



Department of Energy
Office of Civilian Radioactive Waste Management
Yucca Mountain Site Characterization Office
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NOV 12 1997


OVERNIGHT MAIL

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U.S. Nuclear Regulatory Commission
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SUBMITTAL OF PARTICIPANTS' MONTHLY PROGRESS REPORT

As you have requested, the U.S. Nuclear Regulatory Commission is on distribution to receive a copy of the Yucca Mountain Site Characterization Project participants' monthly status report on a regular basis. Enclosed is the U.S. Geological Survey Progress Report for September 1997.

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


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AML:AVG-0185

Enclosure:

Ltr, 10/14/97, Craig to Kozai, w/encl

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INFORMATION ONLY

October 14, 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, September, 1997

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

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

Sincerely,

Raye R. Arnold
for Robert W. Craig
Technical Project Officer
Yucca Mountain Project Branch
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**U. S. GEOLOGICAL SURVEY
EXECUTIVE SUMMARY
SEPTEMBER, 1997**

WBS 1.2.3.1 Coordination and Planning

U. S. Geological Survey - Yucca Mountain Project is currently processing 145 scientific papers prepared by USGS authors. Of these, 96 are related to geologic studies and 47 to hydrologic studies. In addition, 12 abstracts are being processed, as well as 17 reports by LANL personnel.

WBS 1.2.3.2 Geology

Geologic Framework

The re-evaluation of 51 subsurface lithostratigraphic contacts from a total of 80 boreholes was completed and submitted as Milestone Report SPG391M4 on September 30. This study utilized borehole geophysical logs as the primary data source, with descriptive logs from published reports, and photographs of cores serving as secondary and supporting sources of information. This re-evaluation effort was designed to directly support the construction of an updated 3-D geologic framework and integrated site model (ISM3).

In order to expedite and standardize the review of borehole geophysical data, project staff with assistance from M&O personnel developed an Excel macro and workbook referred to as "CONTACT macro" and "CONTACT workbook", respectively. These two Excel-based products provide a standard and integrated format for reviewing contact depths and the availability of geophysical log data for each borehole. The macro expeditiously produces a set of five plots for any depth interval selected by a given user, and the workbook contains the standard diagnostic borehole geophysical logs for density, porosity, resistivity, and saturation for each borehole, plus gamma ray, magnetic, or velocity data that may, or may not, be available for all boreholes. After completion, each CONTACT workbook contains relevant borehole geophysical measurements, QA petrophysical measurements, interpreted lithostratigraphic contacts, and supporting text for the interpretations. In sum, the Excel macro with accompanying workbooks provide a quick and ready means for viewing the integrated lithostratigraphic and geophysical data sets, and represents a marked increase in the overall consistency of the lithostratigraphic data base for Yucca Mountain.

A lithostratigraphic workshop was held in Las Vegas on September 26 to demonstrate the utility of the Excel macro, and to discuss recent modifications to the lithostratigraphic data base for Yucca Mountain.

Meetings were held with M&O and Bureau of Reclamation personnel to discuss the predictive report that is being planned as part of the "Enhanced Characterization of the Repository Block" (ECRB) effort. Project staff that have been involved in geologic mapping and fracture studies are preparing a cross section and accompanying text to portray and describe the nature of

faulting, footwall-hanging wall deformation, and fracturing characteristics that are expected to be encountered along the alignment of the ECRB drift. The planned report, based in large part on existing detailed mapping (scale 1:6000) of the central block area, will address the number of fault splays off the Solitario Canyon fault and the displacements along the faults, and apply these data in the development of a model for footwall deformation. Description of the nature of fracturing will focus on the relative fracture intensities expected to be found in each of the major lithologic units along the ECRB drift, as well as the possible variations in fracture types and orientations. The resulting data will help to constrain future repository design and construction.

The Level 4 Milestone report, "evaluation of the structural significance of bomb-pulse ^{36}Cl at sample locations in the Exploratory Studies Facility, Yucca Mountain, Nevada" (Milestone SPG33M4) that was completed in August, was fully incorporated in a Level 3 Milestone report by LANL (SP2224M3), titled "Evaluation of Flow and Transport Models of Yucca Mountain, based on Chlorine-36 Studies for FY 97". The latter report (submitted September 29) summarizes the existing ^{36}Cl data at Yucca Mountain and its use in constraining models of flow in the unsaturated zone.

Geologic mapping and photography in Alcove #7 of the ESF continued. Project staff completed an analysis paper on the geology of the North and South Portals and submitted it for technical review.

Abstracts for papers to be presented at the 1997 Annual Meeting of the Geological Society of America to be held in Salt Lake City October 20-23 were prepared on the following topics:

1. "Geologic mapping at Yucca Mountain -- focusing traditional and high-tech tools on a critical long-term national issue." This paper discusses the combination of classic geologic mapping techniques with 3-dimensional computer models to provide the geologic framework for cross-disciplinary investigations to address current and future national needs.
2. "Chlorine-36 measurements define structural controls on fast hydrologic pathways at Yucca Mountain, Nevada." The dependency of the long-term performance of the potential high-level radioactive waste repository on the spatial distribution and timing of subsurface fluid percolation is discussed.
3. "Nucleation and interactions of faults at Yucca Mountain, Nevada." This paper focuses on the relative influences of local stratigraphic control and regional tectonic control for faults and joints as documented by detailed mapping of the welded and nonwelded ash-flow tuffs that comprise the Miocene Paintbrush Group.
4. "Rainier Mesa Tuff and timing of faulting at Yucca Mountain, Nevada." Detailed geologic mapping at Yucca Mountain has shown that offsets of various tuffs across major block-bounding faults indicate that multiple episodes of faulting occurred -- one episode occurred prior to deposition of the 12.7 Ma Tiva Canyon Tuff, a second between

deposition of the Tiva Canyon Tuff and the 11.6 Ma Rainier Mesa Tuff, and a third after deposition of the Rainier Mesa Tuff.

The above abstracts are printed in the "Abstracts with Programs" published by the Geological Society of America for the 1997 meeting.

Seismotectonic Studies

Review and final preparation of the probabilistic seismic hazard analysis report continued. A mandatory review comment on the draft report requested that another feedback loop be added between the expert teams and the facilitation teams to ensure that each expert was familiar with the translation of his/her assessment to a hazard curve and that the curve in question accurately represents that assessment and its associated uncertainty. This added step has resulted in a delay of the completion data for the final PSHA report to February, 1998. The extension of time not only accommodates the addition of the needed feedback loop, but also allows more time to recalculate the hazard curves for both seismic source characterization and fault displacement assessments resulting from the expert teams revisions.

Results of the deterministic earthquake studies, which include evaluations of all Type I faults (as defined by NRC) within 5 km of the potential repository site, five distributive fault scenarios, and the Rocky Valley and Furnace Creek faults, were passed on to the Seismic Design Committee for ground motion modeling and for inclusion in the Seismic Design Topical Report.

WBS 1.2.3.3 HYDROLOGY

Regional Hydrology

Discharge and precipitation records collected in FY96 from the three recording streamgage sites on Fortymile Wash were tabulated by the Nevada District Data Section and incorporated into the District's annual water resources report. The report was officially released by the District Office on August 29, which completed this activity and the associated level 4 milestone SPH22CM4 [Publish selected streamflow and precipitation data for FY96].

Streamflow and precipitation data collected through August at the streamgage sites have been compiled and stored in project files. During the month, routine maintenance was made on the three recording streamflow gages along Fortymile Wash. Project staff kept vigilance during the reporting period for potential precipitation and runoff associated with several storms, including Hurricane Nora, that passed through the southern Nevada area. Runoff was observed to have occurred south of the Nevada Test Site, but stream flow was not reported for Fortymile Wash or for drainages on Yucca Mountain. Streamflow and precipitation data collected in FY97 for the three recording gages along Fortymile Wash were entered into tabular format.

In work on the regional saturated-zone modeling synthesis report, the report documenting simulated responses to climate change received several comments from DOE as part of its acceptance review. These comments are being addressed.

Unsaturated-Zone Hydrology

Monitoring of borehole instrumentation 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 any shelter activity. Sensor readings were checked daily as well for unusual occurrences, and any statistical outliers were flagged.

Various maintenance efforts were conducted. Several modifications were made to the IDISPLAY program and on the WDISPLAY program. Staff traveled to NTS to clean the nanovolt circuits at UZ #4 and #5 in order to reduce noise and to check the thermocouple psychrometers at SD-12. Instruments were sent for recalibration (a Keithley 263 sent to Bechtel; a barometer checked for accuracy). Power requirements at UZ-7a and SD-12 remained problematic, with new, larger generators on order through Kiewit/TRW.

Numerous trips were made to field sites for correction of generator, UPS, and chiller problems and for routine maintenance of generators. Five site visits were related to data acquisition, including manual data retrieval from UZ #4 and #5 and from UZ-7a. Staff members were trained in the maintenance of Deltec back-up power systems (UPS).

A data package ("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 January 1, 1997 through June 30, 1997") was submitted.

In borehole monitoring efforts, intermittent monitoring at NRG-6 has been proposed as the most likely to record direct effects of *El Nino*, and the review of transient drying at NRG-7a continued.

