

APPENDIX B

U.S. NUCLEAR REGULATORY COMMISSION
AUDIT REPORT NO. NRC-91-01

UNITED STATES GEOLOGICAL SURVEY
NEVADA TEST SITE & DENVER, COLORADO
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James T. Conway 10/24/91
James T. Conway
Repository Licensing and Quality
Assurance Project Directorate
Division of High-Level Waste
Management

James T. Conway 10/24/91
by John W. Gilray
Repository Licensing and Quality
Assurance Project Directorate
Division of High-Level Waste
Management

Neil M. Coleman 10/24/91
Neil M. Coleman
Hydrology and Systems Performance
Branch
Division of High-Level Waste
Management

Reviewed and Approved by: Kenneth R. Hooks 10/28/91
Kenneth R. Hooks
Repository Licensing and Quality
Assurance Project Directorate
Division of High-Level Waste Management

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) staff conducted Audit No. NRC-91-01 of the U.S. Geological Survey (USGS) at the Nevada Test Site (NTS) and USGS facilities in Denver, Colorado on September 16-17, 1991, and September 18-20, 1991, respectively. The USGS, a participant in the U.S. Department of Energy (DOE) Yucca Mountain Site Characterization Project (YMP), is responsible for site characterization activities in the areas of hydrology, geophysics, seismology, geology, and geochemistry investigations. This report addresses the areas that were covered and the findings that were identified by the NRC audit team, and it gives the NRC staff's assessment of the procedural adequacy and effectiveness of implementation of Quality Assurance (QA) program controls in both programmatic and technical areas.

2.0 OBJECTIVE

The objective of the NRC audit was to determine the adequacy of procedural controls and effectiveness of implementation of the USGS QA program as it applies to a technical activity (TA) from May 1989 to the present in the Yucca Mountain Site Characterization Program (SCP). The TA was the "Site Potentiometric-Level Evaluation" which is a part of the Study Plan (SP) for Characterization of the Site Saturated-Zone Ground-Water Flow Systems (SCP No. 8.3.1.2.3.1). The audit specifically evaluated the effectiveness of QA requirements identified in the USGS Quality Assurance Program Plan (QAPP) and the implementing technical and programmatic procedures.

3.0 SUMMARY AND CONCLUSIONS

The NRC staff based its evaluation of the USGS QA program on examination of procedures and representative records, interviews with USGS and their contractor personnel, and observations by the audit team members. The NRC staff finds that the USGS QA program as it relates to this TA provides adequate procedural controls, and was effectively implemented in eight of the nine programmatic areas evaluated during this audit. The audit team determined that the technical procedures reviewed were technically adequate, the technical staff was appropriately qualified, and the technical work was adequate. The NRC staff also finds that the USGS QA program has improved considerably over the last three years and there is evidence of strong management commitment and involvement in implementation of the USGS QA program.

4.0 AUDIT PARTICIPANTS

The audit team was from the NRC Division of High-Level Waste Management (DHLWM) in the Office of Nuclear Material Safety & Safeguards. Jim Conway, John Gilray and Neil Coleman were lead auditor, auditor, and technical

specialist, respectively. The observers were Susan Zimmerman from the State of Nevada and Jim Blaylock from the DOE's Office of Civilian Radioactive Waste Management (OCRWM).

5.0. REVIEW OF THE AUDIT

The audit was conducted in accordance with DHLWM Procedure Chapter 0330 "Conduct of Audits by High-Level Waste Management" dated August 30, 1991. NRC staff findings are classified in accordance with the guidelines in this procedure.

5.1 SCOPE OF AUDIT

The audit was conducted to evaluate the implementation of QA requirements associated with USGS programmatic and technical activities. The bases of the audit included QA requirements included in the Title 10 Code of Federal Regulations (10 CFR) Part 50 Appendix B criteria, NQA-1, QAPP, and implementing USGS technical procedures (HPs) and programmatic procedures, i.e., Quality Management Procedures (QMPs).

(a) Programmatic Elements

The auditors utilized a checklist developed from requirements in the USGS QAPP and QMPs which implement the requirements of the OCRWM Quality Assurance Requirements Document. The checklist covered QA program controls which were applied to the TA for Criteria 2, 3, 4, 5, 6, 7, 8, 12, and 18 from 10 CFR Part 50, Appendix B.

