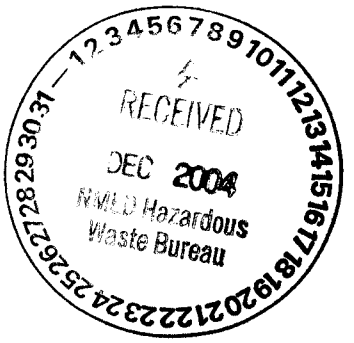
General

Los Alamos
NATIONAL LABORATORY

Solid Waste Regulatory Compliance
P.O. Box 1663, Mail Stop K490
Los Alamos, New Mexico 87545
(505) 667-0666/Fax (505) 667-5224

Date: November 30, 2004
Refer To: ENV-SWRC:04-086

CERTIFIED MAIL
RETURN RECEIPT REQUESTED



Cheryl Frischkorn
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303

SUBJECT: GPS/GIS Survey

Dear Ms. Frischkorn:

Enclosed is a copy of the completed Hazardous Waste GPS/GIS survey form for the Los Alamos National Laboratory. If you have any questions on the information presented in the form, please contact me at telephone number 667-4715 or by email at dyea@lanl.gov.

Sincerely,

Albert Dye

Albert Dye
Environmental Stewardship Division
Solid Waste Regulatory Compliance Group

AD:vc

Enc. a/s

Cy. G.P. Nanos, DIR, A100
K. Hargis, ENV-DO, J591
G. Turner, DOE-LAAO, A316
A. Dorries, ENV-ECR, M992
IM-5, LANL, MS A150
RRES-SWRC File, K490

13884

HAZARDOUS WASTE BUREAU GPS/GIS SURVEY

Facility Name **Los Alamos National Laboratory**
Facility EPA ID **NM0890010515 LANL and NMD986676807 Fenton Hill**
GPS/GIS Contact **Alison Dorries**

1) How are your regulated sites currently being surveyed? (CIRCLE ALL THAT APPLY)

a) traditional survey equipment (transit)
b) GPS (Global Positioning System)--- recreational grade
c) GPS---mapping grade
d) GPS---survey grade
e) other (please indicate) **Shape files drawn with ArcGIS software**

2) What other surveying technologies have been used to locate regulated sites in the past? (CIRCLE ALL THAT APPLY)

a) traditional survey equipment (transit)
b) GPS---recreational grade
c) GPS---mapping grade
d) GPS---survey grade
e) other (please indicate) **Shapefiles drawn with ArcGIS software**

3) If the facility is currently using GPS technology, indicate the equipment manufacturer and model of the receiver(s) being used.

Trimble GEO-XT
Trimble RTK 5700

4) What coordinate system is currently being used by the facility? (CIRCLE ONE)

a) state plane coordinate system
b) latitude/longitude
c) Universal Transverse Mercator (UTM)
d) other (please indicate)_____

5) What horizontal datum is currently being used? (CIRCLE ONE)

a) NAD27
b) NAD83
c) WGS84
d) other (please indicate)_____

6) What is the estimated horizontal position accuracy for features currently being surveyed? (CIRCLE ONE)

a) > 10 meters
b) 5 to 10 meters
c) 1 to 5 meters
d) < 1 meter
e) other (please indicate)_____

7) Does the facility have standard operating procedure (SOPs) for the collection of geospatial data? If yes, please submit a copy with the completed survey. **Yes. A copy of "Coordinating and Evaluating Geodetic Surveys" RRES-Remedial Services Project SOP-03.11, Revision 2, 6/28/2004 is attached.**

8) Does the facility currently utilize any geographical information systems (GIS)? If yes, please indicate software manufacturer and version used.

ESRI ARCGIS 8.3

9) (OPTIONAL) Please provide a general description of the GIS layers created and/or utilized by the facility (*e.g.,* SWMU layer, monitoring well layer, soil association layer, *etc*). Use additional sheets as needed.

Potential Release Sites (SWMUs & Areas of Concern)
Radiological Environmental Sites
Operable Units
Outfalls
Material Disposal Areas
Waste Storage Features
Hypsography (Contour Elevation Data)
Drainage
Ponds
Reaches
Springs
Watersheds
Watershed Aggregates
Geologic Faults
Firing Sites Testing Hazard Zones
Firing Sites Safety and Security Buffer

10) What format or type of spatial data does your facility work with (*e.g.,* shape files, excel files, *etc.*) **Shape Files, Geodatabase (Spatial Database Engine with MS SQL Server)**

11) Are personnel trained in collecting geospacial data using GPS technologies? Please describe training required.

