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

DEC 30 1997

OVERNIGHT MAIL

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High Level Waste & Uranium Recovery
Division of Waste Management
Office of Nuclear Material Safety
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U.S. Nuclear Regulatory Commissio.
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 are the U.S. Geological Survey Progress Reports for October and November 1997.

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

April V. Gil FOR

Stephan J. Brocoum
Assistant Manager for Licensing

AML:AVG-0537

Enclosures.
1. Ltr, 11/25/97, Craig to Kozai, w/encl
2 Ltr, 12/10/97, Craig to Koizai, w/encl

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Enclosure

United States Department of the Interior

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

INFORMATION ONLY

November 25, 1997

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,October, 1997

Attached is the USGS progress report in the required format for the month of October, 1997.

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

Sincerely,

Raye Ritchey Arnold

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

Enclosure:
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U. S. GEOLOGICAL SURVEY
EXECUTIVE SUMMARY

OCTOBER, 1997

WBS 1.2.3.1 Coordination and Planning

U. S. Geological Survey-Yucca Mountain Branch is currently processing 144 scientific papers prepared by USGS authors. Of these, 95 are relative to geologic studies and 49 to hydrologic studies. In addition, 14 abstracts are being processed, as well as 17 reports by LANL personnel.

WBS 1.2.3.2 Geology
Geologic Framework

Primary efforts by project personnel involved in stratigraphic studies of the potential repository site focused on the preparation of the Excel spreadsheet (see September report), composed of a maximum of 51 lithostratigraphic contacts from about 80 boreholes. The work included the continued preparation of geophysical-log data displays using the Excel macro CONTACT. P .h tasks are to be used to expedite the technical review of Milestone Report SPG391M4 that was submitted on September 30, 1997. Project staff also participated in several meetings to assist in planning the upcoming tests in borehole WT-24.

Final edits on the 1.6,000-scale central block geologic map were performed in preparation for its publication as a formal USGS map product. A digital file of the 1 24,000-scale Yucca Mountain site area map was prepared for conversion to the ARC I. rmat, so that it can also be processed for publication as a formal USGS map product. The geologic map of the Paintbrush Canyon area was submitted for approval to publish as a USGS Open-File Report.

Project staff conducted field investigations in the southern part of Yucca Mountain as part of the compilation of a 1 50,000-scale geologic map for the saturated zone site area. The primary purpose of these studies is to evaluate faults and fault zones in southern Yucca Mountain as potential zones of flow channelization or as barriers to hydrologic flow. The resulting data are also being used as geologic input (key faults, fault geometry, fault zone widths, permeability characteristics) for the next iteration of the saturated zone site area model.

The geologic map patterns in the vicinity of the drift in Solitario Canyon that is associated with the "Enhanced Characterization of the Repository Block" (ECRB) effort were refined, and the draft ECRB cross section was modified accordingly. A preliminary version of the cross section was submitted to the M&O. Borehole information from drill holes adjacent to the ESF and ECRB was compiled and logs were drafted for inclusion in the Cross-Block Drift Predictive Report. Data on fracture orientations and densities in the Topopah Spring Tuff in Solitario Canyon were collected to assist in predicting fracture densities at the tunnel level.

Geologic mapping of Alcove #7 was completed, including full-periphery mapping, detailed line surveys, and stereophotography. Also completed were detailed line surveys and stereophotography for Niche #1 in the ESF and the mapping of shrinkage cracks in the concrete lining of the heated drift. A complete set of full-periphery maps showing only ground support (79 drawings) to be used to verify the locations of permanent ground support in the ESF were prepared and submitted as requested by the CMO

Project personnel completed preparation of appropriate documents relative to a contract for software preparation to allow input of detailed line survey data (from the ESF) directly into a palmtop computer. Technical procedure GP-32 (Underground Geologic Mapping) was reviewed and revised. This procedure is being prepared to help guide the mapping of future excavations. A field manual to be used in connection with the procedure is also being prepared

Seismotectonic Studies

The Seismic Source Characterization teams completed feedback discussions and the revisions of their final summary reports. The calculation teams began the modeling of all the teams' fault displacement models. A draft report on deterministic earthquakes for Type I faults at Yucca Mountain was prepared for the International High Level Nuclear Waste Conference to be held in May, 1998. An annotated outline of the USGS report on deterministic earthquakes was also competed. PSHA staff worked with Risk Engineering personnel to clarify the maximum earthquake for ground motion modeling and for inclusion in the Seismic Design Topical Report. The PSHA effort was audited during the last week of October and no deficiencies were found.

Project scientists prepared an assessment of coupled processes (basaltic volcanism and fault displacement) for presentation at the NRC-DOE technical exchange meeting (held in Las Vegas on November 5). An overview and models of basaltic volcanism and fault displacement were also presented to Sandia personnel in Las Vegas on October 15

HYDROLOGY

Regional Hydrology

Changes were made to the recording network of stream-gage stations near Yucca Mountain. Monitoring continued at the stream gage located on Fortymile Wash at Amargosa Valley. The stream gages on Fortymile Wash near borehole J-13 and at the Narrows were deactivated. Formerly used stream gages on upper and lower Split Wash and on Pagany Wash on Yucca Mountain were reactivated. Project staff kept vigilance during the reporting period for potential precipitation and runoff. Runoff was neither observed nor reported for the five recording stream gages or for the Yucca Mountain vicinity. Staff continued entry of streamflow and precipitation data collected in FY97 into tabular format.

Unsaturated-Zone Hydrology

Monitoring of borehole instrumentation continued during October. Borehole data from NRG-7a, UZ #4, UZ #5, UZ-7a, and SD-12 were transferred to Denver, converted to engineering units, and archived to optical disk on a routine basis throughout the month. Daily EKES files were checked for any shelter activity. Sensor readings were checked daily as well for unusual occurrences, and any statistical outliers were flagged. Seven technical procedures were revised to meet new QA requirements and to clarify submittal of supporting documentation Calibration runs were conducted on three pressure transducers and one thermistor, a barometer was checked, and PRED diagnostics were run on benches #5 and #8. One digital thermometer was repaired and calibrated. Sufficient calibrated thermocouple psychrometers are in stock for anticipated experiments.

Numerous trips were made to field sites for correcting generator, UPS, and chiller problems, including 18 site visits for routine generator maintenance, seven site visits to correct UPS and generator problems (the utility UPS at UZ-7a is not functioning and there is no backup for chiller power at this site), and four visits made for temperature-related problems at UZ #4 and #5. The two new generators promised for UZ and SD-12 still do not have instrument-grade governors. The generators have been on site since early April. The latest Kiewit/TRW plan is to order two additional larger generators rather than equipping the two new generators on site with instrument-grade governors. No progress has been reported.

In air-permeability and hydrochemical testing in the ESF, compilation of data from ESF testing (started in FY96) continued during October. Core-water samples from the footwall of the Ghost Dance fault in the Southern Access Drift exhibit post-bomb tritium levels. Tritium levels of five footwall samples are 9.1, 11.6, 2.6, 6.6, and 7.5 tritium units (TU). Those levels indicate that the fault is a fast pathway for the transport of water from the surface and that the travel time from the surface to depth (to the ESF level) is less than 50 years. In active testing, preliminary analysis of the NAD cross-hole pneumatic testing in the Topopah Spring Formation (Tptpmn) broken zone adjacent to the Ghost Dance fault indicates permeability values of 6 to 12 darcies and porosity values of 2 to 6 percent. Tests conducted in the Ghost Dance fault breccia zone indicate higher permeability and porosity values (12 to 18 darcies and 8 to 14 percent, respectively). Pneumatic and tracer testing results show a northwest-southeast preferential flow direction indicating that the fault zone is anisotropic.

Collection of temperature and relative humidity data continued at eight sites in the ESF. Wind- speed data are currently being collected at five sites. Water-potential and water content data are being collected with heat-dissipation probes and time-domain reflectometry (TDR) probes in Alcove 3. Planning and preparation for water-balance data collection in the cross drift has begun. Various types of instrumentation systems are being developed and tested for use in the TBM water-migration study.

Hydrologic studies in the South Ramp of the ESF continued with collection of water-potential data from sets of tensiometers and heat-dissipation probes installed at ESF Stations 66+99, 67+33, 70+54, and 70+56. Water-content data were collected from TDR instrumentation installed at ESF Station 66+99. The areas around these instruments are still covered with plastic to monitor the recovery of the rocks from the drying effects due to tunnel ventilation. Tensiometer data collection at Stations 66+99, 67+33, 70+54, and 70+56 will be stopped because the rock has dried out beyond the tensiometer range, and no usable data were being collected. The rock is not expected to re-wet to the tensiometer measurement range. Pore-water extraction from a single Lexan-enclosed sample from each South Ramp borehole was started using a centrifuge. Boreholes ESF-SR-MOISTSTDY#1 and ESF-SR-MOISTSTDY#2 are not included in these samples because all available cores were previously distributed. The water samples extracted from core will be sent to LANL for analysis of Cl^-, Br^-, and SO_4^{-2}. Selected water samples will be analyzed for ^{36}Cl. Planning for core distribution and types of analysis to be done on the core samples from the South Ramp boreholes was started. Core will be divided between the USGS and LANL, and proposed analyses include Cl^-, Br^-, SO_4^{-2}, ^{36}Cl, $^3H^+$, ^{14}C, major ions, $\delta^{18}O$, Sr/U isotopes, thin sections, and XRD analysis.

Several areas of isotopic analytical support to other studies are underway. Preparations for assessment of infiltration of construction water into the repository block (as part of the enhanced characterization of the repository block [ECRB]) began with planning of potential locations for boreholes. Actual locations are still under discussion. Investigation of matrix water sources and interaction of fracture/matrix water began with sampling of core from USW SD-9. Pore-water Sr isotope analyses as well as whole-rock Sr isotope analyses have begun. In preparation for isotopic analytical support to drift-scale thermal testing, staff discussed layout of necessary boreholes.

In investigations supporting ECRB, staff reviewed existing secondary mineral data from the ESF and discussed reasons for possible variations in the cross-drift due to structural, stratigraphic, and infiltration controls expected over the drift footprint. The excavation will allow important tests of how the current infiltration model may be affected by possible lateral flow in the PTn. Completion of a final predictive report is planned for November. Staff also discussed possible mechanisms for collecting airborne dust or liquid/dust slurries from the TBM with Alan Mitchel (LANL-TCO). The use of large volumes of water during construction is expected, in part, to eliminate much of the airborne dust. Collection of the fine particles, however, is important to provide an independent quantitative estimate of the distribution of calcite and opal in the volume of material excavated by the TBM. In support of determination of water flux through the repository block, staff updated the ESF mineral-distribution data base using previously collected data, subtracting portions of walls in each 30-m segment covered by ribs, lagging and muck. Revised estimates of the percentages of secondary minerals are similar to or slightly higher than previous values.

A manuscript titled *Mixed $^{230}Th/U$ ages for unsaturated-zone opals due to slow rates of deposition, Yucca Mountain, Nevada, USA* (by L. Neymark and J. Paces) was revised based on technical reviews. The manuscript was submitted to the Publications Unit for additional processing and for Director's approval after which it will be submitted for publication in the journal *Earth and Planetary Science Letters*. Staff also worked on extended abstracts for the 1998 High Level Radioactive Waste Management meetings. Papers dealing with aspects of secondary minerals from the ESF or from drill holes include:

Secondary minerals record past percolation flux at Yucca Mountain, Nevada, by B. Marshall, J. Paces, L. Neymark, J. Whelan, and Z. Peterman.

