General

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

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FROM: Charlie Nylander, ESH-18

DATE: November 20, 2000

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SUBJECT: **QUARTERLY MEETING NOTES – OCTOBER 3-5, 2000**

Attached are the minutes from the October 3-4, 2000 Hydrogeologic Characterization Program Quarterly Meeting held in Pojoaque, New Mexico. A number of major issues were discussed. These minutes are being sent to you because you have received a copy of the Laboratory's Hydrogeologic Workplan and a binder for the Annual Reports and Meeting Minutes or you have requested to be on the distribution list. If you are not interested in continuing to receive meeting minutes, please contact me at the address or telephone number listed below.

The action items resulting from the meeting are:

- Consider incorporating summaries of modeling publications into the annual report (LANL)
- Formulate a risk assessment subcommittee for the hydrogeologic workplan implementation (LANL)
- Consider periodic distribution of a one-page summary of well status to stakeholders (LANL)
- Develop better coordination of well "ownership" issues to facilitate access for evaluating post-fire water chemistry (LANL, stakeholders)

Please review these minutes for accuracy. If you identify substantive changes that should be made, please submit your comments to me in writing, or via e-mail at nylander@lanl.gov, or by telephone at 665-4681. Additionally, I would appreciate a reply from the New Mexico Environment Departments' Hazardous Materials Bureau indicating their concurrence with the meeting minutes and action items.

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K. Birdsell, EES-5, MS F649 , w/enc.
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A. Pratt, EES-13, MS M992, w/enc.
A. Dorries, EES-13, MS M992, w/enc.
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S. Bolivar, EES-13, MS H865, w/enc.
D. Daymon, EES-15, MS M992, w/enc.
E. Springer, EES-15, MS J495, w/enc.
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R. Vocke, EM/ER, MS J591, w/enc.
D. Hollis, EM/ER, MS M992, w/enc.
M. Cummings, EM/ER, MS M992, w/enc. , (2 copies)
B. Martin, E-ER, MS M992, w/enc.
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M. Cash, ESH-19, MS P-915, w/enc.
C. Bare, ESH-20, MS M887, w/enc., (3 copies)
P. Schumann, ESH-19, MS M992, w/enc.
J. Sisneros, F-1, MS P908, w/enc.
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Los Alamos National Laboratory
Hydrogeologic Characterization Program
Quarterly Meeting
October 3-5, 2000
Minutes

MEETING PURPOSE, ATTENDEES, AND AGENDA

The Los Alamos National Laboratory Groundwater Integration Team (LANL GIT) met with the New Mexico Environment Department (NMED), the Department of Energy (DOE), the External Advisory Group (EAG) peer reviewers, and stakeholders on October 3-5, 2000 to host the 4th Quarter Groundwater Meeting. The meeting was held at the Cities of Gold Hotel, Pojoaque, New Mexico. Charlie Nylander (GIT Chair) facilitated the meeting.

The following groups and stakeholders were represented (see List of Attendees for specific information):

NMED-Hazardous and Radioactive Materials Bureau
NMED-Groundwater Quality Bureau
NMED-DOE Oversight Bureau
New Mexico Attorney General
DOE-Environment, Safety, and Health
DOE-Environmental Management
DOE-Defense Programs
Nambe Pueblo
Cochiti Pueblo
Santa Clara Pueblo
San Ildefonso Pueblo
Northern New Mexico Citizen's Advisory Board
Concerned Citizens for Nuclear Safety
University of California
Los Alamos County
External Advisory Group (EAG)
LANL-Groundwater Integration Team (GIT)

The purpose of the Quarterly Meeting was to provide NMED, DOE, and stakeholders with information on LANL's groundwater protection efforts and present planned activities for the upcoming fiscal year. The meeting agenda was as follows:

October 3, 2000

Introductions
Groundwater Integration Team (GIT) Subcommittee Reports
- Information Management
- Well Construction
- Geochemistry
- Hydrology
- Modeling

Modeling Demonstration
Modeling Workplan
Detailed Description of Los Alamos-Pueblo Canyon Model
Groundwater Investigation Focus Area
Quality Assurance

