



Department of Energy
Office of Civilian Radioactive Waste Management
Office of Repository Development
1551 Hillshire Drive
Las Vegas, NV 89134-6321

QA: N/A
Project No. WM-00011

JUN 14 2004

OVERNIGHT MAIL

ATTN: Document Control Desk
Director, Division of High-Level Waste
Repository Safety
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

TRANSMITTAL OF REFERENCE DOCUMENTS TO SUPPORT U.S. NUCLEAR REGULATORY COMMISSION (NRC) REVIEW OF KEY TECHNICAL ISSUE (KTI) AGREEMENTS RELATED TO *TECHNICAL BASIS DOCUMENT NO. 11: SATURATED ZONE FLOW AND TRANSPORT*

- References: (1) Ltr, Schlueter to Ziegler, dtd 12/23/03 (Status of NRC Review of DOE KTI Agreement Responses and Information Needed to Complete NRC Reviews, with enclosure)
(2) Ltr, Ziegler to Chief, High-Level Waste Branch, dtd 4/07/04 (Additional Information Requested for KTI Agreements for USFIC 5.05 and RT 2.09)

Reference 1 provided a list of documents the NRC needs to complete their review of six of the seven Technical Basis Documents and associated KTI agreement responses recently submitted by the U.S. Department of Energy.

This letter transmits a hard copy (enclosures 1-9), a compact disc (CD) (enclosure 10) containing seven of the eight documents and two of the five source data requested for NRC to complete its review of certain KTI agreements in the *Technical Basis Document No. 11: Saturated Zone Flow And Transport*. These documents reflect the current status of the Yucca Mountain Project's scientific and design bases and remain subject to future change. Information that evolves through subsequent changes of the referenced documents will be reflected in the License Application. Also enclosed is the CD Document File Information sheet as Enclosure 11.

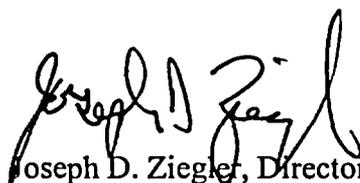
The NRC requested draft revisions (Revision 01A and the Revision 01A Pre-Check Copy) of the *Site-Scale Saturated Zone Flow Model*, MDL-NBS-HS-000011. This document has been finalized and only the approved revision is included in the enclosures.

GS010908314221.001 requested in Reference 1 is a geologic map available in multiple formats online at: <http://pubs.usgs.gov/imap/I-2755>. The NRC can access the map at this web site. An updated version of source data GS030408314211.002 was provided to you in Reference 2. The source data files for the hydrologic framework model are extensive and will be made available for your inspection on site.

AMSS07

JUN 14 2004

There are no new regulatory commitments in the body of this letter or its enclosures. Please direct any questions concerning this letter and its enclosures to Carol L. Hanlon at (702) 794-1324 or e-mail at carol_hanlon@ymp.gov, or Drew H. Coleman at (702) 794-5537 or e-mail at drew_coleman@ymp.gov.



Joseph D. Ziegler, Director
Office of License Application and Strategy

OLA&S:CLH-1180

Enclosures:

1. *Interpretation of the Lithostratigraphy in Drill Hole NC-EWDP-2DB and N-EWDP-19D1,*
2. *Interpretation of the Lithostratigraphy in Deep Boreholes NC-EWDP-18P, NC-EWDP-22SA, NC-EWDP-10SA, NC-EWDP-23P, NC-EWDP-19IM1A, and NC-EWDP-19IM2A, Nye County Early Warning Drilling Program, Phase II*
3. *Geochemical and Isotopic Constraints on Groundwater Flow Directions, Mixing and Recharge at Yucca Mountain, Nevada*
ANL-NBS-HS-000021, Revision 01
4. *Saturated Zone Colloid Transport.*
ANL-NBS-HS-000031, Revision 01
5. *Saturated Zone In-Situ Testing.*
ANL-NBS-HS-000039, Revision 00
6. *Features, Events, and Processes in SZ Flow and Transport.*
ANL-NBS-MD-000002, Revision 02
7. *Site-Scale Saturated Zone Transport Model*
MDL-NBS-HS-000010 Revision 01
8. *Site-Scale Saturated Zone Flow Model.*
MDL-NBS-HS-000011, Revision 01
9. *SZ Flow and Transport Model Abstraction*
MDL-NBS-HS-000021, Revision Rev 00

JUN 14 2004

Enclosures: (continued)

- 10. CD of Enclosures 1-9
- 11. Data File Format Information

cc w/encls 1-11:

B. J. Garrick, ACNW, Rockville, MD
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W. D. Barnard, NWTRB, Arlington, VA

cc w/encls 10 & 11:

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Mike Simon, White Pine County, Ely, NV
R. I. Holden, National Congress of American Indians, Washington, DC

cc w/o encls:

A. C. Campbell, NRC, Rockville, MD
L. L. Campbell, NRC, Rockville, MD
N. K. Stablein, NRC, Rockville, MD

Enclosure 11

Document File Format Information of CD

All files are publicly available.

The pdf files included in the CD are:

<u>Directory/File Name</u>	<u>Size (bytes)</u>	<u>Date</u>
GS011008314211.001	1,758,179 bytes	5/11/04
Nye County 1.pdf	1,380,969 bytes	5/11/04
Nye County 2.pdf	377,190 bytes	5/11/04
GS030108314211.001	348,440 bytes	
5/05/04		
313963README_doc.pdf	86,692 bytes	4/13/04
Lithology_NC_EWDP_10SA.pdf	54,766 bytes	5/04/04
Lithology_NC_EWDP_18P.pdf	61,574 bytes	5/04/04
Lithology_NC_EWDP_19IM1A.pdf	29,663 bytes	5/04/04
Lithology_NC_EWDP_19IM2A.pdf	25,826 bytes	5/04/04
Lithology_NC_EWDP_22SA.pdf	47,288 bytes	5/04/04
Lithology_NC_EWDP_23P.pdf	42,631 bytes	5/04/04
ANL-NBS-HS-000021REV 00.pdf	9,699,840 bytes	2/23/04
ANL-NBS-HS-000031 REV 01.pdf	1,811,968 bytes	12/15/03
ANL-NBS-HS-000039 REV 00.pdf	12,498,944 bytes	3/18/04
ANL-NBS-MD-000002 REV 02.pdf	2,941,952 bytes	4/14/04
MDL-NBS-HS-000010 REV 01.pdf	4,179,968 bytes	3/25/04
MDL-NBS-HS-000011 REV 01.pdf	16,437,760 bytes	3/24/04
MDL-NBS-HS-000021 REV 00.pdf	13,504,000 bytes	12/15/03

Table of Contents Item #8

Title: Interpretation of Lithostratigraphy in Drill Hole NC-EWDP-2DB

Record date: 07/30/2001

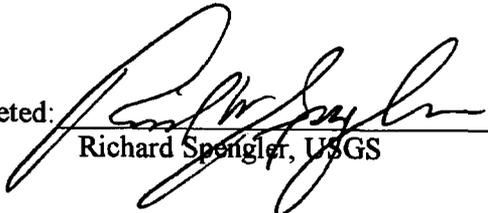
Organization: USGS

QA Designation: QA:QA

Author: R. Spengler, USGS

Traceability Designators: DTN: GS011008314211.001
SCP: 8.3.1.4.2.1.1
WBS: 1.2.21.3.1

Record Completed:


Richard Spengler, USGS

Date: 01/07/02

ENCLOSURE 1

Drill Hole NC-EWDP-2DB

Location=36° 39' 39.354" N, 116° 27' 57.762" W (refer to DTN MO0106GSC01043.000)

Compiled and interpreted by Richard W. Spengler, 7/30/01

Ground Elevation=2628.9 feet

Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997) and Buesch and others (1996).

Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>	
QTu	Quaternary and Tertiary Alluvium (undifferentiated)	Mixture of gravel and sand, very light gray (N8), medium dark gray (N4), and brownish gray (5YR4/1), dominantly composed of devitrified and zeolitic volcanic fragments, moderate orange pink (10R7/4), rare basaltic fragments, black (N1), size of fragments decrease sharply from gravel to coarse sand at 612 feet.		<p>Variability in the resistivity and caliper logs may indicate vertical zonation of particle size within the Quaternary and Tertiary alluvium that cannot be identified within bit-cutting samples. Resistivity logs indicate a progressive decrease in values from the surface to a depth of 208 feet. A low amplitude increase in resistivity occurs between 208 and 245 feet. A moderately high amplitude spike occurs between 389 to 439 feet. Resistivity abruptly decreases at a depth of 496 feet. The caliper log indicates that the hole is excessively "out-of-gauge" to a depth of 393 feet. The holes remains relatively in-gauge, beginning at a depth of 393 feet. The moisture log indicates an abrupt increase at a depth of about 510 feet. The resistivity logs indicate an abrupt decrease in</p>	<p>Low confidence is given to the existence and significance of vertical zonations, based on resistivity, until sufficient correlation of vertical zonal variations can be established with other boreholes where open-hole geophysical measurements have been collected. Some workers believe that Quaternary alluvium rarely exceeds 50 meters in thickness, therefore these deposits are labeled as Quaternary and Tertiary.</p>	0	600	600	2029

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			values at a depth of 600 feet.						
Tal	Tertiary Sand	Reworked tuff, tuffaceous sandstone, and pyroclastic fall deposits, yellowish gray (5Y8/1) and yellowish brown (5Y8/1), poorly to moderately consolidated, localized silicification, fine grained (0.15-0.25 mm), white (N9) pumice clasts, less than 1 mm in size, occur at 670 feet. Unit increases in clay content below 695.0 feet. Significant gravel contamination appears to occur between 825 and 925 feet.	Deposit contains 40-60 percent phenocrysts of sanidine, quartz, and biotite.	An abrupt increase in resistivity logs between 644 and 676 feet may indicate an increase in tuffaceous gravels. The resistivity log shows uniformly low values throughout the interval from 600 to 923 feet, except for a low amplitude peak between 645 and 688 feet. Hole deviation abruptly decreases at top of unit. An abrupt increase in hole erosion occurs at 667, based on the caliper log.	Although samples from 960 to 1010 feet show a high degree of contamination, moderate confidence is given that the interval from 600 to 921 feet is composed of Tertiary deposits, based on the uniform resistivity and resistance log values, an abrupt increase in hole erosion, the abrupt decrease in hole deviation associated with the interval, and the appearance of significantly more volcanic sand size particles in samples.	600	921	321	1708

Drill Hole NC-EWDP-2DB

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>	
Tpt	Topopah Spring Tuff	Pyroclastic flow deposit, light brownish gray (5YR6/1), non-to densely welded (dominantly densely welded), devitrified. Fragments are angular. Samples are contaminated with reworked tuff (pyroclastic fall deposits).	Interval contains 2-3 percent phenocrysts of sanidine and biotite.	Both resistance and resistivity (16-inch normal) log values indicate an abrupt increase at 921 feet, which is interpreted as the top of the Tpt. A peak, located at a depth of 925 feet, may represent the top of the thin densely welded zone. The density log is non-diagnostic within the interval.	Only moderate confidence is assigned to the existence of the Topopah Spring Tuff (Tpt) as bedrock. Unit may be rubble, talus, or severely broken. Although well defined based on the resistivity log, density logs are commonly more diagnostic in defining zonal variations of pyroclastic flow deposits. Because the density log for this drill hole does not aid in defining zones, the possibility exists that the cuttings are of rubble and not bedrock.	921	960	39	1669

Drill Hole NC-EWDP-2DB

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Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tpt Topopah Spring Tuff	Pyroclastic flow deposit, moderately welded. Samples from 960 to 975 feet contain a mixture of two dominant rock types of the Tpt. Fragments include grayish orange pink 95YR7/2) nonwelded tuff and pale yellowish brown (10YR6/2) moderately welded tuff. Samples from 975 to 1005 contain a mixture fragments of welded and nonwelded pyroclastic flow and reworked tuff. Moderately to densely welded tuff is pale yellowish brown (10YR6/2), nonwelded tuff is very pale orange (10YR8/2) and devitrified. Fragments of reworked tuff are very pale orange (10YR8/2) and fine-grained. Contamination of rock types is suspected during drilling and sample collection.	Samples of nonwelded and moderately welded tuff are estimated to contain 1 to 3 percent phenocrysts of sanidine and biotite.	The resistance log indicates an abrupt decrease at 987 feet. High values in the resistivity log occur at 971 feet, which appear to be consistent with an increase in welding within the pyroclastic flow deposit. The density log is nondiagnostic.	Only moderate confidence is assigned to the existence of the Topopah Spring Tuff as bedrock. In general, density logs are commonly more diagnostic in defining zonal variations of pyroclastic flow deposits at Yucca Mountain. Although well defined based on the resistivity log, the density log for this drill hole does not aid in defining zones, therefore, the possibility exists that the interval is either rubble or highly fractured and (or) faulted.	960	987	27	1642
Tpt Topopah Spring Tuff	Mixture of fragments of pyroclastic flow deposit and reworked tuff. Interval may represent the nonwelded basal zone of	Samples of welded tuff contain 1 to 2 percent phenocrysts of sanidine and biotite; samples of	Resistance and resistivity log values abruptly decrease at a depth of 1011 feet, which may be indicative of the	Contamination of samples is suspected during drilling and sampling. Only moderate confidence is assigned to	987	1011	24	1618

Drill Hole NC-EWDP-2DB

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Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
	Tpt. Samples from 975 to 1005 contain a mixture fragments of welded and nonwelded pyroclastic flow and reworked tuff. Moderately to densely welded tuff is pale yellowish brown (10YR6/2), nonwelded tuff is very pale orange (10YR8/2) and devitrified. Fragments of reworked tuff are very pale orange (10YR8/2) and fine-grained. Sample from 1005 to 1010 feet contains several lithologies of the Topopah Spring Tuff, which include pyroclastic flow deposit, pale brown (5YR5/2), densely welded, devitrified; pyroclastic flow deposit, light olive gray (5Y6/1), moderately welded, devitrified; pyroclastic flow deposit, moderate orange pink (5YR8/4), nonwelded, devitrified; and a few black (N8) vitrophyre fragments.	nonwelded tuff contain 1 to 3 percent phenocrysts of sanidine and biotite; samples of reworked tuff contain 60 to 70 percent phenocrysts.	nonwelded base of the Tpt. A low amplitude peak in the resistance and resistivity logs occurs between 1002.5 and 1011 feet, which is characteristic of the base of the Tpt in some holes at Yucca Mountain.	the existence of the Topopah Spring Tuff as bedrock. In general, density logs are commonly more diagnostic in defining zonal variations of pyroclastic flow deposits at Yucca Mountain. Although well defined based on the resistivity log, the density log for this drill hole does not aid in defining zones, therefore, the possibility exists that the interval is either rubble or highly fractured and (or) faulted				
Tpbs	Pre-Topopah Spring Sedimentary	Claystone, very pale orange (5YR8/2) and yellowish gray 95Y7/2),	No conspicuous geophysical signatures define this interval.	High confidence is assigned to existence of deposit, based on the first	1011	1015	4	1614

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Ground Elevation=2628.9 feet

Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997) and Buesch and others (1996).

Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>	
	rocks	amorphous to finely crystalline. Interval may represent an altered pyroclastic fall deposit.			appearance of claystone in the drill hole.				
Tptbt -may correlate with Tptbt1 within the central part of Yucca Mountain	pre-Topopah Spring Bedded Tuff	Pyroclastic fall deposit (reworked?), very pale orange (10YR8/2), poorly to moderately consolidated, rare grayish orange (10YR7/4) altered glass shards, very fine to fine grained. Interval from 1045 to 1065 feet contains a mixture of several lithologies that include reworked tuff, siltstone, and pyroclastic flow deposit, varying in color from very pale orange (10YR8/2), grayish orange (10YR7/4), yellowish gray (5Y8/1), and light greenish gray (5GY8/1). Pyroclastic flow deposit is nonwelded.	Rare (less than 1 percent) phenocrysts of sanidine. Fragments of nonwelded tuff in lower part of interval contain 2 to 3 percent phenocrysts of sanidine and biotite.	Resistance and resistivity logs indicate low values throughout interval. Base is marked by a slight, but abrupt decrease in resistance values.	High confidence is given to the stratigraphic identification, based on a very low phenocryst content, similar to rock units of the Paintbrush Group. High confidence is given to the vertical limits of the deposit, particularly the location of the base of the unit at 1065 feet, which is primarily based on characteristics of resistivity logs.	1015	1065	50	1564

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Tpbs	Pre-Topopah Spring Sedimentary rocks	Claystone, very pale orange (10YR8/2) and dark reddish brown (10R3/4), amorphous, highly siliceous..		Resistivity logs indicate an abrupt, but small, decrease in values between 1065 and 1076 feet. The base of the interval is marked by an increase in resistivity logs, particularly the 16-inch normal. Abrupt increase in hole deviation occurs at 1068 feet. An abrupt decrease in the moisture log occurs at 1069 feet.	High confidence is given for the existence and vertical extent of deposit based on the correlation of low resistivity values and homogenous samples.	1065	1071	6	1558

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>	
Tcbbt	Pre-Bullfrog Bedded Tuff	Reworked tuff, pale red (10R6/2) and pale brown (5YR5/2), coarse grained, unconsolidated to poorly consolidated. Conspicuous pale red (10R6/2) lithic clasts below 1075 feet.	Abundant (20-50 percent) phenocrysts of sanidine, quartz, and biotite within interval. Phenocryst make up approximately 20 percent of the rock. Phenocrysts include subequal proportions of quartz, sanidine, plagioclase, and minor amounts of biotite. These proportions are similar to those commonly found in pyroclastic flow deposits of the Crater Flat Group.	Moisture log is relatively uniform counts/second throughout interval.	High confidence is given for the stratigraphic assignment, based on mineral assemblage and the appearance of this unit in other drill holes in the vicinity. High confidence is given for the vertical limits of the interval, based on homogenous samples and the appearance of claystone and siltstone above and below the deposit.	1071	1085	14	1544
Tcbss	Pre-Bullfrog Sedimentary Rocks	Siltstone, greenish yellow (10Y8/2).		An abrupt decrease in the resistivity logs (particularly the 16-inch normal) occurs at 1095 feet. The interval is represented on the moisture log as a single high amplitude spike.	High confidence is assigned to existence of deposit, based on the first appearance of greenish gray siltstone in the drill hole.	1085	1093	8	1536

