



**Department of Energy**  
Office of Civilian Radioactive Waste Management  
Yucca Mountain Site Characterization Office  
P.O. Box 30307  
North Las Vegas, NV 89036-0307

JAN 05 1999

**OVERNIGHT MAIL**

Sandra L. Wastler  
High Level Waste & Uranium Recovery  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards  
U.S. Nuclear Regulatory Commission  
2 White Flint North  
Rockville, MD 20852

**SUBMITTAL OF PARTICIPANTS' MONTHLY PROGRESS REPORT**

As you have requested, the U.S. Nuclear Regulatory Commission is on distribution to receive a copy of the Yucca Mountain Site Characterization Project participants' monthly status report on a regular basis. Enclosed is the U.S. Geological Survey Progress Report for November 1998.

If you have any questions, please contact April V. Gil at (702) 794-5578.

  
Stephan Brocoum  
Acting Assistant Manager, Office of  
Licensing and Regulatory Compliance

OL&RC:AVG-0567

Enclosure:  
Ltr, 12/14/98, Craig to Kozai, w/encl.

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WM-11 PDR

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JAN 05 1999

cc w/encl:

L. H. Barrett, DOE/HQ (RW-1) FORS  
A. B. Brownstein, DOE/HQ (RW-52) FORS  
C. E. Einberg, DOE/HQ (RW-52) FORS  
S. H. Hanauer, DOE/HQ (RW-2) FORS  
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Jim Regan, Churchill County, Fallon, NV  
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Tom Burton, Nevada Indian Environmental Coalition,  
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K. L. Ashe, M&O, Las Vegas, NV  
M. A. Lugo, M&O, Las Vegas, NV  
E. F. O'Neill, M&O, Las Vegas, NV  
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Records Processing Center = "21"



# United States Department of the Interior

U.S. GEOLOGICAL SURVEY  
Box 25046 M.S. 425  
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Denver, Colorado 80225

IN REPLY REFER TO:

## INFORMATION ONLY

December 14, 1998

Wayne Kozai  
Yucca Mountain Site Characterization  
Project Office  
U. S. Department of Energy  
P.O. Box 30307  
Las Vegas, Nevada 89036-0307

**SUBJECT: Yucca Mountain Project Branch - U.S. Geological Survey (YMPB-USGS)  
Progress Report, November, 1998**

Attached is the USGS progress report in the required format for the month of November, 1998.

If you have any questions or need further information, please call Raye Ritchey Arnold at (303)236-0516, ext. 282.

Sincerely,

*for* Robert W. Craig  
Technical Project Officer  
Yucca Mountain Project Branch  
U.S. Geological Survey

Enclosure:

cc: J. Bresee, DOE/OCRWM-HQ/Forrestal  
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C. Glenn, NRC, Las Vegas (2 copies)  
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**U.S. GEOLOGICAL SURVEY  
EXECUTIVE SUMMARY**

November 1998

**COORDINATION and PLANNING**

The U.S. Geological Survey-Yucca Mountain Project Branch currently is processing some 43 documents prepared by USGS authors. Of these listed items, 25 are USGS reports, 12 are journal articles, and six are abstracts. For the month of November, one complete publication package (a USGS WRIR) was sent to the Records Coordinator for submittal to the Records Processing Center. One OSTI package was sent to DOE. Sixteen QA deficiencies were resolved and sent to the Records Coordinator for submittal to the RPC. Five of the listed abstracts awaited finalization of records packages.

**GEOLOGY**

The underground mapping team completed full-periphery geologic mapping, detailed line surveys (DLS), and rock-mass classification in the ECRB Cross Drift on November 18. All types of mapping were completed to Station 26+64, which is at the rear of the tunnel-boring machine (the rearward extent of the trailing gear). Excavation of the tunnel ceased at approximately Station 26+81. The team is now checking digitized field maps, correlating the maps with the DLS, and preparing the maps for technical review. In work to prepare the Cross-Drift stratigraphic picks for the TDB, stratigraphic data were compiled by the mapping team and technically reviewed by USGS staff.