Los Alamos National Laboratory
Hydrogeologic Characterization Program
Quarterly Meeting
October 3-5, 2000
Minutes

October 4, 2000
FY00 Performance Review
Regulatory Review
    RCRA/HSWA Permit Revisions
    Well Construction Issues
Uranium Chemistry Modeling in Los Alamos-Pueblo Canyon
Los Alamos Canyon Low Head Weir Monitoring
Cerro Grande Fire impact on surface water chemistry
Risk Assessment
EAG/Stakeholder session
LANL Response to stakeholder concerns

October 5, 2000
Modeling Demonstration
EAG Debriefing for Managers
EAG Debriefing for GIT

SUMMARY OF PRESENTATIONS AND DISCUSSIONS

October 3, 2000

Introduction
Charlie Nylander (LANL) welcomed participants to the Los Alamos National Laboratory Hydrogeologic Characterization Program combined quarterly meeting and Semi-Annual Meeting of External Advisory Group (EAG).

Information Management Subcommittee
Kendra Henning (LANL) described the progress on the Water Quality Database in the past quarter. The primary efforts were toward hardware/software, software development, report development, legacy data migration, lookup table standardization, and web access to fire data. The flow and chemistry data for runoff can now be accessed through http://www.esh.lanl.gov/~esh18/teams/GCFire/index.html.

Next quarter, the Water Quality Database work will focus on system in production on yellow and green, user orientation sessions, and continued software development, report development, and data migration.

Feedback on the reports, orientation sessions, and other aspects would be very helpful. Questions and answers included the following.

- What is the uncertainty in the data? The data are standardized to 1 sigma.
- Are there plans to be able to use the web page for statistics, such as average and mean? That capability is not there yet, but this is a perfect example of the type of feedback we need.
- What format can the data be downloaded in? Right now as PDF file, but we are working on text comma delimited file that can be used in spreadsheets.

Well Construction Subcommittee
David Broxton (LANL) summarized the well construction.

- R-9 in Los Alamos Canyon completed with a total depth (TD) = 771 ft, a single screen, two quarterly samples have been collected.
- R-12 in Sandia Canyon completed with a TD = 886 ft, three screens: one regional, two perched; one quarterly sample collected.

- R-25 in TA-16, repaired screen 3, bored through re-cemented screen 3 zone; installed Westbay and packers; achieved good seals and good sampling zones.
- R-15 in Mortandad Canyon completed with a TD = 1107 ft and a single screen interval in the regional aquifer, two quarterly samples have been collected.
- R-31 is located in the southwest corner of the Laboratory and the geology was different than anticipated. It was completed with a TD = 1103 ft and five screened zones.
- R-19 is down-gradient from R-25 and above PM well field. It was completed with a TD = 1903 ft and seven screens. There was some perched water but not as thick as at R-25.
- R-9i is an intermediate well about 30 ft from R-9. It was completed with a TD = 323 ft and two screens, one in the lower Cerros del Rio basalt and one in the upper massive basalt.
- CDV-15-3 was installed in TA-15 down-gradient from the HE sites, but closer to R-25 than R-19. It was completed with TD = 1722 ft and six screens. Westbay has been installed. The screening data had some J-flag hits of HE in upper perched zone.
- R-22 on the mesa top along the northern rim of Pajarito Canyon, near MDA G, has a projected TD of 1500 ft, but want to encounter the Santa Fe Group. The borehole was at a depth of 1233 ft as of yesterday, and expect to finish this week. There was water at 883 ft in basalt. The regional aquifer was projected at 922 ft, and it is unknown whether saturation is continuous below 883 ft, although the water level is stable. It will be completed with multiple screens. A tracer (KBr) for perched zone was added, but it may be causing corrosion of drilling equipment.

Geochemistry Subcommittee
Brent Newman (LANL) described the efforts of the Geochemistry Subcommittee in the fourth quarter of FY2000.