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Tcbbt	Pre-Bullfrog Bedded Tuff	Reworked tuff, grayish orange pink (5YR7/2) and grayish red (5R4/2), unconsolidated to poorly consolidated, coarse grained, rare very pale orange (10YR7/4) zeolitic pumice clasts.	Abundant (60-70 percent) phenocrysts of sanidine, quartz, and biotite.	The moisture log indicates a decrease in counts/second within interval. The interval is characterized by uniformly low resistivity values. The base of unit is indicated by an abrupt increase in resistivity at 1108.5 feet.	High confidence is given for the stratigraphic assignment, based the amount of phenocrysts and the assemblage of essential minerals. Moderate confidence is given for the vertical limits of the thin deposit, based resistivity characteristics.	1093	1105	12	1524
		Pyroclastic fall deposit (reworked?), pale red (5R6/2), poorly consolidated, devitrified, microcrystalline, pumice fragments are pale greenish yellow (10Y8/2) and zeolitic.	The deposit contains approximately 20 percent phenocrysts. Sanidine, quartz, and plagioclase occur in approximately subequal proportions. A minor amount of biotite occurs in the deposit. The mineral assemblage is consistent with rock units that make up the Crater Flat Group.	Base of interval marked by an abrupt increase in values on the moisture log at a depth of 1110 feet.	Diagnostic petrographic characteristics of deposit provide evidence for assigning a high confidence level to the stratigraphic identification of the interval. An abrupt increase in the moisture log at base of unit, characteristic of other siltstone units, provides evidence for assigning a high degree in confidence level to the vertical limits of the deposit.	1105	1110	5	1519

Drill Hole NC-EWDP-2DB

Location=36° 39' 39.354" N, 116° 27' 57.762" W (refer to DTN MO0106GSC01043.000)

Compiled and interpreted by Richard W. Spengler, 7/30/01

Ground Elevation=2628.9 feet

Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997) and Buesch and others (1996).

Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>	
Tcbss	Pre-Bullfrog Sedimentary Rocks	Siltstone, pale red (10R6/2) to pale reddish brown (10R5/4).	Interval contains rare biotite.	The interval indicates a progressive increase in values of the moisture log.	High confidence is assigned to the existence and vertical limits of the unit, based on homogenous samples that allow distinction between pyroclastic fall deposits, reworked tuff, and Tertiary sedimentary strata.	1110	1140	30	1489
Tcbbt	Pre-Bullfrog Bedded Tuff	Pyroclastic fall deposit, pale red (5R6/2), poorly sorted, devitrified and altered, calcareous, contains sparse grayish red (5R4/2) pumice clasts. The deposit is composed of about 10-15 percent conspicuous medium dark gray (N4) silicic volcanic lithic clasts.	The deposit contains 14 percent phenocrysts, of which 7 percent are quartz, 39 percent are alkali feldspar, and 41 percent are plagioclase. This mineral assemblage is consistent with those found in rocks of the Crater Flat Group.	The interval appears to be too thin to carry any diagnostic geophysical signatures.	High confidence is given to the stratigraphic identification of the deposit, based on the assemblage of essential minerals and its position above the underlying Tram Tuff. High confidence is also given on its vertical limits, based on uncontaminated samples.	1140	1145	5	1484
Tcbss	Pre-Bullfrog Sedimentary Rocks	Siltstone, grayish orange pink (5YR7/2) and light brown (5YR6/4).		The interval is marked by a single high amplitude peak on the resistivity (16-inch normal) log, indicating an increase in relative resistivity.	High confidence is assigned to the existence of the deposit, based on homogenous samples that allow identification of interbedded pyroclastic fall deposits and Tertiary sedimentary strata.	1145	1155	10	1474

Drill Hole NC-EWDP-2DB

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
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Tct	Tram Tuff (upper unit)	Pyroclastic flow deposit, pale red (10R6/2), partially welded, sparse grayish pink (5R8/2) pumice clasts, abundant pale red (5R6/2) and medium gray (N5) volcanic lithic fragments.	The deposit contains 12 percent phenocrysts, of which 20 percent is quartz, 36 percent is alkali feldspar, and 41 percent is plagioclase. Biotite accounts for 3 percent of the phenocrysts. Most plagioclase phenocrysts are altered to carbonate.	Unit is characterized by very low resistivity values. The resistivity (16-inch normal) log indicates a gradual decrease in resistivity at the top of the unit, which then forms a subtle trough. The base of unit is selected where resistivity begins to increase at depth of 1183 feet.	High confidence is assigned to the existence of the Tram Tuff in the drill hole, based on amount of phenocrysts and essential mineral assemblage, and its occurrence in nearby drill hole NC-EWDP-2D. High confidence is also given to its vertical limits, based on resistivity log characteristics.	1155	1183	28	1446
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Drill Hole NC-EWDP-2DB

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Compiled and interpreted by Richard W. Spengler, 7/30/01

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Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>	
Tct	Tram Tuff (lower unit)	Pyroclastic flow deposit, brownish gray (5YR4/1), partially welded, devitrified, altered to zeolite and carbonate, abundant conspicuous greenish gray (5GY6/1) zeolitic (?) volcanic and metasedimentary lithic clasts. No bit cuttings were available from 1185 to 1205 feet. Samples from 1205 to 1210 feet contain a mixture of pyroclastic flow and siltstone lithologies, suggesting that samples from this interval may be, in part, contaminated.	This deposit contains about 40 percent phenocrysts, of which 35 percent is quartz, 46 percent is alkali feldspar, and 18 percent is plagioclase. Biotite accounts for less than 1 percent of the total phenocrysts. This deposit contains conspicuously more phenocrysts than the upper part of the Tram Tuff from 1155 to 1183 feet and more than is commonly seen with the Tram Tuff elsewhere. However, the mineral assemblage appears to be consistent with the Tram Tuff and no pyroclastic fall, reworked, and Tertiary sedimentary strata separate the upper unit of the Tram from the lower unit.	The resistivity (16-inch normal) log indicates a gradual increase in resistivity from 1185 to a peak at 1205 feet. The moisture log indicates an abrupt decrease in relative moisture content at 1205 feet.	High confidence is assigned to the existence of the Tram Tuff in the drill hole, based on amount of phenocrysts and essential mineral assemblage, and its occurrence in nearby drill hole NC-EWDP-2D. High confidence is given to the vertical position of the basal contact, based on the abrupt decrease in relative moisture content as indicated on the moisture log.	1183	1205	22	1424

Drill Hole NC-EWDP-2DB

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>	
Tcts	Pre-Tram Sedimentary Rocks	Claystone and siltstone, grayish orange pink (5YR7/2), light brown (5YR6/4), pale red (10R6/2), and yellowish gray (5Y7/2), pale red interval is from 1210 to 1215 feet and is weakly effervescent. No samples are available from 1215 to 1230 feet.	This interval marks the initial appearance of a weakly calcareous siltstone.	Geophysical logs indicate no diagnostic signatures to aid in defining the interval.	High confidence is given to the existence of the deposit. Moderate confidence is given to the vertical extent of the deposit, as no unique geophysical signature could be identified.	1205	1260	55	1369
		Interbedded siltstone and reworked tuffaceous sediments, dominantly pale red (10R6/2). No samples were available from 1270 to 1275 feet.		Geophysical logs indicate no diagnostic signatures.	Only moderate confidence is given in identifying the interval as interbedded. The siltstone may represent contamination.	1260	1265	5	1364
		Claystone, yellowish gray (5Y7/2) and pale red (10R6/2). Interval appears silicified from 1275 to 1290 feet.		The resistivity (16-inch normal) curve indicates a sharp peak, whose frequency extends from 1263 to 1294 feet.	High confidence is given to the existence and vertical extent of this interval, based on character of resistivity curves that bracket the interval.	1265	1290	25	1339
Tcts	Pre-Tram Sedimentary rocks	Interbedded claystone and reworked tuff, pale red (5R6/2), grayish red (5R4/2), and grayish yellow (5Y8/4); claystone is dominantly grayish yellow, reworked tuffaceous sediment is crystal rich and fine to coarse grained.		Geophysical logs indicate no diagnostic signatures.	1290	1310	20	1319	

Drill Hole NC-EWDP-2DB

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Ground Elevation=2628.9 feet