(b) Technical Areas

The technical specialist utilized a checklist developed from information contained in the USGS SP for the TA, associated HPs and the USGS monthly Project Status Reports. The technical specialist evaluated the TA to determine the following:

- o Technical qualifications of USGS Scientific Investigation Personnel (i.e., technical staff);
- o USGS technical staff's understanding of technical requirements as they pertain to scientific investigation activities;
- o Adequacy of technical procedures; and
- o Adequacy of work supporting the SCP, and any related work products.

5.2 CONDUCT OF AUDIT

(a) Pre-audit Conference

A pre-audit conference with the USGS Principal Investigator (PI), QA Manager and staff was held at 8:30 a.m. on September 16, 1991, at the Hydrologic Research Facility (HRF) on the NTS. The purpose, scope and proposed agenda for the audit were presented, and the audit team was introduced. (See Enclosure No. 1 for attendees)

(b) Persons Contacted During the Audit

See Enclosure No. 1 for a list of personnel contacted during the audit.

(c) Post-audit Conference

A post-audit conference was held at 11:00 a.m. on September 20, 1991, at the USGS offices in Denver, CO. A synopsis of the preliminary deficiencies identified during the course of the audit was presented to the Technical Project Officer (TPO), the QA Manager and their staffs. (see Enclosure No. 1 for attendees)

5.3 EXAMINATION OF PROGRAMMATIC ELEMENTS

The programmatic checklists covered the QA program controls which were applied to the TA for the nine elements listed below.

- 2.0 Quality Assurance Program
- 3.0 Scientific Investigation and Design Control
- 4.0 Procurement Document Control
- 5.0 Instructions, Procedures, Plans, and Drawings
- 6.0 Document Control
- 7.0 Control of Purchased Items and Services
- 8.0 Identification and Control of Items, Samples, and Data
- 12.0 Control of Measuring and Test Equipment
- 18.0 Audits

(a) Quality Assurance Program (Criterion 2)

The auditor reviewed documentation and interviewed a number of USGS and their contractor personnel to determine overall programmatic implementation with Section 2 of the QAPP and procedures QMP 2.02, 2.05, and 2.07 which contain requirements related to Criterion 2.

The personnel qualification records for the PI and six individuals working on the TA were reviewed. It was noted that four of the seven individuals are from Foothill Engineering Consultants (FEC). The records for two other individuals who had worked in the TA but are no longer with the YMP were also reviewed.

The records were kept by the USGS TPO and contained a position description (PD), personal resume, and a personnel qualification statement (PQS). A duplicate set of records is maintained in the USGS Local Records Center (LRC).

The PDs identified minimum education and experience requirements, position responsibilities, required capabilities, and were approved by USGS management responsible for the position and also the contractor Project Manager for FEC employees. The PQS stated that the individual was qualified for the duties of the position based on experience and education. For FEC employees, the PQS was signed by the contractor Project Manager. The PI signed the PQSs for USGS personnel, and in addition USGS/Headquarters in Reston, VA verified the experience and education for each position.

The auditor interviewed the Science Applications International Corporation (SAIC) manager responsible for the qualification of audit and surveillance personnel and reviewed the Auditor Qualification Records for four individuals and the Surveillance Qualification Records for three individuals. The seven individuals selected had performed internal surveillances (3), an internal audit (1), and external audits (2) relating to the TA. It was verified that required training, audit participation, lead auditor examination, maintenance of qualification, and proper certification of qualification were completed and maintained. The qualification records were in the LRC, and a second set is maintained in the SAIC offices in Golden, CO.

The SAIC Training Coordinator, who is responsible for all USGS/YMP training was interviewed by the auditor, and the training records (TR) for the nine individuals on the TA were reviewed. A USGS/YMP Indoctrination Assignment completed by the PI requires each individual to attend specific classroom training and complete reading assignments on applicable QMPs, HPs and YMP Administrative Procedures. A review of classroom attendance sheets and USGS/YMP Instruction Records indicated that all nine individuals had received indoctrination into the USGS/YMP QA program and appropriate training for their respective job responsibilities.