- R-19 - residual EZMud and total organic carbon
- LANL background hydrochemistry investigation
- TA-16 investigations
- R-15 completion report
- Surface water and groundwater, post Cerro Grande Fire

EZMUD is a big polymer chain that adsorbs on aquifer material to enhance borehole stability. It has a high negative charge density that can enhance the adsorption of cations. It is strongly hydrophobic so it probably has the ability to absorb organic compounds, like high explosives (HE). It has low solubility in water, but acidic additives can break up EZMUD. Aggressive well development removes EZMUD fairly well without adding additional chemicals, but not perfectly. Total Organic Carbon (TOC) is a good measure for tracking EZMUD. TOC decreases during development, but reaches a point where it does not decrease further. Recommendations: good development; measure pH, turbidity, and TOC; and use polymer titration to evaluate dissociation of EZMUD. Minimize EXMUD in places with known contamination. Continue to monitor, as it should break down over time.

Background hydrochemistry investigation selected areas to sample water from the three saturated zones (alluvial, perched intermediate, and regional aquifer) that have not been affected by LANL activities. In 2000, this study will validate groundwater data for major ions, trace elements; trace metals, radionuclides, and DOC fractionation; identify additional data needs for selected trace elements and trace metals; perform additional groundwater sampling in FY00 (pre- and post-Cerro Grande Fire, Sierra de los Valles springs); perform statistical analysis on groundwater samples; and prepare draft LANL background hydrochemistry report.

Results of investigations at TA-16 are as follows.

- Temporal and spatial variability in contaminant concentrations and other geochemical parameters/species are observed.
- Barium concentrations in groundwater and surface water are controlled by mineral solubility with $BaSO_4$ (oversaturation) and $BaCO_3$ (saturation) controlled by mineral solubility.

- Precipitation and dissolution could be controlled by evapotranspiration.
- Fractures and units control variation of HE concentrations in the subsurface with high permeability such as surge beds.
- Variations in nitrogen isotope ratios within Canon de Valle suggest there are multiple sources of nitrogen.

The R-15 Completion Report is done. The nitrate and perchlorate profile in R-15 has been confirmed by additional analysis. It includes final data and duplicate samples. The profile based on this data is similar to profile based on preliminary data.

Surface water chemistry post-fire has been tested. There is an increase in Mn in Pine Spring, Garcia Canyon. Los Alamos Canyon has a seep below the reservoir where an algal mat has formed. The chemical composition of the algal mat was compared to surface water, and there is an increase on algal mats for all parameters. Big enrichment in algal mats. Algal mats had been present in some locations before the fire, e.g. at Martin Spring.

Hydrology Subcommittee
David Rogers (LANL) reviewed the Hydrology Subcommittee's responses to EAG recommendations, as described in the September 2000 Action Plan.

- Use of supply wells: In order to use the supply well, it would be necessary to turn off all the wells in a field. This could be done in the low demand season (winter). Some of the planned R wells are located near production wells and could be used as observation wells.
- Water samples to outside labs: Water samples are being analyzed by outside labs.
- Spinner tests from production wells determine whether production is from shallow or deep in regional aquifer. The presence of perchlorate, tritium, and nitrate in O-1 could argue for making O-1 into a monitoring well. There has been no spinner testing in O-1, but there has been spinner testing in the Guaje wells. The production in the Guaje wells is from shallow in the regional aquifer, and therefore would speculate O-1 is producing from the same zone.

Bill Stone (LANL) discussed well development for the R-wells. Well development has three purposes: to remove fines and drilling fluid, create stable zone of filtration, and increase hydraulic conductivity near well.

Well development is by combination of four methods. A two- or three-stage protocol using these methods is formulated at each well. The methods are jetting, bailing, airlifting, and pumping.

Development of R-19 was presented as a well development case study.

Problems observed in well development include the following.