History of calcite and opal deposition at Yucca Mountain: Evidence for long-term stability of the unsaturated zone, by L. Neymark, Yu V. Amelin, and J. Paces.

Anomalous uranium isotopic compositions of ground waters in the Yucca Mountain vicinity: Evidence of local recharge? by J. Paces, K. Ludwig, Z. Peterman, and L. Neymark.

Isotopes aid in understanding the Yucca Mountain flow system, Z. Peterman and G. Patterson.

Secondary mineral evidence for past water table changes, by J. Whelan and R. Moscati.

Carbon isotope evidence for past climates (million-year scale) in southern Nevada, by J Whelan, L. Neymark, and R. Moscati.

Inferences on UZ hydrologic behavior based on secondary mineral records, by J. Paces, L. Neymark, B. Marshall, and J. Whelan.

Additional abstracts were prepared for the Field Testing and Associated Modeling (FTAM) workshop to be held at LBNL in December:

Hydraulic inferences from strontium isotopes in pore water from the unsaturated zone at Yucca Mountain, Nevada, by B. Marshall, K. Futa, and Z. Peterman.

Secondary mineral evidence of large-scale water table fluctuations at Yucca Mountain, Nye County, Nevada, by J. Whelan, and R. Moscati.

In unscheduled work, USGS staff met with G. Bodvarsson and E. Sonnenthal (L... ... 'iscuss impacts of various hydrogeochemical data on the UZ flow model. The current version of the moc ... ... s.mited chemical data such as Cl (including ^{36}Cl), SO_4, ^{14}C, ^{3}H, Sr, and $^{87}Sr/^{86}Sr$, commonly in one-dim... ...orm. Hydrologic information contained within secondary minerals is not being seen by the flow model. It was agreed that hydrogeochemical data are important to the flow model, and that USGS and LBNL will attempt to incorporate more information into the model or to provide observational tests of the model.

Efforts in UZ hydrochemistry continued with extraction and analysis of water from WT-24 and from ESF cores. Anion and cation concentrations were analyzed using the ion chromatograph on two water samples collected from the WT-24 borehole. Two samples collected from the WT-24 borehole were processed by vacuum distillation. The water samples will be analyzed for tritium, deuterium/hydrogen (D/H), and $^{18}O/^{16}O$. Similar work continued on seven ESF pore-water samples with the ion chromatograph; seven ESF pore-water samples were also prepared for tritium analysis and counted for tritium concentration. Four ESF core samples were distilled to extract CO_2 and pore water. The extracted pore water will be analyzed for tritium, D/H, and $^{18}O/^{16}O$ isotopes, and the extracted CO_2 gas samples will be analyzed for carbon isotopes. Two ESF core samples were compressed. The extracted pore water will be analyzed for chemical composition, ^{14}C, and stable isotopes.

In unscheduled analytical work, dissolved CO_2 was collected from four SD-12 core samples by vacuum distillation under heat and collected from two SD-12 core samples by acidification. Four SD-12 CO_2 samples were sent to Beta Analytical, Inc., for carbon isotope analysis. A sample of tuff which had previously been distilled and acidified was heat-evacuated under vacuum for 8 hours at 150°C. The sample was then imbibed with a 3.1 mmol solution of $NaHCO_3$ in an enclosed flask that was purged with nitrogen, in preparation for later distillation and acidification to collect the dissolved CO_2. Water was collected from one SD-12 and eight UZ-7A cores by distillation. The water samples will be analyzed for tritium, D/H, and $^{18}O/^{16}O$. Eight SD-12, three NRG-7A, and two UZ-14 pore-water samples were prepared for tritium analysis, counted for tritium concentration; the resulting data were reduced. Results were recorded in the water-collection data base.

Efforts also continued in improvement of instrument capability. The process of restarting the DX-100 ion chromatograph and acquisition of quality data continued with various calibrations and acquisition of necessary equipment. With new suppressors the cation calibration curves and repeatability were satisfactory, but the anion calibration curves and repeatability still need improvement. Staff contacted the USGS tritium lab in Menlo Park, California, for analysis of pore-water samples at lower detection levels of 1 TU by direct count and 0.1 TU by the

tritium-enrichment method.

Saturated-Zone Hydrology

Work on tracer testing at the C-hole complex largely involved preparations for testing in the Prow Pass interval. Procurements of the pumping and tracer-injection system were begun on October 1. Reinstrumentation of the C-holes for hydraulic and tracer testing in the Prow Pass interval is underway. Pumping from UE-25 c #3 will continue until the middle of November to enhance results of the previous Pyridone tracer testing of the Bullfrog interval, per agreement with the State of Nevada. The 2,6 difluorobenzoic acid (DFBA) breakthrough curve is in its final, or "tail" stage of development, and the Pyridone breakthrough curve has shown a steady rise in concentration, with no peak yet identified. That concentration has risen to approximately 400 parts per trillion (ppt).

In response to comments from the SZ Expert Elicitation Panel, planning for the southern Second Tracer Complex (STC) started with a conference call on October 29 in which representatives from the USGS, LANL, and LBNL discussed criteria for the complex to be located in the southern part of the site area. Substantive planning discussions will be initiated with November meetings in Los Alamos, New Mexico.

Saturated-zone water-level monitoring continued during the period. Preliminary hydrographs were constructed for boreholes USW WT-1, USW WT-2, UE-25 WT#3, UE-25 WT#4, UE-25 WT#6, USW WT-7, USW WT-10, USW WT-11, UE-25 WT#13, UE-25 WT#14, UE-25 WT#15, UE-25 WT#16, UE-25 p#1, UE-25 b#1 (upper interval), USW VH-1, USW G-2, J-11, J-12, J-13, USW H-1 (tubes 1, 2, 3, and 4), USW H-3 (upper and lower intervals), USW H-4 (upper and lower intervals), USW H-5 (upper and lower intervals), and USW H-6 (upper and lower intervals).

A data package (for water-level data collected from January through June 1997) was submitted to GENISES on October 15 [DTN: GS9709083123l2.007, TDIF: 306333]. The data package was submitted to the Records Processing Center (RPC) on October 17. A memorandum documenting completion of **milestone SPH37FM4 [Memo to TPO: January - June 1997, Periodic Water-Level Data to RPC]** was submitted to TPO on October 17, 1997, representing early completion of this task.

Water-level monitoring continued with measurements in several boreholes (UE-25 WT#14 on October 1; UE-25 p#1 on October 2; USW WT-24 on October 9, 15, and 27; and UE-25 p#1 on October 21). Calibrations and equipment checks were performed for several boreholes. Data were downloaded from 21-X recorders at USW H-4 (upper interval), UE-25 WT #14, USW G-2 and UE-25 p#1. Hourly monitoring of borehole UE-25 p#1 was discontinued on October 28. The transducer was removed from the borehole so logging operations could be completed at borehole UE-25 p#1.

Several efforts continued at borehole WT-24. By September 30, borehole USW WT-24 was drilled to 1,550 ft below land surface, and additional drilling through October 2 produced a depth of 1,686.3 ft below land surface. The Topopah Spring Tuff crystal-poor vitric densely welded subzone (Tptpv3) was penetrated at approximately 1,685 ft below land surface. After drilling into the Tptpv3, a water probe was used in the borehole to check for ground water in the borehole. Ground water was detected with depth to water approximately 1,663 ft below land surface, giving an approximate 23-ft column of water in the borehole. Well development of borehole USW WT-24 was completed, and a hydraulic test of the water-bearing zone was conducted on October 21 and 22. The borehole was pumped for 24.92 hours at a rate of 2 gallons per minute. Approximately 3,050 gallons were pumped from the borehole with 10.59 ft of drawdown. Recovery in the borehole was monitored for 117 hours before the transducer was removed from the borehole. During pumpage of the borehole, water-quality samples were collected. Video logging of borehole USW WT-24 was completed from land surface to 1,663 ft below land surface on October 28. Geophysical logging of the unsaturated zone (0 to 1 663 ft below land surface) of borehole USW WT-24 was completed on October 31.

The numerical net infiltration model was updated with development of a Fortran program for defining surface drainage boundaries using the 30-m elevation grid as input. The program also calculates the upstream drainage area

for each grid cell, which is used to establish channel networks and geometries. The program is being applied to generate a series of surface-drainage models covering the area of the LBNL unsaturated-flow model. The WT-2 Wash sub-drainage model was used to test the coupled infiltration/runoff model. This sub-drainage model is also being applied to predict net infiltration rates over Alcove 7 in response to an active *El Niño* southern climatic oscillation (ENSO). The calibration of the coupled infiltration/runoff model was initiated using available stream flow records for several drainages on Yucca Mountain. In efforts to predict future net infiltration rates in response to possible future climates, the WT-2 Wash coupled infiltration/runoff model was applied using various wetter future climate analogs to analyze potential channel-flow volumes. This coupled model was also used to compare net infiltration along channel segments and lower sideslopes with simulation results obtained using the 1996 version of the infiltration model. These results are being used to test assumptions of the 1996 model concerning the effects of overland flow in response to current and wetter future climates. The wetter analog-climate simulations were compared with results obtained using the Maxey Eakin method. Evaluation of the analog sites selected for developing stochastic simulations of daily precipitation for various potential future climate scenarios was continued. The application of the 1980-95 daily precipitation record to predict net infiltration in response to an active ENSO was initiated.

Activities in support of completion of sections of the TSPA-VA report concerning SZ ground-water flow modeling included review of a preliminary draft of the Methods section of chapter 6 and feedback to B. Arnold (SNL). A draft of an administrative report documenting particle-tracking analysis in support of PA abstraction/testing was forwarded for USGS approval. Changes to the regional flow model resulting from incorporation of improved evapotranspiration (ET) estimates for Ash Meadows and Franklin Lake Playa also were documented to support PA abstraction/testing. Staff further discussed possible contributions to the TSPA-VA document to summarize USGS modeling results and sensitivity analyses.

CLIMATOLOGY and PALEOHYDROLOGY

Staff reviewed FY98 goals for past discharge work and decided to concentrate on study sites in Ash Meadows. Previous and current investigations of discharge rates from springs and wetlands in that area along with distributions of vegetation and spring deposits were determined to provide the best chance at assessing a relation between discharge volumes and lateral extents. Specific sites will be determined after field reconnaissance.

Preparation for collection of Owens Lake core samples continued. Permission was received from J. Bischoff (USGS Geologic Division) for sampling of material representing the 350- to 410-ka period from the Owens Lake core. The core will be sampled at 10-cm intervals during the first week of November.

SPECIAL STUDIES

Preparation of the PISA report continued. Sections on Surface Water System and Regional Hydrologic System (Chapter 2.4, Hydrology) have been completed and are being prepared for internal review. Drafts of most subsections in the Site Hydrology section have been submitted and are being evaluated relative to their readiness for internal review. For FY98, the staff for this activity has been modified to facilitate compilation, editing, and revision during the scheduled reviews. Original authors are scheduled for minor involvement to assist in the revision process. A partial first draft of the (Chapter 3.4) Paleoclimate subchapter was prepared and is being reviewed by co-authors. Upcoming treatment will clarify linkage of components and identify issues needing further discussion. A partial draft of the meteorological subchapter was also written and has received preliminary review.