Matrix-property investigations continued during September. Samples from the main drift have all been run on both the high-pressure permeameter and the low-pressure permeameter, and a data package has gone through technical review. A soil sample was run in the centrifuge for conductivity and retention. The refrigeration unit in one of the centrifuges is broken (resulting in very high temperatures when the instrument is on) but is being repaired.

Property measurements on all samples from Niche #1 have been completed but not analyzed for accuracy. Analysis of samples collected from the wall of Alcove 7 has started. Evaluation of water-potential data collected from 21 North Ramp boreholes suggests that the filter paper method is probably accurate for samples with a relatively high unsaturated hydraulic conductivity but probably is not accurate on low-conductivity samples. The month or two that the samples are in contact with the filter paper in the steel analytical can is probably not a long enough equilibration time for some samples to transmit water to the filter paper, especially those with a small gradient. A heat-dissipation probe will be put in each of the North Ramp holes for corroboration of the can-sample values. This preliminary analysis suggested that the welded samples will require another method for high-resolution water-potential determinations. The heat-dissipation probe method was tested in chambers in the lab and gave very good results on welded tuff, although it took one to two weeks to complete a suite of four samples. Routine

measurements could only be done on selected samples unless a much more elaborate set of instrumentation is developed.

Level 4 milestone SPH35BM4 [Memo to TPO: Matrix hydrologic properties: completed package to RPC] was completed on September 30. The data package submitted for approval for this activity carries DTN GS970908312242.006; the package title is "Physical properties of borehole samples from the PTn exposure in the ESF North Ramp (ESF Station 7+28 to Station 10+71)."

Preparations for hydrologic characterization of surface-based boreholes SD-6 and WT-24 continued. Borehole WT-24 has only recently begun coring activities, as the basal vitrophyre of the Topopah Spring Tuff was encountered the last week of September. No core has been received from the SMF.

Preparation for studies of percolation flux across the repository horizon produced a plan for *in situ* field estimation of the percolation flux rate. The completed plan was submitted as part of level 4 milestone SPH35PM4 [Memo to TPO: Plan *in situ* field estimation of the percolation flux rate]. That activity is completed. Analysis continued using neutron-log and water-potential data collected in Niche #1 (niche 3566). Chloride analyses were completed for several boreholes cored in the North Ramp. Chloride data indicate the present-day flux rate in the area of the North Ramp is 5 mm/yr. The associated activity is completed; estimation of present-day flux, however, is continuing in FY98 work.

Air-permeability and hydrochemical testing in the ESF continued with work in Ghost Dance fault alcoves. Cross-hole gas-tracer testing using SF₆ and helium was conducted in the Northern Ghost Dance Fault Test Room. The tracer testing was conducted between boreholes NDR-MF#1 and NDR-MF#2 over distances of 4.5 to 6.0 meters. Tracer-gas peak-arrival times ranged from 30 to greater than 420 minutes. The variable travel times reflect different fracture flow paths between different test intervals and indicate retardation factors ranging from 2 to greater than 8. The SF₆ and helium arrival plots were identical, indicating that SF₆ absorption and helium diffusion did not influence the test results.

Moisture monitoring in the ESF culminated in completion of seven data packages. A memorandum documenting the preparation and submittal of those data packages to the Technical Data Base and the Records Processing Center has been sent to the TPO. Seven data packages were prepared, technically reviewed, and submitted to the Technical Data Base and the Records Processing Center as of September 30, 1997. The following data packages were used to satisfy this level 4 milestone SPH36WM4 [Memo to TPO: Data collected thru July 97 to RPC]:

1. DTN:GS970808312242.002: Moisture monitoring in the ESF, 2/1/97 to 7/31/97
2. DTN:GS970808312242.003: Measurement of evaporation from a free-water surface in the ESF, 9/9/96 to 7/24/97
3. DTN:GS970808312242.004: Measurement of net radiation using Eppley precision spectral pyranometers (PSP) and precision infrared radiometer (PIR) in Split Wash
4. DTN:GS970808312242.005: Solar radiation and soil water potential measured on a north-facing slope and on a south-facing slope

5. DTN:GS970808312242.007: Heat-dissipation probe measurements in Alcove 3 of the ESF, 4/22/97 to 7/31/97
6. DTN:GS970808312242.008: Time-domain reflectometry measurements in Alcove 3 of the ESF, 10/8/96 to 7/31/97
7. DTN:GS970808312242.009: Soil water potential measured at four depths at the head of Pagany Wash from 12/1/95 to 7/31/97

South Ramp hydrologic studies continued with collection of water-potential data from the sets of tensiometers and heat-dissipation probes installed at ESF Stations 66+99 and 67+33. Water-content data were collected from the TDR instruments installed at Station 66+99. The areas around these instruments are still covered with plastic to monitor the recovery of the rocks from drying effects due to tunnel ventilation and to allow interpretation of anomalies in the collected data. Drilling was completed on the 46 boreholes in the South Ramp.

Data packages DTN: GS970908312242.009, DTN: GS970908312242.010, and DTN: GS970908312242.011 for South Ramp hydrologic studies have been submitted to the Records Processing Center and the Technical Database. The final acceptance of these data packages completed this activity and provided the data for level 4 milestones SPH34BM4 [Memo to TPO: Data and results of analysis/interpretations March to August 1997] and SPH34AM4 [Memo to TPO: Data package of core/borehole data March to July 1997].

Studies of lateral diversion in the PTn continued with various efforts. Chloride analyses have been completed, and data packages turned in by LANL. Borehole instrumentation to measure and corroborate water-potential data has been developed but not installed. Unsaturated hydraulic conductivity and moisture-retention measurements using the steady state centrifuge have been completed and received. Preliminary analysis has been completed. Level 4 milestone SPH34DM4 [Memo to TPO: Data and results analysis/interpretation lateral diversion, March through August 1997] was completed on September 30. Evaluation of the moisture conditions in these boreholes corroborates previous interpretations of the role of the PTn, and at least on a localized basis, the properties and hydrologic conditions existing in the transition (through the moderately welded, corroded vapor-phase rocks at the base of the Tiva Canyon Tuff into the nonwelded PTn rocks) exhibits the characteristics of a permeability or capillary barrier. This data set provides the information necessary to develop the detailed two-dimensional model that will be used to investigate the potential for lateral diversion in this hydrologically significant stratigraphic region. The second phase of the project, which will incorporate information from vertically drilled boreholes located in Alcoves #3 and #4, will refine the parameters and geometry of this hydrologic horizon.

A memorandum was completed to satisfy level 4 milestone SPH34CM4 [Memo to TPO: Data package of core/borehole data]. The data package submitted for approval for this activity is DTN GS970908312242.006, "Physical properties of borehole samples from the PTn exposure in the ESF north ramp (ESF Station 7+28 to Station 10+71)."

The ESF drift-scale flux and niche study continued with analysis and comparison of neutron logs between Niche #1 and Niche #2. There appears to be some difference in water content between

the known fast pathway and the non-fast pathway. Detailed results were described in an LBNL milestone report. Borehole packer instrumentation is being constructed for Niche #1. Short access holes were drilled for installation of heat-dissipation probes. Data collection continued from existing instrumentation.

Various efforts in UZ hydrochemistry continued during the period. Dissolved carbon was extracted from two NRG-7A core samples as CO₂ using vacuum-distillation and acidification methods. The acidification process produced insufficient CO₂ for sample analysis even when the two acidified samples were combined. Therefore, two distilled CO₂ samples were combined into one sample and shipped to Beta Analytic for carbon isotope analysis. A tuff sample which had previously been distilled and acidified was dried in the oven at 115 C and imbibed for 72 hours with a 2.0 mmol solution of NaHCO₃. Imbibed water was extracted from the core for CO₂ using the same methods. The CO₂ gas samples extracted pre- and post-imbibition were sent to the USGS lab in Denver for ¹³C/¹²C isotope analysis. Weighted average pH values were calculated for 110 SD-7, -9, -12, and UZ-14 pore-water samples collected from different steps of compression extraction. Pore water was distilled from two NRG-7A core samples. The water samples will be analyzed for tritium, deuterium/hydrogen ratio, and ¹⁸O/¹⁶O. Four ESF core samples were distilled for tritium analysis.

Staff performed tests on the Dionex DX-100 Ion Chromatograph to determine the minimum sample size needed for accurate analyses as well as the calibration range of anion standards at various detector-sensitivity levels. The minimum sample size needed was determined to be about 0.5 ml for both anion and cation analyses. At a detector sensitivity of 100 μS, the anion calibration ranges for various species are: Cl, 1.0 to 30 mg/L; Br, 0.3 to 2.0 mg/L; NO₃, 1.0 to 20 mg/L; and SO₄, 5.0 to 100 mg/L.

Nine SD-7, three SD-9, and eight SD-12 pore-water samples were mixed with the scintillation cocktail and counted in the liquid-scintillation counter for tritium-concentration determination. Data were reduced after counting.

Water collection by compression and distillation methods during September was recorded in the water-collection database, and tritium concentrations measured in September were entered into the tritium database. The level 4 data package for the UZ Hydrochemistry Project in the second half of FY97, milestone SPH37EM4 [Memo to TPO: data package of chemical analysis FY97 to RPC], was prepared and sent to the TPO on September 30. The package included tables of the water and gas isotopic and chemical data, a data summary sheet, and all supporting documents. The data package was submitted to technical, data-management, and QA reviews. All comments have been satisfactorily addressed, and the package has been transferred to the Records Center.

