	Carbon Tetrachloride	2 ND	2 ND	0	165
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	Chlorobenzene	2 ND	2 ND	0	220
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	Chloroform	2 ND	2 ND	0	180
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	Methylene Chloride	5 ND	5 ND	0	1930

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
5/12/03	5/19/03	0305332-01	1298	5/19/03	0305332-02	1299	Toluene	5 ND	5 ND	0	190
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	1,1,1-Trichloroethane	5 ND	5 ND	0	590
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	1,1-Dichloroethene	5 ND	5 ND	0	100
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	1,2-Dichloroethane	2 ND	2 ND	0	45
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	Carbon Tetrachloride	2 ND	2 ND	0	165
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	Chlorobenzene	2 ND	2 ND	0	220
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	Chloroform	2 ND	2 ND	0	180
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	Methylene Chloride	5 ND	5 ND	0	1930
5/14/03	5/19/03	0305332-03	1300	5/19/03	0305332-04	1301	Toluene	0.95* J	5 ND	0.95	190
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	1,1,1-Trichloroethane	5 ND	5 ND	0	590
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	1,1-Dichloroethene	5 ND	5 ND	0	100
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	1,2-Dichloroethane	2 ND	2 ND	0	45
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	Carbon Tetrachloride	2 ND	2 ND	0	165
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	Chlorobenzene	2 ND	2 ND	0	220
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	Chloroform	2 ND	2 ND	0	180

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	Methylene Chloride	5 ND	5 ND	0	1930
5/19/03	5/24/03	0305431-01	1302	5/24/03	0305431-02	1303	Toluene	5 ND	5 ND	0	190
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	1,1,1-Trichloroethane	5 ND	5 ND	0	590
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	1,1-Dichloroethene	5 ND	5 ND	0	100
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	1,2-Dichloroethane	2 ND	2 ND	0	45
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	Carbon Tetrachloride	2 ND	2 ND	0	165
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	Chlorobenzene	2 ND	2 ND	0	220
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	Chloroform	2 ND	2 ND	0	180
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	Methylene Chloride	5 ND	5 ND	0	1930
5/20/03	5/24/03	0305431-03	1304	5/24/03	0305431-04	1305	Toluene	5 ND	5 ND	0	190
5/27/03	6/6/03	0305587-01	1306	6/6/03	0305587-02	1307	1,1,1-Trichloroethane	5 ND	5 ND	0	590
5/27/03	6/6/03	0305587-01	1306	6/6/03	0305587-02	1307	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
5/27/03	6/6/03	0305587-01	1306	6/6/03	0305587-02	1307	1,1-Dichloroethene	5 ND	5 ND	0	100
5/27/03	6/6/03	0305587-01	1306	6/6/03	0305587-02	1307	1,2-Dichloroethane	2 ND	2 ND	0	45
5/27/03	6/6/03	0305587-01	1306	6/6/03	0305587-02	1307	Carbon Tetrachloride	2 ND	2 ND	0	165
5/27/03	6/6/03	0305587-01	1306	6/6/03	0305587-02	1307	Chlorobenzene	2 ND	2 ND	0	220
5/27/03	6/6/03	0305587-	1306	6/6/03	0305587-	1307	Chloroform	2 ND	2 ND	0	180

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02						
5/27/03	6/6/03	0305587-01	1306	6/6/03	0305587-02	1307	Methylene Chloride	5 ND	5 ND	0	1930
5/27/03	6/6/03	0305587-01	1306	6/6/03	0305587-02	1307	Toluene	5 ND	5 ND	0	190
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	1,1,1-Trichloroethane	5 ND	5 ND	0	590
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	1,1-Dichloroethene	5 ND	5 ND	0	100
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	1,2-Dichloroethane	2 ND	2 ND	0	45
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	Carbon Tetrachloride	2 ND	2 ND	0	165
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	Chlorobenzene	2 ND	2 ND	0	220
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	Chloroform	2 ND	2 ND	0	180
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	Methylene Chloride	5 ND	5 ND	0	1930
5/28/03	6/6/03	0305587-03	1308	6/6/03	0305587-04	1309	Toluene	5 ND	5 ND	0	190
6/2/03	6/8/03	0306101-01	1312	6/8/03	0306101-02	1313	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/2/03	6/8/03	0306101-01	1312	6/8/03	0306101-02	1313	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/2/03	6/8/03	0306101-01	1312	6/8/03	0306101-02	1313	1,1-Dichloroethene	5 ND	5 ND	0	100
6/2/03	6/8/03	0306101-01	1312	6/8/03	0306101-02	1313	1,2-Dichloroethane	2 ND	2 ND	0	45
6/2/03	6/8/03	0306101-01	1312	6/8/03	0306101-02	1313	Carbon Tetrachloride	2 ND	2 ND	0	165
6/2/03	6/8/03	0306101-	1312	6/8/03	0306101-	1313	Chlorobenzene	2 ND	2 ND	0	220

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02						
6/2/03	6/8/03	0306101-01	1312	6/8/03	0306101-02	1313	Chloroform	2 ND	2 ND	0	180
6/2/03	6/8/03	0306101-01	1312	6/8/03	0306101-02	1313	Methylene Chloride	5 ND	5 ND	0	1930
6/2/03	6/8/03	0306101-01	1312	6/8/03	0306101-02	1313	Toluene	1.41* J	1.03* J	0.38	190
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	1,1-Dichloroethene	5 ND	5 ND	0	100
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	1,2-Dichloroethane	2 ND	2 ND	0	45
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	Carbon Tetrachloride	2 ND	2 ND	0	165
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	Chlorobenzene	2 ND	2 ND	0	220
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	Chloroform	2 ND	2 ND	0	180
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	Methylene Chloride	5 ND	5 ND	0	1930
6/3/03	6/8/03	0306101-03	1314	6/8/03	0306101-04	1315	Toluene	0.85* J	5 ND	0.85	190
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	1,1-Dichloroethene	5 ND	5 ND	0	100
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	1,2-Dichloroethane	2 ND	2 ND	0	45
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	Carbon Tetrachloride	2 ND	2 ND	0	165

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	Chlorobenzene	2 ND	2 ND	0	220
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	Chloroform	2 ND	2 ND	0	180
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	Methylene Chloride	5 ND	5 ND	0	1930
6/9/03	6/17/03	0306261-01	1316	6/17/03	0306261-02	1317	Toluene	5 ND	5 ND	0	190
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	1,1-Dichloroethene	5 ND	5 ND	0	100
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	1,2-Dichloroethane	2 ND	2 ND	0	45
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	Carbon Tetrachloride	2 ND	2 ND	0	165
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	Chlorobenzene	2 ND	2 ND	0	220
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	Chloroform	2 ND	2 ND	0	180
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	Methylene Chloride	5 ND	5 ND	0	1930
6/11/03	6/17/03	0306261-03	1318	6/17/03	0306261-04	1319	Toluene	0.80* J	1.07* J	-0.27	190
6/16/03	6/25/03	0306367-01	1320	6/25/03	0306367-02	1321	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/16/03	6/25/03	0306367-01	1320	6/25/03	0306367-02	1321	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/16/03	6/25/03	0306367-01	1320	6/25/03	0306367-02	1321	1,1-Dichloroethene	5 ND	5 ND	0	100
6/16/03	6/25/03	0306367-01	1320	6/25/03	0306367-02	1321	1,2-Dichloroethane	2 ND	2 ND	0	45
6/16/03	6/25/03	0306367-	1320	6/25/03	0306367-	1321	Carbon	2 ND	2 ND	0	165

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
		01			02		Tetrachloride				
6/16/03	6/25/03	0306367-01	1320	6/25/03	0306367-02	1321	Chlorobenzene	2 ND	2 ND	0	220
6/16/03	6/25/03	0306367-01	1320	6/25/03	0306367-02	1321	Chloroform	2 ND	2 ND	0	180
6/16/03	6/25/03	0306367-01	1320	6/25/03	0306367-02	1321	Methylene Chloride	5 ND	5 ND	0	1930
6/16/03	6/25/03	0306367-01	1320	6/25/03	0306367-02	1321	Toluene	5 ND	5 ND	0	190
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	1,1-Dichloroethene	5 ND	5 ND	0	100
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	1,2-Dichloroethane	2 ND	2 ND	0	45
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	Carbon Tetrachloride	2 ND	2 ND	0	165
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	Chlorobenzene	2 ND	2 ND	0	220
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	Chloroform	2 ND	2 ND	0	180
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	Methylene Chloride	5 ND	5 ND	0	1930
6/17/03	6/25/03	0306367-03	1322	6/25/03	0306367-04	1323	Toluene	0.70* J	5 ND	0.7	190
6/23/03	7/6/03	0306531-01	1324	7/6/03	0306531-02	1325	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/23/03	7/6/03	0306531-01	1324	7/6/03	0306531-02	1325	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/23/03	7/6/03	0306531-01	1324	7/6/03	0306531-02	1325	1,1-Dichloroethene	5 ND	5 ND	0	100
6/23/03	7/6/03	0306531-	1324	7/6/03	0306531-	1325	1,2-Dichloroethane	2 ND	2 ND	0	45

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Differenc e**	CO C
		01			02						
6/23/03	7/6/03	0306531-01	1324	7/6/03	0306531-02	1325	Carbon Tetrachloride	2 ND	2 ND	0	165
6/23/03	7/6/03	0306531-01	1324	7/6/03	0306531-02	1325	Chlorobenzene	2 ND	2 ND	0	220
6/23/03	7/6/03	0306531-01	1324	7/6/03	0306531-02	1325	Chloroform	2 ND	2 ND	0	180
6/23/03	7/6/03	0306531-01	1324	7/6/03	0306531-02	1325	Methylene Chloride	5 ND	5 ND	0	1930
6/23/03	7/6/03	0306531-01	1324	7/6/03	0306531-02	1325	Toluene	0.70* J	5 ND	0.7	190
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	1,1-Dichloroethene	5 ND	5 ND	0	100
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	1,2-Dichloroethane	2 ND	2 ND	0	45
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	Carbon Tetrachloride	2 ND	2 ND	0	165
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	Chlorobenzene	2 ND	2 ND	0	220
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	Chloroform	2 ND	2 ND	0	180
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	Methylene Chloride	5 ND	5 ND	0	1930
6/24/03	7/6/03	0306531-03	1326	7/6/03	0306531-04	1327	Toluene	5 ND	5 ND	0	190
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	1,1,1-Trichloroethane	5 ND	5 ND	0	590
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	1,1,2,2-Tetrachloroethane	2 ND	2 ND	0	50
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	1,1-Dichloroethene	5 ND	5 ND	0	100

Sample Date	B Analysis Date	B Lab ID	B Sample ID	A Analysis Date	A Lab ID	A Sample ID	Compound	A	B	Difference**	COC
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	1,2-Dichloroethane	2 ND	2 ND	0	45
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	Carbon Tetrachloride	2 ND	2 ND	0	165
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	Chlorobenzene	2 ND	2 ND	0	220
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	Chloroform	2 ND	2 ND	0	180
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	Methylene Chloride	5 ND	5 ND	0	1930
6/30/03	7/9/03	0307089-01	1328	7/9/03	0307089-02	1329	Toluene	0.97* J	5 ND	0.97	190

Flags

B = Compound present in the laboratory blank, background subtraction not performed.
NJ, J = Estimated value: Below Method Reporting Limits (MRL), but above Practical Quantitation Limits (PQL).
ND, U = Compound analyzed for, but not detected above the detection limits.
Normalized target VOC concentration.
* = Values flagged with ND are set to zero for calculating differences

3.3 Discussion of Results

For the reporting period, there were 210 samples analyzed for each of the 9 target compounds, representing a total of 1890 data points. A total of 1776, or 94 percent, of the data points were below the MDL. Three compounds were reported by the laboratory as being detected in the samples. These are listed as follows: methylene chloride on 37 occasions, toluene on 55 occasions and 1,1,1-trichloroethane on 22 occasions. Of these 114 non-zero values, all but three values were below the contract-reporting limit for the respective compound. These samples were methylene chloride on September 26, 2002 (detected at VOC-A), toluene on August 28, 2002 (detected at both sampling locations).

The toluene detections in the samples for September 28th showed a higher concentration in the background sample than in the air exhausting from Panel 1 indicating that the concentrations came from normal mine operations. Methylene chloride is also a common laboratory contaminant. Considering that possibility, the low concentration, and the low frequency, it was determined not to be a significant concern.

Methylene chloride was only detected in one of the laboratory blank analyses. There were three methylene chloride detections in the samples associated with the laboratory blank. The data was flagged with a "B", indicating that the compound was detected in the method blank.

3.4 Correlation of VOC Monitoring Results with WWIS Headspace Data

During the reporting period, TRU mixed wastes were received and disposed, however, no significant levels of VOC were measured. Therefore, it is not possible to correlate the measured VOC levels in the mine air with the measured VOC levels in the waste containers.

4.0 Implementation of Mine Ventilation Rate Monitoring Program

WIPP began monitoring the active disposal room ventilation rate when waste was actively being emplaced beginning with the first receipt of waste (March 26, 1999). On October 22, 1999, WIPP began calculating the total underground repository ventilation flow rate in the Central Monitoring Room Operator's (CMRO) Log. With the issuance of the HWFP (October 27, 1999), a draft Mine Ventilation Rate Monitoring Plan (MVRMP) was developed to provide for the collection of ventilation flow rate data to demonstrate compliance with the HWFP, Condition IV.E.3.b and Section M2-2a(3).

The draft MVRMP was submitted to the NMED on November 2, 1999. In this draft plan, WIPP proposed to monitor ventilation flow rates in the active disposal room when wastes were being actively emplaced. Comments on this draft MVRMP were received from NMED on April 17, 2000.

The WIPP revised the draft MVRMP to reflect the NMED's comments, and the plan was re-submitted to the NMED on May 18, 2000. At this time the facility switched from monitoring only when wastes were actively being emplaced, to monitoring the active disposal room at the start of each shift, any time there is an operational mode change, or if there is a change in the system's configuration whenever workers were present. If the minimum 35,000 scfm flow rate in the active disposal room could not be achieved, access to the disposal room was restricted.

On December 5, 2001, the NMED issued a second Request for Supplemental Information on the May 2000 draft MVRMP. To address the NMED comments, a second revised draft MVRMP was submitted to the NMED on February 1, 2002. This revision provided additional details concerning the content of the Test and Balance reports and this annual report; however, no changes were made to the manner in which mine ventilation rate monitoring data is collected. WIPP is currently operating to this February 1, 2002 revision.

4.1 Total Mine Ventilation Rate Monitoring in the Underground Repository

To comply with the HWFP Module IV, the running annual average mine ventilation rate is computed on a monthly basis to assure that it exceeds the minimum value of 260,000 scfm. This running annual average is calculated based on monthly averages for run-times for WIPP's various modes of operation with the calculated number entered into the Central Monitoring Room (CMRO) Log. For example, if the CMRO Log indicates that the ventilation system was configured for Alternate Mode (one - 600 hp fan) at 8:00 a.m., and that this configuration was maintained until 11:30 a.m., a total of 3.5 hours of run-time would be recorded. Run times are recorded to the nearest quarter hour. This information was recorded each time the ventilation system configuration changed; including periods when there is no ventilation. The operator used this logged runtime data for various modes of operation multiplied by the flow-rates for the different modes presented in Table 5 to calculate the average monthly and annual flow rate for the facility.

Table 5. Ventilation Operating Modes and Associated Flow Rates

Mode of Operation	Flow Rate (scfm) Nominal Values	Test and Balance Summary (Oct. '02)
Normal (two 600 hp. fans)	425,000	±4.2%
Alternate (one 600 hp. fan)	260,000	±4.8%
Maintenance Bypass [parallel operation of 600 hp fan(s) and 235 hp. Fan(s)]	260,000 to 425,000	NA*
Reduced (two 235 hp. fans)	120,000	NA*
Minimum (one 235 hp. fan)	60,000	NA*
Filtration (one 235 hp. fan)	60,000	±5.0%

The modes of operations were not included in the October 2002 Test and Balance.

The calculation of the running average annual total mine flow rate was computed monthly using the times entered in the CMRO Log in accordance with the following formula:

Monthly Average Flow Rate = {(Normal Mode Run-time (hrs.) x 425,000 scfm] + [Alternate Mode Run-time (hrs.) x 260,000 scfm] + [Maintenance Bypass Run-time (hrs.) x 260,000 scfm minimum] + [(Reduced Mode Run-time (hrs.) x 120,000 scfm] + [Minimum Mode Run Time (hrs.) x 60,000 scfm] + [Filtration Mode Run-time (hrs.) x 60,000 scfm)}/ 730 Hours per month.

The annual average flow rate was calculated using the times entered in the CMRO Log by the following formula:

$$\text{Annual Average Flow Rate} = \frac{\sum \text{Monthly Average for Previous 12 Months}}{12}$$

4.2 Ventilation Rate Monitoring in the Active Disposal Room

The ventilation flow rate in the active waste disposal room was measured at the entrance to the room to demonstrate compliance with the HWFP, Condition IV.E.3.b and Section M2-2a(3), which requires a minimum of 35,000 scfm of air flow through the active waste room when workers are present. The HWFP, Condition IV.F.3.c, requires compliance to be assessed on a monthly basis for the active disposal room.

A calibrated Davis ball-bearing anemometer and full entry traverse as described in McPherson (1993) is the standard method for measurement of airflow in the active waste disposal room. Airflow measurements were collected at an established location near the entrance of each active disposal room chosen by the operator to minimize airflow disturbances caused by system intersections and corners in accordance with McPherson (1993). The operator used a calibrated anemometer and the completion of a full entry traverse. The anemometer is certified in accordance with the National Institute of Standards and Testing (NIST). These readings verified that a minimum of 35,000 scfm ventilation flow through the active disposal room was achieved. Multiple measurements were taken at each field location to ensure accurate results and correlated within 10 percent to be acceptable. Data were collected and recorded by qualified operators and the data were verified. The facility operator verified proper ventilation at the start of each shift, any time there is an operational mode change, or if there is a change in the system's configuration that could affect the ventilation system. A momentary reduction in

underground ventilation caused by the realignment or switching underground ventilation fans is not an operational mode change and does not require verification of air flow in the active disposal room.

Once the ventilation was verified, the operator records the acfm value on the log sheet. The operator compared the recorded acfm value with the minimum acfm value provided at the top of the Active Disposal Room Ventilation Rate Log Sheet. The actual airflow must be at least 42,000 acfm to meet the 35,000 scfm minimum requirement. The operator checked and recorded the airflow through the active room during the shift whenever there is an operational mode change, or a change in system configuration that could affect the ventilation system. If the required ventilation rate was not achieved, or could not be supported due to operational needs, access to the room would be restricted.

4.3 Test and Balance

The Test and Balance is a comprehensive series of measurements and adjustments designed to ensure that the system is operating within acceptable design parameters. The Test and Balance is an appropriate method of verifying system flow because it provides consistent results based on good engineering practices. The Test and Balance is conducted on 12 to 18-month intervals.

Once completed, the Test and Balance data are the baseline for underground ventilation system operations until the next Test and Balance is performed. Test and Balance results were used to accommodate varying operational conditions and to provide adequate airflow in the mine.

The Test and Balance interval is sufficient to account for changes in the mine and verify system performance. Minor system modifications that occur between tests produce small changes to the system resistance in comparison to the overall system resistance. Historic data reflects changes to be attributed to additional or reduced linear feet of mined passage such as mining new entries or closure of formerly ventilated portions of the mine, or reduction in drift size due to salt creep.

During this report period, a Test and Balance of the mine ventilation system was performed in October, 2002. As required by the draft MVRMP, Section Q-4b, the Test and Balance is conducted every 12 to 18 months. The next Test and Balance is scheduled for March 2004.

4.4 Quarterly Airflow Verification Checks

Quarterly verification checks of the total mine airflow were performed in accordance with the inspection requirements identified in the HWFP (Attachment D), procedure IC041098 (*U/G Exhaust Mass Flow Measurement System*), and IC413000 (*Station B Mass Flow Measurement System*). These checks require the measurement of airflow across each of the fans during various modes of operation using three distinct air flow measurement devices (i.e., pitot traverses, central monitoring system, Kurz/Flowsonic). Air flow measurements for each device are averaged and then compared to the average for the other devices. If the relative percent difference was greater than plus or minus five percent (ten percent for Station B mass flow measurement system), then a full dynamic calibration was performed. These checks were used to verify that ventilation rates for various operation modes (Table 5) are being met. In addition, these checks documented that ventilation rates established by the Test and Balance for various operation modes were accurate.

The equipment used to perform the quarterly airflow verification checks was controlled and calibrated through the WIPP Metrology Program. The WIPP Metrology Program ensures that Maintenance and Test Equipment utilized in the performance of maintenance activities meets the WIPP Quality Assurance Program Description requirements and is traceable to National Institute of Standards and Technology standards. The frequency and method of calibration are governed by the WIPP Metrology Program utilizing the manufacturer's recommendations and the equipment's reliability.

5.0 Mine Ventilation Rate Monitoring Results

This section presents the results of implementing the mine ventilation rate monitoring program. This report covers data generated from July 1, 2002, through June 30, 2003. The data presented in this section was collected in accordance with the latest revision of the draft MVRMP submitted to the NMED on February 1, 2002, in response to the second request for supplemental information dated December 5, 2001.

5.1 Total Mine Ventilation Rate

A summary of the monthly Total Mine Ventilation Rate Flow Rate is provided in Table 6. This table shows that the total mine ventilation flow rate running annual average was 387,502 scfm, for the reporting period. In addition, it shows that the lowest average monthly ventilation rate in the underground repository occurred in May 2003, when the average flow rate was 374,400 scfm. This average was above the 260,000 scfm average required in HWFP, Condition IV.F.3.c.

The data sheets showing the calculation of the mine ventilation rate monitoring data monthly averages are presented in Attachment 1.

Table 6. Summary of Total Mine and Active Disposal Room Ventilation Flow Rate Monitoring Data

	Total Mine Ventilation Flow (avg scfm)	Running Annual Average Total Mine Ventilation Flow (avg scfm)*	Active Disposal Room Ventilation Flow (avg acfm)	Running Annual Active Disposal Room Annual Average (acfm)
Jul 02	378,720	380,215	66,114	64,541
Aug 02	398,330	383,010	64,248	64,344
Sep 02	386,110	384,213	61,277	62,734
Oct 02	389,660	389,208	78,395	63,722
Nov 02	386,590	388,462	76,249	64,878
Dec 02	401,920	389,290	64,307	65,096
Jan 03	395,420	390,226	78,101	66,307
Feb 03	391,200	389.012	70,285	67,146
Mar 03	374,630	387,014	69,641	67,656
Apr 03	392,230	387,551	57,893	67,404
May 03	374,400	386,739	54,931	66,891
Jun 03	380,820	387,502	55,298	66,395

*Note: Running Annual Average is calculated based on the twelve previous months and includes data not presented in this table.

5.2 Active Disposal Room Ventilation Rate

Monitoring was performed at the start of each shift, any time there was an operational mode change, or if there was a change in the system's configuration whenever workers were present. If the minimum 35,000 scfm flow rate in the active disposal room could not be achieved; access to the disposal room was restricted. Access to the active disposal room was restricted several times due to operational needs for ventilation elsewhere in the underground repository.

Table 6 shows that the average of the monthly active disposal room ventilation flow rate was 66,395 acfm for the reporting period. In addition, it shows that the lowest monthly ventilation rate in the active disposal room occurred in May, 2003, when the monthly flow rate was 54,931 acfm.

5.3 Test and Balance

During this report period, a Test and Balance of the mine ventilation system was performed. As required by the draft MVRMP, Section Q-4b, the Test and Balance is conducted every 12 to 18 months. The last Test and Balance was performed in October, 2002 and the next is currently scheduled to occur no later than March, 2004. The October 2002 Test and Balance Report is included as Attachment 2.

5.4 Quarterly Airflow Verification Checks

Maintenance Operations performs a quarterly airflow verification check of the total mine airflow to document that the ventilation rates established by the Test and Balance for the various operation modes are accurate. The quarterly airflow verification checks performed during the reporting period indicated that the mine ventilation system was operating within acceptable parameters for each operation mode. The data sheets showing the as left condition quarterly verification checks are presented in Attachment 3. Due to the frequency of the Kurz flow measurement devices being out of tolerance during the quarterly airflow verifications, options are being reviewed for replacement, such as FloSonic flow measurement devices. The change out to FloSonic is not yet complete.

6.0 Quality Assurance Results

This section describes the QA program and presents the results of the assessments of background contamination, accuracy, and precision.

6.1 Description of Mine Ventilation Rate Monitoring QA Program

Quality assurance associated with the draft MVRMP consists of several elements. The qualifications of personnel conducting ventilation flow measurements are maintained through a prescribed training qualification process. The software used to calculate the monthly and annual running averages and the ventilation simulation software programs are controlled in accordance with the WIPP Quality Assurance Program Description (QAPD) and WIPP computer software quality assurance plans.

Data generated by the draft MVRMP, as well as records, and procedures to support the draft MVRMP are maintained and managed in accordance with the WIPP QAPD. Nonconformance or conditions adverse to quality as identified will be addressed and corrected as necessary in accordance with applicable WIPP QA procedures.

Instrumentation used to implement the draft MVRMP is of known precision and accuracy. This information is recorded in the instrumentation calibration documentation.

6.2 Description of VOC Monitoring QA Program

A comprehensive quality assurance program is an integral part of the VOC monitoring effort. A number of quality control (QC) checks are routinely performed including analysis of method blanks samples, duplicate samples, and laboratory control samples. Given that the regular samples contained little or no VOCs, the key QC checks during the reporting period were the laboratory control samples (LCS) and LCS duplicates (LCSD), and the laboratory surrogate analyses. These QC checks indicate that the laboratory was performing within specifications and was capable of detecting and quantifying the target analytes, had they been present in the regular samples.

Other QC checks, such as precision checks based on the analysis of duplicate samples, did not provide meaningful results given the lack of target analytes present in the samples. The QC checks indicate that the data set meets the program objectives and the data are accurate and defensible. QC data are contained in the VOC results database maintained by WIPP. The database and all supporting information in the project files are available for inspection or audit at any time.

6.2.1 Background Contamination Assessment

A total of 66 blank samples were analyzed during the reporting period. One of the blanks resulted in the detection of methylene chloride at a very low concentration (0.62 ppbv). Samples from 12-2-02 and 12-3-02 that were associated with this blank were flagged to indicate the presence of this compound. The results are summarized in Table 7.

6.2.2 Accuracy Assessment

A laboratory control sample containing all nine target compounds was analyzed for each batch of regular samples. The percent recovery was within the quality assurance objective of 60 to

140 percent.

Table 7. Summary of Method Blank Results

Compound	No. of Samples	Blanks ≥ MDL	Minimum Value (ppbv)	Maximum Value (ppbv)
1,1-Dichloroethene	61	0	ND	ND
Methylene Chloride	61	1	0.62	0.62
Chloroform	61	0	ND	ND
1,1,1-Trichloroethane	61	0	ND	ND
Carbon Tetrachloride	61	0	ND	ND
1,2-Dichloroethane	61	0	ND	ND
Toluene	61	0	ND	ND
Chlorobenzene	61	0	ND	ND
1,1,2,2-Tetrachloroethane	61	0	ND	ND

ND = Non-detect

In addition to the LCS, accuracy was checked by the analysis of three surrogate compounds added to each regular sample, blank, LCS, and LCSD. The three surrogates used were 4-bromofluorobenezene, toluene-d_8, and 1,2-dichloroethane-d_4. The surrogate percent recoveries for all samples were well within the quality assurance objective of 60 to 140 percent.

6.2.3 Precision Assessment

Three checks of precision were performed, LSC/LSC duplicates, field duplicates, and sample duplicates.

<u>LCS/LCS Duplicates:</u> The analysis of LCS and LCSD samples, one per analytical batch, provided the best assessment of precision for this data set. The Relative Percent Difference (RPD) for every compound in every sample was within the acceptable limits (60 to 140 percent).

<u>Field Duplicates:</u> Field precision was assessed by collecting duplicate samples once every twenty regular samples. The quality assurance objective is a RPD of ±35 percent for each target compound. The analysis of these samples provided limited information about sample precision because the vast majority of values for all nine target compounds were below the MDL and the few remaining values were "J" flagged. Two instances occurred where the RPD was 200 percent. The duplicate samples resulted in a concentration that was just above the MDL. The parent samples resulted in a non-detect. It is possible that the amount in the duplicate would have resulted in a RPD within the limits if it were quantitated below the reporting limit.

<u>Sample Duplicates:</u> Laboratory precision was assessed from the duplicate analysis of one sample per analytical batch. The data quality objective is an RPD of ±25 percent for each target compound. The analysis of these samples provided limited information about sample precision because the vast majority of values for all nine target compounds were below the MDL and the few remaining values were "J" flagged. Three instances occurred where the RPD was 200 percent. In these cases the parent samples resulted in concentrations that were just above or quantitated below the MDL. The duplicates resulted in non-detects. It is possible that the amount in the duplicate would have resulted in a RPD within the limits if it were quantitated below the MDL. One instance occurred when methylene chloride had an RPD of 31.17. Both

concentrations were just above the MDL and well below the MRL. The margin of difference is hard to evaluate since the concentrations are so low. Considering that only four compounds out of 432 resulted in RPD exceedances and each of the four were at very low concentrations, it was determined that this had no effect on data quality.

7.0 Summary

A large set of data was collected through the VOC monitoring program during the reporting period. The measured VOC concentrations at each station and the differences between the two sampling stations were very small relative to the COCs. The VOC measurements indicate that the panel contributed little or no VOCs to the mine air downwind of the panel. Therefore, there were no significant releases of VOCs from the waste in Panel 1 or Panel 2 and the measured VOC concentrations downstream of the panel were comparable to the upstream values. The following is a summary of the program for this reporting period:

- All permit requirements have been met;
- Data quality is acceptable;
- No exceedances of COCs were measured; and
- Reporting/notification requirements were not triggered.

In addition to the VOC monitoring program, the WIPP conducts regular mine ventilation rate monitoring of the underground repository and active disposal room. The following is a summary of the program for this reporting period:

- All permit requirements have been met;
- Data quality is acceptable;
- Ventilation through the mine was maintained above permit stipulated levels; and
- Reporting/notification requirements were not triggered.

8.0 Report of Other Noncompliance

This section is intended to comply with Permit Condition I.E.14 that addresses the reporting of other instances of noncompliance not otherwise required to be reported pursuant to Permit Conditions I.E.10 through I.E.13. Permit Condition I.E.14 requires that this information be reported to the NMED Secretary with the submittal of monitoring reports. During the period since the previous report (October 27, 2002), there were three cases of noncompliance identified for reporting under Permit Condition I.E.14.

The first case resulted when a Union dispute over notification of overtime and waste shipments arrived for processing for disposal. Operations requested help from former Waste Handlers who were believed to be current on their training requirements. Several persons volunteered. One individual volunteered to work under the belief that he was still qualified as a Waste Handler as of 7-28-02. The Training Department and Waste Operations later checked the qualification of the employee and found that he had lapsed his Waste Handling requirements. Waste Operations Department issued a corrective action that there would be no personnel utilized from outside the Operations Department in the future as a result of the difficulty in verifying training requirements within a timely fashion. This noncompliance has not occurred again.

The second noncompliance was discovered and reported on 12-31-02 by the Transportation Group (Shipping Coordination). Transportation notified Site Environmental Compliance that a couple of manifests received on 11-23-02 had not been returned to the generator site within the 30 day requirement period as specified in Permit Condition II.J referencing 20.4.1.500 NMAC and incorporating 40 CFR 264.71(a)(4). A corrective action report was generated and no more occurrences have been reported to date.

The third noncompliance occurred when WTS announced a change in the President of the Corporation from Mr. John Lee to Dr. Steven D. Warren on 1-9-03 pending CBFO approval. CBFO subsequently approved this change on 1-14-03. The review and submittal process for this change took longer than anticipated and the Class 1 Permit Modification was submitted on 1-21-03.

9.0 References

New Mexico Environment Department, October 27, 1999, *Waste Isolation Pilot Plant Hazardous Waste Facility Permit*, Identification No. NM4890139088-TSDF.

McPherson, Malcolm J., 1993, *Subsurface Ventilation and Environmental Engineering*, Chapman & Hall, London, First Edition.

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U.S. Environmental Protection Agency. 1994. *Draft Contract Laboratory Program Statement of Work, Volatile Organics Analysis of Ambient Air in Canisters*, EPA 540/R-94-085, December 1994, Washington, D.C.

Attachment 1

Monthly Summary of Mine Ventilation Rate Monitoring Data

WIPP MINE V‾ ΓILATION RATE MONITORING PLAN

SURFACE

CALENDAR MONTH - JULY, 2001

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	38017	633.62	425	269287.08
ALTERNATE VENTILATION (1-700 FAN)	336	5.60	260	1456.00
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	900	15.00	260	3900.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	3096	51.60	260	13416.00
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	1065	17.75	260	4615.00
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	0	0.00	120	0.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	0	0.00	60	0.00
FILTRATION 1-860 FAN thru HEPA)	1095	18.25	60	1095.00
NO VENTILATION	131	2.18	0	0.00
TOTAL		744.00		
SUM OF FLOW(kscfm-hr)				293769.08
MONTHLY AVERAGE FLOW RATE(kscfm)				**394.85**

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35Kscfm = 42Kacfm	**46.408**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		14.00

WIPP MINE V TILATION
RATE MONITORING PLAN

SURFACE

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	34421	573.68	425	243815.42
ALTERNATE VENTILATION (1-700 FAN)	966	16.10	260	4186.00
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	0	0.00	260	0.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	2317	38.62	260	10040.33
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	2126	35.43	260	9212.67
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	0	0.00	120	0.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	0	0.00	60	0.00
FILTRATION 1-860 FAN thru HEPA)	4147	69.12	60	4147.00
NO VENTILATION	663	11.05	0	0.00
TOTAL		744.00		
SUM OF FLOW(kscfm-hr)				271401.42
MONTHLY AVERAGE FLOW RATE(kscfm)				364.79

CALENDAR MONTH - AUGUST, 2001

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	66.613
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		23.00

WIPP MINE V TILATION
RATE MONITORING PLAN

SURFACE

CALENDAR MONTH - SEPTEMBER, 200

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	33960	566.00	425	240550.00
ALTERNATE VENTILATION (1-700 FAN)	852	14.20	260	3692.00
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	0	0.00	260	0.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	2264	37.73	260	9810.67
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	2273	37.88	260	9849.67
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	2	0.03	120	4.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	1	0.02	60	1.00
FILTRATION 1-860 FAN thru HEPA)	3693	61.55	60	3693.00
NO VENTILATION	155	2.58	0	0.00
TOTAL		720.00		
SUM OF FLOW(kscfm-hr)				267600.33
MONTHLY AVERAGE FLOW RATE(kscfm)				**371.67**

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**80.595**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		7.00

WIPP MINE V TILATION RATE MONITORING PLAN

SURFACE

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	29951	499.18	425	212152.92
ALTERNATE VENTILATION (1-700 FAN)	385	6.42	260	1668.33
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	737	12.28	260	3193.67
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	1040	17.33	260	4506.67
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	2587	43.12	260	11210.33
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	1137	18.95	260	4927.00
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	193	3.22	120	386.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	3	0.05	60	3.00
FILTRATION 1-860 FAN thru HEPA)	7262	121.03	60	7262.00
NO VENTILATION	1345	22.42	0	0.00
TOTAL		744.00		
SUM OF FLOW(kscfm-hr)				245309.92
MONTHLY AVERAGE FLOW RATE(kscfm)				**329.72**

CALENDAR MONTH - OCTOBER, 2001

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**66.534**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		9.00

WIPP MINE ᐟ TILATION
RATE MONITORING PLAN

SURFACE

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	37555	625.92	425	266014.58
ALTERNATE VENTILATION (1-700 FAN)	21	0.35	260	91.00
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	0	0.00	260	0.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	1581	26.35	260	6851.00
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	2388	39.80	260	10348.00
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	0	0.00	120	0.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	434	7.23	60	434.00
FILTRATION 1-860 FAN thru HEPA)	1048	17.47	60	1048.00
NO VENTILATION	173	2.88	0	0.00
TOTAL		720.00		
SUM OF FLOW(kscfm-hr)				284786.58
MONTHLY AVERAGE FLOW RATE(kscfm)				**395.54**

CALENDAR MONTH - NOVEMBER, 2001

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**62.377**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		14.00

WIPP MINE VENTILATION RATE MONITORING PLAN

SURFACE

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	35754	595.90	425	253257.50
ALTERNATE VENTILATION (1-700 FAN)	1678	27.97	260	7271.33
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	402	6.70	260	1742.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	4206	70.10	260	18226.00
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	2571	42.85	260	11141.00
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	0	0.00	120	0.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	0	0.00	60	0.00
FILTRATION 1-860 FAN thru HEPA)	0	0.00	60	0.00
NO VENTILATION	29	0.48	0	0.00
TOTAL		744.00		
SUM OF FLOW(kscfm-hr)				291637.83
MONTHLY AVERAGE FLOW RATE(kscfm)				**391.99**

CALENDAR MONTH - DECEMBER, 2001

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**61.693**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		16.00

WIPP MINE [illegible] TILATION
RATE MONITORING PLAN

SURFACE

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	34372	572.87	425	243468.33
ALTERNATE VENTILATION (1-700 FAN)	3598	59.97	260	15591.33
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	0	0.00	260	0.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	5013	83.55	260	21723.00
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	965	16.08	260	4181.67
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	298	4.97	120	596.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	0	0.00	60	0.00
FILTRATION 1-860 FAN thru HEPA)	277	4.62	60	277.00
NO VENTILATION	117	1.95	0	0.00
TOTAL		744.00		
SUM OF FLOW(kscfm-hr)				285837.33
MONTHLY AVERAGE FLOW RATE(kscfm)				**384.19**

CALENDAR MONTH - JANUARY, 2002

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**63.570**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		20.00

WIPP MINE ̃ TILATION RATE MONITORING PLAN

SURFACE

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	35810	596.83	425	253654.17
ALTERNATE VENTILATION (1-700 FAN)	136	2.27	260	589.33
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	0	0.00	260	0.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	2953	49.22	260	12796.33
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	1285	21.42	260	5568.33
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	0	0.00	120	0.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	59	0.98	60	59.00
FILTRATION 1-860 FAN thru HEPA)	11	0.18	60	11.00
NO VENTILATION	66	1.10	0	0.00
TOTAL		672.00		
SUM OF FLOW(kscfm-hr)				272678.17
MONTHLY AVERAGE FLOW RATE(kscfm)				**405.77**

CALENDAR MONTH - FEBRUARY, 2002

COMMENTS:

ROOM 4 WAS CLOSED AT 1430 ON 26 FEBRUARY 2002. BEGINNING AT 0740 ON 27 FEBRUARY, ROOM 3 WAS USED FOR WASTE EMPLACEMENT.

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**60.217**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		17.00

WIPP MINE [illegible] TILATION RATE MONITORING PLAN

SURFACE

CALENDAR MONTH - MARCH, 2002

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	37620	627.00	425	266475.00
ALTERNATE VENTILATION (1-700 FAN)	269	4.48	260	1165.67
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	0	0.00	260	0.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	4974	82.90	260	21554.00
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	1690	28.17	260	7323.33
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	0	0.00	120	0.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	0	0.00	60	0.00
FILTRATION 1-860 FAN thru HEPA)	43	0.72	60	43.00
NO VENTILATION	44	0.73	0	0.00
TOTAL		744.00		
SUM OF FLOW(kscfm-hr)				296561.00
MONTHLY AVERAGE FLOW RATE(kscfm)				**398.60**

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**63.517**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		35.00

WIPP MINE V[illegible]TILATION RATE MONITORING PLAN

SURFACE

CALENDAR MONTH - APRIL, 2002

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	34028	567.13	425	241031.67
ALTERNATE VENTILATION (1-700 FAN)	596	9.93	260	2582.67
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	55	0.92	260	238.33
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	5912	98.53	260	25618.67
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	1802	30.03	260	7808.67
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	0	0.00	120	0.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	0	0.00	60	0.00
FILTRATION 1-860 FAN thru HEPA)	491	8.18	60	491.00
NO VENTILATION	316	5.27	0	0.00
TOTAL		720.00		
SUM OF FLOW(kscfm-hr)				277771.00
MONTHLY AVERAGE FLOW RATE(kscfm)				**385.79**

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**60.917**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		33

WIPP MINE V[illegible]TILATION
RATE MONITORING PLAN

SURFACE

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	37154	619.23	425	263174.17
ALTERNATE VENTILATION (1-700 FAN)	25	0.42	260	108.33
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	0	0.00	260	0.00
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	4241	70.68	260	18377.67
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	0	0.00	260	0.00
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	1739	28.98	120	3478.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	0	0.00	60	0.00
FILTRATION 1-860 FAN thru HEPA)	665	11.08	60	665.00
NO VENTILATION	816	13.60	0	0.00
TOTAL		744.00		
SUM OF FLOW(kscfm-hr)				285803.17
MONTHLY AVERAGE FLOW RATE(kscfm)				**384.14**

CALENDAR MONTH - MAY, 2002

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**61.094**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		31.00

WIPP MINE VE[illegible]TILATION RATE MONITORING PLAN

SURFACE

CALENDAR MONTH - JUNE, 2002

MODE OF OPERATION	RUNTIME (min)	RUNTIME (hours)	FLOW RATE (kscfm)	TOTAL FLOW (kscfmhr)
NORMAL VENTILATION (2-700 FANS)	32052	534.20	425	227035.00
ALTERNATE VENTILATION (1-700 FAN)	353	5.88	260	1529.67
MAINTENANCE BYPASS (1-700 FAN w/ 1-860 FAN)	70	1.17	260	303.33
MAINTENANCE BYPASS (1-700 FAN w/ 2 860-FANS)	0	0.00	260	0.00
MAINTENANCE BYPASS (2-700 FANS w/ 1-860 FAN)	5106	85.10	260	22126.00
MAINTENANCE BYPASS (2-700 FANS w/ 2-860 FANS)	3299	54.98	260	14295.67
REDUCED VENTILATION (0-700 FANS w/ 2-860 FANS)	0	0.00	120	0.00
MINIMUM VENTILATION (0-700 FANS w/ 1-860 FAN)	77	1.28	60	77.00
FILTRATION 1-860 FAN thru HEPA)	2229	37.15	60	2229.00
NO VENTILATION	14	0.23	0	0.00
TOTAL		720.00		
SUM OF FLOW(kscfm-hr)				267595.67
MONTHLY AVERAGE FLOW RATE(kscfm)				371.66

COMMENTS: NONE

ACTIVE ROOM

MONTHLY AVERAGE FLOW (kacfm)	MINIMUM = 35K scfm = 42K acfm	**61.248**
NUMBER OF DATA POINTS USED IN CALCULATION OF AVERAGE		33.00

Attachment 2

Quarterly Airflow Verification Check
"As Left" Data Sheets

Attachment 2

Mine Test and Balance Report

FINAL

DN-1770-03

2002 TESTING AND BALANCING OF THE UNDERGROUND VENTILATION SYSTEM AT THE WIPP FACILITY

Prepared For:

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December 2002

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1. SUMMARY

In October 2002 Mine Ventilation Services, Inc. (MVS), under contract to Westinghouse TRU Solutions, LLC (Westinghouse) performed a study to test and balance the ventilation system at the Waste Isolation Pilot Plant (WIPP). The study consisted of a ventilation survey of the underground facility, with the assistance of Westinghouse personnel, and the development of correlated network models of the ventilation system. Underground field measurements included velocity (for the determination of airflow), differential pressure, and psychrometric properties of the air.

Various operating modes were tested, including Normal (two fan), Alternate (one fan), Filtration, Maintenance, Minimum, Reduced and Reversal modes. The airflow system was balanced to the nominal design flows and directions as shown on Figures 2 through 4. In addition to balancing the ventilation system, regulator resistance curves were determined for the four main regulator locations in the underground as well as the regulators in BH 435, Room 7 in Panel 2, and the AIT Louvers in Building 465. A regulator resistance curve shows the resistance to airflow plotted against the percent that the regulator is open (0-100%). The resistance to airflow was determined by measuring the airflow and differential pressure across each regulator while varying the percentage that the regulator louvers were open. Fan performance curves were taken from the results of a fan testing study at the WIPP facility in August of 2001.

During the ventilation survey the following observations were noted:

- Room 1 in Panel 1 airflow was controlled by a temporary brattice.
- Airflow and differential pressure sensors were verified during the ventilation testing and balancing.
- The mining return regulator in BH435 was not automatically controlled at the time of the survey. This regulator had been recently installed and the final electrical connections had not been finalized at this time. This regulator was controlled manually during the test and balance.
- During the survey, the power was disconnected from the psychrometric station, differential pressure sensor and airflow sensor at the base of the AIS. Psychrometric measurements were performed with hand-held instruments at this location, as well as the base of the SHS.

- The 700 Shop (between E-140 and E-300) is to have an auxiliary ventilation system, hence, the regulators at the back of the shop were closed to simulate this system.
- All modeling was performed using the most current release of the WIPPVENT software (Version 1.0.2).

The results of the ventilation study showed that each mode of operation was successfully tested and balanced and that accurate ventilation models were established for Normal, Alternate and Filtration modes. Regulator resistance curves were developed for the mining (BH 302), waste disposal (BH 313), waste shaft station (BH 308) and north shop (BH 521). Regulator curves were also established for BH 435, the sliding regulator at the end of Room7 in Panel 2, and the AIT louvers in Building 465. The calibration status of the airflow and pressure sensors underground was also verified.

2. INTRODUCTION

This report describes the tests performed and results obtained from an underground ventilation study conducted at the U.S. Department of Energy's (DOE) Waste Isolation Pilot Plant (WIPP). The fieldwork was carried out during the period of October 7th through October 11th, 2002. During the testing and balancing procedure airflows and strategic differential pressures were measured in all major air splits needed to define each of the underground ventilation configurations.

2.1 Description of the Ventilation System

Ventilation of the underground facility at WIPP is accomplished with four main ventilation splits; the north area, the mining area, the waste storage area, and the waste shaft station. In order to minimize occupational exposure of underground personnel to radiation and radioactive materials, the facility is designed and constructed based on the "As Low As Reasonably Achievable" (ALARA) concept. This concept resulted in a design where the nuclear waste transportation and storage areas are separated from the mining and non-radioactive experimental areas. The ventilation system is also designed such that air leakage is from the mining and north areas into the waste storage areas. Furthermore, radiation detectors are strategically located in the underground, and a contingent exhaust filtration system is installed on surface to minimize the effects of an unlikely release of radioactive material to the environment.

The underground facility is accessed and ventilated through four vertical shafts, three of which supply intake air, with the fourth acting as a common exhaust. For reference, Figure 1 is a drawing of the underground infrastructure at the time of the ventilation testing and balancing. This figure identifies doors, regulators, and bulkheads in the underground that affect the ventilation system. Ventilation of the facility is provided by running either one or two of the three 600 hp centrifugal main fans (700 A, 700 B, and 700 C). During concurrent mining and waste handling operations, two of the main fans operate in parallel (normal ventilation mode) to provide a minimum of 425,000 scfm (standard cubic feet of air per minute at a density of 0.075 lbs/ft^3). When either mining or waste emplacement is not taking place, the ventilation demand may be decreased with one 600 hp fan operating (alternate ventilation mode) resulting in a design airflow of 260,000 scfm. In the unlikely event of an underground radioactive material release, the ventilation system is shifted to filtration mode. In filtration mode, the airflow is reduced to a minimum of 60,000 scfm. This is achieved by de-energizing any 600 hp fan(s) in operation and starting one of three 235 hp centrifugal filtration fans (860A, 860B, or 860C). Isolation dampers open and close to divert the air through the High Efficiency Particulate Air (HEPA) filters.

For the normal mode configuration the nominal design airflows are shown on Figure 2. The alternate mode nominal design airflows are shown on Figure 3. Filtration mode nominal design air flows are shown on Figure 4. Figure 5 shows the surface fan configuration.

2.2 Objective

The objective of this report is to provide a synopsis of the field measurements conducted and to present the results of testing and balancing activities for normal mode (two 600 hp fans in operation), alternate mode (single 600 hp fan operation), and filtration mode (one 285 hp fan). Also presented are the results of the resistance tests for each main regulator, the verification of airflow and differential pressure sensors, and a compilation of characteristic fan curves for the 700 A, 700 B and 700 C fans.

2.3 Scope of Study

The scope of this study is as follows:

- Conduct a complete pressure/volume survey of the underground ventilation system with two main fans operating (700 B and C). Calculate airflow resistances for all underground airways. Establish a correlated computer model for this configuration.
- Test and balance the ventilation system under Normal, Alternate, Filtration, Maintenance, Minimum, Reduced and Reversal mode configurations. Establish correlated computer models for Normal, Alternate ~~and Filtration~~ Modes. Identify required regulator settings and system configurations for each mode.
- Verify airflow and differential pressure sensors throughout the underground and check their calibration documentation.
- Evaluate all main regulators throughout the facility and develop individual regulator resistance tables and curves.

Procedures

The procedures and quality assurance requirements for the field measurements and data reduction are described in detail in the MVS documents; "Field Operating Procedures (FOP)" (Rev. 3 dated January 2002), "Project Quality Assurance Plan (PQAP) For Providing Technical Services Related to the Underground Ventilation System at the Waste Isolation Pilot Plant (WIPP) Project" (Rev. 4 dated January 2002), and in the "Mine Ventilation Services, Inc., Quality Assurance Manual" (Rev. 4 dated January 2002). The measurements consisted of determining airflow rates, differential pressures, and psychrometric properties of the air at strategic locations in the facility during each of the prescribed tests.

The FOP describes the measurement devices, calibration requirements, measurement techniques, data assimilation and reduction and quality assurance checks for each type of measurement. For Normal, Alternate and Filtration modes, a computer ventilation model was established. Each model was compared to the field measurements and correlation exercises were conducted. The psychrometric data required to quantify the Natural Ventilation Pressures (NVP), which include the barometric pressure, relative humidity, and dry bulb temperature, were recorded by the mine weather stations. Each ventilation model includes calculated NVP's.

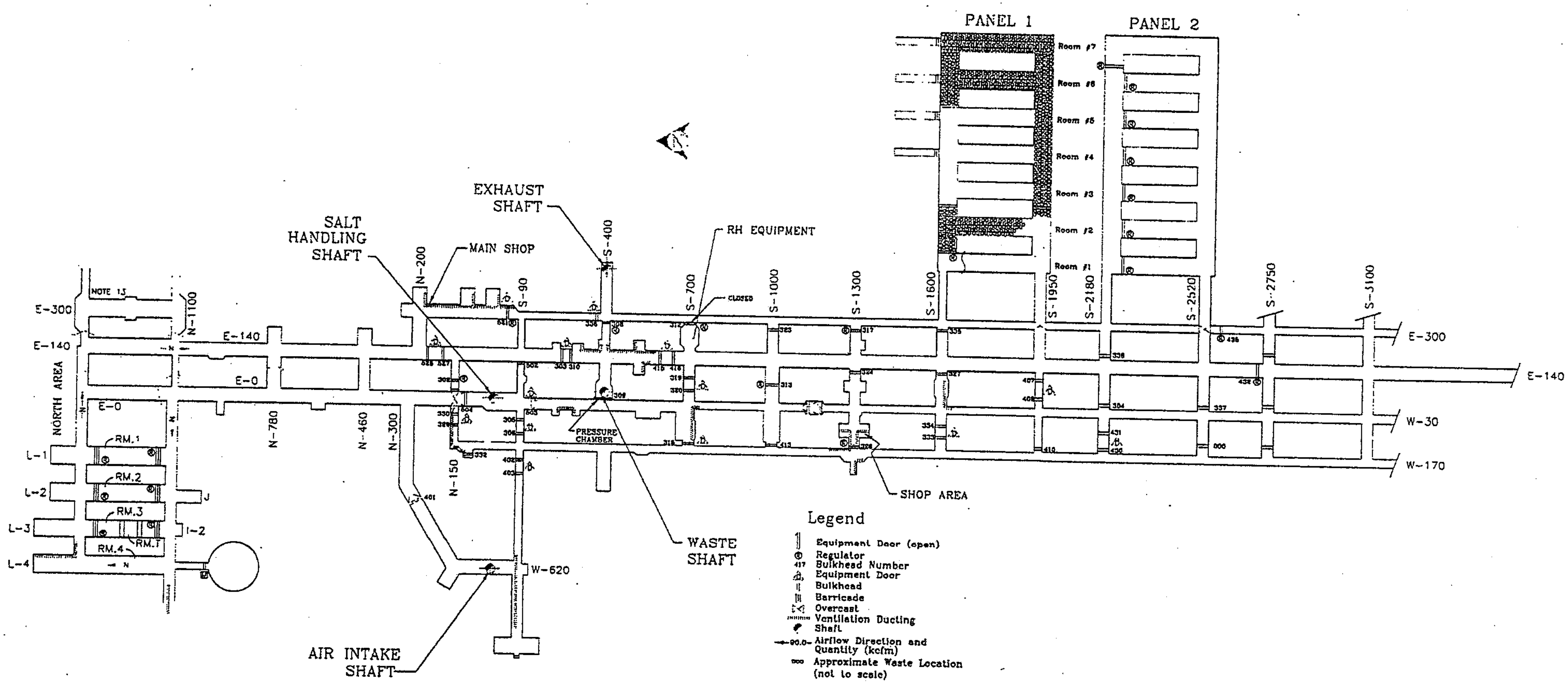

Figure 1: Underground Facility Infrastructure Including Shop Locations, Bulkhead Numbers, Door and Regulator Locations, and Main Shafts.

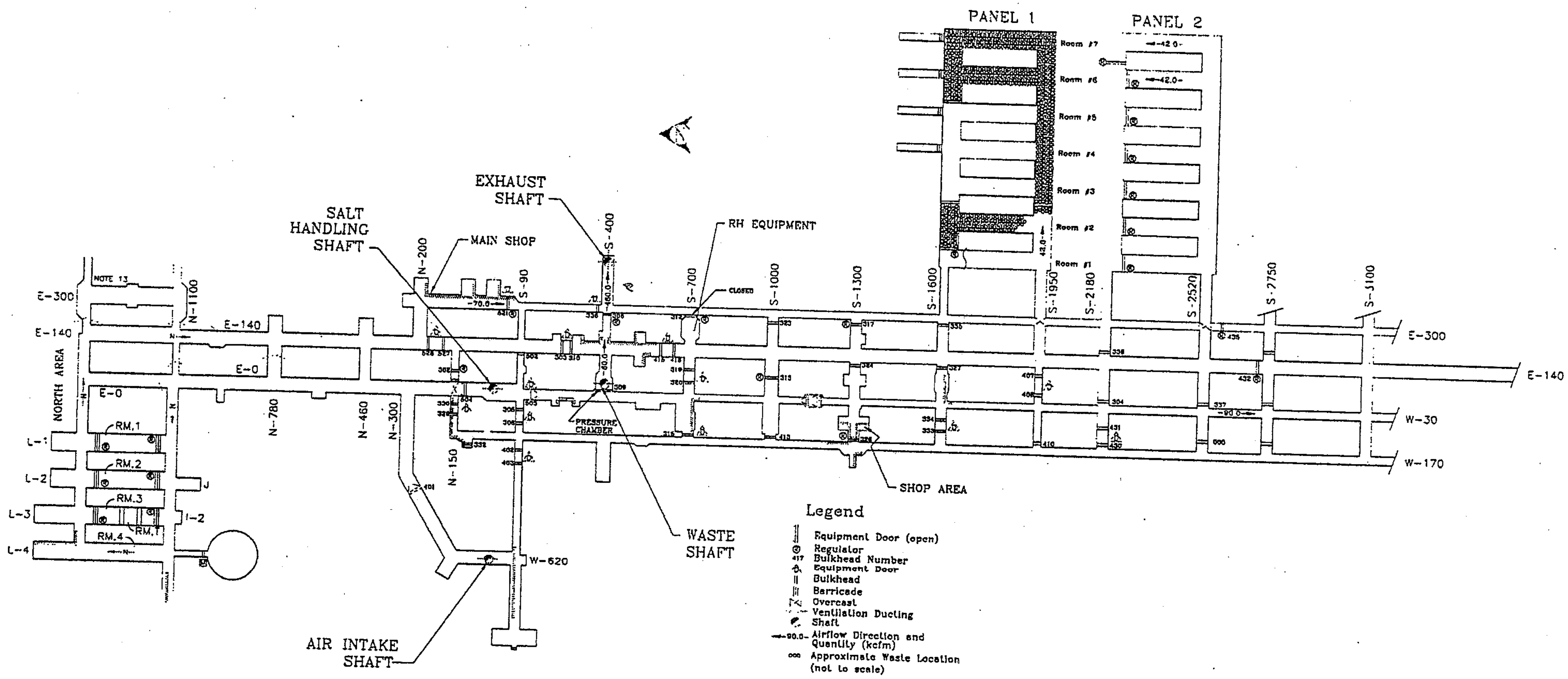

Figure 2: Normal Mode Configuration with Nominal Design Airflows.

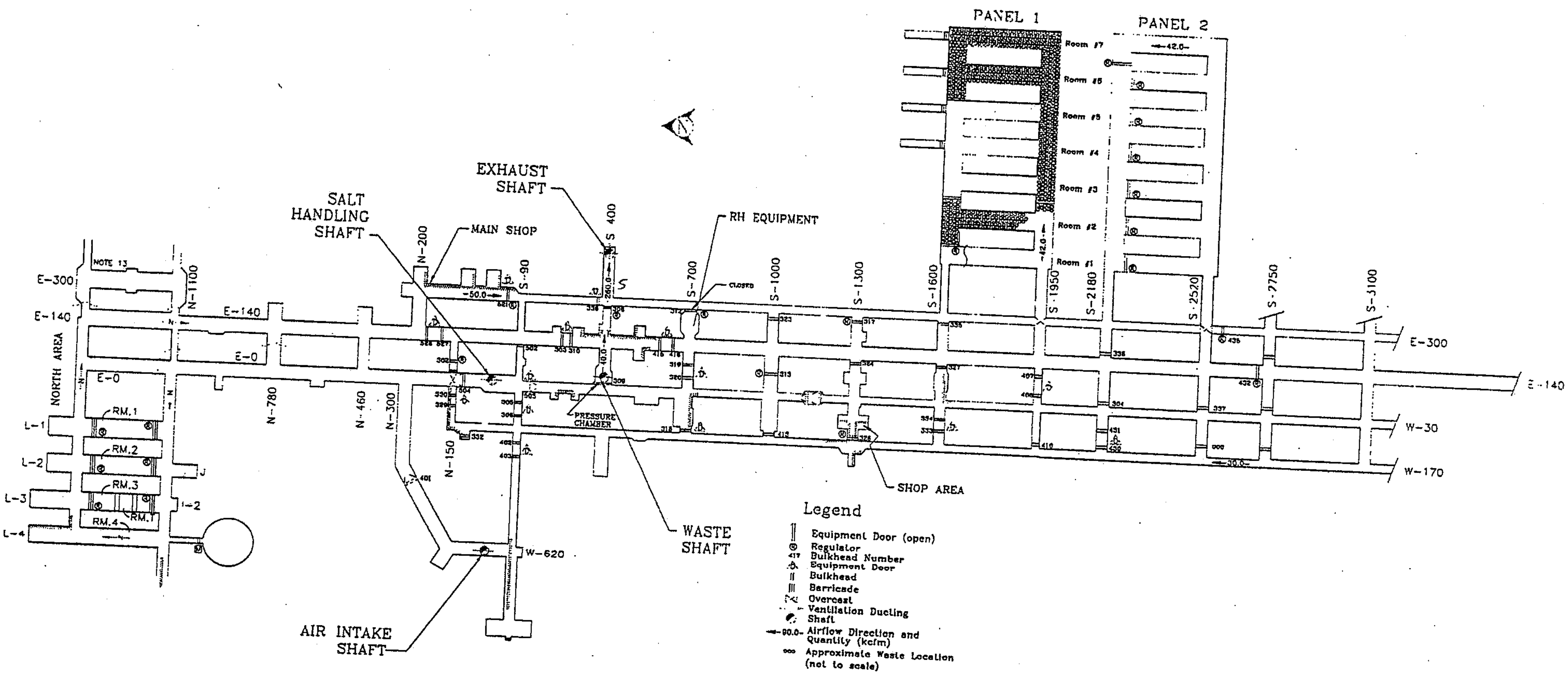

Figure 3: Alternate Mode Configuration with Nominal Design Airflows.

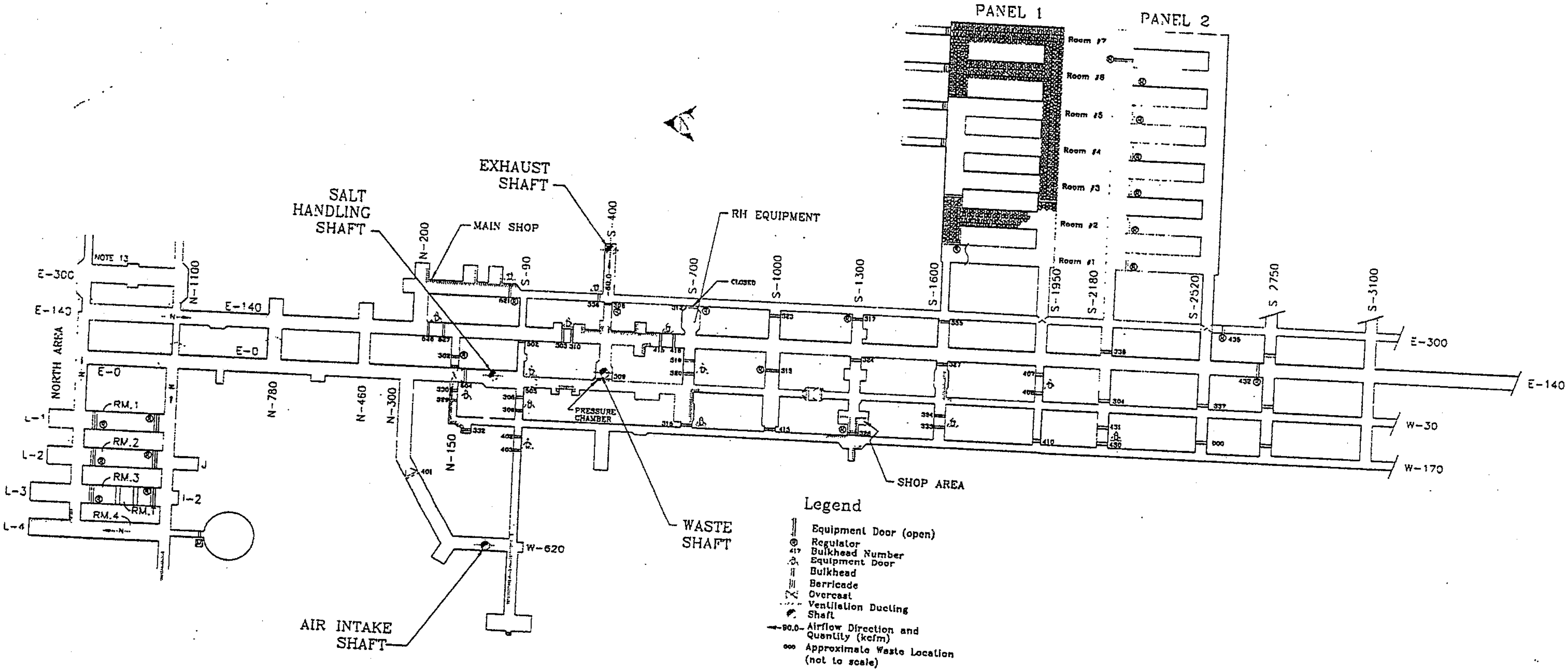

Figure 4: Filtration Mode Configuration with Nominal Design Airflows.

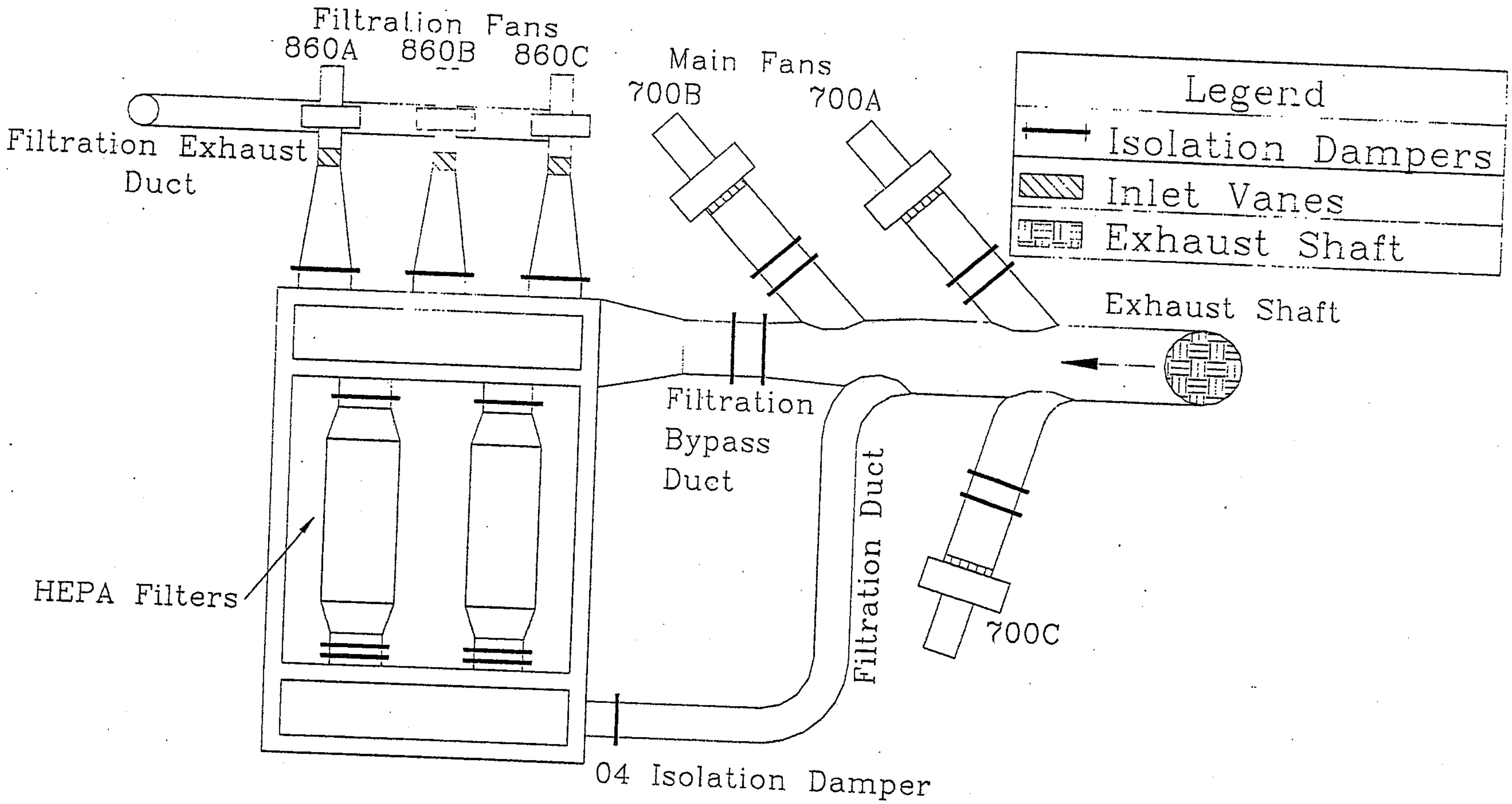

Figure 5: Main Surface Fan Configuration. (Not to Scale)

3. FIELD TESTS

The following subsections describe the field tests conducted during testing and balancing of the WIPP ventilation system. For all testing and balancing activities the auxiliary fan/duct systems in the waste shaft station, the main north shop, the experimental station at W-170 and S-400 (the former core-storage area) and the S-1300 shop (between W-30 and W-170) were in the off position.

3.1 Determination of Regulator Characteristics

The locations for the bulkheads referenced in this report are indicated on Figure 1. Each regulator was initially tested to ensure that the digital readouts of percent open gave meaningful data. To determine regulator resistance curves, the airflow through the regulator and differential pressure across the regulator were measured. Airflows were measured using vane anemometers and differential pressure was measured using a digital manometer. This data was used to establish new resistance curves for each regulator. Measurements of airflow and pressure differentials were taken over a range of louver settings for the following regulators:

- Mining regulator in bulkhead 74-B-302
- Waste shaft station regulator in bulkhead 74-B-308
- Waste disposal regulator in bulkhead 74-B-313
- North shop regulator in bulkhead 74-B-521
- Construction-Split regulator in bulkhead 74-B-435
- Waste disposal regulator in Room 7 Panel 2
- AIT louvers in Building 465

3.2 System Test and Balance

As described in Section 2.1, the WIPP ventilation system is designed to function in seven separate and distinct ventilation modes. The most commonly used/tested of these are Normal Mode, Alternate Mode, and Filtration Mode. The other modes include Minimum and Reduced Mode, operating one or two filtration fans in by-pass mode, operating one 600 hp fan in parallel with one or two of the 235 hp filtration fans (Maintenance Mode), and three air reversal modes. Each of these seven modes was tested during the Ventilation Test and Balance.

The test and balance studies of the WIPP ventilation system consisted of:

- Establishing a ventilation model with the fans set in the Normal Mode.
- Conducting field balancing of the ventilation system to establish regulator settings for normal mode operation.
- Establishing configuration settings during Alternate Mode operation.
- Establishing configuration settings during Filtration Mode operation.
- Establishing configuration settings during Maintenance Mode.
- Establishing configuration settings during Minimum Mode.
- Establishing configuration settings during Reduced Mode.
- Establishing configuration settings during Reversal Mode (air reversed in the Salt Handling Shaft).
- Field verification of air~~flow and differential pressure~~ sensors installed through~~out the facility~~.

Computer network models were developed for Normal, Alternate and Filtration Modes. Branch resistances were determined from measured pressure and airflow data, measured fan pressures and calculated NVP's, and input to the VnetPC200 program. Correlation exercises were conducted on the models for normal, alternate, and filtration modes to determine the deviations between the measured and predicted airflows and pressures for each branch in the network. Notable changes to the facility that affect the ventilation system since the last test and balance conducted in May 2001 were:

- Brattice cloth in Room 1 Panel 1 (instead of a solid bulkhead)
- Rehabilitation of E-0 and E-140 north of the Salt Shaft
- The storage of waste salt in the North Area entries
- The removal of the temporary brattice on the South-side of the AIS and the Restoration of the airlock doors in BH-202 and BH-403.

3.3 Ventilation Survey to Balance System for Various Modes of Operation

To model a ventilation system it is necessary to determine the resistance to airflow for each main underground airway. The resistance to airflow is calculated by measuring the quantity of air and frictional pressure drop in each main airway. For each mode of operation the total mine airflow was determined prior to taking any further airflow or pressure measurements.

The airflow exhausting the WIPP facility can be measured using the Flosonic airflow sensors located in each fan duct. The signals generated by these flow sensors can be used to automatically adjust the inlet vane controls (IVCs) located directly in front of each 600 hp fan to maintain a constant flow through the fans (by changing the characteristic curve). However, Westinghouse Operations does not adjust the IVCs automatically. Currently the angles of the IVCs for each fan are manually set until the desired total exhaust airflow requirement is achieved or the fan motor amperage reaches 95 amps - whichever comes first. Because there is no automatic adjustment of the vanes, any variations in the system resistance (e.g. regulator adjustment) or changes in NVP can result in a shift in the operating point of the fan (which is on a fixed characteristic curve) and a change in the total mine airflow.

During the test and balance of the facility, the inlet vanes were set at the start of shift to give the desired total airflow in the underground. Underground regulators were not normally adjusted during balancing activities, however changes in NVP did impact the fan operating points. The impact on the mine airflow resulting from these changes in pressure was less than 5 % due to the relatively steep slope of the relevant fan characteristic curves.

3.4 Normal Mode (Two Fan) Test and Balance

Figure 2 shows the facility configuration for Normal Mode with the nominal airflow requirements indicated. These design airflows are used to determine the required regulator settings for each ventilation circuit. The surface fan installation is shown on Figure 5. Depending on which operational mode the ventilation system is configured to meet; isolation dampers (shown) are opened or closed so that air passes through the appropriate fan(s). Normal Mode is characterized by operating any two of the 600 hp fans at the minimum design airflow of approximately 425.0 kscfm (standard thousand cubic feet per minute) combined. Prior to testing and balancing the normal mode, the standard flow through the facility was measured directly by setting the fan flow controllers to give a standardized airflow measured at the base of the Exhaust Shaft of at least 425.0 kscfm. The minimum volume flow at the S-400 exhaust drift to give this standard airflow was computed at 462 kacfm (actual measurement) at an approximate air density of 0.069 lb/ft^3.

For normal operation the direction of the pressure differential between the mining and waste disposal systems is from the mining circuit to the waste disposal circuit. A pressure difference less than 2.00 in. w.g. and greater than 0.05 in. w.g. in the correct direction is desired between these systems. The waste shaft is kept as a low flow, downcast shaft. The negative pressure

developed across the headframe should not exceed -1.8 in. w.g. during normal operation. However, because of the system-fans in BH 309 the operating pressure-range of the waste tower can be reduced to between -0.5 and -1.0 in. w.g. by opening the AIT louvers (located in Building 465 on surface). By reducing the tower pressure an increased pressure drop is realized on BH 308.

3.5 Alternate Mode (One Fan) Test and Balance

Figure 3 shows the facility configuration for Alternate Mode with the nominal design airflows indicated. For alternate mode operation a single main 600 hp fan is used to ventilate the facility with a flow of approximately 260.0 kscfm. This corresponds to an actual airflow of 282.6 kacfm underground. During this mode the main airflow requirements are to ventilate two rooms in the panels, the north shop, and the waste shaft station. The mining circuit is maintained at a relatively low flow rate. This configuration requires that the pressure differential between the mining and waste disposal systems be maintained.

3.6 Filtration Mode

Filtration Mode provides confinement of airborne radioactive material from the repository in the unlikely event of an accidental release. The location and main components of the exhaust filter building are illustrated in Figure 5. The switch to filtration is either a manual or automatic function initiated by the Control Monitoring System (CMS). The procedure to switch to filtration involves; (1) turn any operating 600 hp fans off, (2) close the inlet dampers to those fans (time delayed to minimize pulsing), (3) start one of the 235 hp fans with the isolation damper # 04 shut, and (4) open the 235 hp fan IVC and isolation damper to the filtration building.

During Filtration Mode approximately 60 kscfm is drawn through the exhaust shaft and filter building using one 235 hp fan. Figure 4 shows the underground facility configuration for Filtration Mode. The filtration exhaust design airflow is approximately 66 kacfm as measured at E-300/S-400. During Filtration Mode the regulator in BH 313 and the door at E-300/S-350 (BH 336) are closed. Requirements for the directions of pressure differentials are identical to those for normal operation.

3.7 Maintenance

Maintenance mode consists of one 700 fan and one 860 fan running. The configuration of the underground is the same as in Alternate Mode. The total exhaust airflow for this scenario is approximately 255 kacfm.

3.8 Minimum Mode

In Minimum Mode, the underground is configured the same as in Filtration Mode, with BH 313 and the door at E-300/S-350 (BH 336) closed. On the surface, the air is bypassed around the filter building. The total exhaust airflow for this scenario is approximately 66 kacfm.

3.9 Reduced Mode

Reduced Mode features two of the 860 fans operating in parallel. One room in the panel is ventilated, and the total underground airflow is approximately 116 kacfm. The door at BH 336 is closed in this configuration.

3.10 Reversal Mode

Three Reversal Modes exist for the underground ventilation system at the WIPP facility, where the airflow is reversed in the AIS, the SHS and the north shop, respectively. As part of this study, the reversal of air in the SHS was tested. During this scenario, the surface fans are shut off, and the booster fans in the W-30 drift (between S-1000 and S-1300) are utilized to pull air from the south side of the AIS around the mining circuit and out the SHS. BH 302 and BH 313 are both closed in this configuration. The isolation doors at the AIS and SHS are closed (BH 401 and 504) and the doors in S-90 (BH 402 and 403) are opened.

3.11 Data Reduction

MVS personnel were responsible for reducing the survey data and establishing the network models for the Normal, Alternate and Filtration modes of operation. Resistances were calculated using the data collected from the airflow and pressure measurements. Empirical computations of resistance for inaccessible or low flow areas were conducted using pressure differentials computed by difference (from Kirchhoff's Laws) and measured airflows or by using Atkinson's equation with a friction factor measured to be 40 $lbf\ min^2/ft^4 \times 10^{-10}$. Natural ventilation

pressures were computed using the psychrometric data obtained from the WIPP mine weather stations, and by hand-held devices during the survey.

3.12 Calculation of Airway Resistances

For airways in which pressure drop and airflow quantities were measured, the Square Law was utilized to calculate resistance to airflow:

Equation 1: $$R = \frac{p}{Q^2}$$

where:
- R = resistance (Practical Unit or P.U.)
- p = frictional pressure drop (milli inch w.g.)
- Q = airflow (kcfm)

note: P.U. = (milli inch w.g./kcfm^2)

A resistance to airflow was computed for each branch in the ventilation network schematic. During the test and balance of the system all of the resistance values for the various networks were calculated by direct measurement and closure of pressure loops or were computed using Atkinson's equation:

Equation 2: $$R = \frac{k(L + L_e)P_{er}}{52A^3}$$

where:
- k = friction factor (lbf min^2/ft^4 x 10^{10})
- L = length of airway (ft)
- L_e = equivalent length of shock loss (ft)
- P_{er} = perimeter of airway (ft)
- A = cross-sectional area (ft^2)

3.13 Calculation of Natural Ventilation Pressures

Natural ventilation pressures (NVPs) are caused by an imbalance of the densities of air between intake and return shafts. Psychrometric data obtained between the intake and return airways was used to calculate the NVPs for the facility. The polytropic flow processes were assumed to be straight lines, and the area representing the natural ventilating energy (NVE) calculated. This

assumption is based on the fact that for a dry shaft the variations of both temperature and pressure are near linear with respect to depth. In the case of the exhaust shaft, where water evaporation or condensation is occurring, this assumption will have a slight error. However, measuring the air properties along the entire exhaust shaft length is not feasible at WIPP and the error would not be significant. The mean density between the intake and return air shafts is used to calculate the NVP:

Equation 3: $$\mathbf{NVP} = \rho_{mean} \int \mathbf{Vdp}$$

where:

$\int Vdp$ = area enclosed in PV diagram between intake and returns, this is the Natural Ventilation Energy (NVE)

ρ_{mean} = mean density of air in intake and return shafts (AIS, SHS, and waste shaft to exhaust shaft)

In winter, the cool air entering the facility is heated by autocompression (the increase in temperature as a result of potential energy being converted to thermal energy as air falls through a shaft). The exhaust air is warmer than the inlet air. The difference in density between the intake air and exhaust air results in an NVP assisting the main fans. This is equivalent to having a "forcing fan" on the Air Intake Shaft and Salt Handling Shaft. If the winter NVP is significant, then there will be an increase in the waste shaft tower pressure (from a negative value towards zero). This can be explained by Kirchhoff's Second Law, which states that the summation of all pressure drops around a closed circuit will equal zero. Hence, as the NVP in the system becomes more positive the pressure drop across BH 309 will increase (from W-30 to waste shaft station) and that across the headframe will go towards zero or become positive.

During the summer, hot air entering the facility is actually cooled by the strata in the underground. In this case the NVP opposes the main fans. This is equivalent to small "exhaust fans" on the Air Intake Shaft and Salt Handling Shaft. This scenario can result in the pressure differential across BH 309 to be in the incorrect direction, such that there will be leakage from the waste shaft station to W-30. <u>However, operating the high-pressure mini-fans in BH 309 will prevent leakage from the waste shaft station to W-30</u>.

Because NVPs can affect the differential pressure in the underground, a continuous psychrometric monitoring system has been installed at the WIPP. This system consists of strategically placed mine weather stations at the top and bottom of most shafts. From these data

the NVP can be computed over each measurement period. NVPs were computed and incorporated into the network models for each configuration tested

3.14 Air Density Corrections

In addition to NVP analyses, the psychrometric data were also used to determine the expansion and contraction of the ventilation air due to both autocompression as it passes through the shafts and thermal expansion/contraction as it moves through the facility. It is important to note that the mass of air moving through the facility is considered constant. However, the volume (space) that the mass takes up will vary according to the density of the air. To model the expansion and contraction of the air, "reject" branches were added at the base of each intake shaft and an "inject" branch was added at the base of the exhaust shaft. "Inject" and "reject" branches are imaginary branches that connect the bottom of the shafts with the surface. Using "inject" and "reject" branches allows volume changes to be introduced into the network to account for the compressibility of the air.

4. RESULTS

The following section contains the regulator resistance data for each of the seven regulators tested as part of this study as well as the results of the ventilation test and balance for each of the seven ventilation modes.

4.1 Regulator Characteristics

Regulator characteristic curves were established for the waste shaft station regulator (in BH 74-B-308), the mining regulator (in BH 74-B-302), the waste disposal regulator (in BH 74-B-313), and the main north shop regulator (in BH 74-B-521). More amended curves were also generated for the BH-74-435 regulator, the sliding panel regulator at the back of Room 7 Panel 2, and the AIT Louvers in Building 465. The measurement procedure consisted of reading airflows (through the regulator) and pressure differentials (across the regulator) over a full range of louver settings. Since most of the measured regulators have two or more banks of louvers, a number of combinations of louver settings were measured to quantify the regulator resistance over a wide range of settings. To ensure a consistent methodology in taking regulator resistance measurements, the regulators were adjusted from fully closed to fully open starting with the left

(or upper) regulator and moving to the right (or lower) regulator (the directions are referenced from each regulator control location).

It is important to note that the resistance of the BH 521 regulator is affected by the shop fan system that penetrates the bulkhead. During BH 521 regulator testing, the shop auxiliary fan system was switched off; however, air entered the auxiliary duct in each shop alcove. Changes to the damper settings or activation of the auxiliary fan system will change the results of the regulator curves shown in Appendix A for this bulkhead.

Tables 1 through 7 show the louver measurement results for each regulator tested. The tables list the louver percent open for the regulators, where 0% is fully closed and 100% is fully opened, and the corresponding airflows and pressures that were measured. The airflows shown on these tables were established with a single 700 (600 hp) fan operating. The regulator settings were varied from fully closed to fully open. The resistance is computed for each louver setting from the measured data (Equation 1). Regulator curves show the regulator resistance at actual air density and not standard air density. Appendix A gives the regulator curves for the expected operating ranges of the regulators in bulkheads 302, 308, 313, 521, 435, Room 7 Panel 2, and the AIT Louvers. It is important to note that these curves show resistance (Practical Units, PU) against the percent that the regulator is open and not airflow against percent open. The WIPPVENT program is presently capable of using these regulator curves in the ventilation model.

The resistance curves shown in Appendix A reflect not only the louver resistance, but also the resistance of the bulkhead. Given that salt creeps, the integrity of the bulkhead is susceptible to leakage over time. Increased leakage reduces the bulkhead resistance to airflow and changes the regulator resistance curves. It is important that the bulkhead flashing and, particularly, the mandoor frame and seal be properly maintained. The regulator resistance curves shown in this report will change over time because of changes in the bulkhead resistance. At the time of this survey the bulkheads were found to be tight with minimal leakage.

313 Regulator Resistance Data							
Point No.	North Louver (% Open)	N. Middle Louver (% Open)	S. Middle Louver (% Open)	South Louver (% Open)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	0	0	0	0	2.0	1050	262.5000
2	25	0	0	0	10.9	1000	8.4168
3	50	0	0	0	24.0	910	1.5799
4	75	0	0	0	35.8	755	0.5891
5	100	0	0	0	45.0	644	0.3180
6	100	25	0	0	48.2	606	0.2608
7	100	50	0	0	52.7	554	0.1995
8	100	75	0	0	62.1	480	0.1245
9	100	100	0	0	75.4	381	0.0670
10	100	100	50	0	77.1	333	0.0560
11	100	100	100	0	84.2	229	0.0323
12	100	100	100	50	89.1	202	0.0254
13	100	100	100	100	92.0	119	0.0141

Table 3: Results for the BH 313 Regulator Resistance Tests.

521 Regulator Resistance Data					
Point No.	Upper Louver (% Open)	Lower Louver (% Open)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	0	0	14.8	849	3.8760
2	25	0	21.5	808	1.7480
3	50	0	24.2	733	1.2516
4	75	0	36.8	604	0.4460
5	100	0	46.7	518	0.2375
6	100	25	48.3	478	0.2049
7	100	50	51.8	452	0.1685
8	100	75	53.8	397	0.1372
9	100	100	61.7	302	0.0793

Table 4: Results for the BH 521 Regulator Resistance Tests.

435 Regulator Resistance Data				
Point No.	Percent Open (%)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	0	3.0	1346	149.5556
2	25	29.7	1193	1.3525
3	50	58.4	945	0.2771
4	75	79.6	711	0.1122
5	100	79.6	634	0.1001

Table 5: Results for the BH 435 Regulator Resistance Tests.

Panel 2 Room 7 Regulator Resistance Data				
Point No.	Opening Width (ft)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	4	44.1	570	0.2931
2	6	59.0	480	0.1379
3	10	77.4	347	0.0579
4	14	94.2	253	0.0285

Table 6: Results for the Panel 2 Room 7 Regulator Resistance Tests.

AIT Louvers Resistance Data				
Point No.	Louver Position	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	5	4.7	772	34.9479
2	4	12.2	612	4.1118
3	3	15.8	511	2.0469
4	2	18	477	1.4722
5	1	18.4	445	1.3144

Table 7: Results for the AIT Louvers Resistance Tests.

A comparison between the 1997, 1999 and 2001 test and balance regulator tests and the 2002 regulator tests are shown on Table 8 for the resistance of panels fully open and closed. This table contains resistances at measured density. The density variation between the field tests was only slight; hence the resistances can be directly compared. The changes in resistance between previous tests and the 2001 test are likely attributed to changes in the bulkhead resistances due to salt creep and wear.

Regulator Number	Amount Open	Resistance (P.U.) April 1997	Resistance (P.U.) June 1999	Resistance (P.U.) May 2001	Resistance (P.U.) October 2002
302	fully open	0.0150	0.0133	0.0178	0.0147
	top louver open	0.0785	0.0679	0.1112	0.0820
	fully closed	158.2785	42.2222	80.9042	45.760
308*	fully open	0.0378	0.0496	0.0444	0.0875
	North louver open	0.1361	0.1488	0.1289	0.1575
	fully closed	36.0246	29.0148	3807.00	183.141
521**	fully open	0.0787	0.0737	East Damper Removed	0.0793
	West louver open	0.2282	0.2206	0.2078	0.2375
	fully closed	3.6791	1.2948	1.8594	3.8760
313	fully open	0.0235	0.0187	0.0174	0.0141
	three panels open	0.0389	0.0319	0.0336	0.0323
	two panels open	0.0858	0.0684	0.0870	0.0670
	one panel open	0.3927	0.2144	0.4083	0.3180
	fully closed	17.6657	5.7141	419.250	262.500

* Regulator 308 rebuilt in 1999 to include back draft dampers.
** Shop auxiliary fan and duct were not operating during study.

Table 8: Comparison of Selected Regulator Resistances with 1997, 1999, and 2001 Data.

Wipp basic model - normal mode
Avg. Air Density: 0.066(lb/ft³)
Avg. Fan Efficiency: 65.0 %
Cost of Power: 0.0400 $/kWh
Reference Junction: 1
Units: Imperial

Number of Branches: 187
Number of Junctions: 130
Number of Fans: 2
Fixed Quantities: 6

Last Airflow Analysis
Date: 11/06/02
Time: 08:31:22
Modified Since: Yes

Number of Iterations: 6
Number of Errors: 0

Comments:

2002 WIPP Test and Balance
Based on Normal Model
NVP included

NVP added to model based on survey 10/07/02

(a) reg 302 set as fixed resistance from survey p/Q data
(b) reg 308 set as fixed resistance from survey p/Q data
(c) reg 313 set as fixed resistance from survey p/Q data
(d) reg 521 set as fixed resistance from survey p/Q data
(e) reject 14.3 at base of AIS
(f) reject 3.3 at base of SHS
(g) reject 1.8 at base of WS
(h) inject 11.7 at base of ES
note: inject/reject based on measured flows and psychrometrics on 10/07/02
(i)fixed pressure exhaust fans from survey measured data: A = 7.672, C = 7.815
(j)Resistance for all shafts from previous survey data

Corrlation error with measured survey data equals 4.2%

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
1	306	126	W	0.32710	70.66	1633.2	18.18	7313	North Shop-521Regulato
2	40	46	B	0.01744	28.00	13.7	0.06	24	
3	48	46		0.01735	-26.97	-12.6	0.05	22	
4	50	48		0.03906	-25.95	-26.3	0.11	43	
5	52	50		0.04234	-24.92	-26.3	0.10	42	
6	51	52		0.08468	-24.92	-52.6	0.21	83	
7	49	51		0.04234	-24.92	-26.3	0.10	42	
8	49	50		100.00000	-1.03	-105.2	0.02	7	
9	47	49		0.03906	-25.95	-26.3	0.11	43	
10	47	48		150.00000	-1.03	-157.8	0.03	10	
11	45	47		0.01735	-26.97	-12.6	0.05	22	
12	45	46		174.00000	-1.03	-183.0	0.03	12	
13	44	45		0.01744	-28.00	-13.7	0.06	24	
14	44	43		0.00537	78.14	32.8	0.40	162	
15	40	44		0.06925	50.14	174.1	1.38	553	
16	43	39		0.00092	78.14	5.6	0.07	28	
17	42	43		100000.0000	-0.01	-2.7	0.00	0	
18	41	42		10000.00000	-0.01	-0.3	0.00	0	
19	39	41		100000.0000	-0.01	-2.7	0.00	0	
20	40	301		0.00012	-86.72	-0.9	0.01	0	
21	39	40		2.89187	-8.57	-212.5	0.29	115	
22	302	39		0.00012	-86.72	-0.9	0.01	0	
23	26	507		0.00058	52.89	1.6	0.01	0	
24	25	26		0.00090	52.89	2.5	0.02	8	
25	25	23		0.00873	7.08	0.4	0.00	0	
26	505	25		0.00088	59.97	3.2	0.03	12	
27	24	501		0.00113	36.11	1.5	0.01	0	
28	23	24		0.00113	36.11	1.5	0.01	0	
29	22	23		0.00277	29.03	2.3	0.01	4	
30	22	501		0.02657	14.10	5.3	0.01	5	
31	502	22		31000.00000	-0.10	-297.6	0.00	2	
32	20	21	F	0.00000	241.97	0.0	0.00	0	700C Fan
33	19	20		0.00214	241.97	125.3	4.78	1921	700 C Damper
34	5	19		0.00214	241.97	125.3	4.78	1921	700 C Duct
35	17	18		0.00000	-0.28	0.0	0.00	0	700 B Fan
36	16	17		99999.00000	-0.28	-7867.9	0.35	140	700 B Damper
37	5	16		0.00190	-0.28	0.0	0.00	0	700 B Duct
38	14	15	F	0.00000	246.39	0.0	0.00	0	700 A fan branch
39	9	14		0.00000	246.39	0.0	0.00	0	700 A Damper
40	5	9		0.00214	246.39	129.9	5.04	2028	700 A duct
41	11	1	WN	0.00675	-341.66	-787.9	42.42	17058	AIS
42	102	2	WN	0.25572	-77.03	-1517.2	18.42	7406	SHS
43	3	7		0.62101	40.19	1003.1	6.35	2555	AIT - Open/One Bank
44	7	8		0.11931	40.19	192.7	1.22	491	AIT
45	4	8		0.88061	36.85	1195.8	6.94	2792	Waste Tower

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
46	401	8	WN	0.07697	-77.04	-456.8	5.55	2230	Waste Shaft
47	404	6		0.01494	488.08	3559.0	273.72	110076	Exhaust Shaft
48	6	5		0.00075	488.08	178.7	13.74	5527	Exhaust elbow and duct
49	11	10		0.01208	8.46	0.9	0.00	0	AIS Shaft Station
50	10	120		18.41565	8.46	1317.3	1.76	706	S90 to AIS Regulator
51	11	12		0.00116	318.90	118.0	5.93	2385	AIS Shaft Station
52	12	13		0.00161	318.90	163.7	8.23	3308	Access to AIS
53	13	100		0.00129	318.90	131.2	6.59	2651	Access to AIS
54	100	300		0.01385	90.31	113.0	1.61	647	E0 North
55	300	301		0.00012	87.57	0.9	0.01	0	E0
56	301	302		295.00000	0.85	214.3	0.03	12	E0/E140
57	302	303		0.00012	87.57	0.9	0.01	0	E140
58	300	303		28.80859	2.74	216.2	0.09	38	E0/E140
59	303	304		0.01385	90.31	113.0	1.61	647	E140
60	304	124		4.02875	19.65	1555.5	4.82	1937	Doors E140
61	304	305		0.00018	70.66	0.9	0.01	0	N. Shop Entrance
62	305	306		0.00018	70.66	0.9	0.01	0	N. Shop
63	100	101		0.00227	228.59	118.6	4.27	1718	
64	101	123		1163.00000	0.92	973.8	0.14	57	
65	101	122		1025.00000	0.91	852.6	0.12	49	
66	101	102		0.00231	226.76	118.8	4.24	1707	
67	102	103		0.00028	300.51	25.3	1.20	482	
68	103	104		0.00125	295.27	109.0	5.07	2039	
69	104	105		0.00001	295.07	0.9	0.04	0	
70	105	106		0.00126	295.17	109.8	5.11	2054	
71	106	107		0.00195	292.40	166.7	7.68	3089	
72	107	108		0.00401	114.18	52.3	0.94	378	
73	108	109		0.00437	104.54	47.8	0.79	317	
74	109	110		0.00175	104.33	19.0	0.31	126	
75	110	111		0.00098	103.73	10.5	0.17	69	
76	111	112		32400.00000	0.10	315.8	0.00	2	
77	112	113		1416.00000	0.55	434.2	0.04	15	
78	111	114		2200.00000	0.11	27.8	0.00	0	
79	114	115		0.00029	53.22	0.8	0.01	0	
80	115	116		0.00143	53.34	4.1	0.03	14	
81	116	117		0.00227	53.44	6.5	0.05	22	
82	117	118		0.00221	62.98	8.8	0.09	35	
83	118	119		0.00852	64.31	35.2	0.36	143	
84	119	120		0.00995	66.09	43.5	0.45	182	
85	120	121		0.00391	74.99	22.0	0.26	105	
86	121	122		0.00781	74.99	43.9	0.52	209	
87	122	123		0.02103	75.90	121.2	1.45	583	
88	123	124	W	0.15350	76.82	905.8	10.96	4409	BH302
89	124	125		0.00426	96.47	39.6	0.60	242	
90	125	126		0.00373	103.42	39.9	0.65	261	

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
91	126	403		0.00747	174.09	226.4	6.21	2498	
92	103	120		3276.00000	0.44	642.6	0.04	18	
93	106	119		119.11357	1.78	379.5	0.11	43	
94	107	118		100.69444	1.33	177.5	0.04	15	
95	108	117		1.28125	9.54	116.5	0.18	70	
96	109	116		5600.00000	0.11	62.3	0.00	0	
97	110	115		3100.00000	0.11	39.2	0.00	0	
98	107	201	W	0.01410	176.90	441.2	12.30	4946	BH313
99	201	200		0.00541	13.91	1.0	0.00	0	
100	201	202		0.00004	160.95	1.0	0.03	0	
101	202	203		0.00004	159.04	1.0	0.03	0	
102	203	204		0.00004	157.09	1.0	0.02	0	
103	204	205		0.00025	63.98	1.0	0.01	0	
104	205	206		0.00021	61.18	0.8	0.01	0	
105	206	207		0.00044	48.31	1.0	0.01	0	
106	207	208		1000.00000	0.39	152.5	0.01	4	
107	208	209		0.22770	0.39	0.0	0.00	0	
108	209	210		0.22770	0.37	0.0	0.00	0	
109	210	211		0.22770	0.36	0.0	0.00	0	
110	211	212		0.22770	0.35	0.0	0.00	0	
111	212	213		0.22770	0.35	0.0	0.00	0	
112	213	214		0.22708	0.35	0.0	0.00	0	
113	214	215		0.22770	0.36	0.0	0.00	0	
114	215	216		0.22770	0.37	0.0	0.00	0	
115	216	217		0.22770	0.39	0.0	0.00	0	
116	217	218		1000.00000	0.39	152.5	0.01	4	
117	218	219		0.16753	48.31	390.9	2.98	1197	
118	219	221		0.00276	61.18	10.3	0.10	40	
119	220	221		0.01122	146.90	242.1	5.60	2254	
120	221	222		0.00269	210.13	118.8	3.93	1582	
121	222	223		0.00360	212.15	162.0	5.42	2178	
122	223	224		0.00200	214.19	91.8	3.10	1246	
123	224	403		0.00243	230.68	129.3	4.70	1890	
124	104	400	B	0.00000	0.20	0.0	0.00	0	BH309
125	400	105		99900.00000	0.10	1019.5	0.02	6	BH309
126	400	401		99900.00000	0.10	978.7	0.02	6	BH309
127	103	125		76.96000	4.80	1775.5	1.34	540	
128	106	200		638.00000	0.98	609.0	0.09	38	
129	108	202		36400.00000	0.10	390.0	0.01	2	
130	109	203		35200.00000	0.10	343.2	0.01	2	
131	110	204		1328.00000	0.49	325.2	0.03	10	
132	112	204		0.00013	-93.60	-1.1	0.02	0	
133	113	220		0.00149	144.10	30.9	0.70	282	
134	205	220		59.69388	2.79	466.3	0.21	82	
135	206	219		4.20361	12.88	697.2	1.42	569	

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
136	207	218		0.13296	47.91	305.3	2.30	927	
137	208	217		10000.00000	0.01	0.3	0.00	0	
138	209	216		796.00000	0.02	0.2	0.00	0	
139	210	215		788.00000	0.01	0.1	0.00	0	
140	211	214		10000.00000	0.00	0.2	0.00	0	
141	203	221		169.00000	2.05	710.4	0.23	92	
142	202	222		204.75000	2.01	830.2	0.26	106	
143	201	223		237.50000	2.04	993.2	0.32	128	
144	200	224		3.98904	16.48	1083.8	2.81	1132	
145	401	402		0.00020	75.37	1.1	0.01	0	
146	402	403	W	0.38440	71.62	1971.5	22.25	8948	Reg 308
147	403	404		0.00104	476.38	236.0	17.72	7124	
148	402	200		296.44444	1.60	758.4	0.19	77	
149	402	125		367.50000	2.15	1705.2	0.58	232	
150	600	404	R	30.17249	11.70	4130.3	7.61	3062	Exhaust Shaft I/J
151	102	601	B	0.00000	3.28	0.0	0.00	0	Salt Shaft I/J
152	11	602	B	0.00000	14.30	0.0	0.00	0	AIS I/J
153	401	603	B	0.00000	1.77	0.0	0.00	0	Waste Shaft
154	111	504		0.00089	103.52	9.5	0.15	62	
155	504	505		0.00080	103.29	8.5	0.14	56	
156	505	507		900.00000	0.09	7.3	0.00	0	
157	507	506		0.00029	52.98	0.8	0.01	0	
158	506	114		0.00057	53.11	1.6	0.01	0	
159	504	502		31600.00000	0.10	307.4	0.00	2	
160	505	22		0.00068	43.22	1.3	0.01	0	
161	112	502		0.00013	93.15	1.1	0.02	0	
162	502	508		0.00013	93.34	1.1	0.02	0	
163	501	500	W	0.28700	50.21	723.5	5.72	2302	435 Regulator
164	500	113		0.00080	51.18	2.1	0.02	7	
165	508	500		458.02469	0.97	430.0	0.07	26	
166	522	113		0.00026	92.37	2.2	0.03	13	
167	508	509		0.00013	92.37	1.1	0.02	0	
168	514	517		0.27546	38.90	416.8	2.55	1027	
169	513	518		753.06122	0.75	419.0	0.05	20	
170	512	519		1476.00000	0.53	421.2	0.04	14	
171	511	520		2306.25000	0.43	423.5	0.03	12	
172	510	521		4100.00000	0.32	425.8	0.02	9	
173	509	522		304.95868	1.18	428.1	0.08	32	
174	504	506		1000.00000	0.13	16.7	0.00	0	
175	509	510		0.00014	91.19	1.2	0.02	0	
176	510	511		0.00014	90.87	1.2	0.02	0	
177	511	512		0.00014	90.44	1.1	0.02	0	
178	512	513		0.00014	89.90	1.1	0.02	0	
179	513	514		0.00014	89.16	1.1	0.02	0	
180	514	515		0.00045	50.26	1.1	0.01	0	

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
181	515	516		0.00045	50.26	1.1	0.01	0	
182	516	517	W	0.16420	50.26	414.8	3.29	1321	
183	517	518		0.00014	89.16	1.1	0.02	0	
184	518	519		0.00014	89.90	1.1	0.02	0	
185	519	520		0.00014	90.44	1.1	0.02	0	
186	520	521		0.00014	90.87	1.2	0.02	0	
187	521	522		0.00014	91.19	1.2	0.02	0	

4.2 Normal Mode (Two Fan) Test and Balance and Model Development

Figure 6 shows the airflows measured throughout the facility under normal mode conditions. The resistances of the shafts were considered to be the same as in previous surveys. During the testing the Galloway in the AIS remained at the bottom of the shaft. The conveyances in the Salt Handling Shaft and the Waste Shaft were also parked at the bottom of the shafts.

From the measured airflows and differential pressures, resistances were calculated and an updated ventilation model developed. The model correlated to the measured airflow readings within 4.2 %. The airflows and pressures predicted by the model and the correlation achieved with measured data are given in Appendix B.

Balancing the ventilation system during normal mode was accomplished by adjusting the regulators to achieve airflow and pressure criteria as specified on Figure 2. The significant findings of the tests conducted for the normal flow mode were:

- The standardized surface airflow was 437.2 kscfm, which is approximately 12 kscfm higher than the requirement of 425.0 kscfm as specified in the SDD (the density correction factor was approximately 0.92).
- Main fan IVC settings were 90 degrees open for 700A, and 105 degrees for 700C.
- Differential pressures between the mining and waste disposal circuits were maintained in the correct direction with all leakage to the waste disposal circuit.
- The airflow control damper in the AIT (Bldg 465) was fully opened (setting 1) resulting in the tower pressure during this mode of operation to be approximately -1.03 in. w.g.
- Room 2 in Panel 1 and Rooms 6 and 7 in Panel 2 were successfully ventilated with 47.5, 47.4, 36.8 kcfm, respectively (the disparity between the airflows in Room 6 and Room 7 of Panel 2 was caused by a sticking regulator slider in the Room 7 regulator, which made it difficult to make precise airflow adjustments. However, the total amount of air flowing through Rooms 6 and 7 is sufficient to ventilate both rooms at approximately 42.1 kcfm).
- All design airflows were achieved in the mining, north shop, and waste shaft station areas.

Figure 6 shows the measured airflow distribution and the configuration of the facility during normal mode. Table 6 shows a comparison between the normal mode nominal, measured, and predicted airflows at strategic locations in the facility. Table 7 identifies the main fan and regulator setting positions for the normal mode configuration.

Station Location	Nominal Airflow (kacfm)	Measured Airflow (kacfm)	Predicted Airflow (kacfm)
Exhaust Shaft - S-400/E-400	460.0	475.2	476.4
Mining Shop (S-1300/W-100)*	15.0	8.0	9.5
Mining Area (W-170/S-2180)	90.0	106.0	103.5
North Shop (E-300/S-100)	70.0	75.0	70.7
Room 2 in Panel 1	42.0	47.5	47.9
Room 7 in Panel 2	42.0	47.4	50.3
Room 6 in Panel 2	42.0	36.6	38.9
Waste Shaft Station	60.0	71.6	75.4
Fuel Regulator in S-1300	2.0	2.0	2.0

*Shop fan off.

Table 9: Comparison of Design, Measured and Predicted Airflows for Normal Mode Configuration.

Regulator Location	Alternate Mode Configuration (Regulators in % Open)	Normal Mode Configuration (Regulators in % Open)
Air Intake Tunnel Building 465	Two louvers closed (Tornado dampers closed)	Two louvers fully open (Setting #1) on south wall. (Tornado damper fully closed)
Mining Regulator BH 302	Top Panel (A/B) - 100 % Bottom Panel (C/D) - 0 %	Top Panel (A/B) - 100 % Bottom Panel (C/D) - 0 %
Waste Station Regulator BH 308	Louver B – 100% (open) Louver A – 100% (open)	Louver B - 70% open Louver A - 0% (closed)
Waste Disposal Area Regulator BH 313	Panel A - 100 % Panel B - 100 % Panel C - 100 % Panel D - 100 %	Panel A - 100 % Panel B - 100 % Panel C - 100 % Panel D - 100 %
Main Shop Regulator BH 521	Panel A - 100% Panel B - 0 % (closed)	Panel A - 100% Panel B - 0 % (closed)
Con-Split Regulator BH 435	Single Regulator Fully Closed	Single Regulator 50% Open
S-1300 Fuel Bay BH 317	South Panel Closed North Panel approx. 40 % Open	South Panel Closed North Panel approx. 40 % Open
S-700 Shop BH 312	Fully closed	Fully closed
Mining Shop Regulator BH No. 326	Single Regulator - 100 % Open	Single Regulator - 100 % Open
S-90 Regulators BH Nos. 402 and 403	Replaced by Solid Doors	Replaced by Solid Doors
Panel 1 Configuration		
Room 1	Brattice Cloth/Closed	Brattice Cloth/Closed
Room 2	Regulator Open 50 inches each side	Regulator Open Rt. side closed, Lf. at pin
Room 3	Closed and Sealed	Closed and Sealed
Room 4	Closed and Sealed	Closed and Sealed
Room 5	Closed and Sealed	Closed and Sealed
Room 6	Closed and Sealed	Closed and Sealed
Room 7	Closed and Sealed	Closed and Sealed
	Closed and Sealed	Closed and Sealed
Panel 2 Configuration		
Room 1	Mandoor closed/Regulator closed	Mandoor closed/Regulator closed
Room 2	Mandoor closed/Regulator closed	Mandoor closed/Regulator closed
Room 3	Mandoor closed/Regulator closed	Mandoor closed/Regulator closed
Room 4	Mandoor closed/Regulator closed	Mandoor closed/Regulator closed
Room 5	Mandoor closed/Regulator closed	Mandoor closed/Regulator closed
Room 6	Mandoor closed/Regulator closed	Mandoor closed/Regulator open
Room 7	Regulator opened approx. 5½ ft	Regulator opened approx. 5½ ft
Main Fan Settings	**Inlet Vane Controls**	**Inlet Vane Controls**
700A Fan (max. 90 °)	Off (0 ° Open)	Fully Open (90 ° Open)
700B Fan (max. 90 °)	Off (0 ° Open)	Off (0 ° Open)
700C Fan (max. 105 °)	Fully Open (105° Open)	Open (90 ° Open)

Table 10: Regulator and Main Fan Settings for Normal and Alternate Mode Ventilation Surveys.

4.3 Alternate Mode (One Fan) Test and Balance

Figure 7 shows the measured airflow distribution through the facility for the alternate mode test and balance. The 700C fan was operational and developed a flow of 264.0 kscfm. The significant findings of the tests conducted for alternate mode were:

- Room 2 of Panel 1 and Room 7 of Panel 2 were ventilated with approximately 44.2 and 47.3 kscfm, respectively.
- AAIT was closed during this test and the tower pressure approached –0.72 in. w.g.
- Differential pressures between the mining and waste disposal circuits were maintained in the correct direction with all leakage to the waste disposal circuit.
- The waste shaft station was adequately ventilated with 40.1 kscfm and the north shop had approximately 45.2 kscfm.

From the full flow ventilation model and the measured resistance of regulators that were adjusted with one main fan operational, an alternate mode ventilation model was developed. The model correlated to the measured airflow readings to within 4.8 %. The airflows predicted by the model, and the correlation achieved with measured data, are given in Appendix D. Table 11 shows a comparison between the nominal, measured, and predicted airflows at strategic locations in the facility during alternate mode. The main fan and regulator setting positions for the alternate mode configuration are shown on Table 10.

Station Location	Nominal Airflow (kscfm)	Measured Airflow (kscfm)	Predicted Airflow (kscfm)
Mining Area (W-170/S-2180)	30.0	51.5	43.1
North Shop (E-300/S-100)	50.0	45.2	44.3
Room 2 in Panel 1	42.0	44.2	37.0
Room 7 in Panel 2	42.0	47.3	50.7
Waste Shaft Station	40.0	40.1	41.5

Table 11: Comparison of Design, Measured and Predicted Airflows for Alternate Mode Configuration.

4.4 Filtration Mode Test and Balance

Figure 8 shows the measured airflows for the filtration mode test and balance. The measured exhaust airflow was 61.0 kscfm (the density correction factor was 0.92). This slightly exceeds the nominal design airflow of 60.0 kscfm. The ventilation model for this mode of operation correlated to the measured airflow readings to within 5.0%. The airflows and pressures predicted by the model and the correlation achieved with measured data are given in Appendix E.

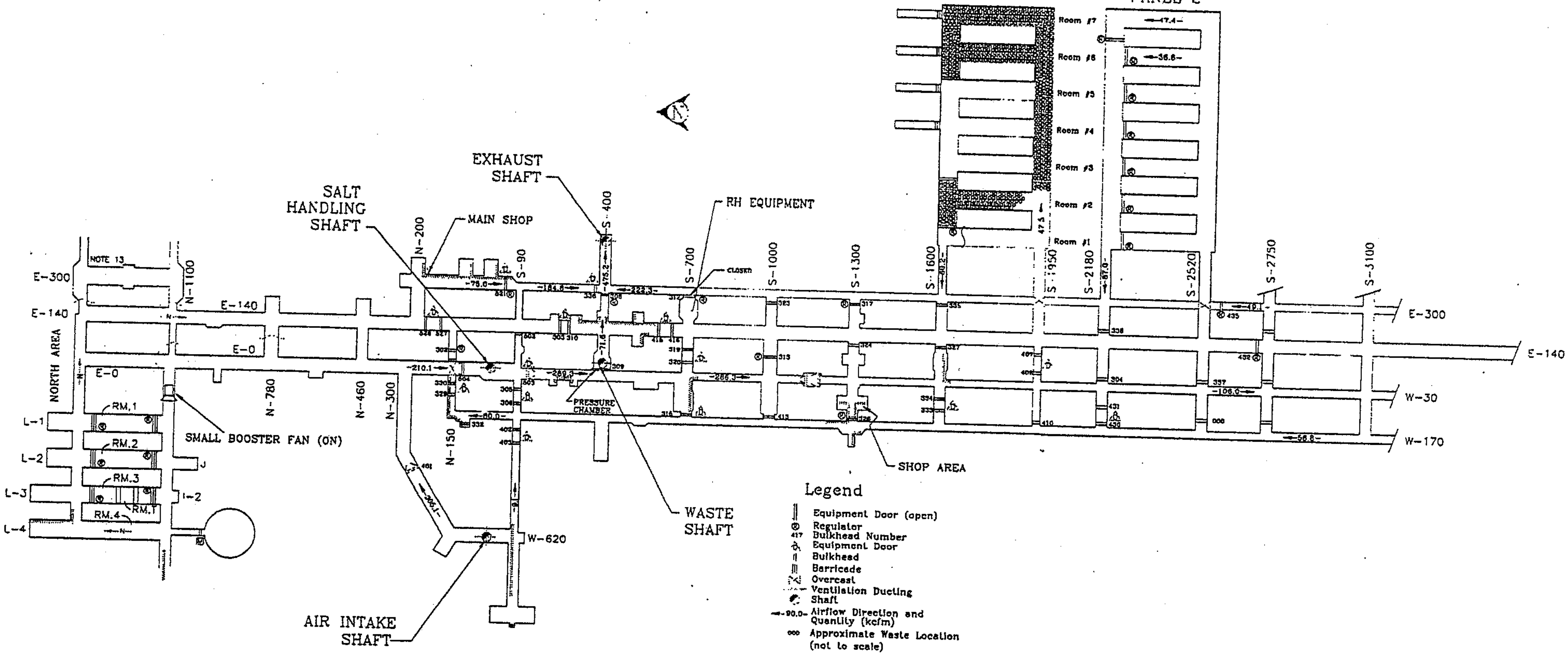

Figure 6: Normal Mode Measured Airflow Results

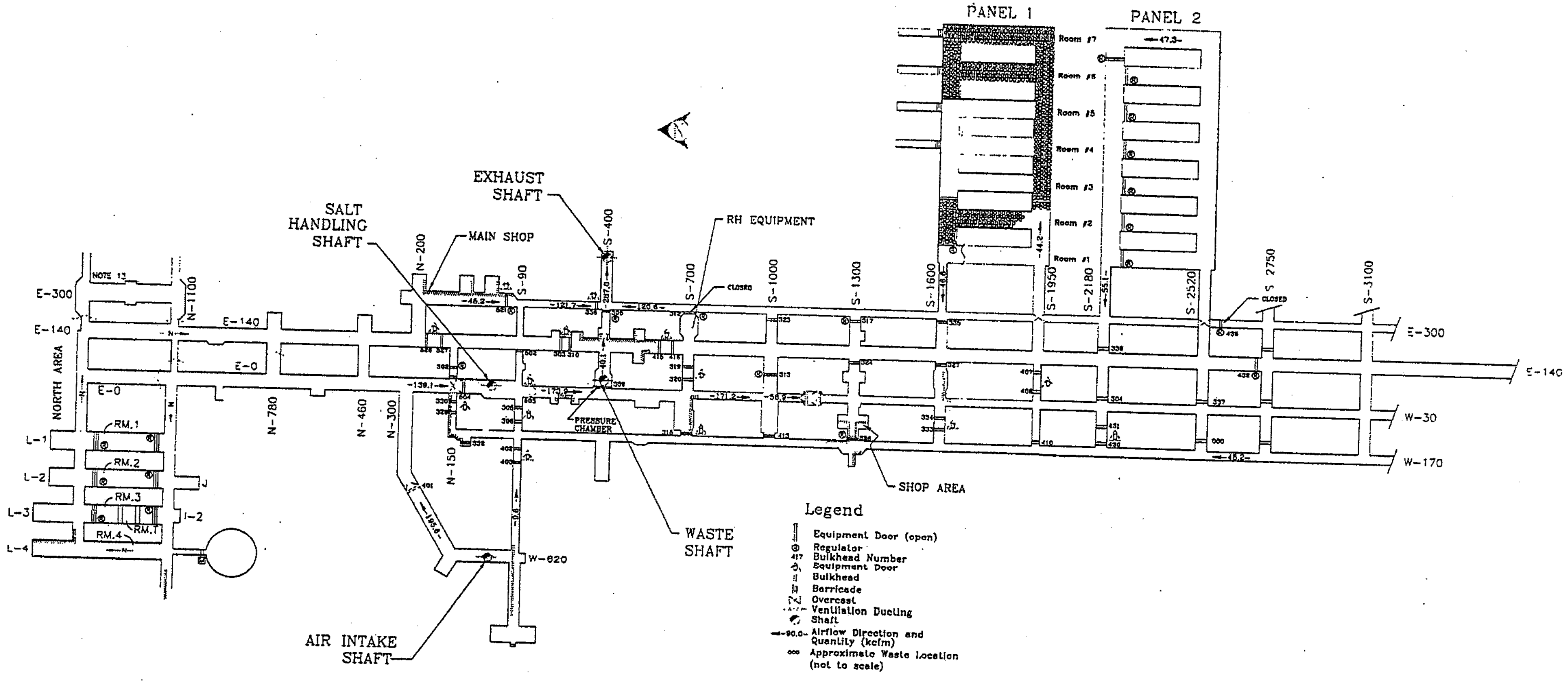

Figure 7: Alternate Mode Measured Airflow Results

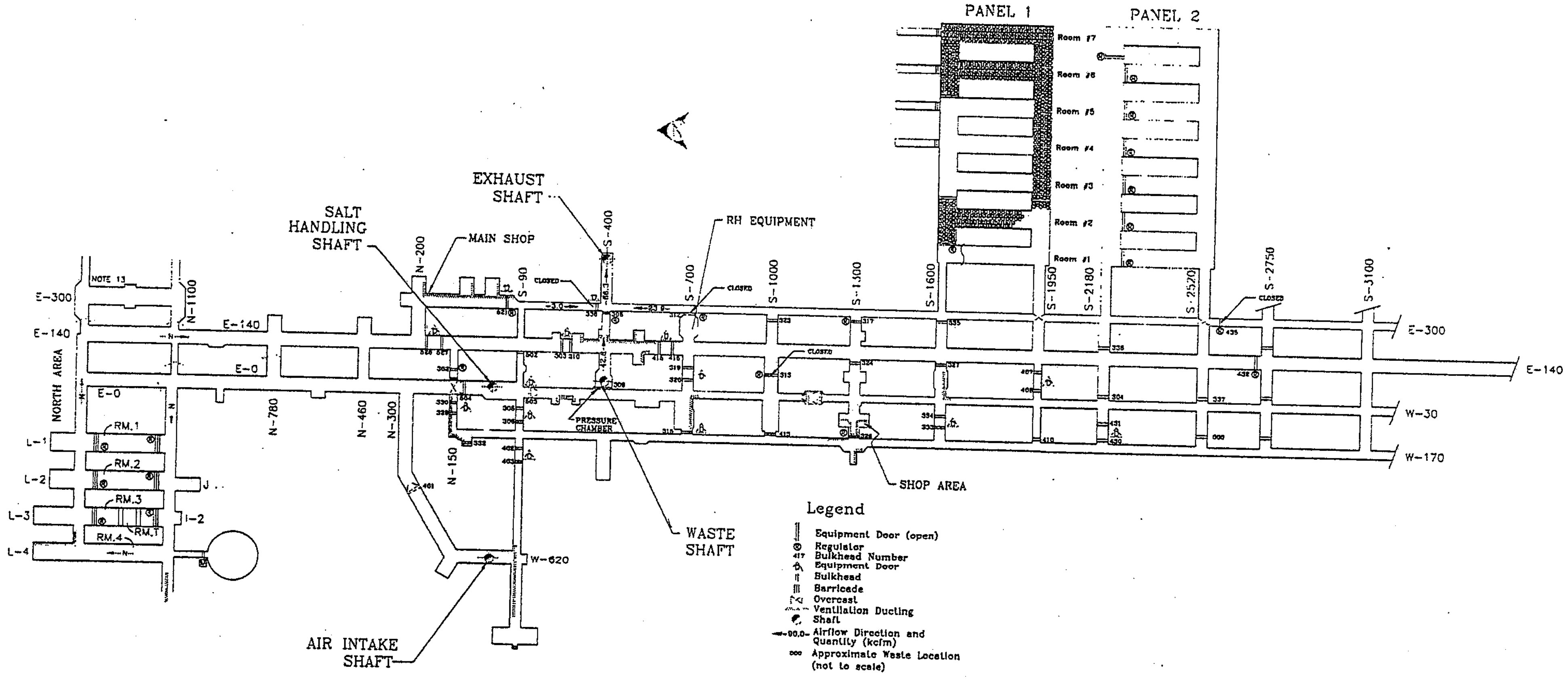

Figure 8: Filtration Mode Measured Airflow Results

5. BAROTRON PRESSURE and FLOSONIC AIRFLOW SENSORS

Barotron pressure sensors are installed on several of the major bulkheads in the facility. They are capable of measuring the differential pressure drop across these bulkheads. Errors calculated in the Barotron Instruments are based upon MVS' own measurements versus the Barotron reading. The sensors were considered acceptable if they had an error of less than 10% for pressure differences of 30 milli-inches water gauge (m. in. w.g.) or more. The results of the Barotron tests are given in Tables 12 through 14. Two sensors were found to have unacceptable errors. MVS recommends that the Barotron sensors in BH 313 and BH 521 be replaced.

Normal Mode				
Location	Measured Pressure Diff. (m. in w.g.)	Barotron Reading (m. in w.g.)	Difference (m. in w.g.)	% Error (%)
BH 313	394	440	46	11.7%
BH 521	2040	10	2030	99.5%
BH 302	1032	980	52	5.0%
BH 303/310	1470	1510	40	2.7%
BH 308	1783	1760	23	1.3%
BH 415/416	667	670	3	0.4%

Table 12: Barotron Error During Normal Mode.

Alternate Mode				
Location	Measured Pressure Diff. (m. in w.g.)	Barotron Reading (m. in w.g.)	Difference (m. in w.g.)	% Error (%)
BH 313	185	235	50	27.0%
BH 302	521	510	11	2.1%
BH 521	775	10	765	98.7%
BH 308	145	130	15	10.3%
BH 415/416	378	415	37	9.8%
BH 303/310	23	30	7	30.4%
BH 324	194	180	14	7.2%

Table 13: Barotron Error During Alternate Mode.

Filtration Mode				
Location	Measured Pressure Diff. (m. in w.g.)	Barotron Reading (m. in w.g.)	Difference (m. in w.g.)	% Error (%)
BH 308	158	130	28	17.7%
BH 415/416	140	135	5	3.6%
BH 303/310	1396	1400	4	0.3%

Table 14: Barotron Error During Filtration Mode.

Tables 15 through 20 show the measured error in the airflow sensors located throughout the underground facility. Errors less than 10% in airflows of at least 5 kcfm were considered acceptable. During testing, two Flosonic sensors (at AMS 101 and AMS 120) were found to be out of calibration. These Flosonic sensors were calibrated and retested. Table 17 shows the measured error in those two sensors after calibration. Although the Flosonic sensors are accurate under a wide range of environmental conditions, the buildup of salt dust on the sensors can eventually affect their performance in an adverse manner. MVS recommends that the sensor heads on the Flosonic sensors be cleaned periodically as needed.

Normal Mode				
Location	Measured Airflow (kcfm)	FloSonic Reading (kcfm)	Difference (kcfm)	% Error (%)
AMS 213	60.2	57.0	3.2	5.3%
AMS 215	190.2	185.3	4.9	2.6%
AMS 218	220.3	227.3	7.0	3.2%
AMS BB	471.7	485.0	13.3	2.8%
AMS 305a	183.6	196.4	12.8	7.0%
AMS 125	109.5	105.5	4.0	3.7%
AMS 402	71.6	58.9	12.7	17.7%
AMS 105*	260.3	241.0	19.3	7.4%
O/C N-150*	75.4	70.0	5.4	7.2%
AMS 107	289.2	278.3	10.9	3.8%
AMS 108	115	122.3	7.3	6.3%
AMS 120	70.9	105.1	34.2	48.2%

*Airboss

Table 15: Airflow Sensor Error During Normal Mode.

Alternate Mode				
Location	Measured Airflow (kcfm)	FloSonic Reading (kcfm)	Difference (kcfm)	% Error (%)
AMS 120	56.5	55.5	1.0	1.8%
AMS 107	171.2	175.0	3.8	2.2%
AMS 105*	165.4	155.0	10.4	6.3%
AMS 213	46.6	44.9	1.7	3.6%
AMS 215	101.4	62.4	39.0	38.5%
AMS 218	120.6	124.5	3.9	3.2%
AMS BB	287.0	285.3	1.7	0.6%
AMS 305a	121.7	131.6	9.9	8.1%
AMS 125	76.5	73.1	3.4	4.4%
AMS 402	40.7	38.2	2.5	6.1%

*Airboss

Table 16: Airflow Sensor Error During Alternate Mode.

Filtration Mode				
Location	Measured Airflow (kcfm)	FloSonic Reading (kcfm)	Difference (kcfm)	% Error (%)
AMS 218	23.9	19.0	4.9	20.5%
AMS BB	63.3	65.0	1.7	2.7%
AMS 402	43.7	43.0	0.7	1.6%
AMS 305a	5.7	0.3	5.4	94.7%

*Airboss

Table 17: Airflow Sensor Error During Filtration Mode.

Maintenance Mode				
Location	Measured Airflow (kcfm)	FloSonic Reading (kcfm)	Difference (kcfm)	% Error (%)
AMS 120	49.9	60.0	10.1	20.2%
AMS 108	53.9	111.6	57.7	107.1%
AMS 107	152.9	150.0	2.9	1.9%
AMS 213	43.2	38.7	4.5	10.4%
AMS 215	95.9	97.5	1.6	1.7%
AMS BB	254.4	255.8	1.4	0.6%
AMS 305a	109.0	114.3	5.3	4.9%
AMS 125	68.2	66.4	1.8	2.6%
AMS 402	39.1	37.8	1.3	3.3%

*Airboss

Table 18: Airflow Sensor Error During Maintenance Mode.

Reduced Mode				
Location	Measured Airflow (kcfm)	FloSonic Reading (kcfm)	Difference (kcfm)	% Error (%)
AMS 218	79.8	86.1	6.3	7.9%
AMS BB	115.8	115.0	0.8	0.7%
AMS 101**	103.4	105.0	1.6	1.5%

*Airboss

** After Calibration

Table 19: Airflow Sensor Error During Reduced Mode.

Minimum Mode				
Location	Measured Airflow (kcfm)	FloSonic Reading (kcfm)	Difference (kcfm)	% Error (%)
AMS 402	40.7	40.5	0.2	0.5%
AMS BB	65.2	61.9	3.3	5.1%
AMS 218	20.8	17.7	3.1	14.9%
AMS 120**	48.7	47.5	1.2	2.5%
AMS 101**	173.4	167.0	6.4	3.7%

* Airboss
**After Calibration

Table 20: Airflow Sensor Error During Minimum Mode.

6. DETERMINATION OF FAN PERFORMANCE CURVES

Precise measurements for the determination of fan curves were not performed during this test and balance. A detailed study of the main fan performance was conducted in August of 2001. The results of that study may be found in the MVS report "2001 Fan Testing at the WIPP Facility", September 2001 (DN-1120-23). The relevant fan curves generated by that study are reproduced here for convenience. Figure 9 shows the fan curve developed for the 700A Fan at an IVC setting of 90 degrees. Figure 10 shows the fan curve for the 700B Fan at an IVC setting of 90 degrees. The fan curve for the 700C Fan at an IVC setting of 105 degrees is shown on Figure 11. The IVC settings depicted for each fan were consistent with those used during the 2002 Ventilation Test and Balance.

A fan performance curve consists of a plot of fan total pressure on the y-axis and fan actual airflow on the x-axis. To develop multiple points on the curve it is necessary to adjust the underground resistance to provide differing fan total pressures and airflows through each fan. To measure the airflow through each fan duct, velocity pressure traverses were performed. The results of these traverses were checked against underground measurements in the S-400 exhaust drift. The two measurements were adjusted for differences in air density to give a meaningful comparison. Spreadsheets were developed to compute the airflow through the fan duct, air density, and compare the results of the underground airflow measurements. Excellent correlation was achieved between the duct and underground measurements.

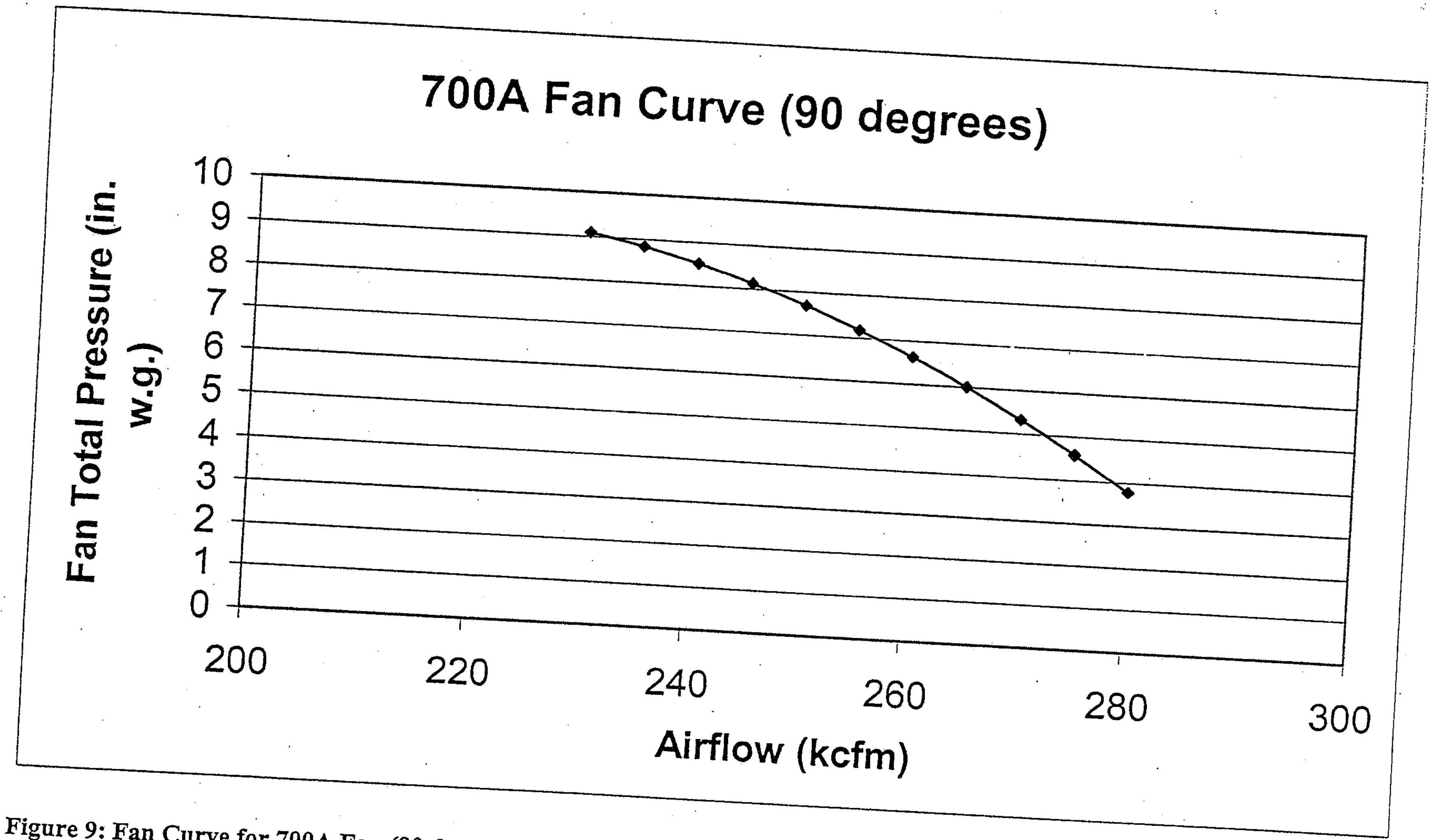

Figure 9: Fan Curve for 700A Fan (90 degrees).

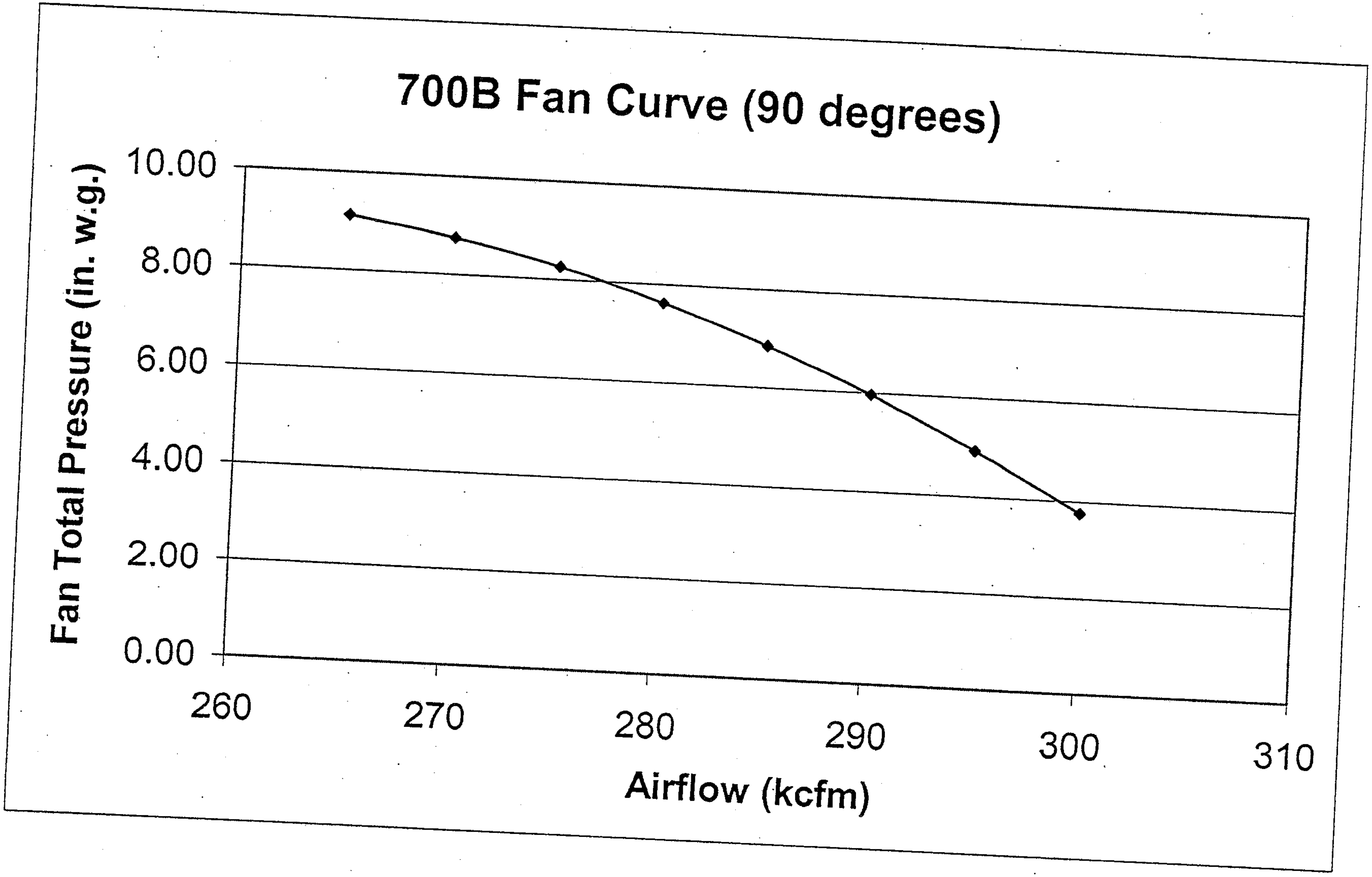

Figure 10: Fan Curve for 700B Fan (90 degrees).

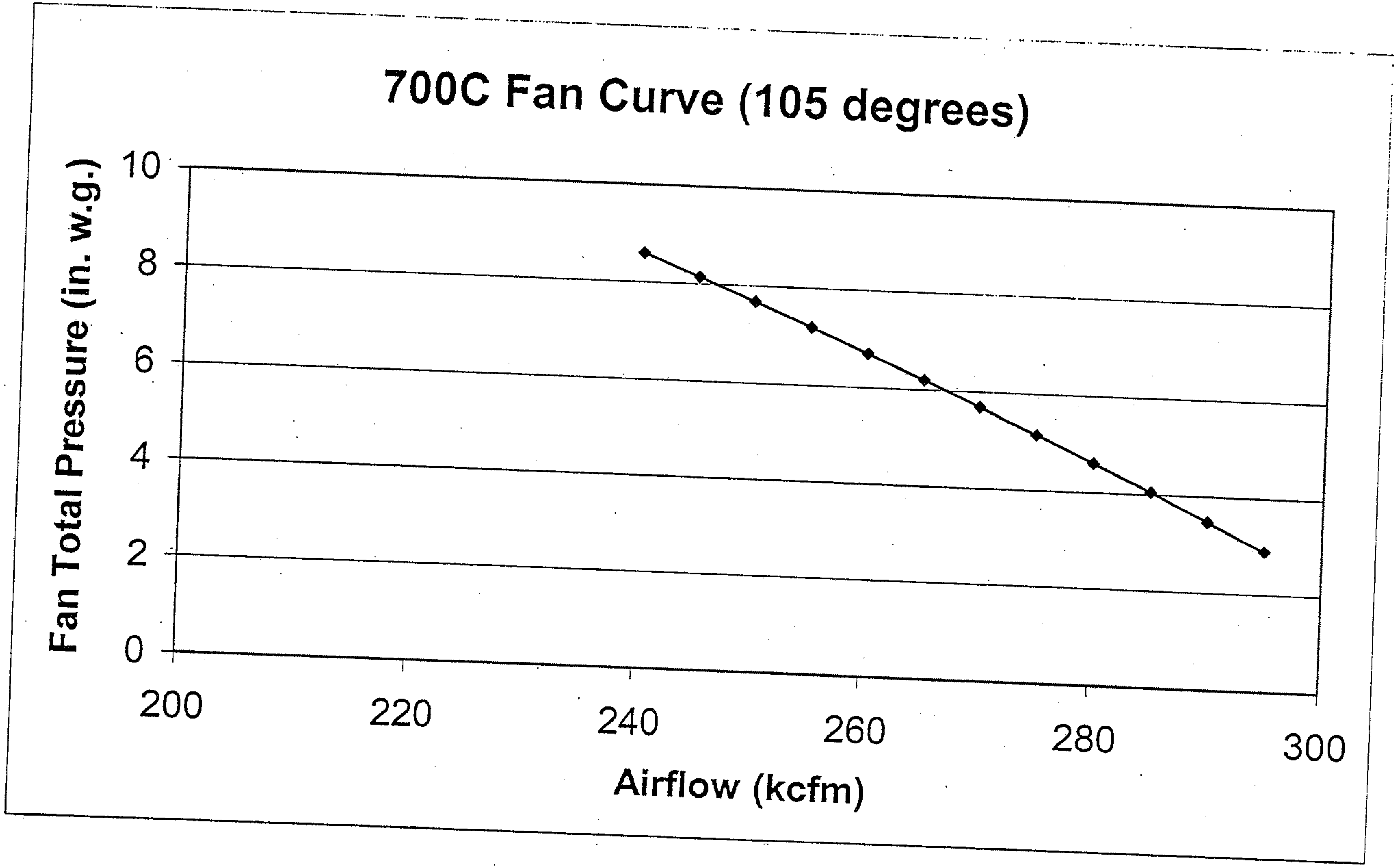

Figure 11: Fan Curve for 700C Fan (105 degrees).

7. CONCLUSIONS

During the 2002 ventilation study, the Normal, Alternate, Filtration, Maintenance, Minimum, Reduced, and Salt-Handling Shaft Reversal modes of operation were successfully tested and balanced. Configuration of the main ventilation controls for normal and alternate mode of operation can be found on Table 10. Testing of all underground airflow and pressure sensors was performed, and all sensors recalibrated when necessary. In addition, computer models were generated using the WIPPVENT software program for Normal, Alternate and Filtration modes. Field-testing also determined the resistance characteristic curves for all main underground regulators. The results of these calculations are given in Appendix A.

The following observations were noted during the 2002 test and balance activities.

- The regulator in Building 465 should be automated for airflow, pressure and position.
- Flosonics should be used (and maintained) for main fan control.
- The Barotron Pressure sensors in BH 313 and BH 521 should be replaced.
- The sensor heads on the Flosonic Airflow sensors should be periodically checked and maintained free from excess salt build-up.
- The required 42,000 acfm total in each waste-handling room appears higher than necessary.

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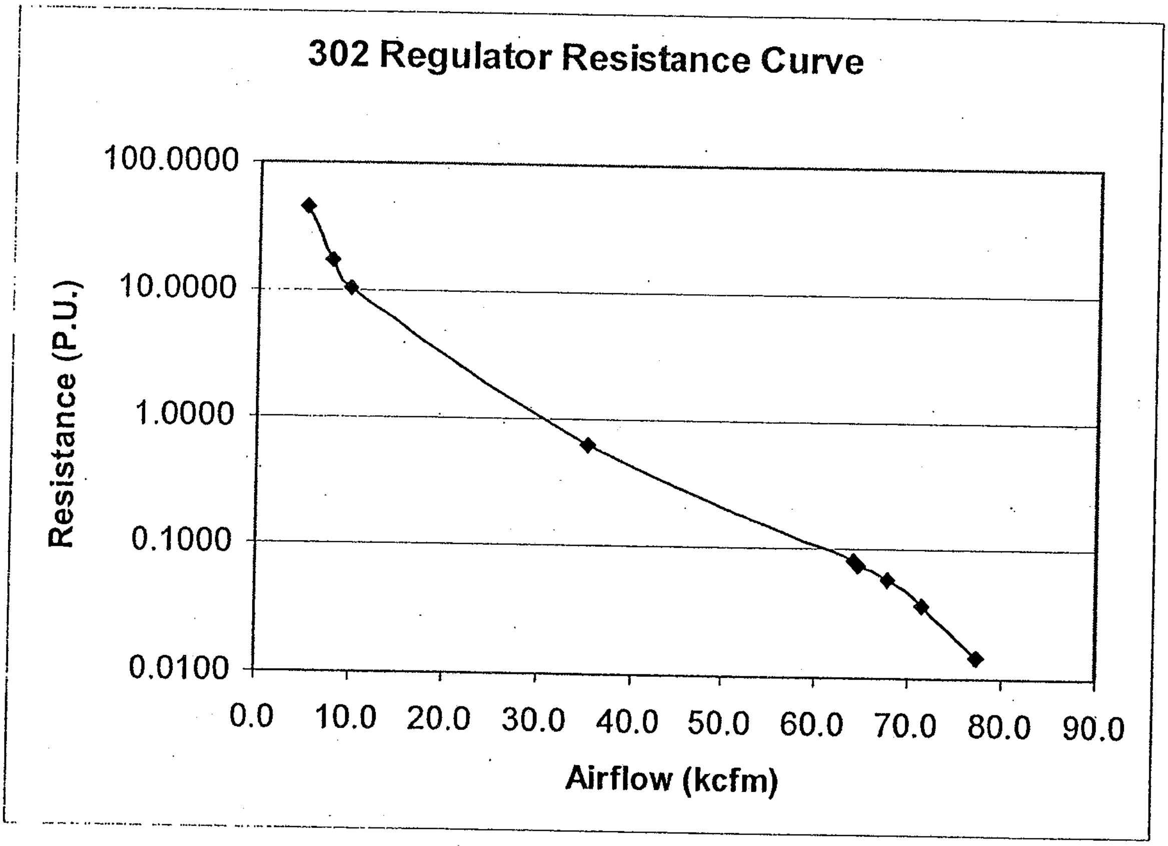
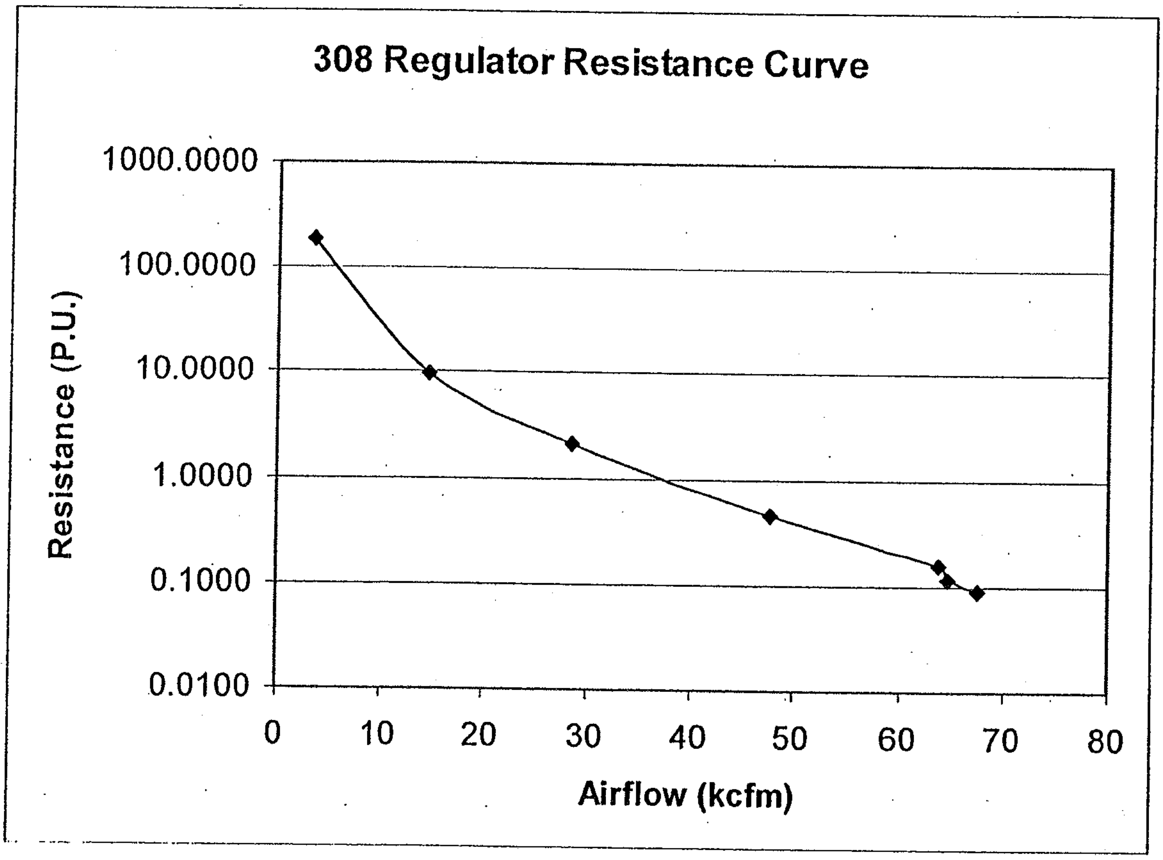
Appendix A: Regulator Resistance Calculations and Curves

This appendix contains the regulator resistance tables and corresponding regulator resistance curves for the four main underground regulators, as well as the regulators in BH 435, Room 7 in Panel 2, and the AIT Louvers in Building 465.