The USGS continued to support development of Site Characterization Progress Report (SCPR) #17, the first progress report prepared using the new "down-sized" format. About 20 pages of consolidated USGS input to SCPR #17 were transmitted to the technical leads in M&O Site Evaluation Program Operations (SPO) on October 12. This compared to about 100 pages of input submitted in March 1997 for SCPR #16. Input was contributed by the USGS to SCPR Chapter 4 (Site Characterization) in each of the following subsections:

for each grid cell, which is used to establish channel networks and geometries. The program is being applied to generate a series of surface-drainage models covering the area of the LBNL unsaturated-flow model. The WT-2 Wash sub-drainage model was used to test the coupled infiltration/runoff model. This sub-drainage model is also being applied to predict net infiltration rates over Alcove 7 in response to an active *El Niño* southern climatic oscillation (ENSO). The calibration of the coupled infiltration/runoff model was initiated using available stream flow records for several drainages on Yucca Mountain. In efforts to predict future net infiltration rates in response to possible future climates, the WT-2 Wash coupled infiltration/runoff model was applied using various wetter future climate analogs to analyze potential channel-flow volumes. This coupled model was also used to compare net infiltration along channel segments and lower sideslopes with simulation results obtained using the 1996 version of the infiltration model. These results are being used to test assumptions of the 1996 model concerning the effects of overland flow in response to current and wetter future climates. The wetter analog-climate simulations were compared with results obtained using the Maxey Eakin method. Evaluation of the analog sites selected for developing stochastic simulations of daily precipitation for various potential future climate scenarios was continued. The application of the 1980-95 daily precipitation record to predict net infiltration in response to an active ENSO was initiated.

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4.1 Integrated site model/Geologic framework
4.2 Site unsaturated-zone modeling and synthesis
4.3 Site saturated-zone hydrologic system synthesis and modeling
4.4 Paleoclimate-paleoenvironmental synthesis
4.7 Disruptive conditions (Probabilistic Seismic Hazard Analysis)

Responses to questions and comments regarding the input were transmitted to M&O SPO technical leads as requested. The SPO draft input that was submitted to the M&O Licensing group on October 22 was received by the USGS on October 27 and was reviewed to determine the extent to which USGS input had been utilized. Virtually all the USGS input provided on paleoclimate synthesis, and most of the input provided on UZ and SZ synthesis, was used in the SPO draft. Surprisingly, however, virtually none of the USGS input on geologic framework was utilized. The USGS is continuing to investigate the reasons for this and intends to use direct interactions with the M&O Licensing group, as well as the formal review process, to ensure that USGS contributions to geologic framework are represented appropriately in SCPR #17.

The USGS parts of Appendix A of the SCPR (documenting differences between the SCP and the current program) also were revised in response to annotations prepared by the M&O Licensing group. About 14 pages of new or revised text for Appendix A were provided by the USGS. One area of substantial revision was in the description of ESF hydrologic tests for which text was added to describe new hydrologic tests started in the ESF during FY 1997 as part of the enhanced characterization of the repository block. These tests include the South Ramp Hydrology Study, the Paintbrush Nonwelded Lateral Diversion Study, and the ESF Drift-Scale Dry Air Flux and Niche Study. Another area of emphasis was responding to questions regarding resolution of uncertainties in the site saturated-zone flow model. Results from the saturated-zone flow and transport abstraction/testing workshop held in May 1997 were utilized extensively to address many of these questions. Because of its size and the need to maintain direct linkage to the SCP, Appendix A will be released by DOE as a separate document rather than being appended to the semiannual progress report.

WATER-RESOURCES MONITORING

Work on the radiological analysis of water samples continued. Staff responded to colleague-review comments on FY97 water-quality data collected to characterize ground water in the Yucca Mountain region with respect to drinking-water standards. A letter report to was provided to DOE summarizing those data on October 6. The corresponding data-records package and electronic data were forwarded to USGS-ESIP on October 7 and October 22 (respectively) for submittal to the RPC and TDB. Property owners were contacted, equipment was prepared, and quality-assurance samples were processed in preparation for November 1997 water-quality sample collection (to support the M&O's Radiological/Environmental Field Programs).

Efforts also continued in water-resources monitoring. Staff obtained periodic water-level measurements from the site-characterization program and compiled data on ground-water levels for six sites. Data on ground-water levels and discharges collected and compiled for monitoring sites during July through September, 1997 (fourth quarter, fiscal year 1997), were reviewed. A summary report describing monitoring was prepared and delivered to DOE and TRW/SAIC on October 31 in completion of milestone SSH13HM3 [LETTER REPORT: 4th QTR FY 1997]. Ground-water levels were measured at 33 sites, and discharge was measured at one flowing well. Ground-water data collected during September were checked and filed. Digital data for geophysical logs collected at well JF-3 during 1992 were provided to USGS-ESIP personnel. Staff provided technical information to NPS personnel in Death Valley National Park for planned NPS collection of water-quality samples at two wells located in the park (near Saratoga and Texas Springs) and offered assistance in data-collection efforts. Comments were received from the USGS-Nevada reports specialist pertaining to the summary monitoring report for calendar year 1996 (FY 97 milestone SSH13GM3) on October 29; staff responded to those comments, revised the report accordingly, and forwarded the draft report for USGS-Nevada district chief and USGS-YMPB approvals on October 31.

WBS No. - 1.2

WBS Title - Yucca Mountain Project

Parent WBS No. - 1.0

Parent WBS Title - Mined Geologic Disposal System

Element ID - 12

Statement of Work:

See the current WBS Dictionary

Cost/Schedule Performance

Id	Description	Current Period BCWS	BCWP	ACWP	SV	CV	FY1998 Cumulative to Date BCWS	BCWP	ACWP	SV	CV	FY1998 at Completion BAC	EAC	VAC
1.2.1	Systems Engineering	43	43	36	0	7	43	43	36	0	7	526	526	0
1.2.3	Site Investigations	992	932	703	-60	229	992	932	703	-60	229	12428	13197	-769
1.2.5	Regulatory	50	50	38	0	12	50	50	38	0	12	638	683	-45
1.2.8	Environment, Safety, and H	47	47	23	0	24	47	47	23	0	24	600	600	0
1.2.9	Project Management	53	53	53	0	0	53	53	53	0	0	683	685	-2
1.2.12	Information Management	5	5	4	0	1	5	5	4	0	1	77	76	1
1.2.15	Support Services	140	140	53	0	87	140	140	53	0	87	1743	1748	-5
Total		1330	1270	910	-60	360	1330	1270	910	-60	360	16695	17515	-820

Resource Distributions by Element of Cost

Fiscal Year 1998

Budgeted Cost of Work Scheduled

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	22445	22408	22390	22479	21230	21110	20785	20754	20575	18046	17255	17247	247624
LABOR	924	986	983	993	933	946	917	922	907	826	737	749	10823
SUBS	150	160	165	180	178	186	181	183	189	179	169	174	2094
TRAVEL	28	59	60	76	64	73	71	74	64	53	42	35	699
PM&E	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	228	242	260	323	257	267	255	254	247	248	246	252	3079
Total BCWS	1330	1447	1468	1572	1432	1472	1424	1433	1407	1306	1194	1210	16695

Actual Cost of Work Performed

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	19347	0	0	0	0	0	0	0	0	0	0	0	19347
LABOR	698	0	0	0	0	0	0	0	0	0	0	0	698
SUBS	190	0	0	0	0	0	0	0	0	0	0	0	190
TRAVEL	6	0	0	0	0	0	0	0	0	0	0	0	6
PM&E	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	16	0	0	0	0	0	0	0	0	0	0	0	16
Total ACWP	910	0	0	0	0	0	0	0	0	0	0	0	910

WBS No. - 1.2 -Yucca Mountain Project

Resource Distributions by Element of Cost

Fiscal Year 1998
Estimate to Complete

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	0	28100	23385	23564	23557	22957	21912	21307	20736	19022	17822	19544	241906
LABOR	0	1270	1027	1043	1040	1020	992	932	920	829	769	908	10750
SUBS	0	176	170	187	189	196	191	183	189	185	169	201	2036
TRAVEL	0	74	68	79	72	79	79	74	66	55	42	37	725
PRDE	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	0	367	260	352	257	282	265	254	247	251	245	294	3094
Total ETC	0	1907	1525	1661	1558	1577	1527	1443	1422	1320	1225	1440	16605

Resource Distributions

Fiscal Year 1998	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
BCWS	1330	1447	1468	1572	1432	1472	1424	1433	1407	1306	1194	1210	16695
BCWP	1270	0	0	0	0	0	0	0	0	0	0	0	1270
ACWP	910	0	0	0	0	0	0	0	0	0	0	0	910
ETC	0	1907	1525	1661	1558	1577	1527	1443	1422	1320	1225	1440	16605

Fiscal Year Distribution

	Prior	FY1998	FY1999	FY2000	Y2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	Future	At Complete
BCWS	32296	16695	9517	4027	920	279	0	0	0	0	0	0	63734
BCWP	32009	1270	0	0	0	0	0	0	0	0	0	0	
ACWP	32040	910	0	0	0	0	0	0	0	0	0	0	
ETC	0	16605	9435	4027	920	279	0	0	0	0	0	0	64216

USGS Level 3 Milestone Report

October 1, 1998 - October 31, 1998

Sorted by Baseline Date

iverable	Due Date	Expected Date	Completed Date	Comments
er Report: 4th Qtr FY 1997	10/31/97	10/30/97	10/30/97	
estone Number: SSH13HM3				

USGS Level 4 Milestone Report

October 1, 1998 - October 31, 1998

Sorted by Baseline Date

rable	Due Date	Expected Date	Completed Date	Comments
to TPO: Jan-Jun97 Perio Wtr Lvl Data to RPC	10/31/97	10/17/97	10/17/97	
ɔne Number: SPH37FM4				

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

Participant U.S. Geological Survey
Date Prepared: 11/21/97 09:47 AM

Fiscal Month/Year OCTOBER 1997

	CURRENT MONTH END						FISCAL YEAR		
WBS ELEMENT	ACTUAL COSTS	PARTICIPANT HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET	APPROVED FUNDS	CUMMULATIVE COSTS
1.2.1	36	944	0	0	59	0	526	0	36
1.2.3	702	15196	3430	0	1915	0	13181	0	702
1.2.5	38	304	704	0	390	0	683	0	38
1.2.8	24	304	0	0	0	0	600	0	24
1.2.9	54	999	252	0	190	0	683	0	54
1.2.12	4	184	0	0	0	0	77	0	4
1.2.15	54	1416	528	0	95	L	1743	0	54
	912	19347	4914	0	2649	0	17493	0	912

U.S GEOLOGICAL SURVEY
TIMATED COSTS FOR 10/1/97 - 10/31/9

		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
1CGA1	USGS Engineering Assurance	35.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.7
21C3075U1	USGS Engineering Assurance (EA)	35.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.7
121CP075		35.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.7
	1.2.1	35.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.7
	1.2.1	35.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.7
311C	Scientific Programs Management & Integ	19.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7
[illegible]	Manage Nevada Operations/Earth Scien	67.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.6
2319090U1	USGS SP&I	87.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.3
12319090		87.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.3
	1.2.3.1	87.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.3
32836FB1	Conduct Probabilistic Seismic Hazards A	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5
32836GB3	Support Seismic Design Input	18.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.9
2321155U1	Prepare Seismic Design Inputs	30.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
32836FB1	Conduct Probabilistic Seismic Hazards A	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
2321155UC	Conduct Prob. Seismic Hazards Ass.	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
32836FB1	Probabilistic Seismic Hazards Analysis -	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
2321155UY	PSHA - 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	0.0
12321155		30.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
32211CA1	Stratigraphic Support to LA & Confirmati	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.4
2322210U1	Stratigraphy	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.4
32212GA3	Structural Support to LA & Confirmation	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
32212GB1	Conduct Fracture Studies	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9
32212GB2	Publish Maps & Reports for Structural St	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0
32212GB4	Structural Support to TSPA/VA	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
2322210U2	Structure	18.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7
32211GB3	Detailed Char. of BH Video Logs from Dr	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
2322210U4	Eval. BH Video Logs - DSHT BHs	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
32211FB2	Stratigraphic Descriptions - WT-24/SD-6	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
2322210UC	Stratigraphic Descriptions - SD6/WT2	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
32211FB2	Develop Stratigraphic Description - Defer	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
2322210UW	Stratigraphic Descriptions - WT-24 De	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