The structural studies group provided support to various efforts. USGS and LANL personnel were in the Cross Drift on November 2 and 3 to collect samples in support of chlorine-36 isotopic studies. Some 26 samples were collected, primarily from faulted portions of the tunnel, in the vicinity of the Solitario Canyon fault. Sampling efforts are hindered because samples must be collected by hand, without mining support, due to dust protocols in the Cross Drift. Sampled locations have been described in terms of their local structural setting and in relation to features mapped by the Bureau of Reclamation underground mapping team. Another sampling trip is planned for early December to collect a portion of the remaining 47 sample localities in the Cross Drift that have been identified to date. Staff continued to respond to review comments on USGS Scientific Notebook SN-0103, "Structural Description of ESF Sampling Localities." In fault-zone studies, staff spent two days in the field examining fault zones in the vicinity of the central block of Yucca Mountain and in Solitario Canyon. Fault-zone data were collected at three faults where such work could be carried out under technical procedure GP-01, "Geologic Mapping." Collected data included description of fault core (width, clast size, clast type, clast sorting and angularity, clast rotation, clast versus matrix support, matrix material, cementation, mineralization, presence of clay gouge), description of damaged zone (changes in fracture intensity and orientation, presence of footwall/hanging-wall fault splays), and description of protolith (orientation and relative expression of local joint sets, presence of nearby faults). A modification was written to technical procedure USGS-HP-246, R0, "Mapping Fractures on Outcrops for Hydrologic Studies." That modification is being checked by QA personnel. In work on the geologic map for the SZ site area in support of TSPA/VA, staff modified the map, cross sections, and text in response to reviewers' comments. That work included addition of attitude symbols and completion of cross section C—C'. Additional field data were collected along Highway 95, also to address reviewers' comments. The effort also included additional work related to new document requirements. In unscheduled work, staff participated in joint exchange with Russian scientists from the K-26 site, including presentation of a brief overview of the geology of the Yucca Mountain site.

USGS staff also participated in oversight of the Nye County early-warning drilling program, organizing field gear at the HRF and obtaining safety equipment for use during hydraulic testing at the drilling sites. Drilling began on November 30, and USGS staff provided on-site technical support. Staff reviewed a

report on geochemical interpretation of recharge, mixing, and ground-water flow directions at Yucca Mountain and the northern Amargosa Desert, written by E. Kwicklis.

## HYDROLOGY

### Unsaturated-Zone Hydrology

Monitoring of selected boreholes continued. Borehole data from NRG-7a, NRG-6, UZ #4, UZ #5, UZ-7a, and SD-12 were transferred to Denver, converted to engineering units, and archived on a routine basis throughout the month. Sensor readings as well were checked daily for unusual occurrences, and statistical outliers were flagged. Staff submitted a position paper to DOE on making a decision on future borehole-monitoring activities, and work continued on preparation of data submittals and calibration records. The review of HP-14, R3 ("Method of Calibrating Peltier-type Thermocouple Psychrometers for Measuring Water Potential of Partially Saturated Media") was completed. Staff worked on final revisions of ROCKWORKS figures for the North Ramp report. Some 27 trips were made to field sites for correction of generator, UPS, chiller, and data-collection problems, including 22 site visits for routine generator maintenance and/or problems. Five site visits were made to collect data or to fix data-collection problems. Problems with chillers occurred at sites 5 (UZ #4 and #5) and 7 (SD-12). Problems with batteries and UPS also occurred at site 5 and at site 6 (UZ-7a). The generator (s/n 76726) at site 3 (NRG-7a) was replaced with generator s/n 76719.