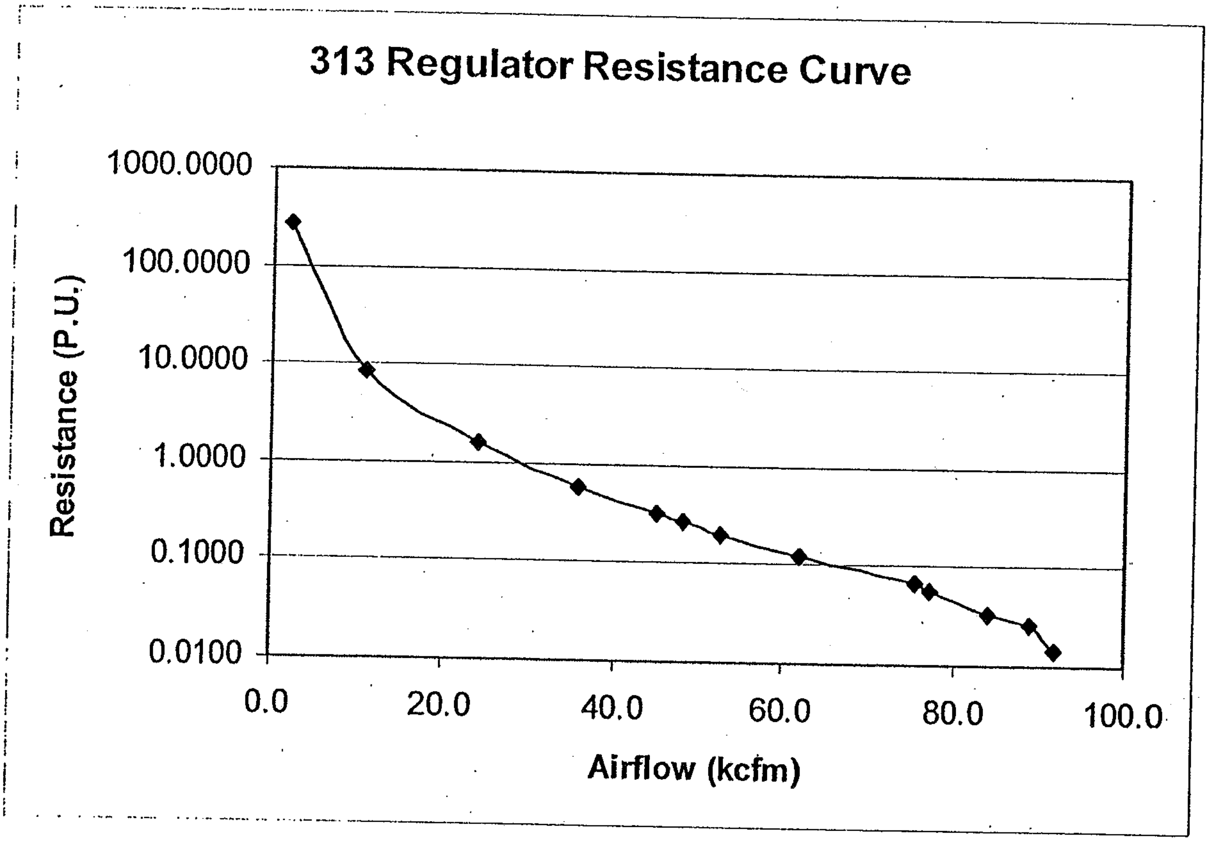
302 Regulator Resistance Data					
Point No.	Upper Louver (% Open)	Lower Louver (% Open)	Overcast Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	0	0	5.0	1144	45.7600
2	25	0	7.9	1063	17.0325
3	50	0	9.7	953	10.1286
4	75	0	35.1	762	0.6185
5	100	0	64.2	338	0.0820
6	100	25	64.7	312	0.0745
7	100	50	67.7	266	0.0580
8	100	75	71.5	185	0.0362
9	100	100	77.4	88	0.0147



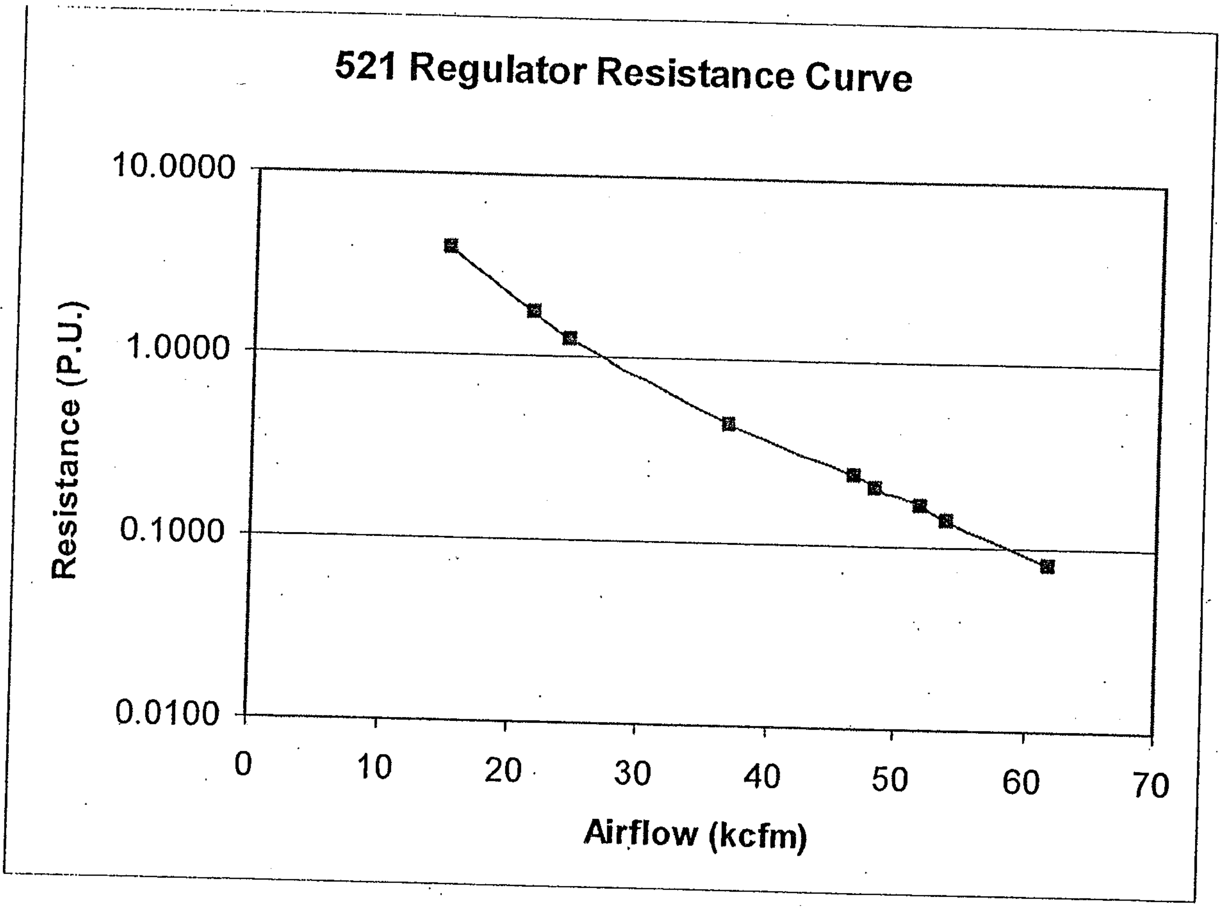
308 Regulator Resistance Data					
Point No.	Upper Louver (% Open)	Lower Louver (% Open)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	0	0	3.6	2377	183.4105
2	25	0	14.7	2147	9.9357
3	50	0	28.6	1711	2.0918
4	75	0	47.8	1017	0.4451
5	100	0	63.7	639	0.1575
6	100	50	64.6	474	0.1136
7	100	75	67.4	409	0.0900
8	100	100	67.6	400	0.0875



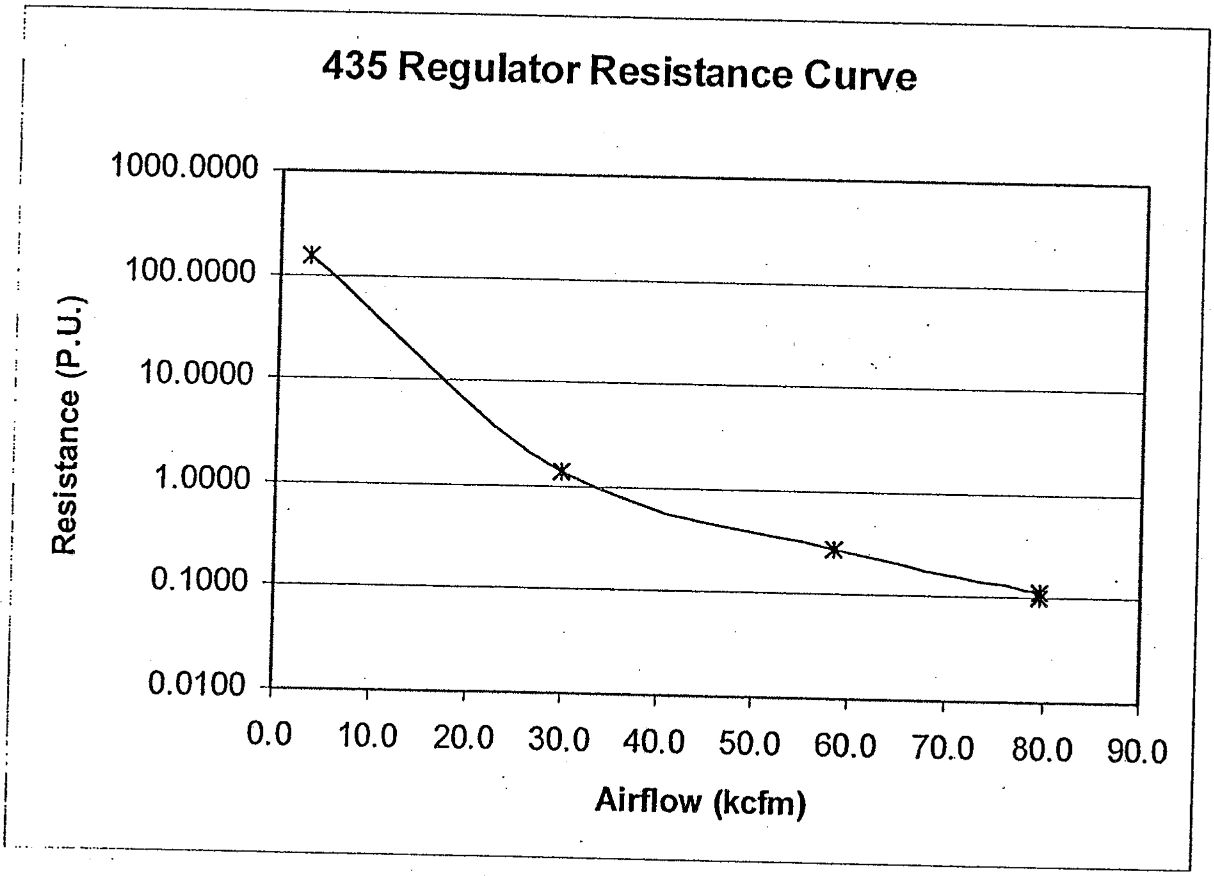
313 Regulator Resistance Data							
Point No.	North Louver (% Open)	N. Middle Louver (% Open)	S. Middle Louver (% Open)	South Louver (% Open)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	0	0	0	0	2.0	1050	262.5000
2	25	0	0	0	10.9	1000	8.4168
3	50	0	0	0	24.0	910	1.5799
4	75	0	0	0	35.8	755	0.5891
5	100	0	0	0	45.0	644	0.3180
6	100	25	0	0	48.2	606	0.2608
7	100	50	0	0	52.7	554	0.1995
8	100	75	0	0	62.1	480	0.1245
9	100	100	0	0	75.4	381	0.0670
10	100	100	50	0	77.1	333	0.0560
11	100	100	100	0	84.2	229	0.0323
12	100	100	100	50	89.1	202	0.0254
13	100	100	100	100	92.0	119	0.0141



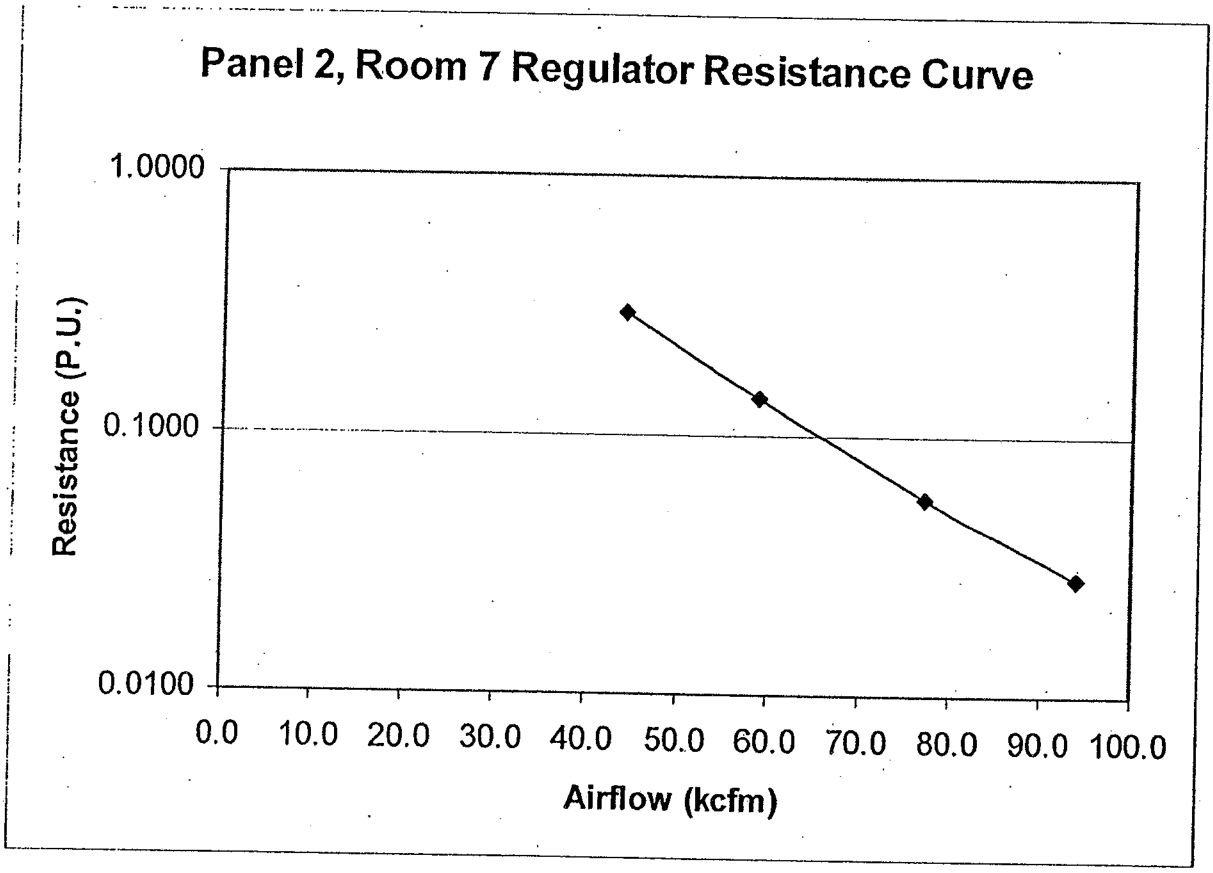
521 Regulator Resistance Data					
Point No.	Upper Louver (% Open)	Lower Louver (% Open)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	0	0	14.8	849	3.8760
2	25	0	21.5	808	1.7480
3	50	0	24.2	733	1.2516
4	75	0	36.8	604	0.4460
5	100	0	46.7	518	0.2375
6	100	25	48.3	478	0.2049
7	100	50	51.8	452	0.1685
8	100	75	53.8	397	0.1372
9	100	100	61.7	302	0.0793



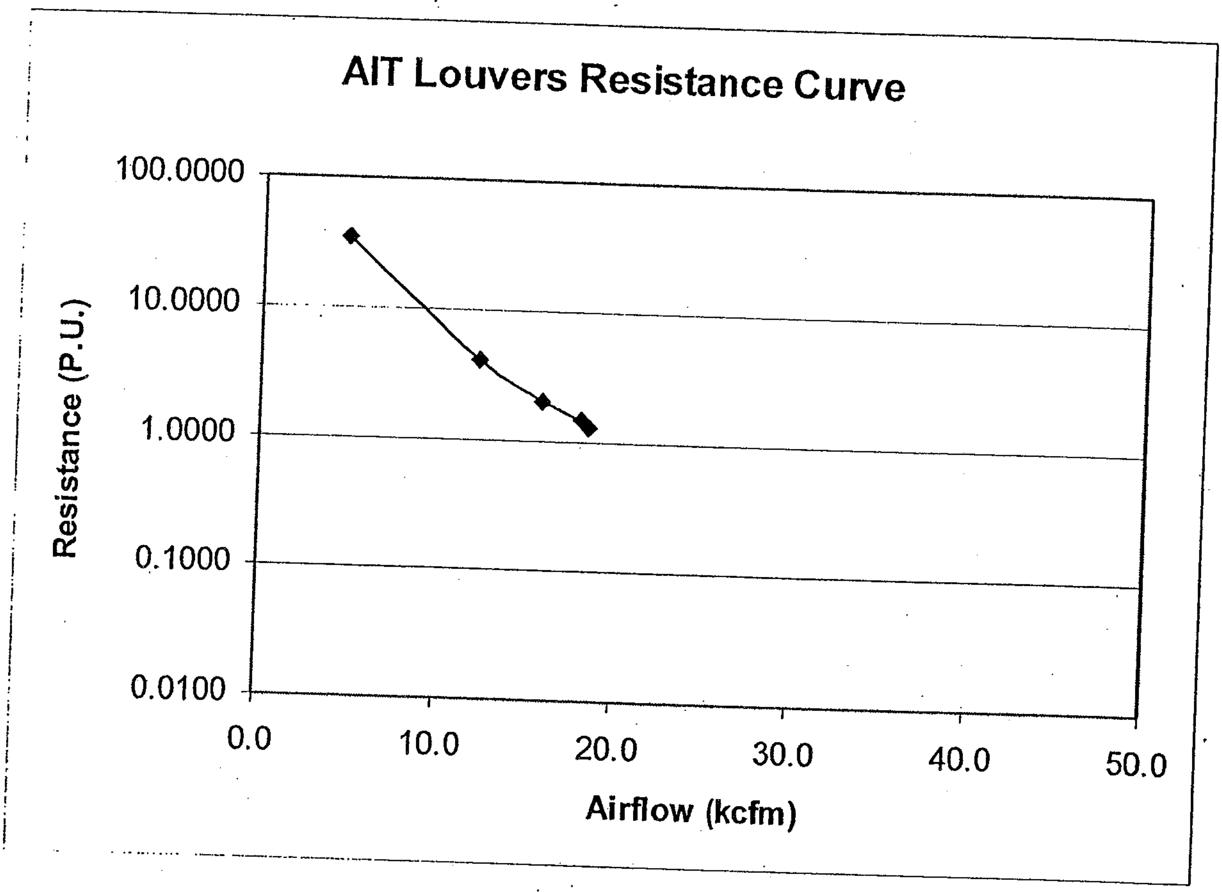
435 Regulator Resistance Data				
Point No.	Percent Open (%)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	0	3.0	1346	149.5556
2	25	29.7	1193	1.3525
3	50	58.4	945	0.2771
4	75	79.6	711	0.1122
5	100	79.6	634	0.1001



Panel 2 Room 7 Regulator Resistance Data				
Point No.	Opening Width (ft)	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	4	44.1	570	0.2931
2	6	59.0	480	0.1379
3	10	77.4	347	0.0579
4	14	94.2	253	0.0285



AIT Louvers Resistance Data				
Point No.	Louver Position	Airflow (kcfm)	Δ Pressure (m. in. w.g.)	Resistance (P.U.)
1	5	4.7	772	34.9479
2	4	12.2	612	4.1118
3	3	15.8	511	2.0469
4	2	18	477	1.4722
5	1	18.4	445	1.3144



Appendix B: NVP Tables and Calculations

This Appendix shows the natural ventilation pressure (NVP) calculation for the various modes of operation tested at the WIPP facility. Psychrometric data obtained between the intake and return airways was used to calculate the NVPs. The polytropic flow processes were assumed to be straight lines, and the area representing each natural ventilating energy (NVE) calculated. The mean density between the intake and return air shafts is used to calculate the NVP: NVP = $\rho_{mean} \int Vdp$ where, $\int Vdp$ = area enclosed in PV diagram between intake and returns (this is termed the Natural Ventilation Energy), and ρ_{mean} = mean density of air in intake and return shafts (AIS, SHS, and waste shaft to exhaust shaft).

Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / CALCULATED DATA

Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. AIS Collar	89.875	16.300	81.030	1.075	0.930	1-2	6365.924
2. AIS Station	96.870	25.300	48.900	1.124	0.890	2-3	-716.506
3. Base of Exhaust Shaft	96.072	28.200	40.860	1.104	0.906	3-4	-7538.178
4. Before Fan	88.010	20.680	57.570	1.037	0.964	5-1	-59.675
5. Fan Outlet	*89.938*						
Input Fan Pressure (kPa):	1.928						

*-ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against
** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units: Metric	System of units: Imperial
Fan Work : 4-5 (J/kg)	1858.828	-
Net Flow Work (J/kg)	-1948.434	-
NVE* (J/kg)	-89.606	-
Mean Density (kg/m3)	1.085	-
NVP (Pa / in. w.g.)**	**97.217**	**0.390**
NVP Standard**	**107.527**	**0.432**

Mine: WIPP
Date of Measurement: 10/07/02
Time of Measurement: 10:30 PM

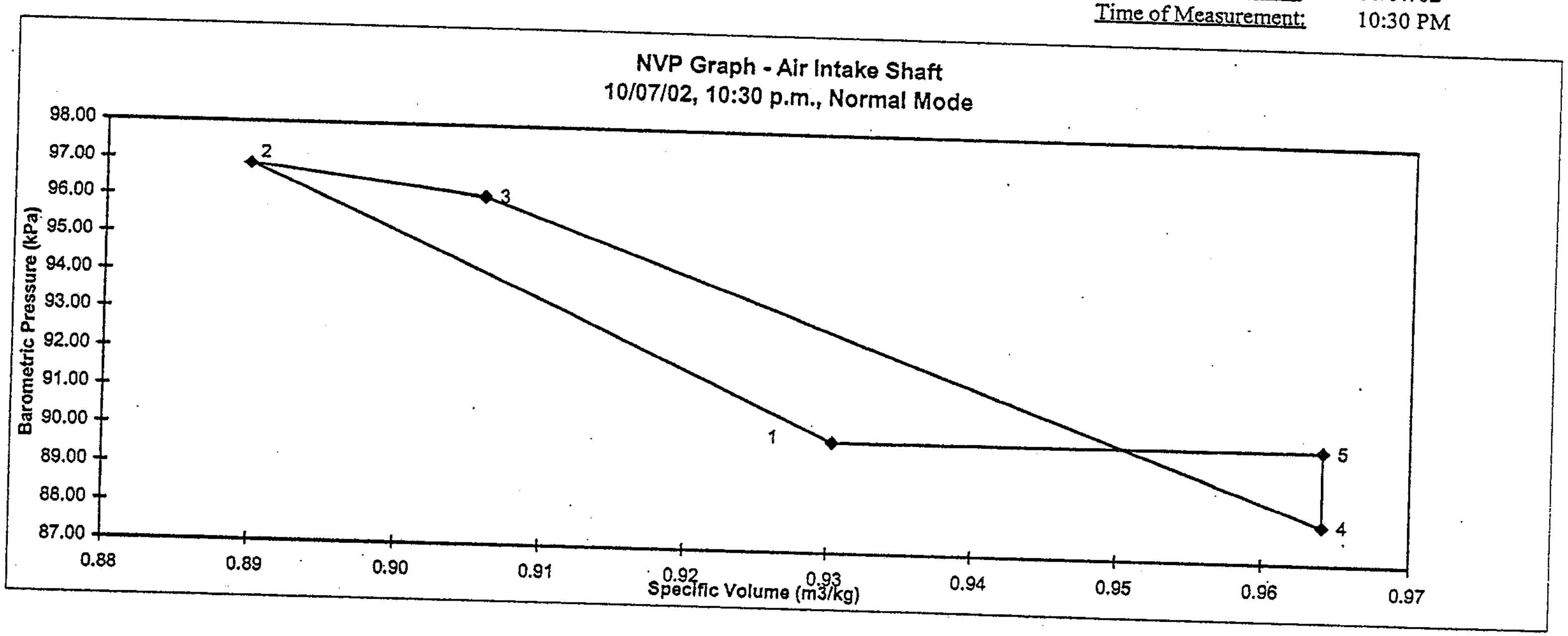


Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / CALCULATED DATA

Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. SHS Collar	89.875	16.300	81.030	1.075	0.930	1-2	6216.232
2. SHS Station	96.681	26.900	44.700	1.116	0.896	2-3	-548.803
3. Base of Exhaust Shaft	96.072	28.200	40.860	1.104	0.906	3-4	-7538.178
4. Before Fan	88.010	20.680	57.570	1.037	0.964	5-1	-59.675
5. Fan Outlet	89.938						
Input Fan Pressure (kPa):	1.928						

* -ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against
** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units: Metric	Imperial
Fan Work : 4-5 (J/kg)	1858.828	-
Net Flow Work (J/kg)	-1930.423	-
NVE* (J/kg)	-71.595	-
Mean Density (kg/m3)	1.083	-
NVP (Pa / in. w.g.)**	77.530	0.311
NVP Standard**	85.914	0.345

Mine: WIPP
Date of Measurement: 10/07/02
Time of Measurement: 10:30 PM

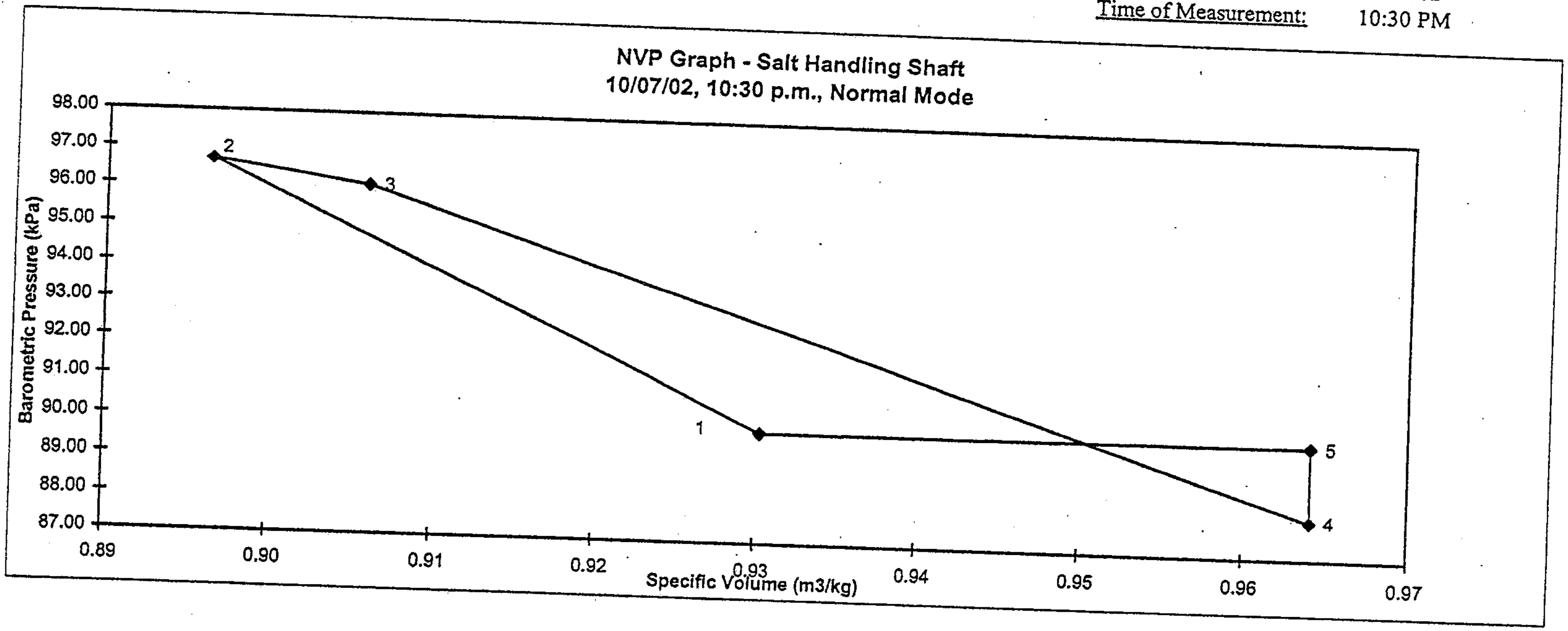


Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / CALCULATED DATA

Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. WS Collar	89.773	15.400	62.940	1.079	0.927	1-2	6171.635
2. WS Station	96.512	29.000	42.820	1.105	0.905	2-3	-398.341
3. Base of Exhaust Shaft	96.072	28.200	40.860	1.104	0.906	3-4	-7538.178
4. Before Fan	88.010	20.680	57.570	1.037	0.964	5-1	-156.010
5. Fan Outlet	*89.938*						
Input Fan Pressure (kPa):	1.928						

* -ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against
** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units	
	Metric	Imperial
Fan Work : 4-5 (J/kg)	1858.828	-
Net Flow Work (J/kg)	-1920.893	-
NVE* (J/kg)	-62.065	-
Mean Density (kg/m3)	1.081	-
NVP (Pa / in. w.g.)**	67.111	0.269
NVP Standard**	74.478	0.299

Mine: WIPP
Date of Measurement: 10/07/02
Time of Measurement: 10:30 PM

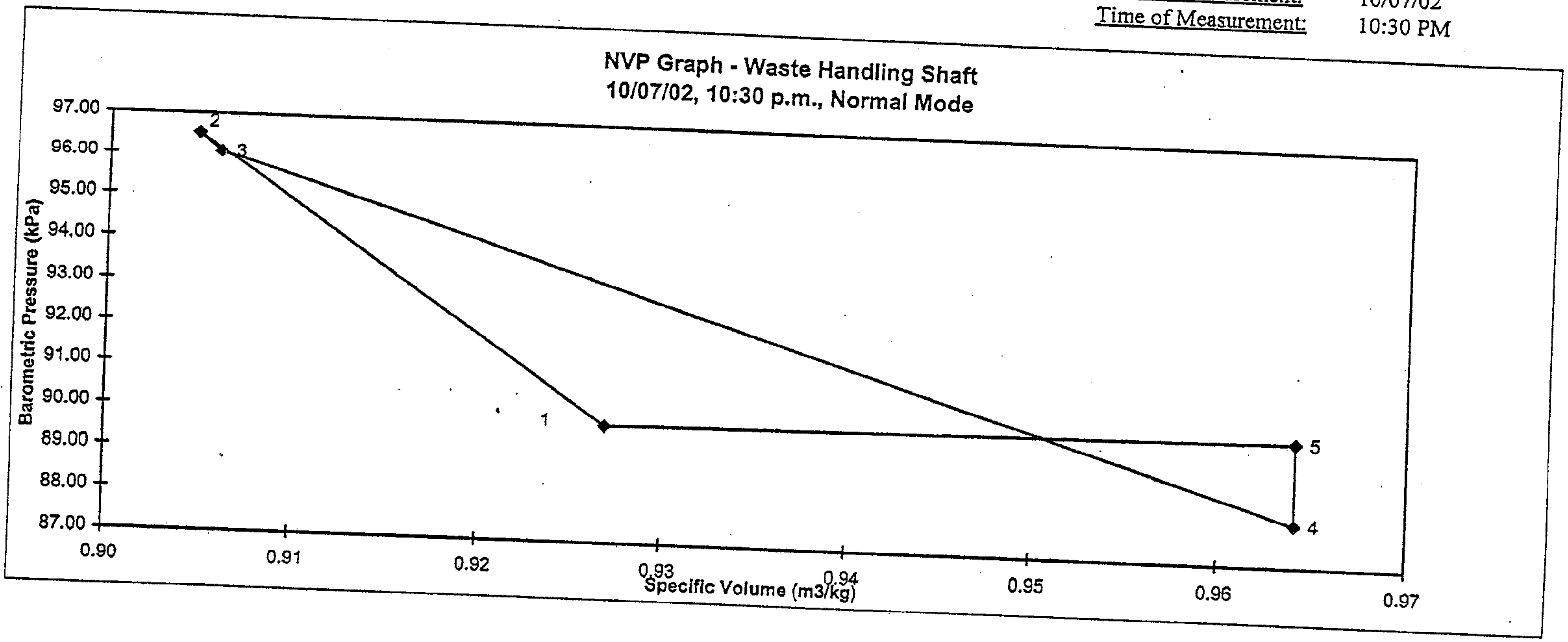


Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / CALCULATED DATA

Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. AIS Collar	89.502	17.600	86.060	1.065	0.939	1-2	6277.793
2. AIS Station	96.330	26.600	51.500	1.112	0.900	2-3	-111.015
3. Base of Exhaust Shaft	96.207	28.300	45.430	1.104	0.906	3-4	-6908.145
4. Before Fan	88.790	21.000	61.670	1.045	0.957	5-1	-129.910
5. Fan Outlet	*89.639*						
Input Fan Pressure (kPa):	0.849						

* -ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against

** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units: Metric	Imperial
Fan Work : 4-5 (J/kg)	812.641	-
Net Flow Work (J/kg)	-871.277	-
NVE* (J/kg)	-58.636	-
Mean Density (kg/m3)	1.081	-
NVP** (Pa / in. w.g.)	63.404	0.255
NVP** Standard	70.363	0.282

Mine: WIPP
Date of Measurement: 10/08/02
Time of Measurement: 8:15 PM

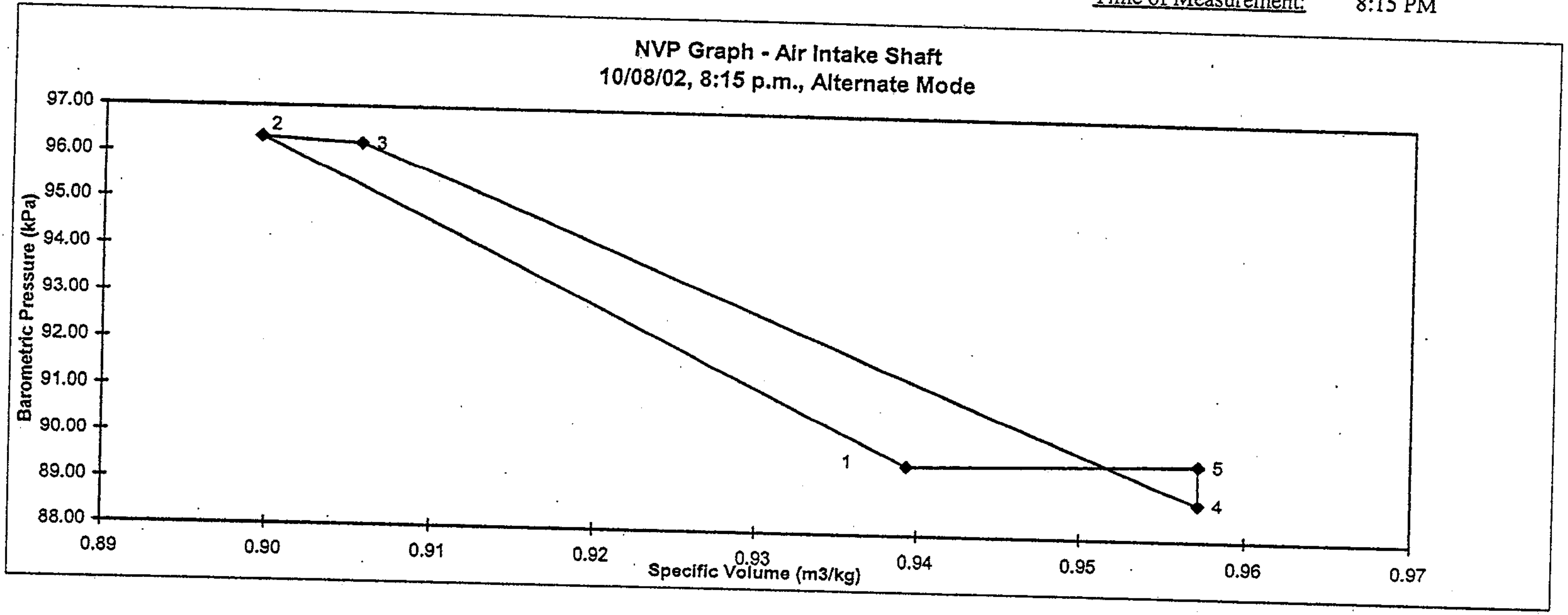


Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / **CALCULATED DATA**

Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. SHS Collar	89.502	17.600	86.060	1.065	0.939	1-2	6263.069
2. SHS Station	96.309	27.000	49.900	1.110	0.901	2-3	-92.130
3. Base of Exhaust Shaft	96.207	28.300	45.430	1.104	0.906	3-4	-6908.145
4. Before Fan	88.790	21.000	61.670	1.045	0.957	5-1	-129.910
5. Fan Outlet	*89.639*						
Input Fan Pressure (kPa):	0.849						

* -ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against
** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units: Metric	Imperial
Fan Work : 4-5 (J/kg)	812.641	-
Net Flow Work (J/kg)	-867.116	-
NVE* (J/kg)	-54.474	-
Mean Density (kg/m3)	1.081	-
NVP (Pa / in. w.g.)**	**58.881**	**0.236**
NVP Standard**	**65.369**	**0.262**

Mine: WIPP
Date of Measurement: 10/08/02
Time of Measurement: 8:15 PM

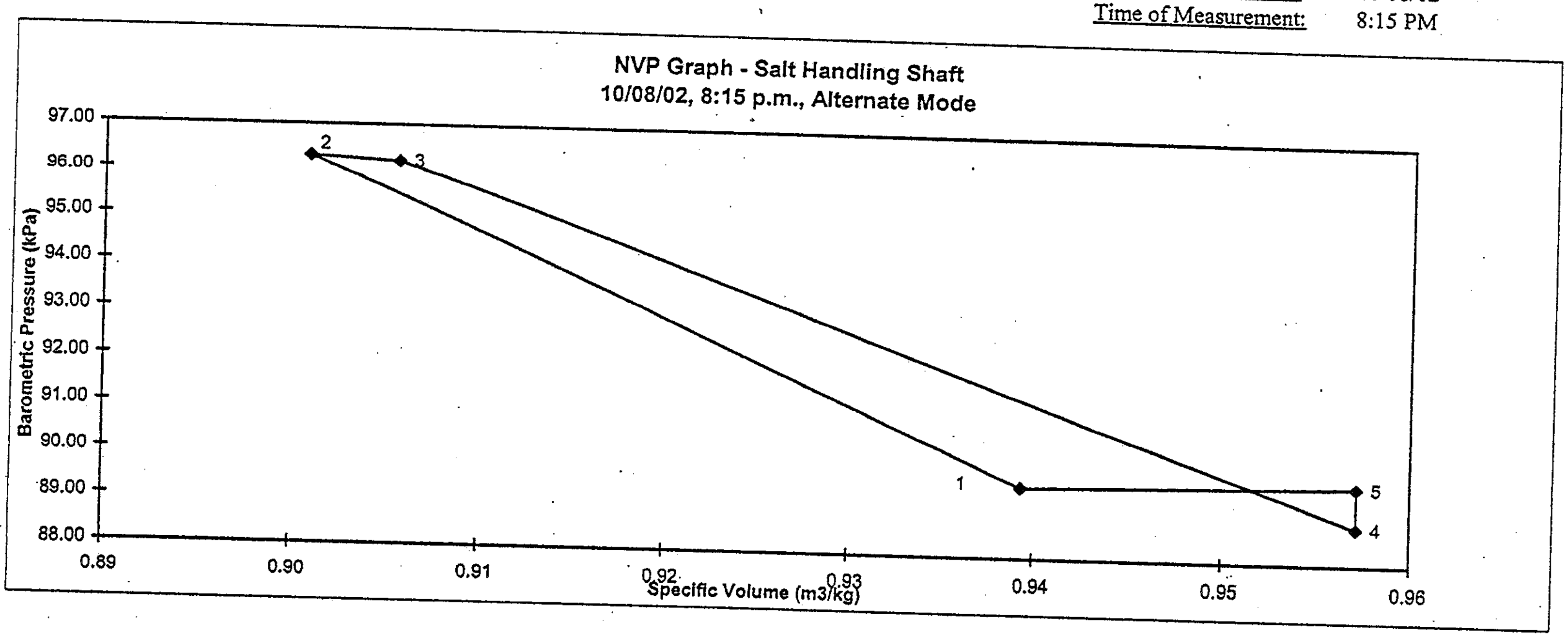


Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / CALCULATED DATA

Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. WS Collar	89.468	14.100	60.600	1.081	0.925	1-2	6121.916
2. WS Station	96.140	29.300	46.000	1.099	0.910	2-3	60.813
3. Base of Exhaust Shaft	96.207	28.300	45.430	1.104	0.906	3-4	-6908.145
4. Before Fan	88.790	21.000	61.670	1.045	0.957	5-1	-160.960
5. Fan Outlet	*89.639*						
Input Fan Pressure (kPa):	0.849						

* -ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against
** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units	
	Metric	Imperial
Fan Work : 4-5 (J/kg)	812.641	-
Net Flow Work (J/kg)	-886.375	-
NVE* (J/kg)	-73.733	-
Mean Density (kg/m3)	1.082	-
NVP (Pa / in. w.g.)**	79.795	0.320
NVP Standard**	88.480	0.355

Mine: WIPP
Date of Measurement: 10/08/02
Time of Measurement: 8:15 PM

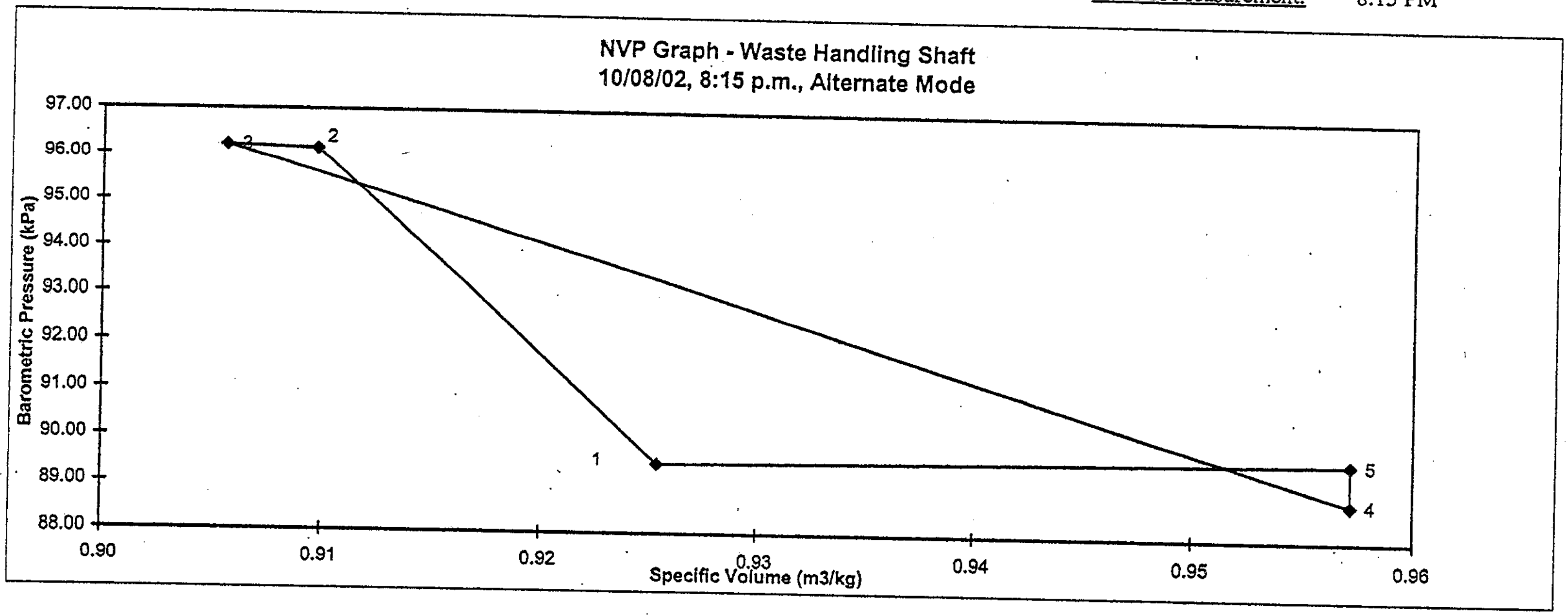


Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / CALCULATED DATA

Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. AIS Collar	89.502	17.600	86.060	1.065	0.939	1-2	6277.793
2. AIS Station	96.330	26.600	51.500	1.112	0.900	2-3	-111.015
3. Base of Exhaust Shaft	96.207	28.300	45.430	1.104	0.906	3-4	-6908.145
4. Before Fan	88.790	21.000	61.670	1.045	0.957	5-1	-527.228
5. Fan Outlet	*90.058*						
Input Fan Pressure (kPa):	1.268						

* -ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against
** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units: Metric	Imperial
Fan Work : 4-5 (J/kg)	1213.698	-
Net Flow Work (J/kg)	-1268.594	-
NVE* (J/kg)	-54.897	-
Mean Density (kg/m3)	1.081	-
NVP (Pa / in. w.g.)**	**59.361**	**0.238**
NVP Standard**	**65.876**	**0.264**

Mine: WIPP
Date of Measurement: 10/08/02
Time of Measurement: 8:15 PM

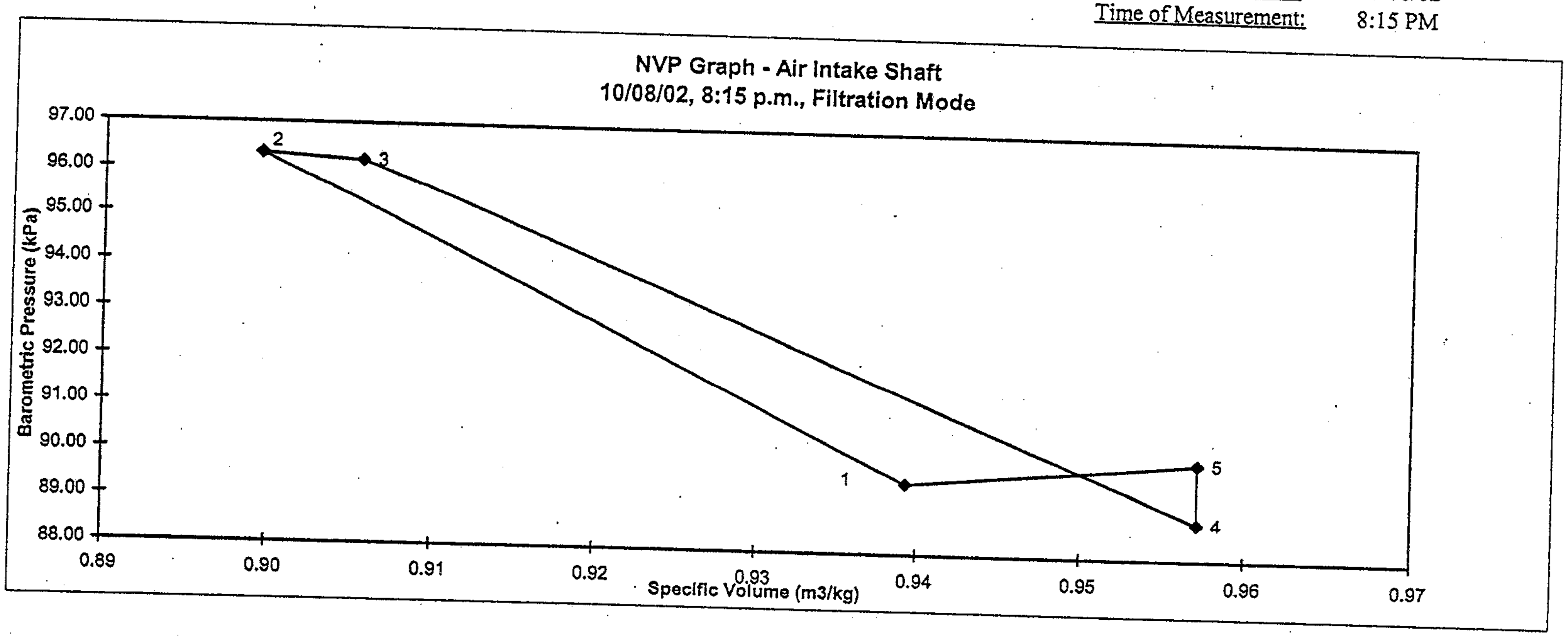


Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / CALCULATED DATA

Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. SHS Collar	89.502	17.600	86.060	1.065	0.939	1-2	6263.069
2. SHS Station	96.309	27.000	49.900	1.110	0.901	2-3	-92.130
3. Base of Exhaust Shaft	96.207	28.300	45.430	1.104	0.906	3-4	-6908.145
4. Before Fan	88.790	21.000	61.670	1.045	0.957	5-1	-527.228
5. Fan Outlet	*90.058*						
Input Fan Pressure (kPa):	1.268						

* -ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against
** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units: Metric	Imperial
Fan Work : 4-5 (J/kg)	1213.698	-
Net Flow Work (J/kg)	-1264.433	-
NVE* (J/kg)	-50.735	-
Mean Density (kg/m3)	1.081	-
NVP (Pa / in. w.g.)**	54.840	0.220
NVP Standard**	60.882	0.244

Mine: WIPP
Date of Measurement: 10/08/02
Time of Measurement: 8:15 PM

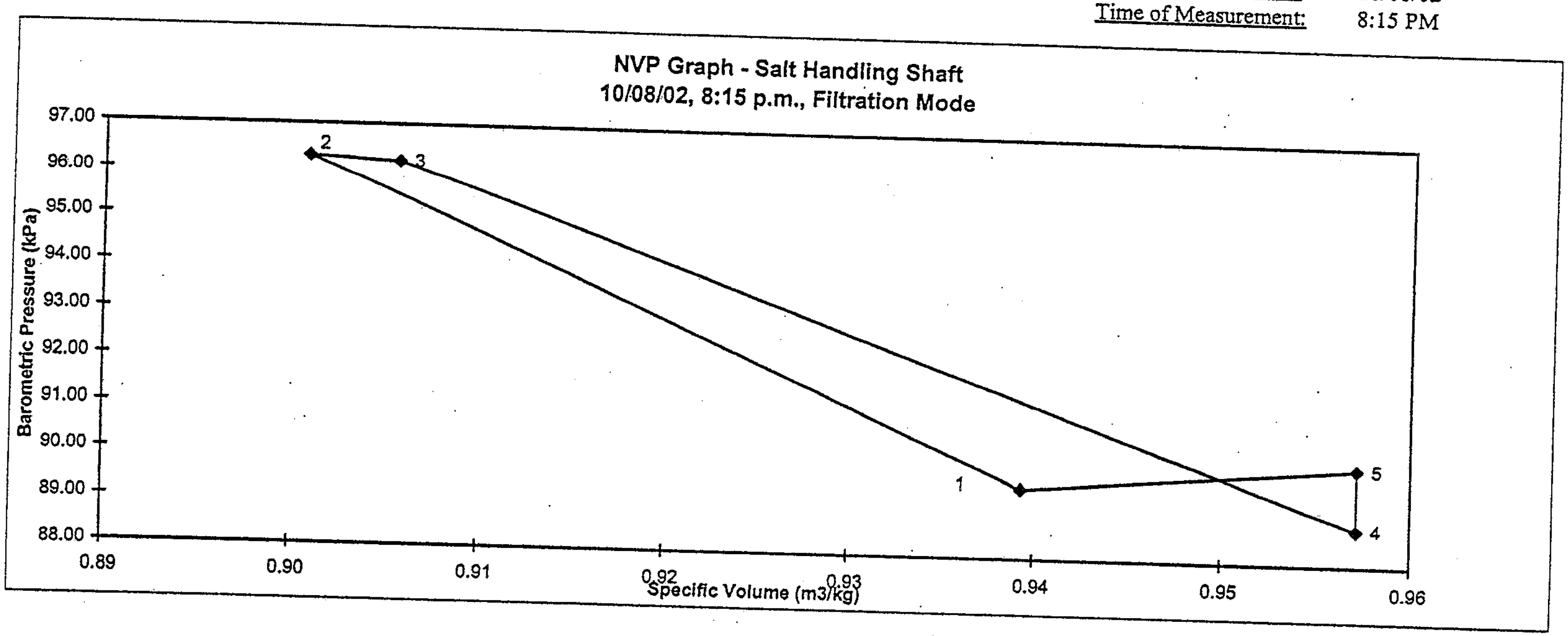


Table to Compute Natural Ventilation Pressures

Exhausting Fan Case

INPUT DATA / **CALCULATED DATA**

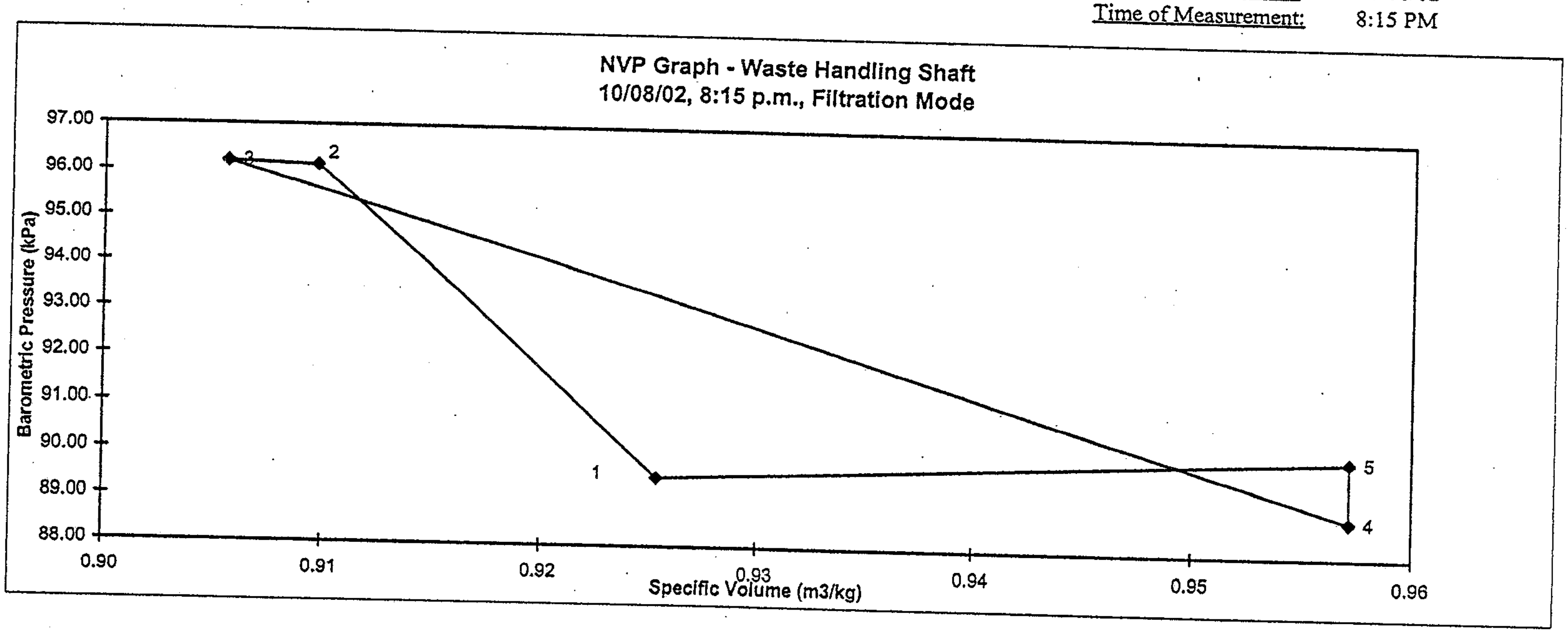
Location	Barometric Pressure (kPa)	Dry Bulb Temperature (C)	Relative Humidity (%)	Density (kg/m3)	Specific Volume (m3/kg)	Points	Flow Work (J/kg)
1. WS Collar	89.468	14.100	60.600	1.081	0.925	1-2	6121.916
2. WS Station	96.140	29.300	46.000	1.099	0.910	2-3	60.813
3. Base of Exhaust Shaft	96.207	28.300	45.430	1.104	0.906	3-4	-6908.145
4. Before Fan	88.790	21.000	61.670	1.045	0.957	5-1	-555.358
5. Fan Outlet	*90.058*						
Input Fan Pressure (kPa):	1.268						

* -ve is work done by the air to overcome airway resistance (aiding the fan).
*+ve is work done on the air by the fan in excess of that required to overcome resistance (against
** -ve is against normal direction of flow / +ve is with normal direction of flow

RESULTS

Natural Ventilation Pressure	System of units: Metric	System of units: Imperial
Fan Work : 4-5 (J/kg)	1213.698	-
Net Flow Work (J/kg)	-1280.773	-
NVE* (J/kg)	-67.075	-
Mean Density (kg/m3)	1.082	-
NVP** (Pa / in. w.g.)	72.590	0.291
NVP** Standard	80.491	0.323

Mine: WIPP
Date of Measurement: 10/08/02
Time of Measurement: 8:15 PM

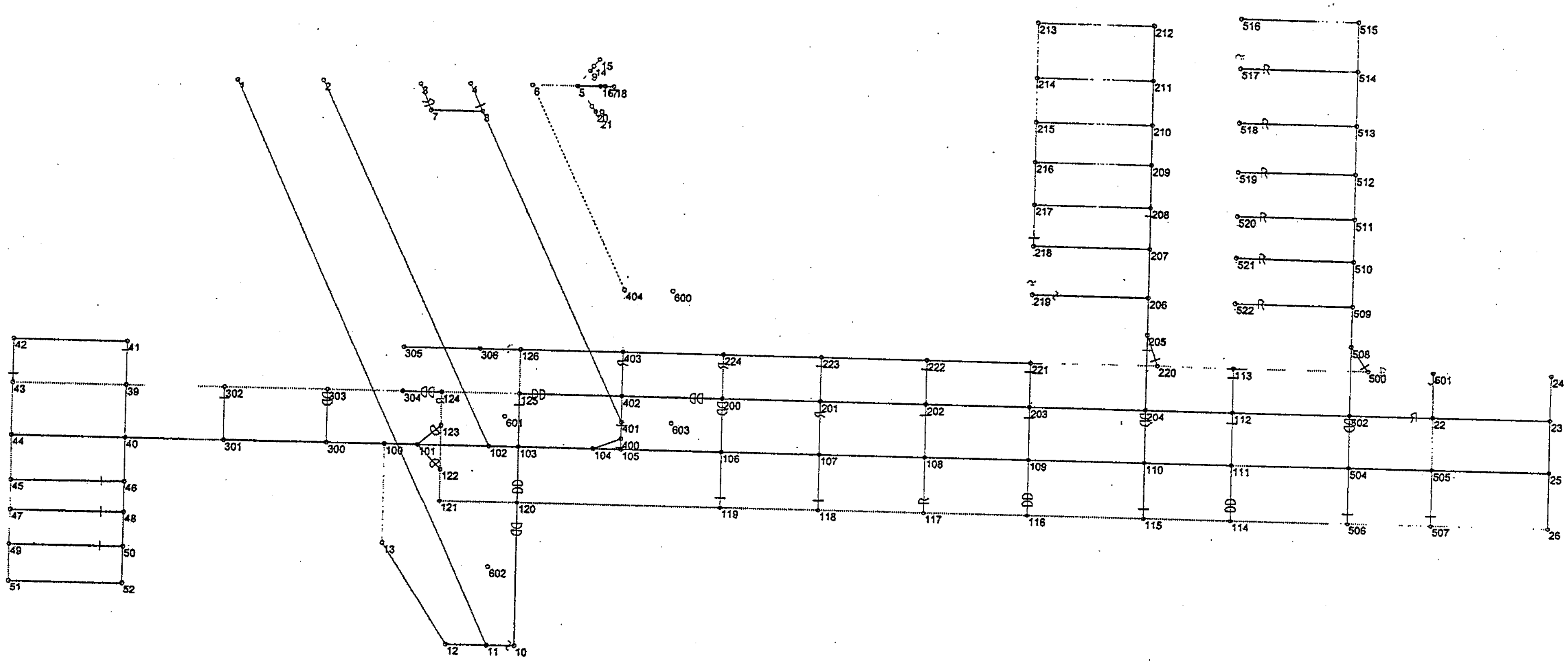


Appendix C: Normal Mode Model Results

This appendix contains the model results generated from the WIPPVENT model of Normal Mode operation at the WIPP facility.

Fixed Q No.	From	To	IR	Fixed Quantity (kcfm)	Booster Pressure (m.in.wg)	Branch Resistance (P.U.)	Regulator Resistance (P.U.)	Total Resistance (P.U.)	Orifice Area (ft²)	Description
1	40	46		28.00	36.3	0.01744				
2	104	400		0.20	1019.6	0.00000				
3	600	404	i	11.70		0.00000	30.17249	30.17249	2.29	
4	102	601	i	3.28	1828.2	0.00000				
5	11	602	i	14.30	1177.9	0.00000				
6	401	603	i	1.77	1921.6	0.00000				

Fan No.	From	To	Fan Pressure (in.w.g.)	Fan Quantity (kcfm)	Air Power (hp)	Operating Cost ($/yr)	Curve Status	Fans in Parallel	Fans in Series	Description
1	20	21	8.119	241.97	309.57	124491	On	1	1	
2	14	15	7.998	246.39	310.52	124876	On	1	1	Fan A



VnetPC 2002
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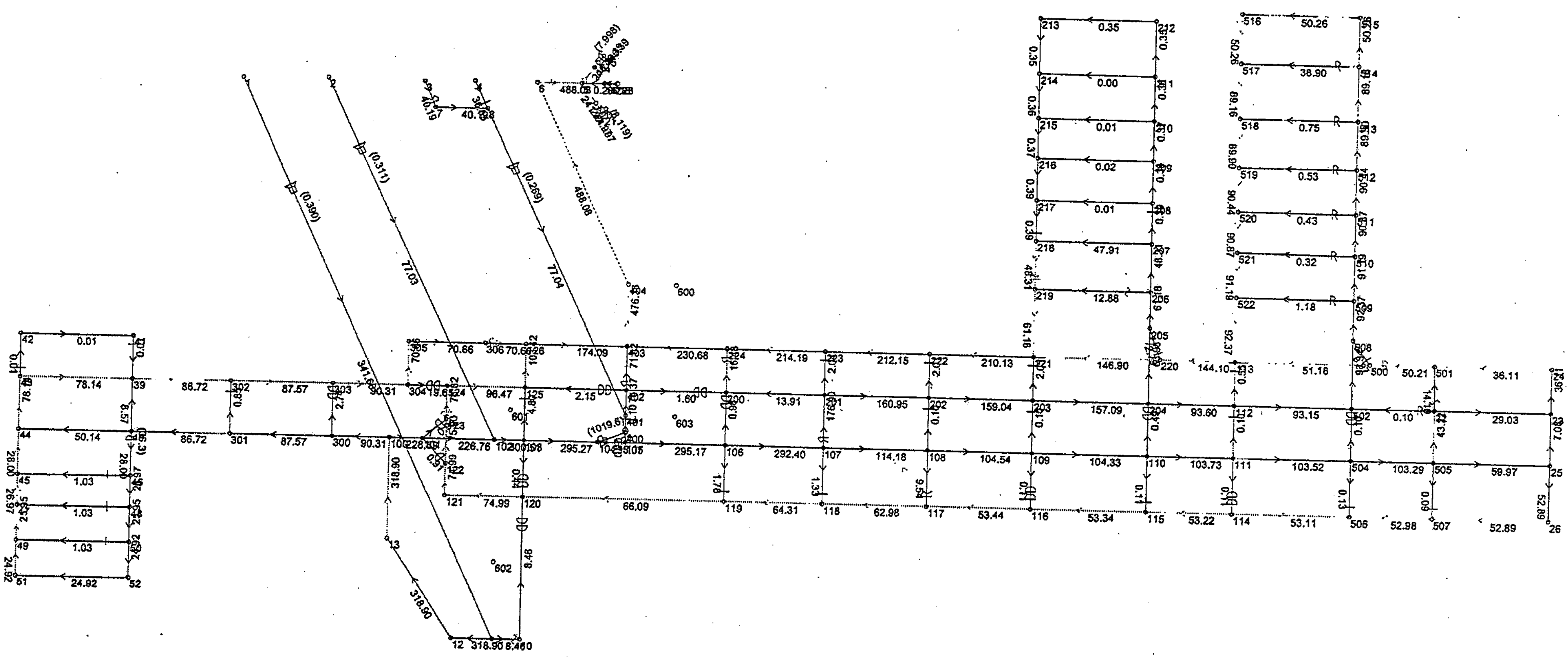
Line Plot
Printed: 12/12/02 13:46:11



VnetPC 2002
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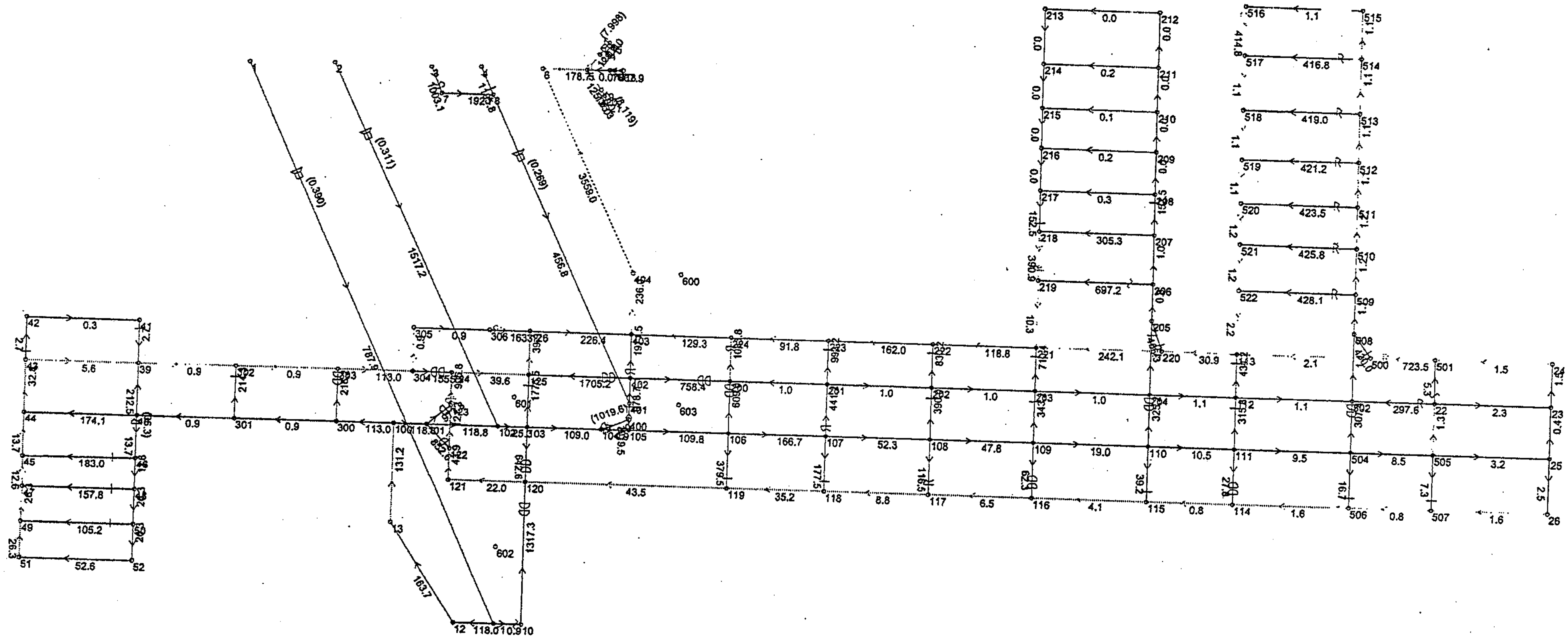
Quantity (kcfm)
Printed: 12/12/02 13:46:45



VnetPC 2002
C:\Documents and Settings\Dan\My Documents\projects\WIPP\2002\2002 T&B\Models\Normal Mode\Normal Mode (Final).vdb
Pressure Drop (m.in.wg)
Printed: 12/12/02 13:47:06

Appendix D: Alternate Mode Model Results

This appendix contains the model results generated from the WIPPVENT model of Alternate Mode operation at the WIPP facility.

Wipp basic model - alternate mode
Avg. Air Density: 0.066(lb/ft³)
Avg. Fan Efficiency: 65.0 %
Cost of Power: 0.0400 $/kWh
Reference Junction: 1
Units: Imperial

Number of Branches: 187
Number of Junctions: 130
Number of Fans: 1
Fixed Quantities: 6

Last Airflow Analysis
Date: 11/06/02
Time: 09:55:41
Modified Since: No

Number of Iterations: 14
Number of Errors: 0

Comments:

2002 WIPP Test and Balance
Alternate Mode
Based on Normal Model
NVP included

NVP added to model based on survey 10/08/02

(a) reg 302 set as fixed resistance from survey p/Q data
(b) reg 308 set as fixed resistance from survey p/Q data
(c) reg 313 set as fixed resistance from survey p/Q data
(d) reg 521 set as fixed resistance from survey p/Q data
(e) reject 9.1 at base of AIS
(f) reject 1.1 at base of SHS
(g) reject 0.7 at base of WS
(h) inject 9.8 at base of ES
note: inject/reject based on measured flows and psychrometrics on 10/08/02
(i)fan curve from survey measured data (August '01): C = 3.408
(j)Resistance for all shafts from previous survey data

Corrlation error with measured survey data equals 4.8%

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
1	306	126	W	0.37930	44.26	743.2	5.18	2084	North Shop-521Regulator
2	40	46	B	0.01744	28.00	13.7	0.06	24	
3	48	46		0.01735	-26.97	-12.6	0.05	22	
4	50	48		0.03906	-25.95	-26.3	0.11	43	
5	52	50		0.04234	-24.92	-26.3	0.10	42	
6	51	52		0.08468	-24.92	-52.6	0.21	83	
7	49	51		0.04234	-24.92	-26.3	0.10	42	
8	49	50		100.00000	-1.03	-105.2	0.02	7	
9	47	49		0.03906	-25.95	-26.3	0.11	43	
10	47	48		150.00000	-1.03	-157.8	0.03	10	
11	45	47		0.01735	-26.97	-12.6	0.05	22	
12	45	46		174.00000	-1.03	-183.0	0.03	12	
13	44	45		0.01744	-28.00	-13.7	0.06	24	
14	44	43		0.00537	51.35	14.2	0.11	46	
15	40	44		0.06925	23.35	37.8	0.14	56	
16	43	39		0.00092	51.34	2.4	0.02	8	
17	42	43		100000.0000	0.00	-2.0	0.00	0	
18	41	42		10000.00000	0.00	-0.2	0.00	0	
19	39	41		100000.0000	0.00	-2.0	0.00	0	
20	40	301		0.00012	-55.68	-0.4	0.00	0	
21	39	40		2.89187	-4.33	-54.3	0.04	15	
22	302	39		0.00012	-55.68	-0.4	0.00	0	
23	26	507		0.00058	40.81	1.0	0.01	0	
24	25	26		0.00090	40.81	1.5	0.01	0	
25	25	23		0.00873	-8.66	-0.7	0.00	0	
26	505	25		0.00088	32.15	0.9	0.00	0	
27	24	501		0.00113	-0.64	0.0	0.00	0	
28	23	24		0.00113	-0.64	0.0	0.00	0	
29	22	23		0.00277	8.02	0.2	0.00	0	
30	22	501		0.02657	2.58	0.2	0.00	0	
31	502	22		31000.00000	-0.08	-191.2	0.00	1	
32	20	21	F	0.00000	290.50	0.0	0.00	0	700C Fan
33	19	20		0.00214	290.50	180.6	8.27	3325	700 C Damper
34	5	19		0.00214	290.50	180.6	8.27	3325	700 C Duct
35	17	18		0.00000	-0.17	0.0	0.00	0	700 B Fan
36	16	17		99999.00000	-0.17	-3051.1	0.08	33	700 B Damper
37	5	16		0.00190	-0.17	0.0	0.00	0	700 B Duct
38	14	15		0.00000	-0.17	0.0	0.00	0	700 A fan branch
39	9	14		99999.00000	-0.17	-3051.1	0.08	33	700 A Damper
40	5	9		0.00214	-0.17	0.0	0.00	0	700 A duct
41	11	1	WN	0.00675	-198.42	-265.8	8.31	3342	AIS
42	102	2	WN	0.19277	-50.73	-496.1	3.97	1595	SHS
43	3	7		34.95000	5.76	1158.7	1.05	423	AIT - Open/One Bank
44	7	8		0.11931	5.76	4.0	0.00	1	AIT
45	4	8		0.88061	36.34	1162.8	6.66	2678	Waste Tower

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
46	401	8	WN	0.00483	-42.10	-8.6	0.06	23	Waste Shaft
47	404	6		0.01494	290.15	1257.8	57.51	23126	Exhaust Shaft
48	6	5		0.00075	290.15	63.1	2.88	1160	Exhaust elbow and duct
49	11	10		0.01208	4.85	0.3	0.00	0	AIS Shaft Station
50	10	120		18.41565	4.85	433.8	0.33	133	S90 to AIS Regulator
51	11	12		0.00116	184.47	39.5	1.15	462	AIS Shaft Station
52	12	13		0.00161	184.47	54.8	1.59	641	Access to AIS
53	13	100		0.00129	184.47	43.9	1.28	513	Access to AIS
54	100	300		0.01385	57.51	45.8	0.42	167	E0 North
55	300	301		0.00012	56.12	0.4	0.00	0	E0
56	301	302		295.00000	0.43	55.1	0.00	2	E0/E140
57	302	303		0.00012	56.12	0.4	0.00	0	E140
58	300	303		28.80859	1.39	55.8	0.01	5	E0/E140
59	303	304		0.01385	57.51	45.8	0.42	167	E140
60	304	124		4.02875	13.24	706.6	1.47	593	Doors E140
61	304	305		0.00018	44.26	0.4	0.00	0	N. Shop Entrance
62	305	306		0.00018	44.26	0.4	0.00	0	N. Shop
63	100	101		0.00227	126.96	36.6	0.73	294	
64	101	123		1163.00000	0.55	351.0	0.03	12	
65	101	122		1025.00000	0.53	291.7	0.02	10	
66	101	102		0.00231	125.88	36.6	0.73	292	
67	102	103		0.00028	175.51	8.6	0.24	96	
68	103	104		0.00125	172.05	37.0	1.00	403	
69	104	105		0.00001	171.85	0.3	0.00	0	
70	105	106		0.00126	171.93	37.2	1.01	405	
71	106	107		0.00195	170.29	56.5	1.52	610	
72	107	108		0.00401	48.52	9.4	0.07	29	
73	108	109		0.00437	43.76	8.4	0.06	23	
74	109	110		0.00175	43.63	3.3	0.02	9	
75	110	111		0.00098	43.19	1.8	0.01	0	
76	111	112		32400.00000	0.08	194.0	0.00	1	
77	112	113		1416.00000	0.52	376.7	0.03	12	
78	111	114		2200.00000	0.06	7.9	0.00	0	
79	114	115		0.00029	41.01	0.5	0.00	0	
80	115	116		0.00143	41.06	2.4	0.02	6	
81	116	117		0.00227	41.12	3.8	0.02	10	
82	117	118		0.00221	45.81	4.6	0.03	13	
83	118	119		0.00852	46.46	18.4	0.13	54	
84	119	120		0.00995	47.45	22.4	0.17	67	
85	120	121		0.00391	52.56	10.8	0.09	36	
86	121	122		0.00781	52.56	21.6	0.18	72	
87	122	123		0.02103	53.09	59.3	0.50	199	
88	123	124	W	0.16210	53.64	466.4	3.94	1585	
89	124	125		0.00426	66.88	19.1	0.20	81	BH302
90	125	126		0.00373	70.42	18.5	0.21	83	

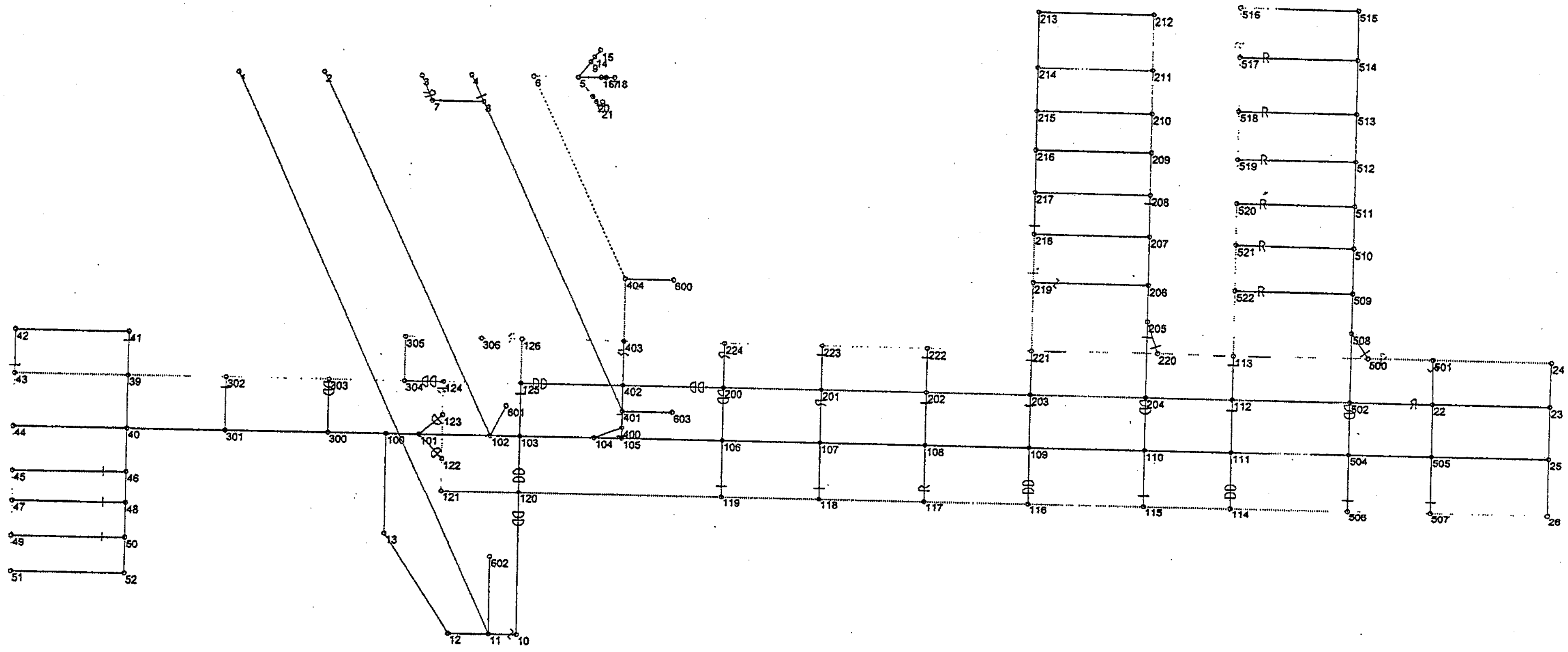
Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
91	126	403		0.00747	114.68	98.2	1.77	714	
92	103	120		3276.00000	0.26	214.1	0.01	4	
93	106	119		119.11357	0.99	117.2	0.02	7	
94	107	118		100.69444	0.65	42.3	0.00	2	
95	108	117		1.28125	4.69	28.2	0.02	8	
96	109	116		5600.00000	0.05	16.0	0.00	0	
97	110	115		3100.00000	0.06	10.3	0.00	0	
98	107	201	W	0.01467	121.12	215.2	4.11	1652	BH313
99	201	200		0.00541	11.97	0.8	0.00	0	
100	201	202		0.00004	107.70	0.5	0.01	0	
101	202	203		0.00004	106.29	0.5	0.01	0	
102	203	204		0.00004	104.78	0.4	0.00	0	
103	204	205		0.00025	49.73	0.6	0.00	0	
104	205	206		0.00021	47.20	0.5	0.00	0	
105	206	207		0.00044	37.27	0.6	0.00	0	
106	207	208		1000.00000	0.30	90.7	0.00	0	
107	208	209		0.22770	0.30	0.0	0.00	2	
108	209	210		0.22770	0.28	0.0	0.00	0	
109	210	211		0.22770	0.27	0.0	0.00	0	
110	211	212		0.22770	0.27	0.0	0.00	0	
111	212	213		0.22770	0.27	0.0	0.00	0	
112	213	214		0.22708	0.27	0.0	0.00	0	
113	214	215		0.22770	0.27	0.0	0.00	0	
114	215	216		0.22770	0.28	0.0	0.00	0	
115	216	217		0.22770	0.30	0.0	0.00	0	
116	217	218		1000.00000	0.30	90.7	0.00	0	
117	218	219		0.16753	37.27	232.7	1.37	2	
118	219	221		0.00276	47.20	6.1	0.05	550	
119	220	221		0.01122	60.14	40.6	0.38	18	
120	221	222		0.00269	108.92	31.9	0.55	155	
121	222	223		0.00360	110.41	43.9	0.76	220	
122	223	224		0.00200	111.86	25.0	0.44	307	
123	224	403		0.00243	123.32	37.0	0.72	177	
124	104	400	B	0.00000	0.20	0.0	0.00	289	
125	400	105		99900.00000	0.08	674.3	0.01	0	BH309
126	400	401		99900.00000	0.12	1387.3	0.03	3	BH309
127	103	125		76.96000	3.21	790.8	0.40	11	BH309
128	106	200		638.00000	0.65	272.5	0.03	161	
129	108	202		36400.00000	0.08	206.2	0.00	11	
130	109	203		35200.00000	0.08	198.3	0.00	1	
131	110	204		1328.00000	0.38	195.4	0.01	1	
132	112	204		0.00013	-55.44	-0.4	0.00	5	
133	113	220		0.00149	57.62	4.9	0.04	0	
134	205	220		59.69388	2.53	380.9	0.15	18	
135	206	219		4.20361	9.93	414.8	0.65	61	
								261	

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
136	207	218		0.13296	36.97	181.7	1.06	426	
137	208	217		10000.00000	0.00	0.2	0.00	0	
138	209	216		796.00000	0.01	0.1	0.00	0	
139	210	215		788.00000	0.01	0.1	0.00	0	
140	211	214		10000.00000	0.00	0.1	0.00	0	
141	203	221		169.00000	1.58	422.4	0.11	42	
142	202	222		204.75000	1.49	454.8	0.11	43	
143	201	223		237.50000	1.45	499.1	0.11	46	
144	200	224		3.98904	11.45	523.3	0.94	380	
145	401	402		0.00020	41.51	0.3	0.00	0	
146	402	403	W	0.08753	42.35	157.0	1.05	421	
147	403	404		0.00104	280.35	81.7	3.61	1451	Reg 308
148	402	200		296.44444	-1.17	-403.2	0.07	30	
149	402	125		367.50000	0.33	40.2	0.00	1	
150	600	404	R	18.01352	9.80	1730.0	2.67	1074	
151	102	601	B	0.00000	1.10	0.0	0.00	0	Exhaust Shaft I/J
152	11	602	B	0.00000	9.10	0.0	0.00	0	Salt Shaft I/J
153	401	603	B	0.00000	0.70	0.0	0.00	0	AIS I/J
154	111	504		0.00089	43.05	1.6	0.01	0	Waste Shaft
155	504	505		0.00080	42.90	1.5	0.01	0	
156	505	507		900.00000	0.06	3.4	0.00	0	
157	507	506		0.00029	40.87	0.5	0.00	0	
158	506	114		0.00057	40.95	1.0	0.01	0	
159	504	502		31600.00000	0.08	192.7	0.00	1	
160	505	22		0.00068	10.68	0.1	0.00	0	
161	112	502		0.00013	55.00	0.4	0.00	0	
162	502	508		0.00013	55.16	0.4	0.00	0	
163	501	500	W	149.50000	1.95	566.5	0.17	70	435 Regulator
164	500	113		0.00080	2.85	0.0	0.00	0	
165	508	500		458.02469	0.90	375.1	0.05	21	
166	522	113		0.00026	54.25	0.8	0.01	0	
167	508	509		0.00013	54.25	0.4	0.00	0	
168	514	517		1476.00000	0.50	370.1	0.03	12	
169	513	518		753.06122	0.70	370.8	0.04	16	
170	512	519		1476.00000	0.50	371.6	0.03	12	
171	511	520		2306.25000	0.40	372.3	0.02	9	
172	510	521		4100.00000	0.30	373.1	0.02	7	
173	509	522		304.95868	1.11	373.9	0.07	26	
174	504	506		1000.00000	0.07	5.3	0.00	0	
175	509	510		0.00014	53.14	0.4	0.00	0	
176	510	511		0.00014	52.84	0.4	0.00	0	
177	511	512		0.00014	52.44	0.4	0.00	0	
178	512	513		0.00014	51.94	0.4	0.00	0	
179	513	514		0.00014	51.24	0.4	0.00	0	
180	514	515		0.00045	50.74	1.2	0.01	0	

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
181	515	516		0.00045	50.74	1.2	0.01	0	
182	516	517	W	0.14300	50.74	368.1	2.94	1184	
183	517	518		0.00014	51.24	0.4	0.00	0	
184	518	519		0.00014	51.94	0.4	0.00	0	
185	519	520		0.00014	52.44	0.4	0.00	0	
186	520	521		0.00014	52.84	0.4	0.00	0	
187	521	522		0.00014	53.14	0.4	0.00	0	

Fixed Q No.	From	To	IR	Fixed Quantity (kcfm)	Booster Pressure (m.in.wg)	Branch Resistance (P.U.)	Regulator Resistance (P.U.)	Total Resistance (P.U.)	Orifice Area (ft²)	Description
1	40	46		28.00	172.6	0.01744				
2	104	400		0.20	674.1	0.00000				
3	600	404	i	9.80		0.00000	18.01352	18.01352	2.96	
4	102	601	i	1.10	732.1	0.00000				
5	11	602	i	9.10	520.8	0.00000				
6	401	603	i	0.70	1491.0	0.00000				

Fan No.	From	To	Fan Pressure (in.w.g.)	Fan Quantity (kcfm)	Air Power (hp)	Operating Cost ($/yr)	Curve Status	Fans in Parallel	Fans in Series	Description
1	20	21	3.412	290.50	156.19	62810	On	1	1	Fan C, 105 d



VnetPC 2002
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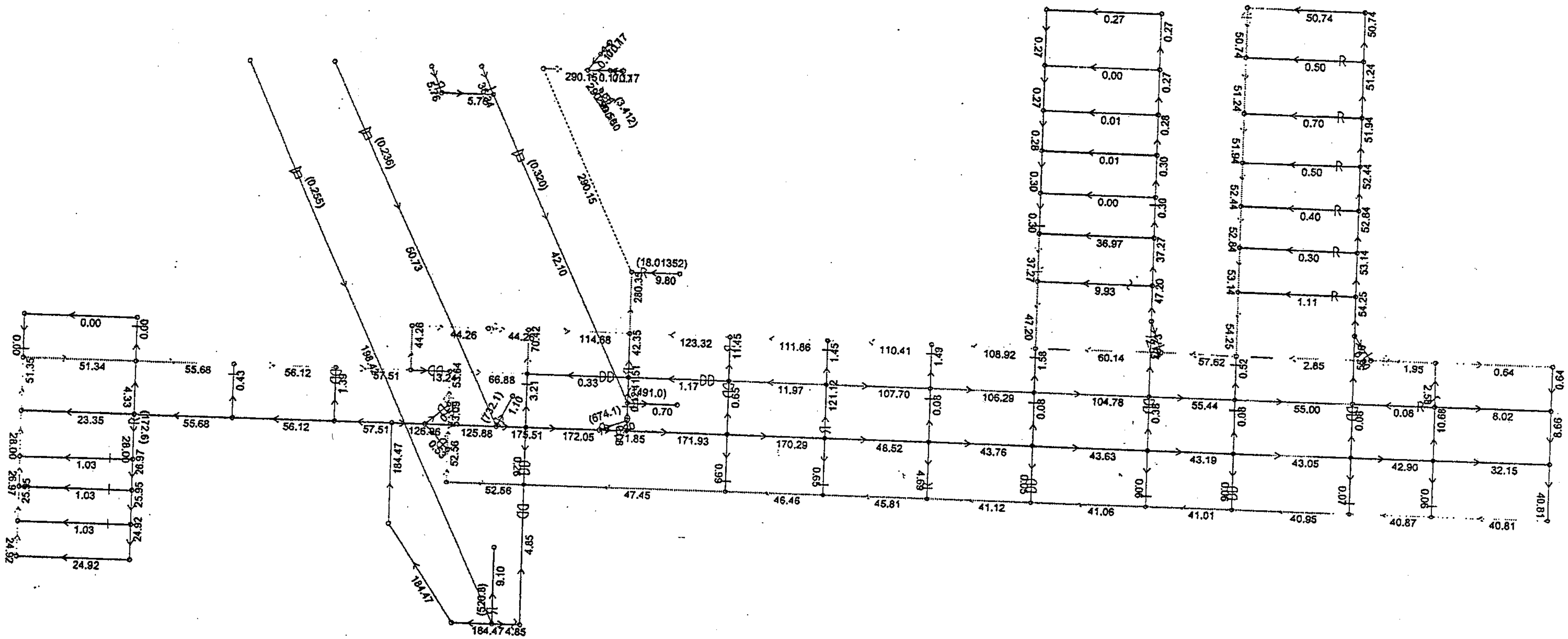
Line Plot
Printed: 12/12/02 14:04:46



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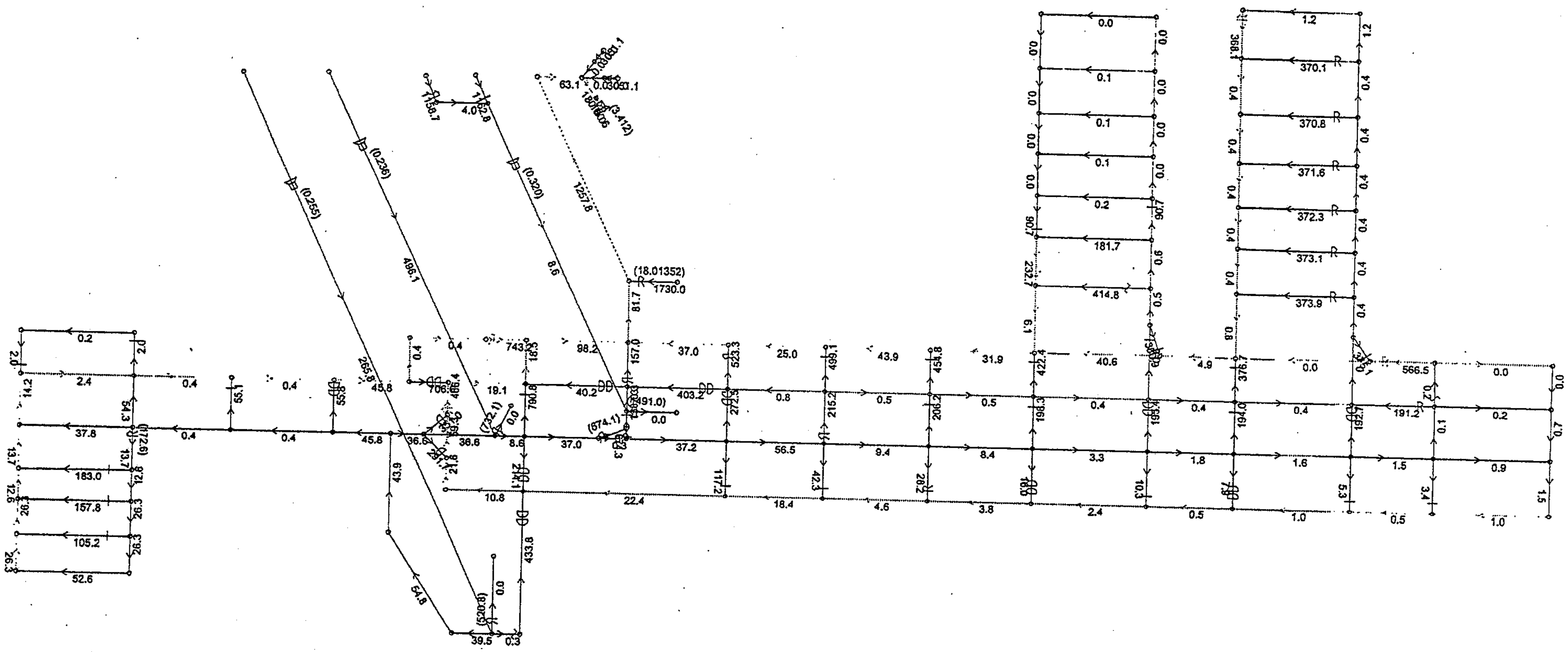
VnetPC 2002
Quantity (kcfm)
Printed: 12/12/02 14:05:16



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Pressure Drop (m.in.wg)
Printed: 12/12/02 14:05:33

Appendix E: Filtration Mode Model Results

This appendix contains the model results generated from the WIPPVENT model of Filtration Mode operation at the WIPP facility.

Wipp basic model - filtration mode
Avg. Air Density: 0.066(lb/ft³)
Avg. Fan Efficiency: 65.0 %
Cost of Power: 0.0400 $/kWh
Reference Junction: 1
Units: Imperial

Number of Branches: 180
Number of Junctions: 123
Number of Fans: 1
Fixed Quantities: 5

Last Airflow Analysis
Date: 11/08/02
Time: 16:06:21
Modified Since: No

Number of Iterations: 6
Number of Errors: 0

Comments:

2002 WIPP Test and Balance
Filtration Mode
Based on Normal Model
NVP included

NVP added to model based on survey 10/08/02

(a) reg 302 set as fixed resistance from survey p/Q data
(b) reg 308 set as fixed resistance from survey p/Q data
(c) reg 313 set as fixed resistance from survey p/Q data
(d) reg 521 set as fixed resistance from survey p/Q data
(e) reject 0.4 at base of AIS
(f) reject 0.6 at base of SHS
(g) reject 0.7 at base of WS
(h) inject 2.3 at base of ES
note: inject/reject based on measured flows and psychrometrics on 10/08/02
(i)fixed pressure exhaust fans from survey measured data: 860A = 5.094
(j)Resistance for all shafts from previous survey data

Corrlation error with measured survey data equals 5.0%

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
1	28	29	F	0.00000	65.22	0.0	0.00	0	
2	27	28		0.74930	65.22	3187.6	32.76	13174	Filtration Building
3	6	27		0.00075	65.22	3.2	0.03	13	Filtration System
4	306	126	W	0.37930	2.23	1.9	0.00	0	North Shop-521Regulator
5	40	46		0.01744	0.84	0.0	0.00	0	
6	48	46		0.01735	-0.81	0.0	0.00	0	
7	50	48		0.03906	-0.78	0.0	0.00	0	
8	52	50		0.04234	-0.75	0.0	0.00	0	
9	51	52		0.08468	-0.75	0.0	0.00	0	
10	49	51		0.04234	-0.75	0.0	0.00	0	
11	49	50		100.00000	-0.03	-0.1	0.00	0	
12	47	49		0.03906	-0.78	0.0	0.00	0	
13	47	48		150.00000	-0.03	-0.1	0.00	0	
14	45	47		0.01735	-0.81	0.0	0.00	0	
15	45	46		174.00000	-0.03	-0.2	0.00	0	
16	44	45		0.01744	-0.84	0.0	0.00	0	
17	44	43		0.00537	2.51	0.0	0.00	0	
18	40	44		0.06925	1.66	0.2	0.00	0	
19	43	39		0.00092	2.51	0.0	0.00	0	
20	42	43		100000.0000	0.00	0.0	0.00	0	
21	41	42		10000.00000	0.00	0.0	0.00	0	
22	39	41		100000.0000	0.00	0.0	0.00	0	
23	40	301		0.00012	-2.79	0.0	0.00	0	
24	39	40		2.89187	-0.28	-0.2	0.00	0	
25	302	39		0.00012	-2.79	0.0	0.00	0	
26	26	507		0.00058	0.62	0.0	0.00	0	
27	25	26		0.00090	0.62	0.0	0.00	0	
28	25	23		0.00873	0.93	0.0	0.00	0	
29	505	25		0.00088	1.56	0.0	0.00	0	
30	24	501		0.00113	2.41	0.0	0.00	0	
31	23	24		0.00113	2.41	0.0	0.00	0	
32	22	23		0.00277	1.48	0.0	0.00	0	
33	22	501		0.02657	0.85	0.0	0.00	0	
34	502	22		31000.00000	-0.23	-1589.9	0.06	23	
35	11	1	WN	0.00675	-9.34	-0.6	0.00	0	AIS
36	102	2	WN	0.19277	-9.94	-19.0	0.03	12	SHS
37	3	7		34.95000	6.20	1344.8	1.31	528	AIT - Closed
38	7	8		0.11931	6.20	4.6	0.00	2	AIT
39	4	8		0.88061	39.14	1349.4	8.32	3347	Waste Tower
40	401	8	WN	0.00483	-45.35	-9.9	0.07	28	Waste Shaft
41	404	6		0.01494	65.22	63.6	0.65	263	Exhaust Shaft
42	11	10		0.01208	0.32	0.0	0.00	0	AIS Shaft Station
43	10	120		18.41565	0.32	1.9	0.00	0	S90 to AIS Regulator
44	11	12		0.00116	8.62	0.1	0.00	0	AIS Shaft Station
45	12	13		0.00161	8.62	0.1	0.00	0	Access to AIS

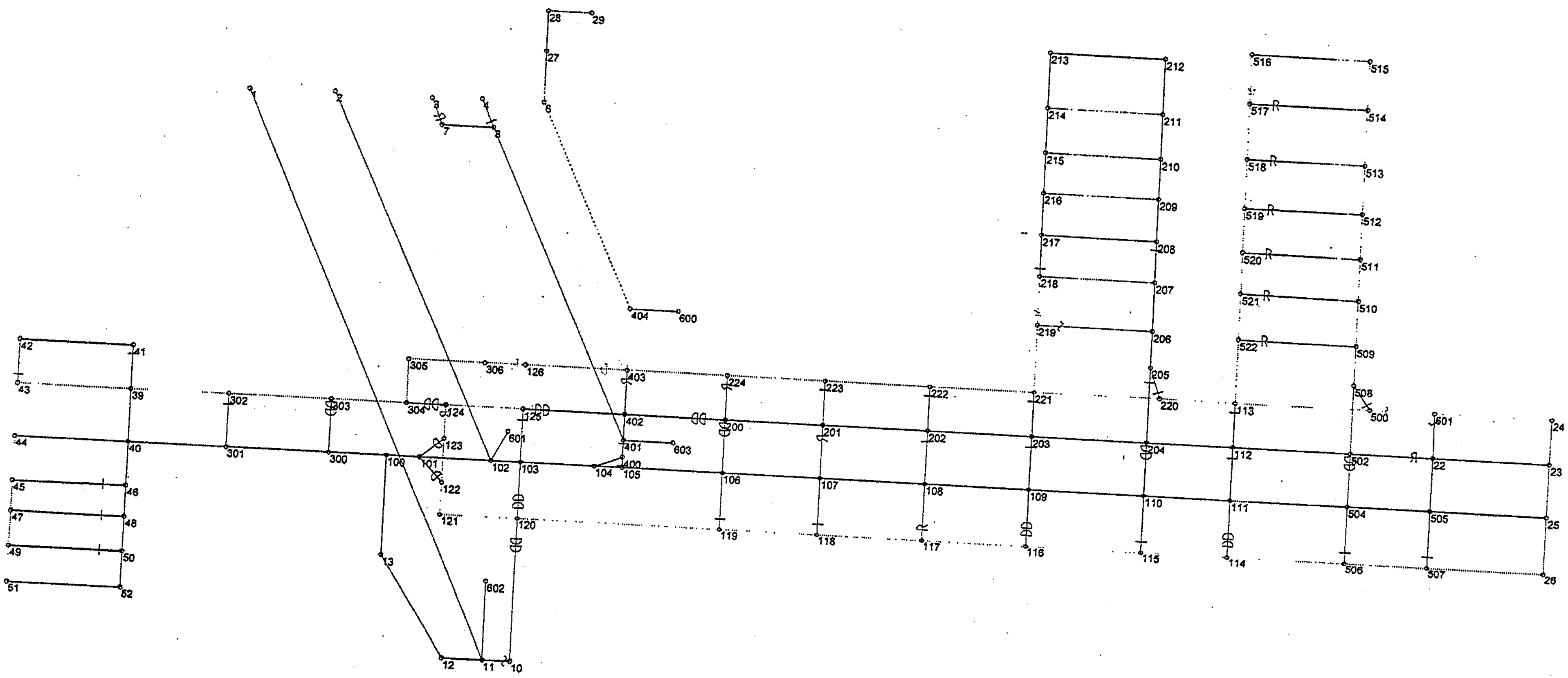
Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
46	13	100		0.00129	8.62	0.1	0.00	0	
47	100	300		0.01385	2.91	0.1	0.00	0	Access to AIS
48	300	301		0.00012	2.82	0.0	0.00	0	E0 North
49	301	302		295.00000	0.03	0.2	0.00	0	E0
50	302	303		0.00012	2.82	0.0	0.00	0	E0/E140
51	300	303		28.80859	0.09	0.2	0.00	0	E140
52	303	304		0.01385	2.91	0.1	0.00	0	E0/E140
53	304	124		4.02875	0.68	1.9	0.00	0	E140
54	304	305		0.00018	2.23	0.0	0.00	0	Doors E140
55	305	306		0.00018	2.23	0.0	0.00	0	N. Shop Entrance
56	100	101		0.00227	5.71	0.1	0.00	0	N. Shop
57	101	123		1163.00000	0.04	1.6	0.00	0	
58	101	122		1025.00000	0.04	1.6	0.00	0	
59	101	102		0.00231	5.63	0.1	0.00	0	
60	102	103		0.00028	14.97	0.1	0.00	0	
61	103	104		0.00125	14.78	0.3	0.00	0	
62	104	105		0.00001	14.58	0.0	0.00	0	
63	105	106		0.00126	14.65	0.3	0.00	0	
64	106	107		0.00195	12.98	0.3	0.00	0	
65	107	108		0.00401	6.81	0.2	0.00	0	
66	108	109		0.00437	6.13	0.2	0.00	0	
67	109	110		0.00175	5.91	0.1	0.00	0	
68	110	111		0.00098	4.77	0.0	0.00	0	
69	111	112		32400.00000	0.22	1589.9	0.06	22	
70	112	113		1416.00000	0.04	2.6	0.00	0	
71	111	114		2200.00000	0.01	0.1	0.00	0	
72	114	115		0.00029	0.83	0.0	0.00	0	
73	115	116		0.00143	0.88	0.0	0.00	0	
74	116	117		0.00227	0.88	0.0	0.00	0	
75	117	118		0.00221	1.36	0.0	0.00	0	
76	118	119		0.00852	1.43	0.0	0.00	0	
77	119	120		0.00995	1.51	0.0	0.00	0	
78	120	121		0.00391	1.85	0.0	0.00	0	
79	121	122		0.00781	1.85	0.0	0.00	0	
80	122	123		0.02103	1.89	0.1	0.00	0	
81	123	124	W	0.16210	1.93	0.6	0.00	0	
82	124	125		0.00426	2.61	0.0	0.00	0	BH302
83	125	126		0.00373	0.82	0.0	0.00	0	
84	126	403		171.60000	3.05	1594.3	0.77	308	
85	103	120		3276.00000	0.02	1.4	0.00	0	
86	106	119		119.11357	0.08	0.8	0.00	0	
87	107	118		100.69444	0.07	0.5	0.00	0	
88	108	117		1.28125	0.48	0.3	0.00	0	
89	109	116		5600.00000	0.01	0.4	0.00	0	
90	110	115		3100.00000	0.05	6.6	0.00	0	

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
91	107	201	W	42.70000	6.10	1590.3	1.53	615	
92	201	200		0.00541	-1.26	0.0	0.00	0	BH313
93	201	202		0.00004	7.23	0.0	0.00	0	
94	202	203		0.00004	7.30	0.0	0.00	0	
95	203	204		0.00004	7.37	0.0	0.00	0	
96	204	205		0.00025	4.48	0.0	0.00	0	
97	205	206		0.00021	4.27	0.0	0.00	0	
98	206	207		0.00044	3.37	0.0	0.00	0	
99	207	208		1000.00000	0.03	0.7	0.00	0	
100	208	209		0.22770	0.03	0.0	0.00	0	
101	209	210		0.22770	0.03	0.0	0.00	0	
102	210	211		0.22770	0.02	0.0	0.00	0	
103	211	212		0.22770	0.02	0.0	0.00	0	
104	212	213		0.22770	0.02	0.0	0.00	0	
105	213	214		0.22708	0.02	0.0	0.00	0	
106	214	215		0.22770	0.02	0.0	0.00	0	
107	215	216		0.22770	0.03	0.0	0.00	0	
108	216	217		0.22770	0.03	0.0	0.00	0	
109	217	218		1000.00000	0.03	0.7	0.00	0	
110	218	219		0.16753	3.37	1.9	0.00	0	
111	219	221		0.00276	4.27	0.1	0.00	0	
112	220	221		0.01122	8.12	0.7	0.00	0	
113	221	222		0.00269	12.54	0.4	0.00	0	
114	222	223		0.00360	12.68	0.6	0.00	0	
115	223	224		0.00200	12.81	0.3	0.00	0	
116	224	403		0.00243	13.91	0.5	0.00	0	
117	104	400	B	0.00000	0.20	0.0	0.00	0	
118	400	105		99900.00000	0.06	418.1	0.00	0	BH309
119	400	401		99900.00000	0.14	1829.0	0.00	2	BH309
120	103	125		76.96000	0.17	2.1	0.04	16	BH309
121	106	200		638.00000	1.58	1590.6	0.00	0	
122	108	202		36400.00000	0.21	1590.1	0.40	159	
123	109	203		35200.00000	0.21	1590.0	0.05	21	
124	110	204		1328.00000	1.09	1589.9	0.05	21	
125	112	204		0.00013	-3.98	0.0	0.27	110	
126	113	220		0.00149	7.91	0.1	0.00	0	
127	205	220		59.69388	0.21	2.7	0.00	0	
128	206	219		4.20361	0.90	3.4	0.00	0	
129	207	218		0.13296	3.35	1.5	0.00	0	
130	208	217		10000.00000	0.00	0.0	0.00	0	
131	209	216		796.00000	0.00	0.0	0.00	0	
132	210	215		788.00000	0.00	0.0	0.00	0	
133	211	214		10000.00000	0.00	0.0	0.00	0	
134	203	221		169.00000	0.14	3.5	0.00	0	
135	202	222		204.75000	0.14	3.9	0.00	0	

Branch No.	From	To	FBR	Total Resistance (P.U.)	Quantity (kcfm)	Pressure Drop (m.in.wg)	Air Power Loss (hp)	Operating Cost ($/yr)	Description
136	201	223		237.50000	0.14	4.5	0.00	0	
137	200	224		3.98904	1.10	4.8	0.00	0	
138	401	402		0.00020	44.78	0.4	0.00	0	
139	402	403	W	0.08750	45.96	184.9	1.34	539	
140	403	404		0.00104	62.92	4.1	0.04	16	Reg 308
141	402	200		296.44444	0.78	179.6	0.02	9	
142	402	125		367.50000	-1.96	-1409.5	0.44	175	
143	600	404	R	347.76590	2.30	1839.7	0.67	268	
144	102	601	B	0.00000	0.60	0.0	0.00	0	Exhaust Shaft I/J
145	11	602	B	0.00000	0.40	0.0	0.00	0	Salt Shaft I/J
146	401	603	B	0.00000	0.70	0.0	0.00	0	AIS I/J
147	111	504		0.00089	4.54	0.0	0.00	0	Waste Shaft
148	504	505		0.00080	4.12	0.0	0.00	0	
149	505	507		900.00000	0.00	0.0	0.00	0	
150	507	506		0.00029	0.63	0.0	0.00	0	
151	506	114		0.00057	0.82	0.0	0.00	0	
152	504	502		31600.00000	0.22	1589.9	0.06	22	
153	505	22		0.00068	2.56	0.0	0.00	0	
154	112	502		0.00013	4.15	0.0	0.00	0	
155	502	508		0.00013	4.60	0.0	0.00	0	
156	501	500	W	149.50000	3.26	1592.5	0.82	329	
157	500	113		0.00080	3.34	0.0	0.00	0	435 Regulator
158	508	500		458.02469	0.08	2.6	0.00	0	
159	522	113		0.00026	4.53	0.0	0.00	0	
160	508	509		0.00013	4.53	0.0	0.00	0	
161	514	517		1476.00000	0.04	2.6	0.00	0	
162	513	518		753.06122	0.06	2.6	0.00	0	
163	512	519		1476.00000	0.04	2.6	0.00	0	
164	511	520		2306.25000	0.03	2.6	0.00	0	
165	510	521		4100.00000	0.03	2.6	0.00	0	
166	509	522		304.95868	0.09	2.6	0.00	0	
167	504	506		1000.00000	0.20	38.5	0.00	0	
168	509	510		0.00014	4.44	0.0	0.00	0	
169	510	511		0.00014	4.41	0.0	0.00	0	
170	511	512		0.00014	4.38	0.0	0.00	0	
171	512	513		0.00014	4.34	0.0	0.00	0	
172	513	514		0.00014	4.28	0.0	0.00	0	
173	514	515		0.00045	4.24	0.0	0.00	0	
174	515	516		0.00045	4.24	0.0	0.00	0	
175	516	517	W	0.14300	4.24	2.6	0.00	1	
176	517	518		0.00014	4.28	0.0	0.00	0	
177	518	519		0.00014	4.34	0.0	0.00	0	
178	519	520		0.00014	4.38	0.0	0.00	0	
179	520	521		0.00014	4.41	0.0	0.00	0	
180	521	522		0.00014	4.44	0.0	0.00	0	

Fixed Q No.	From	To	IR	Fixed Quantity (kcfm)	Booster Pressure (m.in.wg)	Branch Resistance (P.U.)	Regulator Resistance (P.U.)	Total Resistance (P.U.)	Orifice Area (ft²)	Description
1	104	400		0.20	418.1	0.00000				
2	600	404	i	2.30		0.00000	347.76590	347.76590	0.67	
3	102	601	i	0.60	239.0	0.00000				
4	11	602	i	0.40	238.6	0.00000				
5	401	603	i	0.70	1650.3	0.00000				

Fan No.	From	To.	Fan Pressure (in.w.g.)	Fan Quantity (kcfm)	Air Power (hp)	Operating Cost ($/yr)	Curve Status	Fans in Parallel	Fans in Series	Description
1	28	29	5.094	65.22	52.35	21053	None	1	1	860A Fan



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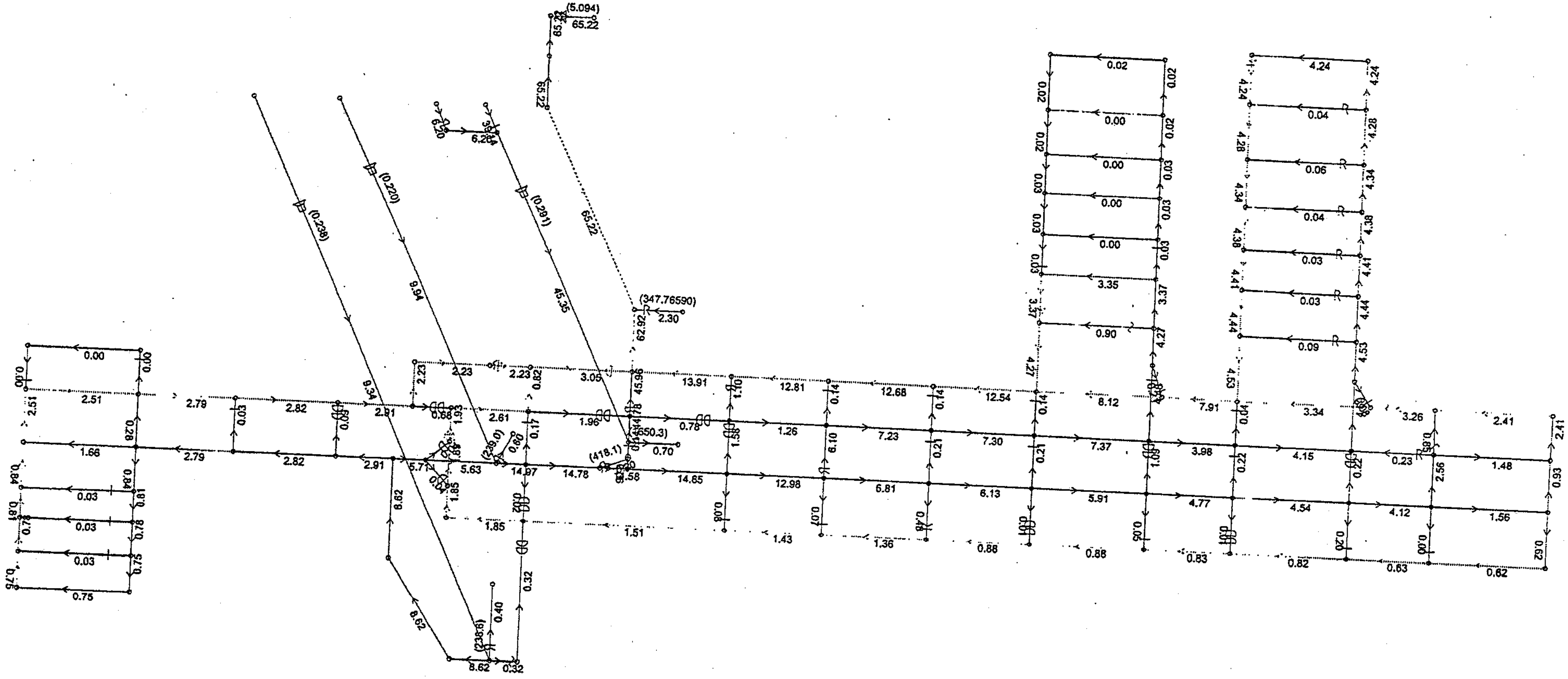
VnetPC 2002
Line Plot
Printed: 12/12/02 14:10:20



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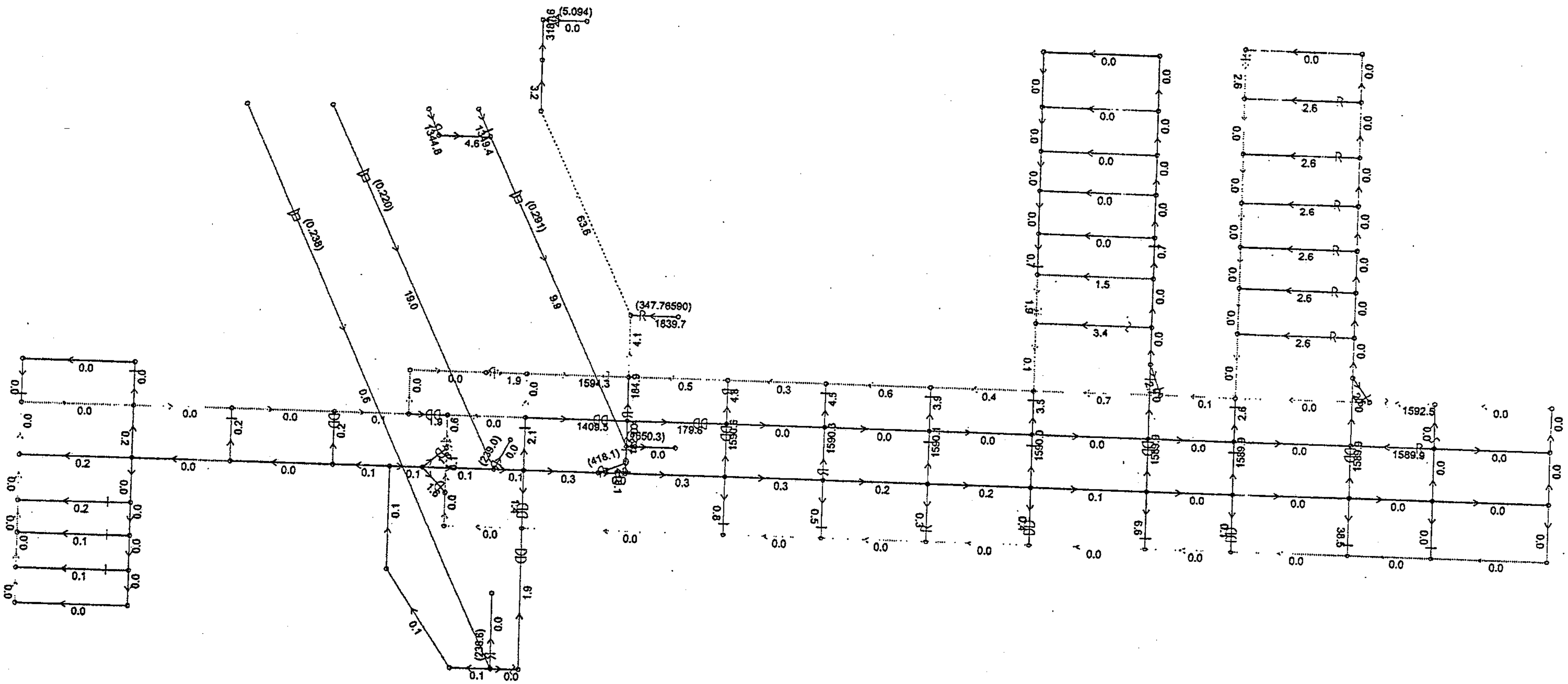
VnetPC 2002
Quantity (kcfm)
Printed: 12/12/02 14:10:50



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VnetPC 2002
Pressure Drop (m.in.wg)
Printed: 12/12/02 14:11:14

Attachment 3

Quarterly Airflow Verification Check
"As Left" Data Sheets

0303887 **Type:** Preventive Maintenance **State:** 60 - RTW

'B700B 41F30702 QTG IT FLOW (RCRA)

I. D.: 41F30702 **PM ID:** IC041098

Equip Name:

Design Class: IIIB **System:** VU01 **Parent:** 41-B-700B

Location: 413 **Room:**

Dept:

Priority: E2

Planner: DAVIS, JACI **Assign to:** ZONE 4

Account:

RCRA

COM Lockout/Tagout (Y) N No. 03-FO-172 (if required) [ ] PLD LO/TO [ ] N/A

13. COM Release/Date 051503	14. ZMM Release/Date 5/19/03
Work Area Inspection completed. Craft/Date Randy Mason 052703	Craft: Randy Mason 052703
15. ZTL Work Comp/Date 05/29/03	16. COM retest Comp/Date N/A

COM Work Complete/Date N/A

19. Overview of Work Performed:

As found data OOT; probes cleaned. As left data in tolerance. No further retest required.

21. Engineer/Date: 5-30-03

Due Date: 05/19/2003

Trade ID: ITECH

Next Due Date: 08/18/2003

RECORD

ORIGINAL

Attachment 5 - Acceptance Criteria Calculation Sheet

[x] As Found [ ] As Left

Nominal Flow Rate 212 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2673.97	2764.22	2735.94	2716.22	2730.36	2727.17

Q_{RM} = (Sum *Traverse Averages* / 6) x 78.5398 ft^2	Ref Method Flow (Q_{RM}) SCFM
	213993.32

Data Block 3. Kurz Flow

$KURZ_{Total}$ SCF	Elapsed Time Minutes
14115000	97.6

$$Kurz_{Avg} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$	$KURZ_{AVG}$ SCFM
	144620.90
$$RPD = \frac{Kurz_{Avg} - Q_{RM}}{Q_{RM}} \times 100$$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	-32.42%

Data Block 4. CMS Flow

Traverse 1 CMS_{Avg}	Traverse 2 CMS_{Avg}	Traverse 3 CMS_{Avg}	Traverse 4 CMS_{Avg}	Traverse 5 CMS_{Avg}	Traverse 6 CMS_{Avg}
145621.67	145463.33	145336.67	145333.33	145588.33	145665.00

$$CMS_{Avg} = \frac{SUM\ CMS\ TRAVERSE\ AVERAGES}{6}$$	CMS_{Avg} SCFM
	145501.39
$$RPD = \frac{CMS_{Avg} - Q_{RM}}{Q_{RM}} \times 100$$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	-32.01%

Attachment 5 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left

Nominal Flow Rate 240 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
3017	3025	3015	3045	3048	3066

Q_{RM} = (Sum *Traverse Averages* / 6) x 78.5398 ft^2

Ref Method Flow (Q_{RM}) SCFM
238433

Data Block 3. Kurz Flow

KURZ $_{Total}$ SCF	Elapsed Time Minutes
16222000	68.3

$$Kurz_{Avg} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

KURZ $_{AVG}$ SCFM
237511

$$RPD = \frac{Kurz_{Avg} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-0.39%

Data Block 4. CMS Flow

Traverse 1 CMS $_{Avg}$	Traverse 2 CMS $_{Avg}$	Traverse 3 CMS $_{Avg}$	Traverse 4 CMS $_{Avg}$	Traverse 5 CMS $_{Avg}$	Traverse 6 CMS $_{Avg}$
239302	239558	239100	238310	237345	238058

$$CMS_{Avg} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS $_{Avg}$ SCFM
238612

$$RPD = \frac{CMS_{Avg} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
0.08%

Attachment 5 - Acceptance Criteria Calculation Sheet

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Nominal Flow Rate 225 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V AVG	Traverse 2 V AVG	Traverse 3 V AVG	Traverse 4 V AVG	Traverse 5 V AVG	Traverse 6 V AVG
2822	2903	2811	2880	2707	2745
Q_{RM} = (Sum *Traverse Averages* / 6) x 78.5398 ft^2				Ref Method Flow (Q_{RM}) SCFM 220799	

Data Block 3. Kurz Flow

$KURZ_{Total}$ SCF	Elapsed Time Minutes
17399000	78.3
$Kurz_{Avg} = \dfrac{KURZ_{TOTAL}}{ELAPSED\ TIME}$	$KURZ_{AVG}$ SCFM 222209
$RPD = \dfrac{Kurz_{Avg} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5% 0.64%

Data Block 4. CMS Flow

Traverse 1 CMS_{Avg}	Traverse 2 CMS_{Avg}	Traverse 3 CMS_{Avg}	Traverse 4 CMS_{Avg}	Traverse 5 CMS_{Avg}	Traverse 6 CMS_{Avg}
221147	222060	222492	222672	224252	223323
$CMS_{Avg} = \dfrac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$				CMS_{Avg} SCFM 222658	
$RPD = \dfrac{CMS_{Avg} - Q_{RM}}{Q_{RM}} \times 100$				Relative Percent Difference ACCEPTANCE CRITERIA ±5% 0.84%	

Attachment 5 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left

Nominal Flow Rate 208 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2640	2583	2711	2709	2700	2686

Q_{RM} = (Sum *Traverse Averages* / 6) x 78.5398 ft^2	Ref Method Flow (Q_{RM}) SCFM
	209806

Data Block 3. Kurz Flow

$KURZ_{Total}$ SCF	Elapsed Time Minutes
13195000	63.8

$Kurz_{Avg} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$	$KURZ_{AVG}$ SCFM
	206818
$RPD = \frac{Kurz_{Avg} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	-1.42%

Data Block 4. CMS Flow

Traverse 1 CMS_{Avg}	Traverse 2 CMS_{Avg}	Traverse 3 CMS_{Avg}	Traverse 4 CMS_{Avg}	Traverse 5 CMS_{Avg}	Traverse 6 CMS_{Avg}
207538	207413	207008	207007	207590	207842

$CMS_{Avg} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$	CMS_{Avg} SCFM
	207400
$RPD = \frac{CMS_{Avg} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	-1.15%

TW 6-2-03

PAGE ___ OF ___

RECORD

Work Order: 0301114 **Type:** Preventive Maintenance **State:** 60 - RTW

Description: 41B700B 41F30702 QTG IT FLOW (RCRA)

2006

Equipment I. D.: 41F30702 **PM ID:** IC041098

MON 2/24

Equip Name:

Design Class: IIIB **System:** VU01 **Parent:** 41-B-700B

Location: 413 **Room:**

Dept:

Priority: 4M6

Planner: DAVIS, JACI **Assign to:** ZONE 4

12.

Account:

RCRA

COM Tagout/Lockout (Y) N No. 03-Fo- (if required) [ ] PLD LO/TO [ ] N/A	
13. COM Release/Date — [signature] 02/23/03 ~~02/20/03~~ 02/23/03	14. ZMM Release/Date — [signature] 2/24/03 Craft: [signature]
15. ZTL Work Comp/Date — [signature] 03/03/03	16. COM retest Comp/Date — N/A
17. COM Work Complete/Date — N/A	

19. Overview of Work Performed:

As found data OOT; probes cleaned. As left data in tolerance. No further retest required.

21. Engineer/Date: [signature] 3-6-03

Due Date: 02/17/2003

Trade ID: ITECH

RECORD

Next Due Date: 05/19/2003

ORIGINAL

0

Attachment 5 - Acceptance Criteria Calculation Sheet

☑ As Found ☐ As Left

Nominal Flow Rate 148 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2582	2535	2507	2534	2533	2509

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM: R 1/7/10 ~~199967~~ 198967.

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
12107000.	81.9

$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$

$KURZ_{AVG}$ SCFM: 147827.

$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: -25.7

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
148850	148500	149000	148740	148060	148110

$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$

CMS_{AVG} SCFM: 148543

$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: -25.3

Attachment 5 - Acceptance Criteria Calculation Sheet

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Nominal Flow Rate 248 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
3265	3248	3256	3264	3246	3182

$$Q_{RM} = \left(\sum TRAVERSE\ AVERAGES \div 6 \right) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM	
254744.	

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
17915000	73.

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
245411

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-3.6

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
245678	245474	245318	245329	245071	244309

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
245197

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-3.7

Work Order: 0209092 **Type:** Preventive Maintenance **State:** 60 - RTW

Description: 41B700B 41F30702 QTG IT FLOW (RCRA)

Equipment I. D.: 41F30702 **PM ID:** IC041098

Equip Name:

Design Class: IIIB **System:** VU01 **Parent:** 41-B-700B

Location: 413 **Room:**

Dept:

Priority: 4M6

Planner: DAVIS, JACI **Assign to:** ZONE 4

Account:

RCRA

COM Tagout/Lockout (Y) (N) No. 02-FO-439 (if required) [ ] PLD LO/TO [ ] N/A

13. COM Release/Date	14. ZMM Release/Date
11-10-02	11/11/02
Man Hours: 72	Craft:
15. ZTL Work Comp/Date: 11/14/02	16. COM retest Comp/Date: N/A

17. COM Work Complete/Date: N/A

19. Overview of Work Performed:

Second set of as found data OOT; probes cleaned. As left data in tolerance. No further retest required.

21. Engineer/Date: 11-22-02

Due Date: 11/18/2002

Trade ID: ITECH

RECORD

Next Due Date: 02/17/2003

ORIGINAL

Attachment 5 - Acceptance Criteria Calculation Sheet

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Nominal Flow Rate ~~210~~ 208 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2728.	2678.5	2647.7	2684.4	2658.67	2614.53

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM
209593.9

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
19660000.	94.9

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
207165.4

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-1.1

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
208740	209106	208408	208008	208302	208608

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
208528.6

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-.5

Attachment 5 - Acceptance Criteria Calculation Sheet

☑ As Found ☐ As Left

Nominal Flow Rate 189 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2249.9	2263.2	2270.2	2273.	2248.1	2290

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM: 177950.2

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
9983000.	53

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 188358.49.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 5.8

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
190127.3	190526	190450.1	190547.3	190084.3	190332.3

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 190344.5

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 6.9

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 205 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2602.	2636.	2599.	2630.	2640.	2619.

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM
205852.

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
~~70.5~~ 14.252	70.5

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
202156.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-1.7

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
203524.	203341.	203346.	203540.	203223.	202821

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
203299.

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-1.2

Attachment 5 - Acceptance Criteria Calculation Sheet

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Nominal Flow Rate 190 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2451.	2462.	2422.	2425.	2434.	2421.

$Q_{RM} = (\sum \text{TRAVERSE AVERAGES} \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM
191309.

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
11521000.	60.9

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
189178.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-1.1

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
189746.	189924.	189874.	189837.	190144.	189796.

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
189885.

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-.7

Work Order: 0206760 Type: Preventive Maintenance State: 60 - RTW
Description: 41B700B 41F30702 QTG IT FLOW (RCRA)

Mod 8/19

Equipment I. D.: 41F30702 PM ID: IC041098
Equip Name:
Design Class: IIIB System: VU01 Parent: 41-B-700B
Location: 413 Room:
Dept:
Priority: 4M6
Planner: DAVIS, JACI Assign to: ZONE 4
Account:

RCRA

COM Tagout/Lockout (Y) N No.__________(if required) [ ] PLD LO/TO [ ] N/A

13. COM Release/Date 8/20/02	14. ZMM Release/Date 8/20/02
Man Hours: 1.94	Craft: Billy Cobb 8/29/02
15. ZTL Work Comp/Date 09/03/02	16. COM retest Comp/Date N/A

17. COM Work Complete/Date
N/A

19. Overview of Work Performed:
As found data OOT, probes cleaned. Data still OOT; performed full dynamic cal. As left data in tolerance. No further retest required.

21. Engineer/Date: 9-3-02

Due Date: 08/19/2002
Trade ID: ITECH
Next Due Date: 11/18/2002

RECORD

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ORIGINAL

Attachment 5 - Acceptance Criteria Calculation Sheet

☑ As Found ☐ As Left

Nominal Flow Rate 260 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2618.3	2698.3	2646.9	2623.9	2607.4	2649.8

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM
207,405.3

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
31,016,000	67.1

$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$

$KURZ_{AVG}$ SCFM
462,235.5

$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
122.9

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
472,450	471,153	472,736	473,208	474,060	474,493

$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$

CMS_{AVG} SCFM
473,016.7

$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
128.06

Attachment 5 - Acceptance Criteria Calculation Sheet

☑ As Found ☐ As Left Nominal Flow Rate 212 KSCFM
pre-full dynamic

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2391.7	2512.9	2462.3	2438.8	2642.1	2496.3

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$	Ref Method Flow (Q_{RM}) SCFM
	195,617.8

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
12.326 MSCF	58.7

$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$	$KURZ_{AVG}$ SCFM
	209,982.9
$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	7.3

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
211,506.6	210,668.3	211,125	211,558.3	211,658.3	211,378.3

$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$	CMS_{AVG} SCFM
	211,315.8
$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	8.0

Attachment 5 - Acceptance Criteria Calculation Sheet

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Nominal Flow Rate 180 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2328.6	2344.4	2316.2	2314.	2332.	2303.2
$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$				Ref Method Flow (Q_{RM}) SCFM	
				182,455.8	

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
10.033	53.8
$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$	$KURZ_{AVG}$ SCFM
	186,486.9
$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	2.20

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
186228.3	186226.7	186506.7	186278.3	186165.	186255
$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$				CMS_{AVG} SCFM	
				186,276.6	
$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$				Relative Percent Difference ACCEPTANCE CRITERIA ±5%	
				2.09	

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 195 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2430.5	2428.2	2441.2	2452.	2407.6	2488.5

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM
191741.8

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
12.214	62.1

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
196682.7

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
2.5

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
197165.	196973.3	196350.	196478.3	197748.3	197595.

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
197051.6

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
2.7

Work Order: 0303106 Type: Preventive Maintenance State: 60 - RTW

Description: 41B700A 41F30703 QTG IT FLOW (RCRA)

Equipment I. D.: 41F30703

Equip Name:

PM ID: IC041098

Design Class: IIIB

System: VU01

Location: 413

Room:

Parent: 41-B-700A

Dept:

Priority: E2

Planner: DAVIS, JACI

Assign to: ZONE 4

Account:

23

RCRA

COM Lockout/Tagout (Y) N No. 03-10-140 (if required) [ ] PLD LO/TO [ ] N/A

13. COM Release/Date 4-27-03

14. ZMM Release/Date 4/28/03

Work Area Inspection completed.

Craft/Date Tommy Richey 5-1-03

Craft: Tommy Richey

15. ZTL Work Comp/Date 05/05/03

16. COM retest Comp/Date N/A

17. COM Work Complete/Date N/A

19. Overview of Work Performed: Brine in the duct caused difficulties with as found data. Computer inserted "0" where readings were not available. Recalculation eliminating bad data indicated readings in tolerance. However, duct entry was required to remove brine & the probes were cleaned at that time. A full 55 gal barrel of brine was removed. As left data was in tolerance. No further retest required.

~~Cost: 55 gallon barrel = $63.30~~

21. Engineer/Date: 5-6-03

Due Date: 04/21/2003

Trade ID: ITECH

Next Due Date: 07/21/2003

RECORD

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ORIGINAL

Attachment 5 - Acceptance Criteria Calculation Sheet

[x] As Found [ ] As Left

Nominal Flow Rate 200 KSCFM KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
~~2182.17~~ 2455	~~2234.47~~ 2681	~~2329.14~~ 2396	~~2283.50~~ 2349	2381.39	2314.89

Q_{RM} = (Sum *Traverse Averages* / 6) x 78.5398 ft^2	Ref Method Flow (Q_{RM}) SCFM
	190812 ~~179667.06~~

Data Block 3. Kurz Flow

$KURZ_{Total}$ SCF	Elapsed Time Minutes
18443000	93.6

$Kurz_{Avg} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$	$KURZ_{AVG}$ SCFM
	197040.60
$RPD = \frac{Kurz_{Avg} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	~~9.67%~~ 3.26%

Data Block 4. CMS Flow

Traverse 1 CMS_{Avg}	Traverse 2 CMS_{Avg}	Traverse 3 CMS_{Avg}	Traverse 4 CMS_{Avg}	Traverse 5 CMS_{Avg}	Traverse 6 CMS_{Avg}
197839.00	197926.83	198232.17	198410.17	198766.00	199002.83

$CMS_{Avg} = \frac{\text{SUM CMS TRAVERSE AVERAGES}}{6}$	CMS_{Avg} SCFM
	198362.83
$RPD = \frac{CMS_{Avg} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	3.96% ~~10.41%~~

Attachment 5 - Acceptance Criteria Calculation Sheet

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Nominal Flow Rate 180 KSCFM KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2330.06	2336.89	2346.06	2350.86	2366.08	2314.06

Q_{RM} = (Sum *Traverse Averages* / 6) x 78.5398 ft^2

Ref Method Flow (Q_{RM}) SCFM
183835.49

Data Block 3. Kurz Flow

$KURZ_{Total}$ SCF	Elapsed Time Minutes
16530000	91

$$Kurz_{Avg} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
181648.35

$$RPD = \frac{Kurz_{Avg} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-1.19%

Data Block 4. CMS Flow

Traverse 1 CMS_{Avg}	Traverse 2 CMS_{Avg}	Traverse 3 CMS_{Avg}	Traverse 4 CMS_{Avg}	Traverse 5 CMS_{Avg}	Traverse 6 CMS_{Avg}
183039.17	182466.00	182924.50	181681.00	180785.50	180448.17

$$CMS_{Avg} = \frac{\text{SUM CMS TRAVERSE AVERAGES}}{6}$$

CMS_{Avg} SCFM
181890.72

$$RPD = \frac{CMS_{Avg} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-1.06%

Attachment 5 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left

Nominal Flow Rate 215 KSCFM KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2622.56	2631.11	2608.03	2659.06	2621.44	2675.78

Q_{RM} = (Sum *Traverse Averages* / 6) x 78.5398 ft^2	Ref Method Flow (Q_{RM}) SCFM
	207056.73

Data Block 3. Kurz Flow

$KURZ_{Total}$ SCF	Elapsed Time Minutes
16292000	78.9

$Kurz_{Avg} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$	$KURZ_{AVG}$ SCFM
	206489.23
$RPD = \frac{Kurz_{Avg} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	-0.27%

Data Block 4. CMS Flow

Traverse 1 CMS_{Avg}	Traverse 2 CMS_{Avg}	Traverse 3 CMS_{Avg}	Traverse 4 CMS_{Avg}	Traverse 5 CMS_{Avg}	Traverse 6 CMS_{Avg}
209447.00	210008.83	211100.17	211125.50	210041.00	210493.83

$CMS_{Avg} = \frac{\text{SUM CMS TRAVERSE AVERAGES}}{6}$	CMS_{Avg} SCFM
	210369.39
$RPD = \frac{CMS_{Avg} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	1.60%

400A April 2003

Attachment 5 - Acceptance Criteria Calculation Sheet

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Nominal Flow Rate 200 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2484.	2517.	2525.	2540.	2532.	~~2515~~ 2523 F 5/5/03

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM: ~~197629.~~ 197941 F 5/5/03

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
17594000.	88.3

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 199253.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: .7

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
200481	200212	199973	201323	200171	200758

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 200486

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 1.3

Work Order: 0300140 **Type:** Preventive Maintenance **State:** 60 - RTW

Description: 41B700A 41F30703 QTG IT FLOW (RCRA)

Equipment I. D.: 41F30703 **PM ID:** IC041098

Equip Name:

Design Class: IIIB **System:** VU01 **Parent:** 41-B-700A

Location: 413 **Room:**

Dept:

Priority: 4M6

Planner: DAVIS, JACI **Assign to:** ZONE 4

Account:

RCRA

COM Tagout/Lockout (Y) N No.__________(if required) [ ] PLD LO/TO [ ] N/A

13. COM Release/Date	14. ZMM Release/Date
Richard C. Marshall 1-27-03	[signature] 1-27-03 Craft: Jerry Rich
15. ZTL Work Comp/Date	16. COM retest Comp/Date
[signature] 02/04/03	n/a

17. COM Work Complete/Date

n/A

19. Overview of Work Performed:

As found data OOT; probes cleaned. Still unable to get in tolerance data, so performed full dynamic cal. As left data in tolerance. No further retest required.

21. Engineer/Date: [signature] 2-11-03

Due Date: 01/20/2003

Trade ID: ITECH

Next Due Date: 04/21/2003

RECORD

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ORIGINAL

Attachment 5 - Acceptance Criteria Calculation Sheet

☑ As Found ☐ As Left

Nominal Flow Rate 222 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2247	2307	2300	2322	2337.	2376.

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM
181807.

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
17817000.	80.2

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
222157.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
22.2

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
223664	223791	222392	222364	227684	227554

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
224575.

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
23.5

Work Order: 0208558 **Type:** Preventive Maintenance **State:** 60 - RTW

Description: 41B700A 41F30703 QTG IT FLOW (RCRA)

Equipment I. D.: 41F30703 **PM ID:** IC041098

MOH 10/21

Equip Name:

Design Class: IIIB **System:** VU01 **Parent:** 41-B-700A

Location: 413 **Room:**

Dept:

Priority: 4M6

Planner: DAVIS, JACI **Assign to:** ZONE 4

Account:

RCRA

COM Tagout/Lockout (Y) N No. 02-F0-410 (if required) [ ] PLD LO/TO [ ] N/A	
13. COM Release/Date Paul J Pinel 10/20/02	14. ZMM Release/Date [signature] 10/~~20~~21/02 10/21/02
Man Hours: 64	Craft: D. Bannesly 10-22-02
15. ZTL Work Comp/Date [signature] 10/23/02	16. COM retest Comp/Date N/A
17. COM Work Complete/Date N/A	

19. Overview of Work Performed:

As found data OOT; probes cleaned. As left data in tolerance. No further retest required.

21. Engineer/Date: [signature] 10-24-02

Due Date: 10/21/2002

Trade ID: ITECH

RECORD

Next Due Date: 01/20/2003

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ORIGINAL

Attachment 5 - Acceptance Criteria Calculation Sheet

☑ As Found ☐ As Left

Nominal Flow Rate 212 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2004.6	1967.9	1997.8	1942.2	2005.8	1986.6

$Q_{RM} = (\sum \text{TRAVERSE AVERAGES} \div 6) \times 78.5398\ ft^2$	Ref Method Flow (Q_{RM}) SCFM
	155834.7

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
23.115 MSCF	76.4 min.

$KURZ_{AVG} = \dfrac{KURZ_{TOTAL}}{\text{ELAPSED TIME}}$	$KURZ_{AVG}$ SCFM
	302552.3
$RPD = \dfrac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	~~29.9~~ 94.1

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
304701.6	306738.3	304661.6	304180	304235.	303671.6

$CMS_{AVG} = \dfrac{\sum \text{CMS TRAVERSE AVERAGES}}{6}$	CMS_{AVG} SCFM
	304698.
$RPD = \dfrac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	95.5

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left Nominal Flow Rate 212 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2694.4	~~2611.5~~ 2662	2644.9	2656.6	2686.7	2689.2

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM: ~~209220.6~~ 209885

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
16172000.	77.4

$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$

$KURZ_{AVG}$ SCFM: 208940.5

$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: ~~-.13~~ -0.45

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
210855.	209910.	209793.3	209905.	209741.6	210240.

$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$

CMS_{AVG} SCFM: 210074.1

$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: ~~.4~~ 0.09

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 192 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2504.4	2472.2	2452.	2377.1	2399.6	2367.30

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM
190806.94

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
18735000.	97.0

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
193144.32

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
1.2

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
194536.6	192958.3	~~192750.~~ 194293.3	193606.6	195165.	193960.

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
194086.6

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
1.7

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☒ As Left

Nominal Flow Rate 180 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2341.1	2427.6	2348.08	2320.58	~~2213.8~~ 2271	2348.4

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM: ~~183253.8~~ 184006

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
13949000	74.4

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 187486.56

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: ~~2.3~~ 1.9

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
187063.3	186723.3	187975.	188151.6	189305	189686.66

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 188150.81

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: ~~2.7~~ 2.25

Work Order: 0205926 **Type:** Preventive Maintenance **State:** 60 - RTW

Description: 41B700A 41F30703 QTG IT FLOW (RCRA)

Hau 7/22

Equipment I. D.: 41F30703 **PM ID:** IC041098

Equip Name:

Design Class: IIIB **System:** VU01 **Parent:** 41-B-700A

Location: 413 **Room:**

Dept:

Priority: 4M6

Planner: DAVIS, JACI **Assign to:** ZONE 4

Account:

RCRA

COM Tagout/Lockout (Y) N No. 02-F0-283 (if required) [ ] PLD LO/TO [ ] N/A	
13. COM Release/Date: [signature] 7-21-02 Man Hours: 60	14. ZMM Release/Date: [signature] 7/22/02 Craft: [signature]
15. ZTL Work Comp/Date: [signature] 07/24/02	16. COM retest Comp/Date: N/A
17. COM Work Complete/Date: N/A	
19. Overview of Work Performed: As found data OOT; probes cleaned. As left data in tolerance. No further retest required.	
21. Engineer/Date: [signature] 7-24-02	

Due Date: 07/15/2002

Trade ID: ITECH

RECORD

Next Due Date: 10/21/2002

ORIGINAL

Attachment 5 - Acceptance Criteria Calculation Sheet

Nominal Flow Rate 260 KSCFM

☒ ~~As~~ Found ☐ As Left

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2535.3	2515.7	2468	2532.8	2465.9	2504.7

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM: 196,642.7

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
22,532,000	75.6

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 298,042.3

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 51.6

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
296,931.8	297,388.7	297,236.8	297,189.2	297,287	297,210.8

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 297,207.4

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 51.1

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 180 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2325.3	2330.7	~~2391.9~~ 2371.9	2370.2	2238.5	2219.4

Q_{RM} = ($\sum$ TRAVERSE AVERAGES ÷ 6) × 78.5398 ft^2

Ref Method Flow (Q_{RM}) SCFM: ~~181,636.4~~ 180,720

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
9,433,000	52.6

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 179,334.6

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: ~~-1.26~~ -0.77

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
179,541.8	179,438	179,646.7	180,033	180,162.7	180,302.8

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 179,854.2

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: ~~-.98~~ -0.48

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 195 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2484.4	2484.8	2421.9	2455.2	2483.1	2487.9

$$Q_{RM} = \left(\sum TRAVERSE\ AVERAGES \div 6 \right) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM: 193957.9

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
10,710,000	55.4

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 193,321.3

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: ~~193,321.3~~ (initialed 11/22/02) −.3

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
194,097.2	193,103.8	193,476	193,926.3	193,519.3	193,220.5

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 193,557.2

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: −.2

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 220 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2639.4	2623.9	2642.4	2639	2586.8	2609.2

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM: 206045.2

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
11,034,000	52.1

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 211,785

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 2.78

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
212,028.8	211,635.8	211,609.2	211,887.3	212,276.8	212,217.5

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 211,942.4

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 2.86

Work Order: 0305202 Type: Preventive Maintenance State: 60 - RTW

Description: 41B700C 41F30704 QTG IT FLOW (RCRA)

Mon 6/23

Equipment I. D.: 41F30704 PM ID: IC041098

Equip Name:

Design Class: IIIB System: VU01 Parent:

Location: 413 Room:

Dept:

Priority: E2

Planner: ZONE 4, * Assign to: ZONE 4

RCRA

Account:

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COM Lockout/Tagout (Y) N No. 03-FO-207 (if required) [ ] PLD LO/TO [ ] N/A	
13. COM Release/Date [signature] 062203	14. ZMM Release/Date [signature] 6/23/03
Work Area Inspection completed. Craft/Date [signature] 6-23-03	Craft: [signature]
15. ZTL Work Comp/Date [signature] ~~06/24/03~~ 06/26/03	16. COM retest Comp/Date N/A
17. COM Work Complete/Date N/A	
19. Overview of Work Performed: As found data was OOT; probes cleaned. As left data in tolerance. No further retest required.	
21. Engineer/Date: [signature] 6-27-03	

Due Date: 06/30/2003

Trade ID: ITECH

ORIGINAL

Next Due Date: 09/29/2003

Attachment 5 - Acceptance Criteria Calculation Sheet

☑ As Found ☐ As Left

Nominal Flow Rate 225 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2404	2414 ~~2350~~ 6-27-03	2429	2436	2445	2404

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM: ~~189386.~~ 6-27-03 | 190223

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
15.82277834 MSCF	74.0

$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$

$KURZ_{AVG}$ SCFM: 213821.

$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 12.94 6-27-03

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
218450	213697	214838	215407	215043	215855

$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$

CMS_{AVG} SCFM: 215582

$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 13.83 6-27-03

Work Order: 0302408 **Type:** Preventive Maintenance **State:** 60 - RTW
Description: 41B700C 41F30704 QTG IT FLOW (RCRA)

MOH
4/7

PM ID: IC041098
Equipment I. D.: 41F30704
Equip Name:
Design Class: IIIB **System:** VU01 **Parent:**
Location: 413 **Room:**
Dept:
Priority: E2
Planner: ZONE 4, * **Assign to:** ZONE 4

18

Account:

RCRA

COM Lockout/Tagout Y N No. 03-70 (if required)		[ ] PLD LO/TO	[ ] N/A
13. COM Release/Date Paul J Powell 4/6/03	14. ZMM Release/Date L Long 04/07/03		
Work Area Inspection completed. Craft/Date Tommy Richs 4-9-03	Craft: Tommy Richs		
15. ZTL Work Comp/Date L Long 04/10/03	16. COM retest Comp/Date n/A		
17. COM Work Complete/Date n/A			

19. Overview of Work Performed:

As found data OOT; probes cleaned. As left data in tolerance. No further retest required.

21. Engineer/Date: [signature] 4-14-03

Due Date: 03/31/2003
Trade ID: ITECH

RECORD

Next Due Date: 06/30/2003

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Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 225 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2809	2831	2826	2826	2880	2851

$$Q_{RM} = \left(\sum TRAVERSE\ AVERAGES \div 6 \right) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM	
222831.	

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
19406770.7	86.5

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
224356.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
.6

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
224650	224420	224630	224220	224570	224850

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
224557.

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
.7

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 210 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2565	2578	2529	2599	2560	2532

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM: 201363.

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
17126129.92	82.1

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 208625.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 3.6

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
209930	209600	209110	209470	208790	208330

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 209210

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 3.8

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 195 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2304	2323	2299	2325	2372	2420

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM	
183822	

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
19908497	104.9

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
189785

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
3.2

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
191618	190953	191568	189718	190035	189570

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
190577

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
3.6

Work Order: 0210467 **Type:** Preventive Maintenance **State:** 60 - RTW
Description: 41B700C 41F30704 QTG IT FLOW (RCRA)

MON
1/6

Equipment I. D.: 41F30704 **PM ID:** IC041098
Equip Name:
Design Class: IIIB **System:** VU01 **Parent:**
Location: 413 **Room:**
Dept:
Priority: 4M6
Planner: ZONE 4, * **Assign to:** ZONE 4
Account:

RCRA

COM Tagout/Lockout (Y) N No.______________(if required) [ ] PLD LO/TO [ ] N/A

13. COM Release/Date
M. Denari 12/30/01

14. ZMM Release/Date
[signature] 01/6/03
Craft: G. Bannister 01-19-03

15. ZTL Work Comp/Date
[signature] 01/20/03

16. COM retest Comp/Date
N/A

17. COM Work Complete/Date
N/A

19. Overview of Work Performed:
As found data OOT; probes cleaned. Still could not be brought within tolerance, so performed full dynamic cal. As left data in tolerance. No further retest required.

21. Engineer/Date: [signature] 1-21-03

Due Date: 12/30/2002
Trade ID: ITECH
Next Due Date: 03/31/2003

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Attachment 5 - Acceptance Criteria Calculation Sheet

☒ As Found ☒ As Left (initialed 1-15-03)

Nominal Flow Rate 212 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2909.25	2928.528	2905.528	2959.33	3001.888	2925.806

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM: 230780.432

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
6115900	30.0

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 203863.33333

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: -11.66

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
208074	207431	207539	205788	207539	205972

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 207057.1667

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: -10.28

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 227 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2948	3000	3072	2970	2954 ~~2926~~ 2-1-21-03	2890 ~~2917~~ 2-1-21-03

$$Q_{RM} = \left(\sum TRAVERSE\ AVERAGES \div 6\right) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM
233433

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
21864285.	95.7

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
228467.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-2.1

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
228841.	229169.	228520	228685	229104	228928

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
228875

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
-1.9

65 78

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left   Nominal Flow Rate 242 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
3047	~~3077.5~~ 3105	2928.	~~3079~~ 3024	~~3063.8~~ 3006	3057

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$

Ref Method Flow (Q_{RM}) SCFM
~~238921.9~~ 237805

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
18691624.	80.2

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
233062.6

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
~~-2.4~~ -1.99

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
233598.	233644.	233773.	233903.	233948	233960

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
233804

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
~~-2.1~~ -1.68

77 78

Work Order: 0208067 **Type:** Preventive Maintenance **State:** 60 - RTW

Description: 41B700C 41F30704 QTG IT FLOW (RCRA)

9/30

Equipment I. D.: 41F30704 **PM ID:** IC041098

Equip Name:

Design Class: IIIB **System:** VU01 **Parent:**

Location: 413 **Room:**

Dept:

Priority: 4M6

Planner: ZONE 4, * **Assign to:** ZONE 4

Account:

RCRA

COM Tagout/Lockout (Y) N No. 02-F0-364 (if required) [ ] PLD LO/TO [ ] N/A

13. COM Release/Date 9/30/02

14. ZMM Release/Date 9/30/02

Man Hours: 80

Craft:

15. ZTL Work Comp/Date 10/04/02

16. COM retest Comp/Date N/A

17. COM Work Complete/Date N/A

19. Overview of Work Performed:

As found data OOT, probes cleaned. As left data in tolerance, No further retest required.

21. Engineer/Date: 10-4-02

Due Date: 09/30/2002

Trade ID: ITECH

RECORD

Next Due Date: 12/30/2002

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Attachment 5 - Acceptance Criteria Calculation Sheet

[X] As Found [ ] As Left

Nominal Flow Rate 236 KSCFM

Data Block 2 Reference Method Flow

Traverse 1 V Average	Traverse 2 V Average	Traverse 3 V Average	Traverse 4 V Average	Traverse 5 V Average	Traverse 6 V Average
2714	2743	2699	2685	2718	2665

Q RM = (Sum Traverse Averages / 6) x 78.5398 FT Square	Ref Method Flow (Q RM) SCFM
	212378

Data Block 3. Kurz Flow

Kurz Total SCF	25622399		Minutes 107.3
Kurz Avg = Kurz Total / ELAPSED TIME			Kurz Avg SCFM
			238792
RPD = (Kurz Avg - Q RM) / Q RM x 100			Relative Percent Difference ACCEPTANCE CRITERIA ±5%
			12.44%

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
239052	238936	238465	239685	240295	240321

CMS Avg= SUM CMS TRAVERSE AVERAGES / 6	CMS Avg SCFM
	239459
RPD= (CMS Avg - Q RM) / Q RM x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±5%
	12.75%

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left Nominal Flow Rate 224. KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
~~3021.9~~ 2966 (9-10-4-02)	2966.1	2945.5	2952.2	2936.0	2920.3

Q_{RM} = ($\sum$ TRAVERSE AVERAGES ÷ 6) × 78.5398 ft²

Ref Method Flow (Q_{RM}) SCFM
~~232238.2~~ 231509 (9-10-4-02)

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
18677530.40	83.3

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM
224220.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
~~-3.45~~ -3.15 (9-10-4-02)

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
223921.	224198.	225620	225460.	225510.	225800.

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM
225084.8

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%
~~-3.0~~ -2.7 (9-10-4-02)

Attachment 5 - Acceptance Criteria Calculation Sheet

☐ As Found ☑ As Left

Nominal Flow Rate 205 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}
2578.	2586.3	2530.9	2573.1	2554.4	2543.6

$$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$$

Ref Method Flow (Q_{RM}) SCFM: 201144.3

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES
18955936.10	95.3

$$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$$

$KURZ_{AVG}$ SCFM: 198908.

$$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: 1.1

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}
201610.	201640	201440	201540	201820	201440

$$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$$

CMS_{AVG} SCFM: 201581.6

$$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$$

Relative Percent Difference ACCEPTANCE CRITERIA ±5%: .2

Work Order: 0304167 **Type:** Preventive Maintenance **State:** 60 - RTW

Description: 413B 41A001W2001 QTG IT FLOW

MON 6/16

Equipment I. D.: 41A001W2001 **PM ID:** IC413000

Equip Name: MASS FLOW INSTRUMENTATION

Design Class: IIIA **System:** VU01 **Parent:**

Location: 413B **Room:**

Dept: FACOP

Priority: P2

30

Planner: DAVIS, JACI **Assign to:** ZONE 4

Account:

COM Lockout/Tagout (Y) N No.________(if required) [ ] PLD LO/TO [ ] N/A	
13. COM Release/Date [signature] 06/15/03 Work Area Inspection completed. Craft/Date [signature] 6-16-03	14. ZMM Release/Date [signature] 6/16/03 Craft: [signature]
15. ZTL Work Comp/Date [signature] 061903	16. COM retest Comp/Date N/A
17. COM Work Complete/Date N/A	
19. Overview of Work Performed: As found data OOT; probes cleaned. As left data in tolerance. No further retest required.	
21. Engineer/Date: [signature] 6-26-03	

Due Date: 06/02/2003

Trade ID: ITECH

Next Due Date: 09/01/2003

RECORD

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ATTACHMENT 1 - Acceptance Criteria Calculation Sheet

✓ As Found / ____ As Left Nominal Flow Rate 110 KSCFM

Data Block 2 - Reference Method Flow

Traverse #1 Average	Traverse #2 Average	Traverse #3 Average	Traverse #4 Average	Traverse #5 Average	Traverse #6 Average
4226	4220	4259	4234	4216	4235

$$RMF = \frac{\text{Total Traverse Averages}}{6} \times 28.2743 \text{ ft}^2$$

Reference Method Flow (RMF) SCFM
119647 ~~717884~~ R 6-16-07

Data Block 3 - Kurz Flow

ADAM Unit Total Flow SCF	Elapsed Time minutes
7.678 MSCF	74.7

$$\text{ADAM Unit Average} = \frac{\text{ADAM Unit Total Flow}}{\text{Elapsed Time}}$$

ADAM Unit Average Flow SCFM
105462.

$$RPD = \frac{\text{ADAM Average Flow - RMF}}{RMF} \times 100$$

Relative Percent Difference (RPD) Acceptance Criteria ± 10%
-11.8

Data Block 4 - CMS Flow

Traverse #1 CMS Avg.	Traverse #2 CMS Avg.	Traverse #3 CMS Avg.	Traverse #4 CMS Avg.	Traverse #5 CMS Avg.	Traverse #6 CMS Avg.
106775	105333	105060	105998	104583	105463

$$\text{CMS Average} = \frac{\text{Total Traverse CMS Average Flows}}{6}$$

CMS Average Flow SCFM
105535.

$$RPD = \frac{\text{CMS Average - RMF}}{RMF} \times 100$$

Relative Percent Difference (RPD) Acceptance Criteria ± 10%
-11.7

ATTACHMENT 1 - Acceptance Criteria Calculation Sheet

____ As Found / ✓ As Left Nominal Flow Rate 120 KSCFM

Data Block 2 - Reference Method Flow

Traverse #1 Average	Traverse #2 Average	Traverse #3 Average	Traverse #4 Average	Traverse #5 Average	Traverse #6 Average
4440 ~~4315~~	4024	4500	4711	4645	4175

RMF = $\frac{\text{Total Traverse Averages}}{6}$ X 28.2743 ft^2	Reference Method Flow (RMF) SCFM
	124855 ~~124266.~~

Data Block 3 - Kurz Flow

ADAM Unit Total Flow SCF	Elapsed Time minutes
8082000	67.6

ADAM Unit Average = $\frac{\text{ADAM Unit Total Flow}}{\text{Elapsed Time}}$	ADAM Unit Average Flow SCFM
	119556
RPD = $\frac{\text{ADAM Average Flow - RMF}}{\text{RMF}}$ X 100	Relative Percent Difference (RPD) Acceptance Criteria ± 10%
	~~-3.7~~ -4.2

Data Block 4 - CMS Flow

Traverse #1 CMS Avg.	Traverse #2 CMS Avg.	Traverse #3 CMS Avg.	Traverse #4 CMS Avg.	Traverse #5 CMS Avg.	Traverse #6 CMS Avg.
117360	117853	117698.	117395	119840	119883

CMS Average = $\frac{\text{Total Traverse CMS Average Flows}}{6}$	CMS Average Flow SCFM
	118338.
RPD = $\frac{\text{CMS Average - RMF}}{\text{RMF}}$ X 100	Relative Percent Difference (RPD) Acceptance Criteria ± 10%
	~~-4.7~~ -5.2

11 31

Work Order: 0301655 **Type:** Preventive Maintenance **State:** 60 - RTW
Description: 413B 41A001W2001 QTG IT FLOW

Tue 3/11

Equipment I. D.: 41A001W2001 **PM ID:** IC413000
Equip Name: MASS FLOW INSTRUMENTATION
Design Class: IIIA **System:** VU01 **Parent:**
Location: 413B **Room:**

Dept: FACOP
Priority: 4M3
Planner: DAVIS, JACI **Assign to:** ZONE 4
14 **Account:**

COM Tagout/Lockout (Y) N No. 03-FO-83 (if required) [ ] PLD LO/TO [ ] N/A
STEP 3.0

13. COM Release/Date	14. ZMM Release/Date
Richard L. Marshall 3-11-03	[signature] 3-11-03
	Craft: G. Bannister
15. ZTL Work Comp/Date	**16. COM retest Comp/Date**
[signature] 03/17/03	N/A

17. COM Work Complete/Date
N/A

19. Overview of Work Performed:

Probes cleaned. As left data in tolerance. No further retest required. Still only 3 operating sensors. Troubleshooting taking place on separate WO.

21. Engineer/Date: [signature] 3-18-03

Due Date: 03/03/2003
Trade ID: ITECH
Next Due Date: 06/02/2003

RECORD

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Attachment 4 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left Nominal Flow Rate ___60___ KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
2155.1	2171.3	2194.4	2180.5	2163.3	2177.0
Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)				Ref Method Flow (Qrm) SCFM	
				61456.9	

Data Block 3. Kurz Flow

Kurz Total SCF	Elapsed Time MINUTES
3967000	65.9
KURZ avg = Kurz total / ELAPSED TIME	Kurz Avg SCFM
	60197.3
RPD= (Kurz avg - Qrm) / Qrm x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	-2.05

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
60565	60632.5	60162.5	60135.0	60395.0	59947.5
CMS Avg = SUM CMS TRAVERSE AVERAGES / 6				CMS Avg SCFM	
				60306.25	
RPD = MS Avg - Qrm x 100 / Qrm				Relative Percent Difference ACCEPTANCE CRITERIA ±10%	
				-1.87	

Attachment 4 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left Nominal Flow Rate ___90___ KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
3305.2	3279.2	3339.1	3283.4	3330.0	3333.9
Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)				Ref Method Flow (Qrm) SCFM	
				93639.0	

Data Block 3. Kurz Flow

Kurz Total SCF		Elapsed Time MINUTES	
4172000		45.7	
KURZ avg = Kurz total / ELAPSED TIME		Kurz Avg SCFM	
		91291.0	
RPD= (Kurz avg - Qrm / Qrm) x 100		Relative Percent Difference ACCEPTANCE CRITERIA ±10%	
		-2.51	

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
90880	91472.5	91222.5	90730.0	90630.0	91280.0
CMS Avg = SUM CMS TRAVERSE AVERAGES / 6				CMS Avg SCFM	
				91035.83	
RPD = (MS Avg - Qrm / Qrm) x 100				Relative Percent Difference ACCEPTANCE CRITERIA ±10%	
				-2.78	

Attachment 4 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left Nominal Flow Rate ___120__ KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
4401.4	4439.7	4375.8	4391.3	4405.3	4269.1

Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)	Ref Method Flow (Qrm) SCFM
	123853.2

Data Block 3. Kurz Flow

Kurz Total SCF	Elapsed Time MINUTES
7723000	63.2

KURZ avg = Kurz total / ELAPSED TIME	Kurz Avg SCFM
	122199.4
RPD= Kurz avg - Qrm x 100 / Qrm	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	-1.34

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
122019.5	122465.5	121962.0	122133.8	122351.0	122431.3

CMS Avg = SUM CMS TRAVERSE AVERAGES / 6	CMS Avg SCFM
	122227.17
RPD = MS Avg - Qrm x 100 / Qrm	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	-1.31

RECORD

Work Order: 0209534 **Type:** Preventive Maintenance **State:** 60 - RTW

Description: 413B 41A001W2001 QTG IT FLOW

12/2

Equipment I. D.: 41A001W2001 **PM ID:** IC413000

Equip Name: MASS FLOW INSTRUMENTATION

Design Class: IIIA **System:** VU01 **Parent:**

Location: 413B **Room:**

Dept: FACOP

Priority: 4M3

Planner: DAVIS, JACI **Assign to:** ZONE 4

Account:

COM Tagout/Lockout (Y) N No. 02-FO-457 (if required) [ ] PLD LO/TO [ ] N/A

13. COM Release/Date [signature] 12/2/02	14. ZMM Release/Date [signature] 12/2/02
Man Hours: 48	Craft: [signature] 120302
15. ZTL Work Comp/Date [signature] 12-4-02	16. COM retest Comp/Date N/A

17. COM Work Complete/Date

N/A

19. Overview of Work Performed:

As found data @ 120Kscfm was in tolerance. One of the 4 sensors was found to be inopperable, so probes were cleaned to maximize performance. No replacement sensor available. As left data in tolerance (120K not repeated because satisfactory data already obtained) No further retest required.