S. GEOLOGICAL SURVEY
ED COSTS FOR 10/1/97 - 10/31/9

		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
2322210		41.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.4
FB2	Complete Site Area Geologic Map - ECR	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
FB5	Geologic Mapping of the ECRB	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2
FB1	Predictive Geotechnical Analysis for EC	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
50U2	Structural Features and ESF Testing	55.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.9
2326050		55.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.9
3B3	Structural Support to Isotopic Age Studie	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9
25U1	Structural Support to Isotopic Age Stud	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9
2327025		3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9
	1 [illegible] 2	131.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	131.6
3BF	Support VA SZ Flow Model Sensitivity A	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
0[illegible]1	Abs/Testing SZ Flow Model for VA	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
2331200		2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
3B5	PTn Lateral Diversion (Phase II)	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9
45U1	Hydrostratigraphy	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9
3B4	Est. of Effective Porosity Values for Tope	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
45U2	Surface-Based Borehole Testing	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
FBB	Air-K & Hydrochemistry Testing ESF	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.0
45U3	ESF Borehole Testing	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.0
3B3	Unsaturated Matrix Flow Properties	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3
45U4	Hydrologic Properties Measurements	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3
3B7	ESF Drift-Scale Flux & Niche Study (Pha	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
3BF	Characterization of Seepage in Alcoves	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3
45U5	Percolation and Seepage	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3
3B2	Hydraulic/Tracer Test of Prow Pass Tuff	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.2
3B4	SZ Hydraulic Testing of Borehole USW	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
3B5	SZ Hydraulic Testing of Borehole USW	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
3A3	Planning for STC SZ Confirmation Studi	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
45U6	Saturated Zone Testing	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.7
3B1	Matrix Water Sources and Fract.-Matrix I	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
3B2	Iso./Hydrochem. Studies of UZ Water an	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5

U.S. GEOLOGICAL SURVEY
TIMATED COSTS FOR 10/1/97 - 10/31/9

		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
2332245U7	UZ Hydrochemistry	24 2	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	0 0	0.0	24.2
33122 BF	Hydrologic Charac. of SB BH - WT-24/S	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
2332245UC	Matrix Properties - SD6/WT24	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
33131FBG	Perched Wtr & SZ Hydrologic Tstg - WT	27.2	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0 0	0 0	0 0	27 2
33131FBH	Iso/Hydrochem Smplg/Anal of SZs - WT	8.2	0 0	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2
2332245UD	Hydrologic Tst/Hydrochem. Samping	35.4	0 0	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	0.0	35 4
33124FBF	South Ramp Hydrology (RM)	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0 0	0.0	1 5
33124FBG	PTn Lateral Diversion - Ph ' 'RM)	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
2332245UR	Risk Mitigation - Hydrostratigraphy	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
33124FBH	ESF Drift Scale & Niche Study (RM)	7.3	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7 3
33124GA1	Support E&I Design Basis Modeling (RM	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 7
2332245US	Risk Mitigation - Percolation & Seepag	8.0	0 0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	8.0
33123FBF	Char. Hydr. of SB Boreholes - 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 0
2332245UW	Matrix Properties WT-24 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	0.0
33131FBG	Conduct Perched Water & SZ Hydraulic	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
33131FBH	Iso/Hydrochem Smplg Init Analyses of S	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
2332245UX	Hydrologic Testing/Hydrochem Sampli	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
33131FBB	Conduct Chemical & Isotopic Analysis -	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
33131FBF	Conduct C-Holes Testing - Deferred	3.4	0.0	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3 4
2332245UY	SZ Testing - Deferred	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
33121GB2	Update & Enhance Net Infiltration Numer	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1
33121GB3	Prediction of Future Net Infil. Rates in Re	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
2332247U1	UZ Modeling	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1
33131GB8	Reduce Uncert. in Flux Values Used to C	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2
33133FB6	Confirm SZ Hydrologic Flow Models	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3
33133GB4	Refine Calibration of Site SZ Flow Model	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	8.8
33133GB6	Test Alternate Conceptual Models	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	6.1
33133GB7	Refine Regional Hydrogeologic Framewo	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4
2332247U2	SZ Modeling	51.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.6
33132GB1	Iso/Hydrochem. Analysis of SZ Ground	24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.9
2332247U4	Isotopic/Hydrochemical SZ Studies	24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.9

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12332245		248.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	248.7
I24FB8	Percolation Flux Across Repository Horiz	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
I24FBD	Moisture Monitoring in the ESF - ECRB	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9
I24GBA	Infiltration of Construction Water in ESF	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
38050I3	Infiltration, Percolation & Seepage	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.6
12338050		16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.6
I12FB1	Collection of Site Streamflow Data	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
I12GB1	Collection of Site Streamflow Data	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
37025U2	Surface Water Monitoring	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
I23FB8	UZ Borehole Instrumentation & Monitorin	18.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4
I23FBC	Integrated Analysis & Interpretation	13.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.6
I23GB1	UZ Borehole Instrumentation & Monitorin	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9
I23GB2	Integrated Analysis & Interpretation	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
37025U3	Surface Based Hydrologic Monitoring	38.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.9
I31FBD	Water-Level Monitoring	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3
I31GB1	Water-Level Monitoring	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5
37025U5	Saturated-Zone Monitoring	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.8
I27GB3	Isotope Support for Thermal Testing	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
370_5U6	Isotope Support for Thermal Testing	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
12337025		54.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.7
	1.2.3.3	322.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	322.2
215GB2	Future 100K Climate Records	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
82252U1	Paleoclimate Analysis	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
221GB3	Water Flux Det. Thru Repos. Blk - Age,	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4
82252U2	Geochronology of Fracture Minerals - L	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4
221GB1	Paleoclimate Confirmatory Analyses - LA	11.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8
82252U3	Paleohydrology and WT Fluctuations	11.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8
12382252		29.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.2
221FB3	Syn. Distr./Anal. Geochron. Age Dets. (E	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2
88050U1	Fracture Mineral Age Dating	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2
12388050		6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2

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98221GB4	Data Qualification for NRC	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
2367027U2	Data Qualification Evaluation for the N	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
12367027		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
	1.2.3.6	35.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.5
98GB6	Support PISA Geology Section	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
2392142U1	SDD - Geology Chapter	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
98FB2	Develop PISA Chapter 3.5 (Hydrology)	20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5
2392142U2	SDD - Hydrology Chapter	20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5
98FB4	Dev Climate/Met. Site Desc.	29.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.5
2392142U3	SDD - Climate/Meteorol. Chapter	29.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.5
98GB5	Support Devel. of PISA Geochem. Sectio	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5
2392142U4	SDD - Geochemistry Chapter	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5
98GB6	Chapter Coord/Consol/Review	23.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.7
2392142U	- Coord/Consol/Review	23.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.7
98FB2	SDD - Hydrology Chapter - 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	0.0
2392142UY	SDD- Hydrology Chapter - 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	0.0
2211GB4	USGS Support to 3-D Geo. Mod. Dev/Re	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
2392212U1	Input to 3-D Integrated Site Model	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
98GA1	Support PR Input/Review	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
2392570U1	PR Review/Input	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
12392142		96.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.7
98GA1C	Provide Regulatory Support	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
98GA1F	Provide QA Implementation Support	9.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3
98GA2C	Provide Support for Dev/Rev of Reg Doc	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
2399090U1	Site Investigations Support	9.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3
12399090		9.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3
	1.2.3.9	106.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	106.0
	1.2.3	684.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	684.6
95GA1	Technical Data Coordination	32.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.8
2532186U1	Provide Technical Data Base Input	32.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.8
12532186		32.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.8

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1.2.5.3		32.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.8
0G544GA1	Support to Performance Assessment	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
12541121U1	Support to Performance Assessment	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
0G541FA2	Provide Support to PA - 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	0.0
12541121UY	Provide Support to Performance Asses	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
12541121		5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
1.2.5.4		5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
1.2.5		38.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.1
0G825GA1	Safety & Health	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3
12829121U1	Federal Occupational Safety & Health	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3
12829121		8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3
1.2.8.2		8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3
0G84GA2	Red Water Quality Sample Collection	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
12842086U1	Red Water Quality Sample Collection	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
12842086		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
0G847GB1	Water Resources	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
12849121U1	Water Resources	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
12849121		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
1.2.8.4		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
1.2.8		8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3
0G9121GA	Technical Project Office	28.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.8
12910135U1	USGS Project Management	28.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.8
12919135		28.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.8
1.2.9.1		28.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.8
0G922GA	Participant Project Control	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.2
12929135U1	Project Control - USGS	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.2
12929135		25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.2
1.2.9.2		25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.2
1.2.9		54.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.0
0GC522GA1	Satellite Records Operations	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
12C59130U1	USGS Satellite Records Operations	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
12C59135		4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0

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	1.2.12.5	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
	1.2.12	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
23GA1	Support/Personnel Services	44.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.6
23GA5	Procurement & Property Management	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
F29110U1	Personnel/Procurement/Property Servi	49.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.1
23GA2	Facilities Management (space)	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
23GA3	Facilities Management (computers/phone	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
23GA4	Facilities Management (other)	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
F29110U2	Facilities Management (USGS)	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
12F29110		49.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.1
	1.2.15.2	49.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.1
9GA1	USGS Training Support	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4
F39110U1	USGS Training Support	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4
12F39110		4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4
	1.2.15.3	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4
	1.2.15	53.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.5
	1.2 OPERATING	878.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	878.3
	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	878.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	878.3
	FTEs													
	FEDERAL	110.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	CONTRACT	31.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	TOTAL	141.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

United States Department of the Interior

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

IN REPLY REFER TO

INFORMATION ONLY

December 10, 1997

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, 1997

Attached is the USGS progress report in the required format for the month of November, 1997.

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

Sincerely,

Raye A. Arnold

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

Enclosure:
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U. S. GEOLOGICAL SURVEY
EXECUTIVE SUMMARY

NOVEMBER 1997

WBS 1.2.3.1 Coordination and Planning

U. S. Geological Survey - Yucca Mountain Branch is currently processing 149 scientific papers prepared by USGS authors. Of these, 96 are relative to geologic studies and 53 to hydrologic studies. In addition, 14 abstracts are being processed, as well as 17 reports by LBL personnel.

WBS 1.2.3.2 Geology

Geologic Framework

The Site Area Geologic Map (scale 1:24,000) was converted to ARC coverage, in preparation for its publication as a USGS map product. Approval was obtained to publish the Geologic Map of the Paintbrush Canyon Area as a USGS Open-File Report. Field work in the southern part of Yucca Mountain continued, focusing on the evaluation of faults and fault zones as potential pathways for flow or channelization or as barriers to hydrologic flow.

Project staff continued preparation of text for the geotechnical data report to be incorporated in the predictive report for the "Enhanced Characterization of the Repository Block" (ECRB), including the assembly of a table for referencing all the data resulting from the mapping of the ESF. A text was delivered to the M&O design personnel on November 26. Project staff also collected fracture orientation and spacing data from the densely welded units of the Topopah Spring Tuff in Solitario Canyon. These data will assist in predicting the nature of fractures to be expected in the middle nonlithophysal, lower lithophysal, and lower nonlithophysal zones of the Topopah Spring Tuff during excavation of the ECRB. Geologic mapping of Alcove #7 in the ESF was completed, and preparation of a field guide for underground mapping in the ECRB was begun.