- Not enough surge, which pushes water into and out of formation. Surging is good, but difficult. Surging can cause collapse of filter materials if the material is bridged. Using surge blocks, swabbing, and pressure jetting is recommended. Moved pump up and down, similar to surging, in R-25.
- Many development methods are not screen-specific. Using assemblies with a pump between two packers has been recommended to be able to develop each screen in isolation.
- Screens are too tortuous. The flow path through the screen makes it difficult for solid materials to get through. Using simpler screens has been recommended.
- Poor performance in hydrologic testing. It is not known if this is due to low hydraulic conductivity zones or poor development. It is recommended that screens not be placed in low hydraulic conductivity zones and use more thorough and aggressive development.

Additionally, the data report on the lab-tested hydrologic properties of core from R-9, R-12, and R-25 is now available.

Steve Mclin (LANL) discussed the hydrologic testing that has been conducted. The purpose of hydrologic testing is to determine representative values for hydraulic conductivity and storativity; measure vertical gradients over time, which is easy in multiple screened Westbay wells; and field input for modeling effects. The methods include pumping test which pumps water to create cone of depression and analyze data by multiple methods to get range of hydraulic conductivity and slug test which adds water to well and measures drop in water as the water enters formation.

Recommendations are to:
- use longer testing periods;
- conduct repetitive tests;
- use alternatives, such as combined slug withdrawal and injection, pump tests with straddle packers, and dipole test configuration; and
- modify well design to support alternative methods:
  - larger diameter wells,
  - simpler well screen (e.g., louvered),
  - shorter filter packs around screens, and
  - closer seal placement above and below filter pack.

In response to a question regarding use of geophysical logging to estimate hydrologic parameter, Steve Mclin (LANL) said that geophysical logs from R-31, R-19, and CDV-15 will provide permeability for comparison with *in situ* hydrologic testing.

Modeling Subcommittee
Bruce Robinson (LANL) started the report with responses to EAG comments on modeling. He then described the modeling accomplishments.
- Regional aquifer
  - Simulated pump tests to recommend sites for R-5 that would make it useful as an observation well for hydrologic tests in O-1
  - Completed 3D simulations of stable isotope transport
  - Initial modeling of major chemistry as influenced by advection, dispersion, and mineral weathering reactions
  - Interpretation of permeability data
  - Long-term aquifer response to pumping
  - Relation between permeability and geologic model
  - HE transport from TA-16
- MDA and Canyons modeling
  - Vapor plume at MDA L; published as a LA-UR report and on web
  - TA-16 HE: probabilistic risk assessment; process models; and Gold Sim risk assessment model
- Initiated a probabilistic approach to groundwater risk assessment with an overall systems model that uses probability distribution of input and has output as a distribution.

Bruce Robinson (LANL) said that the modeling group also has done some post-fire refocusing of priorities, largely assessing the potential effects of high infiltration from flooding, contaminant redistribution, and geochemical effects on transport.

Modeling Demonstration
Bruce Robinson (LANL), Philip Stauffer (LANL), and Marc Witkowski (LANL) demonstrated how the database and GIS system support the modeling and provide the tools to visualize the modeling results.

The demonstration focused on Los Alamos Canyon and simulated the hydrologic response to an area of ponded water near the confluence of Los Alamos and DP canyons.

Questions on the demonstration focused on the quality assurance aspects of modeling, suggestions for a date stamp mechanism, QA of tools (e.g., the tool that displays measured and modeled moisture content profiles side-by-side), and inclusion of error bars so that it would be clear when the model results are within the uncertainty of data.

Modeling Workplan
Charlie Nylander (LANL) provided an overview of the proposed revisions to Section 3 of the Hydrogeologic Workplan regarding information management and modeling activities. Information management will consist of two complementary and compatible databases: Water Quality Database and ER Project Database. Modeling activities consist of supporting models (geologic and geochemistry), process models (FEHM applied to vadose zone and saturated zone), and coupled systems model (Gold Sim). The purpose of modeling is to assimilate and interpret data, site and prioritize wells, and communicate understanding of the hydrogeologic setting of the Pajarito Plateau.

Questions and discussions included the importance of incorporating uncertainty in the geologic model most important, particularly where geologic properties affect transport properties and matrix-dominated flow in the Otowi. However, conditions near the Los Alamos Canyon low-head weir include more basalt and probably have fracture flow.