In unscheduled work, staff completed the draft PISA Geochemistry and Isotope section which is part of the Hydrology chapter. The report includes 12 tables and 26 figures. Staff also prepared a draft report titled *Isotopic Data from Unsaturated-Zone Cores at Yucca Mountain, Nevada* which has entered technical review by colleagues. The paper will be submitted to the International High-Level Radioactive Waste Management Conference scheduled for May of 1998.

Saturated-Zone Hydrology

Work on tracer testing at the C-hole complex involved continuing efforts to design and procure the surface and down-hole components of the pumping, tracer-injection and tracer-mixing system for testing the Prow Pass interval, as well as procurement of tracers for the testing, and otherwise performing tasks leading to the planned testing. The basic design was finalized in July. Procurements for the system were initiated in September, and the various pieces of equipment are expected to arrive at different times through the middle of December 1997.

The State of Nevada has given permission to stop pumping from UE-25 c #3 whenever DOE, M&O, and participants (USGS, LANL) decide to terminate the pyridone tracer test and start preparing for the Prow Pass test. The USGS has requested continued pumping until November 14 to enhance the results from the test (to strengthen calculations of lower bounds and trends of parameter estimates obtained from analyzing the test results). During September, the multiple-well convergent tracer test in the Bullfrog aquifer continued, with the 2,6 difluorobenzoic acid (DFBA) breakthrough curve in its final "tail" stage of development. The pyridone breakthrough curve has shown a steady rise in concentration, but no peak has been identified yet. The concentration has risen to approximately 350 parts per trillion (ppt).

Concentrations of pyridone and DFBA as a function of time, from the tracer tests initiated in January 1997, were prepared as one data package. The pressure and water-level data collected at the C-holes and nearby wells UE-25 ONC #1, USW H-4, UE-25 WT #14, UE-25 WT #3, and UE-25 p #1, were prepared as another data package. These data packages were reviewed, approved, and submitted in September to the Records Processing Center and the Technical Data Base. The completion memo, level 4 milestone SPH23TM4 [Memo to TPO: Tracer test data package to RPC/TDB], was submitted on September 30, as scheduled.

Potentiometric-level monitoring continued. The water-level network includes 31 zones in 24 wells to be measured manually. In anticipation of hydraulic testing to be conducted at borehole USW WT-24, borehole USW G-2 was instrumented with a Paroscientific transducer on September 10. In September, seven manual measurements were completed. Four zones in four wells were monitored hourly with transducer measurements. Monitored wells include UE-25 WT #14, UE-25 p #1, USW H-4, upper interval, and USW G-2. Water-level measurements were made as follows: USW H-3 (lower interval) on September 4; USW G-2 on September 10; UE-25 WT #3 on September 16; USW H-5 (lower interval) and UE-25 WT #16 on September 17; UE-25 WT #6 on September 18; and UE-25 WT #16 on September 23. In support of perched-water SZ hydraulic testing, two monitoring tubes were placed in borehole USW G-2. The borehole was instrumented with a 60-m Paroscientific transducer on September 10.

Calibration checks of barometers (serial numbers) 588128, 385845, and 433311 were completed on September 9. Barometer (serial number) 385845 and Paroscientific transducer (serial number) 62269 were calibrated and installed in borehole USW G-2 on September 10. Barometer (serial number) 433311 was installed at borehole UE-25 p #1 on September 10. A Mount Sopris multiconductor cable unit (serial number) 1532 was calibrated on September 2 to support monitoring of water levels in borehole USW WT-24.

A data package consisting of manual water-level altitude data, January through June 1997, was submitted to the USGS Data Management Group on September 8 for processing and submittal to the Records Processing Center.

The report *Water levels in the Yucca Mountain area, Nevada, 1995* by R.P. Graves and Robert Goemaat was approved as USGS Open-File Report 97-101 in February 1997. The report was returned to the author on September 4 for review before sending the report to the printers.

In efforts on the site SZ synthesis report, work on revisions to the draft report were completed. The report *Hydrogeology and preliminary three-dimensional finite-element ground-water flow model of the site saturated zone, Yucca Mountain, Nevada*, by J. Czarnecki, C. Faunt, C. Gable, and G. Zyvoloski, documents current understanding of the site saturated-zone hydrology and documents the construction of hydrogeologic framework and ground-water flow models that were used to test concepts of the flow system. The report was submitted to DOE on September 29, completing this activity and level 3 milestone SP23NM3 [Site saturated-zone synthesis report].

Work on calculation of particle flow paths and fluxes for present, past, and future climatic conditions, based on regional flow-model output, was completed and transmitted to PA. Work on data recently obtained by the Nevada District (USGS) concerning evapotranspiration from Ash Meadows was completed, and its incorporation into the regional flow model is being documented. This information will be used as part of the sensitivity analyses for TSPA-VA. Final documentation will be transmitted to PA early next fiscal year. Information on ground-water flow paths and fluxes from Yucca Mountain, based on the regional flow model, was transmitted to PA on September 15.

In work on confirmation of the site SZ flow model, staff continued calibration of the flow model in response to review comments. A refined mesh was generated, and simulated recharge at upper Fortymile Wash was estimated by the model. Comparisons were made between simulations with 20 and 44 reference ground-water temperatures. The higher reference temperature resulted in increased model-calculated fluxes at the model boundaries (increases of 44 to 159%) and upper Fortymile Wash (increase of 69%). Parameter-estimation simulations with these revisions continued through the end of the month. Results from the latest simulation, although preliminary, were incorporated into a report documenting the construction of the model. This activity will continue into next fiscal year.

In support to the SZ model expert elicitation, staff participated in elicitation interviews for Shlomo Neuman at the Geomatrix offices in San Francisco. Interview summaries, compiled by Geomatrix, were reviewed and comments were forwarded to Geomatrix for final compilation. This activity as planned is completed. Some minor review and revision of elicitation summaries, however, is expected to continue into next month.

WBS 1.2.3.6 CLIMATOLOGY and PALEOHYDROLOGY

Assembly of hydrologic and climatic data from the Owens Lake region continued in support of development of analog precipitation and temperature-change models depicting changes over the past 400 ky. Discussion of the model data sets is being prepared for a manuscript detailing the relations between the modern climatology, hydrology and limnology of Owens Lake to serve as background for paleoclimate studies. Collection of ostracode data from the Las Vegas and Indian Springs Valley deposits for stable isotope analyses continued.

Several efforts on the paleoclimate synthesis report continued. Staff is preparing a manuscript which treats the climatic and hydrological states that existed in the Las Vegas and Indian Springs Valleys during the Pleistocene in support of level 4 milestone SPC332M4 [updated synthesis report to publication]. Another manuscript in preparation details the modern climatology, hydrology and limnology of Owens Lake to serve as background for paleoclimate studies. The results will allow quantitative analog interpretations of past climatic states at Yucca Mountain and also will support milestone SPC332M4.

Staff contributed to and provided ostracode data for a planned open-file report *High-resolution paleoclimate records of the Last Interglacial from Owens Lake, California*. Data and text of the contribution are in review by the USGS Geological Division. The lead author is J. L. Bischoff.

Climate staff has informally responded to a request for paleoclimate information for TSPA-VA by investigators from Sandia National Laboratory.

Evaluation of paleo ground-water discharge continued during September with staff participating in the OECD/NEA waste disposal workshop on Use of Hydrogeochemical Information in Testing Ground-water Flow Models (held in Borgholm, Sweden). USGS staff presented a poster entitled *Constraints on Quaternary Unsaturated- and Saturated-Zone Hydrology from Geochronological and Isotopic Studies of Calcite and Silica, Yucca Mountain, Nevada, USA*. Authors include J. Paces, Z. Peterman, L. Neymark, J. Whelan, and B. Marshall. The presentation summarizes work on subsurface mineral deposits as records of past UZ flux and on discharge deposits down-gradient of Yucca Mountain as records of past SZ high-water stands.

Six data packages including isotope data (O, C, Sr, U-Th) and micropaleontological data (diatoms and ostracodes) containing results from Amargosa discharge deposits have received final Data Management processing and have been transmitted to the Central Records Facility and the Technical Data Base. Submittal of these data packages along with a memorandum to the USGS-YMPB TPO documenting their transmittal fulfills the criteria for level 4 milestone SPC334M4 [Memo to TPO: data package to RPC/TDB: FY97 data from paleo-discharge sites]. The data were collected in support of the recently completed level 4 milestone report SPC333M4 [Memo: evaluation of data from paleo-discharge sites and interpretation of past discharge activity] summarizing the conclusions of studies of past discharge throughout the Amargosa Desert and adjacent Crater Flat.