Milestone report SPG232M4, "Transmit Fracture Density Data to 3-D Modelers" was completed. The transmitted information on fracture spacing consisted of currently available aggregate data (fractures per 10 m), and integrated data obtained from surface exposures, the ESF, and Q'd boreholes. Two days were spent in the ESF with SNL staff to observe and describe small-scale fracturing in the upper lithophysal zone of the Topopah Spring Tuff.

Seismotectonic Studies

Fault displacement summaries and models (for PSHA) were completed by each expert team, and the reports were sent out for review. Revisions to the summary reports on seismic sources have now been completed. Work continued on Milestone Report SPG28LM3 (Deterministic Evaluations for Type I Faults at Yucca Mountain) by including preliminary PSHA results on maximum magnitudes for comparison with deterministic earthquakes on the Type I faults. Appendix I (Deterministic Earthquakes and Ground Motions) for the Seismic Design Basis Topical Report was revised, and results of the deterministic earthquake study was presented to the Seismic Design group in Oakland on November 12.

Field investigations were conducted in Amargosa Valley to evaluate a possible fault potentially relevant to viability assessment. An analysis of basaltic volcanism and seismicity as coupled processes was presented on behalf of SNL personnel at the DOE-NRC technical review in Las Vegas on November 5.

WBS 1.2.3.3 Hydrology

Regional Hydrology

All stream-flow and precipitation data collected during FY97 and supporting information have been compiled and stored in Project files. Stream-flow and precipitation data for FY97 have been computed and checked and have been scheduled for technical review. Entry of stream-flow and precipitation data for three recording stream-flow gages along Fortymile Wash into tabular format for submittal to the Nevada District data section continued during November.

Routine maintenance at stream gages on Fortymile Wash and at upper and lower Split and Pagany Washes on Yucca Mountain also continued. Project staff kept vigilance during the reporting period for potential precipitation and runoff associated with several storms that passed through the southern Nevada area. Runoff was neither observed nor reported for the five recording stream gages or for the Yucca Mountain vicinity.

Unsaturated-Zone Hydrology

Monitoring of instrumentation in boreholes again continued. Borehole data from NRG-7a, UZ #4, UZ #5, UZ-7a, and SD-12 were transferred to Denver, converted to engineering units, and archived to optical disk on a routine basis throughout the month. Daily EKES files were checked for shelter activity. Sensor readings were checked daily as well for unusual occurrences, and statistical outliers were flagged. A program (TDBMAKE) was written to generate files for the TDB. Staff made a presentation at the monthly progress meeting to discuss observations from station A, the deepest instrumented station in NRG-7a. Shelter reports for field sites 3 through 7 are being prepared for submittal.

Numerous calibration runs were preformed, including three for pressure transducers, two for thermistors, and two for barometers. Instrument records for all Keithley 181s, 182s, 220s, and the Guildline precision resistors were copied and sent to Denver. Pressure calibrations have resumed after repair of the air dryer in the calibration lab. Thirty-nine trips were made to field sites for correction of generator, UPS, and chiller problems. Seven site visits were made to collect data. Data are being collected manually twice weekly at SD-12 until the nonfunctional data-communications computer is replaced (planned for the first week of December). Preliminary planning for resumption of monitoring at NRG-6 has begun.

Compilation of borehole data continued. A data package titled "Deep Unsaturated-Zone Surface-Based Borehole Instrumentation Program - Interim Data Submittal for Boreholes USW NRG-7a, UE-25 UZ #4, UE-25 UZ #5, USW UZ-7a, and USW SD-12 for the Time Period July 1, 1997, through September 30, 1997" was submitted. A data check was performed for the period July 1 through September 30 1997, for boreholes NRG-7a, UZ #4, UZ #5, UZ-7a, and SD-12.

Air-permeability and hydrochemical testing continued in the ESF. Field staff instrumented boreholes in the northern Ghost Dance fault drill/test room (NDR; Alcove #6) in preparation for conducting 3-D cross-hole air-injection and tracer tests. All equipment was installed and checked, and testing will begin at the beginning of December. Compilation of collected data also continued. On-going analysis of the northern Ghost Dance fault alcove cross-hole air-injection tests indicated three zones of different permeability and porosity The zones are 1) the fault zone, 2) the hanging-wall zone, and 3) the footwall zone. The fault zone consists of the main trace and a volume extending approximately 4 m into the hanging wall, in which the permeability is 14 darcies and the porosity is 13 %. The hanging-wall zone exhibits a permeability of 4 darcies and a porosity of 3 %. The footwall zone indicates a permeability of 10 darcies and a porosity of 3 %. The results agree with the borehole core examination that indicated a highly fractured rubble zone near the fault main trace and decreased fracturing in the hanging wall.

Collection of temperature and relative humidity data continued at eight sites in the ESF. Wind-speed data currently are being collected at five sites. Water-potential and water-content data are being collected with heat-dissipation (HD) probes and time-domain reflectometry (TDR) probes at selected locations throughout the ESF. Planning and preparation for water-balance data collection in the cross drift has begun. Various types of instrumentation systems

are being developed and tested for use in the TBM water-migration study. Testing of the surfactant with rock imbibition and evaporation studies is underway.

Hydrologic studies in the South Ramp of the ESF continued with collection of water-potential data from the sets of tensiometers and HD probes installed at ESF stations 66+99, 67+33, 70+54, and 70+56. Water-content data were collected from TDR instrumentation installed at ESF station 66+99. The areas around these instruments are still covered with plastic to monitor the recovery of the rocks from the drying effects due to tunnel ventilation. The collected data have been entered into spreadsheets and graphed. Centrifuge extraction of pore water (samples from South Ramp boreholes) continued. Thirty-five pore-water samples were collected from 29 of the 46 boreholes in the South Ramp. For each of the 35 pore-water samples, pore water was collected after 3 hours and again after 24 hours in the centrifuge. The water samples extracted from core were sent to LANL for analysis of Cl^-, Br^-, and SO_4^{-2} using ion chromotography. Selected water samples will be analyzed for ^{36}Cl. Planning began for distribution of core samples for a variety of chemical, isotopic, and petrographic analyses by USGS and LANL.

In work on the ESF drift-scale and niche flux study, development began of a system for placing HD probes in vertical boreholes. Twenty-one HD probes were installed in Niche 1 to monitor changes in niche water potential. Eight HD probes were installed in Alcove 1. These probes are in the highly fractured rock and are located in the crown of the alcove. Preparations are underway to install 10 additional probes by the end of December. Temperature, relative humidity, and barometric pressure are being measured in the alcove, as well as in Niche 1. A drip-detection system has been developed and is being tested in Niche 1 and Alcove 1. All tests indicate that the system will work in the ESF. Equipment needs for each of the different alcoves has been determined, and procurement of the needed instrumentation is underway. HD-probe holes were drilled in Alcove 7 (58 holes) in preparation for installation of the probes. The first of the probes will be installed in early December.

In chemical studies in support of drift-scale testing, analysis continued of core samples from borehole SD-9. Staff prepared a presentation on the USW SD-7 pore-water strontium data for a meeting with LBNL modelers. In support of thermal testing, staff from the isotopic chemistry group attended the expert elicitation meeting for comment on near-field studies on November 5 and 6.

Several aspects of study of net infiltration continued. Work continued on a Fortran program for defining surface drainage boundaries and for calculating the upstream drainage area for each grid cell using the 30-m elevation grid as input. Modifications allow the occurrence of surface water storage (ponded areas). Watershed modeling domains for the Solitario Canyon, the Drill Hole Wash, and the Dune Wash – Busted Butte drainages were extracted from the digital elevation model (DEM) and test net-infiltration simulations were performed using the Area 12 Mesa 100-year stochastic simulation and the updated version of the coupled infiltration – runoff routing model which allows irregular model boundaries. Application of the model to the WT-2 Wash sub-drainage model for predicting net infiltration rates over Alcove 7 in response to an active ENSO (El Niño climatic oscillation) also continued. The calibration of the coupled infiltration-runoff model using available streamflow records for several drainages on Yucca Mountain likewise continued. Work on the development of a more detailed soil-depth map was initiated.

In work to estimate potential future infiltration under different climatic regimes, the coupled infiltration-runoff model was applied to three different watershed modeling domains using various wetter future climate analogs to analyze potential channel-flow volumes and to compare net infiltration along channel segments and lower sideslopes with simulation results obtained using the 1996 version of the infiltration model. Results are being used to test assumptions (made in the development of the 1996 model) concerning the effects of overland flow in response to current and wetter future climates. Potential future-climate net-infiltration estimates for the site using the 1996 infiltration model and the results of potential future-climate recharge estimates for the Death Valley region using geostatistics and a modified Maxey-Eakin model were submitted as extended abstracts to the upcoming High Level Radioactive Waste Management conference. Evaluation of the analog sites selected for developing stochastic simulations of daily precipitation for various potential future-climate scenarios continued. The application of the 1980—95 daily precipitation record to predict net infiltration in response to an active ENSO continued.

In work supporting evaluation of percolation flux across the repository horizon, a memo to all scientific investigators responsible for parts of the predictive report on the cross drift is being prepared so that the same set of data from the geologic data base is used for the various efforts. The purpose is to have a uniform set of available data for everyone as a starting point for the predictive analysis. Samples of the surfactant being used for dust control in excavation have been distributed to determine a suitable detection method for the surfactant. Tests will also be run to determine the effects of the surfactant on rock hydraulic properties. Monitoring equipment (HD probes, data loggers, temperature/relative humidity probes and related accessories) have been ordered. Scheduling of HD probe calibrations has started.

Work in UZ hydrochemistry continued with collection of pore water from four ESF cores by distillation. The water samples will be analyzed for tritium, D/H, and $^{18}O/^{16}O$. Four ESF core samples also were distilled to extract CO_2 and pore water. That extracted pore water likewise will be analyzed for tritium, D/H, and $^{18}O/^{16}O$, and the extracted CO_2 gas samples will be analyzed for carbon isotopes. Two ESF core samples were compressed, and the extracted pore water will be analyzed for chemical composition, ^{14}C, and stable isotopes. Seven ESF pore-water samples and two ground-water samples from borehole WT-24 were prepared for tritium analysis and counted for tritium concentration. The data were reduced. Replicate analyses of anions and cations from numerous samples (pore-water samples from the ESF, from SD-7 and SD-12 pore water, and from two WT-24 samples) were performed with the ion chromatograph. Water collection by compression and distillation methods during October was recorded in the water collection data base, and tritium data measured in November were entered into the tritium data base.

In other hydrochemical work, two NRG-7A and two SD-9 core samples were distilled to extract CO_2 and pore water. One of the NRG-7A core samples and one of the SD-9 core samples that had been distilled were then acidified with phosphoric acid and distilled. The extracted CO_2 will be analyzed for carbon isotopes, and the extracted pore water will be analyzed for tritium, D/H and ^{18}O. Dissolved CO_2 also was collected from four SD-12 core samples by distillation and from two SD-12 core samples by acidification. A sample of tuff, previously distilled and acidified, yielded extracted CO_2. A sample of the original imbibed $NaHCO_3$ solution, the residual $NaHCO_3$ solution, and the two extracted CO_2 gas samples were delivered for $^{13}C/^{12}C$ analysis.