21. Engineer/Date: [signature] 12-13-02

Due Date: 12/02/2002

Trade ID: ITECH

Next Due Date: 03/03/2003

RECORD

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Attachment 4 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left   Nominal Flow Rate ___60___ KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
2000.8	2008.3	1936.6	2058.8	2012.9	2024.7
Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)				Ref Method Flow (Qrm) SCFM	
				56746.9	

Data Block 3. Kurz Flow

Kurz Total SCF	Elapsed Time MINUTES
2506000	43
KURZ avg = Kurz total / ELAPSED TIME	Kurz Avg SCFM
	58279.1
RPD= (Kurz avg - Qrm / Qrm) x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	2.70

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
58550.25	58046.8	58310.3	58596.0	58069.8	58516.0
CMS Avg = SUM CMS TRAVERSE AVERAGES / 6				CMS Avg SCFM	
				58348.17	
RPD = MS Avg - Qrm / Qrm x 100				Relative Percent Difference ACCEPTANCE CRITERIA ±10%	
				2.82	

Attachment 4 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left Nominal Flow Rate ___90___ KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
3337.6	3345.9	3378.0	3313.5	3381.3	3326.7

Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)	Ref Method Flow (Qrm) SCFM
	94638.6

Data Block 3. Kurz Flow

Kurz Total SCF	Elapsed Time MINUTES
3585000	39.2

KURZ avg = Kurz total / ELAPSED TIME	Kurz Avg SCFM
	91454.1
RPD= (Kurz avg - Qrm / Qrm) x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	-3.36

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
90914.25	91394.5	91474.8	90765.5	91269.0	91440.5

CMS Avg = SUM CMS TRAVERSE AVERAGES / 6	CMS Avg SCFM
	91209.75
RPD = (MS Avg - Qrm / Qrm) x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	-3.62

Work Order: 0207074 **Type:** Preventive Maintenance **State:** 60 - RTW

KWF 7150 Sept 2002

Description: 413B 41A001W2001 QTG IT FLOW

Equipment I. D.: 41A001W2001 **PM ID:** IC413000

TUE 9/3

Equip Name: MASS FLOW INSTRUMENTATION

Design Class: IIIA **System:** VU01 **Parent:**

Location: 413B **Room:**

Dept: FACOP

Priority: 4M3

Planner: DAVIS, JACI **Assign to:** ZONE 4

Account:

COM Tagout/Lockout (Y) N No. 02-F0-336 (if required) RS 091202	[ ] PLD LO/TO [ ] N/A
13. COM Release/Date: [signature] 9/3/02	14. ZMM Release/Date: [signature] 9/10/02
Man Hours: 138	Craft: Randy Mason 091802
15. ZTL Work Comp/Date: [signature] 09/19/02	16. COM retest Comp/Date: N/A
17. COM Work Complete/Date: N/A	

19. Overview of Work Performed:

As found data OOT @ 90K scfm. Full dynamic cal performed. As left data in tolerance. No further retest required.

21. Engineer/Date: [signature] 9-19-02

Due Date: 09/02/2002

Trade ID: ITECH

Next Due Date: 12/02/2002

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ORIGINAL

Attachment 4 - Acceptance Criteria Calculation Sheet

[X] As Found [ ] As Left

Nominal Flow Rate ___90___ KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
3431.0	3779.5	3855.0	3482.6	3759.5	3837.3

Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)	Ref Method Flow (Qrm) SCFM
	104355.7

Data Block 3. Kurz Flow

Kurz Total SCF	Elapsed Time MINUTES
3579000	39.1

KURZ avg = Kurz total / ELAPSED TIME	Kurz Avg SCFM
	91534.5
RPD= (Kurz avg - Qrm) / Qrm x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	-12.29

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
91486.25	91200.3	91108.5	91097.3	91120.3	91292.0

CMS Avg = SUM CMS TRAVERSE AVERAGES / 6	CMS Avg SCFM
	91217.42
RPD = (MS Avg - Qrm) / Qrm x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	-12.59

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Attachment 4 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left Nominal Flow Rate 60 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
2151.9	2181.5	2186.6	2158.7	2100.2	2147.3
Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)				Ref Method Flow (Qrm) SCFM	
				60912.9	

Data Block 3. Kurz Flow

Kurz Total SCF	Elapsed Time MINUTES
2986000	50.3
KURZ avg = Kurz total / ELAPSED TIME	Kurz Avg SCFM
	59363.8
RPD= (Kurz avg - Qrm) / Qrm x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±10%
	-2.54

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
59453	59224.0	59259.8	59536.5	59397.0	59181.8
CMS Avg = SUM CMS TRAVERSE AVERAGES / 6				CMS Avg SCFM	
				59342.00	
RPD = (MS Avg - Qrm) / Qrm x 100				Relative Percent Difference ACCEPTANCE CRITERIA ±10%	
				-2.58	

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Attachment 4 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left Nominal Flow Rate 90 KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
2813.4	2943.9	2870.7	2898.5	2873.5	2881.8
Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)				Ref Method Flow (Qrm) SCFM	
				81439.0	

Data Block 3. Kurz Flow

Kurz Total SCF	Elapsed Time MINUTES
4538000	52.7
KURZ avg = Kurz total / ELAPSED TIME	Kurz Avg SCFM: 86110.1
RPD= (Kurz avg - Qrm) / Qrm x 100	Relative Percent Difference ACCEPTANCE CRITERIA ±10%: 5.74

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
86397.5	85766.5	86194.3	86039.3	86653.8	85846.5
CMS Avg = SUM CMS TRAVERSE AVERAGES / 6				CMS Avg SCFM	
				86149.63	
RPD = (MS Avg - Qrm) / Qrm x 100				Relative Percent Difference ACCEPTANCE CRITERIA ±10%	
				5.78	

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Attachment 4 - Acceptance Criteria Calculation Sheet

[ ] As Found [X] As Left

Nominal Flow Rate ___120__ KSCFM

Data Block 2. Reference Method Flow

Traverse 1 Vavg	Traverse 2 Vavg	Traverse 3 Vavg	Traverse 4 Vavg	Traverse 5 Vavg	Traverse 6 Vavg
3813.4	3902.3	3870.7	3898.5	3915.2	3881.8
Qrm = (Sum TRAVERSE AVERAGES)/6) x 28.2743 ft sq)				Ref Method Flow (Qrm) SCFM	
				109713.3	

Data Block 3. Kurz Flow

Kurz Total SCF	Elapsed Time MINUTES
7779000	66.2
KURZ avg = Kurz total / ELAPSED TIME	Kurz Avg SCFM: 117507.6
RPD= Kurz avg - Qrm x 100 / Qrm	Relative Percent Difference ACCEPTANCE CRITERIA ±10%: 7.10

Data Block 4. CMS Flow

Traverse 1 CMS Avg	Traverse 2 CMS Avg	Traverse 3 CMS Avg	Traverse 4 CMS Avg	Traverse 5 CMS Avg	Traverse 6 CMS Avg
117397.5	117516.5	117194.3	117289.3	117403.8	117596.5
CMS Avg = SUM CMS TRAVERSE AVERAGES / 6				CMS Avg SCFM	
				117399.63	
RPD = MS Avg - Qrm x 100 / Qrm				Relative Percent Difference ACCEPTANCE CRITERIA ±10%	
				7.01	

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DOE/WIPP 03-2225

Waste Isolation Pilot Plant Site Environmental Report Calendar Year 2002

U.S. Department of Energy
Carlsbad Field Office

September 2003

Washington
Regulatory and Environmental Services

This report was prepared for the
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by Washington Regulatory and Environmental Services
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EXECUTIVE SUMMARY

The United States (U.S.) Department of Energy (DOE) Carlsbad Field Office (CBFO) and Washington TRU Solutions LLC (WTS) are dedicated to maintaining high quality management of Waste Isolation Pilot Plant (WIPP) environmental resources. DOE Order 5400.1, *General Environmental Protection Program*, and DOE Order 231.1, *Environment, Safety, and Health Reporting*, require that the environment at and near DOE facilities be monitored to ensure the safety and health of the public and the environment. This *Waste Isolation Pilot Plant 2002 Site Environmental Report* summarizes environmental data from calendar year 2002 that characterize environmental management performance and demonstrate compliance with federal and state regulations.

This report was prepared in accordance with DOE Order 5400.1, DOE Order 231.1, and Guidance for the Preparation of DOE Annual Site Environmental Reports (ASERs) for Calendar Year 2002 (DOE Memorandum EH-41: Natoli:6-1336, April 4, 2003). These Orders and the guidance document require that DOE facilities submit an annual site environmental report to DOE Headquarters, Office of the Assistant Secretary for Environment, Safety, and Health; and the New Mexico Environment Department (NMED).

The purpose of this report is to provide important information needed by DOE Headquarters to assess field environmental program performance and confirm compliance with environmental standards and requirements. It is also the means by which the WIPP site demonstrates compliance with the radiation protection requirements of DOE Order 5400.5, *Release Criteria,* and DOE Order 231.1. This report conveys the DOE's environmental performance to members of the public living near DOE sites and to other stakeholders. The 2002 Site Environmental Report outlines significant programs and efforts of environmental merit at WIPP for 2002.

The following highlights are discussed in the 2002 ASER:

- Discussion of WIPP's Environmental Management System (EMS) and its implementation status within the framework of the Integrated Safety Management System (ISMS).
- Activities pursuant to Executive Order (E.O.) 13148, *Greening the Government Through Leadership in Environmental Management*; and E.O. 13101, *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*.
- Discussion of accomplishments of site pollution prevention activities as applicable to WIPP.
- Report on the radiation protection, radiological doses and releases, if any, at WIPP including authorized limits used for the control or release of real or personal property potentially containing residual radioactive material, and protection of biota.

- Discussion of WIPP's environmental performance measures program, including specific environmental performance measures applicable to operations conducted at WIPP.

- Reporting of WIPP's Groundwater Monitoring Program results.

Environmental Program Information

It is the DOE's policy to conduct its operations at WIPP in compliance with all applicable environmental laws and regulations, and to safeguard the integrity of the southeastern New Mexico environment. This is accomplished through a comprehensive management system consisting of radiological and nonradiological environmental monitoring and surveillance, environmental compliance, wildlife monitoring, and the WIPP Raptor Research Program (WRRP). As part of these programs, the DOE collects data needed to detect and quantify potential impacts WIPP may have on the surrounding environment.

Environmental activities at WIPP generally fall into four categories: collecting environmental samples and analyzing them for a variety of contaminants, preparing and publishing documents demonstrating compliance with federal and state regulations, evaluating whether WIPP activities cause any environmental impacts, and taking corrective action when an adverse effect on the environment is identified.

The *Waste Isolation Pilot Plant Environmental Monitoring Plan* (EMP) (DOE/WIPP 99-2194) outlines the programs that monitor the environment on, and immediately surrounding, the WIPP site. It describes major environmental monitoring and surveillance activities at WIPP and WIPP's quality assurance/quality control (QA/QC) program as it relates to environmental monitoring.

WIPP's effluent monitoring and environmental surveillance programs are designed to ensure adequate protection of the public and the environment during DOE operations and that operations comply with the DOE and other applicable federal and state radiation standards and requirements. The Environmental Monitoring Program monitors the pathways that radionuclides and other contaminants could take to reach the environment surrounding WIPP. Pathways monitored include air, groundwater, surface water, soils, sediments, vegetation, and game animals. Groundwater quality and wildlife populations (raptors) are also monitored. The goal of the program is to determine if the local ecosystem has been impacted during the predisposal and disposal phases of WIPP, and, if so, to evaluate the severity, geographic extent, and environmental significance of those impacts. The Environmental Monitoring Program is conducted in compliance with DOE Orders 5400.1 and 5400.5.

Southeastern New Mexico is home to an abundant array of wildlife. Wildlife species are monitored on the WIPP site to document population changes that may occur as a result of WIPP activities. Species of special concern, including federally listed threatened and endangered species, receive special consideration when planning WIPP activities that may impact wildlife habitat.

The *Waste Isolation Pilot Plant Land Management Plan* (LMP) (DOE/WIPP 93-004) was created in accordance with the WIPP Land Withdrawal Act of 1992 (LWA) (Public Law [Pub. L.] 102-579). This plan identifies resource values, promotes multiple-use management, and identifies long-term goals for the management of WIPP lands. In accordance with the LMP, WIPP follows a land reclamation program and a long-range reclamation plan. WIPP also conducts oil and gas surveillance in the region surrounding the site to identify new activities associated with oil and gas exploration and production.

Environmental Compliance

WIPP is required to comply with applicable federal and state laws and DOE Orders. In order to demonstrate compliance, the following deliverables are submitted to the NMED and the U.S. Environmental Protection Agency (EPA):

NMED Deliverables

A. Hazardous Waste Facility Permit (HWFP)

Annual Volatile Organic Compounds (VOCs) Monitoring and Ventilation Report
Quarterly Solid Waste Management Unit (SWMU) Activities Progress Report
Biennial Treatment, Storage, and Disposal (TSDF) Report
Waste Minimization Report
Detection Monitoring Program Statistical Comparison Report
Round 14 Water Quality Sampling Program (WQSP) Groundwater Report
Round 15 WQSP Groundwater Report
Geotechnical Analysis Report
Monthly Water Level Results Report

B. New Mexico Water Quality Act

Quarterly Discharge Monitoring Reports

EPA

2002 Annual Change Report

Federal Acquisition, Recycling, and Pollution Prevention

In 1995, WIPP adopted a systematic and cost-effective affirmative procurement plan for the promotion and procurement of products containing recovered materials. Affirmative procurement is designed to "close the loop" in the waste minimization recycling process by supporting the market for materials collected through recycling and salvage operations.

WIPP continued its recycling program in 2002. Noteworthy pollution prevention (P2) activities completed:

- Chemical use reduction
- Electronic material data safety sheet (MSDS) system implementation
- Recycled metal bin inspection

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act of 1976 (RCRA) (42 U.S.C. §6901 et seq.) requires that hazardous waste be managed from the point of generation through ultimate disposal in a manner that is protective of human health and the environment. The state of New Mexico is authorized by the EPA to implement the provisions of the RCRA in accordance with the New Mexico Hazardous Waste Act (New Mexico Statutes Annotated [NMSA] 1978, §74-4-1 et seq.). WIPP operates in accordance with an HWFP issued by the NMED in accordance with 20.4.1.500 NMAC [New Mexico Administrative Code] and 20.4.1.900 NMAC. The HWFP authorizes the storage of contact-handled (CH) transuranic (TRU) waste in two locations (the Parking Area Unit and Waste Handling Building) and the disposal of CH TRU waste in the three underground Hazardous Waste Disposal Units.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires the federal government to use all practicable means to consider potential environmental impacts of proposed federal projects as part of the decision-making process. The NEPA dictates the public shall be allowed to review and comment on proposed projects that have the potential to significantly affect the environment. The NEPA also directs the federal government to use all practicable means to improve and coordinate federal plans, functions, programs, and resources relating to human health and the environment.

Title 10 *Code of Federal Regulations* (CFR) §1021.331, "National Environmental Policy Act Implementing Procedures, Mitigation Action Plans," requires, following completion of each Environmental Impact Statement (EIS) and its associated Record of Decision (ROD), that the DOE prepare a mitigation action plan addressing mitigation commitments expressed in the ROD. DOE Order 451.1B, *National Environmental Policy Act Compliance Program,* requires DOE facilities to track and report annual progress in implementing a commitment for environmental impact mitigation. To fulfill this DOE Order requirement, the CBFO issued the 2002 Annual Mitigation Report for the Waste Isolation Pilot Plant in July 2002.

National Historic Preservation Act

The National Historic Preservation Act (NHPA) (16 U.S.C. §470 et seq.) was enacted to protect the nation's cultural resources and establish the National Register of Historic Places. Federal agencies are required to ensure that historic and cultural properties are given proper protection and consideration during land use deliberations and in the

preparation of NEPA-related documents. No new archeological sites were discovered in 2002.

Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act (HMTA) (49 U.S.C. §5101 et seq.; 49 CFR Parts 105 through 178) is one of the major transportation-related statutes that affects WIPP operations. It provides the requirements for the safe transportation of hazardous materials, including radioactive materials. DOE Orders establish packaging and transportation criteria and require DOE field offices to conduct operations in accordance with all applicable international, federal, state, local, and tribal laws, rules, and regulations governing materials transportation. These DOE Orders also require the development of a transportation plan and use of the DOE TRANSCOM (transportation and tracking communications) system to monitor shipments.

Packaging and Transporting Radioactive Materials

The WIPP LWA requires TRU waste containers destined for WIPP to be shipped using specification packagings certified by the Nuclear Regulatory Commission (NRC). Certified shipping containers tor TRU waste satisfy NRC QA requirements. CH TRU waste is shipped in TRUPACT-II (Transuranic Package Transporter Model II) and HalfPACT (short Transuranic Package Transporter) containers. Containers for remote-handled (RH) waste were certified in 2001.

Environmental Compliance Assessment Program

The Environmental Compliance Assessment Program plays a major role in the overall program for environmental protection activities at WIPP. The program was developed to determine if facility activities protect human health and the environment and if these activities are in compliance with applicable federal, state, and local requirements; with permit conditions and requirements; and with best management practices. During 2002, WTS performed environmental assessments (EAs) of the following general areas:

- Construction and demolition debris landfill requirements
- WIPP Hazardous waste management and land disposal restrictions
- WIPP low-volume air sampling program
- Surface water and sediment sampling program

Environmental Management System

WTS has implemented at the WIPP an EMS that conforms to the criteria of the International Organization for Standardization (ISO) 14001, *Environmental Management Systems*. The WTS EMS received a third party ISO 14001 registration on August 5, 1997. An annual review of the EMS, which was completed in December 2002, identified no nonconformance or findings. The EMS registrar recommended continuous registration of the WTS EMS.

All environmental safety performance measures and commitments established for WIPP for FY 2002 have been met and new performance goals are established for FY2003. The annual establishment, implementation, tracking, trending, analysis, and reporting of environmental performance measures is consistent with the ISMS 5th core function, Feedback and Continuous Improvement.

<u>Volatile Organic Compound Monitoring</u>

In 2002 bi-weekly VOC samples were collected during the reporting period. The measured VOC concentrations at each station and the differences between the sampling station upstream and downstream of the active waste panel were very small relative to the concentrations of concern. The VOC measurements indicate that the panel contributed little or no VOCs to the mine air downwind of the active panel. Therefore, there were no significant releases of VOCs from the waste in Panel 1 and the measured VOC concentrations downstream of the panel were comparable to the upstream values. There were no Tentatively Identified Compounds that exceeded concentrations that would warrant further investigation. All HWFP requirements were met and no exceedance notifications to the NMED were required in 2002.

<u>Groundwater Monitoring</u>

In 2002 each of the seven Water Quality Sampling Wells were sampled twice. There were no detections above regulatory thresholds. The analytical data set from each well was compared to the groundwater baseline that was established prior to WIPP being operational. Through this review it was determined that all analytical values for the groundwater samples were within the statistical range established in the baseline. Therefore, all HWFP requirements were met and no exceedance notifications to the NMED or the EPA were required in 2002.

Environmental Radiological Program Information

Radionuclides present in the environment, whether naturally occurring or from human-made sources, contribute to radiation doses to humans. Therefore, environmental monitoring at nuclear facilities is imperative for characterizing radiological conditions, and for detecting releases and determining their effects, should they occur. The WIPP Environmental Monitoring Program monitors air, surface and groundwater, soils, and biota to characterize the radiation environment and to detect potential releases from WIPP activities. Plutonium-238, $^{239+240}$Pu, ^{241}Am, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{234}U, ^{235}U, and ^{238}U are monitored because they are components of TRU waste. Potassium-40 is monitored because of possible enhancement in southeastern New Mexico due to potash mining. There were no statistically significant differences between sampling years 2001 and 2002 for the concentration of any radionuclide.

Radiological Dose Assessment

The potential radiation dose to members of the public from WIPP operations has been calculated and demonstrates compliance with federal regulations and the DOE's policies and objectives of keeping this dose as low as possible.

Dose Limits

For more than 50 years, extensive research has been conducted on the effects of radiation on humans and the environment. Much of this research used standard epidemiological and toxicological approaches to characterize the response of populations and individuals to high radiation doses. From these data, a good understanding of the risks associated with high radiation doses was achieved. However, there is still uncertainty as to what risks are incurred from low radiation dose and dose rates, so models are used to predict these risks. Title 40 CFR §61.92 established that the emissions of radionuclides to the ambient air from DOE facilities shall not exceed an effective dose equivalent of 10 mrem (millirem) per year to a member of the public.

Background Radiation

Radiation is a naturally occurring phenomenon that has been in the environment since the beginning of time. There are several sources of natural radiation: cosmic and cosmogenic radiation (from outer space and the earth's atmosphere), terrestrial radiation (from the earth's crust), and internal radiation (naturally occurring radiation in our bodies). In addition to natural radioactivity, small amounts of radioactivity from the 1986 Chernobyl nuclear accident and above-ground nuclear weapons tests that occurred from 1945 to 1980 are also present in the environment. Together, these sources of radiation are called "background" radiation. Every human is constantly exposed to background radiation. Exposure to radioactivity from weapons testing fallout is quite small compared to natural radioactivity and continually gets smaller as radionuclides decay. The average annual dose received by a member of the public from naturally occurring radionuclides is about 3 mSv (millisievert) (300 mrem) (NCRP [National Council on Radiation Protection and Measurements], 1987b).

Dose from Air Emissions

The National Emission Standards for Hazardous Air Pollutants (NESHAP) issued by the EPA set limits for doses due to radionuclide emissions to air. To determine the potential radiation dose received by members of the public from WIPP, WTS used the EPA-approved computer model CAP88-PC, version 2.0. CAP88-PC dose calculations are based on the assumption that exposed people remain at home during the entire year and all vegetables, milk, and meat consumed are home produced. Thus, this dose calculation is a maximum potential dose which encompasses dose from inhalation, plume submersion, deposition, and ingestion of air-emitted radionuclides.

Total Potential Dose from WIPP Operations

The potential dose to an individual from the ingestion of WIPP-related radionuclides transported in water is estimated to be nonexistent. Drinking water for communities near WIPP comes from groundwater sources that are too far away to be affected by potential WIPP contaminants. Groundwater and surface water samples collected around WIPP during 2002 did not contain radionuclide concentrations different from those in samples collected prior to WIPP receiving waste.

Game animals sampled during 2002 were mule deer, quail, and fish. The only radionuclides detected were not different from background levels measured prior to commencement of waste shipments to WIPP. Therefore, no dose from WIPP-related radionuclides is estimated to have been received by any individual from this pathway during 2002.

The only pathway for which a dose could be estimated was that of air emissions. Air emissions from WIPP were not considered above background ambient air levels. Estimated concentrations of radionuclides in air emissions accounted for the calculable dose from WIPP operations during 2002. The radioactivity of environmental samples collected in 2002 is comparable to the preoperational levels (DOE/WIPP 92-037, *Statistical Summary of the Radiological Baseline for the Waste Isolation Pilot Plant*). The effective dose equivalent to the maximally exposed individual near WIPP is very small (7.61×10^{-6} mrem/year). This dose is insignificant as compared to the EPA limit of 10 mrem/year to a member of the public.

Dose to Nonhuman Biota

DOE Order 5400.5 lists the environmental radiation protection requirements that WIPP must meet to protect aquatic animals. In addition, dose limits below which no deleterious effects on populations of aquatic and terrestrial organisms have been observed, have been discussed by the NCRP and the International Atomic Energy Agency. Those absorbed dose limits are:

- Aquatic Animals 10 mGy/d (milli Gray/day), (1 rad/d)
- Terrestrial Plants 10 mGy/d (1 rad/d)
- Terrestrial Animals 1 mGy/d (0.1 rad/d)

The DOE requires discussion of radiation doses to nonhuman biota in the annual site environmental report using the DOE Technical Standard, DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*. The Standard uses a multiphase approach, including an initial screening phase with conservative assumptions.

This guidance was used to screen radionuclide concentrations observed around WIPP during 2002. The sum of fractions was less than one for all media. Radiation in the environment surrounding WIPP does not have a deleterious effect on populations of plants and animals.

Release of Property Containing Residual Radioactive Material

There was no release of radiologically contaminated materials or property in 2002. The potential for release of contaminated materials or property at WIPP is based on DOE Order 5400.5, and contractor institutional controls.

Quality Assurance

The fundamental objective of a QA program is to ensure high-quality measurements are produced and reported from the analytical laboratory. The defensibility of data generated by laboratories must be based on sound scientific principles, method evaluations, and data verification and validation. Wastren, of Grand Junction, Colorado; Air Toxics, Ltd. of Folsom, California; and Trace Analysis, of Lubbock, Texas, were the contract laboratories that performed the radiological and nonradiological analyses for WIPP environmental samples. WIPP Laboratories performed the radiological analyses on the environmental monitoring samples.

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CHAPTER 1 - INTRODUCTION

Located in southeastern New Mexico, WIPP is the world's first underground repository permitted to safely and permanently dispose of TRU radioactive and mixed waste (as defined in the WIPP LWA) generated through the research and production of nuclear weapons and other activities related to the national defense of the United States. TRU waste is defined in the WIPP LWA as radioactive waste containing more than 100 nanocuries (3,700 becquerels [Bq]) of alpha-emitting elements having atomic numbers greater than uranium-92 per gram of waste, with half-lives greater than 20 years. Most TRU waste is contaminated industrial trash, such as rags, old tools, sludges from solidified liquids; and glass, metal, and other materials from dismantled buildings.

There are certain exceptions to the WIPP LWA definition of TRU waste, including high-level radioactive waste; waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by 40 CFR Part 191 ("Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes") disposal regulations; or waste that the NRC has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

WIPP's legislative mandate is to demonstrate the safe disposal of TRU wastes from national defense activities and programs. To fulfill this mandate, WIPP has been designed to safely handle, store, and dispose of TRU waste in a fully operational disposal facility. When waste arrives at WIPP, it is placed in excavated storage rooms, carved from rock salt, 655 m [meters] (2,150 ft [feet]) below the earth's surface. The nature of the salt is such that after a storage room has been filled, the salt will slowly fill the remaining spaces, thus isolating the waste safely for thousands of years.

WIPP is the world's first underground repository with the necessary permits and certifications for safe and permanent disposal of TRU radioactive and mixed waste generated by defense-related activities. A TRU waste is eligible for disposal at WIPP if it has been generated in whole or in part by one or more of the activities listed in the Nuclear Waste Policy Act of 1982 (42 *United States Code* [U.S.C.] §10101), including naval reactors development, weapons activities, verification and control technology, defense nuclear materials production, defense nuclear waste and materials by-products management, defense nuclear materials security and safeguards and security investigations, and defense research and development.

The WIPP Project is authorized by the DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164). WIPP's legislative mandate is to demonstrate the safe disposal of TRU wastes from national defense activities and programs. To fulfill this mandate, WIPP has been designed to safely handle, store, and dispose of TRU waste in a fully operational disposal facility. After more than 20 years of scientific study, public input, and regulatory research, WIPP received its first shipment of waste on March 26, 1999.

When TRU waste arrives at WIPP, it is transported into the Waste Handling Building. The waste containers are removed from the shipping containers, placed on the waste hoist, and lowered to the repository level of 655 m (2,150 ft; approximately 0.5 mi) below the surface. During the disposal phase, the containers of waste are removed from the hoist and placed in excavated storage rooms in the Salado Formation, a thick sequence of salt beds deposited approximately 250 million years ago (Figure 1.1). Once a disposal area has been filled with waste, specially designed closures will be placed in the excavated disposal rooms, and seals will be placed in the shafts. Salt under pressure is relatively plastic, and mine openings will be allowed to creep closed for final disposal, encapsulating and isolating the waste.

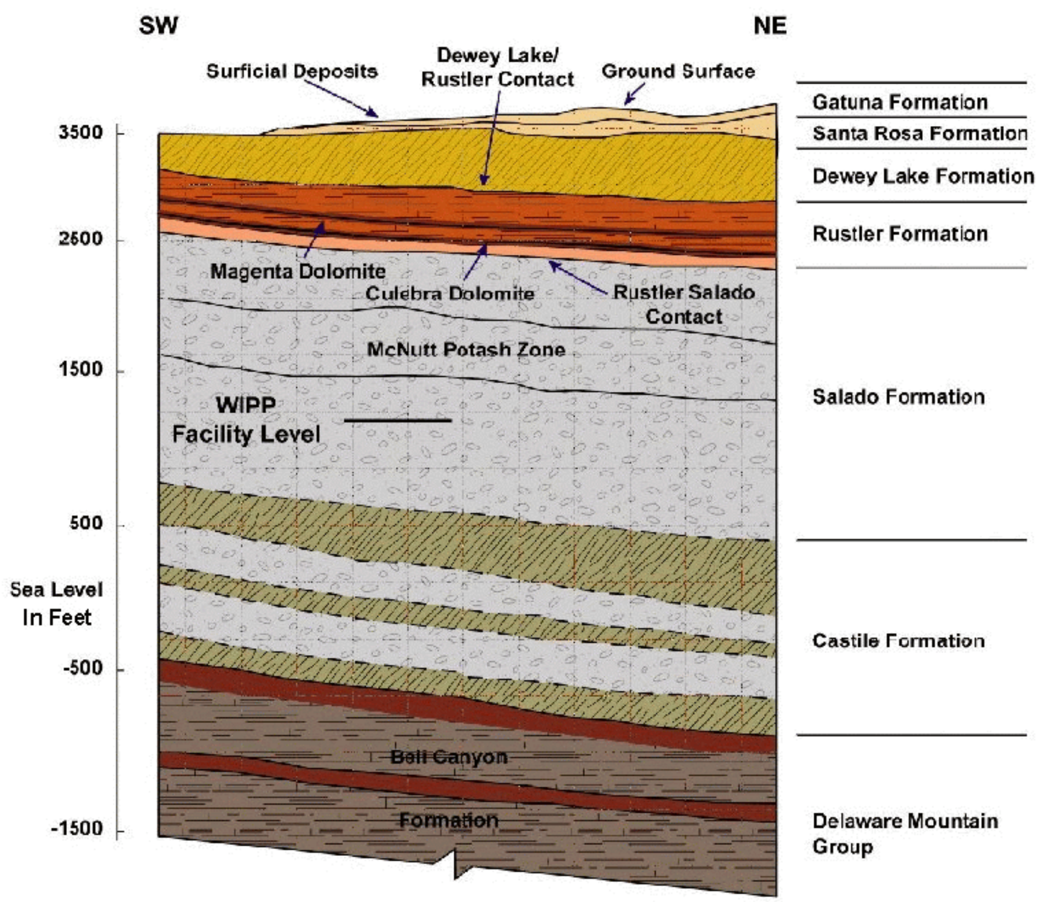

Figure 1.1 - WIPP Stratigraphy

1.1 WIPP History

Government officials and scientists initiated the WIPP site selection process in the 1950s. At that time, the National Academy of Sciences conducted a nationwide search for stable geological formations to contain wastes for thousands of years. In 1955, after extensive study, salt deposits were recommended as a promising medium for the disposal of radioactive waste.

Salt was chosen as the material for the planned disposal of nuclear waste for several reasons. Most deposits of salt are found in stable geological areas with very little earthquake activity, assuring the stability of a waste repository. Salt deposits also demonstrate the absence of flowing fresh water that could move waste to the surface. Water, if it had been or were present, would have dissolved the salt beds. In addition, salt is relatively easy to mine. Finally, rock salt heals its own fractures because it is relatively plastic. This means salt formations will slowly and progressively move in to fill mined areas and will safely seal radioactive waste from the environment.

Government scientists searched for an appropriate site for the disposal of radioactive waste throughout the 1960s, and finally tested the area of southeastern New Mexico in the early 1970s. Salt formations at WIPP were deposited in thick beds during the evaporation of an ancient ocean, the Permian Sea. These geologic formations consist mainly of sodium chloride, the same substance as table salt. However, at WIPP, the salt is not granular, but is in the form of solid rock. The main salt formation at WIPP is about 610-m (2,000-ft) thick, and begins 259 m (850 ft) below the earth's surface. Formed about 225 million years ago during the Permian Age, the large expanses of uninterrupted salt beds provide a repository that has been stable and free from the disturbances of large earthquakes for more than 200 million years. This proven stability over such a long time span offers the predictability that the salt will remain stable for the comparatively short 10,000-year period that WIPP is mandated to isolate the waste from the human environment.

In 1979, Congress authorized the construction of WIPP, and the DOE constructed the facility during the 1980s. In late 1993, the DOE created the Carlsbad Area Office (CAO) (now CBFO) to lead the TRU waste disposal efforts. The CBFO coordinates the TRU program at waste-generating sites and national laboratories.

In 1999, WIPP received its first waste shipment. On March 25, the first waste bound for WIPP departed Los Alamos National Laboratory in New Mexico; it arrived at WIPP the following morning, and the first wastes were placed underground later that day. On April 17, WIPP celebrated its official grand opening. Ten days later, on April 27, the first out-of-state shipment arrived at WIPP, from the Idaho National Engineering and Environmental Laboratory. Later in the year, on October 27, the Secretary of the NMED issued a WIPP HWFP, which allows WIPP to manage, store, and dispose of CH TRU mixed waste. Mixed waste is waste contaminated by both hazardous and radioactive substances. "Contact-handled mixed waste" is TRU mixed waste with a surface dose rate less than 200 mrem per hour.

1.2 WIPP's Mission

Current temporary radioactive waste storage facilities at 23 locations across the United States were never intended to provide permanent disposal. WIPP is the nation's first operating underground repository for defense-generated TRU waste and is a critical step toward solving the nation's nuclear waste disposal problem. Its mission is to provide for the safe, permanent, and environmentally sound disposal of TRU radioactive waste left from research, development, and production of nuclear weapons. Over the next 35 years, WIPP is expected to receive about 37,000 shipments of waste from locations across the United States.

The mission of the CBFO is to protect human health and the environment by opening and operating WIPP for safe disposal of TRU waste and by establishing an effective system for management of TRU waste from generation to disposal.

1.3 WIPP Location

Located in Eddy County in the remote Chihuahuan Desert of southeastern New Mexico (Figure 1.2), the WIPP site encompasses approximately 41.1 square kilometers (km^2), or 16 square miles (mi^2). The site is 42 km (26 mi) east of Carlsbad in a region known as Los Medaños. This part of New Mexico is relatively flat and is sparsely inhabited, with little surface water. The WIPP site boundary extends a minimum of 1.6 km (1 mi) beyond any of the WIPP underground developments. The WIPP LWA was signed into law on October 30, 1992, transferring the land from the U.S. Department of the Interior to the DOE. With the exception of facilities within the boundaries of the posted 5.7 km^2 (2.2 mi^2) Off-Limits Area, the surface land uses remain largely unchanged from pre-1992 uses, and are managed in accordance with accepted practices for multiple land use. However, mining and drilling for purposes other than those which support WIPP are prohibited within the WIPP site.

The majority of the lands in the immediate vicinity of WIPP are managed by the U.S. Department of the Interior's Bureau of Land Management (BLM). Land uses in the surrounding area include livestock grazing; potash mining; oil and gas exploration and production; and recreational activities such as hunting, camping, hiking, and bird watching. The region is home to diverse populations of animals and plants.

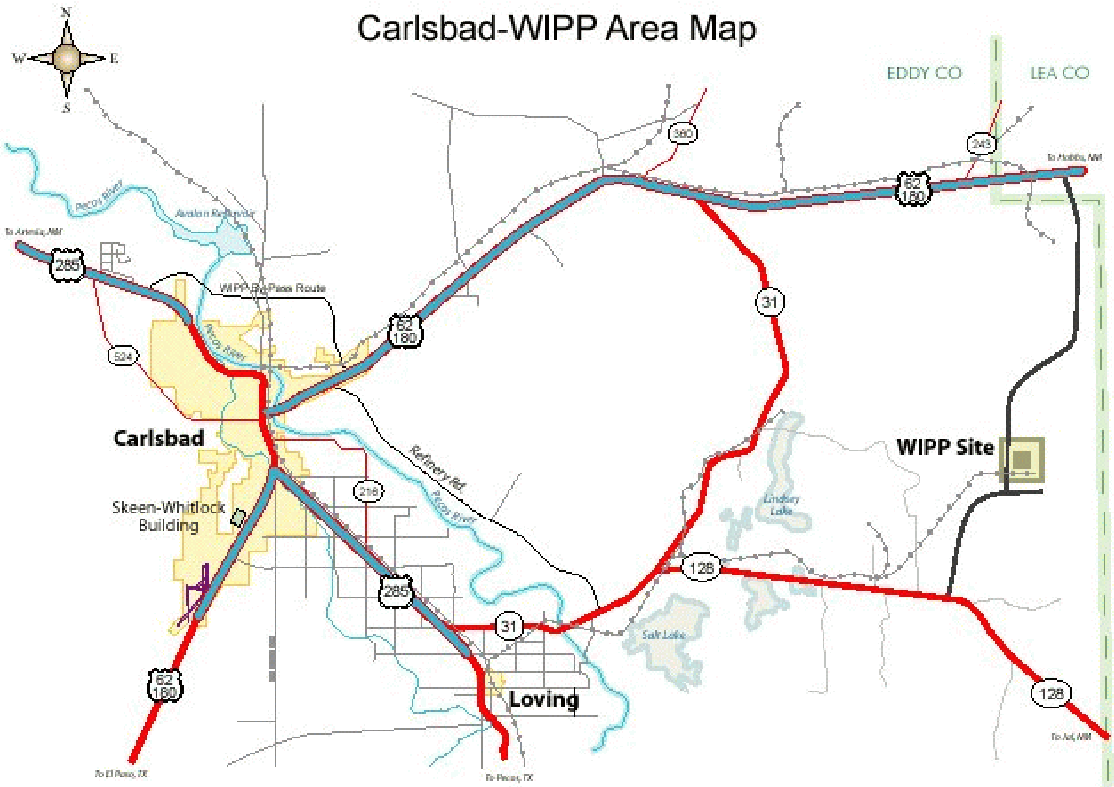

Figure 1.2 - WIPP Location

1.3.1 WIPP Property Areas

Five types of property areas are found within WIPP's boundary (Figure 1.3).

Property Protection Area

The interior core of the facility encompasses approximately 0.129 km^2 (0.05 mi^2) (≈35 acres) surrounded by a chain link fence. This area is under tight security and uniformed security personnel are on duty 24 hours a day.

Exclusive Use Area

The Exclusive Use Area comprises 1.12 km^2 (0.432 mi^2) (≈277 acres). It is surrounded by a five-strand barbed wire fence and is restricted exclusively for the use of the DOE and its contractors and subcontractors in support of the project. In addition, this area is defined as the point of closest public access for the purpose of analyzing accident consequences to the general public in the *Waste Isolation Pilot Plant Contact-Handled (CH) Safety Analysis Report* (DOE/WIPP 95-2065). This area is marked by DOE

warning (e.g., "no trespassing") signs and is patrolled by WIPP security personnel to prevent unauthorized activities or uses.

Off-Limits Area

Managed as an area where unauthorized entry and introduction of weapons and/or dangerous materials is prohibited, the Off-Limits Area includes 5.7 km^2 (2.2 mi^2) (≈1,421 acres). Pertinent prohibitions are posted at consistent intervals along the perimeter. Grazing and public thoroughfare will continue in this area until such time that these activities present a threat to the security, safety, or environmental quality of WIPP. This sector is patrolled by WIPP security personnel to prevent unauthorized activity or use.

WIPP Land Withdrawal Area

The WIPP site boundary delineates the perimeter of the 41.4 km^2 (16 mi^2) (≈10,240 acres) WIPP Land Withdrawal Area (WLWA). This tract includes properties outlying the Property Protection Area, the Exclusive Use Area, and the Off-Limits Area. This sector is designated as a Multiple Land Use Area, and is managed accordingly.

Special Management Areas

Certain properties used in the operation of WIPP (e.g., reclamation sites, well pads, roads) are, or may be, identified as Special Management Areas (SMA). A SMA designation is made due to values, resources, and/or circumstances that meet criteria for protection and management under special management designations. Unique resources of value that are in danger of being lost or damaged, areas where ongoing construction is occurring, fragile plant and/or animal communities, sites of archaeological significance, locations containing safety hazards, or sectors that may receive an unanticipated elevated security status would be suitable for designation as a SMA. Accordingly, the subject sector would receive special management emphasis under this stipulation. Special Management Areas will be posted against trespass and will be safeguarded commensurate with applicable laws governing property protection. WIPP security personnel patrol these areas to prevent unauthorized access or use.

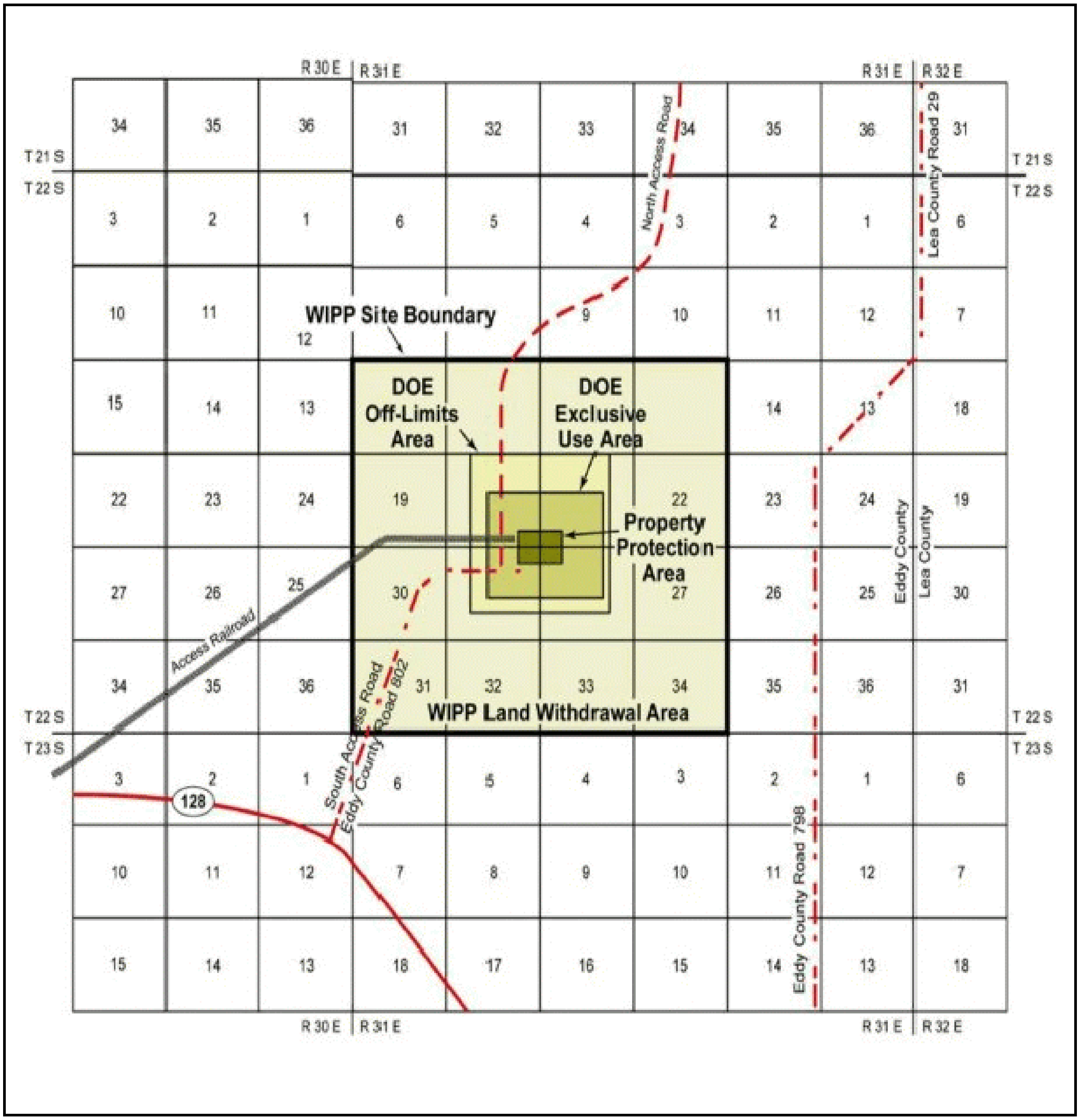

Figure 1.3 - WIPP Property Areas

1.3.2 Population

Approximately 26 residents live within 16 km (10 mi) of the WIPP site. The population within 16 km (10 mi) of WIPP is associated with ranching, oil and gas exploration/production, and potash mining. There are two nearby ranch residences (Smith Ranch and Mills Ranch) which are continuously monitored as part of the EMP.

The majority of the local population within 80.5 km (50 mi) of WIPP is concentrated in and around the communities of Carlsbad, Hobbs, Eunice, Loving, Jal, Lovington, and Artesia, New Mexico. The nearest community is the village of Loving (current estimated

population 1,326), 29 km (18 mi) west-southwest of WIPP. The nearest major populated area is Carlsbad, 42 km (26 mi) west of WIPP. The current estimated population of Carlsbad is approximately 25,625.

1.4 Environmental Performance

The DOE's Environmental Policy Statement (DOE Order 5400.1) describes the DOE's commitment to environmental protection and pledges to conduct operations "in an environmentally safe and sound manner. . . in compliance with the letter and spirit of applicable environmental statutes, regulations, and standards". The Statement also affirms the DOE's commitment to "good environmental management in all of its programs and at all of its facilities in order to correct existing environmental problems and to anticipate and address potential environmental problems before they pose a threat to the quality of the environment or public welfare." Additionally, it states, "It is DOE's policy that efforts to meet environmental obligations be carried out consistently across all operations and among all field organizations and programs. . ."

The DOE used laboratory tests, field tests, and computer models to demonstrate WIPP's expected 10,000-year performance as a permanent disposal site. The EPA certified, in May 1998, WIPP's ability to protect the environment and human health, while assuring continued compliance through periodic recertification.

WTS conducted the Environmental Monitoring Program at WIPP in 2002 to monitor for any potential radiological effects of WIPP on people and the environment. Other organizations that oversee the WIPP program, include the EPA, which is responsible for certifying whether radioactive material disposal requirements are met; the state of New Mexico, which regulates the handling of the hazardous components of mixed wastes; and the Environmental Evaluation Group (EEG), an independent technical oversight group that participates in and comments on various WIPP issues and activities. The Carlsbad Environmental Monitoring and Research Center conducts a supplementary environmental monitoring program around WIPP. Several other agencies, committees, and panels monitor progress at WIPP and contribute to the project's development through regulation, review, and comment at the state and federal levels.

This *Waste Isolation Pilot Plant 2002 Site Environmental Report* was prepared in accordance with DOE Order 231.1. This report documents WIPP's radiological and nonradiological monitoring programs and their results for 2002.

CHAPTER 2 - ENVIRONMENTAL PROGRAM INFORMATION

The DOE's policy for the management of WIPP is to conduct its operations in a manner commensurate with applicable environmental laws and regulations, and to safeguard the integrity of the southeastern New Mexico environment. This is accomplished through radiological and nonradiological environmental monitoring, environmental compliance, and land management programs, which include monitoring wildlife populations, the WRRP, and reclamation of disturbed lands. The purpose of these programs is to obtain land use permits, implement selected compliance functions such as NEPA compliance, collect data needed to detect and quantify possible impacts WIPP may have on the surrounding ecosystem and, when necessary, provide technical support in the disciplines of environmental science and land management to the DOE's CBFO.

Environmental monitoring activities at WIPP generally fall into four categories: collecting environmental samples from various matrices and analyzing them for specific radionuclides; preparing and publishing documents showing compliance with federal, state, and local regulations; evaluating whether WIPP activities cause any environmental impacts; and taking corrective action when an adverse effect on the environment is identified.

2.1 Environmental Monitoring Plan

WIPP's EMP outlines the programs that monitor the environment on, and immediately surrounding, the WIPP site. It discusses major environmental monitoring and surveillance activities at WIPP and reflects the importance of monitoring as a critical element of an effective environmental protection program. The EMP also discusses the WIPP QA/QC program as it relates to environmental monitoring. The purpose of the EMP is to outline the programs that evaluate WIPP's effect on the local ecosystem. Effluent and environmental monitoring also provide the data necessary to demonstrate compliance with applicable environmental protection regulations. The EMP sampling schedule is provided in Table 2.1.

The EMP describes the monitoring of naturally occurring and specific anthropogenic (human-made) radionuclides. The geographic scope of radiological sampling is based on projections of potential release pathways from the waste stored at WIPP. Airborne radioactivity is also monitored at Carlsbad, New Mexico, and local ranches.

The EMP also describes monitoring of VOCs, wildlife populations, meteorological data, groundwater chemistry, and other nonradiological environmental parameters. In general nonradiological monitoring is conducted within or near the WIPP boundary.

Results and discussions pertaining to the monitoring programs prescribed by the EMP are provided in Chapter 4, Environmental Radiological Program Information; and Chapter 5, Environmental Nonradiological Program Information. DOE Order 5400.1 requires the EMP to be reviewed internally every year and updated every three years. The EMP was updated in September 2002.

Table 2.1 - Sampling Schedule for the WIPP Environmental Monitoring Program

Type of Sample	Number of Sampling Locations	Sampling Frequency
Liquid effluent	1	Semiannual (oversight)
Liquid effluent	4	Quarterly (DP 831 permit [a])
Airborne effluent	3	Periodic/Confirmatory
Meteorology	2	Continuous
Atmospheric particulate	7	Weekly
Vegetation	6	Annual
Beef/Deer/Game Birds/Rabbits	Sitewide	Annual
Soil	6	Annual
Surface water	14	Annual
Groundwater	7	Semiannual
Fish	3	Annual
Sediment	12	Annual
Aerial photography	Sitewide	As needed
Volatile organic compounds (VOCs)	2	Semiweekly

[a] Monitoring compliance with the Discharge Plan, DP-831.

2.2 WIPP Environmental Monitoring Program

It is the policy of the DOE to conduct effluent monitoring and environmental surveillance programs that are appropriate for determining adequate protection of the public and the environment during WIPP operations, and to ensure operations comply with DOE and other applicable federal or state radiation standards and requirements. It is the DOE's objective that all DOE operations properly and accurately measure radionuclides in effluent streams and in the ambient environmental media. The goal of the WIPP Environmental Monitoring Program is to determine if the local ecosystem has been impacted during the predisposal and disposal phases of WIPP, and, if so, to evaluate the severity, geographic extent, and environmental significance of those impacts. The program fulfills DOE Orders 5400.1 and 5400.5.

The Environmental Monitoring Program monitors pathways by which WIPP-related radionuclides and other contaminants could reach the environment surrounding the WIPP site. The pathways measured include air, surface water, groundwater, sediments, soils, and biota (e.g., vegetation, select mammals, game birds, and fish). In addition, the program monitors groundwater quality and the overall health of the local environment. Nonradiological portions of the program focus on the area immediately surrounding the site while radiological surveillance generally covers a broader geographical area.

In addition to monitoring for radionuclides contained in WIPP wastes, background radiation (naturally occurring radioactivity and radioactivity associated with worldwide fallout from historic weapons testing) is also monitored. The geographic scope of

radiological sampling is based on projections of potential release pathways for the types of radionuclides in WIPP wastes. Also, Carlsbad, New Mexico, and local ranches are monitored, even though release scenarios involving radiation doses to residents of these population centers are improbable.

The atmospheric pathway, which can lead to the inhalation of radionuclides, has been determined to be the most likely exposure pathway to the public from WIPP. Therefore, airborne particulate sampling for alpha-emitting radionuclides is emphasized. Air sampling results are used to trend environmental radiological levels and determine if there has been a deviation from established baseline concentrations.

Nonradiological environmental monitoring activities at WIPP consist of a comprehensive set of sampling programs designed to detect and quantify impacts of construction and operational activities. The ecological monitoring program focuses on nonradiological effects of WIPP, such as habitat disturbance.

WIPP has collected preoperational radiological and nonradiological environmental data. Baseline conditions were initially characterized by the Radiological Baseline Program. When the first shipment of waste arrived at WIPP, this program became an operational monitoring program.

Preoperational studies must be considered during environmental evaluations. These assessments have contributed to baseline data gathered during the construction phase and provided much of the foundation for long-term monitoring programs. Below are listed examples of such investigations.

- The WIPP Site Characterization Program was instituted in 1976 by Sandia National Laboratories to monitor air quality, background radiation levels, and groundwater quality.

- The WIPP Biology Program began in 1975 with site characterization studies of climate, soils, vegetation, arthropods, and vertebrates.

- Investigations of site geohydrology were conducted by the U.S. Geological Survey at the request of the DOE. In addition, the NRC issued a contract to Columbia University to perform a study of radionuclide mobility in the highly saline groundwaters of the Delaware Basin.

- Radiological monitoring of air, water, and biological media was conducted by the U.S. Atomic Energy Commission before and after the Project Gnome nuclear detonation in 1961.

2.3 Land Management Programs

On October 30, 1992, the WIPP LWA became law. This act transferred the responsibility for the management of the WLWA from the Secretary of the Interior to the

Secretary of Energy. In accordance with Sections 3(a)(1) and (3) of the act, these lands:

> . . . are withdrawn from all forms of entry, appropriation, and disposal under the public land laws . . . and are reserved for the use of the Secretary of Energy . . . for the construction, experimentation, operation, repair and maintenance, disposal, shutdown, monitoring, decommissioning, and other activities associated with the purposes of WIPP as set forth in Section 213 of the DOE National Security and Military Application of the Nuclear Energy Act of 1980 (Pub. L. 96-164); 93 Stat. 1259, 1265, and this Act.

The DOE developed the LMP as required by Section 4 of the LWA. The LMP was developed to identify resource values, promote multiple-use management, and identify long-term goals for the management of WIPP lands until the culmination of the decommissioning phase. This plan was developed in consultation and cooperation with the BLM and the state of New Mexico. Changes or amendments to the plan require the involvement of the BLM, the state of New Mexico, and affected stakeholders, as appropriate.

The LMP encourages direct communication among stakeholders, including federal and state agencies, involved in managing the resources within, or activities impacting the areas adjacent to, the WLWA. It sets forth cooperative arrangements and protocols for addressing WIPP-related land management actions. Commitments contained in current permits, agreements, or concurrent MOUs with other agencies will be respected when addressing and evaluating land use management activities and future amendments that affect the management of WIPP lands.

2.3.1 Land Use Requests

Parties who wish to conduct activities that may impact lands under the jurisdiction of WIPP, but outside the secured fence area of the facility designated as the Property Protection Area, are required by the LMP to prepare a Land Use Request (LUR). A LUR consists of a narrative description of the project, a completed environmental review, and a map depicting the location of the proposed activity. The LUR, and associated NEPA checklists, are used to determine if applicable regulatory requirements have been met prior to the approval of a proposed project. A LUR may be submitted to the land use coordinator by any WIPP organization or outside entity wishing to complete any construction, right-of-way, pipeline easement, or similar action within the WIPP boundary or on lands used in the operation of WIPP, under the jurisdiction of the DOE. During 2002, twelve LURs were submitted for review and approval; all met applicable criteria and were approved.

2.3.2 Wildlife Population Monitoring

Southeastern New Mexico is home to diverse populations of plants and wildlife. Shrubs and grasses are the most prominent components of the local flora. Dominant trees include shinnery oak (*Quercus havardii*), honey mesquite (*Prosopis glandulosa*), and western soapberry (*Sapindus drummondii*). Much of the area is composed of combined dune and grassland habitats that include perennial grasses and shrubs.

According to the BLM's Resource Management Plan for the WIPP area, 15 percent of the identified wildlife species use the shinnery oak habitat, while 30 percent occupy areas consisting primarily of grasses. The combination of shinnery oak/dune with grassland habitat has resulted in a diverse wildlife population.

Southeastern New Mexico supports an abundant and diverse population of mammals, including black-tailed jackrabbits (*Lepus californicus*), desert cottontails (*Sylvilagus audoboni*), desert mule deer (*Odocoileus hemionus*), coyotes (*Canis latrans*), gray foxes (*Urocyon cinereoargenteus*), badgers (*Taxidea taxis*), and striped skunks (*Mephitis mephitis*).

The habitat diversity of the Los Medaños region of southeastern New Mexico also accounts for a wide assortment of bird species. Scaled quail (*Callipepla squamata*), mourning doves (*Zenaida macroura*), loggerhead shrikes (*Lanius ludovicianus*), black-throated sparrows (*Amphispiza bilineata*), Chihuahuan ravens *(Corvus cryptoleucus*), and a unique desert subspecies of the northern bobwhite (*Colinus virginianus*) are but a few examples of the array of avian inhabitants. Due to a scarcity of surface waters in the immediate vicinity of WIPP, migrating or breeding waterfowl are not common.

In addition, this area supports a particularly abundant and diverse population of raptors, or birds of prey. Harris' hawks (*Parabuteo unicinctus*), Swainson's hawks (*Buteo swainsoni*), and great horned owls *(Bubo virginianus*) are species commonly found nesting in the area. Northern harriers (*Cicus cyaneus*), burrowing owls (*Athene cunicularia*), barn owls (*Tyto alba*), and American kestrels (*Falco sparverius*) are also found around the site.

Reptiles and amphibians are also found in great numbers in southeastern New Mexico. Representative of the no fewer than ten native amphibians are the tiger salamander (*Ambystoma tigrinum*), green toad (*Bufo debilis*), plain's spadefoot (*Spea bombifrons*), red-spotted toad (*Bufo punctatus*), and New Mexico spadefoot (*Spea muliplicata*). Their significance is seldom recognized until spring or summer rains, at which time they appear in extraordinary numbers.

Reptiles are more conspicuous due to their diurnal nature. Characteristic reptiles in the region include the ornate box turtles (*Terrapene ornata*), side-blotched lizards (*Uta stansburiana*), western whiptails (*Cnemidophorus tigris*), bullsnakes (*Pituophis melanoleucus*), prairie rattlesnakes (*Crotalus viridis*), and Texas horned lizards *(Phrynosoma cornutum*), a federal notice-of-review species listed under the Endangered Species Act (16 U.S.C. §1531 et seq.).

WTS personnel manage several wildlife research projects and conduct a number of general wildlife management activities. Specific wildlife populations are monitored and researched in accordance with applicable laws, agreements, and regulations. Each activity is mandated and/or supported by state and federal guidelines or by way of commitments created through interagency agreements and MOUs. Wildlife within the WLWA are given consideration by way of the WIPP LUR process during planning stages of projects that may disturb or encroach on wildlife habitat.

In 1995, the U.S. Department of the Interior, Fish and Wildlife Service, provided an updated list of threatened and endangered species for Eddy and Lea Counties, New Mexico. Included were 18 species that may be present on WIPP lands. A comprehensive evaluation in support of the second Supplemental Environmental Impact Statement (SEIS-II) (DOE/EIS-0026-S-2) was conducted in 1996 to determine the presence or absence of threatened or endangered species in the vicinity of WIPP and WIPP's effect on these species. Results indicated that activities associated with the operation of WIPP had no impact on any threatened or endangered species. The protection of threatened and endangered species is taken into consideration when planning and administering projects on WIPP lands.

The DOE, the BLM, and other government agencies are keenly aware of the value and importance of protecting and monitoring raptor populations. To assist in this effort at WIPP, the BLM and the DOE established the WRRP in the early 1990s to monitor, protect, and educate about raptors on the WIPP site. The WRRP is administered by the WIPP Environmental Monitoring Program with input from the BLM and others. Scientific consultation, research direction, and field operations were conducted in 2002 by scientists from Hawks Aloft, a nonprofit biological consultant group in Albuquerque, New Mexico. This research continued on long term studies of productivity and population demographics of the raptor community in and around WIPP. These studies are described in greater detail in Chapter 5.

2.3.3 Reclamation of Disturbed Lands

The DOE recognizes its responsibility pursuant to federal, state, and local environmental regulations to enhance and restore areas affected by WIPP activities, including disturbed lands accepted as part of the land transfer from the BLM.

WIPP reclamation activities are conducted in accordance with DOE Order 5400.1; the DOE Organization Act (42 U.S.C. §7112); the Federal Land Policy and Management Act of 1976 (43 U.S.C. §1751 et seq.); the WIPP Disposal Phase SEIS-II; the SEIS-I (DOE/EIS-0026-FS); the Final Environmental Impact Statement (FEIS) (DOE/EIS-0026); and all applicable reclamation requirements by federal laws and regulations, Executive Orders, MOUs, DOE Orders, and state and local laws.

Without an active reclamation program for disturbed areas, the establishment of stable ecological conditions in arid environments may require decades or centuries to achieve stability, depending on the disturbances and environmental conditions present. Reclamation activities are intended to reduce soil erosion, increase the rate of plant

colonization and succession, and provide habitat for wildlife in disturbed areas. Reclamation ultimately serves to mitigate the effects of WIPP-related activities on affected plant and animal communities. The objective of the reclamation program is to reclaim lands used in the operation of WIPP that are no longer commissioned for WIPP operations. The DOE will also establish reclamation guidelines for land use requesters on a case-by-case basis.

In accordance with the LMP, WIPP follows a reclamation program and a long-range reclamation plan. As locations are identified for reclamation, WIPP personnel reclaim these areas by using the best acceptable reclamation practices. Seed mixes used reflect those species indigenous to the area with priority given to those plant species which are conducive to soil stabilization, wildlife, and livestock needs.

2.3.4 Oil and Gas Surveillance

The oil and gas industry is well established in southeastern New Mexico. Nearly all phases of oil and gas activities have occurred in the vicinity of WIPP, including seismic exploration, exploratory drilling, field development (comprised of production and injection wells), and other activities associated with hydrocarbon extraction.

The Los Medaños region, where WIPP is located, is part of the Delaware Basin. Although the Delaware Basin accounts for approximately 32 percent of lands in Eddy County, approximately 20 percent of the oil and gas wells are located within its boundaries. During 1995, oil and gas reserves in the immediate vicinity of the WLWA were evaluated by the New Mexico Bureau of Mines and Mineral Resources.

One aspect of the WIPP land withdrawal, unique to most DOE facilities, was the intent to maintain a multiple land use concept in the management of the property. However, an exception to a global multiple use strategy was required to reduce likelihood of inadvertent intrusion on the repository and to safeguard the surface infrastructure. Accordingly, all drilling and mining on the WIPP site has been prohibited. Oil and gas activities within 1.6 km (1 mi) of the WIPP boundary are monitored twice monthly to identify new activities associated with oil and gas exploration and production, including:

- Drilling
- Survey staking
- Geophysical exploration
- Pipeline construction
- Work-overs
- Changes in well status
- Anomalous occurrences (e.g., leaks, spills, accidents, etc.)

During 2002, WIPP surveillance teams conducted 24 scheduled surveillances with more than 100 cursory field inspections.

One exception to the prohibition of mining and drilling on the WIPP site involved two mineral leases. Under a provision contained in the LWA, these two mineral leases,

consisting of 129 hectares (320 acres) each, were not appropriated in the proceedings. Both tracts, located in Township 22 South, Range 31 East, Section 31, prohibit drilling within the first 1,830 m (6,000 ft) of the surface.

CHAPTER 3 - COMPLIANCE SUMMARY

WIPP is required to comply with applicable federal and state laws and DOE Orders. Documentation of requisite federal and state permits, notifications, well permits, and applications for approval is maintained by the Site Environmental Compliance Department. Regulatory requirements are incorporated into facility plans and implementing procedures. The primary method for maintaining compliance with environmental requirements is through the use of environmental professionals, routine training of facility personnel, and ongoing self-assessments.

3.1 Compliance Overview

In 2002, WIPP maintained compliance with applicable federal and state environmental regulations. The following sections describes the site compliance posture for 2002. Section 3.2 contains a listing of environmental statutes/regulations applicable to WIPP. Section 3.3 describes significant accomplishments and ongoing compliance activities relative to the regulations most pertinent to WIPP's development. A detailed breakdown of WIPP's compliance with environmental regulations is available in the *Waste Isolation Pilot Plant Biennial Environmental Compliance Report* (DOE/WIPP 02-2171).

3.2 Compliance Status

A summary of WIPP's compliance with major environmental regulations is presented in Table 3.3. Applicable DOE Orders are found in Table 3.4, and a list of WIPP permits appears in Table 3.5.

3.2.1 Comprehensive Environmental Response, Compensation, and Liability Act

No release sites have been identified at WIPP that would require cleanup under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. §9601. CERCLA establishes a comprehensive federal strategy for responding to, and establishing liability for, releases of hazardous substances from a facility to the environment. Any spills of hazardous substances that exceed a reportable quantity must be reported to the National Response Center under the provisions of CERCLA and 40 CFR Part 302. Hazardous substance cleanup procedures are specified in the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300).

<u>Superfund Amendments and Reauthorization Act of 1986</u>

WIPP is required by Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III (also known as the Emergency Planning and Community Right-to-Know Act) to submit (1) a list of hazardous chemicals for which an MSDS is required, and (2) an Emergency and Hazardous Chemical Inventory Form (Tier II Form), which identifies the inventory of hazardous chemicals present during the preceding year to the State

Emergency Response Commission, the Local Emergency Planning Committee, and the fire departments with jurisdiction over the facility.

Section 313, "Toxic Chemical Release Form," identifies requirements for facilities to submit a toxic chemical release report to the EPA in the resident state if toxic chemicals are used at the facility in excess of established threshold amounts.

The list of chemicals provides external emergency responders with information they may need when responding to a hazardous chemical emergency at WIPP. The Tier II Form, due on March 1 of each year, provides information to the public about hazardous chemicals that a facility has on-site at any time during the year above threshold planning quantities. WIPP submits the list of chemicals and the Tier II Form to each fire department with which the CBFO maintains an MOU. WIPP also provides the list of chemicals and the Tier II Form to the LEPC and SERC, as well as the fire departments that have MOUs with WIPP.

Accidental Releases of Reportable Quantities of Hazardous Substances

During 2002, there were no releases of hazardous substances exceeding the reportable quantity limits.

3.2.2 Federal Acquisition, Recycling, and Pollution Prevention

In July 1995, WIPP adopted a systematic and cost-effective affirmative procurement plan for the promotion and procurement of products containing recovered materials. Affirmative procurement is designed to "close a loop" in the waste minimization and recycling processes by supporting the market for materials collected through recycling and salvage operations.

Affirmative procurement programs are mandated by the RCRA, which requires federal procuring departments to establish material preference programs targeted to purchase recycled materials. Executive Order (E.O.) 13101 and EPA guidelines in 40 CFR Part 247, provide additional guidance for implementing affirmative procurement programs at federal facilities.

Affirmative procurement programs must include four elements: (1) a preference program, (2) a promotion program, (3) an estimation, certification, and verification procedure, and (4) annual review and monitoring procedures. The purchase and use of recycled products at WIPP will help foster markets for recovered materials and reduce the amount of solid waste requiring disposal.

WIPP's Affirmative Procurement Program Plan is defined in WP 02-EC.07, Waste Isolation Pilot Plant Affirmative Procurement Plan. In 2002, WTS purchased 99.98 percent of the items identified in the EPA guidelines through this program. WTS also purchased numerous items which were not required by the EPA program but, nevertheless, contained recovered materials.

3.2.3 Resource Conservation and Recovery Act

The RCRA was enacted in 1976. Implementing regulations were promulgated in May 1980. This body of regulations ensures that hazardous waste is managed and disposed of in a way that protects human health and the environment. The Hazardous and Solid Waste Amendments of 1984 prohibit land disposal of hazardous waste unless treatment standards are met. The amendments also place increased emphasis on waste minimization activities and serve as a mechanism to enforce RCRA cleanup requirements.

Title 40 CFR Part 280 addresses underground storage tanks (USTs) containing petroleum products or hazardous chemicals. Requirements for UST management pertain to the design, construction, installation, and operation of USTs, as well as notification and corrective action requirements in the event of a release and actions required for out-of-service USTs. The NMED was authorized by the EPA to regulate USTs. The annual registration fee for two USTs is submitted by July 1 of each year.

The NMED is authorized by the EPA to implement the RCRA program in New Mexico pursuant to the New Mexico Hazardous Waste Act. The technical standards for treatment storage and disposal facilities are outlined in 20.4.1.500 NMAC (incorporating 40 CFR Part 264). The hazardous waste management permitting program is administered through 20.4.1.900 NMAC (incorporating 40 CFR Part 270), which outlines the administrative aspects for processing permit applications and modifications.

WIPP was issued the HWFP on October 27, 1999. The operating conditions set forth in the permit were effective November 26, 1999. The HWFP authorized WIPP to receive, store, and dispose of CH TRU waste. Specifically, two storage units (the Parking Area and Waste Handling Building) and three underground Hazardous Waste Disposal Units are permitted for the management of CH TRU waste.

The 2002 HWFP modifications submitted to the NMED in accordance with 20.4.1.900 NMAC are listed in the table below. These modifications, shown in Table 3.1, were processed to support economic and operational efficiencies at WIPP. These innovative technologies will simplify waste characterization and reduce employee exposure at the DOE TRU waste generator sites.

Table 3.1 - Permit Modification Requests Submitted During Calendar Year 2002

ID	Submittal Date	Class	Name	Number of Items
35	2/4/02	1	ASTM (American Society for Testing and Materials) Type I Water	1
36	2/28/02	1	Updating the RCRA Emergency Coordinator List - 2	1
37	3/1/02	1	Headspace Gas Sampling Needle Insertion	1
38	3/21/02	1	Filter Vent Location on Standard Waste Boxes and Ten-Drum Overpacks	1
39	5/30/02	1	Update Contingency Plan and Revised Part A	10
40	6/10/02	1*	Remove Booster Fans	1
41	6/27/02	2	Waste Characterization Updates and Other Process Improvements	5
42	6/27/02	2	Add Waste Containers	1
43	6/27/02	3	Data Management Requirements	1
44	7/3/02	3	Remote Handled Transuranic Waste	2
46	10/7/02	3	Panel Closure Redesign	1
47	11/21/02	1*	Panel Closure Schedule	1
51	12/27/02	1	Name Change	1

Several RCRA regulatory inspections took place at the WIPP site during 2002. There was an NMED inspection on January 3, 2002. No violations were noted and the inspection report was closed. On January 7, 2002, the NMED sent Compliance Order HWB 01-08. Compliance Order HWB 01-08 alleged that WTS and the DOE had violated the HWFP, citing findings identified by the WIPP audit team during a recertification audit of the TRU waste characterization program at the Los Alamos National Laboratory. The NMED initially sought a civil penalty of $210,450.00. The DOE and WTS agreed to pay $25,000.00 to settle the matter. On February 14, 2002, WTS, the DOE, and the NMED executed a Settlement Agreement resolving Compliance Order HWB 01-08. On September 24, 2002, the NMED witnessed the test concrete pour for the monolith for Panel 1 closure. No issues were noted from that visit.

Hazardous Waste Generator Compliance

Nonradioactive hazardous waste is currently generated through normal facility operations, and is managed in Satellite Accumulation Areas and a "less-than-90-day" storage area. In addition, hazardous waste generated at WIPP is characterized, packaged, labeled, and manifested to off-site treatment, storage, and disposal facilities in accordance with the requirements codified in 40 CFR Part 262.

WIPP Solid Waste Management Units and Areas of Concern

Module VII of the HWFP contains the requirements for corrective action for the WIPP SWMUs and Areas of Concern (AOCs). The HWFP identified fifteen SWMUs requiring a RCRA Facility Investigation (RFI), three SWMUs not requiring a RFI (the Hazardous

Waste Management Units), and eight AOCs in the 4,146 hectares (16 mi^2) WLWA. There was no SWMU classification change during 2002.

Solid Waste Management Units

The 15 SWMUs included in the HWFP that require a RFI are listed below:

SWMU 001g (H-14/P-1 Mud Pits)
SWMU 001h (H-15/P-2 Mud Pits)
SWMU 001j (P-3 Mud Pit)
SWMU 001k (P-4 Mud Pit)
SWMU 001l (WIPP-12/P-5 Drilling Mud Pits)
SWMU 001m (P-6 Mud Pit)
SWMU 001n (P-15 Mud Pit)
SWMU 001o (Badger Unit Drilling Mud Pits)
SWMU 001p (Cotton Baby Drilling Mud Pits)
SWMU 001q (DOE-1 Drilling Mud Pits)
SWMU 001s (ERDA 9 Mud Pit)
SWMU 001t (IMC 347 Mud Pit)
SWMU 001x (WIPP-13 Drilling Mud Pits)
SWMU 004a (Portacamp Storage Yard, West Side)
SWMU 007b (SW Evaporation Pond)

Areas of Concern

Following are the eight AOCs included in the HWFP.

AOC 001r (D-123 Mud Pit)
AOC 001u (IMC-376 Mud Pit)
AOC 001v (IMC-456 Mud Pit)
AOC 001w (IMC-457 Mud Pit)
AOC 001ac (DSP-207 Mud Pit)
AOC 001ae (IMC-377 Mud Pit)
AOC 010b (Waste Handling Shaft Sump)
AOC 010c (Exhaust Shaft Sump)

The SWMU program at WIPP began in 1994 under EPA regulatory authority. The NMED subsequently received regulatory authority from the EPA. A Phase 1 RFI was completed at WIPP during 1996 as part of a Voluntary Release Assessment.

The fifteen SWMUs and eight AOCs identified in the permit are associated with natural resource exploration activities prior to the development of the WIPP, early WIPP mineral assessment and geologic studies to support facility, or facility construction.

Program Deliverables and Schedule

As required by Module VII, Table 1 RFI/CMS (Corrective Measures Study) Schedule of Compliance, WIPP is in compliance with the Permit reporting requirements. The key Permit deliverables and their dates of submittal as contained in Module VII, Table 1, include: (1) the first initiating activity, SWMU sampling plan approval and subsequent sampling, occurred in August of 2001; and (2) the first Quarterly Report was submitted in November 2001. Quarterly progress reports have been submitted through February 2003.

The Sampling and Analysis Plan addresses the current permit requirements for an RFI of SWMUs and AOCs. It uses the results of previous investigations performed at WIPP and expands the investigations as required by the permit. As an alternative to the RFI specified in Module VII of the permit, current NMED guidance identifies an Accelerated Corrective Action Approach (ACAA) that may be used for all SWMUs and AOCs. This ACAA is used to replace the standard RFI Work Plan and Report sequence for all current SWMUs and AOCs with a more flexible decision-making approach. The ACAA process allows a facility to proceed on an accelerated time line. The ACAA process can be entered either before or after an RFI Work Plan. According to the NMED's guidance, a facility can, and has, prepared an RFI Work Plan or ACAA for any SWMU or AOC. The NMED recognized that the facility was using the ACAA in lieu of the standard RFI in 2001. The required RFI work plan was superseded by the ACAA and the ACAA is used as a basis for the No Further Action (NFA) petition.

The ACAA process was used to produce an NFA report and petition, which was submitted to the NMED in October 2002. The NMED is reviewing the NFA petition and, if comments are given, WIPP will respond to them. When an NFA petition is granted, WIPP will proceed with an HWFP modification and remove the 15 SWMUs and 8 AOCs from the HWFP.

A revised facility work plan was submitted on February 13, 2002.

3.2.4 National Environmental Policy Act

The NEPA requires the federal government to use all practicable means to consider potential environmental impacts of proposed projects as part of the decision-making process. The NEPA dictates the public shall be allowed to review and comment on proposed projects that have the potential to significantly affect the environment. The NEPA also directs the federal government to use all practicable means to improve and coordinate federal plans, functions, programs, and resources relating to human health and the environment.

NEPA procedural objectives and public involvement requirements are detailed in the Council on Environmental Quality regulations implementing NEPA in 40 CFR Parts 1500 through 1508. The DOE codified its requirements for implementing the council's regulations in 10 CFR Part 1021. Further procedural NEPA compliance guidance is provided in DOE Order 451.1B. Title 10 CFR §1021.331 requires that,

following completion of each EIS and its associated ROD, the DOE shall prepare a mitigation action plan that addresses mitigation commitments expressed in the ROD. To fulfill this DOE Order requirement, the CBFO issued the 2002 Annual Mitigation Report for the Waste Isolation Pilot Plant in July 2002.

Day-to-day operational compliance with the NEPA at WIPP is achieved through implementation of the WIPP National Environmental Policy Act Compliance Plan (WP 02-EC.08) and the WIPP NEPA compliance procedure. These documents describe the roles and responsibilities of both the DOE NEPA Compliance Officer and the WRES NEPA Coordinator to evaluate the impacts of proposed projects at the site. A NEPA Database is used to track all proposed projects at the site. Proposed projects are pre-screened by the WRES NEPA Coordinator and the DOE NEPA Compliance Officer gives concurrence prior to project commencement. Every project at WIPP must be approved in this manner. Approximately 211 projects were approved in 2002. These projects primarily were performed as routine maintenance of equipment, to enhance efficiency and upgrade equipment at the WIPP site.

In June 2002, the DOE issued an EA and Finding of No Significant Impact for the proposed use of the Carlsbad Environmental Monitoring and Research Center for conducting actinide chemistry experiments in support of WIPP (DOE/EA-1404, *Environmental Assessment for Actinide Chemistry and Repository Science Laboratory*).

In November 2002, the DOE issued a supplement analysis that addressed the impacts of disposal of additional plutonium bearing materials from Rocky Flats that were not included in the original SEIS-II waste inventory at WIPP.

3.2.5 Clean Air Act

The Clean Air Act (CAA) (42 U.S.C. §7401 et seq.) provides for the preservation, protection, and enhancement of air quality, particularly at locations of special interest such as areas of natural, recreational, scenic, or historic value. Authority for the implementation and enforcement of the CAA has been delegated to New Mexico through the approval of their State Implementation Plan by EPA Region VI. Regulations to ensure compliance with the CAA have been developed and administered by the NMED.

Under the CAA, the EPA established the National Ambient Air Quality Standards for six "criteria" pollutants: sulfur dioxide, total suspended particulates, carbon monoxide, ozone, nitrogen oxides, and lead. These standards establish primary and secondary criteria for ambient air quality that the EPA considers necessary to protect public health and welfare.

The initial 1993 WIPP air emissions inventory was developed as a baseline document to calculate maximum potential hourly and annual emissions of both hazardous and criteria pollutants. Based on the current air emissions inventory, WIPP operations do not exceed the 10-ton-per-year emission limit for any individual hazardous air pollutant or the 25-ton-per-year limit for any combination of hazardous air pollutant emissions

established in Subpart A of NESHAP. Proposed facility modifications are reviewed to determine if they will create new air emission sources and require permit applications.

Based on the initial 1993 air emissions inventory, the WIPP site is not required to obtain federal CAA permits. WIPP, in consultation with the NMED Air Quality Bureau, working in concert with data provided in the first air emissions inventory, was required to obtain a New Mexico Air Quality Control Regulation 702, Operating Permit (recodified in 1997 as 20.2.72 NMAC, "Construction Permits") for two primary backup diesel generators at the site. During 2002, the backup diesel generators were operated for approximately 15 of the 480 hours allowed by the permit. There have been no activities or modifications to the operating conditions of the diesel generators that would require reporting under the conditions of the permit.

WIPP's normal operations do not involve or entail any planned or expected releases of airborne radioactive materials to the workplace or the environment. Waste containers accepted for disposal at WIPP are required to meet the 10 CFR Part 835 external contamination limits. To ensure compliance, the containers are surveyed both prior to release from the generator sites and as the TRUPACT-II containers are opened at WIPP.

Since radioactive material remains in the waste containers, there are no emissions of radionuclides to the ambient air from DOE facilities during normal WIPP waste handling, and the public is not subjected to radioactivity from the WIPP facility. The WIPP 2002 NESHAP report concluded that WIPP was operated in compliance with the release standards of 40 CFR Part 191, Subpart A, and 40 CFR Part 61, Subpart H.

External doses to workers from the handling of CH waste containers were estimated to be well within the DOE's "as low as reasonably achievable" goals and well below regulatory limits. Similarly, consequences to the public and workers as a result of the release of VOCs during disposal phase normal operations were shown to be many orders of magnitude below health-based limits.

3.2.6 Clean Water Act

The Clean Water Act (33 U.S.C. §§1251 through 1376) establishes provisions for the issuance of permits for discharges into waters of the United States. The regulation defining the scope of the permitting process is contained in 40 CFR Part 122, Subpart A, Section (b)(1), and states that ". . . National Pollutant Discharge Elimination System (NPDES) program requires permits for the discharge of 'pollutants' from any 'point source' into waters of the United States."

On August 29, 1997, WIPP submitted to the EPA a Notice of Intent (NOI) for Storm Water Discharges Associated with Industrial Activity under a NPDES Multi-Sector General Permit. Permit NMR05A823 was issued February 23, 1998. Since WIPP does not discharge storm water to the waters of the United States, a Notice of Termination was submitted to the EPA on December 19, 2001, and coverage under the Storm Water Multi-Sector Permit was terminated on January 9, 2002.

The NPDES sewage sludge regulations promulgated in 40 CFR Part 503 require all facilities that generate or dispose of sewage sludge to submit an information package describing sewage sludge management and disposal practices. WIPP did not dispose of any sewage sludge from the wastewater treatment systems during 2002.

3.2.7 New Mexico Water Quality Act

On January 16, 1992, the NMED issued the original discharge plan (DP-831) for the WIPP sewage facility. DP-831, as amended through December 2001, allows the disposal of 23,000 gallons per day (gpd) of sewage effluent to five lagoons; 2,000 gpd of nonhazardous brine water to the north evaporation cell; 8,000 gpd of nonhazardous brine water to the H-19 Evaporation Pond; and 100 gallons per year of neutralized acid to the domestic wastewater lagoons. A Discharge Plan Renewal was submitted to the NMED on June 5, 2002.

The DOE submits quarterly discharge monitoring reports to the NMED to demonstrate compliance with the inspection, monitoring, and reporting requirements identified in the plan.

DP-831 requires quarterly sampling and analysis of the sewage system influent for nitrate, total Kjeldahl nitrogen, total dissolved solids (TDS), ^{238}Pu, $^{239+240}$Pu, ^{241}Am, ^{234}U, ^{235}U, ^{238}U, and ^{90}Sr. Characterization samples are collected to appropriately disposition brine wastes prior to discharge into the H-19 Evaporation Pond.

An NOI was submitted to the NMED Water Quality Bureau on October 30, 2002. This NOI was submitted to update the information provided in an NOI submitted on April 20, 1983, related to the salt pile and Salt Pile Evaporation Pond. The NMED notified WIPP that a Discharge Plan, as defined in 6.2.1101 NMAC is required for the WIPP salt pile operations. The discharge plan modification application was submitted to the NMED on April 25, 2003.

3.2.8 Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) (42 U.S.C. §300f, et seq.) provides the regulatory strategy for protecting public water supply systems and underground sources of drinking water. The NMED notified WIPP in a September 9, 1992, letter that the WIPP public water supply was categorized as a nontransient, noncommunity system for reporting and testing requirements.

New Mexico water supply regulations mandate that when a public water supply system supplements other systems, that water system is treated as a single system for compliance sampling purposes. The Carlsbad municipal water supply system is contracted to provide "raw" water to WIPP from city-owned wells 50 km (31 mi) north of the site.

In a letter dated August 28, 1996, the NMED set the frequency for sampling lead and copper in the drinking water supply at ten samples every three years. The required

samples were collected in July 2002 and the results were submitted to the NMED. All samples were below action levels as specified by New Mexico monitoring requirements for lead and copper in tap water. The next lead and copper sampling period will be in July 2005.

Bacterial samples were collected and reported monthly throughout 2002. All bacteriological/analytical results were below the SDWA regulatory limits.

3.2.9 National Historic Preservation Act

The NHPA was enacted to protect the nation's cultural resources and establish the National Register of Historic Places. Federal agencies are required to coordinate NEPA compliance with the responsibilities of the NHPA to ensure that historic and cultural properties are given proper consideration in the preparation of NEPA documentation. Agency obligations under the NHPA, however, are independent from NEPA and must be complied with even when no additional NEPA documentation is required (i.e., for proposed projects not classified as major federal actions with significant environmental impacts, the DOE must still consider impacts to historic properties and sites). Where both NEPA and the NHPA are applicable, EAs and EISs must integrate NHPA considerations along with other environmental impact analyses and studies (see 40 CFR §1502.25).

During 2002, one archaeological investigation was conducted to assess cultural resources for installation of livestock corrals as a range improvement activity within the WLWA. No artifacts were encountered.

3.2.10 Hazardous Materials Transportation Act

The HMTA is one of the major transportation-related statutes that affects the DOE at WIPP. It provides for safe transportation of hazardous materials, including radioactive materials. The DOE complies with applicable U.S. Department of Transportation (DOT) regulations, corresponding NRC regulations, and DOE Orders 460.1B, *Packaging and Transportation Safety*; and 460.2, *Departmental Materials Transportation and Packaging Management,* for the transportation of hazardous materials. DOE Orders require the development of a transportation plan, and implementing procedures to ensure that the DOT regulations and requirements of each NRC-certified package are met. DOE Order 460.2 also requires the use of the DOE TRANSCOM system to monitor shipments.

Other federal transportation regulations applicable to WIPP include:

- Title 10 CFR Part 71, NRC requirements for packaging, design, construction, certification, and payload control

- Title 40 CFR Part 262, Subpart B, requirements for use of the hazardous waste manifest

- Title 49 CFR Parts 382 through 397, federal motor carrier safety regulations

The WTS Shipping Coordination Section implements applicable DOT and EPA regulations and DOE Orders for the transport of hazardous waste and hazardous materials from WIPP through the use of a transportation plan and implementing procedures. These implementing procedures address the classification, labeling, marking, placarding, and the shipping documentation needed to transport these materials in a safe and regulatory compliant manner.

3.2.11 Packaging and Transporting Radioactive Materials

Regulations for transportation of radioactive materials, under the authority of the DOT, are found in 49 CFR Parts 171 through 178. If the quantity of radioactive material exceeds certain limits, as determined by 49 CFR §173.431, a Type B shipping container (packaging) must be used. The specific requirements for the shipment of radioactive materials and requirements applicable to the Type B packages to be used to transport waste to the WIPP facility are detailed in 49 CFR Parts 171 through 173, and the NRC Certificate of Compliance (C of C) for the package. Regulations for Type B packaging, under the authority of the NRC, are found in 10 CFR Part 71, "Packaging and Transportation of Radioactive Materials." The WIPP LWA requires that TRU waste containers shipped to WIPP shall be transported using packages which have had the design certified by the NRC and which have been determined by the NRC to satisfy its QA requirements.

Additional transportation requirements for the mixed waste shipments (i.e., TRU mixed wastes) are detailed in 40 CFR Part 262. The appendix to Part 262 provides an example of a uniform hazardous waste manifest and instructions to waste generators and shippers of hazardous wastes.

CH TRU waste is shipped in the TRUPACT-II and the HalfPACT. The HalfPACT is a shorter version of the TRUPACT-II; it was designed to transport heavier CH TRU waste containers. The NRC certified the TRUPACT-II container on August 30, 1989. Since 1989, expansion of the TRUPACT-II payload envelope has been accomplished through applications to the NRC for revisions of the *TRUPACT-II Safety Analysis Report for Packaging* (NRC-Docket-71-9218) and the C of C, when applicable. The TRUPACT-II C of C, No. 14, expires June 30, 2004. The HalfPACT C of C was revised August 16, 2002, and expires October 31, 2005.

RH waste is not yet approved for disposal at WIPP; when this occurs, RH waste will be shipped in the RH-72B and the CNS 10-160B casks. The current C of C for the RH-72B cask expires February 8, 2005. The current revision of the C of C for the 10-160B expires October 31, 2005.

Emergency response for transportation of TRU waste is addressed by defense in depth. The first line of defense is the packaging itself. The NRC-certified packagings are able to survive "hypothetical" accident conditions without loss of contents. The testing

process subjects the package to forces that are more severe than those that would be experienced in a vehicular accident.

The second line of defense rests with the driver. The qualifications for the drivers are set at a high mark. The driver's record is reviewed for at least five years. The driver must be accident free and moving violation free in this time period. In addition to prior skills, the driver must attend and pass WIPP-specified training.

In the event an incident should occur, the DOE has trained emergency responders and hospital personnel along the transportation routes to mitigate the incident. In addition to the training provided to the first responders, the DOE and the states have conducted "WIPPTREXes" (training exercises) to provide emergency response personnel the opportunity to put into practice the training they receive. In addition to the training, the DOE has an Incident/Accident Response Team that is on standby to respond to an incident to assist the on-scene Incident Commander in the mitigation of the incident.

3.2.12 Toxic Substances Control Act

In 2002, the CBFO began to pursue the ability to dispose of PCB (polychlorinated biphenyl)-contaminated mixed waste under the Toxic Substances Control Act of 1974 (15 U.S.C. §2601 et seq.). In addition, the NMED determined that WIPP is exempt from the solid waste regulations for the purpose of disposal of asbestos waste and, therefore, is exempt from the registration and permitting requirements in accordance with 20.9.1 NMAC, "Solid Waste Management."

3.3 Other Significant Accomplishments and Ongoing Compliance Activities

3.3.1 Environmental Compliance Assessment Program

The Environmental Compliance Assessment Program plays a major role in the overall program for environmental protection activities at WIPP. The program was developed to determine if impactive or potentially impactive facility activities protect human health and the environment and if these activities are in compliance with applicable federal, state, and local requirements; permit conditions and requirements; and best management practices.

The QA manager and the Environmental Compliance Coordinator develop an assessment schedule based upon the results of the grading process identified in (1) WP 13-QA.03, Quality Assurance Independent Assessment Program, Attachment 8; (2) the amount of previous oversight; (3) customer input trending data; and (4) historical approval. Following is a summary of the assessments performed in 2002 and the results.

An assessment of Construction and Demolition Debris Landfill Requirements (Assessment No. ECA 02-002) was performed on January 22, 23, 24, and 25, 2002. The purpose of this assessment was to evaluate the effectiveness of WIPP procedures,

policies, and practices for compliance with applicable Construction and Demolition Debris Landfill requirements specified in 20.9.1 NMAC.

The assessment identified weaknesses in the implementation of certain aspects of the Construction and Demolition Debris Landfill process. When considering how well all other aspects of the program are performing, the overall implementation of the process is acceptable. Even when viewed in the aggregate, the assessment findings do not significantly affect the overall quality of the Construction and Demolition Debris Landfill Program.

The assessment resulted in two findings and no observations. The weaknesses noted by the two findings were related to incomplete documentation and departure from procedure requirements.

An assessment of WIPP Hazardous Waste Management and Land Disposal Restrictions (Assessment No. ECA 02-003) was performed on April 9, 10, 11, and 15, 2002. The purpose of this assessment was to evaluate the effectiveness of WIPP procedures, policies, and practices for compliance with applicable Hazardous Waste Management and Land Disposal Restriction requirements specified in 40 CFR Part 262, Subpart B, "The Manifest," and 40 CFR Part 268, "Land Disposal Restrictions."

The results of this assessment noted that implementation of the Hazardous Waste Management and Land Disposal Restriction program processes was acceptable. All Transportation Engineer training records indicated up-to-date qualifications. The Land Disposal Restriction forms were present and completed for all hazardous waste shipments, as required. The Hazardous Waste Shipment portfolios contained the documentation required by WP 08-NT3103, Shipment of Nonradioactive Waste. An evaluation has determined that the one assessment finding and one observation do not significantly affect the overall quality of the program.

The assessment resulted in one finding and one observation. The weakness noted by the finding was related to deviation from WP 15-PR, WIPP Records Management Program. The observation noted inconsistencies in completion of the Hazardous Waste Manifest.

An assessment of the WIPP Low Volume Air Sampling Program (Assessment No. ECA 02-004) was conducted on June 18, 19, 20, 24, 25, and 27, 2002. The purpose of this assessment was to evaluate the effectiveness of WIPP procedures, policies, and practices for compliance with applicable low volume airborne particulate sampling requirements specified in the DOE Environment, Safety, and Health *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, EH-0173T, January 1991; DOE/WIPP 99-2194; and EPA 402-R-97-01, *Guidance for the Implementation of EPA's Standards for Management and Storage of Transuranic Waste at WIPP*.

The assessment resulted in three exemplary practices, three findings, two observations, and three recommendations. All three exemplary practices were attributed to the

Environmental Monitoring staff for their thoroughness and professionalism. The weaknesses noted by the findings were related to records management, inadequate procedure, and personnel error. The observations identified insufficient personnel qualifications and a possible disconnect in the processes used to handle, transport, and dispose of loaded sample filters. The recommendations pertained to procedure revisions, sampler locations, and vendor calibrations.

An assessment of the Surface Water and Sediment Sampling Program (Assessment No. ECA 02-005) was conducted on August 19, 20, 21, 23, and 26, 2002. The purpose of this assessment was to evaluate the effectiveness of WIPP procedures, policies, and practices for compliance with applicable surface water and sediment sampling requirements specified in the EH-0173T and DOE/WIPP 99-2194.

The assessment resulted in three findings (one which was corrected during the course of the assessment) and two observations. The weaknesses noted by the findings pertained to documentation of environmental monitoring guidance exemptions, personnel qualifications, and incomplete documentation. The observations identified a failure to document pre-job safety briefings and a procedure violation.

3.3.2 Environmental Management System

WTS has established and implemented an EMS as a proactive approach to achieve environmental protection at WIPP through good environmental stewardship, regulatory compliance, pollution prevention/waste minimization, and continuous improvement. The WTS EMS is described in WP 02-EC.0.

WP 02-EC.0 incorporates the requirements of E.O. 13148, using the format of ISO 14001. The document also addresses the administrative control programs necessary to implement Management Policy (MP) 1.14, Environmental Management.

WTS has a number of programmatic and administrative documents that define how operational, safety, radiological, and environmental controls are implemented at WIPP. This includes controls to avoid hazards and enhance prevention such as pollution prevention options. The controls also include immediate protective actions in the WTS stop-work policy (MP 1.2, Work Suspension and Stop-Work Direction), as well as overall programmatic controls in MP 1.12, Worker Protection Policy.

The WTS EMS conforms to the ISO 14001 standard and is integrated with the ISMS as described in DOE/CBFO 98-2276. An annual review of the WTS EMS was conducted in December 2002. No nonconformance or findings were identified. The EMS registrar recommended continuous registration of the WTS EMS.

In 2002, WTS met its annual goal of zero reportable releases in all media as well as the established annual pollution prevention/waste reduction objectives. The WTS environmental performance measures and indicators for 2002 are identified in WP 02-EC.0 and WP 02-EC.11, Waste Isolation Pilot Plant Pollution Prevention Program Plan. The WP 02-EC.0, Environmental Management System Description

Document, describes the WTS policies, plans, and procedures that make up the WTS EMS. The WTS EMS is also integrated in the ISMS as described in DOE/CBFO 98-2276, *Integrated Safety Management System Description.*

EMS Performance Measures

Site responsibilities for the P2 Program are an integral part of the WIPP EMS. These values are prescribed by the DOE Secretary of Energy, waste stream reduction goals from routine operations must be decreased by the following percentages by FY 2005:

Hazardous	90 percent
Low-level radioactive	80 percent
Low-level mixed radioactive	80 percent
TRU	80 percent

The following are 2002 waste volumes and the reduction goals for 2005.

Waste Type	2002 Actual (Metric Tons)	FY 2005 Reduction Goal (Metric Tons)
RCRA (Hazardous)	0.34	.51
RCRA Leaded Brine (1995 baseline)	7.73	5.86
Low-level radioactive (2000 baseline)	0.43	.16
Low-level mixed radioactive (2000 baseline)	0.02	.004
Sanitary	99.61	673
Medical	0.06	N/A, No required waste stream reduction

The DOE Secretary of Energy's new goals for fiscal year (FY) 2005 and beyond are to recycle 45 percent of sanitary wastes from all operations by FY 2005 and 50 percent by FY 2010, based on the 1993 baseline.

3.3.3 Pollution Prevention Committee

The P2 Committee was formed in 1993 with a representative from each department. The primary purpose of this committee is to foster recycling activities at WIPP. The committee prepared a waste minimization charter, which outlines the committee's responsibilities.

The identified primary areas for pollution prevention are reductions in the generation of the following waste streams: lead brine, sanitary waste, RCRA waste, low-level mixed waste, and low-level radioactive waste. Other waste minimization efforts at WIPP include recycling of, but are not limited to, used oil, pallets, scrap metal, fire extinguishers, wet batteries, ethylene glycol, Safety-Kleen solvent, computer equipment, aluminum cans, toner cartridges, paper, etc.. Actual WIPP materials recycled in metric tons for 2002 are shown in WP 02-EC.11. Actual WIPP performance against the established reportable release and P2 goals were reported to WTS senior management and to the CBFO through the ISMS process.

On Earth Day 2002, the committee conducted activities to heighten employee awareness of xeriscaping and its efficient use of water. WIPP also participated in the River Blitz 2002 project in April as part of Earth Day activities.

The WIPP P2 Committee celebrated America Recycles Day in November 2002, using a display showing products made from recycled materials. The WIPP P2 Committee also participated in the city of Carlsbad activities for America Recycles Day by sponsoring a fashion show featuring items of clothing made from "trash."

During October 2002, Energy Month was celebrated with posters being hung around the site emphasizing the importance of saving energy.

Pollution Prevention Programs

The P2 program during 2002 included the following Pollution Prevention Opportunity Assessment (PPOA) activities:

- PPOA 2000-01 – Chemical Use Reduction. Implementation of this activity continued in 2002. Issues addressed included implementing an online, electronic MSDS system at WIPP, and increasing product substitution. This chemical use reduction is an ongoing PPOA activity. To date, 37 hazardous products have been eliminated or replaced by less hazardous products.

Noteworthy P2 activities during 2002 included the following:

- WTS continues to promote affirmative procurement strategies in the following ways: evaluate ways to improve data collection of affirmative program items on-line, *WIPPtoday* articles, and America Recycles Day activities.

- Recycling – WIPP continued its mandatory recycling program. Table 3.2 identifies the volume of materials recycled at WIPP in 2002.

Table 3.2 - Materials Recycled at WIPP in 2002

Recycled Material	2002 Actual (Metric Tons)
Paper	20.80
Aluminum cans	0.36
Cardboard	6.42
Toner cartridges	0.80
Pallets	0.80
Oil	3.99
Fluorescent bulbs/high-pressure sodium bulbs	0.60
Wet batteries	2.36
Silver	0.10
Ethylene glycol (RCRA)	0
Safety-Kleen solvent (RCRA)	0.10
Scrap metal	54.47

Table 3.2 - Materials Recycled at WIPP in 2002

Recycled Material	2002 Actual (Metric Tons)
Plastic	0.24
Fire extinguishers	0
Computer equipment	7.46
Total Sanitary and RCRA Materials Recycled	98.50
Total Sanitary and RCRA Materials Generated	198.11
PERCENT RECYCLED	49.7%

- WTS implemented an online, electronic MSDS system. Employees now have access to all MSDSs on their desktop computers. This reduced the number of paper copies generated and the amount of paper used and discarded at the WIPP site.

3.3.4 Environmental Training

Environmental training was provided to personnel associated with environmental operations at WIPP. Training courses included technical topics (e.g., RCRA sampling), EMS, basic environmental safety and health training, and general sitewide training such as the required General Employee Training module. These courses were conducted both on-site by WIPP personnel and off-site by various contractors.

Table 3.3 - Activities Associated with Major Environmental Statutes Applicable to the WIPP Project in 2002

Statute/Regulation	Related Activity
Clean Air Act of 1980 (42 U.S.C. §7401 et seq.)	Monitoring/reporting began upon first receipt of waste, March 26, 1999.
Clean Water Act of 1970 (33 U.S.C. §1251 et seq.)	Notice of Termination for the Multi-Sector Storm Water Discharge Permit was submitted on December 19, 2001. Storm Water Multi-Sector Discharge Permit was terminated by the EPA on January 9, 2002.
Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act (SARA) (42 U.S.C. §9601 et seq.)	No CERCLA site cleanup activity performed. Reports filed as required under SARA for hazardous substances are maintained on-site.
Endangered Species Act of 1973 (16 U.S.C. §1531 et seq.) (7 U.S.C. §136)	In November 1996, WIPP completed the 1996 Threatened and Endangered Species Survey. The survey is part of the analysis required for the SEIS-II. There were no threatened or endangered species located on WIPP land. Individual permits to collect biological samples and to band nonendangered species of raptors are maintained. Consultation with federal and state agencies is not required.
Federal Land Policy and Management Act of 1976 (43 U.S.C. §1751 et seq.)	An MOU between the DOE and the BLM was issued in July 1994. This MOU outlines the responsibilities the BLM and the DOE have with regard to land use management for the withdrawal area.
Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. §136-136y [1996])	All pesticides must be approved by Industrial Safety and Hygiene.
Hazardous Materials Transportation Act of 1974 (49 U.S.C §5101 et seq.)	Appropriate shipping papers accompany hazardous materials and hazardous wastes shipped off-site to ensure compliance with the act.
National Environmental Policy Act of 1969 (as supplemented by DOE Order 451.1B, and 10 CFR Part 1021) (42 U.S.C. §§4321-4347)	The 2002 Annual Mitigation Report for the Waste Isolation Pilot Plant (NEPA ID# WIP:00:002) was issued July 2002, in accordance with the requirement of DOE Order 451.1B, *National Environmental Policy Act Compliance Program*. This order requires DOE facilities to track and annually report progress in implementing a commitment for environmental impact mitigation that is essential to render the impacts of a proposed action nonsignificant or that is made in the ROD.
	In June 2002, the DOE issued an EA and Finding of No Significant Impact for the proposed use of the Carlsbad Environmental Monitoring and Research Center for conducting actinide chemistry experiments in support of WIPP (DOE/EA-1404, *Environmental Assessment for Actinide Chemistry and Repository Science Laboratory*). This Environmental Assessment was required to support a congressional directive to make maximum use of existing WIPP facilities to further the scientific missions assigned to the DOE by Congress.
National Historic Preservation Act of 1996 (16 U.S.C. §470)	Activities requiring excavation in previously undisturbed areas are surveyed by licensed, permitted archaeologists. Required reports are submitted to the New Mexico State Historic Preservation Officer. There was one archeological clearance for installation of livestock corrals performed in 2002, resulting in no findings or encounters.

Table 3.3 - Activities Associated with Major Environmental Statutes Applicable to the WIPP Project in 2002

Statute/Regulation	Related Activity
New Mexico Air Quality Control Act (§§74-2-1 to 74-2-22 NMSA 1978)	During 2002, the backup diesel generators were operated for approximately 15 of the 480 hours allowed by the permit. There were no malfunctions or abnormal conditions of operation that would cause a violation of the permit.
New Mexico Water Quality Act of 1978 (§§74-6-1 to 74-6-17 NMSA 1978)	An application for the renewal of Discharge Plan (DP-831) for the disposal of site-generated wastewater was submitted on June 5, 2002. An NOI was submitted to the NMED to update information submitted in a 1983 NOI for WIPP mining activities. The DOE submits quarterly discharge monitoring reports to the NMED Groundwater Quality Bureau to comply with the requirements of DP-831.
New Mexico Wildlife Conservation Act (§§17-2-37 to 17-2-46 NMSA 1978)	See "Endangered Species Act."
Resource Conservation and Recovery Act of 1976 (42 U.S.C. §6901 et seq.)	Hazardous-waste generator compliance: All site-generated hazardous wastes were transported off-site within the 90-day accumulation period. Permit compliance: NMED granted RCRA permit NM4890139088 effective November 26, 1999. Underground Storage Tanks: Annual registration fee paid.
Toxic Substances Control Act of 1974 (15 U.S.C. §2601 et seq.)	Procurement of PCB-containing materials not allowed. The CBFO began to pursue the ability to dispose of PCB-contaminated mixed waste at WIPP. Mixed waste containing asbestos waste is currently being disposed of at WIPP.
Safe Drinking Water Act of 1974 (42 U.S.C. §300f et seq.)	The WIPP public water system is characterized as a nontransient, noncommunity system (NMED, September 9, 1992). Drinking water is piped from the Carlsbad, New Mexico, municipal system.
Waste Isolation Pilot Plant Land Withdrawal Act of 1992 (Pub. L. 102-579)	The Biennial Environmental Compliance Report was published in September 2002.

Table 3.4 - Primary DOE Orders Affecting the WIPP Environmental Program

Order No.	Title	Annotation
DOE Order 5400.1	General Environmental Protection Program	Establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for ensuring compliance with federal and state environmental protection laws and regulations, federal executive orders, and internal department policies.
DOE Order 5400.5 Paragraph 1a (3)(a) of Chapter II is canceled by DOE O 231.1	Radiation Protection of the Public and the Environment	Establishes standards and requirements for operations of the DOE and DOE contractors with respect to protection of the public and the environment against undue risk from radiation.
DOE O 231.1	Environmental, Safety, and Health Reporting	Ensures collecting and reporting on operations information.
DOE O 225.1A, cancels DOE O 225.1	Accident Investigation	Prescribes requirements for conducting investigations of accidents and preventing recurrence of such accidents.
DOE O 414.1A	Quality Assurance	Promotes effective management through performance requirements and technical standards.
DOE O 435.1	Radioactive Waste Management	Promotes radioactive waste management in a manner that is protective of workers, public health and safety, and the environment.
DOE O 451.1B	National Environmental Policy Act Compliance Program	Establishes DOE policy for implementation of the NEPA of 1969 (Pub. L. 91-190).
DOE O 460.1A	Packaging and Transportation Safety	Establishes safety requirements for the proper packaging and transporting of DOE off-site shipments and on-site transfers of hazardous materials and for model transportation.
DOE O 460.2	Transportation and Packaging	Prescribes requirements for materials transportation and packaging.
DOE O 151.1A	Comprehensive Emergency Management System	Establishes requirements for comprehensive planning, preparedness, response, and recovery activities of emergency management programs for the DOE and for programs requiring DOE assistance.
DOE O 430.1A	Life-Cycle Assessment Management	Establishes procedures to plan, acquire, operate, maintain, and dispose of physical assets as valuable national resources.

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003 (Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
1	Department of the Interior, Bureau of Land Management	Right-of-Way for Water Pipeline	NM53809	8/17/83	In Perpetuity	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
2	Department of the Interior, Bureau of Land Management	Right-of-Way for the North Access Road	NM55676	8/24/83	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
3	Department of the Interior, Bureau of Land Management	Right-of-Way for Railroad	NM55699	9/27/83	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
4	Department of the Interior, Bureau of Land Management	Right-of-Way for Dosimetry and Aerosol Sampling Sites	NM63136	7/31/86	7/31/11	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
5	Department of the Interior, Bureau of Land Management	Right-of-Way for Seven Subsidence Monuments	NM65801	11/7/86	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
6	Department of the Interior, Bureau of Land Management	Right-of-Way for Aerosol Sampling Site	NM77921	8/18/89	8/18/19	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
7	Department of the Interior, Bureau of Land Management	Right-of-Way for 2 Survey Monuments	NM82245	12/13/89	12/13/19	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
8	Department of the Interior, Bureau of Land Management	Right-of-Way for telephone cable	NM46029	7/3/90	9/4/11	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
9	Department of the Interior, Bureau of Land Management	Right-of-Way for SPS Powerline	NM43203	2/20/96	10/19/11	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
10	Department of the Interior, Bureau of Land Management	Right-of-Way for South Access Road	NM46130	9/26/94	8/17/31	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
11	Department of the Interior, Bureau of Land Management	Right-of-Way for Duval Telephone Line	NM60174	11/6/96	3/8/15	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003
(Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
12	Department of the Interior, Bureau of Land Management	Right-of-Way for Wells AEC-7 & AEC-8	NM108365	8/30/02	8/30/32	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
13	Department of the Interior, Bureau of Land Management	Right-of-Way for ERDA-6	NM108365	8/30/02	8/30/32	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
14	Department of the Interior, Bureau of Land Management	Right-of-Way for Well C-2756 (P-18)	NM108365	8/30/02	8/30/32	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
15	Department of the Interior, Bureau of Land Management	Right-of-Way for Monitoring Well C-2664 (Cabin Baby)	NM107944	4/23/02	4/23/32	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
16	Department of the Interior, Bureau of Land Management	Right-of-Way for Seismic Monitoring Station	NM85426	9/23/91	None	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
17	Department of the Interior, Bureau of Land Management	Right-of-Way for Wells C-2725 (H-4A), C-2775 (H-4B), & C-2776 (H-4C)	NM108365	8/30/02	8/30/32	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
18	Department of the Interior, Bureau of Land Management	Right-of-Way for Monitoring Wells C-2723 (WIPP-25), C-2724 (WIPP-26), C-2722 (WIPP-27), C-2636 (WIPP-28), C-2743 (WIPP-29), & C-2727 (WIPP-30)	NM108365	8/30/02	8/30/32	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
19	Department of the Interior, Bureau of Land Management	Right-of-Way for Aerosol Sampling Sites	NM77921	10/3/89	8/18/19	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE
20	Department of the Interior, Bureau of Land Management	Right-of-way Easement for Accessing State Trust Lands in Eddy and Lea Counties	NM25430	2/29/00	9/28/04	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required	DOE

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003 (Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
21	U.S. Department of the Interior, Fish and Wildlife Service	Concurrence that WIPP Construction Activities Will Have No Significant Impact on Federally-Listed Threatened or Endangered Species	None	5/29/80	None	Active	Environmental Monitoring	N/A	N/A
22	New Mexico Environment Department Groundwater Bureau	Discharge Permit	DP-831	7/3/97	7/3/02 (Comments on draft renewal submitted 4/10/03)	Active	Environmental Monitoring and Facility Operations	G. E. Dials, Manager 12/16/96	DOE
23	New Mexico Environment Department Air Quality Bureau	Operating Permit for two backup diesel generators	310-M-2	12/7/93	None	Active	Facility Operations	A. E. Hunt Project Manager 6/18/93	DOE
24	New Mexico Department of Game and Fish	Concurrence that WIPP construction activities will have no significant impact on state-listed threatened or endangered species	None 7/25/83	5/26/89	None	Active	Environmental Monitoring	N/A	N/A
25	New Mexico Environment Department-UST Bureau	Underground Storage Tanks	NMED11811 (Number changes annually)	7/1/02	6/30/03 (2003 registration submitted 6/18/02)	Active	Facility Operations	V. Daub, Deputy Project Site Manager 6/18/92 (Initial UST registration)	DOE
26	New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2801	2/23/01	None	Active	EM&H	H. E. Johnson, DOE	DOE
27	New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2802	2/23/01	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 9/10/97	DOE
28	New Mexico State Engineer Office	Monitoring Well Exhaust Shaft Exploratory Borehole	C-2803	2/23/01	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 9/10/97	DOE

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003 (Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
29	New Mexico State Engineer Office	Monitoring Well	C-2811	3/2/02	None	Active	EM&H	H. E. Johnson, DOE	DOE
30	New Mexico State Engineer Office	Appropriation: WQSP-1 Well	C-2413	10/21/96	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 7/3/96 DOE	DOE
31	New Mexico State Engineer Office	Appropriation: WQSP-2 Well	C-2414	10/21/96	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 7/3/96	DOE
32	New Mexico State Engineer Office	Appropriation: WQSP-3 Well	C-2415	10/21/96	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 7/3/96	DOE
33	New Mexico State Engineer Office	Appropriation: WQSP-4 Well	C-2416	10/21/96	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 7/3/96	DOE
34	New Mexico State Engineer Office	Appropriation: WQSP-5 Well	C-2417	10/21/96	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 7/3/96	DOE
35	New Mexico State Engineer Office	Appropriation: WQSP-6 Well	C-2418	10/21/96	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 7/3/96	DOE
36	New Mexico State Engineer Office	Appropriation: WQSP-6a Well	C-2419	10/21/96	None	Active	EM&H	E. K. Hunter, Asst. Manager ONTWO 7/3/96	DOE
37	New Mexico State Engineer Office	Monitoring Well AEC-7	C-2742	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
38	New Mexico State Engineer Office	Monitoring Well AEC-8	C-2744	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
39	New Mexico State Engineer Office	Monitoring Well Cabin Baby	C-2664	7/30/99	None	Active	EM&H	Richard A. Jepson, Sandia National Laboratories 7/29/99	DOE
40	New Mexico State Engineer Office	Monitoring Well D-268 Plugged to 220' Livestock watering	C-2638	1/12/99	None	Active	EM&H	G. T. Basabilvaso, DOE 12/10/98	DOE

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003 (Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
41	New Mexico State Engineer Office	Monitoring Well DOE-1	C-2757	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
42	New Mexico State Engineer Office	Monitoring Well DOE-2	C-2682	4/17/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
43	New Mexico State Engineer Office	Monitoring Well ERDA-9	C-2752	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
44	New Mexico State Engineer Office	Monitoring Well H-1	C-2765	11/6/00	None	P&A*	EM&H	D. C. Lynn, 10/23/00	DOE
45	New Mexico State Engineer Office	Monitoring Well H-2A	C-2762	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
46	New Mexico State Engineer Office	Monitoring Well H-2B1	C-2758	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
47	New Mexico State Engineer Office	Monitoring Well H-2B2	C-2763	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
48	New Mexico State Engineer Office	Monitoring Well H-2C	C-2759	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
49	New Mexico State Engineer Office	Monitoring Well H-3B1	C-2764	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
50	New Mexico State Engineer Office	Monitoring Well H-3B2	C-2760	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
51	New Mexico State Engineer Office	Monitoring Well H-3B3	C-2761	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
52	New Mexico State Engineer Office	Monitoring Well H-3D	Pending	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
53	New Mexico State Engineer Office	Monitoring Well H-4A	C-2725	11/6/00	None	P&A	EM&H	D. C. Lynn, 10/23/00	DOE
54	New Mexico State Engineer Office	Monitoring Well H-4B	C-2775	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
55	New Mexico State Engineer Office	Monitoring Well H-4C	C-2776	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
56	New Mexico State Engineer Office	Monitoring Well H-5A	C-2746	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003 (Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
57	New Mexico State Engineer Office	Monitoring Well H-5B	C-2745	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
58	New Mexico State Engineer Office	Monitoring Well H-5C	C-2747	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
59	New Mexico State Engineer Office	Monitoring Well H-6A	C-2751	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
60	New Mexico State Engineer Office	Monitoring Well H-6B	C-2749	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
61	New Mexico State Engineer Office	Monitoring Well H-6C	C-2750	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
62	New Mexico State Engineer Office	Monitoring Well H-7A	C-2694	4/17/00	None	P&A	EM&H	D. C. Lynn, 10/23/00	DOE
63	New Mexico State Engineer Office	Monitoring Well H-7B1	C-2770	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
64	New Mexico State Engineer Office	Monitoring Well H-7B2	C-2771	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
65	New Mexico State Engineer Office	Monitoring Well H-7C	C-2772	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
66	New Mexico State Engineer Office	Monitoring Well H-8A	C-2780	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
67	New Mexico State Engineer Office	Monitoring Well H-8B	C-2781	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
68	New Mexico State Engineer Office	Monitoring Well H-8C	C-2782	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
69	New Mexico State Engineer Office	Monitoring Well H-9A	C-2785	11/6/00	None	P&A	EM&H	D. C. Lynn, 10/23/00	DOE
70	New Mexico State Engineer Office	Monitoring Well H-9B	C-2783	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
71	New Mexico State Engineer Office	Monitoring Well H-9C	C-2784	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
72	New Mexico State Engineer Office	Monitoring Well H-10A	C-2779	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003 (Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
73	New Mexico State Engineer Office	Monitoring Well H-10B	C-2778	11/6/00	None	P&A	EM&H	D. C. Lynn, 10/23/00	DOE
74	New Mexico State Engineer Office	Monitoring Well H-10C	C-2695	4/17/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
75	New Mexico State Engineer Office	Monitoring Well H-11B1	C-2767	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
76	New Mexico State Engineer Office	Monitoring Well H-11B2	C-2687	4/17/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
77	New Mexico State Engineer Office	Monitoring Well H-11B3	C-2768	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
78	New Mexico State Engineer Office	Monitoring Well H-11B4	C-2769	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
79	New Mexico State Engineer Office	Monitoring Well H-12	C-2777	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
80	New Mexico State Engineer Office	Monitoring Well H-14	C-2766	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
81	New Mexico State Engineer Office	Monitoring Well H-15	C-2685	4/17/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
82	New Mexico State Engineer Office	Monitoring Well H-16	C-2753	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
83	New Mexico State Engineer Office	Monitoring Well H-17	C-2773	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
84	New Mexico State Engineer Office	Monitoring Well H-18	C-2683	4/17/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
85	New Mexico State Engineer Office	Monitoring Well H-19B0	C-2420	1/25/95	1/31/98	Inactive - Renew when necessary	EM&H	Harold F. Klaus, Jr. DOE 11/9/94	DOE
86	New Mexico State Engineer Office	Monitoring Well H-19B1	C-2420	1/25/95	1/31/98	Inactive - Renew when necessary	EM&H	Harold F. Klaus, Jr. DOE 11/9/94	DOE
87	New Mexico State Engineer Office	Monitoring Well H-19B2	C-2421	1/25/95	1/31/98	Inactive - Renew when necessary	EM&H	Harold F. Klaus, Jr. DOE 11/9/94	DOE

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003 (Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
88	New Mexico State Engineer Office	Monitoring Well H-19B3	C-2422	1/25/95	1/31/98	Inactive - Renew when necessary	EM&H	Harold F. Klaus, Jr. DOE 11/9/94	DOE
89	New Mexico State Engineer Office	Monitoring Well H-19B4	C-2423	1/25/95	1/31/98	Inactive - Renew when necessary	EM&H	Harold F. Klaus, Jr. DOE 11/9/94	DOE
90	New Mexico State Engineer Office	Monitoring Well H-19B5	C-2424	1/25/95	1/31/98	Inactive - Renew when necessary	EM&H	Harold F. Klaus, Jr. DOE 11/9/94	DOE
91	New Mexico State Engineer Office	Monitoring Well H-19B6	C-2425	1/25/95	1/31/98	Inactive - Renew when necessary	EM&H	Harold F. Klaus, Jr. DOE 11/9/94	DOE
92	New Mexico State Engineer Office	Monitoring Well H-19B7	C-2426	1/25/95	1/31/98	Inactive - Renew when necessary	EM&H	Harold F. Klaus, Jr. DOE 11/9/94	DOE
93	New Mexico State Engineer Office	Monitoring Well P-14	C-2637	1/2/99	None	P&A*	EM&H	G. T. Basabilvaso, DOE 11/17/98	DOE
94	New Mexico State Engineer Office	Monitoring Well P-15	C-2686	4/17/00	None	P&A*	EM&H	D. C. Lynn, 10/23/00	DOE
95	New Mexico State Engineer Office	Monitoring Well P-17	C-2774	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
96	New Mexico State Engineer Office	Monitoring Well P-18	C-2756	11/6/00	None	P&A*	EM&H	D. C. Lynn, 10/23/00	DOE
97	New Mexico State Engineer Office	Monitoring Well WIPP-12	C-2639	1/12/99	None	Active	EM&H	G. T. Basabilvaso, DOE 11/17/98	DOE
98	New Mexico State Engineer Office	Monitoring Well WIPP-13	C-2748	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
99	New Mexico State Engineer Office	Monitoring Well WIPP-18	C-2684	4/17/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
100	New Mexico State Engineer Office	Monitoring Well WIPP-19	C-2755	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
101	New Mexico State Engineer Office	Monitoring Well WIPP-21	C-2754	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE

Table 3.5 - Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant - April 1, 2003 (Does Not Include Hazardous Waste Facility Permit)

	Granting Agency	Type of Permit	Permit Number	Date	Expiration	Current Permit Status	WTS Owner	Signed By/Title	Signed For
102	New Mexico State Engineer Office	Monitoring Well WIPP-25	C-2723	7/26/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
103	New Mexico State Engineer Office	Monitoring Well WIPP-26	C-2724	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
104	New Mexico State Engineer Office	Monitoring Well WIPP-27	C-2722	11/6/00	None	Active	EM&H	D. C. Lynn, 7/24/00	DOE
105	New Mexico State Engineer Office	Monitoring Well WIPP-28	C-2636	1/12/99	None	P&A*	EM&H	G. T. Basabilvaso, DOE 11/17/98	DOE
106	New Mexico State Engineer Office	Monitoring Well WIPP-29	C-2743	11/6/00	None	Active	EM&H	D. C. Lynn, 10/23/00	DOE
107	New Mexico State Engineer Office	Monitoring Well WIPP-30	C-2727	8/4/00	None	Active	EM&H	G. T. Basabilvaso, DOE 7/31/00	DOE

* Plugged and abandoned

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CHAPTER 4 - ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

Radionuclides present in the environment, whether naturally occurring or human-made, contribute to radiation doses to humans. Therefore, environmental monitoring around nuclear facilities is imperative to characterize radiological conditions, detect releases, and determine their effects, should they occur. Because of this, the DOE requires an environmental monitoring program for nuclear facilities (DOE Order 5400.1).

The WIPP Environmental Monitoring Program monitors air, groundwater, surface water, soils, sediments and biota to characterize the radiation environment around the WIPP facility. This program is carried out in accordance with the EMP. The WIPP Effluent Monitoring Program monitors the air from the underground storage areas and the Waste Handling Building to detect potential releases from WIPP activities.

The radiological environment near WIPP includes natural radioactivity, global fallout and, potentially, radioactive contamination from the Project Gnome. A nuclear device was detonated underground in bedded salt on December 10, 1961. The test site for Project Gnome was located approximately 9 km (5.4 miles) southwest of the WIPP site. The Project Gnome shot vented into the drift and up the shaft to the atmosphere. Therefore, most environmental samples are expected to contain small amounts of natural radioactivity and fission products.

Throughout this chapter, radionuclides were considered "detected" in a sample if the measured concentration or activity is greater than 2 sigma total propagated uncertainty (2 sigma TPU or 2 x TPU) and the minimum detectable concentration (MDC). The MDC was determined by the different analytical laboratories based on the natural background radiation, the analytical technique, and inherent characteristics of the analytical equipment. The MDC represents the minimum concentration of a radionuclide detectable in a given sample using the given equipment and techniques with a specific statistical confidence (usually 95 percent).

Total propagated uncertainty is an estimate of the uncertainty in the measurement due to all sources, including counting error, measurement error, chemical recovery error, detector efficiency, randomness of radioactive decay and any other sources of uncertainty.

Comparisons of radionuclide concentrations were made between years and locations using the statistical procedure, ANOVA [Analysis of Variance]. When this, or another statistical test, was used, the p-value was reported. The p-value is the probability under the null hypothesis of observing a value as unlikely or more unlikely than the value of the test statistic. In many cases, scientists have accepted a value of $p < 0.05$ as indicative of a difference between samples. However, interpretation of p requires some judgment on the part of the reader; individual readers may choose to defend higher or lower values of p as their cutoff value. For this report, $p < 0.05$ was used.

4.1 Effluent Monitoring

The WIPP facility has three effluent emission points, Stations A, B, and C, that may release airborne radionuclides to the atmosphere. Station A samples the unfiltered underground exhaust air. Station B samples the underground exhaust air after HEPA (high-efficiency particulate air) filtration and, sometimes, nonfiltered air during maintenance. Station C samples the air from the Waste Handling Building after HEPA filtration. Each station employs one or more fixed air samplers, collecting particulates from the effluent air stream using a Versapore filter.

During 2002, 347 samples were collected from Station A for a total air volume sampled of 25,872 m^3 (913,667 ft^3). Because only a small fraction of the air released through Station A is sampled, the activity on the filter is normalized to the total air flow through Station A. Sixty-six samples were collected from Station B for a total air volume sampled of 29,960 m^3 (1,058,049 ft^3), and 53 samples were collected from Station C for a total air volume sampled of 8,682.7 m^3 (306,630 ft^3). Samples were composited each quarter for stations B and C. Because of the large number of samples from Station A, these samples were composited monthly. Samples were analyzed radiochemically for ^{241}Am, ^{238}Pu, $^{239+240}$Pu, and ^{90}Sr, the components of the CH waste at WIPP expected to produce 98 percent of the potential radiation dose to humans.

Out of 80 total composite samples, no sample had detectable radioactivity (Table 4.1). For the 80 samples, the WIPP Laboratories reported an activity less than 2 x TPU and the MDC. It was conservatively assumed that the actual activity was equal to the MDC for the WIPP 2002 Annual Periodic Confirmatory Measurement Compliance Report (40 CFR Part 61, Subpart H), and for other effluent reporting requirements.

In reference to Table 4.1, the WIPP Laboratories reports the radionuclide results in units of picoCurie/sample (pCi/sample). The laboratory results are converted from pCi/sample to becquerels (Bq)/sample. The laboratory results are converted to Bq/sample by multiplying the laboratory results by 0.037.

Results from Stations A, B, and C were used as input for the dose assessment presented in Chapter 7.

Additional sampling was routinely performed in the underground using fixed air samplers and continuous air monitors. Evaluation of the samples from both indicate there were no detectable releases above background activity from the WIPP facility.

4.2 Airborne Gross Alpha/Beta

Gross alpha and beta measurements in airborne particulates are used as a screening technique to provide timely information on levels of radioactivity in the environment around the WIPP site. Airborne particulate samples were collected by the WRES Environmental Monitoring group from seven different locations around WIPP: Southeast Control (SEC), Carlsbad (CBD), J. C. Mills Ranch (MLR), Smith Ranch (SMR), WIPP East (WEE), WIPP South (WSS), and WIPP Far Field (WFF) (Figure 4.1).

Each week at each station, approximately 600 m^3 (21,200 ft^3) of air was filtered through a 4.7-cm (centimeters) (1.85-in.) diameter glass microfiber filter using a low-volume continuous air sampler. The samples were collected at a height of 1.5-2 m (5-6.6 ft) to closely match the height at which air is inhaled by humans. Filters were counted for gross alpha and beta only after being stored for three days in the laboratory to ensure that the short-lived radon progeny had decayed.

Blank filters were also counted for gross alpha and beta activities so that background corrections (activities present in the blank filters) could be made in the gross alpha and beta measurements of the air samples. Blanks were counted weekly along with the samples. The gross alpha and beta activities per cubic meter of air were then determined by dividing the total activity of gross alpha and beta found in each weekly sample by the amount of air pulled through each sample. The results are given in Appendix D. The mass and volume of air collected each week are reported in Appendix E.

As expected, weekly gross alpha activity concentrations measured in 2002 varied by an order of magnitude throughout the year at each location (Figure 4.2). Measured concentrations ranged from a minimum of $1.47\times10^{-5} \pm 1.27\times10^{-5}$ Bq/m^3 ($3.97\times10^{-4} \pm 3.43\times10^{-4}$ pCi/m^3) to a maximum of $2.35\times10^{-4} \pm 5.35\times10^{-5}$ Bq/m^3 ($6.35\times10^{-3} \pm 1.44\times10^{-3}$ pCi/m^3) (Table 4.2). However, the annual mean concentrations of gross alpha activities found at all locations were similar, ranging from $7.19\times10^{-5} \pm 6.59\times10^{-5}$ to $8.16\times10^{-5} \pm 7.10\times10^{-5}$ Bq/m^3 ($1.94\times10^{-3} \pm 1.78\times10^{-3}$ to $2.20\times10^{-3} \pm 1.92\times10^{-3}$ pCi/m^3). ANOVA indicated no statistically significant difference between sampling stations ($p = 0.908$).

Table 4.1 - Activity (Bq) of Quarterly Composite Air Samples from Effluent Monitoring Stations A, B, and C

Nuclide	Activity	2 × TPU[a]	MDC[b]	Activity	2 × TPU	MDC	Activity	2 × TPU	MDC
	Station A			Station B			Station C		
	1st Quarter								
^{241}Am	See below [c]			$1.31\text{x}10^{-4}$	$4.55\text{x}10^{-4}$	$9.66\text{x}10^{-4}$	$3.25\text{x}10^{-4}$	$4.63\text{x}10^{-4}$	$4.40\text{x}10^{-4}$
^{238}Pu				$1.62\text{x}10^{-4}$	$5.62\text{x}10^{-4}$	$1.19\text{x}10^{-3}$	$1.62\text{x}10^{-4}$	$3.25\text{x}10^{-4}$	$4.37\text{x}10^{-4}$
$^{239+240}Pu$				$1.62\text{x}10^{-4}$	$3.24\text{x}10^{-4}$	$4.37\text{x}10^{-4}$	$0.00\text{x}10^{0}$	$0.00\text{x}10^{0}$	$4.37\text{x}10^{-4}$
^{90}Sr				$1.71\text{x}10^{-2}$	$2.29\text{x}10^{-2}$	$3.77\text{x}10^{-2}$	$1.49\text{x}10^{-2}$	$2.69\text{x}10^{-2}$	$4.48\text{x}10^{-2}$
	2nd Quarter								
^{241}Am	See below			$0.00\text{x}10^{0}$	$0.00\text{x}10^{0}$	$4.6\text{x}10^{-4}$	$0.00\text{x}10^{0}$	$0.00\text{x}10^{0}$	$5.02\text{x}10^{-4}$
^{238}Pu				$0.00\text{x}10^{0}$	$0.00\text{x}10^{0}$	$4.05\text{x}10^{-4}$	$0.00\text{x}10^{0}$	$0.00\text{x}10^{0}$	$3.47\text{x}10^{-4}$
$^{239+240}Pu$				$0.00\text{x}10^{0}$	$0.00\text{x}10^{0}$	$1.49\text{x}10^{-4}$	$1.28\text{x}10^{-4}$	$4.43\text{x}10^{-4}$	$9.42\text{x}10^{-4}$
^{90}Sr				$1.29\text{x}10^{-2}$	$1.18\text{x}10^{-2}$	$1.95\text{x}10^{-2}$	$2.35\text{x}10^{-3}$	$1.17\text{x}10^{-2}$	$2.03\text{x}10^{-2}$
	3rd Quarter								
^{241}Am	See below			$5.85\text{x}10^{-4}$	$6.25\text{x}10^{-4}$	$8.62\text{x}10^{-4}$	$2.54\text{x}10^{-4}$	$5.11\text{x}10^{-4}$	$9.36\text{x}10^{-4}$
^{238}Pu				$-1.33\text{x}10^{-4}$	$2.66\text{x}10^{-4}$	$9.73\text{x}10^{-4}$	$0.00\text{x}10^{0}$	$0.00\text{x}10^{0}$	$8.88\text{x}10^{-4}$
$^{239+240}Pu$				$5.29\text{x}10^{-4}$	$5.37\text{x}10^{-4}$	$3.58\text{x}10^{-4}$	$0.00\text{x}10^{0}$	$0.00\text{x}10^{0}$	$3.26\text{x}10^{-4}$
^{90}Sr				$1.59\text{x}10^{-2}$	$1.92\text{x}10^{-2}$	$3.19\text{x}10^{-2}$	$-8.25\text{x}10^{-3}$	$1.92\text{x}10^{-2}$	$3.37\text{x}10^{-2}$

Table 4.1 - Activity (Bq) of Quarterly Composite Air Samples from Effluent Monitoring Stations A, B, and C

Nuclide	Activity	2 × TPU[a]	MDC[b]	Activity	2 × TPU	MDC	Activity	2 × TPU	MDC
				4th Quarter					
^{241}Am				0.00x10^{0}	0.00x10^{0}	7.73x10^{-4}	1.15x10^{-4}	4x10^{-4}	8.47x10^{-4}
^{238}Pu		See below		0.00x10^{0}	0.00x10^{0}	3.28x10^{-4}	2.32x10^{-4}	4.66x10^{-4}	6.29x10^{-4}
$^{239+240}$Pu				4.85x10^{-4}	4.92x10^{-4}	3.28x10^{-4}	0.00x10^{0}	0.00x10^{0}	1.71x10^{-3}
^{90}Sr				1.82x10^{-3}	2.25x10^{-2}	3.85x10^{-2}	1.80x10^{-2}	2.30x10^{-2}	3.81x10^{-2}

			Station A	1st Quarter		Monthly[c]			
		January			February			March	
^{241}Am	1.19x10^{-4}	2.40x10^{-4}	3.24x10^{-4}	4.29×10^{-4}	6.48×10^{-4}	1.06×10^{-3}	4.33×10^{-4}	4.37×10^{-4}	2.92×10^{-4}
^{238}Pu	0.00x10^{0}	0.00x10^{0}	3.53x10^{-4}	0.00×10^{0}	0.00×10^{0}	8.77×10^{-4}	2.17×10^{-4}	3.09×10^{-4}	2.93×10^{-4}
$^{239+240}$Pu	1.30x10^{-4}	2.61x10^{-4}	3.53x10^{-4}	3.57×10^{-4}	4.14×10^{-4}	3.22×10^{-4}	1.08×10^{-4}	3.74×10^{-4}	7.96×10^{-4}
^{90}Sr	9.99x10^{-3}	2.23x10^{-2}	3.74x10^{-2}	-4.55x10^{-3}	2.33x10^{-2}	4.03x10^{-2}	5.70x10^{-3}	2.46x10^{-2}	4.18x10^{-2}
			Station A	2nd Quarter		Monthly			
		April			May			June	
^{241}Am	2.6×10^{-5}	5.23x10^{-5}	7.05x10^{-5}	0.00×10^{0}	0.00×10^{0}	1.93×10^{-4}	2.40x10^{-5}	4.82x10^{-5}	6.5x10^{-5}
^{238}Pu	1.33×10^{-4}	2.67×10^{-4}	4.87×10^{-4}	-6.33×10^{-5}	1.27x10^{-4}	4.65×10^{-4}	1.51x10^{-4}	2.15×10^{-4}	2.03×10^{-4}
$^{239+240}$Pu	6.62×10^{-5}	1.33x10^{-4}	1.9×10^{-4}	1.89×10^{-4}	2.20×10^{-4}	1.72×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.03×10^{-4}
^{90}Sr	-2.85x10^{-3}	1.09x10^{-2}	1.92x10^{-2}	1.10x10^{-2}	1.16x10^{-2}	1.95x10^{-2}	-4.10x10^{-3}	1.10x10^{-2}	1.95x10^{-2}
			Station A	3rd Quarter		Monthly			
		July			August			September	
^{241}Am	5.85×10^{-4}	8.29×10^{-4}	7.92×10^{-4}	5.88×10^{-4}	8.36×10^{-4}	7.96×10^{-4}	6.70×10^{-4}	6.81×10^{-4}	4.51×10^{-4}
^{238}Pu	-3.15x10^{-4}	6.33×10^{-4}	2.32×10^{-3}	2.97×10^{-4}	5.96×10^{-4}	8.03×10^{-4}	0.00×10^{0}	0.00×10^{0}	5.03×10^{-4}
$^{239+240}$Pu	0.00×10^{0}	0.00×10^{0}	8.51×10^{-4}	5.92×10^{-4}	8.44×10^{-4}	8.03×10^{-4}	1.86x10^{-4}	3.74×10^{-4}	5.03×10^{-4}
^{90}Sr	1.81x10^{-3}	1.82x10^{-2}	3.13x10^{-2}	-3.96x10^{-3}	1.70x10^{-2}	2.98x10^{-2}	-6.73x10^{-3}	1.89x10^{-2}	3.31x10^{-2}
			Station A	4th Quarter		Monthly			
		October			November			December	
^{241}Am	4.40×10^{-4}	6.29×10^{-4}	5.96×10^{-4}	1.22×10^{-4}	2.45×10^{-4}	3.31x10^{-4}	1.32×10^{-4}	4.55×10^{-4}	9.69×10^{-4}
^{238}Pu	-1.34×10^{-4}	2.70×10^{-4}	9.88×10^{-4}	-1.20×10^{-3}	1.21x10^{-3}	8.84x10^{-3}	0.00×10^{0}	0.00×10^{0}	1.28x10^{-3}
$^{239+240}$Pu	1.34×10^{-4}	2.69×10^{-4}	3.63×10^{-4}	0.00×10^{0}	0.00×10^{0}	3.25x10^{-3}	0.00×10^{0}	0.00×10^{0}	4.74×10^{-4}
^{90}Sr	-7.66x10^{-3}	2.38x10^{-2}	4.22x10^{-2}	6.29x10^{-3}	2.16x10^{-2}	3.7x10^{-2}	4.59x10^{-3}	2.18x10^{-2}	3.74x10^{-2}

[a] Total propagated uncertainty
[b] Minimum detectable concentration
[c] Station A - composited monthly due to the large number of samples

Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

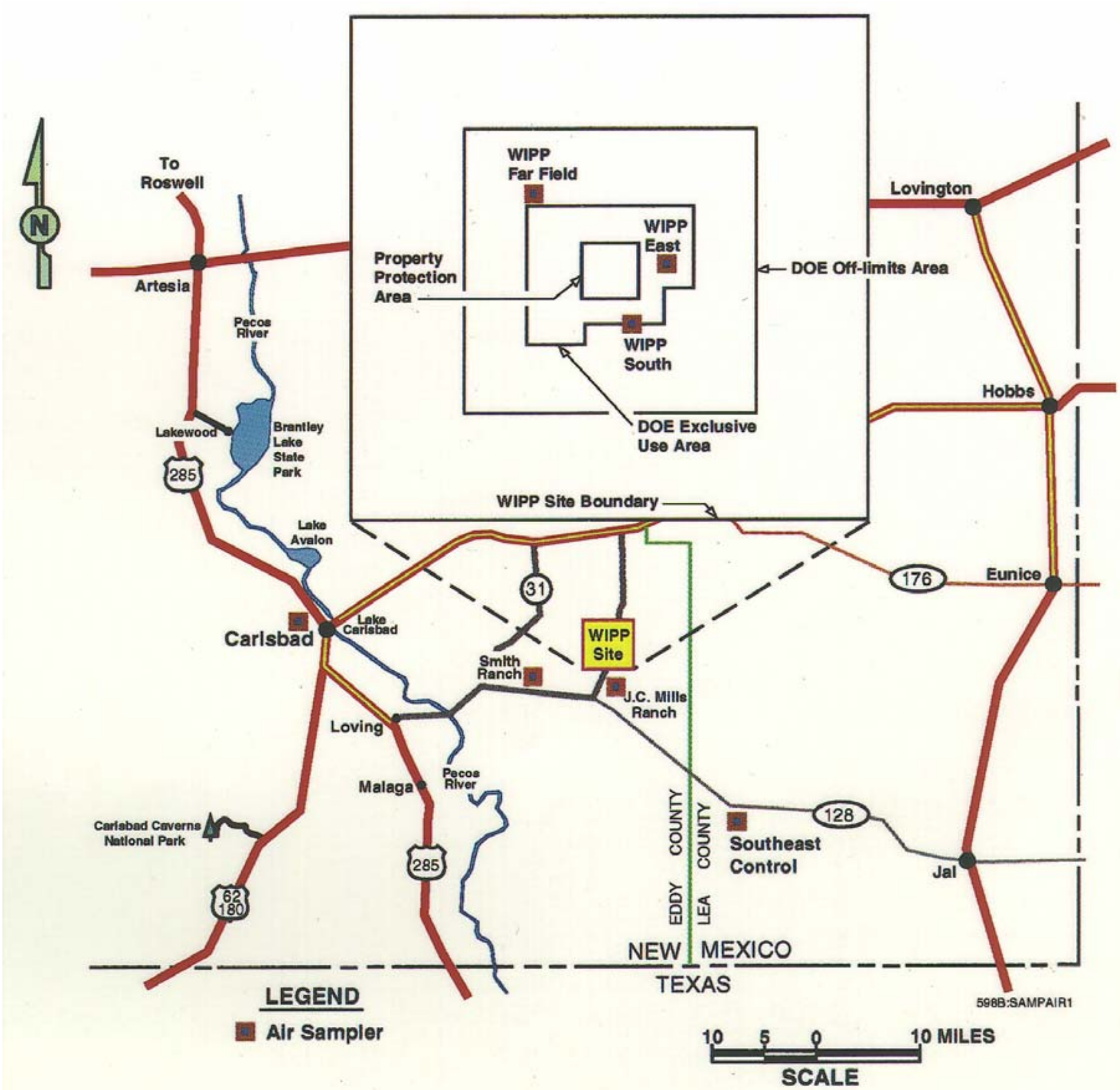


Figure 4.1 - Air Sampling Locations on and Near the WIPP Facility

In 2002, the weekly gross beta concentrations also varied throughout the year at each station (Figure 4.3). Stations tended to vary together, showing a strong annual pattern.

Concentrations ranged over almost an order of magnitude, from a minimum of $4.82\times10^{-4} \pm 7.81\times10^{-5}$ Bq/m^3 ($1.30\times10^{-2} \pm 2.11\times10^{-3}$ pCi/m^3) to a maximum of $1.77\times10^{-3} \pm 2.10\times10^{-4}$ Bq/m^3 ($4.78\times10^{-2} \pm 5.67\times10^{-3}$ pCi/m^3) (Table 4.2). However, the annual mean concentrations of gross beta activities found at all locations were similar, ranging from $9.60\times10^{-4} \pm 4.67\times10^{-4}$ to $1.01\times10^{-3} \pm 4.78\times10^{-4}$ Bq/m^3 ($2.59\times10^{-2} \pm 1.26\times10^{-2}$ to $2.73\times10^{-2} \pm 1.29\times10^{-2}$ pCi/m^3). There was no significant difference between sampling stations (ANOVA, $p = 0.923$).

Gross alpha and gross beta activity concentrations in four consecutive years were compared to determine whether they had increased since waste began to be received at WIPP (Figure 4.4). There was no significant difference in measured gross alpha ($p = 0.098$) or gross beta ($p = 0.056$) activity concentration between years for the same location comparison. The gross alpha and gross beta activity concentrations measured in 2002 were within the 95% confidence interval ranges of preoperational radiological baseline report covering the period from 1985 to 1989 (DOE/WIPP 92-037).

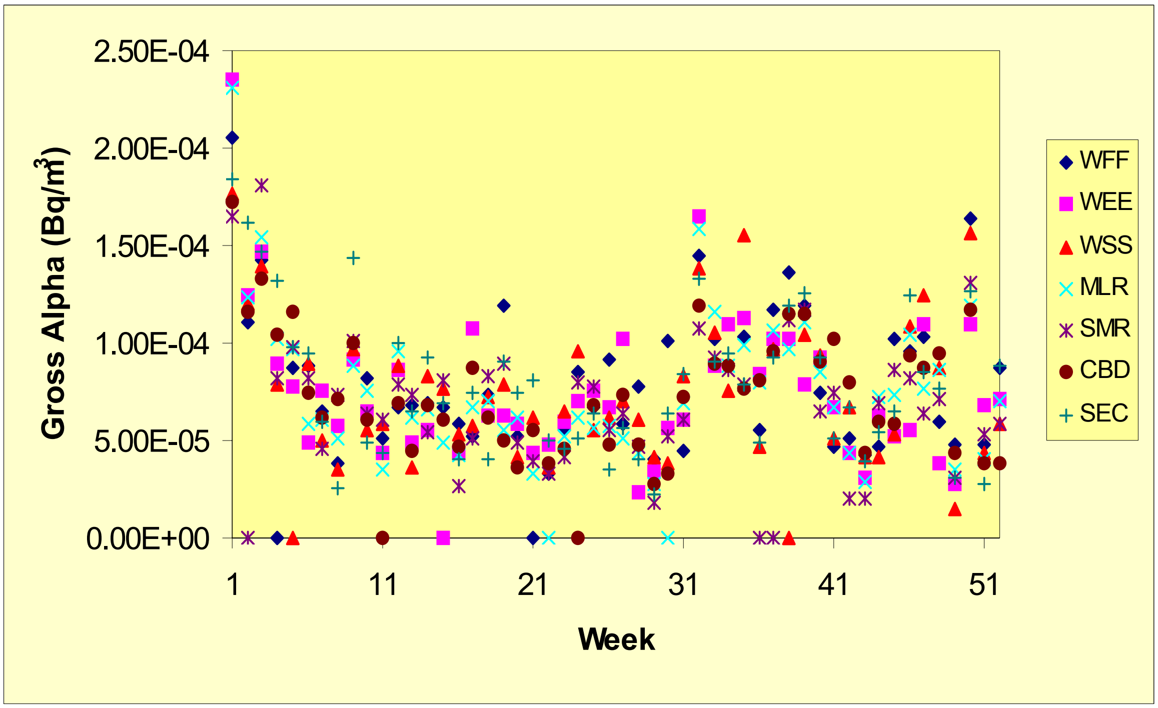


Figure 4.2 - Gross Alpha Activity Concentration Measured in Air Particulates Each Week in 2002. See Appendix B for sampling station locations.

One duplicate sample was collected every quarter by rotating the portable sampler from one location to another: CBD in the first quarter, SEC in the second quarter, WFF in the third quarter, and WEE in the fourth quarter. The samples were collected by both samplers in identical conditions at all four locations. Duplicate samples were collected and analyzed for the QC of (1) air sampling technique, (2) determination of gross alpha and beta activities, and (3) analysis of the individual radionuclides in airborne particulate. Relative Error Ratios (RER) (see Appendix C) were less than one in all of the weekly gross alpha and 98 percent of the weekly gross beta measurements. An RER less than one indicates good agreement between duplicates. The duplicate data are provided in Appendix D.

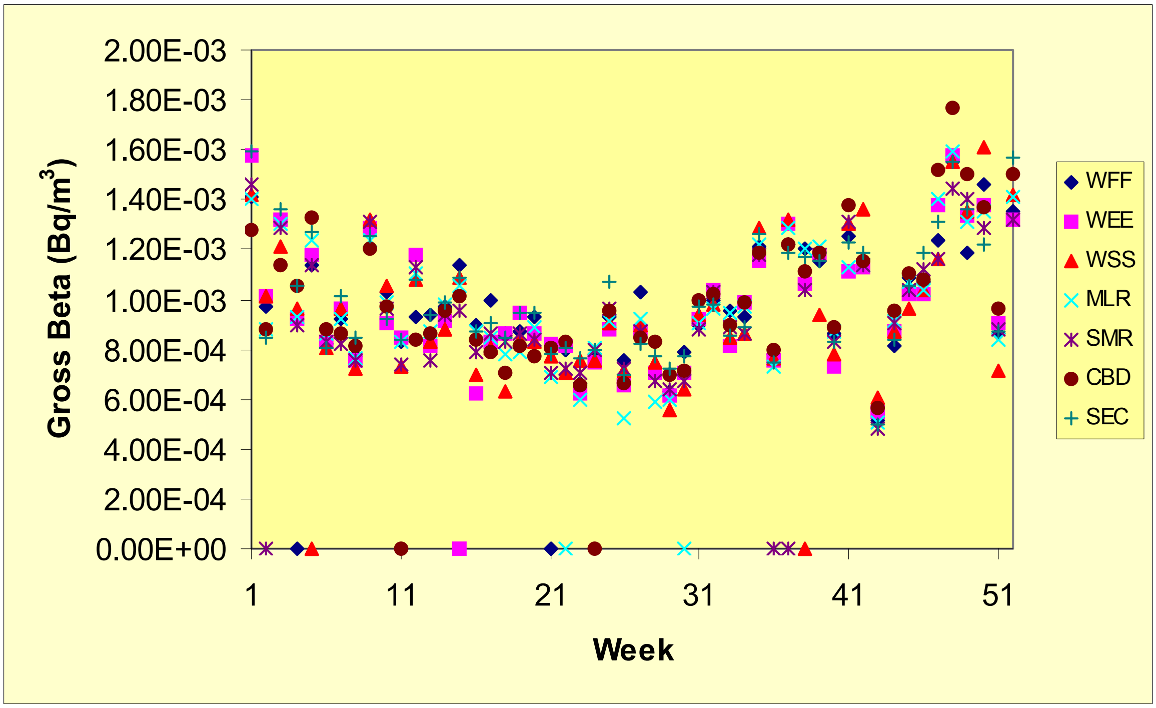
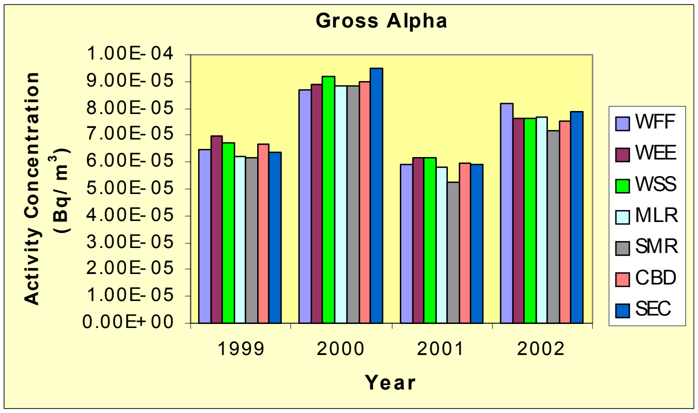


Figure 4.3 - Gross Beta Activity Concentration Measured in Air Particulates Each Week in 2002. See Appendix B for sampling station locations.

Table 4.2 - Mean Gross Alpha and Gross Beta Activity Concentrations (Bq/m³) Found in Weekly Air Particulate Samples (See Appendix B for sample locations.)

Location	Minimum	2 × TPU[a]	Maximum	2 × TPU	Mean	2 × SD[b]
			Gross Alpha			
CBD	2.76×10^{-5}	1.88×10^{-5}	1.72×10^{-4}	4.47×10^{-5}	7.54×10^{-5}	6.08×10^{-5}
MLR	2.72×10^{-5}	1.95×10^{-5}	2.31×10^{-4}	5.35×10^{-5}	7.70×10^{-5}	7.44×10^{-5}
SEC	2.28×10^{-5}	1.76×10^{-5}	1.84×10^{-4}	4.73×10^{-5}	7.87×10^{-5}	7.46×10^{-5}
SMR	1.76×10^{-5}	1.59×10^{-5}	1.81×10^{-4}	4.81×10^{-5}	7.19×10^{-5}	6.59×10^{-5}
WEE	2.36×10^{-5}	1.82×10^{-5}	2.35×10^{-4}	5.35×10^{-5}	7.63×10^{-5}	7.49×10^{-5}
WFF	3.33×10^{-5}	2.04×10^{-5}	2.05×10^{-4}	5.02×10^{-5}	8.16×10^{-5}	7.10×10^{-5}
WSS	1.47×10^{-5}	1.27×10^{-5}	1.77×10^{-4}	4.60×10^{-5}	7.63×10^{-5}	7.09×10^{-5}
			Gross Beta			
CBD	5.62×10^{-4}	8.66×10^{-5}	1.77×10^{-3}	2.10×10^{-4}	1.00×10^{-3}	5.14×10^{-4}
MLR	5.07×10^{-4}	8.14×10^{-5}	1.59×10^{-3}	1.92×10^{-4}	9.83×10^{-4}	5.00×10^{-4}
SEC	4.94×10^{-4}	8.01×10^{-5}	1.59×10^{-3}	1.93×10^{-4}	1.01×10^{-3}	4.78×10^{-4}
SMR	4.82×10^{-4}	7.81×10^{-5}	1.46×10^{-3}	1.80×10^{-4}	9.60×10^{-4}	4.67×10^{-4}
WEE	5.48×10^{-4}	8.55×10^{-5}	1.58×10^{-3}	1.91×10^{-4}	9.73×10^{-4}	4.99×10^{-4}
WFF	5.15×10^{-4}	8.11×10^{-5}	1.55×10^{-3}	1.88×10^{-4}	9.99×10^{-4}	4.44×10^{-4}
WSS	5.55×10^{-4}	8.57×10^{-5}	1.61×10^{-3}	2.06×10^{-4}	9.60×10^{-4}	5.25×10^{-4}

[a] Total propagated uncertainty
[b] Standard deviation of the mean



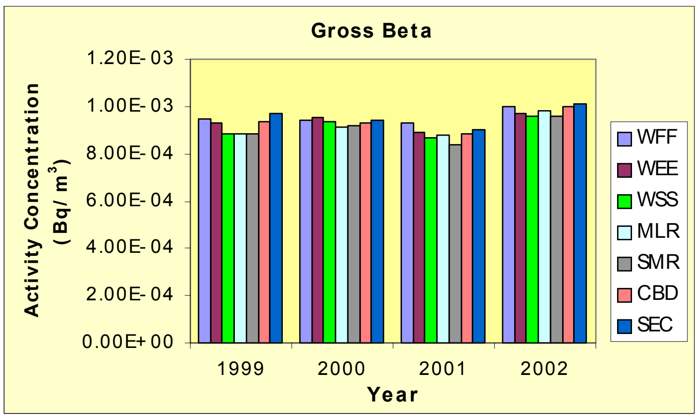


Figure 4.4 - Average Gross Alpha and Beta Activity Concentrations Measured in Air Particulates in Four Consecutive Years. (The year 1999 was the first year in which TRU waste was stored in WIPP. See Appendix B for sampling station locations.)

4.3 Airborne Particulates

The major pathways for the intake of radioactive materials into the human body are from the inhalation of dust particles and the ingestion of food and drinking water. Plutonium is the major constituent of the TRU wastes to be disposed at the WIPP site. Accordingly, plutonium and other radionuclides of interest were determined in air particulate samples around the WIPP site.

Isotopes of plutonium and americium were analyzed because they are the most significant alpha-emitting radionuclides among the constituents of TRU wastes received at the WIPP site. Uranium isotopes were analyzed because they are prominent alpha-emitting radionuclides in the natural environment.

WIPP analyzed samples for ^{90}Sr, ^{60}Co, and ^{137}Cs in order to demonstrate the ability to quantify these beta and gamma-emitting contaminants should they appear in the TRU waste stream. These radionuclides have been the subject of background studies at

WIPP prior to 1999 and continue to be monitored. Potassium-40, a natural gamma-emitting radionuclide which is ubiquitous in the earth's crust, was also monitored because of its possible enhancement in southeastern New Mexico due to potash mining.