Detailed Description of the Los Alamos Canyon Flow and Transport Model
Bruce Robinson (LANL) reported that the process for construction model is a synthesis of a variety of data sources: geologic model, water budget study, moisture content, hydrologic property contaminant transport, and locations of perched zone. Flow calibration allows central tendency of properties to be bounded. Tritium travel times of 40 years through vadose zone are explained by model. Cerro Grande Fire may influence subsurface contaminant migration if increased infiltration persists for several years as result of ponding.

Groundwater Investigations Focus Area
David Broxton (LANL) described the Groundwater Investigations planned activities for FY 01.

- R-5 is a NWT-funded well with a planned TD of 1200 ft to be completed as a multiple screen well. It is located between O-1 and the Los Alamos County wastewater treatment plant. The primary purpose will be to determine hydraulic properties, not as a sentry well.
- R-7 is located south of MDA V. It is an ER-funded well planned to be 1500 ft deep and completed with multiple screens. The primary purpose will be to monitor for contaminant on regional aquifer, verify perched zones, and identify additional perched zones if present. It is located in a recharge area and will provide information on stratigraphic and structural controls on infiltration. It was started this summer, with casing installed down to 18 ft. It was subsequently flooded with water and was sealed off.
- R-8 was located near the DP confluence, but would like to move the location about three-quarters of a mile down because data from TW-3 and O-4 is available; therefore, would like to have more distance and opportunity for infiltration from the discharge from DP Canyon. It is a NWT-funded well with a planned TD of 1420 ft to be completed with multiple screens. The primary purposes are to detect contamination in saturated zones (it will be down-gradient of all major Los Alamos Canyon sites) and verify perched zones and depth to the regional aquifer.
- R-13 is a possible third well if funding is available. It would be an ER-funded well in Mortandad Canyon downstream of the TA-50 outfall and would be completed with multiple screens. The purpose would be to determine the impact from the outfall on the intermediate perched zone and the regional aquifer.

- R-22 is currently being drilled. It is located on the mesa just east of MDA G in Pajarito Canyon watershed. It is an ER-funded well with a planned TD of 1500 ft. It is anticipated that R-22 will be penetrated to the Santa Fe group because no well in this program has yet reached the Santa Fe. The regional aquifer was encountered at 883 ft. R-22 will serve as a monitoring point for TA-54 and will collect data to support the Area G Performance Assessment.
- R-27 is located in Water Canyon. The location shown in the Hydrogeologic Workplan was moved down canyon due to logistical problems. It is an ER-funded well with a planned TD of 1000 ft and will be completed with multiple screens. The purpose is to assess the nature and extent of potential groundwater contamination in perched zones and regional aquifer and to reduce hydrologic uncertainty. There are currently no wells deep enough in Water Canyon to find perched zones. It is down-gradient from the HE area.
- CDV-R-27-2 is located in Canyon del Valle within TA-27 and on the mesa top southeast of R-25. It is an ER-funded well with a planned TD of 1900 to1950 ft and will be completed with multiple screens. This is one of three wells that have been added to the ER Project in response to the contaminants found in R-25. The purpose is to define the plume, measure water quality, and obtain water level data for the perched zone.
- Intermediate depth wells in ER baseline are placeholders, two will be in Mortandad, and both are located up-gradient of R-15. Saturation was expected in the Guaje pumice and the Cerro Toledo in R-15. Neither was saturated, but water was found in the basalt. Both of the intermediate wells are targeting perched water. It is important to do these wells this year because they are a commitment for the TA-50 discharge plan.

To accomplish the wells listed above, two drill rigs will be used: Rig 1 for R-22, R-7, CDV-R-27-2, and R-13; and Rig 2 for R-27, R-5, MCOBT-1, MCOBT-2, and R-8.

Quality Assurance
Andrew Gallegos (LANL) said that a Management Assessment was conducted to assess the Groundwater Investigation Focus Area's effectiveness in meeting the requirements of the ER Project Quality Management Plan, specifically drilling activities associated with R-25 and CDV-R-15-3. The Management Assessment identified problems, requirements, and corrective actions to address the identified nonconforming conditions. Problems were observed in meeting requirements in all 10 of the ER Quality Management Plan elements.