Pore-water extractions provided additional samples for isotopic analysis. Pore water was collected from one SD-12, three NRG-7A, and eight UZ-7A cores by distillation. The water samples will be analyzed for tritium, D/H, and $^{18}O/^{16}O$. Seven UZ-7A core samples were compressed. The extracted pore water will be analyzed for chemical composition, ^{14}C, and stable isotopes. Five NRG-7A and five UZ-7A pore water samples were prepared for tritium analysis and counted for tritium concentration, and the data were reduced.

In unscheduled work, the LKB Liquid Scintillation Counter was calibrated. Staff attended the Geotrans, Inc., presentation of ground-water flow and transport at the Arizona site on November 21. Staff prepared an extended abstract for submission to the LBNL workshop on "Field Testing and Associated Modeling of Potential High-Level Nuclear Waste Geologic Disposal Sites" to be held December 15 and 16 at the University of California, Berkeley. The paper received technical review.

Saturated-Zone Hydrology

The tracer-injection tests in the Bullfrog interval in the C-hole complex (where Pyridone and 2,6 difluorobenzoic acid (2,6 DFBA) had been injected) was finally terminated with cessation of pumping in borehole UE-25 c #3 on November 12 to allow reinstrumentation and preparation for tracer testing of the Prow Pass interval. The long-term hydraulic test had begun in May 1996, and the Pyridone tracer test had been initiated in January 1997. The C-holes will now be monitored for recovery, with packer/transducer strings expected to be removed from boreholes c #2 and c #3 in mid-December. Prow Pass testing is anticipated for January 1998. The Pyridone breakthrough curve from the Bullfrog interval continued its steady rise in concentration, but no peak was identified. The concentration rose to a maximum of approximately 400 parts per trillion (ppt) at the time of shutdown.

Planning for the Second (southern) Tracer Complex continued with discussion of criteria for the complex and evaluation of four potential sites at a meeting of USGS, LANL, and LBNL representatives at Los Alamos, N. M.

Mexico. A follow-up meeting was planned for the second week of January 1998 at the Nevada Test Site to finalize the selection.

Saturated-zone water-level monitoring continued with measurements in several wells: in boreholes UE-25 WT#6, UE-25 WT#16 and UE-25 WT#15 on November 6; in UE-25 WT#3, USW WT-01, and USW H-3 (upper and lower intervals) on November 10; in USW WT-11, USW WT-10, USW WT-7, USW H-6 (upper and lower intervals), and USW VH-1 on Novembe 18; in USW H-1 (tubes 1, 2, 3, and 4), USW WT-2, UE-25 WT#4, UE-25 WT#13, and J-11 on November 19; in USW WT-24 on November 20; and in J-12, J-13, UE-25 b#1 (upper interval), and USW H-4 (lower interval) on November 25.

In drilling operations for SZ hydrologic testing, borehole USW WT-24 was drilled during November to a depth of 1,747 ft below land surface. The hole has been reamed to a diameter of 12-1/4 inches. Geophysical logging of the borehole from 1,663 to 1,747 ft below land surface (or deeper) still remains to be completed before casing is set in the borehole. Level 4 milestone **SPH228M4 [Memo to TPO: Results of Perched Water Hydraulic Test of borehole USW WT-24]** was completed on November 10, slightly ahead of schedule. Data were retrieved from borehole WT-24 during November in support of hydraulic testing. (An initial set of samples was collected in October, with additional sampling anticipated in early December, due to extension of hydraulic testing.) A monitoring string was set in the hole on November 18 through 20, and Paroscientific transducer (serial number 55021) and barometer (s/n 385845) were installed, a calibration check was performed. Drilling of borehole USW SD-6 began during November, and as of November 26, SD-6 had been drilled to 51 ft below land surface.

The water level in borehole USW WT-24 was approximately 1,663 ft below land surface. Drawdown in the borehole was desired to be below the top of the Topopah Spring Tuff lower densely welded vitric sub-zone (Tptpv3) at 1,685 ft below land surface. Because of mud in the borehole, the transducer was placed in the borehole at 1,692 ft below land surface, allowing for a maximum drawdown of about 29 ft. From November 21 through November 26, WT-24 was pumped 12 times, 11 times at 2 gal per minute and once at 1 gal per minute. At a pumping rate of 2 gal per minute, the maximum drawdown was reached after pumping between 180 and 240 minutes. Pumping at a rate of 1 gal per minute, the drawdown in the borehole after 960 minutes was only 5.36 ft, with drawdown from 4.31 to 5.36 ft taking about 810 minutes, a rate of about 0.07 ft per hour. Water-quality samples were collected during pump tests.

In support of SZ flow-model sensitivity analyses for the VA effort, USGS staff met with Sandia PA staff on November 20 to discuss alternate climatic scenarios. The strategy is to increase incrementally regional recharge rates until water levels beneath Yucca Mountain reach a maximum of 120 m above existing levels. When that point is determined, fluxes beneath Yucca Mountain (needed for PA abstraction for a maximum glacial climate) will be calculated and forwarded to PA. Work began on running those simulations. An outline of TSPA-VA chapter 2.9 (Saturated-Zone Flow and Transport) was provided which identified parts of the report to be written by USGS staff. Work began on collecting previously published USGS reports that will be summarized for inclusion in the TSPA-VA report.

Work on the SZ synthesis report continued with completion of revisions to the regional flow model climate-simulation report in response to DOE review comments. The report was re-submitted and received DOE concurrence on November 19. The report was forwarded for USGS Director's approval, completing Level 3 milestone **SP230M3R1 [Regional Saturated-Zone Synthesis Report]**. Staff also worked on the site flow modeling milestone report in response to DOE review comments. That report received USGS Director's approval on November 4.

Review of the current site SZ hydrogeologic framework model continued in an on-going process refining the framework as the most realistic possible. Formal review will begin after revisions to the current framework are completed. Staff converted the SZ hydrogeologic model to Earthvision (3.1) and transmitted it to the M&O modeling team. In conjunction with LANL, the preliminary 250-m grid was converted to an FEHM mesh. Work began on digitization of faults and structures to be used in the site SZ flow model, as well as on digitization of

available potentiometric surface maps to compare with the current potentiometric surface map. Staff worked on various issues related to the integrated site model (ISM), responded to comments, and completed submittal of software QA documents for software used in the framework and flow modeling processes. Conversion began of flux output from the regional SZ model in the area of the site SZ model into a 2-D vector plot. This information will be used for boundary conditions of the site SZ flow model. Compilation began of available temperature data. Work continued on a report describing the site SZ hydrogeologic framework model.

Testing continued of a revised flow model that uses a framework model generated with 250-m grid spacing. Tests are intended to determine potential run times for the model so that optimal mesh spacing can be used that will balance detail in the horizontal discretization with simulation times. Forward run times are about an hour. A parameter-estimation test simulation was successfully run on November 14, taking about 20 iterations between the parameter-estimation and flow codes. Analysis of the results of the simulation is continuing.

In work to refine hydrogeologic framework and flow models, USGS modeling staff met with HIS-GeoTrans staff on November 25 to coordinate additional sensitivity analysis of existing YMP/Hydrologic Resource Monitoring Program (HRMP) and underground testing assessment (UGTA) regional models and transfer of regional modeling data from the Environmental Restoration Program

Preparations were made for testing of alternate conceptual models, including outlining of major tasks, identification of data fields in the USGS NWIS data base helpful for estimation of perched water, and preliminary design of a data base for this conceptual modeling exercise. Additional modifications to the data base are expected based upon additional data types and formats that likely will become incorporated. Several software packages are being evaluated to determine the best method of analysis for the data presently available. Some data have been incorporated into data-base, visualization, and spreadsheet software for analysis. An evaluation of the data has been started to identify potential wells that have anomalous water levels. The data are being analyzed in various groupings, such as hydrographic areas, to aid in the analysis. Results of further calibration of regional flow model using preliminary evapotranspiration (ET) data from Ash Meadows were reviewed. Methods for assessing reduction of uncertainty in modeling were developed. Methods were refined for evaluation of where best to add additional vertical discretization to the regional ground-water flow model Staff reviewed methods for development of new regional infiltration estimates to replace Maxey-Eakin estimates ...ently used in YMP/HRMP and UGTA regional flow models.

USGS-Nevada District Office staff developed work plans and procedures for delineating ET Areas in Death Valley region A list of regional springs in the Furnace Creek, Grapevine Canyon, Indian Springs, and northern Las Vegas Valley that require hydrograph analysis was compiled. Pumping data for the Indian Springs Valley were obtained. Additional regional springs in the Pahrump, Shoshone, and Tecopa areas were selected for discharge measurement and water quality sampling.

In unscheduled work, staff reviewed documents related to potential upcoming water-appropriation hearings, and met with other individuals who may be involved in the hearings to discuss work needed to be done prior to the hearings.

WBS 1.2.3.6 Climatology and Paleohydrology

A variety of efforts continued in studies of Owens Lake. Staff developed a sampling plan for the Owens Lake co.e that incorporated requirements for a high-resolution time series and the needs of several investigators. Staff traveled to Menlo Park and executed the sampling plan by taking 197 samples from the core interval representing the period about 350 to 410 ka. Some 126 sub-samples have been taken from the Owens Lake samples for study of ostracodes, diatoms, and stable oxygen and carbon isotopes. Those sub-samples are in various stages of analysis. Preparation of open-file reports on Owens Lake continued. YMPB, WRD, and Geologic Division staff, with staff from Connecticut College, have completed an open-file report titled *A test of uranium series dating of ostracode*

shells from the last interglaciation at Owens Lake, California, Core OL-92. These reports will be submitted through the Geologic Division. A manuscript has been prepared for submission to the High Level Radioactive Waste Management symposium in May and submitted to branch review. The manuscript deals with the integration of the Owens Lake climatic record from the past 200 ky with other records in the region. Those integrated records offer a means of initiating a model that will establish future climatic bounding parameters from the older Owens Lake record. Work continued on an outside peer-reviewed paper dealing with the hydroclimatic processes that integrate Owens Lake paleolimnology with climate.

Isotopic studies of secondary minerals and paleoclimatic studies continued. Staff prepared for an NWTRB field trip to Ash Meadows and past-discharge sites in the Amargosa Valley (to be held in early December). A report that summarizes the distribution and major characteristics of secondary minerals from the ESF and predicts the likely distribution of minerals in the cross-block drift was completed **(milestone SPC233M4 [Memo to TPO: Predictive report describing spatiotemporal distribution of secondary minerals], Level 4)**. Predictions are based on various working hypotheses of the factors controlling percolation and deposition of minerals. Excavation of the cross-block drift will allow important tests of the infiltration model. Submission of the memorandum report completed the milestone. Planning continued for completion of line surveys of secondary mineral distribution in the ESF North Ramp and remaining areas in ESF, alcoves, and niches. That work is anticipated for early December. Staff submitted review drafts of extended abstracts for the High Level Radioactive Waste Management conference. Papers dealing with various aspects of ESF or drill holes include:

Secondary minerals record past percolation flux at Yucca Mountain, Nevada, by B. Marshall, J. Paces, L. Neymark, J. Whelan, and Z. Peterman.

History of calcite and opal deposition at Yucca Mountain: Evidence for long-term stability of the unsaturated zone, by L. Neymark, Yu V. Amelin, and J. Paces.

Secondary mineral evidence for past water table changes, by J. Whelan and R. Moscati.

Carbon isotope evidence for past climates (million-year scale) in southern Nevada, by J. Whelan, L. Neymark, and R. Moscati.

Inferences on UZ hydrologic behavior based on secondary mineral records, by J. Paces, L. Neymark, B. Marshall, and J. Whelan.

Additional abstracts were prepared for the Field Testing and Associated Modeling (FTAM) workshop to be held at LBNL in December:

Hydraulic inferences from strontium isotopes in pore water from the unsaturated zone at Yucca Mountain, Nevada, by B. Marshall, K. Futa, and Z. Peterman.

