LANL Groundwater, HWP Meeting Notes General

Los Alamos National Laboratory
Groundwater Protection Program
Quarterly Meeting
January 28, 2004
Agenda (with Handouts Attached)

(~40 people in attendance)

Wednesday, January 28
Courtyard by Marriott, 3347 Cerrillos Road, Santa Fe, New Mexico

9:00 Introduction and Agenda (C. Nylander)

9:15 Status of Wells (T. Whitacre)

9:45 Water Quality Sampling Results (P. Longmire and ~~A.~~ Armand Groffman) (→No Handouts)

→ CdVi field screening results? any screening from 2003 wells? (none yet)

10:15 Break

10:30 Los Alamos and Pueblo Groundwater Investigation Work Plan Addendum (P. Longmire)

11:00 Hydrogeologic Conceptual Model (B. Robinson)

11:30 Hydrogeologic Workplan Final Report (B. Robinson)

12:00 DP Canyon Tracer Study (A. Groffman) (no Handouts)

12:30 Adjourn

Data Trends: (A. Groffman)

10/20/03 MCO-7,4 ClO_4^- decreasing since 1995 (But methods have changed / data may not be comparable)

2002-2003 CdV-37-2 Fe, Mn above standards in top screen

since 10/02 - TA-50 effluent: ClO_4^- not detectable in effluent

13829

PRB in Mortandad Canyon

- last sampling event in Sept. 2003: composite sample from all wells in PRB, because very little water in each well
- PRB will only work if there is water running through it

1/28/04

AQUEOUS SPECIATION OF DISSOLVED CONTAMINANTS OBSERVED IN GROUNDWATER[1], LOS ALAMOS NATIONAL LABORATORY (P. Longmire, 01/28/04)

Contaminant	Calculated Speciation	Distribution (%)
Perchlorate	ClO_4^-	100 → (i.e. if perchlorate is found in groundwater, 100% of the perchlorate will be in this form (ClO_4^-))
Nitrate	NO_3^-	100
Barium	Ba^{2+}	100
RDX	$C_3H_6N_6O_6^0$	100
TNT	$C_7H_5N_3O_6^0$	100

1. The computer program MINTEQA2 was used for the simulation (nitrate and barium). Concentrations of Ba, Ca, Mg, Na, K, Cl, NO_3, SO_4, and HCO_3 (calculated) are (mg/L): 0.010, 16.0, 5.0, 15.0, 3.0, 15.6, 0.10, 7.99, and 61, respectively. pH = 6.71. Charge balance = -2.39%. Mineral precipitation limits dissolved concentrations of Ba in groundwater. Barium undergoes weak cation exchange and can precipitate as $BaSO_4$ and $BaCO_3$.

General

CONCEPTUAL MODEL OF ADSORPTION OF ANIONS AND CATIONS ONTO HYDROGEOLOGICAL MEDIA AT pH 7 (P. Longmire, 01/28/04)

Adsorbent (solid)	Hydrogeologic Media	Anions	Cations
Silica Glass	Bandelier Tuff pumice-rich seds	very limited	strong
Clay Minerals Smectite Kaolinite	Bandelier Tuff, Cerros del Rio basalt, Puye Fm	limited	strong
Iron-Manganese Oxyhydroxides	Bandelier Tuff, Cerros del Rio basalt, Puye Fm, Santa Fe Group	limited	strong
Calcite	Cerros del Rio Basalt, Puye Fm, Santa Fe Group	moderate	moderate

Anions: phosphate, arsenate, chromate, molybdate, arsenite, flouride, sulfate, uranium(VI) nitrate, nitrite, and perchlorate [weakest adsorbing]

Cations: metals (Al, Ba, Be, Cd, Co, Hg, Ni, Pb, Zn)[variable adsorption],

Radionuclides: Am-241, Cs-137, Pu-238, Pu-239,240, Sr-90, U-234,235,238, Tc-99, H-3 [weakest adsorption]

High explosive (HE) compounds: TNT, RDX, and HMX and HE degradation products (2-A-4,6 dinitrotoluene [2-ADNT] and 4-A-2,6-dinitrotoluene [4-ADNT] are mobile in the subsurface at LANL due to limited adsorption. Biodegradation of TNT, 2-ADNT, and 4-ADNT is observed.

Well Drilling Status Report

January 28, 2004

Tom Whitacre
DOE Project Director

Los Alamos Site Office

Overview

- Technical Approach
- Drilling Accomplishments
- Well Development and Testing Activities
- Remaining Field Work
- Reporting Activities

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Technical Approach

- Multiple drilling systems and rigs onsite
  - Air Rotary System
  - Mud Rotary System
  - Casing Advance System
- Perched water detection
  - Bromide fluid sensor system
  - Tripping out entire casing string each night
  - Piezometer installation in selected cored boreholes → monitoring water levels in piezos
- Well developed soon after completion
- Reports and Fact Sheets contract deliverables

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Drilling Accomplishments

- R-1 – Mortandad Canyon – 1165 feet – 1 screen
  350 feet core – open hole geophysics suite
- R-2 – Pueblo Canyon - 943 feet - 1 screen
  228 feet core – open hole geophysics suite
- R-4 – Pueblo Canyon - 844 feet - 1 screen
  243 feet core – open hole geophysics suite
- R-11 – Sandia Canyon – 927 feet - 1 screen
  224 feet core – open hole geophysics suite
- R-26 – Canyon de Valle – 1485 feet - 2 screens
  250 feet core – open hole geophysics suite

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all core holes were drilled dry

Drilling Accomplishments (Con't)

- R-28 – Mortandad Canyon – 1006 feet – 1 screen
  315 feet core – open hole geophysics suite
- CdV-16-1(I) – TA-16 – 680 feet – 1 screen
  200 feet core – open hole geophysics suite
- CdV-16-2(I) – TA-16 – 1063 feet – 2 screens @962' had water level
  no core collected – open hole geophysics suite
- CdV-16-3(I) – TA-16 – 1405 feet – no regional water saturation – no well installed – no core collected - open hole geophysics suite

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5

Well Development and Testing Activities

- R-1 – development and hydrotesting completed
  about 25,000 gallons removed
- R-2 – development and hydrotesting completed
  about 14,000 gallons removed
- R-4 – development and hydrotesting completed
  about 24,000 gallons removed
- R-11 – development and hydrotesting completed
  about 26,000 gallons removed

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6

LANL plans to monitor CdV2i + CdV3i over the next few months to see if there is any groundwater in either well; then they will consult w/ the state regarding what to do next (maybe drill deeper)

Well Development and Testing Activities (Con't)

- R-26 – development completed – awaiting hydrotesting – about 37,000 gallons removed
- R-28 – development and hydrotesting completed about 15,000 gallons removed
- CdV-16-1(I) – development completed – awaiting hydrotesting - about 5500 gallons removed

* Remaining Field Work

- Hydrotesting – R-26 and CdV-16-1(I) - 2/04
- Sampling Pump Installation – R-1, R-2, R-4, R-11, R-28, and CdV-16-1(I) – 2/04
- Westbay Installation – R-26 – 2/04
- Water level detection – CdV-16-2(I) and 16-3(I) - ongoing
- Site Restoration – All nine drill sites – 3/04

* Reporting Activities

- R-1 – Well completed 11/03
  - Fact Sheet submitted to NMED
  - Well Completion Report due 4/04
- R-2 – Well completed 10/03
  - Fact Sheet submitted to NMED
  - Well Completion Report due 3/04
- R-4 – Well completed 10/03
  - Fact Sheet submitted to NMED
  - Well Completion Report due 3/04

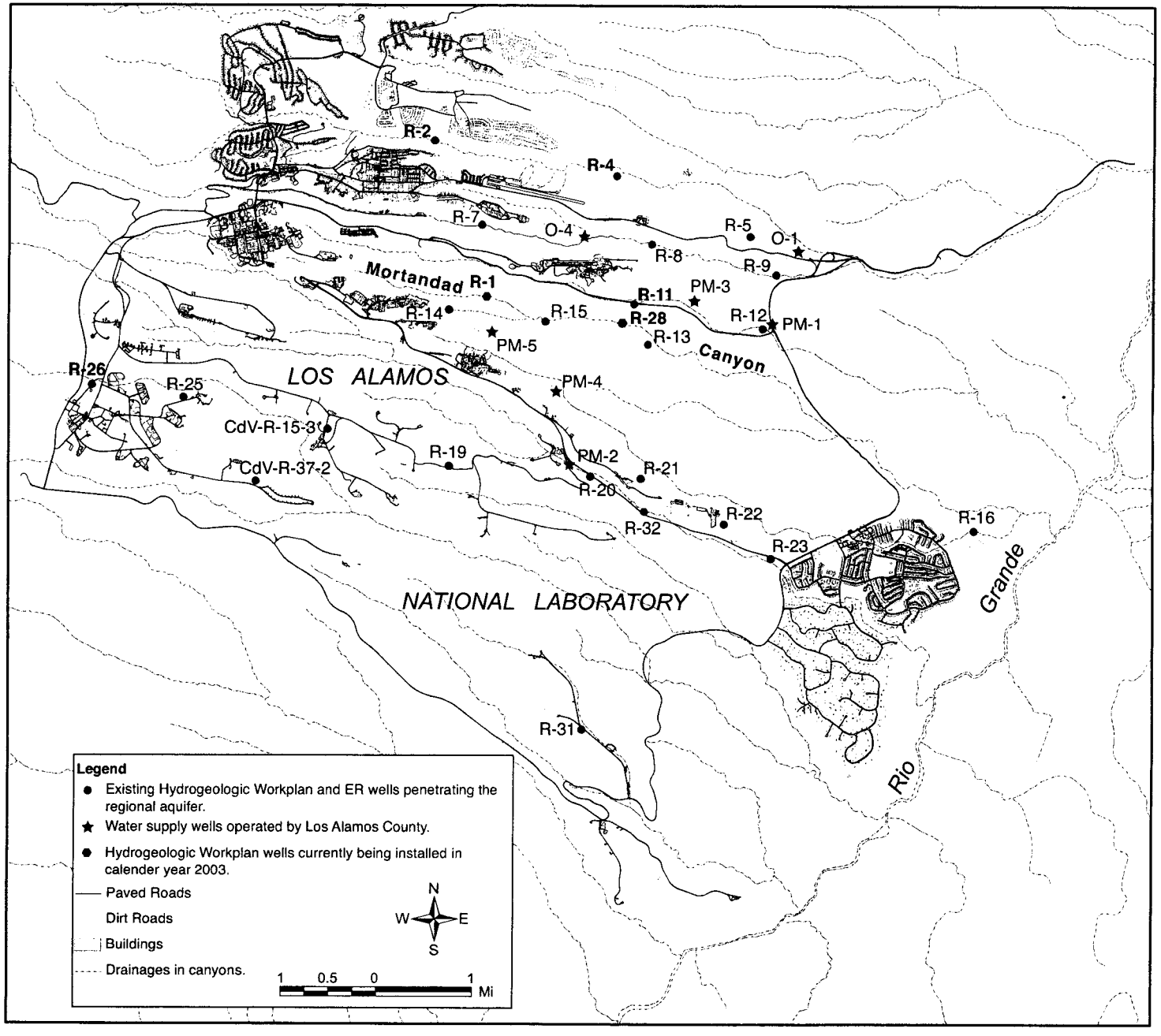
Reporting Activities (Con't)

- R-11 – Well completed 9/03
  - Fact Sheet submitted to NMED
  - Well Completion Report due 2/04
- R-26 – Well completed 10/03
  - Fact Sheet submitted to NMED
  - Well Completion Report due 3/04
- R-28 – Well completed 12/03
  - Fact Sheet due 2/04
  - Well Completion Report due 5/04