Analytical geochronology and determination of ages from the potential repository block continued with sample collection and analysis from the southern part of the Main Drift and the South Ramp. Staff completed about 14 U-Th isotope analyses of subsurface opal from the South

Ramp. Resulting $^{230}\text{Th}/\text{U}$ ages range between 320 and 86 ka. Subsamples from five of seven occurrences have initial $^{234}\text{U}/^{238}\text{U}$ ratios between about 1.2 to 2.5 and are consistent with previously obtained results from Tiva Canyon Tuff secondary minerals. Two occurrences contain subsamples with initial $^{234}\text{U}/^{238}\text{U}$ ratios between 4.4 and 6.0, however, indicating that not all flow paths in the shallow subsurface behave uniformly in terms of their ability to gain excess ^{234}U . These data, along with other ESF U-series data collected since March 1997, were compiled into a data package that received technical review and was submitted in completion of level 4 milestone SPC23MM4 [Data to RPC: FY97 analyses and unreported geochronological data]. Four data packages documenting isotope data (O, C, Sr, U-Th-Pb) collected from secondary minerals in the ESF have received final Data Management processing and have been transmitted to the Central Records Facility and the Technical Data Base.

Staff worked on revisions in response to technical reviews by J. Stuckless (USGS-WRD-YMPB) and J. Bischoff (USGS-GD) on a manuscript entitled *Mixed $^{230}\text{Th}/\text{U}$ ages for subsurface opals due to slow rates of deposition, Yucca Mountain, Nevada, USA* intended for publication in the peer-reviewed journal *Earth and Planetary Science Letters*.

WBS 1.2.3.9 SPECIAL STUDIES

Development of PISA chapter 2.4 (Hydrology) continued during the period, with completion of drafts of two sections, *Surface-Water System* and *Regional Hydrology*, and completion of several subsections of the Site Hydrology section. Evaluation of draft sections has been deferred until completion of most of the sections of the chapter.

Staff members of the Climate team have begun preparation of the PISA chapter 3.4 (*Past, Present, and Future Climate*) as part of the Climate/Meteorologic site description.

The USGS technical lead for the Site Characterization Progress Report (SCPR) received and reviewed advance copies of SCPR #17 guidance documents from the M&O coordinator and used this information to finalize the USGS plan for providing input to SCPR #17. Because of change in format for the SCPR, the templates previously prepared for input to SCPR #17 had to be revised by eliminating the SCP study and activity objectives and consolidating the input structure at the SCP study level. Although the new format for the SCPR will not use the SCP structure, most USGS summary accounts correspond fairly closely to SCP studies because of the relationship between the WBS structure and the SCP.

An instructional memorandum to USGS investigators that describes the organization, focus, and level of detail for the revised format for SCPR #17 was prepared and distributed the week of September 15. The memo was distributed to 26 USGS investigators and requested summaries of progress for 35 summary accounts for the period April 1 to September 30, 1997. SCPR #17 will contain five chapters: *Introduction, Repository Performance, Design, Site Characterization, and Progress Toward Future Objectives*. The USGS will contribute primarily to chapter 4 on site characterization, which will be subdivided into eight technical topics as follows:

A. Integrated Site Model/Geologic Framework

- B. Site Unsaturated-Zone Modeling and Synthesis
- C. Site Saturated-Zone Hydrologic System Synthesis and Modeling
- D. Paleoclimate-Paleoenvironmental Synthesis
- E. Three-Dimensional Rock Properties Model
- F. Site Geochemistry
- G. Disruptive Conditions
- H. Altered-Zone Study

Under each topic, the USGS will contribute brief "highlight" narratives that will describe the principal, "bottom line" scientific results of each major study and how those results relate to the Waste Containment and Isolation Strategy, performance assessment, and major Project objectives (VA, SR, and LA). A major focus of the SCPR will be how the results of scientific studies have contributed to the reduction in uncertainty of predicted repository performance. Under the schedule for SCPR #17 preparation, input from PIs is due to the USGS technical lead the week of September 29. Consolidated USGS input will be transmitted to the technical leads in M&O Site Evaluation Program Operations (SPO) by October 10 and to the M&O SCPR coordinator by October 22. Under the revised SCPR format, Appendix A (documenting changes in the program since the SCP) will remain in the same format as for SCPR #16 but will be published as a separate document. Any necessary changes to the USGS parts of Appendix A will be transmitted to M&O SPO by October 20 and forwarded to the M&O SCPR coordinator by October 29.

WBS 1.2.8.4.7 WATER RESOURCES MONITORING

Ground-water levels were measured at 34 sites, and discharge was measured at one flowing well. Ground-water data collected during August were checked and filed. Various preparations were made for continuation of water-monitoring efforts in FY1998.

Revisions to the summary report through calendar year 1996 were made as a result of colleague and editorial review. Those revisions were completed on September 2, and the report was submitted for Nevada sub-district review on September 3. After additional modifications, the report was submitted for Nevada District and reports-unit approval on September 12, and it was submitted for DOE acceptance review on September 15 in completion of level 3 milestone SSH13GM3 [Report: summary, monitoring through Calendar Year 1996].

In ongoing studies of water quality, staff received the remainder of analytical results for water-quality samples (collected during May 1997 to characterize ground-water in the Yucca Mountain region with respect to drinking-water standards). Review of preliminary analytical data was completed, and data and records packages were prepared for colleague review. The records package was submitted to the colleague reviewer for technical review on September 22.

USGS Level 3 Milestone Report

October 1, 1996 - September 30, 1997

Sorted by Baseline Date

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
LETTER REPORT Milestone Number: SSH13BM3	11/1/96	10/30/96	10/30/96	
LETTER REPORT Milestone Number: SSH13CM3	1/31/97	1/30/97	1/30/97	
Ltr Rpt: Geo S.R. Sta 55+00 to STA 63+47 Milestone Number: SPG42BM3	2/28/97	2/27/97	2/27/97	
Rpt Geo North/South Main Drft Sta 28+00 to55+00 Milestone Number: SPG42AM3	2/28/97	2/28/97	2/28/97	
Main Drift Hydrogeology Report Milestone Number: SPH223M3	3/14/97	3/14/97	3/14/97	
Complete Fracture Evaluation Report Milestone Number: SPG32M3	4/30/97	4/29/97	4/29/97	
LETTER REPORT Milestone Number: SSH13DM3	5/1/97	4/29/97	4/29/97	
Site Saturated-Zone Flow Model Milestone Number: SP24CBM3	6/16/97	6/16/97	6/16/97	
LETTER REPORT Milestone Number: SSH13EM3	8/1/97	7/28/97	7/28/97	

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Results of Hydraulic & Tracer Tests C-Hole Compl Milestone Number: SP23PM3	8/1/97	8/1/97	8/1/97	
Regional Saturated-Zone Synthesis Report Milestone Number: SP23OM3	8/1/97	8/1/97	8/1/97	
Site Saturated-Zone Synthesis Report Milestone Number: SP23NM3	8/29/97	9/29/97	9/29/97	
Ltr Rpt: Geo of S.Ramp, Sta 55+00 to S. Portal Milestone Number: SPG42CM3	8/29/97	8/29/97	8/29/97	
Geol. Map of the Yucca Mountain Site Area Milestone Number: SPG22M3	8/29/97	8/22/97	8/22/97	
REPORT: SUMMARY MONITORING THROUGH CY 1996 Milestone Number: SSH13GM3	9/15/97	9/15/97	9/15/97	

USGS Level 4 Milestone Report

October 1, 1996 - September 30, 1997

Sorted by Baseline Date

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Memo to TPO: SS Hazards Methodologies Wrkshop Milestone Number: SPG28FM4	10/25/96	10/24/96	10/24/96	
Memo to TPO: Jan-Jun96 Perio Wtr Lvl Data to RPC Milestone Number: SPH21CM4	10/31/96	10/30/96	10/30/96	
Memo to TPO: SS Hazards Method. Wrkshop Summary Milestone Number: SPG28GM4	11/15/96	11/14/96	11/14/96	
Memo to TPO: Seis. Src. Mdls & Proponents Wrkshop Milestone Number: SPG28HM4	11/27/96	11/26/96	11/26/96	
Memo to TPO: Comp Frac Data Coll: Cal. Hills, Prow Milestone Number: SPG34M4	11/27/96	11/27/96	11/27/96	
Memo to TPO: Comp Re-Eval Priority Strat Contact Milestone Number: SPG21M4	12/13/96	12/13/96	12/13/96	
Memo to TPO: Detailed Content Outline Milestone Number: SPH391M4	12/13/96	12/13/96	12/13/96	
Memo to TPO: SS Modls & Propnents Wrkshop Summry Milestone Number: SPG28IM4	12/19/96	12/19/96	12/19/96	
Report: Mod Flow In UZ Frac Ntwk TS W-U in ESF Milestone Number: SPH21AM4	12/31/96	12/19/96	12/19/96	
Memo to TPO: Monitoring Data Apr-Sep 1996 to RPC Milestone Number: SPH22GM4	12/31/96	12/23/96	12/23/96	
Memo to TPO: GM Models and Interpret. Workshop Milestone Number: SPG28AM4	1/17/97	1/13/97	1/13/97	
Memo to TPO: Seismic Source Interp. Wrkshop Milestone Number: SPG28JM4	1/17/97	1/13/97	1/13/97	