Evaluation of percolation flux across the repository horizon continued. Water potential in the Cross Drift was monitored with 100 heat-dissipation (HD) probes installed in 2-m-deep drill holes at 25-m intervals from Cross Drift Station 0+50 to Station 25+25. The measured water potentials continued to indicate that the rock mass is wetter (that is, the potentials are higher) and that the moisture is more uniformly distributed than expected. Measured potentials in the Cross Drift range between -0.2 and -0.5 bars. Preliminary laboratory tests and field measurements indicate that the Cross-Drift water-potential measurements are accurate. Probes installed at shallower depths into the Cross-Drift wall revealed signs of drying due to ventilation. The drying front is progressing into the wall as expected. This demonstrates that the Cross-Drift HD probes would read lower potentials if the rock were drier. Laboratory tests and field measurements using sand as a contact medium instead of silica flour provided uniform wet-potential measurements regardless of the contact medium. Laboratory measurements in rocks brought to a known water potential on pressure pots also indicated that the probes are providing accurate measurements. The 2-m cored boreholes at 50-m intervals from Cross Drift Stations 19+00 to 25+00 were neutron-logged to measure a water-content profile in each borehole.

Moisture monitoring also continued in the subsurface workings. Nine temperature and relative humidity stations are being monitored in the Cross Drift; five of those stations also record wind speed. Some 106 HD probes recorded soil moisture potential 2-m into the rock wall. Those probes are placed every 25 m in the Cross Drift. Fifty HQ-size drill holes periodically were neutron-logged to monitor the tunnel-wall dry-out. All data collection continued, and data are being assembled in a data-package format. In work supporting characterization of seepage in Alcove #1, monitoring data were collected in the ESF, and those collected data are being reviewed and assembled into a data package. Monitoring of temperature, relative humidity, and barometric pressure also continued in the ESF Main Drift, niches, and Alcove #7, including data collected from 51 HD probes in Alcove #7. Eight surface-based HD probes monitored the soil moisture potential in and adjacent to the Ghost Dance fault. Dust samples were collected in Alcove #7. Twenty-one HD probes monitored the rock water potential in Niche #1. Preparations for the tracer experiment in Alcove #1 are being tested and installed in the field. Tracer application is expected to begin in the next month. Water application was resumed on November 16. To date 1180 gallons of water have been applied to the plot. No water has yet been detected in the alcove. Monitoring of Alcove #1 with 21 HD probes and eight sets of time-domain reflectometry probes continued. Eight HD probes monitored changes in the water potential of the surface soil/rock interface.

In air-permeability work, preparation of a report on the Ghost Dance fault pneumatic and tracer testing continued. USGS scientists successfully developed both an equivalent-continuum model and a discrete-fracture model that replicate the field-test pressure and tracer-transport responses. USGS staff presented

the results at the October 1998 Geological Society of America annual meeting. The Northern Ghost Dance Fault Testing data package has completed technical review and been submitted for final QA review. The data package contains all required information and supporting documents, including scientific notebook and calibration documents for all field equipment used.

In work in support of isotopic analyses in drift-scale tests (as well as more general UZ hydrochemical work), several personnel participated in a three-day training class to learn quantitative analytical techniques for water samples using the Inductively Coupled Plasma Mass Spectrometer (ICP-MS). Those techniques allow analysis of water samples as small as 100 microliters for a wide range of elements.

Multiple efforts continued in UZ hydrochemistry. Staff prepared the data package for the interpretive report on correction of perched-water  $^{14}\text{C}$  ages. (That draft report is titled  *$^{14}\text{C}$  age correction on perched water at Yucca Mountain, Nevada, using the NETPATH geochemical model.*) Strontium isotopic analysis of core samples from SD-12 continued, for Sr isotopic composition of both pore water and rock. Analysis of water from WT-24 and SD-6 cores continued. Moisture contents were determined for 13 SD-6 core samples. Pore water was extracted by centrifuge from two WT-24 core samples (moisture contents of about 20 percent). Extracted pore water will be analyzed for major-ion chemistry. Two WT-24 and four SD-6 pore-water samples were prepared for tritium analysis and counted; the data were reduced. Vacuum distillation was used to extract pore water from eight SD-6 and four WT-24 core samples. The extracted pore water will be analyzed for tritium, D/H, and  $^{18}\text{O}/^{16}\text{O}$ . Six WT-24 pore-water samples were analyzed for anions; ten WT-24 and two SD-6 pore-water samples were analyzed for cations; and six WT-24 pore-water samples were analyzed for silica. Pore water was collected from two WT-24 core samples using high-pressure one-dimensional compression, with extracted pore water slated for analysis of major-ion chemistry. Pore water collected by centrifuge, compression, and distillation was recorded in the water-collection data base. Tritium values and major-ion values from water samples were recorded in the appropriate data bases. The LKB liquid scintillation counter was calibrated. Samples were transported by truck from the Nevada Test Site to Denver. A data package containing stable isotopic data from borehole UZ-14 was prepared and underwent technical review.