Reporting Activities (Con't)

one Report

- CdV-16-1(I) – Well completed 11/03
  - Fact Sheet due 2/04
  - Well Completion Report due 5/04
- CdV-16-2(I) – Well completed 12/03
  - Fact Sheet due 2/04
  - Well Completion Report due 5/04
- CdV-16-3(I) – Borehole completed 1/04
  - Fact Sheet due 3/04
  - Well Completion Report due 5/04


R-2
R-4
R-7
O-4
R-5
O-1
R-8
R-9
Mortandad
R-1
R-11
PM-3
R-14
R-15
R-28
R-12
PM-1
PM-5
R-13
Canyon
R-26
R-25
LOS ALAMOS
PM-4
CdV-R-15-3
R-19
PM-2
R-21
CdV-R-37-2
R-20
R-22
R-16
R-32
R-23
Grande
NATIONAL LABORATORY
R-31
Rio
Legend
Existing Hydrogeologic Workplan and ER wells penetrating the regional aquifer.
Water supply wells operated by Los Alamos County.
Hydrogeologic Workplan wells currently being installed in calender year 2003.
Paved Roads
Dirt Roads
Buildings
Drainages in canyons.
N
W
E
S
1
0.5
0
1
Mi

Location: Upper Mortandad Canyon - TA-5

Description: Brass Marker
Northing: Survey to be performed February 2004
Easting: Survey to be performed February 2004
Elevation: Survey to be performed February 2004

Description: Well Casing
Northing: Survey to be performed February 2004
Easting: Survey to be performed February 2004
Elevation: Survey to be performed February 2004

Description: Core Hole
Northing: Survey to be performed February 2004
Easting: Survey to be performed February 2004
Elevation: Survey to be performed February 2004

Coring:
(0' - 399') Continuous Sampler

Drilling:
(0' - 90') 13-3/8" Air Rotary Casing Hammer
(90' - 1165') 12-1/4" Mill-Tooth Tri-Cone

Data Collection:
- Hydrologic Properties:
  Proposed Constant Discharge
  Pumping Test - Scheduled for Jan. 2004
- Cores/Cuttings submitted for geochemical and contaminant characterization: 19
- Ground Water Samples Submitted
  Perched Ground Water - 11/01/03 (72.6')
  Regional Ground Water - 11/9/03 (1020')
  11/25/03 (1000')

Geologic Properties:
Minerology, petrography, and chemistry: 7

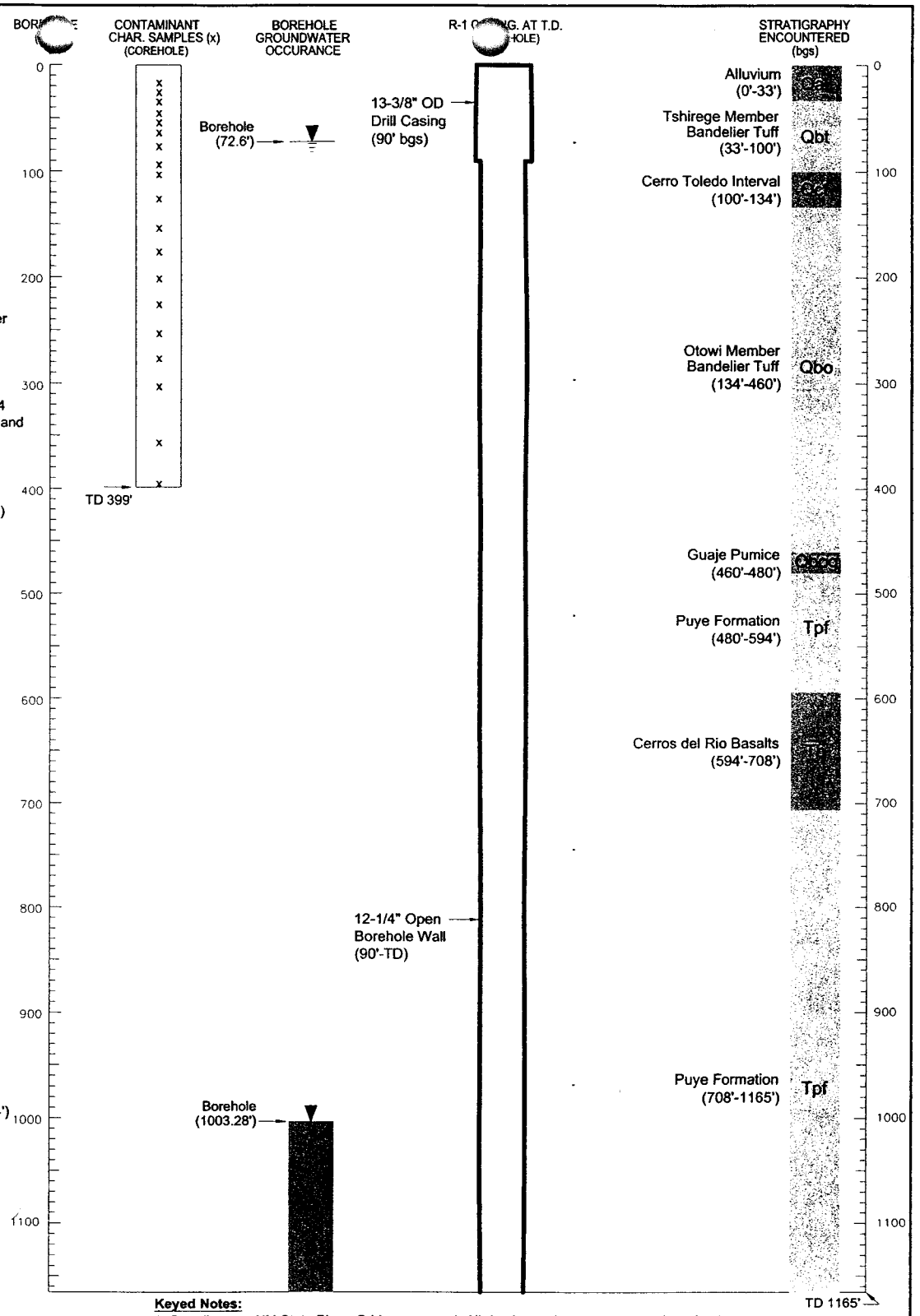
Borehole Logs:
- Lithologic: 0' - 1165'
- Video (LANL tool): 0' - 1000'
- Schlumberger logs:
  Compensated Neutron Log:
  Cased: 30'-90'; Open Hole: 90'-1165'
  Triple Litho-Density:
  Cased: 30'-90'; Open Hole: 90'-1165'
  Array Induction Imager:
  Cased: none; Open Hole: 90'-1135'
  Elemental Capture Sonde:
  Cased: none; Open Hole: 110'-1156'
  Natural GR Spectroscopy:
  Cased: none; Open Hole: 90'-1142'
  Combinable Magnetic Resonance:
  Cased: none; Open Hole: 110'-1146'
  Fullbore Formation Micro Imager:
  Cased: none; Open Hole: 980'-1165'

Corehole Logs:
- Lithologic: 0' - 399'
- Video (LANL tool): None
- Gamma Ray (LANL Tool): 01/05/04

Core Drilling Completed: 12/01/03 - 12/17/03
Rotary Drilling Completed: 10/31/03 - 11/08/03
Contract Geophysics: 11/08/03
Well Installation: 11/10/03 - 11/14/03
Well Development Completed: 11/19/03 - 11/25/03

- Casing:
  4.5" I.D. / 5.0" O.D. A304 Stainless Steel casing with external couplings
- Number of Screens:
  One (1) 4.46" I.D./5.27" OD, Rod-based, with external couplings - (1031.1' - 1057.4') wire wrapped 0.020 slot stainless steel,

Well Development performed by swabbing, bailing, and pumping.
Total Volume Purged: 9,730 gallons



Geologic contacts are for R-1 deep borehole; contacts were determined from cuttings, borehole video, and geophysical logs. Note: Contacts for upper units in the R-1 corehole are slightly different from those shown here from the deep borehole.

Keyed Notes:

1. Coordinates - NM State Plane Grid Central Zone (North America) Datum - 1983 (NAD83); expressed in feet.
2. Elevations - National Geodetic Vertical Datum (NGVD 29); expressed in feet above mean sea level.
3. Surface completion and surveying to be performed February 2004.
4. All depths are below ground surface (bgs).
5. Post development groundwater level measurement recorded 12-20-03.
6. Groundwater measurement of 72.6' was made with 20' of 13-3/8" casing in place on November 1, 2003.
7. Drill casing removed during well installation.

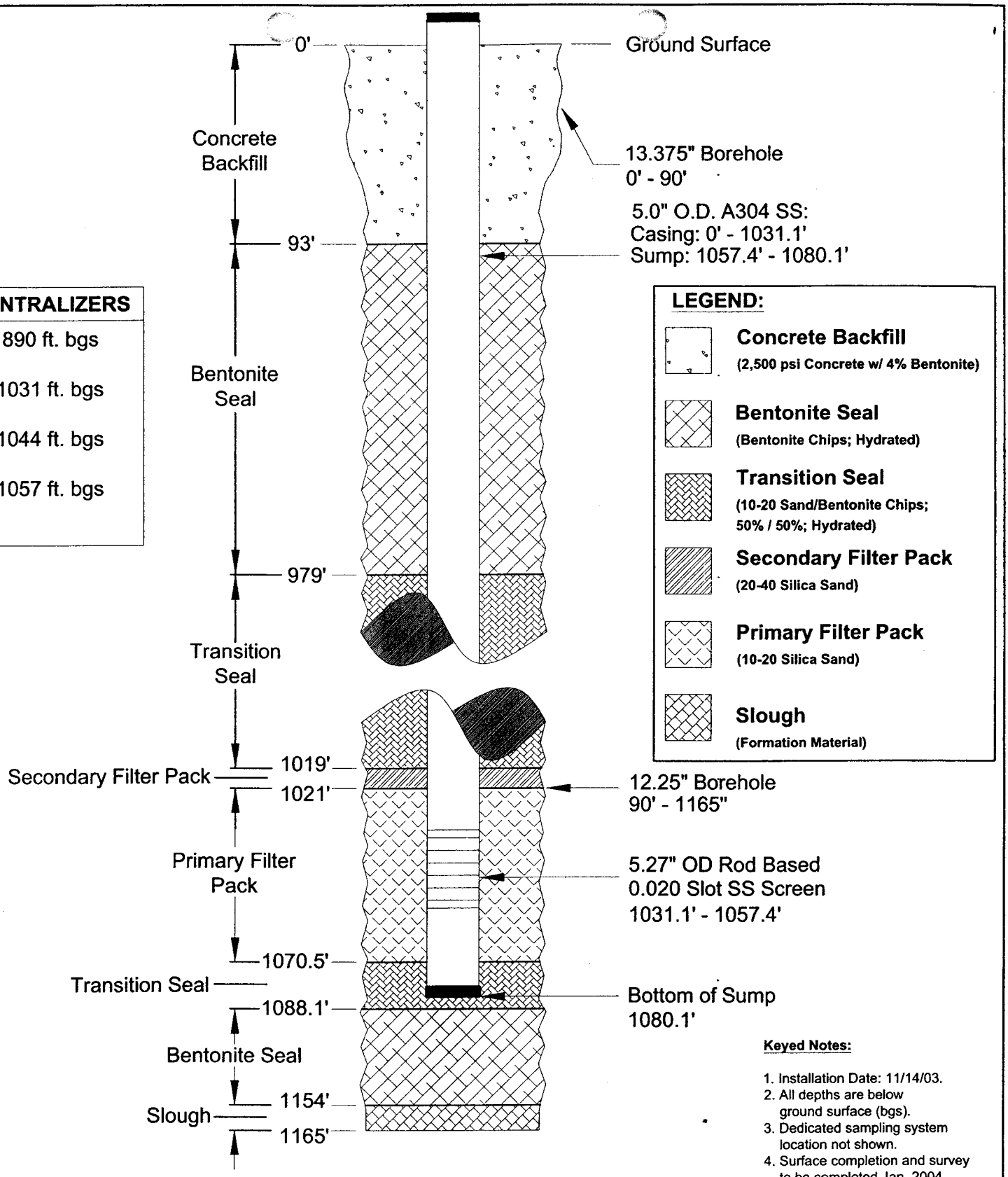
DCN: ALB04DR001 Rev.2

KLEINFELDER

Drawn By: C. Landon	Date: January 2004
Project No.: 37151	Filename: ALB04DR001 REV 2
Scale: Not-To-Scale	Revision: 2
Reviewed By: F. Schelby	Approved By: M. Everett

Construction, Stratigraphic, and Hydrogeologic Information for Characterization Well R-1
Los Alamos National Laboratory
Los Alamos, New Mexico

FIGURE
1



Keyed Notes:

1. Installation Date: 11/14/03.
2. All depths are below ground surface (bgs).
3. Dedicated sampling system location not shown.
4. Surface completion and survey to be completed Jan. 2004.
5. Screen depths are slotted intervals.
6. Drill casing removed during well construction.