(b) Scientific Investigation and Design Control (Criterion 3)

For this TA, the PI pursued an investigation for improving reliability and quality of data collection by using data collection platforms (DCP) as an emergency notification system for anomalous water level readings and as a data-storage system to replace the current data logger-based system. As a consequence of this investigation, the PI generated a Scientific Notebook Plan (SNP) (NWM-USGS-HP-196T, RO) "Data Collection Platforms" describing the basic objective and work plan of this TA and placing the implementation of this plan under the control of the Scientific Notebook (SN). The auditor reviewed this plan and use of the SN.

The SN did have an entry that a check list is recommended to instruct the technician in collecting and dumping data to preclude errors and the possibility of losing the electronically collected data. Important details of the check list were not described in the notebook. The SN also made reference to data collecting events where the data was lost by changing the mode of the DCP. This statement alone alerts one to the need for step-by-step details in the SN to preclude this from happening again.

In general, the SNP and the SN were properly documented and maintained except that the step-by-step process for collecting and dumping data from the DCPs was not sufficiently documented as required by procedure QMP 5.05 "Scientific Notebook System" (See Deficiency No. 4).

Throughout the investigation of this TA, the NRC staff found no evidence that the scientific data collected and recorded was not acceptable. Overall, the conduct of the scientific investigation in this area was found to be professionally performed with a sound attitude and commitment to achieving a quality product.

(c) Procurement Document Control and Control of Purchased Items and Services (Criteria 4 and 7)

To date, all the items (transducers, barometers, data loggers and DCPs) for the TA have been ordered as commercial items. Therefore, compliance with the requirements of Section 4 of the QAPP and procedure QMP 4.01, "Procurement Document Control," could not be verified.

The auditor reviewed records and interviewed SAIC personnel responsible for the purchase of items and services to determine programmatic implementation with Section 7 of the QAPP and QMP 7.01 which contain requirements related to Criterion 7. Approximately 11 Approved Vendor Lists (AVL) were reviewed from June 1989 through August 1991. It was noted that Campbell Scientific, Inc. (CSI) was

on all the AVLs from June 1989 to the present. CSI provides repair and calibration services for the CSI 21X Micrologger which is purchased as a commercial item and then undergoes a system calibration by USGS. Druck, Inc. has been on the AVLs since November 1989, and Y.S.I. was added to the AVL in May 1991. Druck supplies transducers, which also undergo a system calibration by USGS, and Y.S.I. supplies calibrated barometers. The USGS accepts "services" through its audits and surveillances of the applicable vendors.

It was noted that an award/contract to FEC is renewed on an annual basis for FEC to provide personnel, materials, and labor in support of the Hydrogeological and Geophysical Technical Support Services at the NTS. All contractor personnel work under the USGS QAPP. For requirements of the intra-USGS procurement of services or calibration standards, a Management Agreement (MA) is documented. Two MAs (dated November 16, 1989 and September 27, 1990) between USGS/YMP and USGS Hydrologic Instrumentation Facility (HIF) for repair and/or calibration of electronic and mechanical hydrologic equipment used by USGS/YMP were evaluated. The MAs were signed by the TPO, the Chief of HIF and the QA Manager. It was verified that the QA office reviews the MAs, and appropriate documentation is maintained in the LRC.

(d) Instructions, Procedures, Plans, and Drawings (Criterion 5)

The auditor interviewed members of the USGS technical and QA staff regarding the preparation, review and approval of technical procedures. Record packages pertaining to the preparation, review, comment, resolution and approval of six technical procedures were evaluated. It was determined that the technical and QA reviews were performed in accordance with sound review criteria and that the technical and QA review comments were adequately resolved to the satisfaction of the reviewers. The review and comment forms were correctly filled out with the signatures of the reviewers and documentation attesting to the acceptability of resolutions and close out of comments. The released procedures were also reviewed and a determination made that the appropriate resolutions to comments were properly incorporated and that the necessary approval dates and signatures were recorded on the procedures. The record packages for the six technical procedures for this TA were complete and well maintained by the USGS QA organization. Technical and QA personnel interviewed were familiar and knowledgeable of the detailed controls in procedure QMP-5.01, "Preparation of Technical Procedures."