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Memo to TPO: Clim Scenarios Recvd & Sim Started Milestone Number: SPH23AM4	1/30/97	1/13/97	1/13/97	
Memo to TPO: SS Interpretations Wrkshop Summary Milestone Number: SPG28KM4	2/4/97	2/3/97	2/3/97	
Memo to TPO: GM Modls & Interpret Wrkshp Summry Milestone Number: SPG28BM4	2/6/97	2/5/97	2/5/97	
Memo to TPO: Sub Bh Video Frac Db to GENISES Milestone Number: SPG211M4	2/28/97	2/27/97	2/27/97	
Memo to TPO: Jul-Dec96 Perio Wtr Lvl Data to RPC Milestone Number: SPH21BM4	2/28/97	2/7/97	2/7/97	
Memo to TPO: Annotated Outline Site SZ Synth Rpt Milestone Number: SPH23VM4	2/28/97	2/11/97	2/11/97	
Memo to TPO: Summary of Meetings with PA Mdlrs Milestone Number: SPH25CM4	2/28/97	2/13/97	2/13/97	
Memo to TPO: Rslts New Age & Iso Determinations Milestone Number: SPC23FM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: 1995 Water-Level Data Milestone Number: SPH21FM4	3/14/97	2/13/97	2/13/97	
Memo to TPO: Meteorological Data FY96 to RPC/TDB Milestone Number: SPH21IM4	3/14/97	3/14/97	3/14/97	
Publish Sel Streamflow & Precip Data for FY96 Milestone Number: SPH22CM4	3/14/97	9/4/97	9/4/97	
Memo to TPO: Subm FY96 Data to RPC/TDB Milestone Number: SPH22DM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Trans Funct Precip/Infil of Num Mdl Milestone Number: SPH22FM4	3/14/97	3/11/97	3/11/97	
Memo to TPO: Synth UZ Mont Data fm MD of ESF Milestone Number: SPH22IM4	3/14/97	3/14/97	3/14/97	

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Memo to TPO: Reslt of Matrix-Hydro-Prop Determin Milestone Number: SPH22KM4	3/14/97	3/11/97	3/11/97	
Memo to TPO: Matrix-Hydro-Prop Compl Pkg to RPC Milestone Number: SPH22LM4	3/14/97	3/11/97	3/11/97	
Memo to TPO: Monitoring Data Thru Jan 97 to RPC Milestone Number: SPH22NM4	3/14/97	3/7/97	3/7/97	
Memo to TPO: Rslts Analyses/Interpret thru Jan97 Milestone Number: SPH22QM4	3/14/97	3/11/97	3/11/97	
Memo to TPO: Data Collected thru Jan 97 to RPC Milestone Number: SPH22RM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Rslts Chem Analysis Thru Jan 1997 Milestone Number: SPH22WM4	3/14/97	3/10/97	3/10/97	
Memo to TPO: Pkg of Chem Anal thru Jan 97 to RPC Milestone Number: SPH22XM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Final Hydrogeo Framewrk Data to RPC Milestone Number: SPH23DM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Test Data for July-Dec 1996 to RPC Milestone Number: SPH23MM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Results of Tests Comp Jul-Dec 96 Milestone Number: SPH23NM4	3/14/97	3/14/97	3/14/97	
Memo to TPO: Tech Anal/Interp Air-Perm & Hydroch Milestone Number: SPH35EM4	3/14/97	3/13/97	3/13/97	
Memo to TPO: Subm Air-Perm/Hydrochem Tstg to RPC Milestone Number: SPH35FM4	3/14/97	3/14/97	3/14/97	
Memo to TPO:Elicit of Experts Interpret Complete Milestone Number: SPG28LM4	3/20/97	3/20/97	3/20/97	
Memo to TPO: Comp QA Eval pre-1992 Bh Geo Logs Milestone Number: SPG212M4	3/28/97	3/26/97	3/26/97	

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Memo to TPO: Draft Site Area Geol. Map to PISA Milestone Number: SPG222M4	4/18/97	4/17/97	4/17/97	
Memo to TPO: Ground Motion Feedback Workshop Milestone Number: SPG28CM4	4/21/97	4/21/97	4/21/97	
Memo to TPO: Seismic Source Feedback Workshop Milestone Number: SPG28MM4	4/25/97	4/21/97	4/21/97	
Memo to TPO: Updated Geohydro Frmwrk Sub for Rev Milestone Number: SPH24FM4	4/30/97	4/29/97	4/29/97	
Memo to TPO: Rev Dft Reg SZ Synth Rpt Clim Chng Milestone Number: SPH23BM4	5/1/97	5/1/97	5/1/97	
Memo to TPO: GM Feedback Workshop Summary Milestone Number: SPG28DM4	5/13/97	5/13/97	5/13/97	
Memo to TPO: SS Feedback Workshop Summary Milestone Number: SPG28NM4	5/19/97	5/19/97	5/19/97	
Memo to TPO: Regional Seismology Milestone Number: SPG39AM4	5/29/97	5/29/97	5/29/97	
Memo to TPO: Regional Struct Geology & Tectonics Milestone Number: SPG39BM4	5/29/97	5/29/97	5/29/97	
memo to TPO: Site Stratigraphy Milestone Number: SPG39CM4	5/29/97	5/29/97	5/29/97	
Memo to TPO: Regional Stratigraphy Milestone Number: SPG39DM4	5/29/97	5/29/97	5/29/97	
Memo to TPO: Site Seismology Milestone Number: SPG39EM4	5/29/97	5/29/97	5/29/97	
Memo to TPO: Site Struct Geology and Tectonics Milestone Number: SPG39FM4	5/29/97	5/29/97	5/29/97	
Memo to TPO: Rev Draft Site SZ Synthesis Report Milestone Number: SPH23WM4	5/30/97	7/7/97	7/7/97	

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Memo to TPO: Reviewed Data Package to TDB Milestone Number: SPG32M4	6/10/97	6/9/97	6/9/97	
Memo to TPO: Baseline Hydchem Meas Drft Scale Tst Milestone Number: SPH37DM4	6/13/97	6/10/97	6/10/97	
Memo to TPO: GM Characterization Input to PSHA Milestone Number: SPG28EM4	6/30/97	7/15/97	7/15/97	
Memo to TPO: SS Characterization Input to PSHA Milestone Number: SPG28OM4	6/30/97	7/15/97	7/15/97	
Memo to TPO: Comp Geo Mapping of Thermal Tst Are Milestone Number: SPG42FM4	6/30/97	6/27/97	6/27/97	
Memo to TPO: Rev Drft Rslts Hydra&Tracer Tsts C- Milestone Number: SPH23SM4	6/30/97	7/9/97	7/9/97	
Memo To TPO: Prov Pred Hydro Property WT-24 Milestone Number: SPH255M4	7/10/97	7/10/97	7/10/97	
Memo to TPO: PSHA Draft Report Milestone Number: SPG28PM4	7/15/97	8/18/97	8/18/97	
Memo to TPO: Provide Pred Property Value, WT-24 Milestone Number: SPG33SM4	7/15/97	7/15/97	7/15/97	
Memo to TPO: Predicted SZ Chemical Parameters Milestone Number: SPH23FM4	7/15/97	7/14/97	7/14/97	
Memo To TPO: Prov Pred Hydro Property SD-6 Milestone Number: SP256M4	7/31/97	7/29/97	7/29/97	
Memo to TPO: Data Pkg of Existing SZ Chem Data Milestone Number: SPC34BM4	7/31/97	7/22/97	7/22/97	
Memo to TPO: Provide Pred Property Value, SD-6 Milestone Number: SPG33TM4	7/31/97	7/30/97	7/30/97	
Memo to TPO: Model Input/Output Update Data Milestone Number: SPH35RM4	7/31/97	7/30/97	7/30/97	

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Memo to TPO: Summary of Interactions with PA Mdl Milestone Number: SPH25DM4	8/1/97	7/24/97	7/24/97	
Memo to TPO: Status of Prep of PISA Chapter 2.6 Milestone Number: SPC321M4	8/15/97	7/28/97	7/28/97	
Memo to TPO: Status of Hydra&Tracer Tst Prow Pass Milestone Number: SPH233M4	8/15/97	8/11/97	8/11/97	
Subm Upd FY96 Synth Report to Peer-Revwd Journal Milestone Number: SPC332M4	8/29/97	8/26/97	8/26/97	
Memo to TPO: Eval Data fm Paleo-Discharge Sites Milestone Number: SPC333M4	8/29/97	8/27/97	8/27/97	
Memo to TPO: Maps, Data, Interpretations & Concl Milestone Number: SPG33M4	8/29/97	8/29/97	8/29/97	
Memo to TPO: Reslt of Matrix-Hydro-Prop Determin Milestone Number: SPH35AM4	8/29/97	8/29/97	8/29/97	
Memo to TPO: Plan In-situ Fld Est Perc Flux Rate Milestone Number: SPH35PM4	8/29/97	8/29/97	8/29/97	
Memo to TPO: Rslts Analyses/Interpret thru Jul97 Milestone Number: SPH36VM4	8/29/97	8/29/97	8/29/97	
Data to CRF: Data & Analyses Completed FY97 Milestone Number: SPC23MM4	9/30/97	9/29/97	9/29/97	
Data to CRF: FY97 Data Collected & Analyses Milestone Number: SPC331M4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Collected/Analyses FY97 Data to RPC Milestone Number: SPC334M4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Re-Eval Subsurf Litho Contacts at YM Milestone Number: SPG39IM4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Test Data for Jan-Mar 1997 to RPC Milestone Number: SPH23TM4	9/30/97	9/29/97	9/29/97	