DCN: ALB04DR002 Rev.2

KLEINFELDER		Schematic Diagram of Characterization Well R-1 Los Alamos National Laboratory Los Alamos, New Mexico	FIGURE 2
Drawn By: C. Landon	Date: January 2004		
Project No.: 37151	Filename: ALB04DR002 REV 2		
Scale: Not-To-Scale	Revision: 2		
Reviewed By: F. Schelby	Approved By: M. Everett		

Location: Upper Pueblo Canyon,
Los Alamos County Property

Description: Brass Marker
Northing: Survey to be performed January 2004
Easting: Survey to be performed January 2004
Elevation: Survey to be performed January 2004

Description: Well Casing
Northing: Survey to be performed January 2004
Easting: Survey to be performed January 2004
Elevation: Survey to be performed January 2004

Description: Core Hole
Northing: Survey to be performed January 2004
Easting: Survey to be performed January 2004
Elevation: Survey to be performed January 2004

Coring:
(0' - 16.5') Continuous Sampler
(16.5' - 24') Split Spoon
(24' - 29') Continuous Sampler
(29' - 34') Split Spoon
(34' - 39') Continuous Sampler
(39' - 241') Split Spoon

Drilling:
(0' - 40') 13-3/8" Air Rotary Casing Hammer
(40' - 944') 12-1/4" Mill-Tooth Tri-Cone
(40'-143') Air
(143'-403') Air with Water, QuickFoam, & E-Z Mud
(403'-944') Water with Bentonite, Soda Ash, & PAC-L

Data Collection:
- Hydrologic Properties:
  Proposed Constant Discharge
  Pumping Test: To be performed Jan. 2004
- Cores/Cuttings submitted for geochemical and contaminant characterization: 12
- Ground Water Samples Submitted
  Regional Ground Water - none; mud-filled borehole
  Perched Ground Water - none encountered

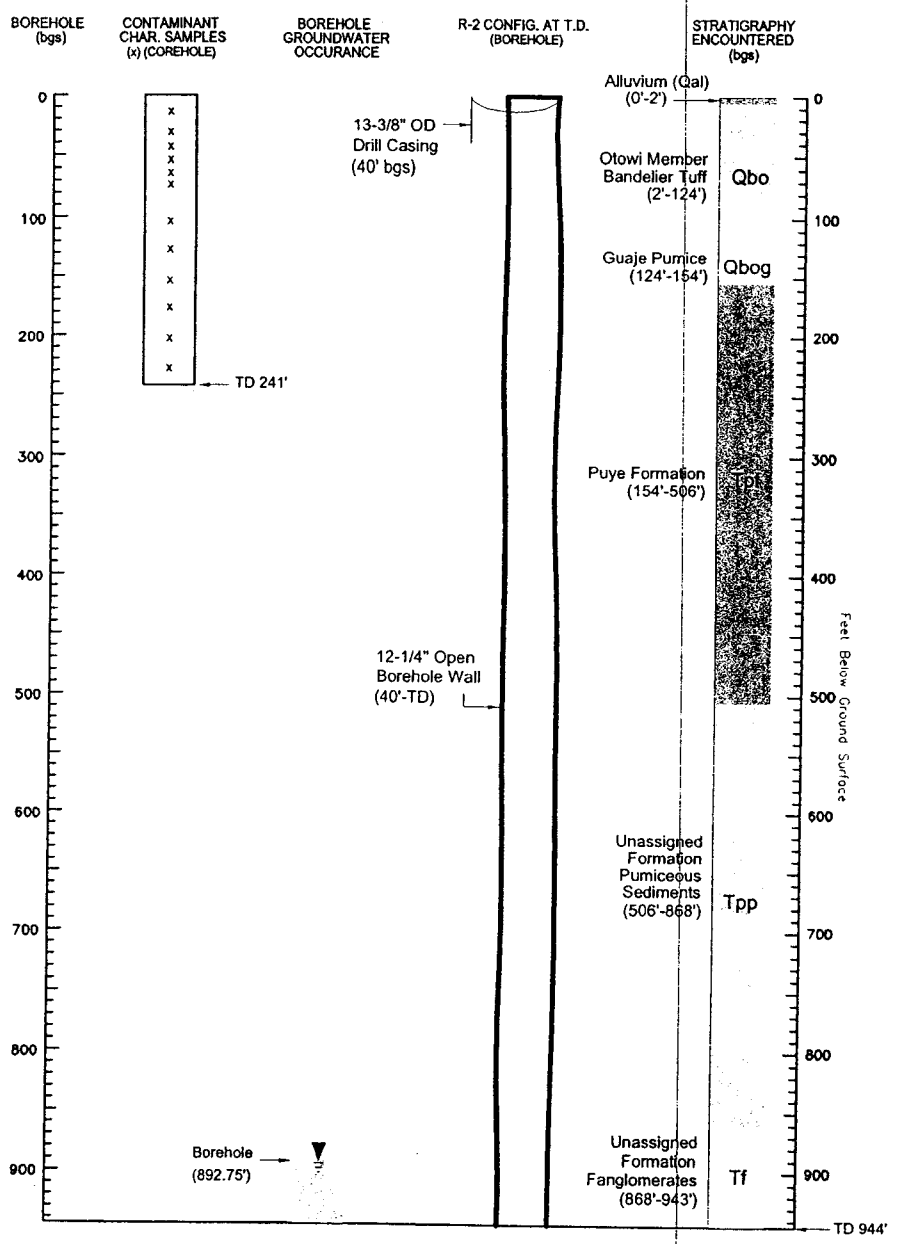
Geologic Properties:
Minerology, petrography, and chemistry: 7

Borehole Logs:
- Lithologic: 0' - 944'
- Video (LANL tool): none
- Schlumberger logs: mud filled borehole
  Compensated Neutron Log:
  Cased: 20'-40'; Open Hole: 40'-941'
  Triple Litho-Density:
  Cased: 20'-40'; Open Hole: 40'-941'
  Array Induction Imager:
  Cased: 20'-40'; Open Hole: 40'-936'
  Elemental Capture Sonde:
  Cased: none; Open Hole: 50'-937'
  Natural GR Spectroscopy:
  Cased: 20'-40'; Open Hole: 40'-919'
  Combinable Magnetic Resonance:
  Cased: none; Open Hole: 50'-919'
  Fullbore Formation Micro Imager:
  Cased: none; Open Hole: 50'-937'

Core Drilling Completed: 9/16/03 - 9/26/03
Rotary Drilling Completed: 10/11/03 - 10/16/03
Contract Geophysics: 10/17/03
Well Installation: 10/19/03 - 10/22/03
Well Development Completed: 12/11/03
- Casing:
  4.5" I.D. / 5.0" O.D. A304 Stainless Steel casing with external couplings
- Screen Type:
  One (1) 4.46" I.D./5.27" O.D. wire wrapped stainless steel rod-based 0.020 slot screen with external couplings.
- Screen Interval: 906.4' - 929.6'

Well Development performed by swabbing, bailing, and pumping.
Total Volume Purged:
Purged/Bailed - 375 Gal. (10/27/03)
Pumped - 10,940 Gal.

Geologic contacts for R-2 were determined from core samples, cuttings, and geophysical logs.

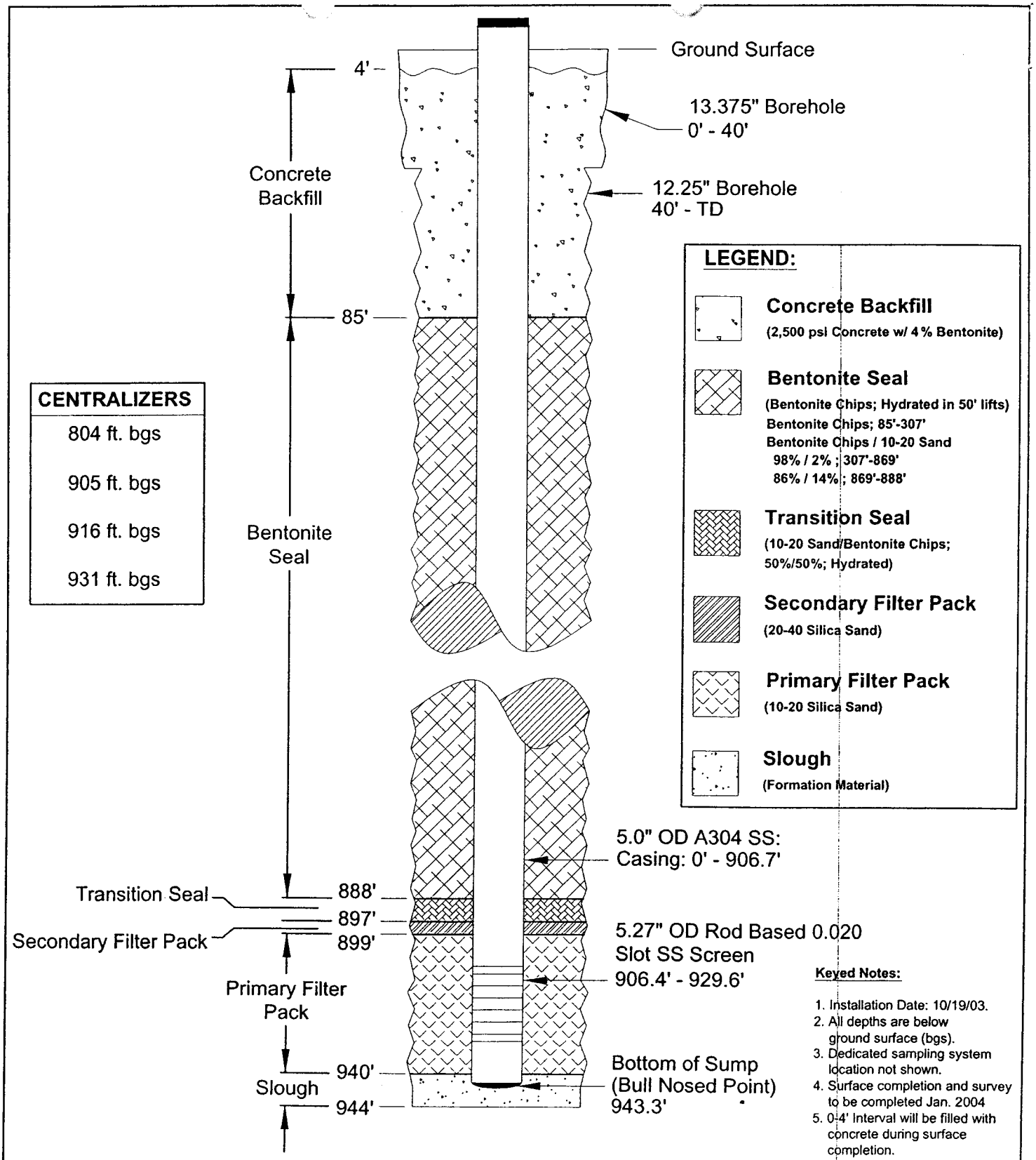


Keyed Notes:

1. Coordinates - NM State Plane Grid Central Zone (North America) Datum - 1983 (NAD83); expressed in feet.
2. Elevations - National Geodetic Vertical Datum (NGVD 29); expressed in feet above mean sea level.
3. Surface completion and surveying pending.
4. All depths are below ground surface (bgs).
5. Ground water level measured after well installation - 10-25-03

DCN: ALB03DR001 Rev 1

KLEINFELDER		Construction, Stratigraphic, and Hydrogeologic Information for Characterization Well R-2 Los Alamos National Laboratory Los Alamos, New Mexico	FIGURE 1
Drawn By: C. Landon	Date: December 2003		
Project No.: 37151	Filename: ALB03DR001 REV 1		
Scale: Not-To-Scale	Revision: 1		
Reviewed By: F. Schelby	Approved By: M. Everett		



CENTRALIZERS
804 ft. bgs
905 ft. bgs
916 ft. bgs
931 ft. bgs

Keyed Notes:

1. Installation Date: 10/19/03.
2. All depths are below ground surface (bgs).
3. Dedicated sampling system location not shown.
4. Surface completion and survey to be completed Jan. 2004
5. 0-4' Interval will be filled with concrete during surface completion.
6. Screen depths are slotted intervals.
7. Conductor casing removed.

DCN: ALB03DR002 Rev.1

KLEINFELDER

Drawn By: C. Landon	Date: December 2003
Project No.: 37151	Filename: ALB03DR002 REV 1
Scale: Not-To-Scale	Revision: 1
Reviewed By: F. Schelby	Approved By: M. Everett

Schematic Diagram of Characterization Well R-2
Los Alamos National Laboratory
Los Alamos, New Mexico

FIGURE
2

Location: At inactive emergency Landing Strip in Pueblo Canyon; TA-74

Survey Coordinates / Elevations:
- Coordinates: NAD83
- Elevation: NGVD29

Description: Brass Marker in Concrete Pad
Northing: 1776530.2840
Easting: 1639287.9770
Elevation: 6577.49

Description: Well Casing
Northing: 1776528.0041
Easting: 1639289.9809
Elevation: 6579.46

Description: Abandoned Borehole
Distance from Brass Marker: 125.35' South East

Description: Core Hole Piezometer - West
Distance from Brass Marker: 16.38' South East

Description: Core Hole Piezometer - East
Distance from Brass Marker: 16.47' South East

Coring:
(0'-68') Continuous Sampler
(68'-233') Split Spoon

Drilling: Completed Borehole
(0'-40') 13-3/8" Air Rotary Casing Hammer
(40'-266') 12.25" Milltooth Tri-Cone w/Foam
(266'-843') 12.25" Milltooth Tri-Cone w/Mud

Data Collection:
- Hydrologic Properties: Continuous Rate Pumping Test
- Cores/Cuttings submitted for geochemical and contaminant characterization: 11
- Ground Water Samples Submitted
  Regional Ground Water - 9/4/03 (835')
  Perched Ground Water - 9/9/03 (114'-125')

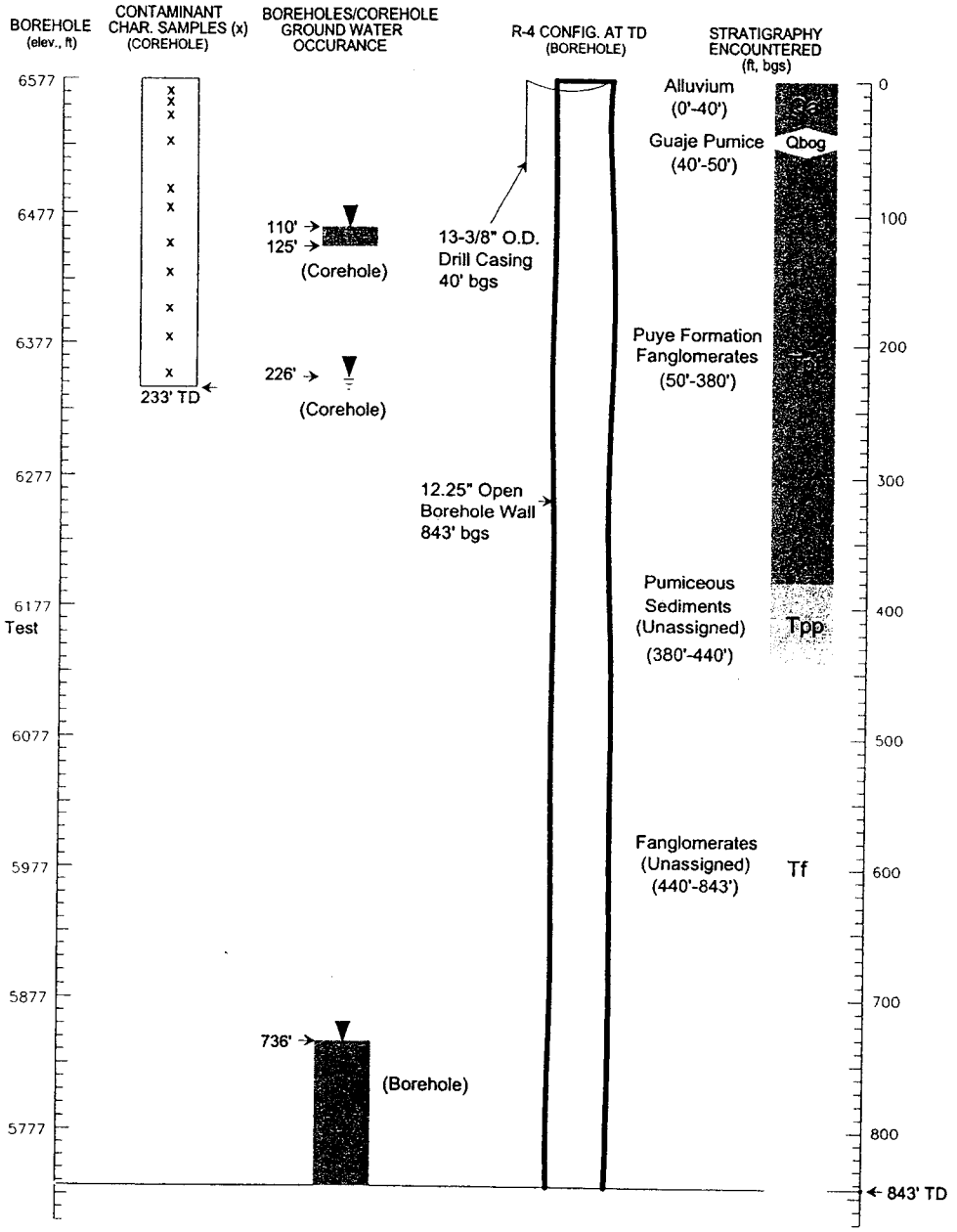
Geologic Properties:
Minerology, petrography, and chemistry: 7

Borehole Logs:
- Lithologic: 0'-843'
- Video (LANL tool):
  Corehole: 0' - 230'
  Abandoned Borehole: 0' - 173'
- Schlumberger logs:
  (Top of Drilling Fluid at 18' bgs)
  Compensated Neutron Tool: 6'-840'
  Triple Litho-Density: 4'-840'
  Array Induction Tool: 70'-840'
  Elemental Capture Spectroscopy: 6'-840'
  Natural Gamma Spectroscopy: 11'-826'
  Combinable Magnetic Resonance: 34'-820'
  Full-bore Formation Micro Imager: 96'-840'

Core Drilling Completed: 8/28/03 - 9/5/03
Rotary Drilling Completed: 9/16/03 - 9/26/03
Contract Geophysics: 9/27/03
Well Constructed: 9/28/03 - 10/3/03
Well Developed: 10/6/03 - 10/10/03
Well Completion:
- Casing - 4.46" ID / 5.0" OD A304 Stainless Steel casing with external couplings
- Number of Screens - One (1) 4.46" ID / 5.27" OD wire wrapped 0.020 slot stainless steel with external couplings
- Screen Interval - 792.9' - 816' bgs

Well development performed by swabbing, bailing, and pumping.
Total Volume Purged: 14,150 gal.

Geologic contacts for R-4 were determined from core samples, cuttings and geophysical logs.



Keyed Notes:

1. Coordinates - NM State Plane Grid Central Zone (North America), Datum - 1983 (NAD83); expressed in feet.
2. Elevations - National Geodetic Vertical Datum (NGVD29); expressed in feet above mean sea level.
3. All depths are below ground surface (bgs).

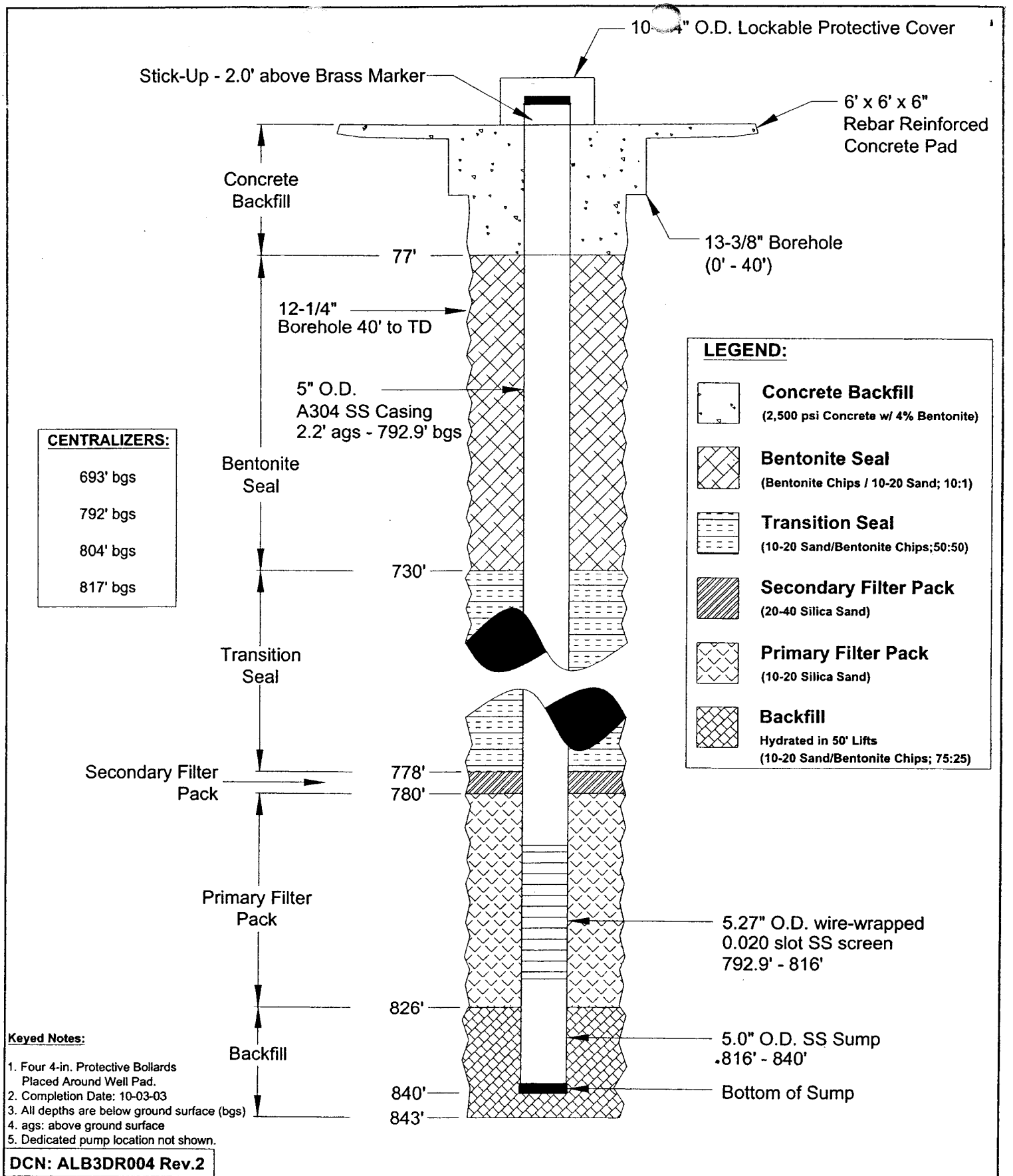
DCN: ALB3DR003 Rev.2

KLEINFELDER

Drawn By: C. Landon	Date: November 2003
Project No.: 37151	Filename: ALB3DR003 REV 2
Scale: Not-To-Scale	Revision: 2
Reviewed By: F. Schelby	Approved By: M. Everett