Secondary mineral evidence of large-scale water table fluctuations at Yucca Mountain, Nye County, Nevada, by J. Whelan, and R. Moscati.

WBS .2.3.9 Special Studies

Sections on Surface-Water System and Regional Hydrologic System are being prepared for internal review. Subsections on paleohydrology and water supply are incomplete, but the sections are expected to go to internal review in the first week of December. Drafts of most subsections in Site Hydrology are still being evaluated relative to readiness for internal review. Several subsections are being revised substantially. Revisions to the section on the tectonic model (chapter 2.3, Site Description) of the PISA chapter on site description continued during the period. Extensive comments were received on both the tectonic model and structural setting sections. Most comments have been addressed, and changes are being incorporated. Climate staff discussed USGS data sets needed for the compilation of the PISA geochemistry section.

The USGS technical lead for Site Characterization Progress Report (SCPR) #17 continued to attempt to ensure inclusion of important USGS input into PR #17, particularly that for the Integrated Site Model/Geologic Framework section of chapter 4. Several important technical topics that had been excluded from the SPO draft of this section included 1) reevaluation of lithostratigraphic contacts, 2) site-scale geologic map, 3) descriptive structural model of the site, 4) fracture synthesis for the UZ flow model, and 5) geologic mapping of the ESF. After intervention by the USGS TPO, a commitment was made by the M&O Licensing group and M&O SPO to rectify the situation. Verification of the extent to which the problem has been solved will be performed as part of the M&O/USGS interactive review of PR #17, scheduled for December 1 through 10.

The USGS technical lead also reviewed the M&O Licensing group draft of "Documentation of Program Changes" (formerly known as Appendix A of the SCPR) to verify inclusion of USGS input. It was concluded that USGS input and suggestions had in fact been included in the draft document.

WBS 1.2.8.4.7 Water Resources Monitoring

Ground-water monitoring continued, with measurement of ground-water levels at 34 sites. In addition, ground-water discharge was measured at five springs and at one flowing well. Data collected during October were checked and filed. USGS-Nevada district chief approval was received for the summary monitoring report for calendar year 1996 (FY97 milestone SSH13GM3). Staff also provided supplemental information to USGS-ESIP personnel for submittal of 1996 data to the RPC.

In support to the Environmental Program, theoretical ground-water levels (for various quantities of ground-water withdrawals and aquifer properties in Jackass Flats) were calculated according to Theis analyses. Potential revisions to DOE's formal monitoring plan (relative to new DOE water-appropriations permits) were discussed with DOE, M&O, USGS-YMPB, and USGS-Nevada District staff on November 7. Plans and status of well drilling, subsequent collection of water samples, and geohydrology in Death Valley National Park were discussed with the National Park Service in Furnace Creek.

Participant YMP_USGS
Prepared - 12/10/97:08:07:07

Yucca Mountain Site Char. Project - Planning and Control System
PACS Participant Work Station (PPWS)
WBS Status Sheet (WBS02)

01-Nov-97 to 30-Nov-97

Inc. Dollars in Thousands

WBS No. - 1.2
WBS Title - Yucca Mountain Project
Parent WBS No. - 1.0
Parent WBS Title - Mined Geologic Disposal System
Element ID - 12

Statement of Work:

See the current WBS Dictionary

Cost/Schedule Performance

		Current Period					FY1998 Cumulative to Date					FY1998 at Completion		
To	Description	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV	BAC	EAC	VAC
1.2.1	Systems Engineering	44	44	25	0	19	87	87	61	0	26	526	526	0
1.2.3	Site Investigations	1092	1049	759	-43	290	2084	1981	1462	-103	519	12428	13170	-742
1.2.5	Regulatory	53	53	32	0	21	103	103	70	0	33	638	682	-44
1.2.8	Environment, Safety, and H	51	51	46	0	5	98	98	69	0	29	600	600	0
1.2.9	Project Management	57	57	52	0	5	110	110	105	0	5	683	684	-1
1.2.12	Information Management	6	6	3	0	3	11	11	7	0	4	77	77	0
1.2.15	Support Services	144	144	232	0	-88	284	284	285	0	-1	1743	1743	0
Total		1447	1404	1149	-43	255	2777	2674	2059	-103	615	16695	17482	-787

Resource Distributions by Element of Cost

Fiscal Year 1998
Budgeted Cost of Work Scheduled

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	22445	22408	22390	22479	21230	21110	20785	20754	20575	18946	17255	17247	247624
LABOR	924	986	983	993	933	946	917	922	907	826	737	769	10823
SUBS	150	160	165	180	178	186	181	183	189	179	169	174	2094
TRAVEL	28	59	60	76	64	73	71	74	64	53	42	35	699
PM&E	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	228	242	260	323	257	267	255	254	247	248	246	252	3079
Total BCWS	1330	1447	1468	1572	1432	1472	1424	1433	1407	1306	1194	1210	16695

Actual Cost of Work Performed

LBRHRS	19347	15629	0	0	0	0	0	0	0	0	0	0	34976
LABOR	698	634	0	0	0	0	0	0	0	0	0	0	1332
SUBS	190	151	0	0	0	0	0	0	0	0	0	0	341
TRAVEL	6	27	0	0	0	0	0	0	0	0	0	0	33
PM&E	0	62	0	0	0	0	0	0	0	0	0	0	62
OTHER	16	275	0	0	0	0	0	0	0	0	0	0	291
Total ACWP	910	1149	0	0	0	0	0	0	0	0	0	0	2059

WBS No. - 1.2 -Yucca Mountain Project

Resource Distributions by Element of Cost

Fiscal Year 1998
Estimate to Complete

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	0	0	24394	24264	23807	2328	22422	21517	20923	20165	20123	20433	221332
LABOR	0	0	1089	1114	1045	1041	1022	947	927	889	882	926	9882
SUBS	0	0	195	197	199	196	191	183	193	221	222	228	2025
TRAVEL	0	0	81	80	71	79	79	74	66	55	42	36	663
PMLE	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	0	0	308	352	257	292	274	253	259	254	288	316	2853
Total ETC	0	0	1673	1743	1572	1608	1566	1457	1445	1419	1434	1506	15423

Resource Distributions

Fiscal Year 1998	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
BCWS	1330	1447	1468	1572	1432	1472	1424	1433	1407	1306	1194	1210	16695
BCWP	1270	1404	0	0	0	0	0	0	0	0	0	0	2674
ACWP	910	1149	0	0	0	0	0	0	0	0	0	0	2059
ETC	0	0	1673	1743	1572	1608	1566	1457	1445	1419	1434	1506	15423

Fiscal Year Distribution

	Prior	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	Future	At Complete
BCWS	32294	16695	9517	4027	920	279	0	0	0	0	0	0	63734
BCWP	32071	2674	0	0	0	0	0	0	0	0	0	0	
ACWP	32040	2059	0	0	0	0	0	0	0	0	0	0	
ETC	0	15423	9435	4027	920	279	0	0	0	0	0	0	64183

USGS Level 3 Milestone Report

October 1, 1997 - September 30, 1998

Sorted by Baseline Date

verable	Due Date	Expected Date	Completed Date	Comments
r Report: 4th Qtr FY 1997 stone Number: SSH13HM3	10/31/97	10/30/97	10/30/97	
ional Saturated Zone Synthesis Report stone Number: SP23OM3R1	11/21/97	11/21/97	11/12/97	

USGS Level 4 Milestone Report

October 1, 1997 - September 30, 1998

Sorted by Baseline Date

/erable	Due Date	Expected Date	Completed Date	Comments
o to TPO: Jan-Jun97 Perio Wtr Lvl Data to RPC **stone Number:** SPH37FM4	10/31/97	10/17/97	10/17/97	
o to TPO: Trans Frac Density Data to 3-D Mdl **stone Number:** SPG232M4	11/14/97	11/13/97	11/13/97	
o to TPO:Rslts of Prch Wtr Hydraul Tst WT-24 **stone Number:** SPH228M4	11/14/97	11/10/97	11/10/97	
o to TPO: ECRB Spatiotemporal Predictions **stone Number:** SPC233M4	11/28/97	11/25/97	11/25/97	
o to TPO: Struc Data/Interps to LANL **stone Number:** SPG395M4	12/1/97	11/25/97	11/25/97	

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

Participant U.S. Geological Survey
Date Prepared: 12/10/97 03:43 PM

Fiscal Month/Year NOVEMBER 1997

	CURRENT MONTH END						FISCAL YEAR		
WBS ELEMENT	ACTUAL COSTS	PARTICIPANT HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET	APPROVED FUNDS	CUMMULATIVE COSTS
1.2.1	25	818	0	0	0	0	526	0	61
1.2.3	761	11784	3073	0	1791	0	13181	0	1463
1.2.5	32	320	640	0	370	0	663	0	70
1.2.8	46	575	0	0	0	0	600	0	70
1.2.9	53	744	390	0	107	0	663	0	107
1.2.12	3	160	0	0	0	0	77	0	7
1.2.15	233	1228	540	0	80	0	1743	0	286
	1151	15629	4583	0	2348	0	17493	0	2064

U.S GEOLOGICAL SURVEY
STIMATED COSTS FOR 10/1/97 - 11/30/97
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		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
G1CGA1	USGS Engineering Assurance	35 7	25.2	0.0	0.0	0 0	0.0	0 0	0.0	0.0	0.0	0 0	0.0	61 0
121C9075U1	USGS Engineering Assurance (EA)	35.7	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.0
121C9075		35.7	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	61.0
	1.2.1.1	35.7	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	61.0
	1.2.1	35.7	25 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.0
G311GA1	Scientific Programs Management & Integ	19.7	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34 4
G312GA1	Manage Nevada Operations/Earth Scien	73.3	53 2	0 0	0 0	0.0	0.0	0 0	0.0	0.0	0 0	0 0	0.0	126.5
12319090U1	USGS SP&I	93.0	68 0	0 0	0 0	0 0	0.0	0.0	0.0	0 0	0.0	0 0	0.0	160 9
12319090		93.0	68.0	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	160.9
	1.2 3 1	93.0	68 0	0.0	0.0	0.0	0 0	0 0	0.0	0.0	0 0	0.0	0 0	160 9
G32636FB1	Conduct Probabilistic Seismic Hazards A	11.5	-3.7	0 0	0.0	0.0	0 0	0 0	0.0	0.0	0.0	0 0	0.0	7.8
G32636GB3	Support Seismic Design Input	18.9	22.6	0 0	0 0	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0 0	41 5
12321155U1	Prepare Seismic Design Inputs	30.5	18 9	0 0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	0.0	0.0	49 4
G32636FB1	Conduct Probabilistic Seismic Hazards A	0 0	6.1	0 0	0 0	0.0	0.0	0 0	0 0	0.0	0.0	0 0	0 0	6.1
12321155UC	Conduct Prob. Seismic Hazards Ass.	0 0	6 1	0 0	0 0	0.0	0.0	0 0	0.0	0 0	0.0	0.0	0.0	6.1
G32636FB1	Probabilistic Seismic Hazards Analysis -	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
12321155UY	PSHA - 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	0.0
12321155		30.5	25 0	0 0	0 0	0.0	0 0	0 0	0.0	0 0	0 0	0.0	0 0	55 5
G32211GA1	Stratigraphic Support to LA & Confirmati	21.4	9 6	0 0	0.0	0.0	0.0	0.0	0.0	0 0	0 0	0.0	0.0	31 0
12322210U1	Stratigraphy	21.4	9 6	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0 0	0.0	0.0	31.0
G32212GA3	Structural Support to LA & Confirmation	0.8	0 2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	1.0
G32212GB1	Conduct Fracture Studies	3.9	3 7	0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	0.0	7 5
G32212GB2	Publish Maps & Reports for Structural St	12.0	5.1	0	0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	0.0	17.1
G32212GB4	Structural Support to TSPA/VA	2.1	3 1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2
12322210U2	Structure	18.7	12 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	30 9
G32211GB3	Detailed Char. of BH Video Logs from Dr	1.3	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0 0	0.0	9 8
12322210U4	Eval. BH Video Logs - DSHT BHs	1.3	8.6	0 0	0 0	0 0	0.0	0 0	0.0	0.0	0 0	0.0	0 0	9 8
G32211FB2	Stratigraphic Descriptions - WT-24/SD-6	0.0	18.5	0 0	0.0	0 0	0 0	0.0	0.0	0.0	0.0	0.0	0 0	18 5
12322210UC	Stratigraphic Descriptions - SD6/WT2	0.0	18 5	0.0	0 0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	18 5
G32211FB2	Develop Stratigraphic Description - Defer	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
12322210UW	Stratigraphic Descriptions - WT-24 De	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