<u>Deliverable</u>	<u>Due Date</u>	<u>Expected Date</u>	<u>Completed Date</u>	<u>Comments</u>
Memo to TPO: Data Pkg of Core/Bh Data Mar-Jul 97 Milestone Number: SPH34AM4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Data & Rslts Analys/Inter Mar-Aug 97 Milestone Number: SPH34BM4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Data Pkg of Core/Bh Data Mar-Jul 97 Milestone Number: SPH34CM4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Data&Rslts Analys/Inter Mar-Aug 97 Milestone Number: SPH34DM4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Matrix-Hydro-Prop Compl Pkg to RPC Milestone Number: SPH35BM4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Data Collected thru July 97 to RPC Milestone Number: SPH36WM4	9/30/97	9/29/97	9/29/97	
Memo to TPO: Data Pkg of Chem Anal Fy97 to RPC Milestone Number: SPH37EM4	9/30/97	9/29/97	9/29/97	

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

See the current WBS Dictionary

		Cost/Schedule Performance										FY1997 at Completion		
		Current Period					FY1997 Cumulative to Date							
Id	Description	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV	BAC	EAC	VAC
1.2.1	Systems Engineering	61	61	66	0	-5	181	181	166	0	15	181	166	15
1.2.3	Site Investigations	1302	954	1455	-348	-501	12984	12635	12376	-349	259	12984	12376	608
1.2.5	Regulatory	46	46	52	0	-6	504	504	451	0	53	504	451	53
1.2.8	Environment, Safety, and H	50	50	50	0	0	612	612	674	0	-62	612	674	-62
1.2.9	Project Management	55	55	89	0	-34	664	664	657	0	7	664	657	7
1.2.12	Information Management	7	7	20	0	-13	80	80	80	0	0	80	80	0
1.2.15	Support Services	144	144	188	0	-44	1722	1722	1728	0	-6	1722	1728	-6
Total		1665	1317	1920	-348	-603	16747	16398	16132	-349	266	16747	16132	615

Resource Distributions by Element of Cost

Fiscal Year 1997

Budgeted Cost of Work Scheduled

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	19540	19599	16166	20824	21557	21010	23147	23329	24443	26495	26479	27320	269909
LABOR	885	899	632	866	886	935	948	959	1009	1116	1133	1207	11475
SUBS	139	143	87	148	145	145	225	150	159	168	167	149	1825
TRAVEL	25	43	34	45	43	53	43	43	50	65	71	64	579
PM&E	7	6	7	5	9	6	7	6	9	7	5	4	78
OTHER	197	201	179	206	293	241	248	253	193	304	234	241	2790
Total BCWS	1253	1292	939	1270	1376	1380	1471	1411	1420	1660	1610	1665	16747

Actual Cost of Work Performed

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	19283	18578	18523	18723	17133	18725	19233	19288	18237	19855	17120	18949	223647
LABOR	771	712	732	829	727	782	788	826	788	836	936	1100	9827
SUBS	127	139	117	185	134	179	226	134	236	176	280	225	2158
TRAVEL	11	24	61	53	42	46	44	57	48	30	37	69	522
PM&E	43	16	88	85	89	110	60	192	98	105	160	209	1255
OTHER	119	129	145	158	252	239	174	165	194	233	245	317	2370
Total ACWP	1071	1020	1143	1310	1244	1356	1292	1374	1364	1380	1658	1920	16132

VBS No.

- 1.2

-Yucca Mountain Project

Resource Distributions by Element of Cost

Fiscal Year 1997

Estimate to Complete

[illegible]

Resource Distributions

[illegible]

Fiscal Year Distribution

[illegible]

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR 10/1/96 - 09/30/97

		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
		EST	EST	EST	EST	EST	EST	EST	EST	EST	EST	EST	EST	
OG1CFA1	USGS Engineering Assurance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.6	36.4	28.7	65.0	163.7
1.2.1.12		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.6	36.4	28.7	65.0	163.7
*1.2.1.1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.6	36.4	28.7	65.0	163.7
**1.2.1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.6	36.4	28.7	65.0	163.7
OG311FA1	Scientific Programs Management & Integra	15.7	16.6	12.0	21.8	62.3	32.4	35.6	28.3	33.1	23.4	34.4	29.9	345.5
1.2.3.1.1		15.7	16.6	12.0	21.8	62.3	32.4	35.6	28.3	33.1	23.4	34.4	29.9	345.5
OG312FA1	Nevada Operations/Earth Science Investig	55.0	57.4	62.9	66.3	98.9	87.7	57.2	46.4	59.0	56.9	62.9	150.1	860.7
1.2.3.1.2		55.0	57.4	62.9	66.3	98.9	87.7	57.2	46.4	59.0	56.9	62.9	150.1	860.7
*1.2.3.1		70.7	74.0	74.9	88.1	161.2	120.1	92.8	74.7	92.1	80.3	97.3	180.0	1206.2
OG32211FB1	Review & Revision of Lithostratigraphy B	14.1	13.4	50.3	23.9	8.6	14.0	2.4	6.6	-4.8	3.5	0.3	-0.4	131.9
OG32211FB2	Stratigraphic Descriptions for WT-24 and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.6	1.1
1.2.3.2.2.1.1		14.1	13.4	50.3	23.9	8.6	14.0	2.4	6.6	-4.8	3.8	0.5	0.2	133.0
OG32212FB2	Complete Site Area Geologic Map	36.9	24.9	34.2	12.0	21.2	50.7	18.6	25.8	52.8	21.0	26.9	0.5	325.5
OG32212FB3	Fracture Studies	6.3	16.8	14.9	12.2	9.9	9.7	10.8	5.7	10.6	13.2	19.6	30.2	159.9
OG32212FB4	Geologic Mapping of the Exploratory Stud	119.7	139.2	106.3	155.8	135.2	146.7	148.2	124.8	138.2	132.0	264.4	203.4	1813.9
1.2.3.2.2.1.2		162.9	180.9	155.4	180.0	166.3	207.1	177.6	156.3	201.6	166.2	310.9	234.1	2299.3
OG3252FB1	Evalute Tectonic Scenarios for PA	10.6	4.1	-4.1	2.3	0.0	2.5	0.6	0.1	0.0	10.5	20.4	27.1	74.1
1.2.3.2.5.2		10.6	4.1	-4.1	2.3	0.0	2.5	0.6	0.1	0.0	10.5	20.4	27.1	74.1
OG32836FB1	Conduct Probabilistic Seismic Hazards An	88.3	62.1	54.3	46.4	36.5	3.0	53.5	47.4	3.2	29.8	86.9	83.1	594.5
1.2.3.2.8.3.6		88.3	62.1	54.3	46.4	36.5	3.0	53.5	47.4	3.2	29.8	86.9	83.1	594.5
*1.2.3.2		275.9	260.5	255.9	252.6	211.4	226.6	234.1	210.4	200.0	210.3	418.7	344.5	3100.9
OG33111FB4	Collection of Site Meteor. Data for Hydr	7.8	8.8	12.2	17.5	14.3	29.6	0.4	5.9	-0.2	2.3	-6.0	0.0	92.6
1.2.3.3.1.1.1		7.8	8.8	12.2	17.5	14.3	29.6	0.4	5.9	-0.2	2.3	-6.0	0.0	92.6
OG33112FB1	Collection of Site Streamflow Data	5.6	5.1	5.3	7.4	5.7	7.1	0.0	0.0	0.0	0.0	0.0	0.0	36.2
OG33112FB2	Collection of Site Streamflow Data	0.0	0.0	0.0	0.0	0.0	0.0	6.8	6.0	6.9	9.5	9.5	11.1	49.8
1.2.3.3.1.1.2		5.6	5.1	5.3	7.4	5.7	7.1	6.8	6.0	6.9	9.5	9.5	11.1	86.0
OG33114FB3	Regional Saturated Zone Synthesis Report	7.6	7.6	0.0	12.5	29.1	11.6	55.4	15.7	56.2	17.5	9.1	25.9	248.2
1.2.3.3.1.1.4		7.6	7.6	0.0	12.5	29.1	11.6	55.4	15.7	56.2	17.5	9.1	25.9	248.2
OG33121FB1	Infiltration Processes	21.5	16.0	19.0	18.3	30.7	41.4	6.1	-6.8	0.9	2.0	-4.6	-0.8	143.7
1.2.3.3.1.2.1		21.5	16.0	19.0	18.3	30.7	41.4	6.1	-6.8	0.9	2.0	-4.6	-0.8	143.7
OG33123FB4	Integrated Analysis & Interpretation	14.5	5.4	14.5	20.9	38.8	10.6	-14.8	-0.2	17.4	1.0	0.0	0.0	108.1
OG33123FB5	Matrix Properties of Hydrologic Units	14.1	12.0	16.2	17.8	1.8	3.7	4.9	0.4	0.9	1.4	-4.4	0.4	69.2
OG33123FBA	Unsaturated Zone Borehole Instrumentatio	31.9	36.3	32.6	32.3	34.2	-10.8	1.5	0.0	0.0	0.1	-0.1	0.8	158.8
OG33123FBB	Unsaturated Zone Borehole Instrumentatio	0.0	0.0	0.0	0.0	0.0	11.0	24.4	21.5	25.4	40.6	37.6	87.2	247.7
OG33123FBC	Integrated Analysis & Interpretation	0.0	0.0	0.0	0.0	0.0	9.3	32.9	13.6	21.4	15.2	-9.6	16.1	98.9
OG33123FBD	Matrix Properties of Hydrologic Units	0.0	0.0	0.0	0.0	0.0	0.0	16.5	15.6	14.7	15.3	17.0	27.9	107.0
OG33123FBF	Hydrologic Characterization of SB Boreho	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