Gross alpha and gross beta measurements are used as a screening technique and to identify any seasonal trends. The results are compared to historical values. Any result above the 2 sigma TPU warning limit is investigated for sampling error, instrument problems, and any other steps involved in the gross alpha and gross beta analysis. If the above-mentioned were ruled out as a contribution to the high result, a destructive analysis is performed to identify the specific nuclide contributing to the activity.

4.3.1 Sample Preparation

Weekly air particulate samples were collected as described in Section 4.2 and composited for each quarter. The composites were transferred into a Pyrex beaker, spiked with appropriate tracers, and heated in a Muffle furnace at 250°C (482°F) for two hours, followed by two hours at 375°C (707°F) and six hours at 525°C (977°F).

The ash was cooled, transferred quantitatively into a Teflon beaker by rinsing with concentrated nitric acid, and heated with concentrated hydrofluoric acid until completely dissolved. Hydrofluoric acid was removed by evaporating to dryness.

Approximately 25 ml (milliliters) (0.845 oz [ounce]) of concentrated nitric acid and one gram (0.0353 oz) of boric acid were added, heated, and finally evaporated to dryness. The residue was dissolved in 8 M (molar) nitric acid for gamma spectrometry and determinations of ^{90}Sr and alpha-emitting radionuclides.

4.3.2 Determination of Individual Radionuclides

Gamma-emitting radionuclides were measured in the air filters by gamma spectrometry. Strontium-90 and alpha-emitting radionuclides were determined by sequential separation and counting. Determination of actinides involved co-precipitation, ion exchange separation, and alpha spectrometry.

4.3.3 Results and Discussions

The minimum, maximum, and average for all stations combined are reported in Table 4.3. Detailed data for each station are reported in Appendix G (Table G.1). Natural uranium isotopes were detected in every composite sample. Concentrations of ^{234}U ranged from $2.11\times10^{-6} \pm 5.07\times10^{-7}$ Bq/m^3 ($5.70\times10^{-5} \pm 1.37\times10^{-5}$ pCi/m^3) at SEC in the fourth quarter to $4.74\times10^{-6} \pm 1.57\times10^{-6}$ Bq/m^3 ($1.28\times10^{-4} \pm 4.24\times10^{-5}$ pCi/m^3) at CBD in the first quarter (Appendix G, Table G.1). There was no significant difference between concentrations measured in 2001 and 2002 (ANOVA, $p = 0.853$).

Table 4.3 - Minimum, Maximum and Average Radionuclide Concentrations (Bq/m^3) in Air Filter Composites from Stations Surrounding the WIPP Site. See Appendix G for supporting data.

Radionuclide		[RN][a]	2×TPU[b]	MDC[c]
^{241}Am	Minimum	0.00×10^{0}	0.00×10^{0}	3.85×10^{-8}
	Maximum	9.48×10^{-8}	9.07×10^{-8}	1.55×10^{-7}
	Average[d]	4.66×10^{-8}	4.98×10^{-8}	9.64×10^{-8}
^{238}Pu	Minimum	-6.80×10^{-7}	1.37×10^{-6}	3.89×10^{-8}
	Maximum	2.69×10^{-6}	5.42×10^{-6}	9.88×10^{-6}
	Average	3.60×10^{-7}	1.63×10^{-6}	1.30×10^{-6}
$^{239+240}Pu$	Minimum	-6.77×10^{-7}	1.36×10^{-6}	3.89×10^{-8}
	Maximum	5.97×10^{-6}	6.15×10^{-6}	7.96×10^{-5}
	Average	4.39×10^{-7}	2.46×10^{-6}	3.64×10^{-6}
^{234}U	Minimum	2.11×10^{-6}	5.07×10^{-7}	3.60×10^{-8}
	Maximum	4.74×10^{-6}	1.57×10^{-6}	1.51×10^{-7}
	Average	3.00×10^{-6}	1.45×10^{-6}	6.29×10^{-8}
^{235}U	Minimum	2.07×10^{-8}	4.16×10^{-8}	4.44×10^{-8}
	Maximum	2.29×10^{-7}	1.41×10^{-7}	1.86×10^{-7}
	Average	1.07×10^{-7}	1.22×10^{-7}	7.28×10^{-8}
^{238}U	Minimum	1.74×10^{-6}	4.52×10^{-7}	3.58×10^{-8}
	Maximum	4.22×10^{-6}	8.21×10^{-7}	4.14×10^{-7}
	Average	2.69×10^{-6}	1.24×10^{-6}	7.41×10^{-8}
^{40}K	Minimum	1.12×10^{-4}	2.93×10^{-4}	1.23×10^{-4}
	Maximum	6.69×10^{-4}	3.31×10^{-4}	4.30×10^{-4}
	Average	2.68×10^{-4}	2.30×10^{-4}	2.60×10^{-4}
^{60}Co	Minimum	-1.28×10^{-5}	2.12×10^{-5}	2.12×10^{-5}
	Maximum	3.72×10^{-5}	3.50×10^{-5}	4.30×10^{-5}
	Average	1.06×10^{-5}	2.88×10^{-5}	3.01×10^{-5}
^{90}Sr	Minimum	-2.28×10^{-6}	2.79×10^{-6}	2.93×10^{-6}
	Maximum	4.02×10^{-6}	2.50×10^{-6}	6.35×10^{-6}
	Average	7.01×10^{-7}	3.76×10^{-6}	4.96×10^{-6}
^{137}Cs	Minimum	-5.99×10^{-5}	3.74×10^{-5}	1.70×10^{-5}
	Maximum	2.13×10^{-5}	2.57×10^{-5}	3.99×10^{-5}
	Average	-9.11×10^{-6}	4.55×10^{-5}	2.62×10^{-5}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
[d] Arithmetic average for concentration and MDC; average TPU equals the standard deviation of the mean.
Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

The activity concentration of ^{235}U in the natural environment is very low compared to the concentrations of ^{234}U and ^{238}U (1 µg of natural uranium contains 12.2 mBq [millibecquerel] [0.33 pCi] of ^{238}U, 0.56 mBq [0.01 pCi] of ^{235}U, and 12.8 mBq [0.35 pCi] of ^{234}U); therefore, the amount of ^{235}U in air particulate samples is expected to be lower. Uranium-235 was detected in approximately 46 percent of the quarterly composite samples. The lowest concentration ($2.07\times10^{-8} \pm 4.16\times10^{-8}$ Bq/m^3 [$5.59\times10^{-7} \pm 1.12\times10^{-6}$ pCi/m^3]) was measured at MLR in the fourth quarter and the highest

concentration ($2.29\times10^{-7} \pm 1.41\times10^{-7}$ Bq/m^3 [$6.18\times10^{-6} \pm 3.08\times10^{-6}$ pCi/m^3]) was found at SEC in the second quarter (Table G.1). There was a significant difference between years (ANOVA, p = 0.041), with 2001 having higher concentration than 2002.

Uranium-238 was also, as expected, detected in 100 percent of the composite air filters. Concentrations ranged from $1.74\times10^{-6} \pm 4.52\times10^{-7}$ Bq/m^3 ($4.70\times10^{-5} \pm 1.22\times10^{-5}$ pCi/m^3) at WFF in the fourth quarter to $4.22\times10^{-6} \pm 8.21\times10^{-7}$ Bq/m^3 ($1.14\times10^{-4} \pm 2.22\times10^{-5}$ pCi/m^3) at WEE in the first quarter (Table G.1). There was no significant difference between concentrations measured in 2001 and 2002 (ANOVA, p = 0.205). The concentrations of uranium isotopes in 2002 were within the 95 percent confidence interval ranges of preoperational radiological baseline report covering the period from 1985 to 1989 (DOE/WIPP 92-037).

Neither ^{238}Pu nor ^{241}Am were detected in any sample in 2002. Plutonium-239+240 was detected once with concentration of $9.99\times10^{-8} \pm 8.31\times10^{-8}$ Bq/m^3 ($2.70\times10^{-6} \pm 2.24\times10^{-6}$ pCi/m^3) at WSS in the fourth quarter composite.

Concentrations of ^{40}K (Table G.1) were detected in approximately 64 percent of the samples. The minimum ($1.12\times10^{-4} \pm 2.93\times10^{-4}$ Bq/m^3 [$3.02\times10^{-3} \pm 7.91\times10^{-3}$ pCi/m^3]) was found at MLR in the second quarter, while the maximum ($6.69\times10^{-4} \pm 3.31\times10^{-4}$ Bq/m^3 [$1.81\times10^{-2} \pm 8.94\times10^{-3}$ pCi/m^3]) was found at WFF in the third quarter.

Cesium-137, ^{60}Co and ^{90}Sr were detected once in the quarterly composite samples in 2002. All of these detected concentrations were within the 95 percent confidence interval range of the preoperational radiological baseline report covering the period from 1985 to 1989 (DOE/WIPP 92-037).

Duplicate air particulate samples were collected by rotating the portable sampler from one location to another every quarter: CBD in the first quarter, SEC in the second quarter, WFF in the third quarter, and WEE in the fourth quarter. The samples were collected by both samplers in identical conditions at all four locations. The duplicate samples were analyzed to check the reproducibility of the data. The results are given in Table 4.4. The original and duplicate results for ^{234}U, ^{238}U, and ^{40}K were compared using the RER. The results for all other radionuclides were excluded because of insufficient detections for a meaningful test. Relative Error Ratios were less than one for all results shown in Table 4.4.

The results obtained for the concentrations of ^{238}Pu, $^{239+240}$Pu, and ^{241}Am in air particulates compared favorably with those measured by the EEG (Table 4.5). The annual mean concentrations of these radionuclides were very low, and most samples collected by either WIPP or EEG did not contain detectable concentrations.

Table 4.4 - Results of Duplicate Composite Air Filter Sampling. Units are Bq/m³. See Appendix B for sampling stations.

		[RN][a]	2×TPU[b]	MDC[c]	RER[d]
Location	Quarter	^{40}K			
CBD	1	4.07×10^{-4}	3.32×10^{-4}	3.89×10^{-4}	0.235
CBD Dup.	1	3.21×10^{-4}	1.58×10^{-4}	2.12×10^{-4}	
SEC	2	1.33×10^{-4}	8.51×10^{-5}	1.23×10^{-4}	0.889
SEC Dup.	2	3.37×10^{-4}	2.13×10^{-4}	2.86×10^{-4}	
WFF	3	6.69×10^{-4}	3.31×10^{-4}	3.90×10^{-4}	0.805
WFF Dup.	3	3.07×10^{-4}	3.04×10^{-4}	3.49×10^{-4}	
WEE	4	4.15×10^{-4}	1.71×10^{-4}	2.36×10^{-4}	0.068
WEE Dup.	4	3.97×10^{-4}	2.01×10^{-4}	2.69×10^{-4}	
		^{234}U			
CBD	1	4.74×10^{-6}	1.57×10^{-6}	1.51×10^{-7}	0.733
CBD Dup.	1	3.47×10^{-6}	7.40×10^{-7}	1.31×10^{-7}	
SEC	2	3.05×10^{-6}	6.36×10^{-7}	3.89×10^{-8}	0.044
SEC Dup.	2	3.01×10^{-6}	6.40×10^{-7}	3.96×10^{-8}	
WFF	3	2.22×10^{-6}	5.51×10^{-7}	5.15×10^{-8}	0.616
WFF Dup.	3	2.75×10^{-6}	6.61×10^{-7}	5.21×10^{-8}	
WEE	4	2.12×10^{-6}	5.26×10^{-7}	4.78×10^{-8}	0.103
WEE Dup.	4	2.20×10^{-6}	5.72×10^{-7}	5.64×10^{-8}	
		^{238}U			
CBD	1	3.05×10^{-6}	1.12×10^{-6}	1.50×10^{-7}	0.361
CBD Dup.	1	3.54×10^{-6}	7.51×10^{-7}	4.81×10^{-8}	
SEC	2	2.63×10^{-6}	5.66×10^{-7}	3.85×10^{-8}	0.559
SEC Dup.	2	3.12×10^{-6}	6.59×10^{-7}	3.96×10^{-8}	
WFF	3	1.93×10^{-6}	4.97×10^{-7}	5.13×10^{-8}	0.687
WFF Dup.	3	2.47×10^{-6}	6.09×10^{-7}	5.19×10^{-8}	
WEE	4	1.90×10^{-6}	4.85×10^{-7}	4.76×10^{-8}	0.792
WEE Dup.	4	2.53×10^{-6}	6.31×10^{-7}	5.61×10^{-8}	

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
[d] Relative error ratio

Table 4.5 - Preliminary Quarterly Average Radionuclide Concentrations (Bq/m³) Measured in Air Particulate Samples by the Environmental Evaluation Group in 2002

	Quarter			
	1	2	3	4
	^{241}Am			
Concentration	9.77×10^{-9}	8.00×10^{-9}	7.22×10^{-9}	NR[b]
2×SD[a]	1.65×10^{-8}	3.55×10^{-8}	7.80×10^{-9}	NR
	^{238}Pu			
Concentration	5.08×10^{-9}	4.17×10^{-9}	2.90×10^{-10}	NR
2×SD	9.06×10^{-9}	5.51×10^{-9}	4.82×10^{-9}	NR
	$^{239+240}Pu$			
Concentration	1.52×10^{-8}	2.06×10^{-8}	1.21×10^{-8}	NR
2×SD	9.70×10^{-9}	7.76×10^{-9}	9.71×10^{-9}	NR

[a] Standard deviation
[b] Not reported

4.4 Groundwater

4.4.1 Sample Collection

Groundwater samples were collected from seven different wells around the WIPP site as shown in Figure 6.1. Approximately three bore volumes (approximately 3,800 liters [1,000 gallons]) of water were pumped out of each well before collecting approximately 38 liters (10 gallons) of water samples. The water samples were collected from depths ranging from 180-270 m (600-900 ft) from six wells (WQSP-1 to WQSP-6), and from a depth of 69 m (225 ft) from WQSP-6A. Samples were collected twice in 2002. Approximately 8 liters (2 gallons) of water were sent to the laboratory for the determination of radionuclides of interest. The rest of the samples were used to analyze for nonradiological parameters or were put into storage. The samples were acidified to pH $\leq$ 2 by titrating concentrated nitric acid.

4.4.2 Determination of Individual Radionuclides

The acidified water samples were used for the determination of gamma-emitting radionuclides, such as ^{40}K, ^{60}Co, and ^{137}Cs, by gamma spectrometry. An aliquot of approximately 0.5 liters (16.9 oz) was used for the determination of ^{90}Sr. Another aliquot was used for the sequential determinations of the uranium isotopes, the plutonium isotopes, and ^{241}Am by alpha spectrometry, which involved the co-precipitation of actinides with iron carrier, ion exchange chromatographic separation of individual radionuclides, source preparation by micro-precipitating, and alpha spectrometry.

4.4.3 Results and Discussions

Isotopes of naturally occurring uranium were detected in every well in 2002 (Table 4.6). The mean concentrations of ^{234}U ranged from 2.35×10^{-1} $\pm3.17\times10^{-2}$ Bq/L (becquerels per liter) ($6.35\times10^{0} \pm 8.56\times10^{-1}$ pCi/L) (picoCuries per liter) in WQSP-6A to $1.32\times10^{0} \pm 2.89\times10^{-1}$ Bq/L ($3.56\times10^{1} \pm 7.80\times10^{0}$ pCi/L) in WQSP-1. Uranium-235 ranged from $3.49\times10^{-3} \pm 7.11\times10^{-5}$ Bq/L ($9.42\times10^{-2} \pm 1.92\times10^{-3}$ pCi/L) in WQSP-3 to $1.69\times10^{-2} \pm 9.05\times10^{-3}$ Bq/L ($4.56\times10^{-1} \pm 2.44\times10^{-1}$ pCi/L) in WQSP-1. The mean concentration of ^{238}U ranged from $3.71\times10^{-2} \pm 9.90\times10^{-3}$ Bq/L ($1.00\times10^{0} \pm 2.67\times10^{-1}$ pCi/L) in WQSP-3 to $2.23\times10^{-1} \pm 5.69\times10^{-2}$ Bq/L ($6.02\times10^{0} \pm 1.54\times10^{0}$ pCi/L) in WQSP-1.

Table 4.6 - Average Radionuclide Concentrations (Bq/L) in Groundwater from Wells at the WIPP Site. See Chapter 6 for the sampling locations.

Location	Mean	2 × SD[a]	MDC[b]	Mean	2 × SD	MDC	Mean	2 × SD	MDC
	^{241}Am			^{238}Pu			$^{239+240}$Pu		
WQSP-1	3.95×10^{-4}	2.13×10^{-4}	6.94×10^{-4}	1.16×10^{-4}	3.20×10^{-4}	2.11×10^{-4}	-5.75×10^{-5}	1.59×10^{-4}	7.37×10^{-4}
WQSP-2	1.58×10^{-4}	4.38×10^{-4}	7.45×10^{-4}	8.94×10^{-5}	2.48×10^{-4}	6.27×10^{-4}	0.00×10^{0}	0.00×10^{0}	3.84×10^{-4}
WQSP-3	1.99×10^{-5}	6.29×10^{-4}	1.13×10^{-3}	5.08×10^{-4}	4.41×10^{-4}	4.62×10^{-4}	8.30×10^{-5}	2.30×10^{-4}	4.62×10^{-4}
WQSP-4	1.24×10^{-4}	3.44×10^{-4}	1.17×10^{-3}	-1.46×10^{-4}	9.42×10^{-4}	1.39×10^{-3}	0.00×10^{0}	0.00×10^{0}	1.04×10^{-3}
WQSP-5	1.15×10^{-4}	3.20×10^{-4}	7.73×10^{-4}	3.22×10^{-5}	4.24×10^{-4}	6.94×10^{-4}	6.03×10^{-5}	1.67×10^{-4}	4.13×10^{-4}
WQSP-6	-1.61×10^{-4}	4.45×10^{-4}	1.21×10^{-3}	3.38×10^{-4}	1.14×10^{-5}	9.29×10^{-4}	3.37×10^{-4}	1.23×10^{-5}	3.80×10^{-4}
WQSP-6A	1.89×10^{-4}	5.23×10^{-4}	6.19×10^{-4}	5.33×10^{-5}	1.48×10^{-4}	3.23×10^{-4}	2.13×10^{-4}	5.90×10^{-4}	6.32×10^{-4}
	^{234}U			^{235}U			^{238}U		
WQSP-1	1.32×10^{0}	2.89×10^{-1}	7.02×10^{-4}	1.69×10^{-2}	9.05×10^{-3}	5.62×10^{-4}	2.23×10^{-1}	5.69×10^{-2}	4.54×10^{-4}
WQSP-2	1.13×10^{0}	3.64×10^{-2}	5.25×10^{-4}	1.63×10^{-2}	1.58×10^{-2}	6.49×10^{-4}	1.81×10^{-1}	1.88×10^{-2}	5.24×10^{-4}
WQSP-3	2.50×10^{-1}	2.22×10^{-2}	3.19×10^{-4}	3.49×10^{-3}	7.11×10^{-5}	3.94×10^{-4}	3.71×10^{-2}	9.90×10^{-3}	3.18×10^{-4}
WQSP-4	5.70×10^{-1}	1.01×10^{-1}	1.40×10^{-3}	8.81×10^{-3}	8.73×10^{-5}	7.42×10^{-4}	9.93×10^{-2}	1.91×10^{-2}	4.75×10^{-3}
WQSP-5	5.38×10^{-1}	5.78×10^{-2}	2.76×10^{-4}	6.93×10^{-3}	3.15×10^{-3}	3.41×10^{-4}	8.17×10^{-2}	3.09×10^{-2}	2.75×10^{-4}
WQSP-6	5.52×10^{-1}	4.82×10^{-2}	3.15×10^{-4}	6.90×10^{-3}	1.59×10^{-3}	3.88×10^{-4}	7.34×10^{-2}	2.59×10^{-3}	3.13×10^{-4}
WQSP-6A	2.35×10^{-1}	3.17×10^{-2}	6.33×10^{-4}	6.95×10^{-3}	1.32×10^{-3}	3.96×10^{-4}	1.22×10^{-1}	2.22×10^{-2}	6.30×10^{-4}
	^{137}Cs			^{60}Co			^{40}K		
WQSP-1	1.07×10^{-1}	3.85×10^{-1}	3.41×10^{-1}	-1.60×10^{-1}	5.75×10^{-2}	3.97×10^{-1}	1.66×10^{1}	3.34×10^{0}	3.76×10^{0}
WQSP-2	-2.85×10^{-1}	8.71×10^{-1}	4.02×10^{-1}	6.31×10^{-2}	1.88×10^{-1}	4.20×10^{-1}	1.54×10^{1}	4.33×10^{0}	3.99×10^{0}
WQSP-3	1.17×10^{-1}	3.34×10^{-1}	4.19×10^{-1}	1.43×10^{-1}	2.85×10^{-1}	4.59×10^{-1}	4.94×10^{1}	1.47×10^{0}	3.69×10^{0}
WQSP-4	3.85×10^{-2}	5.92×10^{-1}	4.11×10^{-1}	1.85×10^{-1}	4.28×10^{-2}	4.54×10^{-1}	2.52×10^{1}	4.03×10^{0}	3.20×10^{0}
WQSP-5	-1.71×10^{-2}	1.08×10^{-1}	4.05×10^{-1}	2.32×10^{-1}	5.97×10^{-1}	4.42×10^{-1}	1.25×10^{1}	7.62×10^{0}	4.48×10^{0}
WQSP-6	-4.40×10^{-1}	1.46×10^{-1}	5.29×10^{-1}	4.48×10^{-1}	1.10×10^{0}	5.57×10^{-1}	7.04×10^{0}	5.31×10^{0}	5.08×10^{0}
WQSP-6A	-3.60×10^{-1}	4.47×10^{-1}	5.05×10^{-1}	-2.12×10^{-1}	3.98×10^{-1}	4.97×10^{-1}	7.41×10^{0}	1.77×10^{0}	5.18×10^{0}
	^{90}Sr			^{226}Ra			^{228}Ra		
WQSP-1	9.56×10^{-3}	1.28×10^{-2}	4.31×10^{-2}	5.52×10^{0}	4.79×10^{-1}	4.05×10^{-2}	1.04×10^{0}	1.39×10^{-1}	1.07×10^{-1}
WQSP-2	5.73×10^{-3}	1.24×10^{-2}	3.54×10^{-2}	3.72×10^{0}	8.21×10^{-2}	2.78×10^{-2}	4.95×10^{-1}	6.91×10^{-2}	1.06×10^{-1}
WQSP-3	1.09×10^{-2}	3.62×10^{-2}	4.31×10^{-2}	7.00×10^{0}	1.37×10^{0}	4.02×10^{-2}	1.14×10^{0}	2.48×10^{-1}	1.06×10^{-1}
WQSP-4	-5.08×10^{-3}	2.08×10^{-2}	6.47×10^{-2}	9.07×10^{0}	9.04×10^{-1}	4.13×10^{-2}	1.41×10^{0}	4.68×10^{-2}	1.20×10^{-1}
WQSP-5	-7.03×10^{-2}	1.12×10^{-2}	4.89×10^{-2}	2.75×10^{0}	1.16×10^{-1}	2.37×10^{-2}	3.72×10^{-1}	2.00×10^{-1}	1.18×10^{-1}
WQSP-6	-1.89×10^{-3}	4.71×10^{-2}	5.39×10^{-2}	1.23×10^{0}	2.24×10^{-1}	1.71×10^{-2}	1.46×10^{-1}	1.00×10^{-1}	1.06×10^{-1}
WQSP-6A	-7.25×10^{-5}	1.51×10^{-2}	4.05×10^{-2}	-7.15×10^{-4}	7.25×10^{-3}	1.34×10^{-2}	-1.35×10^{-2}	1.29×10^{-1}	1.02×10^{-1}

[a] Standard deviation of the mean
[b] Minimum detectable concentration
Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

The concentrations of uranium isotopes in water samples collected from these wells were compared between 2001 and 2002. There was no significant difference in the concentration of uranium isotopes between years (ANOVA, ^{234}U $p = 0.701$, ^{235}U $p = 0.113$, ^{238}U $p=0.914$).

Plutonium-238, $^{239+240}$Pu, and ^{241}Am were also analyzed in these groundwater samples (Table 4.6). Neither $^{239+240}$Pu nor ^{241}Am were detected in any sample. The mean concentration of ^{238}Pu was greater than the MDC in one sample from well WQSP-3 ($5.08\times10^{-4} \pm 4.41\times10^{-4}$ Bq/L; MDC = 4.62×10^{-4} Bq/L [$1.37\times10^{-2} \pm 1.19\times10^{-2}$ pCi/L; MDC =

1.25×10^{-2} pCi/L]). However, this result was very close to the MDC and the MDC falls within the error associated with the result. All wells' sample results and means were below the detection limit for $^{239+240}$Pu and ^{241}Am. Analysis of variance did not show significant differences in ^{238}Pu, $^{239+240}$Pu, or ^{241}Am (ANOVA ^{238}Pu p = 0.497, $^{239+240}$Pu p = 0.087, ^{241}Am p = 0.599) between 2001 and 2002.

The concentrations of ^{241}Am, plutonium isotopes, and uranium isotopes in groundwater in 2002 were within the 95 percent confidence interval ranges of preoperational radiological baseline report covering the period from 1985 to 1989 (DOE/WIPP 92-037).

As discussed in the 2000 annual Site Environmental Report (DOE/WIPP 01-2225), groundwater results from wells WQSP-1, WQSP-3, and WQSP-4 had tendency to exhibit a pattern of activity above the MDC for ^{238}Pu and ^{241}Am. To help explain these concentrations apparently above background, WIPP began analyzing groundwater for ^{226}Ra and ^{228}Ra during the fall sampling of 2000. Radium-226 and ^{228}Ra were detected in 100 percent of the samples except for well WQSP-6A in 2002. The mean concentrations were all above the mean detection limits except for well WQSP-6A (Table 4.6). However, the concentrations of ^{226}Ra in water from wells WQSP-1, WQSP-3, and WQSP-4 were all lower than those reported in the 1995 annual Site Environmental Report (6.0 ± 0.06 Bq/L, 7.8 ± 0.06 Bq/L, and 9.1 ± 0.07 Bq/L, respectively).

These results are important because one decay product of ^{226}Ra, ^{222}Rn, emits alpha particles with an energy of 5.489 MeV (million electron volts), very close to the most abundant alpha energy of ^{241}Am (5.486 MeV) and ^{238}Pu (5.499 MeV). Because these energies are close, the region of interest in the alpha spectrum from the groundwater samples likely contained counts originating from ^{222}Rn that were identified as ^{238}Pu or ^{241}Am. Additional ^{226}Ra progeny were also likely present. The solubility of the components can vary, causing the ^{222}Rn activity and associated ^{226}Ra progeny to appear in some analyses, but not all. This phenomenon may explain the trend of seemingly high concentrations of ^{238}Pu and ^{241}Am observed in some groundwater samples over time.

Cesium-137 was not detected in any of the samples. Potassium-40 was detected in all wells except for the fall sampling round of WQSP-6. Strontium-90 was detected once in the spring sampling round of WQSP-6.

4.5 Surface Water

4.5.1 Sample Collection

Fourteen different locations around the WIPP site, as shown in Figure 4.5, were identified for collecting the surface water samples (see Appendix B for location codes). Samples were collected once in 2002 from 13 sampling locations. If the surface water collection location was dry, sediment was collected. Sediment results are described in Section 4.7. This year, surface water was collected from all sites, including the FWT, RCP1, RCP2, and SOO.

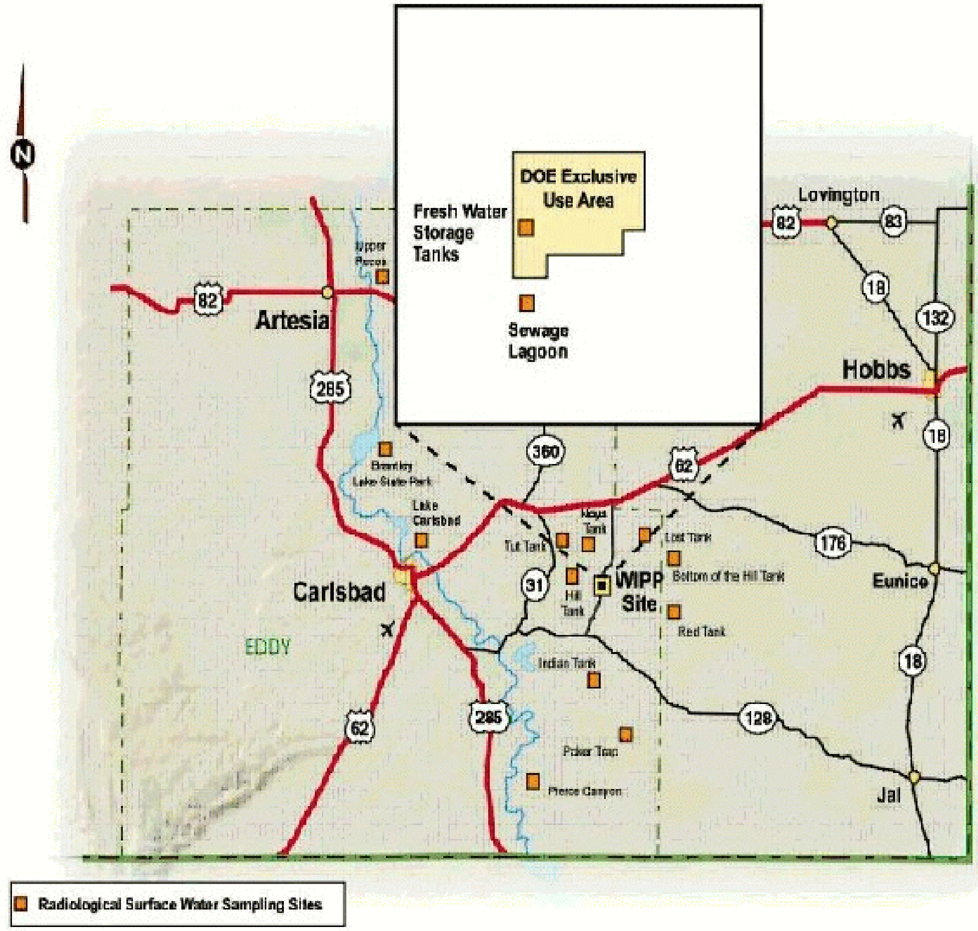


Figure 4.5 - Routine Surface Water Sampling Locations

Water from the sampling location was used to rinse 3.78-l (1-gallon) polyethylene containers several times. Approximately 3.78 l (1 gallon) of water was collected from each location. The samples were acidified immediately after collection with concentrated nitric acid to pH $\leq$ 2. Later, the samples were shipped to the laboratory for analysis. Chain of custody was maintained throughout the process.

4.5.2 Determination of Individual Radionuclides

Gamma-spectrometry was used for the determination of ^{40}K, ^{60}Co, and ^{137}Cs. Strontium-90, a beta-emitting radionuclide, was determined by chemical separation and counting it on the gas proportional counter. Uranium, plutonium, and americium were determined by alpha spectrometry. These alpha-emitting radionuclides were separated from the bulk of water samples by co-precipitation with an iron carrier. Ion-exchange chromatography was used for the separation of individual radionuclides. Finally, the samples were counted by alpha spectrometry.

4.5.3 Results and Discussions

Isotopes of natural uranium (^{234}U and ^{238}U) were detected in surface water at every sampling location (Table 4.7). Uranium-235 was detected in 65 percent of sampling locations except at IDN, PKR, RCP-1, RCP-2, RED, and SOO. Uranium-234 was lowest at Rainwater Catchment Pond 2 (RCP2) ($2.95\times10^{-3} \pm 1.22\times10^{-3}$ Bq/L [$7.97\times10^{-2} \pm 3.30\times10^{-2}$ pCi/L]) and highest at Pierce Canyon (PCN) ($2.29\times10^{-1} \pm 3.54\times10^{-2}$ Bq/L [$6.18\times10^{0} \pm 9.56\times10^{-1}$ pCi/L]). Uranium-235 was detected in 65 percent of the samples. Concentrations ranged from $-4.73\times10^{-4} \pm 9.51\times10^{-4}$ Bq/L ($-1.28\times10^{-2} \pm 2.57\times10^{-2}$ pCi/L) at SOO to $6.14\times10^{-3} \pm 2.08\times10^{-3}$ Bq/L ($1.66\times10^{-1} \pm 5.62\times10^{-2}$ pCi/L) at PCN. Concentrations of ^{238}U, detected in all samples, ranged from $1.72\times10^{-3} \pm 8.81\times10^{-4}$ Bq/L ($4.65\times10^{-2} \pm 2.38\times10^{-2}$ pCi/L) at RCP2 to $1.24\times10^{-1} \pm 1.96\times10^{-2}$ Bq/L ($3.35\times10^{0} \pm 5.30\times10^{-1}$ pCi/L) at PCN.

Results for uranium concentrations in 2002 samples were compared with the uranium concentrations in 2001 samples. There was no significant difference in the concentration of any uranium isotope between years (ANOVA, ^{234}U p = 0.381, ^{235}U p = 0.339, ^{238}U p = 0.425). The concentrations of uranium isotopes in surface water in 2002 were also within the 95 percent confidence interval ranges of preoperational radiological baseline report covering the period from 1985 to 1989 (DOE/WIPP 92-037).

Table 4.7 - Uranium Concentrations (Bq/L) in Surface Water Near the WIPP Site. See Appendix B for the sampling locations.

	[RN][a]	2 × TPU[b]	MDC[c]	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
Location	^{234}U			^{235}U			^{238}U		
BHT	7.35×10^{-3}	2.15×10^{-3}	8.09×10^{-4}	6.77×10^{-4}	6.14×10^{-4}	3.67×10^{-4}	5.46×10^{-3}	1.76×10^{-3}	2.96×10^{-4}
BRA	1.51×10^{-1}	2.59×10^{-2}	3.26×10^{-4}	4.88×10^{-3}	1.88×10^{-3}	4.03×10^{-4}	7.18×10^{-2}	1.30×10^{-2}	8.81×10^{-4}
CBD	1.58×10^{-1}	2.80×10^{-2}	3.96×10^{-4}	3.96×10^{-3}	1.82×10^{-3}	4.88×10^{-4}	6.81×10^{-2}	1.30×10^{-2}	3.96×10^{-4}
FWT	6.25×10^{-2}	1.34×10^{-3}	4.88×10^{-4}	1.11×10^{-3}	1.02×10^{-3}	6.03×10^{-4}	2.30×10^{-2}	5.92×10^{-3}	1.32×10^{-3}
HIL	1.04×10^{-2}	2.73×10^{-3}	3.02×10^{-4}	1.10×10^{-3}	7.99×10^{-4}	3.74×10^{-4}	1.11×10^{-2}	2.87×10^{-3}	8.18×10^{-4}
IDN	8.92×10^{-3}	2.50×10^{-3}	3.10×10^{-4}	1.41×10^{-4}	2.83×10^{-4}	3.81×10^{-4}	6.14×10^{-3}	1.96×10^{-3}	3.09×10^{-4}
LST	2.68×10^{-2}	5.65×10^{-3}	3.35×10^{-4}	1.07×10^{-3}	8.24×10^{-4}	4.13×10^{-4}	2.15×10^{-2}	4.76×10^{-3}	3.33×10^{-4}
NOY	8.40×10^{-2}	1.51×10^{-2}	3.42×10^{-4}	3.43×10^{-3}	1.62×10^{-3}	1.15×10^{-3}	8.18×10^{-2}	1.47×10^{-2}	9.29×10^{-4}
PCN	2.29×10^{-1}	3.54×10^{-2}	8.14×10^{-4}	6.14×10^{-3}	2.08×10^{-3}	1.00×10^{-3}	1.24×10^{-1}	1.96×10^{-2}	2.98×10^{-4}
PKT	1.41×10^{-2}	3.33×10^{-3}	2.92×10^{-4}	1.33×10^{-4}	4.63×10^{-4}	9.81×10^{-4}	1.21×10^{-2}	3.00×10^{-3}	7.92×10^{-4}
RCP1	1.07×10^{-2}	2.80×10^{-3}	3.13×10^{-4}	2.85×10^{-4}	4.07×10^{-4}	3.89×10^{-4}	7.14×10^{-3}	2.15×10^{-3}	3.12×10^{-4}
RCP2	2.95×10^{-3}	1.22×10^{-3}	7.51×10^{-4}	1.25×10^{-4}	2.52×10^{-4}	3.40×10^{-4}	1.72×10^{-3}	8.81×10^{-4}	2.75×10^{-4}
RED	1.19×10^{-2}	2.95×10^{-3}	2.96×10^{-4}	2.69×10^{-4}	3.85×10^{-4}	3.65×10^{-4}	9.14×10^{-3}	2.46×10^{-3}	2.95×10^{-4}
SOO	3.45×10^{-3}	2.43×10^{-3}	1.04×10^{-3}	-4.73×10^{-4}	9.51×10^{-4}	3.48×10^{-3}	4.20×10^{-3}	2.71×10^{-3}	1.03×10^{-3}
SWL	3.09×10^{-2}	6.85×10^{-3}	3.89×10^{-4}	1.24×10^{-3}	9.62×10^{-4}	4.81×10^{-4}	1.29×10^{-2}	3.52×10^{-3}	3.89×10^{-4}
TUT	5.54×10^{-2}	9.68×10^{-3}	3.05×10^{-4}	1.80×10^{-3}	1.11×10^{-3}	1.02×10^{-3}	5.65×10^{-2}	9.85×10^{-3}	3.03×10^{-3}
UPR	9.47×10^{-2}	1.64×10^{-2}	3.11×10^{-4}	3.26×10^{-3}	1.51×10^{-3}	1.04×10^{-3}	5.51×10^{-2}	1.01×10^{-2}	8.44×10^{-4}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration

These water samples were also analyzed for ^{238}Pu, $^{239+240}Pu$, and ^{241}Am (Table 4.8). Concentrations of ^{241}Am, ^{238}Pu and $^{239+240}Pu$ were either below the MDC or less than 2×TPU in every sample.

Potassium-40, ^{60}Co, ^{90}Sr, and ^{137}Cs are ubiquitous in soils and might reasonably be expected in surface water samples due to leaching from sediments. As expected, ^{40}K was detected in 47 percent of the surface water samples (Table 4.9). Its concentration ranged from $-1.05\times10^{0} \pm 3.61\times10^{0}$ Bq/L ($-2.84\times10^{1} \pm 9.76\times10^{1}$ pCi/L) at Red Tank (RED) to $4.29\times10^{1} \pm 6.92\times10^{0}$ Bq/L ($1.16\times10^{3} \pm 1.87\times10^{2}$ pCi/L) at Sewage Lagoons (SWL). Cobalt-60, ^{137}Cs, and ^{90}Sr were not detected in the samples.

Table 4.8 - Americium and Plutonium Concentrations (Bq/L) in Surface Water Near the WIPP Site. See Appendix B for the sampling locations.

	[RN][a]	2 × TPU[b]	MDC[c]	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
Location	^{241}Am			^{238}Pu			$^{239+240}Pu$		
BHT	4.22×10^{-4}	4.26×10^{-4}	2.86×10^{-4}	-1.17×10^{-4}	2.35×10^{-4}	8.60×10^{-4}	0.00×10^{0}	0.00×10^{0}	3.16×10^{-4}
BRA	-1.84×10^{-4}	6.40×10^{-4}	1.71×10^{-3}	3.53×10^{-4}	5.03×10^{-4}	4.77×10^{-4}	1.76×10^{-4}	3.53×10^{-4}	4.77×10^{-4}
CBD	3.03×10^{-4}	4.33×10^{-4}	4.11×10^{-4}	4.88×10^{-4}	5.70×10^{-4}	4.40×10^{-4}	-1.62×10^{-4}	5.62×10^{-4}	1.51×10^{-3}
FWT	2.58×10^{-4}	3.67×10^{-4}	3.49×10^{-4}	1.07×10^{-4}	2.15×10^{-4}	2.89×10^{-4}	1.07×10^{-4}	2.14×10^{-4}	2.89×10^{-4}
HIL	0.00×10^{0}	0.00×10^{0}	8.25×10^{-4}	0.00×10^{0}	0.00×10^{0}	1.29×10^{-3}	1.75×10^{-4}	3.52×10^{-4}	4.74×10^{-4}
IDN	2.16×10^{-4}	3.08×10^{-4}	2.93×10^{-4}	0.00×10^{0}	0.00×10^{0}	3.06×10^{-4}	2.26×10^{-4}	3.21×10^{-4}	3.06×10^{-4}
LST	-1.09×10^{-4}	3.76×10^{-4}	1.01×10^{-3}	-1.16×10^{-4}	4.04×10^{-4}	1.08×10^{-3}	2.32×10^{-4}	3.30×10^{-4}	3.15×10^{-4}
NOY	2.78×10^{-4}	3.96×10^{-4}	3.77×10^{-4}	6.14×10^{-4}	7.18×10^{-4}	5.51×10^{-4}	6.11×10^{-4}	7.14×10^{-4}	5.51×10^{-4}
PCN	1.34×10^{-4}	5.99×10^{-4}	1.24×10^{-3}	1.26×10^{-4}	5.66×10^{-4}	1.17×10^{-3}	3.77×10^{-4}	4.40×10^{-4}	3.41×10^{-4}
PKT	2.62×10^{-4}	3.74×10^{-4}	3.54×10^{-4}	-1.48×10^{-4}	2.97×10^{-4}	1.09×10^{-3}	5.92×10^{-4}	5.99×10^{-4}	4.00×10^{-4}
RCP1	5.29×10^{-4}	5.37×10^{-4}	3.58×10^{-4}	1.10×10^{-4}	2.21×10^{-4}	2.97×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.97×10^{-4}
RCP2	3.20×10^{-4}	4.81×10^{-4}	7.84×10^{-4}	-1.07×10^{-4}	2.15×10^{-4}	7.88×10^{-4}	1.07×10^{-4}	2.14×10^{-4}	2.90×10^{-4}
RED	0.00×10^{0}	0.00×10^{0}	3.07×10^{-4}	3.17×10^{-4}	4.51×10^{-4}	4.29×10^{-4}	6.33×10^{-4}	6.40×10^{-4}	4.29×10^{-4}
SOO	4.61×10^{-4}	4.67×10^{-4}	3.12×10^{-4}	00×10^{0}	00×10^{0}	3.18×10^{-4}	1.17×10^{-4}	2.35×10^{-4}	3.18×10^{-4}
SWL	2.65×10^{-4}	3.77×10^{-4}	3.58×10^{-4}	1.17×10^{-4}	2.34×10^{-4}	3.15×10^{-4}	0.00×10^{0}	0.00×10^{0}	3.15×10^{-4}
TUT	2.34×10^{-4}	4.70×10^{-4}	8.62×10^{-4}	1.40×10^{-4}	2.81×10^{-4}	3.78×10^{-4}	8.38×10^{-4}	8.02×10^{-4}	1.03×10^{-3}
UPR	5.55×10^{-4}	5.62×10^{-4}	3.77×10^{-4}	4.11×10^{-4}	4.81×10^{-4}	3.70×10^{-4}	1.37×10^{-4}	2.74×10^{-4}	3.70×10^{-4}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

Table 4.9 - Selected Radionuclide Concentrations (Bq/L) in Surface Water Near the WIPP Site. See Appendix B for the sampling locations.

	[RN][a]	2 × TPU[b]	MDC[c]	[RN]	2 × TPU	MDC
Location	^{137}Cs			^{60}Co		
BHT	7.51×10^{-2}	3.13×10^{-1}	3.59×10^{-1}	3.15×10^{-3}	3.53×10^{-1}	4.08×10^{-1}
BRA	-5.92×10^{-2}	3.20×10^{-1}	3.54×10^{-1}	8.36×10^{-2}	3.64×10^{-1}	4.29×10^{-1}
CBD	7.92×10^{-2}	3.22×10^{-1}	3.68×10^{-1}	2.73×10^{-1}	3.23×10^{-1}	4.07×10^{-1}
FWT	1.60×10^{-1}	3.07×10^{-1}	3.58×10^{-1}	2.72×10^{-1}	3.43×10^{-1}	4.26×10^{-1}
HIL	-8.18×10^{-2}	3.27×10^{-1}	3.60×10^{-1}	1.27×10^{-1}	3.31×10^{-1}	4.00×10^{-1}
IDN	-1.35×10^{-2}	3.22×10^{-1}	3.61×10^{-1}	1.64×10^{-1}	3.44×10^{-1}	4.18×10^{-1}
LST	-2.50×10^{-1}	2.44×10^{-1}	2.57×10^{-1}	7.13×10^{-2}	2.96×10^{-1}	3.45×10^{-1}
NOY	-1.63×10^{-1}	3.38×10^{-1}	3.58×10^{-1}	-6.11×10^{-2}	3.64×10^{-1}	4.11×10^{-1}
PCN	-4.63×10^{-1}	3.56×10^{-1}	3.43×10^{-1}	8.21×10^{-2}	3.50×10^{-1}	4.11×10^{-1}
PKT	1.37×10^{-3}	3.31×10^{-1}	3.70×10^{-1}	-4.40×10^{-1}	3.61×10^{-1}	4.14×10^{-1}
RCP1	-2.70×10^{-1}	3.46×10^{-1}	3.57×10^{-1}	-8.81×10^{-2}	3.61×10^{-1}	4.03×10^{-1}
RCP2	1.19×10^{-1}	2.19×10^{-1}	2.66×10^{-1}	8.92×10^{-2}	2.74×10^{-1}	3.23×10^{-1}
RED	2.21×10^{-1}	3.05×10^{-1}	3.59×10^{-1}	2.29×10^{-1}	3.50×10^{-1}	4.29×10^{-1}
SOO	-2.91×10^{-1}	4.67×10^{-1}	5.08×10^{-1}	4.75×10^{-1}	4.67×10^{-1}	5.53×10^{-1}
SWL	-3.69×10^{-2}	2.33×10^{-1}	2.71×10^{-1}	8.95×10^{-2}	2.95×10^{-1}	3.44×10^{-1}
TUT	-2.04×10^{-2}	3.21×10^{-1}	3.59×10^{-1}	-2.19×10^{-1}	3.86×10^{-1}	4.09×10^{-1}
UPR	-4.29×10^{-3}	3.32×10^{-1}	3.70×10^{-1}	-1.54×10^{-1}	3.96×10^{-1}	4.29×10^{-1}
	^{90}Sr			^{40}K		
BHT	1.28×10^{-3}	2.15×10^{-2}	3.69×10^{-2}	4.42×10^{0}	3.45×10^{0}	4.48×10^{0}
BRA	8.36×10^{-3}	2.11×10^{-2}	3.57×10^{-2}	4.88×10^{0}	3.17×10^{0}	4.26×10^{0}
CBD	2.12×10^{-3}	2.21×10^{-2}	3.64×10^{-2}	4.66×10^{0}	3.25×10^{0}	4.29×10^{0}
FWT	-1.02×10^{-2}	2.01×10^{-2}	3.54×10^{-2}	4.77×10^{0}	3.09×10^{0}	4.18×10^{0}
HIL	8.40×10^{-3}	1.95×10^{-2}	3.30×10^{-2}	3.12×10^{0}	3.50×10^{0}	4.37×10^{0}
IDN	2.70×10^{-3}	2.03×10^{-2}	3.47×10^{-2}	3.33×10^{0}	3.55×10^{0}	4.48×10^{0}
LST	1.92×10^{-3}	2.24×10^{-2}	3.85×10^{-2}	2.16×10^{0}	2.69×10^{0}	3.31×10^{0}
NOY	1.89×10^{-3}	3.85×10^{-2}	6.70×10^{-2}	3.85×10^{0}	2.29×10^{0}	3.34×10^{0}
PCN	1.05×10^{-2}	2.06×10^{-2}	3.47×10^{-2}	3.49×10^{0}	2.39×10^{0}	3.59×10^{0}
PKT	7.07×10^{-3}	2.10×10^{-2}	3.56×10^{-2}	2.12×10^{0}	1.48×10^{0}	2.15×10^{0}
RCP1	-9.69×10^{-3}	1.93×10^{-2}	3.38×10^{-2}	5.07×10^{0}	3.35×10^{0}	4.44×10^{0}
RCP2	1.37×10^{-2}	2.16×10^{-2}	3.63×10^{-2}	-1.28×10^{-1}	2.74×10^{0}	3.33×10^{0}
RED	9.84×10^{-3}	2.16×10^{-2}	3.63×10^{-2}	-1.05×10^{0}	3.61×10^{0}	4.00×10^{0}
SOO	-8.13×10^{-4}	2.03×10^{-2}	3.49×10^{-2}	4.07×10^{0}	4.39×10^{0}	5.02×10^{0}
SWL	1.65×10^{-2}	2.36×10^{-2}	3.92×10^{-2}	2.19×10^{1}	6.92×10^{0}	2.91×10^{0}
TUT	-1.03×10^{-2}	2.27×10^{-2}	3.99×10^{-2}	6.13×10^{0}	3.54×10^{0}	4.67×10^{0}
UPR	2.21×10^{-2}	2.47×10^{-2}	4.07×10^{-2}	2.97×10^{0}	3.46×10^{0}	4.37×10^{0}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration

Duplicate samples were collected from two locations (Indian Tank [IDN] and RED) to check the reproducibility of the sampling and the measurement techniques (Table 4.10). The RER values for all the isotopes in these samples were less than one, indicating no difference between duplicate samples.

Table 4.10 - Results of Duplicate Surface Water Sample Analysis. Units are Bq/L. See Appendix B for the sampling locations.

	[RN][a]	2×TPU[b]	MDC[c]	RER[d]	[RN]	2×TPU	MDC	RER
Location	^{234}U				^{235}U			
IDN	8.92×10^{-3}	2.50×10^{-3}	3.10×10^{-4}	0.207	1.41×10^{-4}	2.83×10^{-4}	3.81×10^{-4}	0.901
IDN Dup.	9.66×10^{-3}	2.56×10^{-3}	2.88×10^{-4}		7.84×10^{-4}	6.55×10^{-4}	3.55×10^{-4}	
RED	1.19×10^{-2}	2.95×10^{-3}	2.96×10^{-4}	0.02	2.69×10^{-4}	3.85×10^{-4}	3.65×10^{-4}	0.159
RED Dup.	1.20×10^{-2}	2.83×10^{-3}	2.64×10^{-4}		3.60×10^{-4}	4.22×10^{-4}	3.26×10^{-4}	
	^{238}U				^{40}K			
IDN	6.14×10^{-3}	1.96×10^{-3}	3.09×10^{-4}	0.632	3.33×10^{0}	3.55×10^{0}	4.48×10^{0}	0.422
IDN Dup.	8.03×10^{-3}	2.26×10^{-3}	2.87×10^{-4}		1.23×10^{0}	3.49×10^{0}	4.18×10^{0}	
RED	9.14×10^{-3}	2.46×10^{-3}	2.95×10^{-4}	0.691	-1.05×10^{0}	3.61×10^{0}	4.00×10^{0}	0.803
RED Dup.	1.17×10^{-2}	2.77×10^{-3}	2.63×10^{-4}		2.26×10^{0}	1.99×10^{0}	3.10×10^{0}	

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
[d] Relative error ratio

4.6 Soil Samples

4.6.1 Sample Collection

Soil samples were collected from near the low-volume air samplers at six different locations around the WIPP site: MLR, SEC, SMR, WEE, WFF, and WSS (Figure 4.6). Samples were collected from each location in three incremental profiles: surface soil (SS, 0-2 cm [0-0.8 in.]), intermediate soil (SI, 2-5 cm [0.8-2 in.]), and deep soil (SD, 5-10 cm [2-4 in.]). Measurements of radionuclides in depth profiles provide information about their vertical movements in the soil systems.

4.6.2 Sample Preparation

Soil samples were dried at 110°C (230°F) for several hours and homogenized by grinding to small particle sizes. One gram (0.04 oz) of soil was dissolved by heating it with a mixture of nitric, hydrochloric, and hydrofluoric acids. Finally, it was heated with nitric and boric acids, and the residue was dissolved in hydrochloric acid for the determination of individual radionuclides.

4.6.3 Determination of Individual Radionuclides

Gamma-emitting radionuclides (^{40}K, ^{60}Co, and ^{137}Cs) were determined by counting an aliquot of well-homogenized ground soil samples by gamma-spectrometry. Strontium-90 was analyzed from an aliquot of the sample solution by separating it from other stable and radioactive elements using radiochemical techniques and beta counting. Another aliquot of the sample solution was used for the sequential determinations of alpha-emitting radionuclides, such as ^{234}U, ^{235}U, and ^{238}U; ^{238}Pu and $^{239+240}$Pu; and ^{241}Am. These radionuclides were separated from the bulk of the inorganic materials present in the soil samples and from one another by radiochemical separations including co-precipitation and ion-exchange chromatography. Finally, the

samples were micro-precipitated, filtered onto micro-filters, and counted on the alpha spectrometer.

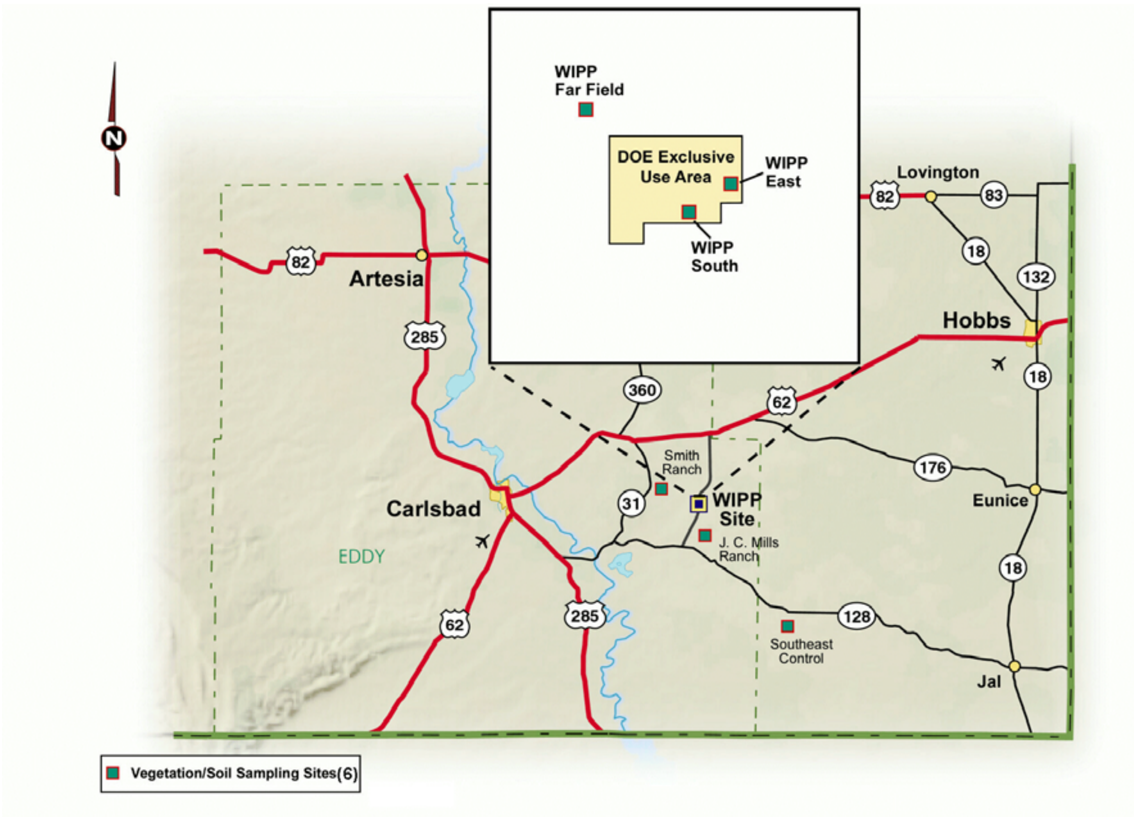


Figure 4.6 - Routine Soil and Vegetation Sampling Areas

4.6.4 Results and Discussions

Uranium-234, ^{238}U, and ^{235}U were detected in every soil sample in 2002. Concentrations of ^{234}U in surface soils (0-2 cm) ranged from a minimum of $8.77\times10^{-3} \pm 1.71\times10^{-3}$ Bq/g ($2.37\times10^{-1} \pm 4.62\times10^{-2}$ pCi/g) at WFF to a maximum of $2.75\times10^{-2} \pm 4.59\times10^{-3}$ Bq/g ($7.43\times10^{-1} \pm 1.24\times10^{-1}$ pCi/g) at MLR (Table 4.11). Concentrations of ^{235}U in the same samples ranged from $4.37\times10^{-4} \pm 3.00\times10^{-4}$ Bq/g ($1.18\times10^{-2} \pm 8.11\times10^{-3}$ pCi/g) at WFF to $1.65\times10^{-3} \pm 5.33\times10^{-4}$ Bq/g ($4.46\times10^{-2} \pm 1.44\times10^{-2}$ pCi/g) at SMR. The concentration of ^{238}U in surface soils ranged from $9.40\times10^{-3} \pm 1.81\times10^{-3}$ Bq/g ($2.54\times10^{-1} \pm 4.89\times10^{-2}$ pCi/g) at WFF to $2.85\times10^{-2} \pm 4.77\times10^{-3}$ Bq/g ($7.70\times10^{-1} \pm 1.29\times10^{-1}$ pCi/g) at MLR.

The results for uranium in intermediate depth (2-5 cm) soil samples are also given in Table 4.11. The concentration of ^{234}U ranged from $6.96\times10^{-3} \pm 1.43\times10^{-3}$ Bq/g ($1.88\times10^{-1} \pm 3.86\times10^{-2}$ pCi/g) at WFF to $2.66\times10^{-2} \pm 4.37\times10^{-3}$ Bq/g ($7.19\times10^{-1} \pm 1.18\times10^{-1}$ pCi/g) at MLR. Uranium-235 in these soils was lowest at WFF ($2.57\times10^{-4} \pm 1.99\times10^{-4}$ Bq/g [$6.95\times10^{-3} \pm 5.38\times10^{-3}$ pCi/g]) and highest at MLR ($1.38\times10^{-3} \pm 4.66\times10^{-4}$ Bq/g [$3.73\times10^{-2} \pm 1.26\times10^{-2}$ pCi/g]). The concentration of ^{238}U ranged from 8.66×10^{-3} ±

1.72×10^{-3} Bq/g ($2.34\times10^{-1} \pm 4.65\times10^{-2}$ pCi/g) at WFF to $2.66\times10^{-2} \pm 4.40\times10^{-3}$ Bq/g ($7.19\times10^{-1} \pm 1.19\times10^{-1}$ pCi/g) at MLR.

Table 4.11 - Uranium Concentrations (Bq/g) in Soil Near the WIPP Site. See Appendix B for the sampling locations.

Location	Depth (cm)	^{234}U [RN][a]	^{234}U 2 × TPU[b]	^{234}U MDC[c]	^{235}U [RN]	^{235}U 2 × TPU	^{235}U MDC	^{238}U [RN]	^{238}U 2 × TPU	^{238}U MDC
MLR	0-2	2.75×10^{-2}	4.59×10^{-3}	7.25×10^{-5}	1.52×10^{-3}	5.07×10^{-3}	8.95×10^{-5}	2.85×10^{-2}	4.77×10^{-3}	7.22×10^{-5}
MLR	2-5	2.66×10^{-2}	4.37×10^{-3}	6.92×10^{-5}	1.38×10^{-3}	4.66×10^{-4}	8.51×10^{-5}	2.66×10^{-2}	4.40×10^{-3}	6.88×10^{-5}
MLR	5-10	2.52×10^{-2}	4.18×10^{-3}	1.93×10^{-4}	1.23×10^{-3}	4.51×10^{-4}	2.38×10^{-4}	2.57×10^{-2}	4.26×10^{-3}	7.07×10^{-5}
SEC	0-2	1.68×10^{-2}	3.05×10^{-3}	7.51×10^{-5}	7.88×10^{-4}	3.52×10^{-4}	9.25×10^{-5}	1.69×10^{-2}	3.05×10^{-3}	7.47×10^{-5}
SEC	2-5	1.73×10^{-2}	2.99×10^{-3}	7.29×10^{-5}	8.95×10^{-4}	3.70×10^{-4}	8.99×10^{-5}	1.83×10^{-2}	3.14×10^{-3}	7.25×10^{-5}
SEC	5-10	2.22×10^{-2}	3.89×10^{-3}	7.62×10^{-5}	1.18×10^{-3}	4.59×10^{-4}	2.56×10^{-4}	2.05×10^{-2}	3.62×10^{-3}	7.62×10^{-5}
SMR	0-2	2.43×10^{-2}	4.11×10^{-3}	6.96×10^{-5}	1.65×10^{-3}	5.33×10^{-4}	2.33×10^{-4}	2.54×10^{-2}	4.29×10^{-3}	6.92×10^{-5}
SMR	2-5	2.21×10^{-2}	3.77×10^{-3}	6.73×10^{-5}	1.31×10^{-3}	4.51×10^{-4}	8.29×10^{-5}	2.22×10^{-2}	3.77×10^{-3}	6.70×10^{-5}
SMR	5-10	2.63×10^{-2}	4.59×10^{-3}	7.84×10^{-5}	1.28×10^{-3}	4.77×10^{-4}	9.66×10^{-5}	2.73×10^{-2}	4.74×10^{-3}	7.81×10^{-5}
WEE	0-2	1.31×10^{-2}	2.38×10^{-3}	2.05×10^{-4}	5.85×10^{-4}	2.97×10^{-4}	9.29×10^{-5}	1.21×10^{-2}	2.21×10^{-3}	7.51×10^{-5}
WEE	2-5	1.51×10^{-2}	2.92×10^{-3}	8.77×10^{-5}	8.77×10^{-4}	4.03×10^{-4}	1.08×10^{-4}	1.45×10^{-2}	2.82×10^{-3}	2.99×10^{-4}
WEE	5-10	1.27×10^{-2}	2.39×10^{-3}	2.13×10^{-4}	6.40×10^{-4}	3.50×10^{-4}	3.31×10^{-4}	1.14×10^{-2}	2.18×10^{-3}	2.12×10^{-4}
WFF	0-2	8.77×10^{-3}	1.71×10^{-3}	2.18×10^{-4}	4.37×10^{-4}	3.00×10^{-4}	3.39×10^{-4}	9.40×10^{-3}	1.81×10^{-3}	2.17×10^{-4}
WFF	2-5	6.96×10^{-3}	1.43×10^{-3}	8.07×10^{-5}	2.57×10^{-4}	1.99×10^{-4}	9.95×10^{-5}	8.66×10^{-3}	1.72×10^{-3}	2.18×10^{-4}
WFF	5-10	9.73×10^{-3}	2.07×10^{-3}	1.06×10^{-4}	6.77×10^{-4}	3.81×10^{-4}	1.31×10^{-4}	1.03×10^{-2}	2.17×10^{-3}	1.06×10^{-4}
WSS	0-2	1.23×10^{-2}	2.15×10^{-3}	6.92×10^{-5}	5.66×10^{-4}	2.80×10^{-4}	8.55×10^{-5}	1.20×10^{-2}	2.09×10^{-3}	6.88×10^{-5}
WSS	2-5	1.09×10^{-2}	2.02×10^{-3}	7.29×10^{-5}	3.32×10^{-4}	2.16×10^{-4}	8.99×10^{-5}	1.11×10^{-2}	2.05×10^{-3}	7.25×10^{-5}
WSS	5-10	1.34×10^{-2}	2.44×10^{-3}	7.22×10^{-5}	4.26×10^{-4}	2.46×10^{-4}	8.92×10^{-5}	1.27×10^{-2}	2.33×10^{-3}	7.18×10^{-5}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration

Concentrations of ^{234}U, ^{235}U, and ^{238}U were also measured in deep soils (5-10 cm) (Table 4.11). Concentrations of ^{234}U varied from $9.73\times10^{-3} \pm 2.07\times10^{-3}$ Bq/g ($2.63\times10^{-1} \pm 5.59\times10^{-2}$ pCi/g) at WFF to $2.63\times10^{-2} \pm 4.59\times10^{-3}$ Bq/g ($7.11\times10^{-1} \pm 1.24\times10^{-1}$ pCi/g) at SMR. The lowest concentration of ^{235}U in deep soils was found at WSS ($4.26\times10^{-4} \pm 2.46\times10^{-4}$ Bq/g [$1.15\times10^{-2} \pm 6.65\times10^{-3}$ pCi/g]) and the highest concentration was found at SMR ($1.28\times10^{-3} \pm 4.77\times10^{-4}$ Bq/g [$3.46\times10^{-2} \pm 1.29\times10^{-2}$ pCi/g]). Uranium-238 lowest concentration was $1.03\times10^{-2} \pm 2.17\times10^{-3}$ Bq/g ($2.78\times10^{-1} \pm 5.86\times10^{-2}$ pCi/g) at WFF and the highest was found $2.73\times10^{-2} \pm 4.74\times10^{-3}$ Bq/g ($7.38\times10^{-1} \pm 1.28\times10^{-1}$ pCi/g) at SMR.

No uranium isotope varied significantly for the same location comparisons between 2001 and 2002 (ANOVA, ^{234}U $p = 0.109$, ^{238}U $p = 0.174$). All maximum measured concentrations fell within the range of natural concentrations of uranium found in soils throughout the world. All these results suggest a pattern of natural variability consistent with the existence of natural uranium, without enhancement from artificial sources.

Plutonium-238, $^{239+240}Pu$, and ^{241}Am were also analyzed in these soil samples (Table 4.12). Plutonium-238 was not detected in any of the samples. The measured concentration of $^{239+240}Pu$ was greater than the MDC at location SEC and SMR at all

three depths. Location MLR had detectable concentration for the surface depth (0-2 cm). Americium-241 was detected at MLR, 0-2 cm and 5-10 cm, SEC, 0-2 cm and 2-5 cm, and SMR, 2-5 cm and 5-10 cm. Historically, soil samples collected in the same locations have shown positive results on numerous occasions. Since 1997, soil samples collected by the Environmental Monitoring group at WEE, SEC, MLR, and SMR have shown levels of ^{241}Am and $^{239+240}$Pu slightly above background. During this time period, three different analytical laboratories were used; all had similar results. The source of activity in WIPP samples could be due to natural transport of contaminated soil from the Gnome Site via wind. The Gnome Site lies about 9 km southwest of the WIPP boundary and was contaminated with fission products in 1961 when an underground test of a 3-kiloton ^{239}Pu device vented to the surface. Because there are elevated levels of radionuclides in the soil near the Gnome Site, there is potential for contamination of WIPP environmental samples. The levels of radionuclides remains relatively high around the Gnome Site despite remediation efforts.

Table 4.12 - Americium and Plutonium Concentrations (Bq/g) in Soil Near the WIPP Site. See Appendix B for the sampling locations.

Location	Depth (cm)	[RN][a]	2 × TPU[b]	MDC[c]	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
		^{241}Am			^{238}Pu			$^{239+240}$Pu		
MLR	0-2	4.51×10^{-4}	2.96×10^{-4}	3.22×10^{-4}	2.50×10^{-4}	3.77×10^{-4}	6.14×10^{-4}	1.58×10^{-3}	8.40×10^{-4}	6.14×10^{-4}
MLR	2-5	1.54×10^{-4}	1.65×10^{-4}	2.27×10^{-4}	2.24×10^{-4}	2.14×10^{-4}	2.74×10^{-4}	1.49×10^{-4}	1.51×10^{-4}	1.01×10^{-4}
MLR	5-10	2.46×10^{-4}	1.79×10^{-4}	8.36×10^{-5}	1.25×10^{-4}	2.22×10^{-4}	3.89×10^{-4}	2.50×10^{-4}	2.39×10^{-4}	3.07×10^{-4}
SEC	0-2	2.34×10^{-4}	1.70×10^{-4}	7.92×10^{-5}	-1.45×10^{-4}	2.91×10^{-4}	7.81×10^{-4}	1.23×10^{-3}	6.48×10^{-4}	1.96×10^{-4}
SEC	2-5	3.06×10^{-4}	2.35×10^{-4}	2.85×10^{-4}	2.80×10^{-4}	4.22×10^{-4}	6.88×10^{-4}	8.40×10^{-4}	5.92×10^{-4}	2.52×10^{-4}
SEC	5-10	2.14×10^{-4}	2.06×10^{-4}	2.85×10^{-4}	3.70×10^{-5}	1.66×10^{-4}	3.44×10^{-4}	4.44×10^{-4}	2.87×10^{-4}	2.72×10^{-4}
SMR	0-2	1.04×10^{-4}	1.22×10^{-4}	9.44×10^{-5}	1.77×10^{-4}	2.52×10^{-4}	4.11×10^{-4}	4.00×10^{-4}	2.75×10^{-4}	1.20×10^{-4}
SMR	2-5	2.63×10^{-4}	2.12×10^{-4}	2.42×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.93×10^{-4}	5.96×10^{-4}	3.24×10^{-4}	1.08×10^{-4}
SMR	5-10	3.25×10^{-4}	2.31×10^{-4}	2.40×10^{-4}	9.69×10^{-5}	1.45×10^{-4}	2.38×10^{-4}	6.77×10^{-4}	3.15×10^{-4}	8.73×10^{-5}
WEE	0-2	1.08×10^{-4}	1.09×10^{-4}	7.33×10^{-5}	6.29×10^{-5}	8.92×10^{-5}	8.51×10^{-5}	2.19×10^{-4}	1.91×10^{-4}	2.31×10^{-4}
WEE	2-5	8.47×10^{-5}	9.84×10^{-5}	7.62×10^{-5}	2.98×10^{-5}	5.99×10^{-5}	8.07×10^{-5}	1.19×10^{-4}	1.21×10^{-4}	8.07×10^{-5}
WEE	5-10	1.25×10^{-4}	1.26×10^{-4}	8.44×10^{-5}	2.80×10^{-5}	5.62×10^{-5}	7.59×10^{-5}	1.68×10^{-4}	1.61×10^{-4}	2.06×10^{-4}
WFF	0-2	9.77×10^{-5}	1.47×10^{-4}	2.40×10^{-4}	3.24×10^{-5}	6.51×10^{-5}	8.77×10^{-5}	9.73×10^{-5}	1.46×10^{-4}	2.39×10^{-4}
WFF	2-5	5.92×10^{-5}	8.44×10^{-5}	8.03×10^{-5}	3.89×10^{-5}	7.77×10^{-5}	1.05×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.85×10^{-4}
WFF	5-10	6.07×10^{-5}	8.66×10^{-5}	8.21×10^{-5}	0.00×10^{0}	0.00×10^{0}	8.25×10^{-5}	0.00×10^{0}	0.00×10^{0}	8.25×10^{-5}
WSS	0-2	9.14×10^{-5}	1.62×10^{-4}	2.83×10^{-4}	-1.30×10^{-4}	2.30×10^{-4}	5.66×10^{-4}	1.30×10^{-4}	1.51×10^{-4}	1.17×10^{-4}
WSS	2-5	8.81×10^{-5}	1.32×10^{-4}	2.16×10^{-4}	1.04×10^{-4}	1.48×10^{-4}	1.40×10^{-4}	1.55×10^{-4}	1.82×10^{-4}	1.40×10^{-4}
WSS	5-10	1.15×10^{-4}	1.42×10^{-4}	2.12×10^{-4}	1.31×10^{-4}	1.54×10^{-4}	1.18×10^{-4}	1.75×10^{-4}	1.78×10^{-4}	1.18×10^{-4}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

Potassium-40, as expected, was detected in every sample (Table 4.13). This naturally occurring gamma-emitting radionuclide is ubiquitous in soils. Concentrations in surface soils ranged from $1.74\times10^{-1} \pm 2.31\times10^{-2}$ Bq/g ($4.70\times10^{0} \pm 6.24\times10^{-1}$ pCi/g) at WFF to $6.73\times10^{-1} \pm 8.62\times10^{-2}$ Bq/g ($1.82\times10^{1} \pm 1.33\times10^{0}$ pCi/g) at SMR. In intermediate depth

soils, concentrations of ^{40}K varied from $1.93\times10^{-1} \pm 2.56\times10^{-2}$ Bq/g ($5.22\times10^{0} \pm 6.92\times10^{-1}$ pCi/g) at WFF to $6.99\times10^{-1} \pm 9.03\times10^{-2}$ Bq/g ($1.89\times10^{1} \pm 2.44\times10^{0}$ pCi/g) at SMR. Potassium-40 concentrations in deep soils were lowest at WFF ($1.81\times10^{-1} \pm 2.39\times10^{-2}$ Bq/g ($4.89\times10^{0} \pm 6.46\times10^{-1}$ pCi/g) and highest at SMR ($6.81\times10^{-1} \pm 8.70\times10^{-2}$ Bq/g ($1.84\times10^{1} \pm 2.35\times10^{0}$ pCi/g).

The concentration of ^{40}K was not significantly different between 2001 and 2002 (ANOVA, p = 0.771). The range of concentrations observed is consistent with the average natural ^{40}K concentration in soils around the world (4.00×10^{-1} Bq/g [1.08×10^{1} pCi/g]; NCRP 1987a).

Cesium-137 was detected in 17 of the 18 soil samples (Table 4.13). In surface soils, concentrations ranged from $4.18\times10^{-4} \pm 1.72\times10^{-4}$ Bq/g ($1.13\times10^{-2} \pm 4.65\times10^{-3}$ pCi/g) at WFF to $1.09\times10^{-2} \pm 1.42\times10^{-3}$ Bq/g ($2.95\times10^{-1} \pm 3.84\times10^{-2}$ pCi/g) at MLR. The concentration in intermediate depth soils ranged from $4.00\times10^{-4} \pm 2.90\times10^{-4}$ Bq/g ($1.08\times10^{-2} \pm 7.84\times10^{-3}$ pCi/g) at WFF to $1.30\times10^{-2} \pm 1.67\times10^{-3}$ Bq/g ($3.51\times10^{-1} \pm 4.51\times10^{-2}$ pCi/g) at SMR. In deep soils, the lowest concentrations of ^{137}Cs were found at WFF ($-1.42\times10^{-4} \pm 4.66\times10^{-4}$ Bq/g [$-3.84\times10^{-3} \pm 1.26\times10^{-2}$ pCi/g]) and the highest concentrations were found at SMR ($1.13\times10^{-2} \pm 1.46\times10^{-3}$ Bq/g [$3.05\times10^{-1} \pm 3.94\times10^{-2}$ pCi/g]).

Although ^{137}Cs is a fission product, it is ubiquitous in soils because of global fallout from atmospheric nuclear weapons testing. In 1998, prior to WIPP accepting any waste, the average concentration of ^{137}Cs in soils around WIPP was 4.3×10^{-3} Bq/g (1.16×10^{-1} pCi/g). There was no statistically significant difference between concentrations measured in 2001 and 2002 (ANOVA, p = 0.883).

Strontium-90 and ^{60}Co were not detected at any locations (Table 4.13).

Soil samples collected from one location (SEC) were divided into two parts and analyzed separately (Table 4.14). Uranium-234, ^{235}U, ^{238}U, $^{239+240}$Pu, ^{40}K, and ^{137}Cs were compared between the duplicates. Other radionuclides of interest had insufficient detections to allow a reasonable comparison. The RER was greater than one for ^{234}U at depth 2-5 cm and for $^{239+240}$Pu at depth 0-2 cm. This circumstance may indicate a lack of precision in these analyses, primarily due to the nonhomogeneous distribution of radionuclides in soils. Because of small-scale differences in topography, soil type and structure, soil moisture, and other microenvironmental conditions, radionuclides are rarely homogeneously distributed in soils, and good agreement between duplicate samples is sometimes difficult to achieve. However, all the measurements were low, within the range of natural concentrations, and did not differ in time or space in such a way as to suggest WIPP-related contamination of the environment.

Table 4.13 - Selected Radionuclide Concentrations (Bq/g) in Soil Near the WIPP Site. See Appendix B for the sampling locations.

Location	Depth (cm)	[RN][a]	2 × TPU[b]	MDC[c]	[RN]	2 × TPU	MDC
		^{137}Cs			^{60}Co		
MLR	0-2	1.09×10^{-2}	1.42×10^{-3}	4.00×10^{-4}	1.79×10^{-4}	5.37×10^{-4}	6.14×10^{-4}
MLR	2-5	2.30×10^{-3}	3.55×10^{-4}	2.95×10^{-4}	3.52×10^{-4}	4.81×10^{-4}	5.59×10^{-4}
MLR	5-10	1.09×10^{-3}	2.82×10^{-4}	5.07×10^{-4}	4.40×10^{-4}	4.96×10^{-4}	5.77×10^{-4}
SEC	0-2	4.92×10^{-3}	7.44×10^{-4}	5.25×10^{-4}	3.56×10^{-4}	3.96×10^{-4}	4.70×10^{-4}
SEC	2-5	5.07×10^{-3}	7.14×10^{-4}	3.53×10^{-4}	1.02×10^{-4}	3.96×10^{-4}	4.55×10^{-4}
SEC	5-10	2.86×10^{-3}	5.18×10^{-4}	5.07×10^{-4}	-1.95×10^{-4}	4.85×10^{-4}	5.33×10^{-4}
SMR	0-2	6.33×10^{-3}	9.10×10^{-4}	5.55×10^{-4}	1.11×10^{-5}	5.59×10^{-4}	6.33×10^{-4}
SMR	2-5	1.30×10^{-2}	1.67×10^{-3}	3.40×10^{-4}	2.25×10^{-4}	5.62×10^{-4}	6.40×10^{-4}
SMR	5-10	1.13×10^{-2}	1.46×10^{-3}	4.11×10^{-4}	-8.55×10^{-5}	5.88×10^{-4}	6.59×10^{-4}
WEE	0-2	1.88×10^{-3}	3.43×10^{-4}	3.15×10^{-4}	5.92×10^{-5}	3.89×10^{-4}	4.44×10^{-4}
WEE	2-5	1.66×10^{-3}	5.44×10^{-4}	7.66×10^{-4}	-7.59×10^{-5}	4.66×10^{-4}	5.22×10^{-4}
WEE	5-10	1.66×10^{-3}	3.50×10^{-4}	3.85×10^{-4}	2.53×10^{-4}	3.85×10^{-4}	4.51×10^{-4}
WFF	0-2	4.18×10^{-4}	1.72×10^{-4}	2.42×10^{-4}	1.63×10^{-4}	3.55×10^{-4}	4.14×10^{-4}
WFF	2-5	4.00×10^{-4}	2.90×10^{-4}	3.53×10^{-4}	2.77×10^{-4}	3.62×10^{-4}	4.29×10^{-4}
WFF	5-10	-1.42×10^{-4}	4.66×10^{-4}	5.11×10^{-4}	5.33×10^{-5}	4.33×10^{-4}	4.96×10^{-4}
WSS	0-2	1.18×10^{-3}	2.96×10^{-4}	3.62×10^{-4}	-2.23×10^{-4}	4.22×10^{-4}	4.51×10^{-4}
WSS	2-5	2.24×10^{-3}	4.55×10^{-4}	4.96×10^{-4}	-1.53×10^{-4}	4.74×10^{-4}	5.22×10^{-4}
WSS	5-10	1.77×10^{-3}	3.32×10^{-4}	3.15×10^{-4}	2.01×10^{-4}	3.92×10^{-4}	4.55×10^{-4}
		^{90}Sr			^{40}K		
MLR	0-2	-2.78×10^{-3}	7.81×10^{-3}	1.35×10^{-2}	4.33×10^{-1}	5.55×10^{-2}	5.77×10^{-3}
MLR	2-5	1.29×10^{-2}	1.04×10^{-2}	1.67×10^{-2}	4.11×10^{-1}	5.37×10^{-2}	5.66×10^{-3}
MLR	5-10	-9.47×10^{-4}	7.99×10^{-3}	1.38×10^{-2}	4.14×10^{-1}	5.37×10^{-2}	4.96×10^{-3}
SEC	0-2	3.18×10^{-3}	5.59×10^{-3}	9.21×10^{-3}	2.19×10^{-1}	2.89×10^{-2}	4.26×10^{-3}
SEC	2-5	1.38×10^{-3}	5.29×10^{-3}	8.84×10^{-3}	2.30×10^{-1}	3.03×10^{-2}	4.59×10^{-3}
SEC	5-10	4.66×10^{-3}	5.44×10^{-3}	8.81×10^{-3}	2.04×10^{-1}	2.70×10^{-2}	7.36×10^{-3}
SMR	0-2	4.22×10^{-3}	6.96×10^{-3}	1.14×10^{-2}	6.73×10^{-1}	8.62×10^{-2}	6.03×10^{-3}
SMR	2-5	2.18×10^{-3}	6.70×10^{-3}	1.11×10^{-2}	6.99×10^{-1}	9.03×10^{-2}	5.77×10^{-3}
SMR	5-10	-1.47×10^{-4}	5.48×10^{-3}	9.29×10^{-3}	6.81×10^{-1}	8.70×10^{-2}	6.40×10^{-3}
WEE	0-2	-1.88×10^{-3}	5.40×10^{-3}	9.44×10^{-3}	2.26×10^{-1}	2.98×10^{-2}	3.70×10^{-3}
WEE	2-5	7.62×10^{-3}	5.74×10^{-3}	9.36×10^{-3}	2.26×10^{-1}	2.96×10^{-2}	5.51×10^{-3}
WEE	5-10	1.20×10^{-3}	5.37×10^{-3}	9.18×10^{-3}	2.24×10^{-1}	2.95×10^{-2}	3.77×10^{-3}
WFF	0-2	4.33×10^{-3}	5.37×10^{-3}	8.95×10^{-3}	1.74×10^{-1}	2.31×10^{-2}	3.62×10^{-3}
WFF	2-5	-5.70×10^{-4}	5.40×10^{-3}	9.40×10^{-3}	1.93×10^{-1}	2.56×10^{-2}	3.69×10^{-3}
WFF	5-10	1.45×10^{-3}	5.51×10^{-3}	9.44×10^{-3}	1.81×10^{-1}	2.39×10^{-2}	5.66×10^{-3}
WSS	0-2	1.40×10^{-3}	5.59×10^{-3}	9.32×10^{-3}	2.25×10^{-1}	2.96×10^{-2}	3.74×10^{-3}
WSS	2-5	-5.00×10^{-3}	5.33×10^{-3}	9.36×10^{-3}	2.19×10^{-1}	2.87×10^{-2}	5.55×10^{-3}
WSS	5-10	4.77×10^{-4}	5.66×10^{-3}	9.55×10^{-3}	2.46×10^{-1}	3.24×10^{-2}	3.92×10^{-3}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration

Table 4.14 - Results of Duplicate Soil Sample Analysis. Units are Bq/g. See Appendix B for the sampling locations.

Location	Depth (cm)	[RN][a]	2×TPU[b]	MDC[c]	RER[d]	[RN]	2×TPU[a]	MDC[b]	RER[c]
		^{234}U				^{238}U			
SEC	0-2	1.68×10^{-2}	3.05×10^{-3}	7.51×10^{-5}	0.18	1.69×10^{-2}	3.05×10^{-3}	7.47×10^{-5}	0.13
SEC D[e]	0-2	1.76×10^{-2}	3.14×10^{-3}	7.47×10^{-5}		1.63×10^{-2}	2.93×10^{-3}	7.44×10^{-5}	
SEC	2-5	1.73×10^{-2}	2.99×10^{-3}	7.29×10^{-5}	1.08	1.83×10^{-2}	3.14×10^{-3}	7.25×10^{-5}	0.80
SEC D[e]	2-5	2.27×10^{-2}	4.03×10^{-3}	7.70×10^{-5}		2.23×10^{-2}	3.96×10^{-3}	7.66×10^{-4}	
SEC	5-10	2.22×10^{-2}	3.89×10^{-3}	7.62×10^{-5}	0.85	2.05×10^{-2}	3.62×10^{-3}	7.62×10^{-5}	0.70
SEC D[e]	5-10	1.78×10^{-2}	3.34×10^{-3}	8.47×10^{-5}		1.71×10^{-2}	3.22×10^{-3}	2.89×10^{-4}	
		^{235}U				$^{239+240}Pu$			
SEC	0-2	7.88×10^{-4}	3.52×10^{-4}	9.25×10^{-5}	0.48	1.23×10^{-3}	6.48×10^{-4}	1.96×10^{-4}	1.05
SEC D[e]	0-2	1.05×10^{-3}	4.37×10^{-4}	3.16×10^{-4}		5.00×10^{-4}	2.47×10^{-4}	7.51×10^{-5}	
SEC	2-5	8.95×10^{-4}	3.70×10^{-4}	8.99×10^{-5}	0.03	8.40×10^{-4}	5.92×10^{-4}	2.52×10^{-4}	0.17
SEC D[e]	2-5	9.10×10^{-4}	3.89×10^{-4}	9.51×10^{-5}		7.22×10^{-4}	3.16×10^{-4}	8.14×10^{-5}	
SEC	5-10	1.18×10^{-3}	4.59×10^{-4}	2.56×10^{-4}	0.49	4.44×10^{-4}	2.87×10^{-4}	2.72×10^{-4}	0.25
SEC D[e]	5-10	8.88×10^{-4}	4.44×10^{-4}	1.04×10^{-4}		5.44×10^{-4}	2.88×10^{-4}	9.25×10^{-4}	
		^{40}K				^{137}Cs			
SEC	0-2	2.19×10^{-1}	2.89×10^{-2}	4.26×10^{-3}	0.39	4.92×10^{-3}	7.44×10^{-4}	5.25×10^{-4}	0.04
SEC D[e]	0-2	2.03×10^{-1}	2.68×10^{-2}	5.62×10^{-3}		4.96×10^{-3}	7.18×10^{-4}	4.18×10^{-4}	
SEC	2-5	2.30×10^{-1}	3.03×10^{-2}	4.59×10^{-3}	0.03	5.07×10^{-3}	7.14×10^{-4}	3.53×10^{-4}	0.80
SEC D[e]	2-5	2.31×10^{-1}	3.05×10^{-2}	3.77×10^{-3}		4.33×10^{-3}	5.96×10^{-4}	2.51×10^{-4}	
SEC	5-10	2.04×10^{-1}	2.70×10^{-2}	7.36×10^{-3}	0.60	2.86×10^{-3}	5.18×10^{-4}	5.07×10^{-4}	0.38
SEC D[e]	5-10	2.28×10^{-1}	2.99×10^{-2}	5.74×10^{-3}		3.15×10^{-3}	5.59×10^{-4}	5.33×10^{-4}	

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
[d] Relative error ratio
[e] Duplicate

4.7 Sediments

4.7.1 Sample Collection

Sediment samples were collected from 12 locations around the WIPP site, mostly from the same water bodies from which the surface water samples were collected (Figure 4.7, see Appendix B for location codes). The samples were collected in 1-l plastic containers from the top 15 cm (6 in.) of the sediments of the water bodies and shipped to the laboratory for the determination of individual radionuclides.

4.7.2 Sample Preparation

Sediment samples were dried at 110°C (230°F) for several hours and homogenized by grinding to smaller particle sizes. A 0.75 g (0.04 oz) aliquot was dissolved by heating it with a mixture of nitric, hydrochloric, and hydrofluoric acids. The residue was heated with nitric and boric acids to remove hydrofluoric acid quantitatively. Finally, the residue was dissolved in hydrochloric acid for the determination of individual radionuclides.

4.7.3 Determination of Individual Radionuclides

About 100 g (4 oz) of dried and homogenized sediment samples were counted by gamma-spectrometry for the determinations of ^{40}K, ^{60}Co, and ^{137}Cs. Strontium-90 was determined from an aliquot of dissolved sediment samples by chemical separation and beta counting. Uranium, plutonium, and americium were determined by alpha spectrometry after chemical separations, micro-precipitating, and filtering onto micro filter papers.

4.7.4 Results and Discussions

Uranium-234, ^{235}U,and ^{238}U were detected in every sediment sample (Table 4.15). The concentration of ^{234}U ranged from $1.68\times10^{-2} \pm 2.97\times10^{-3}$ Bq/g ($4.54\times10^{-1} \pm 8.02\times10^{-2}$ pCi/g) at NOY to $4.40\times10^{-2} \pm 7.25\times10^{-3}$ Bq/g ($1.19\times10^{0} \pm 1.96\times10^{-1}$ pCi/g) at CBD. The concentration of ^{235}U ranged from $9.92\times10^{-4} \pm 4.11\times10^{-4}$ Bq/g ($2.68\times10^{-2} \pm 1.11\times10^{-2}$ pCi/g) at RED to $2.06\times10^{-3} \pm 6.14\times10^{-4}$ Bq/g ($5.56\times10^{-2} \pm 1.66\times10^{-2}$ pCi/g) at IND. The concentration of ^{238}U was lowest at BHT ($1.84\times10^{-2} \pm 3.21\times10^{-3}$ Bq/g [$4.97\times10^{-1} \pm 8.67\times10^{-2}$ pCi/g]) and highest at UPR ($3.15\times10^{-2} \pm 5.18\times10^{-3}$ Bq/g [$8.51\times10^{-1} \pm 1.40\times10^{-1}$ pCi/g]). As expected, the ^{235}U concentration was much lower than the concentrations of ^{234}U and ^{238}U. There was not a significant difference between 2001 and 2002 (ANOVA ^{234}U p = 0.543, ^{235}U p = 0.935, ^{238}U p = 0.788).

Plutonium-238 was detected in one sediment sample in 2002 at SOO (Table 4.16). Americium-241 was detected at CBD and PKT. Plutonium-239+240 was detected at 69 percent of sampling locations. The samples showed concentration barely above the MDC or 2xTPU and were within the normal background range as compared to the previous years.

Cesium-137 was detected in all the sediment samples except at PCN, ranging from $5.77\times10^{-4} \pm 1.65\times10^{-4}$ Bq/g ($1.56\times10^{-2} \pm 4.46\times10^{-3}$ pCi/g) at UPR to $1.07\times10^{-2} \pm 1.42\times10^{-3}$ Bq/g ($2.89\times10^{0} \pm 3.83\times10^{-2}$ pCi/g) at SOO (Table 4.17). Cesium-137 did not differ statistically between sampling years 2001 and 2002 (ANOVA p = 0.258).

Strontium-90 and ^{60}Co were not detected in any sediment samples. None of these radionuclides had sufficient detections to justify statistical comparisons between locations or years.

Potassium-40 was detected, as expected, in all sediment samples (Table 4.17). Its lowest concentration was found at BRA ($3.16\times10^{-1} \pm 4.14\times10^{-2}$ Bq/g [$8.53\times10^{0} \pm 1.12\times10^{0}$ pCi/g]) and its highest concentration was found at TUT ($9.66\times10^{-1} \pm 1.24\times10^{-1}$ Bq/g [$2.61\times10^{1} \pm 3.35\times10^{0}$ pCi/g]). Potassium-40 did not vary significantly between years (ANOVA, p = 0.839). Overall, the concentrations measured in 2002 were similar to the average concentration of ^{40}K found in soils throughout the United States (4.00×10^{-1} Bq/g [1.08×10^{1} pCi/g]; NCRP, 1987a).

Duplicate analyses were performed for all the radionuclides in sediment samples IDN and RED (Table 4.18). The RER was less than one for ^{241}Am, ^{40}K, and all uranium

isotopes, indicating acceptable correspondence between the original and the duplicate samples. For ^{137}Cs, it was greater than one for location RED. However, a t-test indicated no significant difference between any of these duplicate measurements for ^{137}Cs (p = 0.377).

Table 4.15 - Uranium Concentrations (Bq/g) in Sediment Near the WIPP Site. See Appendix B for the sampling locations.

	[RN][a]	2 × TPU[b]	MDC[c]	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
Location	^{234}U			^{235}U			^{238}U		
BRA	2.87×10^{-2}	4.85×10^{-3}	6.18×10^{-5}	1.21×10^{-3}	4.18×10^{-4}	7.62×10^{-5}	2.72×10^{-2}	4.63×10^{-3}	1.68×10^{-4}
BHT	1.79×10^{-2}	3.12×10^{-3}	1.62×10^{-4}	1.08×10^{-3}	3.85×10^{-4}	7.33×10^{-5}	1.84×10^{-2}	3.21×10^{-3}	1.61×10^{-4}
CBD	4.40×10^{-2}	7.25×10^{-3}	6.92×10^{-5}	1.83×10^{-3}	5.66×10^{-4}	2.33×10^{-4}	3.00×10^{-2}	5.03×10^{-3}	6.92×10^{-5}
HIL	2.20×10^{-2}	3.85×10^{-3}	6.44×10^{-5}	1.15×10^{-3}	4.11×10^{-4}	7.96×10^{-5}	2.20×10^{-2}	3.85×10^{-3}	6.44×10^{-5}
IDN	2.21×10^{-2}	3.92×10^{-3}	1.90×10^{-4}	2.06×10^{-3}	6.14×10^{-4}	8.62×10^{-5}	2.45×10^{-2}	4.33×10^{-3}	6.96×10^{-5}
LST	2.23×10^{-2}	4.00×10^{-3}	1.86×10^{-4}	1.99×10^{-3}	5.99×10^{-4}	8.44×10^{-5}	2.29×10^{-2}	4.07×10^{-3}	1.85×10^{-4}
NOY	1.68×10^{-2}	2.97×10^{-3}	6.18×10^{-5}	1.47×10^{-3}	4.70×10^{-4}	7.62×10^{-5}	1.88×10^{-2}	3.28×10^{-3}	6.14×10^{-5}
PCN	2.68×10^{-2}	4.40×10^{-3}	6.22×10^{-5}	1.36×10^{-3}	4.44×10^{-4}	7.70×10^{-5}	2.82×10^{-2}	4.63×10^{-3}	6.22×10^{-5}
PKT	2.71×10^{-2}	4.37×10^{-3}	5.37×10^{-5}	1.20×10^{-3}	3.92×10^{-4}	1.80×10^{-4}	2.65×10^{-2}	4.29×10^{-3}	5.37×10^{-5}
RED	2.04×10^{-2}	3.58×10^{-3}	8.07×10^{-5}	9.92×10^{-4}	4.11×10^{-4}	9.95×10^{-5}	1.95×10^{-2}	3.43×10^{-3}	8.03×10^{-5}
SOO	2.39×10^{-2}	4.03×10^{-3}	6.40×10^{-5}	1.17×10^{-3}	4.11×10^{-4}	7.92×10^{-5}	2.43×10^{-2}	4.11×10^{-3}	6.40×10^{-5}
TUT	2.47×10^{-2}	4.07×10^{-3}	1.52×10^{-4}	1.27×10^{-3}	4.14×10^{-4}	1.87×10^{-4}	2.70×10^{-2}	4.40×10^{-3}	5.55×10^{-5}
UPR	2.97×10^{-2}	4.92×10^{-3}	5.99×10^{-5}	1.94×10^{-3}	5.51×10^{-4}	7.40×10^{-5}	3.15×10^{-2}	5.18×10^{-3}	5.96×10^{-5}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration

Table 4.16 - Americium and Plutonium Concentrations (Bq/g) in Sediment Near the WIPP Site. See Appendix B for the sampling locations.

	[RN][a]	2 × TPU[b]	MDC[c]	[RN]	2 × TPU	MDC	[RN]	2 × TPU	MDC
Location	^{241}Am			^{238}Pu			$^{239+240}Pu$		
BRA	1.75×10^{-4}	3.52×10^{-4}	6.44×10^{-4}	0.00×10^{0}	0.00×10^{0}	4.81×10^{-4}	6.51×10^{-5}	1.31×10^{-4}	1.76×10^{-4}
BHT	1.45×10^{-4}	1.56×10^{-4}	2.14×10^{-4}	9.14×10^{-5}	9.21×10^{-5}	6.18×10^{-5}	2.50×10^{-4}	1.80×10^{-4}	2.12×10^{-4}
CBD	1.77×10^{-4}	1.62×10^{-4}	9.58×10^{-5}	7.47×10^{-5}	8.70×10^{-5}	6.73×10^{-5}	1.49×10^{-4}	1.24×10^{-4}	6.73×10^{-5}
HIL	0.00×10^{0}	0.00×10^{0}	7.10×10^{-4}	3.23×10^{-5}	1.12×10^{-4}	2.38×10^{-4}	1.61×10^{-4}	1.47×10^{-4}	8.73×10^{-5}
IDN	9.66×10^{-5}	1.20×10^{-4}	1.78×10^{-4}	3.53×10^{-5}	1.22×10^{-4}	2.60×10^{-4}	3.17×10^{-4}	2.19×10^{-4}	9.55×10^{-5}
LST	1.37×10^{-4}	1.82×10^{-4}	2.94×10^{-4}	0.00×10^{0}	0.00×10^{0}	1.57×10^{-4}	3.20×10^{-4}	1.72×10^{-4}	5.77×10^{-5}
NOY	3.11×10^{-5}	1.08×10^{-4}	2.29×10^{-4}	9.73×10^{-5}	1.20×10^{-4}	1.79×10^{-4}	1.70×10^{-4}	1.31×10^{-4}	6.59×10^{-5}
PCN	4.07×10^{-5}	5.77×10^{-5}	5.51×10^{-5}	1.00×10^{-4}	1.50×10^{-4}	2.46×10^{-4}	3.33×10^{-5}	6.70×10^{-5}	9.03×10^{-5}
PKT	1.36×10^{-4}	1.24×10^{-4}	7.40×10^{-5}	8.25×10^{-5}	1.18×10^{-4}	1.12×10^{-4}	9.07×10^{-4}	4.22×10^{-4}	1.12×10^{-4}
RED	1.02×10^{-4}	1.03×10^{-4}	6.92×10^{-5}	-1.25×10^{-4}	3.06×10^{-4}	7.47×10^{-4}	5.00×10^{-4}	3.69×10^{-4}	1.69×10^{-4}
SOO	7.10×10^{-5}	1.07×10^{-4}	1.75×10^{-4}	1.53×10^{-4}	1.18×10^{-4}	5.92×10^{-5}	4.14×10^{-4}	2.01×10^{-4}	5.92×10^{-5}
TUT	1.17×10^{-4}	1.45×10^{-4}	2.15×10^{-4}	6.99×10^{-5}	9.95×10^{-5}	9.44×10^{-5}	1.05×10^{-4}	1.22×10^{-4}	9.44×10^{-5}
UPR	0.00×10^{0}	0.00×10^{0}	2.45×10^{-4}	-4.26×10^{-5}	8.58×10^{-5}	3.14×10^{-4}	1.28×10^{-4}	1.49×10^{-4}	1.15×10^{-4}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

Table 4.17 - Selected Radionuclide Concentrations (Bq/g) in Sediment Near the WIPP Site. See Appendix B for the sampling locations.

	[RN][a]	2 × TPU[b]	MDC[c]	[RN]	2 × TPU	MDC
Location	^{137}Cs			^{60}Co		
BRA	8.33×10^{-4}	1.83×10^{-4}	2.84×10^{-4}	4.33×10^{-4}	4.66×10^{-4}	5.44×10^{-4}
BHT	7.07×10^{-3}	1.10×10^{-3}	8.95×10^{-4}	-1.06×10^{-5}	6.33×10^{-4}	6.73×10^{-4}
CBD	2.95×10^{-3}	4.33×10^{-4}	2.87×10^{-4}	1.18×10^{-5}	4.70×10^{-4}	5.29×10^{-4}
HIL	1.57×10^{-3}	2.74×10^{-4}	3.27×10^{-4}	7.10×10^{-5}	5.51×10^{-4}	6.22×10^{-4}
IDN	7.14×10^{-3}	9.51×10^{-4}	3.44×10^{-4}	1.82×10^{-4}	5.66×10^{-4}	6.44×10^{-4}
LST	4.66×10^{-3}	6.44×10^{-4}	3.55×10^{-4}	-6.33×10^{-5}	5.66×10^{-4}	6.29×10^{-4}
NOY	4.11×10^{-3}	5.77×10^{-4}	3.64×10^{-4}	1.32×10^{-4}	6.03×10^{-4}	6.77×10^{-4}
PCN	1.20×10^{-4}	2.69×10^{-4}	5.00×10^{-4}	-1.52×10^{-4}	5.85×10^{-4}	6.44×10^{-4}
PKT	7.40×10^{-3}	9.84×10^{-4}	3.96×10^{-4}	-6.18×10^{-5}	6.03×10^{-4}	6.48×10^{-4}
RED	3.17×10^{-3}	4.92×10^{-4}	3.39×10^{-4}	4.88×10^{-4}	4.88×10^{-4}	5.70×10^{-4}
SOO	1.07×10^{-2}	1.42×10^{-3}	5.37×10^{-4}	5.03×10^{-4}	5.40×10^{-4}	6.03×10^{-4}
TUT	2.63×10^{-3}	5.48×10^{-4}	6.33×10^{-4}	5.03×10^{-4}	7.51×10^{-4}	8.07×10^{-4}
UPR	5.77×10^{-4}	1.65×10^{-4}	3.20×10^{-4}	3.89×10^{-4}	5.33×10^{-4}	5.96×10^{-4}
	^{90}Sr			^{40}K		
BRA	3.23×10^{-3}	4.18×10^{-3}	7.10×10^{-3}	3.16×10^{-1}	4.14×10^{-2}	6.99×10^{-3}
BHT	1.47×10^{-3}	3.61×10^{-3}	6.22×10^{-3}	4.92×10^{-1}	6.36×10^{-2}	6.81×10^{-3}
CBD	1.85×10^{-3}	5.22×10^{-3}	9.07×10^{-3}	3.40×10^{-1}	4.44×10^{-2}	5.25×10^{-3}
HIL	5.07×10^{-3}	4.85×10^{-3}	8.10×10^{-3}	7.14×10^{-1}	9.18×10^{-2}	6.07×10^{-3}
IDN	1.34×10^{-3}	4.77×10^{-3}	8.29×10^{-3}	6.62×10^{-1}	8.55×10^{-2}	5.81×10^{-3}
LST	4.92×10^{-3}	6.11×10^{-3}	1.03×10^{-2}	6.70×10^{-1}	8.62×10^{-2}	6.18×10^{-3}
NOY	1.10×10^{-3}	3.96×10^{-3}	6.70×10^{-3}	8.58×10^{-1}	1.11×10^{-1}	6.99×10^{-3}
PCN	-2.02×10^{-3}	4.85×10^{-3}	8.55×10^{-3}	6.88×10^{-1}	8.84×10^{-2}	5.55×10^{-3}
PKT	1.82×10^{-3}	4.48×10^{-3}	7.59×10^{-3}	5.40×10^{-1}	7.62×10^{-2}	5.81×10^{-2}
RED	1.11×10^{-3}	6.81×10^{-3}	1.18×10^{-2}	4.66×10^{-1}	6.03×10^{-2}	5.59×10^{-3}
SOO	6.36×10^{-3}	6.66×10^{-3}	1.10×10^{-2}	4.03×10^{-1}	5.74×10^{-2}	5.85×10^{-3}
TUT	1.93×10^{-3}	4.40×10^{-3}	7.47×10^{-3}	9.66×10^{-1}	1.24×10^{-1}	6.62×10^{-3}
UPR	5.37×10^{-3}	5.14×10^{-3}	8.44×10^{-3}	3.44×10^{-1}	4.92×10^{-2}	5.70×10^{-3}

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration

All of the radionuclides analyzed in sediment samples in 2002 were within the 95 percent confidence interval ranges of preoperational radiological baseline report covering the period from 1985 to 1989 (DOE/WIPP 92-037).

Table 4.18 - Results of Duplicate Sediment Sample Analysis. Units are Bq/g. See Appendix B for the sampling locations.

Location	[RN][a]	2×TPU[b]	MDC[c]	RER[d]	[RN]	2×TPU[a]	MDC[b]	RER[c]
	^{241}Am				^{137}Cs			
IDN	9.66×10^{-5}	1.20×10^{-4}	1.78×10^{-4}	0.55	7.14×10^{-3}	9.51×10^{-4}	3.44×10^{-4}	0
IDN Dup.	1.99×10^{-4}	1.45×10^{-4}	6.73×10^{-5}		7.14×10^{-3}	9.47×10^{-4}	3.45×10^{-4}	
RED	1.02×10^{-4}	1.03×10^{-4}	6.92×10^{-5}	0.35	3.17×10^{-3}	4.92×10^{-4}	3.39×10^{-4}	5.55
RED Dup.	5.11×10^{-5}	1.02×10^{-4}	1.88×10^{-4}		3.61×10^{-4}	1.20×10^{-4}	2.43×10^{-4}	
	^{40}K				^{234}U			
IDN	6.62×10^{-1}	8.55×10^{-2}	5.81×10^{-3}	0	2.21×10^{-2}	3.92×10^{-3}	1.90×10^{-4}	0.56
IDN Dup.	6.62×10^{-1}	8.55×10^{-2}	6.99×10^{-3}		2.54×10^{-2}	4.59×10^{-3}	7.70×10^{-5}	
RED	4.66×10^{-1}	6.03×10^{-2}	5.59×10^{-3}	0.21	2.04×10^{-2}	3.58×10^{-3}	8.07×10^{-5}	0.46
RED Dup.	4.85×10^{-1}	6.29×10^{-2}	5.11×10^{-3}		2.27×10^{-2}	3.77×10^{-3}	5.85×10^{-5}	
	^{235}U				^{238}U			
IDN	2.06×10^{-3}	6.14×10^{-4}	8.62×10^{-5}	0.99	2.45×10^{-2}	4.33×10^{-3}	6.96×10^{-5}	0.19
IDN Dup.	1.30×10^{-3}	4.77×10^{-4}	9.47×10^{-5}		2.57×10^{-2}	4.63×10^{-3}	7.66×10^{-5}	
RED	9.92×10^{-4}	4.11×10^{-4}	9.95×10^{-5}	0.09	1.95×10^{-2}	3.43×10^{-3}	8.03×10^{-5}	0.91
RED Dup.	1.04×10^{-3}	3.70×10^{-4}	7.25×10^{-5}		2.43×10^{-2}	4.00×10^{-3}	1.59×10^{-4}	

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
[d] Relative error ratio

Figure 4.7 - Sediment Sampling Sites

4.8 Biota

4.8.1 Sample Collection

The concentration of radionuclides in plants is an important factor in estimating the intake of individual radionuclides by humans through ingestion. Therefore, rangeland vegetation samples were collected from the same six locations from where the soil samples were collected (Figure 4.6). The vegetation samples were chopped into 2.5-5-cm (1-2-in)-pieces, mixed together well, air dried at room temperature, and analyzed. Also collected were muscle tissues from two road-killed deer and one quail, both species commonly consumed by humans. Fish is also consumed in large amounts; therefore, fish samples from BRA, PEC, and SOO (three different locations on the Pecos River) were collected. The muscle tissues from the deer, quail, and fish were also analyzed.

4.8.2 Sample Preparation

Weighed aliquots were taken from the bulk of the chopped vegetation samples and animal tissue samples from each location. The aliquots were transferred into separate containers and dried at 100°C (212°F). Gamma spectrometric determinations of ^{40}K, ^{60}Co, and ^{137}Cs were performed directly from these aliquots. The samples were then dry-ashed, followed by wet-ashing and dissolution in 8 M nitric acid. Aliquots from the dissolved samples were taken for the determinations of ^{90}Sr, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239+240}$Pu, and ^{241}Am.

4.8.3 Results and Discussions

Vegetation

Uranium-234 was detected in all vegetation samples; because of its naturally low concentration, ^{235}U was not detected in any vegetation sample (Table 4.19). Concentrations of ^{234}U ranged from $2.90\times10^{-4} \pm 1.51\times10^{-4}$ Bq/g ($7.83\times10^{-3} \pm 4.08\times10^{-3}$ pCi/g) at SEC to $8.03\times10^{-4} \pm 3.07\times10^{-4}$ Bq/g ($2.17\times10^{-2} \pm 8.30\times10^{-3}$ pCi/g) at MLR. Uranium-238 was also detected in all the vegetation samples and varied between $2.51\times10^{-4} \pm 1.37\times10^{-4}$ Bq/g ($6.78\times10^{-3} \pm 3.70\times10^{-3}$ pCi/g) at WEE to $4.11\times10^{-4} \pm 2.02\times10^{-4}$ Bq/g ($1.11\times10^{-2} \pm 5.51\times10^{-3}$ pCi/g) at MLR. The concentration of ^{234}U and ^{238}U for the same location did not vary significantly between years 2001 and 2002 (ANOVA, ^{234}U $p = 0.727$, ^{238}U $p = 0.976$). The primary source for uranium in plant tissues is the soil, so this difference from the uranium results for soils may seem counterintuitive. However, uptake of radionuclides and contamination by resuspension are highly species dependent. Because of small-scale differences in soil type, shading, water availability, and other microenvironmental conditions, plants of the same species collected adjacent to one another will often have very different radionuclide concentrations.

Plutonium-238, $^{239+240}$Pu, and ^{241}Am were not detected in every vegetation sample (Table 4.19).

Potassium-40 was detected in every vegetation sample (Table 4.19), ranging from $2.92\times10^{-1} \pm 4.55\times10^{-2}$ Bq/g ($7.89\times10^{0} \pm 1.23\times10^{0}$ pCi/g) at SEC to $8.47\times10^{-1} \pm 1.22\times10^{-1}$ Bq/g ($1.16\times10^{1} \pm 1.75\times10^{0}$ pCi/g) at SMR. The concentration of ^{40}K in vegetation was not significantly different for the same location between years (ANOVA, p = 0.364). Like uranium, the primary source for potassium in plant tissues is the soil, and this difference from the ^{40}K results for soil is probably due to the same factors. Cesium-137 and ^{60}Co were not detected in vegetation samples. Strontium-90 was detected at locations WEE, WFF, and WSS ranging from $9.36\times10^{-3} \pm 3.42\times10^{-3}$ Bq/g ($2.53\times10^{-1} \pm 9.23\times10^{-2}$ pCi/g) to $1.54\times10^{-2} \pm 3.89\times10^{-3}$ Bq/g ($4.16\times10^{-1} \pm 1.05\times10^{-1}$ pCi/g). There was no significant difference in ^{90}Sr concentration between 2001 and 2002 (ANOVA, p = 0.434).

Table 4.19 - Radionuclide Concentrations (Bq/g Wet Mass) in Vegetation Near the WIPP Site. See Appendix B for the sampling locations.

	[RN][a]	2×TPU[b]	MDC[c]	[RN]	2×TPU	MDC	[RN]	2×TPU	MDC
Location	**^{241}Am**			**^{238}Pu**			**^{239}Pu**		
MLR	7.22×10^{-5}	8.44×10^{-5}	6.51×10^{-5}	3.74×10^{-5}	7.55×10^{-5}	1.38×10^{-4}	3.74×10^{-5}	5.33×10^{-5}	5.07×10^{-5}
SEC	8.07×10^{-5}	8.66×10^{-5}	1.19×10^{-3}	4.11×10^{-5}	8.21×10^{-5}	1.51×10^{-4}	0.00×10^{0}	0.00×10^{0}	5.55×10^{-5}
SMR	1.64×10^{-5}	5.70×10^{-5}	1.21×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.20×10^{-3}	0.00×10^{0}	0.00×10^{0}	8.10×10^{-5}
WEE	-1.94×10^{-5}	3.89×10^{-5}	1.42×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.11×10^{-4}	2.86×10^{-5}	5.77×10^{-5}	7.77×10^{-5}
WFF	4.14×10^{-5}	5.92×10^{-5}	5.62×10^{-5}	0.00×10^{0}	0.00×10^{0}	5.92×10^{-5}	4.37×10^{-5}	6.22×10^{-5}	5.92×10^{-5}
WSS	8.70×10^{-5}	1.75×10^{-4}	3.20×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.22×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.22×10^{-4}
	^{234}U			**^{235}U**			**^{238}U**		
MLR	8.03×10^{-4}	3.07×10^{-4}	1.60×10^{-4}	2.68×10^{-5}	5.37×10^{-5}	7.25×10^{-5}	4.11×10^{-4}	2.02×10^{-4}	5.85×10^{-5}
SEC	2.90×10^{-4}	1.51×10^{-4}	1.19×10^{-4}	7.96×10^{-5}	8.03×10^{-5}	5.37×10^{-5}	2.56×10^{-4}	1.35×10^{-4}	4.33×10^{-5}
SMR	5.96×10^{-4}	2.50×10^{-4}	5.77×10^{-5}	5.25×10^{-5}	7.51×10^{-5}	7.10×10^{-5}	3.39×10^{-4}	1.81×10^{-4}	5.74×10^{-5}
WEE	3.53×10^{-4}	1.65×10^{-4}	4.55×10^{-5}	0.00×10^{0}	0.00×10^{0}	1.53×10^{-4}	2.51×10^{-4}	1.37×10^{-4}	4.55×10^{-5}
WFF	4.07×10^{-4}	1.72×10^{-4}	4.22×10^{-5}	1.92×10^{-5}	3.85×10^{-5}	5.22×10^{-5}	3.26×10^{-4}	1.52×10^{-4}	4.22×10^{-5}
WSS	4.40×10^{-4}	1.82×10^{-4}	4.29×10^{-4}	0.00×10^{0}	0.00×10^{0}	5.29×10^{-5}	2.51×10^{-4}	1.32×10^{-4}	4.26×10^{-5}
	^{137}Cs			**^{60}Co**					
MLR	5.29×10^{-4}	1.18×10^{-3}	1.43×10^{-3}	-5.03×10^{-3}	1.68×10^{-3}	1.84×10^{-3}			
SEC	9.47×10^{-5}	1.22×10^{-3}	1.44×10^{-3}	1.75×10^{-3}	1.51×10^{-3}	1.88×10^{-3}			
SMR	-1.28×10^{-3}	2.00×10^{-3}	2.11×10^{-3}	1.49×10^{-3}	2.06×10^{-3}	2.55×10^{-3}			
WEE	-1.91×10^{-3}	1.92×10^{-3}	1.95×10^{-3}	-9.51×10^{-4}	2.02×10^{-3}	2.22×10^{-3}			
WFF	6.73×10^{-4}	1.21×10^{-3}	1.46×10^{-3}	1.62×10^{-4}	1.61×10^{-3}	1.84×10^{-3}			
WSS	-2.10×10^{-4}	1.76×10^{-3}	1.96×10^{-3}	1.80×10^{-3}	1.83×10^{-3}	2.33×10^{-3}			
	^{90}Sr			**^{40}K**					
MLR	4.26×10^{-3}	4.92×10^{-3}	8.10×10^{-3}	4.37×10^{-1}	6.51×10^{-2}	2.03×10^{-2}			
SEC	3.27×10^{-3}	5.03×10^{-3}	8.40×10^{-3}	2.92×10^{-1}	4.55×10^{-2}	1.83×10^{-2}			
SMR	3.32×10^{-3}	3.70×10^{-3}	6.11×10^{-3}	8.47×10^{-1}	1.22×10^{-1}	2.15×10^{-2}			
WEE	1.04×10^{-2}	3.54×10^{-3}	5.22×10^{-3}	5.62×10^{-1}	8.36×10^{-2}	1.82×10^{-2}			
WFF	1.54×10^{-2}	3.89×10^{-3}	5.37×10^{-3}	5.66×10^{-1}	8.25×10^{-2}	1.83×10^{-2}			
WSS	9.36×10^{-3}	3.42×10^{-3}	5.11×10^{-3}	4.70×10^{-1}	7.03×10^{-2}	1.48×10^{-2}			

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

A duplicate analysis of the vegetation sample from SEC was performed for all the radionuclides of interest (Table 4.20). Concentrations of ^{234}U, ^{238}U, and ^{40}K were above

detection limits in the duplicate sample. Relative Error Ratio value exceeded one for ^{40}K, indicating a nonhomogenous sample.

Table 4.20 - Results of Duplicate Vegetation Sample Analysis. Units are Bq/g. See Appendix B for the sampling locations.

	[RN][a]	2×TPU[b]	MDC[c]	RER[d]	[RN]	2×TPU	MDC	RER
Location		^{234}U				^{40}K		
SEC	2.90×10^{-4}	1.51×10^{-4}	1.19×10^{-4}	0.7	2.92×10^{-1}	4.55×10^{-2}	1.83×10^{-2}	1.77
SEC Dup.	4.55×10^{-4}	1.81×10^{-4}	4.11×10^{-5}		4.33×10^{-1}	6.55×10^{-2}	1.71×10^{-2}	
		^{238}U						
SEC	2.56×10^{-4}	1.35×10^{-4}	4.33×10^{-5}	0.92				
SEC Dup.	4.66×10^{-4}	1.84×10^{-4}	4.07×10^{-5}					

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
[d] Relative error ratio

Animals

Of the radionuclides of interest, ^{234}U, ^{238}U, and ^{40}K were detected in deer and quail tissue (Table 4.21). The mean concentrations were similar to year 2001. These results can be used only as a gross indication of uptakes, as the sample sizes are too small to provide a robust analysis.

Table 4.21 - Radionuclide Concentrations (Bq/g Wet Mass) in Deer and Quail Near the WIPP Site

	[RN][a]	2×TPU[b]	MDC[c]	[RN]	2×TPU	MDC	[RN]	2×TPU	MDC
Sample Type		^{241}Am			^{238}Pu			^{239}Pu	
Deer[d]	7.01×10^{-7}	1.66×10^{-6}	1.15×10^{-6}	7.17×10^{-7}	6.68×10^{-7}	5.39×10^{-7}	1.20×10^{-7}	3.31×10^{-7}	5.39×10^{-7}
Quail[e]	2.58×10^{-6}	2.01×10^{-6}	9.98×10^{-7}	0.00×10^{0}	0.00×10^{0}	1.75×10^{-6}	7.13×10^{-7}	8.32×10^{-7}	6.44×10^{-7}
		^{234}U			^{235}U			^{238}U	
Deer	2.67×10^{-6}	9.70×10^{-7}	2.54×10^{-7}	1.86×10^{-7}	0.00×10^{0}	1.68×10^{-7}	2.91×10^{-6}	2.49×10^{-6}	2.53×10^{-7}
Quail	6.07×10^{-5}	1.16×10^{-5}	5.39×10^{-7}	3.19×10^{-6}	1.84×10^{-6}	6.65×10^{-7}	5.65×10^{-5}	1.09×10^{-5}	1.46×10^{-6}
		^{137}Cs			^{60}Co				
Deer	3.39×10^{-5}	6.14×10^{-5}	1.51×10^{-4}	-3.06×10^{-5}	6.35×10^{-5}	1.99×10^{-4}			
Quail	-4.22×10^{-5}	5.88×10^{-4}	6.55×10^{-4}	2.49×10^{-4}	6.79×10^{-4}	8.07×10^{-4}			
		^{90}Sr			^{40}K				
Deer	-3.97×10^{-6}	8.51×10^{-6}	2.04×10^{-6}	1.18×10^{-1}	6.93×10^{-3}	2.04×10^{-3}			
Quail	2.15×10^{-4}	1.02×10^{-4}	1.55×10^{-4}	1.12×10^{-1}	1.77×10^{-2}	7.41×10^{-3}			

[a] Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
[d] Mean of two samples collected near WIPP. TPU represents the standard deviation of the mean.
[e] Single sample
Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

Uranium-234 and ^{238}U were detected in all the fish samples. Uranium-235 was detected in 25 percent of the fish samples (Table 4.22). Neither ^{238}Pu or ^{241}Am isotope was detected in fish. Plutonium-239 was detected once in the fish samples.

Cesium-137, ^{60}Co, and ^{90}Sr were not detected in any of the fish samples (Table 4.22). Potassium-40 was detected in 88 percent of the fish (Table 4.22). It was lowest in the sample from BRA ($4.95\times10^{-2} \pm 2.12\times10^{-2}$ Bq/g [$1.34\times10^{0} \pm 5.72\times10^{-1}$ pCi/g]), and highest in the sample from SOO ($2.89\times10^{-1} \pm 4.77\times10^{-2}$ Bq/g [$7.80\times10^{0} \pm 1.29\times10^{0}$pCi/g]).

Table 4.22 - Radionuclide Concentrations (Bq/g Wet Mass) in Fish Near the WIPP Site. See Appendix B for the sampling locations.

	[RN][a]	2×TPU[b]	MDC[c]	[RN]	2×TPU	MDC	[RN]	2×TPU	MDC
Location	^{241}Am			^{238}Pu			^{239}Pu		
BRA	4.33×10^{-6}	6.18×10^{-6}	5.85×10^{-6}	1.29×10^{-5}	1.94×10^{-5}	3.16×10^{-5}	0.00×10^{0}	0.00×10^{0}	1.16×10^{-5}
BRA	2.12×10^{-6}	4.26×10^{-6}	5.74×10^{-6}	3.74×10^{-5}	3.85×10^{-5}	2.53×10^{-5}	0.00×10^{0}	0.00×10^{0}	2.53×10^{-5}
BRA	3.01×10^{-6}	1.04×10^{-5}	2.22×10^{-5}	7.99×10^{-6}	9.29×10^{-6}	7.18×10^{-6}	0.00×10^{0}	0.00×10^{0}	7.18×10^{-6}
BRA	5.33×10^{-6}	9.44×10^{-6}	1.65×10^{-5}	1.14×10^{-6}	2.28×10^{-6}	3.07×10^{-6}	1.25×10^{-5}	7.77×10^{-6}	3.07×10^{-6}
PEC	2.91×10^{-6}	4.14×10^{-6}	3.92×10^{-6}	4.40×10^{-6}	8.88×10^{-6}	1.19×10^{-5}	0.00×10^{0}	0.00×10^{0}	1.19×10^{-5}
PEC	5.74×10^{-6}	8.18×10^{-6}	7.77×10^{-6}	9.84×10^{-5}	2.02×10^{-4}	3.61×10^{-4}	0.00×10^{0}	0.00×10^{0}	1.33×10^{-4}
SOO[d]	3.23×10^{-6}	4.59×10^{-6}	4.37×10^{-6}	6.55×10^{-5}	9.58×10^{-5}	1.52×10^{-4}	1.63×10^{-5}	3.32×10^{-5}	4.44×10^{-5}
SOO[d]	4.86×10^{-6}	7.25×10^{-6}	1.19×10^{-5}	1.56×10^{-6}	5.40×10^{-6}	1.15×10^{-5}	0.00×10^{0}	0.00×10^{0}	4.22×10^{-6}
	^{234}U			^{235}U			^{238}U		
BRA	3.55×10^{-4}	7.51×10^{-5}	4.92×10^{-6}	6.70×10^{-6}	7.81×10^{-6}	6.07×10^{-6}	1.59×10^{-4}	4.18×10^{-5}	4.88×10^{-6}
BRA	1.44×10^{-4}	4.11×10^{-5}	5.48×10^{-6}	-2.50×10^{-6}	5.03×10^{-6}	1.84×10^{-5}	1.01×10^{-4}	3.26×10^{-5}	5.48×10^{-6}
BRA	2.67×10^{-4}	6.88×10^{-5}	2.01×10^{-5}	6.73×10^{-6}	1.35×10^{-5}	2.48×10^{-5}	1.11×10^{-4}	3.89×10^{-5}	7.36×10^{-6}
BRA	3.66×10^{-4}	6.99×10^{-5}	3.19×10^{-6}	8.73×10^{-6}	8.33×10^{-6}	1.07×10^{-5}	2.12×10^{-4}	4.55×10^{-5}	3.18×10^{-6}
PEC	9.99×10^{-4}	1.71×10^{-4}	8.88×10^{-6}	2.08×10^{-5}	1.16×10^{-5}	4.03×10^{-6}	4.40×10^{-4}	8.25×10^{-5}	3.26×10^{-6}
PEC	2.60×10^{-4}	6.99×10^{-5}	8.40×10^{-6}	-3.81×10^{-6}	7.66×10^{-6}	2.82×10^{-5}	9.58×10^{-5}	3.85×10^{-5}	2.28×10^{-5}
SOO[d]	8.55×10^{-4}	1.54×10^{-4}	1.16×10^{-5}	1.16×10^{-5}	1.11×10^{-5}	1.43×10^{-5}	3.60×10^{-4}	7.44×10^{-5}	1.15×10^{-5}
SOO[d]	7.10×10^{-4}	1.23×10^{-4}	2.83×10^{-6}	1.67×10^{-5}	9.62×10^{-6}	3.49×10^{-6}	3.64×10^{-4}	6.88×10^{-5}	2.81×10^{-6}
	^{137}Cs			^{60}Co					
BRA	1.64×10^{-3}	8.33×10^{-4}	2.09×10^{-3}	-7.10×10^{-4}	4.59×10^{-3}	4.85×10^{-3}			
BRA	1.49×10^{-3}	2.01×10^{-3}	2.49×10^{-3}	5.81×10^{-4}	2.81×10^{-3}	3.25×10^{-3}			
BRA	-6.14×10^{-3}	6.70×10^{-3}	6.62×10^{-3}	5.37×10^{-3}	6.51×10^{-3}	7.18×10^{-3}			
BRA	-4.74×10^{-4}	2.53×10^{-3}	2.86×10^{-3}	1.62×10^{-3}	2.66×10^{-3}	2.99×10^{-3}			
PEC	3.08×10^{-4}	1.30×10^{-3}	1.55×10^{-3}	-3.63×10^{-4}	1.66×10^{-3}	1.84×10^{-3}			
PEC	-9.73×10^{-3}	7.96×10^{-3}	7.66×10^{-3}	-4.14×10^{-3}	8.18×10^{-3}	8.33×10^{-3}			
SOO[d]	-2.86×10^{-4}	1.61×10^{-4}	1.86×10^{-3}	1.61×10^{-3}	1.97×10^{-3}	2.41×10^{-3}			
SOO[d]	8.95×10^{-4}	1.12×10^{-3}	1.37×10^{-3}	-3.77×10^{-5}	1.46×10^{-3}	1.65×10^{-3}			
	^{90}Sr			^{40}K					
BRA	3.53×10^{-4}	2.87×10^{-4}	4.81×10^{-4}	1.54×10^{-1}	4.29×10^{-2}	5.40×10^{-2}			
BRA	5.81×10^{-5}	3.40×10^{-4}	5.99×10^{-4}	4.59×10^{-2}	2.12×10^{-2}	2.97×10^{-2}			
BRA	8.81×10^{-4}	5.44×10^{-4}	8.88×10^{-4}	9.77×10^{-2}	4.51×10^{-2}	6.62×10^{-2}			
BRA	2.35×10^{-4}	1.98×10^{-4}	3.34×10^{-4}	1.22×10^{-1}	2.68×10^{-2}	2.81×10^{-2}			
PEC	3.03×10^{-4}	2.08×10^{-4}	3.44×10^{-4}	1.94×10^{-1}	3.29×10^{-2}	2.05×10^{-2}			
PEC	5.18×10^{-4}	5.07×10^{-4}	8.73×10^{-4}	6.40×10^{-2}	5.03×10^{-2}	7.88×10^{-2}			
SOO[d]	3.34×10^{-4}	2.56×10^{-4}	4.29×10^{-4}	2.89×10^{-1}	4.77×10^{-2}	2.76×10^{-2}			
SOO[d]	1.17×10^{-4}	1.75×10^{-4}	3.01×10^{-4}	1.99×10^{-1}	3.36×10^{-2}	2.21×10^{-2}			

[a] [RN] = Radionuclide concentration
[b] Total propagated uncertainty
[c] Minimum detectable concentration
[d] Located at 10-mile dam

Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

4.9 Summary and Conclusion

The Environmental Monitoring Program collected samples of air particulates, soil, sediment, groundwater, surface water, and biota and analyzed them for radionuclides considered to be indicators of potential contamination from the WIPP facility, as well as other radionuclides of potential interest. Measured concentrations were examined for evidence of WIPP-related contamination, such as higher concentrations of TRU radionuclides after 1998, or higher concentrations in downwind or down gradient directions. Radionuclide concentrations observed were very small and were highly variable in space and time and between media. However, no time or space relationships related to WIPP were observed, and concentrations were consistent with background levels (DOE/WIPP 92-037). In no case, could environmental concentrations be attributed to WIPP releases. In addition, no events occurred at WIPP which would have led to a release.

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CHAPTER 5 - ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

This chapter discusses nonradiological environmental surveillance data collected between January 1 and December 31, 2002. Nonradiological programs at WIPP include wildlife population monitoring, meteorological monitoring, and seismic monitoring. In addition, VOCs were monitored to comply with the provisions of WIPP's hazardous waste permit, and liquid effluent monitoring was conducted in accordance with WIPP's Discharge Plan (DP-831).

5.1 Principal Functions of Nonradiological Sampling

The principal functions of the nonradiological environmental surveillance program are to:

- Assess the impacts of WIPP operations on the surrounding ecosystem;
- Monitor ecological conditions in the Los Medaños region;
- Investigate unusual or unexpected elements in the ecological databases;
- Provide environmental data which are important to the mission of the WIPP project, but which have not or will not be acquired by other programs; and
- Comply with applicable commitments identified with existing agreements (e.g., BLM/DOE MOU, Interagency Agreements, etc.).

5.2 WIPP Raptor Research Program

WIPP, and the region surrounding it, is widely recognized for its concentration and diversity of raptors. The area is home to several raptor species of special concern, including Harris' hawks, Swainson's hawks, burrowing owls, and barn owls, as well as other species.

The DOE, the BLM, and other government agencies are aware of the value and importance of protecting and monitoring raptor populations. To assist in this effort at WIPP, the BLM and the DOE established the WRRP in the early 1990s to monitor and protect raptors on the WIPP site, and to educate site workers and the public about these birds. The WRRP is administrated by the WIPP Environmental Monitoring Program with input from the BLM. During 2002, scientific consultation, research direction, and field operations were conducted by scientists from Hawks Aloft Incorporated, a nonprofit biological consultant group.

Raptor research at WIPP began in 1981 when the DOE commissioned a study of the social behavior of Harris' hawks by the University of New Mexico. Research results revealed the extent of the overall raptor population, and provided new information about raptor species in the area. In the late 1980s, the BLM designated the Los Medaños Raptor Area, which included the WIPP site, as a National Key Raptor Area. This

designation served as a catalyst for the development of the WRRP. Simultaneously, the DOE reorganized its program to encompass expanded objectives.

The WRRP presently serves three significant functions:

- Wildlife Monitoring. The WRRP provides the DOE, the BLM, and other agencies with current information about the status of raptor populations in and around WIPP.
- Scientific Research. WRRP staff conduct research on topics that contribute to the understanding of raptors in the desert southwest.
- Interagency Cooperation. The WRRP is funded by the DOE, but works closely with several other federal and state agencies.

In 2002, long-term studies of productivity and population demographics of the raptor community in and around WIPP continued. The primary objective for the 2002 nesting season was to locate all raptor and raven nests within the 3000 km^2 study area, centered on WIPP. Secondary objectives were to estimate raptor productivity in the area and to determine causes of raptor mortality.

Intensive ground searches for nesting raptors began on May 29, 2002, and ended September 12, 2002. Nest locations, activity, productivity, species, and behavioral data were collected and documented. Included in this research protocol were extended behavioral observations. These aided in assessments of group size, foraging behaviors, fledging success, and prey items. A total of 20 occupied Harris' hawk territories were observed. The mean brood size per active nest was 1.83 (n=6). Territorial occupancy average was 2.75 with group size ranging from one to five individuals. Fifty-five percent of territorial occupancy consisted of pairs.

Electrocution by power poles continues to be an important cause of raptor mortality and is predicted to increase as oil and gas exploration increases in the area. To date, objective evidence indicates that electrocutions and random shootings comprise the most common mortality factors of adult Harris' hawks in the study area. Egg and nestling attrition are more naturally related to climatic conditions and prey availability.

5.3 Meteorology

The primary WIPP meteorological station is located 600 m (1,970 ft) northeast of the Waste Handling Building. The main function of the station is to provide data for atmospheric dispersion modeling. The station measures and records wind speed, wind direction, and temperature at elevations of 2,10, and 50 m (6.5, 33, and 165 ft). The station records ground-level measurements of barometric pressure, relative humidity, precipitation, and solar radiation.

5.3.1 Climatic Data

The precipitation at the WIPP site for 2002 was 286 mm (11.2 in.), which was 46 mm (1.8 in.) less than the previous year's rainfall. Figure 5.1 displays the monthly precipitation at WIPP.

The mean temperature for the WIPP area in 2002 was 17.2°C (62.3°F). The mean monthly temperatures for the WIPP area ranged from 6.1°C (43°F) during December to 28°C (82.4°F) in July. Generally, maximum temperatures occurred from May through September, while minimum temperatures occurred in January, November, and December, as illustrated in Figures 5.2, 5.3, and 5.4 and Tables 5.1, 5.2, and 5.3. The lowest recorded temperature was -10.4°C (13.3°F) in March. The maximum recorded temperature was 40.82°C (105.5°F) in August. The minimum and maximum temperatures were recorded at the 2-m location on the meteorological tower.

5.3.2 Wind Direction and Wind Speed

Winds in the WIPP area in 2002 blew predominantly from the southeast. Seasonal weather systems move through this area, briefly altering the predominant southeasterly winds and sometimes resulting in violent convectional storms. Wind speed measured at the 10-m (33-ft) level were calm (less than 0.5 meters per second [m/s]) (1.1 miles per hour [mph]) about 19.3 percent of the time. At the 10-m level, winds of 0.5 through 1.41 m/s (1.12 to 3.15 mph) were the most prevalent over 2002, occurring 39.3 percent of the time. Figures 5.5, 5.6, and 5.7 and Tables 5.4, 5.5, and 5.6 display the annual wind data at WIPP for 2002.

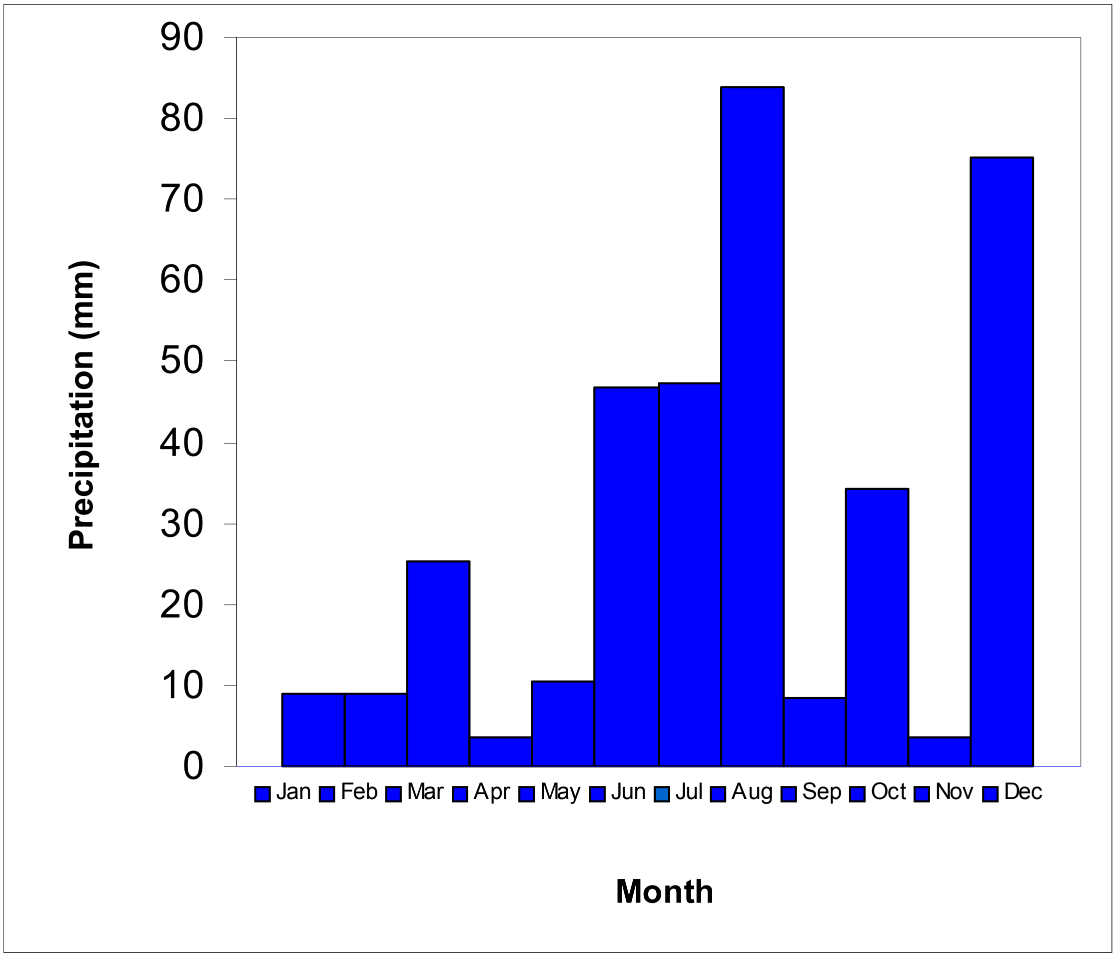

Figure 5.1 - 2002 Precipitation at WIPP

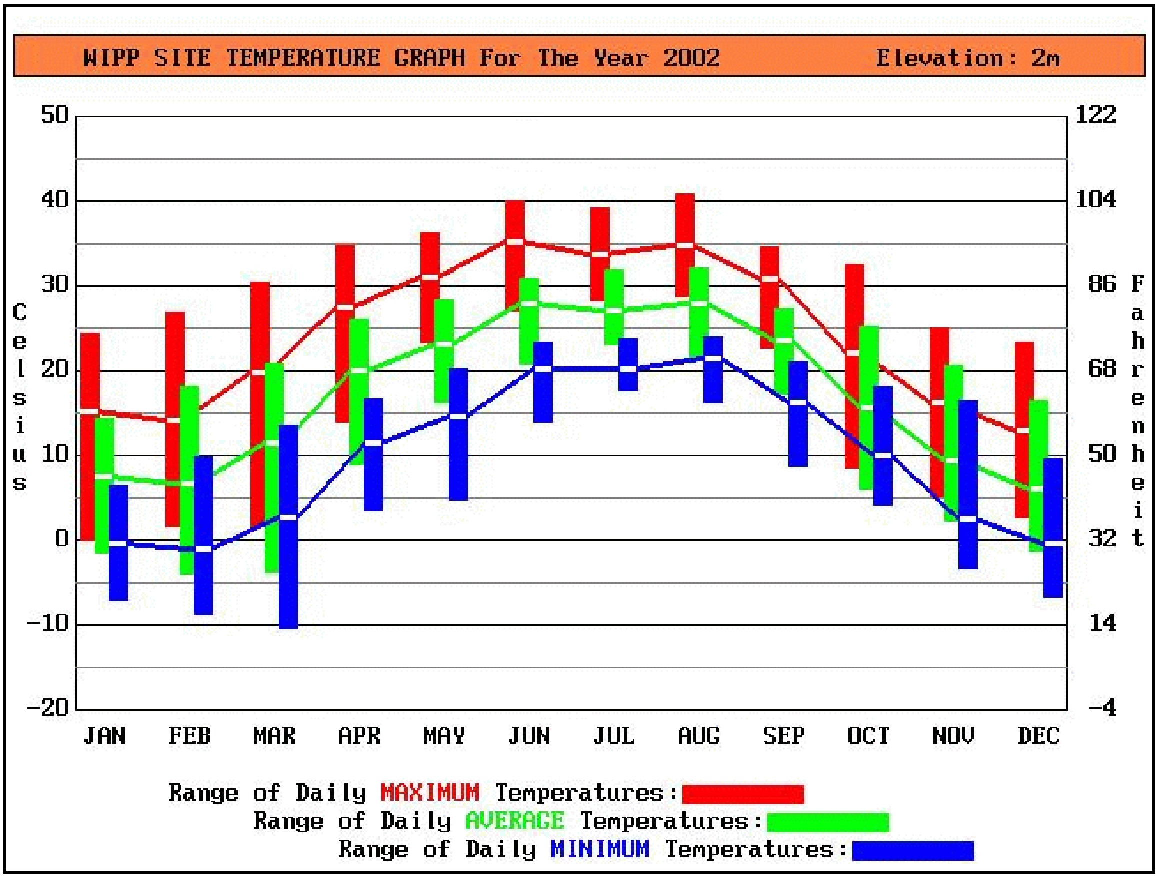

Figure 5.2 - 2002 WIPP Site Temperature at 2-Meter Height

Table 5.1 - A Summary of 2002 Temperature Observations at 2-Meter Height

Month	Max of Daily Highs (°C)	Avg of Daily Highs (°C)	Min of Daily Highs (°C)	Max of Daily Averages (°C)	Avg of Daily Averages (°C)	Min of Daily Averages (°C)	Max of Daily Lows (°C)	Avg of Daily Lows (°C)	Min of Daily Lows (°C)
Jan	24.33	15.18	-0.02	14.47	7.42	-1.45	6.38	-0.47	-7.06
Feb	26.95	14.13	1.75	18.11	6.67	-4	9.89	-1	-8.82
Mar	30.33	19.70	1.66	20.83	11.36	-3.65	13.57	2.68	-10.44
Apr	34.8	27.49	14.04	26.11	19.9	8.86	16.72	11.53	3.56
May	36.24	31.02	23.37	28.38	23.11	16.27	20.23	14.66	4.88
Jun	40.01	35.19	26.98	30.87	27.9	20.9	23.36	20.31	14.02
Jul	39.23	33.69	28.33	31.83	27.08	23.12	23.82	20.27	17.73
Aug	40.82	34.79	28.82	32.16	27.95	21.69	23.9	21.36	16.29
Sept	34.54	30.90	22.72	27.3	23.47	17.25	20.98	16.16	8.84
Oct	32.6	22.01	8.62	25.14	15.56	5.99	18.18	9.96	4.17
Nov	25.1	16.16	5.13	20.62	9.54	2.22	16.4	2.46	-3.42
Dec	23.28	12.93	2.77	16.48	6.02	-1.31	9.6	-0.33	-6.64
Annual	40.82	24.43	-0.02	32.16	17.16	-4	23.9	9.8	-10.44

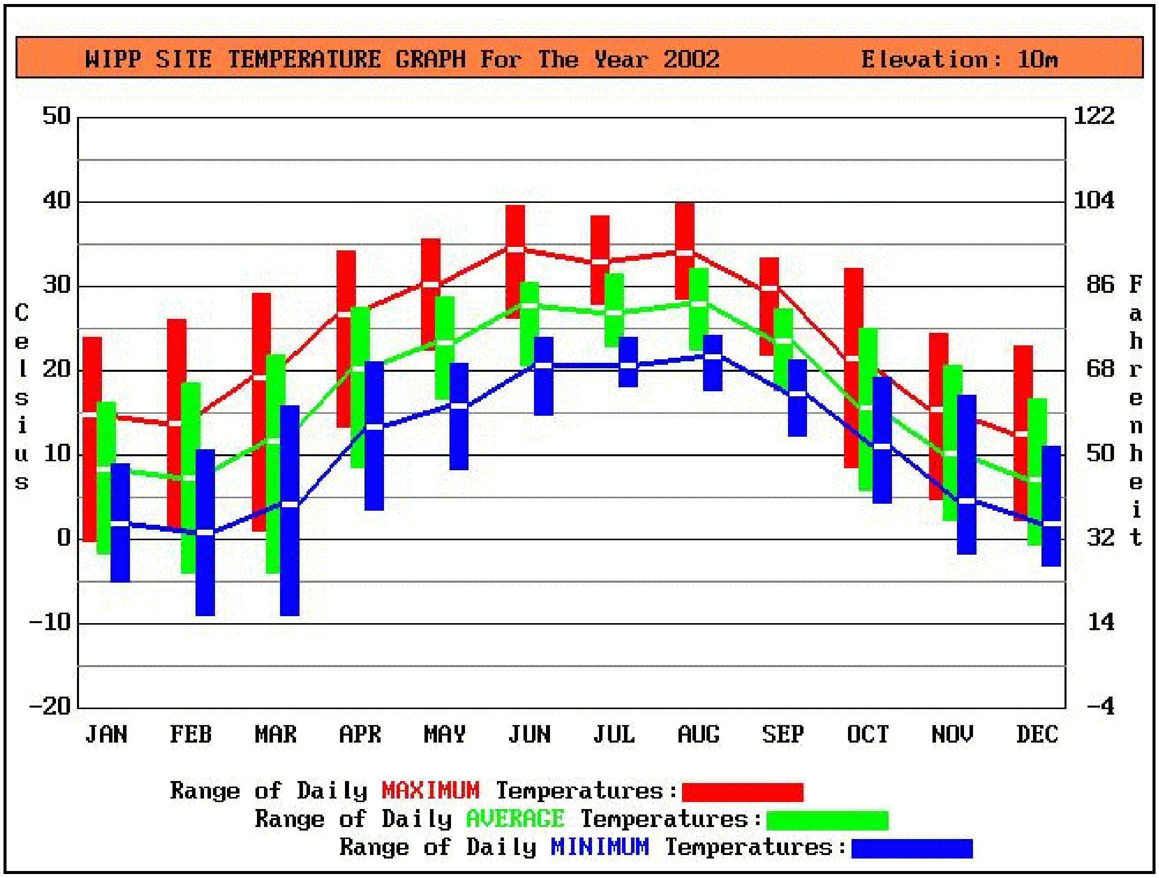

Figure 5.3 - 2002 WIPP Site Temperature at 10-Meter Height

Table 5.2 - A Summary of 2002 Temperature Observations at 10-Meter Height

Month	Max of Daily Highs (°C)	Avg of Daily Highs (°C)	Min of Daily Highs (°C)	Max of Daily Averages (°C)	Avg of Daily Averages (°C)	Min of Daily Averages (°C)	Max of Daily Lows (°C)	Avg of Daily Lows (°C)	Min of Daily Lows (°C)
Jan	23.92	14.76	-0.23	16.31	8.43	-1.58	8.87	1.94	-5.01
Feb	26.04	13.67	1.20	18.52	7.3	-4.03	10.67	0.9	-8.87
Mar	29.10	19.27	1.07	21.86	11.75	-3.91	15.79	4.24	-8.88
Apr	34.16	26.67	13.31	27.46	20.18	8.5	21.14	13.4	3.54
May	35.53	30.15	22.53	28.94	23.27	16.7	20.9	15.84	8.23
Jun	39.57	34.34	26.15	30.51	27.65	20.56	23.87	20.63	14.89
Jul	38.38	32.85	27.87	31.55	26.9	22.83	24.02	20.67	18.17
Aug	39.81	34.05	28.51	32.12	27.89	22.4	24.14	21.77	17.76
Sep	33.40	29.78	21.84	27.20	23.54	17.7	21.33	17.36	12.27
Oct	32.04	21.40	8.52	24.91	15.71	5.75	19.19	11.01	4.28
Nov	24.33	15.49	4.79	20.62	10.14	2.26	17.05	4.62	-1.66
Dec	22.82	12.45	2.33	16.76	7.13	-0.72	10.98	1.92	-3.19
Annual	39.81	23.74	-0.23	32.12	17.49	-4.03	24.14	11.19	-8.88

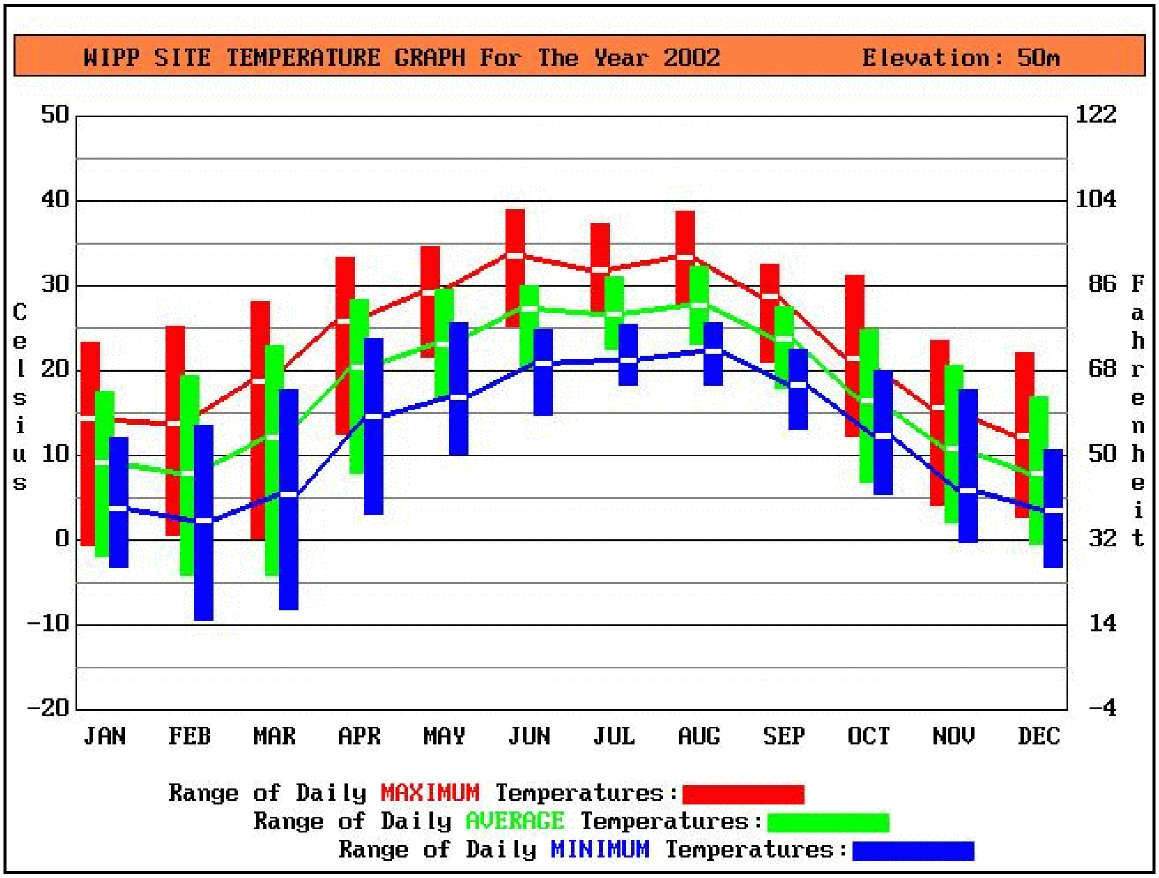

Figure 5.4 - 2002 WIPP Site Temperature at 50-Meter Height

Table 5.3 - A Summary of 2002 Temperature Observations at 50-Meter Height

Month	Max of Daily Highs (°C)	Avg of Daily Highs (°C)	Min of Daily Highs (°C)	Max of Daily Averages (°C)	Avg of Daily Averages (°C)	Min of Daily Averages (°C)	Max of Daily Lows (°C)	Avg of Daily Lows (°C)	Min of Daily Lows (°C)
Jan	23.23	14.33	-0.68	17.58	9.19	-1.87	12.14	3.69	-3.11
Feb	25.14	13.67	0.66	19.36	7.84	-4.13	13.47	2.26	-9.35
Mar	28.12	18.78	0.29	22.85	12.15	-4.27	17.71	5.39	-8.14
Apr	33.25	25.91	12.46	28.31	20.35	7.98	23.7	14.56	3.20
May	34.61	29.25	21.61	29.48	23.22	16.75	25.66	16.91	10.31
Jun	38.95	33.47	25.31	30.02	27.29	20.14	24.73	20.85	14.71
Jul	37.39	31.95	27.17	31.11	26.66	22.41	25.34	21.18	18.39
Aug	38.73	33.23	27.98	32.3	27.78	23.07	25.63	22.22	18.38
Sep	32.52	28.84	21.09	27.59	23.74	17.88	22.59	18.3	13.11
Oct	31.35	21.43	12.36	24.74	16.45	6.96	20.05	12.23	5.36
Nov	23.61	15.53	4.15	20.53	10.87	2.04	17.76	5.79	-0.24
Dec	22.16	12.19	2.65	16.85	7.96	-0.5	10.72	3.6	-3.14
Annual	38.95	23.22	-0.68	32.3	17.79	-4.27	25.66	12.25	-9.35

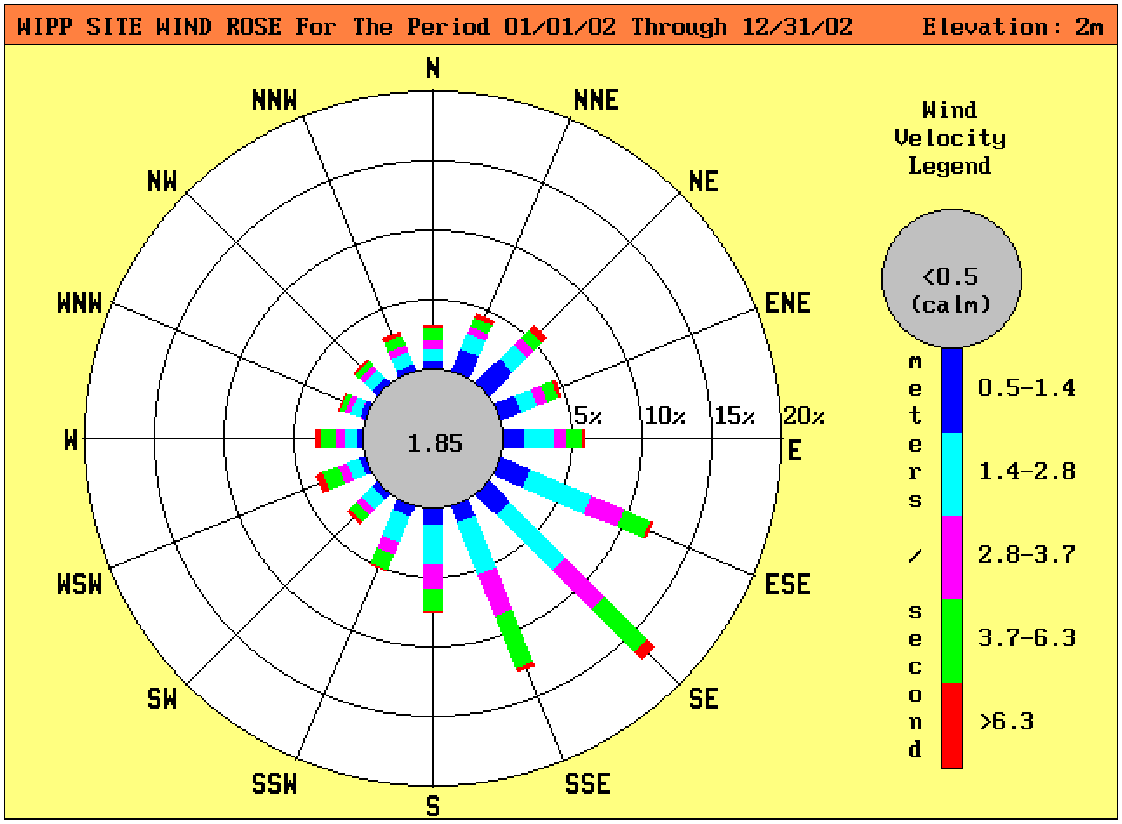

Figure 5.5 - 2002 WIPP Site Wind Rose at 2-Meter Height

Table 5.4 - 2002 Wind Frequencies at 2-Meter Height, Stratified by Direction and Speed (%)

	Wind Speed Range, Meters/Second						
Direction	**<0.5**	**0.5-1.41**	**1.4-2.8**	**2.8-3.7**	**3.7-6.3**	**>6.3**	**Totals**
N	0.075	0.518	0.999	0.645	0.919	0.196	3.352
NNE	0.150	1.728	1.296	0.521	0.853	0.274	4.821
NE	0.236	2.480	1.593	0.625	0.939	0.475	6.348
ENE	0.297	1.573	1.342	0.783	0.999	0.144	5.138
E	0.228	1.575	2.215	0.936	1.195	0.23	6.379
ESE	0.158	2.281	4.807	2.511	2.172	0.127	12.056
SE	0.181	2.065	5.826	3.966	4.467	0.685	17.191
SSE	0.112	1.333	4.107	3.358	4.101	0.256	13.269
S	0.089	1.178	2.915	1.861	1.653	0.009	7.704
SSW	0.072	0.781	2.013	1.017	1.164	0.072	5.118
SW	0.035	0.446	1.241	0.547	0.781	0.181	3.231
WSW	0.04	0.418	1.045	0.668	1.319	0.452	3.943
W	0.023	0.412	0.901	0.665	1.181	0.314	3.496
WNW	0.026	0.386	0.809	0.452	0.389	0.066	2.128
NW	0.046	0.452	0.948	0.495	0.504	0.164	2.609
NNW	0.078	0.420	1.063	0.611	0.752	0.291	3.214
Total	1.846	18.047	33.121	19.662	23.386	3.937	100

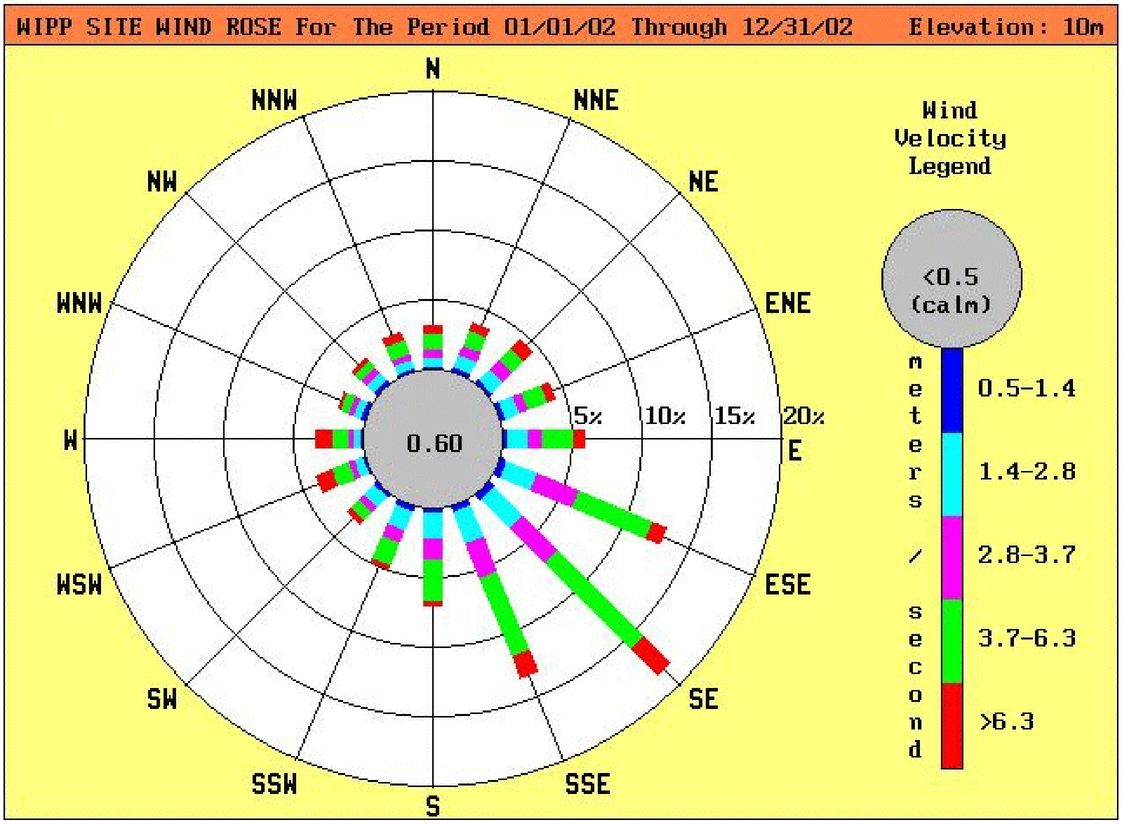

Figure 5.6 - 2002 WIPP Site Wind Rose at 10-Meter Height

Table 5.5 - 2002 Wind Frequencies at 10-Meter Height, Stratified by Direction and Speed (%)

	Wind Speed Range, Meters/Second						
Direction	**<0.5**	**0.5-1.41**	**1.4-2.8**	**2.8-3.7**	**3.7-6.3**	**>6.3**	**Totals**
N	0.037	0.181	0.709	0.628	1.227	0.593	3.375
NNE	0.04	0.291	1.069	0.757	1.241	0.688	4.087
NE	0.052	0.305	1.166	0.925	1.247	1.04	4.735
ENE	0.040	0.354	1.135	0.709	1.584	0.596	4.418
E	0.035	0.366	1.538	1.112	2.353	0.870	6.273
ESE	0.066	0.484	2.439	3.260	5.864	1.014	13.128
SE	0.066	0.504	2.961	3.591	8.753	2.733	18.608
SSE	0.020	0.469	2.624	2.696	6.215	1.717	13.741
S	0.049	0.363	1.970	1.575	3.013	0.308	7.278
SSW	0.035	0.348	1.555	1.008	1.823	0.346	5.115
SW	0.014	0.325	1.057	0.562	0.979	0.475	3.413
WSW	0.029	0.245	0.709	0.533	1.256	1.213	3.983
W	0.026	0.222	0.605	0.406	1.204	1.207	3.669
WNW	0.037	0.265	0.749	0.403	0.662	0.187	2.304
NW	0.026	0.271	0.766	0.553	0.685	0.340	2.641
NNW	0.023	0.179	0.703	0.588	1.051	0.688	3.231
Total	0.596	5.173	21.753	19.305	39.158	14.015	100

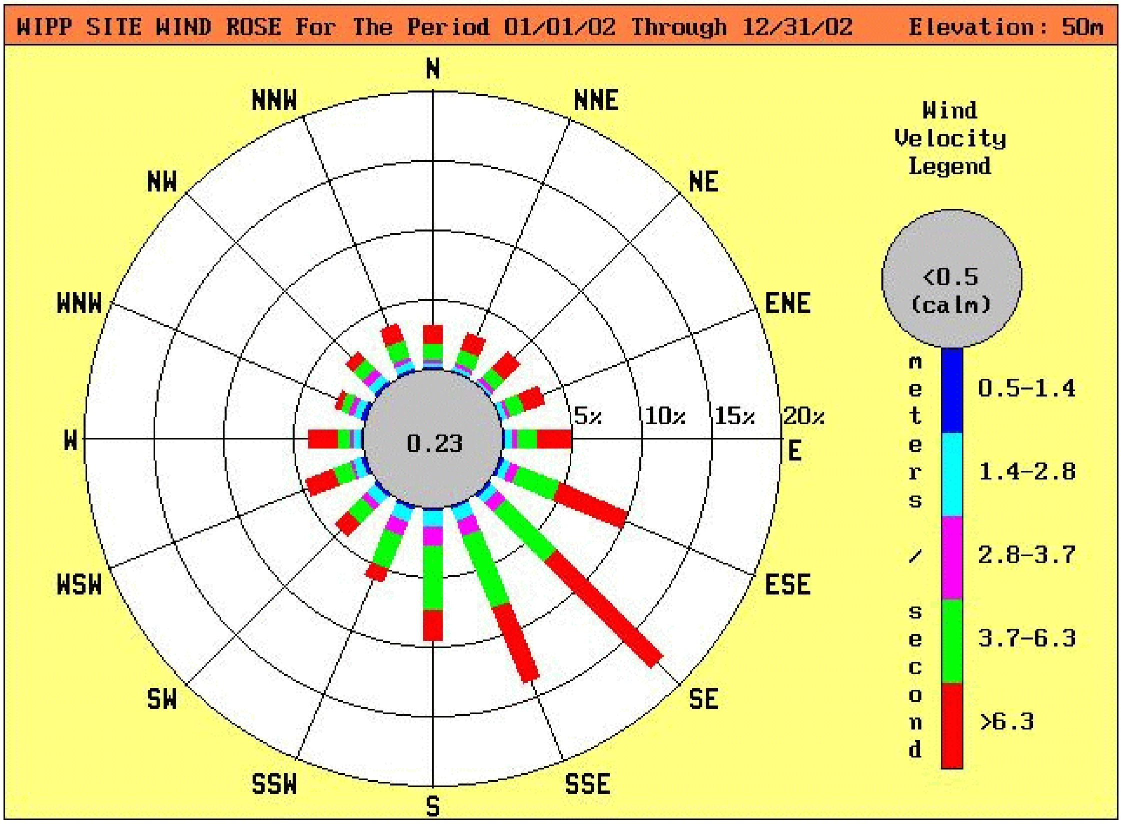

Figure 5.7 - 2002 WIPP Site Wind Rose at 50-Meter Height

Table 5.6 - 2002 Wind Frequencies at 50-Meter Height, Stratified by Direction and Speed (%)

	Wind Speed Range, Meters/Second						
Direction	<0.5	0.5-1.41	1.4-2.8	2.8-3.7	3.7-6.3	>6.3	Totals
N	0.02	0.124	0.412	0.348	1.247	1.331	3.482
NNE	0.014	0.124	0.380	0.305	1.057	1.339	3.220
NE	0.009	0.104	0.360	0.297	1.040	1.737	3.545
ENE	0.017	0.112	0.392	0.363	1.189	1.624	3.698
E	0.009	0.156	0.559	0.481	1.449	2.425	5.078
ESE	0.012	0.138	0.662	0.691	3.136	5.351	9.991
SE	0.017	0.193	0.783	0.821	5.187	10.933	17.934
SSE	0.014	0.190	1.028	1.236	5.726	5.795	13.989
S	0.014	0.239	1.21	1.380	4.640	2.160	9.643
SSW	0.009	0.245	1.115	1.227	2.609	1.060	6.264
SW	0.014	0.173	0.899	0.622	1.380	1.270	4.358
WSW	0.009	0.253	0.749	0.363	1.264	2.163	4.801
W	0.014	0.199	0.622	0.331	0.896	2.042	4.104
WNW	0.026	0.302	0.723	0.441	0.68	0.392	2.563
NW	0.020	0.207	0.815	0.565	1.04	0.827	3.473
NNW	0.012	0.153	0.585	0.423	1.348	1.336	3.856
Total	0.23	2.912	11.293	9.893	33.887	41.785	100

5.4 Volatile Organic Compound Monitoring

VOC monitoring was implemented on April 21, 1997, in accordance with WP12-VC.01, Confirmatory Volatile Organic Compound Monitoring Program. This program was implemented as a requirement of the HWFP, Module IV, Section D and Attachment N, and is intended to demonstrate that regulated VOCs are not being emitted by the waste at concentrations in excess of concentrations of concern as defined in the permit.