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
	Interbedded siltstone and reworked tuffaceous sediments, dominant colors include dark gray (N3), brownish gray (5YR4/1), light brownish gray (5YR6/1), and yellowish gray (5Y8/1), siltstone appears silicified (amorphous texture), tuffaceous sediment appears poorly consolidated or unconsolidated.		The resistivity curves (both 16-inch and 32-inch normal curves) indicate the interval is characterized by 2 sharp high amplitude peaks; the dominant peak occurs at 1324.5 feet. Size and shape of the peaks are similar to those found within a silicified claystone interval between depths of 1265 and 1290 feet.	High confidence is given for the existence of silicification, based on the similarity of resistivity spikes that are found within other zones of silicification.	1310	1330	20	1299
	Interbedded reworked tuffaceous beds and siltstone, pale red (5R6/4) to moderate red (5R5/4), and yellowish gray (5Y7/2). Poorly consolidated to unconsolidated tuffaceous material appears to be the dominant lithology.		Resistivity (16-inch and 32-inch normal) logs indicate that resistivity gradually decreases within interval.	Only moderate confidence is given that the interval is interbedded; some lithologies may represent contamination.	1330	1360	30	1269

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tgegl Pre-volcanic Tertiary Gravels	Gravel, dominantly composed of fragments of limestone and dolomite, with minor proportions of siltstone and quartzite. Colors range from grayish black (N3) to brownish gray (5YR4/1). Lithologies are fine grained and occur as rounded and angular fragments in bit-cutting samples. Interval may be moderately sorted, based on the absence of tuffaceous sands and silt. Fragments of limestone, dolomite and quartzite may include some boulder, cobble, and gravel sizes, based on high resistivity values.		Unit is defined by resistivity (16-inch and 32-inch normal) logs as one of the more dominant anomalies recognized within the drill hole. The entire interval is associated with one of the higher amplitude resistivity peaks found within the saturated zone. The shoulders of the peak extend from 1360 to 1393 feet. The moisture curve indicates a conspicuous low between 1361 and 1393 feet.	High confidence in the existence and location of this rock interval based on the first occurrence of conspicuous Paleozoic rock fragments that dominate the interval and conspicuous geophysical signatures that bracket the interval. The first appearance of gravels that contain an abundance of Paleozoic rock fragments is tentatively used to assign rocks to the Tertiary Prevolcanic sedimentary rock stratigraphic interval in the vicinity of Fortymile Wash. A similar gravel deposit occurs in NC-EWDP-19D1 at approximately the same elevation.	1360	1393	33	1236

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tge Pre-volcanic Tertiary Sedimentary Rocks	Reworked tuffaceous sediments, pale yellowish brown (10YR6/2), light brown (5YR5/6), and grayish black (N2). Samples contain a high proportion of siltstone fragments. Some contamination of samples may be present in the interval.		Spontaneous Potential (SP) log indicates a sharp inflection, followed by a moderate decline at a depth of 1392.5 feet. Values are below 600 millivolts (mv), whereas values that commonly vary between 600 and 700 millivolts (mv) occur within thick intervals that contain siltstone and claystone.	Low confidence that interval contains siltstone; contamination from intervals above is strongly suspected. Both resistivity and Spontaneous potential (SP) logs indicate some degree of erratic behavior, similar to intervals known to contain siltstone and claystone several hundred feet uphole.	1393	1415	22	1214
	Breccia, light gray (N7), composed of angular fragments of siltstone, light brown (5YR6/4), within a matrix composed of fine to coarse sand. Sand particles are dominated by volcanic phenocrysts. Samples from 1425 to 1440 contain a high proportion of siltstone that is interpreted as contamination from above.		The interval is included within a zone of extremely low resistivity values between 1415 and 1560 feet.	Moderate confidence is given to the interpretation that much of the sand size particles within the interval had been winnowed out during the drilling process. A significant amount of siltstone fragments (representing uphole lithologies) may, in effect, represent contamination	1415	1440	25	1189

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		Sandstone, olive gray (5Y4/1), fine grained, calcareous.		The interval contains no unique geophysical signatures.	Low confidence is given for the existence of this interval. The sandstone is thin and may represent contamination. Interval has no distinctive geophysical signature.	1440	1450	10	1179
Tge	Pre-volcanic Tertiary Sedimentary Rocks	tuffaceous sand and sandstone, light gray (N7), unconsolidated to poorly consolidated, coarse grained, poorly sorted, dominated by phenocrysts of sanidine and quartz, includes dark gray (N3) lithic fragments of limestone and chert. Proportion of limestone and chert increases with depth.		Very low resistivity values occur between 1447 and 1483 feet, based on 16-inch normal resistivity log.	Moderate confidence is given for the existence and vertical limits of the interval, based on resistivity logs.	1450	1480	30	1149
Tge	Pre-volcanic Tertiary Sedimentary Rocks	Tuffaceous sandstone, light olive gray (5Y6/1), fine to medium grained.		The interval is included within a zone of extremely low resistivity values between 1415 and 1560 feet.	Moderate confidence is given for the existence and vertical limits of the unit, based on no indication of sample contamination and uniform geophysical signatures throughout the interval.	1480	1495	15	1134

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
	Siltstone, light brownish gray (5YR6/1) and light olive gray (5Y6/1). No samples are available from 1500 to 1510 feet. Siltstone may represent contamination.		The resistivity (16-inch normal) log indicates relatively uniform behavior throughout the interval.	Low confidence is given for existence and vertical limits of the interval, based on very few siltstone beds found within the interval from 1400 to 1560 feet. Erratic behavior of the resistivity (16-inch normal) log, commonly seen in intervals of siltstone, is not apparent.	1495	1515	20	1114
	Sandstone, brownish gray (5YR4/1), coarse grained, moderately consolidated, poorly sorted.		The interval is represented on the resistivity (16-inch normal) log as a minor high amplitude peak.	Moderate confidence is given for existence of interval. No apparent sample contamination.	1515	1520	5	1109
	Siltstone, light olive gray (5YR4/1), calcareous.		This interval does not appear to be associated with any diagnostic geophysical signature.	Moderate confidence in existence of interval. No apparent sample contamination.	1520	1525	5	1104
	Sandstone, moderate brown (5YR3/4), very fine to fine grained, moderately sorted, poorly indurated, grades downward to medium grained at about 1550 feet.		The interval is characterized on resistivity (16-inch normal) log as 2 low amplitude peaks. The 32-inch normal resistivity curve indicates an abrupt increase in ohm-meters at a depth of 1562 feet.	Moderate confidence in existence of interval. No apparent sample contamination.	1525	1565	40	1064

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tgeg2	Pre-volcanic Tertiary Gravels	Conglomerate, sandy (?), medium gray (N5) to dark gray (N3), unconsolidated to poorly consolidated, dominantly composed of angular to subrounded fragments of limestone, dolomite, and chert.	The interval is represented on all resistivity logs as a single conspicuous high amplitude peak. Its character is similar to the conspicuous peak between 1360 and 1393 feet, which is also associated with a conglomerate or gravel deposit. The resistivity peak declines sharply at the base of the unit at a depth of 1607 feet. The abundant fragments of limestone, dolomite and chert may include boulder, cobble, and gravel sizes, based on high resistivity values. The top and base of the interval is also characterized on the moisture log by an abrupt decrease in values at about 1561 feet and an abrupt increase at 1602 feet, respectively. The caliper log indicates that hole erosion decreases between 1349 and 1396 feet, which may indicate that the deposit is cemented or lithified. Gamma ray log indicates abrupt decrease from 1554 to 1618 feet.	High confidence in the existence and vertical extent of the gravel, based on conspicuous lithology and unique resistivity, caliper, moisture, and gamma ray log signatures.	1565	1607	42	1022

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tge Pre-volcanic Tertiary Sedimentary Rocks	Sandstone, clayey, pale brown (5YR5/2), fine grained, well sorted, moderately indurated.		An abrupt increase in resistivity occurs at the top of unit at 1607 feet. The moisture log also indicates an abrupt increase in values at 1604 feet.	High confidence is assigned to the existence and vertical extent of the deposit, based on abrupt decrease in resistivity a top of interval.	1607	1622	15	1007
	Tuffaceous sand, pale yellowish brown (10YR6/2) to pale brown (5YR5/2), unconsolidated to poorly consolidated, poorly sorted, coarse grained, contained abundant fragments of limestone, dolomite, and chert.		The moisture log indicates a very slight decline. As in other intervals of sand within this drill hole, resistivity remains uniformly very low.	High confidence is given for the existence and location based on abrupt lithologic change, character of the resistivity log, and no indication of sample contamination.	1622	1625	3	1004
	Claystone, sandy, pale brown (5YR5/2) and light gray (N7), poorly to moderately indurated.		The moisture log indicates a slight decline at 1556 feet.	High confidence is given for the existence and location, based on unique lithology.	1625	1660	35	969
Tge Pre-volcanic Tertiary Sedimentary Rocks	Tuffaceous sandstone, medium light gray (N6), color is a light brownish gray (5YR6/1) between 1715 and 1725 feet, medium to coarse grained, poorly sorted, poorly indurated, weakly calcareous, contains abundant grains of sanidine and biotite, may contain clay seams.		The resistivity logs indicate very low values throughout this interval. The gamma ray log indicates generally lower (but erratic) values from 1654 to 1731 feet.	High confidence is given for the existence and vertical extent of the interval, based on unique and distinctive lithology and geophysical signatures associated with the deposit.	1660	1725	65	904