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1.2.3.3.1.2.3	60.5	53.7	63.3	71.0	74.8	23.8	65.4	50.9	79.8	73.6	40.5	132.4	789.7
OG33124E96 Air-K and Hydrochemisty Test - North Ram	5.5	3.1	6.4	6.1	1.4	5.8	0.1	0.0	10.9	0.3	0.0	1.0	40.6
OG33124FA1 Support E&I Design Basis Modeling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	2.1	4.2	0.1	8.4	16.9
OG33124FB7 Air Permeability & Hydrochem Testing ESF	46.1	40.6	40.9	68.9	62.7	21.6	-5.9	10.8	12.3	-7.7	13.9	16.1	320.3
OG33124FB8 Percolation Flux across Repository Horiz	0.0	0.0	0.0	0.0	0.0	3.9	1.8	-0.9	0.0	6.1	4.1	0.0	15.0
OG33124FBA Moisture Monitoring in the ESF	2.4	2.4	1.5	18.3	8.3	2.6	2.2	1.9	-14.2	14.9	-12.8	0.3	27.8
OG33124FBB Air-Permeability & Hydrochem Testing ESF	0.0	0.0	0.0	0.0	0.0	14.5	56.6	62.1	34.7	32.7	83.0	90.8	374.4
OG33124FBD Moisture Monitoring in the ESF	0.0	0.0	0.0	0.0	0.0	4.9	18.8	16.7	-21.8	10.3	7.0	18.2	54.1
OG33124FBE South Ramp Hydrology	0.0	0.0	0.0	0.0	0.0	44.3	18.1	80.2	20.7	-3.2	20.0	6.9	187.0
OG33124FBG PTn Lateral Diversion (Phase I)	0.0	0.0	0.0	0.0	0.0	2.0	8.5	3.9	16.5	23.4	24.7	6.0	85.0
OG33124FBH ESF Drift Scale Flux and Niche Study	0.0	0.0	0.0	0.0	0.0	2.0	10.8	8.8	32.9	21.4	15.2	18.7	109.8
1.2.3.3.1.2.4	54.0	46.1	48.8	93.3	72.4	101.6	111.0	185.6	94.1	102.4	155.2	166.4	1230.9
OG33127B96 UZ Hydrochemistry	0.0	0.0	0.0	20.0	0.0	0.4	3.1	3.6	0.0	0.2	0.0	0.0	27.3
OG33127FBA UZ Hydrochemistry	23.0	27.1	22.0	1.2	18.0	14.5	-14.3	-2.3	22.1	-1.8	0.3	0.5	110.3
OG33127FBB UZ Hydrochemistry	0.0	0.0	0.0	0.0	0.0	12.8	29.7	25.0	20.0	14.8	23.9	37.2	163.4
1.2.3.3.1.2.7	23.0	27.1	22.0	21.2	18.0	27.7	18.5	26.3	42.1	13.2	24.2	37.7	301.0
OG33128FBD Fluid Flow in Unsaturated Zone Fractured	7.6	5.3	2.9	6.0	4.8	2.0	-0.4	0.0	0.0	0.0	0.0	0.0	28.2
1.2.3.3.1.2.8	7.6	5.3	2.9	6.0	4.8	2.0	-0.4	0.0	0.0	0.0	0.0	0.0	28.2
OG33129FBG Site Unsaturated Zone Flow Model	7.8	6.4	8.3	25.5	-13.3	10.9	-0.8	7.0	-3.3	0.5	16.5	-3.3	62.2
OG33129FBK Support UZ Model Expert Elicitation	0.0	21.2	6.8	8.6	7.4	3.5	3.2	0.3	0.6	0.0	0.0	2.7	54.3
1.2.3.3.1.2.9	7.8	27.6	15.1	34.1	-5.9	14.4	2.4	7.3	-2.7	0.5	16.5	-0.6	116.5
OG33131FBA C-Well Complex Hydraulic & Conservative	46.5	42.2	46.6	74.2	58.5	31.3	4.0	0.3	-0.5	3.3	-3.3	-2.5	300.6
OG33131FBB C-Well Complex Hydraulic & Tracer Test	0.0	0.0	0.0	0.0	0.0	22.2	49.4	52.0	52.6	82.3	30.4	44.6	333.5
OG33131FBC Water-Level Monitoring	20.7	17.8	20.5	18.2	14.3	6.2	0.8	0.0	0.0	0.0	2.4	-2.7	98.2
OG33131FBD Water-Level Monitoring	0.0	0.0	0.0	0.0	0.0	6.0	12.0	8.8	4.5	15.7	7.5	38.6	93.1
OG33131FBE WT Eh and Ph Measurements	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.7	1.2	7.5	8.7	12.6	35.0
OG33131FBG Perched Water and SZ Hydrologic Testing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.9	0.9	21.8
OG33131FBH Isotopic & Hydrochem Sampling/Analysis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2	-1.0	20.2
1.2.3.3.1.3.1	67.2	60.0	67.1	92.4	72.8	65.7	68.5	63.8	57.8	108.8	87.8	90.5	902.4
OG33133FB3 Site Saturated Zone Flow Model	16.5	25.9	21.8	27.0	22.2	10.3	39.3	24.0	50.5	15.7	12.5	-0.9	264.8
OG33133FB4 Site Saturated Zone Synthesis Report	1.3	0.0	2.5	0.3	11.0	6.2	10.4	23.6	16.7	23.2	21.9	26.1	143.2
OG33133FB5 Conduct VA SZ Flow Model Sensitivity An	4.0	2.0	2.6	8.5	8.9	12.9	22.0	16.2	17.3	1.0	44.8	11.7	151.9
OG33133FB6 Confirm SZ Hydrologic Flow Models	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	5.2	4.2	13.3
OG33133FB7 Support SZ Model Expert Elicitation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	15.6	26.4	12.7	4.4	60.3
1.2.3.3.1.3.3	21.8	27.9	26.9	35.8	42.1	29.4	71.7	65.0	100.1	70.2	97.1	45.5	633.5
*1.2.3.3	284.4	285.2	282.6	409.5	358.8	354.3	405.8	419.7	435.0	400.0	429.3	508.1	4572.7
OG3521FA1 Tracer Gas Support	5.7	5.1	6.0	6.8	5.4	9.5	6.4	2.9	5.8	6.1	8.4	7.6	75.7