(e) Document Control (Criterion 6)

The auditor verified that the PI for the site potentiometric-level evaluation activity and personnel under his direction had controlled technical procedures for this technical activity, and the procedures were controlled, available and well understood by the users.

The USGS QA organization maintains a master index of all current quality related procedures (including technical procedures) and a controlled distribution list for each procedure. This controlled distribution list identifies the current revision of the procedures and personnel who received controlled copies of the procedures. Documented evidence was available showing that configuration checks of controlled procedures were performed annually to assure procedures are current and controlled at work stations.

(f) Control of Measuring and Test Equipment (Criterion 12)

The controls used on the measuring and test equipment (M&TE) at the three well sites that were visited were reviewed to determine programmatic implementation with Section 12 of the QAPP and procedure QMP 12.01 which contain requirements related to Criterion 12.

It was verified that Section 5.0 of the four technical procedures USGS-HP-25, -60, -71, and -75 documented the calibration requirements for the transducer/data logger system and the transducer/DCP system used on this TA. Well site USW H-6 contained two transducers and a DCP. A DCP along with one transducer and one barometer made up the system at site USW WT-11. The system consisted of a transducer and a DSI 21X micrologger at site UE-25 WT-16. All the M&TE at the three sites were uniquely identified and contained a Calibration Status Sticker (CSS). The CSS identified the instrument, date calibrated, recalibration due date, procedure no., and calibrator. A review of the records in Denver indicated that the PI, or his designate, sent a completed Notice of Calibration Status form for each M&TE on the three well sites to the QA department. In addition, the calibrations performed by USGS/YMP personnel are recorded in the well site log books.

It was noted that the QA Office maintains a calibration tracking system. The Calibration Record (CR) is produced on a quarterly basis, and it is distributed to the PI. The CR lists the instrument name, ID No., date of last calibration and next calibration, calibrator, and the test procedure.

Qualification Audit No. USGS-91-02 of Y.S.I. conducted on December 19, 1990, indicated (Nonconformance Report NCR-91-03) that a barometer (S/N 90 H-22118) at well site USW WT-11 was calibrated by a noncertified vendor. The corrective action identified was to examine the traceability of the calibration documentation during the next audit/surveillance of the vendor's site.

At well site USW WT-16, it was noted that a packet in a USGS van contained six technical "HP" procedures for this TA, but an outdated version of HP-26 was in the packet, and there was no documented evidence either at the Hydrologic Research Facility (HRF) at the NTS or at the Federal Center in Denver, CO that a check-out log for the distribution of the documents was maintained (See Deficiency No. 1). The superceded copy of HP-26 was removed from the packet when it was brought to the attention of USGS personnel.

(g) Audits (Criterion 18)

The auditor interviewed USGS personnel responsible for audits and surveillances and reviewed records to determine programmatic implementation with Section 18 of the QAPP and procedures QMP 18.01 and 18.02 which contain requirements related to Criterion 18.

Regarding this TA, approximately one internal and two external audits and four internal surveillances were conducted from December 1988 to the present. Three QA Audit and Surveillance Schedules for fiscal years 1989, 1990, and 1991 were reviewed. This schedule is prepared by the QA department on a quarterly basis and sent to the TPO and is also maintained in the LRC. The QA record package for the USGS-89-01 internal audit was reviewed. The package contained an audit notification and plan, audit checklists for four auditors, the audit report dated January 12, 1989, and documentation relating to three findings. It was noted that corrective action was taken on the findings which addressed deficiencies dealing with personnel certification forms, software QA, and review of technical procedures. The QA record packages, which are kept in the LRC, for the two external audits were also reviewed. Audits USGS-90-12 and USGS-91-02 were performed on Druck and Y.S.I. in August and December 1990, respectively.

The Project QA Surveillance Log (SL), which is maintained by the QA Department, for fiscal years 1989, 1990, and 1991 was reviewed. The SL identifies the date, subject, activity, location, team leader, number and type of findings, and closure data for each surveillance. The Surveillance Record Packages (SRPs) for the four internal surveillances were reviewed. Three of the SRPs contained a surveillance notification and plan, completed checklist, and report. The three surveillances conducted in 1990 verified the implementation of CA for a non-conformance identified in the internal audit, and the adequacy and effectiveness of the implementation of requirements pertaining to document control and software QA. Surveillance No. USGS-91-S16 was recently performed on August 26-28, 1991, and the surveillance plan indicated that the surveillance was to verify compliance with applicable elements of the YMP-USGS QA Program and technical procedures for the TA. The report was in preparation.