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
	Claystone, light brownish gray (5YR6/1), sandy, poorly indurated.		The resistivity logs indicate very low values within interval.	High confidence is assigned to existence and vertical extent, based on unique and distinctive lithology.	1725	1730	5	899
	Claystone, light brownish gray (5YR3/2) to moderate brown (5YR3/4).		The moisture log indicates an abrupt increase at a depth of 1730 feet. The resistivity (16-inch normal) log indicates a slight increase at 1733 feet.	High confidence is given for the existence and vertical extent because of distinctive lithology, which appears to contain less sand size fraction than unit above.	1730	1817	87	812

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tgeg3	Pre-volcanic Tertiary Gravels		<p>The resistivity logs show an abrupt increase at top of interval at 1817 feet and an abrupt decrease at 1853 feet near the base of unit. Fragments of limestone, dolomite and chert may include boulder, cobble, and gravel sizes, based on the high resistivity values. The moisture log indicates an abrupt decline in values between 1817 and 1861 feet. The caliper logs indicates significantly less hole enlargement from 1818 to 1842 feet, which may indicate that the deposit is cemented or lithified. The gamma ray log indicates abrupt decline in values from 1818 to 1868 feet.</p>	High confidence is assigned to the existence and vertical extent of the deposit, based on distinctive lithology and distinctive character of the resistivity, moisture, gamma ray, and caliper logs. However, samples indicate the unit may be poorly consolidated, where as, geophysics indicate that the deposit is cemented or lithified.	1817	1853	36	776

Drill Hole NC-EWDP-2DB

Location=36° 39' 39.354" N, 116° 27' 57.762" W (refer to DTN MO0106GSC01043.000)

Compiled and interpreted by Richard W. Spengler, 7/30/01

Ground Elevation=2628.9 feet

Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997) and Buesch and others (1996).

Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tge Prevolcanic Tertiary Sedimentary Rocks	Claystone, pale brown (5YR5/2), mixed with some sand.		Low resistivity occurs throughout the interval, except between 1901 and 1914 feet and between 1920 and 1938 feet. These intervals of higher resistivity may represent gravel or sand layers that were not recognized in bit cutting samples. These peaks are smaller than those seen in other gravel layers, but have a typical shape. Caliper log indicates severe hole erosion for almost all of the interval between 1856 and 2092 feet.	High confidence is assigned to the existence and vertical extent of the deposit, except for possible gravel layers that were described under geophysical signature.	1853	2095	242	534

Drill Hole NC-EWDP-2DB

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Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tgeg4	Prevolcanic Tertiary Gravels		<p>Resistivity logs indicate a conspicuous, single, nearly symmetrical high amplitude peak that encompasses the entire interval between 2095 and 2122 feet. Fragments of limestone, dolomite and chert may include boulder, cobble, and gravel sizes, based on high resistivity values. Shape and intensity of the peak is similar to those identified within other gravel-bearing intervals within the drill hole. The moisture log indicates a corresponding decrease in values from 2106 to 2118 feet. Caliper logs indicates less hole erosion from 2083 to 2111 feet, which may indicate that the deposit is cemented or lithified.</p>	High confidence is given for the existence and vertical extent, based on diagnostic geophysical signatures and unique composition of conglomeratic intervals. However, samples indicate the unit may be poorly consolidated, where as, geophysics may indicate that the deposit is cemented or lithified	2095	2121	26	508

Drill Hole NC-EWDP-2DB

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Ground Elevation=2628.9 feet

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Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tge Prevolcanic Tertiary Sedimentary Rocks	Claystone, pale yellowish brown (10YR6/2) and pale brown (5YR5/2), sandy near upper part of unit; interval from 2140 to 2142.5 feet may be a clayey sandstone, poorly to moderately indurated, coarse to medium grained, and poorly sorted. samples from the lower 8 feet are pale brown (5YR5/2) and appear to contain less sand.		The interval forms a trough, representing lower values on the resistivity (16-inch normal) curve between 2121 and 2140 feet. The moisture log indicates a high amplitude peak of higher values between 2118 and 2149 feet. Gamma ray log indicates a high amplitude peak from 2118 to 2149 feet.	High confidence is given to the existence and extent of the interval, based on corresponding geophysical signatures.	2121	2148	27	481

Drill Hole NC-EWDP-2DB

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Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tgeg5	Pre-volcanic Tertiary Gravels	Interbedded sandy conglomerate and tuffaceous sandstone, grayish red (5R4/2), moderate reddish brown (10R4/6), grayish orange (10YR7/4), and grayish black (5YR2/1), poorly sorted, poorly consolidated, includes abundant tuffaceous sand size fragments. Gravel size fragments commonly include chert, siltstone, limestone, and quartzite, no samples available from 2185 to 2190 feet and 2225 to 2230 feet. Samples from 2300 to 2360 feet contain similar lithologies but contamination of interval is suspected, based on the character of resistivity signatures.	Resistivity logs indicate an abrupt increase in resistivity from 2148 to 2300 feet. Within this interval, the resistivity curves display subtle, low amplitude highs and lows.	High confidence is assigned to the existence and vertical position of interbedded sand and gravel to a depth of 2300 feet based on sample and resistivity correlation. Sand and gravel may extend downward to 2360 feet, however, this is given a low confidence level, based on the lack of positive correlation with the resistivity logs.	2148	2300	152	329

Drill Hole NC-EWDP-2DB

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Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Tge Pre-volcanic Tertiary Sedimentary Rocks	Interbedded siltstone and sandstone, pale yellowish brown (10YR6/2) and medium light gray (N6), sandstone in fine to medium grained, moderately sorted, clayey.		The interval indicates uniformly low resistivity values between 2300 and 2390 feet. A slight increase in resistivity, based on the resistivity (16-inch normal) curve, occurs between 2375 and 2390 feet. At 2375 feet, resistivity curves abruptly increase and become notably more erratic in character.	Moderate confidence is given to the existence and vertical limits of this interval, based on character of resistivity curve.	2300	2390	90	239

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Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997) and Buesch and others (1996). Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>	
Tgeg6	Prevolcanic Tertiary Gravels	Conglomerate, sandy, medium gray (N5) to grayish black (N2). Samples indicate that the deposit is unconsolidated to poorly consolidated, dominantly composed of fragments of chert, quartzite, and siltstone. Smaller sand-size fragments are composed of volcanic material.		Resistivity logs indicate an abrupt increase at 2391 feet and an abrupt decrease at 2426 feet. The shape of resistivity curve is irregular, similar to other gravel intervals that contain a large proportion of sand size particles. The moisture log displays two high amplitude peaks between 2377 and 2410 feet. Caliper log indicates less hole erosion from 2370 to 2412 feet, which may indicate that the deposit is cemented or lithified. Gamma ray log indicates two high amplitude peaks from 2379 to 2421 feet.	High confidence is given to the existence and vertical extent of this gravel interval based on character of resistivity and moisture logs. However, samples indicate the unit may be poorly consolidated, where as, geophysics may indicate that the deposit is cemented or lithified	2390	2426	36	203
Tge	Prevolcanic Tertiary Sedimentary Rocks	Claystone, moderate brown (5YR4/4) to pale brown (5YR5/2), yellowish gray (5Y8/1) from 2665 to 2675 feet.		Resistivity logs (particularly the 16-inch normal) show a progressive increase in ohm-meters from 2629 to 2670 feet. Resistivity increases abruptly at 2670 feet. The moisture log indicates an abrupt decrease at 2690 feet.	High confidence is assigned to the existence and vertical extent of the claystone, based on first appearance of a unique lithology and correlation with a significant increase in ohm-meters at the base of the unit at 2670 feet.	2426	2670	244	-41

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Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Pz (undivided)	Paleozoic and Late Proterozoic rocks (undivided)		Resistivity logs indicate an abrupt and very large increase in ohm-meters at 2670 feet. Caliper log shows an abrupt increase in hole size between 2686 and 2696 feet.	High confidence is given for the existence and vertical extent of the quartzite, based on first appearance of the unique lithology and correlation with significant a increase of resistivity logs.	2670	2795	125	-166
			Interbedded quartzite and dolomite, medium dark gray (N4), fragments of dolomite are weakly effervescent. No sample from 2810 to 2815 feet.	No geophysical logs are available below 2710 feet.	2795	2825	30	-196
			Claystone, moderate brown (SYR3/4).	No geophysical logs are available below 2710 feet.	2825	2840	15	-211