Nine target compounds, which contribute approximately 99 percent of the calculated human health risks from RCRA constituents, were chosen for monitoring. These target compounds are 1,1-dichloroethylene, methylene chloride, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, 1,2-dichloroethane, toluene, chlorobenzene, and 1,1,2,2-tetrachloroethane.

Sampling for target compounds is performed at two air monitoring stations. The stations are identified as VOC-A, located downstream from hazardous waste disposal unit Panel 1 in Drift E300, and VOC-B, located upstream from Panel 1. In 2002, VOC-B was located in Drift S1950. As waste is placed in new panels, VOC-B will be relocated to ensure that it samples underground air before it passes the waste panels. The location of VOC-A is not anticipated to change.

Target compounds found in VOC-B represent air found in the underground before the air passes through the panels containing waste. The VOC concentrations measured at this location are the sum of background concentrations entering the mine through the air intake shaft plus additional concentrations contributed by facility operations upstream of the waste panels. Concentrations measured at VOC-A will be equal to those found at VOC-B plus any contributions from the waste panels. Differences measured between the two stations will then represent any VOC contributions from the waste panels. Any concentration differences between the two stations must be less than the concentrations of concern listed in Attachment N of the HWFP (Table 5.7).

Table 5.7 - Concentrations of Concern for Volatile Organic Compounds, from Attachment N of the HWFP (No. NM4890139088)

Compound	Concentration of Concern ppbv[a]
1,1,1-Trichloroethane	590
1,1,2,2-Tetrachloroethane	50
1,1-Dichloroethylene	100
1,2-Dichloroethane	45
Carbon tetrachloride	165
Chlorobenzene	220
Chloroform	180
Methylene chloride	1930
Toluene	190

[a] Parts per billion by volume

Sample pair differences are calculated by subtracting the concentration of a compound of interest observed at VOC-B from that measured at VOC-A for the given sampling period (Table 5.8). Negative values indicate ambient air concentrations of a compound (VOC-B) were greater than concentrations in the air passing out of the panel (VOC-A). Negative values could be caused by emissions from normal mining activities near VOC-B which quickly dispersed in the mine ventilation flow and were not detected at VOC-A. The annual averages shown in Table 5.8 were calculated by averaging all sample pair differences from January 1, 2002, to December 31, 2002.

During 2002, three of the nine target compounds (1,1,1-trichloroethane, methylene chloride, and toluene) were measured above the 0.5 ppbv MDL (minimum detection limit). For each of the detected target compounds, the annual average was less than 0.2 percent of the respective concentration of concern listed in Table 5.7 and were, therefore, at insignificant levels with respect to human health and the environment.

Positive sample pair differences for methylene chloride were found in 26 of 105 sample pairs. The 2002 annual average sample pair difference for methylene chloride was 0.11 ppbv, with a minimum difference value of -1.06 ppbv and a maximum value of 7.53 ppbv. Methylene chloride, a common laboratory contaminant, can also be found in paint remover, aerosol propellant, degreasing and metal cleaning agents, and adhesives.

Positive sample pair differences for toluene were found in 32 of the 105 sample pairs. The overall 2002 average for toluene sample pair differences was 0.26 ppbv, with a minimum difference value of -2.69 and a maximum difference value of 3.3 ppbv. Possible sources of toluene contamination could be products of incomplete combustion of diesel fuel, cleaning solvents, or paint.

Positive sample pair differences for 1,1,1-trichloroethane were found in 14 of the 105 samples pairs. The overall 2002 average for 1,1,1-trichloroethane sample pair differences was 0.16 ppbv, with a minimum difference value of -1.09 and a maximum difference value of 3.09 ppbv. This compound is a common constituent in cleaning solutions and is also one of the main VOC components in the waste stream.

The routine laboratory reporting limit was 5.0 ppbv for 1,1,1-trichloroethane, 1,1-dichloroethylene, methylene chloride, and toluene and 2.0 ppbv for 1,1,2,2-tetrachloroethane, 1,2-dichloroethane, carbon tetrachloride, chlorobenzene, and chloroform. For dilution factors greater than one, the 5.0 ppbv and 2.0 ppbv values are multiplied by the dilution factor to calculate the laboratory reporting limits for the diluted sample.

The MDL is defined as the minimum concentration of a substance that can be measured and reported with a 99 percent confidence to be greater than zero. Values were estimated for constituents detected at concentrations less than the laboratory reporting limits but above the 0.5 ppbv MDL.

VOC sampling reported in this section was performed using guidance included in Compendium Method TO-14A, *Compendium Methods for the Determination of Toxic Organic Compounds in Ambient Air* (EPA, 1999). The samples were analyzed using gas chromatography/mass spectrometry under an established QA/QC program. Laboratory analytical procedures were developed based on the concepts contained in both TO-14A and the draft *EPA Contract Laboratory Program Volatile Organics Analysis of Ambient Air in Canisters* (EPA 1994). The results of year 2002 VOC monitoring indicated an increase in the number of detections of 1,1,1-trichloroethane in air downstream of Panel 1.

Table 5.8 - Volatile Organic Compound Sample Pair Differences Measured at WIPP in 2002

Compound	No. of Sample Pairs (A and B)	2002 Annual Average of Sample Pair Differences (ppbv[a])	Minimum of Sample Pair Differences (ppbv[a])	Maximum of Sample Pair Differences (ppbv[a])
1,1,1-Trichloroethane	105	0.16	-1.09	3.09
1,1,2,2-Tetrachloroethane	105	0	0	0
1,1-Dichloroethylene	105	0	0	0
1,2-Dichloroethane	105	0	0	0
Carbon Tetrachloride	105	0	0	0
Chlorobenzene	105	0	0	0
Chloroform	105	0	0	0
Methylene Chloride	105	0.11	-1.06	7.53
Toluene	105	0.26	-2.69	3.3

[a] Parts per billion by volume

5.5 Seismic Activity

WIPP is located about 60 miles east of the western margin of the Permian Basin. The geologic structure and tectonic pattern of the Permian Basin are chiefly the result of large-scale subsidence and uplift during the Paleozoic era. The broad basin is divided into a series of subbasins which passed through their last stage of significant subsidence during the Late Permian age. The Delaware subbasin occupies the southwestern portion of the Permian Basin and hosts the WIPP site. It is bordered by the Roosevelt Uplift to the north, the Marathon Thrust Belt to the south, the Central (Permian) Basin Platform to the east, and the Sierra Diablo Platform and Guadalupe and Sacramento Mountains to the west. The Delaware Basin contains a thick sequence of evaporite layers.

All major tectonic elements of the Delaware Basin were essentially formed before deposition of the Permian evaporites, and the region has been relatively stable since then. Deep-seated faults are rare, except along the western and eastern basin margins, and there is no evidence of young, deep-seated faults inside the basin.

Researchers suspect that some low-magnitude earthquakes may result from secondary oil recovery (water flooding). Their foci are about as deep as the bottom of relatively shallow hydrocarbon wells.

Significant recent seismic events near WIPP on January 2, 1992, and April 14, 1995, had magnitudes of 5.0 and 5.3 respectively. The January 2, 1992, Rattlesnake Canyon earthquake had an epicenter 60 km (36 mi) east-southeast of the WIPP site, while an April 14, 1995, event's epicenter was located about 240 km (144 mi) southwest of WIPP, near Alpine, Texas. Neither earthquake had any effect on WIPP structures, as documented by post-event inspections by WIPP staff and the NMED. The magnitudes of both events were within the parameters used to develop the seismic risk assessment of the WIPP structures.

Seismic information for the WIPP region before 1962 was derived from chronicles of the effects of those tremors on people, structures, and surface features. Seismicity in New Mexico reported prior to 1962 was mostly limited to the corridor between Albuquerque and Socorro, part of a structure known as the Rio Grande Rift. Since 1962, most seismic information has been based on instrumental data recorded at various seismograph stations.

Currently, seismicity within 300 km (186 mi) of the WIPP site is being monitored by the New Mexico Institute of Mining and Technology (NMIMT), using data from a seven-station network approximately centered on the site (Figure 5.14). Station signals are transmitted to the NMIMT Seismological Observatory in Socorro. When appropriate, readings from the WIPP network stations are combined with readings from an additional NMIMT network in the central Rio Grande Rift. Occasionally, data are also exchanged with the University of Texas at El Paso and Texas Tech University in Lubbock, both of which operate stations in west Texas.

The mean operational efficiency of the WIPP seismic monitoring stations during 2002 was approximately 97.1 percent. From January 1 through December 31, 2002, locations for 104 seismic events were recorded within 300 km (186 mi) of WIPP. These data included origin times, epicenter coordinates, and magnitudes. The strongest recorded event (magnitude 3.4) occurred on September 17 and was located approximately 86 km (53 mi) west-northwest of the site. The closest event to the site had a magnitude of 1.5. These events had no effect on WIPP structures.

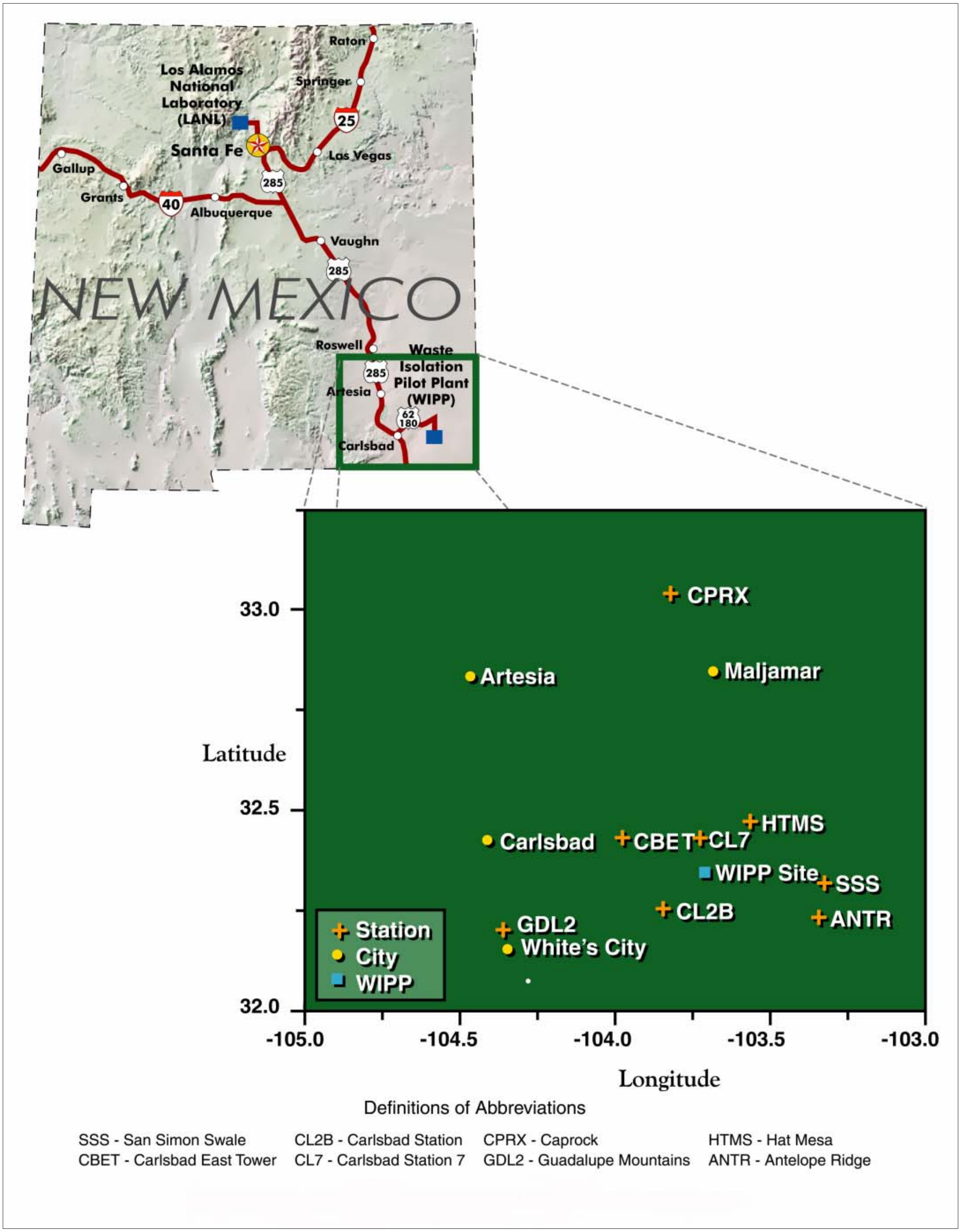

Figure 5.8 - WIPP Seismograph Station Locations

5.6 Liquid Effluent Monitoring

The WIPP sewage lagoon system is a zero-discharge facility consisting of two primary settling lagoons, two polishing lagoons, and three evaporation basins. The entire facility is lined with 30-mil synthetic liners and is designed to dispose of domestic sewage as well as site-generated brine waters from observation well pumping and underground dewatering activities at the site.

The WIPP sewage facility is operated under DP-831, issued by the state of New Mexico; New Mexico Water Quality Control Regulations (20.6.2 NMAC, *Ground and Surface Water Protection*); and applicable WIPP procedures. These requirements provide the framework for disposal of domestic sewage, site-generated brine waters, and nonhazardous waste waters.

DP-831 allows for the disposal of up to 23,000 gpd of sewage effluent and 7,570 liters (2,000 gallons) of nonhazardous brine water to the North Evaporation and at the sewage lagoon system. An additional 30,283 liters (8,000 gallons) per day of nonhazardous brine waters are permitted for disposal in the H-19 Evaporation Pond. Quarterly discharge monitoring reports are submitted to the NMED to demonstrate compliance with the inspection monitoring and reporting requirements identified in the plan. The quarterly discharge monitoring reports summarize the volumes of water discharged and the analytical results for quarterly monitoring required by DP-831. Because the facility is designed to not have any discharges to the environment, no effluent limits were established in DP-831.

CHAPTER 6 - GROUNDWATER MONITORING

Current groundwater monitoring activities at WIPP are outlined in the WIPP Groundwater Monitoring Program Plan (WP 02-1). This is a QA document containing program plans for each activity performed by groundwater monitoring personnel. In addition, WIPP has detailed procedures for performing specific activities, such as pumping system installations, field parameter analyses and documentation, and QA records management. Groundwater monitoring activities are also defined in the EMP.

The objectives of the Groundwater Monitoring Program are to:

- Determine the physical and chemical characteristics of groundwater;
- Maintain surveillance of groundwater levels surrounding the WIPP facility, both before and throughout the operational lifetime of the facility;
- Document and identify effects, if any, of WIPP operations on groundwater parameters; and
- Fulfill the requirements of the HWFP, the EPA Compliance Certification Application, and DOE Order 5400.1.

The data obtained by the WIPP Groundwater Monitoring Program supported two major programs at WIPP: (1) the RCRA Detection Monitoring Program supporting the RCRA Part B Permit in compliance with 40 CFR Part 264 and 20.4.1 NMAC (HWFP Module V), and (2) performance assessment supporting the Compliance Certification Application (DOE/CAO 96-2184, *40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant*) in compliance with 40 CFR Part 191 and 40 CFR Part 194. Each of these programs requires a unique set of analyses and data. Particular sample needs are defined by each program.

Background data were collected from 1995 through 1997 and reported in the *Waste Isolation Pilot Plant RCRA Background Groundwater Quality Baseline Report* (DOE/WIPP 98-2285). The background data were expanded in 2000 to include ten rounds of sampling instead of five. The data were published in Addendum 1, Waste Isolation Pilot Plant RCRA Background Groundwater Quality Baseline Update Report (IT Corporation, 2000). These background data will be compared to water quality data collected throughout the operational life of the facility.

Groundwater monitoring activities during 2002 included groundwater quality sampling and groundwater level surveillance. Groundwater quality data were gathered from six wells completed in the Culebra Member of the Rustler Formation (wells WQSP-1 through WQSP-6) and one well completed in the Dewey Lake Redbeds Formation (well WQSP-6A; Figure 6.1). Groundwater surface elevation data were gathered from 76 well bores, four of which were equipped with production-inflated packers to allow groundwater level surveillance of more than one producing zone through the same well bore (Figure 6.2).

6.1 Groundwater Quality Sampling

The HWFP Module V requires groundwater quality sampling twice a year, from March through May (Round 14 for 2002) and, again, from September through November (Round 15 for 2002). Sampling for groundwater quality was performed at seven well sites during 2002 (Figure 6.1). Field analysis for Eh (Intensity Factor: an indicator of oxidation or reduction of chemical species), specific gravity, specific conductance, acidity or alkalinity, chloride, divalent cations, and total iron were performed periodically during the sampling.

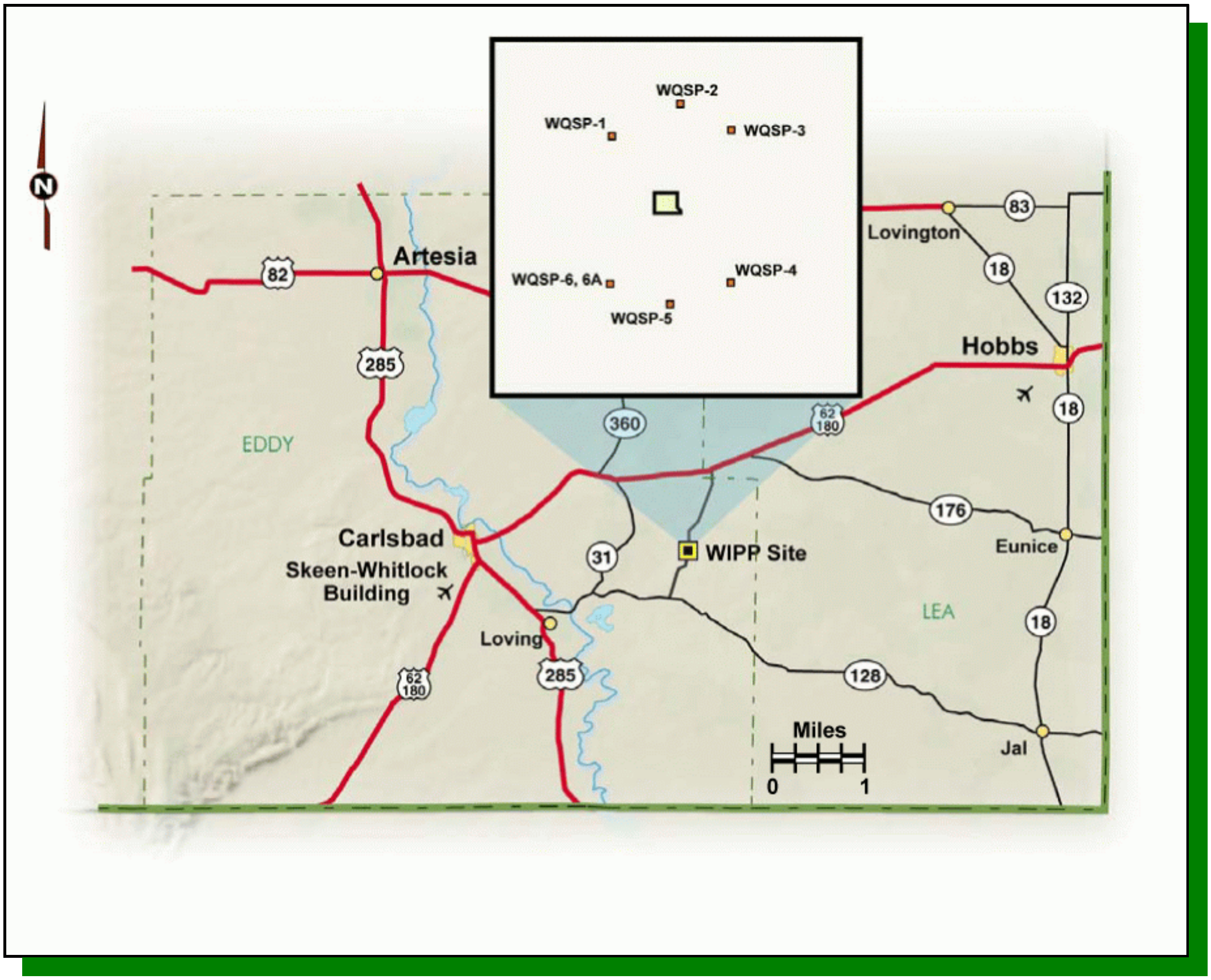

Figure 6.1 - Water Quality Sampling Program Wells (Inset represents the locations of the DMP wells in the four-square-mile area of the WIPP site [Land Withdrawal Area].)

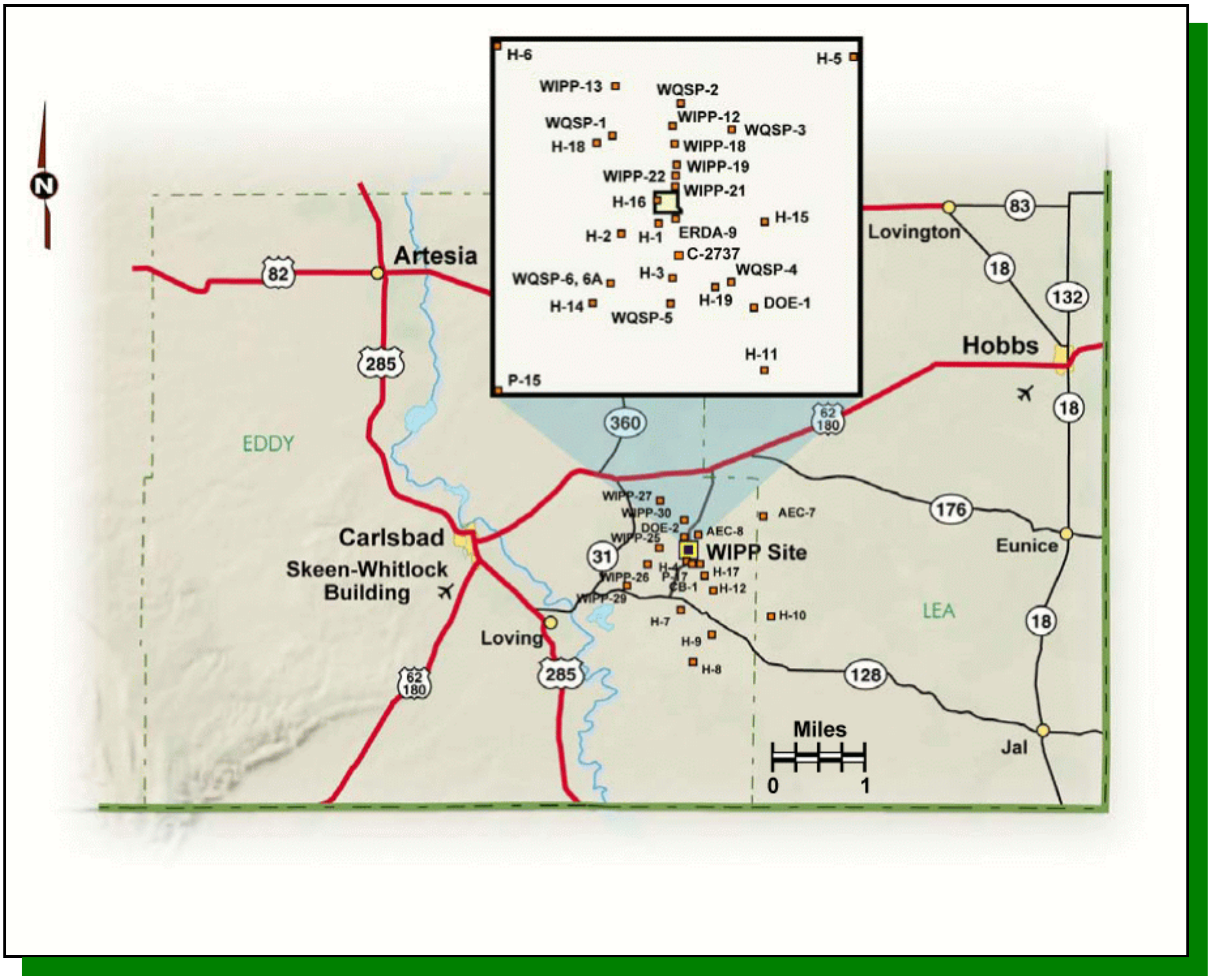

Figure 6.2 - Groundwater Level Surveillance Wells (Inset represents the locations of the groundwater surveillance wells in the four-square-mile area of the WIPP site [Land Withdrawal Area].)

Table 6.2 lists the analytical parameters included in the year 2002 groundwater sampling program.

During 2002, groundwater surveillance activities removed approximately 14,560 gallons (55,116 liters) of water from the Culebra Member of the Rustler Formation and 3,269 gallons (12,375 liters) from the Dewey Lake Redbeds Formation. The quality of the Culebra water sampled near WIPP is naturally poor and not suitable for human consumption or for agricultural purposes. The groundwater of the Culebra is considered to be Class III water by EPA guidelines.

Water quality measurements performed in the Dewey Lake Redbeds Formation indicate the waters are considerably better quality than the Culebra water. The TDS values were less than 5,000 mg/L (milligrams per liter). The water is suitable for livestock consumption, and classified as Class II water according to EPA guidance. Saturation of

the Dewey Lake Redbeds Formation in the area of WIPP is discontinuous. No hydrologic connection has been established that would indicate WIPP activities have had an impact on naturally occurring groundwater in the Dewey Lake Redbeds Formation. However, anthropogenic shallow subsurface water (SSW) has been encountered in the upper Dewey Lake Redbeds Formation at the Santa Rosa Formation contact. To date there are no data that indicate the SSW has commingled with the naturally occurring groundwater in the lower Dewey Lake Redbeds Formation (see Section 6.4).

Because of the highly variable transmissivity and TDS values within the Culebra, baseline groundwater quality was defined for each individual well. Tables 6.3 through 6.9 summarize the results of analyses for each parameter or constituent for the two sampling sessions in 2002 (rounds 14 and 15).

In these tables, either the 95th upper tolerance limit value (UTLV) or the 95th percentile value is presented depending on the type of distribution exhibited by the parameter. Both values represent the value beneath which 95 percent of the values in a population are expected to occur. The UTLVs were calculated for data that exhibited a normal or a lognormal distribution. The 95th percentile was determined for data that were considered nonparametric; having neither a normal nor a lognormal distribution. Due to the large number of nondetectable concentrations of organic compounds, the limits for organic compounds were considered nonparametric and based on the method detection limit reported by the laboratory. These values have been recomputed after baseline sampling was completed in 2000, and were used for sampling rounds 14 and 15 to evaluate potential contamination of the groundwater wells.

The analytical results for detectable constituents are plotted as Time Trend Plots compared to the baseline established prior to 2000 (Appendix F, Figures F.1 through F.98).

In a few isolated cases, reported concentrations of some parameters, such as potassium and total organic halogens slightly exceeded the calculated 95th percentile or the 95th UTLV. Such exceedences do not indicate the presence of contamination. The 95th UTLV or percentile is a value representing where 5 percent of the concentration in the population will be greater than the UTLV or percentile. WIPP groundwater in the Culebra Dolomite Member of the Rustler Formation has very high concentrations of dissolved solids. The contract analytical laboratory has had some difficulty performing the analyses for some of the cations found in the highly concentrated brines.
Table 6.10 summarizes the overall Groundwater Sampling Program.

6.2 Groundwater Level Surveillance

Groundwater surface elevations in the vicinity of WIPP may be influenced by localized disturbances, such as pumping tests for site characterization, water quality sampling, or shaft sealing. Other influences on groundwater surface elevations may be caused by natural groundwater level fluctuations and industrial influences from agriculture, mining, and resource exploration.

Well bores were used to perform surveillance of eight water-bearing zones in the WIPP area (Figure 6.2). The two zones of primary interest were the Culebra and Magenta Members of the Rustler Formation (see Figure 1.1). Throughout the year, forty-eight measurements were taken in the Culebra and eleven in the Magenta. Two measurements were taken in the Dewey Lake Redbeds Formation. Two measurements were taken in the Bell Canyon Formation. One measurement each was taken in the Forty-niner and Rustler/Salado contact. In 2002, groundwater level measurements were taken monthly in at least one accessible well bore at each well site for each available formation. Redundant well bores (well bores located on well pads with multiple wells completed in the same formation) at each well site were measured on a quarterly basis (Table 6.11).

Four well bores (WIPP-30 Culebra/Magenta, Cabin Baby Culebra/Bell Canyon, C-2737 Culebra/Magenta, and WIPP-25 Culebra/Magenta) were completed at multiple depths. By using packers, these well bores can monitor more than one formation.

Groundwater elevation measurements in the Culebra Member indicated the generalized directional flow of groundwater was north to south at the center of the WIPP site (Figure 6.3). Regionally, the flow is from the north to the southwest. Water elevation trend analysis was performed in 46 of 48 wells completed in the Culebra. Rising water level trends were noted in 39 wells while 7 of the wells had falling trends.

A total rise in groundwater level of more than 0.6 m (2 ft) occurred this year in seven wells completed to the Culebra. WIPP-30 had a steady methodical increase totaling 2.36 ft, which is similar to regional Culebra water level rise. The remaining six wells WQSP-3, H-10c, H-11b1, H-11b4, Cabin Baby, and C2737 had water level increases of more than 2 ft, which directly correlates to well maintenance activities in their immediate vicinity (see Section 6.3). Many of these wells were cleaned and developed during 2002. The increase in water levels is most likely due to the equilibration of water levels to pre-cleaning elevations.

During the year, a program was planned to determine the reasons for the rising water levels. Additional monitoring wells will be installed in 2003 to evaluate different hypotheses for this trend. Sandia National Laboratories will be performing a series of tests, analyses, and modeling to evaluate the hypotheses.

Groundwater level data were transmitted on a monthly basis to the NMED, EEG, Sandia National Laboratories, the CBFO Technical Assistance Contractor, and technical subcontractors as requested by the CBFO. A copy of the data was placed in the operating record for inspection by authorized agencies.

Culebra flow rates across the Land Withdrawal Area were determined using numerical modeling techniques calibrated to current groundwater head elevations. Flow rates ranged from 3.5 x 10^{-5} ft per day (ft/d) to 6 x 10^{-4} ft/d in the southwestern and west sections of the Land Withdrawal Area. Flow rates in the central portion of the Land Withdrawal Area ranged from 3.4 x 10^{-4} ft/d to 4.3 x 10^{-4} ft/d. Centrally, the flow rate ranged from 1.1 x 10^{-4} ft/d to 8.2 x 10^{-4} ft/d (Figure 6.4).

The interpretation of groundwater data collected in 2002 is similar to previous years. To date there is no indication WIPP operations have had a measurable or significant impact on either the elevation or the quality of naturally occurring groundwater in the Dewey Lake Redbeds, Magenta, and Culebra Formations (see Section 6.4).

Culebra groundwater in the vicinity of WIPP exhibits highly variable TDS concentrations. These variable TDS concentrations are reflected in a commensurate variability in groundwater density. Each year the WIPP conducts a program to measure the density of well-bore fluids in water level monitoring wells. Due to the high concentration of TDS in WIPP groundwater, density must be taken into account to accurately determine relative water levels between wells. Measured water levels are adjusted to equivalent fresh-water head values, considering fluid density differences between measuring points.

For the year 2002, the Pressure-Density Survey measured well-bore fluid density in eleven wells, as shown in Table 6.1.

Table 6.1 - Pressure Density Survey for 2002

WELL NAME	DATE	FORMATION	DENSITY
DOE-1	11/18/02	Culebra	1.0902 g/cc
H-03b2	11/7/02	Culebra	1.000 g/cc
H-19b2	10/4/02	Culebra	1.632 g/cc
H-11b4	11/19/02	Culebra	1.0638 g/cc
H-17	10/7/02	Culebra	1.1350 g/cc
H-09c	12/18/02	Culebra	1.0029 g/cc
H-10c	9/26/02	Culebra	1.000 g/cc
H-C-2737	7/12/02	Culebra	1.0013 g/cc
WIPP-19	10/22/02	Culebra	1.0506 g/cc
WIPP-12	10/29/02	Culebra	1.0987 g/cc
WIPP-22	10/15/02	Culebra	1.0614 g/cc

6.3 Well Maintenance Activities

Maintenance activities were performed on eighteen wells in 2002. Maintenance is performed to prepare wells for future experiments, repair nonfunctioning wells, recomplete wells to monitor additional zones of interest, and plug and abandon wells that are no longer useful.

Evaluations were performed to determine the condition of the well casing and the wells' ability to yield useful data. The wells were first cleaned with a casing scraper and circulated with fresh water to remove the scale. After cleaning, ultrasonic imaging logs were performed to determine the condition of the casing and the cement seal behind the casing. If the wells were determined to be in good condition, they were returned to service. Alternatively if problems were found, the well bores were plugged and abandoned.

Plugging and abandonment (P&A) activities in 2002 took place at H-9a in January; at H-10b, P-15, and P-18 in February; and at H-11b3 in March. After cleaning and logging, the well bores were cemented from the bottom of the well to the surface and a monument was placed at the surface in the top of the well casing.

Nine wells were cleaned and returned to service between January and March 2002. These wells are:

H-3b1	February
H-3b2	February
H-3b3	February
H-10a	February
H-7b1	March
H-7b2	March
H-7c	March
H-11b1	March
H-11b4	March

In addition to the nine wells returned to service, H-9b had also been cleaned and returned to service; however, during P&A activities at H-9a, cement migrated to H-9b and consequently plugged the Culebra. The well was subsequently removed from service, but not plugged. H-9c was reconfigured as a Magenta monitoring well in January after the evaluation process was completed.

H-10c was reconfigured as a Culebra monitoring well in February after H-10b was removed from service and plugged and abandoned.

6.4 Shallow Subsurface Water Monitoring Program

Shallow subsurface water occurs beneath the WIPP site at a depth of less than 100 ft below ground surface (bgs) at the contact between the lower Santa Rosa Formation and the upper Dewey Lake Redbeds Formation. This SSW yields generally less than one gallon per minute in monitoring wells and piezometers and contains high concentrations of TDS and chlorides. The origin of this water is believed to be primarily from anthropogenic causes, with some contribution from natural sources. The SSW occurs not only under the WIPP site surface facilities but also to the south as indicated by the recent encounter in drill hole C-2737 about a half mile south of the Waste Shaft (Figure 6.6). Natural shallow groundwater occurs in the middle part of the Dewey Lake Redbeds Formation at the southern portion of the WIPP site and to the south of the WIPP site. To date, there is no indication that the SSW has affected the naturally occurring groundwater in the Dewey Lake Redbeds Formation.

Since discovery of the SSW in the late 1990's, 12 piezometers and four wells (C-2505, C-2506, C-2507, and C-2811) have been part of a monitoring program to monitor spatial and temporal changes in SSW water levels and water quality. Shallow subsurface water (SSW) monitoring activities during 2002 included SSW quality sampling and SSW level surveillance at these 16 locations (Figure 6.6).

6.4.1 Shallow Subsurface Water Quality Sampling

One round of water-quality samples from 15 wells/piezometers was collected in year 2002 from the SSW monitoring program. Wells in this monitoring system are poor producers, yielding less than two gallons per minute when developed. The quality of SSW sampled near the WIPP is poor and not suitable for human consumption. TDS concentrations measured in the SSW ranged from 2,160 mg/L to 135,000 mg/L (Table 6.12). Four sample locations have TDS concentrations that less than 10,000 mg/L: (C-2507, C-2811, PZ-2, and PZ-10); all other locations have TDS values in excess of 10,000 mg/L.

6.4.2 Shallow Subsurface Water Level Surveillance

Sixteen wells were used to perform surveillance of the shallow subsurface water-bearing horizon in the Santa Rosa Formation and the upper Dewey Lake Redbeds Formation. Water levels were collected monthly for all locations presented in Figure 6.6. Fluctuations in water level have varied less than one-half a foot during the year. Water levels have indicated a decreasing trend during the year in response to decreased precipitation resulting in less recharge to the shallow subsurface (Table 6.13). Piezometer PZ-8 has historically been dry.

Groundwater elevation measurements in the SSW indicate that flow moves radially away from a potentiometric high located near PZ-7 adjacent to the Salt Pile Evaporation Pond (Figure 6.7). A potentiometric low is located near PZ-12. A second low is located east of PZ-8, located east of the site, which has historically been a dry hole. Investigations are under way in 2003 to characterize the conditions of the SSW south of the site.

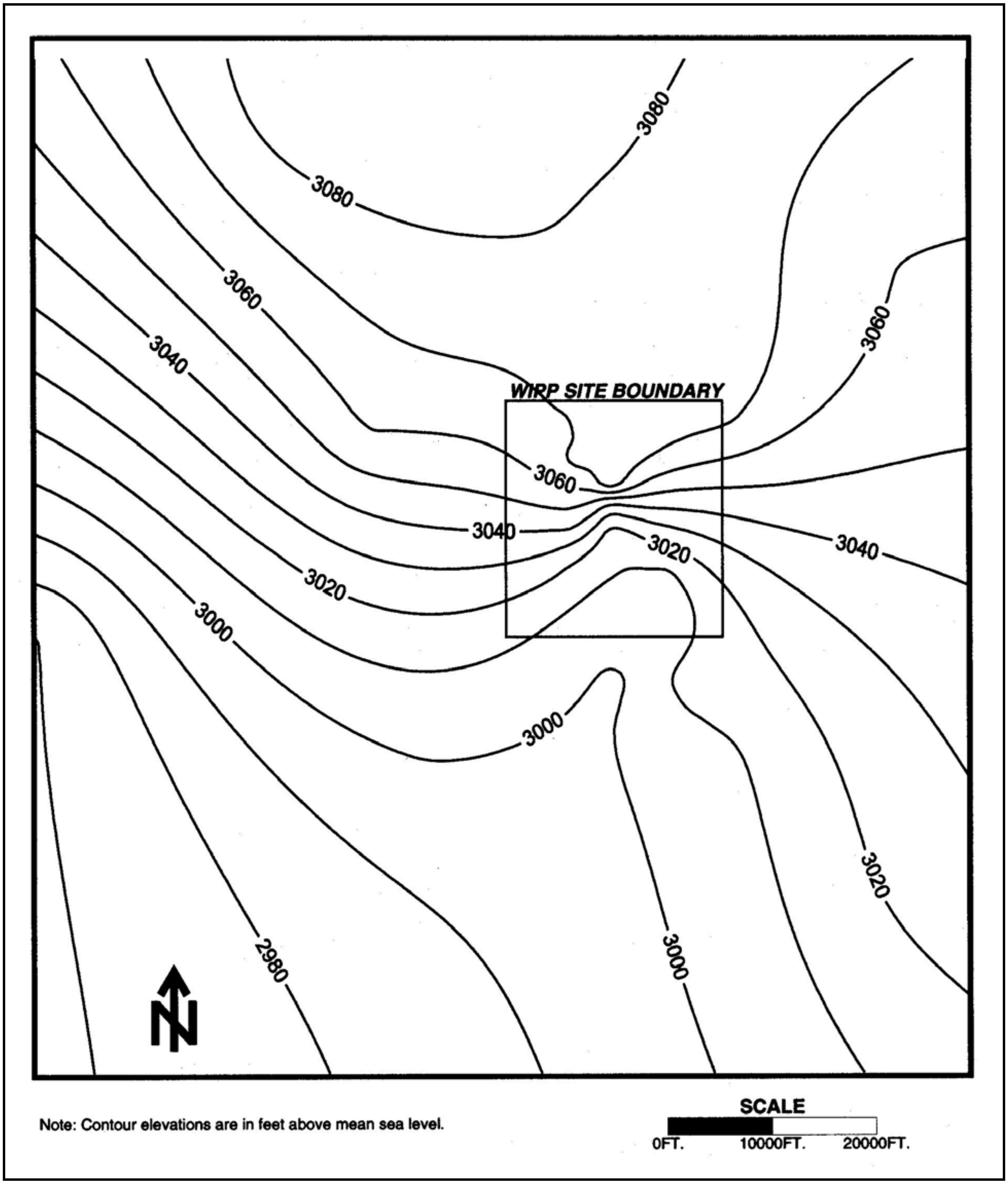

Figure 6.3 - Potentiometric Surface, Adjusted to Equivalent Freshwater Head, of the Culebra Dolomite Member of the Rustler Formation Near the WIPP Site, December 2002

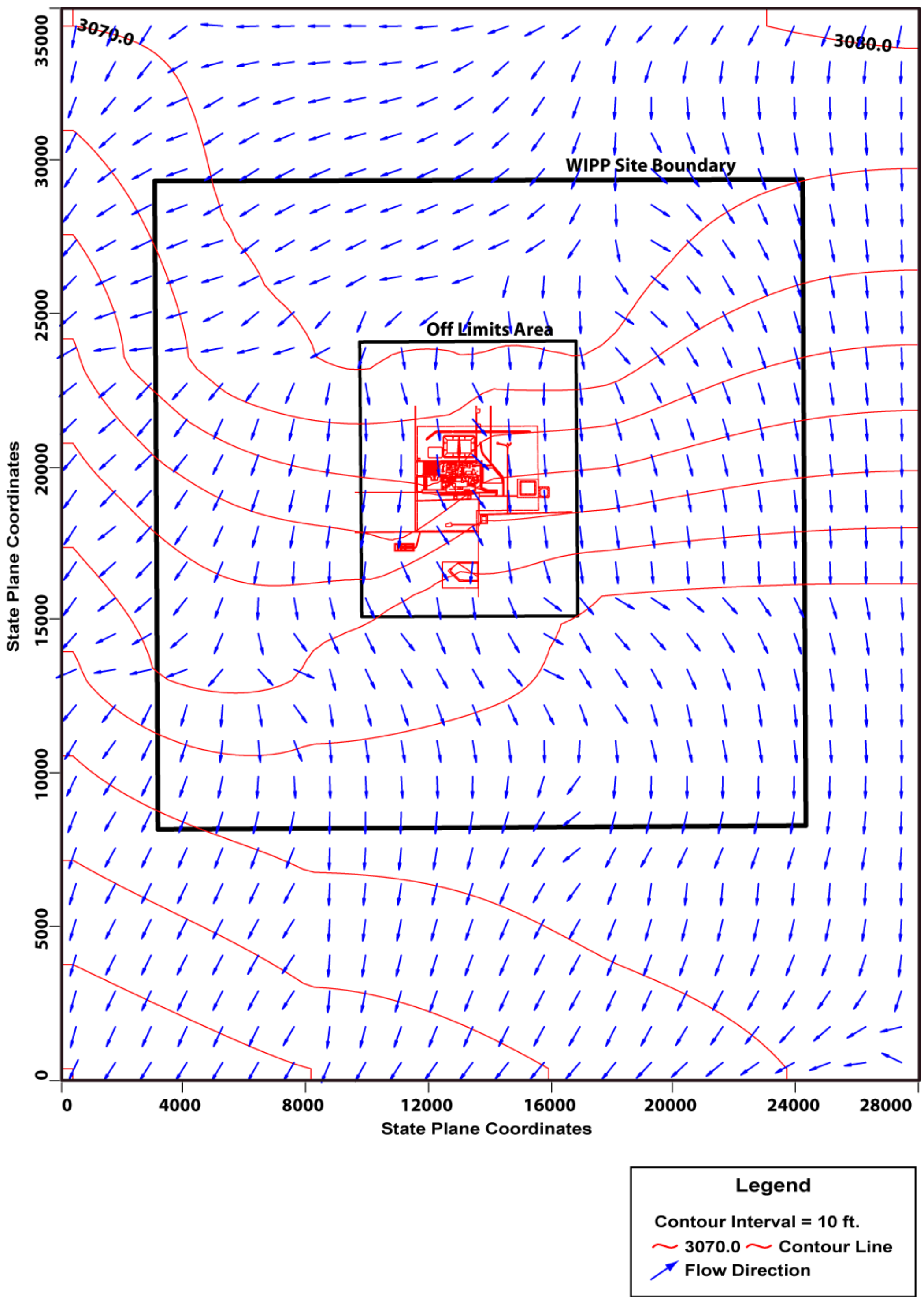

Figure 6.4 - Flow Rte and Direction of Groundwater Flowing Across the WIPP Site from the Culebra Formation, December 2002

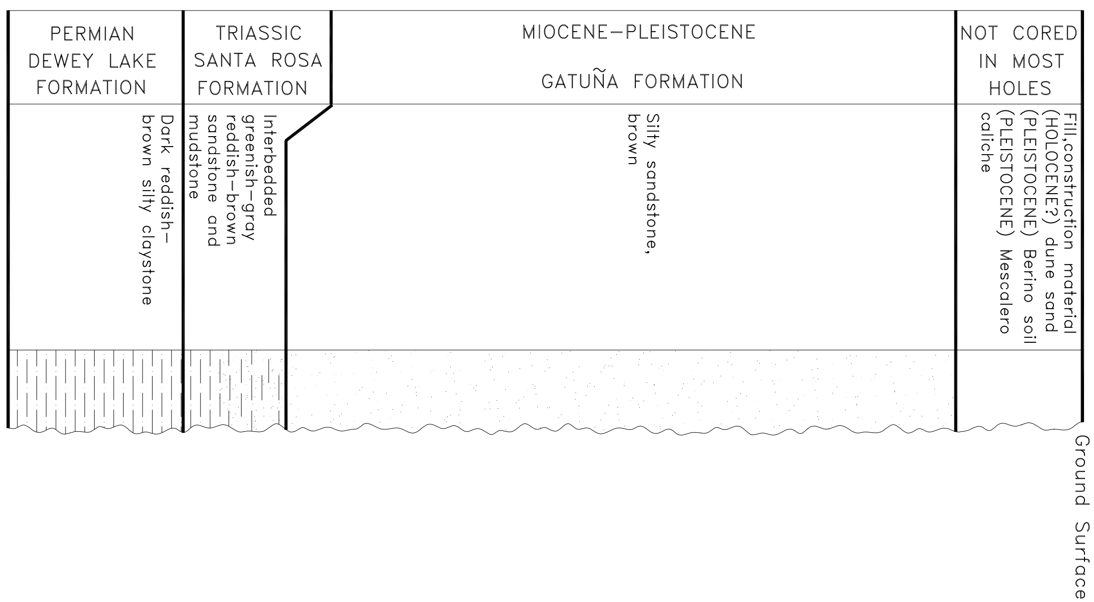

Figure 6.5 - Units Commonly Encountered During Shallow Drilling at WIPP

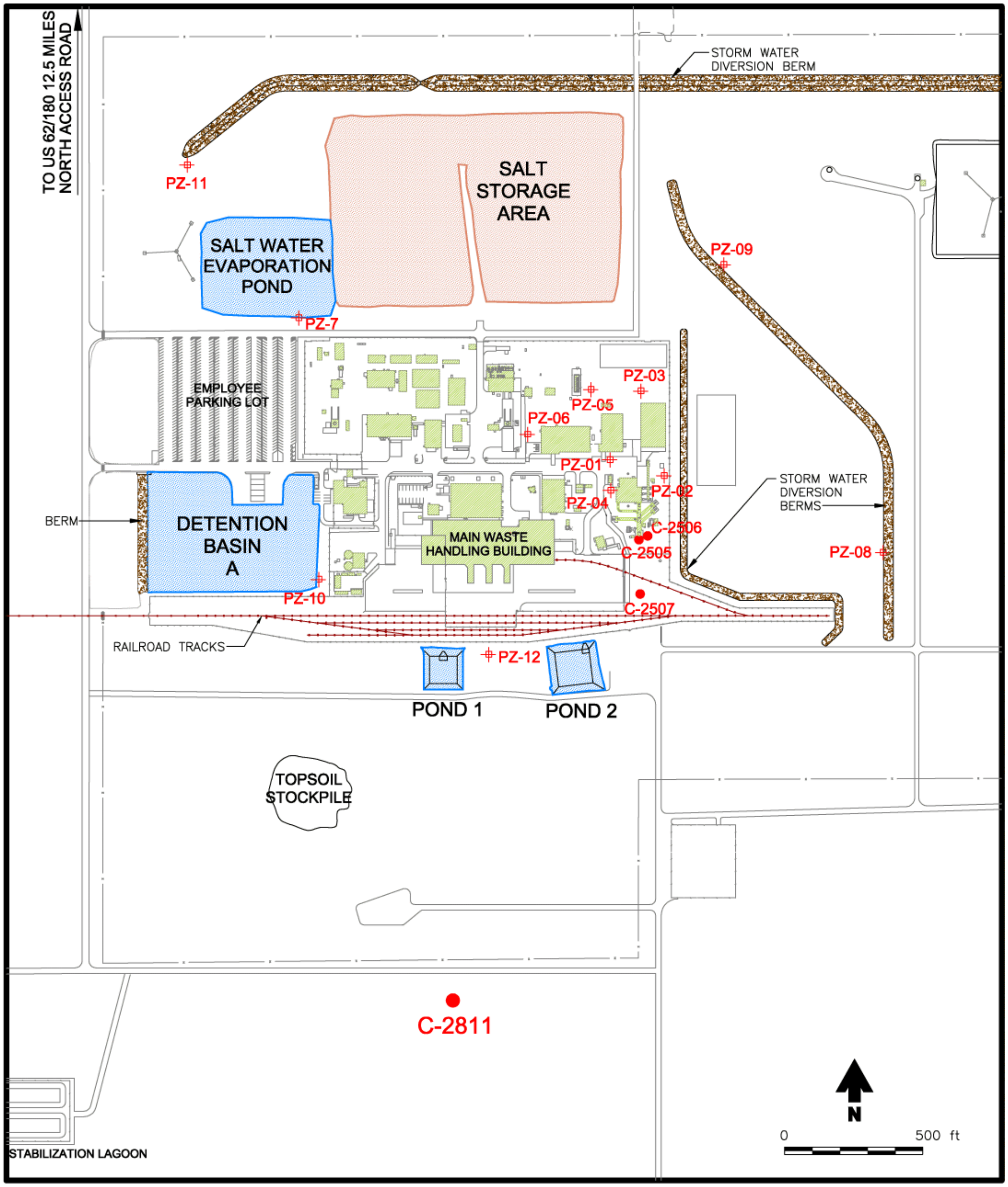

Figure 6.6 - Locations of SSW Wells (Piezometers PZ-1 through 12, C-2811, Wells C-2505, C-2506- and C-2507)

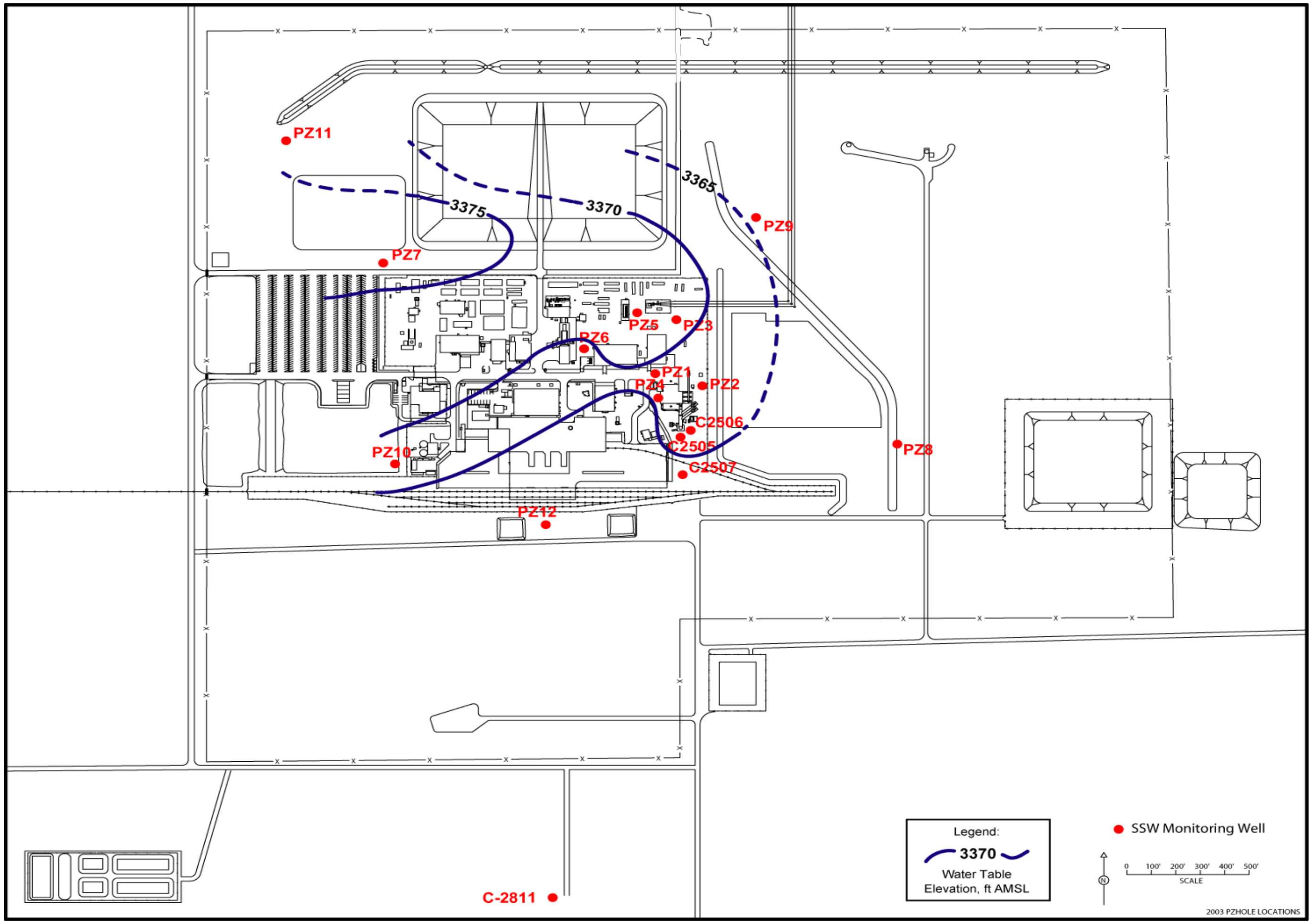

Figure 6.7 - Contour Plot of the SSW Potentionmetric Surface in the Santa Rosa Formation: December 2002

Table 6.2 - Analytical Parameters for Which Groundwater Was Analyzed

CAS No.[a]	Parameter	EPA Method Number	CAS No.	Parameter	EPA Method Number
71-55-6	1,1,1-Trichloroethane	8260B	7782-50-5	Chloride	300
79-34-5	1,1,2,2-Tetrachloroethane	8260B		Density[b]	
79-00-5	1,1,2-Trichloroethane	8260B	7727-37-9	Nitrate (as N)	300
75-34-3	1,1-Dichloroethane	8260B		pH	150.1
75-35-4	1,1-Dichloroethylene	8260B		Specific conductance	120.1
107-06-2	1,2-Dichloroethane	8260B		Sulfate	300
56-23-5	Carbon tetrachloride	8260B		Total dissolved solids (TDS)	160.1
108-90-7	Chlorobenzene	8260B		Total organic carbon (TOC)	415.1
67-66-3	Chloroform	8260B		Total organic halogen (TOH)	9020B
540-59-0	*cis*-1,2-Dichloroethylene	8260B		Total suspended solids (TSS)	160.2
540-59-0	*trans*-1, 2-Dichloroethylene	8260B			
78-93-3	Methyl ethyl ketone	8260B			
75-09-2	Methylene chloride	8260B			
127-18-4	Tetrachloroethylene	8260B	7440-36-0	Alkalinity	310.1
108-88-3	Toluene	8260B	7440-38-2	Antimony	6010B
79-01-6	Trichloroethylene	8260B	7440-39-3	Arsenic	6010B
75-69-4	Trichlorofluoromethane	8260B	7440-41-7	Barium	6010B
75-01-4	Vinyl chloride	8260B	7440-43-9	Beryllium	6010B
1330-20-7	Xylene	8260B	7440-70-2	Cadmium	6010B
95-50-1	1,2-Dichlorobenzene	8270C	7440-47-3	Calcium	6010B
106-46-7	1,4-Dichlorobenzene	8270C	7439-89-6	Chromium	6010B
51-28-5	2,4-Dinitrophenol	8270C	7439-92-1	Iron	6010B
121-14-2	2,4-Dinitrotoluene	8270C	7439-95-4	Lead	6010B
95-48-7	2-Methylphenol	8270C	7439-97-6	Magnesium	6010B
108-39-4/ 106-44-5	3-Methylphenol/ 4-Methylphenol	8270C	2023473	Mercury	7470A
			2023692	Nickel	6010B
118-74-1	Hexachlorobenzene	8270C	7782-49-2	Potassium	6010B
67-72-1	Hexachloroethane	8270C	7440-22-4	Selenium	6010B
98-95-3	Nitrobenzene	8270C	7440-23-5	Silver	6010B
87-86-5	Pentachlorophenol	8270C	7440-28-0	Sodium	6010B
110-86-1	Pyridine	8270C	7440-62-2	Thallium	6010B
78-83-1	Isobutanol	8015B	7440-66-6	Vanadium	6010B

[a] Chemical Abstract Service Registry Number
[b] Analysis method was ASTM D854-92

Table 6.3 - Analytical Results for Groundwater Sampled from Well WQSP-1

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL[b]
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/L	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/L	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/L	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
trans-1, 2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/L	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/L	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Toluene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/L	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/L	1	1	<RL
Xylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/L	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/L	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/L	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/L	5	5	<RL
Isobutanol	<5	<5	<5	<5	µg/L	5	5	<RL
Alkalinity	50	48	49	51	mg/L	4	4	55.7
Chloride	36600	32300	35400	37800	mg/L	0.5	2	40472
Density	1.035	1.037	1.049	1.046	g/mL	N/A[c]	N/A	1.072
Nitrate (as N)	<.10	<.10	<.10	<.10	mg/L	0.1	0.1	<10
pH	7.1	7.1	7.2	7.2	SU[d]	N/A	N/A	6.89-7.65
Specific conductance	99400	99000	77700	71800	µmhos/cm	N/A	N/A	175000
Sulfate	4270	4010	5110	5640	mg/L	0.5	2	5757

Table 6.3 - Analytical Results for Groundwater Sampled from Well WQSP-1

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
Total dissolved solids	60500	60600	64500	63900	mg/L	10	10	80700
Total organic carbon	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	<5.0
Total organic halogen	2.6	2.2	3.3	3.7	mg/L	N/A	0.005	14.6
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	33.5
Antimony	<0.025	<0.025	<0.125	<0.125	mg/L	0.025	0.025	0.33
Arsenic	<0.05	<0.05	<0.25	<0.25	mg/L	0.05	0.05	<0.1
Barium	<0.05	<0.05	<0.50	<0.50	mg/L	0.05	0.05	<1.0
Beryllium	<0.01	<0.01	<0.0125	<0.0125	mg/L	0.01	0.0125	<0.02
Cadmium	<0.050	<0.050	<0.005	<0.005	mg/L	0.05	0.005	<0.2
Calcium	1620	1580	1700	1620	mg/L	0.2	0.5	2,087
Chromium	<0.05	<0.05	<0.05	<0.051	mg/L	0.05	0.05	<0.5
Iron	<0.20	<0.20	0.358	0.253	mg/L	0.2	0.5	1.32
Lead	<0.10	<0.10	<0.01	<0.01	mg/L	0.1	0.01	0.105
Magnesium	1240	1220	1120	1040	mg/L	0.2	0.5	1,247
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/L	0	0	<0.002
Nickel	<0.10	<0.10	<0.125	<0.125	mg/L	0.1	0.125	0.490
Potassium	695	721	681	691	mg/L	0.2	0.5	799
Selenium	<0.05	<0.05	<0.25	<0.25	mg/L	0.05	0.25	0.15
Silver	<0.0125	<0.0125	<0.0625	<0.0625	mg/L	0.013	0.0625	<0.50
Sodium	18400	19600	18600	15100	mg/L	0.2	0.5	22,090
Thallium	<0.20	<0.20	<0.25	<0.25	mg/L	0.2	0.25	0.980
Vanadium	<0.10	<0.10	<0.125	<0.125	mg/L	0.1	0.125	<0.1

[A] 95th Upper tolerance limit value, equivalent to 95% confidence limit
[b] Reporting limit
[c] Not applicable
[d] Standard unit
[e] Not reported by the laboratory

Table 6.4 - Analytical Results for Groundwater Sampled from Well WQSP-2

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL[b]
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/L	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/L	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/L	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
trans-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/L	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/L	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Toluene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/L	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/L	1	1	<RL
Xylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/L	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/L	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/L	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/L	5	5	<RL
Isobutanol	<5	<5	<5	<5	µg/L	5	5	<RL
Alkalinity	48	46	42	44	mg/L	4	4	70.3
Chloride	34500	33900	36100	34100	mg/L	2	2	39670
Density	1.0467	1.0409	1.04	1.043	g/mL	N/A[d]	N/A	1.06
Nitrate (as N)	<0.1	<0.1	<0.1	<0.1	mg/L	0.1	0.1	<10
pH	7.2	7.2	7.1	7.1	SU[e]	N/A	N/A	7.00-7.60
Specific conductance	75600	79300	76870	74060	µmhos/cm	N/A	N/A	124000
Sulfate	5570	5650	6310	5560	mg/L	2	2	6590

Table 6.4 - Analytical Results for Groundwater Sampled from Well WQSP-2

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
Total dissolved solids	59800	59600	67700	67600	mg/L	10	10	80500
Total organic carbon	1.59	2.02	<1.0	<1.0	mg/L	1	1	7.97
Total organic halogen	3.2	3.2	2.6	2.7	mg/L	0.01	0.01	63.8
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	43
Antimony	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	<0.50
Arsenic	<0.05	<0.05	<0.05	<0.05	mg/L	0.05	0.05	0.062
Barium	<0.10	<0.10	<0.10	<0.10	mg/L	0.1	0.1	<1.0
Beryllium	<0.0025	<0.0025	<0.0025	<0.0025	mg/L	0	0	<1.0
Cadmium	<0.005	<0.005	<0.00	<0.00	mg/L	0.01	0.01	<0.5
Calcium	1662	1624	1510	1450	mg/L	0.5	0.5	1,827
Chromium	<0.01	<0.01	<0.01	<0.01	mg/L	0.01	0.01	<0.5
Iron	<0.50	<0.50	<0.05	<0.05	mg/L	0.0.5	0.05	1.32
Lead	<0.01	<0.01	<0.01	<0.01	mg/L	0.01	0.01	0.163
Magnesium	1093	1074	11080	1030	mg/L	0.5	0.5	1,244
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/L	0	0	<0.002
Nickel	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	0.490
Potassium	759	797	852	813	mg/L	0.5	0.5	845
Selenium	<0.05	<0.05	0.051	<0.05	mg/L	0.05	0.05	0.150
Silver	<0.0125	<0.0125	<0.0125	<0.0125	mg/L	0.013	0.013	<0.50
Sodium	20240	20490	15900	16500	mg/L	0.5	0.5	21,900
Thallium	<0.05	<0.05	<0.05	<0.05	mg/L	0.05	0.05	0.98
Vanadium	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	<0.1

[A] 95th Upper tolerance limit value, equivalent to 95% confidence limit
[b] Reporting limit
[c] Not reported by the laboratory
[d] Not applicable
[e] Standard unit

Table 6.5 - Analytical Results for Groundwater Sampled from Well WQSP-3

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL[b]
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/L	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/L	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/L	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
trans-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/L	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/L	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Toluene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/L	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/L	1	1	<RL
Xylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/L	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/L	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/L	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/L	5	5	<RL
Isobutanol	<5	<5	<5	<5	µg/L	5	5	<RL
Alkalinity	36	38	32	33	mg/L	4	4	54.5
Chloride	125000	126000	128600	124800	mg/L	2	2	149100
Density	1.144	1.142	1.14	1.14	g/mL	N/A[d]	N/A	1.17
Nitrate (as N)	<0.10	<0.10	<0.10	<0.10	mg/L	0.1	0.1	<12
pH	6.8	6.8	6.8	6.8	SU[e]	N/A	N/A	6.6-7.2
Specific conductance	232000	233000	186000	187000	µmhos/cm	N/A	N/A	517000
Sulfate	7540	7150	7640	7270	mg/L	2	2	8015

Table 6.5 - Analytical Results for Groundwater Sampled from Well WQSP-3

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
Total dissolved solids	228000	230000	228000	216000	mg/L	10	10	261000
Total organic carbon	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	<5.0
Total organic halogen	8.4	11	3.2	3.5	mg/L	0.005	0.005	55
Total suspended solids	6	6	<1.0	<1.0	mg/L	1	1	107
Antimony	<0.025	<0.025	<0.625	<0.625	mg/L	0.025	0.625	<1.0
Arsenic	<0.05	<0.05	<1.25	<1.25	mg/L	0.05	1.25	0.207
Barium	<0.10	<0.10	<2.50	<2.50	mg/L	0.1	2.5	<1.0
Beryllium	<0.0025	<0.0025	<0.0625	<0.0625	mg/L	0.003	0.0625	<0.1
Cadmium	<0.005	<0.005	<0.125	<0.125	mg/L	0.005	0.125	<0.5
Calcium	1500	1560	1460	1420	mg/L	0.5	0.5	1,680
Chromium	<0.01	<0.01	<0.25	<0.25	mg/L	0.01	0.25	<2.0
Iron	<0.25	<0.25	<1.25	<1.25	mg/L	0.25	1.25	<1.0
Lead	<0.01	<0.012	0.669	0.654	mg/L	0.01	0.02	0.80
Magnesium	2270	2400	2300	2280	mg/L	0.5	0.5	2,625
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/L	0	0	<0.002
Nickel	<0.025	<0.025	<0.625	<0.625	mg/L	0.025	0.625	<5.00
Potassium	1960	1950	2430	2210	mg/L	0.5	0.5	3,438
Selenium	<0.05	<0.05	<1.250	<1.250	mg/L	0.05	1.25	<2.00
Silver	<0.0125	<0.0125	<0.312	<0.312	mg/L	0.0125	0.312	0.31
Sodium	73200	75100	77200	76500	mg/L	0.5	0.5	140,400
Thallium	<0.05	<0.05	<1.25	<1.25	mg/L	0.05	1.25	5.800
Vanadium	<0.025	<0.025	<0.625	<0.625	mg/L	0.025	0.625	<5.00

[a] 95th Upper tolerance limit value, equivalent to 95% confidence limit
[b] Reporting limit
[c] Not reported by the laboratory
[d] Not applicable
[e] Standard unit

Table 6.6 - Analytical Results for Groundwater Sampled from Well WQSP-4

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL[b]
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/L	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/L	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/L	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
trans-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/L	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/L	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Toluene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/L	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/L	1	1	<RL
Xylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/L	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/L	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/L	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/L	5	5	<RL
Isobutanol	<5	<5	<5	<5	µg/L	5	5	<RL
Alkalinity	42	40	38	40	mg/L	4	4	47.1
Chloride	49700	50500	56400	53900	mg/L	2	2	63960
Density	1.07	1.075	1.066	1.073	g/mL	N/A[c]	N/A	1.1
Nitrate (as N)	<0.10	<0.10	<0.10	<0.10	mg/L	0.1	0.1	<10
pH	7.1	7.1	7.1	7.1	SU[d]	N/A	N/A	6.80-7.61
Specific conductance	109630	111823	109700	110900	µmhos/cm	N/A	N/A	319800
Sulfate	6560	6400	6960	6760	mg/L	2	2	7927

Table 6.6 - Analytical Results for Groundwater Sampled from Well WQSP-4

Parameter	Concentration Round 14 Sample	Concentration Round 14 Dup.	Concentration Round 15 Sample	Concentration Round 15 Dup.	Units	Reporting Limit Round 14	Reporting Limit Round 15	95th UTLV[a]
Total dissolved solids	101000	104000	115400	113600	mg/L	10	10	123500
Total organic carbon	1.39	1.75	<1.0	1.14	mg/L	1	1	<5.0
Total organic halogen	2.6	2.7	3	1.8	mg/L	NR[e]	0.01	17
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	57
Antimony	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	0.8
Arsenic	<0.05	<0.05	<0.05	<0.05	mg/L	0.05	0.05	<0.50
Barium	<0.10	<0.10	<0.10	<0.10	mg/L	0.1	0.1	<1.0
Beryllium	<0.0025	<0.0025	<0.0025	<0.0025	mg/L	0.003	0	0.25
Cadmium	<0.005	<0.005	<0.005	<0.005	mg/L	0.005	0.01	<0.50
Calcium	1610	1590	1530	1640	mg/L	0.5	0.5	1,834
Chromium	<0.010	<0.010	<0.010	<0.010	mg/L	0.01	0.01	<2.0
Iron	<0.50	<0.50	0.078	0.0736	mg/L	0.5	0.5	<4.0
Lead	<0.01	<0.01	0.029	0.0169	mg/L	0.01	0.02	0.525
Magnesium	1260	1200	1110	1230	mg/L	0.5	0.5	1,472
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/L	0	0	<0.002
Nickel	<0.025	<0.025	<0.250	<0.250	mg/L	0.025	0.25	<5.00
Potassium	1220	1230	1030	1120	mg/L	0.5	0.5	1,648
Selenium	<0.05	<0.05	<0.05	<0.05	mg/L	0.05	0.05	2.009
Silver	<0.0125	<0.0125	<0.0125	<0.0125	mg/L	0.0125	0.013	0.519
Sodium	27200	31600	33900	35400	mg/L	0.5	0.5	38,790
Thallium	<0.050	<0.050	0.125	0.0882	mg/L	0.05	0.013	1.00
Vanadium	<0.025	<0.025	<0.250	<0.250	mg/L	0.025	0.025	<5.00

[A] 95th Upper tolerance limit value, equivalent to 95% confidence limit
[b] Reporting limit
[c] Not applicable
[d] Standard unit
[e] Not reported by the laboratory

Table 6.7 - Analytical Results for Groundwater Sampled from Well WQSP-5

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL[b]
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/L	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/L	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/L	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
trans-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/L	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/L	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Toluene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/L	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/L	1	1	<RL
Xylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/L	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/L	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/L	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/L	5	5	<RL
Isobutanol	<5	<5	<5	<5	µg/L	5	5	<RL
Alkalinity	46	48	50	48	mg/L	4	4	56
Chloride	15900	15200	14300	14100	mg/L	2	2	18100
Density	1.027	1.0195	1.02	1.015	g/mL	N/A[d]	N/A	1.04
Nitrate (as N)	<0.1	<0.1	<0.10	<0.10	mg/L	0.1	0.1	<10
pH	7.6	7.6	7.5	7.5	SU[e]	N/A	N/A	7.40-7.90
Specific conductance	39200	38810	43680	43760	µmhos/cm	N/A	N/A	67700
Sulfate	5230	5250	4700	4730	mg/L	2	2	6129

Table 6.7 - Analytical Results for Groundwater Sampled from Well WQSP-5

	Concentration							
	Round 14		Round 15			Reporting Limit		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
Total dissolved solids	33600	33300	32500	32700	mg/L	10	10	43950
Total organic carbon	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	<5.0
Total organic halogen	1.7	2.2	3.6	4	mg/L	0.005	0.005	8.37
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	<10.0
Antimony	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	0.073
Arsenic	<0.05	<0.05	<0.05	<0.05	mg/L	0.05	0.05	<0.50
Barium	<0.10	<0.10	<0.10	<0.10	mg/L	0.1	0.1	<1.0
Beryllium	<0.0025	<0.0025	<0.0025	<0.0025	mg/L	0.003	0.003	0.02
Cadmium	<0.005	<0.005	<0.005	<0.005	mg/L	0.005	0.005	<0.050
Calcium	1010	1080	928	947	mg/L	0.5	0.5	1,303
Chromium	<0.01	<0.01	<0.01	<0.01	mg/L	0.01	0.01	<0.50
Iron	<0.25	0.49	0.0761	0.077	mg/L	0.5	0.5	0.795
Lead	<0.01	<0.01	0.0263	0.028	mg/L	0.01	0.02	<0.05
Magnesium	451	457	426	443	mg/L	0.5	0.5	547.0
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/L	0	0	<0.002
Nickel	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	<0.10
Potassium	398	422	357	251	mg/L	0.5	0.5	622.0
Selenium	<0.05	<0.05	<0.05	<0.05	mg/L	0.05	0.05	<0.10
Silver	<0.0125	<0.0125	<0.0125	<0.0125	mg/L	0.0125	0.0125	<0.50
Sodium	8740	7750	7660	7410	mg/L	0.5	0.5	11,190
Thallium	<0.05	<0.05	<0.05	<0.05	mg/L	0.05	0.05	0.209
Vanadium	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	2.70

[a] 95th Upper tolerance limit value, equivalent to 95% confidence limit
[b] Reporting limit
[c] Not reported by the laboratory
[d] Not applicable
[e] Standard unit

Table 6.8 - Analytical Results for Groundwater Sampled from Well WQSP-6

	Concentration							
	Round 14		Round 15			Reporting		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL[b]
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
Carbon tetrachloride	<1	<1	<1	<1	µg/L	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/L	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/L	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
trans-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/L	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/L	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Toluene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/L	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/L	1	1	<RL
Xylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/L	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/L	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/L	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/L	5	5	<RL
Isobutanol	<5	<5	<5	<5	µg/L	5	5	<RL
Alkalinity	46	46	48	50	mg/L	4	4	55.8
Chloride	4990	4950	5020	4940	mg/L	2	2	6200
Density	1.0121	1.0145	1.009	1.006	g/mL	N/A[d]	N/A	1.02
Nitrate (as N)	<0.10	<0.10	<0.10	<0.10	mg/L	0.1	0.1	7.45
pH	7.7	7.7	7.8	7.8	SU[e]	N/A	N/A	7.50-7.90
Specific conductance	21060	21040	19200	18900	µmhos/cm	N/A	N/A	27660
Sulfate	4640	4600	4720	4740	mg/L	2	2	5557

Table 6.8 - Analytical Results for Groundwater Sampled from Well WQSP-6

	Concentration							
	Round 14		Round 15			Reporting		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 14	Round 15	95th UTLV[a]
Total dissolved solids	15800	15000	15820	16260	mg/L	10	10	22500
Total organic carbon	1.53	<1.0	<1.0	<1.0	mg/L	1	1	10.14
Total organic halogen	2.8	1.8	3.6	3.3	mg/L	0.005	0.005	1.54
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	14.8
Antimony	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	0.14
Arsenic	<0.05	<0.05	<0.05	<0.05	mg/L	0.05	0.05	<0.50
Barium	<0.10	<0.10	<0.10	<0.10	mg/L	0.1	0.1	<1.0
Beryllium	<0.0025	<0.0025	<0.0025	<0.0025	mg/L	0.003	0.003	<0.020
Cadmium	<0.005	<0.005	<0.005	<0.005	mg/L	0.005	0.005	<0.050
Calcium	738	735	647	616	mg/L	0.5	0.5	796
Chromium	<0.010	<0.010	<0.010	<0.010	mg/L	0.01	0.01	<0.50
Iron	<0.050	<0.050	0.0698	0.069	mg/L	0.05	0.05	3.105
Lead	<0.01	<0.01	0.0447	0.046	mg/L	0.01	0.02	0.150
Magnesium	238	238	234	239	mg/L	0.5	0.5	255
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/L	0	0	<0.002
Nickel	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	<0.50
Potassium	221	223	231	205	mg/L	0.5	0.5	270
Selenium	<0.050	<0.050	<0.050	<0.050	mg/L	0.05	0.05	<0.10
Silver	<0.0125	<0.0125	<0.0125	<0.0125	mg/L	0.0125	0.0125	<0.50
Sodium	3870	3860	4210	3850	mg/L	0.5	0.5	6,290
Thallium	<0.050	<0.050	<0.050	<0.050	mg/L	0.05	0.05	0.560
Vanadium	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	<0.10

[A] 95th Upper tolerance limit value, equivalent to 95% confidence limit
[b] Reporting limit
[c] Not reported by the laboratory
[d] Not applicable
[e] Standard unit

Table 6.9 - Analytical Results for Groundwater Sampled from Well WQSP-6A

	Concentration							
	Round 12		Round 13			Reporting		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 12	Round 13	95th UTLV[a]
1,1,1-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL[b]
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1,2-Trichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL
1,1-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichloroethane	<1	<1	<1	<1	µg/L	1	1	<RL

Table 6.9 - Analytical Results for Groundwater Sampled from Well WQSP-6A

	Concentration							
	Round 12		Round 13			Reporting		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 12	Round 13	95th UTLV[a]
Carbon tetrachloride	<1	<1	<1	<1	µg/L	1	1	<RL
Chlorobenzene	<1	<1	<1	<1	µg/L	1	1	<RL
Chloroform	<1	<1	<1	<1	µg/L	1	1	<RL
cis-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
trans-1,2-Dichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Methyl ethyl ketone	<5	<5	<5	<5	µg/L	5	5	<RL
Methylene chloride	<5	<5	<5	<5	µg/L	5	5	<RL
Tetrachloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Toluene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichloroethylene	<1	<1	<1	<1	µg/L	1	1	<RL
Trichlorofluoromethane	<1	<1	<1	<1	µg/L	1	1	<RL
Vinyl chloride	<1	<1	<1	<1	µg/L	1	1	<RL
Xylene	<1	<1	<1	<1	µg/L	1	1	<RL
1,2-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
1,4-Dichlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrophenol	<5	<5	<5	<5	µg/L	5	5	<RL
2,4-Dinitrotoluene	<5	<5	<5	<5	µg/L	5	5	<RL
2-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
3-Methylphenol/ 4-Methylphenol	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachlorobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Hexachloroethane	<5	<5	<5	<5	µg/L	5	5	<RL
Nitrobenzene	<5	<5	<5	<5	µg/L	5	5	<RL
Pentachlorophenol	<5	<5	<5	<5	µg/L	5	5	<RL
Pyridine	<5	<5	<5	<5	µg/L	5	5	<RL
Isobutanol	<2	<2	<2	<2	mg/L	2	2	<RL
Alkalinity	104	106	102	102	mg/L	4	4	113
Bromide	1.23	1.23	1.14	<1.11	mg/L	1	0.2	14.5
Chloride	536	505	414	411	mg/L	0.5	2	1040
Density	1.005	1.005	1.005	1.005	g/mL	N/A[c]	N/A	1.01
Fluoride	1.91	1.91	1.39	1.44	mg/L	0.1	0.1	2.95
Iodide	<2.0	<2.0	<2.0	<2.0	mg/L	2	2	<2.0
Nitrate (as N)	6.37	6.37	3.67	3.82	mg/L	0.1	0.1	12.2
Orthophosphate (as P)	<0.04	<0.04	<0.04	<0.04	mg/L	0.04	0.04	0.11
pH	7.4	7.3	7.52	7.51	SU[d]	N/A	N/A	6.80-8.00
Specific conductance	4400	4370	4160	4050	µmhos/cm	N/A	N/A	5192
Sulfate	1900	1830	1900	1870	mg/L	0.5	2	2543
Total dissolved solids	3680	3670	4600	4550	mg/L	10	10	11000
Total organic carbon	1.28	<1.0	<1.0	<1.0	mg/L	1	1	15.45

Table 6.9 - Analytical Results for Groundwater Sampled from Well WQSP-6A

Concentration								
	Round 12		Round 13			Reporting		
Parameter	Sample	Dup.	Sample	Dup.	Units	Round 12	Round 13	95th UTLV[a]
Total organic halogen	0.029	0.041	0.039	0.039	mg/L	NR	0.01	0.19
Total phenols	<0.10	<0.10	<0.10	<0.10	mg/L	0.1	0.1	<0.28
Total suspended solids	<1.0	<1.0	<1.0	<1.0	mg/L	1	1	91
Antimony	<0.013	<0.013	<0.025	<0.025	mg/L	0.013	0.025	0.48
Arsenic	<0.050	<0.050	<0.010	<0.010	mg/L	0.05	0.01	<0.50
Barium	<0.020	<0.020	<0.100	<0.100	mg/L	0.02	0.1	<0.10
Beryllium	<0.010	<0.010	<0.0025	<0.0025	mg/L	0.01	0	<0.01
Boron	0.38	0.362	0.397	0.376	mg/L	0.05	0.05	<0.75
Cadmium	<0.010	<0.010	<0.005	<0.005	mg/L	0.01	0.01	<0.05
Calcium	570	540	622	620	mg/L	0.5	0.5	733
Chromium	<0.025	<0.025	<0.010	<0.010	mg/L	0.025	0.01	<0.50
Cobalt	<0.013	<0.013	<0.025	<0.025	mg/L	0.013	0.025	<0.50
Copper	<0.050	<0.050	<0.0125	<0.0125	mg/L	0.05	0.013	<1.0
Iron	<0.500	<0.500	<0.050	<0.050	mg/L	0.5	0.05	<1.0
Lead	<0.020	0.013	<0.010	<0.010	mg/L	0.02	0.01	<0.05
Lithium	0.204	0.205	0.135	0.142	mg/L	0.01	0.01	<0.50
Magnesium	150	146	186	169	mg/L	0.5	5	188
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	mg/L	0	0	<0.002
Nickel	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	0.284
Potassium	7.2	7.5	7.55	7.59	mg/L	0.5	0.5	10.1
Selenium	0.0385	0.022	<0.050	<0.050	mg/L	0.013	0.05	0.220
Silica	10.6	11.2	10.2	9.65	mg/L	0.5	0.5	40.10
Silver	<0.013	<0.013	<0.0125	<0.0125	mg/L	0.013	0.013	<0.50
Sodium	260	255	302	267	mg/L	0.5	0.5	369.0
Thallium	<0.013	<0.013	<0.050	<0.050	mg/L	0.013	0.05	0.058
Tin	<0.025	<0.025	<0.025	<0.025	mg/L	0.025	0.025	0.230
Vanadium	0.052	0.051	0.046	0.047	mg/L	0.025	0.025	<0.50

[A] 95th Upper tolerance limit value, equivalent to 95% confidence limit
[b] Reporting limit
[c] Not applicable
[d] Standard unit
[e] Not reported by the laboratory

Table 6.10 - Summary of 2002 DOE Sitewide Groundwater Monitoring Program

	Purposes for Which Monitoring was Performed			
	Remediation	Waste Management	Environmental Surveillance	Other Drivers
Number of Active Wells Monitored	N/A	N/A	7	N/A
Number of Samples Taken	N/A	N/A	14	N/A
Number of Analyses Performed	N/A	N/A	1512	N/A
% of Analyses that are Non-Detects	N/A	N/A	83%*	N/A

* All VOCs, SVOCs, and the majority of trace metals were nondetect. Most detections are the routine major water chemistry parameters.

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
AEC-7	CUL	3657.25	01/15/02	619.16	188.72	3038.09	926.01	3061.03
AEC-7	CUL	3657.25	02/06/02	619.14	188.71	3038.11	926.02	3061.05
AEC-7	CUL	3657.25	03/12/02	619.08	188.70	3038.17	926.03	3061.12
AEC-7	CUL	3657.25	04/09/02	619.15	188.72	3038.10	926.01	3061.04
AEC-7	CUL	3657.25	05/08/02	618.95	188.66	3038.30	926.07	3061.26
AEC-7	CUL	3657.25	06/12/02	619.01	188.67	3038.24	926.06	3061.19
AEC-7	CUL	3657.25	07/15/02	619.16	188.72	3038.09	926.01	3061.03
AEC-7	CUL	3657.25	08/13/02	618.92	188.65	3038.33	926.08	3061.29
AEC-7	CUL	3657.25	09/09/02	619.04	188.68	3038.21	926.05	3061.16
AEC-7	CUL	3657.25	10/09/02	619.19	188.73	3038.06	926.00	3061.00
AEC-7	CUL	3657.25	11/05/02	619.13	188.71	3038.12	926.02	3061.06
AEC-7	CUL	3657.25	12/03/02	619.12	188.71	3038.13	926.02	3061.07
AEC-8	B/C	3537.10	01/15/02	491.52	149.82	3045.58	928.29	N/A
AEC-8	B/C	3537.10	02/06/02	490.39	149.47	3046.71	928.64	N/A
AEC-8	B/C	3537.10	03/12/02	488.94	149.03	3048.16	929.08	N/A
AEC-8	B/C	3537.10	04/09/02	487.65	148.64	3049.45	929.47	N/A
AEC-8	B/C	3537.10	05/08/02	486.36	148.24	3050.74	929.87	N/A
AEC-8	B/C	3537.10	06/13/02	484.84	147.78	3052.26	930.33	N/A
AEC-8	B/C	3537.10	07/15/02	482.53	147.08	3054.57	931.03	N/A
AEC-8	B/C	3537.10	08/13/02	480.20	146.36	3056.90	931.74	N/A
AEC-8	B/C	3537.10	09/10/02	478.22	145.76	3058.88	932.35	N/A
AEC-8	B/C	3537.10	10/09/02	476.71	145.30	3060.39	932.81	N/A
AEC-8	B/C	3537.10	11/05/02	475.66	144.98	3061.44	933.13	N/A
AEC-8	B/C	3537.10	12/03/02	474.75	144.70	3062.35	933.40	N/A
C-2505	SR/D	3413.05	08/15/02	45.61	13.90	3367.44	1026.40	N/A
C-2505	SR/D	3413.05	09/12/02	45.49	13.87	3367.56	1026.43	N/A
C-2505	SR/D	3413.05	10/10/02	45.55	13.88	3367.50	1026.41	N/A
C-2505	SR/D	3413.05	11/06/02	45.64	13.91	3367.41	1026.39	N/A

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
C-2505	SR/D	3413.05	12/04/02	45.53	13.88	3367.52	1026.42	N/A
C-2506	SR/D	3412.87	08/15/02	45.00	13.72	3367.87	1026.53	N/A
C-2506	SR/D	3412.87	09/12/02	44.89	13.68	3367.98	1026.56	N/A
C-2506	SR/D	3412.87	10/10/02	44.93	13.69	3367.94	1026.55	N/A
C-2506	SR/D	3412.87	11/06/02	45.01	13.72	3367.86	1026.52	N/A
C-2506	SR/D	3412.87	12/04/02	44.90	13.69	3367.97	1026.56	N/A
C-2507	SR/D	3410.01	08/15/02	45.85	13.98	3364.16	1025.40	N/A
C-2507	SR/D	3410.01	09/12/02	45.62	13.90	3364.39	1025.47	N/A
C-2507	SR/D	3410.01	10/10/02	45.59	13.90	3364.42	1025.48	N/A
C-2507	SR/D	3410.01	11/06/02	45.64	13.91	3364.37	1025.46	N/A
C-2507	SR/D	3410.01	12/04/02	45.60	13.90	3364.41	1025.47	N/A
C-2737 (ANNULUS)	MAG	3399.30	01/16/02	254.49	77.57	3144.81	958.54	N/A
C-2737 (ANNULUS)	MAG	3399.30	02/05/02	254.63	77.61	3144.67	958.50	N/A
C-2737 (ANNULUS)	MAG	3399.30	03/12/02	255.26	77.80	3144.04	958.3	N/A
C-2737 (ANNULUS)	MAG	3399.30	04/08/02	255.47	77.87	3143.83	958.24	N/A
C-2737 (ANNULUS)	MAG	3399.30	05/07/02	256.06	78.05	3143.24	958.06	N/A
C-2737 (ANNULUS)	MAG	3399.30	06/10/02	256.33	78.13	3142.97	957.98	N/A
C-2737 (ANNULUS)	MAG	3399.30	07/16/02	256.87	78.29	3142.43	957.81	N/A
C-2737 (ANNULUS)	MAG	3399.30	08/13/02	256.95	78.32	3142.35	957.79	N/A
C-2737 (ANNULUS)	MAG	3399.30	09/12/02	257.23	78.40	3142.07	957.70	N/A
C-2737 (ANNULUS)	MAG	3399.30	10/09/02	257.35	78.44	3141.95	957.67	N/A
C-2737 (ANNULUS)	MAG	3399.30	11/06/02	257.63	78.53	3141.67	957.58	N/A
C-2737 (ANNULUS)	MAG	3399.30	12/04/02	257.69	78.54	3141.61	957.56	N/A
C-2737 (PIP)	CUL	3399.30	01/16/02	384.86	117.31	3014.44	918.80	3014.44
C-2737 (PIP)	CUL	3399.30	02/05/02	384.75	117.27	3014.55	918.83	3014.55
C-2737 (PIP)	CUL	3399.30	03/12/02	383.25	116.81	3016.05	919.29	3016.05
C-2737 (PIP)	CUL	3399.30	04/08/02	382.98	116.73	3016.32	919.37	3016.32
C-2737 (PIP)	CUL	3399.30	05/07/02	382.93	116.72	3016.37	919.39	3016.37

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
C-2737 (PIP)	CUL	3399.30	06/10/02	382.58	116.61	3016.72	919.50	3016.72
C-2737 (PIP)	CUL	3399.30	07/15/02	382.6	116.62	3016.70	919.49	3016.70
C-2737 (PIP)	CUL	3399.30	08/13/02	382.29	116.52	3017.01	919.58	3017.01
C-2737 (PIP)	CUL	3399.30	09/12/02	382.26	116.51	3017.04	919.59	3017.04
C-2737 (PIP)	CUL	3399.30	10/09/02	382.14	116.48	3017.16	919.63	3017.16
C-2737 (PIP)	CUL	3399.30	11/06/02	382.52	116.59	3016.78	919.51	3016.78
C-2737 (PIP)	CUL	3399.30	12/04/02	382.39	116.55	3016.91	919.55	3016.91
C-2811	SR/D	3398.92	08/15/02	61.35	18.70	3337.57	1017.29	N/A
C-2811	SR/D	3398.92	09/12/02	61.24	18.67	3337.68	1017.32	N/A
C-2811	SR/D	3398.92	10/10/02	60.92	18.57	3338.00	1017.42	N/A
C-2811	SR/D	3398.92	11/06/02	60.93	18.57	3337.99	1017.42	N/A
C-2811	SR/D	3398.92	12/04/02	60.76	18.52	3338.16	1017.47	N/A
CB-1	CUL	3328.38	01/15/02	48.03	14.64	3280.35	999.85	3293.47
CB-1	CUL	3328.38	02/05/02	45.24	13.79	3283.14	1000.70	3296.34
CB-1	CUL	3328.38	04/10/02	36.72	11.19	3291.66	1003.30	3305.13
CB-1	CUL	3328.38	04/10/02	36.72	11.19	3291.66	1003.30	3305.13
CB-1	CUL	3328.38	07/16/02	440.22	134.18	2888.16	880.31	2889.12
CB-1	CUL	3328.38	08/14/02	422.88	128.89	2905.50	885.60	2907.00
CB-1	CUL	3328.38	10/09/02	392.90	119.76	2935.48	894.73	2937.90
CB-1	CUL	3328.38	11/06/02	379.61	115.71	2948.77	898.79	2951.61
CB-1	CUL	3328.38	03/13/02	40.37	12.30	3288.01	1002.19	3301.36
CB-1	CUL	3328.38	06/11/02	463.65	141.32	2864.73	873.17	2864.96
CB-1	CUL	3328.38	09/12/02	406.85	124.01	2921.53	890.48	2923.52
CB-1	CUL	3328.38	12/04/02	367.12	111.90	2961.26	902.59	2964.48
CB-1 (PIP)	B/C	3328.38	01/15/02	313.73	95.62	3014.65	918.87	N/A
CB-1 (PIP)	B/C	3328.38	02/05/02	313.73	95.62	3014.65	918.87	N/A
CB-1 (PIP)	B/C	3328.38	03/13/02	313.58	95.58	3014.80	918.91	N/A
CB-1 (PIP)	B/C	3328.38	04/10/02	313.76	95.63	3014.62	918.86	N/A

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
CB-1 (PIP)	B/C	3328.38	04/10/02	313.76	95.63	3014.62	918.86	N/A
CB-1 (PIP)	B/C	3328.38	06/11/02	313.64	95.60	3014.74	918.89	N/A
CB-1 (PIP)	B/C	3328.38	07/16/02	313.83	95.66	3014.55	918.83	N/A
CB-1 (PIP)	B/C	3328.38	08/14/02	313.78	95.64	3014.60	918.85	N/A
CB-1 (PIP)	B/C	3328.38	09/12/02	313.83	95.66	3014.55	918.83	N/A
CB-1 (PIP)	B/C	3328.38	10/09/02	313.81	95.65	3014.57	918.84	N/A
CB-1 (PIP)	B/C	3328.38	11/06/02	313.95	95.69	3014.43	918.80	N/A
CB-1 (PIP)	B/C	3328.38	12/04/02	313.87	95.67	3014.51	918.82	N/A
DOE-1	CUL	3466.04	01/16/02	489.16	149.10	2976.88	907.35	3005.37
DOE-1	CUL	3466.04	02/05/02	488.95	149.03	2977.09	907.42	3005.60
DOE-1	CUL	3466.04	03/13/02	488.80	148.99	2977.24	907.46	3005.76
DOE-1	CUL	3466.04	04/10/02	489.30	149.14	2976.74	907.31	3005.22
DOE-1	CUL	3466.04	05/07/02	488.82	148.99	2977.22	907.46	3005.74
DOE-1	CUL	3466.04	06/11/02	488.48	148.89	2977.56	907.56	3006.11
DOE-1	CUL	3466.04	07/15/02	488.18	148.80	2977.86	907.65	3006.43
DOE-1	CUL	3466.04	08/14/02	488.06	148.76	2977.98	907.69	3006.56
DOE-1	CUL	3466.04	09/11/02	487.95	148.73	2978.09	907.72	3006.68
DOE-1	CUL	3466.04	10/07/02	487.92	148.72	2978.12	907.73	3006.72
DOE-1	CUL	3466.04	11/06/02	487.87	148.70	2978.17	907.75	3006.77
DOE-1	CUL	3466.04	12/04/02	487.94	148.72	2978.10	907.72	3006.69
ERDA-9	CUL	3410.10	01/16/02	401.70	122.44	3008.40	916.96	3023.84
ERDA-9	CUL	3410.10	02/05/02	401.64	122.42	3008.46	916.98	3023.90
ERDA-9	CUL	3410.10	03/12/02	401.57	122.40	3008.53	917.00	3023.98
ERDA-9	CUL	3410.10	04/08/02	401.23	122.29	3008.87	917.10	3024.33
ERDA-9	CUL	3410.10	05/07/02	400.97	122.22	3009.13	917.18	3024.61
ERDA-9	CUL	3410.10	06/10/02	400.62	122.11	3009.48	917.29	3024.97
ERDA-9	CUL	3410.10	07/15/02	400.44	122.05	3009.66	917.34	3025.16
ERDA-9	CUL	3410.10	08/14/02	400.23	121.99	3009.87	917.41	3025.38

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
ERDA-9	CUL	3410.10	09/10/02	400.15	121.97	3009.95	917.43	3025.47
ERDA-9	CUL	3410.10	10/07/02	400.11	121.95	3009.99	917.44	3025.51
ERDA-9	CUL	3410.10	11/04/02	400.23	121.99	3009.87	917.41	3025.38
ERDA-9	CUL	3410.10	12/02/02	400.27	122.00	3009.83	917.40	3025.34
H-02a	CUL	3378.09	03/13/02	340.01	103.64	3038.08	926.01	3041.61
H-02a	CUL	3378.09	06/11/02	339.79	103.57	3038.30	926.07	3041.83
H-02a	CUL	3378.09	09/10/02	339.57	103.50	3038.52	926.14	3042.06
H-02a	CUL	3378.09	12/04/02	339.33	103.43	3038.76	926.21	3042.30
H-02b1	MAG	3378.46	01/16/02	231.31	70.50	3147.15	959.25	N/A
H-02b1	MAG	3378.46	02/05/02	231.29	70.50	3147.17	959.26	N/A
H-02b1	MAG	3378.46	03/13/02	231.31	70.50	3147.15	959.25	N/A
H-02b1	MAG	3378.46	04/08/02	231.25	70.49	3147.21	959.27	N/A
H-02b1	MAG	3378.46	05/08/02	231.29	70.50	3147.17	959.26	N/A
H-02b1	MAG	3378.46	06/11/02	231.32	70.51	3147.14	959.25	N/A
H-02b1	MAG	3378.46	07/16/02	231.37	70.52	3147.09	959.23	N/A
H-02b1	MAG	3378.46	08/13/02	231.45	70.55	3147.01	959.21	N/A
H-02b1	MAG	3378.46	09/10/02	231.50	70.56	3146.96	959.19	N/A
H-02b1	MAG	3378.46	10/08/02	231.57	70.58	3146.89	959.17	N/A
H-02b1	MAG	3378.46	11/05/02	231.60	70.59	3146.86	959.16	N/A
H-02b1	MAG	3378.46	12/04/02	231.72	70.63	3146.74	959.13	N/A
H-02b2	CUL	3378.31	01/16/02	340.57	103.81	3037.74	925.90	3040.09
H-02b2	CUL	3378.31	02/05/02	340.46	103.77	3037.85	925.94	3040.2
H-02b2	CUL	3378.31	03/13/02	340.13	103.67	3038.18	926.04	3040.54
H-02b2	CUL	3378.31	04/08/02	340.00	103.63	3038.31	926.08	3040.67
H-02b2	CUL	3378.31	05/08/02	339.89	103.60	3038.42	926.11	3040.78
H-02b2	CUL	3378.31	06/11/02	339.86	103.59	3038.45	926.12	3040.81
H-02b2	CUL	3378.31	07/16/02	339.90	103.60	3038.41	926.11	3040.77
H-02b2	CUL	3378.31	08/13/02	339.65	103.53	3038.66	926.18	3041.02

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-02b2	CUL	3378.31	09/10/02	339.66	103.53	3038.65	926.18	3041.01
H-02b2	CUL	3378.31	10/08/02	339.56	103.50	3038.75	926.21	3041.11
H-02b2	CUL	3378.31	11/05/02	339.38	103.44	3038.93	926.27	3041.29
H-02b2	CUL	3378.31	12/04/02	339.39	103.45	3038.92	926.26	3041.28
H-02c	CUL	3378.41	03/13/02	340.39	103.75	3038.02	925.99	3050.93
H-02c	CUL	3378.41	06/11/02	340.00	103.63	3038.41	926.11	3051.33
H-02c	CUL	3378.41	09/10/02	339.73	103.55	3038.68	926.19	3051.62
H-02c	CUL	3378.41	12/04/02	339.46	103.47	3038.95	926.27	3051.90
H-03b1	MAG	3390.64	01/16/02	240.20	73.21	3150.44	960.25	N/A
H-03b1	MAG	3390.64	02/05/02	240.34	73.26	3150.30	960.21	N/A
H-03b1	MAG	3390.64	03/18/02	263.15	80.21	3127.49	953.26	N/A
H-03b1	MAG	3390.64	04/09/02	266.40	81.20	3124.24	952.27	N/A
H-03b1	MAG	3390.64	05/08/02	260.01	79.25	3130.63	954.22	N/A
H-03b1	MAG	3390.64	06/10/02	259.18	79.00	3131.46	954.47	N/A
H-03b1	MAG	3390.64	07/17/02	257.53	78.50	3133.11	954.97	N/A
H-03b1	MAG	3390.64	08/14/02	257.41	78.46	3133.23	955.01	N/A
H-03b1	MAG	3390.64	09/10/02	257.79	78.57	3132.85	954.89	N/A
H-03b1	MAG	3390.64	10/07/02	259.16	78.99	3131.48	954.48	N/A
H-03b1	MAG	3390.64	11/06/02	259.29	79.03	3131.35	954.44	N/A
H-03b1	MAG	3390.64	12/02/02	260.25	79.32	3130.39	954.14	N/A
H-03b2	CUL	3390.03	01/16/02	390.68	119.08	2999.35	914.20	3010.71
H-03b2	CUL	3390.03	02/05/02	390.60	119.05	2999.43	914.23	3010.80
H-03b2	CUL	3390.03	03/18/02	390.88	119.14	2999.15	914.14	3010.50
H-03b2	CUL	3390.03	04/09/02	390.88	119.14	2999.15	914.14	3010.50
H-03b2	CUL	3390.03	05/07/02	390.96	119.16	2999.07	914.12	3010.42
H-03b2	CUL	3390.03	06/10/02	390.29	118.96	2999.74	914.32	3011.12
H-03b2	CUL	3390.03	07/17/02	390.31	118.97	2999.72	914.31	3011.10
H-03b2	CUL	3390.03	08/14/02	390.01	118.88	3000.02	914.41	3011.41

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-03b2	CUL	3390.03	09/10/02	389.98	118.87	3000.05	914.42	3011.44
H-03b2	CUL	3390.03	10/07/02	389.92	118.85	3000.11	914.43	3011.50
H-03b2	CUL	3390.03	11/06/02	390.60	119.05	2999.43	914.23	3010.80
H-03b2	CUL	3390.03	12/02/02	389.97	118.86	3000.06	914.42	3011.45
H-03b3	CUL	3388.67	03/18/02	385.22	117.42	3003.45	915.45	3013.30
H-03b3	CUL	3388.67	06/10/02	384.63	117.24	3004.04	915.63	3013.91
H-03b3	CUL	3388.67	09/10/02	384.26	117.12	3004.41	915.74	3014.29
H-03b3	CUL	3388.67	12/02/02	384.29	117.13	3004.38	915.74	3014.26
H-03d/DL (PVC)	DL	3390.01	01/16/02	315.91	96.29	3074.10	936.99	N/A
H-03d/DL (PVC)	DL	3390.01	02/05/02	315.80	96.26	3074.21	937.02	N/A
H-03d/DL (PVC)	DL	3390.01	03/18/02	315.87	96.28	3074.14	937.00	N/A
H-03d/DL (PVC)	DL	3390.01	04/09/02	315.80	96.26	3074.21	937.02	N/A
H-03d/DL (PVC)	DL	3390.01	05/07/02	315.68	96.22	3074.33	937.06	N/A
H-03d/DL (PVC)	DL	3390.01	06/10/02	315.57	96.19	3074.44	937.09	N/A
H-03d/DL (PVC)	DL	3390.01	07/17/02	315.50	96.16	3074.51	937.11	N/A
H-03d/DL (PVC)	DL	3390.01	08/14/02	315.41	96.14	3074.60	937.14	N/A
H-03d/DL (PVC)	DL	3390.01	09/10/02	315.33	96.11	3074.68	937.16	N/A
H-03d/DL (PVC)	DL	3390.01	10/07/02	315.25	96.09	3074.76	937.19	N/A
H-03d/DL (PVC)	DL	3390.01	11/06/02	315.17	96.06	3074.84	937.21	N/A
H-03d/DL (PVC)	DL	3390.01	12/02/02	315.09	96.04	3074.92	937.24	N/A
H-04b	CUL	3333.35	01/16/02	332.11	101.23	3001.24	914.78	3004.83
H-04b	CUL	3333.35	02/05/02	332.04	101.21	3001.31	914.80	3004.90
H-04b	CUL	3333.35	03/13/02	331.69	101.10	3001.66	914.91	3005.26
H-04b	CUL	3333.35	04/09/02	331.83	101.14	3001.52	914.86	3005.11
H-04b	CUL	3333.35	05/08/02	331.49	101.04	3001.86	914.97	3005.46
H-04b	CUL	3333.35	07/16/02	331.54	101.05	3001.81	914.95	3005.41
H-04b	CUL	3333.35	08/12/02	331.43	101.02	3001.92	914.99	3005.52
H-04b	CUL	3333.35	09/11/02	331.62	101.08	3001.73	914.93	3005.33

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-04b	CUL	3333.35	10/07/02	331.65	101.09	3001.70	914.92	3005.30
H-04b	CUL	3333.35	11/04/02	331.55	101.06	3001.80	914.95	3005.40
H-04b	CUL	3333.35	12/02/02	331.68	101.10	3001.67	914.91	3005.27
H-04b	CUL	3333.35	06/10/02	331.34	100.99	3002.01	915.01	3005.61
H-04c	MAG	3334.04	01/16/02	189.73	57.83	3144.31	958.39	N/A
H-04c	MAG	3334.04	02/05/02	189.73	57.83	3144.31	958.39	N/A
H-04c	MAG	3334.04	03/13/02	189.60	57.79	3144.44	958.43	N/A
H-04c	MAG	3334.04	04/08/02	189.46	57.75	3144.58	958.47	N/A
H-04c	MAG	3334.04	05/08/02	189.44	57.74	3144.60	958.47	N/A
H-04c	MAG	3334.04	06/10/02	189.47	57.75	3144.57	958.46	N/A
H-04c	MAG	3334.04	07/16/02	189.51	57.76	3144.53	958.45	N/A
H-04c	MAG	3334.04	08/12/02	189.52	57.77	3144.52	958.45	N/A
H-04c	MAG	3334.04	09/11/02	189.65	57.81	3144.39	958.41	N/A
H-04c	MAG	3334.04	10/07/02	189.63	57.80	3144.41	958.42	N/A
H-04c	MAG	3334.04	11/04/02	190.13	57.95	3143.91	958.26	N/A
H-04c	MAG	3334.04	12/02/02	190.75	58.14	3143.29	958.07	N/A
H-05a	CUL	3506.24	03/12/02	474.90	144.75	3031.34	923.95	3071.29
H-05a	CUL	3506.24	06/12/02	474.74	144.70	3031.50	924.00	3071.47
H-05a	CUL	3506.24	09/10/02	474.83	144.73	3031.41	923.97	3071.37
H-05a	CUL	3506.24	12/03/02	474.62	144.66	3031.62	924.04	3071.60
H-05b	CUL	3506.04	01/16/02	477.51	145.55	3028.53	923.10	3073.42
H-05b	CUL	3506.04	02/06/02	477.46	145.53	3028.58	923.11	3073.48
H-05b	CUL	3506.04	03/12/02	477.39	145.51	3028.65	923.13	3073.55
H-05b	CUL	3506.04	04/09/02	477.30	145.48	3028.74	923.16	3073.65
H-05b	CUL	3506.04	05/08/02	477.19	145.45	3028.85	923.19	3073.77
H-05b	CUL	3506.04	06/12/02	477.20	145.45	3028.84	923.19	3073.76
H-05b	CUL	3506.04	07/15/02	477.25	145.47	3028.79	923.18	3073.71
H-05b	CUL	3506.04	08/13/02	477.18	145.44	3028.86	923.20	3073.79

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-05b	CUL	3506.04	09/10/02	477.27	145.47	3028.77	923.17	3073.69
H-05b	CUL	3506.04	10/09/02	477.10	145.42	3028.94	923.22	3073.87
H-05b	CUL	3506.04	11/05/02	477.16	145.44	3028.88	923.20	3073.81
H-05b	CUL	3506.04	12/03/02	477.14	145.43	3028.90	923.21	3073.83
H-05c	MAG	3506.04	01/16/02	348.86	106.33	3157.18	962.31	N/A
H-05c	MAG	3506.04	02/06/02	348.80	106.31	3157.24	962.33	N/A
H-05c	MAG	3506.04	03/12/02	348.79	106.31	3157.25	962.33	N/A
H-05c	MAG	3506.04	04/09/02	348.77	106.31	3157.27	962.34	N/A
H-05c	MAG	3506.04	05/08/02	348.67	106.27	3157.37	962.37	N/A
H-05c	MAG	3506.04	06/12/02	348.74	106.30	3157.30	962.35	N/A
H-05c	MAG	3506.04	07/15/02	348.85	106.33	3157.19	962.31	N/A
H-05c	MAG	3506.04	08/13/02	348.82	106.32	3157.22	962.32	N/A
H-05c	MAG	3506.04	09/10/02	348.99	106.37	3157.05	962.27	N/A
H-05c	MAG	3506.04	10/09/02	348.89	106.34	3157.15	962.30	N/A
H-05c	MAG	3506.04	11/05/02	348.97	106.37	3157.07	962.27	N/A
H-05c	MAG	3506.04	12/03/02	349.04	106.39	3157.00	962.25	N/A
H-06a	CUL	3348.11	03/11/02	294.12	89.65	3053.99	930.86	3066.23
H-06a	CUL	3348.11	06/10/02	293.65	89.50	3054.46	931.00	3066.72
H-06a	CUL	3348.11	09/09/02	293.39	89.43	3054.72	931.08	3066.99
H-06a	CUL	3348.11	12/02/02	293.10	89.34	3055.01	931.17	3067.29
H-06b	CUL	3348.25	01/16/02	295.39	90.03	3052.86	930.51	3065.05
H-06b	CUL	3348.25	02/05/02	295.26	90.00	3052.99	930.55	3065.18
H-06b	CUL	3348.25	03/11/02	294.99	89.91	3053.26	930.63	3065.47
H-06b	CUL	3348.25	04/08/02	294.76	89.84	3053.49	930.70	3065.70
H-06b	CUL	3348.25	05/06/02	294.70	89.82	3053.55	930.72	3065.77
H-06b	CUL	3348.25	06/10/02	294.54	89.78	3053.71	930.77	3065.93
H-06b	CUL	3348.25	07/15/02	294.37	89.72	3053.88	930.82	3066.11
H-06b	CUL	3348.25	08/12/02	294.25	89.69	3054.00	930.86	3066.23

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-06b	CUL	3348.25	09/09/02	294.31	89.71	3053.94	930.84	3066.17
H-06b	CUL	3348.25	10/07/02	294.28	89.70	3053.97	930.85	3066.20
H-06b	CUL	3348.25	11/04/02	294.06	89.63	3054.19	930.92	3066.43
H-06b	CUL	3348.25	12/02/02	294.01	89.61	3054.24	930.93	3066.48
H-06c	MAG	3348.52	01/16/02	283.57	86.43	3064.95	934.20	N/A
H-06c	MAG	3348.52	02/05/02	283.50	86.41	3065.02	934.22	N/A
H-06c	MAG	3348.52	03/11/02	283.32	86.36	3065.20	934.27	N/A
H-06c	MAG	3348.52	04/08/02	283.09	86.29	3065.43	934.34	N/A
H-06c	MAG	3348.52	05/06/02	283.20	86.32	3065.32	934.31	N/A
H-06c	MAG	3348.52	06/10/02	283.10	86.29	3065.42	934.34	N/A
H-06c	MAG	3348.52	07/15/02	283.20	86.32	3065.32	934.31	N/A
H-06c	MAG	3348.52	08/12/02	283.13	86.30	3065.39	934.33	N/A
H-06c	MAG	3348.52	09/09/02	283.23	86.33	3065.29	934.30	N/A
H-06c	MAG	3348.52	10/07/02	283.29	86.35	3065.23	934.28	N/A
H-06c	MAG	3348.52	11/04/02	283.15	86.30	3065.37	934.32	N/A
H-06c	MAG	3348.52	12/02/02	283.00	86.26	3065.52	934.37	N/A
H-07b1	CUL	3164.17	03/11/02	166.20	50.66	2997.97	913.78	2998.42
H-07b1	CUL	3164.17	06/12/02	166.29	50.69	2997.88	913.75	2998.33
H-07b1	CUL	3164.17	09/11/02	166.57	50.77	2997.60	913.67	2998.05
H-07b1	CUL	3164.17	12/03/02	166.44	50.73	2997.73	913.71	2998.18
H-07b2	CUL	3164.40	01/14/02	166.92	50.88	2997.48	913.63	2997.39
H-07b2	CUL	3164.40	02/06/02	166.85	50.86	2997.55	913.65	2997.46
H-07b2	CUL	3164.40	03/11/02	166.59	50.78	2997.81	913.73	2997.72
H-07b2	CUL	3164.40	04/10/02	166.89	50.87	2997.52	913.64	2997.43
H-07b2	CUL	3164.40	04/10/02	166.89	50.87	2997.52	913.64	2997.43
H-07b2	CUL	3165.07	06/12/02	167.44	51.04	2997.63	913.68	2997.54
H-07b2	CUL	3164.40	07/16/02	167.63	51.09	2996.77	913.42	2996.68
H-07b2	CUL	3164.40	08/12/02	167.57	51.08	2996.83	913.43	2996.74

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-07b2	CUL	3165.07	09/11/02	167.73	51.12	2997.34	913.59	2997.25
H-07b2	CUL	3165.07	10/08/02	167.65	51.10	2997.42	913.61	2997.33
H-07b2	CUL	3165.07	11/05/02	167.66	51.10	2997.41	913.61	2997.32
H-07b2	CUL	3165.07	12/03/02	167.62	51.09	2997.45	913.62	2997.36
H-08a	MAG	3432.99	01/15/02	406.23	123.82	3026.76	922.56	N/A
H-08a	MAG	3432.99	02/06/02	406.12	123.79	3026.87	922.59	N/A
H-08a	MAG	3432.99	03/13/02	406.09	123.78	3026.90	922.60	N/A
H-08a	MAG	3432.99	04/10/02	406.03	123.76	3026.96	922.62	N/A
H-08a	MAG	3432.99	05/06/02	405.98	123.74	3027.01	922.63	N/A
H-08a	MAG	3432.99	06/11/02	405.96	123.74	3027.03	922.64	N/A
H-08a	MAG	3432.99	07/16/02	406.10	123.78	3026.89	922.60	N/A
H-08a	MAG	3432.99	08/13/02	406.01	123.75	3026.98	922.62	N/A
H-08a	MAG	3432.99	09/11/02	406.02	123.75	3026.97	922.62	N/A
H-08a	MAG	3432.99	10/09/02	406.03	123.76	3026.96	922.62	N/A
H-08a	MAG	3432.99	11/06/02	406.03	123.76	3026.96	922.62	N/A
H-08a	MAG	3432.99	12/03/02	406.05	123.76	3026.94	922.61	N/A
H-08c	R/S	3432.90	01/15/02	453.72	138.29	2979.18	908.05	N/A
H-08c	R/S	3432.90	02/06/02	453.56	138.25	2979.34	908.10	N/A
H-08c	R/S	3432.90	03/13/02	453.52	138.23	2979.38	908.12	N/A
H-08c	R/S	3432.90	04/10/02	453.45	138.21	2979.45	908.14	N/A
H-08c	R/S	3432.90	05/06/02	453.37	138.19	2979.53	908.16	N/A
H-08c	R/S	3432.90	06/11/02	453.30	138.17	2979.60	908.18	N/A
H-08c	R/S	3432.90	07/16/02	453.24	138.15	2979.66	908.20	N/A
H-08c	R/S	3432.90	08/13/02	453.23	138.14	2979.67	908.20	N/A
H-08c	R/S	3432.90	09/11/02	453.19	138.13	2979.71	908.22	N/A
H-08c	R/S	3432.90	10/09/02	453.14	138.12	2979.76	908.23	N/A
H-08c	R/S	3432.90	11/06/02	453.10	138.10	2979.80	908.24	N/A
H-08c	R/S	3432.90	12/03/02	453.09	138.10	2979.81	908.25	N/A

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-10a	MAG	3688.67	01/15/02	526.59	160.50	3162.08	963.80	N/A
H-10a	MAG	3688.67	02/06/02	484.67	147.73	3204.00	976.58	N/A
H-10a	MAG	3688.67	03/13/02	468.88	142.91	3219.79	981.39	N/A
H-10a	MAG	3688.67	04/10/02	468.34	142.75	3220.33	981.56	N/A
H-10a	MAG	3688.67	05/06/02	468.35	142.75	3220.32	981.55	N/A
H-10a	MAG	3688.67	06/11/02	468.47	142.79	3220.20	981.52	N/A
H-10a	MAG	3688.67	07/16/02	468.68	142.85	3219.99	981.45	N/A
H-10a	MAG	3688.67	08/13/02	468.70	142.86	3219.97	981.45	N/A
H-10a	MAG	3688.67	09/11/02	468.75	142.88	3219.92	981.43	N/A
H-10a	MAG	3688.67	10/09/02	468.75	142.88	3219.92	981.43	N/A
H-10a	MAG	3688.67	11/06/02	468.68	142.85	3219.99	981.45	N/A
H-10a	MAG	3688.67	12/03/02	468.63	142.84	3220.04	981.47	N/A
H-10c	CUL	3688.64	04/22/02	660.82	201.42	3027.82	922.88	3027.82
H-10c	CUL	3688.64	05/07/02	661.17	201.52	3027.47	922.77	3027.47
H-10c	CUL	3688.64	06/11/02	661.69	201.68	3026.95	922.61	3026.95
H-10c	CUL	3688.64	07/16/02	662.30	201.87	3026.34	922.43	3026.34
H-10c	CUL	3688.64	08/13/02	662.56	201.95	3026.08	922.35	3026.08
H-10c	CUL	3688.64	09/11/02	662.32	201.88	3026.32	922.42	3026.32
H-10c	CUL	3688.64	10/09/02	662.39	201.90	3026.25	922.40	3026.25
H-10c	CUL	3688.64	11/06/02	662.76	202.01	3025.88	922.29	3025.88
H-10c	CUL	3688.64	12/03/02	662.93	202.06	3025.71	922.24	3025.71
H-11b1	CUL	3411.62	12/03/01	430.39	131.18	2981.23	908.68	3004.41
H-11b1	CUL	3411.62	06/11/02	419.21	127.78	2992.41	912.09	3016.42
H-11b1	CUL	3411.62	09/12/02	419.03	127.72	2992.59	912.14	3016.61
H-11b1	CUL	3411.62	12/04/02	419.11	127.74	2992.51	912.12	3016.52
H-11b4	CUL	3410.89	01/15/02	426.35	129.95	2984.54	909.69	3004.64
H-11b4	CUL	3410.89	02/05/02	426.19	129.90	2984.70	909.74	3004.81
H-11b4	CUL	3410.89	03/13/02	434.32	132.38	2976.57	907.26	2996.15

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-11b4	CUL	3410.89	04/10/02	427.93	130.43	2982.96	909.21	3002.95
H-11b4	CUL	3410.89	05/06/02	427.43	130.28	2983.46	909.36	3003.49
H-11b4	CUL	3410.89	06/11/02	427.05	130.16	2983.84	909.47	3003.89
H-11b4	CUL	3410.89	07/16/02	426.98	130.14	2983.91	909.50	3003.97
H-11b4	CUL	3410.89	08/14/02	426.84	130.10	2984.05	909.54	3004.12
H-11b4	CUL	3410.89	09/12/02	426.80	130.09	2984.09	909.55	3004.16
H-11b4	CUL	3410.89	10/09/02	426.69	130.06	2984.20	909.58	3004.28
H-11b4	CUL	3410.89	11/06/02	426.80	130.09	2984.09	909.55	3004.16
H-11b4	CUL	3410.89	12/04/02	426.72	130.06	2984.17	909.58	3004.24
H-12	CUL	3427.19	01/15/02	457.57	139.47	2969.62	905.14	3006.87
H-12	CUL	3427.19	02/06/02	457.50	139.45	2969.69	905.16	3006.95
H-12	CUL	3427.19	03/13/02	457.12	139.33	2970.07	905.28	3007.37
H-12	CUL	3427.19	04/10/02	457.26	139.37	2969.93	905.23	3007.21
H-12	CUL	3427.19	05/06/02	457.00	139.29	2970.19	905.31	3007.50
H-12	CUL	3427.19	06/11/02	456.81	139.24	2970.38	905.37	3007.71
H-12	CUL	3427.19	07/16/02	456.90	139.26	2970.29	905.34	3007.61
H-12	CUL	3427.19	08/13/02	456.41	139.11	2970.78	905.49	3008.15
H-12	CUL	3427.19	09/11/02	456.69	139.20	2970.50	905.41	3007.84
H-12	CUL	3427.19	10/09/02	456.57	139.16	2970.62	905.44	3007.97
H-12	CUL	3427.19	11/06/02	456.59	139.17	2970.60	905.44	3007.95
H-12	CUL	3427.19	12/03/02	456.47	139.13	2970.72	905.48	3008.08
H-17	CUL	3385.31	01/15/02	423.28	129.02	2962.03	902.83	3011.27
H-17	CUL	3385.31	02/05/02	423.20	128.99	2962.11	902.85	3011.36
H-17	CUL	3385.31	03/13/02	422.69	128.84	2962.62	903.01	3011.96
H-17	CUL	3385.31	04/10/02	422.95	128.92	2962.36	902.93	3011.65
H-17	CUL	3385.31	05/07/02	422.60	128.81	2962.71	903.03	3012.06
H-17	CUL	3385.31	06/11/02	422.32	128.72	2962.99	903.12	3012.39
H-17	CUL	3385.31	07/16/02	422.36	128.74	2962.95	903.11	3012.34

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-17	CUL	3385.31	08/14/02	422.19	128.68	2963.12	903.16	3012.54
H-17	CUL	3385.31	09/12/02	422.24	128.70	2963.07	903.14	3012.48
H-17	CUL	3385.31	10/09/02	422.17	128.68	2963.14	903.17	3012.56
H-17	CUL	3385.31	11/06/02	422.19	128.68	2963.12	903.16	3012.54
H-17	CUL	3385.31	12/04/02	422.16	128.67	2963.15	903.17	3012.57
H-19b0	CUL	3418.38	01/16/02	428.30	130.55	2990.08	911.38	3011.87
H-19b0	CUL	3418.38	02/05/02	428.19	130.51	2990.19	911.41	3011.99
H-19b0	CUL	3418.38	03/13/02	428.02	130.46	2990.36	911.46	3012.17
H-19b0	CUL	3418.38	04/09/02	428.30	130.55	2990.08	911.38	3011.87
H-19b0	CUL	3418.38	05/07/02	428.06	130.47	2990.32	911.45	3012.13
H-19b0	CUL	3418.38	06/11/02	427.60	130.33	2990.78	911.59	3012.62
H-19b0	CUL	3418.38	07/15/02	427.54	130.31	2990.84	911.61	3012.68
H-19b0	CUL	3418.38	08/14/02	427.40	130.27	2990.98	911.65	3012.83
H-19b0	CUL	3418.38	09/10/02	427.39	130.27	2990.99	911.65	3012.84
H-19b0	CUL	3418.38	10/07/02	427.32	130.25	2991.06	911.68	3012.92
H-19b0	CUL	3418.38	11/04/02	427.63	130.34	2990.75	911.58	3012.59
H-19b0	CUL	3418.38	12/04/02	427.42	130.28	2990.96	911.64	3012.81
H-19b2	CUL	3419.01	03/13/02	429.33	130.86	2989.68	911.25	3011.55
H-19b2	CUL	3419.01	06/11/02	428.92	130.73	2990.09	911.38	3011.98
H-19b2	CUL	3419.01	09/10/02	428.71	130.67	2990.30	911.44	3012.21
H-19b2	CUL	3419.01	12/04/02	428.72	130.67	2990.29	911.44	3012.20
H-19b3	CUL	3419.09	03/13/02	429.55	130.93	2989.54	911.21	3011.30
H-19b3	CUL	3419.09	06/11/02	429.14	130.80	2989.95	911.34	3011.74
H-19b3	CUL	3419.09	09/10/02	428.91	130.73	2990.18	911.41	3011.98
H-19b3	CUL	3419.09	12/04/02	428.93	130.74	2990.16	911.40	3011.96
H-19b4	CUL	3419.03	03/13/02	428.79	130.70	2990.24	911.43	3011.89
H-19b4	CUL	3419.03	06/11/02	428.38	130.57	2990.65	911.55	3012.33
H-19b4	CUL	3419.03	09/10/02	428.14	130.50	2990.89	911.62	3012.59

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
H-19b4	CUL	3419.03	12/04/02	428.19	130.51	2990.84	911.61	3012.53
H-19b5	CUL	3418.63	03/13/02	428.90	130.73	2989.73	911.27	3011.29
H-19b5	CUL	3418.63	06/11/02	428.49	130.60	2990.14	911.39	3011.73
H-19b5	CUL	3418.63	09/10/02	428.27	130.54	2990.36	911.46	3011.96
H-19b5	CUL	3418.63	12/04/02	428.28	130.54	2990.35	911.46	3011.95
H-19b6	CUL	3419.07	03/13/02	429.45	130.90	2989.62	911.24	3011.32
H-19b6	CUL	3419.07	06/11/02	429.04	130.77	2990.03	911.36	3011.75
H-19b6	CUL	3419.07	09/10/02	428.81	130.70	2990.26	911.43	3012.00
H-19b6	CUL	3419.07	12/04/02	428.85	130.71	2990.22	911.42	3011.96
H-19b7	CUL	3418.99	03/13/02	429.59	130.94	2989.40	911.17	3011.12
H-19b7	CUL	3418.99	06/11/02	429.16	130.81	2989.83	911.30	3011.58
H-19b7	CUL	3418.99	09/10/02	428.95	130.74	2990.04	911.36	3011.81
H-19b7	CUL	3418.99	12/04/02	428.96	130.75	2990.03	911.36	3011.80
P-17	CUL	3337.24	01/15/02	353.77	107.83	2983.47	909.36	2997.65
P-17	CUL	3337.24	02/05/02	353.71	107.81	2983.53	909.38	2997.72
P-17	CUL	3337.24	03/13/02	353.30	107.69	2983.94	909.50	2998.15
P-17	CUL	3337.24	04/10/02	353.45	107.73	2983.79	909.46	2997.99
P-17	CUL	3337.24	05/07/02	353.15	107.64	2984.09	909.55	2998.31
P-17	CUL	3337.24	06/11/02	352.92	107.57	2984.32	909.62	2998.56
P-17	CUL	3337.24	07/16/02	353.00	107.59	2984.24	909.60	2998.47
P-17	CUL	3337.24	08/14/02	352.87	107.55	2984.37	909.64	2998.61
P-17	CUL	3337.24	09/12/02	352.90	107.56	2984.34	909.63	2998.58
P-17	CUL	3337.24	10/09/02	352.83	107.54	2984.41	909.65	2998.65
P-17	CUL	3337.24	11/06/02	352.97	107.59	2984.27	909.61	2998.51
P-17	CUL	3337.24	12/04/02	352.85	107.55	2984.39	909.64	2998.63
PZ-01	SR/D	3413.41	08/15/02	42.44	12.94	3370.97	1027.47	N/A
PZ-01	SR/D	3413.41	09/12/02	42.51	12.96	3370.90	1027.45	N/A
PZ-01	SR/D	3413.41	10/10/02	42.56	12.97	3370.85	1027.44	N/A

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
PZ-01	SR/D	3413.41	11/06/02	42.64	13.00	3370.77	1027.41	N/A
PZ-01	SR/D	3413.41	12/04/02	42.55	12.97	3370.86	1027.44	N/A
PZ-02	SR/D	3413.42	08/15/02	43.68	13.31	3369.74	1027.10	N/A
PZ-02	SR/D	3413.42	09/12/02	43.85	13.37	3369.57	1027.04	N/A
PZ-02	SR/D	3413.42	10/10/02	43.92	13.39	3369.50	1027.02	N/A
PZ-02	SR/D	3413.42	11/06/02	44.08	13.44	3369.34	1026.97	N/A
PZ-02	SR/D	3413.42	12/04/02	44.88	13.68	3368.54	1026.73	N/A
PZ-03	SR/D	3416.15	08/15/02	45.29	13.80	3370.86	1027.44	N/A
PZ-03	SR/D	3416.15	09/12/02	45.44	13.85	3370.71	1027.39	N/A
PZ-03	SR/D	3416.15	10/10/02	45.49	13.87	3370.66	1027.38	N/A
PZ-03	SR/D	3416.15	11/06/02	45.63	13.91	3370.52	1027.33	N/A
PZ-03	SR/D	3416.15	12/04/02	45.45	13.85	3370.70	1027.39	N/A
PZ-04	SR/D	3412.10	08/15/02	47.74	14.55	3364.36	1025.46	N/A
PZ-04	SR/D	3412.10	09/12/02	47.62	14.51	3364.48	1025.49	N/A
PZ-04	SR/D	3412.10	10/10/02	47.63	14.52	3364.47	1025.49	N/A
PZ-04	SR/D	3412.10	11/06/02	47.74	14.55	3364.36	1025.46	N/A
PZ-04	SR/D	3412.10	12/04/02	47.61	14.51	3364.49	1025.50	N/A
PZ-05	SR/D	3415.31	08/15/02	43.12	13.14	3372.19	1027.84	N/A
PZ-05	SR/D	3415.31	09/12/02	43.27	13.19	3372.04	1027.80	N/A
PZ-05	SR/D	3415.31	10/10/02	43.33	13.21	3371.98	1027.78	N/A
PZ-05	SR/D	3415.31	11/06/02	43.43	13.24	3371.88	1027.75	N/A
PZ-05	SR/D	3415.31	12/04/02	43.26	13.19	3372.05	1027.80	N/A
PZ-06	SR/D	3413.49	08/15/02	43.66	13.31	3369.83	1027.12	N/A
PZ-06	SR/D	3413.49	09/12/02	43.65	13.30	3369.84	1027.13	N/A
PZ-06	SR/D	3413.49	10/10/02	43.68	13.31	3369.81	1027.12	N/A
PZ-06	SR/D	3413.49	11/06/02	43.74	13.33	3369.75	1027.10	N/A
PZ-06	SR/D	3413.49	12/04/02	43.65	13.30	3369.84	1027.13	N/A
PZ-07	SR/D	3413.99	08/15/02	37.19	11.34	3376.80	1029.25	N/A

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
PZ-07	SR/D	3413.99	09/12/02	37.49	11.43	3376.50	1029.16	N/A
PZ-07	SR/D	3413.99	10/10/02	37.58	11.45	3376.41	1029.13	N/A
PZ-07	SR/D	3413.99	11/06/02	37.78	11.52	3376.21	1029.07	N/A
PZ-07	SR/D	3413.99	12/04/02	37.61	11.46	3376.38	1029.12	N/A
PZ-09	SR/D	3421.21	08/15/02	57.59	17.55	3363.62	1025.23	N/A
PZ-09	SR/D	3421.21	09/12/02	57.79	17.61	3363.42	1025.17	N/A
PZ-09	SR/D	3421.21	10/10/02	57.75	17.60	3363.46	1025.18	N/A
PZ-09	SR/D	3421.21	11/06/02	57.81	17.62	3363.40	1025.16	N/A
PZ-09	SR/D	3421.21	12/04/02	57.26	17.45	3363.95	1025.33	N/A
PZ-10	SR/D	3405.80	08/15/02	38.47	11.73	3367.33	1026.36	N/A
PZ-10	SR/D	3405.80	09/12/02	38.31	11.68	3367.49	1026.41	N/A
PZ-10	SR/D	3405.80	10/10/02	38.34	11.69	3367.46	1026.40	N/A
PZ-10	SR/D	3405.80	11/06/02	38.36	11.69	3367.44	1026.40	N/A
PZ-10	SR/D	3405.80	12/04/02	38.19	11.64	3367.61	1026.45	N/A
PZ-11	SR/D	3418.95	08/15/02	45.30	13.81	3373.65	1028.29	N/A
PZ-11	SR/D	3418.95	09/12/02	45.54	13.88	3373.41	1028.22	N/A
PZ-11	SR/D	3418.95	10/10/02	45.56	13.89	3373.39	1028.21	N/A
PZ-11	SR/D	3418.95	11/06/02	45.74	13.94	3373.21	1028.15	N/A
PZ-11	SR/D	3418.95	12/04/02	45.63	13.91	3373.32	1028.19	N/A
PZ-12	SR/D	3408.99	08/15/02	53.60	16.34	3355.39	1022.72	N/A
PZ-12	SR/D	3408.99	09/12/02	53.15	16.20	3355.84	1022.86	N/A
PZ-12	SR/D	3408.99	10/10/02	53.17	16.21	3355.82	1022.85	N/A
PZ-12	SR/D	3408.99	11/06/02	53.40	16.28	3355.59	1022.78	N/A
PZ-12	SR/D	3408.99	12/04/02	53.28	16.24	3355.71	1022.82	N/A
WIPP-12	CUL	3472.06	01/16/02	439.82	134.06	3032.24	924.23	3069.05
WIPP-12	CUL	3472.06	02/05/02	439.68	134.01	3032.38	924.27	3069.2
WIPP-12	CUL	3472.06	03/12/02	439.47	133.95	3032.59	924.33	3069.43
WIPP-12	CUL	3472.06	04/08/02	439.23	133.88	3032.83	924.41	3069.7

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
WIPP-12	CUL	3472.06	05/07/02	439.10	133.84	3032.96	924.45	3069.84
WIPP-12	CUL	3472.06	06/10/02	438.95	133.79	3033.11	924.49	3070
WIPP-12	CUL	3472.06	07/15/02	438.90	133.78	3033.16	924.51	3070.06
WIPP-12	CUL	3472.06	08/13/02	438.84	133.76	3033.22	924.53	3070.12
WIPP-12	CUL	3472.06	09/10/02	438.85	133.76	3033.21	924.52	3070.11
WIPP-12	CUL	3472.06	10/07/02	438.82	133.75	3033.24	924.53	3070.15
WIPP-12	CUL	3472.06	11/04/02	438.81	133.75	3033.25	924.53	3070.16
WIPP-12	CUL	3472.06	12/02/02	438.77	133.74	3033.29	924.55	3070.20
WIPP-13	CUL	3405.71	01/15/02	348.45	106.21	3057.26	931.85	3067.83
WIPP-13	CUL	3405.71	02/05/02	348.46	106.21	3057.25	931.85	3067.82
WIPP-13	CUL	3405.71	03/11/02	348.22	106.14	3057.49	931.92	3068.06
WIPP-13	CUL	3405.71	04/08/02	348.07	106.09	3057.64	931.97	3068.22
WIPP-13	CUL	3405.71	05/06/02	348.04	106.08	3057.67	931.98	3068.25
WIPP-13	CUL	3405.71	06/11/02	347.80	106.01	3057.91	932.05	3068.50
WIPP-13	CUL	3405.71	07/15/02	347.87	106.03	3057.84	932.03	3068.42
WIPP-13	CUL	3405.71	08/13/02	347.81	106.01	3057.90	932.05	3068.49
WIPP-13	CUL	3405.71	09/09/02	347.92	106.05	3057.79	932.01	3068.37
WIPP-13	CUL	3405.71	10/08/02	347.73	105.99	3057.98	932.07	3068.57
WIPP-13	CUL	3405.71	11/05/02	347.72	105.99	3057.99	932.08	3068.58
WIPP-13	CUL	3405.71	12/02/02	347.71	105.98	3058.00	932.08	3068.59
WIPP-19	CUL	3435.14	01/16/02	395.13	120.44	3040.01	926.60	3077.82
WIPP-19	CUL	3435.14	02/05/02	395.01	120.40	3040.13	926.63	3077.95
WIPP-19	CUL	3435.14	03/12/02	394.90	120.37	3040.24	926.67	3078.08
WIPP-19	CUL	3435.14	04/08/02	394.62	120.28	3040.52	926.75	3078.38
WIPP-19	CUL	3435.14	05/07/02	394.50	120.24	3040.64	926.79	3078.52
WIPP-19	CUL	3435.14	06/10/02	394.24	120.16	3040.90	926.87	3078.80
WIPP-19	CUL	3435.14	07/15/02	394.26	120.17	3040.88	926.86	3078.78
WIPP-19	CUL	3435.14	08/13/02	394.05	120.11	3041.09	926.92	3079.01

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
WIPP-19	CUL	3435.14	09/10/02	394.08	120.12	3041.06	926.92	3078.98
WIPP-19	CUL	3435.14	10/07/02	394.10	120.12	3041.04	926.91	3078.96
WIPP-19	CUL	3435.14	11/04/02	394.02	120.10	3041.12	926.93	3079.04
WIPP-19	CUL	3435.14	12/02/02	393.92	120.07	3041.22	926.96	3079.15
WIPP-21	CUL	3418.96	01/16/02	402.99	122.83	3015.97	919.27	3040.11
WIPP-21	CUL	3418.96	02/05/02	402.88	122.80	3016.08	919.30	3040.23
WIPP-21	CUL	3418.96	03/12/02	402.80	122.77	3016.16	919.33	3040.31
WIPP-21	CUL	3418.96	04/08/02	402.39	122.65	3016.57	919.45	3040.75
WIPP-21	CUL	3418.96	05/07/02	402.16	122.58	3016.80	919.52	3041.00
WIPP-21	CUL	3418.96	06/10/02	401.83	122.48	3017.13	919.62	3041.35
WIPP-21	CUL	3418.96	07/15/02	401.71	122.44	3017.25	919.66	3041.48
WIPP-21	CUL	3418.96	08/13/02	401.50	122.38	3017.46	919.72	3041.70
WIPP-21	CUL	3418.96	09/10/02	401.20	122.29	3017.76	919.81	3042.02
WIPP-21	CUL	3418.96	10/07/02	401.58	122.40	3017.38	919.70	3041.62
WIPP-21	CUL	3418.96	11/04/02	401.64	122.42	3017.32	919.68	3041.55
WIPP-21	CUL	3418.96	12/02/02	401.63	122.42	3017.33	919.68	3041.56
WIPP-22	CUL	3428.12	01/16/02	397.95	121.30	3030.17	923.60	3061.24
WIPP-22	CUL	3428.12	02/05/02	397.86	121.27	3030.26	923.62	3061.34
WIPP-22	CUL	3428.12	03/12/02	397.73	121.23	3030.39	923.66	3061.48
WIPP-22	CUL	3428.12	04/08/02	397.39	121.12	3030.73	923.77	3061.85
WIPP-22	CUL	3428.12	05/07/02	397.28	121.09	3030.84	923.80	3061.97
WIPP-22	CUL	3428.12	06/10/02	396.99	121.00	3031.13	923.89	3062.29
WIPP-22	CUL	3428.12	07/15/02	396.23	120.77	3031.89	924.12	3063.11
WIPP-22	CUL	3428.12	08/13/02	396.75	120.93	3031.37	923.96	3062.55
WIPP-22	CUL	3428.12	09/10/02	396.75	120.93	3031.37	923.96	3062.55
WIPP-22	CUL	3428.12	10/07/02	396.75	120.93	3031.37	923.96	3062.55
WIPP-22	CUL	3428.12	11/04/02	396.68	120.91	3031.44	923.98	3062.62
WIPP-22	CUL	3428.12	12/02/02	396.61	120.89	3031.51	924.00	3062.70

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
WIPP-25 (ANNULUS)	MAG	3214.39	01/14/02	163.78	49.92	3050.61	929.83	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	02/06/02	163.59	49.86	3050.80	929.88	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	03/11/02	163.84	49.94	3050.55	929.81	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	04/09/02	163.17	49.73	3051.22	930.01	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	05/06/02	163.04	49.69	3051.35	930.05	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	06/10/02	162.97	49.67	3051.42	930.07	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	07/16/02	162.72	49.60	3051.67	930.15	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	08/12/02	162.62	49.57	3051.77	930.18	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	09/11/02	162.56	49.55	3051.83	930.20	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	10/08/02	162.49	49.53	3051.90	930.22	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	11/05/02	162.14	49.42	3052.25	930.33	N/A
WIPP-25 (ANNULUS)	MAG	3214.39	12/03/02	162.30	49.47	3052.09	930.28	N/A
WIPP-25 (PIP)	CUL	3214.39	01/14/02	153.78	46.87	3060.61	932.87	3057.53
WIPP-25 (PIP)	CUL	3214.39	02/06/02	153.49	46.78	3060.90	932.96	3057.82
WIPP-25 (PIP)	CUL	3214.39	03/11/02	153.20	46.70	3061.19	933.05	3058.11
WIPP-25 (PIP)	CUL	3214.39	04/09/02	153.14	46.68	3061.25	933.07	3058.17
WIPP-25 (PIP)	CUL	3214.39	05/06/02	152.84	46.59	3061.55	933.16	3058.46
WIPP-25 (PIP)	CUL	3214.39	06/10/02	152.75	46.56	3061.64	933.19	3058.55
WIPP-25 (PIP)	CUL	3214.39	07/16/02	152.42	46.46	3061.97	933.29	3058.88
WIPP-25 (PIP)	CUL	3214.39	08/12/02	152.23	46.40	3062.16	933.35	3059.07
WIPP-25 (PIP)	CUL	3214.39	09/11/02	152.29	46.42	3062.10	933.33	3059.01
WIPP-25 (PIP)	CUL	3214.39	10/08/02	152.11	46.36	3062.28	933.38	3059.19
WIPP-25 (PIP)	CUL	3214.39	11/05/02	151.91	46.30	3062.48	933.44	3059.38
WIPP-25 (PIP)	CUL	3214.39	12/03/02	152.07	46.35	3062.32	933.40	3059.23
WIPP-26	CUL	3153.20	01/15/02	131.48	40.08	3021.72	921.02	3021.85
WIPP-26	CUL	3153.20	02/06/02	131.38	40.04	3021.82	921.05	3021.96
WIPP-26	CUL	3153.20	03/11/02	131.36	40.04	3021.84	921.06	3021.98
WIPP-26	CUL	3153.20	04/09/02	131.25	40.01	3021.95	921.09	3022.09

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
WIPP-26	CUL	3153.20	05/06/02	131.06	39.95	3022.14	921.15	3022.28
WIPP-26	CUL	3153.20	06/12/02	131.27	40.01	3021.93	921.08	3022.07
WIPP-26	CUL	3153.20	07/16/02	130.77	39.86	3022.43	921.24	3022.57
WIPP-26	CUL	3153.20	08/12/02	130.81	39.87	3022.39	921.22	3022.53
WIPP-26	CUL	3153.20	09/11/02	131.34	40.03	3021.86	921.06	3022.00
WIPP-26	CUL	3153.20	10/08/02	130.97	39.92	3022.23	921.18	3022.37
WIPP-26	CUL	3153.20	11/05/02	130.25	39.70	3022.95	921.40	3023.09
WIPP-26	CUL	3153.20	12/03/02	130.19	39.68	3023.01	921.41	3023.15
WIPP-27 (PIP)	CUL	3178.98	01/14/02	96.43	29.39	3082.55	939.56	3088.65
WIPP-27 (PIP)	CUL	3178.98	02/06/02	96.33	29.36	3082.65	939.59	3088.75
WIPP-27 (PIP)	CUL	3178.98	03/11/02	96.19	29.32	3082.79	939.63	3088.90
WIPP-27 (PIP)	CUL	3178.98	04/09/02	96.38	29.38	3082.60	939.58	3088.70
WIPP-27 (PIP)	CUL	3178.98	05/06/02	96.36	29.37	3082.62	939.58	3088.72
WIPP-27 (PIP)	CUL	3178.98	06/10/02	96.68	29.47	3082.30	939.49	3088.39
WIPP-27 (PIP)	CUL	3178.98	07/16/02	97.02	29.57	3081.96	939.38	3088.04
WIPP-27 (PIP)	CUL	3178.98	08/12/02	97.12	29.60	3081.86	939.35	3087.94
WIPP-27 (PIP)	CUL	3178.98	09/10/02	97.30	29.66	3081.68	939.30	3087.76
WIPP-27 (PIP)	CUL	3178.98	10/08/02	97.37	29.68	3081.61	939.27	3087.68
WIPP-27 (PIP)	CUL	3178.98	11/05/02	97.06	29.58	3081.92	939.37	3088.00
WIPP-27 (PIP)	CUL	3178.98	12/02/02	96.59	29.44	3082.39	939.51	3088.49
WIPP-29	CUL	2978.26	01/14/02	11.42	3.48	2966.84	904.29	2969.96
WIPP-29	CUL	2978.26	02/06/02	11.11	3.39	2967.15	904.39	2970.33
WIPP-29	CUL	2978.26	03/11/02	11.26	3.43	2967.00	904.34	2970.15
WIPP-29	CUL	2978.26	04/09/02	11.01	3.36	2967.25	904.42	2970.45
WIPP-29	CUL	2978.26	05/06/02	10.97	3.34	2967.29	904.43	2970.50
WIPP-29	CUL	2978.26	06/12/02	11.19	3.41	2967.07	904.36	2970.24
WIPP-29	CUL	2978.26	07/16/02	11.16	3.40	2967.10	904.37	2970.27
WIPP-29	CUL	2978.26	08/12/02	11.10	3.38	2967.16	904.39	2970.34