5.4 EXAMINATION OF TECHNICAL ACTIVITY

The activity for potentiometric level evaluation is part of the Site Saturated-Zone Hydrology Investigation and is described as one of eight activities under Study Plan 8.3.1.2.3.1, "Characterization of the Site Saturated-Zone Ground-Water Flow System." The activity covers the monitoring of water levels in a network of more than 25 wells. Twelve of these wells are automated monitoring sites that typically have a recording interval of about one hour. Two well sites, UE-25 B#1 and USW H-4, are outfitted with strip chart recorders to monitor water levels in a truly continuous fashion. The remaining wells in the network are manually monitored on a monthly basis.

The NRC audit team visited two of the most distant well sites in the network of monitoring wells established by the YMP. These wells, USW WT-11 and USW H-6 which are located west of Yucca Mountain along branches of Solitario Canyon (See Figure No. 1) are outside the NTS. The audit team also visited well site UE-25 WT-16, located about one mile northeast of the repository site to observe the replacement of a transducer and the method used to measure the potentiometric level during calibration of the data recorder and transducer.

Six technical procedures (USGS-HP-25, -26, -60, -71, -75 and -93) relate directly to the TA. In addition, work involving the new DCP is being performed using the scientific notebook procedure. During the audit, the team observed demonstrations of work under three of these procedures.

The project is minimally staffed at present, due to several vacant positions and the recent transfer of an experienced field technician. According to the PI, there are adequate staff to perform the work. Some of the staff in Denver are also trained to perform the field work and could be sent to the site if needed to fill any gaps in the work schedule.

Wells at the Yucca Mountain site typically include an iron marker post that is used to support equipment and to clearly display the well location and thus protect the surface casing from accidental damage. The identifying number of a well was displayed on this marker post. However, well sites UWS WT-11 and UWS H-6 had incorrect well numbers displayed on their posts. These posts had been used at other well sites, and were subsequently recycled for use at these two sites. Although the NRC staff is not aware of specific QA requirements for the marker posts, it is a poor practice to have incorrect identifiers at the well sites.

At well site USW H-6, the logbook did not identify the DCP by either model number and/or serial number (See Deficiency No. 2). It should be noted that the PI took immediate action to remedy the finding.

At well site USW WT-11 there was evidence that an intruder attempted to gain entry to the locked trailer that houses the data recording and transmitting equipment. This was noted by a field technician who recorded on April 4, 1991, that there were indications of attempted forced entry. The logbook at this site was not signed or initialed by the field technician for a daily entry (See Deficiency No. 3).

Piezometers for the automated well sites are protected from any influx of dust and precipitation only by adhesive tape placed over the tops of piezometers. Standard practice in the water well industry calls for reasonable precautions to prevent either tampering with wells or the entrance of foreign materials into them. This kind of protection is easily obtained by the use of a lockable cover at the well head. Such protection is especially important to protect groundwater in wells that will be sampled for hydrochemical analyses. Standard well construction practices are discussed in readily available references, including Environmental Protection Agency's "Manual of Water Well Construction Practices" and the National Water Well Association's "Design and Construction of Water Wells."

Starting in 1989, the PI for this activity began experimenting with the DCPs for continuous monitoring of water levels. The DCP's are similar in design to remote systems used to provide early warning of river flooding. Six out of the 12 automated well sites have now been converted to DCPs. The previous system required periodic downloading of data, typically on a monthly basis. However, any event that caused loss of power or transducer failure would result in the loss of days or even weeks of data. The DCPs transmit eight hours of data every four hours to a Geostationary Operational Environmental Satellite, which retransmits the data to receiving stations in Denver, CO and the Distribution Facility in Camp Spring, MD. The data are also periodically downloaded manually and sent to Denver in the form of record tapes which can be used to verify the remote transmitted data. The DCPs have reduced the amount of data lost and provide almost immediate notice of problems at well sites. For example, if a signal from a given well is lost, project staff in Denver are thereby notified almost immediately, and field personnel at the site can be dispatched to correct any problems. The DCPs use two backup batteries as auxiliary power supplies in addition to a solar panel. The previous data recorders used only one battery backup and were more susceptible to data loss if power was accidentally disrupted.