Yes. Depends on the type and use of GPS data. Training may range from reading the GPS user manual to requiring a registered professional land surveyor.

12) Please include any additional information that may be helpful to this survey.

Identifier: **SOP-03.11**	Revision: **2**
Effective Date: **06/28/2004**	
Document Catalog Number: **ER2004-0076**	
Author: **Bill Kopp**	

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Los Alamos
NATIONAL LABORATORY
Ideas That Change the World

Risk Reduction and Environmental Stewardship—Remediation Services Project

Standard Operating Procedure

for

Coordinating and Evaluating Geodetic Surveys

Revision Log

Revision No.	Effective Date	Prepared By	Description of Changes	Affected Pages
R0	3/21/95	Richard Koch	New Procedure	All
R1	11/13/01	Steven Reneau	Revised to follow format of QP-4.2, R3 and to make procedure consistent with current geodetic surveying in the ER Project.	All
R2	06/28/2004	Bill Kopp	Revised and rewritten to reflect new procedures and incorporate new format.	All

COORDINATING AND EVALUATING GEODETIC SURVEYS

Table of Contents

List of Acronyms and Abbreviations

GIS	geographic information system	PPE	personal protective equipment
GPS	Global Positioning System	PTL	project team leader
IA	Information Architecture	RPF	Records Processing Facility
ID	identification number	RRES-RS	Risk Reduction and Environmental Stewardship—Remediation Services
LANL	Los Alamos National Laboratory	SOP	standard operating procedure
LCN	Laboratory Control Network	SPCS	state plane coordinate system
PTL	project team leader	SSHASP	site-specific health and safety plan
QA	quality assurance	US ft	US survey foot
QP	quality procedure		
QPPL	quality program project leader		

COORDINATING AND EVALUATING GEODETIC SURVEYS

1.0 PURPOSE

This standard operating procedure (SOP) states the responsibilities and describes the methodology for coordinating and evaluating geodetic surveys and establishing quality assurance (QA) and control for geodetic survey data. This procedure applies to all Los Alamos National Laboratory (LANL) Risk Reduction and Environmental Stewardship—Remediation Services (RRES-RS) Project activities that require geodetic survey.

2.0 SCOPE

2.1 All **RRES-RS Project participants** shall implement this mandatory SOP.

2.2 Subcontractors performing work under the RRES-RS Project Quality Program shall follow this SOP.

OR

2.3 **Subcontractors** may use the subcontractor's procedure as long as the substitute meets the requirements prescribed by the RRES-RS Quality Management Plan and the RRES-RS Project Quality Program project leader (QPPL) and a RRES-RS technical staff person review the procedure before the subcontractor begins the designated activity.

3.0 TRAINING

3.1 **RRES-RS Project participants** shall train to and use the current version of this SOP; contact the author if the SOP text is unclear.

3.2 **RRES-RS Project participants** using this SOP shall document training in accordance with QP-2.2, "Personnel Orientation and Training."

3.3 The responsible RRES-RS **Project team leader (PTL)** shall monitor the proper implementation of this procedure and ensure that the appropriate personnel complete all applicable training assignments.

3.4 The **PTL** shall ensure that field team members who coordinate, conduct, or evaluate geodetic surveys for the RRES-RS Project are familiar with the objectives and requirements of the intended surveying activities and have sufficient relevant experience with Global Positioning System (GPS) units and/or Total Station surveying instruments to conduct this work.

3.5 **RRES-RS Project participants** may request any needed assistance with implementation of this procedure from the RRES-RS Project Quality Integration and Improvement team.

4.0 DEFINITIONS

4.1 *Coordinates*—Points defined in the New Mexico State Plane Coordinate System (Tranverse Mercator), Central Zone, North American Datum 1983 (SPCS 83, NM Central). Distances are expressed as ground distance in US survey feet (US ft).

4.2 *Global Positioning System (GPS)*—A sytem of receivers, computers, antennas, relay stations, and data collectors that uses satellite signals to determine location information.

4.3 *Site-specific health and safety plan (SSHASP)*—A health and safety plan that is specific to a site or RRES-RS-related field activity that has been approved by a RRES-RS health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

4.4 *Stakeout survey*—A survey the purpose of which is to locate in the field a point of interest for which the coordinates have previously been defined.