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
WIPP-29	CUL	2978.26	09/11/02	11.19	3.41	2967.07	904.36	2970.24
WIPP-29	CUL	2978.26	10/08/02	11.24	3.43	2967.02	904.35	2970.18
WIPP-29	CUL	2978.26	11/05/02	11.00	3.35	2967.26	904.42	2970.46
WIPP-29	CUL	2978.26	12/03/02	11.06	3.37	2967.20	904.40	2970.39
WIPP-30 (PIP)	CUL	3429.05	01/15/02	360.79	109.97	3068.26	935.21	3075.33
WIPP-30 (PIP)	CUL	3429.05	02/06/02	360.64	109.92	3068.41	935.25	3075.48
WIPP-30 (PIP)	CUL	3429.05	03/11/02	360.05	109.74	3069.00	935.43	3076.09
WIPP-30 (PIP)	CUL	3429.05	04/09/02	359.89	109.69	3069.16	935.48	3076.25
WIPP-30 (PIP)	CUL	3429.05	05/08/02	359.35	109.53	3069.70	935.64	3076.81
WIPP-30 (PIP)	CUL	3429.05	06/12/02	359.11	109.46	3069.94	935.72	3077.05
WIPP-30 (PIP)	CUL	3429.05	07/15/02	359.03	109.43	3070.02	935.74	3077.13
WIPP-30 (PIP)	CUL	3429.05	08/13/02	358.82	109.37	3070.23	935.81	3077.35
WIPP-30 (PIP)	CUL	3429.05	09/09/02	358.86	109.38	3070.19	935.79	3077.31
WIPP-30 (PIP)	CUL	3429.05	10/08/02	358.64	109.31	3070.41	935.86	3077.53
WIPP-30 (PIP)	CUL	3429.05	11/05/02	358.57	109.29	3070.48	935.88	3077.61
WIPP-30 (PIP)	CUL	3429.05	12/03/02	358.49	109.27	3070.56	935.91	3077.69
WQSP-1	CUL	3419.20	01/16/02	365.31	111.35	3053.89	930.83	3070.58
WQSP-1	CUL	3419.20	02/05/02	365.18	111.31	3054.02	930.87	3070.72
WQSP-1	CUL	3419.20	03/11/02	364.83	111.20	3054.37	930.97	3071.09
WQSP-1	CUL	3419.20	04/08/02	364.58	111.12	3054.62	931.05	3071.35
WQSP-1	CUL	3419.20	05/06/02	364.46	111.09	3054.74	931.08	3071.47
WQSP-1	CUL	3419.20	06/10/02	364.24	111.02	3054.96	931.15	3071.71
WQSP-1	CUL	3419.20	07/15/02	364.23	111.02	3054.97	931.15	3071.72
WQSP-1	CUL	3419.20	08/12/02	364.07	110.97	3055.13	931.20	3071.88
WQSP-1	CUL	3419.20	09/09/02	364.18	111.00	3055.02	931.17	3071.77
WQSP-1	CUL	3419.20	10/07/02	364.14	110.99	3055.06	931.18	3071.81
WQSP-1	CUL	3419.20	11/04/02	364.01	110.95	3055.19	931.22	3071.95
WQSP-1	CUL	3419.20	12/02/02	363.92	110.92	3055.28	931.25	3072.04

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
WQSP-3	CUL	3480.30	01/16/02	468.32	142.74	3011.98	918.05	3069.14
WQSP-3	CUL	3480.30	02/05/02	468.08	142.67	3012.22	918.12	3069.41
WQSP-3	CUL	3480.30	03/12/02	467.68	142.55	3012.62	918.25	3069.87
WQSP-3	CUL	3480.30	04/08/02	472.06	143.88	3008.24	916.91	3064.85
WQSP-3	CUL	3480.30	05/07/02	468.25	142.72	3012.05	918.07	3069.22
WQSP-3	CUL	3480.30	06/10/02	467.60	142.52	3012.70	918.27	3069.96
WQSP-3	CUL	3480.30	07/15/02	467.40	142.46	3012.90	918.33	3070.19
WQSP-3	CUL	3480.30	08/12/02	467.17	142.39	3013.13	918.40	3070.45
WQSP-3	CUL	3480.30	09/09/02	467.06	142.36	3013.24	918.44	3070.58
WQSP-3	CUL	3480.30	10/07/02	473.79	144.41	3006.51	916.38	3062.87
WQSP-3	CUL	3480.30	11/04/02	468.35	142.75	3011.95	918.04	3069.10
WQSP-3	CUL	3480.30	12/02/02	467.69	142.55	3012.61	918.24	3069.86
WQSP-4	CUL	3433.00	01/16/02	445.54	135.80	2987.46	910.58	3012.41
WQSP-4	CUL	3433.00	02/05/02	445.42	135.76	2987.58	910.61	3012.54
WQSP-4	CUL	3433.00	03/13/02	445.26	135.72	2987.74	910.66	3012.71
WQSP-4	CUL	3433.00	04/09/02	445.54	135.80	2987.46	910.58	3012.41
WQSP-4	CUL	3433.00	05/07/02	445.31	135.73	2987.69	910.65	3012.66
WQSP-4	CUL	3433.00	06/10/02	444.89	135.60	2988.11	910.78	3013.11
WQSP-4	CUL	3433.00	07/15/02	444.78	135.57	2988.22	910.81	3013.23
WQSP-4	CUL	3433.00	08/12/02	444.53	135.49	2988.47	910.89	3013.50
WQSP-4	CUL	3433.00	09/09/02	444.55	135.50	2988.45	910.88	3013.47
WQSP-4	CUL	3433.00	10/07/02	444.56	135.50	2988.44	910.88	3013.46
WQSP-4	CUL	3433.00	11/04/02	444.82	135.58	2988.18	910.80	3013.18
WQSP-4	CUL	3433.00	12/02/02	444.58	135.51	2988.42	910.87	3013.44
WQSP-5	CUL	3384.40	01/16/02	381.43	116.26	3002.97	915.31	3010.03
WQSP-5	CUL	3384.40	02/05/02	381.29	116.22	3003.11	915.35	3010.17
WQSP-5	CUL	3384.40	03/13/02	381.30	116.22	3003.10	915.34	3010.16
WQSP-5	CUL	3384.40	04/09/02	381.28	116.21	3003.12	915.35	3010.18

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
WQSP-5	CUL	3384.40	05/08/02	381.46	116.27	3002.94	915.30	3010.00
WQSP-5	CUL	3384.40	06/10/02	380.77	116.06	3003.63	915.51	3010.71
WQSP-5	CUL	3384.40	07/15/02	380.68	116.03	3003.72	915.53	3010.80
WQSP-5	CUL	3384.40	08/12/02	380.40	115.95	3004.00	915.62	3011.09
WQSP-5	CUL	3384.40	09/09/02	380.36	115.93	3004.04	915.63	3011.13
WQSP-5	CUL	3384.40	10/07/02	380.34	115.93	3004.06	915.64	3011.15
WQSP-5	CUL	3384.40	11/04/02	381.67	116.33	3002.73	915.23	3009.78
WQSP-5	CUL	3384.40	12/02/02	380.43	115.96	3003.97	915.61	3011.05
WQSP-6	CUL	3363.80	01/16/02	347.61	105.95	3016.19	919.33	3019.92
WQSP-6	CUL	3363.80	02/05/02	347.47	105.91	3016.33	919.38	3020.07
WQSP-6	CUL	3363.80	03/13/02	347.07	105.79	3016.73	919.50	3020.47
WQSP-6	CUL	3363.80	04/09/02	347.20	105.83	3016.60	919.46	3020.34
WQSP-6	CUL	3363.80	05/08/02	346.83	105.71	3016.97	919.57	3020.72
WQSP-6	CUL	3363.80	06/10/02	347.43	105.90	3016.37	919.39	3020.11
WQSP-6	CUL	3363.80	07/15/02	347.06	105.78	3016.74	919.50	3020.48
WQSP-6	CUL	3363.80	08/12/02	346.79	105.70	3017.01	919.58	3020.76
WQSP-6	CUL	3363.80	09/09/02	346.71	105.68	3017.09	919.61	3020.84
WQSP-6	CUL	3363.80	10/07/02	346.70	105.67	3017.10	919.61	3020.85
WQSP-6	CUL	3363.80	11/04/02	346.54	105.63	3017.26	919.66	3021.01
WQSP-6	CUL	3363.80	12/02/02	347.35	105.87	3016.45	919.41	3020.19
WQSP-6A	DL	3364.70	01/16/02	166.44	50.73	3198.26	974.83	N/A
WQSP-6A	DL	3364.70	02/05/02	166.46	50.74	3198.24	974.82	N/A
WQSP-6A	DL	3364.70	03/13/02	166.22	50.66	3198.48	974.90	N/A
WQSP-6A	DL	3364.70	04/09/02	166.67	50.80	3198.03	974.76	N/A
WQSP-6A	DL	3364.70	05/08/02	166.31	50.69	3198.39	974.87	N/A
WQSP-6A	DL	3364.70	06/10/02	166.33	50.70	3198.37	974.86	N/A
WQSP-6A	DL	3364.70	07/15/02	166.49	50.75	3198.21	974.81	N/A
WQSP-6A	DL	3364.70	08/12/02	166.43	50.73	3198.27	974.83	N/A

Table 6.11 - Groundwater Level Measurement Results for 2002

Well Number	Zone	Top of Casing Elevation	Date	Measured Depth From Top of Casing	Measured Depth in Meters	Elevation in Feet AMSL*	Elevation in Meters	Elevation Adjusted to Equivalent Fresh Water Head
WQSP-6A	DL	3364.70	09/09/02	166.60	50.78	3198.10	974.78	N/A
WQSP-6A	DL	3364.70	10/07/02	166.73	50.82	3197.97	974.74	N/A
WQSP-6A	DL	3364.70	11/04/02	166.60	50.78	3198.10	974.78	N/A
WQSP-6A	DL	3364.70	12/02/02	166.48	50.74	3198.22	974.82	N/A

N/A = Not applicable
* Above mean sea level

Table 6.12 - Shallow Subsurface Water Analyses

	Well ID					
Parameter	**C-2505**	**C2506**	**C-2507**	**C-2507 (Dup.)**	**PZ-1**	**PZ-2**
Ammonium	0.359	0.341	0.0641	0.0097	0.214	<0.004
Arsenic	0.0018	0.0018	0.0017	0.0017	0.0013	0.0019
Barium	0.0885	0.0969	0.0453	0.044	0.173	0.0191
Boron	0.2	0.078	0.27	0.25	<0.011	0.18
Bromide	10	6	4.4	4.3	2.9	7.4
Cadmium	<0.001	0.001	0.00012	0.0001	0.0014	0.00052
Calcium	833	1150	446	444	5140	452
Chloride	5920	8870	1520	1560	48500	1230
Chromium	0.0201	0.0156	0.0421	0.0411	0.0179	0.0088
Iron	0.0161	<0.014	0.0019	<0.0014	<0.014	<0.0014
Lead	<0.001	<0.001	0.00052	0.00018	<0.001	0.00011
Magnesium	574	753	338	337	2700	338
Mercury	<0.001	<0.001	<0.0002	<0.0002	0.0012	<0.0002
Nitrate	24.2	25.7	25.9	26.3	6.16	9.68
Nitrite	<0.0061	<0.0061	0.0252	0.0307	<0.0061	<0.0061
pH	7.21	7.09	7.15	7.17	6.8	7.43
Potassium	11	14.6	6.7	6.6	41.3	7.2
Selenium	0.0895	0.0911	0.0633	0.0646	0.0801	0.121
Silicon	23.2	22.1	24.6	24.6	21	22.1
Silver	<0.001	<0.001	0.00053	0.00015	0.0029	<0.0001
Sodium	2090	3240	348	343	19000	417
Specific Gravity	1.01	1.012	1.006	1.006	1.058	1.004
Sulfate	1200	1280	977	996	1790	1550
Total Dissolved Solids	12000	17700	3650	3630	86700	4260
Total Inorganic Carbon	53.5	49.1	82.7	83.8	25	56.2
Total Organic Carbon	3.4	3.3	3.4	3.3	3.5	4
Total Suspended Solids	<10	<10	<10	<10	<10	<10
Zinc	<0.01	<0.01	0.0125	0.0021	<0.01	<0.001
Parameter	**PZ-3**	**PZ-4**	**PZ-5**	**PZ-6**	**PZ-6 (Dup.)**	**PZ-7**
Ammonium	0.264	0.606	0.259	0.585	0.599	0.378
Arsenic	0.0014	0.0015	0.00095	0.00088	0.00092	0.001
Barium	0.0746	0.18	0.0882	0.108	0.108	0.0605
Boron	0.093	0.064	0.035	0.063	0.034	0.054
Bromide	7.2	6.1	15.2	5.2	5.2	10.9
Cadmium	<0.001	0.0011	0.0014	0.0018	0.0018	0.0017
Calcium	933	2370	2500	2160	2150	3020
Chloride	16100	39300	30900	48500	47400	33000
Chromium	0.0141	0.0209	0.0155	0.0191	0.0192	0.0202
Iron	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	635	1210	1480	1340	1340	1760
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate	14.9	16.3	13.2	25.5	25.5	19.9
Nitrite	<0.0061	<0.0061	<0.0061	<0.0061	<0.0061	<0.0061
pH	7.03	7.14	6.88	6.74	7.02	6.75
Potassium	65.2	47.5	63.3	344	349	57.8

Table 6.12 - Shallow Subsurface Water Analyses

	Well ID					
Parameter	**C-2505**	**C2506**	**C-2507**	**C-2507 (Dup.)**	**PZ-1**	**PZ-2**
Selenium	0.123	0.0533	0.0839	0.0589	0.0579	0.0908
Silicon	18.9	20.6	20	20.4	20.2	22.2
Silver	<0.001	0.0012	<0.001	0.0012	0.0011	0.0011
Sodium	7890	19000	13300	24600	24600	13600
Specific Gravity	1.022	1.046	1.038	1.06	1.058	1.04
Sulfate	1410	1420	1550	2550	2610	2040
Parameter	**PZ-3**	**PZ-4**	**PZ-5**	**PZ-6**	**PZ-6 (Dup.)**	**PZ-7**
Total Dissolved Solids	29700	69000	55200	86400	86400	61000
Total Inorganic Carbon	40.3	43.7	33	43.6	44.3	40.4
Total Organic Carbon	3.4	1.9	1.1	2.1	2.3	6.2
Total Suspended Solids	11.8	<10	<10	<10	<10	<10
Zinc	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010

Parameter	PZ-7 (Dup.)	PZ-9	PZ-10	PZ-11	PZ-12	PZ-12 (Dup.)	C-2811
Ammonium	0.399	0.159	0.0145	0.116	0.826	0.854	0.0125
Arsenic	0.00073	<0.0005	0.0017	0.00088	0.0012	0.0014	0.0021
Barium	0.0614	0.21	0.0484	0.229	0.116	0.113	0.102
Boron	0.03	0.082	0.29	<0.011	0.13	0.097	0.17
Bromide	9.1	35	2.2	17	4.2	4.1	1.9
Cadmium	0.0017	0.005	<0.0001	0.0047	<0.001	<0.001	<0.0001
Calcium	3030	3250	242	3430	769	771	272
Chloride	33200	73800	445	55800	6250	6300	899
Chromium	0.0209	0.0219	0.0019	0.0217	0.0166	0.0163	0.003
Iron	<0.014	<0.014	0.0042	<0.014	<0.014	<0.014	<0.0014
Lead	<0.001	0.004	<0.0001	0.0014	<0.001	<0.001	<0.0001
Magnesium	1790	3360	163	2720	551	549	206
Mercury	<0.001	0.0027	<0.0002	0.0034	<0.001	<0.001	<0.0002
Nitrate	19.8	14	20.9	28.2	30.9	30.6	27.6
Nitrite	<0.0061	0.0217	0.02	<0.0061	<0.0061	0.0207	0.0265
PH	6.7	6.49	7.37	6.62	6.97	7.03	7.4
Potassium	59	523	3.9	73.3	25	24.8	4.3
Selenium	0.0904	0.0466	0.0256	0.0264	0.0372	0.0375	0.0246
Silicon	22.2	14.8	21.7	18.2	21.3	21.2	21.8
Silver	0.0011	0.0033	<0.0001	0.0022	<0.001	<0.001	<0.0001
Sodium	13700	34800	178	26200	2280	2260	134
Specific Gravity	1.042	1.086	1.004	1.068	1.01	1.012	1
Sulfate	2010	3560	650	2410	815	809	355
Total Dissolved Solids	59800	135000	2160	104000	12500	12500	2400
Total Inorganic Carbon	39.5	41.4	99	34.5	71.6	72.3	50
Total Organic Carbon	6	1.5	2.7	1.7	2.9	2.5	1.9
Total Suspended Solids	<10	<10	29.3	<10	<10	<10	<10
Zinc	<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001

Note:
"<" denotes concentration is below method detection limit of value indicated
All concentrations are reported in milligrams per liter (mg/L)

Table 6.13 - Shallow Subsurface Water Level Measurements

Well Number	Date	Casing Elevation (AMSL*)	Depth to Water (Feet)	Water Level Elevation (AMSL)
C-2505	1/31/02	3413.05	45.81	3367.24
C-2505	2/28/02	3413.05	45.54	3367.51
C-2505	3/25/02	3413.05	45.73	3367.32
C-2505	4/29/02	3413.05	45.65	3367.4
C-2505	5/30/02	3413.05	45.73	3367.32
C-2505	6/25/02	3413.05	45.96	3367.09
C-2505	7/29/02	3413.05	45.77	3367.28
C-2505	8/15/02	3413.05	45.61	3367.44
C-2505	9/12/02	3413.05	45.49	3367.56
C-2505	10/10/02	3413.05	45.55	3367.5
C-2505	11/6/02	3413.05	45.64	3367.41
C-2505	12/4/02	3413.05	45.53	3367.52
C-2506	1/31/02	3412.87	45.2	3367.67
C-2506	2/28/02	3412.87	44.86	3368.01
C-2506	3/25/02	3412.87	45.09	3367.78
C-2506	4/29/02	3412.87	45.02	3367.85
C-2506	5/30/02	3412.87	45.06	3367.81
C-2506	6/25/02	3412.87	45.32	3367.55
C-2506	7/29/02	3412.87	45.13	3367.74
C-2506	8/15/02	3412.87	45	3367.87
C-2506	9/12/02	3412.87	44.89	3367.98
C-2506	10/10/02	3412.87	44.93	3367.94
C-2506	11/6/02	3412.87	45.01	3367.86
C-2506	12/4/02	3412.87	44.9	3367.97
C-2507	1/31/02	3410.01	46.12	3363.89
C-2507	2/28/02	3410.01	45.88	3364.13
C-2507	3/25/02	3410.01	46.1	3363.91
C-2507	4/29/02	3410.01	46.02	3363.99
C-2507	5/30/02	3410.01	46.01	3364
C-2507	6/25/02	3410.01	46.22	3363.79
C-2507	7/29/02	3410.01	46.02	3363.99
C-2507	8/15/02	3410.01	45.85	3364.16
C-2507	9/12/02	3410.01	45.62	3364.39
C-2507	10/10/02	3410.01	45.59	3364.42
C-2507	11/6/02	3410.01	45.64	3364.37
C-2507	12/4/02	3410.01	45.6	3364.41
PZ-1	1/31/02	3413.41	42.54	3370.87
PZ-1	2/28/02	3413.41	42.13	3371.28
PZ-1	3/25/02	3413.41	42.32	3371.09
PZ-1	4/29/02	3413.41	42.29	3371.12
PZ-1	5/30/02	3413.41	42.3	3371.11
PZ-1	6/25/02	3413.41	42.5	3370.91
PZ-1	7/29/02	3413.41	42.45	3370.96
PZ-1	8/15/02	3413.41	42.44	3370.97
PZ-1	9/12/02	3413.41	42.51	3370.9
PZ-1	10/10/02	3413.41	42.56	3370.85
PZ-1	11/6/02	3413.41	42.64	3370.77
PZ-1	12/4/02	3413.41	42.55	3370.86
PZ-2	1/31/02	3413.42	43.72	3369.7
PZ-2	2/28/02	3413.42	43.45	3369.97
PZ-2	3/25/02	3413.42	43.6	3369.82

Table 6.13 - Shallow Subsurface Water Level Measurements

Well Number	Date	Casing Elevation (AMSL*)	Depth to Water (Feet)	Water Level Elevation (AMSL)
PZ-2	4/29/02	3413.42	43.58	3369.84
PZ-2	5/30/02	3413.42	43.6	3369.82
PZ-2	6/25/02	3413.42	43.8	3369.62
PZ-2	7/29/02	3413.42	43.72	3369.7
PZ-2	8/15/02	3413.42	43.68	3369.74
PZ-2	9/12/02	3413.42	43.85	3369.57
PZ-2	10/10/02	3413.42	43.92	3369.5
PZ-2	11/6/02	3413.42	44.08	3369.34
PZ-2	12/4/02	3413.42	44.88	3368.54
PZ-3	1/31/02	3416.15	45.51	3370.64
PZ-3	2/28/02	3416.15	45.52	3370.63
PZ-3	3/25/02	3416.15	45.44	3370.71
PZ-3	4/29/02	3416.15	45.41	3370.74
PZ-3	5/30/02	3416.15	45.71	3370.44
PZ-3	6/25/02	3416.15	45.48	3370.67
PZ-3	7/29/02	3416.15	45.34	3370.81
PZ-3	8/15/02	3416.15	45.29	3370.86
PZ-3	9/12/02	3416.15	45.44	3370.71
PZ-3	10/10/02	3416.15	45.49	3370.66
PZ-3	11/6/02	3416.15	45.63	3370.52
PZ-3	12/4/02	3416.15	45.45	3370.7
PZ-4	1/31/02	3412.1	48	3364.1
PZ-4	2/28/02	3412.1	47.77	3364.33
PZ-4	3/25/02	3412.1	48	3364.1
PZ-4	4/29/02	3412.1	47.93	3364.17
PZ-4	5/30/02	3412.1	47.93	3364.17
PZ-4	6/25/02	3412.1	47.12	3364.98
PZ-4	7/29/02	3412.1	46.91	3365.19
PZ-4	8/15/02	3412.1	47.74	3364.36
PZ-4	9/12/02	3412.1	47.62	3364.48
PZ-4	10/10/02	3412.1	47.63	3364.47
PZ-4	11/6/02	3412.1	47.74	3364.36
PZ-4	12/4/02	3412.1	47.61	3364.49
PZ-5	1/31/02	3415.31	43.2	3372.11
PZ-5	2/28/02	3415.31	42.9	3372.41
PZ-5	3/25/02	3415.31	43.05	3372.26
PZ-5	4/29/02	3415.31	43.05	3372.26
PZ-5	5/30/02	3415.31	43.21	3372.1
PZ-5	6/25/02	3415.31	43.22	3372.09
PZ-5	7/29/02	3415.31	43.14	3372.17
PZ-5	8/15/02	3415.31	43.12	3372.19
PZ-5	9/12/02	3415.31	43.27	3372.04
PZ-5	10/10/02	3415.31	43.33	3371.98
PZ-5	11/6/02	3415.31	43.43	3371.88
PZ-5	12/4/02	3415.31	43.26	3372.05
PZ-6	1/31/02	3413.49	43.65	3369.84
PZ-6	2/28/02	3413.49	43.4	3370.09
PZ-6	3/25/02	3413.49	43.54	3369.95
PZ-6	4/29/02	3413.49	43.59	3369.9
PZ-6	5/30/02	3413.49	43.81	3369.68
PZ-6	6/25/02	3413.49	43.84	3369.65

Table 6.13 - Shallow Subsurface Water Level Measurements

Well Number	Date	Casing Elevation (AMSL*)	Depth to Water (Feet)	Water Level Elevation (AMSL)
PZ-6	7/29/02	3413.49	43.74	3369.75
PZ-6	8/15/02	3413.49	43.66	3369.83
PZ-6	9/12/02	3413.49	43.65	3369.84
PZ-6	10/10/02	3413.49	43.68	3369.81
PZ-6	11/6/02	3413.49	43.74	3369.75
PZ-6	12/4/02	3413.49	43.65	3369.84
PZ-7	1/31/02	3413.99	37.32	3376.67
PZ-7	2/28/02	3413.99	36.98	3377.01
PZ-7	3/25/02	3413.99	37.07	3376.92
PZ-7	4/29/02	3413.99	37.09	3376.9
PZ-7	5/30/02	3413.99	37.06	3376.93
PZ-7	6/25/02	3413.99	37.24	3376.75
PZ-7	7/29/02	3413.99	37.24	3376.75
PZ-7	8/15/02	3413.99	37.19	3376.8
PZ-7	9/12/02	3413.99	37.49	3376.5
PZ-7	10/10/02	3413.99	37.58	3376.41
PZ-7	11/6/02	3413.99	37.78	3376.21
PZ-7	12/4/02	3413.99	37.61	3376.38
PZ-9	1/31/02	3421.21	57.87	3363.34
PZ-9	2/28/02	3421.21	57.61	3363.6
PZ-9	3/25/02	3421.21	57.78	3363.43
PZ-9	4/29/02	3421.21	57.32	3363.89
PZ-9	5/30/02	3421.21	57.6	3363.61
PZ-9	6/25/02	3421.21	57.83	3363.38
PZ-9	7/29/02	3421.21	57.67	3363.54
PZ-9	8/15/02	3421.21	57.59	3363.62
PZ-9	9/12/02	3421.21	57.79	3363.42
PZ-9	10/10/02	3421.21	57.75	3363.46
PZ-9	11/6/02	3421.21	57.81	3363.4
PZ-9	12/4/02	3421.21	57.26	3363.95
PZ-10	1/31/02	3405.8	38.15	3367.65
PZ-10	2/28/02	3405.8	37.9	3367.9
PZ-10	3/25/02	3405.8	38.17	3367.63
PZ-10	4/29/02	3405.8	37.74	3368.06
PZ-10	5/30/02	3405.8	38.28	3367.52
PZ-10	6/25/02	3405.8	38.57	3367.23
PZ-10	7/29/02	3405.8	38.68	3367.12
PZ-10	8/15/02	3405.8	38.47	3367.33
PZ-10	9/12/02	3405.8	38.31	3367.49
PZ-10	10/10/02	3405.8	38.34	3367.46
PZ-10	11/6/02	3405.8	38.36	3367.44
PZ-10	12/4/02	3405.8	38.19	3367.61
PZ-11	1/31/02	3418.95	45.31	3373.64
PZ-11	2/28/02	3418.95	45.04	3373.91
PZ-11	3/25/02	3418.95	45.16	3373.79
PZ-11	4/29/02	3418.95	45.13	3373.82
PZ-11	5/30/02	3418.95	45.11	3373.84
PZ-11	6/25/02	3418.95	45.38	3373.57
PZ-11	7/29/02	3418.95	45.37	3373.58
PZ-11	8/15/02	3418.95	45.3	3373.65
PZ-11	9/12/02	3418.95	45.54	3373.41

Table 6.13 - Shallow Subsurface Water Level Measurements

Well Number	Date	Casing Elevation (AMSL*)	Depth to Water (Feet)	Water Level Elevation (AMSL)
PZ-11	10/10/02	3418.95	45.56	3373.39
PZ-11	11/6/02	3418.95	45.74	3373.21
PZ-11	12/4/02	3418.95	45.63	3373.32
PZ-12	1/31/02	3408.99	54.12	3354.87
PZ-12	2/28/02	3408.99	53.87	3355.12
PZ-12	3/25/02	3408.99	54.26	3354.73
PZ-12	4/29/02	3408.99	54.15	3354.84
PZ-12	5/30/02	3408.99	54.03	3354.96
PZ-12	6/25/02	3408.99	54.44	3354.55
PZ-12	7/29/02	3408.99	53.97	3355.02
PZ-12	8/15/02	3408.99	53.6	3355.39
PZ-12	9/12/02	3408.99	53.15	3355.84
PZ-12	10/10/02	3408.99	53.17	3355.82
PZ-12	11/6/02	3408.99	53.4	3355.59
PZ-12	12/4/02	3408.99	53.28	3355.71
C-2811	1/31/02	3398.92	61.7	3337.22
C-2811	2/28/02	3398.92	61.37	3337.55
C-2811	3/25/02	3398.92	61.68	3337.24
C-2811	4/29/02	3398.92	61.46	3337.46
C-2811	5/30/02	3398.92	61.41	3337.51
C-2811	6/25/02	3398.92	61.59	3337.33
C-2811	7/29/02	3398.92	61.53	3337.39
C-2811	8/15/02	3398.92	61.35	3337.57
C-2811	9/12/02	3398.92	61.24	3337.68
C-2811	10/10/02	3398.92	60.92	3338
C-2811	11/6/02	3398.92	60.93	3337.99
C-2811	12/4/02	3398.92	60.76	3338.16

* AMSL - Above mean sea level

CHAPTER 7 - RADIOLOGICAL DOSE ASSESSMENT

It is the policy of DOE ". . . to conduct its operations in an environmentally safe and sound manner. Protection of the environment and the public are responsibilities of paramount importance and concern to DOE" (DOE Order 5400.1). In addition, DOE Order 5400.5 states, "It is also a DOE objective that potential exposures to members of the public be as far below the limits as is reasonably achievable. . . ."

Chapter 4 of this report summarized the amount of radioactivity in air emissions and other media sampled in the WIPP environment in 2002. It is the purpose of this chapter to summarize the air emission levels in regard to the potential dose from WIPP operations.

Specifically, this chapter summarizes:

- Regulatory requirements on emissions of radionuclides, effective dose equivalents, and use of CAP88-PC computer model;
- The national average dose from naturally occurring sources of radiation;
- The estimated dose from air emissions from WIPP;
- The total potential dose from WIPP operations; and
- Potential doses to nonhuman biota from radioactivity measured near WIPP.

7.1 Introduction and Dose Limits

Title 40 CFR Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," states "Emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/year."

Compliance with the above regulatory requirement is determined by measuring effluent flow rate; monitoring, extracting, collecting, and measuring radionuclides; and calculating the effective dose equivalent (EDE). The EDE is the weighted sum of the doses to the individual organs of the body. The dose to each organ is weighted according to the risk that dose represents. These organ doses are then added together, and that total is the effective dose equivalent. In this manner, the risk from different sources of radiation can be controlled by a single standard.

Calculating the EDE to members of the public requires the use of CAP88-PC or other EPA approved computer models and procedures. The WIPP Effluent Monitoring Program generally uses CAP88-PC. CAP88-PC is a set of computer programs, datasets and associated utility programs for estimation of dose and risk from radionuclide air emissions. CAP88-PC uses a Gaussian Plume dispersion model, which

predicts air concentrations, deposition rates, concentrations in food, and intake rates for people. CAP88-PC estimates dose and risk to individuals and populations from multiple pathways. Dose and risk is calculated for ingestion, inhalation, ground level air immersion, and ground surface irradiation exposure pathways.

Environmental radiation protection standards for the management and disposal of TRU wastes set limits on the total annual radiation dose equivalent to members of the public at 0.25 mSv (25 mrem) to the whole body and 0.75 mSv (75 mrem) to any critical organ (40 CFR §191.03). National standards for emissions of radionuclides from DOE facilities state that the maximum annual dose equivalent to any member of the public from air emissions must be no greater than 0.1 mSv (10 mrem) (40 CFR §61.92). The SDWA (40 CFR §141.16) states that average annual concentrations of beta- and gamma-emitting human-made radionuclides in drinking water shall not result in an annual dose equivalent greater than 0.04 mSv (4 mrem). It is important to note that all of these dose equivalent limits are set for radionuclides released to the environment from DOE operations. They do not include, but are limits in addition to, doses from natural background radiation or from medical procedures.

7.2 Background Radiation

Radiation is a naturally occurring phenomenon that has been in the environment since the beginning of time. There are several sources of natural radiation: cosmic and cosmogenic radiation (from outer space and the earth's atmosphere), terrestrial radiation (from the earth's crust), and internal radiation (naturally occurring radiation in our bodies, such as ^{40}K). The most common sources of terrestrial radiation are uranium, thorium, and their decay products. Potassium-40 is another source of terrestrial radiation. While not a major radiation source, ^{40}K may be enhanced in the southeastern New Mexico environment due to local potash mining. Radon gas, a decay product of uranium, is the most widely known naturally occurring terrestrial radionuclide. In addition to natural radioactivity, small amounts of radioactivity from above-ground nuclear weapons tests that occurred from 1945 through 1980 and the 1986 Chernobyl nuclear accident are also present in the environment. Together, these sources of radiation are called "background" radiation. Every human is constantly exposed to background radiation. Exposure to radioactivity from weapons testing fallout is quite small compared to natural radioactivity and continually gets smaller as radionuclides decay.

Naturally occurring radiation in our environment can deliver both internal and external doses. Internal dose is received as a result of the intake of radionuclides. The major routes of intake of radionuclides for members of the public are ingestion and inhalation. Ingestion includes the intake of the radionuclides from eating and drinking contaminated food or drink. Inhalation includes the intake of radionuclides through breathing dust particles containing radioactive materials or radon gas. External dose can occur from submersion in contaminated air or deposition of contaminants on surfaces. The average annual dose received by a member of the public from naturally occurring radionuclides is about 3 mSv (300 mrem) (Table 7.1).

Table 7.1 - Annual Estimated Average Radiation Dose Received by a Member of the Population of the United States from Naturally Occurring Radiation Sources (adapted from NCRP, 1987)

Source	Average Annual Effective Dose Equivalent (mSv)	(mrem)
Inhaled (Radon and Decay Products)	2	200
Internal Radionuclides	0.39	39
Terrestrial Radiation	0.28	28
Cosmic Radiation	0.27	27
Cosmogenic Radioactivity	0.01	1
Rounded Total from Natural Sources	3	300

7.3 Dose from Air Emissions

The NESHAP issued by the EPA set limits for radionuclide emissions to air (40 CFR Part 61, Subpart H). Compliance procedures for DOE facilities (40 CFR §61.93[a]) require the use of CAP88-PC or AIRDOS-PC computer models, or an equivalent, to calculate dose to members of the public. For the determination of the radiation dose received by members of the public, WIPP used the computer model CAP88-PC, version 2.0. Source term input for the program was determined by radiochemical analyses of periodic air samples taken from the effluent Stations A, B, and C (see Section 4.1). Air samples were analyzed for ^{241}Am, $^{239+240}$Pu, ^{238}Pu, and ^{90}Sr because they constitute over 98 percent of the dose potential from CH waste. Measured activity values greater than the MDC were used as a part of the source term for the air emission pathway and, for measured results less than the MDC, the MDC value was used as part of the source term (see Table 4.1). CAP88-PC dose calculations are based on the assumption that exposed persons remain at home during the entire year and all vegetables, milk, and meat consumed are home produced. Thus, this dose calculation is a maximum potential dose which encompasses dose from inhalation, submersion, deposition, and ingestion of air emitted radionuclides.

For 2002, the CAP88-PC model predicted the highest dose to someone residing near WIPP to be at the Smith Ranch approximately 8 km (5 mi) west-northwest of WIPP. Results showed the whole body dose potentially received by someone residing at this location to be about 7.61×10^{-8} mSv (7.61×10^{-6} mrem) per year.

7.4 Total Potential Dose from WIPP Operations

The radiation dose equivalent received by members of the public as a result of the management and storage of TRU radioactive wastes at any disposal facility operated by the DOE is regulated under 40 CFR Part 191, Subpart A. Specific standards state that the combined annual dose equivalent to any member of the public in the general

environment shall not exceed 0.25 mSv (25 mrem) to the whole body and 0.75 mSv (75 mrem) to any critical organ. Section 7.3 discussed the potential dose equivalent received from radionuclides released to the air from WIPP. The following sections discuss the potential dose equivalent through other pathways and the total potential dose equivalent a member of the public may have received from WIPP operations during 2002.

7.4.1 Potential Dose from Water Ingestion Pathway

The potential dose to individuals from the ingestion of WIPP-related radionuclides transported in water is estimated to be nonexistent for several reasons. Drinking water for communities near WIPP comes from groundwater sources which are not expected to be affected by potential WIPP contaminants based on current radionuclide transport scenarios summarized in DOE/WIPP 95-2065). The only credible pathway for contaminants from WIPP to accessible groundwater is through the Culebra Member of the Rustler Formation as stated in DOE/CAO 96-2184. Water from the Culebra is naturally not potable due to high levels of TDS. Water from the Dewey Lake Formation is suitable for livestock consumption having TDS values below 10,000 mg/L. Groundwater and surface water samples collected around WIPP during 2002 did not contain radionuclide concentrations discernable from those in samples collected prior to WIPP receiving waste.

7.4.2 Potential Dose from Wild Game Ingestion

Game animals sampled during 2002 were mule deer, quail, and fish. The only radionuclides detected were not different from background levels measured prior to commencement of waste shipments to WIPP. Therefore, no dose from WIPP-related radionuclides is estimated to have been received by any individual from this pathway during 2002.

7.4.3 Total Potential Dose from All Pathways

The only pathway for which a dose could be estimated was that of air emissions. Air emissions from WIPP were not above background ambient air levels. Estimated concentrations of radionuclides in air emissions accounted for the calculable dose from WIPP operations during 2002. The effective dose equivalent potentially received by the maximally exposed individual residing 8 km (5 mi) west-northwest of WIPP was calculated to be 7.61×10^{-8} mSv (7.61×10^{-6} mrem) per year whole body. This value is in compliance with the requirements of 0.1 mSv (10 mrem) per year as specified in 40 CFR §61.92. The total radiological dose and atmospheric release at WIPP in 2002 is summarized in Table 7.2.

Table 7.2 - WIPP Radiological Dose and Release Summary

WIPP Radiological Atmospheric Releases [a] During 2002 [b, c]			
^{238}Pu	$^{239+240}Pu$	^{241}Am	^{90}Sr
1.30×10^{-7} Ci	8.10×10^{-8} Ci	7.10×10^{-8} Ci	4.00×10^{-6} Ci
4.81×10^{3} Bq	3.00×10^{3} Bq	2.63×10^{3} Bq	1.48×10^{5} Bq

WIPP Radiological Dose Reporting Table in 2002 per CFR §61.92							
Pathway	Effective Dose Equivalent to the Maximally Exposed Individual at 7500 Meters WNW		% of EPA 10-mrem/ year limit to member of the public	Estimated Population Dose within 50 miles		Estimated Population within 50 miles	Estimated Natural Radiation Population Dose[d]
	(mrem/year)	(*mSv/year*)		*(person-rem/year)*	(*person-Sv/year*)		(*person-rem*)
Air	7.61×10^{-6}	7.61×10^{-8}	7.61×10^{-5}	1.66×10^{-5}	1.66×10^{-7}	78959	23688

WIPP Radiological Dose Reporting Table in 2002 per 40 CFR §191.03(b)						
Pathway	Dose equivalent to the receptor's whole body resides year-round at WIPP fence line 350 meters NW		% of EPA 25-mrem/year whole body limit	Dose equivalent to the receptor's critical organ resides year-round at WIPP fence line 350 meters NW		% of EPA 75-mrem/year critical organ limit
	(*mrem/year*)	*(mSv/year)*		*(mrem/year)*	*(mSv/year)*	
Air	1.51×10^{-4}	1.51×10^{-6}	6.04×10^{-4}	2.46×10^{-3}	2.46×10^{-5}	3.28×10^{-3}

[a] Total releases from the combination of Effluent Stations A, B, and C
[b] Curies = Ci
[c] Becquerels = Bq
[d] Estimated natural radiation populations dose = (Estimated population within 50 miles) x (300 mrem/year)

In compliance with 40 CFR Part 191, Subpart A, the receptor selected resides year-round at the WIPP fence line located 350 meters in the NW sector. The dose to this receptor is estimated to be 1.51×10^{-6} mSv (1.51×10^{-4} mrem) per year whole body and 2.46×10^{-5} mSv (2.46×10^{-3} mrem) per year to the critical organ. These values are in compliance with the requirements of 0.25 mSv (25 mrem) and 0.75 mSv (75mrem) per year to the critical organ as specified in 40 CFR §191.03(b).

7.5 Dose to Nonhuman Biota

DOE Order 5400.5 lists the environmental radiation protection requirements that WIPP must meet to protect aquatic animals. In addition, dose limits below which no deleterious effects on populations of aquatic and terrestrial organisms have been observed have been discussed in NCRP Report No. 109, Effects of Ionizing Radiation on Aquatic Organisms, (NCRP, 1991) and the International Atomic Energy Agency (IAEA Technical Report Series No. 332). Those dose limits are:

- Aquatic animals - 10 mGy/d (1 rad/d)
- Terrestrial plants - 10 mGy/d (1 rad/d)
- Terrestrial animals - 1 mGy/d (0.1 rad/d)

The DOE has considered proposing these dose standards for aquatic and terrestrial biota under proposed rule 10 CFR Part 834, "Radiation Protection of the Public and the Environment" but has delayed until guidance for demonstrating compliance was developed. DOE-STD-1153-2002 was developed to meet this need. The DOE requires reporting of radiation doses to nonhuman biota in the annual SER using DOE-STD-1153-2002.

The new Technical Standard uses a multiphase approach, including an initial screening phase with conservative assumptions. Software is provided with the new Technical Standard to conduct the screening evaluation. In the initial screen, Biota Concentration Guides (BCGs) are derived using very conservative assumptions for a variety of generic organisms. Maximum concentrations of radionuclides detected in soil, sediment, and water during environmental monitoring are divided by the BCGs and the results are summed for each organism (DOE-STD-1153-2002). If the sum of these fractions is less than 1, the site is deemed to have passed the screen and no further action is required. This screening evaluation is intended to provide a very conservative evaluation of whether the site is in compliance with the recommended limits.

This guidance was used to screen radionuclide concentrations observed around WIPP during 2002 using the maximum radionuclide concentrations listed in Table 7.3. The sum of fractions was less than one for all media, demonstrating compliance with the proposed rule. Radiation in the environment surrounding WIPP does not have a deleterious effect on populations of plants and animals.

7.6 Release of Property Containing Residual Radioactive Material

There was no release of radiologically contaminated materials or property in 2002. The potential for release of contaminated materials or property at WIPP is based on DOE Order 5400.5, and contractor institutional controls.

Table 7.3 - General Screening Results for Potential Radiation Dose to Nonhuman Biota from Radionuclide Concentrations in Surface Water (Bq/L), Sediment (Bq/g), and Soil (Bq/g) Near the WIPP Site. Maximum detected concentrations were compared with BCG[a] values to assess potential dose to biota. As long as the sum of the ratios between observed maximum concentrations and the associated BCG is below 1.0, no adverse effects on plant or animal populations are expected (DOE-STD-1153-2002).

Medium	Radionuclide	Maximum Observed Concentration	BCG	Concentration/BCG
		Aquatic System Evaluation		
Sediment (Bq/g)	^{60}Co	6.85×10^{-4}	5.00×10^{1}	1.37×10^{-5}
	^{137}Cs	4.59×10^{-2}	1.00×10^{2}	4.59×10^{-4}
	^{234}U	4.96×10^{-2}	2.00×10^{2}	2.48×10^{-4}
	^{235}U	2.12×10^{-3}	1.00×10^{2}	2.12×10^{-5}
	^{238}U	3.35×10^{-2}	9.00×10^{1}	3.72×10^{-4}
	^{241}Am	7.10×10^{-4}	2.00×10^{2}	3.55×10^{-6}
Water[b] (Bq/L)	^{60}Co	4.66×10^{-1}	1.00×10^{2}	4.66×10^{-3}
	^{137}Cs	3.23×10^{-1}	2.00×10^{0}	1.62×10^{-1}
	^{234}U	2.18×10^{-1}	7.00×10^{0}	3.11×10^{-2}
	^{235}U	6.51×10^{-3}	8.00×10^{0}	8.14×10^{-3}
	^{238}U	1.08×10^{-1}	8.00×10^{0}	1.35×10^{-2}
	^{241}Am	6.51×10^{-4}	2.00×10^{1}	3.26×10^{-5}
			Sum of Fractions	2.21×10^{-1}
		Terrestrial System Evaluation		
Soil (Bq/g)	^{60}Co	3.66×10^{-4}	3.00×10^{1}	1.22×10^{-5}
	^{137}Cs	1.65×10^{-2}	8.00×10^{-1}	2.06×10^{-2}
	^{234}U	2.09×10^{-2}	2.00×10^{2}	1.05×10^{-4}
	^{235}U	2.32×10^{-3}	1.00×10^{2}	2.32×10^{-5}
	^{238}U	2.27×10^{-2}	6.00×10^{1}	3.78×10^{-4}
	^{241}Am	4.18×10^{-4}	1.00×10^{2}	4.18×10^{-6}
Water (Bq/L)	^{60}Co	4.66×10^{-1}	4.00×10^{4}	1.17×10^{-5}
	^{137}Cs	3.23×10^{-1}	2.00×10^{4}	1.62×10^{-5}
	^{234}U	2.18×10^{-1}	1.00×10^{4}	2.18×10^{-5}
	^{235}U	6.51×10^{-3}	2.00×10^{4}	3.26×10^{-7}
	^{238}U	1.08×10^{-1}	2.00×10^{4}	5.40×10^{-6}
	^{241}Am	6.51×10^{-4}	7.00×10^{3}	9.30×10^{-8}
			Sum of Fractions	2.12×10^{-2}

[a] The radionuclide concentration in the medium that would produce a radiation dose in the organism equal to the dose limit under the conservative assumptions in the model.
[b] Sediment and water samples were assumed to be co-located.

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CHAPTER 8 - QUALITY ASSURANCE

The fundamental objective of a QA program, as applied to environmental work, is to ensure high-quality measurements are produced and reported from the analytical laboratory. The defensibility of data generated by laboratories must be based on sound scientific principles, method evaluations, and data verification and validation. WIPP Laboratories and contract laboratories, Wastren, in Grand Junction, Colorado; Air Toxics, Ltd., in Folsom, California; and Trace Analysis, in Lubbock, Texas, were the laboratories that performed the radiological and nonradiological analyses for WIPP environmental samples. (Wastren was purchased by SM Stoller Corporation in 2002. They will be referred to as "SM Stoller Corp." However, tables provided by the contract laboratory still denote "Wastren" in the title.)

All laboratories were required contractually to have documented QA programs, including standard procedures to perform the work, and to participate in some intercomparison programs with the National Institute of Standards and Technology Radiochemistry Intercomparison Program (NRIP), the Environmental Monitoring Laboratory of the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP), the Environmental Resource Associates® (ERA) interlaboratory assessment, and/or any other reputable intercomparison program.

The laboratories used one or more of these accepted protocols in their QA program.

- American Society of Mechanical Engineers NQA-1-1989, *Quality Assurance Program Requirements for Nuclear Facilities*
- Title 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"
- EPA/600 14-83-004, QAMS-005/80, *Interim Guidelines and Specification for Preparing Quality Assurance Project Plans*
- NRC Regulatory Guide 4.15, Rev. 1, Quality Assurance for Radiological Monitoring Program-Effluent Streams and the Environment
- HPS N13.30 ANSI [American National Standards Institute], *Performance Criteria for Radiobioassay*
- Proposed ANSI/ASQC [American Society for Quality Control]-E4, *Quality Assurance Program Requirements for Environmental Programs*

The WIPP Environmental Monitoring Section performed assessments and audits to ensure the quality of the systems, processes, and deliverables were maintained or improved. Along with these regulatory requirements, the Environmental Monitoring Section also implements DOE Order 414.1A, *Quality Assurance*. The parameters for performance evaluations are completeness, precision, accuracy, comparability, and representativeness.

8.1 Completeness

The completeness parameter was calculated as the ratio of the number of valid samples collected to the total number of samples collected and analyzed. The gross alpha/beta analyses were 96 percent complete for 2002. Samples for air particulates were 95 percent complete. Samples and measurements for all other media (groundwater, surface water, soil, sediment, and animal and plant tissues) were 100 percent complete. The data quality objective established for the environmental program is 98 percent complete.

8.2 Precision

The precision of the measurements was validated through analyses of duplicate samples. A low-volume air sampler was rotated in each quarter from location to location, and sampled along with routine samples. The results of these duplicate comparisons are shown in Tables 8.1, 8.2, 8.3, and 8.4 for the four quarters of 2002. The duplicate samples for other matrices were collected at the same time, same place, and under similar conditions as routine samples. These samples were analyzed in the same analytical batch and/or sample delivery group using similar methods for radiochemical separation and counting as the original samples. Tables 4.10, 4.14, 4.18, and 4.20 show duplicate results for water, soil, sediment, and vegetation samples, respectively.

Precision is partially influenced by statistical counting uncertainty, so variances were expected between samples with very low activities (environmental levels). As a part of data validation all radiochemical duplicate samples are evaluated for the RER and on analytical chemistry the relative percent difference (RPD).

$$RER = \frac{|(Mean\ Activity)_{ori} - (Mean\ Activity)_{dup}|}{\sqrt{(2 \times SD)^2_{ori} + (2 \times SD)^2_{dup}}}$$

Where:

$(\text{Mean Activity})_{ori}$	=	Mean Activity of Original Sample
$(\text{Mean Activity})_{dup}$	=	Mean Activity of Duplicate Sample
SD	=	Standard Deviation of Original and Duplicate Samples

Relative error ratio results equal to or less than one are acceptable and considered to demonstrate reproducibility. A gross alpha result for the week of July 24, 2002, RER is greater than one, 1.34 (Table 8.3). A gross beta result for the week of January 30, 2002, RER is also greater than one, 1.07 (Table 8.1). The batches containing these two samples were recounted but still did not pass the RER criteria, which indicates a nonhomogeneous sample.

$$RPD = \left[\frac{(S - D)}{(S + D)/2}\right] \times 100$$

Where:

S = Sample concentration
D = Duplicate sample concentration

An acceptable range for RPD is < 25 percent for the analytical methods. The duplicate results, RER, and RPD for all required analysis passed the required criteria with the exception of one gross alpha sample and one gross beta sample. WIPP's requirement is to reanalyze the batch of samples associated with the duplicate that failed to meet criteria.

8.3 Accuracy

The accuracy of the analyses were assured/controlled by using NIST-traceability for instrument calibration. Internal QC is performed by using NIST-traceable spiked laboratory control samples. Intercomparisons were performed with the DOE EML QAP, NRIP, AbsoluteGrade PT Program, and ERA to ensure the reliability of radiochemical separation methods and counting instruments. Accuracy, expressed as percent bias, was calculated by:
Where:

$$\%Bias = \frac{\left(A_m - A_k\right)}{A_k} \times 100$$

% Bias	=	Percent Bias
A_m	=	Measured Sample Activity
A_k	=	Known Sample Activity

The DOE EML QAP and NRIP prepare QC samples containing various alpha-, beta-, and gamma-emitting nuclides in water, soil, air filter, vegetation, synthetic urine, and tissue media and distributes them to numerous laboratories. ERA and AbsoluteGrade PT Program prepare QC samples with organic and inorganic components. The programs are an interlaboratory comparison in that results from the participants are compared with the experimentally determined results of EML and NRIP. Also, the administering programs assess the results as acceptable or not within a range of bias from the known result.

8.4 Comparability

SM Stoller Corp. participated in the QAP and WIPP Laboratories participated in the QAP and NRIP programs. The results for SM Stoller Corp. are provided in Tables 8.5, 8.6, 8.7, and 8.8 for QAP, air, soil, vegetation, and water, respectively. Table 8.9 displays the results for ERA water. Table 8.10 contains the NRIP results for WIPP Laboratories and Tables 8.11, 8.12, 8.13, and 8.14 contain the results for the QAP air, soil, vegetation, and water, respectively. WIPP Laboratories percent bias was acceptable for all radionuclides and all media with two exceptions: ^{239}Pu in soil and in vegetation during the December intercomparison (QAP 57). It was determined that the soil and vegetation samples had been loaded into mislabeled petri dishes. The soil samples were labeled with vegetation information, and the vegetation samples were labeled with soil information. When the samples were recounted with the correct sample information, all results met acceptance criteria. The results for ^{239}Pu in soil and vegetation were acceptable during the June round of testing (QAP 56).

SM Stoller Corp.'s percent bias in evaluating soil was acceptable for all radionuclides and all media except for ^{40}K in soil and ^{134}Cs in water during the June intercomparison (QAP 56); and ^{234}Th in soil and ^{60}Co in water during the December intercomparison (QAP 57). WIPP does not require the analysis of ^{234}Th and ^{134}Cs in any media. No errors were detected in the analysis of ^{40}K or ^{60}Co. Potassium-40 measurements on samples with very low activities by gamma spectroscopy where the system background for 40K is very high, will result in high uncertainties. The activities of nuclides in the EML samples are always very low, usually near the detection limit where the analytical uncertainties are high. However, EML does not account for the uncertainty reported by laboratories when evaluating results.

DOE EML QAP participant's analytical performance is evaluated based on the historical analytical capabilities for individual analyte/matrix pairs. The criteria for acceptable performance have been chosen to be between the 15th and 85th percentile of the cumulative normalized distribution, which can be viewed as the 70 percent of all historic measurements. The acceptable with warning criteria are between the 5th and 15th percentile and between the 85th and 95th percentile. In other words, the middle 90 percent of all reported values are acceptable, while the outer 5th through 15th (10 percent) and 85th through 95th (10 percent) percentiles are in the warning area. The not acceptable criteria are established at less than the 5th percentile and greater than the 95th percentile, that is, the outer 10 percent of historical data.

Air Toxics, Ltd., participated in the ERA, for 49 VOCs in nonpotable water. Results were 100 percent satisfactory (Table 8.15).

Trace Analysis, Inc., participated in several AbsoluteGrade PT Program interlaboratory assessments. For the PT Program runs from March to November 2002 for response performance standards (Tables 8.16, 8.17, and 8.18), 13 of 150 8.6 percent) parameters were not acceptable. Subsequently, blind samples were reanalyzed for all analytes missed during later evaluations. When reevaluated, most were acceptable. Examples of some unacceptable analytical results include the following.

Alkalinity results for the PT study, round 10 (PT study 10), was unacceptable due to contaminated glassware. Corrective action was to rinse glassware with distilled water prior to running alkalinity analysis. Rerun had an acceptable recovery of 98 percent.

Chemical oxygen demand (COD) result on PT study 10 was unacceptable due to dilution error. Corrective action was to take more care when doing dilutions for all analyses when performing wet chemistry.

Phosphate result for PT study 10 was unacceptable due to dilution error. Corrective action was to take more care when doing dilutions for all wet chemistry analyses.

Unacceptable result for PCBs in water for PT study 10 due to lack of injector maintenance. Corrective action was to improve injector maintenance and clipping of column maintenance cycle increased.

Turbidity result was not acceptable for PT study 10 due to improper shaking of sample before analysis. Corrective action was to instruct analysts in proper sample preparation.

Conductivity analysis was not acceptable for PT study 10 due to contaminated glassware. Corrective action was to rinse glassware with distilled water prior to running conductivity.

Bromide analysis for PT study 10 was unacceptable due to IC difficulties. Corrective action was to replace column, guard column, and filters, and prepare a new standards curve.

Unacceptable results for metals beryllium, strontium, and thallium for the WP portion of the PT study 10 due to noisy background from high wattage settings for the RF generator. Corrective action was to reduce wattage output and calibrating instrument at new level.

Unacceptable results for the metals thallium, molybdenum, and zinc for the WS portion of PT study 10 due to noisy background from high wattage setting of the RF generator. Corrective action was to reduce wattage output and recalibrate instrument at new level.

8.5 Representativeness

The primary objective of environmental monitoring has been to protect the health and safety of the population surrounding the WIPP facility. The quality objective of representativeness was based on potential radiation exposure of the population through inhalation and ingestion. Samples of ambient air, surface water, sediment, groundwater, and biota were collected from areas representative of potential pathways for intake.

The samples were collected using generally accepted methodologies for environmental sampling and approved procedures, ensuring they were representative of the media

sampled. These samples were analyzed for natural radioactivity, fallout radioactivity from nuclear weapons tests, and other anthropogenic radionuclides. The reported concentrations at various locations were representative of the baseline information for radionuclides of interest at the WIPP facility.

Table 8.1 - Comparison of Duplicate Air Monitoring Results (First Quarter of 2002) from WIPP Laboratories Data from Carlsbad (CBD) Sampling Location

	Gross Alpha (Bq/m^3)					Gross Beta (Bq/m^3)				
Week Beginning	**Sample**	**2 x TPU**[a]	**Duplicate**	**2 x TPU**	**RER**[b]	**Sample**	**2 x TPU**	**Duplicate**	**2 x TPU**	**RER**
1/2	1.72×10^{-4}	4.47×10^{-5}	NR[c]	NR	N/A[d]	1.28×10^{-3}	1.60×10^{-4}	NR	NR	N/A
1/9	1.16×10^{-4}	3.69×10^{-5}	1.36×10^{-4}	4.03×10^{-5}	0.37	8.81×10^{-4}	1.22×10^{-4}	9.99×10^{-4}	1.34×10^{-4}	0.65
1/16	1.33×10^{-4}	3.88×10^{-5}	1.20×10^{-4}	3.67×10^{-5}	0.24	1.14×10^{-3}	1.46×10^{-4}	1.20×10^{-3}	1.52×10^{-4}	0.28
1/23	1.04×10^{-4}	3.40×10^{-5}	1.04×10^{-4}	3.38×10^{-5}	0	1.05×10^{-3}	1.38×10^{-4}	8.94×10^{-4}	1.21×10^{-4}	0.85
1/30	1.16×10^{-4}	3.59×10^{-5}	8.33×10^{-5}	3.10×10^{-5}	0.69	1.33×10^{-3}	1.63×10^{-4}	1.10×10^{-3}	1.41×10^{-4}	1.07
2/6	7.41×10^{-5}	2.90×10^{-5}	9.25×10^{-5}	3.40×10^{-5}	0.41	8.82×10^{-4}	1.22×10^{-4}	1.01×10^{-3}	1.38×10^{-4}	0.69
2/13	6.18×10^{-5}	2.24×10^{-5}	5.84×10^{-5}	2.18×10^{-5}	0.11	8.65×10^{-4}	1.11×10^{-4}	9.42×10^{-4}	1.19×10^{-4}	0.47
2/20	7.14×10^{-5}	2.96×10^{-5}	5.63×10^{-5}	2.54×10^{-5}	0.39	8.10×10^{-4}	1.18×10^{-4}	8.87×10^{-4}	1.24×10^{-4}	0.45
2/27	9.97×10^{-5}	3.41×10^{-5}	7.08×10^{-5}	2.77×10^{-5}	0.66	1.20×10^{-3}	1.53×10^{-4}	1.23×10^{-3}	1.54×10^{-4}	0.14
3/6	6.04×10^{-5}	2.72×10^{-5}	NR	NR	N/A	9.73×10^{-4}	1.32×10^{-4}	NR	NR	N/A
3/13	NR	NR	NR	NR	N/A	NR	NR	NR	NR	N/A
3/20	6.91×10^{-5}	2.80×10^{-5}	7.58×10^{-5}	2.96×10^{-5}	0.16	8.36×10^{-4}	1.17×10^{-4}	9.41×10^{-4}	1.28×10^{-4}	0.61
3/27	4.51×10^{-5}	2.19×10^{-5}	7.84×10^{-5}	2.96×10^{-5}	0.9	8.66×10^{-4}	1.17×10^{-4}	9.32×10^{-4}	1.26×10^{-4}	0.38

[a] Total propagated uncertainty
[b] Relative error ratio
[c] Not reported
[d] Not applicable since sample or duplicate value is not reported

Table 8.2 - Comparison of Duplicate Air Monitoring Results (Second Quarter of 2002) from WIPP Laboratories Data from Southeast Control (SEC) Sampling Location

	Gross Alpha (Bq/m^3)					Gross Beta (Bq/m^3)				
Week Beginning	Sample	2 x TPU[a]	Duplicate	2 x TPU	RER[b]	Sample	2 x TPU	Duplicate	2 x TPU	RER
4/3	9.21×10^{-5}	3.36×10^{-5}	7.44×10^{-5}	3.06×10^{-5}	0.39	9.84×10^{-4}	1.32×10^{-4}	9.50×10^{-4}	1.29×10^{-4}	0.18
4/10	6.96×10^{-5}	2.86×10^{-5}	6.91×10^{-5}	2.90×10^{-5}	0.01	1.09×10^{-3}	1.41×10^{-4}	1.13×10^{-3}	1.46×10^{-4}	0.2
4/17	4.05×10^{-5}	2.16×10^{-5}	4.57×10^{-5}	2.28×10^{-5}	0.17	8.69×10^{-4}	1.19×10^{-4}	8.27×10^{-4}	1.15×10^{-4}	0.25
4/24	7.40×10^{-5}	2.94×10^{-5}	7.58×10^{-5}	2.96×10^{-5}	0.04	9.01×10^{-4}	1.23×10^{-4}	9.11×10^{-4}	1.24×10^{-4}	0.06
5/1	4.02×10^{-5}	2.02×10^{-5}	7.10×10^{-5}	2.76×10^{-5}	0.9	8.46×10^{-4}	1.16×10^{-4}	8.87×10^{-4}	1.21×10^{-4}	0.24
5/8	9.00×10^{-5}	3.19×10^{-5}	7.98×10^{-5}	3.05×10^{-5}	0.23	9.45×10^{-4}	1.25×10^{-4}	8.55×10^{-4}	1.17×10^{-4}	0.53
5/15	7.49×10^{-5}	3.08×10^{-5}	7.49×10^{-5}	2.92×10^{-5}	0	9.48×10^{-4}	1.29×10^{-4}	8.97×10^{-4}	1.21×10^{-4}	0.29
5/22	8.11×10^{-5}	3.15×10^{-5}	5.37×10^{-5}	2.58×10^{-5}	0.67	7.83×10^{-4}	1.12×10^{-4}	8.10×10^{-4}	1.15×10^{-4}	0.17
5/29	4.97×10^{-5}	2.39×10^{-5}	4.17×10^{-5}	2.27×10^{-5}	0.24	8.02×10^{-4}	1.11×10^{-4}	8.13×10^{-4}	1.14×10^{-4}	0.07
6/5	4.61×10^{-5}	2.24×10^{-5}	6.16×10^{-5}	2.54×10^{-5}	0.46	7.66×10^{-4}	1.10×10^{-4}	7.23×10^{-4}	1.04×10^{-4}	0.28
6/12	5.10×10^{-5}	2.40×10^{-5}	6.98×10^{-5}	2.87×10^{-5}	0.5	7.94×10^{-4}	1.11×10^{-4}	7.75×10^{-4}	1.10×10^{-4}	0.12
6/19	6.43×10^{-5}	2.82×10^{-5}	5.46×10^{-5}	2.51×10^{-5}	0.26	1.07×10^{-3}	1.41×10^{-4}	1.03×10^{-3}	1.36×10^{-4}	0.2
6/26	3.47×10^{-5}	2.06×10^{-5}	5.24×10^{-5}	2.54×10^{-5}	0.54	6.94×10^{-4}	1.02×10^{-4}	7.25×10^{-4}	1.06×10^{-4}	0.21

[a] Total propagated uncertainty
[b] Relative error ratio

Table 8.3 - Comparison of Duplicate Air Monitoring Results (Third Quarter of 2002) from WIPP Laboratories Data from WIPP Far Field (WFF) Sampling Location

	Gross Alpha (Bq/m^3)					Gross Beta (Bq/m^3)				
Week Beginning	Sample	2 x TPU[a]	Duplicate	2 x TPU	RER[b]	Sample	2 x TPU	Duplicate	2 x TPU	RER
7/3	5.87×10^{-5}	2.70×10^{-5}	5.63×10^{-5}	2.66×10^{-5}	0.06	1.03×10^{-3}	1.37×10^{-4}	9.13×10^{-4}	1.26×10^{-4}	0.63
7/10	7.76×10^{-5}	3.02×10^{-5}	5.59×10^{-5}	2.63×10^{-5}	0.54	8.28×10^{-4}	1.15×10^{-4}	7.42×10^{-4}	1.08×10^{-4}	0.55
7/17	2.36×10^{-5}	1.82×10^{-5}	4.02×10^{-5}	2.12×10^{-5}	0.59	6.29×10^{-4}	9.28×10^{-5}	6.23×10^{-4}	9.19×10^{-5}	0.05
7/24	1.01×10^{-4}	3.53×10^{-5}	4.49×10^{-5}	2.24×10^{-5}	1.34	7.91×10^{-4}	1.13×10^{-4}	7.88×10^{-4}	1.11×10^{-4}	0.02
7/31	4.52×10^{-5}	2.25×10^{-5}	5.86×10^{-5}	2.57×10^{-5}	0.39	8.95×10^{-4}	1.21×10^{-4}	9.74×10^{-4}	1.29×10^{-4}	0.45
8/7	1.45×10^{-4}	4.22×10^{-5}	1.39×10^{-4}	4.13×10^{-5}	0.1	9.92×10^{-4}	1.32×10^{-4}	1.02×10^{-3}	1.35×10^{-4}	0.15
8/14	1.02×10^{-4}	3.51×10^{-5}	1.02×10^{-4}	3.53×10^{-5}	0	9.53×10^{-4}	1.29×10^{-4}	8.32×10^{-4}	1.16×10^{-4}	0.7
8/21	8.79×10^{-5}	3.21×10^{-5}	8.16×10^{-5}	3.12×10^{-5}	0.14	9.28×10^{-4}	1.25×10^{-4}	9.27×10^{-4}	1.26×10^{-4}	0.01
8/28	1.03×10^{-4}	3.56×10^{-5}	9.88×10^{-5}	3.46×10^{-5}	0.08	1.21×10^{-3}	1.55×10^{-4}	1.21×10^{-3}	1.54×10^{-4}	0
9/4	5.56×10^{-5}	2.49×10^{-5}	7.56×10^{-5}	2.89×10^{-5}	0.52	7.79×10^{-4}	1.09×10^{-4}	6.81×10^{-4}	9.84×10^{-5}	0.67
9/11	1.17×10^{-4}	3.80×10^{-5}	1.03×10^{-4}	3.51×10^{-5}	0.27	1.22×10^{-3}	1.57×10^{-4}	1.30×10^{-3}	1.63×10^{-4}	0.35
9/18	1.36×10^{-4}	3.94×10^{-5}	1.19×10^{-4}	3.72×10^{-5}	0.31	1.20×10^{-3}	1.52×10^{-4}	1.05×10^{-3}	1.38×10^{-4}	0.73
9/25	1.19×10^{-4}	3.74×10^{-5}	1.42×10^{-4}	4.13×10^{-5}	0.41	1.15×10^{-3}	1.48×10^{-4}	1.06×10^{-3}	1.39×10^{-4}	0.44

[a] Total propagated uncertainty
[b] Relative error ratio

Table 8.4 - Comparison of Duplicate Air Monitoring Results (Fourth Quarter of 2002) from WIPP Laboratories Data from WIPP East (WEE) Sampling Location

	Gross Alpha (Bq/m^3)					Gross Beta (Bq/m^3)				
Week Beginning	**Sample**	**2 x TPU[a]**	**Duplicate**	**2 x TPU**	**RER[b]**	**Sample**	**2 x TPU**	**Duplicate**	**2 x TPU**	**RER**
10/2	9.24×10^{-5}	3.28×10^{-5}	9.54×10^{-5}	3.35×10^{-5}	0.06	7.31×10^{-4}	1.05×10^{-4}	8.19×10^{-4}	1.14×10^{-4}	0.57
10/9	6.67×10^{-5}	2.76×10^{-5}	6.80×10^{-5}	2.81×10^{-5}	0.03	1.11×10^{-3}	1.44×10^{-4}	1.24×10^{-3}	1.57×10^{-4}	0.61
10/16	4.38×10^{-5}	2.26×10^{-5}	5.37×10^{-5}	2.48×10^{-5}	0.3	1.13×10^{-3}	1.46×10^{-4}	1.09×10^{-3}	1.41×10^{-4}	0.2
10/23	3.11×10^{-5}	1.79×10^{-5}	4.86×10^{-5}	2.24×10^{-5}	0.61	5.48×10^{-4}	8.55×10^{-5}	4.88×10^{-4}	7.87×10^{-5}	0.52
10/30	6.25×10^{-5}	2.78×10^{-5}	4.72×10^{-5}	2.47×10^{-5}	0.41	8.68×10^{-4}	1.20×10^{-4}	8.42×10^{-4}	1.17×10^{-4}	0.16
11/6	5.18×10^{-5}	2.80×10^{-5}	7.26×10^{-5}	2.98×10^{-5}	0.51	1.02×10^{-3}	1.40×10^{-4}	1.02×10^{-3}	1.35×10^{-4}	0
11/13	5.54×10^{-5}	2.47×10^{-5}	6.27×10^{-5}	2.62×10^{-5}	0.2	1.02×10^{-3}	1.35×10^{-4}	1.13×10^{-3}	1.46×10^{-4}	0.55
11/20	1.10×10^{-4}	3.61×10^{-5}	1.22×10^{-4}	3.88×10^{-5}	0.23	1.38×10^{-3}	1.73×10^{-4}	1.31×10^{-3}	1.66×10^{-4}	0.29
11/27	3.82×10^{-5}	2.03×10^{-5}	5.69×10^{-5}	2.49×10^{-5}	0.58	1.58×10^{-3}	1.91×10^{-4}	1.45×10^{-3}	1.78×10^{-4}	0.5
12/4	2.77×10^{-5}	1.72×10^{-5}	2.75×10^{-5}	1.71×10^{-5}	0.01	1.34×10^{-3}	1.68×10^{-4}	1.40×10^{-3}	1.73×10^{-4}	0.25
12/11	1.10×10^{-4}	3.63×10^{-5}	NR[c]	NR	N/A[d]	1.38×10^{-3}	1.71×10^{-4}	NR	NR	N/A
12/18	6.76×10^{-5}	2.68×10^{-5}	5.50×10^{-5}	2.73×10^{-5}	0.33	9.07×10^{-4}	1.20×10^{-4}	9.84×10^{-4}	1.35×10^{-4}	0.43
12/25	7.12×10^{-5}	3.44×10^{-5}	7.40×10^{-5}	3.57×10^{-5}	0.06	1.32×10^{-3}	1.77×10^{-4}	1.53×10^{-3}	2.00×10^{-4}	0.79

[a] Total propagated uncertainty
[b] Relative error ratio
[c] Not reported
[d] Not applicable since sample or duplicate value is not reported.

Table 8.5 - Environmental Measurements Laboratory Assessments for Wastren, 2002
MATRIX: Air Filter (Bq/Filter)

	QAP[a] 56 June 2002					QAP 57 December 2002				
	Reported		EML[b]		%	Reported		EML		%
RN[c]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
^{241}Am	0.087	0.01	0.09	0.01	1.136	0.189	0.01	0.191	0	1.047
^{60}Co	36	2	30.52	0.652	17.96	26	2	23	0.06	13.04
^{137}Cs	31	2	28.23	0.701	9.81	36	4	32.5	0.777	10.77
Gross α	0.542	0.056	0.534	0.053	1.498	0.322	0.036	0.287	0.03	12.2
Gross β	1.29	0.13	1.3	0.13	0.77	0.822	0.098	0.871	0.09	5.626
^{54}Mn	43	8	38.53	0.867	11.6	57	10	52.2	1.17	9.195
^{238}Pu	0.057	0.01	0.06	0	0	0.106	0.01	0.119	0	10.92
^{239}Pu	0.191	0.014	0.187	0	2.139	0.205	0.014	0.206	0	0.485
^{90}Sr	4.26	0.25	4.832	0.184	11.84	5.68	0.35	5.561	0.119	2.14
U	NA[d]	NA	NA	NA	NA	17	NA	18.59	0.34	8.553
^{234}U	0.285	0.026	0.297	0	4.04	0.216	0.019	0.228	0	5.263
^{238}U	0.281	0.026	0.298	0	5.705	0.217	0.019	0.23	0	5.652
TOT U(µg)	22.7	N/A[e]	24.11	0.103	5.829	NA	N/A	NA	NA	NA

[a] Quality Assurance Program
[b] Environmental Measurements Laboratory
[c] Radionuclide
[d] Not acceptable
[e] Not applicable

Table 8.6 - Environmental Measurements Laboratory Assessments for Wastren, 2002
MATRIX: Soil (Bq/kg)

	QAP[a] 56 June 2002					QAP 57 December 2002				
	Reported		EML[b]		%	Reported		EML		%
RN[c]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
^{228}Ac	46	10	51.167	1.941	10.098	NA	NA	NA	NA	NA
^{241}Am	11.6	0.64	10.927	0.373	6.159	6.89	0.34	6.767	0.301	1.818
^{212}Bi	58	22	53.43	5.215	8.553	55	18	45.93	4.51	19.747
^{214}Bi	55	8	53.933	2.249	1.978	33	6	33.63	1.56	1.873
^{137}Cs	1240	172	1326.67	66.51	6.533	820	124	829.33	41.58	1.125
^{40}K	482	70	621.67	33.86	22.467	593	66	637.67	34.26	7.005
^{212}Pb	62	18	51.1	2.753	21.331	41	8	43.43	2.71	5.595
^{214}Pb	NA	NA	NA	NA	NA	39	6	35.2	1.51	10.795
^{239}Pu	20.53	1.48	19.098	0.706	7.498	13.15	0.9	12.903	0.465	1.914
^{90}Sr	50	4.2	53.756	1.446	6.987	41.8	3.8	41.16	0.253	1.555
^{234}Th	NA	NA	NA	NA	NA	131	24	48.4	4.83	170.661
U	NA	NA	NA	NA	NA	3.8	NA	3.61	0.32	5.263
^{234}U	90.7	8.2	93.885	7.767	3.392	42.37	3.7	42.32	3.1	0.118
^{238}U	91.3	8.2	96.778	8.41	5.66	45.35	3.92	44.89	3.2	1.025
TOTU(µg)	7.8	N/A	7.829	0.755	0.37	NA	N/A	NA	NA	NA

[a] Quality Assurance Program
[b] Environmental Measurements Laboratory
[c] Radionuclide
[d] Not acceptable
[e] Not applicable

Table 8.7 - Environmental Measurements Laboratory Assessments for Wastren, 2002
MATRIX: Vegetation (Bq/kg)

	QAP[a] 56 June 2002					QAP 57 December 2002				
	Reported		EML[b]		%	Reported		EML		%
RN[c]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
^{241}Am	2.3	0.14	2.228	0.216	3.232	2.26	0.14	2.253	0.1	0.311
^{244}Cm	1.24	0.092	1.32	0.164	6.061	1.067	0.085	1.247	0.065	14.44
^{60}Co	13	2	11.23	0.677	15.761	9	2	9.66	0.63	6.832
^{137}Cs	319	44	313.667	15.91	1.7	317	48	300.67	15.25	5.431
^{40}K	800	116	864.33	47.22	7.443	1453	160	1480	77.8	1.824
^{239}Pu	3.52	0.27	3.543	0.377	0.649	3.53	0.27	3.427	0.149	3.006
^{90}Sr	580	30	586.28	11.14	1.071	465	29	476.26	6.673	2.364

[a] Quality Assurance Program
[b] Environmental Measurements Laboratory
[c] Radionuclide

Table 8.8 - Environmental Measurements Laboratory Assessments for Wastren, 2002
MATRIX: Water (Bq/L)

	QAP[a] 56 June 2002					QAP 57 December 2002				
	Reported		EML[b]		%	Reported		EML		%
RN[c]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
^{241}Am	2.3	0.14	2.228	0.216	0.07	2.76	0.11	3.043	0.082	9.3
^{60}Co	322	28	347.33	12.4	7.293	342	28	268.67	9.71	27.29
^{134}Cs	2	1	3.357	0.2	40.42	55	4	60.2	1.86	8.638
^{137}Cs	45	10	56.067	2.929	19.74	96	12	81.43	4.28	17.89
Gross α	361	40	375	37.5	3.733	257	28	210	21	22.38
Gross β	930	55	1030	103	9.709	740	37	900	90	17.78
^{3}H	300	11	283.7	3.38	5.746	249	9	227.3	5.615	9.547
^{238}Pu	0.518	0.039	0.49	0.032	5.714	4.18	0.28	4.331	0.117	3.486
^{239}Pu	4.39	0.3	4.219	0.172	4.053	2.1	0.14	2.07	0.074	1.449
^{90}Sr	6.92	0.48	7.579	0.176	8.695	8.74	0.59	8.69	0.42	0.575
U	NA	NA	NA	NA	NA	0.241	NA	0.273	0.012	11.72
^{234}U	1.26	0.12	1.402	0.056	10.13	3.13	0.26	3.323	0.114	5.808
^{238}U	1.28	0.12	1.381	0.079	7.314	3.08	0.25	3.37	0.14	8.605
TOTU(μg)	0.104	N/A[d]	0.112	0.007	7.143	NA	NA	NA	NA	NA

[a] Quality Assurance Program
[b] Environmental Measurements Laboratory
[c] Radionuclide
[d] Not applicable

Table 8.9 - Environmental Resource Associates® for Wastren, 2002
MATRIX: Water (pCi/L)

	Reported		ERA[a]		%	Reported		ERA		%
RN[b]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
U(NAT)	NA[c]	NA	NA	NA	NA	N/A[d]	N/A	N/A	N/A	N/A
^{226}Ra	NA	NA	NA	NA	NA	N/A	N/A	N/A	N/A	N/A
^{228}Ra	NA	NA	NA	NA	NA	N/A	N/A	N/A	N/A	N/A
Gross α	N/A	N/A	N/A	N/A	N/A	NA	NA	NA	NA	NA
Gross β	N/A	N/A	N/A	N/A	N/A	NA	NA	NA	NA	NA

[a] Environmental Resource Associates®
[b] Radionuclide
[c] Not acceptable
[d] Not applicable

Table 8.10 - NRIP for WIPP Laboratories, 2002

	Synthetic Urine (Bq/g)					Soil (Bq/g)				
	Reported		NIST[a]			Reported		NIST		
RN[b]	Value	% 2 σ Error	Value	% 2 σ Error	% Bias	Value	% 2 σ Error	Value	% 2 σ Error	% Bias
^{241}Am	0.8607	50.35	0.84	0.63	2.4	0.3993	45.5	0.426	0.67	-6.3
^{238}Pu	0.8077	43.88	0.853	1.1	-5.3	0.4231	45	0.44	1.14	-3.8
^{239}Pu	0.8365	43.3	0.84	0.76	-0.4	0.4709	44.4	0.436	0.79	8
^{90}Sr	0.841	36.07	0.858	0.75	-2.1	0.4028	35.4	0.435	0.77	-7.5
^{238}U	0.8224	38.16	0.828	0.6	-0.7	0.4649	26.4	0.42	0.63	10.7

	Synthetic Feces (Bq/g)					Water (Bq/g)				
	Reported		NIST[a]			Reported		NIST		
RN[b]	Value	% 2σ Error	Value	% 2 σ Error	% Bias	Value	% 2 σ Error	Value	% 2 σ Error	% Bias
^{241}Am	1.956	17.17	1.84	0.64	6.3	7.055	40.36	7.99	0.64	-12
^{238}Pu	1.511	18.95	1.637	1.12	-7.7	7.883	37.74	7.86	0.7	0.3
^{90}Sr	6.337	20.22	7.288	0.74	-13	19.096	15.08	15.8	0.74	21
^{238}U	6.523	29.39	7.193	0.6	-9.3	7.884	33.2	8.06	0.6	-2.2

	Air Filters (Bq/g)				
	Reported		NIST[a]		
RN[b]	Value	% 2 σ Error	Value	% 2 σ Error	% Bias
^{241}Am	2.541	16.71	2.437	0.67	4.3
^{238}Pu	2.221	17.04	2.168	1.14	2.4
^{90}Sr	9.523	12.2	9.653	0.77	-1.3
^{238}U	9.432	14.47	9.527	0.63	-1

[a] National Institute of Standards and Technology
[b] Radionuclide

Table 8.11 - Environmental Measurements Laboratory Assessments for WIPP Laboratories, 2002
MATRIX: Air Filter (Bq/Filter)

	QAP[a] 56 June 2002					QAP 57 December 2002				
	Reported		EML[b]		%	Reported		EML		%
RN[c]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
^{241}Am	0.0954	0.18	0.0883	0.005	8.04	0.172	0.024	0.191	0.004	-9.95
^{60}Co	30.8	4.14	30.52	0.652	0.92	23.2	3.18	23	0.059	0.87
^{137}Cs	28.9	3.93	28.23	0.701	2.37	32.7	4.41	32.5	0.777	0.62
Gross α	0.548	0.063	0.534	0.053	2.62	0.27	0.034	0.287	0.029	-5.92
Gross β	1.18	0.123	1.3	0.13	-9.23	0.751	0.081	0.871	0.087	-13.8
^{54}Mn	39	5.31	38.53	0.867	1.22	54	7.23	52.2	1.17	3.45
^{238}Pu	0.0573	0.01	0.0574	0.001	-0.21	0.113	0.016	0.119	0.003	-5.04
^{239}Pu	0.185	0.031	0.1874	0.003	-1.28	0.21	0.028	0.206	0.002	1.94
^{90}Sr	4.2	0.22	4.8317	0.184	-13.1	4.68	0.249	5.561	0.119	-15.8
Bq U	0.574	0.065	0.6076	0.005	-5.53	0.458	0.043	0.467	0.008	-1.93

[a] Quality Assurance Program
[b] Environmental Measurements Laboratory
[c] Radionuclide

Table 8.12 - Environmental Measurements Laboratory Assessments for WIPP Laboratories, 2002
MATRIX: Soil (Bq/kg)

	QAP[a] 56 June 2002					QAP 57 December 2002				
	Reported		EML[b]		%	Reported		EML		%
RN[c]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
^{228}Ac	43.8	6.82	51.1667	1.941	-14.4	40.4	6.65	42.3	1.56	-4.49
^{241}Am	12	2.23	10.9267	0.373	9.82	6.49	1.15	6.767	0.301	-4.09
^{212}Bi	53.4	12.5	53.43	5.215	-0.056	40.2	10.7	45.93	4.51	-12.48
^{214}Bi	NR[e]	NR	NR	NR	NR	30.8	4.68	33.63	1.56	-8.42
Bq U	173	17.2	194.769	15.642	-11.18	70.27	6.434	87.21	7.3	-19.42
^{137}Cs	1150	145	1326.67	66.51	-13.32	759	96	829.33	41.58	-8.48
^{40}K	628	83.6	621.67	33.86	1.02	704	94.7	637.67	34.26	10.4
^{212}Pb	56	8	51.1	2.753	9.59	50.3	7.24	43.43	2.71	15.82
^{214}Pb	53.9	7.83	54.3667	2.249	-0.858	37.6	5.97	35.2	1.51	6.82
^{239}Pu	20.8	3.23	19.098	0.706	8.91	5.17	1.07	12.903	0.465	-40.1d
^{90}Sr	43.8	7.97	53.7558	1.446	-18.52	39	6.07	41.16	0.253	-5.25

[a] Quality Assurance Program
[b] Environmental Measurements Laboratory
[c] Radionuclide
[d] Not acceptable
[e] Not requested

Table 8.13 - Environmental Measurements Laboratory Assessments for WIPP Laboratories, 2002 MATRIX: Vegetation (Bq/kg)

	QAP[a] 56 June 2002					QAP 57 December 2002				
	Reported		EML[b]		%	Reported		EML		%
RN[c]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
^{241}Am	2.19	0.48	2.2283	0.216	-1.72	2.31	0.5	2.253	0.1	2.53
^{244}Cm	1.27	0.33	1.32	0.164	-3.79	NR	NR	NR	NR	NR[d]
^{60}Co	10.1	1.64	11.23	0.677	-10.06	9.61	1.58	9.66	0.63	-0.52
^{137}Cs	258	32.7	313.667	15.91	-17.75	260	33	300.67	15.25	-13.53
^{40}K	868	115	864.33	47.22	0.42	1600	213	1480	77.8	8.11
^{239}Pu	3.53	0.701	3.5433	0.377	-0.375	6.49	1.16	3.427	0.149	89.4
^{90}Sr	503	75.1	586.28	11.14	-14.2	365	36.5	476.26	6.673	-23.36

[a] Quality Assurance Program
[b] Environmental Measurements Laboratory
[c] Radionuclide
[d] Not requested
[e] Not acceptable

Table 8.14 - Environmental Measurements Laboratory Assessments for WIPP Laboratories, 2002 MATRIX: Water (Bq/L)

	QAP[a] 56 June 2002					QAP 57 December 2002				
	Reported		EML[b]		%	Reported		EML		%
RN[c]	Value	Error	Value	Error	Bias	Value	Error	Value	Error	Bias
^{241}Am	1.43	0.21	1.4737	0.021	-2.97	2.45	0.336	3.043	0.082	-19.49
Bq U	2.56	0.256	2.8355	0.121	-9.72	6.27	0.314	6.836	0.266	-8.28
^{60}Co	348	46.4	347.33	12.4	0.19	281	36.7	268.67	9.71	4.59
^{137}Cs	55.5	7.66	56.067	2.929	-1.01	85	11.5	81.43	4.28	4.38
^{134}Cs	3.07	0.835	3.3572	0.2	-8.55	60.8	8.23	60.2	1.86	0.99
^{238}Pu	0.483	0.078	0.4904	0.032	-1.51	4.29	0.618	4.331	0.117	-0.95
^{239}Pu	4.38	0.581	4.219	0.172	3.82	2.06	0.304	2.07	0.074	-0.48
^{90}Sr	7.17	0.456	7.5786	0.176	5.39	7.32	0.44	8.69	0.42	-15.76

[a] Quality Assurance Program
[b] Environmental Measurements Laboratory
[c] Radionuclide

Table 8.15 - Environmental Resource Associates® Assessment of Air Toxics, Ltd., WP-93, December 9, 2002, for Volatile Organic Compounds

Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Acetone	µg/L	< 10.00	0	NR[a]	Acceptable
Acetonitrile	µg/L	< 10.00	0	NR	Acceptable
Acrylonitrile	µg/L	< 2.00	0	NR	Acceptable
Acrolein	µg/L	< 10.00	0	NR	Acceptable
Benzene	µg/L	66.2	65.6	47.4 - 84.2	Acceptable
Bromodichloromethane	µg/L	14.3	12.6	8.68 - 16.6	Acceptable
Bromoform	µg/L	58.5	52	33.9 - 71.2	Acceptable
Bromomethane	µg/L	< 2.00	0	NR	Acceptable
2-Butanone (MEK)	µg/L	17	26.4	7.4 - 39.9	Acceptable
Carbon disulfide	µg/L	< 2.00	0	NR	Acceptable
Carbon tetrachloride	µg/L	87.8	69.7	143.0 - 98.3	Acceptable

Table 8.15 - Environmental Resource Associates® Assessment of Air Toxics, Ltd., WP-93, December 9, 2002, for Volatile Organic Compounds

Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Chlorobenzene	µg/L	76.2	74.7	52.3 - 95.5	Acceptable
Chlorodibromomethane	µg/L	<2.00	0	NR	Acceptable
Chloroethane	µg/L	24	20	12.0 - 37.8	Acceptable
2-Chloroethylvinylether	µg/L	< 10.0	0	NR	Acceptable
Chloroform	µg/L	14.5	13.7	9.8 - 17.9	Acceptable
Chloromethane	µg/L	< 2.00	0	NR	Acceptable
DBCP	µg/L	< 10.0	0	NR	Acceptable
1,2-Dibromoethane (EDB)	µg/L	< 2.00	0	NR	Acceptable
Dibromomethane	µg/L	< 2.00	0	NR	Acceptable
1,2-Dichlorobenzene	µg/L	52.6	50	35.3 - 63.2	Acceptable
1,3-Dichlorobenzene	µg/L	<2.00	0	NR	Acceptable
1,4-Dichlorobenzene	µg/L	30.6	28.8	19.6 - 37.5	Acceptable
Dichlorodifluoromethane	µg/L	< 2.00	0	NR	Acceptable
1,1-Dichloroethane	µg/L	< 2.00	0	NR	Acceptable
1,2-Dichloroethane	µg/L	19.6	17.4	12.2 - 23.7	Acceptable
1,1-Dichloroethylene	µg/L	44.3	42.5	22.5 - 66.1	Acceptable
cis-1,2-Dichloroethylene	µg/L	15.8	14.7	7.3 - 19.7	Acceptable
trans-1,2-Dichloroethylene	µg/L	52.1	49.1	30.0 - 68.2	Acceptable
1,2-Dichloropropane	µg/L	115	111	74.6 - 141.0	Acceptable
cis-1,3-Dichloropropylene	µg/L	< 2.00	0	NR	Acceptable
trans-1,3-Dichloropropylene	µg/L	< 2.00	0	NR	Acceptable
Ethylbenzene	µg/L	47.2	45.7	30.5 - 59.7	Acceptable
2-Hexanone	µg/L	< 10.0	0	NR	Acceptable
Methylene chloride	µg/L	65.7	61.5	38.8 - 84.5	Acceptable
4-Methyl-2-pentanone (MIBK)	µg/L	154	140	57.3 - 214.0	Acceptable
Styrene	µg/L	< 2.00	0	NR	Acceptable
1,1,1,2-Tetrachloroethane	µg/L	90.3	86.3	50.8 - 122.0	Acceptable
1,1,2,2-Tetrachloroethane	µg/L	199	190	112.0 - 265.0	Acceptable
Tetrachloroethylene	µg/L	<2.00	0	NR	Acceptable
Toluene	µg/L	15	14	9.7 - 18.0	Acceptable
1,1,1-Trichloroethane	µg/L	30	32.1	20.9 - 42.3	Acceptable
1,1,2-Trichloroethane	µg/L	<2.00	0	NR	Acceptable
Trichloroethylene	µg/L	37.8	36.5	23.7 - 47.3	Acceptable
Trichlorofluoromethane	µg/L	<2.00	0	NR	Acceptable
1,2,3-Trichloropropane	µg/L	< 2.00	0	NR	Acceptable
Vinyl acetate	µg/L	< 10.0	0	NR	Acceptable
Vinyl chloride	µg/L	19.4	18	4.1 - 30.1	Acceptable
Xylenes, total	µg/L	169	182	93.0 - 217.0	Acceptable

[a] Not reported

**Table 8.16 - AbsoluteGrade PT Program Assessment of Trace Analysis, Inc.
March - November, 2002**

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
pH	S.U.	5.74	5.8	5.67 - 5.93	Acceptable
Cyanide	mg/L	0.404	0.426	0.319 - 0.532	Acceptable
Phenolics, total	mg/L	1.7	1.31	0.723 - 1.90	Acceptable
Grease & Oil (Gravimeteric)	mg/L	23	24.9	15.2 - 30.0	Acceptable
Total Residual Chlorine	mg/L	0.98	0.847	0.627 - 1.07	Acceptable
Mercury	µg/L	3.41	2.89	2.07 -3.72	Acceptable
Hexavalent Chromium	µg/L	574	573	467 - 659	Acceptable
Minerals					
Total solids at 105°C	mg/L	278	316	252 - 380	Acceptable
Total Dissolved Solids	mg/L	144	136	102 - 170	Acceptable
Conductivity at 25°C	µmhos	145	136	128 - 144	Not Acceptable
Alkalinity as CaCO3	mg/L	24	24.8	20.7 - 29.8	Acceptable
Chloride	mg/L	39.8	44.4	39.3 - 49.0	Check for Error
Fluoride	mg/L	2.72	2.89	2.52 - 3.22	Acceptable
Potassium	mg/L	16.2	15.7	13.4 - 18.0	Acceptable
Sodium	mg/L	15.5	14.9	13.2 - 17.2	Acceptable
Sulfate	mg/L	17.4	19.2	3.17 - 34.8	Acceptable
Hardness					
Total suspended solids	mg/L	62.6	66.3	50.8 - 71.4	Acceptable
Calcium	mg/L	12.6	11.7	10.1 - 13.5	Acceptable
Magnesium	mg/L	8.6	8.18	7.1 - 9.2	Acceptable
Calcium hardness as $CaCO_3$	mg/L	NR[a]	67.9	NR	NR
Total hardness as $CaCO_3$	mg/L	669	62.8	56.0 - 71.2	Acceptable
Demand					
BOD	mg/L	166	147	74.3 - 219	Acceptable
CBOD	mg/L	112	126	56.5 - 196	Acceptable
COD	mg/L	159	239	187 - 270	Not Acceptable
TOC	mg/L	87.5	94.7	79.2 - 109.0	Acceptable
Nutrients					
Ammonia as N	mg/L	4.7	5.37	4.1 - 6.6	Acceptable
Nitrate as N	mg/L	3.99	4.27	3.35 - 5.11	Acceptable
Ortho-phosphate as P	mg/L	3.23	1.38	1.17 - 1.61	Not Acceptable
Total phosphorus as P	mg/L	1.26	1.42	1.07 - 1.70	Acceptable
Total kjeldahl nitrogen as N	mg/L	12	12.1	8.7-15.1	Acceptable
Trace Metals					
Aluminum	µg/L	301	330	270 - 391	Acceptable
Antimony	µg/L	31	35.9	25.1 - 46.7	Acceptable
Arsenic	µg/L	129	139	122 - 155	Acceptable
Barium	µg/L	1730	1759	1760 - 2340	Acceptable
Beryllium	µg/L	4.4	4.99	4.24 - 5.74	Acceptable
Boron	µg/L	999	1029	956 - 1137	Acceptable
Cadmium	µg/L	43.5	47.9	38.3 - 57.5	Acceptable
Chromium	µg/L	100	103	87.4 - 119.0	Acceptable
Cobalt	µg/L	530	519	NR	NR
Copper	µg/L	830	870	783 - 957	Acceptable

Table 8.16 - AbsoluteGrade PT Program Assessment of Trace Analysis, Inc. March - November, 2002

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Iron	µg/L	774	829	732 - 938	Acceptable
Lead	µg/L	71.1	76.9	53.8 - 99.9	Acceptable
Manganese	µg/L	525	560	521 - 588	Acceptable
Molybdenum	µg/L	21.4	29.9	24.8 - 35.0	Not Acceptable
Nickel	µg/L	249	260	221 - 299	Acceptable
Selenium	µg/L	67.5	71.9	57.5 - 86.3	Acceptable
Silver	µg/L	357	360	309 - 412	Acceptable
Strontium	µg/L	1930	200	170 - 229	Not Acceptable
Thallium	µg/L	<0.05	6.46	4.52 - 8.39	Not Acceptable
Vanadium	µg/L	1860	1850	NR	NR
Zinc	µg/L	867	880	808 - 946	Acceptable
PCBs in H_2O (Standard #1)					
Aroclor 1016	µg/L	0	0	0	Acceptable
Aroclor 1221	µg/L	NR	0	NR	Acceptable
Aroclor 1232	µg/L	0	0	0	Acceptable
Aroclor 1248	µg/L	0	0	0	Acceptable
Aroclor 1254	µg/L	2.07	2.83	1.4 - 4.3	Acceptable
Aroclor 1260	µg/L	0	0	0	Acceptable
PCBs in H_2O (Standard #2)					
Aroclor 1016	µg/L	6.33	9.28	2.9 - 15.7	Acceptable
Aroclor 1221	µg/L	NR	0	NR	Acceptable
Aroclor 1232	µg/L	0	0	0	Acceptable
Aroclor 1248	µg/L	0	0	0	Acceptable
Aroclor 1254	µg/L	0	0	0	Acceptable
Aroclor 1260	µg/L	0	0	0	Acceptable
PCBs in Oil (Standard #1)					
Aroclor 1016/1242	mg/kg	0	0	0	Acceptable
Aroclor 1254	mg/kg	13.1	34.7	7.15 - 62.2	Check for Error
Aroclor 1260	mg/kg	0	0	0	Acceptable
PCBs in Oil (Standard #2)					
Aroclor 1016/1242	mg/kg	0	0	0	Acceptable
Aroclor 1254	mg/kg	0	0	0	Acceptable
Aroclor 1260	mg/kg	6.36	16.2	3.8 - 28.7	Check for Error
Volatiles					
Acetone	µg/L	NR	0	NR	NR
Acetonitrile	µg/L	NR	0	NR	NR
Acrylonitrile	µg/L	NR	0	NR	NR
Acrolein	µg/L	NR	0	NR	NR
Benzene	µg/L	66.4	60	43.4 - 77.1	Acceptable
Bromodichloromethane	µg/L	30.8	27.6	19.4 - 36.1	Acceptable
Bromoform	µg/L	66.5	68	45.4 - 92.3	Acceptable
Bromomethane	µg/L	NR	0	NR	NR
2-Butanone (MEK)	µg/L	NR	0	NR	NR
Carbon disulfide	µg/L	NR	0	NR	NR
Carbon tetrachloride	µg/L	65.1	68	41.9 - 95.9	Acceptable

**Table 8.16 - AbsoluteGrade PT Program Assessment of Trace Analysis, Inc.
March - November, 2002**

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Chlorobenzene	µg/L	47.3	44	31.2 - 56.0	Acceptable
Chlorodibromomethane	µg/L	22.1	0	NR	NR
Chloroethane	µg/L	NR	0	NR	NR
2-Chloroethylvinylether	µg/L	NR	0	NR	NR
Chloroform	µg/L	44.7	40	27.9 - 51.4	Acceptable
Chloromethane	µg/L	NR	0	NR	NR
DBCP	µg/L	NR	0	NR	NR
1,2-Dibromoethane (EDB)	µg/L	NR	0	NR	NR
Dibromomethane	µg/L	NR	0	NR	NR
1,2-Dichlorobenzene	µg/L	10.7	9.6	6.4 - 12.8	Acceptable
1,3-Dichlorobenzene	µg/L	63.9	56	39.7 - 69.7	Acceptable
1,4-Dichlorobenzene	µg/L	55.1	48	33.0 - 61.9	Acceptable
Dichlorodifluoromethane	µg/L	NR	0	NR	NR
1,1-Dichloroethane	µg/L	NR	0	NR	NR
1,2-Dichloroethane	µg/L	20.6	19.2	13.4 - 26.1	Acceptable
1,1-Dichloroethylene	µg/L	100	86.9	NR	NR
cis-1,2-Dichloroethylene	µg/L	2.01	0	NR	NR
trans-1,2-Dichloroethylene	µg/L	110	94.1	NR	NR
1,2-Dichloropropane	µg/L	54.2	49.7	NR	NR
cis-1,3-Dichloropropylene	µg/L	2.82	0.911	NR	NR
trans-1,3-Dichloropropylene	µg/L	32.3	41.4	NR	NR
Ethylbenzene	µg/L	13.8	12.4	8.5 - 16.0	Acceptable
2-Hexanone	µg/L	NR	0	NR	NR
Methylene chloride	µg/L	28	24.8	15.7 - 34.7	Acceptable
4-Methyl-2-pentanone (MIBK)	µg/L	NR	0	NR	NR
Styrene	µg/L	NR	0	NR	NR
1,1,1,2-Tetrachloroethane	µg/L	NR	0	NR	NR
1,1,2,2-Tetrachloroethane	µg/L	67.5	62.4	NR	NR
Tetrachloroethylene	µg/L	19.6	29.6	19.6 - 38.2	Acceptable
Toluene	µg/L	29.5	26	18.5 - 32.8	Acceptable
1,1,1-Trichloroethane	µg/L	16.3	15.2	10.1 - 20.0	Acceptable
1,1,2-Trichloroethane	µg/L	63.9	58.2	NR	NR
Trichloroethylene	µg/L	16.4	16.4	10.8 - 21.4	Acceptable
Trichlorofluoromethane	µg/L	69.8	65.3	NR	NR
1,2,3-Trichloropropane	µg/L	NR	0	NR	NR
Vinyl acetate	µg/L	NR	0	NR	NR
Vinyl chloride	µg/L	NR	0	NR	NR
Xylenes, total	µg/L	145.8	128	89.6 - 166.4	Acceptable
<u>Acids</u>					
Benzoic acid	µg/L	NR	0	NR	NR
4-Chloro-3-methylphenol	µg/L	128	114	NR	NR
2-Chlorophenol.	µg/L	56	65.4	NR	NR
2,4-Dichlorophenol	µg/L	108	188	67.5 - 225	Acceptable
2,6-Dichlorophenol	µg/L	NR	0	NR	NR
2,4-Dimethylphenol	µg/L	23.4	41.5	26.4 - 56.0	Acceptable

Table 8.16 - AbsoluteGrade PT Program Assessment of Trace Analysis, Inc.
March - November, 2002

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
4,6-Dinitro-2-methylphenol	µg/L	165	194	16.9 - 288	Acceptable
2,4-Dinitrophenol	µg/L	16.7	43.3	0.0 - 71.4	Acceptable
2-Methlyphenol	µg/L	NR	0	NR	NR
3-Methylphenol	µg/L	NR	0	NR	NR
4-Methylphenol	µg/L	NR	0	NR	NR
2-Nitrophenol	µg/L	114	197	57.4 - 260	Acceptable
3-Nitrophenol	µg/L	NR	0	NR	NR
4-Nitrophenol	µg/L	34.6	117	0.00 - 159	Acceptable
Pentachlorophenol	µg/L	148	198	55.9 - 275	Acceptable
Phenol	µg/L	37.6	184	0.00 - 246	Acceptable
2,4,5-Trichlorophenol	µg/L	<5.0	0	0	Acceptable
2,4,6-Trichlorophenol	µg/L	38.7	55.8	19.3 - 73.3	Acceptable
Base Neturals					
Acenaphthene	µg/L	80.2	115	42.7 - 147	Acceptable
Acenaphthylene	µg/L	131	192	77.1 - 231	Acceptable
Aniline	µg/L	NR	0	NR	NR
Anthracene	µg/L	134	171	56.5 - 221	Acceptable
Benzidine	µg/L	NR	0	NR	NR
Benzo(a)anthracene	µg/L	83.4	113	56.8 - 140	Acceptable
Benzo(b)fluoranthene	µg/L	116	187	35.5 - 271	Acceptable
Benzo(k)fluoranthene	µg/L	70.9	102	25.6 - 147	Acceptable
Benzo(g,h,i)perylene	µg/L	120	186	55.9 - 277	Acceptable
Benzo(a)pyrene	µg/L	113	153	88.6 - 218	Acceptable
Benzyl alcohol	µg/L	NR	0	NR	NR
4-Bromophenyl-phenylether	µg/L	124	111	NR	NR
Butylbenzylphthalate	µg/L	144	134	NR	NR
Carbazole	µg/L	NR	0	NR	NR
4-Chloroaniline	µg/L	< 5.00	0	0	Acceptable
bis(2-Chloroethoxy)methane	µg/L	76.1	130	51.3 - 154	Acceptable
bis(2-Chloroethyl)ether	µg/L	48.5	80.3	22.4 - 99.5	Acceptable
bis(2-Chloroisopropyl)ether	µg/L	63.1	96.5	24.0 - 142	Acceptable
1-Chloronaphthalene	µg/L	NR	0	NR	NR
2-Chloronaphthalene	µg/L	38.6	45.6	NR	NR
4-Chlorophenyl-phenylether	µg/L	125	170	58.5 - 217	Acceptable
Chrysene	µg/L	117	141	51.1 - 186	Acceptable
Dibenz(a,h)anthracene	µg/L	140	177	124 - 229	Check for Error
Dibenzofuran	µg/L	44.1	55.6	37.0 - 74.2	Acceptable
Di-n-butylphthalate	µg/L	134	173	16.9 - 241	Acceptable
1,2-Dichlorobenzene	µg/L	46.6	67	25.8 - 108	Acceptable
1,3-Dichlorobenzene	µg/L	51.7	67.6	31.4 - 104	Acceptable
1,4-Dichlorobenzene	µg/L	31	40.8	21.5 - 60.1	Acceptable
3,3'-Dichlorobenzidine	µg/L	NR	0	NR	NR
Diethylphthalate	µg/L	124	164	0.00 - 243	Acceptable
Dimethlyphthalate	µg/L	47	64.4	0.00 - 98.3	Acceptable
2,4-Dinitrotoluene	µg/L	36.7	46.4	15.9 - 61.0	Acceptable

**Table 8.16 - AbsoluteGrade PT Program Assessment of Trace Analysis, Inc.
March - November, 2002**

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
2,6-Dinitrotoulene	µg/L	29.5	37.6	14.4 - 46.9	Acceptable
Di-n-octylphthalate	µg/L	87.8	160	20.3 - 231	Acceptable
bis(2-ethylhexyl)phthalate	µg/L	275	172	21.8 - 253	Not Acceptable
Fluoranthene	µg/L	35.5	41.1	19.7 - 52.7	Acceptable
Fluorene	µg/L	26.6	35.8	15.2 - 46.8	Acceptable
Hexachlorobenzene	µg/L	91.4	115	50.3 - 149	Acceptable
Hexachlorobutadiene	µg/L	68.2	124	21.5 - 149	Acceptable
Hexachlorocyclopentadiene	µg/L	65.8	142	0 - 180	Acceptable
Hexachloroethane	µg/L	70.2	127	10.5 - 162	Acceptable
Indeno(1,2,3-cd)pyrene	µg/L	114	159	82.0 - 235	Acceptable
Isophorone	µg/L	42.9	62	23.1 - 81.7	Acceptable
1-Methylnaphthalene	µg/L	NR	0	NR	NR
2-Methylnaphthalene	µg/L	NR	0	NR	NR
Naphthalene	µg/L	95.1	171	40.1 - 222	Acceptable
2-Nitroaniline	µg/L	31.3	38.1	28 - 48.1	Check for Error
3-Nitroaniline	µg/L	47.1	48.7	14.9 - 82.5	Acceptable
4-Nitroaniline	µg/L	51.7	70.8	30.1 - 112	Acceptable
Nitrobenzene	µg/L	62.4	117	37.6-153	Acceptable
N-Nitrosodiethylamine	µg/L	NR	0	NR	NR
N-Nitrosodimethylamine	µg/L	55.3	189	0.0 - 220	Acceptable
N-Nitrosodiphenylamine	µg/L	NR	0	NR	NR
N-Nitroso-di-n-propylamine	µg/L	70.6	101	31 - 132	Acceptable
Phenanthrene	µg/L	42.1	51	24.9 - 64.4	Acceptable
Pyrene	µg/L	101	161	53.6 - 215	Acceptable
Pyridine	µg/L	NR	0	NR	NR
1,2,4-Trichlorobenzene	µg/L	74	134	39.2 - 159	Acceptable

[a] Not reported
[b] Check for Error indicates result is above the warning limit, but within the acceptance limit.

**Table 8.17 - AbsoluteGrade PT Program Assessment of Trace Analysis, Inc., Petroleum
March - November, 2002**

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Gasoline in Water					
Unleaded Gasoline	µg/L	14800	4504	2702 - 6305	Not Acceptable
Benzene	µg/L	53.4	48	33.6 - 62.4	Acceptable
Ethylbenzene	µg/L	29.5	26.8	18.8 - 34.8	Acceptable
Toluene	µg/L	22.6	20	14.0 - 26.0	Acceptable
Xylenes, M/P	µg/L	113	100	70 - 130	Acceptable
Diesel in Water					
No. 2 Diesel	µg/L	4200	3410	NR	NR
TPH in Water					
TPH (gravimetric)	mg/bttl	NR[a]	120	NR	NR
TPH (IR)	mg/bttl	184	144	NR	NR
BTEX in Water					

Table 8.17 - AbsoluteGrade PT Program Assessment of Trace Analysis, Inc., Petroleum March - November, 2002

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Benzene	mg/L	59.2	58.6	NR	NR
Ethylbenzene	mg/L	9.8	10	NR	NR
Toluene	mg/L	74.9	73.9	NR	NR
Xylenes, total	mg/L	197	225	NR	NR

[a] Not reported

Table 8.18 - AbsoluteGrade PT Program Assessment of Trace Analysis, Inc., Pesticides March - November, 2002

Parameter	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Aldrin	µg/L	3.1	0.93	0.294 - 1.57	Not Acceptable
alpha-BHC	µg/L	2.5	5.24	NR	NR
beta-BHC	µg/L	2.5	3.01	NR	NR
delta-BHC	µg/L	NR	NR	NR	NR
gamma-BHC (Lindane)	µg/L	2.8	6.32	NR	NR
alpha-Chlordane	µg/L	NR	NR	NR	NR
gamma-Chlordane	µg/L	1.9	2.7	NR	NR
Chlordane, technical	µg/L	8.2	9.01	3.93 - 12.8	Acceptable
4,4'-DDD	µg/L	5.86	4.51	2.35 - 6.66	Acceptable
4,4'-DDE	µg/L	5.32	2.08	1.07 - 3.09	Not Acceptable
4,4'-DDT	µg/L	6.47	6.38	3.23 - 9.52	Acceptable
Dieldrin	µg/L	5.76	3.67	2.00-5.34	Not Acceptable
Endrin	µg/L	NR	1.09	NR	NR
Endrin aldehyde	µg/L	NR	NR	NR	NR
Endrin ketone	µg/L	NR	NR	NR	NR
Endosulfan I	µg/L	1.5	2.19	NR	NR
Endosulfan II	µg/L	2.4	3.83	NR	NR
Endosulfan sulfate	µg/L	6	7.77	NR	NR
Heptachlor	µg/L	3.56	1.16	0.375 - 1.96	Not Acceptable
Heptachlor epoxide	µg/L	2.99	1.08	0.61 - 1.55	Not Acceptable
Methoxychlor	µg/L	5	6.39	NR	NR
Toxaphene	µg/L	NR	NR	NR	NR

[a] Not reported

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Appendix A
Acronyms, Abbreviations, and Symbols

A

ACAA	Accelerated Corrective Action Approach
AMSL	above mean sea level
ANOVA	Analysis of Variance
ANSI	American National Standards Institute
AOC	Area of Concern
ASER	annual site environmental report
ASTM	American Society for Testing and Materials

B

BCG	Biota Concentration Guides
BLM	U.S. Department of the Interior, Bureau of Land Management
Bq	becquerel
Bq/L	becquerels per liter
Bq/m^3	becquerels per cubic meter

C

C of C	Certificate of Compliance
CAA	Clean Air Act
CAP88	computer code for calculating both dose and risk from radionuclide emissions
CBFO	Carlsbad Field Office
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	*Code of Federal Regulations*
CH	contact-handled
Ci	curie
cm	centimeter
COD	chemical oxygen demand

D

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DP	Discharge Permit

E

EA	Environmental Assessment
EDE	effective dose equivalent
EEG	Environmental Evaluation Group
Eh	Intensity Factor
EH	DOE Environment, Safety, and Health
EIS	Environmental Impact Statement
EML	Environmental Measurements Laboratory
EMP	WIPP Environmental Monitoring Plan

EMS	Environmental Management System
E.O.	Executive Order
EPA	U.S. Environmental Protection Agency
ERA	Environmental Resource Associates

F

ft	foot
ft^3	cubic foot
FEIS	Final Environmental Impact Statement
FY	fiscal year

G

g	gram
gpd	gallons per day
Gy	Gray

H

HalfPACT	Short Transuranic Package Transporter
HEPA	high-efficiency particulate air (filter)
HMTA	Hazardous Materials Transportation Act
HWFP	Hazardous Waste Facility Permit

I

IAEA	International Atomic Energy Agency
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization

K

kg	kilogram
km	kilometer
km^2	square kilometers

L

L	liter
LMP	Land Management Plan
LUR	Land Use Request
LWA	Land Withdrawal Act

M

m	meter
m^3	cubic meters
mBq	millibecquerel
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
MeV	million electron volts
mg	milligram
mg/L	milligram per liter

mi	mile
mi^2	square miles
ml	milliliter
MOU	Memorandum of Understanding
MP	Management Policy
mrem	millirem
MSDS	material safety data sheet
mSv	millisievert
mSv/yr	millisievert per year

N

N/A	not applicable
N/C	not collected
NCRP	National Council for Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	No Further Action
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMIMT	New Mexico Institute of Mining Technology
NMSA	New Mexico Statutes Annotated
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NQA	Nuclear Quality Assurance
NR	not reported
NRC	Nuclear Regulatory Commission
NRIP	National Institute of Standards and Technology Radiochemistry Intercomparison Program

O

oz	ounce

P

P&A	plugging and abandonment
P2	pollution prevention
Pub. L.	Public Law
PCB	polychlorinated biphenyl
pCi	picoCuries
pCi/L	picoCuries per liter
PIP	production injection packer
ppbv	parts per billion by volume
PPOA	Pollution Prevention Opportunity Assessment

Q

QA	quality assurance
QAP	Quality Assurance Program
QC	quality control

R

RCRA	Resource Conservation and Recovery Act
rem	Roentgen equivalent man
RER	Relative Error Ratio
RFI	RCRA Facility Investigation
RFI/CMS	RCRA Facility Investigation/Corrective Measures Study
RH	remote-handled
RL	Reporting Limit
ROD	Record of Decision
RPD	relative percent difference

S

SARA	Superfund Amendments and Reauthorization Act
SD	Standard Deviation
SDWA	Safe Drinking Water Act
SEIS-I	First Supplemental Environmental Impact Statement
SEIS - II	Second Supplemental Environmental Impact Statement
SI	Soil Intermediate
SMA	Special Management Area
SS	Soil Surface
SU	Standard Unit
SWMU	Solid Waste Management Unit

T

TDS	Total Dissolved Solid
TOC	Total Organic Compound
TPU	Total Propagated Uncertainty
TRANSCOM	Transportation Tracking and Communications (system)
TRU	transuranic (waste)
TRUPACT - II	Transuranic Package Transporter Model II
TSDF	treatment, storage, and disposal facility

U

U.S.	United States
U.S.C.	*United States Code*
UST	underground storage tank
UTLV	Upper Tolerance Limit Value

V

VOC	Volatile Organic Compound

W

WIPP	Waste Isolation Pilot Plant
WLWA	WIPP Land Withdrawal Area
WQSP	WIPP Groundwater Quality Sampling Program
WRES	Washington Regulatory and Environmental Services
WRRP	WIPP Raptor Research Program
WTS	Washington TRU Solutions LLC

Symbols

σ	sigma
°C	Degrees Celsius
°F	Degrees Fahrenheit
μCi	microcurie
μg	microgram
μmhos	micromhos
%	Percent
[RN]	Radionuclide concentration

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Appendix B
Location Codes

Table B.1 - Codes Used to Identify the Sites from Which Samples Were Collected

Code	Location	Code	Location
BHT	Bottom of the Hill Tank	RCP	Rainwater Catchment Pond
BRA	Brantley Lake	RED	Red Tank
CBD	Carlsbad	RNS	Rinse Aid Blank
COW	Coyote Well (deionized water blank)	SE1	South East 1
COY	Coyote (surface water duplicate)	SE2	South East 2
CT1	Control 1	SEC	South East Control
CT2	Control 2	SMR	Smith Ranch
FWT	Fresh Water Tank	SOO	Sample Of Opportunity
HIL	Hill Tank	SWL	Sewage Lagoons
IDN	Indian Tank	TUT	Tut Tank
LAG	Laguna Grande del Sol	UPR	Upper Pecos River
LST	Lost Tank	WAB	WIPP Air Blank
MLR	Mills Ranch	WE1	WIPP East 1
NOY	Noya Tank	WEE	WIPP East
NW1	NorthWest1	WIP	WIPP 16 Sections
NW2	NorthWest2	WFF	WIPP Far Field
PCN	Pierce Canyon	WQSP	Water Quality Sample Program
PEC	Pecos River	WSS	WIPP South
PKT	Poker Trap		

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Appendix C
Equations

Minimum Detectable Concentration (MDC)

MDC is equal to the mean of a distribution such that 95 percent of the measurements of the distribution will produce analytical results that have the activity above that of a blank. It is possible to achieve a very low level of detection by analyzing a large sample size and counting for a very long time.

The laboratory used the following equation for calculating the MDCs for each radionuclide in various sample matrices:

$$MDC = \frac{4.65 \quad S_b}{K \; T} + \frac{3}{K \; T}$$

Where:

S_b	=	Standard deviation of the background count
K	=	A correction factor that includes items such as unit conversions, sample volume/weight, decay correction, detector efficiency, chemical recovery and abundance correction, etc.
T	=	Counting time

For further evaluation of MDC, refer to HPS N13.30 - 1996, *Performance Criteria for Radiobioassay*.

Total Propagated Uncertainty (TPU)

TPU is an estimate of the uncertainty in the measurement due to all sources, including counting error, measurement error, chemical recovery error, detector efficiency, randomness of radioactive decay, and any other sources of uncertainty.

Total propagated uncertainty for each data point must be reported at 2σ level. The TPU was calculated by using the following equation:

$$TPU_{1\sigma} = \sigma_{ACT} = \frac{\sqrt{\sigma_{NCR}{}^2 + (NCR)^2 * (RE_{EFF}^2 + RE_{ALI}^2 + RE_R^2 + \Sigma\, RE_{CF}^2)}}{2.22 * EFF * ALI * R * ABN_S * e^{-\lambda t} * CF}$$

Where:

EFF	=	Detector Efficiency
ALI	=	Sample Aliquot Volume or Mass
R	=	Sample Tracer/Carrier Recovery

ABN_s = Abundance Fraction of the Emissions Used for Identification/Quantification
σ^2_{NCR} = Variance of the Net Sample Count Rate
NCR = Net Sample Count Rate
RE^2_{EFF} = Square of the Relative Error of the Efficiency Term
RE^2_{ALI} = Square of the Relative Error of the Aliquot
RE^2_{R} = Square of the Relative Error of the Sample Recovery
RE^2_{CF} = Square of the Relative Error of Other Correction Factors
λ = Analyte Decay Constant = ln 2/(half-life) [Same units as the half-life used to compute λ]
t = Time from Sample Collection to Radionuclide Separation or Mid-Point of Count Time (Same units as half-life)
CF = Other Correction Factors as Appropriate (i.e., ingrowth factor, self-absorption factor, etc.).

For further discussion of TPU, refer to HPS N13.30-1996, *Performance Criteria for Radiobioassay*, and/or *Waste Acceptance Criteria for Off-Site Generators*, Fernald Environmental Management Project (DOE, 1994).

Relative Error Ratio (RER)

The Relative Error Ratio is a method, similar to a t-test, with which to compare duplicate results (see Chapters 4 and 8; WP 02-EM3004).

$$RER = \frac{|\, x_A - x_B \,|}{\sqrt{(2\sigma_A)^2 + (2\sigma_B)^2}}$$

Where:

X_A = Mean Activity of Population A
X_B = Mean Activity of Population B
σ_A = Standard Deviation of Population A
σ_B = Standard Deviation of Population B.

Percent Bias (% Bias)

A measure of the accuracy of radiochemical separation methods and counting instruments; that is, a measure of how reliable the results of analyses are when compared to the actual values.

$$\%\ BIAS = [\frac{A_m - A_k}{A_k}] * 100\%$$

Where:

% BIAS = Percent Bias
A_m = Measured Sample Activity
A_k = Known Sample Activity

Appendix D
Concentrations of Alpha and Beta Activities in Air Particulates

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
		Carlsbad			
1	AL-CBD-20020102 1.2	1.72×10^{-4}	4.47×10^{-5}	1.28×10^{-3}	1.60×10^{-4}
2	AL-CBD-20020109 1.2	1.16×10^{-4}	3.69×10^{-5}	8.81×10^{-4}	1.22×10^{-4}
3	AL-CBD-20020116 1.2	1.33×10^{-4}	3.88×10^{-5}	1.14×10^{-3}	1.46×10^{-4}
4	AL-CBD-20020123 1.2	1.04×10^{-4}	3.40×10^{-5}	1.05×10^{-3}	1.38×10^{-4}
5	AL-CBD-20020130 1.2	1.16×10^{-4}	3.59×10^{-5}	1.33×10^{-3}	1.63×10^{-4}
6	AL-CBD-20020206 1.2	7.41×10^{-5}	2.90×10^{-5}	8.82×10^{-4}	1.22×10^{-4}
7	AL-CBD-20020213 1.2	6.18×10^{-5}	2.24×10^{-5}	8.65×10^{-4}	1.11×10^{-4}
8	AL-CBD-20020220 1.2	7.14×10^{-5}	2.96×10^{-5}	8.10×10^{-4}	1.18×10^{-4}
9	AL-CBD-20020227 1.2	9.97×10^{-5}	3.41×10^{-5}	1.20×10^{-3}	1.53×10^{-4}
10	AL-CBD-20020306 1.2	6.04×10^{-5}	2.72×10^{-5}	9.73×10^{-4}	1.32×10^{-4}
11	AL-CBD-20020313 1.2	N/C[b]	N/C	N/C	N/C
12	AL-CBD-20020320 1.2	6.91×10^{-5}	2.80×10^{-5}	8.36×10^{-4}	1.17×10^{-4}
13	AL-CBD-20020327 1.2	4.51×10^{-5}	2.19×10^{-5}	8.66×10^{-4}	1.17×10^{-4}
14	AL-CBD-20020403 1.1	6.80×10^{-5}	2.85×10^{-5}	9.54×10^{-4}	1.28×10^{-4}
15	AL-CBD-20020410 1.1	6.05×10^{-5}	2.77×10^{-5}	1.01×10^{-3}	1.35×10^{-4}
16	AL-CBD-20020417 1.1	4.71×10^{-5}	2.36×10^{-5}	8.37×10^{-4}	1.17×10^{-4}
17	AL-CBD-20020424 1.1	8.74×10^{-5}	3.20×10^{-5}	7.91×10^{-4}	1.12×10^{-4}
18	AL-CBD-20020501 1.1	6.14×10^{-5}	2.54×10^{-5}	7.03×10^{-4}	1.02×10^{-4}
19	AL-CBD-20020508 1.1	5.00×10^{-5}	2.41×10^{-5}	8.10×10^{-4}	1.12×10^{-4}
20	AL-CBD-20020515 1.1	3.62×10^{-5}	2.22×10^{-5}	7.68×10^{-4}	1.11×10^{-4}
21	AL-CBD-20020522 1.1	5.49×10^{-5}	2.64×10^{-5}	8.01×10^{-4}	1.14×10^{-4}
22	AL-CBD-20020529 1.1	3.88×10^{-5}	2.19×10^{-5}	8.32×10^{-4}	1.16×10^{-4}
23	AL-CBD-20020605 1.1	4.59×10^{-5}	2.17×10^{-5}	6.53×10^{-4}	9.61×10^{-5}
24	AL-CBD-20020612 1.1	N/C	N/C	N/C	N/C
25	AL-CBD-20020619 1.1	6.80×10^{-5}	2.80×10^{-5}	9.52×10^{-4}	1.28×10^{-4}
26	AL-CBD-20020626 1.1	4.74×10^{-5}	2.44×10^{-5}	6.68×10^{-4}	1.00×10^{-4}
27	AL-CBD-20020703 1.1	7.29×10^{-5}	2.95×10^{-5}	8.48×10^{-4}	1.18×10^{-4}
28	AL-CBD-20020710 1.1	4.76×10^{-5}	2.37×10^{-5}	8.29×10^{-4}	1.15×10^{-4}
29	AL-CBD-20020717 1.1	2.76×10^{-5}	1.88×10^{-5}	6.94×10^{-4}	1.01×10^{-4}
30	AL-CBD-20020724 1.1	3.28×10^{-5}	1.96×10^{-5}	7.15×10^{-4}	1.04×10^{-4}
31	AL-CBD-20020731 1.1	7.20×10^{-5}	2.86×10^{-5}	9.96×10^{-4}	1.32×10^{-4}
32	AL-CBD-20020807 1.1	1.19×10^{-4}	3.78×10^{-5}	1.02×10^{-3}	1.35×10^{-4}
33	AL-CBD-20020814 1.1	8.95×10^{-5}	3.27×10^{-5}	8.98×10^{-4}	1.23×10^{-4}
34	AL-CBD-20020821 1.1	8.84×10^{-5}	3.23×10^{-5}	9.84×10^{-4}	1.31×10^{-4}
35	AL-CBD-20020828 1.1	7.70×10^{-5}	3.00×10^{-5}	1.19×10^{-3}	1.52×10^{-4}
36	AL-CBD-20020904 1.1	8.05×10^{-5}	3.03×10^{-5}	7.94×10^{-4}	1.11×10^{-4}
37	AL-CBD-20020911 1.1	9.58×10^{-5}	3.36×10^{-5}	1.22×10^{-3}	1.55×10^{-4}
38	AL-CBD-20020918 1.1	1.15×10^{-4}	3.62×10^{-5}	1.11×10^{-3}	1.43×10^{-4}
39	AL-CBD-20020925 1.1	1.15×10^{-4}	3.64×10^{-5}	1.19×10^{-3}	1.52×10^{-4}
40	AL-CBD-20021002 1.1	9.07×10^{-5}	3.27×10^{-5}	8.92×10^{-4}	1.22×10^{-4}
41	AL-CBD-20021009 1.1	1.02×10^{-4}	3.40×10^{-5}	1.38×10^{-3}	1.71×10^{-4}
42	AL-CBD-20021016 1.1	7.95×10^{-5}	3.01×10^{-5}	1.15×10^{-3}	1.47×10^{-4}
43	AL-CBD-20021023 1.1	4.36×10^{-5}	2.12×10^{-5}	5.62×10^{-4}	8.66×10^{-5}
44	AL-CBD-20021030 1.1	5.94×10^{-5}	2.71×10^{-5}	9.52×10^{-4}	1.28×10^{-4}
45	AL-CBD-20021106 1.1	5.84×10^{-5}	2.67×10^{-5}	1.10×10^{-3}	1.42×10^{-4}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
46	AL-CBD-20021113 1.1	9.36×10^{-5}	3.22×10^{-5}	1.08×10^{-3}	1.40×10^{-4}
47	AL-CBD-20021120 1.1	8.73×10^{-5}	3.06×10^{-5}	1.52×10^{-3}	1.84×10^{-4}
48	AL-CBD-20021127 1.1	9.43×10^{-5}	3.26×10^{-5}	1.77×10^{-3}	2.10×10^{-4}
49	AL-CBD-20021204 1.1	4.36×10^{-5}	2.17×10^{-5}	1.50×10^{-3}	1.84×10^{-4}
50	AL-CBD-20021211 1.1	1.17×10^{-4}	3.78×10^{-5}	1.37×10^{-3}	1.71×10^{-4}
51	AL-CBD-20021218 1.1	3.88×10^{-5}	2.05×10^{-5}	9.59×10^{-4}	1.25×10^{-4}
52	AL-CBD-20021225 1.1	3.85×10^{-5}	2.78×10^{-5}	1.50×10^{-3}	1.99×10^{-4}
		Mills Ranch			
1	AL-MLR-20020102 1.1	2.31×10^{-4}	5.35×10^{-5}	1.40×10^{-3}	1.73×10^{-4}
2	AL-MLR-20020109 1.1	1.23×10^{-4}	3.73×10^{-5}	8.77×10^{-4}	1.20×10^{-4}
3	AL-MLR-20020116 1.1	1.54×10^{-5}	4.18×10^{-5}	1.30×10^{-3}	1.62×10^{-4}
4	AL-MLR-20020123 1.1	1.02×10^{-4}	3.28×10^{-5}	9.31×10^{-4}	1.24×10^{-4}
5	AL-MLR-20020130 1.1	9.63×10^{-5}	3.26×10^{-5}	1.24×10^{-3}	1.55×10^{-4}
6	AL-MLR-20020206 1.1	5.90×10^{-5}	2.44×10^{-5}	8.61×10^{-4}	1.17×10^{-4}
7	AL-MLR-20020213 1.1	6.10×10^{-5}	2.48×10^{-5}	9.18×10^{-4}	1.23×10^{-4}
8	AL-MLR-20020220 1.1	5.14×10^{-5}	2.44×10^{-5}	7.66×10^{-4}	1.12×10^{-4}
9	AL-MLR-20020227 1.1	8.79×10^{-5}	3.18×10^{-5}	1.24×10^{-3}	1.57×10^{-4}
10	AL-MLR-20020306 1.1	7.51×10^{-5}	2.89×10^{-5}	9.89×10^{-4}	1.31×10^{-4}
11	AL-MLR-20020313 1.1	3.47×10^{-5}	1.92×10^{-5}	8.26×10^{-4}	1.13×10^{-4}
12	AL-MLR-20020320 1.1	9.54×10^{-5}	3.26×10^{-5}	1.10×10^{-3}	1.43×10^{-4}
13	AL-MLR-20020327 1.1	6.14×10^{-5}	2.58×10^{-5}	8.70×10^{-4}	1.18×10^{-4}
14	AL-MLR-20020403 1.1	6.59×10^{-5}	2.88×10^{-5}	9.81×10^{-4}	1.32×10^{-4}
15	AL-MLR-20020410 1.1	4.91×10^{-5}	2.37×10^{-5}	1.05×10^{-3}	1.36×10^{-4}
16	AL-MLR-20020417 1.1	4.24×10^{-5}	2.26×10^{-5}	8.73×10^{-4}	1.21×10^{-4}
17	AL-MLR-20020424 1.1	6.65×10^{-5}	2.86×10^{-5}	8.46×10^{-4}	1.19×10^{-4}
18	AL-MLR-20020501 1.1	7.05×10^{-5}	2.75×10^{-5}	7.77×10^{-4}	1.10×10^{-4}
19	AL-MLR-20020508 1.1	5.54×10^{-5}	2.60×10^{-5}	7.89×10^{-4}	1.11×10^{-4}
20	AL-MLR-20020515 1.1	6.22×10^{-5}	2.78×10^{-5}	8.84×10^{-4}	1.22×10^{-4}
21	AL-MLR-20020522 1.1	3.32×10^{-5}	2.03×10^{-5}	6.89×10^{-4}	1.01×10^{-4}
22	AL-MLR-20020529 1.1	N/C	N/C	N/C	N/C
23	AL-MLR-20020605 1.1	5.16×10^{-5}	2.32×10^{-5}	5.97×10^{-4}	9.06×10^{-5}
24	AL-MLR-20020612 1.1	6.21×10^{-5}	2.78×10^{-5}	8.02×10^{-4}	1.15×10^{-4}
25	AL-MLR-20020619 1.1	5.69×10^{-5}	2.61×10^{-5}	9.16×10^{-4}	1.25×10^{-4}
26	AL-MLR-20020626 1.1	5.70×10^{-5}	2.69×10^{-5}	5.20×10^{-4}	8.53×10^{-5}
27	AL-MLR-20020703 1.1	5.09×10^{-5}	2.54×10^{-5}	9.19×10^{-4}	1.27×10^{-4}
28	AL-MLR-20020710 1.1	4.35×10^{-5}	2.38×10^{-5}	5.91×10^{-4}	9.27×10^{-5}
29	AL-MLR-20020717 1.1	2.72×10^{-5}	1.95×10^{-5}	5.96×10^{-4}	9.33×10^{-5}
30	AL-MLR-20020724 1.1	N/C	N/C	N/C	N/C
31	AL-MLR-20020731 1.1	6.93×10^{-5}	3.04×10^{-5}	9.03×10^{-4}	1.28×10^{-4}
32	AL-MLR-20020807 1.1	1.58×10^{-4}	4.43×10^{-5}	9.66×10^{-4}	1.30×10^{-4}
33	AL-MLR-20020814 1.1	1.16×10^{-4}	3.73×10^{-5}	9.48×10^{-4}	1.27×10^{-4}
34	AL-MLR-20020821 1.1	8.84×10^{-5}	3.23×10^{-5}	9.67×10^{-4}	1.29×10^{-4}
35	AL-MLR-20020828 1.1	9.85×10^{-5}	3.45×10^{-5}	1.22×10^{-3}	1.56×10^{-4}
36	AL-MLR-20020904 1.1	7.96×10^{-5}	3.00×10^{-5}	7.30×10^{-4}	1.04×10^{-4}
37	AL-MLR-20020911 1.1	1.06×10^{-4}	3.59×10^{-5}	1.29×10^{-3}	1.63×10^{-4}
38	AL-MLR-20020918 1.1	9.67×10^{-5}	3.31×10^{-5}	1.20×10^{-3}	1.52×10^{-4}
39	AL-MLR-20020925 1.1	1.11×10^{-4}	3.57×10^{-5}	1.21×10^{-3}	1.54×10^{-4}
40	AL-MLR-20021002 1.1	8.48×10^{-5}	3.15×10^{-5}	8.73×10^{-4}	1.20×10^{-4}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	**Sample ID**	**Concentration**	**2 x TPU[a]**	**Concentration**	**2 x TPU**
41	AL-MLR-20021009 1.1	6.70×10^{-5}	2.77×10^{-5}	1.13×10^{-3}	1.45×10^{-4}
42	AL-MLR-20021016 1.1	4.40×10^{-5}	2.27×10^{-5}	1.14×10^{-3}	1.47×10^{-4}
43	AL-MLR-20021023 1.1	2.88×10^{-5}	1.73×10^{-5}	5.07×10^{-4}	8.14×10^{-5}
44	AL-MLR-20021030 1.1	7.19×10^{-5}	2.94×10^{-5}	9.16×10^{-4}	1.24×10^{-4}
45	AL-MLR-20021106 1.1	7.37×10^{-5}	2.97×10^{-5}	1.07×10^{-3}	1.39×10^{-4}
46	AL-MLR-20021113 1.1	1.04×10^{-4}	3.42×10^{-5}	1.04×10^{-3}	1.37×10^{-4}
47	AL-MLR-20021120 1.1	7.61×10^{-5}	2.91×10^{-5}	1.40×10^{-3}	1.74×10^{-4}
48	AL-MLR-20021127 1.1	8.58×10^{-5}	3.05×10^{-5}	1.59×10^{-3}	1.92×10^{-4}
49	AL-MLR-20021204 1.1	3.51×10^{-5}	1.92×10^{-5}	1.31×10^{-3}	1.64×10^{-4}
50	AL-MLR-20021211 1.1	1.19×10^{-4}	3.64×10^{-5}	1.35×10^{-3}	1.66×10^{-4}
51	AL-MLR-20021218 1.1	4.04×10^{-5}	2.13×10^{-5}	8.42×10^{-4}	1.14×10^{-4}
52	AL-MLR-20021225 1.1	7.01×10^{-5}	3.48×10^{-5}	1.41×10^{-3}	1.87×10^{-4}
		Southeast Control			
1	AL-SEC-20020102 1.1	1.84×10^{-4}	4.73×10^{-5}	1.59×10^{-3}	1.93×10^{-4}
2	AL-SEC-20020109 1.1	1.62×10^{-4}	4.31×10^{-5}	8.45×10^{-4}	1.16×10^{-4}
3	AL-SEC-20020116 1.1	1.47×10^{-4}	4.06×10^{-5}	1.36×10^{-3}	1.68×10^{-4}
4	AL-SEC-20020123 1.1	1.32×10^{-4}	3.87×10^{-5}	1.05×10^{-3}	1.37×10^{-4}
5	AL-SEC-20020130 1.1	9.77×10^{-5}	3.27×10^{-5}	1.27×10^{-3}	1.57×10^{-4}
6	AL-SEC-20020206 1.1	9.52×10^{-5}	3.35×10^{-5}	8.07×10^{-4}	1.15×10^{-4}
7	AL-SEC-20020213 1.1	5.95×10^{-5}	2.52×10^{-5}	1.01×10^{-3}	1.34×10^{-4}
8	AL-SEC-20020220 1.1	2.58×10^{-5}	1.73×10^{-5}	8.45×10^{-4}	1.21×10^{-4}
9	AL-SEC-20020227 1.1	1.44×10^{-4}	3.98×10^{-5}	1.25×10^{-3}	1.56×10^{-4}
10	AL-SEC-20020306 1.1	4.94×10^{-5}	2.34×10^{-5}	9.24×10^{-4}	1.24×10^{-4}
11	AL-SEC-20020313 1.1	4.34×10^{-5}	2.11×10^{-5}	8.36×10^{-4}	1.13×10^{-4}
12	AL-SEC-20020320 1.1	9.99×10^{-5}	3.41×10^{-5}	1.08×10^{-3}	1.42×10^{-4}
13	AL-SEC-20020327 1.1	6.47×10^{-5}	2.67×10^{-5}	9.34×10^{-4}	1.25×10^{-4}
14	AL-SEC-20020403 1.2	9.21×10^{-5}	3.36×10^{-5}	9.84×10^{-4}	1.32×10^{-4}
15	AL-SEC-20020410 1.2	6.96×10^{-5}	2.86×10^{-5}	1.09×10^{-3}	1.41×10^{-4}
16	AL-SEC-20020417 1.2	4.05×10^{-5}	2.16×10^{-5}	8.69×10^{-4}	1.19×10^{-4}
17	AL-SEC-20020424 1.2	7.40×10^{-5}	2.94×10^{-5}	9.01×10^{-4}	1.23×10^{-4}
18	AL-SEC-20020501 1.2	4.02×10^{-5}	2.02×10^{-5}	8.46×10^{-4}	1.16×10^{-4}
19	AL-SEC-20020508 1.2	9.00×10^{-5}	3.19×10^{-5}	9.45×10^{-4}	1.25×10^{-4}
20	AL-SEC-20020515 1.2	7.49×10^{-5}	3.08×10^{-5}	9.48×10^{-4}	1.29×10^{-4}
21	AL-SEC-20020522 1.2	8.11×10^{-5}	3.15×10^{-5}	7.83×10^{-4}	1.12×10^{-4}
22	AL-SEC-20020529 1.2	4.97×10^{-5}	2.39×10^{-5}	8.02×10^{-4}	1.11×10^{-4}
23	AL-SEC-20020605 1.2	4.61×10^{-5}	2.24×10^{-5}	7.66×10^{-4}	1.10×10^{-4}
24	AL-SEC-20020612 1.2	5.10×10^{-5}	2.40×10^{-5}	7.94×10^{-4}	1.11×10^{-4}
25	AL-SEC-20020619 1.2	6.43×10^{-5}	2.82×10^{-5}	1.07×10^{-3}	1.41×10^{-4}
26	AL-SEC-20020626 1.2	3.47×10^{-5}	2.06×10^{-5}	6.94×10^{-4}	1.02×10^{-4}
27	AL-SEC-20020703 1.1	5.62×10^{-5}	2.52×10^{-5}	8.24×10^{-4}	1.14×10^{-4}
28	AL-SEC-20020710 1.1	4.05×10^{-5}	2.21×10^{-5}	7.71×10^{-4}	1.09×10^{-4}
29	AL-SEC-20020717 1.1	2.28×10^{-5}	1.76×10^{-5}	7.19×10^{-4}	1.04×10^{-4}
30	AL-SEC-20020724 1.1	6.43×10^{-5}	2.70×10^{-5}	7.73×10^{-4}	1.09×10^{-4}
31	AL-SEC-20020731 1.1	8.36×10^{-5}	3.06×10^{-5}	9.70×10^{-4}	1.29×10^{-4}
32	AL-SEC-20020807 1.1	1.33×10^{-4}	4.07×10^{-5}	9.76×10^{-4}	1.31×10^{-4}
33	AL-SEC-20020814 1.1	8.99×10^{-5}	3.24×10^{-5}	8.56×10^{-4}	1.18×10^{-4}
34	AL-SEC-20020821 1.1	9.45×10^{-5}	3.40×10^{-5}	8.85×10^{-4}	1.22×10^{-4}
35	AL-SEC-20020828 1.1	7.87×10^{-5}	3.07×10^{-5}	1.26×10^{-3}	1.60×10^{-4}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
36	AL-SEC-20020904 1.1	4.93×10^{-5}	2.39×10^{-5}	7.45×10^{-4}	1.06×10^{-4}
37	AL-SEC-20020911 1.1	9.27×10^{-5}	3.30×10^{-5}	1.19×10^{-3}	1.52×10^{-4}
38	AL-SEC-20020918 1.1	1.19×10^{-4}	3.69×10^{-5}	1.17×10^{-3}	1.49×10^{-4}
39	AL-SEC-20020925 1.1	1.26×10^{-4}	3.86×10^{-5}	1.15×10^{-3}	1.48×10^{-4}
40	AL-SEC-20021002 1.1	9.23×10^{-5}	3.28×10^{-5}	8.30×10^{-4}	1.15×10^{-4}
41	AL-SEC-20021009 1.1	5.13×10^{-5}	2.43×10^{-5}	1.23×10^{-3}	1.55×10^{-4}
42	AL-SEC-20021016 1.1	6.65×10^{-5}	2.75×10^{-5}	1.19×10^{-3}	1.51×10^{-4}
43	AL-SEC-20021023 1.1	3.95×10^{-5}	2.04×10^{-5}	4.94×10^{-4}	8.01×10^{-5}
44	AL-SEC-20021030 1.1	5.46×10^{-5}	2.55×10^{-5}	8.41×10^{-4}	1.15×10^{-4}
45	AL-SEC-20021106 1.1	6.45×10^{-5}	2.81×10^{-5}	1.05×10^{-3}	1.38×10^{-4}
46	AL-SEC-20021113 1.1	1.24×10^{-4}	4.87×10^{-5}	1.19×10^{-3}	1.75×10^{-4}
47	AL-SEC-20021120 1.1	8.48×10^{-5}	3.05×10^{-5}	1.31×10^{-3}	1.64×10^{-4}
48	AL-SEC-20021127 1.1	7.65×10^{-5}	2.88×10^{-5}	1.55×10^{-3}	1.88×10^{-4}
49	AL-SEC-20021204 1.1	3.04×10^{-5}	1.81×10^{-5}	1.36×10^{-3}	1.70×10^{-4}
50	AL-SEC-20021211 1.1	1.27×10^{-4}	3.93×10^{-5}	1.22×10^{-3}	1.55×10^{-4}
51	AL-SEC-20021218 1.1	2.79×10^{-5}	1.80×10^{-5}	8.75×10^{-4}	1.17×10^{-4}
52	AL-SEC-20021225 1.1	8.87×10^{-5}	3.88×10^{-5}	1.57×10^{-3}	2.04×10^{-4}
		Smith Ranch			
1	AL-SMR-20020102 1.1	1.65×10^{-4}	4.47×10^{-5}	1.46×10^{-3}	1.80×10^{-4}
2	AL-SMR-20020109 1.1	N/C	N/C	N/C	N/C
3	AL-SMR-20020116 1.1	1.81×10^{-4}	4.81×10^{-5}	1.29×10^{-3}	1.65×10^{-4}
4	AL-SMR-20020123 1.1	8.16×10^{-5}	2.92×10^{-5}	8.97×10^{-4}	1.20×10^{-4}
5	AL-SMR-20020130 1.1	9.75×10^{-5}	3.34×10^{-5}	1.14×10^{-3}	1.46×10^{-4}
6	AL-SMR-20020206 1.1	8.17×10^{-5}	3.05×10^{-5}	8.34×10^{-4}	1.17×10^{-4}
7	AL-SMR-20020213 1.1	4.55×10^{-5}	1.97×10^{-5}	8.24×10^{-4}	1.09×10^{-4}
8	AL-SMR-20020220 1.1	7.38×10^{-5}	3.00×10^{-5}	7.54×10^{-4}	1.11×10^{-4}
9	AL-SMR-20020227 1.1	1.01×10^{-4}	3.36×10^{-5}	1.31×10^{-3}	1.63×10^{-4}
10	AL-SMR-20020306 1.1	6.40×10^{-5}	2.69×10^{-5}	9.64×10^{-4}	1.29×10^{-4}
11	AL-SMR-20020313 1.1	6.06×10^{-5}	2.56×10^{-5}	7.40×10^{-4}	1.04×10^{-4}
12	AL-SMR-20020320 1.1	7.92×10^{-5}	2.95×10^{-5}	1.13×10^{-3}	1.46×10^{-4}
13	AL-SMR-20020327 1.1	7.39×10^{-5}	2.83×10^{-5}	7.59×10^{-4}	1.07×10^{-4}
14	AL-SMR-20020403 1.1	5.44×10^{-5}	2.62×10^{-5}	9.41×10^{-4}	1.28×10^{-4}
15	AL-SMR-20020410 1.1	8.09×10^{-5}	3.05×10^{-5}	9.56×10^{-4}	1.27×10^{-4}
16	AL-SMR-20020417 1.1	2.65×10^{-5}	1.84×10^{-5}	7.90×10^{-4}	1.12×10^{-4}
17	AL-SMR-20020424 1.1	5.11×10^{-5}	2.41×10^{-5}	8.67×10^{-4}	1.19×10^{-4}
18	AL-SMR-20020501 1.1	8.29×10^{-5}	3.04×10^{-5}	8.27×10^{-4}	1.16×10^{-4}
19	AL-SMR-20020508 1.1	8.92×10^{-5}	3.21×10^{-5}	8.66×10^{-4}	1.18×10^{-4}
20	AL-SMR-20020515 1.1	4.88×10^{-5}	2.49×10^{-5}	8.42×10^{-4}	1.17×10^{-4}
21	AL-SMR-20020522 1.1	3.97×10^{-5}	2.24×10^{-5}	7.04×10^{-4}	1.03×10^{-4}
22	AL-SMR-20020529 1.1	3.27×10^{-5}	2.10×10^{-5}	7.18×10^{-4}	1.06×10^{-4}
23	AL-SMR-20020605 1.1	4.11×10^{-5}	2.06×10^{-5}	7.09×10^{-4}	1.02×10^{-4}
24	AL-SMR-20020612 1.1	7.98×10^{-5}	3.11×10^{-5}	8.00×10^{-4}	1.14×10^{-4}
25	AL-SMR-20020619 1.1	7.76×10^{-5}	2.93×10^{-5}	9.60×10^{-4}	1.27×10^{-4}
26	AL-SMR-20020626 1.1	5.49×10^{-5}	2.52×10^{-5}	7.18×10^{-4}	1.03×10^{-4}
27	AL-SMR-20020703 1.1	6.36×10^{-5}	2.93×10^{-5}	8.72×10^{-4}	1.24×10^{-4}
28	AL-SMR-20020710 1.1	4.73×10^{-5}	2.42×10^{-5}	6.71×10^{-4}	1.00×10^{-4}
29	AL-SMR-20020717 1.1	1.76×10^{-5}	1.59×10^{-5}	6.38×10^{-4}	9.56×10^{-5}
30	AL-SMR-20020724 1.1	5.21×10^{-5}	2.46×10^{-5}	6.71×10^{-4}	9.96×10^{-5}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
31	AL-SMR-20020731 1.1	6.05×10^{-5}	2.60×10^{-5}	8.83×10^{-4}	1.20×10^{-4}
32	AL-SMR-20020807 1.1	1.07×10^{-4}	3.61×10^{-5}	1.03×10^{-3}	1.36×10^{-4}
33	AL-SMR-20020814 1.1	9.27×10^{-5}	3.34×10^{-5}	8.87×10^{-4}	1.22×10^{-4}
34	AL-SMR-20020821 1.1	8.61×10^{-5}	3.24×10^{-5}	8.60×10^{-4}	1.19×10^{-4}
35	AL-SMR-20020828 1.1	7.86×10^{-5}	3.06×10^{-5}	1.18×10^{-3}	1.51×10^{-4}
36	AL-SMR-20020904 1.1	N/C	N/C	N/C	N/C
37	AL-SMR-20020911 1.1	N/C	N/C	N/C	N/C
38	AL-SMR-20020918 1.1	1.12×10^{-4}	3.56×10^{-5}	1.04×10^{-3}	1.35×10^{-4}
39	AL-SMR-20020925 1.1	1.17×10^{-4}	3.70×10^{-5}	1.18×10^{-3}	1.51×10^{-4}
40	AL-SMR-20021002 1.1	6.45×10^{-5}	2.77×10^{-5}	8.26×10^{-4}	1.15×10^{-4}
41	AL-SMR-20021009 1.1	7.46×10^{-5}	2.92×10^{-5}	1.31×10^{-3}	1.64×10^{-4}
42	AL-SMR-20021016 1.1	2.05×10^{-5}	1.63×10^{-5}	1.14×10^{-3}	1.47×10^{-4}
43	AL-SMR-20021023 1.1	2.04×10^{-5}	1.44×10^{-5}	4.82×10^{-4}	7.81×10^{-5}
44	AL-SMR-20021030 1.1	6.95×10^{-5}	2.90×10^{-5}	9.01×10^{-4}	1.23×10^{-4}
45	AL-SMR-20021106 1.1	8.63×10^{-5}	3.20×10^{-5}	1.04×10^{-3}	1.36×10^{-4}
46	AL-SMR-20021113 1.1	8.16×10^{-5}	3.01×10^{-5}	1.12×10^{-3}	1.45×10^{-4}
47	AL-SMR-20021120 1.1	6.35×10^{-5}	2.60×10^{-5}	1.16×10^{-3}	1.49×10^{-4}
48	AL-SMR-20021127 1.1	7.17×10^{-5}	2.79×10^{-5}	1.44×10^{-3}	1.77×10^{-4}
49	AL-SMR-20021204 1.1	3.06×10^{-5}	1.82×10^{-5}	1.40×10^{-3}	1.73×10^{-4}
50	AL-SMR-20021211 1.1	1.31×10^{-4}	3.98×10^{-5}	1.29×10^{-3}	1.62×10^{-4}
51	AL-SMR-20021218 1.1	5.34×10^{-5}	2.39×10^{-5}	8.80×10^{-4}	1.17×10^{-4}
52	AL-SMR-20021225 1.1	5.90×10^{-5}	3.22×10^{-5}	1.32×10^{-3}	1.78×10^{-4}
		WIPP Air Blank			
1	AL-WAB-20020102 1.1	2.96×10^{-3}	5.09×10^{-3}	3.68×10^{-2}	1.68×10^{-2}
2	AL-WAB-20020109 1.1	4.46×10^{-3}	5.89×10^{-3}	4.24×10^{-2}	1.76×10^{-2}
3	AL-WAB-20020116 1.1	7.44×10^{-3}	7.23×10^{-3}	6.24×10^{-2}	2.04×10^{-2}
4	AL-WAB-20020123 1.1	8.94×10^{-5}	7.82×10^{-3}	6.56×10^{-2}	2.09×10^{-2}
5	AL-WAB-20020130 1.1	-5.53×10^{-5}	5.14×10^{-3}	5.12×10^{-2}	1.86×10^{-2}
6	AL-WAB-20020206 1.1	5.92×10^{-3}	5.85×10^{-3}	4.54×10^{-2}	1.79×10^{-2}
7	AL-WAB-20020213 1.1	4.41×10^{-3}	5.04×10^{-3}	6.67×10^{-2}	2.09×10^{-2}
8	AL-WAB-20020220 1.1	8.89×10^{-3}	7.19×10^{-3}	5.63×10^{-2}	1.94×10^{-2}
9	AL-WAB-20020227 1.1	4.43×10^{-3}	6.52×10^{-3}	4.23×10^{-2}	1.76×10^{-2}
10	AL-WAB-20020306 1.1	8.89×10^{-3}	8.28×10^{-3}	3.64×10^{-2}	1.68×10^{-2}
11	AL-WAB-20020313 1.1	9.19×10^{-3}	8.01×10^{-3}	5.01×10^{-2}	1.80×10^{-2}
12	AL-WAB-20020320 1.1	1.06×10^{-2}	7.95×10^{-3}	6.16×10^{-2}	1.99×10^{-2}
13	AL-WAB-20020327 1.1	5.95×10^{-3}	7.17×10^{-3}	3.01×10^{-2}	1.63×10^{-2}
14	AL-WAB-20020403 1.1	6.09×10^{-3}	7.93×10^{-3}	3.55×10^{-2}	1.75×10^{-2}
15	AL-WAB-20020410 1.1	6.08×10^{-3}	7.93×10^{-3}	4.56×10^{-2}	1.89×10^{-2}
16	AL-WAB-20020417 1.1	7.50×10^{-3}	7.83×10^{-3}	4.66×10^{-2}	1.89×10^{-2}
17	AL-WAB-20020424 1.1	-1.53×10^{-3}	5.13×10^{-3}	3.82×10^{-2}	1.77×10^{-2}
18	AL-WAB-20020501 1.1	6.04×10^{-3}	5.95×10^{-3}	3.43×10^{-2}	1.69×10^{-2}
19	AL-WAB-20020508 1.1	-1.54×10^{-3}	5.97×10^{-3}	6.85×10^{-2}	2.13×10^{-2}
20	AL-WAB-20020515 1.1	1.50×10^{-3}	5.95×10^{-3}	4.81×10^{-2}	1.85×10^{-2}
21	AL-WAB-20020522 1.1	-7.53×10^{-6}	5.12×10^{-3}	4.38×10^{-2}	1.89×10^{-2}
22	AL-WAB-20020529 1.1	1.50×10^{-3}	5.91×10^{-3}	6.17×10^{-2}	2.13×10^{-2}
23	AL-WAB-20020605 1.1	1.34×10^{-2}	8.86×10^{-3}	4.54×10^{-2}	1.79×10^{-2}
24	AL-WAB-20020612 1.1	-1.04×10^{-5}	4.16×10^{-3}	4.57×10^{-2}	1.78×10^{-2}
25	AL-WAB-20020619 1.1	2.93×10^{-3}	5.88×10^{-3}	6.22×10^{-2}	2.01×10^{-2}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
26	AL-WAB-20020626 1.1	-1.55×10^{-3}	5.23×10^{-3}	4.46×10^{-2}	1.89×10^{-2}
27	AL-WAB-20020703 1.1	-1.55×10^{-3}	5.23×10^{-3}	4.68×10^{-2}	1.92×10^{-2}
28	AL-WAB-20020710 1.1	-1.50×10^{-3}	5.83×10^{-3}	3.08×10^{-2}	1.76×10^{-2}
29	AL-WAB-20020717 1.1	-2.98×10^{-3}	6.52×10^{-3}	2.00×10^{-2}	1.61×10^{-2}
30	AL-WAB-20020724 1.1	4.50×10^{-3}	5.90×10^{-3}	5.69×10^{-2}	1.92×10^{-2}
31	AL-WAB-20020731 1.1	-1.53×10^{-3}	5.15×10^{-3}	4.13×10^{-2}	1.84×10^{-2}
32	AL-WAB-20020807 1.1	3.10×10^{-3}	6.08×10^{-3}	4.20×10^{-2}	1.84×10^{-2}
33	AL-WAB-20020814 1.1	3.09×10^{-3}	6.08×10^{-3}	4.75×10^{-2}	1.92×10^{-2}
34	AL-WAB-20020821 1.1	1.08×10^{-2}	9.18×10^{-3}	3.70×10^{-2}	1.77×10^{-2}
35	AL-WAB-20020828 1.1	7.75×10^{-3}	8.07×10^{-3}	3.39×10^{-2}	1.73×10^{-2}
36	AL-WAB-20020904 1.1	2.98×10^{-3}	5.86×10^{-3}	3.27×10^{-2}	1.61×10^{-2}
37	AL-WAB-20020911 1.1	-3.00×10^{-3}	5.87×10^{-3}	3.86×10^{-2}	1.70×10^{-2}
38	AL-WAB-20020918 1.1	4.43×10^{-3}	6.52×10^{-3}	4.04×10^{-2}	1.73×10^{-2}
39	AL-WAB-20020925 1.1	1.44×10^{-3}	5.03×10^{-3}	6.59×10^{-2}	2.08×10^{-2}
40	AL-WAB-20021002 1.1	-4.55×10^{-3}	7.27×10^{-3}	3.06×10^{-2}	1.72×10^{-2}
41	AL-WAB-20021009 1.1	5.90×10^{-3}	7.14×10^{-3}	6.67×10^{-2}	2.09×10^{-2}
42	AL-WAB-20021016 1.1	4.42×10^{-3}	6.51×10^{-3}	5.80×10^{-2}	1.97×10^{-2}
43	AL-WAB-20021023 1.1	4.51×10^{-3}	5.13×10^{-3}	3.95×10^{-2}	1.73×10^{-2}
44	AL-WAB-20021030 1.1	8.84×10^{-3}	9.19×10^{-3}	3.24×10^{-2}	1.71×10^{-2}
45	AL-WAB-20021106 1.1	1.03×10^{-2}	9.64×10^{-3}	4.33×10^{-2}	1.86×10^{-2}
46	AL-WAB-20021113 1.1	4.45×10^{-3}	5.09×10^{-3}	4.03×10^{-2}	1.69×10^{-2}
47	AL-WAB-20021120 1.1	5.95×10^{-3}	5.89×10^{-3}	4.56×10^{-2}	1.77×10^{-2}
48	AL-WAB-20021127 1.1	8.99×10^{-3}	7.26×10^{-3}	2.46×10^{-2}	1.45×10^{-2}
49	AL-WAB-20021204 1.1	5.92×10^{-3}	5.88×10^{-3}	6.21×10^{-2}	2.00×10^{-2}
50	AL-WAB-20021211 1.1	-1.54×10^{-3}	5.96×10^{-3}	4.57×10^{-2}	1.91×10^{-2}
51	AL-WAB-20021218 1.1	-1.36×10^{-5}	5.16×10^{-3}	2.89×10^{-2}	1.67×10^{-2}
52	AL-WAB-20021225 1.1	-1.54×10^{-3}	5.97×10^{-3}	5.69×10^{-2}	2.05×10^{-2}
		WIPP East			
1	AL-WEE-20020102 1.1	2.35×10^{-4}	5.35×10^{-4}	1.58×10^{-3}	1.90×10^{-4}
2	AL-WEE-20020109 1.1	1.25×10^{-4}	3.88×10^{-5}	1.01×10^{-3}	1.36×10^{-4}
3	AL-WEE-20020116 1.1	1.47×10^{-4}	4.05×10^{-5}	1.32×10^{-3}	1.64×10^{-4}
4	AL-WEE-20020123 1.1	8.97×10^{-5}	3.08×10^{-5}	9.20×10^{-4}	1.23×10^{-4}
5	AL-WEE-20020130 1.1	7.80×10^{-5}	2.91×10^{-5}	1.81×10^{-3}	1.48×10^{-4}
6	AL-WEE-20020206 1.1	4.87×10^{-5}	2.26×10^{-5}	8.34×10^{-4}	1.16×10^{-4}
7	AL-WEE-20020213 1.1	7.53×10^{-5}	2.90×10^{-5}	9.63×10^{-4}	1.30×10^{-4}
8	AL-WEE-20020220 1.1	5.77×10^{-5}	2.44×10^{-5}	7.53×10^{-4}	1.06×10^{-4}
9	AL-WEE-20020227 1.1	9.17×10^{-5}	3.18×10^{-5}	1.29×10^{-3}	1.61×10^{-4}
10	AL-WEE-20020306 1.1	6.44×10^{-5}	2.77×10^{-5}	9.02×10^{-4}	1.24×10^{-4}
11	AL-WEE-20020313 1.1	4.38×10^{-5}	2.20×10^{-5}	8.49×10^{-4}	1.16×10^{-4}
12	AL-WEE-20020320 1.1	8.65×10^{-5}	3.00×10^{-5}	1.18×10^{-3}	1.49×10^{-4}
13	AL-WEE-20020327 1.1	4.92×10^{-5}	2.32×10^{-5}	8.10×10^{-4}	1.12×10^{-4}
14	AL-WEE-20020403 1.1	5.54×10^{-5}	2.60×10^{-5}	9.17×10^{-4}	1.25×10^{-4}
15	AL-WEE-20020410 1.1	N/C	N/C	N/C	N/C
16	AL-WEE-20020417 1.1	4.36×10^{-5}	2.32×10^{-5}	6.19×10^{-4}	9.52×10^{-5}
17	AL-WEE-20020424 1.1	1.07×10^{-4}	3.56×10^{-5}	8.31×10^{-4}	1.16×10^{-4}
18	AL-WEE-20020501 1.1	6.26×10^{-5}	2.64×10^{-5}	8.60×10^{-4}	1.20×10^{-4}
19	AL-WEE-20020508 1.1	6.30×10^{-5}	2.82×10^{-5}	9.45×10^{-4}	1.28×10^{-4}
20	AL-WEE-20020515 1.1	5.83×10^{-5}	2.67×10^{-5}	8.60×10^{-4}	1.19×10^{-4}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
21	AL-WEE-20020522 1.1	4.31×10^{-5}	2.43×10^{-5}	8.20×10^{-4}	1.18×10^{-4}
22	AL-WEE-20020529 1.1	4.82×10^{-5}	2.46×10^{-5}	8.16×10^{-4}	1.15×10^{-4}
23	AL-WEE-20020605 1.1	5.96×10^{-5}	2.51×10^{-5}	6.19×10^{-4}	9.30×10^{-5}
24	AL-WEE-20020612 1.1	6.99×10^{-5}	2.88×10^{-5}	7.45×10^{-4}	1.07×10^{-4}
25	AL-WEE-20020619 1.1	7.58×10^{-5}	2.86×10^{-5}	8.79×10^{-4}	1.18×10^{-4}
26	AL-WEE-20020626 1.1	6.66×10^{-5}	2.85×10^{-5}	6.56×10^{-4}	9.87×10^{-5}
27	AL-WEE-20020703 1.1	1.02×10^{-4}	3.48×10^{-5}	8.71×10^{-4}	1.20×10^{-4}
28	AL-WEE-20020710 1.1	2.36×10^{-5}	1.82×10^{-5}	7.07×10^{-4}	1.04×10^{-4}
29	AL-WEE-20020717 1.1	3.43×10^{-5}	2.02×10^{-5}	6.12×10^{-4}	9.19×10^{-5}
30	AL-WEE-20020724 1.1	5.60×10^{-5}	2.58×10^{-5}	7.07×10^{-4}	1.04×10^{-4}
31	AL-WEE-20020731 1.1	6.04×10^{-5}	2.65×10^{-5}	9.25×10^{-4}	1.25×10^{-4}
32	AL-WEE-20020807 1.1	1.65×10^{-4}	4.52×10^{-5}	1.04×10^{-3}	1.36×10^{-4}
33	AL-WEE-20020814 1.1	8.78×10^{-5}	3.26×10^{-5}	8.11×10^{-4}	1.14×10^{-4}
34	AL-WEE-20020821 1.1	1.10×10^{-4}	3.66×10^{-5}	9.89×10^{-4}	1.32×10^{-4}
35	AL-WEE-20020828 1.1	1.13×10^{-4}	3.67×10^{-5}	1.15×10^{-3}	1.48×10^{-4}
36	AL-WEE-20020904 1.1	8.41×10^{-5}	3.07×10^{-5}	7.54×10^{-4}	1.06×10^{-4}
37	AL-WEE-20020911 1.1	1.02×10^{-4}	3.53×10^{-5}	1.30×10^{-3}	1.65×10^{-4}
38	AL-WEE-20020918 1.1	1.02×10^{-4}	3.40×10^{-5}	1.06×10^{-3}	1.38×10^{-4}
39	AL-WEE-20020925 1.1	7.91×10^{-5}	3.04×10^{-5}	1.18×10^{-3}	1.51×10^{-4}
40	AL-WEE-20021002 1.2	9.24×10^{-5}	3.28×10^{-5}	7.31×10^{-4}	1.05×10^{-4}
41	AL-WEE-20021009 1.2	6.67×10^{-5}	2.76×10^{-5}	1.11×10^{-3}	1.44×10^{-4}
42	AL-WEE-20021016 1.2	4.38×10^{-5}	2.26×10^{-5}	1.13×10^{-3}	1.46×10^{-4}
43	AL-WEE-20021023 1.2	3.11×10^{-5}	1.79×10^{-5}	5.48×10^{-4}	8.55×10^{-5}
44	AL-WEE-20021030 1.2	6.25×10^{-5}	2.78×10^{-5}	8.68×10^{-4}	1.20×10^{-4}
45	AL-WEE-20021106 1.2	5.18×10^{-5}	2.80×10^{-5}	1.02×10^{-3}	1.40×10^{-4}
46	AL-WEE-20021113 1.2	5.54×10^{-5}	2.47×10^{-5}	1.02×10^{-3}	1.35×10^{-4}
47	AL-WEE-20021120 1.2	1.10×10^{-4}	3.61×10^{-5}	1.38×10^{-3}	1.73×10^{-4}
48	AL-WEE-20021127 1.2	3.82×10^{-5}	2.03×10^{-5}	1.58×10^{-3}	1.91×10^{-4}
49	AL-WEE-20021204 1.2	2.77×10^{-5}	1.72×10^{-5}	1.34×10^{-3}	1.68×10^{-4}
50	AL-WEE-20021211 1.2	1.10×10^{-4}	3.63×10^{-5}	1.38×10^{-3}	1.71×10^{-4}
51	AL-WEE-20021218 1.2	6.76×10^{-5}	2.68×10^{-5}	9.07×10^{-4}	1.20×10^{-4}
52	AL-WEE-20021225 1.2	7.12×10^{-5}	3.44×10^{-5}	1.32×10^{-3}	1.77×10^{-4}
		WIPP Far Field			
1	AL-WFF-20020102 1.1	2.05×10^{-4}	5.02×10^{-5}	1.41×10^{-3}	1.75×10^{-4}
2	AL-WFF-20020109 1.1	1.11×10^{-4}	3.48×10^{-5}	9.71×10^{-4}	1.28×10^{-4}
3	AL-WFF-20020116 1.1	1.43×10^{-4}	3.91×10^{-5}	1.31×10^{-3}	1.61×10^{-4}
4	AL-WFF-20020123 1.1	N/C	N/C	N/C	N/C
5	AL-WFF-20020130 1.1	8.71×10^{-5}	3.11×10^{-5}	1.14×10^{-3}	1.45×10^{-4}
6	AL-WFF-20020206 1.1	8.81×10^{-5}	3.10×10^{-5}	8.20×10^{-4}	1.14×10^{-4}
7	AL-WFF-20020213 1.1	6.45×10^{-5}	2.58×10^{-5}	9.18×10^{-4}	1.23×10^{-4}
8	AL-WFF-20020220 1.1	3.86×10^{-5}	2.00×10^{-5}	7.75×10^{-4}	1.10×10^{-4}
9	AL-WFF-20020227 1.1	9.39×10^{-5}	3.17×10^{-5}	1.29×10^{-3}	1.60×10^{-4}
10	AL-WFF-20020306 1.1	8.21×10^{-5}	3.10×10^{-5}	1.03×10^{-3}	1.37×10^{-4}
11	AL-WFF-20020313 1.1	5.11×10^{-5}	2.30×10^{-5}	8.34×10^{-4}	1.13×10^{-4}
12	AL-WFF-20020320 1.1	6.66×10^{-5}	2.65×10^{-5}	9.29×10^{-4}	1.24×10^{-4}
13	AL-WFF-20020327 1.1	6.84×10^{-5}	2.76×10^{-5}	9.34×10^{-4}	1.26×10^{-4}
14	AL-WFF-20020403 1.1	6.96×10^{-5}	2.86×10^{-5}	9.69×10^{-4}	1.29×10^{-4}
15	AL-WFF-20020410 1.1	6.66×10^{-5}	2.91×10^{-5}	1.14×10^{-3}	1.49×10^{-4}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m³)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
16	AL-WFF-20020417 1.1	5.88×10^{-5}	2.59×10^{-5}	8.98×10^{-4}	1.22×10^{-4}
17	AL-WFF-20020424 1.1	5.16×10^{-5}	2.51×10^{-5}	1.00×10^{-3}	1.35×10^{-4}
18	AL-WFF-20020501 1.1	7.37×10^{-5}	2.83×10^{-5}	8.65×10^{-4}	1.19×10^{-4}
19	AL-WFF-20020508 1.1	1.19×10^{-4}	3.88×10^{-5}	8.74×10^{-4}	1.21×10^{-4}
20	AL-WFF-20020515 1.1	5.26×10^{-5}	2.54×10^{-5}	9.29×10^{-4}	1.25×10^{-4}
21	AL-WFF-20020522 1.1	N/C	N/C	N/C	N/C
22	AL-WFF-20020529 1.1	3.33×10^{-5}	2.04×10^{-5}	7.94×10^{-4}	1.12×10^{-4}
23	AL-WFF-20020605 1.1	5.49×10^{-5}	2.47×10^{-5}	6.60×10^{-4}	9.89×10^{-5}
24	AL-WFF-20020612 1.1	8.52×10^{-5}	3.21×10^{-5}	7.78×10^{-4}	1.11×10^{-4}
25	AL-WFF-20020619 1.1	6.71×10^{-5}	2.66×10^{-5}	9.31×10^{-4}	1.23×10^{-4}
26	AL-WFF-20020626 1.1	9.18×10^{-5}	3.31×10^{-5}	7.54×10^{-4}	1.08×10^{-4}
27	AL-WFF-20020703 1.2	5.87×10^{-5}	2.70×10^{-5}	1.03×10^{-3}	1.37×10^{-4}
28	AL-WFF-20020710 1.2	7.76×10^{-5}	3.02×10^{-5}	8.28×10^{-4}	1.15×10^{-4}
29	AL-WFF-20020717 1.2	4.05×10^{-5}	2.14×10^{-5}	6.29×10^{-4}	9.28×10^{-5}
30	AL-WFF-20020724 1.2	1.01×10^{-4}	3.53×10^{-5}	7.91×10^{-4}	1.13×10^{-4}
31	AL-WFF-20020731 1.2	4.52×10^{-5}	2.25×10^{-5}	8.95×10^{-4}	1.21×10^{-4}
32	AL-WFF-20020807 1.2	1.45×10^{-4}	4.22×10^{-5}	9.92×10^{-4}	1.32×10^{-4}
33	AL-WFF-20020814 1.2	1.02×10^{-4}	3.51×10^{-5}	9.53×10^{-4}	1.29×10^{-4}
34	AL-WFF-20020821 1.2	8.79×10^{-5}	3.21×10^{-5}	9.28×10^{-4}	1.25×10^{-4}
35	AL-WFF-20020828 1.2	1.03×10^{-4}	3.56×10^{-5}	1.21×10^{-3}	1.55×10^{-4}
36	AL-WFF-20020904 1.2	5.56×10^{-5}	2.49×10^{-5}	7.79×10^{-4}	1.09×10^{-4}
37	AL-WFF-20020911 1.2	1.17×10^{-4}	3.80×10^{-5}	1.22×10^{-3}	1.57×10^{-4}
38	AL-WFF-20020918 1.2	1.36×10^{-4}	3.94×10^{-5}	1.20×10^{-3}	1.52×10^{-4}
39	AL-WFF-20020925 1.2	1.19×10^{-4}	3.74×10^{-5}	1.15×10^{-3}	1.48×10^{-4}
40	AL-WFF-20021002 1.1	7.43×10^{-5}	2.90×10^{-5}	8.60×10^{-4}	1.17×10^{-4}
41	AL-WFF-20021009 1.1	4.70×10^{-5}	2.36×10^{-5}	1.25×10^{-3}	1.58×10^{-4}
42	AL-WFF-20021016 1.1	5.08×10^{-5}	2.41×10^{-5}	1.15×10^{-3}	1.47×10^{-4}
43	AL-WFF-20021023 1.1	4.28×10^{-5}	2.08×10^{-5}	5.15×10^{-4}	8.11×10^{-5}
44	AL-WFF-20021030 1.1	4.66×10^{-5}	2.44×10^{-5}	8.15×10^{-4}	1.14×10^{-4}
45	AL-WFF-20021106 1.1	1.02×10^{-4}	3.47×10^{-5}	1.09×10^{-3}	1.41×10^{-4}
46	AL-WFF-20021113 1.1	9.56×10^{-5}	3.25×10^{-5}	1.07×10^{-3}	1.39×10^{-4}
47	AL-WFF-20021120 1.1	1.03×10^{-4}	3.34×10^{-5}	1.24×10^{-3}	1.55×10^{-4}
48	AL-WFF-20021127 1.1	5.93×10^{-5}	2.54×10^{-5}	1.55×10^{-3}	1.88×10^{-4}
49	AL-WFF-20021204 1.1	4.79×10^{-5}	2.25×10^{-5}	1.19×10^{-3}	1.51×10^{-4}
50	AL-WFF-20021211 1.1	1.64×10^{-4}	4.53×10^{-5}	1.46×10^{-3}	1.80×10^{-4}
51	AL-WFF-20021218 1.1	4.84×10^{-5}	2.28×10^{-5}	8.59×10^{-4}	1.15×10^{-4}
52	AL-WFF-20021225 1.1	8.77×10^{-5}	3.84×10^{-5}	1.35×10^{-3}	1.81×10^{-4}
		WIPP South			
1	AL-WSS-20020102 1.1	1.77×10^{-4}	4.60×10^{-5}	1.42×10^{-3}	1.76×10^{-4}
2	AL-WSS-20020109 1.1	1.20×10^{-4}	3.64×10^{-5}	$1..01\times10^{-3}$	1.32×10^{-4}
3	AL-WSS-20020116 1.1	1.39×10^{-4}	3.95×10^{-5}	1.21×10^{-3}	1.53×10^{-4}
4	AL-WSS-20020123 1.1	7.83×10^{-5}	2.88×10^{-5}	9.65×10^{-4}	1.28×10^{-4}
5	AL-WSS-20020130 1.1	N/C	N/C	N/C	N/C
6	AL-WSS-20020206 1.1	8.90×10^{-5}	3.09×10^{-5}	8.04×10^{-4}	1.12×10^{-4}
7	AL-WSS-20020213 1.1	5.01×10^{-5}	2.33×10^{-5}	9.63×10^{-4}	1.30×10^{-4}
8	AL-WSS-20020220 1.1	3.51×10^{-5}	1.89×10^{-5}	7.18×10^{-4}	1.03×10^{-4}
9	AL-WSS-20020227 1.1	9.63×10^{-5}	3.26×10^{-5}	1.32×10^{-3}	1.64×10^{-4}
10	AL-WSS-20020306 1.1	5.48×10^{-5}	2.53×10^{-5}	1.05×10^{-3}	1.39×10^{-4}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
11	AL-WSS-20020313 1.1	5.83×10^{-5}	2.51×10^{-5}	7.34×10^{-4}	1.04×10^{-4}
12	AL-WSS-20020320 1.1	8.87×10^{-5}	3.16×10^{-5}	1.08×10^{-3}	1.41×10^{-4}
13	AL-WSS-20020327 1.1	3.63×10^{-5}	2.00×10^{-5}	8.33×10^{-4}	1.14×10^{-4}
14	AL-WSS-20020403 1.1	8.33×10^{-5}	3.24×10^{-5}	8.82×10^{-4}	1.23×10^{-4}
15	AL-WSS-20020410 1.1	7.61×10^{-5}	2.96×10^{-5}	1.09×10^{-3}	1.41×10^{-4}
16	AL-WSS-20020417 1.1	5.29×10^{-5}	2.44×10^{-5}	6.95×10^{-4}	1.01×10^{-4}
17	AL-WSS-20020424 1.1	5.70×10^{-5}	2.56×10^{-5}	8.08×10^{-4}	1.13×10^{-4}
18	AL-WSS-20020501 1.1	7.28×10^{-5}	2.84×10^{-5}	6.33×10^{-4}	9.58×10^{-5}
19	AL-WSS-20020508 1.1	7.86×10^{-5}	3.23×10^{-5}	8.41×10^{-4}	1.20×10^{-4}
20	AL-WSS-20020515 1.1	4.13×10^{-5}	2.18×10^{-5}	8.33×10^{-4}	1.13×10^{-4}
21	AL-WSS-20020522 1.1	6.16×10^{-5}	2.69×10^{-5}	7.72×10^{-4}	1.09×10^{-4}
22	AL-WSS-20020529 1.1	3.59×10^{-5}	2.20×10^{-5}	7.05×10^{-4}	1.05×10^{-4}
23	AL-WSS-20020605 1.1	6.54×10^{-5}	2.65×10^{-5}	7.59×10^{-4}	1.08×10^{-4}
24	AL-WSS-20020612 1.1	9.58×10^{-5}	3.40×10^{-5}	7.54×10^{-4}	1.09×10^{-4}
25	AL-WSS-20020619 1.1	5.55×10^{-5}	2.43×10^{-5}	9.07×10^{-4}	1.21×10^{-4}
26	AL-WSS-20020626 1.1	6.18×10^{-5}	2.65×10^{-5}	7.12×10^{-4}	1.02×10^{-4}
27	AL-WSS-20020703 1.1	6.98×10^{-5}	2.93×10^{-5}	8.98×10^{-4}	1.24×10^{-4}
28	AL-WSS-20020710 1.1	6.03×10^{-5}	2.70×10^{-5}	7.48×10^{-4}	1.08×10^{-4}
29	AL-WSS-20020717 1.1	4.13×10^{-5}	2.18×10^{-5}	5.55×10^{-4}	8.57×10^{-5}
30	AL-WSS-20020724 1.1	3.83×10^{-5}	2.12×10^{-5}	6.40×10^{-4}	9.63×10^{-5}
31	AL-WSS-20020731 1.1	8.33×10^{-5}	3.00×10^{-5}	9.34×10^{-4}	1.24×10^{-4}
32	AL-WSS-20020807 1.1	1.38×10^{-4}	4.13×10^{-5}	9.77×10^{-4}	1.31×10^{-4}
33	AL-WSS-20020814 1.1	1.05×10^{-4}	3.53×10^{-5}	8.45×10^{-4}	1.17×10^{-4}
34	AL-WSS-20020821 1.1	7.55×10^{-5}	3.05×10^{-5}	8.59×10^{-4}	1.20×10^{-4}
35	AL-WSS-20020828 1.1	1.55×10^{-4}	4.33×10^{-5}	1.29×10^{-3}	1.62×10^{-4}
36	AL-WSS-20020904 1.1	4.65×10^{-5}	2.25×10^{-5}	7.63×10^{-4}	1.06×10^{-4}
37	AL-WSS-20020911 1.1	9.72×10^{-5}	3.36×10^{-5}	1.32×10^{-3}	1.65×10^{-4}
38	AL-WSS-20020918 1.1	N/C	N/C	N/C	N/C
39	AL-WSS-20020925 1.1	1.04×10^{-4}	3.85×10^{-5}	9.35×10^{-4}	1.33×10^{-4}
40	AL-WSS-20021002 1.1	9.40×10^{-5}	3.29×10^{-5}	7.84×10^{-4}	1.10×10^{-4}
41	AL-WSS-20021009 1.1	5.10×10^{-5}	2.36×10^{-5}	1.30×10^{-3}	1.61×10^{-4}
42	AL-WSS-20021016 1.1	6.73×10^{-5}	2.73×10^{-5}	1.36×10^{-3}	1.67×10^{-4}
43	AL-WSS-20021023 1.1	4.17×10^{-5}	2.09×10^{-5}	6.04×10^{-4}	9.15×10^{-5}
44	AL-WSS-20021030 1.1	4.15×10^{-5}	2.32×10^{-5}	8.71×10^{-4}	1.20×10^{-4}
45	AL-WSS-20021106 1.1	5.33×10^{-5}	2.56×10^{-5}	9.64×10^{-4}	1.29×10^{-4}
46	AL-WSS-20021113 1.1	1.08×10^{-4}	3.47×10^{-5}	1.04×10^{-3}	1.36×10^{-4}
47	AL-WSS-20021120 1.1	1.24×10^{-4}	3.73×10^{-5}	1.16×10^{-3}	1.49×10^{-4}
48	AL-WSS-20021127 1.1	8.75×10^{-5}	3.06×10^{-5}	1.55×10^{-3}	1.86×10^{-4}
49	AL-WSS-20021204 1.1	1.47×10^{-5}	1.27×10^{-5}	1.35×10^{-3}	1.70×10^{-4}
50	AL-WSS-20021211 1.1	1.56×10^{-4}	5.03×10^{-5}	1.61×10^{-3}	2.06×10^{-4}
51	AL-WSS-20021218 1.1	4.31×10^{-5}	2.20×10^{-5}	7.17×10^{-4}	1.01×10^{-4}
52	AL-WSS-20021225 1.1	5.81×10^{-5}	3.18×10^{-5}	1.42×10^{-3}	1.88×10^{-4}
		Duplicate Samples			
Carlsbad (CBD)					
1	AL-CBD-20020102 1.2	N/C[b]	N/C	N/C	N/C
2	AL-CBD-20020109 1.2	1.36×10^{-4}	4.03×10^{-5}	9.99×10^{-4}	1.34×10^{-4}
3	AL-CBD-20020116 1.2	1.20×10^{-4}	3.67×10^{-5}	1.20×10^{-3}	1.52×10^{-4}
4	AL-CBD-20020123 1.2	1.04×10^{-4}	3.38×10^{-5}	8.94×10^{-4}	1.21×10^{-4}