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1.2.3.5.2.1	5.7	5.1	6.0	6.8	5.4	9.5	6.4	2.9	5.8	6.1	8.4	7.6	75.7
*1.2.3.5	5.7	5.1	6.0	6.8	5.4	9.5	6.4	2.9	5.8	6.1	8.4	7.6	75.7
OG36212FB1 Confirmatory Aquatic Investigations	0.0	2.1	6.9	7.9	3.0	4.1	7.2	0.0	19.4	2.2	16.2	7.5	76.5
1.2.3.6.2.1.2	0.0	2.1	6.9	7.9	3.0	4.1	7.2	0.0	19.4	2.2	16.2	7.5	76.5
OG36215FB2 Paleoclimate/Paleoenvironmental Synthesis	40.1	38.6	31.7	62.4	37.8	19.5	9.6	30.1	2.1	-9.0	22.7	45.0	330.6
1.2.3.6.2.1.5	40.1	38.6	31.7	62.4	37.8	19.5	9.6	30.1	2.1	-9.0	22.7	45.0	330.6
OG36221FB1 Evaluation of Paleo Ground-Water Discharge	17.4	15.4	27.9	28.8	13.0	9.9	-34.8	30.2	0.1	15.3	22.8	92.3	238.3
OG36221FB2 Geo. Fract. Fill Mater, ESF & Est Past W	57.0	39.2	87.6	70.6	85.8	107.1	10.0	7.6	12.1	1.3	6.3	1.6	486.2
OG36221FB3 Syn.Dist.&Anal Geochron. Age Dets Potent	0.0	0.0	0.0	0.0	0.0	24.4	66.4	73.0	49.8	67.4	49.6	63.7	394.3
1.2.3.6.2.2.1	74.4	54.6	115.5	99.4	98.8	141.4	41.6	110.8	62.0	84.0	78.7	157.6	1118.8
*1.2.3.6	114.5	95.3	154.1	169.7	139.6	165.0	58.4	140.9	83.5	77.2	117.6	210.1	1525.9
OG395FB1 Update 3-D Geologic Model/Database	0.0	0.0	0.0	0.0	0.0	0.0	5.7	15.5	21.3	19.4	21.8	27.3	111.0
1.2.3.9.5	0.0	0.0	0.0	0.0	0.0	0.0	5.7	15.5	21.3	19.4	21.8	27.3	111.0
OG39BFA1D Support Systems Engineering Reports & St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2
OG39BFA1F Data & Del Mgt., QA Compl, Oversight Sup,	14.6	13.0	13.3	10.9	15.1	26.8	22.2	22.9	42.7	0.8	12.0	26.5	220.8
OG39BFB1 Support Development of PISA Ch 2.3 (Geol	30.1	29.7	43.9	50.1	55.5	50.1	69.2	69.3	48.1	49.6	31.5	17.3	544.4
OG39BFB1C Provide Support to LA Plan	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
OG39BFB1E Provide Input to SC Progress Report 16	9.9	11.0	10.9	5.6	13.1	9.1	9.5	10.0	11.2	-2.1	0.0	0.1	88.3
OG39BFB2 Develop PISA Chapter 2.4 (Hydrology)	11.6	12.5	33.0	31.0	43.5	54.0	54.8	68.4	81.8	59.6	48.6	73.7	572.5
OG39BFB2E Provide Input to SC Progress Report 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	9.1	7.4	26.5
OG39BFB4 Dev Climate/Meteorologic Sys Desc (PISA	0.0	0.0	0.0	0.0	0.0	16.1	51.3	35.3	31.0	49.3	52.3	44.5	279.8
1.2.3.9.11	66.2	66.2	101.1	97.6	127.2	156.1	207.0	205.9	214.8	167.2	153.5	171.7	1734.5
*1.2.3.9	66.2	66.2	101.1	97.6	127.2	156.1	212.7	221.4	236.1	186.6	175.3	199.0	1845.5
**1.2.3	817.4	786.3	874.6	1024.3	1003.6	1031.6	1010.2	1070.0	1052.5	960.5	1246.6	1449.3	12326.9
OG535FA1 Provide FY97 Technical Data Base Input	21.3	18.0	18.0	40.7	25.5	29.9	30.5	38.0	28.9	34.5	52.7	52.3	390.3
1.2.5.3.5	21.3	18.0	18.0	40.7	25.5	29.9	30.5	38.0	28.9	34.5	52.7	52.3	390.3
*1.2.5.3	21.3	18.0	18.0	40.7	25.5	29.9	30.5	38.0	28.9	34.5	52.7	52.3	390.3
OG541FA2 Viability Assessment Scenarios Developme	0.0	0.0	0.0	3.5	0.0	0.0	-0.1	1.3	0.0	0.0	0.0	0.0	4.7
1.2.5.4.1	0.0	0.0	0.0	3.5	0.0	0.0	-0.1	1.3	0.0	0.0	0.0	0.0	4.7
OG544FA1 UZ Flow Model Abstractions for VA	0.0	0.0	5.5	1.3	5.2	8.3	0.0	5.3	1.6	0.0	4.2	0.0	31.4
OG544FA2 SZ Flow Model Abstractions for VA	0.0	0.0	7.1	-0.4	-0.4	1.6	5.2	4.8	0.6	0.0	2.5	0.0	21.0
1.2.5.4.4	0.0	0.0	12.6	0.9	4.8	9.9	5.2	10.1	2.2	0.0	6.7	0.0	52.4
*1.2.5.4	0.0	0.0	12.6	4.4	4.8	9.9	5.1	11.4	2.2	0.0	6.7	0.0	57.1
**1.2.5	21.3	18.0	30.6	45.1	30.3	39.8	35.6	49.4	31.1	34.5	59.4	52.3	447.4
OG825FA1 Federal Occupation Safety & Health	8.8	7.1	9.0	8.9	7.3	7.4	7.0	11.9	7.5	9.2	7.7	8.5	100.3
1.2.8.2.5	8.8	7.1	9.0	8.9	7.3	7.4	7.0	11.9	7.5	9.2	7.7	8.5	100.3
*1.2.8.2	8.8	7.1	9.0	8.9	7.3	7.4	7.0	11.9	7.5	9.2	7.7	8.5	100.3

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OG845FA1 Radiation Protection	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.4	-0.4	0.0	0.2
1.2.8.4.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.4	-0.4	0.0	0.2
OG847FA1 Water Resources Envir Impact Stmt Suppor	0.0	0.0	0.0	0.0	2.4	2.8	0.0	0.2	0.0	0.0	0.0	0.0	5.4
OG847FA2 Rad Water Quality Sample Collection	0.0	0.0	0.0	0.0	0.0	49.3	3.8	0.0	11.9	70.0	14.6	0.5	150.1
OG847FB1 Water Resources	30.4	29.6	30.3	48.3	17.0	37.6	32.8	36.7	31.5	39.7	45.0	39.8	418.7
1.2.8.4.7	30.4	29.6	30.3	48.3	19.4	89.7	36.6	36.9	43.4	109.7	59.6	40.3	574.2
*1.2.8.4	30.4	29.6	30.4	48.3	19.4	89.7	36.6	36.9	43.5	110.1	59.2	40.3	574.4
**1.2.8	39.2	36.7	39.4	57.2	26.7	97.1	43.6	48.8	51.0	119.3	66.9	48.8	674.7
OG912FA1 Participant Technical Project Office	25.0	23.2	27.3	25.9	29.0	22.2	24.1	42.8	25.4	45.6	44.0	62.7	397.2
1.2.9.1.2	25.0	23.2	27.3	25.9	29.0	22.2	24.1	42.8	25.4	45.6	44.0	62.7	397.2
*1.2.9.1	25.0	23.2	27.3	25.9	29.0	22.2	24.1	42.8	25.4	45.6	44.0	62.7	397.2
OG922FA1 Participant Project Control - USGS	21.4	18.6	18.1	20.5	17.5	19.9	34.8	12.5	20.2	24.7	26.8	27.6	262.6
1.2.9.2.2	21.4	18.6	18.1	20.5	17.5	19.9	34.8	12.5	20.2	24.7	26.8	27.6	262.6
*1.2.9.2	21.4	18.6	18.1	20.5	17.5	19.9	34.8	12.5	20.2	24.7	26.8	27.6	262.6
**1.2.9	46.4	41.8	45.4	46.4	46.5	42.1	58.9	55.3	45.6	70.3	70.8	90.3	659.8
OGC522FA1 Satellite Records Operations	3.8	3.5	4.7	4.2	4.2	3.9	4.0	4.8	4.2	6.4	15.2	19.4	78.3
1.2.12.5.2.2	3.8	3.5	4.7	4.2	4.2	3.9	4.0	4.8	4.2	6.4	15.2	19.4	78.3
*1.2.12.5	3.8	3.5	4.7	4.2	4.2	3.9	4.0	4.8	4.2	6.4	15.2	19.4	78.3
**1.2.12	3.8	3.5	4.7	4.2	4.2	3.9	4.0	4.8	4.2	6.4	15.2	19.4	78.3
OGF23FA1 Support/Personnel Services	32.4	28.7	35.4	25.6	22.5	27.7	25.9	35.2	29.9	42.9	49.0	83.0	438.2
OGF23FA2 Facilities Management - Space	61.7	61.7	61.7	61.7	61.7	61.7	64.0	59.3	61.7	61.7	61.7	77.9	756.5
OGF23FA3 Facilities Management - Computers/Phones	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	27.6	211.3
OGF23FA4 Facilities Management - Other	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	-26.3	111.2
OGF23FA5 Procurement/Property Management - USGS	10.2	11.0	8.0	7.3	11.5	9.9	8.5	9.9	9.2	7.1	7.2	11.3	111.1
1.2.15.2.3	133.5	130.6	134.3	123.8	124.9	128.5	127.6	133.6	130.0	140.9	147.1	173.5	1628.1
*1.2.15.2	133.5	130.6	134.3	123.8	124.9	128.5	127.6	133.6	130.0	140.9	147.1	173.5	1628.3
OGF3FA1 USGS Training Support	4.5	4.2	3.7	4.8	4.2	4.2	3.8	4.6	6.5	9.9	15.1	12.6	78.1
1.2.15.3	4.5	4.2	3.7	4.8	4.2	4.2	3.8	4.6	6.5	9.9	15.1	12.6	78.1
*1.2.15.3	4.5	4.2	3.7	4.8	4.2	4.2	3.8	4.6	6.5	9.9	15.1	12.6	78.1
**1.2.15	138.0	134.8	138.0	128.6	129.1	132.7	131.4	138.2	136.5	150.8	162.2	186.1	1706.4
1.2 OPERATING	1066.1	1021.1	1132.7	1305.8	1240.4	1347.2	1283.7	1366.5	1354.5	1378.2	1649.8	1911.2	16057.2
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	1066.1	1021.1	1132.7	1305.8	1240.4	1347.2	1283.7	1366.5	1354.5	1378.2	1649.8	1911.2	16057.2
FTEs													
FEDERAL	112.7	108.9	108.0	109.3	99.7	109.6	112.6	113.0	106.9	115.8	100.3	110.8	
CONTRACT	17.0	17.8	19.2	26.5	22.1	25.9	29.0	29.6	27.8	27.7	26.8	24.7	
TOTAL	129.7	126.7	127.2	135.8	121.8	135.5	141.6	142.6	134.7	143.5	127.1	135.5	

- * Fourth level WBS roll-up
- ** Third level WBS roll-up