4.5 *Surveyor*—A person who is professionally licensed to perform control, property, easement, or boundary surveys according to the conditions and qualifications defined by the New Mexico Engineering and Surveying Practice Act.

Note: For the purposes of conducting RRES-RS Project surveys to determine the location and elevation of groundwater monitoring wells, the surveyor must be registered in the State of New Mexico.

4.6 *Survey personnel*—Licensed professional surveyors, earth scientists, or other professionals whose field experience with the use of Total Stations, GPS units, or other surveying equipment is sufficient to obtain survey data of acceptable quality for RRES-RS Project requirements.

4.7 *Total Station*—A surveying instrument that consists of an integrated electronic distance measuring system, an optical horizontal and vertical angle measuring system, an internal or external electronic data recording device, and an internal or external computer.

4.8 *Unknown location survey*—A survey the purpose of which is to establish the coordinates of a location.

5.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure:

- PTL

- QPPL
- RRES-RS Project participants
- subcontractors
- survey personnel
- user

6.0 BACKGROUND AND PRECAUTIONS

This SOP is focused on obtaining survey data of acceptable quality for use in RRES-RS Project investigations. To be acceptable, survey data must conform to Laboratory Information Architecture (IA) project standards IA-CB02, "GIS Horizontal Spatial Reference System," and IA-D802, "Geospatial Positioning Accuracy Standards for A/E/C and Facility Management." Survey data must also meet RRES-RS Project survey objectives. At a minimum, RRES-RS Project requirements for survey data are as follows.

6.1 All survey coordinates must be expressed as SPCS 83, NM Central, US ft coordinates. All elevation data must be reported relative to the National Geodetic Vertical Datum of 1929.

6.2 All surveys must originate from, and be derivative of, control monuments set in the 1992/1993 Laboratory Control Network (LCN).

Note: The LCN is available from the RRES-RS Project Records Processing Facility (RPF) as the "LANL Survey Monument Network Manual," (ER-ID 55599). The LCN contains maps showing the location of the control monuments and provides their coordinate values. Because the Laboratory no longer maintains the LCN, survey personnel should be aware that coordinates listed in the LCN are accurate to 1993 monument locations and do not reflect changes to monument locations (for example as the result of a physical disturbance that caused the monument to be moved or damaged) that may have occurred since 1993.

6.3 If a survey requires traversing with a Total Station from LCN control monuments to the survey site, the survey must close by returning either to the place of beginning or to another LCN control monument.

6.4 The **PTL** shall determine the accuracy requirements for survey data and inform survey personnel of those requirements before surveying activities are undertaken.

Note: Survey data with horizontal accuracy to within 0.1 ft are acceptable for most RRES-RS Project investigations, and data with a lesser degree of horizontal accuracy are occasionally acceptable. Vertical accuracy is required for surveys for which elevation data (i.e., vertical coordinates)

are required. Many surveys, such as surveys to identify sample locations, may not require elevation data.

In general, and recognizing that any survey method can return unacceptable survey data as a result of human error or other causes (e.g., imprecise GPS measurements), **RRES-RS survey personnel** should employ such survey methods and use such survey tools (Total Station, high-precision GPS) as are most suited to obtaining acceptable survey data.

7.0 EQUIPMENT

7.1 This SOP is to be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

7.2 Attachment A provides a checklist of suggested equipment and supplies needed to implement this procedure.

8.0 PROCEDURE

Note: Deviations from SOPs are documented in accordance with QP-5.7, "Notebook Documentation for Environmental Restoration Technical Activities."

8.1 Evaluate Geodetic Survey Requirements

8.1.1 The **PTL** or a designated RRES-RS Project participant (designee) shall determine the type of survey to be performed, the information that will be required by survey personnel, and the survey information to be reported (e.g., sample points, historical information, excavation boundaries).

8.1.1.1 The **PTL** or the designee shall determine whether the survey is for purposes of staking out previously defined locations (a stakeout survey) or to identify unknown locations (an unknown location survey).

8.1.1.2 For stakeout surveys, the **PTL** or designee shall gather the following information: coordinate values for the stakeout points (or documents from which coordinate values can be calculated); instructions for field identification of stakeout points (e.g., stakes, pin flags, whiskers, spray paint, ribbon); and the location identification numbers (IDs) to be assigned to the stakeout points.

8.1.1.3 For unknown location surveys, the **PTL** or designee shall gather information that will assist survey personnel in location identification, for example, a map on which

pin flags mark existing sampling locations, documentation of the perimeter of an excavated trench, or an indication of the elevation of a well head.