Until now, the work involving DCPs has been documented using a SNP (NWM-USGS-HP-196T, RO) "Data Collection Platforms." The effective date of this notebook plan was February 12, 1990. According to the PI, there is now sufficient experience on use of the DCPs to prepare a written procedure for the work. It also appears that a written procedure is needed for the data reduction work that will be carried out on a yearly basis in the Denver office.

Transducers used previously on the project experienced recurrent problems with equipment failure and anomalous readings thought to be associated with electrical storms. The problems have been reduced by switching from the previous equipment to so-called "current loop" transducers. According to the PI, these transducers have a much lower rate of failure, seldom give erratic measurements, and have resulted in fewer gaps in potentiometric data.

In interviewing the PI, determination of accuracy and precision of water levels was discussed. For example, in the mid-1980's the altitudes of casings for most of the project wells were resurveyed to confirm their accuracy. The PI noted that three wells (J-11, J-12, and J-13) in the network remain to be resurveyed. The effects of borehole deviation on water level measurements were also discussed. One of the assumptions for measuring water levels with reeled steel tapes (ref. procedure HP-75) is that wells are vertical. This procedure states that experience has shown it to produce the most accurate and precise water-level measurements. The criterion is that repeated measurements show a range of no more than one part in 5000 for depths greater than 500 ft. However, well deviations at the site are significant and will affect measured depths to water. The PI noted that effects of well deviation are accounted for during the report writing stage. This was confirmed by reviewing a draft report that was in preparation.

5.5 SUMMARY OF NRC STAFF FINDINGS

(a) The NRC staff identified four deficiencies relating to the implementation of QA requirements documented in the USGS QA program, and these are described in Appendix A.

(b) Weaknesses

At well sites USW WT-11 and USW H-6, incorrect well numbers were displayed on the marker posts.

The PI was not informed of the attempted forced entry on April 4, 1991, into the trailer at well site USW WT-11.

At well sites USW WT-11, H-6, and WT-16, proper lockable covers for the tops of well casings were not provided.

The reference steel tape, which is used to calibrate the field tapes, is not kept under special storage conditions at the HRF.

(c) Good Practices

The efforts of USGS management as well as the QA and technical staff personnel facilitated the smooth and effective conduct of the audit.

Technical and QA staffs demonstrated good knowledge of QA requirements, their QA responsibilities, and a commitment to comply with their QA program.

There is a strong commitment and support for an effective QA program from the TPO on down to the line organizations.

Installation of the DCPs for continuous monitoring of potentiometric levels is a great improvement over the previous system of data recorders.

Recurrent problems with transducers have been reduced by switching from the previous equipment to "current loop" transducers.

The PI and staff have documented the calibration traceability of the reference steel tape to the National Institute of Standards and Technology.

U.S. GEOLOGICAL SURVEY
NRC-91-01 AUDIT ROSTER

<u>NAME</u>	<u>ORGANIZATION</u>	<u>Pre-Audit</u>	<u>Contacted</u> <u>Audit</u>	<u>Post-Audit</u>
Appel, David H.	USGS-HIP	x		x
Blaylock, Jim	DOE-QA	x	x	x
Boucher, Michelle	USGS-SAIC	x	x	
Burgess-Kohn, Karen	USGS-SAIC		x	x
Causseaux, Wil	USGS-HIP	x	x	x
Chaney, Tom	USGS-QA	x	x	x
Coleman, Neil	NRC-HLWM	x		x
Conway, Jim	NRC-HLWM	x		x
Ducret, Louis	USGS		x	x
Gilray, John	NRC-HLWM	x		x
Handy, Al	USGS-QA			x
Hayes, Larry	USGS-TPO		x	x
Luckey, Dick	USGS-HIP	x	x	x
Lykins, Alice	USGS-QA		x	
Mustard, Martha	USGS-QA		x	x
Porter, Darrell	USGS-SAIC		x	x
Prestholt, Paul	NRC-HLWM		x	x
Rodman, Wayne	USGS-QA	x	x	
Whiteside, Ardell	USGS-SAIC	x	x	x
Woolverton, Jon	USGSHIP			x
Zimmerman, Susan	State of Nevada	x	x	x