In unscheduled work, staff prepared the data package for the draft report titled  *$^{14}\text{C}$  activity of carbon dioxide obtained by vacuum-distillation and one-dimensional compression methods and tritium by enrichment on Yucca Mountain cores, Nevada* and sent that package for review. Staff also provided an electronic copy of data presented in USGS-WRIR-96-4058 (*Interpretation of chemical and isotopic data from boreholes in the unsaturated zone at Yucca Mountain, Nevada*) to the YMPB data-management group. Additional work was done on percolation-flux calculations using gas-phase  $\text{CO}_2$   $^{14}\text{C}$  data and moisture-content data provided in the Sandia reports for Tiva Canyon, PTn, and TSw tuff units in the unsaturated zone.

#### Saturated-Zone Hydrology

The USGS will contribute to the Level 3 LANL milestone on testing the Prow Pass interval at the C-hole complex. A joint meeting between USGS and LANL staff was held in Denver on November 10, discussing details of the USGS contribution to the milestone and associated schedules. Description of the hydraulic-testing part of the contribution has already been written in stand-alone format, and it will be condensed during December for inclusion into the LANL milestone. The conservative-tracer analysis part has not been started yet but will be written after completion of the tracer-test analysis in December. The USGS supported LANL in the Prow Pass reactive-tracer testing at the C-hole complex. That work involved manning one five-day shift during every 15-day period and providing as-needed consultation from Denver on running and maintaining the equipment and data-acquisition software at the site. While the LANL reactive-tracer test progressed, the conservative-tracer tests that the USGS had initiated from borehole c#3 to c#2 and from c#1 to c#2 also progressed concurrently. Samples of water obtained from the pumped well (c#2) at four-hour intervals were transported weekly from the C-holes to UNLV in Las Vegas for analysis. Those c#2 samples were analyzed for iodide and 2,4,5 trifluorobenzoic acid (245 TFBA), the tracers injected into c#3 on June 17, and for 2,3,4,5 tetrafluorobenzoic acid (2345 TeFBA), the tracer injected into c#1 on July 31. On November 23, pumping out of c#2 was stopped for the Thanksgiving holiday and then restarted on November 30. The part of the c#2 breakthrough curves of the various tracers for the period

immediately following the November 30 restart will be analyzed to obtain information on transport parameters in addition to that obtained from analysis of the full curves.

No water-level measurements were made during November, and no data were retrieved. The data package for the fourth quarter (FY1998) was reviewed during November and submitted to the data group on November 11, a step toward completion of Level 4 milestone SPH38PM4 [Water-level data: 4<sup>th</sup> quarter FY98 data package to RPC/TDB]. No data were processed during November, but all field data were transcribed to water-level work sheets and organized by well name.

Through November 30, the total depth of borehole USW WT-24 remained at 2,834 ft below land surface (bls). Progress currently is waiting on appropriation of funds needed to complete borehole USW WT-24 into the lower volcanic aquifer. No drilling activity at USW WT-24 occurred during November 1998. Work began on the interpretive report of hydraulic testing in the perched-water body of USW WT-24, and supervisory review was completed during November. The report was prepared for transcription checks and technical review. Also through November 30, total depth of borehole USW SD-6 is still at about 2,541 ft bls and currently awaits completion of contracting by the M&O to bring in a vendor to attempt to fish the drill bit and four links of drill pipe from the borehole. No drilling occurred at USW SD-6 during November 1998.