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

Week	Sample ID	Gross Alpha Concentration	Gross Alpha 2 x TPU[a]	Gross Beta Concentration	Gross Beta 2 x TPU
5	AL-CBD-20020130 1.2	8.33×10^{-5}	3.10×10^{-5}	1.10×10^{-3}	1.41×10^{-4}
6	AL-CBD-20020206 1.2	9.25×10^{-5}	3.40×10^{-5}	1.01×10^{-3}	1.38×10^{-4}
7	AL-CBD-20020213 1.2	5.84×10^{-5}	2.18×10^{-5}	9.42×10^{-4}	1.19×10^{-4}
8	AL-CBD-20020220 1.2	5.63×10^{-5}	2.54×10^{-5}	8.87×10^{-4}	1.24×10^{-4}
9	AL-CBD-20020227 1.2	7.08×10^{-5}	2.77×10^{-5}	1.23×10^{-3}	1.54×10^{-4}
10	AL-CBD-20020306 1.2	N/C	N/C	N/C	N/C
11	AL-CBD-20020313 1.2	N/C	N/C	N/C	N/C
12	AL-CBD-20020320 1.2	7.58×10^{-5}	2.96×10^{-5}	9.41×10^{-4}	1.28×10^{-4}
13	AL-CBD-20020327 1.2	7.84×10^{-5}	2.96×10^{-5}	9.32×10^{-4}	1.26×10^{-4}
South East Control (SEC)					
14	AL-SEC-20020403 1.2	7.44×10^{-5}	3.06×10^{-5}	9.50×10^{-4}	1.29×10^{-4}
15	AL-SEC-20020410 1.2	6.91×10^{-5}	2.90×10^{-5}	1.13×10^{-3}	1.46×10^{-4}
16	AL-SEC-20020417 1.2	4.57×10^{-5}	2.28×10^{-5}	8.27×10^{-4}	1.15×10^{-4}
17	AL-SEC-20020424 1.2	7.58×10^{-5}	2.96×10^{-5}	9.11×10^{-4}	1.24×10^{-4}
18	AL-SEC-20020501 1.2	7.10×10^{-5}	2.76×10^{-5}	8.87×10^{-4}	1.21×10^{-4}
19	AL-SEC-20020508 1.2	7.98×10^{-5}	3.05×10^{-5}	8.55×10^{-4}	1.17×10^{-4}
20	AL-SEC-20020515 1.2	7.49×10^{-5}	2.92×10^{-5}	8.97×10^{-4}	1.21×10^{-4}
21	AL-SEC-20020522 1.2	5.37×10^{-5}	2.58×10^{-5}	8.10×10^{-4}	1.15×10^{-4}
22	AL-SEC-20020529 1.2	4.17×10^{-5}	2.27×10^{-5}	8.13×10^{-4}	1.14×10^{-4}
23	AL-SEC-20020605 1.2	6.16×10^{-5}	2.54×10^{-5}	7.23×10^{-4}	1.04×10^{-4}
24	AL-SEC-20020612 1.2	6.98×10^{-5}	2.87×10^{-5}	7.75×10^{-4}	1.10×10^{-4}
25	AL-SEC-20020619 1.2	5.46×10^{-5}	2.51×10^{-5}	1.03×10^{-3}	1.36×10^{-4}
26	AL-SEC-20020626 1.2	5.24×10^{-5}	2.54×10^{-5}	7.25×10^{-4}	1.06×10^{-4}
WIPP Far Field (WFF)					
27	AL-WFF-20020703 1.2	5.63×10^{-5}	2.66×10^{-5}	9.13×10^{-4}	1.26×10^{-4}
28	AL-WFF-20020710 1.2	5.59×10^{-5}	2.63×10^{-5}	7.42×10^{-4}	1.08×10^{-4}
29	AL-WFF-20020717 1.2	4.02×10^{-5}	2.12×10^{-5}	6.23×10^{-4}	9.19×10^{-5}
30	AL-WFF-20020724 1.2	4.49×10^{-5}	2.24×10^{-5}	7.88×10^{-4}	1.11×10^{-4}
31	AL-WFF-20020731 1.2	5.86×10^{-5}	2.57×10^{-5}	9.74×10^{-4}	1.29×10^{-4}
32	AL-WFF-20020807 1.2	1.39×10^{-4}	4.13×10^{-5}	1.02×10^{-3}	1.35×10^{-4}
33	AL-WFF-20020814 1.2	1.02×10^{-4}	3.53×10^{-5}	8.32×10^{-4}	1.16×10^{-4}
34	AL-WFF-20020821 1.2	8.16×10^{-5}	3.12×10^{-5}	9.27×10^{-4}	1.26×10^{-4}
35	AL-WFF-20020828 1.2	9.88×10^{-5}	3.46×10^{-5}	1.21×10^{-3}	1.54×10^{-4}
36	AL-WFF-20020904 1.2	7.56×10^{-5}	2.89×10^{-5}	6.81×10^{-4}	9.84×10^{-5}
37	AL-WFF-20020911 1.2	1.03×10^{-4}	3.51×10^{-5}	1.30×10^{-3}	1.63×10^{-4}
38	AL-WFF-20020918 1.2	1.19×10^{-4}	3.72×10^{-5}	1.05×10^{-3}	1.38×10^{-4}
39	AL-WFF-20020925 1.2	1.42×10^{-4}	4.13×10^{-5}	1.06×10^{-3}	1.39×10^{-4}
WIPP East (WEE)					
40	AL-WEE-20021002 1.2	9.54×10^{-5}	3.35×10^{-5}	8.19×10^{-4}	1.14×10^{-4}
41	AL-WEE-20021009 1.2	6.80×10^{-5}	2.81×10^{-5}	1.24×10^{-3}	1.57×10^{-4}
42	AL-WEE-20021016 1.2	5.37×10^{-5}	2.48×10^{-5}	1.09×10^{-3}	1.41×10^{-4}
43	AL-WEE-20021023 1.2	4.86×10^{-5}	2.24×10^{-5}	4.88×10^{-4}	7.87×10^{-5}
44	AL-WEE-20021030 1.2	4.72×10^{-5}	2.47×10^{-5}	8.42×10^{-4}	1.17×10^{-4}
45	AL-WEE-20021106 1.2	7.26×10^{-5}	2.98×10^{-5}	1.02×10^{-3}	1.35×10^{-4}
46	AL-WEE-20021113 1.2	6.27×10^{-5}	2.62×10^{-5}	1.13×10^{-3}	1.46×10^{-4}
47	AL-WEE-20021120 1.2	1.22×10^{-4}	3.88×10^{-5}	1.31×10^{-3}	1.66×10^{-4}
48	AL-WEE-20021127 1.2	5.69×10^{-5}	2.49×10^{-5}	1.45×10^{-3}	1.78×10^{-4}
49	AL-WEE-20021204 1.2	2.75×10^{-5}	1.71×10^{-5}	1.40×10^{-3}	1.73×10^{-4}
50	AL-WEE-20021211 1.2	N/C	N/C	N/C	N/C

Table D.1 - Results of Gross Alpha and Gross Beta Analyses in Air Particulates (Bq/m^3)

		Gross Alpha		Gross Beta	
Week	Sample ID	Concentration	2 x TPU[a]	Concentration	2 x TPU
51	AL-WEE-20021218 1.2	5.50×10^{-5}	2.73×10^{-5}	9.84×10^{-4}	1.35×10^{-4}
52	AL-WEE-20021225 1.2	7.40×10^{-5}	3.57×10^{-5}	1.53×10^{-3}	2.00×10^{-4}

[a] Total propagated uncertainty

[b] Not collected

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Appendix E
Air Sampling Data: Mass and Volume of Composite Air Samples

Table E.1 - Mass (mg) of Air Particulates and Volume (m^3) of Air Sampled (First Quarter of 2002).

Week	Mass	Volume	Mass	Volume	Mass	Volume	Mass	Volume
	WIPP Far Field (WFF)		WIPP East (WEE)		WIPP South (WSS)		Mills Ranch (MLR)	
1	3	568.519	4.1	590.644	3.8	572.767	5.8	576.024
2	7	603.322	7.5	547.459	9.2	597.372	12.9	583.415
3	12.2	633.029	14.2	606.421	12.2	598.719	14.5	598.371
4	N/C[a]	N/C	9.7	612.241	12.3	605.157	11.9	615.188
5	6.4	612.817	6	625.708	N/C	N/C	7.2	616.316
6	9.3	570.115	9.3	573.27	11.5	581.349	9.5	598.923
7	12	593.002	12.6	547.703	12.2	555.598	11.3	603.019
8	9.8	569.845	11.1	587.327	12.6	584.49	12.2	515.237
9	14.5	612.279	16.7	594.759	19.6	596.908	18.1	569.889
10	19.1	557.116	20.7	549.244	23.5	563.137	21.8	588.79
11	20.6	625.286	25.8	589.74	29.9	601.191	20	611.915
12	18.7	591.582	24.4	612.948	20.6	564.146	22.6	572.352
13	11.5	585.136	17.2	601.903	18.5	610.461	17.6	602.62
Total	144.1	7122	179.3	7639.4	185.9	7031.3	185.4	7652.1

[a] Not collected

Table E.1 - Mass (mg) of Air Particulates and Volume (m^3) of Air Sampled (First Quarter of 2002).

Week	Mass	Volume	Mass	Volume	Mass	Volume	Mass	Volume
	Smith Ranch (SMR)		Carlsbad (CBD) #1		Carlsbad (CBD) #2		Southeast Control (SEC)	
1	5.3	558.954	11	589.811	N/C	N/C	3.3	566.165
2	N/C[a]	N/C	15.1	554.491	15.9	557.034	9	591.932
3	21	535.029	23	591.582	24.4	591.937	13.3	598.683
4	22.2	618.399	21.1	586.44	24	589.315	10.2	586.94
5	7	593.953	7.2	615.575	7.5	587.338	5.1	622.242
6	18.7	542.355	17.3	537.38	17.2	494.691	7.9	528.202
7	23	708.966	27.4	761.747	27.8	754.492	14.5	567.34
8	24.9	500.446	15	495.921	17.1	522.565	15.6	506.073
9	33.4	585.484	28.4	562.128	30.6	601.903	17.3	615.432
10	46.4	575.543	29.1	535.654	N/C	N/C	28.3	595.133
11	29.5	603.916	N/C	N/C	N/C	N/C	25.7	630.567
12	26.8	573.827	18.1	548.261	22.8	540.061	22.5	546.725
13	18.8	602.542	25.3	623.353	26.3	586.18	17.6	595.133
Total	277	6999.4	238	7002.3	213.6	5825.5	190.3	7550.6

[a] Not collected

Table E.2 - Mass (mg) of Air Particulates and Volume (m^3) of Air Sampled (Second Quarter of 2002).

Week	Mass	Volume	Mass	Volume	Mass	Volume	Mass	Volume
	WIPP Far Field (WFF)		WIPP East (WEE)		WIPP South (WSS)		Mills Ranch (MLR)	
14	7.9	588.751	8.5	574.598	7.8	546.949	8.7	551.954
15	10.1	546.149	N/C	N/C	12.2	597.973	13.1	616.176
16	14.8	582.698	10	547.605	14.8	592.292	18.1	560.803
17	23.6	547.163	26	561.562	25.4	575.961	24.8	539.009
18	17.8	572.454	17.6	553.279	15.5	559.623	18	577.013
19	16.8	546.398	19.7	551.591	16.6	519.539	19.6	573.141
20	16.4	573.564	18.3	569.999	21.3	620.849	15	559.129
21	N/C[a]	N/C	14.8	522.448	16.2	586.13	20.1	587.633
22	13.5	586.624	13.8	560.782	14.7	544.115	N/C	N/C
23	8	542.035	8.1	573.922	12.8	568.519	9.6	576.693
24	17.1	544.526	17.2	555.93	18.6	546.725	17	529.408
25	14.4	623.412	13.4	611.242	18.4	619.387	15	551.618
26	9	567.633	8.9	552.545	11.8	594.514	8.4	537.479
Total	169.4	6821.4	176.3	6735.5	206.1	7472.6	187.4	6208.1
	Smith Ranch (SMR)		Carlsbad (CBD)		Southeast Control (SEC) #1		Southeast Control (SEC) #2	
14	13.7	556.946	19.4	580.259	8.8	560.782	8.2	550.629
15	20.6	600.834	21	551.212	11.6	587.99	10.2	570.524
16	23.1	556.783	27.5	568.485	14.8	586.24	13.8	586.24
17	33.2	583.221	35.7	565.313	23.9	565.492	24.1	571.204
18	26.1	563.473	31	588.734	20	597.618	18.9	577.259
19	24.3	594.067	37.1	604.035	20.2	605.075	17	588.031
20	22.2	557.034	28.9	541.084	20	544.925	17.5	605.473
21	24.2	567.333	28.6	547.277	16	556.783	15.2	559.958
22	19.9	551.76	38.4	579.855	17.3	604.713	14.7	576.323
23	12.4	578.289	18.5	583.668	8.2	548.096	8.7	579.661
24	24.2	543.877	N/C	N/C	19.4	585.832	17.1	557.255
25	22.9	597.326	24.4	571.081	13.7	534.655	14	573.64
26	18.8	585.136	17.1	548.588	10.4	571.883	9	555.4
Total	285.6	7436.1	327.6	6829.6	204.3	7450.1	188.4	7451.6

[a] Not collected

Table E.3 - Mass (mg) of Air Particulates and Volume (m^3) of Air Sampled (Third Quarter of 2002).

Week	Mass	Volume	Mass	Volume	Mass	Volume	Mass	Volume
	WIPP Far Field (WFF) #1		WIPP Far Field (WFF) #2		WIPP East (WEE)		WIPP South (WSS)	
27	11.9	546.725	11.3	543.228	12	571.328	14.4	548.261
28	7.6	570.376	7.5	553.179	7.2	556.375	8.1	562.111
29	8.1	617.002	8.2	622.823	7.2	599.988	9.1	605.785
30	8.4	522.371	8.5	567.306	9.5	535.278	9.8	547.193
31	11.4	599.039	11	590.44	11.2	573.294	14.7	615.05
32	11	567.466	11.1	567.466	11.8	572.797	12.6	561.924
33	13.4	563.64	14.4	561.112	14.1	564.309	18.1	575.767
34	9.5	581.398	9.9	569.437	9.9	562.938	10.4	553.786
35	13.1	555.913	13.6	564.251	13.5	576.916	16.6	580.462
36	9	589.213	8.7	592.159	9.2	585.929	11.3	608.781
37	6.3	536.599	6.3	550.428	7.4	540.622	8.5	567.024
38	11.9	587.64	11.6	570.424	13	579.427	N/C	N/C
39	8.5	560.446	8.4	560.446	10.2	558.115	9	456.691
Total	130.1	7397.8	130.5	7412.7	136.2	7377.3	142.6	6782.8
	Mills Ranch (MLR)		Smith Ranch (SMR)		Carlsbad (CBD)		Southeast Control (SEC)	
27	10	540.061	13.2	505.031	17.7	567.33	10.9	599.353
28	6.5	541.393	12	559.78	16.2	586.529	6.4	579.957
29	7.8	539.658	14.1	578.357	16.5	583.459	8.6	574.537
30	N/C	N/C	16.5	547.173	18.1	547.494	10	560.249
31	9.4	500.05	15.4	596.823	19.3	585.29	11.6	595.133
32	14.5	567.571	18.7	564.408	20	573.484	11	558.285
33	14.6	573.922	25.6	568.183	33.2	570.864	14.7	585.747
34	10.1	577.66	16.1	557.586	22.9	577.776	9.5	557.116
35	11.4	565.631	29.2	570.986	26	582.531	14.3	570.15
36	9.2	580.519	N/C	N/C	19	574.17	8.7	574.17
37	10.1	546.127	N/C	N/C	13.2	560.293	4.5	562.361
38	14.3	579.427	24.3	582.628	19.8	579.661	15.2	581.034
39	10.1	572.767	15.4	566.501	23.2	575.543	8.5	562.262
Total	128	6684.8	200.5	6197.5	265.1	7464.4	133.9	7460.4

[a] Not collected

Table E.4 - Mass (mg) of Air Particulates and Volume (m^3) of Air Sampled (Fourth Quarter of 2002).

Week	WIPP Far Field (WFF) Mass	WIPP Far Field (WFF) Volume	WIPP East (WEE) #1 Mass	WIPP East (WEE) #1 Volume	WIPP East (WEE) #2 Mass	WIPP East (WEE) #2 Volume	WIPP South (WSS) Mass	WIPP South (WSS) Volume
40	9.2	604.64	9.3	584.577	9.9	581.639	10.1	590.644
41	6.5	559.773	7.4	573.141	6.5	561.791	8.1	602.62
42	10.7	576.382	7.8	567.571	8.4	573.219	8.9	588.386
43	2.9	596.526	2.2	579.24	2.4	587.676	3.9	576.08
44	5.2	564.819	4.6	562.636	5.1	556.924	5.1	562.97
45	8.6	576.109	7.8	479.526	9.7	564.644	8.8	576.109
46	6.7	571.883	6.1	554.273	6.2	560.293	6.8	574.598
47	10	587.64	9.7	536.315	9.3	520.128	11	575.426
48	8.9	560.293	9.8	554.214	8.1	559.413	14.8	585.484
49	4.8	574.095	5.1	556.045	4.7	556.375	5	536.3
50	14.5	562.6	17.1	574.857	N/C	N/C	4	424.937
51	7.5	652.946	8.4	646.787	7.8	520.2	9.8	628.888
52	3.1	412.524	4.7	422.735	4	406.397	3.7	413.21
Total	98.6	7400.2	100	7191.9	82.1	6548.7	100	7235.7

Week	Mills Ranch (MLR) Mass	Mills Ranch (MLR) Volume	Smith Ranch (SMR) Mass	Smith Ranch (SMR) Volume	Carlsbad (CBD) Mass	Carlsbad (CBD) Volume	Southeast Control (SEC) Mass	Southeast Control (SEC) Volume
40	14.7	583.321	18.6	579.427	17.1	578.392	8.3	584.707
41	5.1	570.376	9.1	570.874	10.7	578.392	6.8	570.201
42	10.8	565.247	10.5	561.083	18.9	574.254	6.7	574.656
43	3.3	572.111	3.7	585.98	4.9	585.635	2	570.714
44	3.7	571.204	4.1	569.362	7.8	566.165	4.9	590.09
45	9.4	576.109	18.1	577.602	16.3	575.084	8	566.995
46	11.4	567.525	9.2	559.623	16	568.485	5	322.548
47	13.6	557.326	17.1	575.767	22.4	586.787	11.6	571.19
48	18.6	579.318	20.9	569.505	15.4	557.95	8.4	571.501
49	5.7	567.333	5.9	550.639	11	556.045	5.3	554.148
50	16.3	622.405	27	574.857	24.9	566.319	15.9	569.889
51	7.1	632.587	10.7	648.478	15.3	658.254	6.6	644.526
52	3.9	407.334	6.3	407.334	9	387.251	3.6	407.334
Total	123.6	7372.2	161.2	7330.5	189.7	7339	93.1	7098.5

[a] Not collected

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Appendix F
Time Trend Plots for Detectable Constituents in Groundwater

The figures in this appendix show the concentrations of various groundwater constituents relative to a baseline concentration, and are in a form required by the NMED and the HWFP. Baseline concentrations were measured from 1995 through 2000. These plots indicate the sample and duplicate concentration values with respect to sample round. Sampling round 14 occurred in March through May 2002 and sampling round 15 occurred from September through November 2002. See Chapter 6 for specific concentration information on the groundwater wells.