U.S. GEOLOGICAL SURVEY
TIMATED COSTS FOR 10/1/97 - 11/30/97
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		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
12322210		41.4	48.7	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.2
32212FB2	Complete Site Area Geologic Map - ECR	0.0	29.6	0.0	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	29.6
32212FB5	Geologic Mapping of the ECRB	55.2	69 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124 8
32733FB1	Predictive Geotechnical Analysis for EC	0.6	7.5	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	0.0	8.1
12326050U2	Structural Features and ESF Testing	55.9	106.7	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	0.0	162.6
12326050		55.9	106.7	0.0	0.0	0.0	0 0	0 0	0.0	0.0	0.0	0.0	0.0	162.6
32212GB3	Structural Support to Isotopic Age Studie	3 9	0.9	0.0	0.0	0.0	0.0	0 0	0 0	0 0	0.0	0.0	0.0	4.8
12327025U1	Structural Support to Isotopic Age Stud	3 9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8
12327025		3 9	0.9	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	0.0	4.8
	1.2.3.2	131.6	181.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	313.0
33133GBF	Support VA SZ Flow Model Sensitivity A	2.3	2.2	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	0.0	4.5
12331200U1	Abs/Testing SZ Flow Model for VA	2.3	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
12331200		2 3	2 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4 5
33124GB5	P'n Lateral Diversion (Phase II)	6.9	7.4	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	0.0	14.4
2332245U1	Hydrostratigraphy	6.9	7 4	0.0	0.0	0.0	0.0	0 0	0 0	0.0	0.0	0.0	0.0	14 4
33123GB4	Est. of Effective Porosity Values for Tope	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
12332245U2	Surface-Based Borehole Testing	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
33124FBB	Air-K & Hydrochemistry Testing ESF	45.0	36.6	0.0	0 0	0.0	0 0	0 0	0.0	0.0	0.0	0.0	0.0	81.7
12332245U3	ESF Borehole Testing	45 0	36 6	0.0	0.0	0.0	0 0	0 0	0.0	0.0	0.0	0.0	0.0	81.7
33123GB3	Unsaturated Matrix Flow Properties	6 3	17 8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1
12332245U4	Hydrologic Properties Measurements	6.3	17.8	0.0	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	24.1
33124GB7	ESF Drift-Scale Flux & Niche Study (Pha	0.0	5.5	0 0	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0	5.5
33124GBF	Characterization of Seepage in Alcoves	11.3	36.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.6
12332245U5	Percolation and Seepage	11.3	41 8	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.1
33131GB2	Hydraulic/Tracer Test of Prow Pass Tuff	20.2	7 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.3
33131GB4	SZ Hydraulic Testing of Borehole USW	0 0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4
33131GB5	SZ Hydraulic Testing of Borehole USW	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
33133GA3	Planning for STC SZ Confirmation Studi	1.5	-1.2	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.3
12332245U6	Saturated Zone Testing	21.7	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0
33127GB1	Matrix Water Sources and Fract.-Matrix I	10.7	8 7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.3
33127GB2	Iso./Hydrochem. Studies of UZ Water an	13.5	17.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.8

U.S. GEOLOGICAL SURVEY
TIMATED COSTS FOR 10/1/97 - 11/30/97
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		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
2332245U7	UZ Hydrochemistry	24.2	25.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.1
33123FBF	Hydrologic Charac. of SB Bri - WT-24/5	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
2332245UC	Matr'.: Properties - SD6/WT24	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
33131FBG	Perched Wtr & SZ Hydrologic Tstg - WT	27.2	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.7
33131FBH	Iso/Hydrochem Smplg/Anal of SZs - WT	8.2	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.5
2332245UD	Hydrologic Tst/Hydrochem. Sampling	35.4	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.2
33124FBF	South Ramp Hydrology (RM)	1.5	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6
33124FBG	PTn Lateral Diversion - Ph I (RM)	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
2332245UR	Risk Mitigation - Hydrostratigraphy	1.5	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4
33124FBH	ESF Drift Scale & Niche Study (RM)	7.3	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9
33124GA1	Support E&I Design Basis Modeling (RM	0.7	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2332245US	Risk Mitigation - Percolation & Seepag	8.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9
33123FBF	Char. Hydr. of SD Boreholes - 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	0.0
2332245UW	Matrix Properties WT-24 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	0.0
33131FBG	Conduct Perched Water & SZ Hydraulic	1.5	40.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.6
33131FBH	Iso/Hydrochem Smplg/Init Analyses of S	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
2332245UX	Hydrologic Testing/Hydrochem Sampli	1.5	40.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.6
33131FBB	Conduct Chemical & Isotopic Analysis -	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
33131FBF	Conduct C-Holes Testing - Deferred	3.4	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2
2332245UY	SZ Testing - Deferred	3.4	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2
33121GB2	Update & Enhance Net Infiltration Numer	7.1	17.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.8
33121GB3	Prediction of Future Net Infil. Rates in Re	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
2332247U1	UZ Modeling	7.1	17.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.8
33131GB8	Reduce Uncert. in Flux Values Used to C	2.2	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1
33133FB8	Confirm SZ Hydrologic Flow Models	14.3	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.9
33133GB4	Refine Calibration of Site SZ Flow Model	8.6	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.8
33133GB5	Test Alternate Conceptual Models	6.1	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0
33133GB7	Refine Regional Hydrogeologic Framewo	20.4	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.2
2332247U2	SZ Modeling	51.6	47.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.9
33132GB1	Iso/Hydrochem. Analysis of SZ Ground	24.9	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.1
2332247U4	Isotopic/Hydrochemical SZ Studies	24.9	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.1

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		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
12332245		248.7	305.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	554.3
IG33124FB8	Percolation Flux Across Repository Horiz	0.0	26.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.4
IG33124FBD	Moisture Monitoring in the ESF - ECRB	5.9	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8
IG33124GBA	Infiltration of Construction Water in ESF	10.7	-3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7
12338050U3	Infiltration, Percolation & Seepage	16.6	31.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.9
12338050		16.6	31.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.9
IG33112FB1	Collection of Site Streamflow Data	11.7	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0
IG33112GB1	Collection of Site Streamflow Data	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
12337025U2	Surface Water Monitoring	11.7	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0
IG33123FBB	UZ Borehole Instrumentation & Monitorin	18.4	16.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.5
IG33123FBC	Integrated Analysis & Interpretation	13.6	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2
IG33123GB1	UZ Borehole Instrumentation & Monitorin	8.9	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0
IG33123GB2	Integrated Analysis & Interpretation	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
12337025U3	Surface Based Hydrologic Monitoring	38.9	29.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.8
IG33131FBD	Water-Level Monitoring	10.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4
IG33131GB1	Water-Level Monitoring	5.5	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8
12337025U5	Saturated-Zone Monitoring	15.8	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.2
IG33127GB3	Isotope Support for Thermal Testing	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
12337025U6	Isotope Support for Thermal Testing	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
12337025		66.4	48.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.9
	1.2.3.3	334.0	387.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	721.6
IG36215GB2	Future 100K Climate Records	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7
12362252U1	Paleoclimate Analysis	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7
IG36221GB3	Water Flux Det. Thru Repos. Blk - Age,	17.4	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2
12362252U2	Geochronology of Fracture Minerals - L	17.4	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2
IG36221GB1	Paleoclimate Confirmatory Analyses - LA	11.8	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0
12362252U3	Paleohydrology and WT Fluctuations	11.8	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0
12362252		29.2	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.9
IG36221FB3	Syn. Distr./Anal. Geochron. Age Data. (E	6.2	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7
12366050U1	Fracture Mineral Age Dating	6.2	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7
12366050		6.2	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7

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		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
	1.2.5.3	32.8	25.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.6
2G544GA1	Support to Performance Assessment	5.3	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7
12541121U1	Support to Performance Assessment	5.3	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7
2G541FA2	Provide Support to PA - 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	0.0
12541121UY	Provide Support to Performance Asses	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
12541121		5.3	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7
	1.2.5.4	5.3	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7
	1.2.5	38.1	32.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.3
2G825GA1	Safety & Health	8.3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7
12829121U1	Federal Occupational Safety & Health	8.3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7
12829121		8.3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7
	1.2.8.2	8.3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7
2G84GA2	Rad Water Quality Sample Collection	15.7	-4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2
12842066U1	Rad Water Quality Sample Collection	15.7	-4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2
12842066		15.7	-4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2
2G847GB1	Water Resources	0.0	44.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.0
12849121U1	Water Resources	0.0	44.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.0
12849121		0.0	44.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.0
	1.2.8.4	15.7	39.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2
	1.2.8	24.0	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.9
2G9121GA	Technical Project Office	28.8	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.5
12919135U1	USGS Project Management	28.8	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.5
12919135		28.8	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.5
	1.2.9.1	28.8	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.5
2G922GA	Participant Project Control	25.2	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.3
12929135U1	Project Control - USGS	25.2	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.3
12929135		25.2	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.3
	1.2.9.2	25.2	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.3
	1.2.9	54.0	52.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	106.7
2GC522GA1	Satellite Records Operations	4.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
12C59130U1	USGS Satellite Records Operations	4.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
12C59130		4.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0

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		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
	1.2.12.5	4.0	3 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
	1.2.12	4.0	3.0	0.0	0.0	0.0	).0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
'23GA1	Support/Personnel Services	44.6	42.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	86.8
'23GA5	Procurement & Property Management	4.5	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3
!F29110U1	Personnel/Procurement/Property Servi	49.1	49.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	C.0	99 1
'23GA2	Facilities Management (space)	0.0	123.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	123.3
'23GA3	Facilities Management (computers/phone	0.0	36.3	0.C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.3
'23GA4	Facilities Management (other)	0.0	19.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7
!F29110U2	Facilities Management (USGS)	0.0	179.3	0.0	0.0	'.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	179.3
12F29110		49.1	229.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	278.4
	1.2.15.2	49.1	229.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	278.4
'3GA1	USGS Training Support	4.4	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7
!F30110U1	USGS Training Support	4.4	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7
12F30110		4.4	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7
	1.2.15.3	4.4	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7
	1.2.15	53.E	232.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	286.1
CPERATI' .		911.4	1152.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2064.2
PITAL 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
AND TOTAL		911.4	1152.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2064.2
:s														
FEDERAL		111.7	90.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
CONTRACT		31.5	29.4	0.0	0.0	0.0	0.0	0.0	0.0	)	0.C	0.0	0.0	
TOTAL		143.2	120.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	