Construction, Stratigraphic, and Hydrogeologic Information for Characterization Well R-4
Los Alamos National Laboratory
Los Alamos, New Mexico

FIGURE
1



Keyed Notes:

1. Four 4-in. Protective Bollards Placed Around Well Pad.
2. Completion Date: 10-03-03
3. All depths are below ground surface (bgs)
4. ags: above ground surface
5. Dedicated pump location not shown.

DCN: ALB3DR004 Rev.2

KLEINFELDER		Schematic Diagram of Characterization Well R-4 Los Alamos National Laboratory Los Alamos, New Mexico	FIGURE 2
Drawn By: C. Landon	Date: November 2003		
Project No.: 37151	Filename: ALB3DR004 REV 2		
Scale: Not-To-Scale	Revision: 2		
Reviewed By: F. Schelby	Approved By: M. Everett		

Location: Southwest of TA-72 Firing Range in Sandia Canyon

Survey Coordinates:
(Brass marker in NW corner of R-11 well pad)
- Coordinates: NAD83
- Elevation: NGVD29

Description: Brass Marker in Concrete Pad
Northing: 1769344.02
Easting: 1640034.76
Elevation: 6672.43

Description: Well Casing
Northing: 1769341.35
Easting: 1640037.08
Elevation: 6674.94

Description: Core Hole
Northing: 1769363.10
Easting: 1639961.57
Elevation: 6673.20

Coring:
(0' - 180') Continuous Sampler
(180' - 268.5') HQ Coring
(268.5' - 274.5') Split Spoon
(274.5' - 296.5') HQ Coring

Drilling: (0' - 47') 24" Bucket Auger
(47' - 59') 13" Air Rotary Casing Hammer
(59' - 272') 12.25" Milltooth Tri-Cone
(272' - 926.5') 12.25" T1200 SD 12 Millennium Rotary Hammer

Data Collection:
Hydrologic Properties: Pending
Cores/Cuttings submitted for geochemical and contaminant characterization: 14

Geologic Properties:
Minerology, petrography, and chemistry: 7

Borehole Logs:
Lithologic: 0'-926.5'
Video (LANL tool):
0'-803' bgs & 0-921'-8" bgs (open hole)
Schlumberger logs:
Compensated Neutron Log: 15'-926'
Triple Litho-Density: 15'-922'
Array Induction Imager: 59'-916'
Elemental Capture Sonde: 50'-917'
Natural GR Spectroscopy: 30'-899'
Combinable Magnetic Resonance: 75'-903'
Fullbore Formation Micro Imager: 834'-924'

Core Drilling Completed: 8/18/03-8/26/03
Rotary Drilling Completed: 8/25/03-09/6/03
Contract Geophysics: 09/06/03-09/07/03
Well Constructed: 09/08/03-09/10/03
Well Developed: 09/23/03-09/28/03

Casing: 4.46" I.D. / 5.0" O.D. A304 Stainless Steel casing with external couplings

Number of Screens:
One (1) 4.46" I.D. / 5.27" O.D. wire wrapped 0.020 slot stainless steel with external couplings

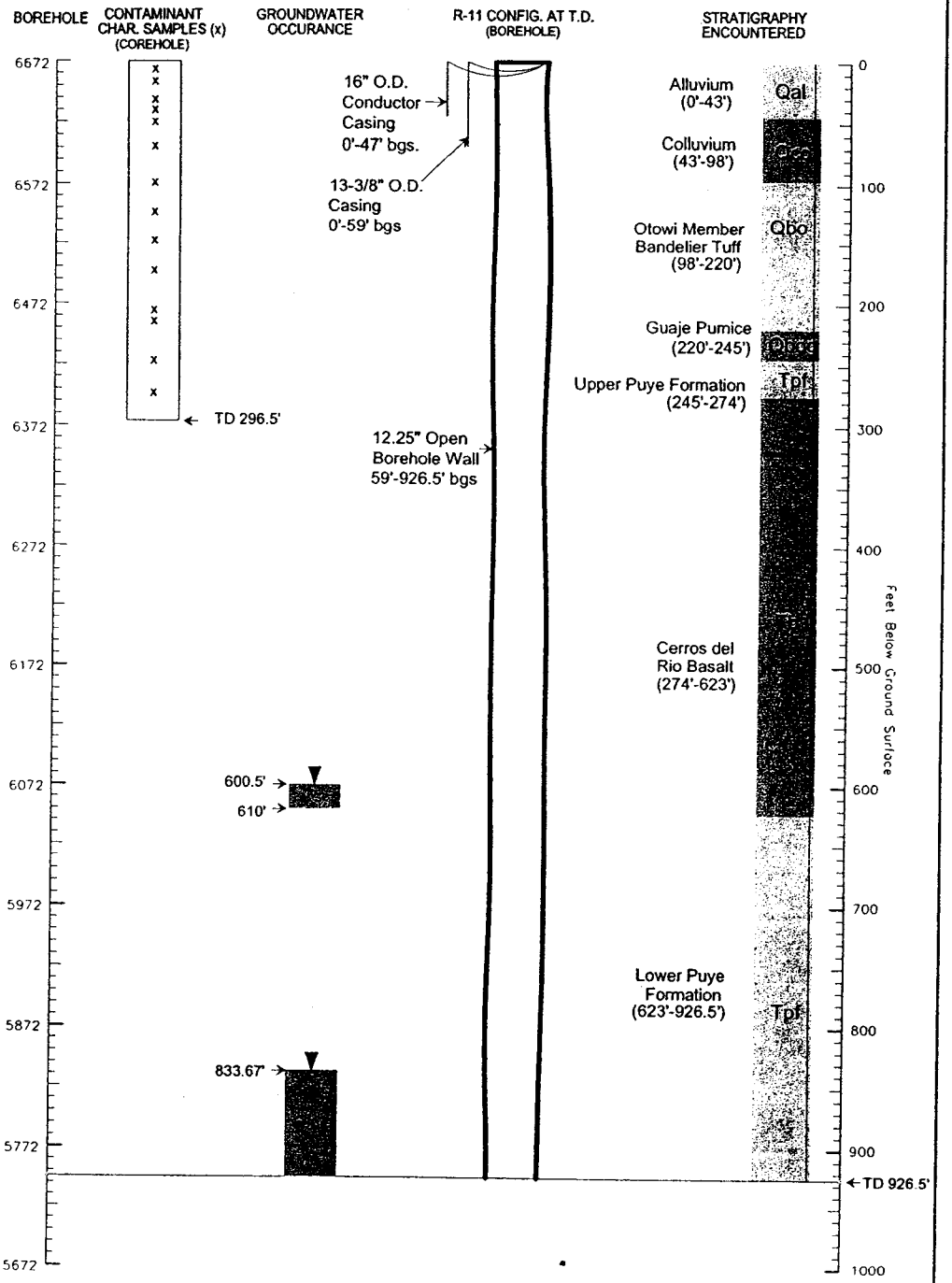
Screen Interval: 856.3'-878.5' bgs

Well Development performed by swabbing, bailing, and pumping.
Total Volume Purged: 18,970 gal.

Geologic contacts for R-11 were determined from core samples, cuttings, borehole video, and geophysical logs.

Keyed Notes:

1. Coordinates - NM State Plane Grid Central Zone (North America), Datum - 1983 (NAD83); expressed in feet.
2. Elevations - National Geodetic Vertical Datum (NGVD29); expressed in feet above mean sea level.
3. Main Borehole 10'-28' bgs spot recovery, 47'-58' bgs spot recovery, 85'-90' bgs no recovery, 245'-280' bgs no recovery, 380'-435' bgs no recovery, 653'-713' bgs no recovery, 733'-743' bgs no recovery, 748'-753' bgs no recovery