Data from studies of SZ water (eH-pH task) from springs and wells was added to the isotopic and hydrochemical data base throughout November.

Work on license-application SZ flow-model sensitivity continued. Support to SZ model abstractions included preparation for a December meeting to plan the upcoming Abstraction/Testing Workshop. Other discussion topics included the potential impacts of procedure AP-3.10Q on the workshop and how to implement AP-3.10Q in workshop activities. USGS staff provided boundary fluxes from the regional 3-D flow model to SNL staff for use in a site-scale flow model currently under construction.

#### CLIMATE and PALEOHYDROLOGY

Fluid inclusion studies continued during the period. Ten sample sites in the ESF, reported by Yuri Dublyansky to contain calcite that hosts primary two-phase inclusions, were visited and sampled by Project staff. Preliminary petrographic observations have been made of those samples, but no data have been collected. In unscheduled work, Project scientists prepared a detailed internal review of a report by Yuri Dublyansky which discussed results of his fluid-inclusion studies of UZ calcite samples from the ESF. Dublyansky's report argues that the fluid inclusions reflect repeated upwelling of heated fluids into the unsaturated zone. The review identified many instances where the author apparently has drawn incorrect or inappropriate conclusions from his observations, or where observations appear inadequate, and the review concluded that evidence supporting the author's hypothesis appears weak and contradictory.

#### SPECIAL STUDIES

Staff continued taking geochemical and mineralogical data and descriptions from Chapter 6 of the Site Description (rev. 0) and incorporating that material into Chapter 3 where it supports the description of surficial and site geology. Seven Branch personnel attended mandatory training on preparation of the WDLA as well as a two-day discussion of the direction the Site Description (rev. 1) will be taking.

As a follow-up to the review of Site Characterization Progress Report #19 and the Documentation of Program Change (Revision 1), extensive work was performed to upgrade the reference citations in the DPC. To bring the DPC into compliance with the new M&O document-preparation standards, all references were reviewed to determine which required page-number citations and to locate accession numbers. Numerous reference documents, located either in hard copy or in the Reference Information System, were evaluated and verified. In those cases where a document page number was appropriate, it was supplied. In a number of cases, however, the mere existence of a report was evidence of a particular

program direction, and the reference was cited in its entirety. Unfortunately, the DCP relies on citation of numerous "informal" references (such as Level 4 milestones) to document many changes in program direction, and there is concern that some of these references may be ruled "not citable" by editors. In those cases, the reference citation will be embedded in the text in its entirety, and the citation will not appear in the reference list.

# USGS Level 4 Milestone Report

October 1, 1998 - November 30, 1998

Sorted by Baseline Date

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Cross-Drift Q Stratigraphic Picks to TDB Milestone Number: SPG470M4	10/15/98	11/30/98		
Water-Level Data 4th Qtr FY98 DP to RPC/TDB Milestone Number: SPH38PM4	11/30/98	12/31/98		

# USGS Level 4 Milestone Report

October 1, 1998 - November 30, 1998

Sorted by Baseline Date

<u>Deliverable</u>	Due Date	Expected Date	Completed Date	Comment
<i>FY99 milestone (from FY98/outyears schedule) delivered in October</i>				
Water-Level Altitude Data from the Periodic Network 10/1/97 through 6/30/98 Milestone        SPH37KM4	10/30/98	10/30/98	10/9/98	Not in FY99 planning
<i>Late FY98 milestones delivered in October</i>				
Memo to TPO: Analy Cond for Input to Site Scale Mdl Milestone        SPH253M4	9/30/98	9/30/98	10/2/98	
Memo to TPO: Analy Boundary Conds Oct-Jul 98 Milestone        SPH225M4	9/30/98	9/30/98	10/2/98	
Memo to TPO: Chem/Iso Analy on Wtr Samples WT-17 Milestone        SPC34CM4	9/15/97	9/30/98	10/8/98	