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
Pz (undivided)	Paleozoic and Late Proterozoic rocks (undivided)	Shale, yellowish gray (5Y7/2).	No geophysical logs are available below 2710 feet.	Moderate confidence is given for the existence and vertical extent. Shale is a previously unseen lithology; the possibility of uphole contamination is remote. However, the interval is thin.	2840	2860	20	-231
		Shale, medium dark gray (N4), calcareous. No samples are available from 2865 to 2870 feet.	No geophysical logs are available below 2710 feet.	Moderate confidence is given for the existence and vertical extent of the unit. Shale is a previously unseen lithology.	2860	2870	10	-241
		Limestone, light olive gray (5Y6/1) to olive gray (5Y4/1), silty.	No geophysical logs are available below 2710 feet.	Moderate confidence is given for the existence and vertical extent of the unit. Silty limestone as the dominant lithology in samples has not been seen uphole.	2870	2900	30	-271
Pz (undivided)	Paleozoic and Late Proterozoic rocks (undivided)	Limestone, light olive gray (5GY6/1) to dark gray (N3).	No geophysical logs are available below 2710 feet.	Moderate confidence in existence and vertical extent. Limestone as the dominant lithology in samples has not been seen uphole.	2900	2935	35	-306

Drill Hole NC-EWDP-2DB

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace-Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit Top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of unit (feet)</u>
	Limestone, light olive gray (SY6/1)		No geophysical logs are available below 2710 feet.	Moderate confidence is given for the existence and vertical extent of the unit. Slight possibility that limestone is contamination from above. However, limestone occurs within intervals above and below this interval.	2935	2955	20	-326
	Limestone, medium dark gray (N4), fine grained.		No geophysical logs are available below 2710 feet.	Moderate confidence is given for the existence and vertical extent of the unit. Limestone with this color had not previously been seen uphole, and therefore uphole contamination can be ruled out.	2955	3075	120	-446

TOTAL DEPTH=3075 feet

Reference: Wahl, Ronald R., Sawyer, David A., Minor, Scott A., Carr, Michael D., Cole, James C., Swadley, WC, Laczniak, Randell J., Warren, Richard G., Green, Katryn S., and Engle Colin M., 1997, Digital Geologic Map Database of the Nevada Test Site area, Nevada, U.S Geological Survey Open-File Report 97-140, 47 p. (TIC #247201)

Buesch, David C., Spengler, Richard W., Moyer, Thomas C., and Geslin, Jeffery K., 1996, Proposed Stratigraphic Nomenclature and Macroscopic Identification of Lithostratigraphic Units of the Paintbrush Group Exposed at Yucca Mountain, Nevada, USGS Open-File Report 94-469, 45 p. (TIC#226214)

Table of Contents Item #9

Title: Interpretation of Lithostratigraphy in Drill Hole NC-EWDP-19D1

Record date: 07/30/2001

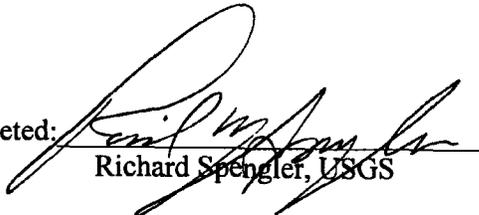
Organization: USGS

QA Designation: QA:QA

Author: R. Spengler, USGS

Traceability Designators: DTN: GS011008314211.001
SCP: 8.3.1.4.2.1.1
WBS: 1.2.21.3.1

Record Completed:


Richard Spengler, USGS

Date: 11/05/2001

Drill Hole NC-EWDP-19D1

Location=36° 40' 13.963" N, 116° 26' 56.410" W (refer to DTN MO0106GSC01043.000)

Compiled and interpreted by Richard W. Spengler, 7/30/01

Ground Elevation=2686.64 feet

Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997).

Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of Unit (feet)</u>
QTu	Quaternary and Tertiary Alluvium		Caliper log indicates erratic behavior from 354 to 574 feet. Below 574 feet to 825.5 feet, caliper logs indicate smoother inflections. Resistivity logs indicate 4 conspicuous subzones within the alluvium. Extremely large high frequency and high amplitude inflections characterize a zone from 353 (approximate depth of bottom casing) to 454 feet. From 454 feet to 600 feet, resistivity curves indicate moderate frequency and low amplitude inflections. From 600 to 714, resistivity curves indicate only slight variations in amplitude and frequency. From 714 to 811 feet, resistivity curves indicate very little variations with depth. These changes in character of the resistivity curves may reflect variations in the distribution of boulders, cobbles, sand, and silt within the alluvium.	Until a better sampling of alluvial deposits can be performed and more resistivity logs are available for correlation within the alluvium between boreholes, low confidence is given to the identification and lateral continuity of the subzones within the Quaternary alluvium that are inferred principally from the resistivity signatures. Some workers believe that Quaternary alluvium rarely exceeds 50 meters in thickness, therefore these deposits are labeled as Quaternary and Tertiary.	0	820	820	1867

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Tpt Topopah Spring Tuff	Pyroclastic flow deposit, very pale orange (10YR8/2), nonwelded, highly vesiculated, zeolitic, pumice-rich, very pale orange, zeolitic and slightly argillic, sparse light olive gray (5Y6/1) volcanic lithic fragments. Lithology appears remarkably uniform throughout interval, except for a change in color to white (N9) from 1255 to 1260 feet. Porosity is estimated to vary between 10 and 25 percent. Microcrystalline quartz and (or) zeolites commonly line cavities, which rarely exceed 1mm in size. Samples indicate only minor mixing throughout interval, however, no samples were available from 1250 to 1255 feet.	Estimates of the amount of phenocrysts within the tuff vary from 0.2 to 0.5 percent. Estimates of the essential mineral content indicate that quartz varies from 6.5 to 8.8 percent; alkali feldspar varies from 6.5 to 32.4 percent; plagioclase varies from 38.5 to 87 percent. The rock commonly contains 3 to 8 percent biotite. These petrographic features appear to match those found in samples of the crystal poor member of the Topopah Spring Tuff. However, the nonwelded basal part of the	Top of tuff is marked by an abrupt decrease in gravity at 796 feet; an abrupt decrease in the moisture log at 820.5 feet; an abrupt decrease in the gamma ray log at 820 feet; and an abrupt increase in resistivity values at 813 feet. Caliper logs indicates that the hole gradually becomes in-gauge between 811 and 827 feet. Caliper log also indicates a conspicuous cluster of "wash-outs" between 885 to 1060 feet. Resistivity curves indicate an increase from 931 to about 980 feet. Moisture log indicates a slight and progressive increase in values near the middle of the tuff. The gamma ray log indicates lower values relative to the overlying alluvium and underlying	High confidence is given that the tuff is part of the Paintbrush Group, based on very low phenocryst content and the essential mineral assemblage. High confidence is given that the tuff represents the nonwelded basal part of the Topopah Spring Tuff on the basis of petrographic characteristics, trace element characteristics, and proximity to outcrops of the same unit. The thick section of the nonwelded part of the Tpt in this vicinity appears uncommon and may represent a pyroclastic flow deposit infilling a pre-existing channel. Abrupt variations occur in most geophysical logs near the top and base of unit.	820	1260	440	1427

Drill Hole NC-EWDP-19D1

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		<p>Topopah Spring Tuff rarely exceeds a few ten of feet in thickness at outcrops in the vicinity of the drill hole. Trace-element analysis of nine samples from 19D1 indicates that relatively immobile trace elements such as Ti, Zr, and Ba are tightly clustered and fall within the tightly clustered domain of the Topopah spring Tuff. Mean concentrations for Ti, Zr, and Ba are 725 ppm, 112 ppm, and 176 ppm, respectively. Ti, Zr, and Ba values range from 660-852 ppm, 101-118 ppm, and</p>	<p>lithologies. Both the gamma ray and moisture logs abruptly decrease then abruptly increase at a depth of 1257 feet. Resistivity curves indicate an abrupt change from a uniform behavior to an erratic behavior at 1250 feet. The compressional travel time log (DT) indicates an abrupt increase in values at 1260 feet. Gravity meter indicates a uniform density of about 1.9 gm/cc throughout most of the interval. Densities are higher above and below inferred contacts. Most geophysical logs indicate relatively uniform properties within the interval identified as tuff.</p>					

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		64-701 ppm, respectively.							
Tpts	Pre-Topopah Spring Sedimentary Rocks	Interbedded siltstone and sandstone, light olive gray (5Y6/1), grayish orange (10YR7/4), and grayish yellow (5Y8/4). Sandstone is very fine grained.		The compressional travel time log indicates an abrupt increase at 1257 feet and a more uniform character that begins at 1347 feet. Both the gamma ray and moisture logs indicate several large amplitude inflections from 1257 to 1348 feet. Resistivity curves indicate a series of small amplitude inflections that begin at a depth of 1250 feet and continue to base of the logged interval at 1440 feet.	High confidence level is assigned to the existence and vertical extent of this lithologic unit. Siltstones were not previously encountered in the drill hole, therefore uphole contamination can be ruled out. Variations in resistivity curves support a conspicuous change in lithologies at the interpreted depths. Only moderate confidence is given to the stratigraphic assignment, as no pyroclastic flow deposit occurs at the base of the interval to aid in bracketing the deposit. Alternatively, the interval may represent part of Pre-Volcanic sedimentary rocks (Tge).	1260	1350	90	1337

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<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of Unit (feet)</u>
Tpts	Pre-Topopah Spring Sedimentary rocks		No diagnostic geophysical signature could be identified.	High confidence is assigned to the existence of the interval, as no similar lithology was encountered uphole. Moderate confidence is assigned to the precise location of the top and base, as no distinctive geophysical log signature was identifiable. Only moderate confidence is given to assigning this gravel deposit the top of the pre-Topopah Spring sedimentary rocks (Tpts), as the intercalated crystal-rich reworked tuffs suggest a younger deposit. However, a conglomerate of similar lithologic character occurs in at about the same elevation in drill hole NC-EWDP-2DB, which may suggest that these sediments belong to the interval referred to as pre-volcanic sedimentary rocks.	1350	1355	5	1332

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Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997).

Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of Unit (feet)</u>	
Tge	Pre-volcanic Sedimentary Rocks	Reworked tuff, yellowish gray (5Y8/1), poorly consolidated, contains an abundance of phenocrysts, which include sanidine, quartz, and biotite.	Interval contains approximately 60-70 percent phenocrysts of sanidine, quartz, and biotite. The larger proportion of phenocrysts suggests considerable reworking of the deposit.	No diagnostic geophysical signature could be identified.	Only moderate confidence is given to the stratigraphic assignment, as no pyroclastic flow deposits bracket the deposit. Alternatively, the interval may represent Tertiary sedimentary rocks that occur between tuffs of the Crater Flat Group, based on the high concentrations of phenocrysts within the interval.	1355	1370	15	1317

Drill Hole NC-EWDP-19D1

Location=36° 40' 13.963" N, 116° 26' 56.410" W (refer to DTN MO0106GSC01043.000)

Compiled and interpreted by Richard W. Spengler, 7/30/01

Ground Elevation=2686.64 feet

Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997).

Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of Unit (feet)</u>
	Siltstone, yellowish gray (5Y8/1).		No diagnostic geophysical signature could be identified.	Only moderate confidence is assigned to the existence of the lithology, as similar color siltstones were encountered uphole, and therefore may represent contamination. Low confidence is assigned to the vertical limits of the deposit, as no distinctive geophysical signature was identified. Only moderate confidence is given to the stratigraphic assignment, as no pyroclastic flow deposits bracket the deposit. Alternatively, the interval may represent Tertiary sedimentary rocks that occur between tuffs of the Crater Flat Group, however due the high concentrations of phenocrysts within the interval.	1370	1375	5	1312

Drill Hole NC-EWDP-19D1

Location=36° 40' 13.963" N, 116° 26' 56.410" W (refer to DTN MO0106GSC01043.000)

Compiled and interpreted by Richard W. Spengler, 7/30/01

Ground Elevation=2686.64 feet

Nomenclature of lower volcanic units and Tertiary sedimentary strata, for the most part, follows that found in Wahl and others (1997).

Geophysical log observations based on raw counts of geophysical logs. Geophysical measurements from Nye County drill holes are currently (3/2001) considered non-Q data.

<u>Stratigraphy</u>	<u>Lithologic Description</u>	<u>Petrographic and Trace Element Characteristics</u>	<u>Geophysical Signature</u>	<u>Confidence Assessment</u>	<u>Unit top (feet)</u>	<u>Unit Base (feet)</u>	<u>Thickness (feet)</u>	<u>Elevation of Base of Unit (feet)</u>
	Reworked tuff, yellowish gray (5Y8/1), unconsolidated to poorly consolidated, coarse to very coarse grained, phenocryst rich. Unit also contains an abundance of rounded white (N9) pumice clasts.	Interval contains approximately 40-50 percent phenocrysts of sanidine, quartz, and biotite. The larger proportion of phenocrysts suggests considerable reworking of the deposit.	No diagnostic geophysical signature could be identified.	Only moderate confidence is assigned to the existence of the lithology, as similar color reworked tuff was encountered uphole, and therefore, part of the interval could represent contamination. Low confidence is assigned to the vertical limits of the deposit, as no distinctive geophysical signature was identified. Only moderate confidence is given to the stratigraphic assignment, as no pyroclastic flow deposits bracket the deposit. Alternatively, the interval may represent Tertiary sedimentary rocks that occur between tuffs of the Crater Flat Group, based on the high concentrations of phenocrysts within the interval.	1375	1448	73	1239
Total Depth=1448 feet								
Reference: Wahl, Ronald R., Sawyer, David A., Minor, Scott A., Carr, Michael D., Cole, James C., Swadley, WC, Laczniak, Randell J., Warren, Richard G., Green, Katryn S., and Engle Colin M., 1997, Digital Geologic Map Database of the Nevada Test Site area, Nevada, U.S Geological Survey Open-File Report 97-140, 47 p. (TIC#247201)								

S02017_001 DATA REPORT

TABLE DESCRIPTION:

Lithostratigraphy, Bed Thickness, Contact Elevation, and Lithologic Description data for Nye County Early Warning Detection Program Wells NC-EWDP-2DB and NC-EWDP-19D1, 04/05/2000 to 05/30/2001.

TDIF: 312725

DTN: GS011008314211.001

FOOTNOTES: Lithostratigraphy and related data in this table results from an interpretation of bit-cuttings corroborated by geophysical log data. Contact accuracy is +/- 10 feet. Drill Hole NC-EWDP-2DB: Geographic Coordinates = 36 deg 39 min 39.345 sec N, 116 deg 27 min 57.762 sec W; Ground Elevation = 2628.9 feet; Total Depth = 3075 feet. Nomenclature of lower volcanic units and Tertiary sedimentary strata in NC-EWDP-2DB, for the most part, follows that of USGS OFR 97-140, Wahl and others (1997) TIC Catalog #247201, and USGS OFR 94-469, Buesch and others (1996) DTN: GS931208314211.049.

PARAMETERS:

- LITHOSTRATIGRAPHY
- LITHOSTRATIGRAPHIC THICKNESS
- STRATIGRAPHIC CONTACT ELEVATION
- LITHOLOGIC DESCRIPTION

ROW#	LOCATION	LITHOSTRATIGRAPHY	DEPTH INTERVAL(ft)	STRATIGRAPHIC CONTACT ELEVATION(ft)
		LITHOSTRATIGRAPHIC THICKNESS(ft)		
		LITHOLOGIC DESCRIPTION	IDENTIFICATION NUMBER	
1	NC-EWDP-2DB	QTu = Quaternary and Tertiary Alluvium	0 - 600	600 2029
	(undifferentiated)			Mixture of gravel and sand
				RCT01015601+RCT01015602+RCT01015603+RCT01017523
2	NC-EWDP-2DB	Tal = Tertiary Sand	600 - 921	321 1708
				Reworked tuff, tuffaceous sandstone, and pyroclastic fall deposits
				RCT01017523+RCT01017524
3	NC-EWDP-2DB	Tpt = Topopah Spring Tuff	921 - 960	39 1669
				Pyroclastic flow deposit
				RCT01017524+RCT01017525
4	NC-EWDP-2DB	Tpt = Topopah Spring Tuff	960 - 987	27 1642
				Pyroclastic flow deposit, moderately welded
				RCT01017525
5	NC-EWDP-2DB	Tpt = Topopah Spring Tuff	987 - 1011	24 1618
				Mixture of fragments of pyroclastic flow deposit and reworked tuff
				RCT01017525
6	NC-EWDP-2DB	Tpbs = Pre-Topopah Spring Sedimentary rocks	1011 - 1015	4 1614
				Claystone
				RCT01017525
7	NC-EWDP-2DB	Tptbt = pre-Topopah Spring Bedded Tuff [1]	1015 - 1065	50 1564
				Pyroclastic fall deposit (reworked?)
				RCT01017525
8	NC-EWDP-2DB	Tpbs = Pre-Topopah Spring Sedimentary rocks	1065 - 1071	6 1558
				Claystone