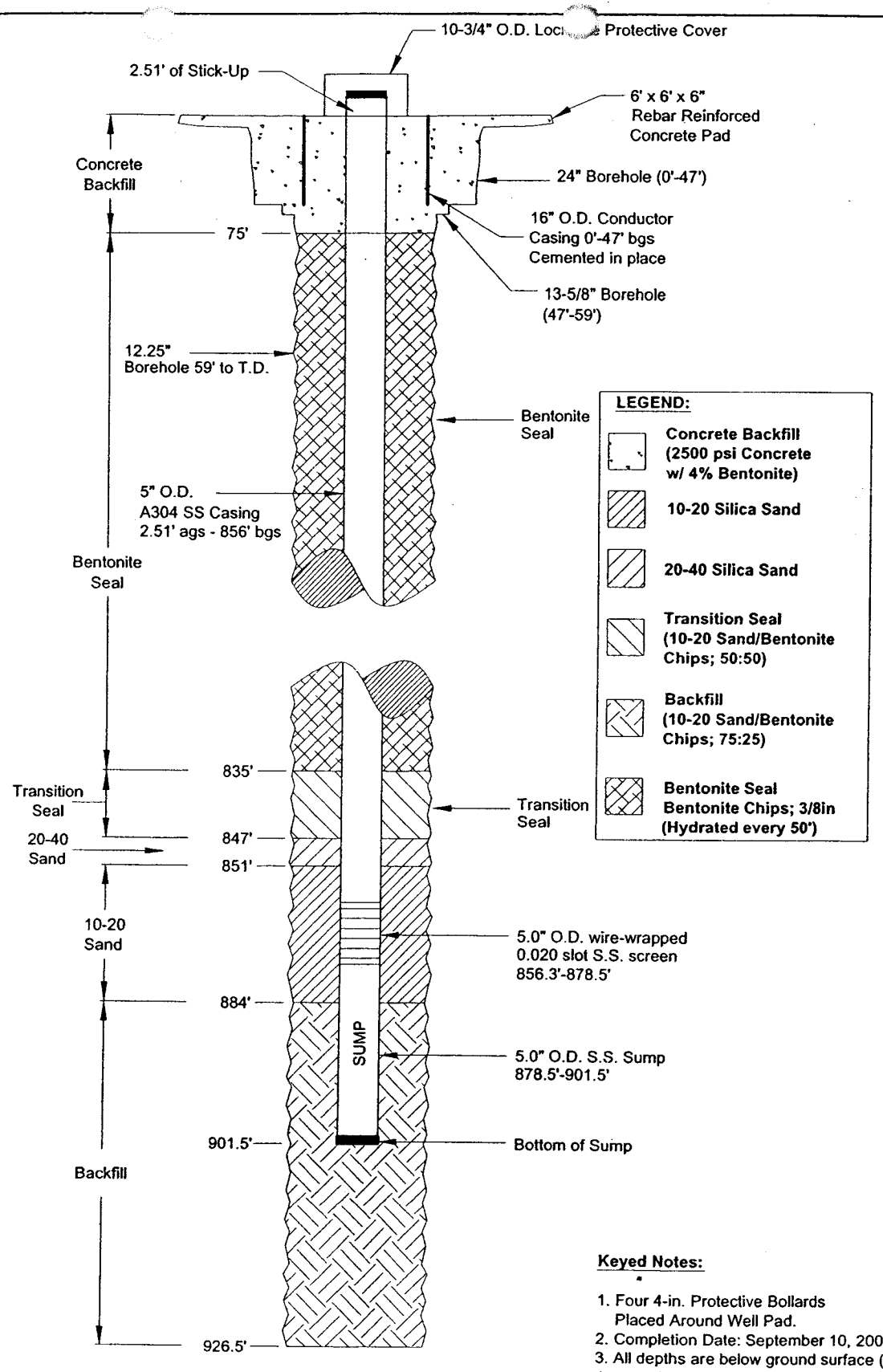
DCN: ALB3DR001 Rev. 3

KLEINFELDER

Drawn By: C. Landon	Date: October 2003
Project No.: 33220	Filename: ALB3DR001 REV 3
Scale: N/A	Revision: 3

Construction, Stratigraphic, and Hydrologic Information for Characterization Well R-11
Los Alamos National Laboratory
Los Alamos, New Mexico

FIGURE
1



Keyed Notes:

1. Four 4-in. Protective Bollards Placed Around Well Pad.
2. Completion Date: September 10, 2003.
3. All depths are below ground surface (bgs)
4. ags: above ground surface
5. Dedicated pump location not shown.

DCN: ALB3DR002 Rev. 3

KLEINFELDER		Schematic Diagram of Characterization Well - R-11 Los Alamos National Laboratory Los Alamos, New Mexico	FIGURE 2
Drawn By: C. Landon	Date: October 2003		
Project No.: 33220	Filename: ALB3DR002 REV 3		
Scale: N/A	Revision: 3		

Location: Mesa South of Cañon de Valle
(on down thrown side of Pajarito Fault) TA-16

Description: Brass Marker
Northing: Survey to be performed January, 2004
Easting: Survey to be performed January, 2004
Elevation: Survey to be performed January, 2004

Description: Well Casing
Northing: Survey to be performed January, 2004
Easting: Survey to be performed January, 2004
Elevation: Survey to be performed January, 2004

Description: Core Hole
Northing: Survey to be performed January, 2004
Easting: Survey to be performed January, 2004
Elevation: Survey to be performed January, 2004

Coring:
(0' - 19') Split Spoon
(19' - 25') Continuous Sampler
(25' - 55') HQ Coring
(55' - 62.5') Split Spoon
(62.5' - 250') HQ Coring

Drilling:
(0' - 77') 13-3/8" Air Rotary Casing Hammer
(77' - 140') 12-1/4" Tri-Cone
(140' - 205') 12-1/4" Downhole Hammer
(205' - 1005') 12-1/4" Tri-Cone
(1005' - 1490.5') 8.5" Tri-Cone

Reaming:
(77' - 1005') 14" Roller Reamed - unsuccessful
(1005' - 1490') 10" Reamed - partial success

Data Collection:
- Hydrologic Properties: Pending
- Cores/Cuttings submitted for geochemical and contaminant characterization: 13
- Ground Water Samples Submitted
  Perched Ground Water - 9/15/03 (241') - corehole
  Deep Ground Water - 9/21/03 (604')

Geologic Properties:
Minerology, petrography, and chemistry: 7

Borehole Logs:
- Lithologic: 0' - 1490.5'
- Video (LANL tool): 0' - 717'
- Caliper Logging: 1374' - 1474'
- Schlumberger logs:
  Compensated Neutron Log:
  9/26/03: Open Hole: 70'-985'
  10/14/03: Cased: 500'-1005'; Open Hole: 1005'-1481'
  Triple Litho-Density:
  9/28/03: Open Hole: 70'-985'
  10/14/03: Cased: 500'-1005'; Open Hole: 1005'-1481'
  Array Induction Imager:
  9/28/03: Open Hole: 70'-979'
  10/14/03: Cased: 500'-1005'; Open Hole: 1005'-1476'
  Elemental Capture Sonde:
  9/28/03: Open Hole: 70'-981'
  10/14/03: Cased: 500'-1005'; Open Hole: 1005'-1477'
  Natural GR Spectroscopy:
  9/28/03: Open Hole: 70'-979'
  10/14/03: Cased: 500'-1005'; Open Hole: 1005'-1460'
  Combinable Magnetic Resonance:
  9/28/03: Open Hole: 100'-967'
  10/14/03: Cased: none; Open Hole: 1050'-1464'
  Fullbore Formation Micro Imager:
  9/28/03: Open Hole: 450'-985'
  10/14/03: Cased: none; Open Hole: 1005'-1483'

Corehole Logs:
- Lithologic: 0' - 250'
- Video (LANL tool): 0' - 241'
- Gamma Ray (LANL Tool): 0'-245'

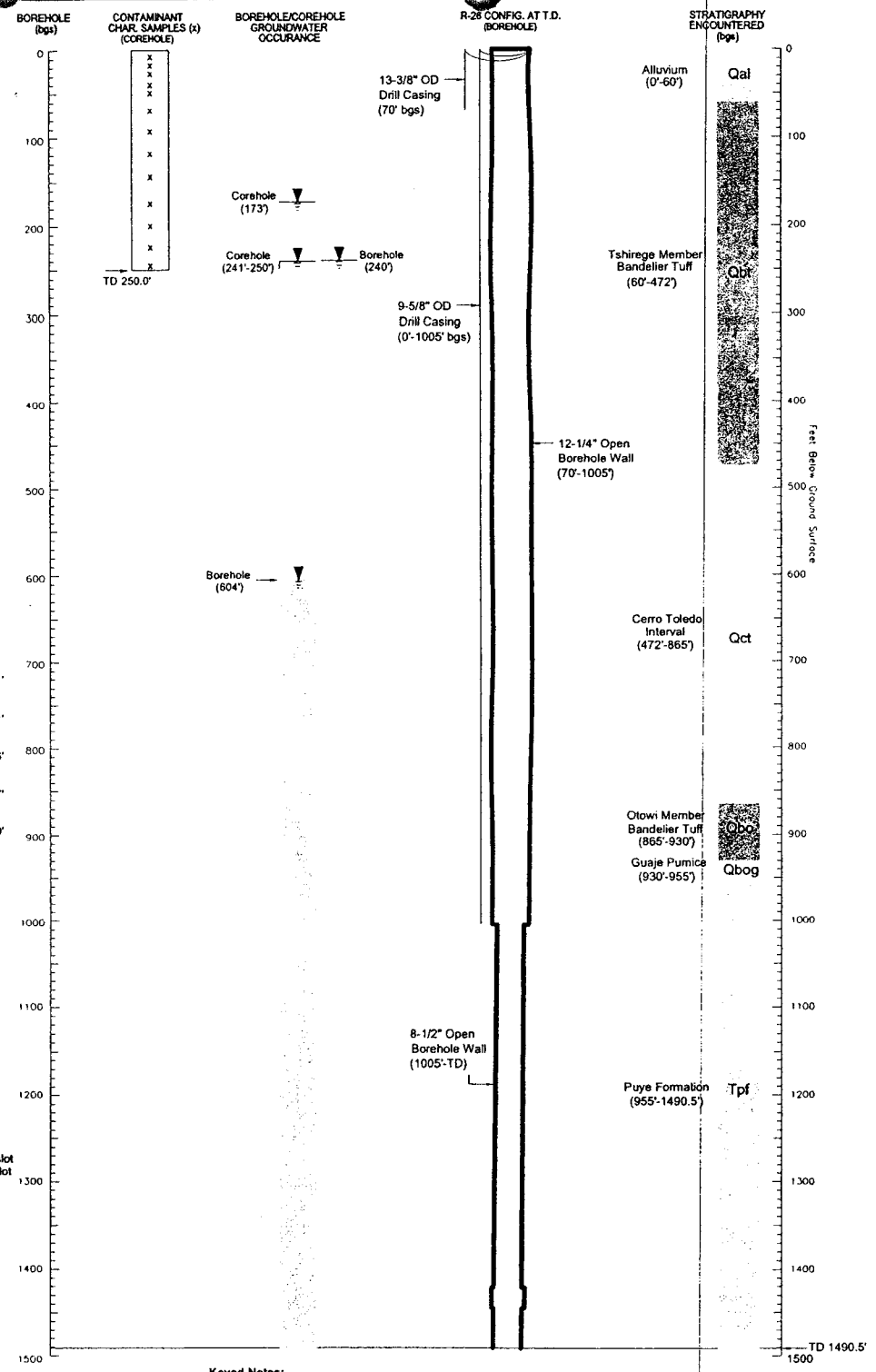
Core Drilling Completed: 9/8/03-9/12/03
Rotary Drilling Completed: 9/18/03-10/14/03
Contract Geophysics: 9/28/03 and 10/14/03-10/15/03
Well Installation: 10/17/03-10/19/03
Well Developed: 11/4/03-11/17/03

- Casing:
  4.5" I.D. / 5.0" O.D. A304 Stainless Steel casing with external couplings
- Number of Screens:
  Two (2) 4.46" ID wire wrapped stainless steel with external couplings.
  Screen #1 (Upper): 5.53" OD Pipe based 0.010 slot
  Screen #2 (Lower): 5.27" OD Rod based 0.020 slot
- Screen Intervals:
  Screen #1 (Upper): 651.8' - 669.9'
  Screen #2 (Lower): 1421.8' - 1445'

Well Development performed by swabbing, bailing, and pumping.
Total Volume Purged: 36,200 gallons

Corehole Piezometer Completions
- Casing - 2" OD Sched. 40 PVC threaded
- Number of Screens - One (1) 2" OD Sched. 40 PVC 0.010 slotted
- Screen Interval -
  Upper - 150' - 180'
  Lower - 230' - 250'

Geologic contacts for R-26 were determined from core samples, cuttings, borehole video, and geophysical logs.



Keyed Notes:

1. Coordinates - NM State Plane Grid Central Zone (North America) Datum - 1983 (NAD83); expressed in feet.
2. Elevations - National Geodetic Vertical Datum (NGVD29); expressed in feet above mean sea level.
3. Surface completion and surveying pending.
4. All depths are below ground surface (bgs).
5. Drill casing removed prior to well installation.
6. Borehole reamed across Screen #2 Interval (1421'-1445')
7. Water level measurements in shallow piezometer was 172.97', the deep piezometer was dry when sounded on 11-25-03.
8. Post development deep groundwater level measurement recorded on 9-21-03.