# USGS Level 3 Milestone Report

October 1, 1998 - November 30, 1998

Sorted by Baseline Date

## Deliverable

Letter Report: 4th Qtr FY98  
Milestone Number: SSH14HM3

<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
10/30/98	10/29/98	10/29/98	

**YMP PLANNING AND CONTROL SYSTEM (PACS)**

**MONTHLY COST/FTE REPORT**

Participant U.S. Geological Survey  
 Date Prepared 12/16/98 03:16 PM

Fiscal Month/Year November 30, 1998  
Page 1 of 1

WBS ELEMENT	<u>CURRENT MONTH END</u>						<u>FISCAL YEAR</u>		
	ACTUAL COSTS	PARTICIPANT HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET	APPROVED FUNDS	CUMMULATIVE COSTS
1.2.1	44	1795	225	0	87	0	670	0	87
1.2.3	705	17719	2761	0	1487	0	9610	0	1345
1.2.5	37	349	731	0	366	0	657	0	77
1.2.8	42	2570	0	0	0	0	462	0	65
1.2.9	49	1216	222	0	91	0	601	0	91
1.2.12	9	512	0	0	0	0	100	0	19
1.2.15	131	1998	330	0	90	0	1454	0	251
	1017	26159	4269	0	2121	0	13554	0	1935

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR October 1, 1998 November 30, 1998

12/4/98 9:49:20 AM

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
0G1C81 Conduct Engineering Assurance Activiti	38.0	36.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.65
81912019U1 Engineering Assurance FY99	38.0	36.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.65
Personnel Qualifications - Deferred	3.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.97
0G1C82 Support Line Org. Doc. Issues/Backlog	2.8	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.86
81912019UX Support Line Organization, Docume	5.9	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.83
81912019	43.9	43.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.48
1.2.1	43.9	43.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.48
0G33124NB8 Conduct Air-K & Hydrochemistry Testing	62.0	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.64
0G33124NB7 Characterize Seepage into Alcoves I	14.1	18.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.72
0G33124NB6 Characterize Seepage into Alcoves II	1.7	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.83
0G33127NB2 Conduct Isotopic & Hydrochemical Anal	16.2	20.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.99
0G36221NB1 Conduct Fluid Inclusion Studies	4.4	20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.32
0G36221NB3 Cond Frac Mineral Dtg & Iso Analy - ES	32.2	21.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.57
81912025U1 Moisture Monitoring & Fault Fractur	130.7	97.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	228.09
0G36221NB5 Water Flux Thru Repository Block	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912025UX Geochronology of Fracture Minerals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912025	130.7	97.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	228.09
0G33131NB2 Cond. Hydraulic & Tracer Testing of Pro	39.9	34.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.34
0G33132NB1 Cond Isotopic & Hydrochemical Studies	8.6	29.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.44
0G36221N77 Paleodischarge at Nye County Sites	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0G3000XN77 Provide SMF Well-Site Support	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.86
0G3000XN81 Oversee Nye County Drilling Program	8.3	-5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.13
81912029U1 SZ Data Analysis for SR FY99	56.8	62.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	119.76
81912029	56.8	62.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	119.76
Reduce Uncertainty - Recharge Work	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Hydrogeologic Framework Model	8.1	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.59
Ground Water Flow Modeling	0.4	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.14
Comp. Geo. Interpretations - Cross Sect	2.1	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.66
Reduce Uncertainty - Hydrochemical Flo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
Comp. Geo. Interpretations - Amargosa	2.5	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.23

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR October 1, 1998 November 30, 1998