8.1.2 The **PTL** shall ensure that survey personnel meet the applicable requirements of the RRES-RS Project and the New Mexico Engineering and Surveying Practice Act for conducting the type of survey required.

8.1.2.1 According to the New Mexico Engineering and Surveying Practice Act, **survey personnel** who perform control, property, easement, or boundary surveys must be registered professional land surveyors.

8.1.2.2 The RRES-RS Project requires that **survey personnel** who perform surveys to determine the location and elevation of groundwater monitoring wells must be professional land surveyors registered in the State of New Mexico.

8.1.3 The **PTL** shall ensure that survey personnel have sufficient experience in the application of survey methods and the use of surveying equipment to obtain data of acceptable quality for use in the RRES-RS Project. See Section 6.0.

8.2 Prepare to Perform a Geodetic Survey

8.2.1 The **PTL** or designee shall provide survey personnel with a statement of the type of survey to be performed and the data and degree of accuracy the survey is required to produce.

8.2.2 For stakeout surveys, the **PTL** or designee shall provide survey personnel with the following:

- the coordinates for the survey locations or documentation, such as as-built drawings, aerial photographs, or historical notes, from which the survey coordinates can be calculated
- instructions for the method of marking points in the field (e.g., with stakes, pin flags, whiskers, spray paint, or ribbon)
- the location IDs to be assigned to the staked out points

8.2.3 For unknown location surveys, the **PTL** or designee shall provide survey personnel with the following:

- a clear statement of the locations to be surveyed
- a statement of the required accuracy for each point location

8.3 Perform Geodetic Survey Field Activities

8.3.1 **Survey personnel** shall chronologically document the survey field activities by maintaining a handwritten field notebook and recording, at a minimum, the names of LCN control monuments used, intermediate traverse points, the sequence of measurements made, and brief descriptors of the points measured, as required by QP-5.7, "Notebook Documentation for Environmental Restoration Technical Activities."

Note: Angles and distances measured do not need to be recorded in the field notebook.

8.3.2 For stakeout surveys, **survey personnel** shall mark and identify survey locations as instructed by the PTL and record the marker in the field notebook.

8.4 Prepare Geodetic Survey Data for QA Review

8.4.1 After completing field survey activities, **survey personnel** shall return to the office and prepare the survey data for QA review.

8.4.2 **Survey personnel** shall prepare a plot of the points located by the survey and identify each location point with the surveyor's point label.

8.4.3 **Survey personnel** shall prepare a Microsoft Excel spreadsheet that lists the survey location points; SPCS 83, NM Central coordinates (in US ft); and surveyor's point labels.

8.4.4 For Total Station surveys, **survey personnel** shall calculate the "error of closure" (i.e., the ratio of the closure error to the distance traversed) and record the calculation result and the locations and derivative coordinate values on the Microsoft Excel spreadsheet.

8.4.5 For GPS surveys, **survey personnel** shall record the individual point uncertainty value associated with the derivative coordinate value (as statistically calculated by the GPS receiver) on the Microsoft Excel spreadsheet.

Note: Some survey data used during field investigations, such as traverse points, intermediate reference points, referenced attribute information, etc., do not need to be captured in the Microsoft Excel spreadsheet.

8.5 Perform QA Review of Geodetic Survey Data

8.5.1 **Survey personnel** shall submit the survey plot, an electronic copy of the Microsoft Excel spreadsheet for survey location points, and the field notebook to the PTL and QPPL for QA review

and required by QP-5.7, "Notebook Documentation for Environmental Restoration Technical Activities."

8.5.2 The **PTL** shall ensure that all documentation (e.g., plats, coordinate values, and reports) of work performed by registered professional survey personnel for the RRES-RS Project bear the surveyor's seal and signature.

8.5.3 The **PTL** or designee shall assure that survey data are acceptable for use by the RRES-RS Project by verifying that the survey personnel have used SPCS 83, NM Central coordinates expressed in US ft; have assigned a surveyor's label to each survey point; have completed the field notebook; and have satisfied RRES-RS Project survey requirements for documentation of LCN control monuments, traverse points, etc.

8.5.4 The **PTL** or designee shall assure that the survey plot is both internally consistent (all surveyed points in correct location relative to each other) and that the error of closure or the individual point uncertainty value associated with the derivative coordinate value (as statistically calculated by the GPS receiver) are sufficiently small.