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RCT01017525

9	NC-EWDP-2DB 1071 - 1085	Tcbbt = Pre-Bullfrog Bedded Tuff 14 1544 Reworked tuff RCT01017525
10	NC-EWDP-2DB 1085 - 1093	Tcbss = Pre-Bullfrog Sedimentary Rocks 8 1536 Siltstone RCT01017525
11	NC-EWDP-2DB 1093 - 1105	Tcbbt = Pre-Bullfrog Bedded Tuff 12 1524 Reworked tuff RCT01017525
12	NC-EWDP-2DB 1105 - 1110	Tcbbt = Pre-Bullfrog Bedded Tuff 5 1519 Pyroclastic fall deposit (reworked?) RCT01017597
13	NC-EWDP-2DB 1110 - 1140	Tcbss = Pre-Bullfrog Sedimentary Rocks 30 1489 Siltstone RCT01017597
14	NC-EWDP-2DB 1140 - 1145	Tcbbt = Pre-Bullfrog Bedded Tuff 5 1484 Pyroclastic fall deposit RCT01017597
15	NC-EWDP-2DB 1145 - 1155	Tcbss = Pre-Bullfrog Sedimentary Rocks 10 1474 Siltstone RCT01017597
16	NC-EWDP-2DB 1155 - 1183	Tct = Tram Tuff (upper unit) 28 1446 Pyroclastic flow deposit RCT01017597
17	NC-EWDP-2DB 1183 - 1205	Tct = Tram Tuff (lower unit) 22 1424 Pyroclastic flow deposit RCT01017597
18	NC-EWDP-2DB 1205 - 1260	Tcts = Pre-Tram Sedimentary Rocks 55 1369 Claystone and siltstone RCT01017597
19	NC-EWDP-2DB 1260 - 1265 tuffaceous sediments	Tcts = Pre-Tram Sedimentary Rocks 5 1364 Interbedded siltstone and reworked RCT01017597
20	NC-EWDP-2DB 1265 - 1290	Tcts = Pre-Tram Sedimentary Rocks 25 1339 Claystone RCT01017597
21	NC-EWDP-2DB 1290 - 1310 tuff	Tcts = Pre-Tram Sedimentary Rocks 20 1319 Interbedded claystone and reworked RCT01017597
22	NC-EWDP-2DB 1310 - 1330 tuffaceous sediments	Tcts = Pre-Tram Sedimentary Rocks 20 1299 Interbedded siltstone and reworked RCT01017597+RCT01017599
23	NC-EWDP-2DB 1330 - 1360 and siltstone	Tcts = Pre-Tram Sedimentary Rocks 30 1269 Interbedded reworked tuffaceous beds RCT01017599
24	NC-EWDP-2DB	Tgeg1 = Pre-volcanic Tertiary Gravels

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	1360 - 1393	33	1236	Gravel, mostly limestone and dolomite fragments, with siltstone and quartzite	RCT01017599
25	NC-EWDP-2DB 1393 - 1415	Tge =	22	Pre-volcanic Tertiary Sedimentary Rocks 1214 Reworked tuffaceous sediments	RCT01017599
26	NC-EWDP-2DB 1415 - 1440	Tge =	25	Pre-volcanic Tertiary Sedimentary Rocks 1189 Breccia	RCT01017599
27	NC-EWDP-2DB 1440 - 1450	Tge =	10	Pre-volcanic Tertiary Sedimentary Rocks 1179 Sandstone	RCT01017599
28	NC-EWDP-2DB 1450 - 1480	Tge =	30	Pre-volcanic Tertiary Sedimentary Rocks 1149 tuffaceous sand and sandstone	RCT01017599
29	NC-EWDP-2DB 1480 - 1495	Tge =	15	Pre-volcanic Tertiary Sedimentary Rocks 1134 Tuffaceous sandstone	RCT01017599
30	NC-EWDP-2DB 1495 - 1515	Tge =	20	Pre-volcanic Tertiary Sedimentary Rocks 1114 Siltstone	RCT01017599+RCT01017821
31	NC-EWDP-2DB 1515 - 1520	Tge =	5	Pre-volcanic Tertiary Sedimentary Rocks 1109 Sandstone	RCT01017821
32	NC-EWDP-2DB 1520 - 1525	Tge =	5	Pre-volcanic Tertiary Sedimentary Rocks 1104 Siltstone	RCT01017821
33	NC-EWDP-2DB 1525 - 1565	Tge =	40	Pre-volcanic Tertiary Sedimentary Rocks 1064 Sandstone	RCT01017821
34	NC-EWDP-2DB 1565 - 1607	Tgeg2 =	42	Pre-volcanic Tertiary Gravels 1022 Conglomerate, sandy (?)	RCT01017821
35	NC-EWDP-2DB 1607 - 1622	Tge =	15	Pre-volcanic Tertiary Sedimentary Rocks 1007 Sandstone, clayey	RCT01017821
36	NC-EWDP-2DB 1622 - 1625	Tge =	3	Pre-volcanic Tertiary Sedimentary Rocks 1004 Tuffaceous sand	RCT01017821
37	NC-EWDP-2DB 1625 - 1660	Tge =	35	Pre-volcanic Tertiary Sedimentary Rocks 969 Claystone, sandy	RCT01017821
38	NC-EWDP-2DB 1660 - 1725	Tge =	65	Pre-volcanic Tertiary Sedimentary Rocks 904 Tuffaceous sandstone	RCT01017821+RCT01017813
39	NC-EWDP-2DB 1725 - 1730	Tge =	5	Pre-volcanic Tertiary Sedimentary Rocks 899 Claystone, sandy	RCT01017813

zz_sep_241500.txt

40	NC-EWDP-2DB 1730 - 1817	Tge = Pre-volcanic Tertiary Sedimentary Rocks 87 812 Claystone RCT01017813
41	NC-EWDP-2DB 1817 - 1853	Tgeg3 = Pre-volcanic Tertiary Gravels 36 776 Conglomerate, sandy RCT01017813
42	NC-EWDP-2DB 1853 - 2095	Tge = Pre-volcanic Tertiary Sedimentary Rocks 242 534 Claystone RCT01017813+RCT01017814+RCT01017815
43	NC-EWDP-2DB 2095 - 2121	Tgeg4 = Pre-volcanic Tertiary Gravels 26 508 Conglomerate, sandy RCT01017815
44	NC-EWDP-2DB 2121 - 2148	Tge = Pre-volcanic Tertiary Sedimentary Rocks 27 481 Claystone RCT01017815
45	NC-EWDP-2DB 2148 - 2300 tuffaceous sandstone	Tgeg5 = Pre-volcanic Tertiary Gravels 152 329 Interbedded sandy conglomerate and RCT01017815+RCT01017816
46	NC-EWDP-2DB 2300 - 2390	Tge = Pre-volcanic Tertiary Sedimentary Rocks 90 239 Interbedded siltstone and sandstone RCT01017816
47	NC-EWDP-2DB 2390 - 2426	Tgeg6 = Pre-volcanic Tertiary Gravels 36 203 Conglomerate, sandy RCT01017816+RCT01017817
48	NC-EWDP-2DB 2426 - 2670	Tge = Pre-volcanic Tertiary Sedimentary Rocks 244 -41 Claystone RCT01017817+RCT01017818
49	NC-EWDP-2DB rocks (undivided) 2670 -	Pz (undivided) = Paleozoic and Late Proterozoic 2795 125 -166 Quartzite RCT01017818+RCT01017819
50	NC-EWDP-2DB rocks (undivided) 2795 - dolomite	Pz (undivided) = Paleozoic and Late Proterozoic 2825 30 -196 Interbedded quartzite and RCT01017819
51	NC-EWDP-2DB rocks (undivided) 2825 -	Pz (undivided) = Paleozoic and Late Proterozoic 2840 15 -211 Claystone RCT01017819
52	NC-EWDP-2DB rocks (undivided) 2840 -	Pz (undivided) = Paleozoic and Late Proterozoic 2860 20 -231 Shale RCT01017819
53	NC-EWDP-2DB rocks (undivided) 2860 -	Pz (undivided) = Paleozoic and Late Proterozoic 2870 10 -241 Shale, calcareous RCT01017819
54	NC-EWDP-2DB rocks (undivided) 2870 -	Pz (undivided) = Paleozoic and Late Proterozoic 2900 30 -271 Limestone, silty RCT01017819
55	NC-EWDP-2DB rocks (undivided) 2900 - (5Y6/1) to dark gray (N3)	Pz (undivided) = Paleozoic and Late Proterozoic 2935 35 -306 Limestone, light olive gray RCT01017819

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56	NC-EWDP-2DB rocks (undivided) (5Y6/1)	2935 - 2955	Pz (undivided) = Paleozoic and Late Proterozoic 20 -326	Limestone, light olive gray RCT01017819+RCT01017820
57	NC-EWDP-2DB rocks (undivided) (N4), fine grained	2955 - 3075	Pz (undivided) = Paleozoic and Late Proterozoic 120 -446	Limestone, medium dark gray RCT01017820
58	NC-EWDP-19D1 0 - 820	820	QTu = Quaternary and Tertiary Alluvium 1867	Gravel, tuffaceous RCT01016851+RCT01016852
59	NC-EWDP-19D1 820 - 1260	440	Tpt = Topopah Spring Tuff 1427	Pyroclastic flow deposit, nonwelded RCT01016852+RCT01016853+RCT01016854
60	NC-EWDP-19D1 1260 - 1350	90	Tpts = Pre-Topopah Spring Sedimentary Rocks 1337	Interbedded siltstone and sandstone RCT01016854+RCT01016855
61	NC-EWDP-19D1 1350 - 1355	5	Tpts = Pre-Topopah Spring Sedimentary Rocks 1332	Gravels and sand (conglomerate) RCT01016855
62	NC-EWDP-19D1 1355 - 1370	15	Tge = Pre-volcanic Sedimentary Rocks 1317	Reworked tuff RCT01016855
63	NC-EWDP-19D1 1370 - 1375	5	Tge = Pre-volcanic Sedimentary Rocks 1312	Siltstone RCT01016855
64	NC-EWDP-19D1 1375 - 1448	73	Tge = Pre-volcanic Sedimentary Rocks 1239	Reworked tuff RCT01016855+RCT01016856