12/4/98 9:49:20 AM

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
Comp. Geo. Interpretations - Hydrostruc	2.4	13.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.96
Comp. Geo. Interpretations - Geologic	7.4	16.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.42
0633133#82 Conduct LA SZ Flow Model Sensitivity A	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.99
0633133#83 Refine Geologic Framework Model	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.41
0633133#84 Develop Regional SZ Model	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.32
81912031#1 Regional and Site Scale Saturated Z	22.9	71.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.72
0633132#82 Iso & Hhdrochem Studies SZ Water (WT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0633133#87 Reduce Uncertain Flux Values to Calibr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0633133#8A Refine Regional Hydrogeologic Framew	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912031#X "?? Modeling & Hydrochem Studies (	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912031	22.9	71.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.72
0632212#87 Conduct Geologic Mapping of the ECRB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912050#2 Geologic Testing in the ECRB FY99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0633124#88 Eval Percolation Flux Across Repository	3.6	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.20
0633124#8D Conduct Moisture Monitoring in the ESF	17.1	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.93
0636221#84 Cond E-W X-Drift Frac Min Dting & Iso	21.2	-14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.08
81912050#3 Moisture Monitoring & Infiltration St	41.9	26.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.21
0632212#85 Conduct Geologic Mapping of the ECRB	75.0	71.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	146.30
81912050#X Geologic Mapping of the ECRB (Def	75.0	71.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	146.30
81912050	116.9	97.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	214.51
0632211#83 Complete Stratigraphic Descriptions UZ-	0.6	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.83
0632211#85 Correlate Lithostratigraphy & Geophysic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0632212#81 Provide Structural Support to Isotopic A	4.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.19
0632212#82 Conduct Fracture Syn in Sup of Reposit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0632212#83 Conduct Spatial Analysis of Fracture Int	0.4	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0632212#84 Provide Geo Sup to LBNL Geophys Inve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0632212#85 Evaluate Short Trace Length Fract. Distr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0632212#86 Char. Structure of Alcove - X-Drift Infil. E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0632212#88 Conduct Fault Zone Studies	0.9	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.72
0632212#89 Provide Structural Support to TSPA/VA	29.8	18.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.71
06395#81 Provide USGS Support to 3-D Model G	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.45

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR October 1, 1998 November 30, 1998  
12/4/98 9:49:20 AM

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
06395MB2 Provide USGS Support to 3-D Model St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912210U1 Geologic Studies FY99	53.1	32.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.89
0632211MB2 Conduct Stratigraphic Descriptions	8.9	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.89
81912210UX Stratigraphic Description of SD6WT	8.9	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.89
81912210	62.0	46.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108.78
0633123M77 Hydraulic properties - Busted Butte Core	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.59
0633124MBF Characterize Seepage into Alcoves I	0.0	13.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.72
0633124MBG Characterize Seepage into Alcoves II	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.32
0633127MB2 Cond Iso/Hydrochem Studies of UZ & P	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912215U1 Moisture Monitoring & Fault Fractur	0.0	22.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.63
Paleodischarge/Paleoclimate - Deferred	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912215UX Paleodischarge/Paleoclimate (Deferr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912215	0.0	22.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.63
0633132MB1 Cond Isotopic & Hydrochemical Studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0633000MB2 Oversees Nye County Drilling Program	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81912245U1 SZ Data Analysis for SR/LA FY99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0633127MB3 Iso & Hydrochem Studies of UZ Water a	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.94
0633131MBG SZ Hydrologic Testing	9.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.20
81912245UX SZ Testing & UZ Hydrochemistry (D	9.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.14
81912245	9.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.14
06398MB9 Support Preparation of the WDLA	26.3	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.41
81916105U1 Support for Preparation of the WDL	26.3	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.41
0632836MB1 Rvw Impacts of New Data on Volcanic &	15.7	-11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.34
0633129MB1 Provide Updated UZ Model Abstractions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0633100MB1 Provide Support to Flow & Transport Mo	3.9	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.85
0633000M77 LADS Support	0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.09
81916105U2 Review of Literature and Special Stu	19.7	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.28
Coupled Infiltration Surface Water Flow	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.81
Surface Based Testing Closeout Activiti	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.05
Climate Closeout Activities	0.0	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.11

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR October 1, 1998 November 30, 1998  
12/4/98 9:49:20 AM