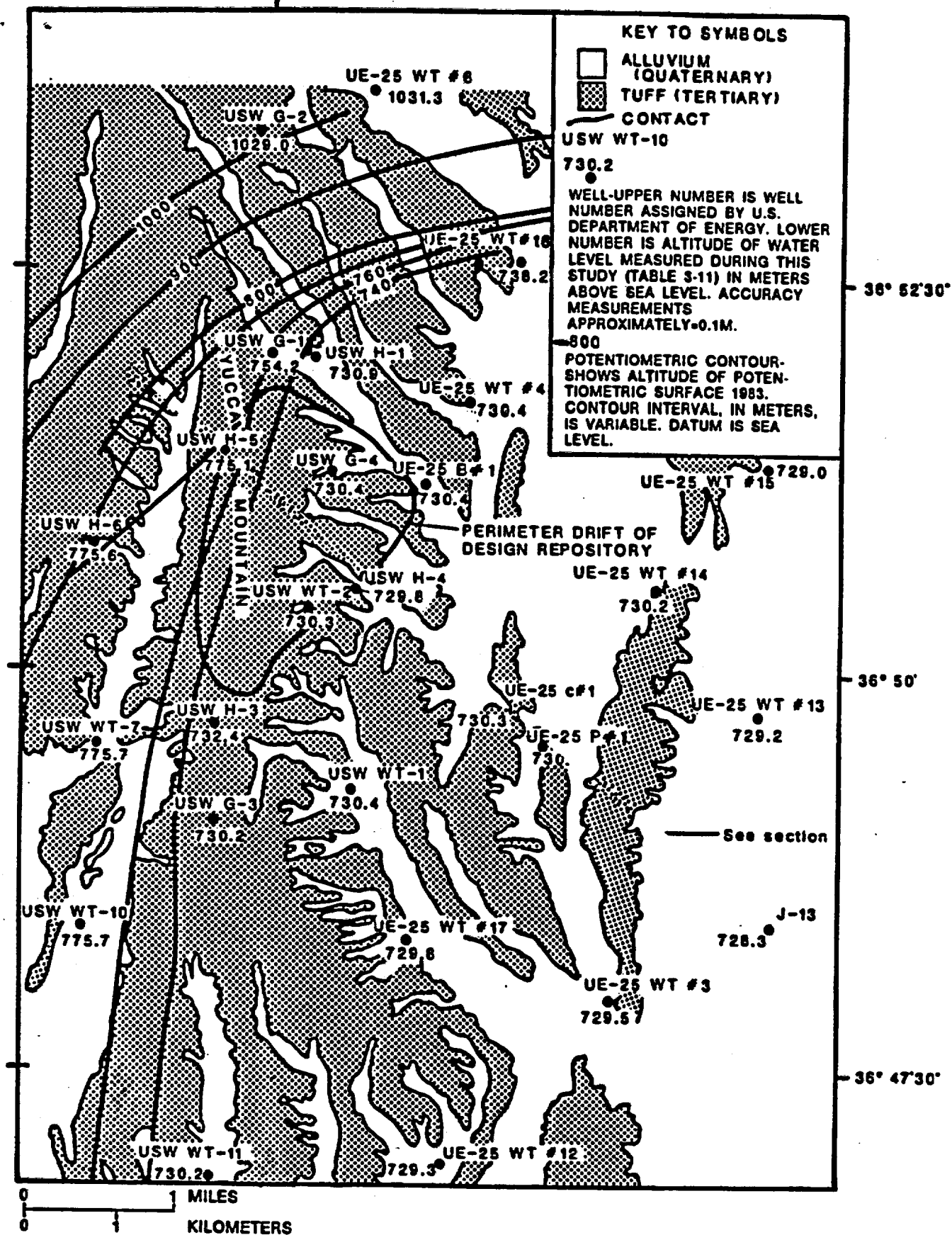


FIGURE NO. 1