8.5.5 The **PTL** shall notify survey personnel of any errors in the data that require resolution.

8.6 Submit Geodetic Survey Data

8.6.1 When the survey data are determined to be acceptable, the **PTL** or designee shall complete the Microsoft Excel spreadsheet for the survey locations by assigning location ID labels to each of the surveyor's point labels within the spreadsheet.

Note: The completed spreadsheet will contain the following information for each survey location:

- surveyor's point label
- PTL-assigned location ID
- SPCS 83, NM Central coordinates
- The closure error (for surveys conducted with the Total Station) or the individual point uncertainty values (for surveys conducted with the GPS)

8.6.2 The **PTL** or designee shall open the survey location template (available at http://erinternal.lanl.gov/ from the "Service Request" menu).

8.6.3 The **PTL** shall perform a "Save As" operation from the survey location template to rename and save the template to a local disk or hard drive.

8.6.4 The **PTL** or designee shall follow the instructions provided in the "Saved As" copy of the template to upload the contents of the Microsoft Excel spreadsheet and complete the template copy.

8.6.5 After uploading the contents of the Microsoft Excel spreadsheet and completing the template, the PTL shall close and save all changes to the file.

8.6.6 The **PTL** or designee shall attach the completed survey location file to an e-mail and send the e-mail and attachment to ERLocationUpload@lanl.gov.

Note: By submitting the electronic copy of the survey location file to ERLocationUpload@lanl.gov, the **PTL** or designee certifies the quality of the survey data.

9.0 LESSONS LEARNED

9.1 Before performing work described in this SOP, **RRES-RS Project participants** should go to the Department of Energy Lessons Learned Information Services web site at http://www.tis.eh.doe.gov/ll/ll.html and/or to the LANL Lessons Learned Resources web site at http://www.lanl.gov/projects/lessons_learned/ and search for applicable lessons.

9.2 During work performance and/or after the completion of work activities, **RRES-RS Project participants**, as appropriate, shall identify, document, and submit lessons to the LANL Lessons Learned Resources web site at http://www.lanl.gov/projects/lessons_learned/.

10.0 RECORDS

10.1 The **PTL** shall submit the following records to the RPF in accordance with QP-4.4, "Record Transmittal to the Records Processing Facility."

- field notebook
- hardcopy printout of raw measurements (for Total Station surveys)
- survey location map
- a copy of the approved procedure used by a subcontractor (if applicable)

11.0 REFERENCES

To properly implement this SOP, **RRES-RS Project participants** should become familiar with the contents of the following documents located at http://erinternal.lanl.gov/home_links/Library_proc.shtml:

- QP-2.2, "Personnel Orientation and Training"
- QP-4.4, "Record Transmittal to the Records Processing Facility"
- QP-5.7, "Notebook Documentation for Environmental Restoration Technical Activities"
- "Los Alamos National Laboratory Risk Reduction and Environmental Stewardship – Remediation Services Project Quality Management Plan"
- SOP-01.01, "General Instructions for Field Investigations"

RRES-RS Project participants implementing this SOP should also become familiar with the contents of these documents, available as indicated by the information provided in parentheses:

- Laboratory IA project standards IA-CB02, "GIS Horizontal Spatial Reference System," and IA-D802, "Geospatial Positioning Accuracy Standards for A/E/C and Facility Management" (available at http://int.lanl.gov/projects/ia/stds_views/stdsbyteam.shtml)
- "LANL Survey Monument Network Manual" (available from the RRES-RS Project RPF, ER-ID 55599)

12.0 ATTACHMENTS

The **user** of this SOP may locate all forms associated with this procedure at http://erinternal.lanl.gov/Quality/ user/forms.asp.

Attachment A: Equipment and Supplies Checklist Form (1 page)

Using a token card, click here to record "self-study" training to this procedure.
If you do not possess a token card or encounter problems, contact the RRES-ECR training specialist.

Equipment and Supplies Checklist

CHECK	ITEM DESCRIPTION	QUANTITY
[✓]		[X]
☐	brush ax	
☐	concrete or "pk" nails	
☐	gps unit	
☐	hammer	
☐	indelible felt tip pens for marking location ID	
☐	machete	
☐	pin flags	
☐	shovels	
☐	spare batteries for surveying instruments	
☐	surveyor's tacks	
☐	tape measure graduated in 0.1 ft	
☐	total station	
☐	tripods	
☐	walkie/talkies or field radios	
☐	wooden stakes	
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SOP-03.11, R2	**Los Alamos National Laboratory** **RRES-Remediation Services Project**