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
Tectonic Closeout Activities	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.45
0G398HA1 Support Closeout Activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0G398HA1 Supports KTIs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
0G398HA1 Support Peer Reviews	4.9	-2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.92
0G398HA1 Support Topical Rpts; MWTRB, ACNW,	5.8	-5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.69
0G398HA1 Support Semiannual Progress Reports	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.95
81916105U3 Technical Interactions and Special P	10.7	22.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.98
81916105	56.7	47.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	103.66
0G33127NB1 Conduct Chem. & Isotopic Analyses Drif	9.3	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.17
81916107U1 Isotope Support for Thermal Testing	9.3	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.17
81916107	9.3	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.17
0G33131NB1 Conduct Water-Level Monitoring	7.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.59
81917027U1 Long-Term PC Monitoring FY99	7.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.59
81917027	7.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.59
Unfunded Work	91.7	97.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188.64
0G31NB1 Support Scientific Programs Mgmt & Int	9.8	24.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.37
0G31NB2 Manage Nevada Operations/Earth Scien	40.4	61.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.55
81919090U1 USGS SP&I FY99	141.9	182.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	324.55
0G398HA1C Provide Site Investigations Technical Su	27.1	38.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.62
81919090U3 USGS Site Investigations Technical	27.1	38.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.62
0G398HA2C Support QA Compliance, Implementatio	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81919090U4 QA Compliance, Implementation, an	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
81919090	169.0	221.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	390.17
1.2.3	640.4	704.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,345.22
0G54X1 Provide Support to Performance Assess	0.9	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.99
81912220U1 USGS Support to Performance Asses	0.9	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.99
81912220	0.9	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.99
0G535NB1 Provide Technical Data Coordination	38.8	31.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.90
81912470U1 Technical Data Management FY99	38.8	31.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.90

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR October 1, 1998 - November 30, 1998

12/4/98 9:49:21 AM

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
81912670	38.8	31.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.90
1.2.5	39.7	37.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.89
06825NB1 Implement Federal Safety & Occupation	6.8	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.45
81919121U1 Federal Occupational Safety & Health	6.8	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.45
06847NB1 Conduct Water Resources Studies	15.8	34.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.80
81919121U2 Water Resources FY99	15.8	34.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.80
06847NB2 Water Appropriation Hearings	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.71
81919121U3 Water Appropriation Hearings	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.71
81919121	22.6	42.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.97
1.2.8	22.6	42.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.97
06912NB1 Provide TPO Office Support	14.3	26.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.19
81919135U1 USGS Project Management FY99	14.3	26.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.19
06922NB1 Conduct Project Control Activities	27.7	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.16
81919135U2 USGS Project Control FY99	27.7	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.16
81919135	42.0	49.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.34
1.2.9	42.0	49.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.34
06C522NB1 Conduct Satellite Records Operations	10.3	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.05
81919197U1 USGS Satellite Records Operations	10.3	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.05
81919197	10.3	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.05
1.2.12	10.3	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.05
06F23NB1 Provide Support/Personnel Services	18.8	22.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.44
06F23NB5 Provide Procurement & Property Manag	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
06F23NB6 Provide Computer Support	13.6	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.82
81919110U1 Personnel, Procurement, Property S	32.4	47.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.25
06F23NB2 Provide Facilities Management (space)	65.3	65.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.67
06F23NB3 Provide Facilities Management (comput)	13.7	13.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.33
06F23NB4 Provide Facilities Management (other)	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.00

**U.S. GEOLOGICAL SURVEY**

**ESTIMATED COSTS FOR October 1, 1998 - November 30, 1998**  
 12/4/98 9:49:21 AM

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
81919110U2 Facilities Management (USGS)	81.5	81.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	163.00
06F3181 Provide USGS Training Support	6.1	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.76
81919111U1 USGS Training Support	6.1	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.76
81919110	120.0	131.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	251.02
1.2.15	120.0	131.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	251.02
1.2 OPERATING	919.0	1,017.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,935.97
CAPITAL EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	919.0	1,017.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,935.97
FTEs													
FEDERAL	86.0	150.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
CONTRACT	29.2	27.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL	115.2	178.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	