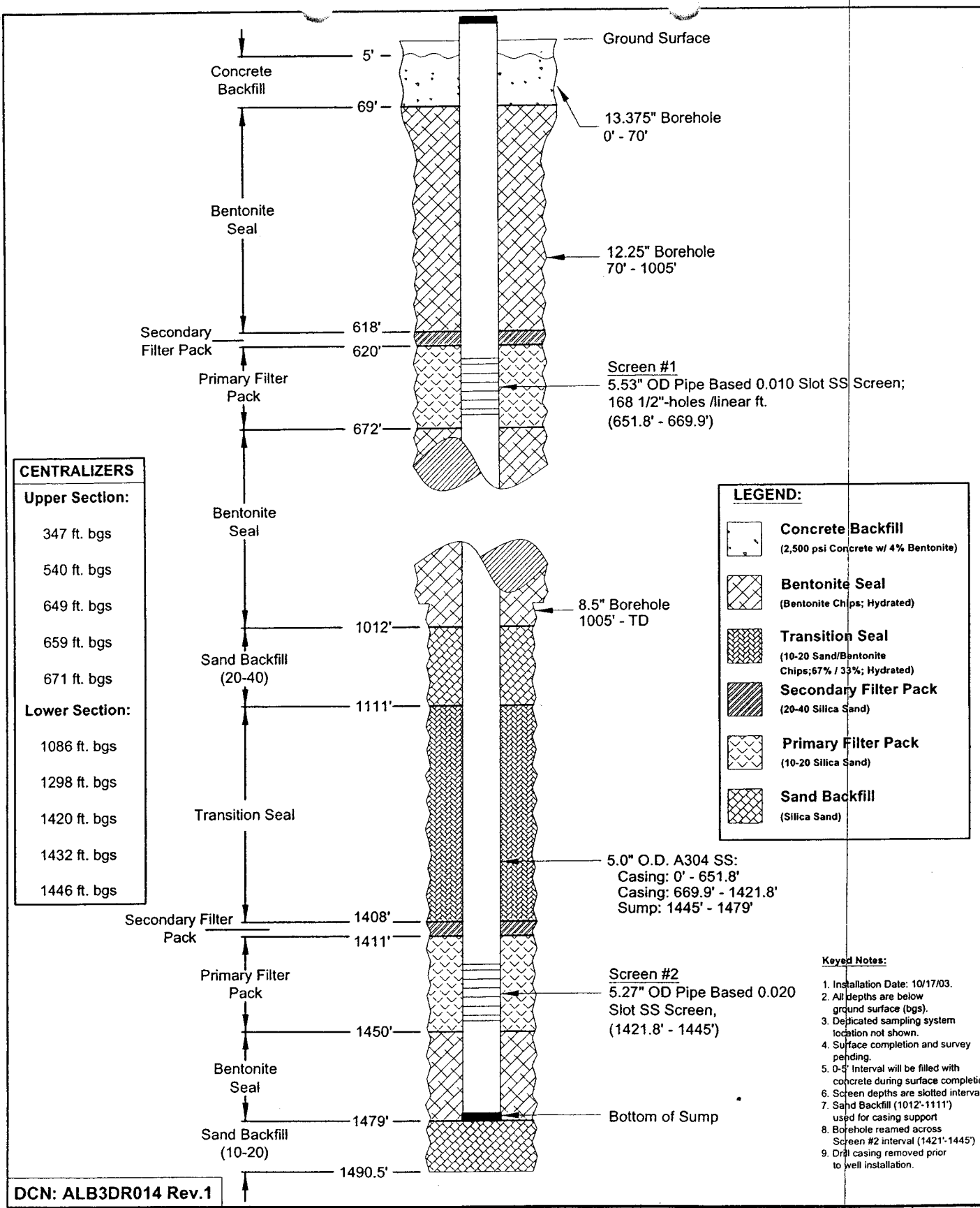
DCN: ALB3DR015 Rev.1

KLEINFELDER

Drawn By: C. Landon	Date: December 2003
Project No.: 37151	Filename: ALB3DR015 REV 1
Scale: Not-To-Scale	Revision: 1
Reviewed By: F. Schelby	Approved By: M. Everett

Construction, Stratigraphic, and Hydrogeologic Information for Characterization Well R-26
Los Alamos National Laboratory
Los Alamos, New Mexico

FIGURE
1



DCN: ALB3DR014 Rev.1

KLEINFELDER		Schematic Diagram of Characterization Well R-26 Los Alamos National Laboratory Los Alamos, New Mexico	FIGURE 2
Drawn By: C. Landon	Date: December 2003		
Project No.: 37151	Filename: ALB3DR014 REV 1		
Scale: Not-To-Scale	Revision: 1		
Reviewed By: F. Schelby	Approved By: M. Everett		

Hydrogeologic Conceptual Model

Bruce Robinson

Groundwater Protection Program Quarterly Meeting
January 28, 2004

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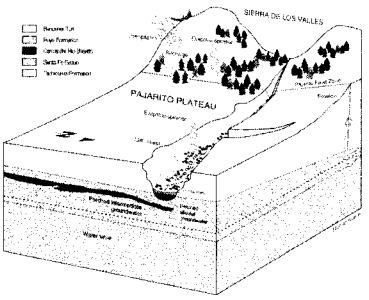
Slide 1

Outline



- Summary of Conceptual Model
  - Alluvial groundwater
  - Vadose Zone
  - Regional Aquifer
- Implications for groundwater contamination on the Plateau

Collaborators: Kay Birdsell, David Broxton, Bruce Gallaher, Steve McLin, Pat Longmire, David Rogers, Bill Stone, David Vaniman, Velimir Vesselinov

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Slide 2

Alluvial Groundwater Flow and Transport

Order of Magnitude Estimate: Los Alamos Canyon:

Conductivity = 10^{-4} m/s

Gradient = 0.03

Darcy Velocity = 10^{-4} x 0.03 = 3 x 10^{-6} m/s = 95 m/y

Porosity = 0.3

Transport Velocity = 95/0.3 = 320 m/y estimate of transport of mobile contaminants in alluvial groundwater

(Purtymun's measurements are even faster)

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Slide 3

Alluvial Groundwater Flow and Transport

Tritium and Chloride Tracer Test in Mortandad Canyon
Purtymun, 1974, LA-5716-MS

	Distance, m	Tritium		Chloride	
		Transit Time, days	Transport Velocity, m/y	Transit Time, days	Transport Velocity, m/y
MCO-5 to MCO-6	393	20	7300	25	5800
MCO-6 to MCO-7	320	77	1500	63	1900
MCO-7 to MCO-7.5	290	66	1600	52	2000
MCO-7.5 to MCO-8	183	109	620	79	840

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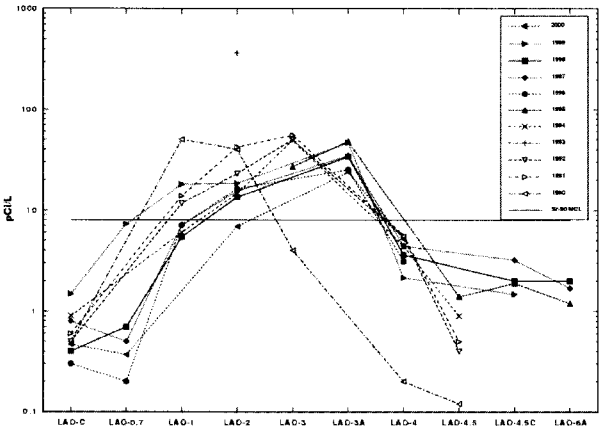
Slide 4

Alluvial Groundwater Flow and Transport

Migration of Sr-90 in alluvial groundwater



Distribution of strontium-90 in upper Los Alamos Canyon (source of data: WQH)

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Slide 5

Alluvial Groundwater Flow and Transport

Conclusion: Transport velocities in the alluvium are expected to be fast for nonsorbing contaminants based on simple calculations, and data from contaminant and tracer migration confirm this result. Sorption reduces transport velocities significantly.

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Slide 6

Vadose Zone Flow and Transport

Order of Magnitude Estimate: Bandelier Tuff, Dry Canyon

Infiltration Rate = 1 mm/y
Water Content = 0.1
Transport Velocity = 1/0.1 = 10 mm/y = 0.01 m/y

10,000 years to traverse 100 m thickness of vadose zone

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Slide 7

Vadose Zone Flow and Transport

Order of Magnitude Estimate: Wet Canyon

Infiltration Rate = 500 mm/y
Water Content (tuff) = 0.2
Water Content (Basalt) = 10^{-3}
Transport Velocity (tuff) = 500/0.2 = 2500 mm/y = 2.5 m/y
Transport Velocity (Basalt) = $500/10^{-3} = 5x10^5$ mm/y = 500 m/y

40 years to traverse 100 m thickness of vadose zone in tuff
0.2 years to traverse 100 m thickness of vadose zone in Basalt

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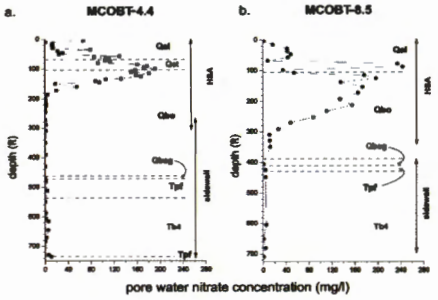
Slide 8

Vadose Zone Flow and Transport

Wet Canyon, Bandelier Tuff

Conclusion: Moisture profiles and contaminant transport distances are consistent with local downward percolation rates of 100-400 mm/y. However, lateral transport pathways are also evident: intermediate groundwater significantly below the location also contain contaminants. Contaminant front locations are consistent with transport through the rock matrix most of the units of the Bandelier Tuff.



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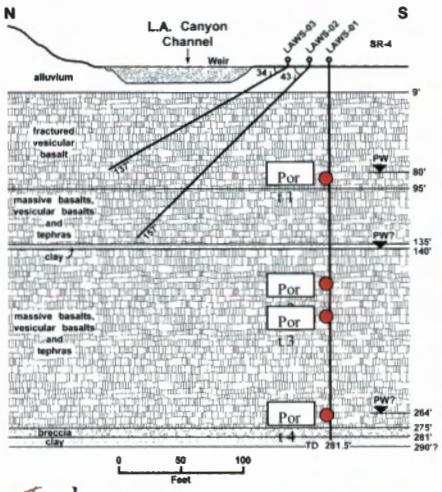
Slide 9

Vadose Zone Flow and Transport

Wet Canyon, Basalt



Low Head Weir in Los Alamos Canyon

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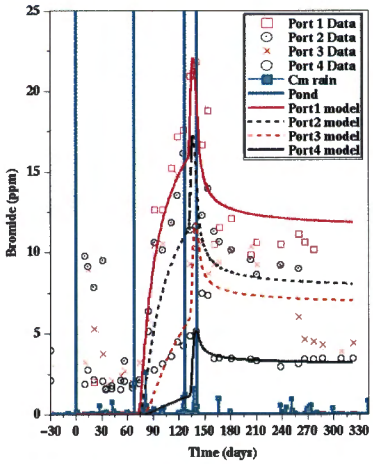
Slide 10

Vadose Zone Flow and Transport

Wet Canyon, Basalt

Conclusion: Water and contaminant transport times through Basalts are short. Regions where Basalts are thick in the vadose zone may be locations where transport to the regional aquifer are most rapid, provided the percolation rates are high enough.