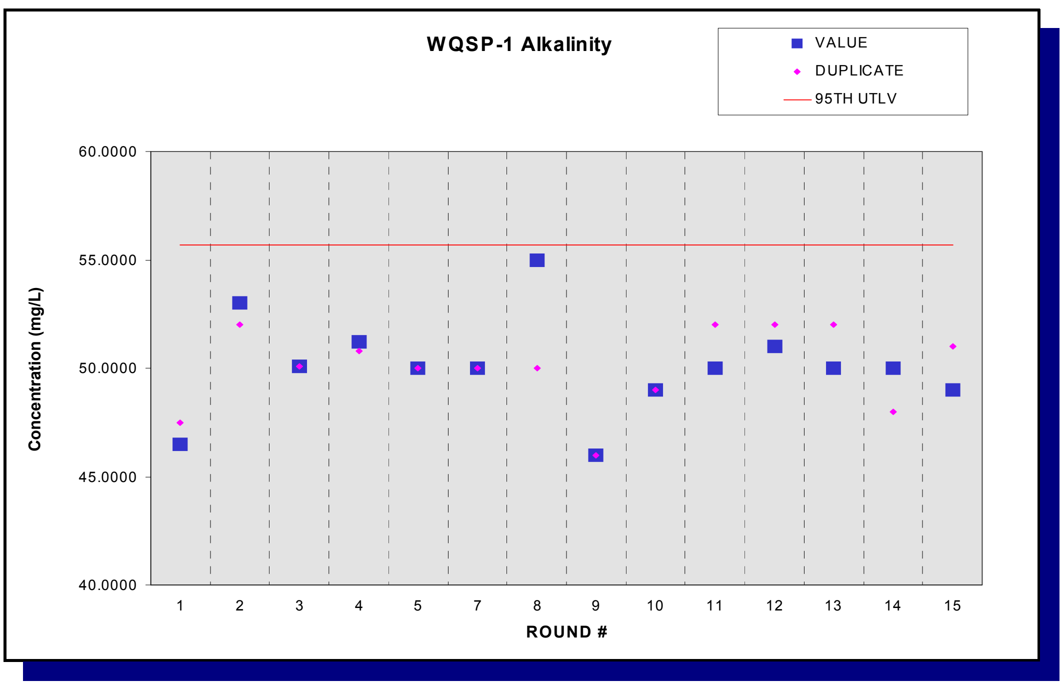

Figure F.1 - Time Trend Plot for Alkalinity at WQSP-1

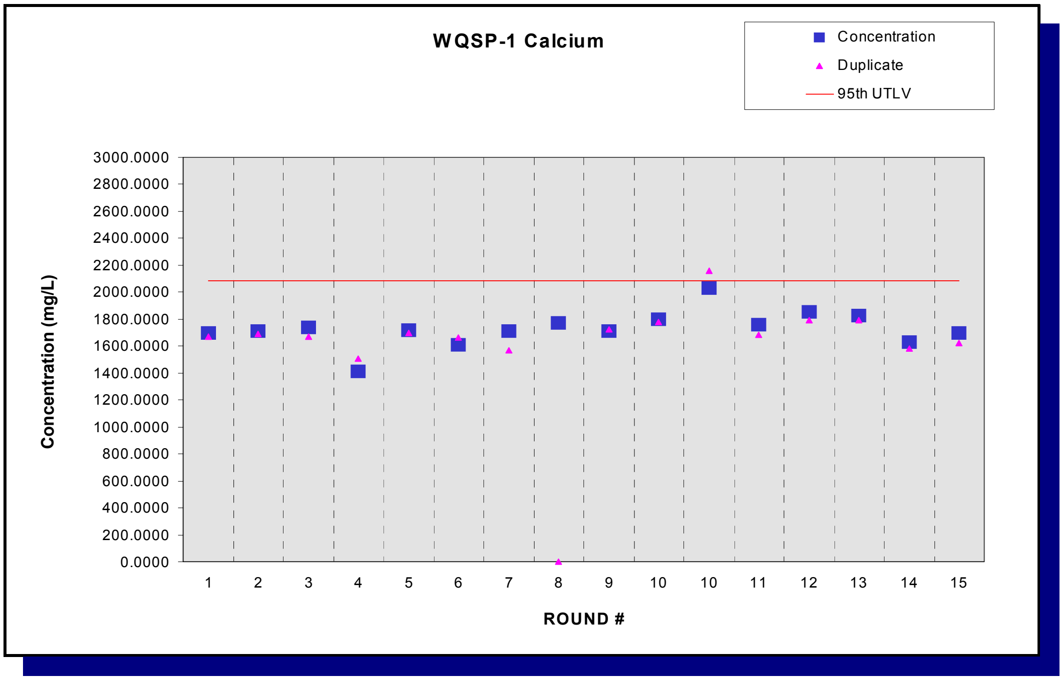

Figure F.2 - Time Trend Plot for Calcium at WQSP-1

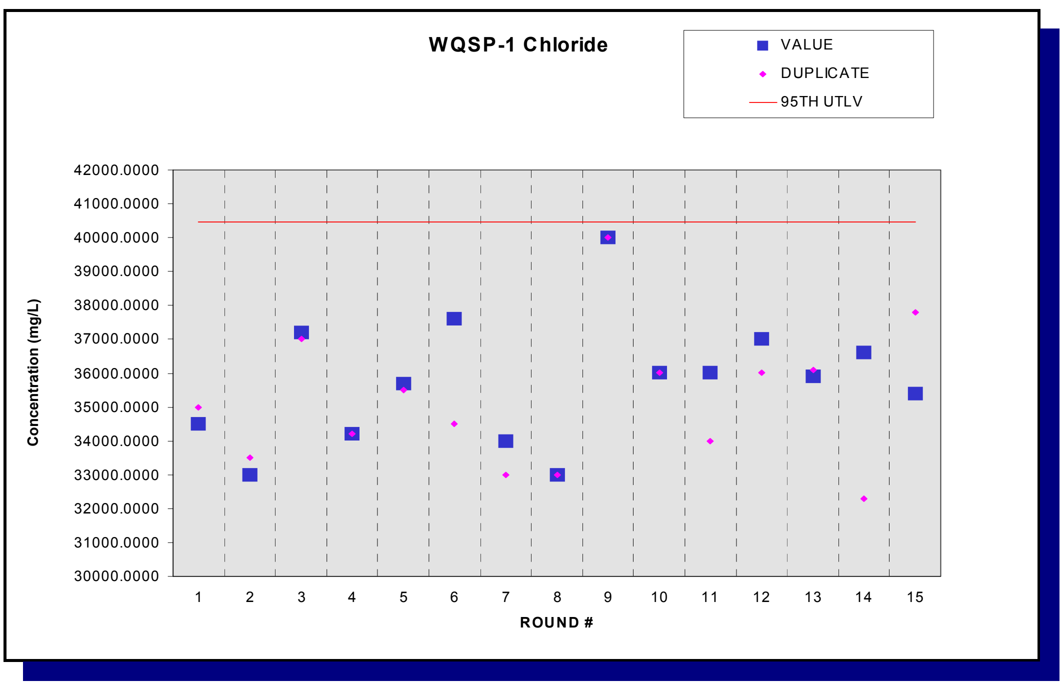

Figure F.3 - Time Trend Plot for Chloride at WQSP-1

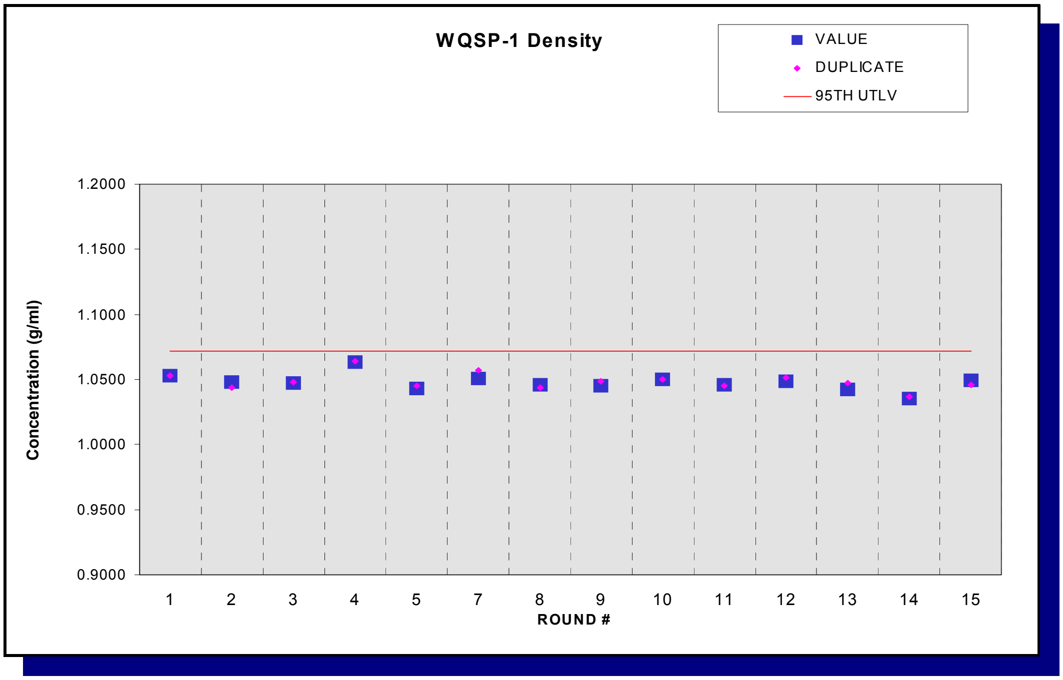

Figure F.4 - Time Trend Plot for Density at WQSP-1

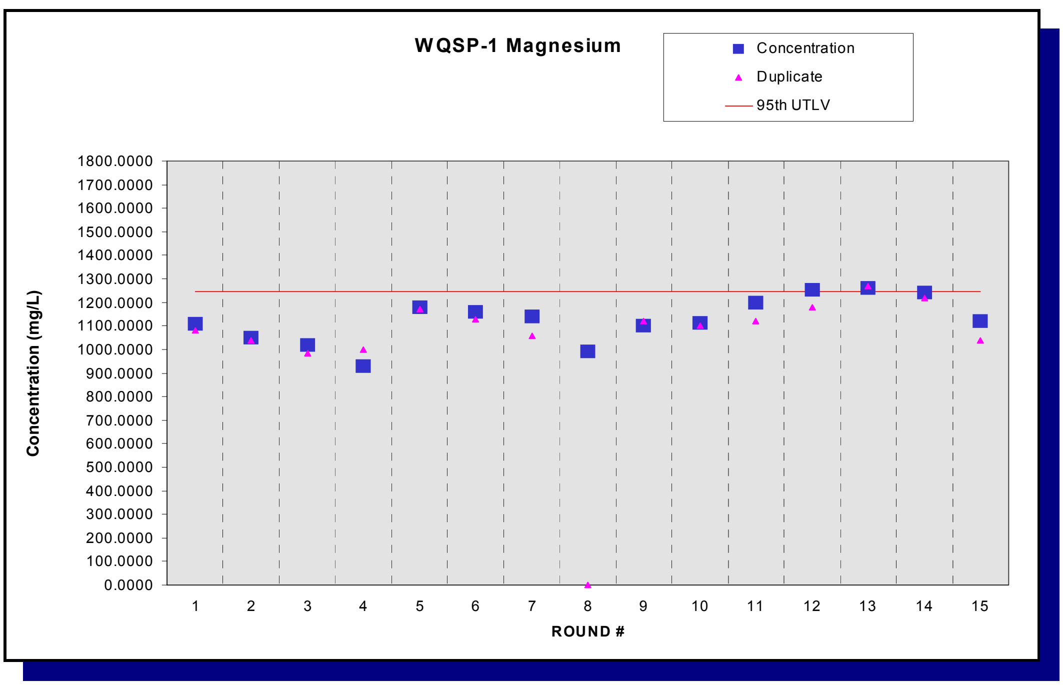

Figure F.5 - Time Trend Plot for Magnesium at WQSP-1

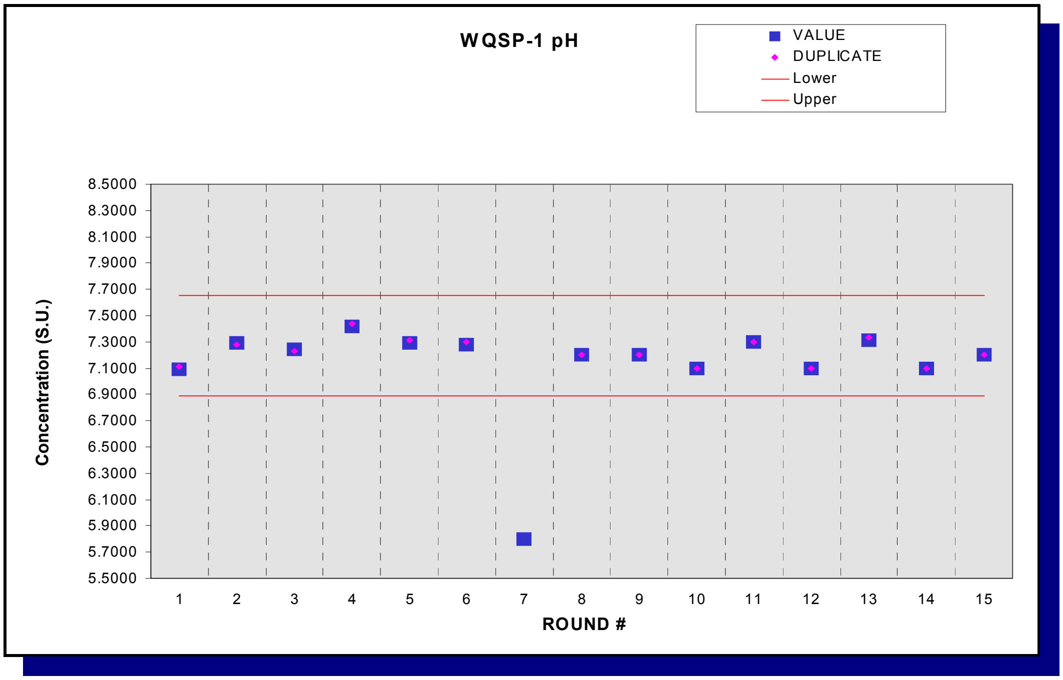

Figure F.6 - Time Trend Plot for pH at WQSP-1

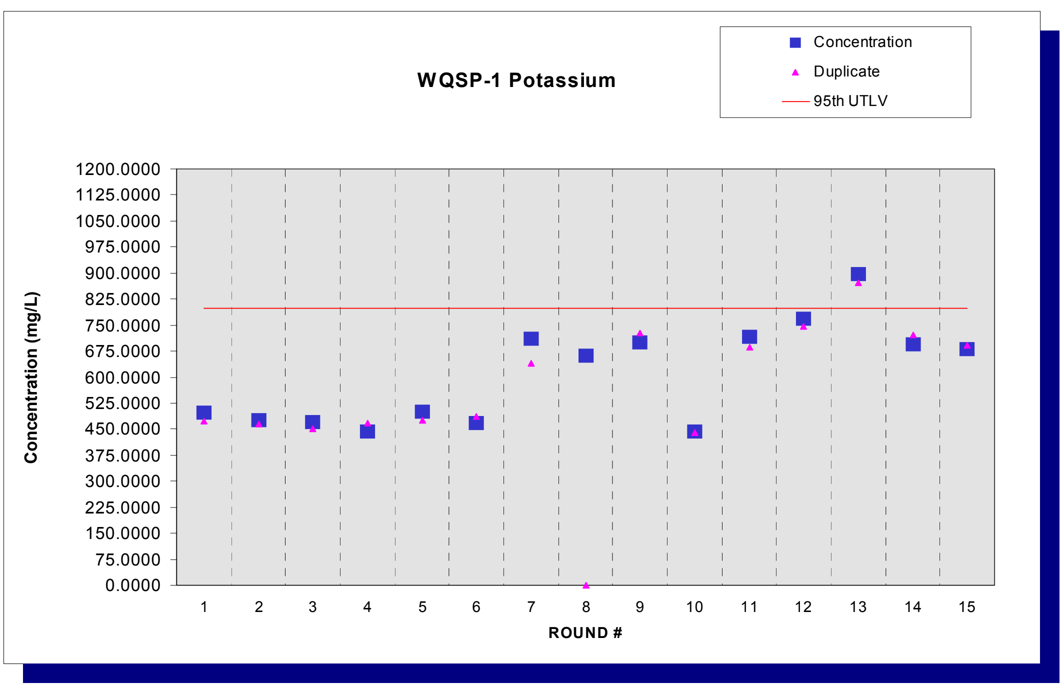

Figure F.7 - Time Trend Plot for Potassium at WQSP-1

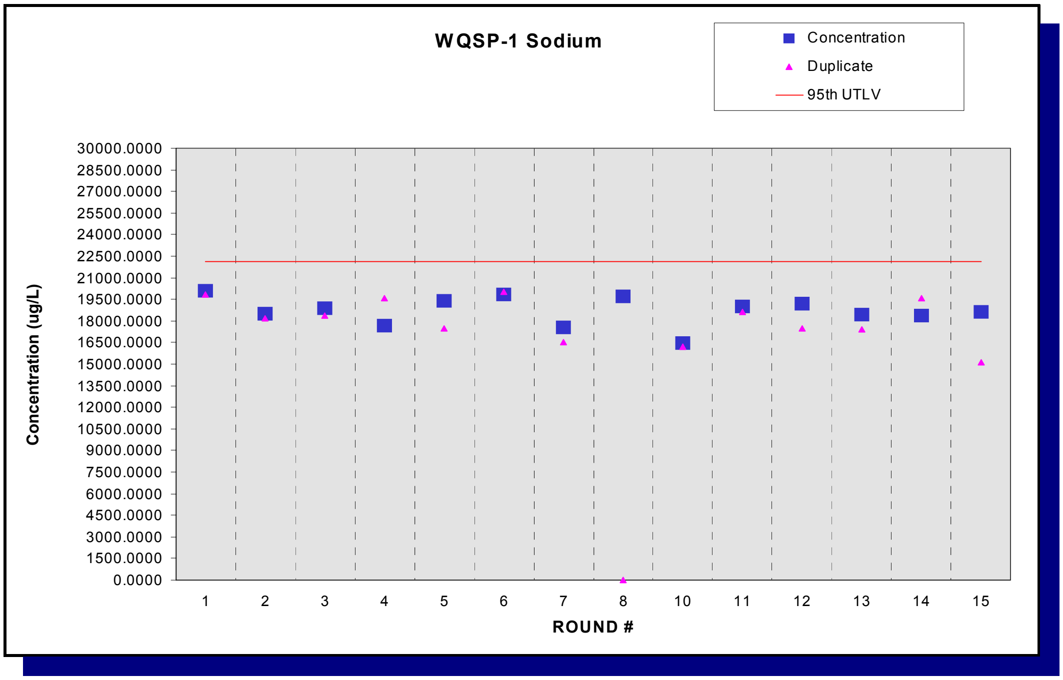

Figure F.8 - Time Trend Plot for Sodium at WQSP-1

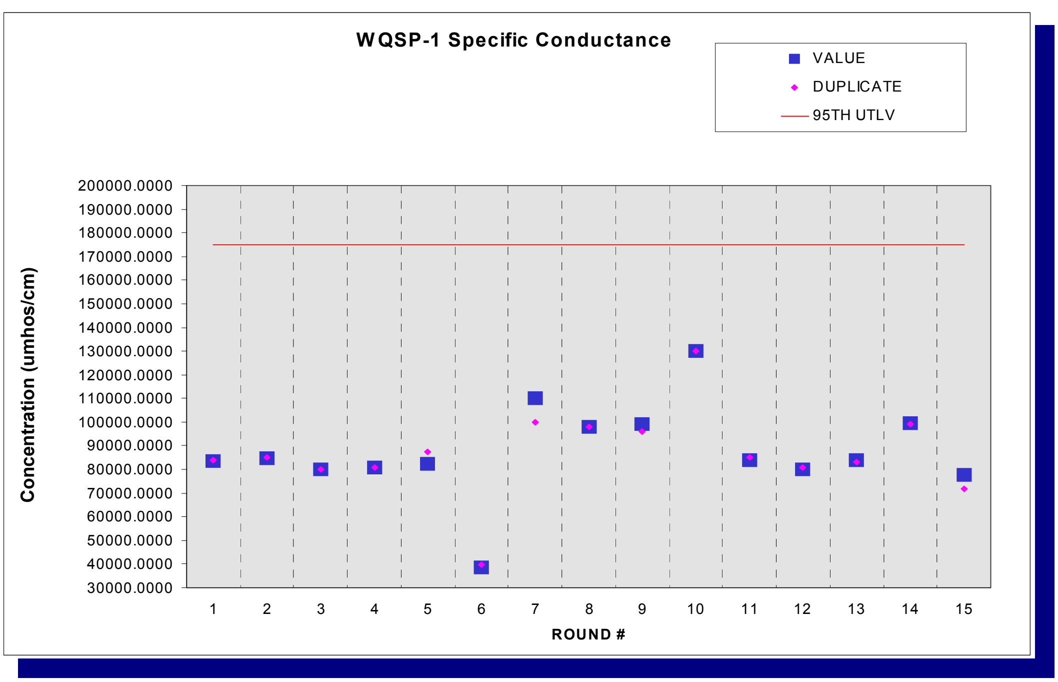

Figure F.9 - Time Trend Plot for Specific Conductance at WQSP-1

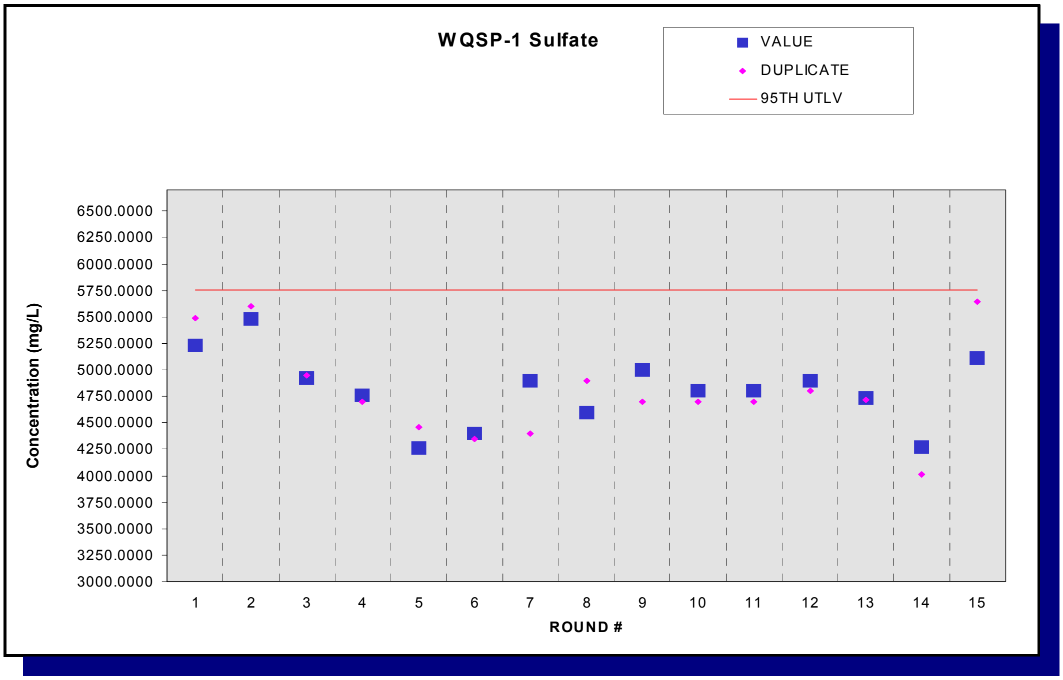

Figure F.10 - Time Trend Plot for Sulfate at WQSP-1

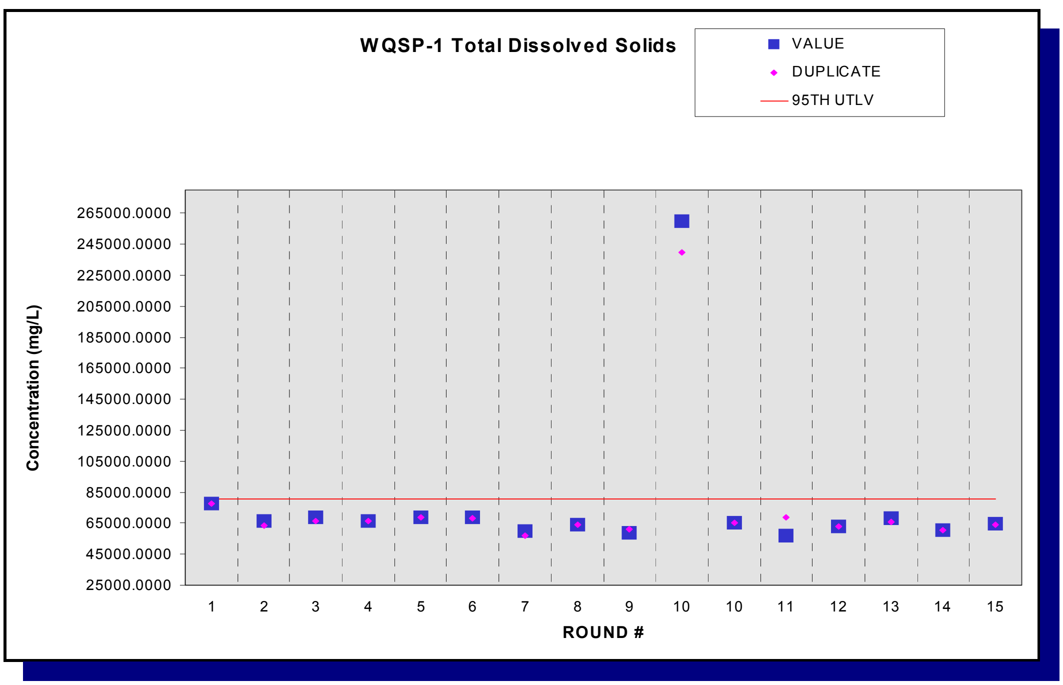

Figure F.11 - Time Trend Plot for Total Dissolved Solids at WQSP-1

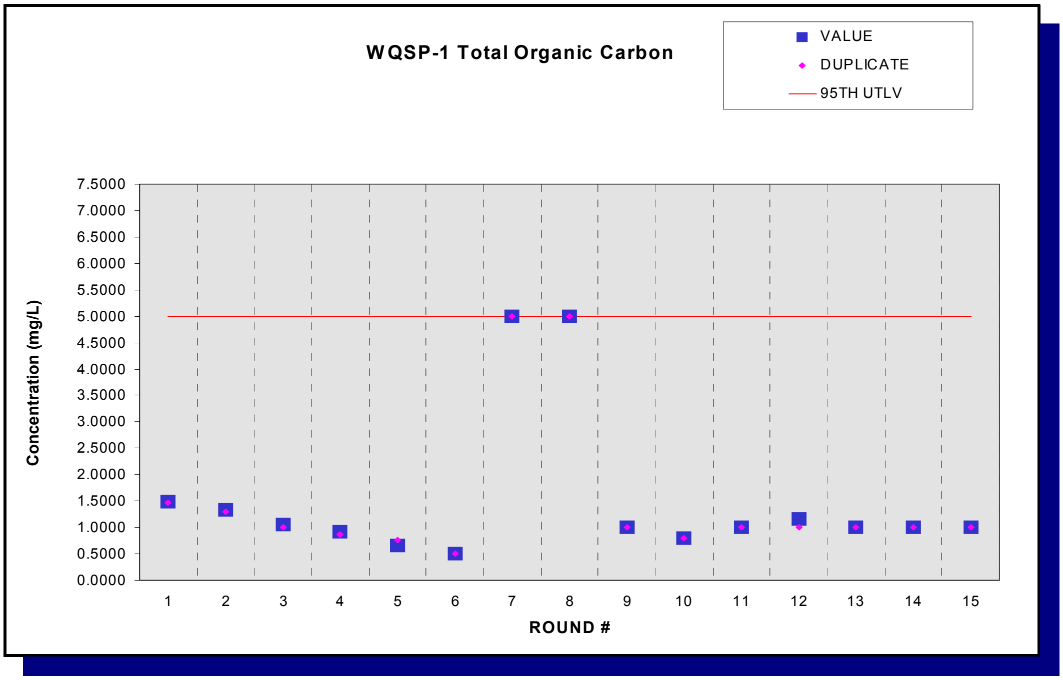

Figure F.12 - Time Trend Plot for Total Organic Carbon at WQSP-1

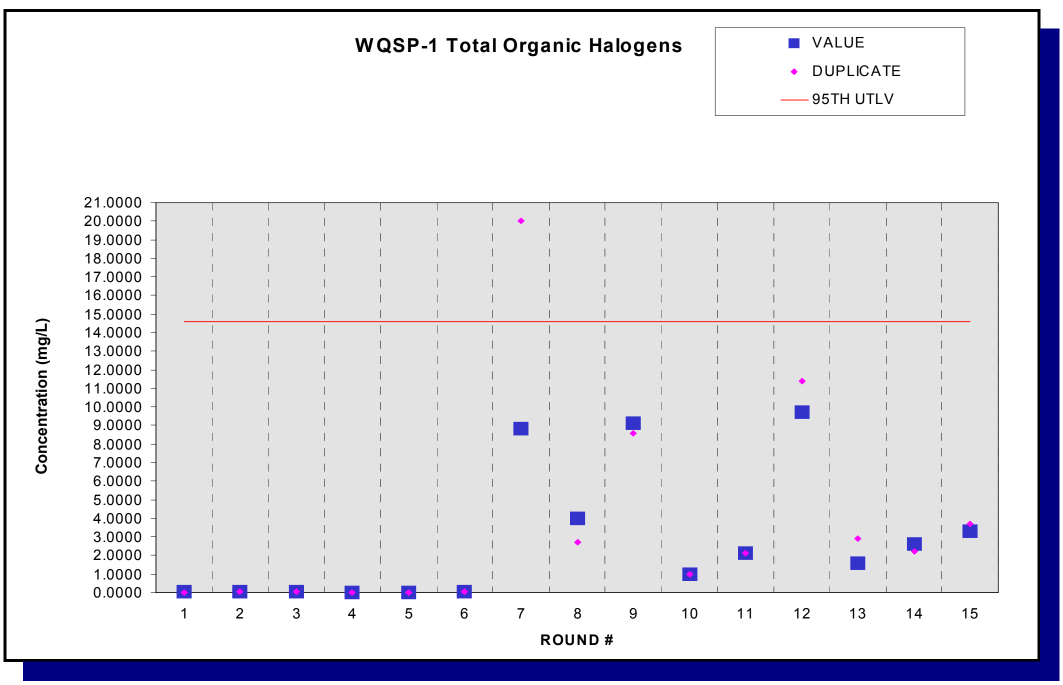

Figure F.13 - Time Trend Plot for Total Organic Halogens at WQSP-1

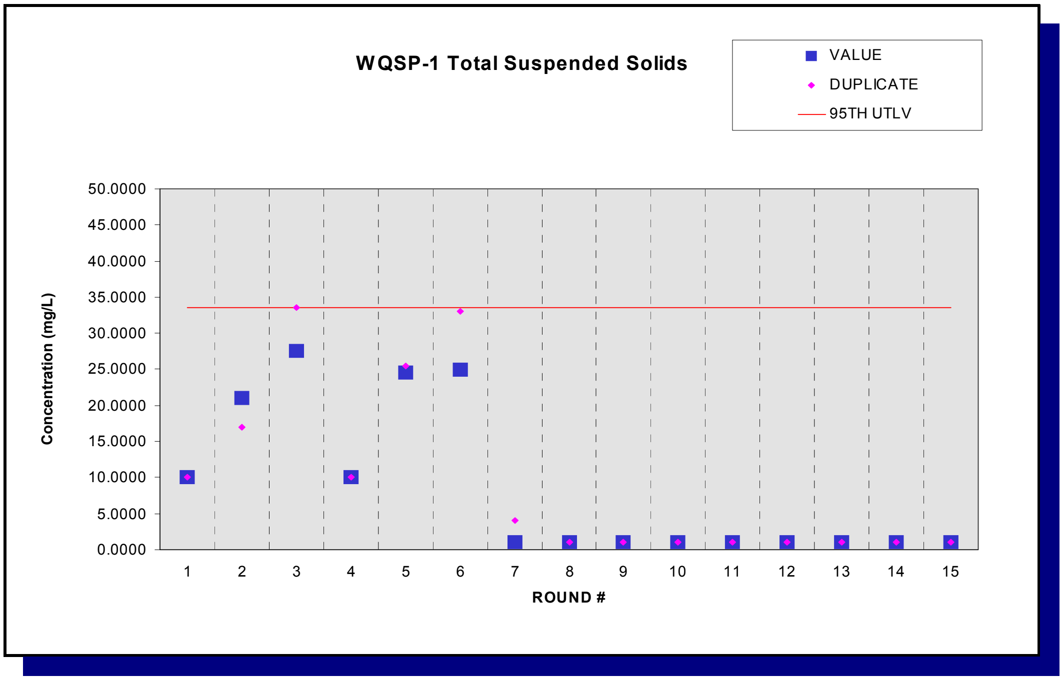

Figure F.14 - Time Trend Plot for Total Suspended Solids at WQSP-1

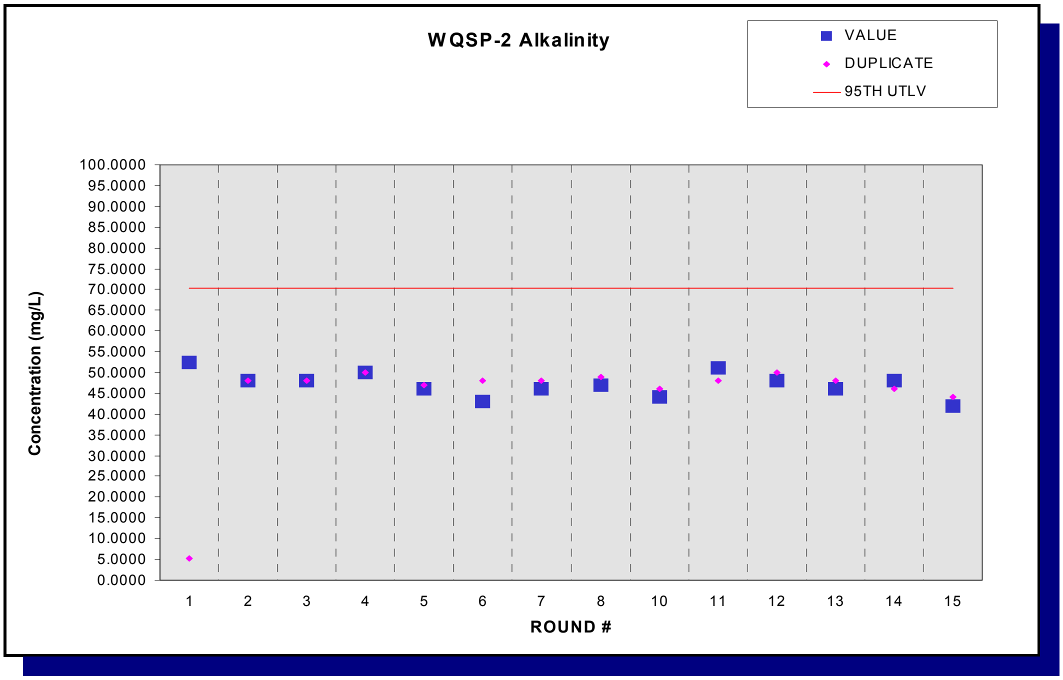

Figure F.15 - Time Trend Plot for Alkalinity at WQSP-2

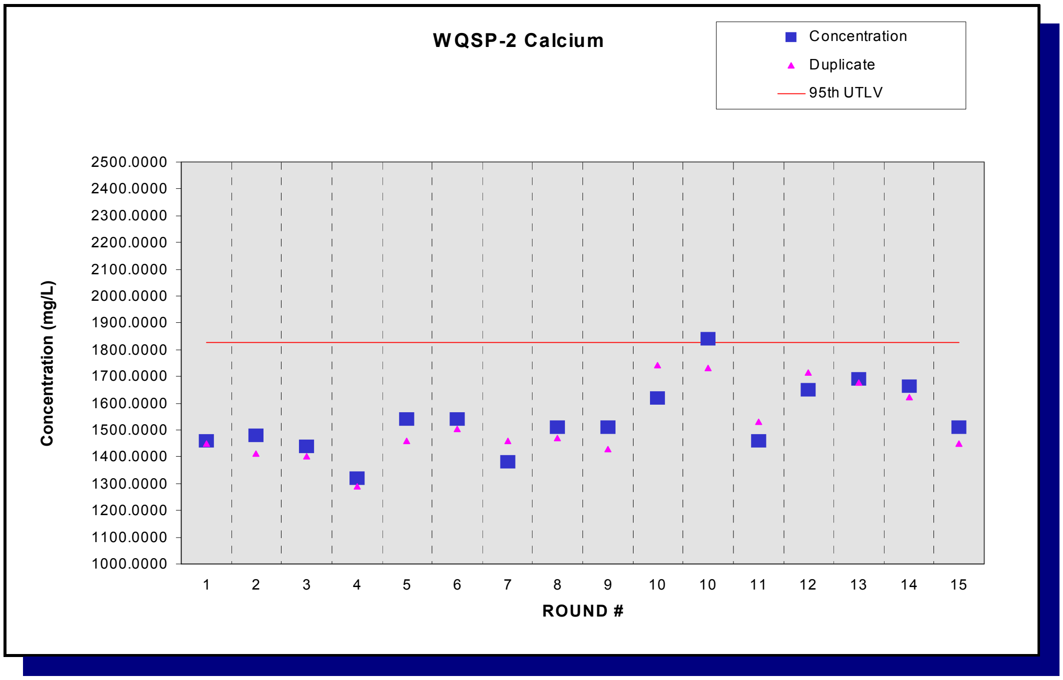

Figure F.16 - Time Trend Plot for Calcium at WQSP-2

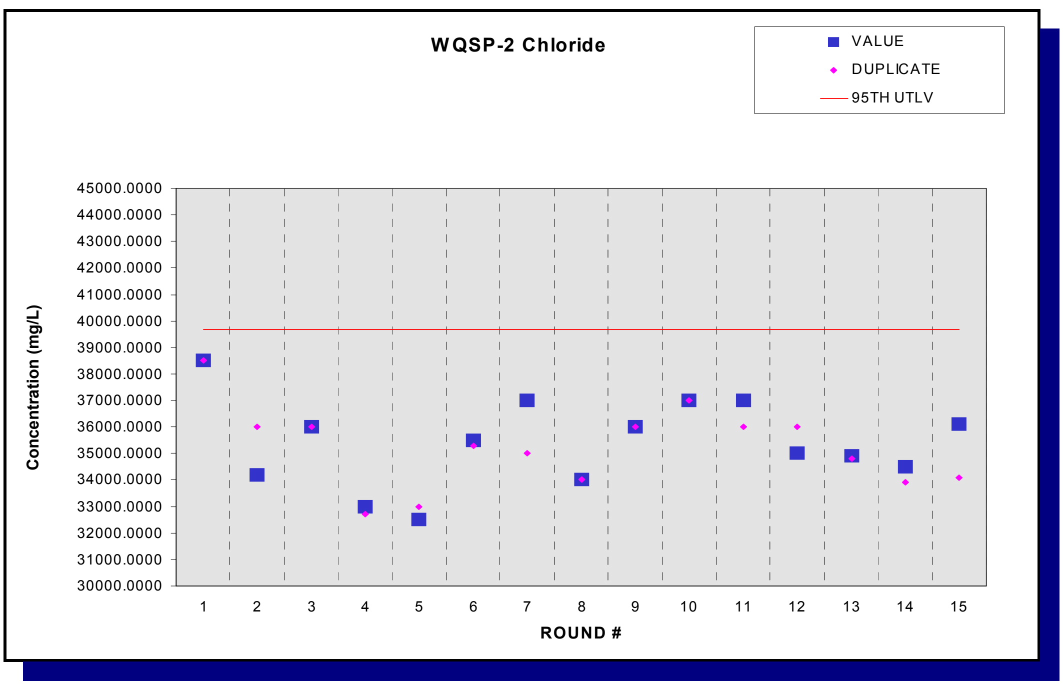

Figure F.17 - Time Trend Plot for Chloride at WQSP-2

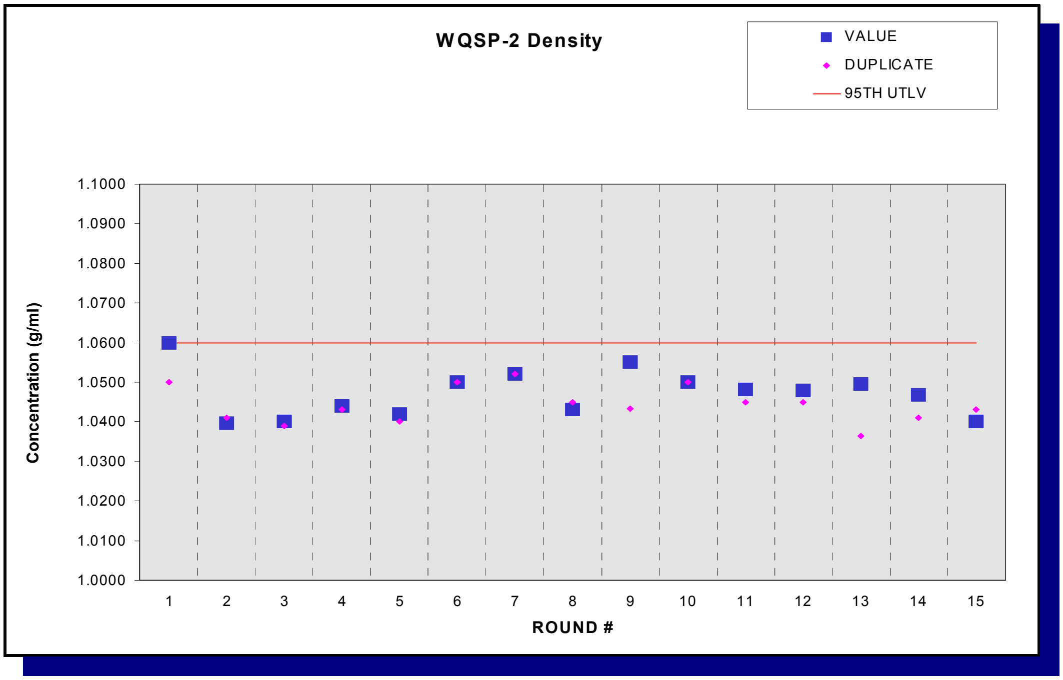

Figure F.18 - Time Trend Plot for Density at WQSP-2

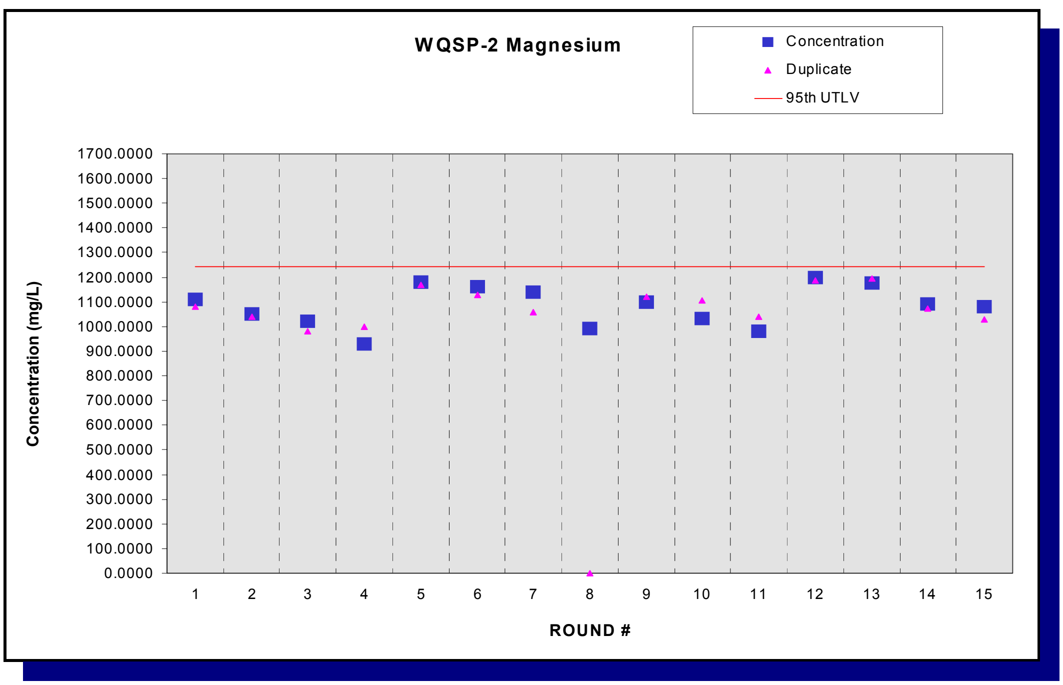

Figure F.19 - Time Trend Plot for Magnesium at WQSP-2

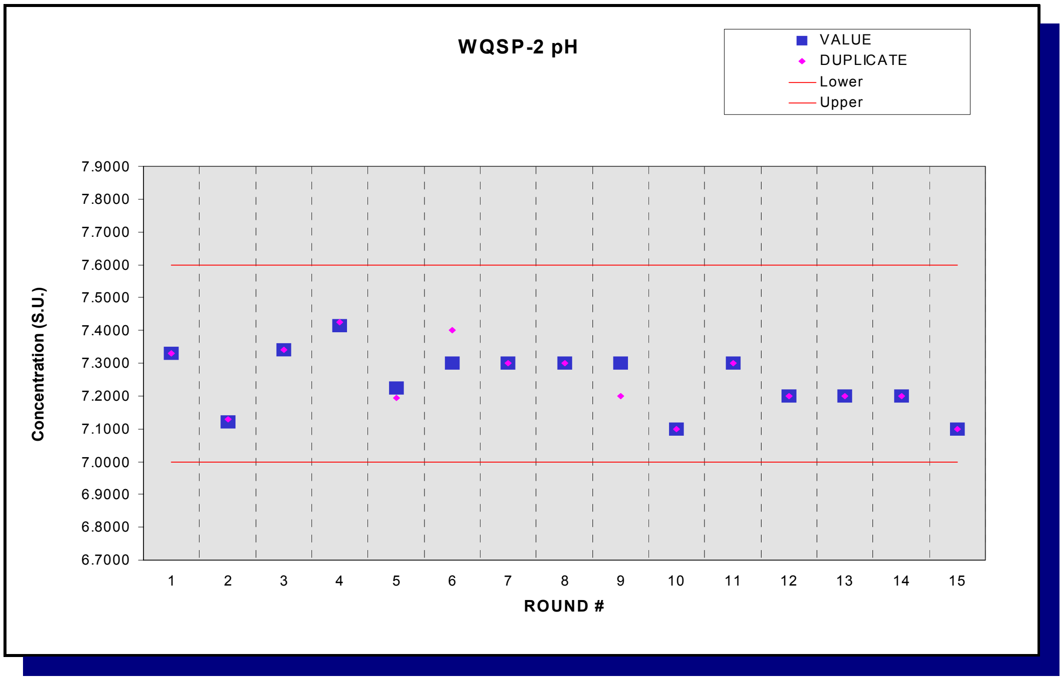

Figure F.20 - Time Trend Plot for pH at WQSP-2

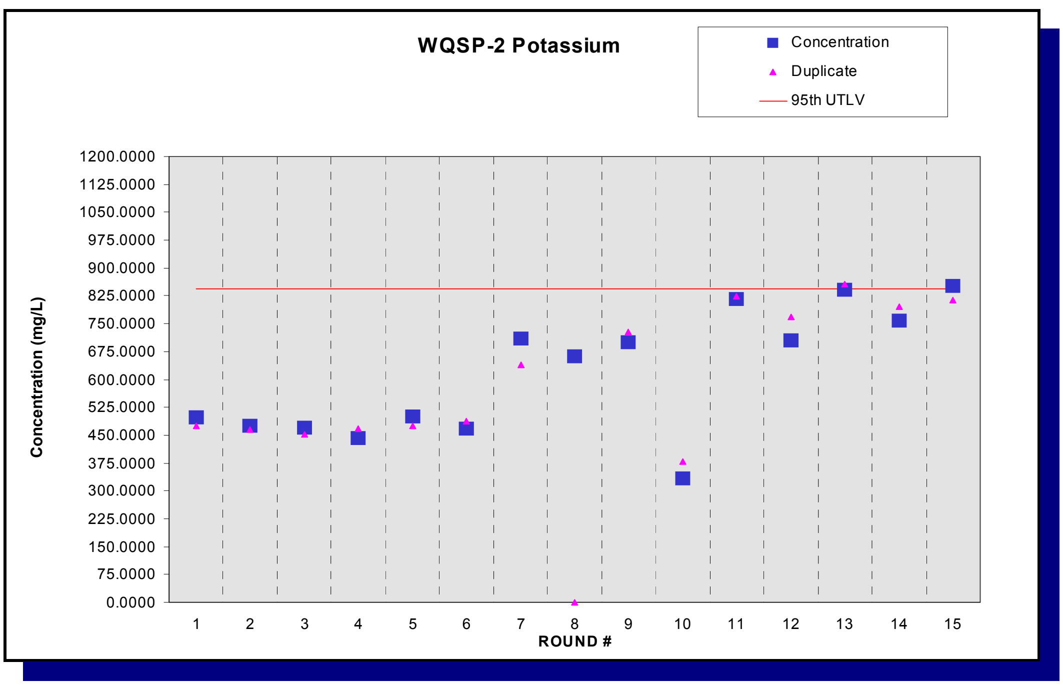

Figure F.21 - Time Trend Plot for Potassium at WQSP-2

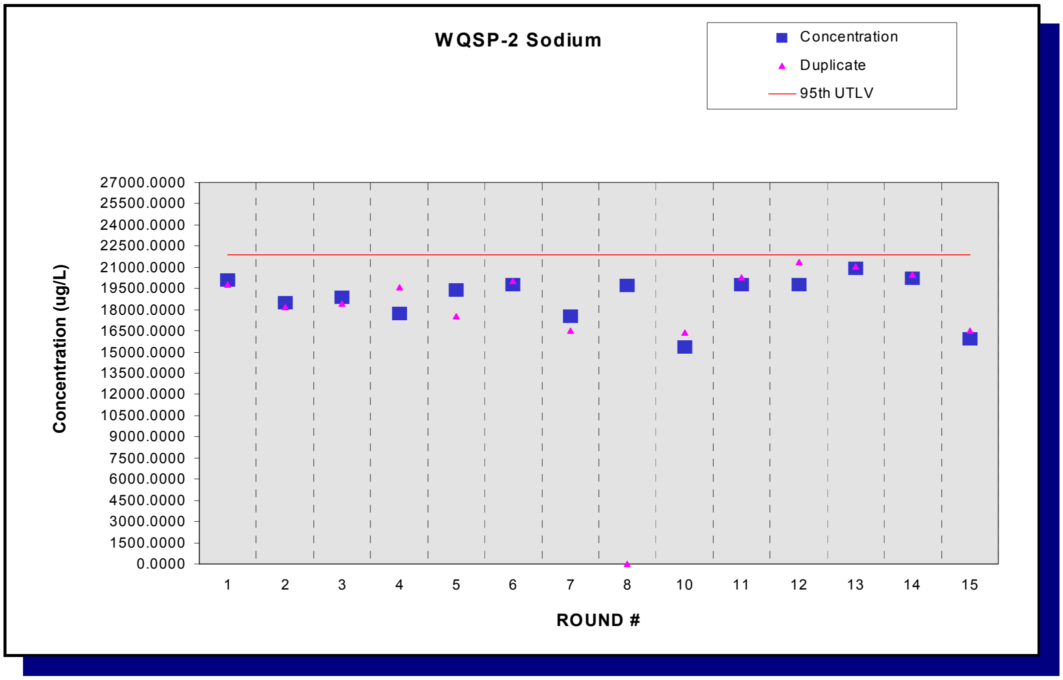

Figure F.22 - Time Trend Plot for Sodium at WQSP-2

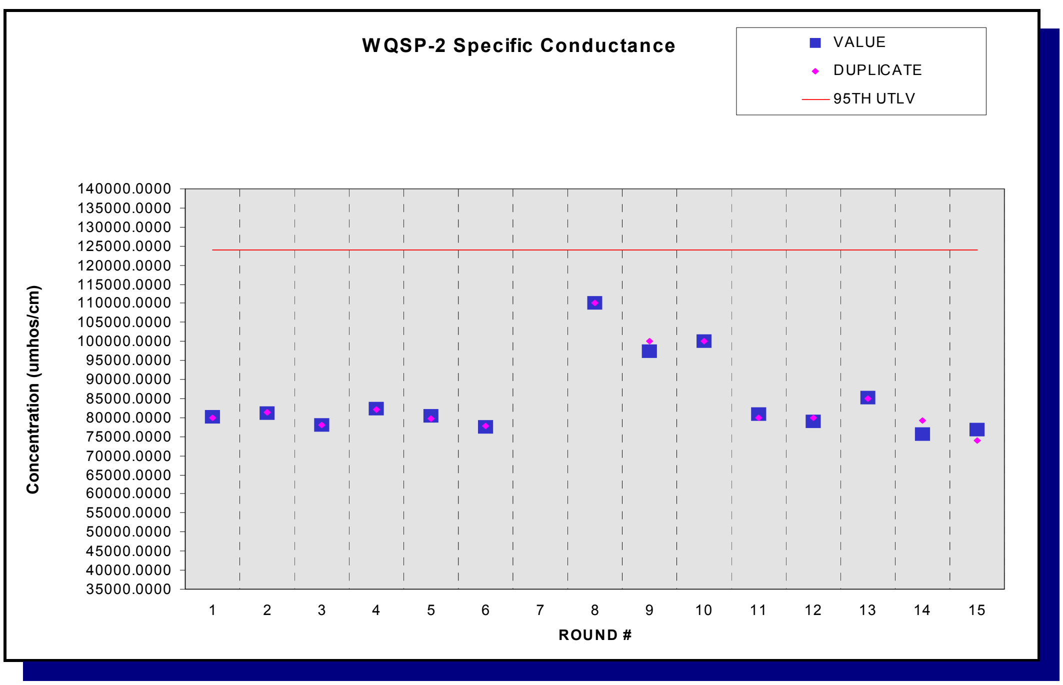

Figure F.23 - Time Trend Plot for Specific Conductance at WQSP-2

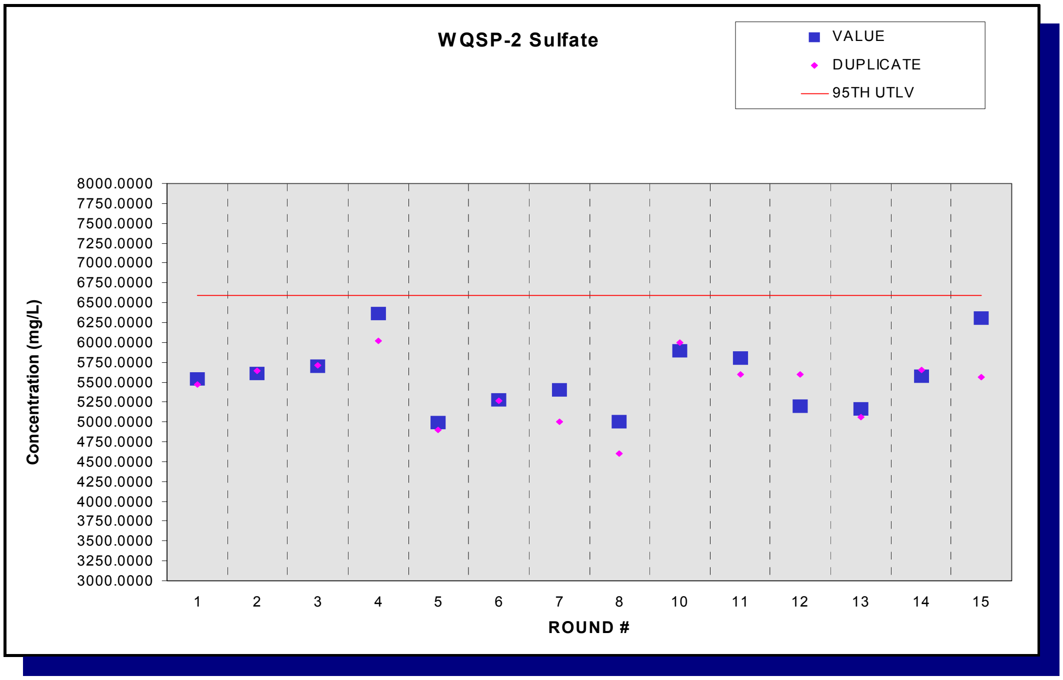

Figure F.24 - Time Trend Plot for Sulfate at WQSP-2

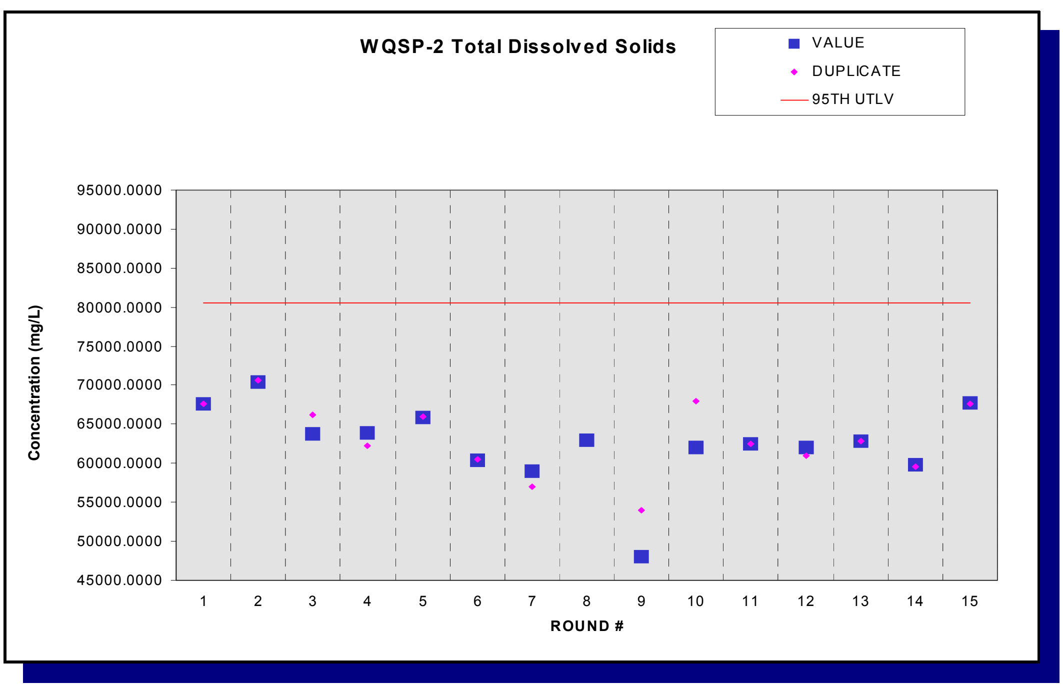

Figure F.25 - Time Trend Plot for Total Dissolved Solids at WQSP-2

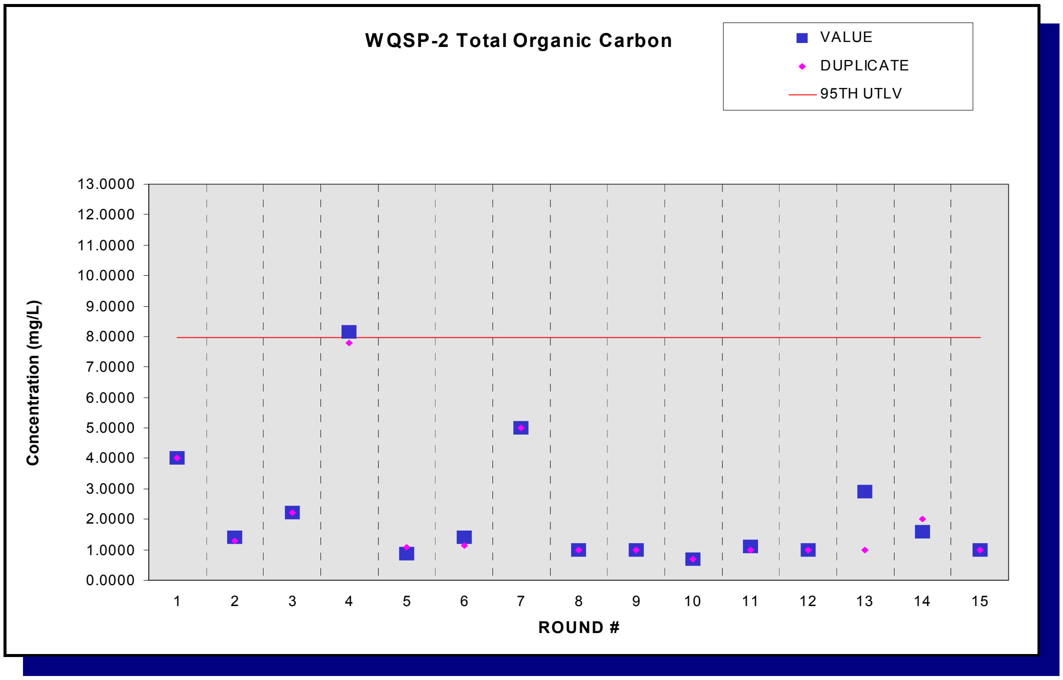

Figure F.26 - Time Trend Plot for Total Organic Carbon at WQSP-2

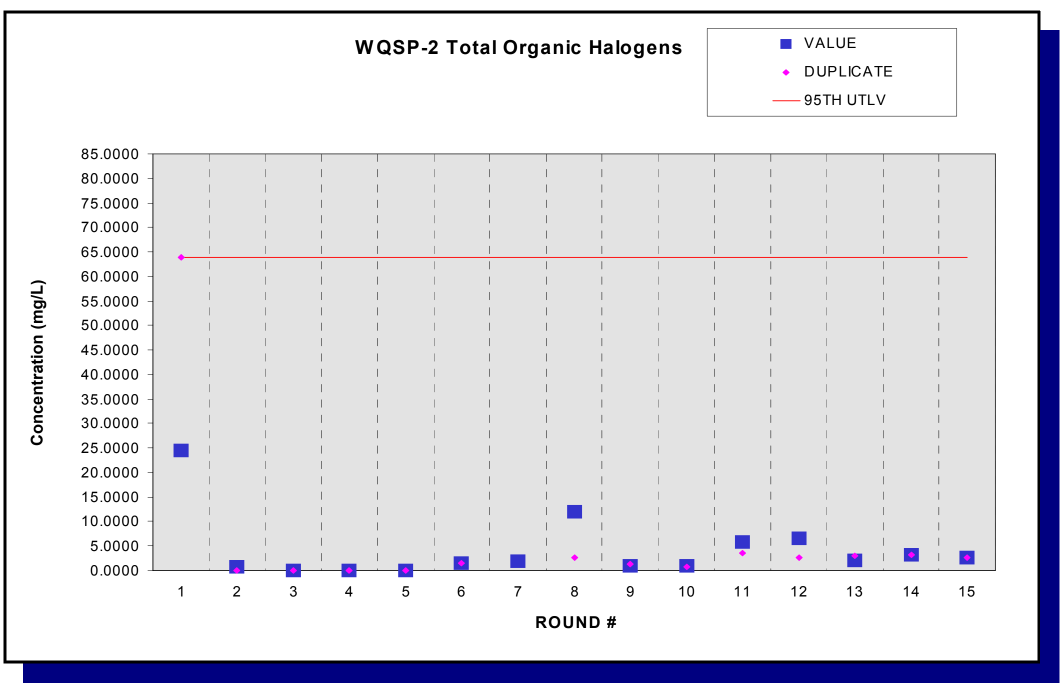

Figure F.27 - Time Trend Plot for Total Organic Halogens at WQSP-2

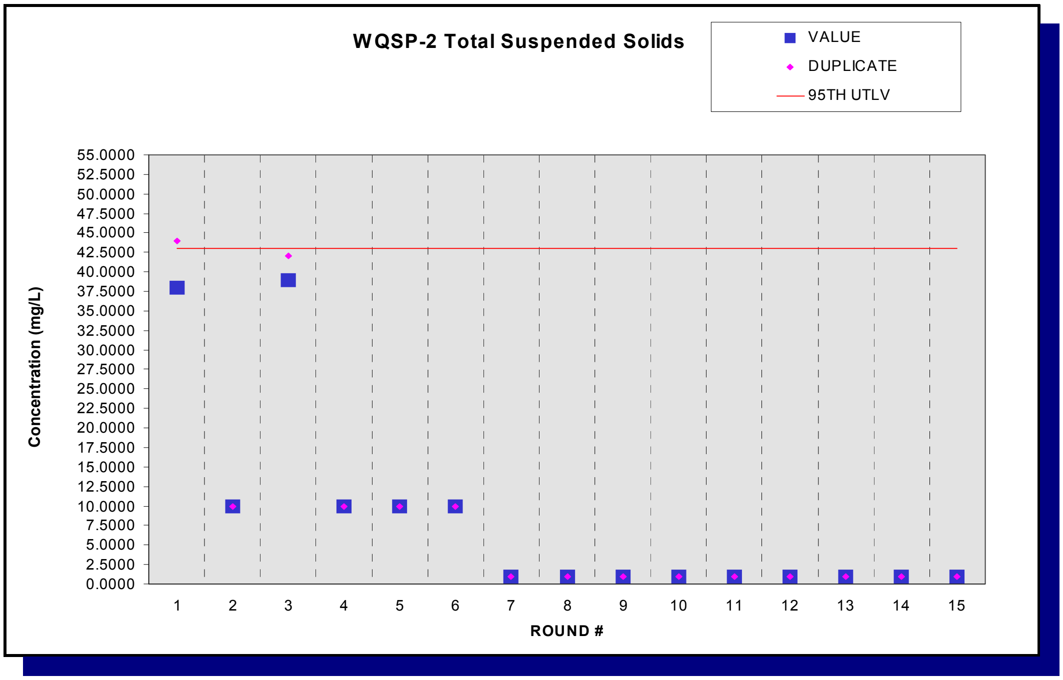

Figure F.28 - Time Trend Plot for Total Suspended Solids at WQSP-2

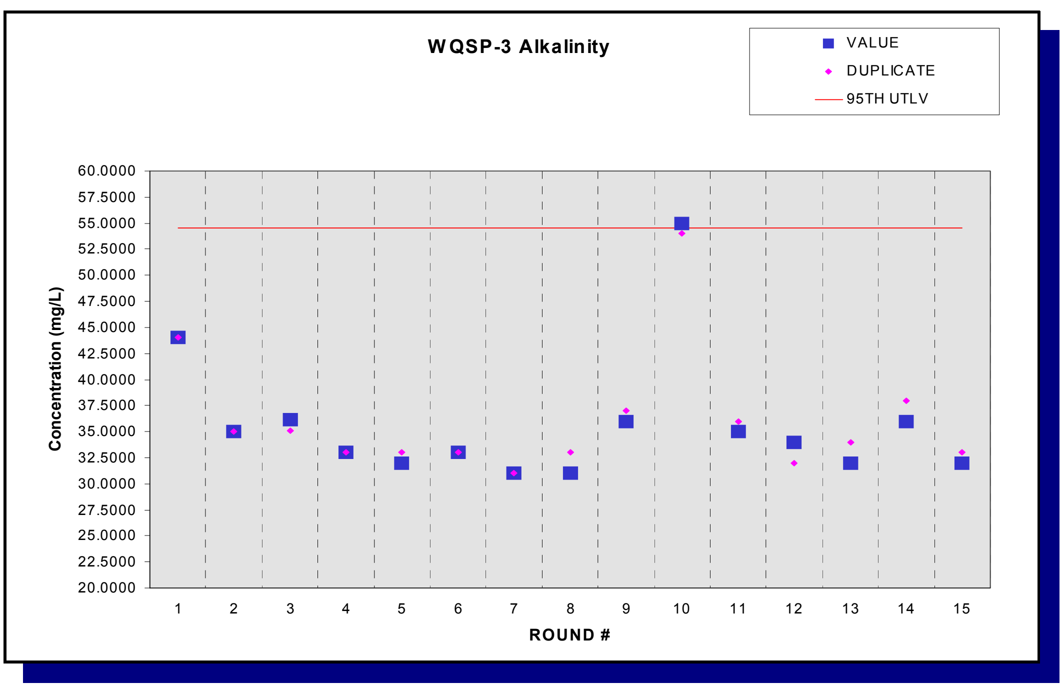

Figure F.29 - Time Trend Plot for Alkalinity at WQSP-3

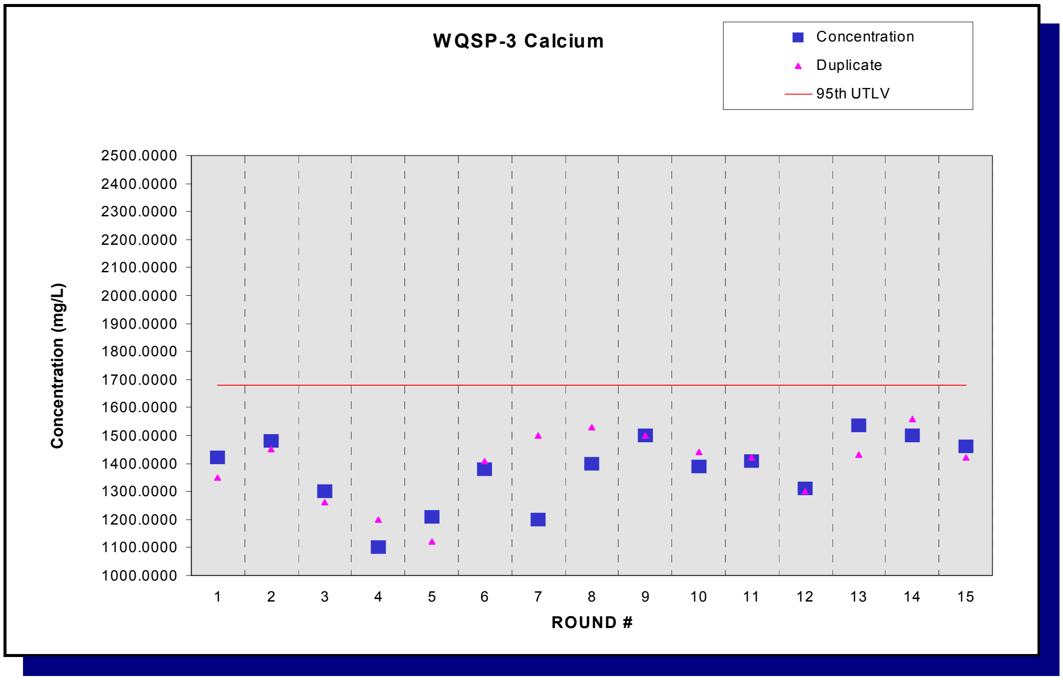

Figure F.30 - Time Trend Plot for Calcium at WQSP-3

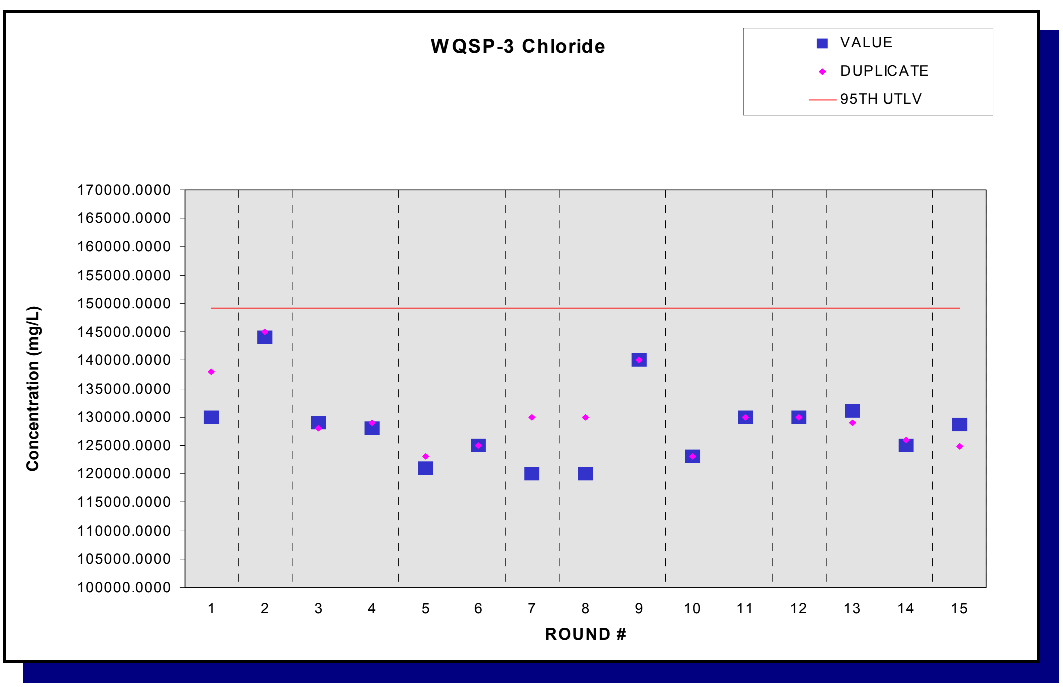

Figure F.31 - Time Trend Plot for Chloride at WQSP-3

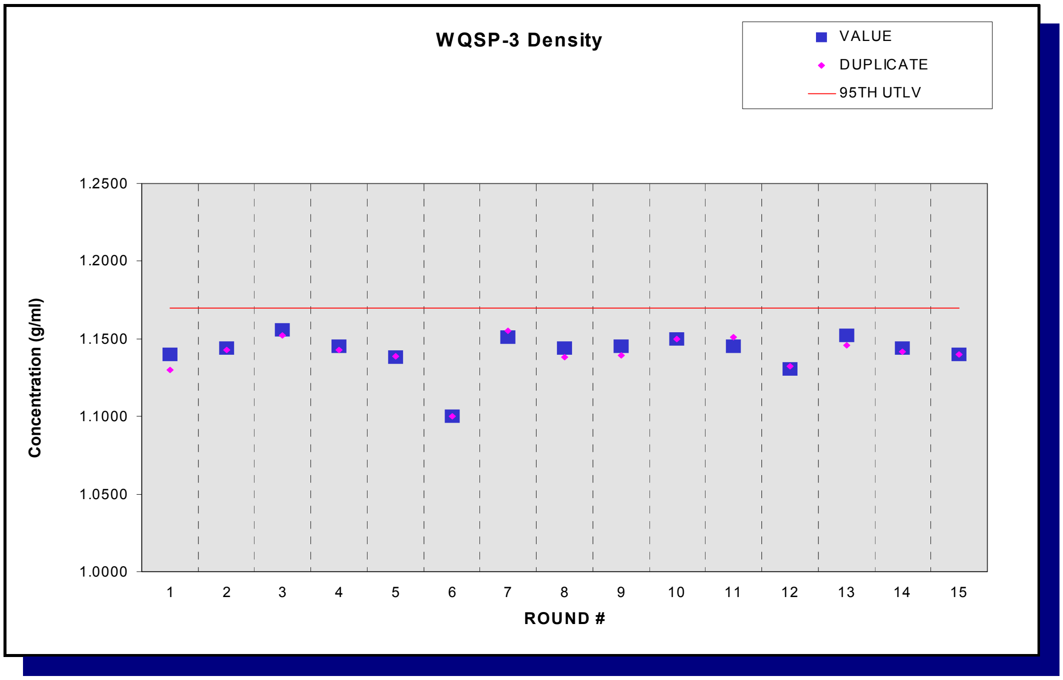

Figure F.32 - Time Trend Plot for Density at WQSP-3

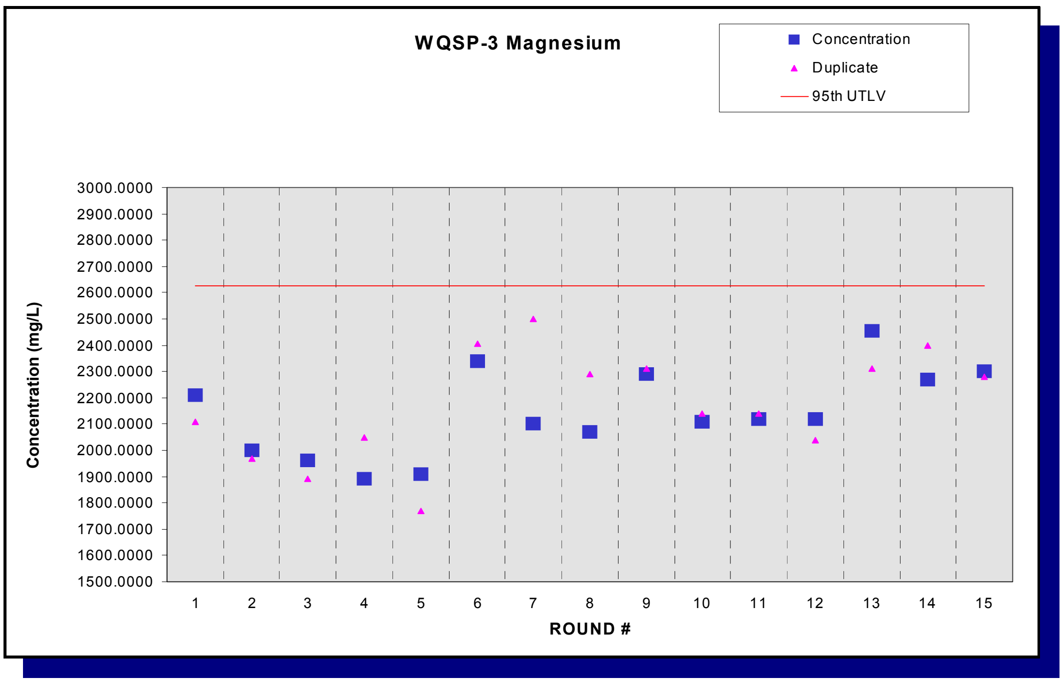

Figure F.33 - Time Trend Plot for Magnesium at WQSP-3

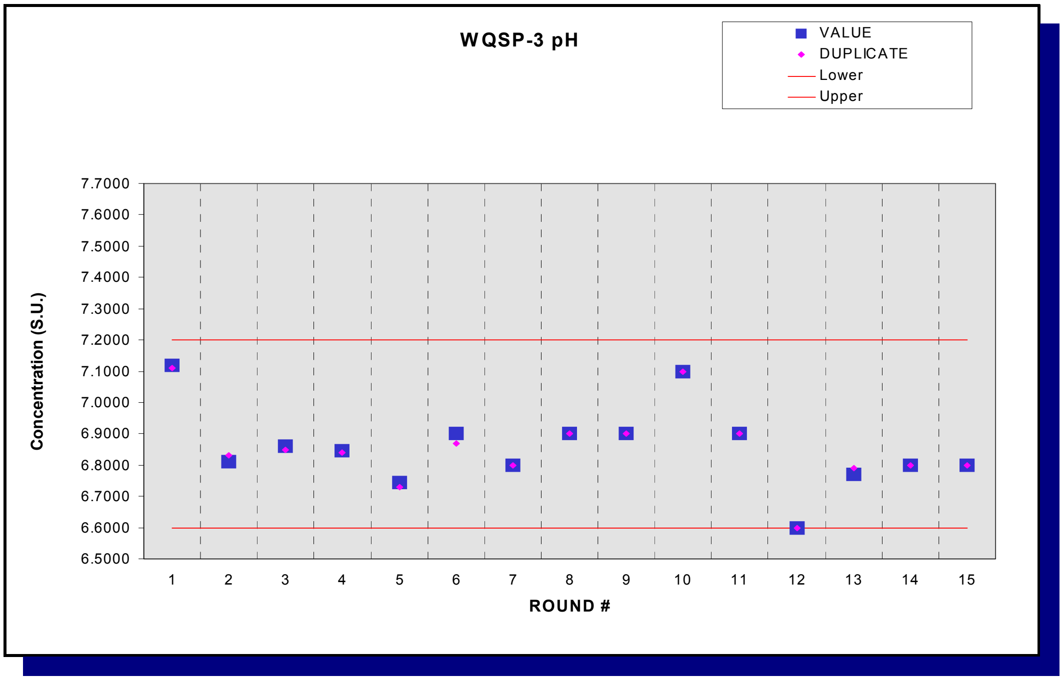

Figure F.34 - Time Trend Plot for pH at WQSP-3

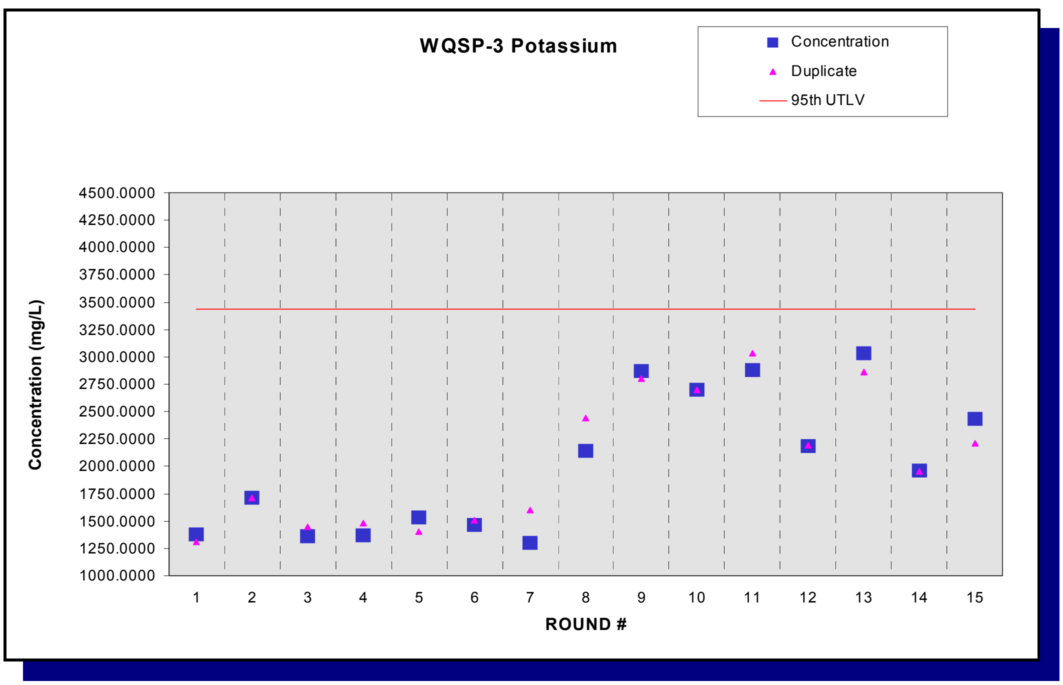

Figure F.35 - Time Trend Plot for Potassium at WQSP-3

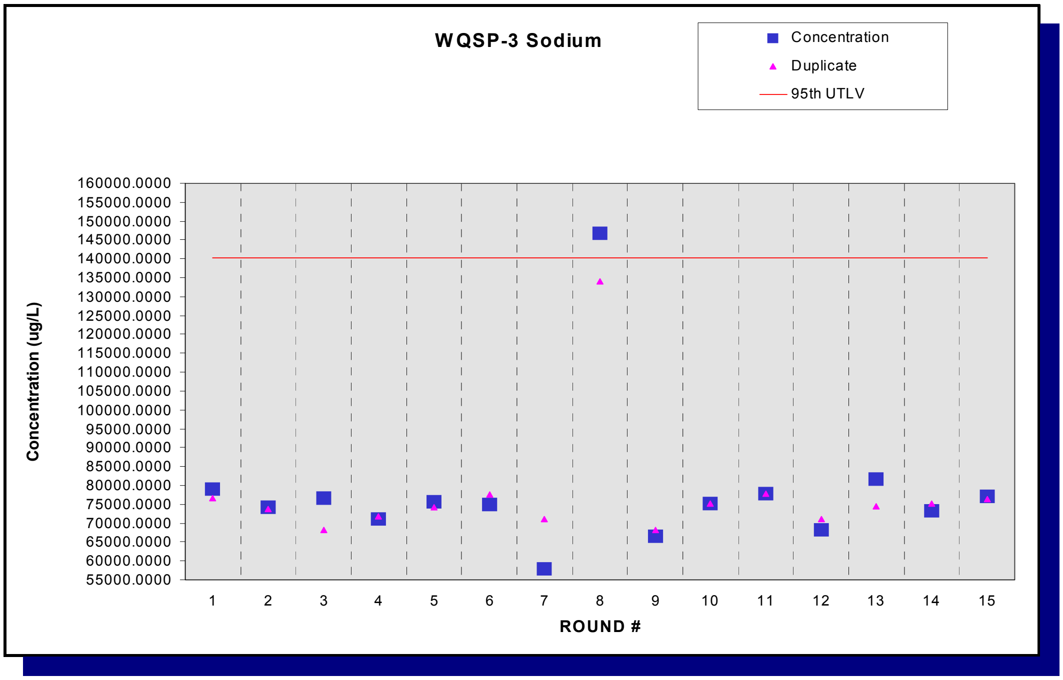

Figure F.36 - Time Trend Plot for Sodium at WQSP-3

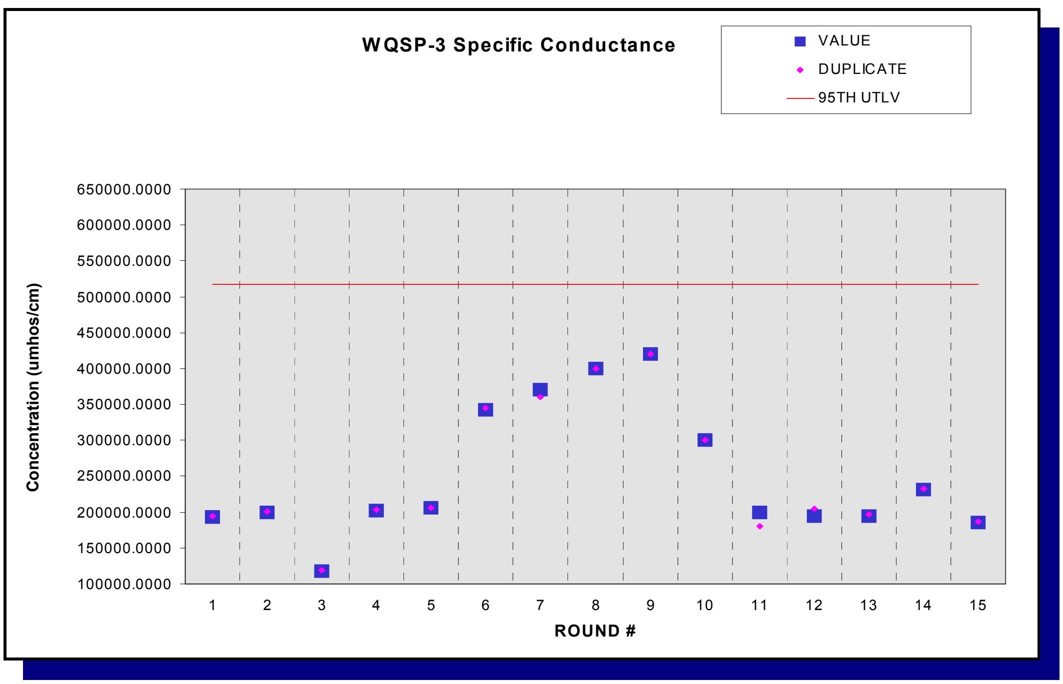

Figure F.37 - Time Trend Plot for Specific Conductance at WQSP-3

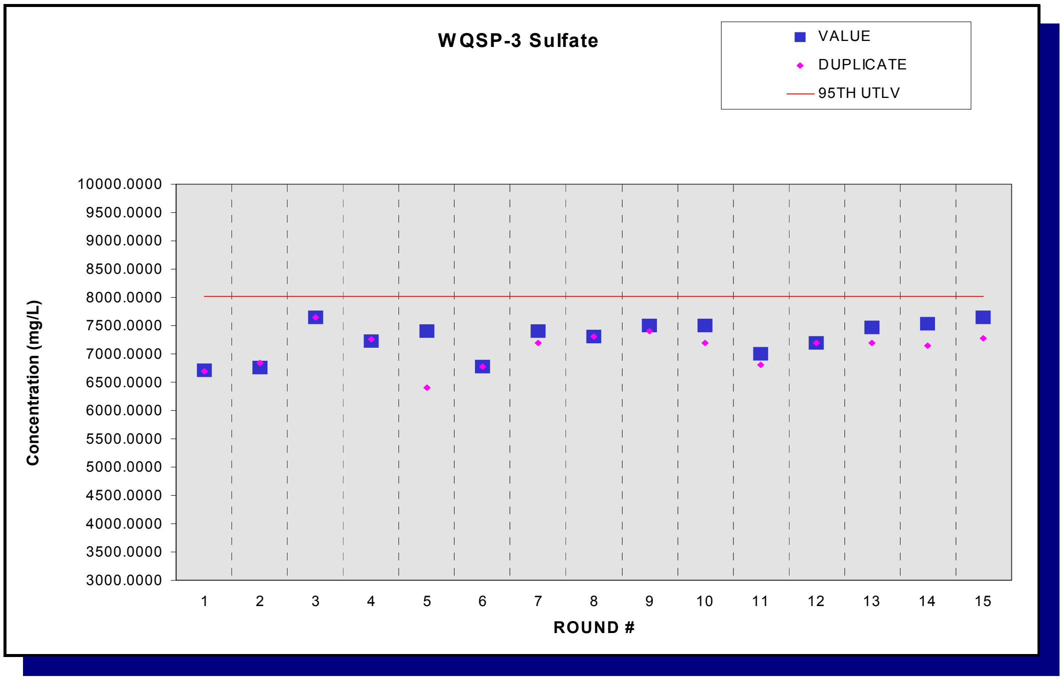

Figure F.38 - Time Trend Plot for Sulfate at WQSP-3

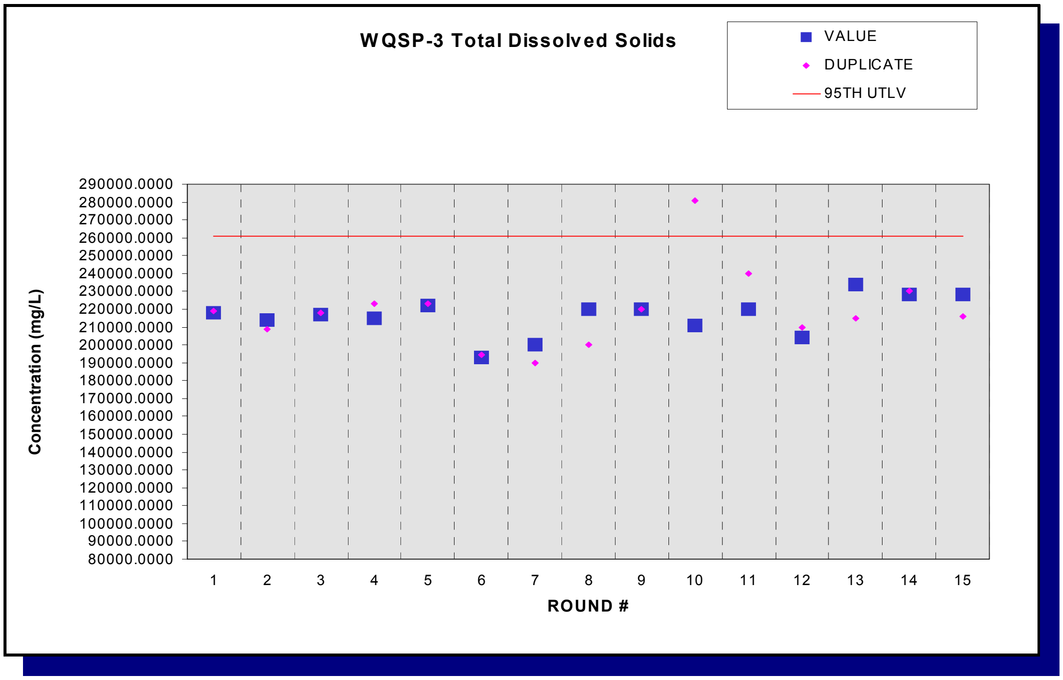

Figure F.39 - Time Trend Plot for Total Dissolved Solids at WQSP-3

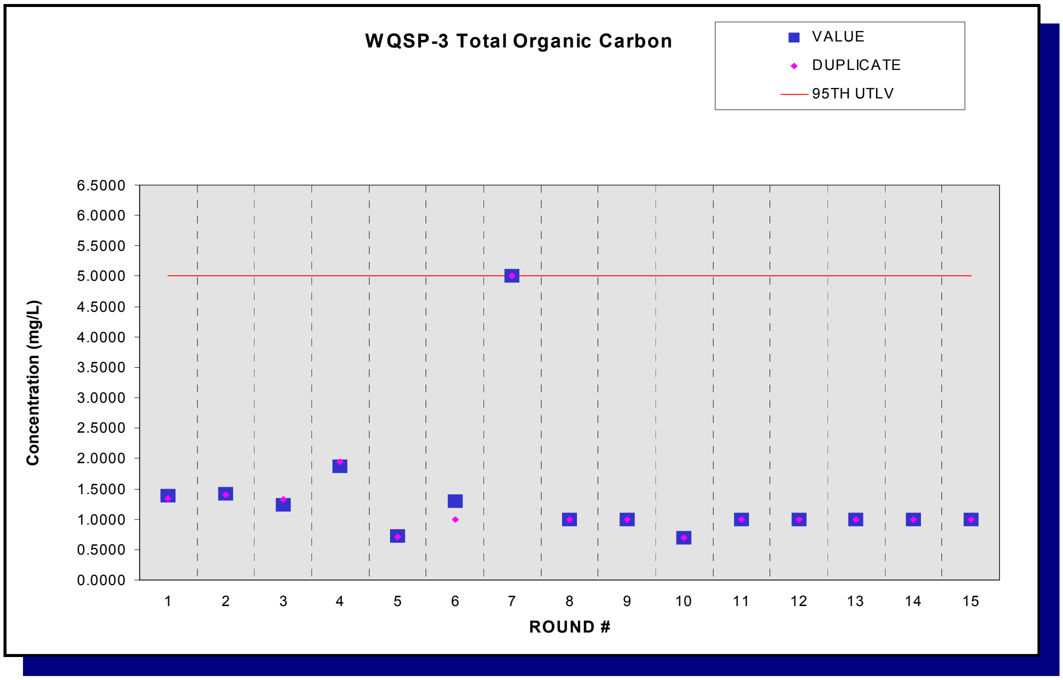

Figure F.40 - Time Trend Plot for Total Organic Carbon at WQSP-3

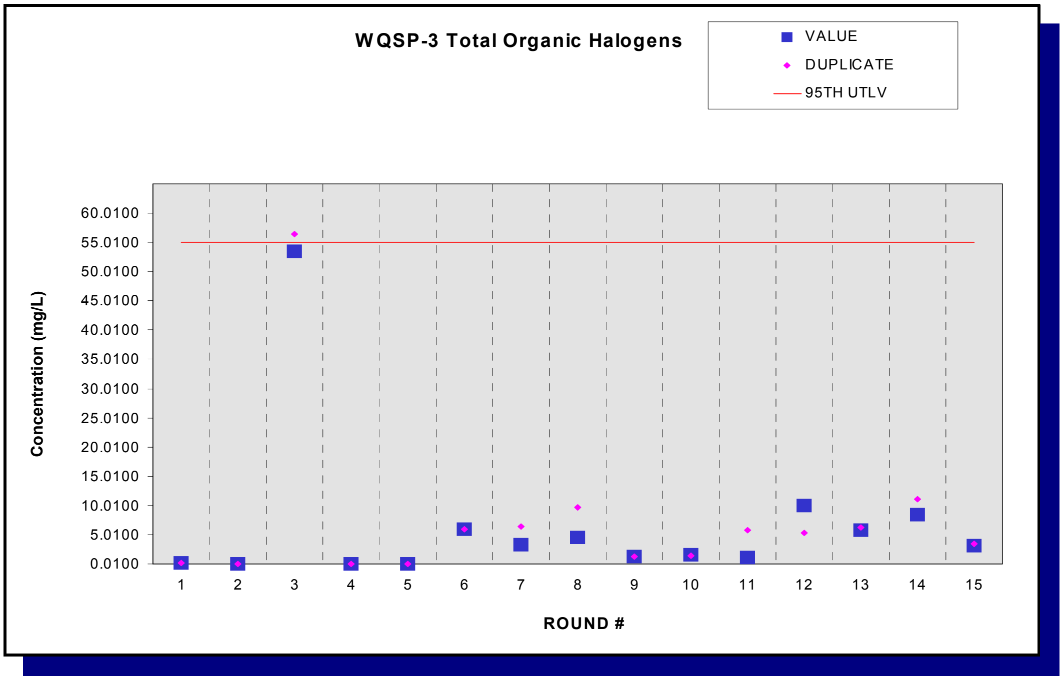

Figure F.41 - Time Trend Plot for Total Organic Halogens at WQSP-3

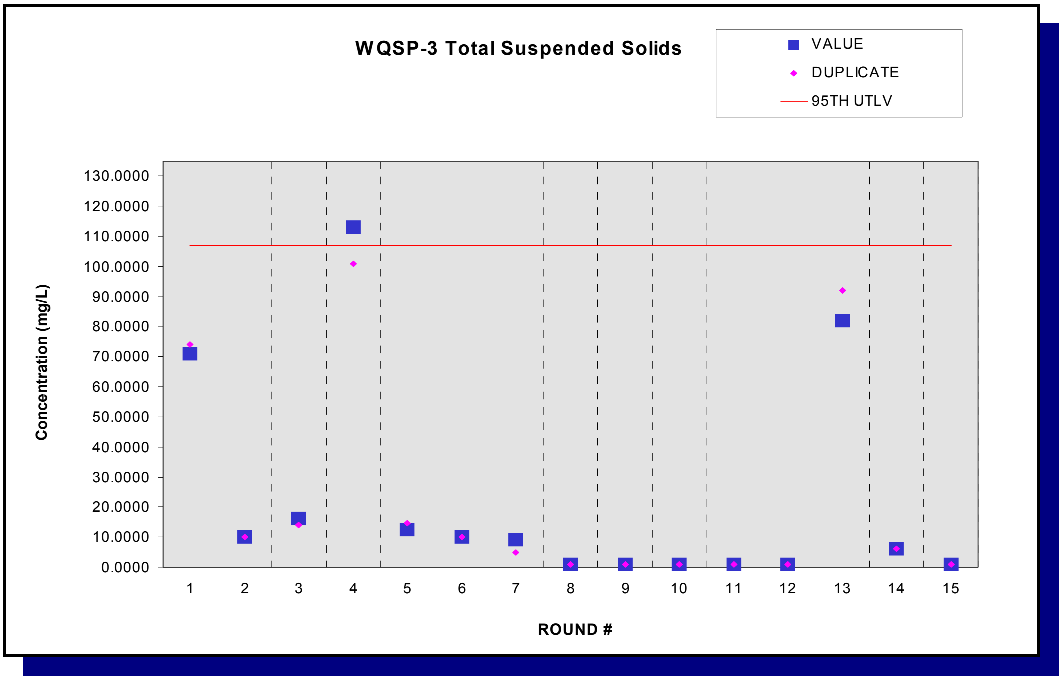

Figure F.42 - Time Trend Plot for Total Suspended Solids at WQSP-3

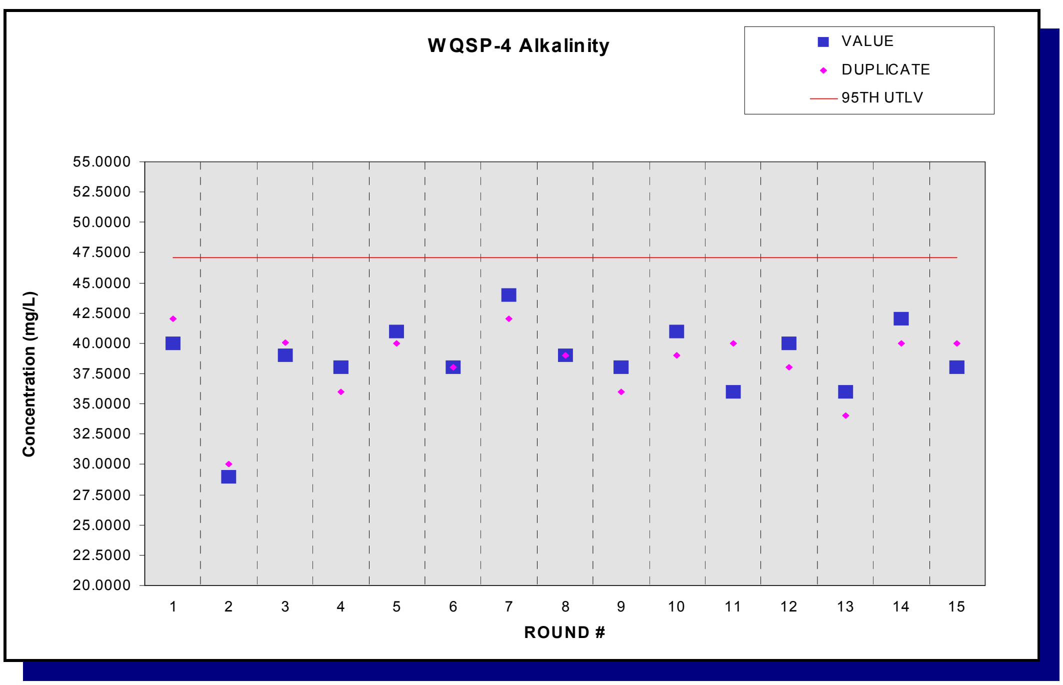

Figure F.43 - Time Trend Plot for Alkalinity at WQSP-4

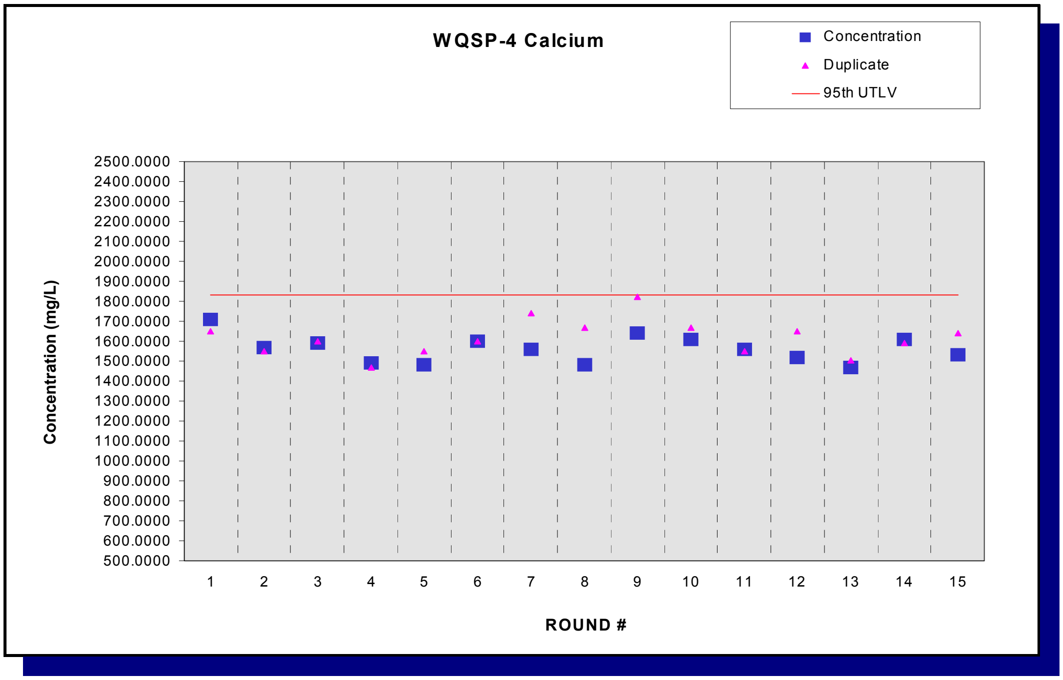

Figure F.44 - Time Trend Plot for Calcium at WQSP-4

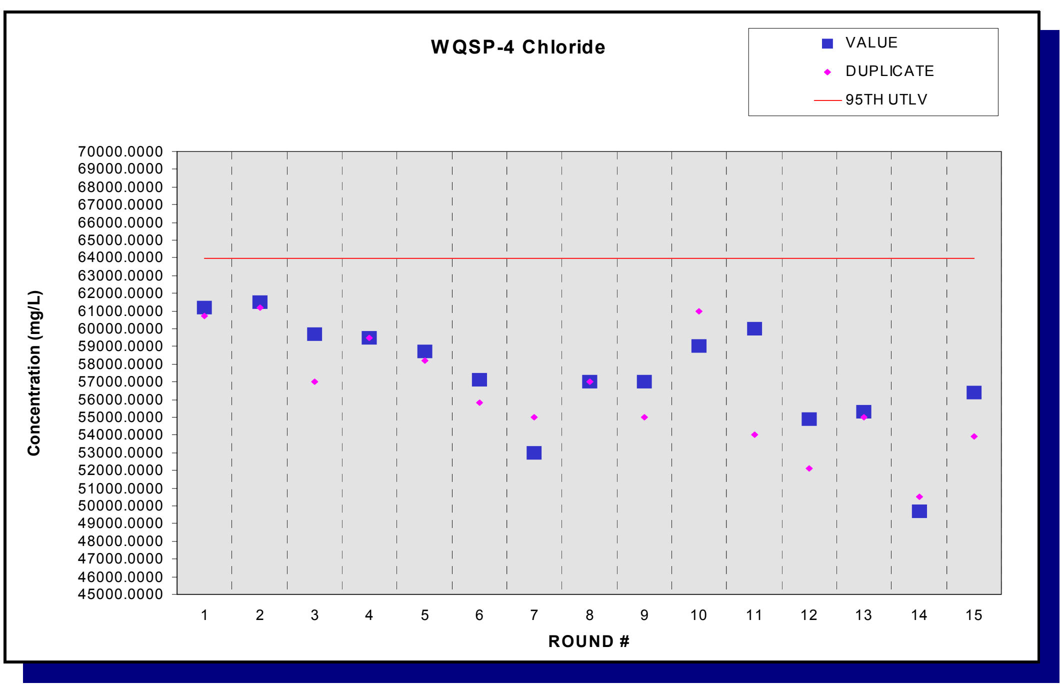

Figure F.45 - Time Trend Plot for Chloride at WQSP-4

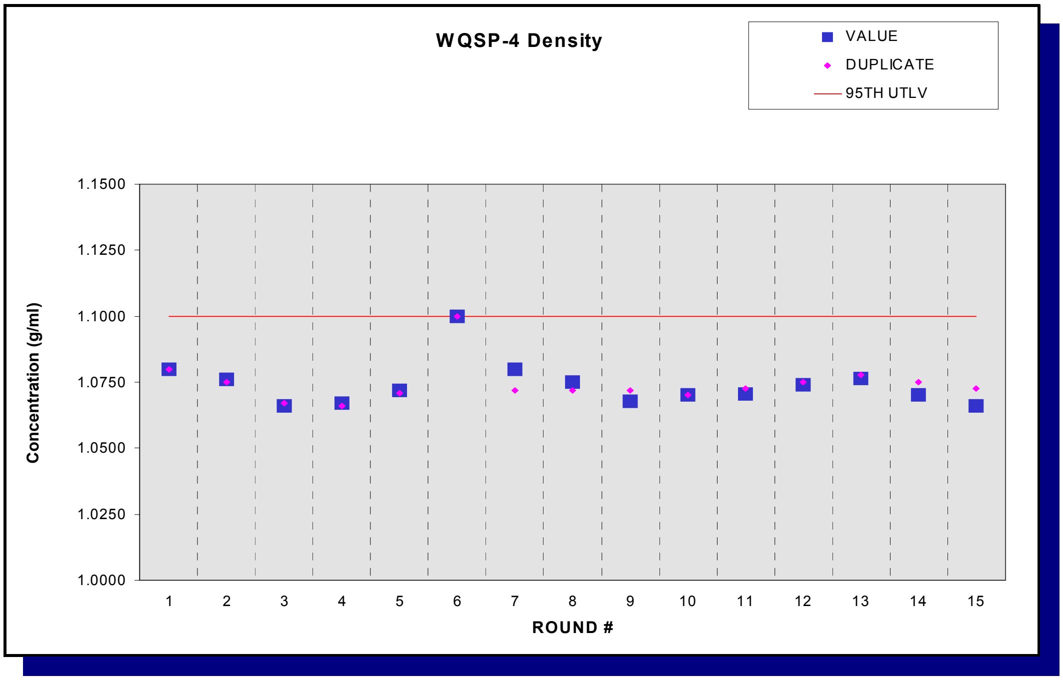

Figure F.46 - Time Trend Plot for Density at WQSP-4

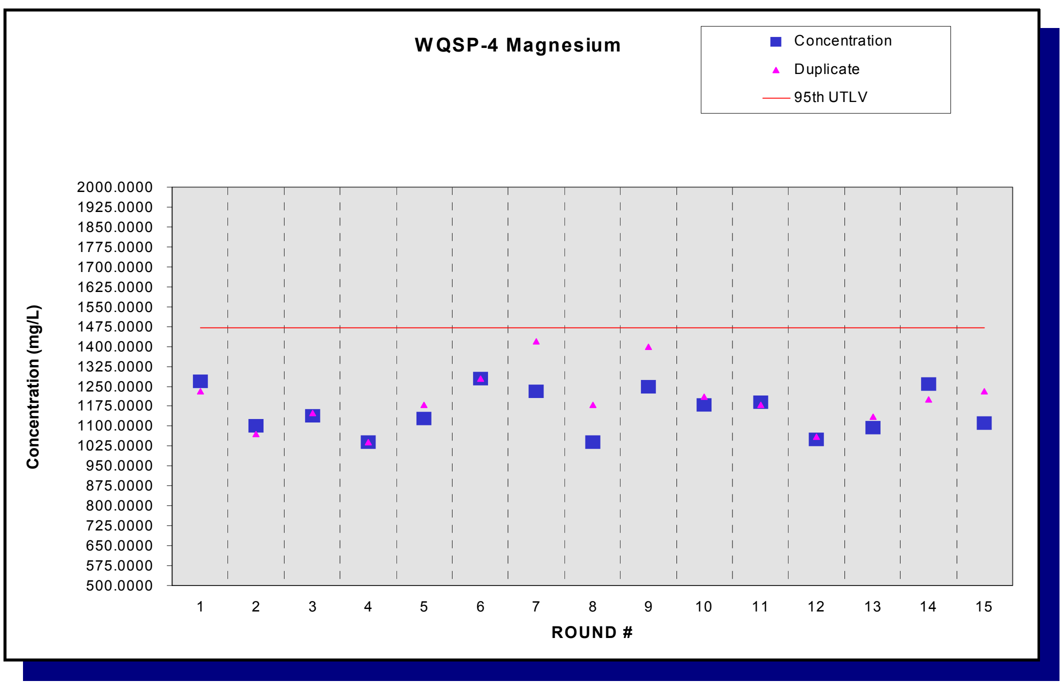

Figure F.47 - Time Trend Plot for Magnesium at WQSP-4

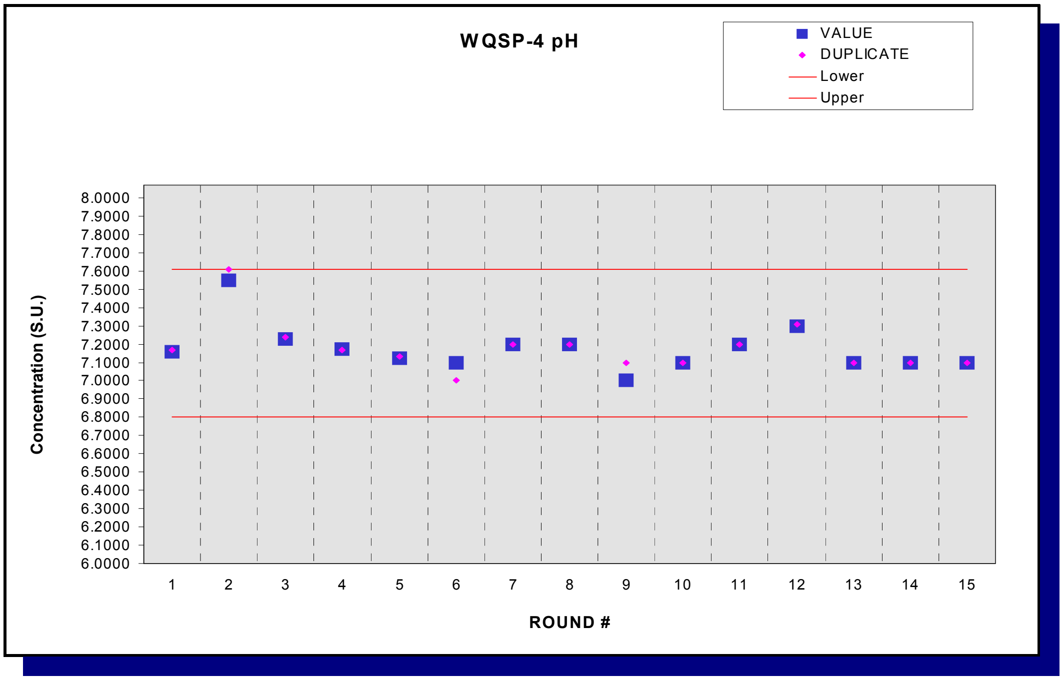

Figure F.48 - Time Trend Plot for pH at WQSP-4

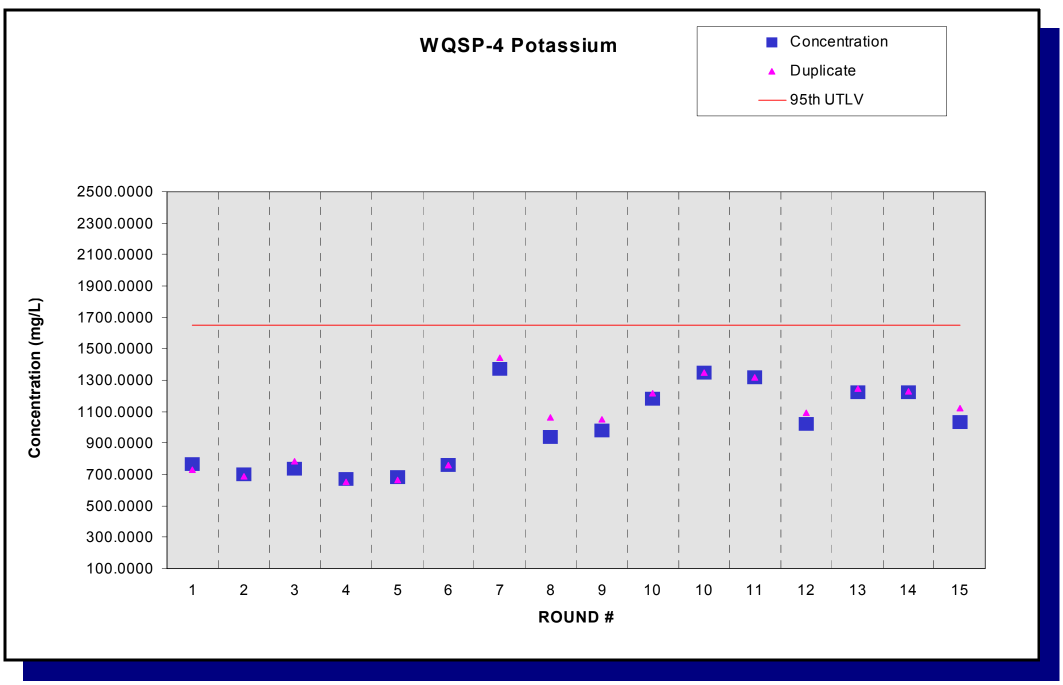

Figure F.49 - Time Trend Plot for Potassium at WQSP-4

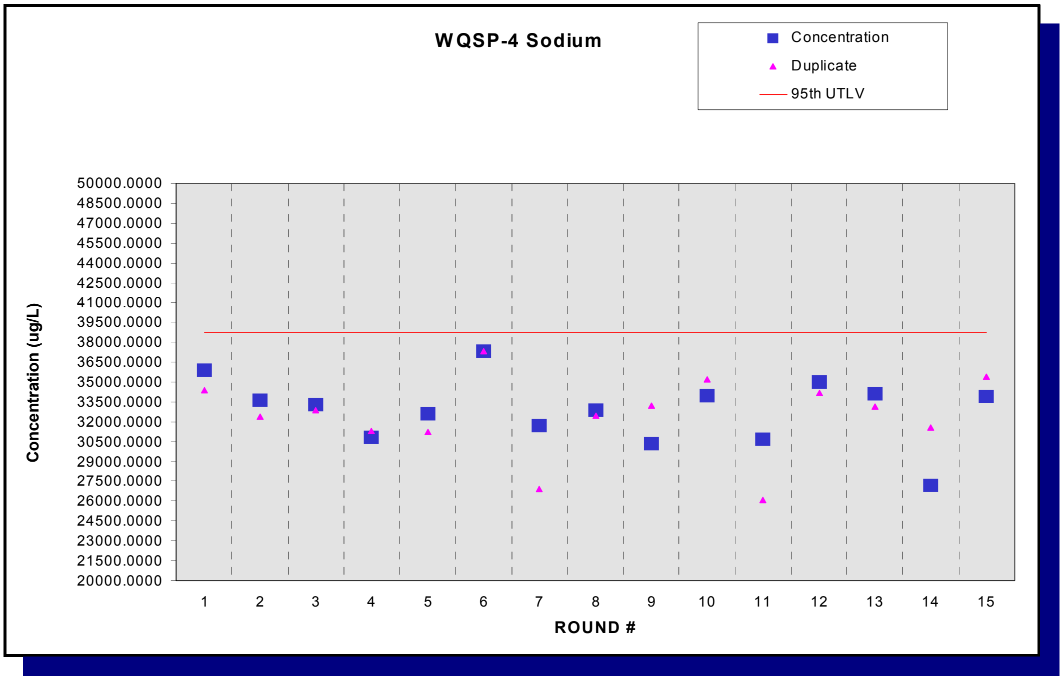

Figure F.50 - Time Trend Plot for Sodium at WQSP-4

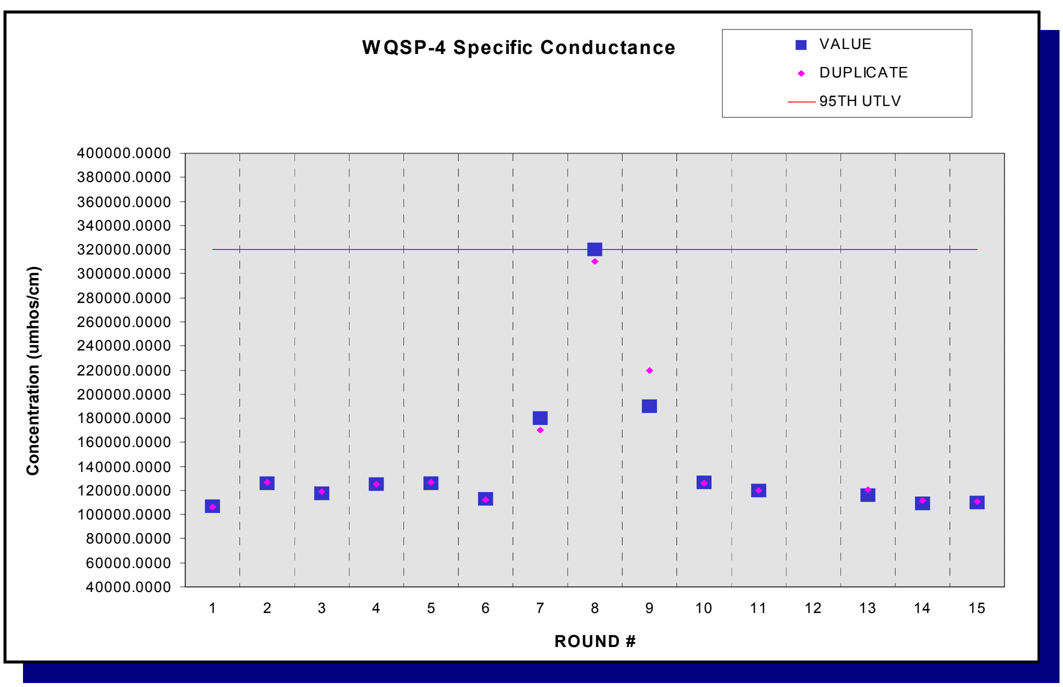

Figure F.51 - Time Trend Plot for Specific Conductance at WQSP-4

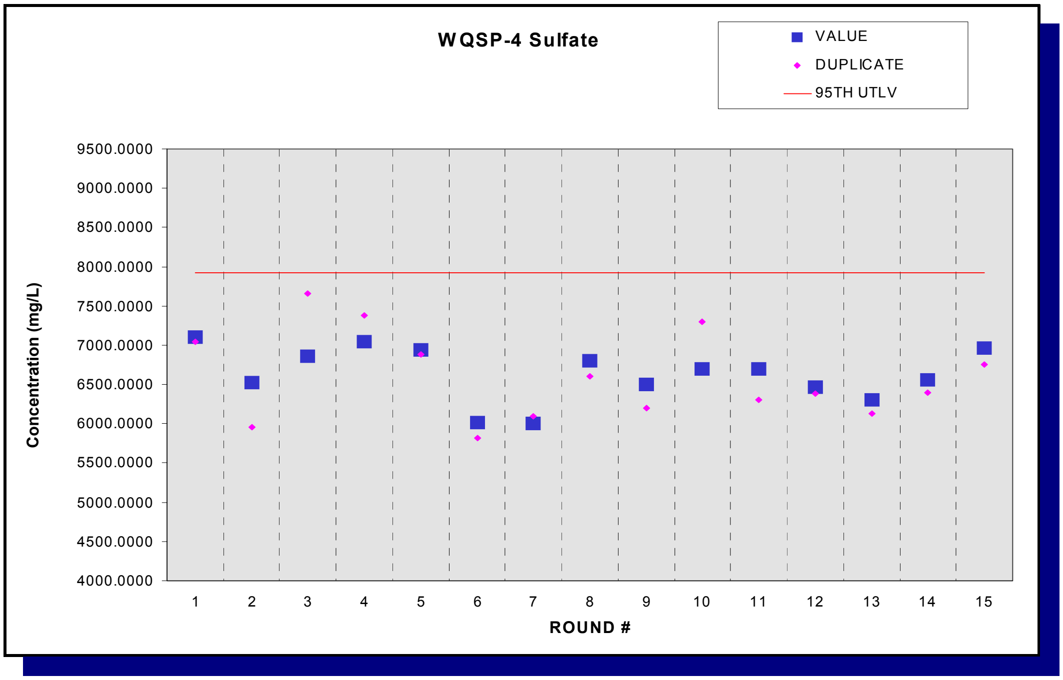

Figure F.52 - Time Trend Plot for Sulfate at WQSP-4

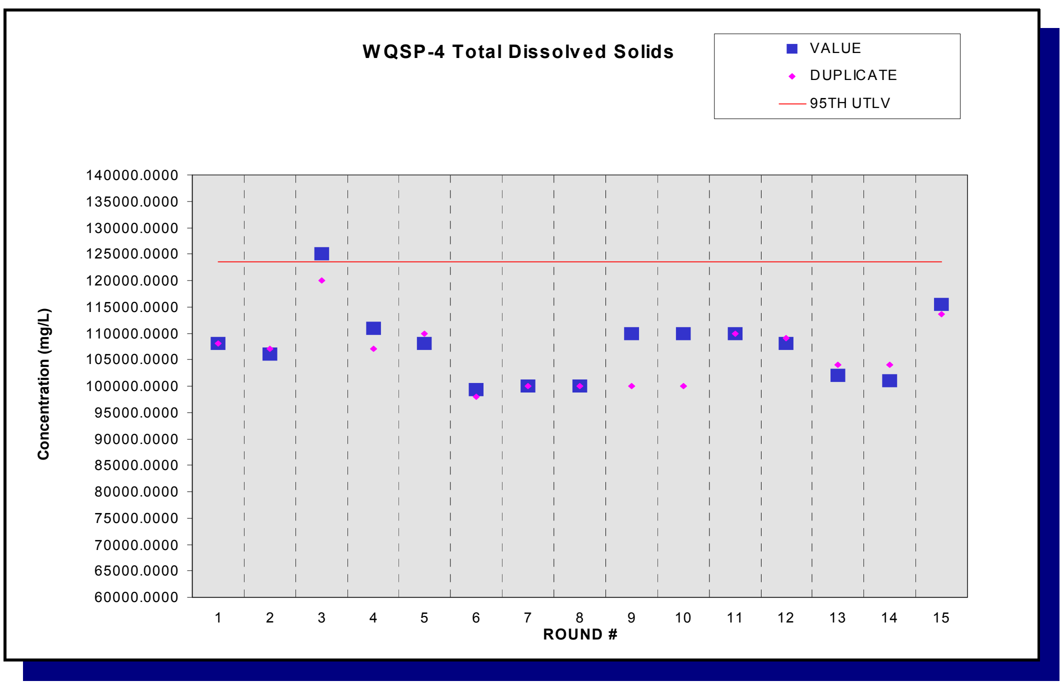

Figure F.53 - Time Trend Plot for Total Dissolved Solids at WQSP-4

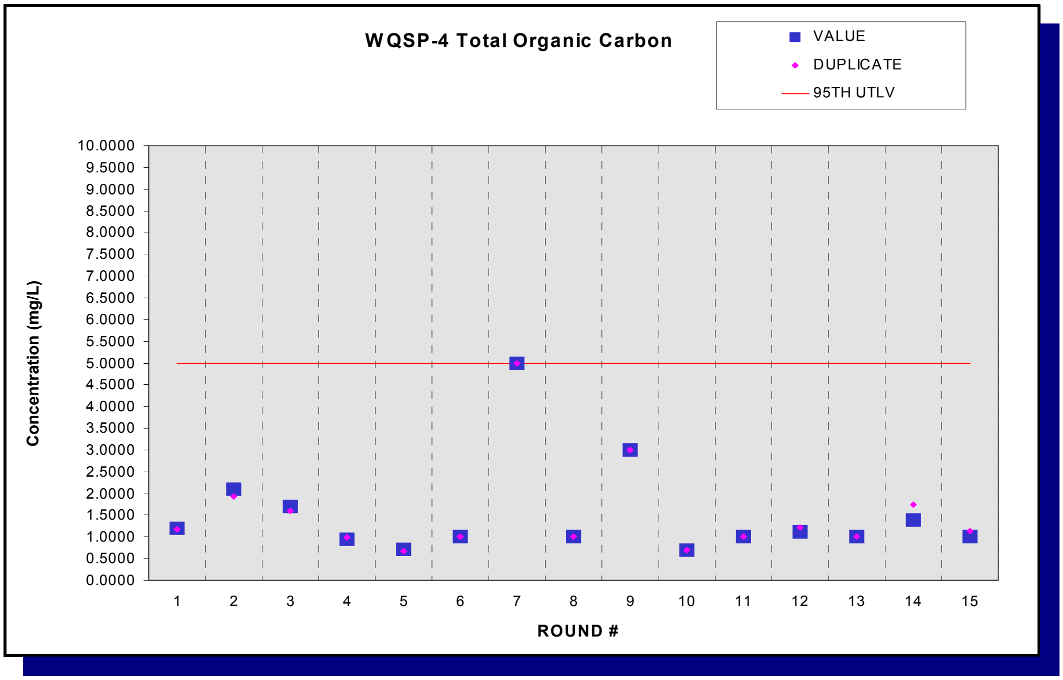

Figure F.54 - Time Trend Plot for Total Organic Carbon at WQSP-4

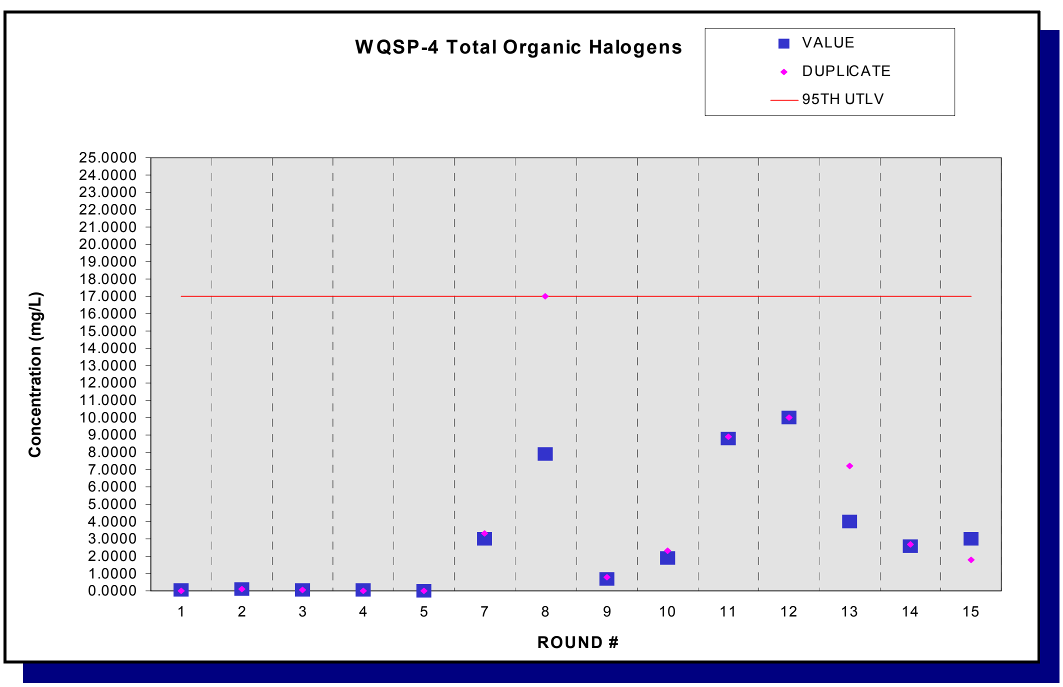

Figure F.55 - Time Trend Plot for Total Organic Halogens at WQSP-4

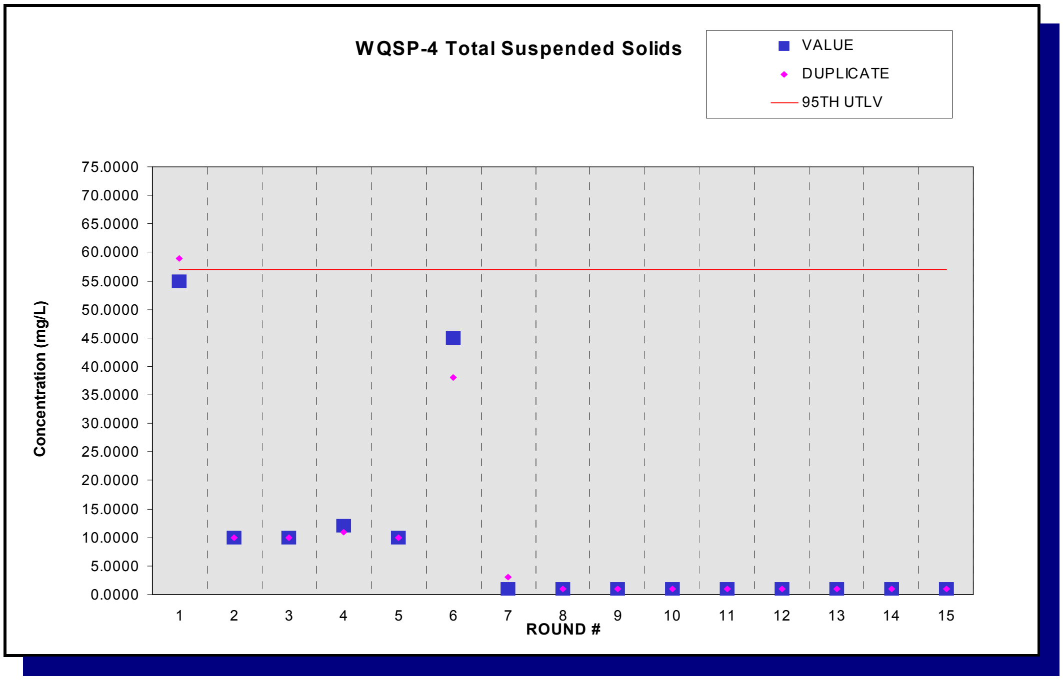

Figure F.56 - Time Trend Plot for Total Suspended Solids at WQSP-4

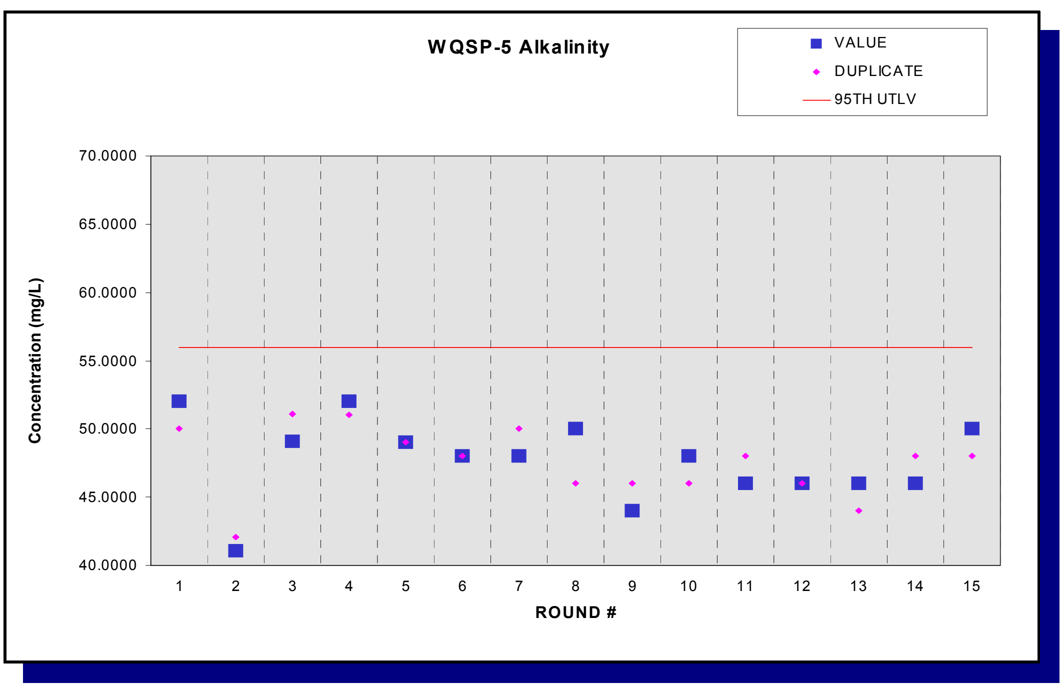

Figure F.57 - Time Trend Plot for Alkalinity at WQSP-5

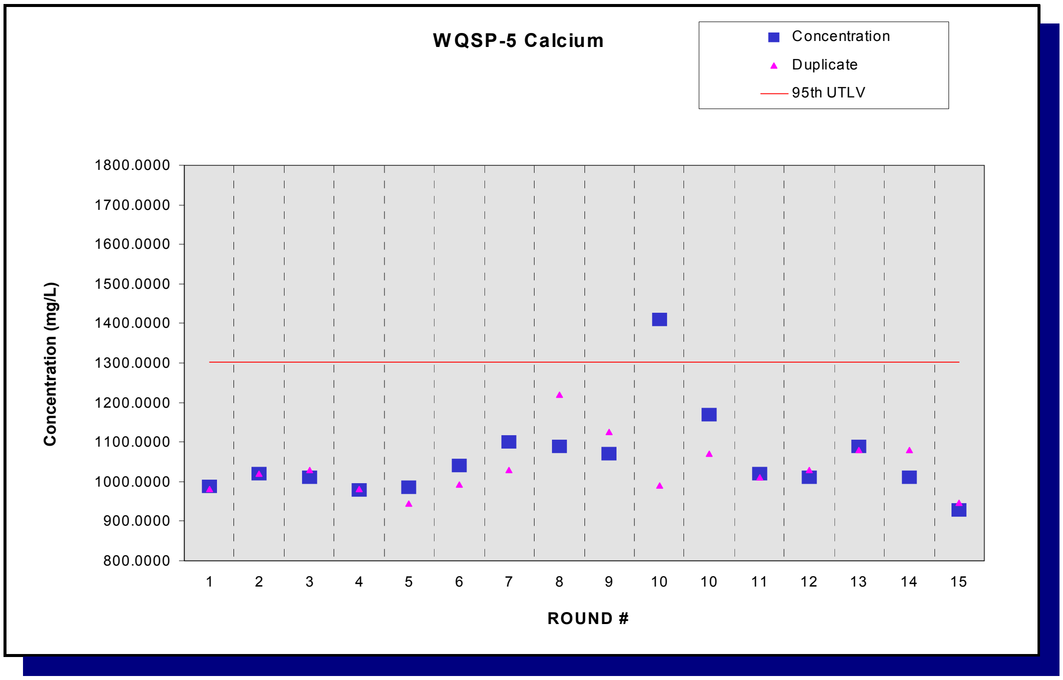

Figure F.58 - Time Trend Plot for Calcium at WQSP-5

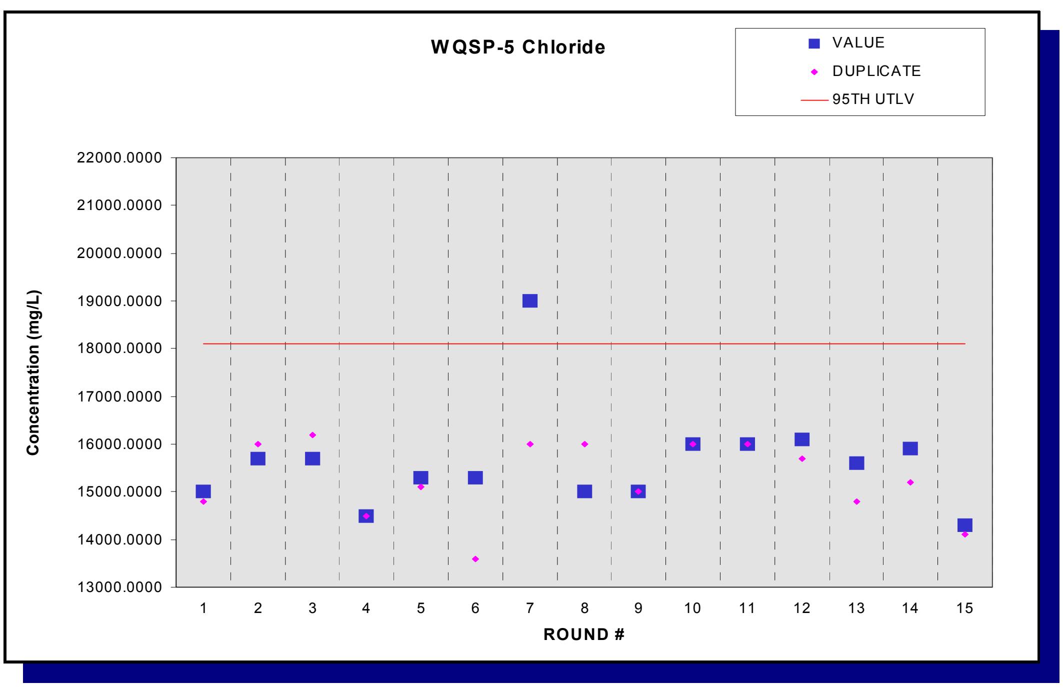

Figure F.59 - Time Trend Plot for Chloride at WQSP-5

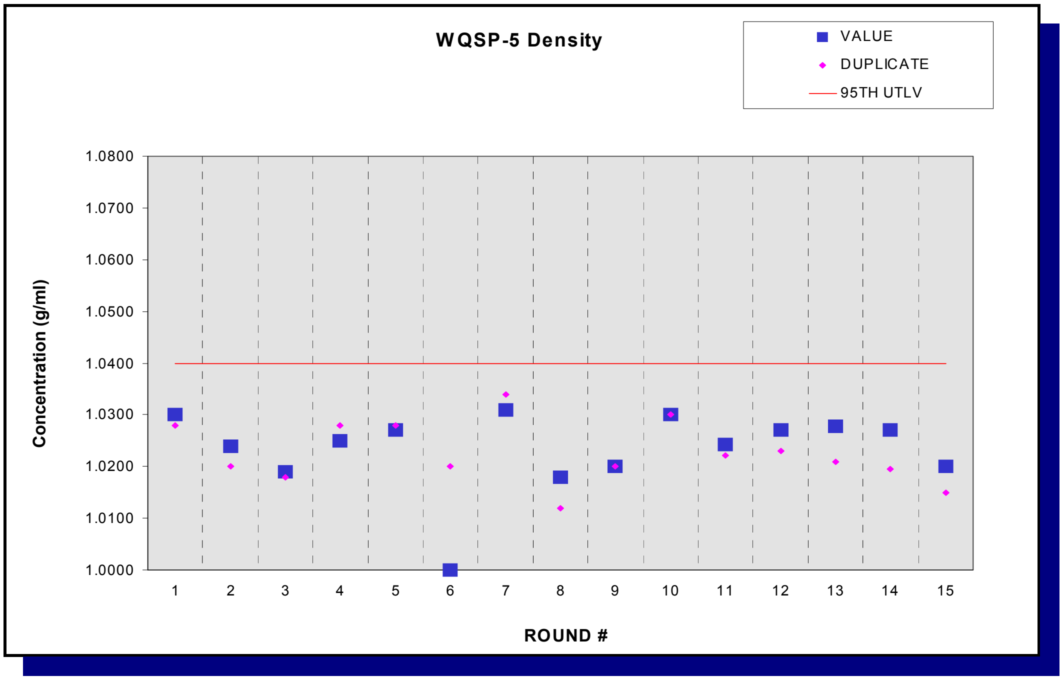

Figure F.60 - Time Trend Plot for Density at WQSP-5

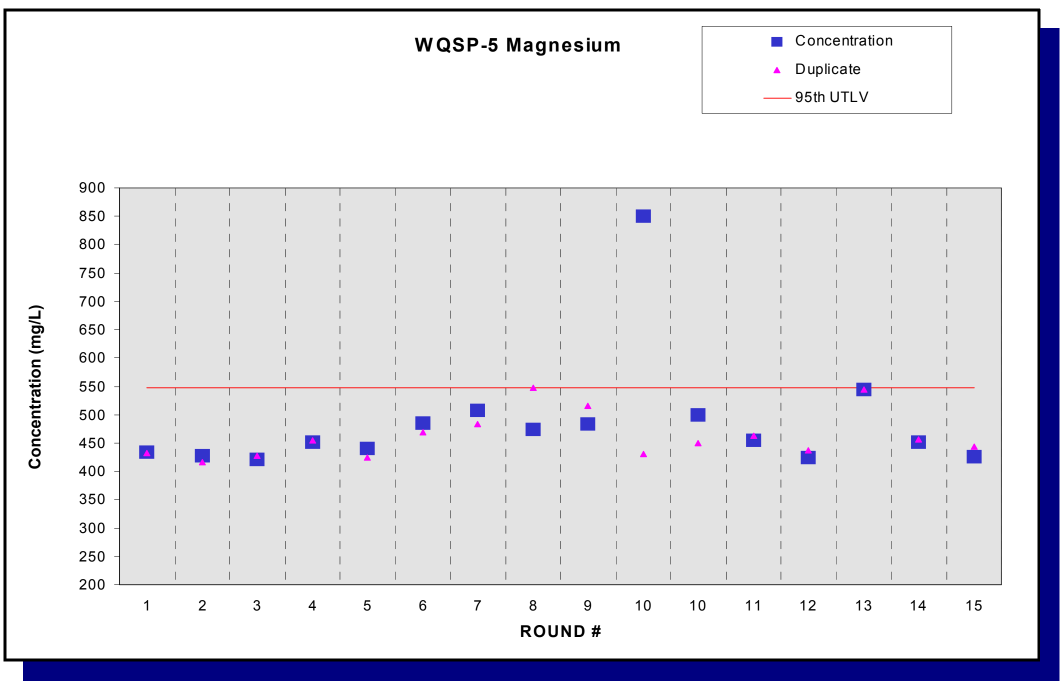

Figure F.61 - Time Trend Plot for Magnesium at WQSP-5

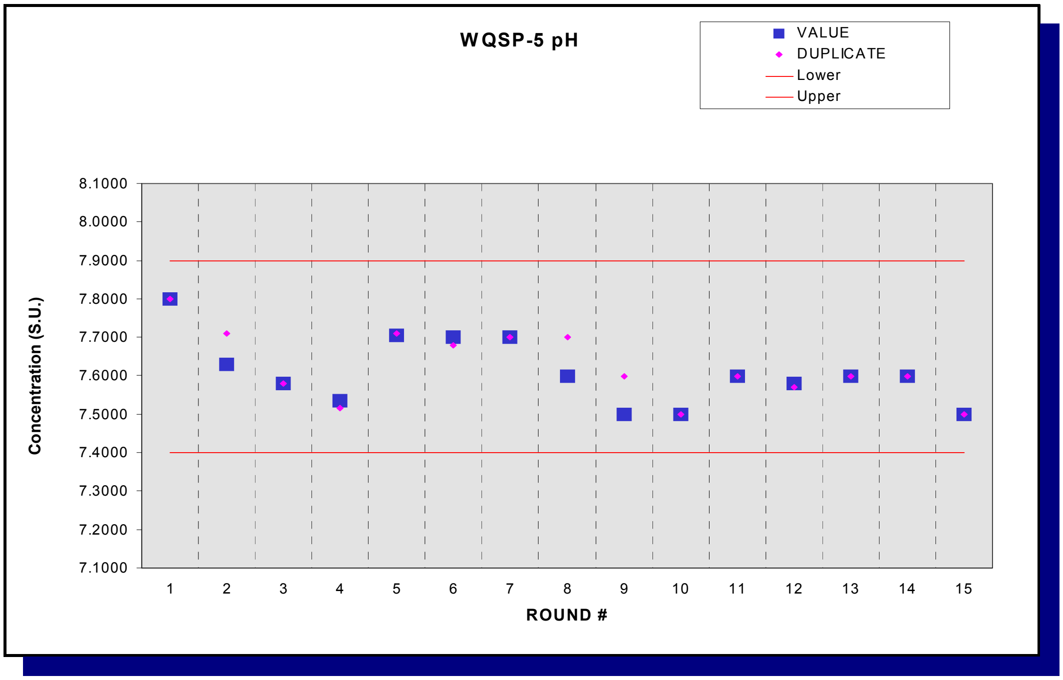

Figure F.62 - Time Trend Plot for pH at WQSP-5

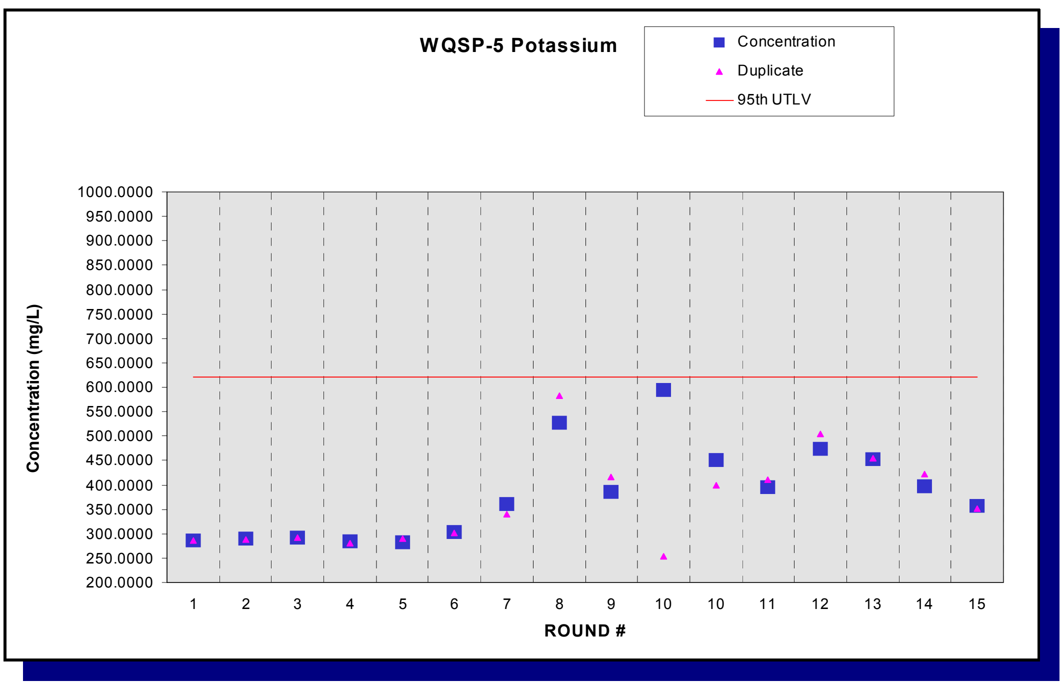

Figure F.63 - Time Trend Plot for Potassium at WQSP-5

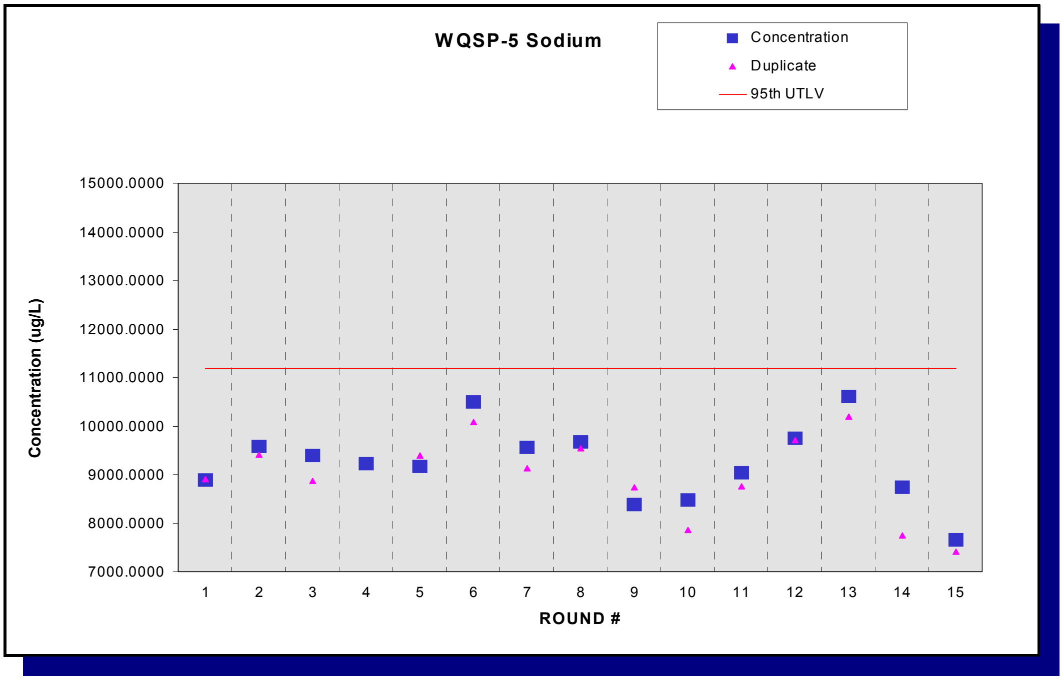

Figure F.64 - Time Trend Plot for Sodium at WQSP-5

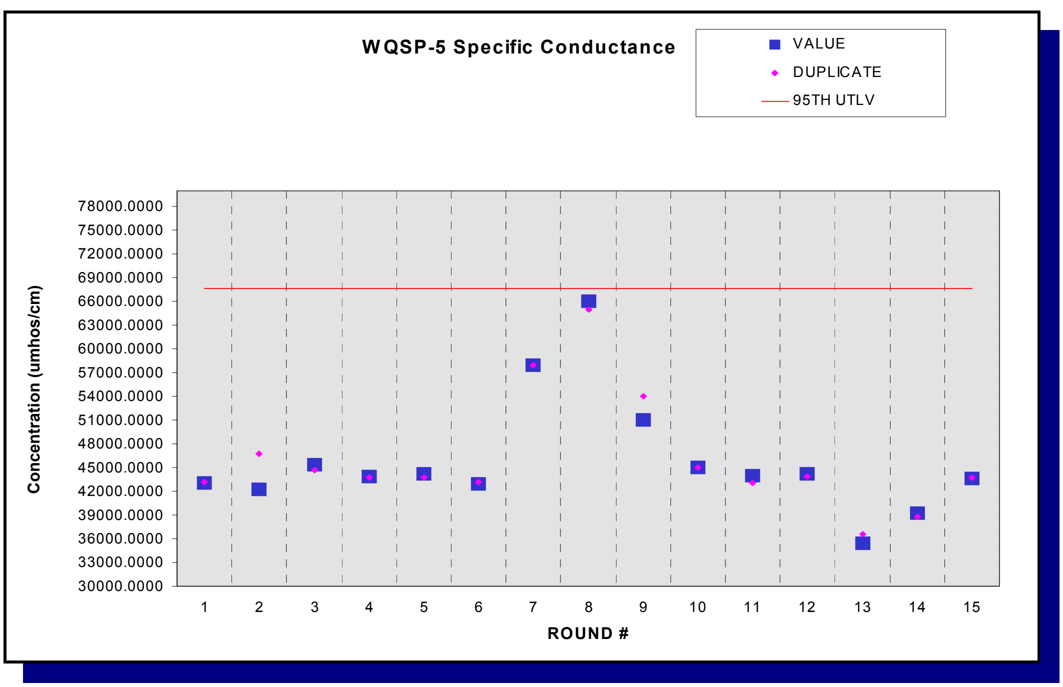

Figure F.65 - Time Trend Plot for Specific Conductance at WQSP-5

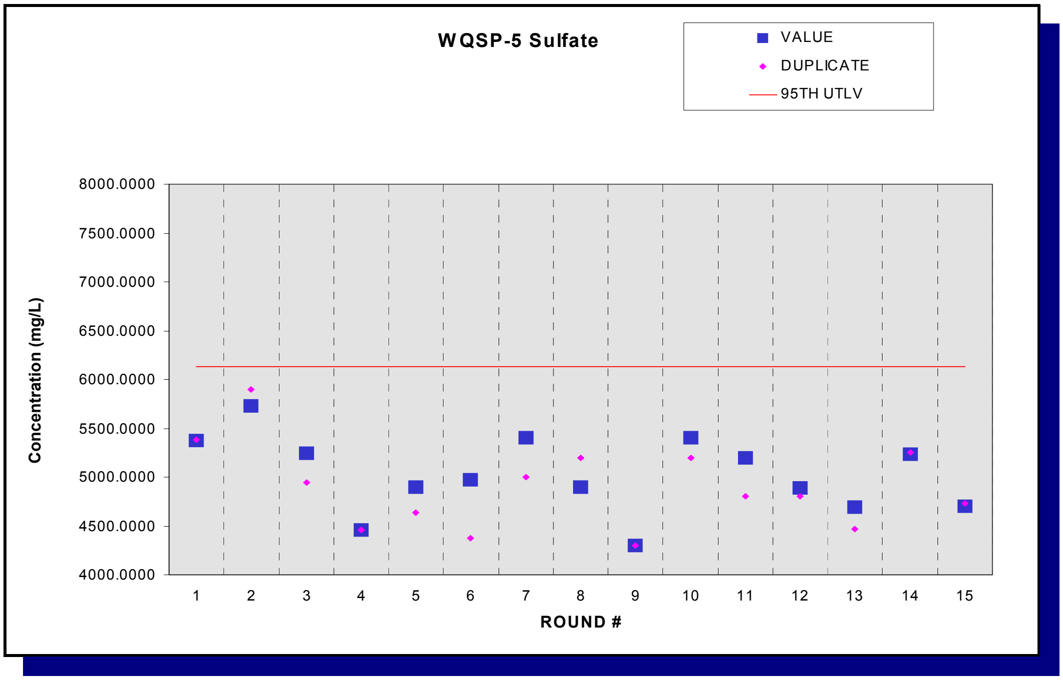

Figure F.66 - Time Trend Plot for Sulfate at WQSP-5

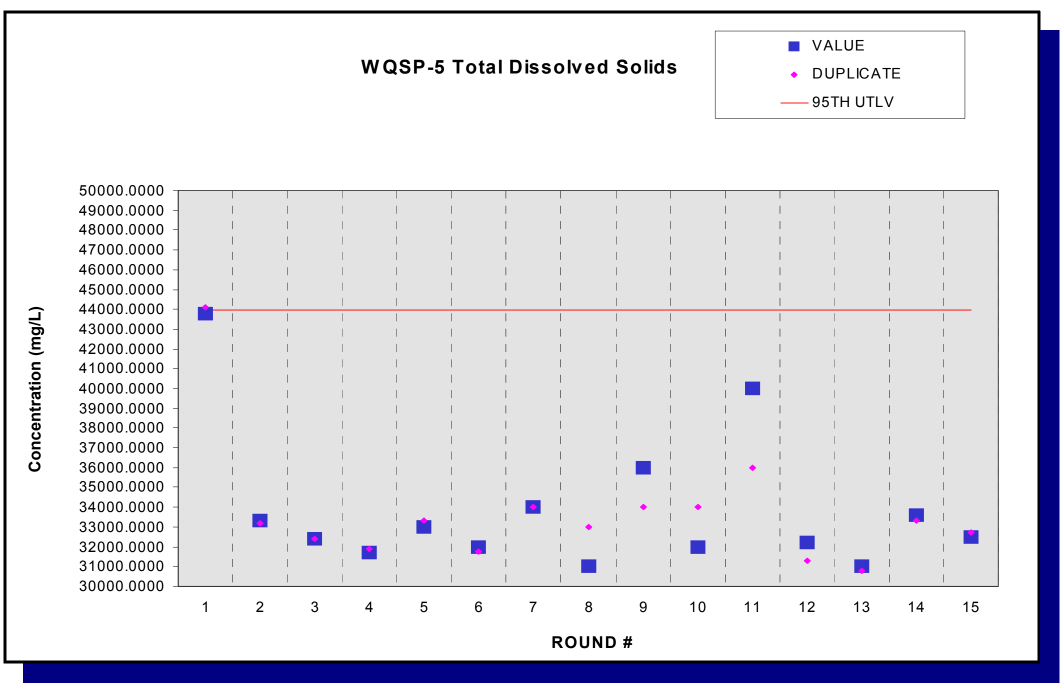

Figure F.67 - Time Trend Plot for Total Dissolved Solids at WQSP-5

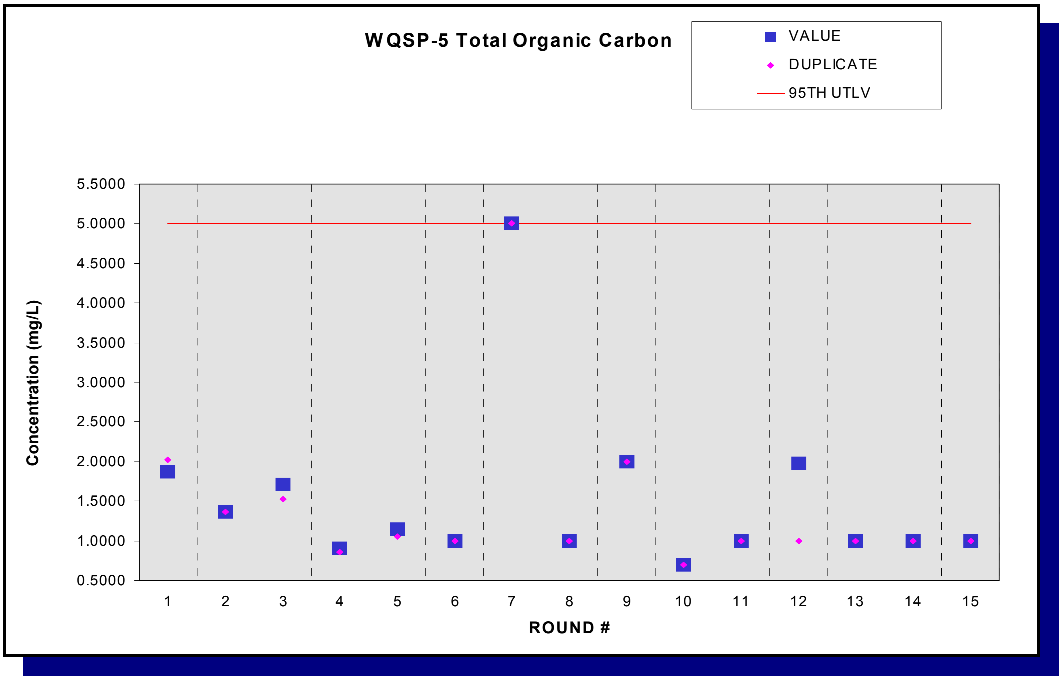

Figure F.68 - Time Trend Plot for Total Organic Carbon at WQSP-5

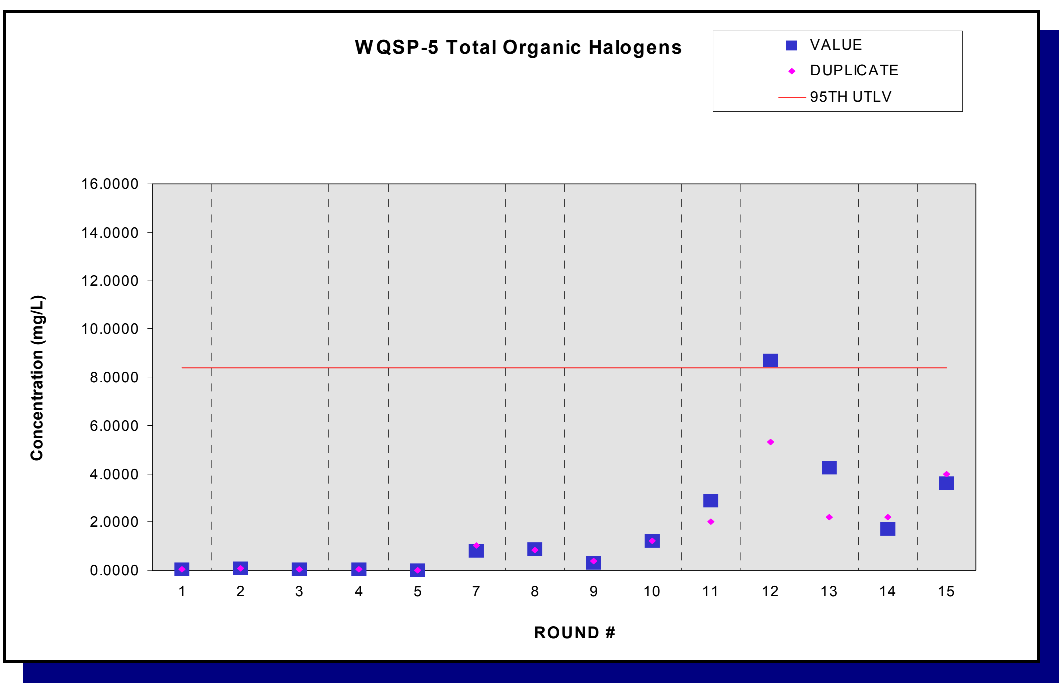

Figure F.69 - Time Trend Plot for Total Organic Halogens at WQSP-5

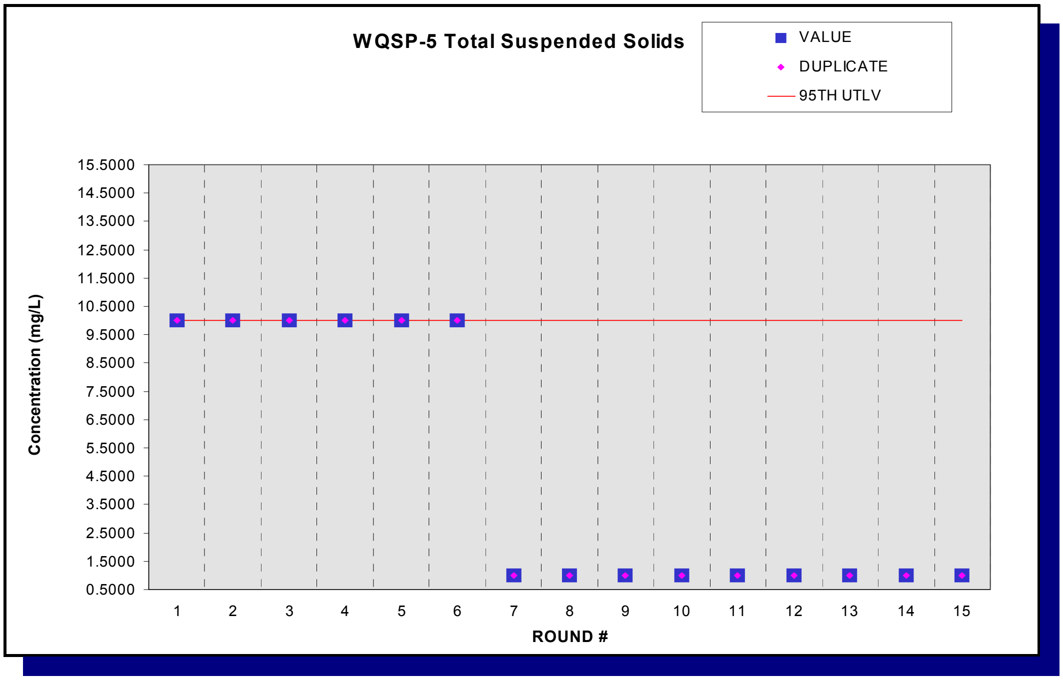

Figure F.70 - Time Trend Plot for Total Suspended Solids at WQSP-5

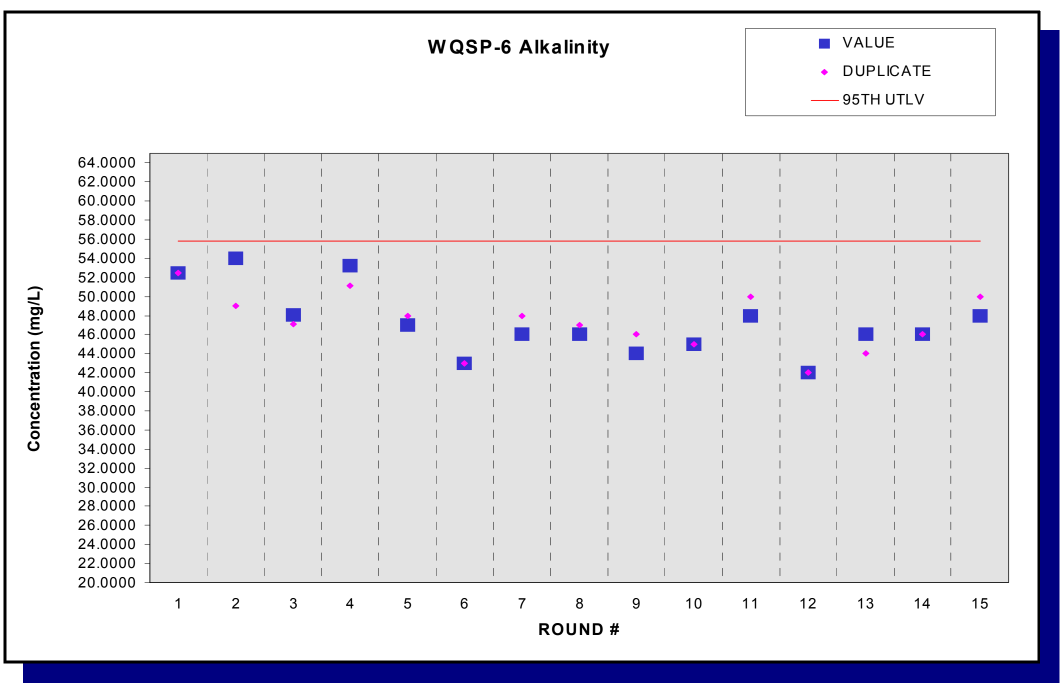

Figure F.71 - Time Trend Plot for Alkalinity at WQSP-6

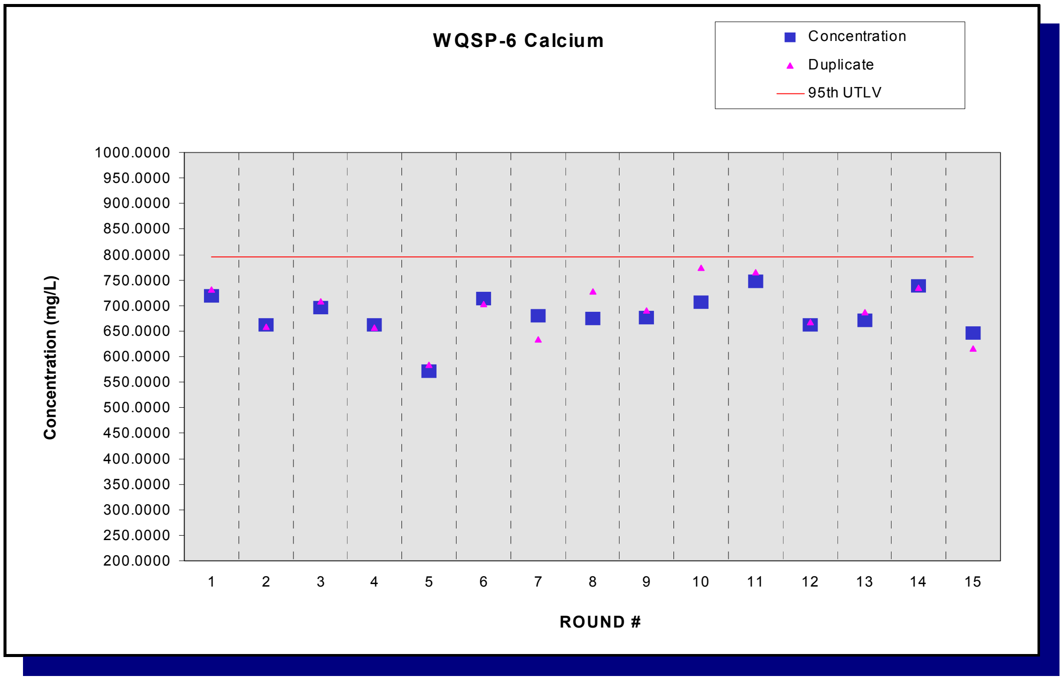

Figure F.72 - Time Trend Plot for Calcium at WQSP-6

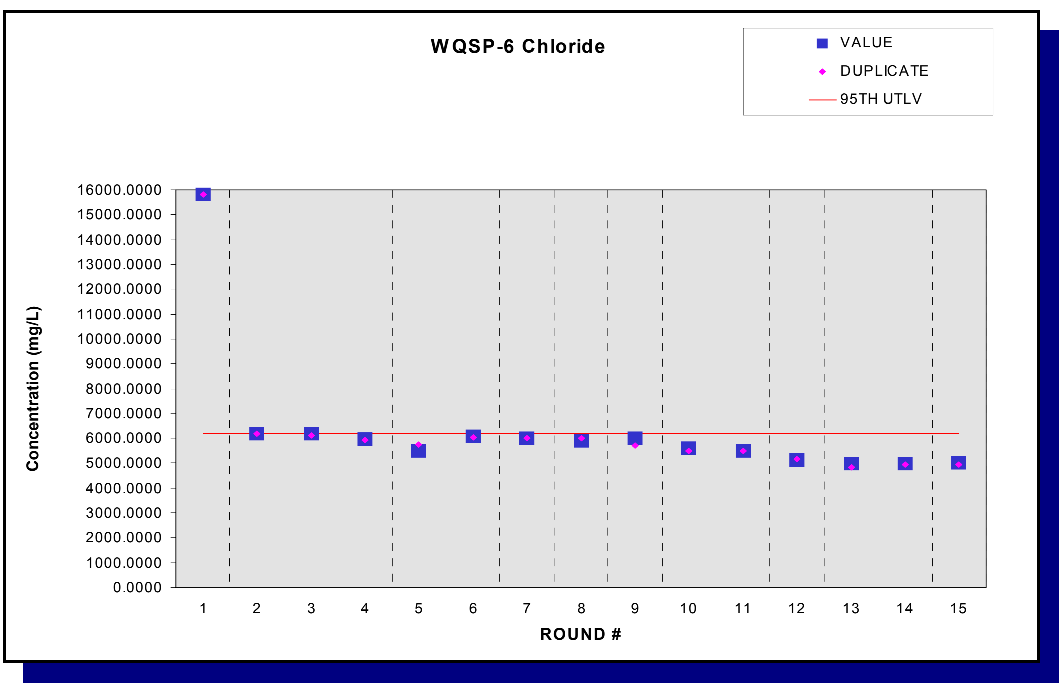

Figure F.73 - Time Trend Plot for Chloride at WQSP-6

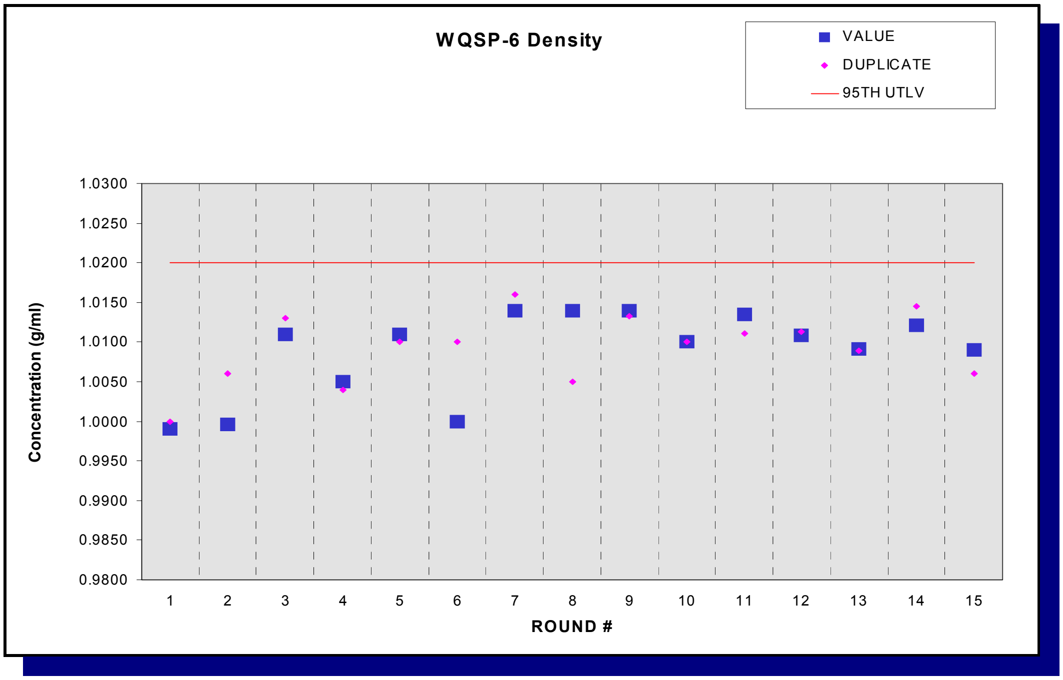

Figure F.74 - Time Trend Plot for Density at WQSP-6

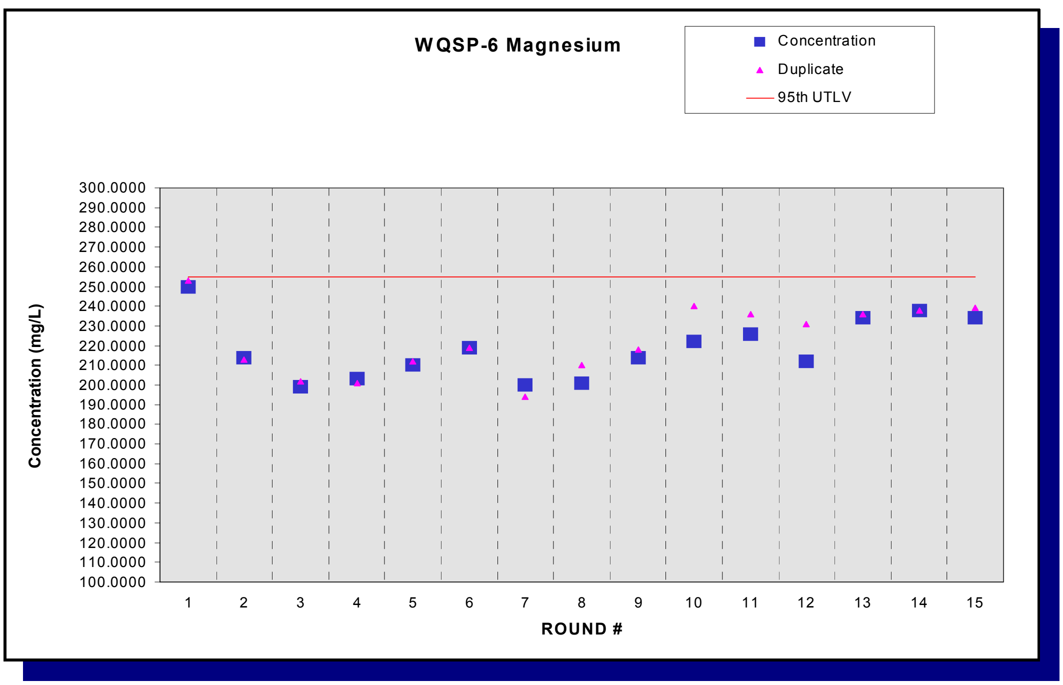

Figure F.75 - Time Trend Plot for Magnesium at WQSP-6

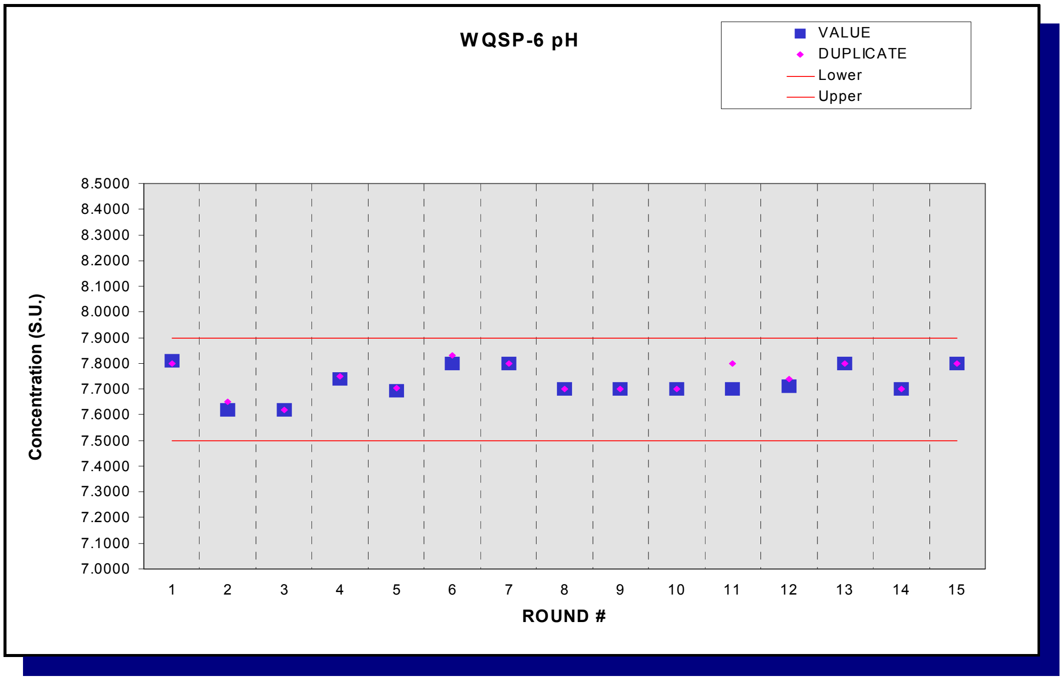

Figure F.76 - Time Trend Plot for pH at WQSP-6

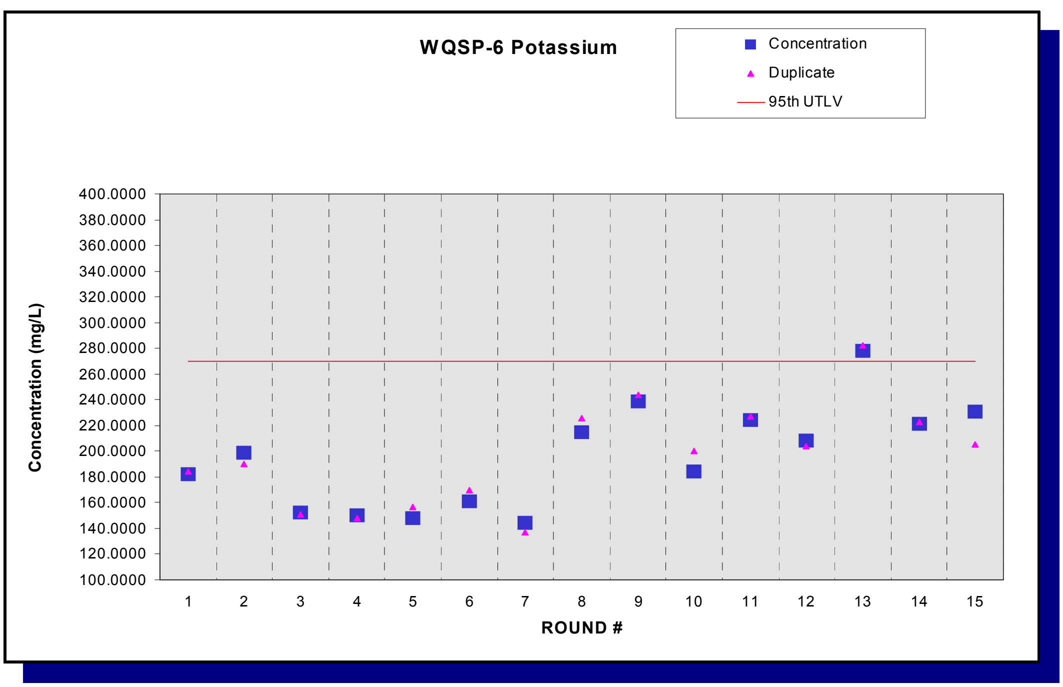

Figure F.77 - Time Trend Plot for Potassium at WQSP-6

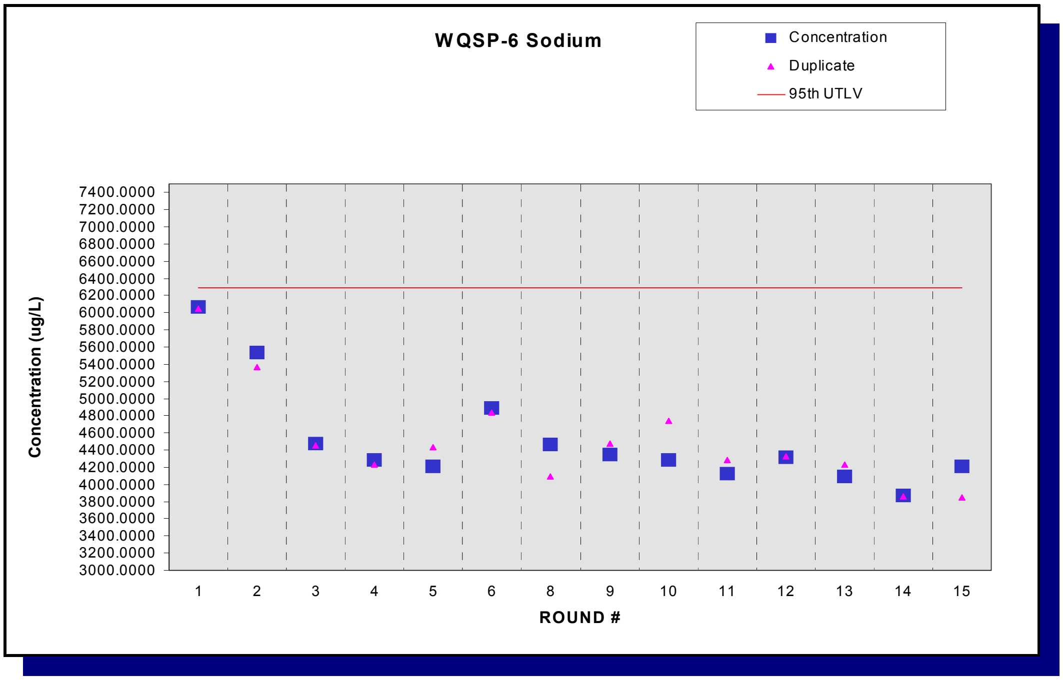

Figure F.78 - Time Trend Plot for Sodium at WQSP-6

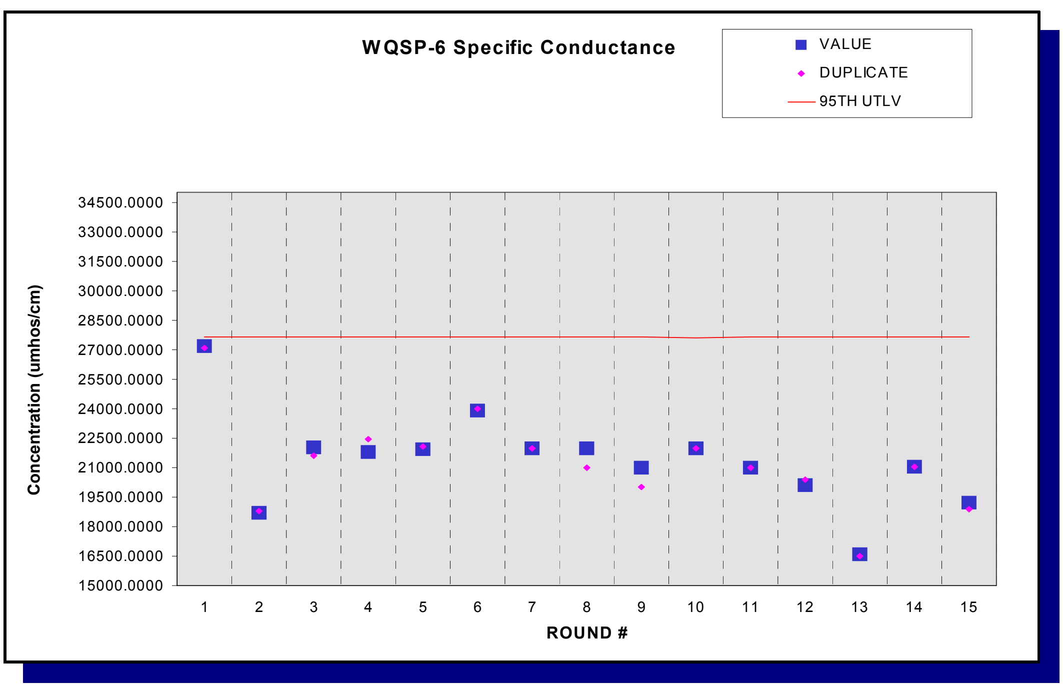

Figure F.79 - Time Trend Plot for Specific Conductance at WQSP-6

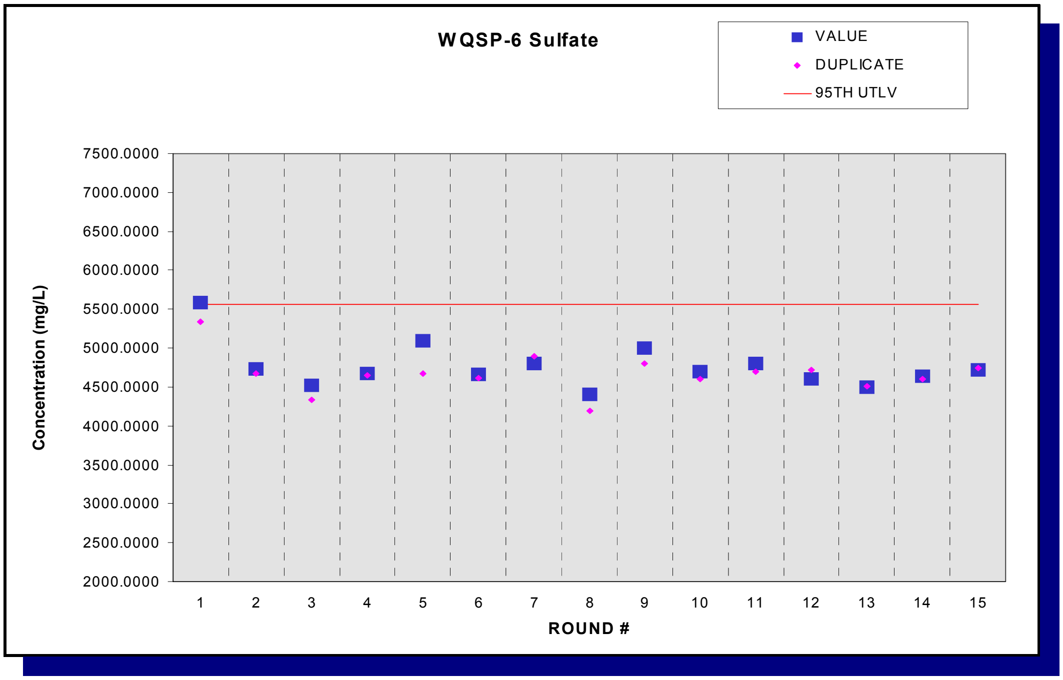

Figure F.80 - Time Trend Plot for Sulfate at WQSP-6

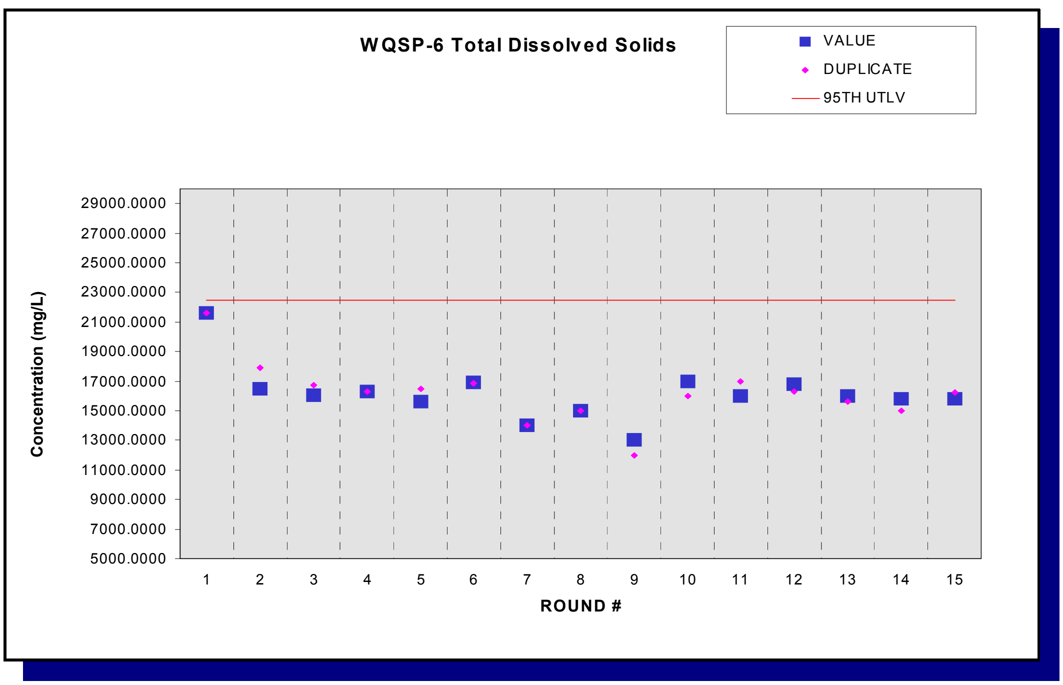

Figure F.81 - Time Trend Plot for Total Dissolved Solids at WQSP-6

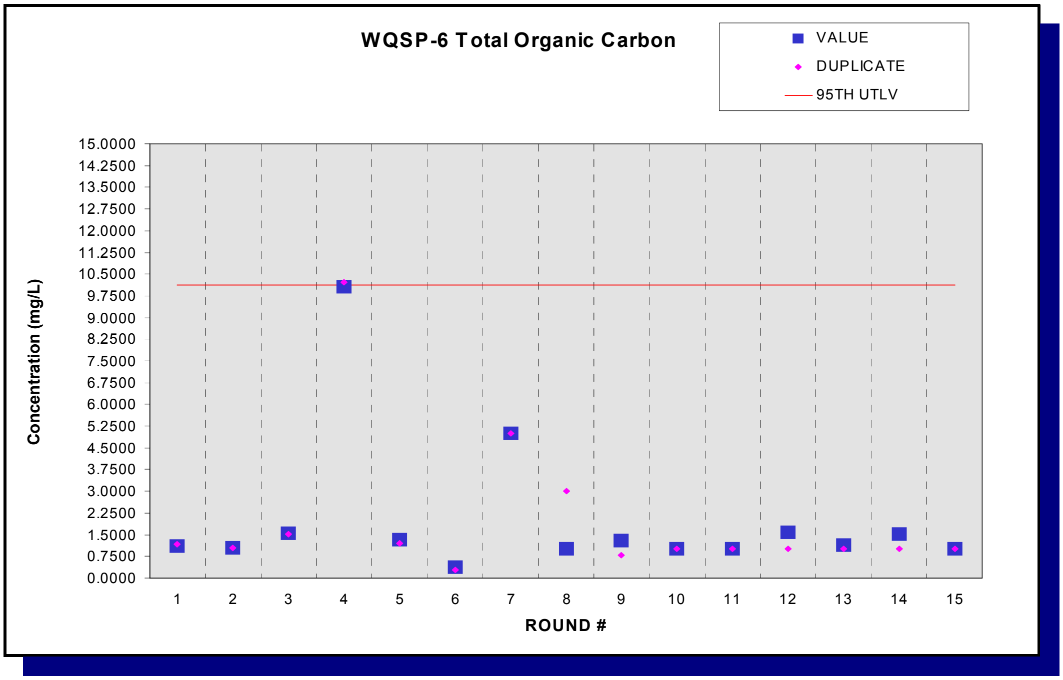

Figure F.82 - Time Trend Plot for Total Organic Carbon at WQSP-6

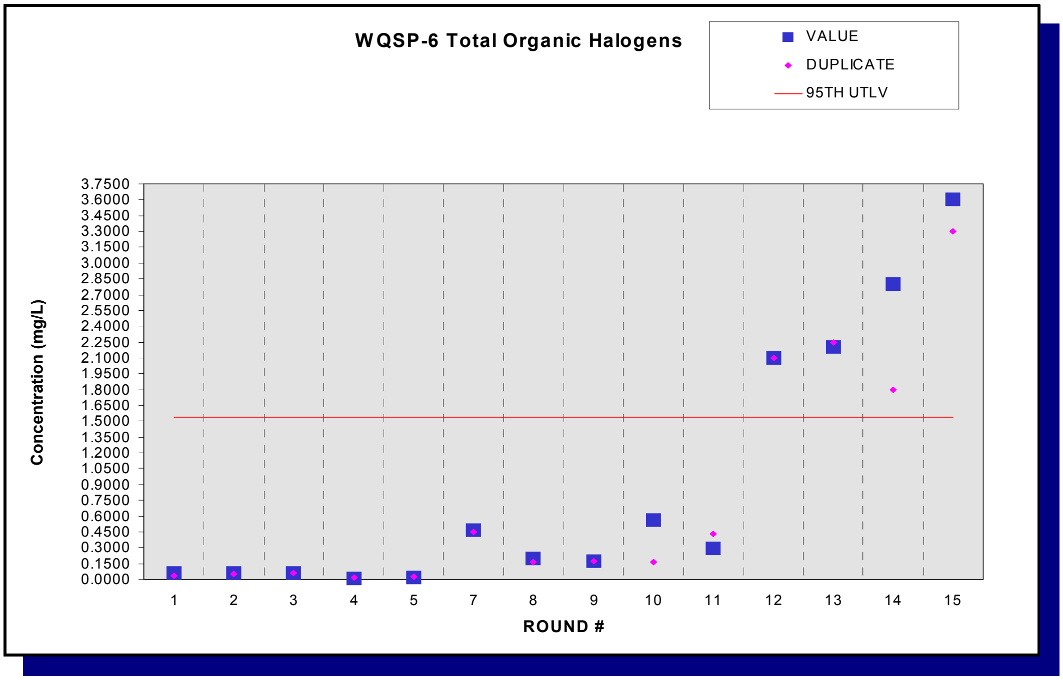

Figure F.83 - Time Trend Plot for Total Organic Halogens at WQSP-6

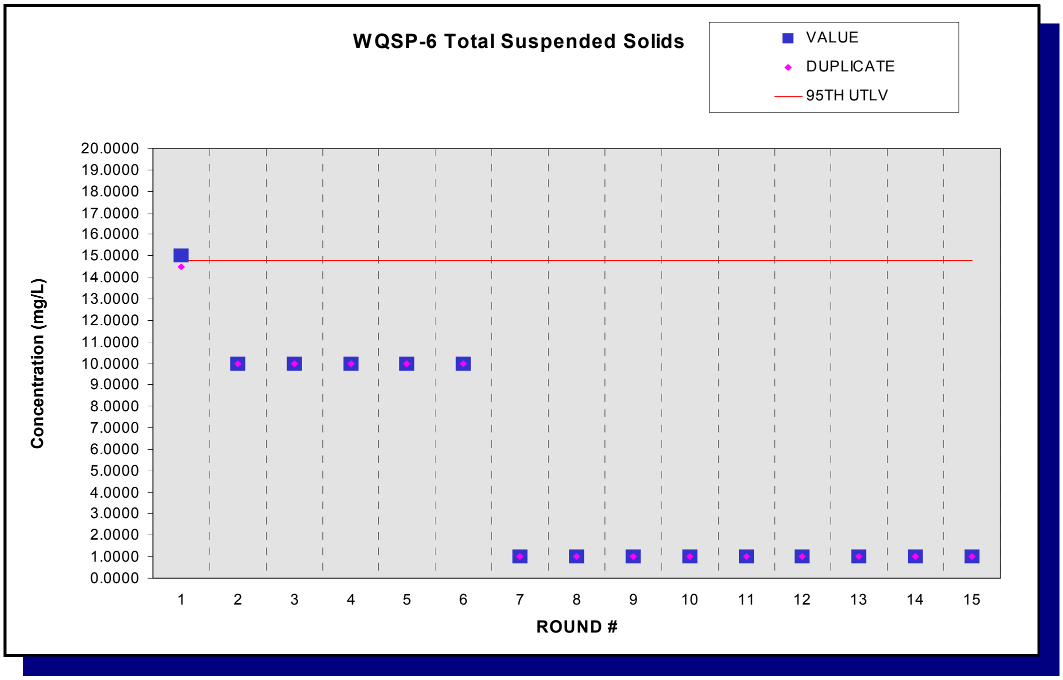

Figure F.84 - Time Trend Plot for Total Suspended Solids at WQSP-6

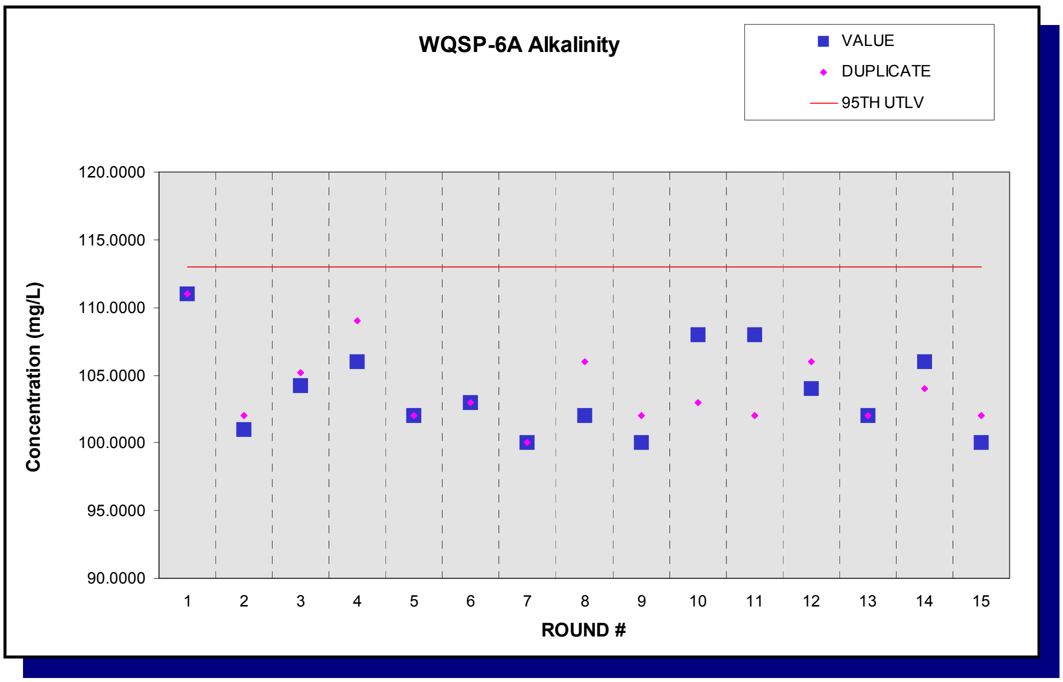

Figure F.85 - Time Trend Plot for Alkalinity at WQSP-6A

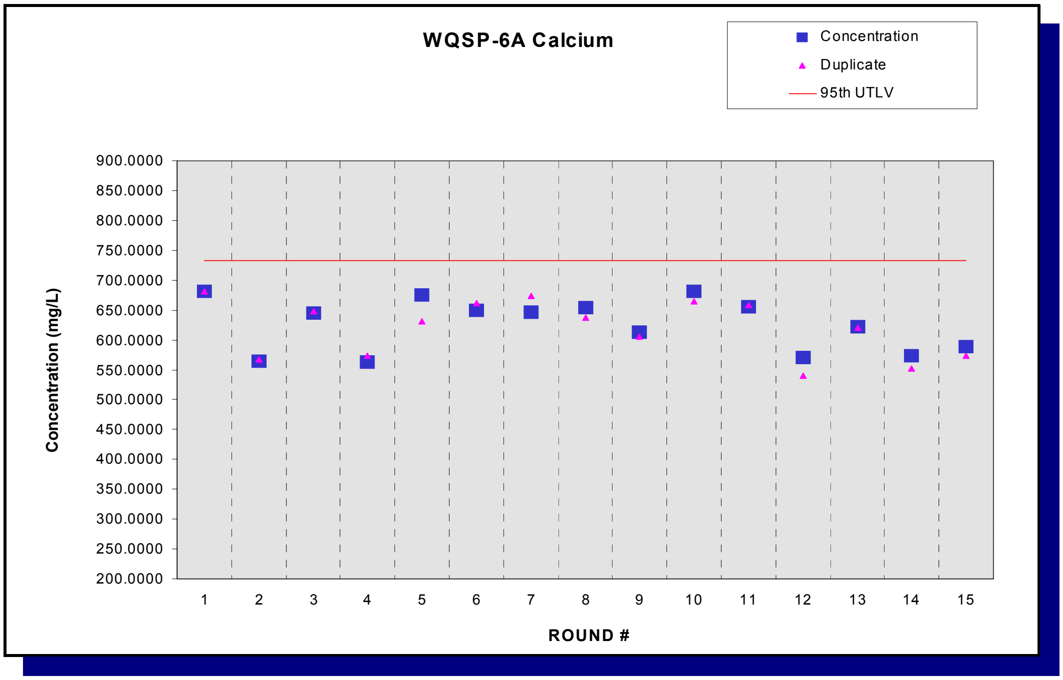

Figure F.86 - Time Trend Plot for Calcium at WQSP-6A

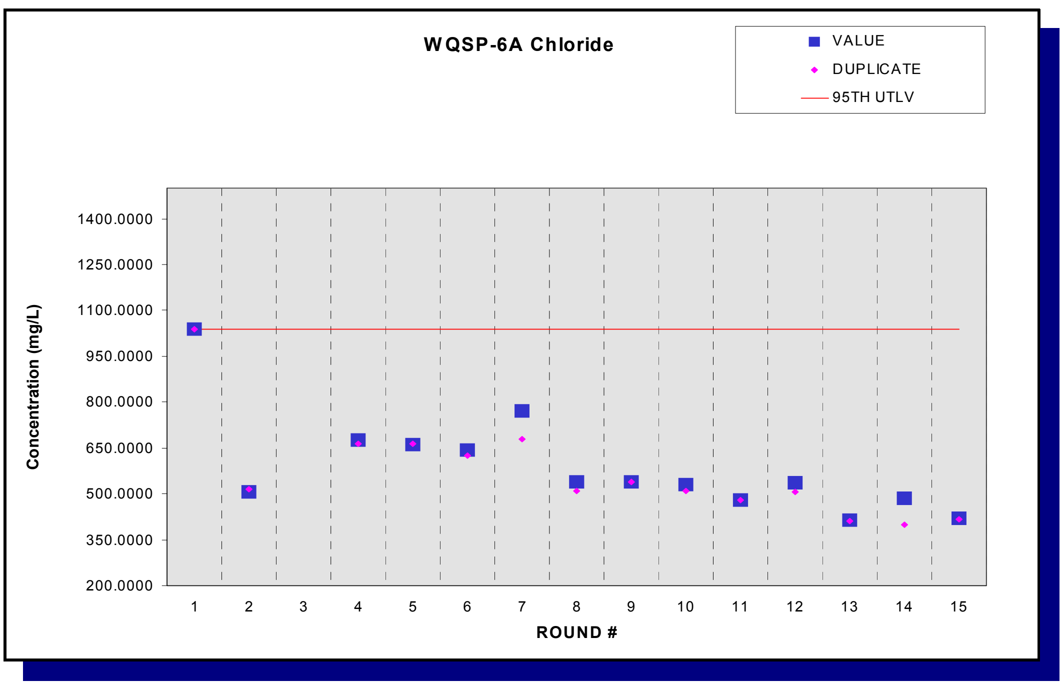

Figure F.87 - Time Trend Plot for Chloride at WQSP-6A

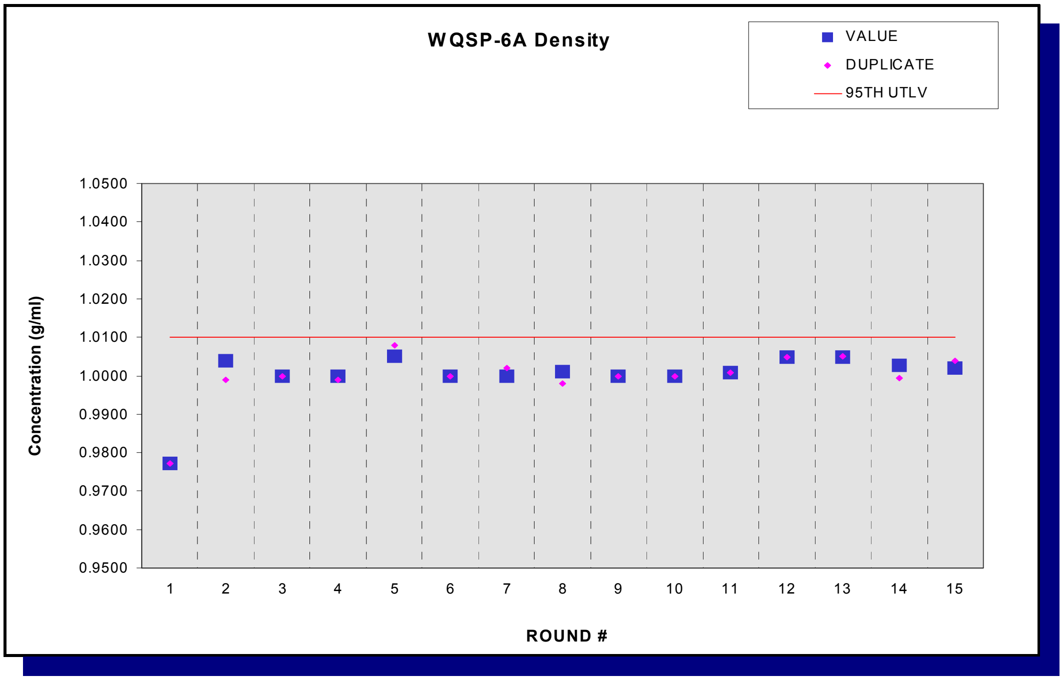

Figure F.88 - Time Trend Plot for Density at WQSP-6A

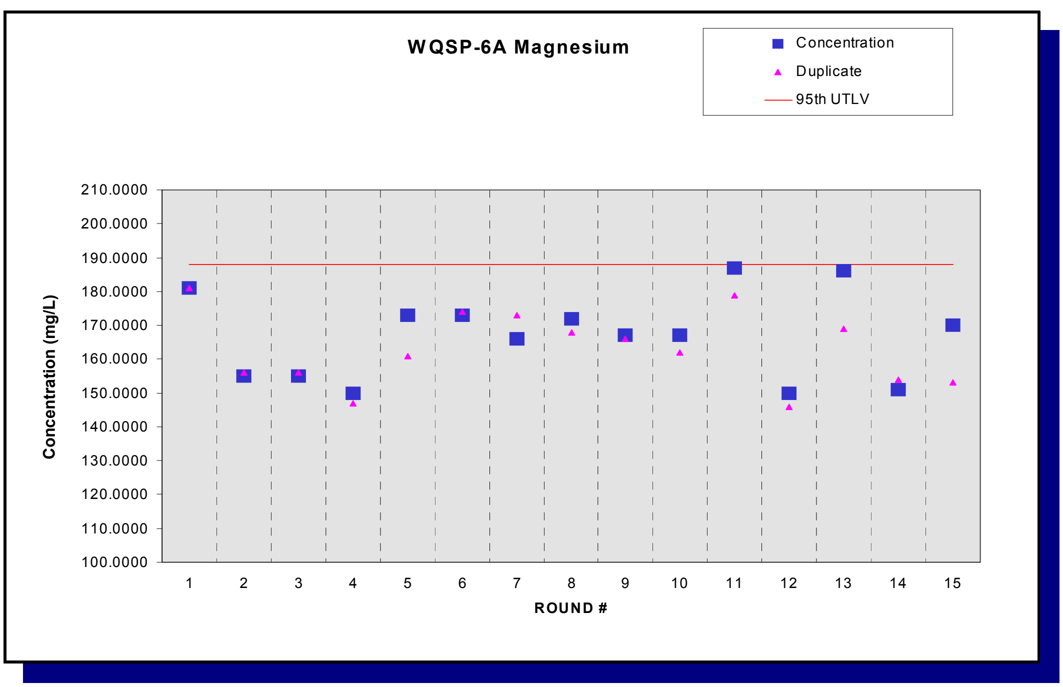

Figure F.89 - Time Trend Plot for Magnesium at WQSP-6A

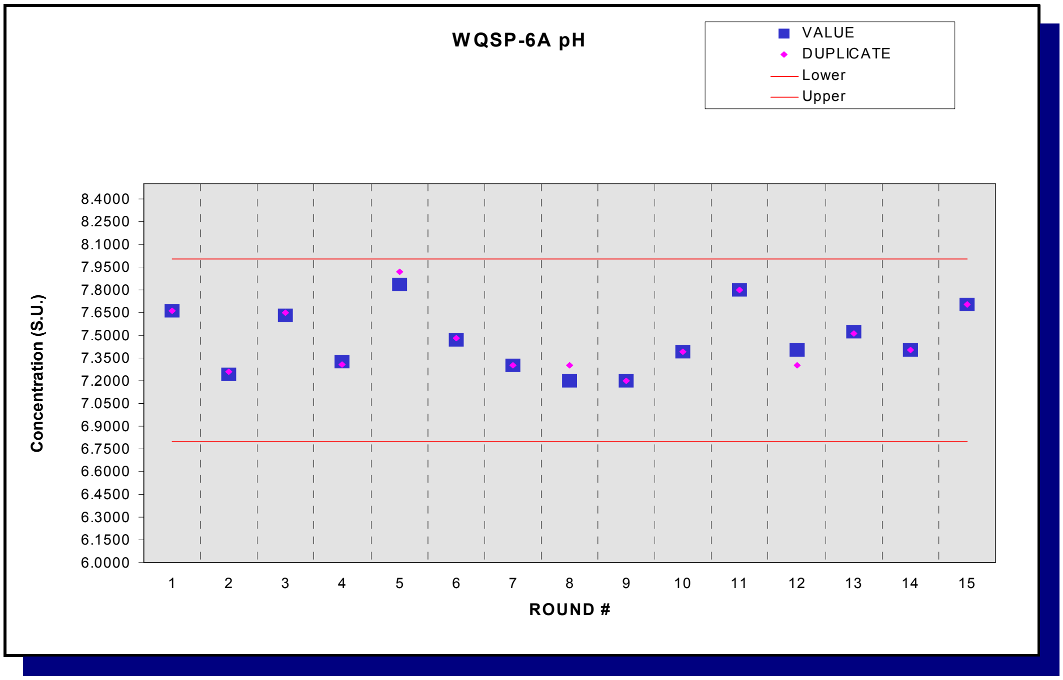

Figure F.90 - Time Trend Plot for pH at WQSP-6A

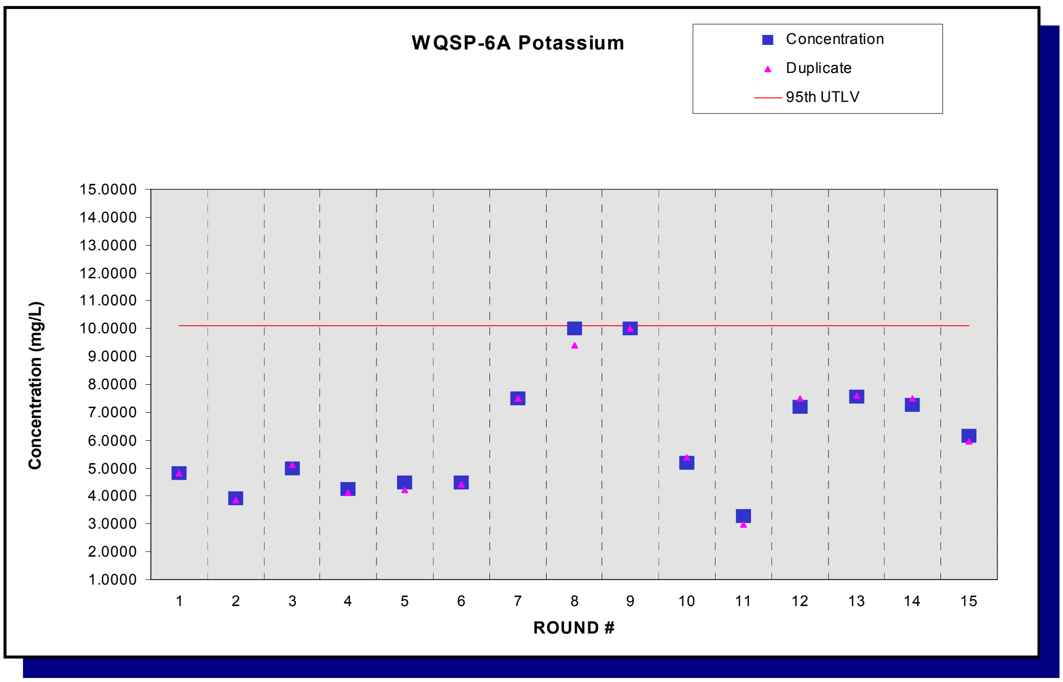

Figure F.91 - Time Trend Plot for Potassium at WQSP-6A

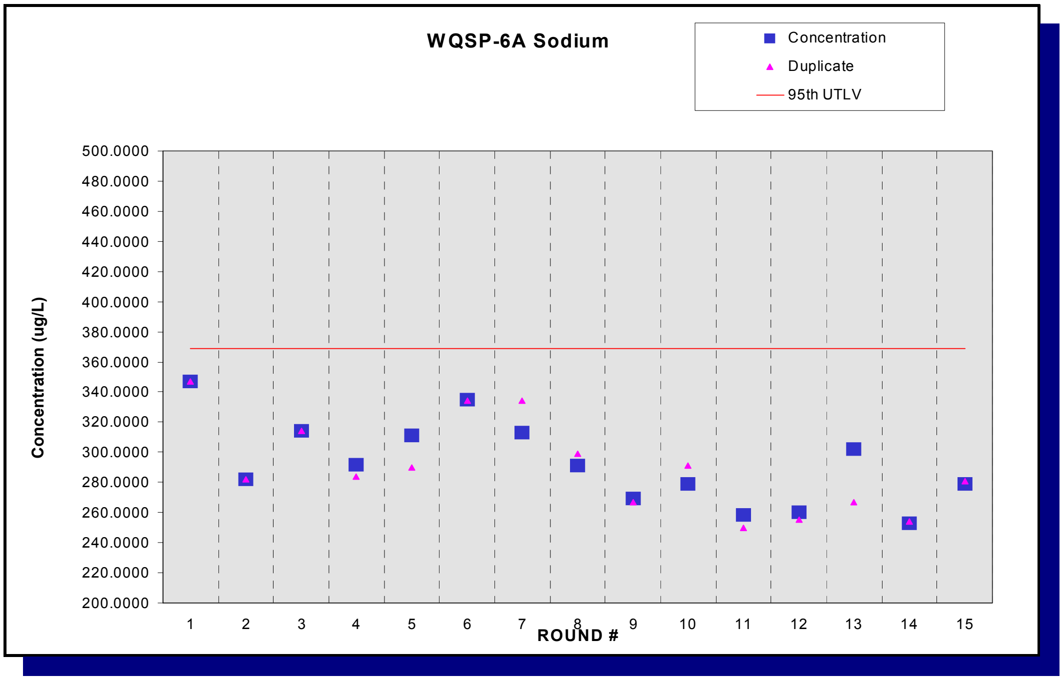

Figure F.92 - Time Trend Plot for Sodium at WQSP-6A

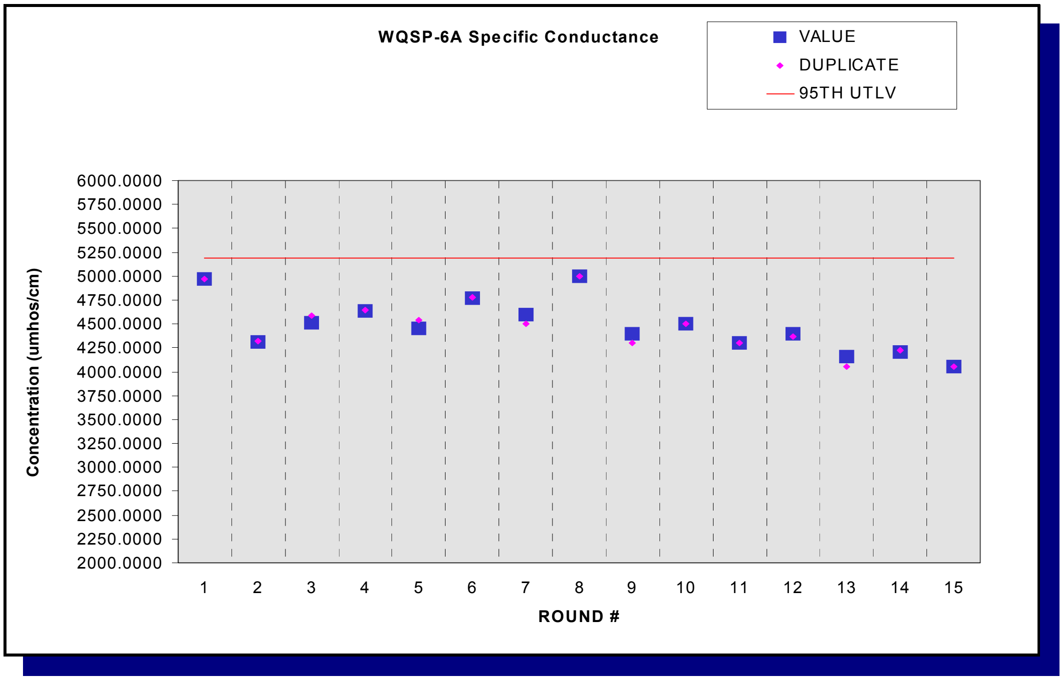

Figure F.93 - Time Trend Plot for Specific Conductance at WQSP-6A

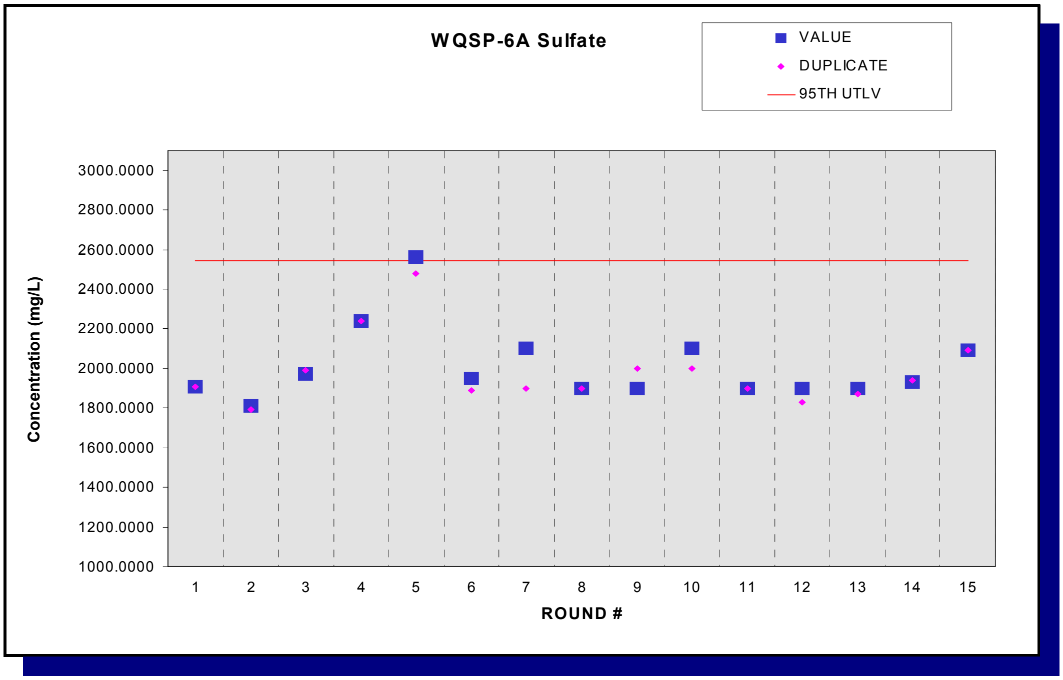

Figure F.94 - Time Trend Plot for Sulfate at WQSP-6A

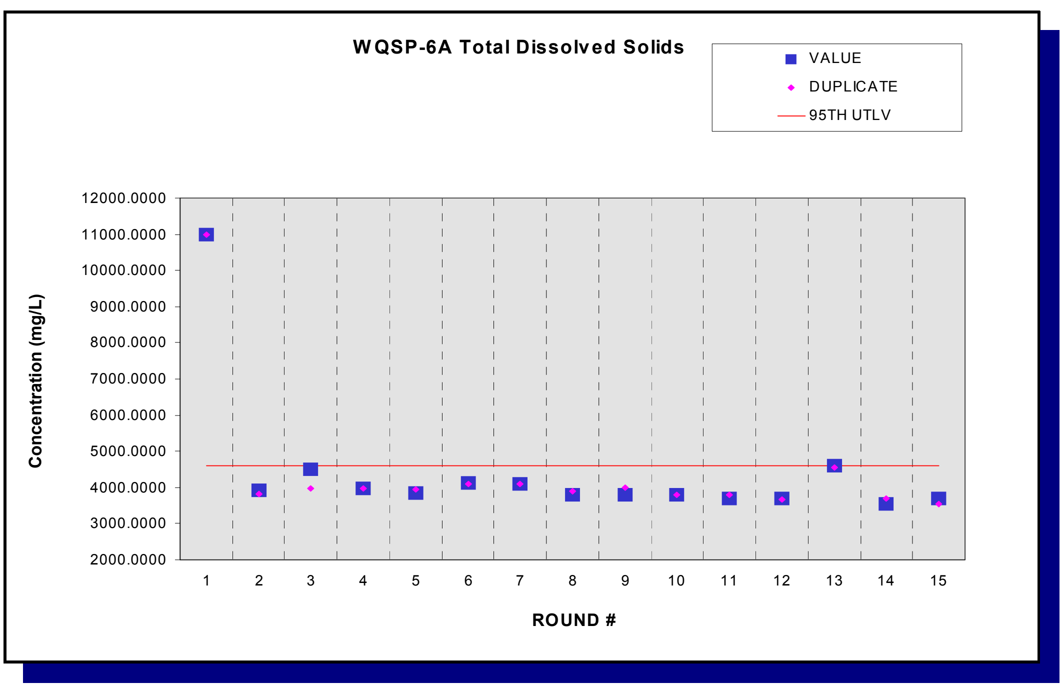

Figure F.95 - Time Trend Plot for Total Dissolved Solids at WQSP-6A

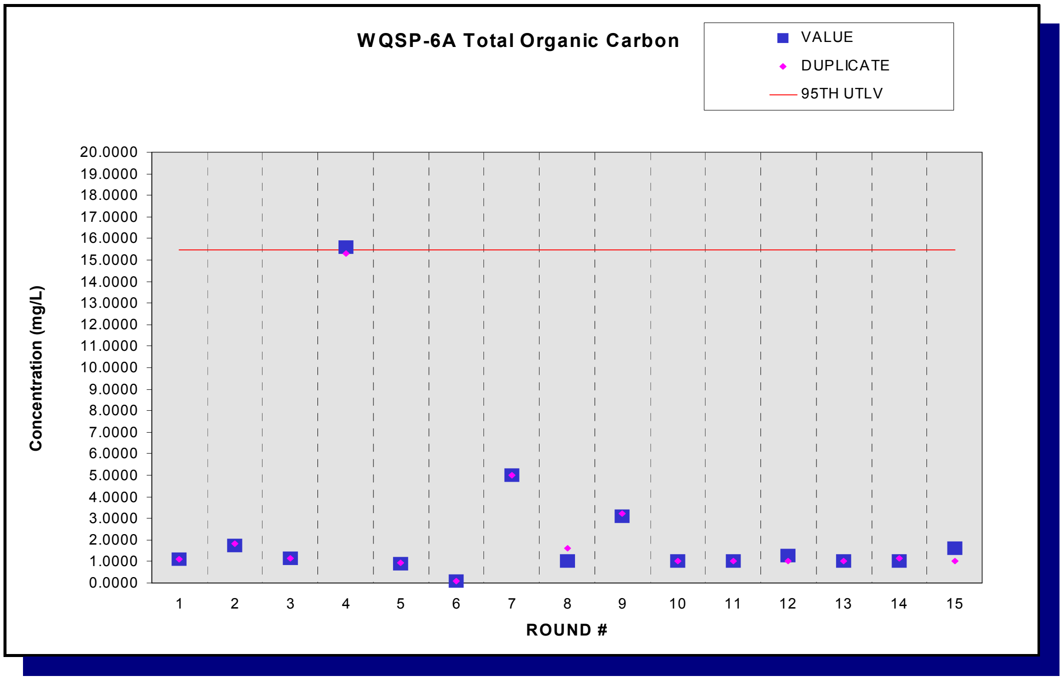

Figure F.96 - Time Trend Plot for Total Organic Carbon at WQSP-6A

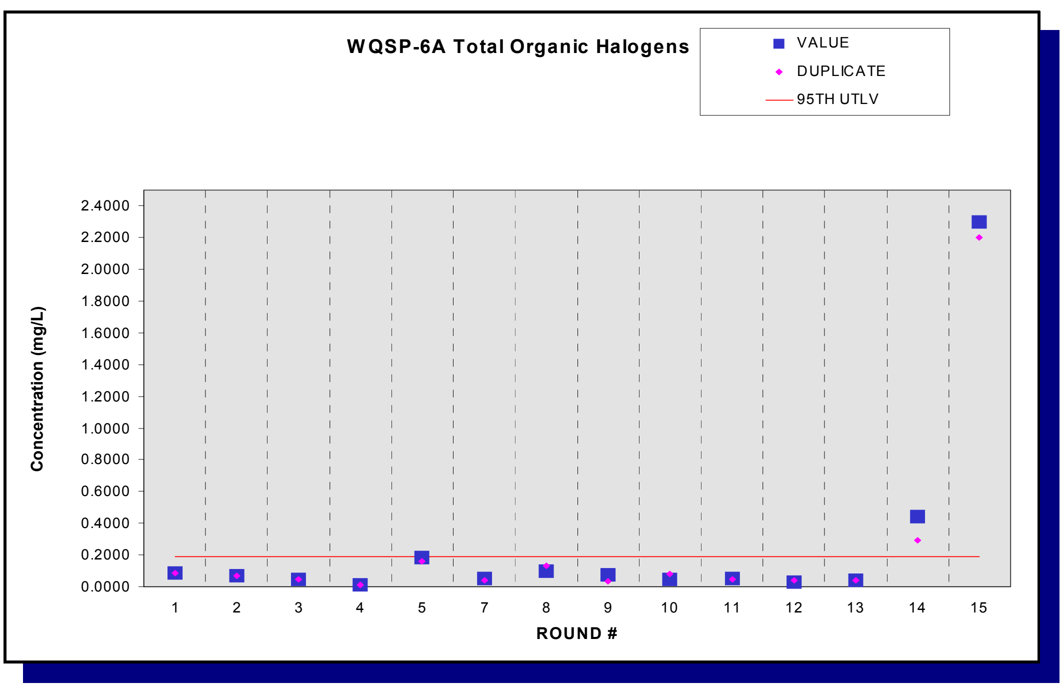

Figure F.97 - Time Trend Plot for Total Organic Halogens at WQSP-6A

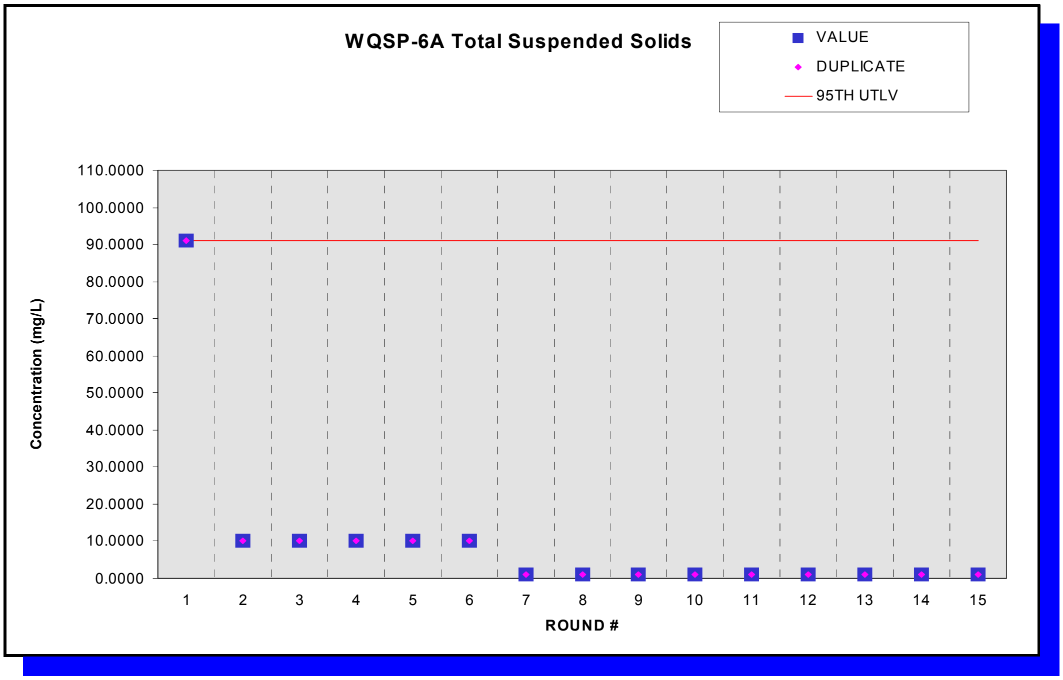

Figure F.98 - Time Trend Plot for Total Suspended Solids at WQSP-6A

Appendix G
Air Sampling Data: Concentrations of Radionuclides

Table G.1 - Radionuclide Concentrations (Bq/m^3) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN][a]	2xTPU[b]	MDC[c]	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC
		^{241}Am			^{238}Pu			$^{239+240}$Pu		
CBD	1	2.92×10^{-8}	5.88×10^{-8}	1.08×10^{-7}	3.39×10^{-8}	4.81×10^{-8}	4.59×10^{-8}	1.69×10^{-8}	3.39×10^{-8}	4.59×10^{-8}
CBD	2	0.00×10^{0}	0.00×10^{0}	1.38×10^{-7}	0.00×10^{0}	0.00×10^{0}	4.88×10^{-8}	7.22×10^{-8}	7.33×10^{-8}	4.88×10^{-8}
CBD	3	4.12×10^{-8}	8.26×10^{-8}	1.52×10^{-7}	2.13×10^{-6}	2.49×10^{-6}	1.91×10^{-6}	1.41×10^{-6}	2.01×10^{-6}	1.91×10^{-6}
CBD	4	3.92×10^{-8}	5.59×10^{-8}	5.31×10^{-8}	-2.40×10^{-8}	8.31×10^{-8}	2.22×10^{-7}	2.39×10^{-8}	4.80×10^{-8}	6.47×10^{-8}
MLR	1	2.81×10^{-8}	5.62×10^{-8}	1.03×10^{-7}	3.46×10^{-8}	4.92×10^{-8}	4.66×10^{-8}	5.18×10^{-8}	6.03×10^{-8}	4.66×10^{-8}
MLR	2	6.33×10^{-8}	9.47×10^{-8}	1.55×10^{-7}	1.65×10^{-8}	3.31×10^{-8}	4.44×10^{-8}	6.59×10^{-8}	8.10×10^{-8}	1.21×10^{-7}
MLR	3	8.12×10^{-8}	8.69×10^{-8}	1.20×10^{-7}	2.69×10^{-6}	5.42×10^{-6}	9.88×10^{-6}	0.00×10^{0}	0.00×10^{0}	3.63×10^{-6}
MLR	4	3.09×10^{-8}	6.21×10^{-8}	1.14×10^{-7}	0.00×10^{0}	0.00×10^{0}	2.09×10^{-7}	0.00×10^{0}	0.00×10^{0}	6.09×10^{-8}
SEC	1	4.29×10^{-8}	5.00×10^{-8}	3.85×10^{-8}	5.62×10^{-8}	6.55×10^{-8}	5.07×10^{-8}	3.74×10^{-8}	5.33×10^{-8}	5.07×10^{-8}
SEC	2	7.07×10^{-8}	7.14×10^{-8}	4.77×10^{-8}	5.62×10^{-8}	6.59×10^{-8}	5.07×10^{-8}	0.00×10^{0}	0.00×10^{0}	5.07×10^{-8}
SEC	3	7.69×10^{-8}	8.22×10^{-8}	1.13×10^{-7}	-6.80×10^{-7}	1.37×10^{-6}	4.99×10^{-6}	-6.77×10^{-7}	1.36×10^{-6}	4.99×10^{-6}
SEC	4	1.82×10^{-8}	6.30×10^{-8}	1.34×10^{-7}	0.00×10^{0}	0.00×10^{0}	4.03×10^{-7}	3.83×10^{-7}	3.74×10^{-7}	5.08×10^{-7}
SMR	1	5.11×10^{-8}	7.62×10^{-8}	1.25×10^{-7}	-2.45×10^{-8}	4.92×10^{-8}	1.80×10^{-7}	0.00×10^{0}	0.00×10^{0}	6.62×10^{-8}
SMR	2	0.00×10^{0}	0.00×10^{0}	1.41×10^{-7}	3.37×10^{-8}	6.77×10^{-8}	1.24×10^{-7}	0.00×10^{0}	0.00×10^{0}	4.55×10^{-8}
SMR	3	7.01×10^{-8}	8.18×10^{-8}	6.33×10^{-8}	1.72×10^{-6}	3.45×10^{-6}	6.29×10^{-6}	1.71×10^{-6}	2.44×10^{-6}	2.31×10^{-6}
SMR	4	4.94×10^{-8}	5.76×10^{-8}	4.46×10^{-8}	0.00×10^{0}	0.00×10^{0}	1.81×10^{-7}	0.00×10^{0}	0.00×10^{0}	5.27×10^{-8}
WEE	1	5.77×10^{-8}	5.85×10^{-8}	3.92×10^{-8}	8.25×10^{-8}	9.66×10^{-8}	7.44×10^{-8}	0.00×10^{0}	0.00×10^{0}	7.44×10^{-8}
WEE	2	7.36×10^{-8}	9.10×10^{-8}	1.35×10^{-7}	0.00×10^{0}	0.00×10^{0}	1.29×10^{-7}	3.49×10^{-8}	4.96×10^{-8}	4.74×10^{-8}
WEE	3	6.00×10^{-8}	7.00×10^{-8}	5.42×10^{-8}	0.00×10^{0}	0.00×10^{0}	3.48×10^{-6}	2.57×10^{-6}	3.68×10^{-6}	3.48×10^{-6}
WEE	4	6.11×10^{-8}	7.54×10^{-8}	1.13×10^{-7}	9.19×10^{-8}	1.11×10^{-7}	1.71×10^{-7}	1.83×10^{-8}	3.68×10^{-8}	4.97×10^{-8}
WFF	1	3.68×10^{-8}	5.25×10^{-8}	5.00×10^{-8}	-2.53×10^{-8}	5.07×10^{-8}	1.86×10^{-7}	0.00×10^{0}	0.00×10^{0}	6.81×10^{-8}
WFF	2	4.77×10^{-8}	6.81×10^{-8}	6.48×10^{-8}	3.54×10^{-8}	7.10×10^{-8}	1.30×10^{-7}	3.53×10^{-8}	5.03×10^{-8}	4.77×10^{-8}
WFF	3	9.48×10^{-8}	9.07×10^{-8}	1.16×10^{-7}	1.50×10^{-6}	3.02×10^{-6}	4.04×10^{-6}	5.97×10^{-6}	6.15×10^{-6}	4.04×10^{-6}
WFF	4	5.59×10^{-8}	6.53×10^{-8}	5.05×10^{-8}	1.38×10^{-7}	1.99×10^{-7}	1.87×10^{-7}	4.14×10^{-7}	4.05×10^{-7}	5.08×10^{-7}
WSS	1	1.60×10^{-8}	5.51×10^{-8}	1.18×10^{-7}	1.87×10^{-8}	6.48×10^{-8}	1.37×10^{-7}	3.74×10^{-8}	5.29×10^{-8}	5.03×10^{-8}
WSS	2	3.46×10^{-8}	6.92×10^{-8}	1.27×10^{-7}	1.44×10^{-8}	2.89×10^{-8}	3.89×10^{-8}	2.87×10^{-8}	4.11×10^{-8}	3.89×10^{-8}
WSS	3	7.37×10^{-8}	7.47×10^{-8}	4.99×10^{-8}	2.17×10^{-6}	3.10×10^{-6}	2.93×10^{-6}	0.00×10^{0}	0.00×10^{0}	7.96×10^{-5}
WSS	4	0.00×10^{0}	0.00×10^{0}	1.31×10^{-7}	0.00×10^{0}	0.00×10^{0}	1.55×10^{-7}	9.99×10^{-8}	8.31×10^{-8}	4.51×10^{-8}
WAB	1	-1.14×10^{-4}	2.28×10^{-4}	8.36×10^{-4}	-1.19×10^{-4}	2.39×10^{-4}	8.77×10^{-4}	1.19×10^{-4}	2.38×10^{-4}	3.22×10^{-4}
WAB	2	2.15×10^{-4}	4.29×10^{-4}	7.92×10^{-4}	-1.07×10^{-4}	2.15×10^{-4}	7.84×10^{-4}	0.00×10^{0}	0.00×10^{0}	2.89×10^{-4}

Table G.1 - Radionuclide Concentrations (Bq/m^3) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN][a]	2xTPU[b]	MDC[c]	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC
WAB	3	1.28×10^{-4}	4.45×10^{-4}	9.45×10^{-4}	6.04×10^{-3}	1.22×10^{-2}	1.63×10^{-2}	2.41×10^{-2}	2.45×10^{-2}	1.63×10^{-2}
WAB	4	0.00×10^{0}	0.00×10^{0}	8.43×10^{-4}	-4.55×10^{-4}	9.17×10^{-4}	3.34×10^{-3}	-4.53×10^{-4}	9.14×10^{-4}	3.34×10^{-3}
Minimum		0.00×10^{0}	0.00×10^{0}	3.85×10^{-8}	-6.80×10^{-7}	1.37×10^{-6}	3.89×10^{-8}	-6.77×10^{-7}	1.36×10^{-6}	3.89×10^{-8}
Maximum		9.48×10^{-8}	9.07×10^{-8}	1.55×10^{-7}	2.69×10^{-6}	5.42×10^{-6}	9.88×10^{-6}	5.97×10^{-6}	6.15×10^{-6}	7.96×10^{-5}
Mean[c]		4.66×10^{-8}	4.98×10^{-8}	9.64×10^{-8}	3.60×10^{-7}	1.63×10^{-6}	1.30×10^{-6}	4.39×10^{-7}	2.46×10^{-6}	3.64×10^{-6}
			^{234}U			^{235}U			^{238}U	
CBD	1	4.74×10^{-6}	1.57×10^{-6}	1.51×10^{-7}	2.06×10^{-7}	2.43×10^{-7}	1.86×10^{-7}	3.05×10^{-6}	1.12×10^{-6}	1.50×10^{-7}
CBD	2	2.77×10^{-6}	6.07×10^{-7}	1.14×10^{-7}	9.51×10^{-8}	1.02×10^{-7}	1.40×10^{-7}	2.73×10^{-6}	5.96×10^{-7}	4.14×10^{-7}
CBD	3	3.17×10^{-6}	7.01×10^{-7}	4.55×10^{-8}	1.04×10^{-7}	9.41×10^{-8}	5.61×10^{-8}	2.67×10^{-6}	6.14×10^{-7}	4.53×10^{-8}
CBD	4	2.39×10^{-6}	6.08×10^{-7}	5.50×10^{-8}	2.50×10^{-8}	5.02×10^{-8}	6.78×10^{-8}	2.36×10^{-6}	6.02×10^{-7}	5.47×10^{-8}
MLR	1	3.63×10^{-6}	7.14×10^{-7}	3.60×10^{-8}	2.29×10^{-7}	1.28×10^{-7}	4.44×10^{-8}	3.81×10^{-6}	7.36×10^{-7}	3.58×10^{-8}
MLR	2	3.34×10^{-6}	7.03×10^{-7}	4.51×10^{-8}	8.21×10^{-8}	8.29×10^{-8}	5.55×10^{-8}	2.95×10^{-6}	6.40×10^{-7}	4.48×10^{-8}
MLR	3	2.79×10^{-6}	6.37×10^{-7}	1.30×10^{-7}	2.18×10^{-8}	7.54×10^{-8}	1.60×10^{-7}	2.34×10^{-6}	5.61×10^{-7}	1.63×10^{-7}
MLR	4	2.23×10^{-6}	5.32×10^{-7}	4.55×10^{-8}	2.07×10^{-8}	4.16×10^{-8}	5.61×10^{-8}	2.17×10^{-6}	5.21×10^{-7}	4.53×10^{-8}
SEC	1	3.62×10^{-6}	7.14×10^{-7}	3.67×10^{-8}	6.70×10^{-8}	8.25×10^{-8}	1.23×10^{-7}	3.08×10^{-6}	6.29×10^{-7}	9.95×10^{-8}
SEC	2	3.05×10^{-6}	6.36×10^{-7}	3.89×10^{-8}	2.29×10^{-7}	1.41×10^{-7}	1.30×10^{-7}	2.63×10^{-6}	5.66×10^{-7}	3.85×10^{-8}
SEC	3	2.79×10^{-6}	6.34×10^{-7}	4.57×10^{-8}	6.25×10^{-8}	7.29×10^{-8}	5.64×10^{-8}	2.15×10^{-6}	5.34×10^{-7}	1.24×10^{-7}
SEC	4	2.11×10^{-6}	5.07×10^{-7}	4.39×10^{-8}	4.00×10^{-8}	5.69×10^{-8}	5.42×10^{-8}	1.87×10^{-6}	4.65×10^{-7}	4.37×10^{-8}
SMR	1	3.26×10^{-6}	8.29×10^{-7}	6.85×10^{-8}	1.87×10^{-7}	1.57×10^{-7}	8.44×10^{-8}	3.27×10^{-6}	8.33×10^{-7}	6.81×10^{-8}
SMR	2	3.16×10^{-6}	6.40×10^{-7}	3.81×10^{-8}	1.22×10^{-7}	9.40×10^{-8}	4.74×10^{-8}	2.78×10^{-6}	5.77×10^{-7}	3.81×10^{-8}
SMR	3	2.34×10^{-6}	5.65×10^{-7}	5.11×10^{-8}	2.10×10^{-7}	1.44×10^{-7}	6.31×10^{-8}	2.82×10^{-6}	6.47×10^{-7}	5.09×10^{-8}
SMR	4	2.79×10^{-6}	6.43×10^{-7}	1.28×10^{-7}	1.29×10^{-7}	1.07×10^{-7}	5.82×10^{-8}	2.27×10^{-6}	5.50×10^{-7}	4.70×10^{-8}
WEE	1	4.29×10^{-6}	8.36×10^{-7}	3.70×10^{-8}	1.86×10^{-7}	1.16×10^{-7}	4.59×10^{-8}	4.22×10^{-6}	8.21×10^{-7}	3.69×10^{-8}
WEE	2	2.69×10^{-6}	5.96×10^{-7}	1.17×10^{-7}	1.38×10^{-7}	1.06×10^{-7}	5.33×10^{-8}	3.29×10^{-6}	6.92×10^{-7}	4.29×10^{-8}
WEE	3	2.65×10^{-6}	6.00×10^{-7}	4.55×10^{-8}	8.28×10^{-8}	8.39×10^{-8}	5.61×10^{-8}	2.41×10^{-6}	5.60×10^{-7}	4.53×10^{-8}
WEE	4	2.12×10^{-6}	5.26×10^{-7}	4.78×10^{-8}	8.70×10^{-8}	8.82×10^{-8}	5.89×10^{-8}	1.90×10^{-6}	4.85×10^{-7}	4.76×10^{-8}
WFF	1	3.96×10^{-6}	7.66×10^{-7}	3.92×10^{-8}	1.07×10^{-7}	8.88×10^{-8}	4.85×10^{-8}	3.70×10^{-6}	7.25×10^{-7}	3.92×10^{-8}
WFF	2	2.76×10^{-6}	5.88×10^{-7}	4.03×10^{-8}	5.51×10^{-8}	6.44×10^{-8}	5.00×10^{-8}	2.27×10^{-6}	5.11×10^{-7}	4.03×10^{-8}
WFF	3	2.22×10^{-6}	5.51×10^{-7}	5.15×10^{-8}	9.38×10^{-8}	9.51×10^{-8}	6.35×10^{-8}	1.93×10^{-6}	4.97×10^{-7}	5.13×10^{-8}
WFF	4	2.19×10^{-6}	5.31×10^{-7}	1.29×10^{-7}	6.47×10^{-8}	7.55×10^{-8}	5.85×10^{-8}	1.74×10^{-6}	4.52×10^{-7}	1.28×10^{-7}
WSS	1	4.55×10^{-6}	8.81×10^{-7}	4.00×10^{-8}	1.09×10^{-7}	9.07×10^{-8}	4.92×10^{-8}	3.51×10^{-6}	7.14×10^{-7}	4.00×10^{-8}
WSS	2	3.49×10^{-6}	7.14×10^{-7}	4.11×10^{-8}	9.36×10^{-8}	8.47×10^{-8}	5.07×10^{-8}	2.88×10^{-6}	6.14×10^{-7}	4.11×10^{-8}
WSS	3	2.87×10^{-6}	6.77×10^{-7}	5.29×10^{-8}	4.81×10^{-8}	6.85×10^{-8}	6.52×10^{-8}	2.31×10^{-6}	5.77×10^{-7}	5.26×10^{-8}
WSS	4	2.12×10^{-6}	5.16×10^{-7}	4.59×10^{-8}	1.04×10^{-7}	9.49×10^{-8}	5.66×10^{-8}	2.21×10^{-6}	5.32×10^{-7}	4.57×10^{-8}

Table G.1 - Radionuclide Concentrations (Bq/m^3) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN][a]	2xTPU[b]	MDC[c]	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC
WAB	1	2.19×10^{-2}	4.44×10^{-3}	2.78×10^{-4}	3.77×10^{-4}	5.66×10^{-4}	9.32×10^{-4}	2.15×10^{-2}	4.37×10^{-3}	2.76×10^{-4}
WAB	2	1.77×10^{-2}	4.37×10^{-3}	3.70×10^{-4}	3.37×10^{-4}	4.81×10^{-4}	4.55×10^{-4}	1.72×10^{-2}	4.26×10^{-3}	3.68×10^{-4}
WAB	3	2.29×10^{-2}	5.28×10^{-3}	9.98×10^{-4}	6.68×10^{-4}	6.78×10^{-4}	4.53×10^{-4}	1.50×10^{-2}	3.83×10^{-3}	3.65×10^{-4}
WAB	4	1.07×10^{-2}	2.89×10^{-3}	9.07×10^{-4}	7.59×10^{-4}	6.90×10^{-4}	4.12×10^{-4}	1.43×10^{-2}	3.51×10^{-3}	3.32×10^{-4}
Minimum		2.11×10^{-6}	5.07×10^{-7}	3.60×10^{-8}	2.07×10^{-8}	4.16×10^{-8}	4.44×10^{-8}	1.74×10^{-6}	4.52×10^{-7}	3.58×10^{-8}
Maximum		4.74×10^{-6}	1.57×10^{-6}	1.51×10^{-7}	2.29×10^{-7}	1.41×10^{-7}	1.86×10^{-7}	4.22×10^{-6}	8.21×10^{-7}	4.14×10^{-7}
Mean		3.00×10^{-6}	1.45×10^{-6}	6.29×10^{-8}	1.07×10^{-7}	1.22×10^{-7}	7.28×10^{-8}	2.69×10^{-6}	1.24×10^{-6}	7.41×10^{-8}
			^{40}K			**^{60}Co**				
CBD	1	4.07×10^{-4}	3.32×10^{-4}	3.89×10^{-4}	3.07×10^{-5}	3.34×10^{-5}	3.96×10^{-5}			
CBD	2	4.00×10^{-4}	2.39×10^{-4}	3.22×10^{-4}	2.75×10^{-5}	2.38×10^{-5}	3.10×10^{-5}			
CBD	3	2.49×10^{-4}	1.85×10^{-4}	2.36×10^{-4}	-1.28×10^{-5}	2.12×10^{-5}	2.22×10^{-5}			
CBD	4	2.89×10^{-4}	1.89×10^{-4}	2.44×10^{-4}	1.26×10^{-5}	1.96×10^{-5}	2.37×10^{-5}			
MLR	1	2.66×10^{-4}	1.13×10^{-4}	1.48×10^{-4}	4.22×10^{-6}	1.82×10^{-5}	2.12×10^{-5}			
MLR	2	1.12×10^{-4}	2.93×10^{-4}	3.51×10^{-4}	9.58×10^{-6}	2.84×10^{-5}	3.41×10^{-5}			
MLR	3	2.57×10^{-4}	3.79×10^{-4}	4.30×10^{-4}	3.47×10^{-5}	3.87×10^{-5}	4.30×10^{-5}			
MLR	4	3.09×10^{-4}	2.57×10^{-4}	4.03×10^{-4}	2.17×10^{-5}	3.76×10^{-5}	4.10×10^{-5}			
SEC	1	2.12×10^{-4}	3.09×10^{-4}	3.56×10^{-4}	4.40×10^{-6}	3.06×10^{-5}	3.52×10^{-5}			
SEC	2	1.33×10^{-4}	8.51×10^{-4}	1.23×10^{-4}	5.85×10^{-6}	1.88×10^{-5}	2.22×10^{-5}			
SEC	3	2.51×10^{-4}	1.16×10^{-4}	1.49×10^{-4}	-6.77×10^{-6}	2.52×10^{-5}	2.80×10^{-5}			
SEC	4	1.26×10^{-4}	1.54×10^{-4}	2.47×10^{-4}	4.08×10^{-6}	2.43×10^{-5}	2.87×10^{-5}			
SMR	1	1.92×10^{-4}	1.12×10^{-4}	1.55×10^{-4}	1.39×10^{-5}	2.34×10^{-5}	2.94×10^{-5}			
SMR	2	2.54×10^{-4}	1.14×10^{-4}	1.54×10^{-4}	-7.66×10^{-6}	2.08×10^{-5}	2.25×10^{-5}			
SMR	3	2.80×10^{-4}	3.56×10^{-4}	4.05×10^{-4}	3.57×10^{-5}	3.76×10^{-5}	4.30×10^{-5}			
SMR	4	3.77×10^{-4}	1.67×10^{-4}	2.34×10^{-4}	5.13×10^{-5}	3.35×10^{-5}	3.66×10^{-5}			
WEE	1	2.26×10^{-4}	1.00×10^{-4}	1.31×10^{-4}	8.88×10^{-6}	1.83×10^{-5}	2.18×10^{-5}			
WEE	2	2.02×10^{-4}	2.48×10^{-4}	3.12×10^{-4}	1.21×10^{-5}	2.62×10^{-5}	3.17×10^{-5}			
WEE	3	1.60×10^{-4}	9.78×10^{-5}	1.42×10^{-4}	-3.42×10^{-7}	1.96×10^{-5}	2.23×10^{-5}			
WEE	4	4.15×10^{-4}	1.71×10^{-4}	2.36×10^{-4}	2.60×10^{-5}	3.32×10^{-5}	3.76×10^{-5}			
WFF	1	2.05×10^{-4}	1.14×10^{-4}	1.63×10^{-4}	-7.77×10^{-6}	2.21×10^{-5}	2.38×10^{-5}			
WFF	2	1.57×10^{-4}	1.12×10^{-4}	1.69×10^{-4}	-1.99×10^{-6}	2.12×10^{-5}	2.37×10^{-5}			
WFF	3	6.69×10^{-4}	3.31×10^{-4}	3.90×10^{-4}	3.72×10^{-5}	3.50×10^{-5}	3.91×10^{-5}			
WFF	4	3.20×10^{-4}	1.74×10^{-4}	2.33×10^{-4}	-3.41×10^{-6}	2.11×10^{-5}	2.32×10^{-5}			
WSS	1	4.03×10^{-4}	3.25×10^{-4}	3.81×10^{-4}	5.40×10^{-7}	3.19×10^{-5}	3.63×10^{-5}			
WSS	2	2.11×10^{-4}	1.09×10^{-4}	1.52×10^{-4}	7.29×10^{-6}	1.87×10^{-5}	2.22×10^{-5}			

Table G.1 - Radionuclide Concentrations (Bq/m^3) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN][a]	2xTPU[b]	MDC[c]	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC
WSS	3	2.27×10^{-4}	2.57×10^{-4}	3.24×10^{-4}	3.31×10^{-5}	2.41×10^{-5}	3.20×10^{-5}			
WSS	4	1.87×10^{-4}	2.42×10^{-4}	3.01×10^{-4}	3.53×10^{-6}	2.30×10^{-5}	2.71×10^{-5}			
WAB	1	1.20×10^{0}	7.70×10^{-1}	1.13×10^{0}	6.03×10^{-2}	1.45×10^{-1}	1.72×10^{-1}			
WAB	2	1.59×10^{0}	1.23×10^{0}	1.88×10^{0}	3.47×10^{-2}	1.76×10^{-1}	2.09×10^{-1}			
WAB	3	4.39×10^{0}	2.52×10^{0}	2.94×10^{0}	1.04×10^{-1}	2.67×10^{-1}	2.91×10^{-1}			
WAB	4	9.10×10^{-1}	2.50×10^{0}	2.82×10^{0}	3.68×10^{-1}	2.64×10^{-1}	2.98×10^{-1}			
Minimum		1.12×10^{-4}	2.93×10^{-4}	1.23×10^{-4}	-1.28×10^{-5}	2.12×10^{-5}	2.12×10^{-5}			
Maximum		6.69×10^{-4}	3.31×10^{-4}	4.30×10^{-4}	3.72×10^{-5}	3.50×10^{-5}	4.30×10^{-5}			
Mean		2.68×10^{-4}	2.30×10^{-4}	2.60×10^{-4}	1.06×10^{-5}	2.88×10^{-5}	3.01×10^{-5}			
			^{90}Sr			**^{137}Cs**				
CBD	1	-1.59×10^{-6}	3.19×10^{-6}	5.44×10^{-6}	-5.07×10^{-5}	3.57×10^{-5}	3.53×10^{-5}			
CBD	2	1.08×10^{-6}	2.80×10^{-6}	4.85×10^{-6}	5.00×10^{-6}	2.32×10^{-6}	2.64×10^{-6}			
CBD	3	3.55×10^{-6}	2.41×10^{-6}	3.89×10^{-6}	3.50×10^{-6}	1.45×10^{-5}	1.74×10^{-5}			
CBD	4	-5.47×10^{-7}	3.68×10^{-6}	6.35×10^{-6}	1.20×10^{-6}	1.53×10^{-5}	1.80×10^{-5}			
MLR	1	-1.86×10^{-6}	2.88×10^{-6}	4.92×10^{-6}	5.96×10^{-6}	1.41×10^{-5}	1.70×10^{-5}			
MLR	2	8.14×10^{-7}	3.08×10^{-6}	5.37×10^{-6}	2.13×10^{-5}	2.57×10^{-5}	3.03×10^{-5}			
MLR	3	3.39×10^{-6}	2.74×10^{-6}	4.48×10^{-6}	-2.27×10^{-5}	3.90×10^{-5}	3.99×10^{-5}			
MLR	4	5.89×10^{-8}	3.61×10^{-6}	6.17×10^{-6}	-3.72×10^{-5}	3.46×10^{-5}	3.65×10^{-5}			
SEC	1	-2.13×10^{-6}	2.84×10^{-6}	4.88×10^{-6}	-1.53×10^{-5}	3.13×10^{-5}	3.35×10^{-5}			
SEC	2	1.55×10^{-6}	2.42×10^{-6}	4.14×10^{-6}	1.31×10^{-5}	1.44×10^{-5}	1.78×10^{-5}			
SEC	3	1.69×10^{-6}	2.30×10^{-6}	3.85×10^{-6}	1.74×10^{-5}	2.11×10^{-5}	2.49×10^{-5}			
SEC	4	-1.22×10^{-6}	3.46×10^{-6}	6.01×10^{-6}	-1.02×10^{-5}	2.33×10^{-5}	2.51×10^{-5}			
SMR	1	-4.77×10^{-7}	3.23×10^{-6}	5.40×10^{-6}	-1.94×10^{-5}	2.45×10^{-5}	2.53×10^{-5}			
SMR	2	3.74×10^{-6}	2.49×10^{-6}	4.07×10^{-6}	9.62×10^{-6}	1.47×10^{-5}	1.79×10^{-5}			
SMR	3	2.48×10^{-6}	2.27×10^{-6}	2.93×10^{-6}	-5.44×10^{-5}	3.83×10^{-5}	3.87×10^{-5}			
SMR	4	-5.31×10^{-7}	3.60×10^{-6}	6.20×10^{-6}	-1.52×10^{-5}	3.06×10^{-5}	3.37×10^{-5}			
WEE	1	-2.28×10^{-6}	2.79×10^{-6}	4.81×10^{-6}	2.08×10^{-5}	1.38×10^{-5}	1.75×10^{-5}			
WEE	2	1.91×10^{-6}	2.61×10^{-6}	4.44×10^{-6}	1.28×10^{-5}	2.41×10^{-5}	2.80×10^{-5}			
WEE	3	4.02×10^{-6}	2.50×10^{-6}	4.00×10^{-6}	-1.59×10^{-6}	1.55×10^{-5}	1.81×10^{-5}			
WEE	4	7.27×10^{-7}	3.54×10^{-6}	6.00×10^{-6}	-5.19×10^{-5}	3.39×10^{-5}	3.41×10^{-5}			
WFF	1	-1.77×10^{-7}	3.26×10^{-6}	5.44×10^{-6}	-8.77×10^{-7}	1.61×10^{-5}	1.88×10^{-5}			
WFF	2	3.52×10^{-6}	2.69×10^{-6}	4.44×10^{-6}	1.04×10^{-6}	1.58×10^{-5}	1.88×10^{-5}			
WFF	3	2.60×10^{-6}	2.28×10^{-6}	3.94×10^{-6}	-1.83×10^{-5}	3.53×10^{-5}	3.63×10^{-5}			
WFF	4	1.01×10^{-6}	3.71×10^{-6}	6.28×10^{-6}	-4.84×10^{-6}	1.52×10^{-5}	1.73×10^{-5}			

Table G.1 - Radionuclide Concentrations (Bq/m^3) in Quarterly Composite Air Filters Collected from Locations Surrounding the WIPP Site. See Appendix B for the sampling locations.

Location	Quarter	[RN][a]	2xTPU[b]	MDC[c]	[RN]	2xTPU	MDC	[RN]	2xTPU	MDC
WSS	1	-1.21×10^{-6}	3.36×10^{-6}	5.70×10^{-6}	-5.99×10^{-5}	3.74×10^{-5}	3.61×10^{-5}			
WSS	2	1.48×10^{-6}	2.48×10^{-6}	4.26×10^{-6}	-2.75×10^{-7}	1.51×10^{-5}	1.77×10^{-5}			
WSS	3	1.92×10^{-6}	2.69×10^{-6}	4.51×10^{-6}	-1.10×10^{-5}	2.54×10^{-5}	2.73×10^{-5}			
WSS	4	-1.55×10^{-6}	3.54×10^{-6}	6.15×10^{-6}	7.02×10^{-6}	2.18×10^{-5}	2.51×10^{-5}			
WAB	1	9.99×10^{-4}	2.27×10^{-2}	3.92×10^{-2}	-5.85×10^{-3}	1.08×10^{-1}	1.27×10^{-1}			
WAB	2	-2.42×10^{-3}	1.31×10^{-2}	2.25×10^{-2}	1.65×10^{-1}	1.55×10^{-1}	1.85×10^{-1}			
WAB	3	2.31×10^{-2}	2.06×10^{-2}	3.39×10^{-2}	-3.31×10^{-1}	2.79×10^{-1}	2.70×10^{-1}			
WAB	4	1.48×10^{-3}	2.49×10^{-2}	4.24×10^{-2}	-2.77×10^{-2}	2.57×10^{-1}	2.72×10^{-1}			
Minimum		-2.28×10^{-6}	2.79×10^{-6}	2.93×10^{-6}	-5.99×10^{-5}	3.74×10^{-5}	1.70×10^{-5}			
Maximum		4.02×10^{-6}	2.50×10^{-6}	6.35×10^{-6}	2.13×10^{-5}	2.57×10^{-5}	3.99×10^{-5}			
Mean		7.01×10^{-7}	3.76×10^{-6}	4.96×10^{-6}	-9.11×10^{-6}	4.55×10^{-5}	2.62×10^{-5}			

[a] Radionuclide concentration
[b] Total Propagated uncertainty
[c] Minimum detectable concentration
[d] Arithmetic average concentration and MDC; TPU equals the standard deviation of the mean.

Note: An anomaly in the Canberra software for the alpha spectrometer prevents it from calculating uncertainty when the activity is 0.

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