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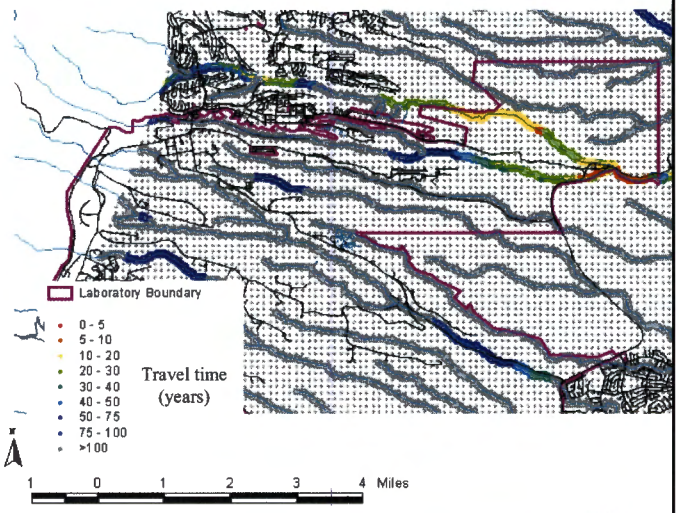
Slide 11

Vadose Zone Travel Time Predictions

Conclusion: Vadose zone travel times on the order of decades are predicted in wet canyons. Locations where the vadose zone stratigraphy consists of thin Bandelier tuff and thick Basalt have the potential for short travel times to the regional aquifer.



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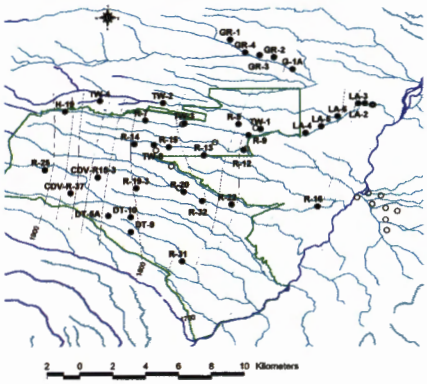
Slide 12

Regional aquifer flow and transport

Potentiometric Data



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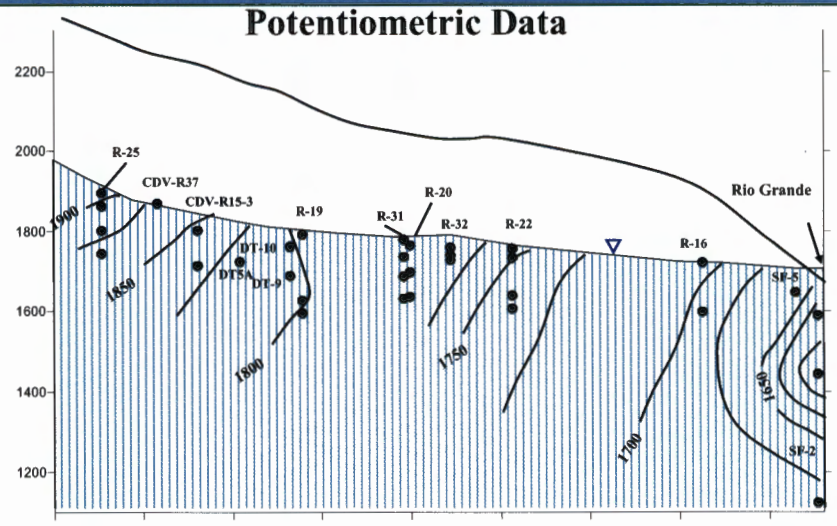
Slide 13

Regional aquifer flow and transport

Potentiometric Data



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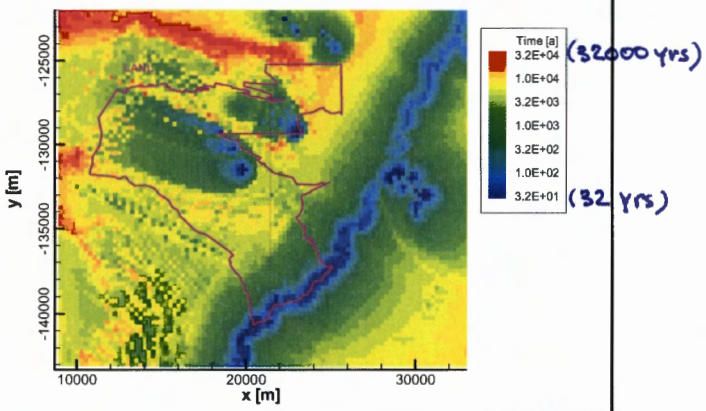
Slide 14

Regional aquifer flow and transport

Travel times and Capture Zones

Conclusion: Travel times from the water table to a point of discharge (the Rio Grande or water supply wells) are predicted to be short if the location is close to the discharge location, but otherwise they are expected to be large.



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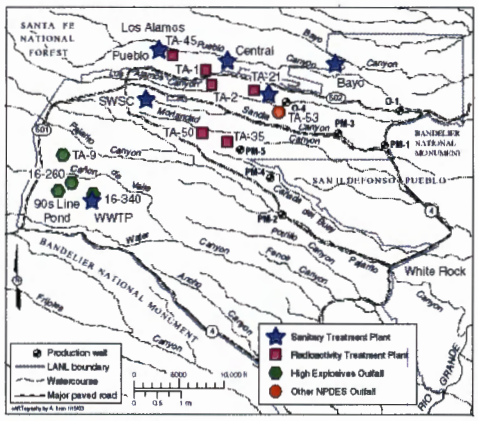
Slide 15

Contaminant Detections

Liquid Effluent Discharge Locations



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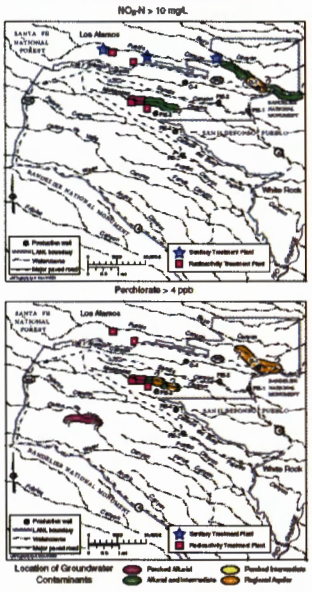
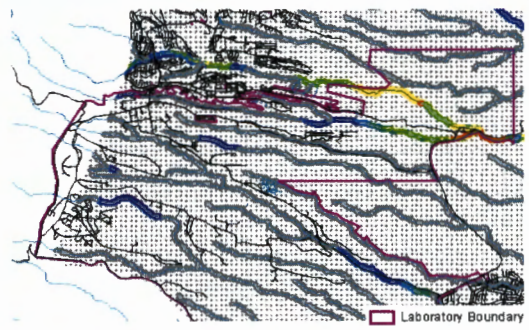
Slide 16

Contaminant Detections





Suggest extending this map to the Rio Grande

Surveillance data are consistent with the conceptual models that have emerged from Hydrogeologic Workplan studies

Slide 17

Conclusions

From the perspective of input to groundwater risk assessment studies, the most important potential pathways of concern are:

- Wet canyons with contaminant discharges
- Vadose zone hydrogeologic pathways yielding rapid migration to the regional aquifer
  - Thin Bandelier Tuff
  - Basalt pathways
- Contaminant pathways that occur close to existing water discharge points
  - Water supply wells
  - Some springs

However, transport over long distances in the regional aquifer is not consistent with our current understanding. Transport through Basalts and the possibility of preferential transport through sedimentary rocks warrants further study. Transport of sorbing contaminants is likely to be slow.

- The most likely large scale transport (kilometers distance) is via surface and alluvial groundwater. → importance of monitoring surface water
- Surveillance data are consistent with the conceptual models that have emerged from Hydrogeologic Workplan studies.

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Hydrogeologic Workplan Final Report

Bruce Robinson

Groundwater Protection Program Quarterly Meeting
January 28, 2004

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Slide 19

Hydrogeologic Workplan

Technical Objectives

The following technical issues were identified:

- Individual zones of saturation are not adequately delineated, and "hydraulic interconnection" between them is not understood
- Recharge areas for the regional aquifer and intermediate perched zone not identified; effect of fracture-fault zones on recharge is unknown
- GW flow directions of regional aquifer and intermediate perched zones, as influenced by pumping, are unknown
- Aquifer characteristics cannot be determined without additional monitoring wells; location of wells cannot be addressed adequately without delineation of individual zones of saturation

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Slide 20

Hydrogeologic Workplan

Questions Addressed

- Is characterization adequate to determine where GW exists and whether contaminant concentrations exceed regulatory limits or risk levels?
- Is characterization sufficient to establish a detection monitoring program?
- Is characterization sufficient to satisfy conditions of HSWA portion of LANL's RCRA operating permit?

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Slide 21

Hydrogeologic Workplan

Outcome of Studies

- Refined understanding of hydrogeologic setting (recharge, hydraulic interconnections, flow paths, flow rates, synthesized by modeling)
- Information sufficient to design and implement a detection monitoring program
- Defined areas of existing or potential groundwater contamination, from surface to regional aquifer, with predictions of direction and rates of movement and risk based on modeling

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Report Elements

- Executive Summary
- Introduction
  - Hydrogeologic Workplan drivers
  - Scientific questions addressed by Workplan Activities
  - Approach – integrated program of well drilling, data collection, incorporation of data from other sources, modeling
- Hydrogeology
  - Geologic conceptual model (describes the hydrogeologic information used to define the controls on hydrology)
  - Geologic model description – representative cross sections
  - Connection between geology and hydrologic properties – vadose zone and regional aquifer
  - Alluvial groundwater conceptual model
  - Hydrologic conceptual model, vadose zone (describes the information available that constrains our models of vadose zone flow and transport at the site – moisture and contaminant observations, pore water chemistry)
  - Perched water conceptual model
  - Hydrologic conceptual model, regional aquifer (describes the information available that constrains our models of regional aquifer flow and transport at the site – water budget information, water levels, hydrologic properties, geochemistry, contaminant observations)

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Report Elements (cont.)

- Geochemistry
  - Conceptual model (describes what is known about the chemical composition of the GW, and postulates rock-water interactions)
  - Chemical factors affecting contaminant transport – GW chemistry controls on solubility, speciation, and sorption of contaminants
- Contaminant Distributions
  - Contaminant sources
  - Maps of contaminant concentration levels in GW
  - Discussion of concurrence with main elements of conceptual model
  - Outstanding uncertainties
- Numerical Models (each section addresses basic model formulation, data sources, model development, and uncertainties)
  - 3D geologic model
  - Vadose zone flow and transport models – site-wide modeling
  - Regional aquifer flow and transport models – background flow conditions and as influenced by pumping
  - Contaminant transport model predictions – representative canyon and mesa sites

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Report Elements (cont.)

- Implications of Hydrogeologic Workplan Study Results
  - Input to design of detection monitoring program
  - Input and uncertainties of parameters in risk assessments
  - Conceptual model uncertainties relevant to monitoring and risk assessment
- Discussion of Alternate Conceptual Models
  - Rapid vadose zone fracture flow and transport to depth
  - Colloid-facilitated transport
  - Perchlorate transport to the Rio Grande
  - Alternate geochemical interpretation of regional aquifer flow path
- Conclusions

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Slide 25

Regional wells drilled/needed (in circle)
1, 2, 3, 4, 5, 6, 7, 8,
9, 10, 11, 12, 13, 14, 15, 16,
17, 18, 19, 20, 21, 22, 23, 24,
25, 26, 27, 28, 29, 30,
31, 32

[9 wells remain to be drilled under HWP]

Funding and Schedule

- Half of funding is available in FY04
- Report due – March 15, 2005 (assumes funding available next FY to complete)
- High-Level Schedule
  - Annotated outline completed – February 29, 2004
  - All analyses and interpretations completed, September 30, 2004
  - Draft writeup for introductory text and sections for which interpretations are already complete – September 30, 2004
  - Draft writeup for entire report – December 31, 2004
  - Review and publication completed – March 15, 2005

We welcome NMED and stakeholder input during the preparation and review of this report

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HWP was required by NMED; its completion and report have to be approved by NMED

The new driver for installing wells is the workplans – Mat Johansen