Recurrence Prevention
- Identify, document, and report nonconforming conditions
- Conduct self-assessments of processing
- Conduct management walk-arounds
- Manage verbal/visual support of quality

Conclusions
- Past: noted lessons learned and corrective actions were not implemented as expected and/or required
- Present: noted nonconforming conditions are being addressed by management
- Future: quality improvement action here?

October 4, 2000

Review of LANL Hydrogeologic Characterization Program FY00
Charlie Nylander (LANL) reviewed the program from a technical and budget standpoint. The presentation provided a program description, regulatory framework, accomplishments, issues, budget performance, and FY01 proposed budget.

The Laboratory accomplishments are as follows.

- Drilled and constructed four wells (R-19, R-9i, CDV-15, and R-31); completed four wells (R-15, R-25, R-9, R-12); started drilling R-22
- Conducted two rounds of quarterly sampling (R-9, R-9i, R-12, R-15)
- Completed Well Completion Reports for R-9, R-9i, R-12, R-15, R-19
- Produced the FY99 Groundwater Protection Program Annual Status Report, published as a LANL Status Report (LA-13710-SR)
- GIT participated in LANL ESH Division Review and the presentation was rated as "outstanding" and received Los Alamos Achievement Award
- Developed a stochastic approach to modeling variations in hydraulic conductivity within the Puye Formation for the regional aquifer model
- Evaluated pump test simulations for possible O-1/R-5 cross-hole testing in support of R-5 siting decision
- Analyzed site-wide hydraulic conductivity trends using hydraulic conductivity data, water levels and inverse modeling
- Updated Los Alamos Canyon model, including predicting potential impacts of the Cerro Grande Fire
- Completed Area L organic vapor plume study, documented in a written report and web-based presentation.
- Hosted a field trip of characterization activities for the National Groundwater Association
- External Advisory Group produced two reports and Groundwater Integration Team (GIT) responded with two action plans
- GIT Risk-Based Decisions Subcommittee formed
- Underwent a Management Assessment for compliance with ER Project QA Plan
- Database runoff flow and chemistry modules available to public at http://www.esh.lanl.gov/~esh18/teams/GCFire/index.html
- Incorporated DP Monitoring Well Project into ER Project Planning and Control System (PP&CS)
- Produced monthly joint DP/ER status reports
- Held GIT biweekly meetings, three quarterly meetings, and the annual meeting
- Successfully awarded a task order for ER Project Groundwater Investigation Focus Area field support and drilling
- Underwent an audit for compliance with LIRs by the Project Management Division
- Prepared data reports on the mechanical testing of hydrologic properties on samples from R-9, R-12, R-25
- Produced an expanded Hydrogeologic Atlas
- Implemented well head protection after Cerro Grande Fire
- Developed a proposal for monitoring at Los Alamos Canyon low-head weir

Charlie Nylander (LANL) discussed the following issues and described resolutions for each issue.

- R-25 repairs: repairs to screens 3 and 9; schedule impact of 19 months and cost impact of $1.5 million.
- Cerro Grande Fire: schedule impacts due to LANL closure and potential flooding in canyons; chemical changes in runoff may affect groundwater, and engineered flood control structures may cause perturbations in the hydrogeologic system.
- Well construction problems: R-19 had schedule delay for dropped packer; CDV-15 has bentonite seals offset and present in some screened intervals; NMED has expressed concern regarding usability of data from R-25 and CDV-15.
- Drilling subcontract re-bid: award of task order was later than anticipated, limiting the amount of planning for FY01 activities that could be accomplished in FY00; and structure of RFP may constrain the use of multiple drilling contractors.

- Budget shortfall: $300,000 less allocated in FY00, R-25 required $1.5 more than expected, and ER funding diverted to fire recovery; caused postponement of R-5 until FY01 and delayed modeling in the last quarter.
- Early FY00 delayed start: due to October 1999 decision not to drill R-31 and other wells with mud and procurement delays, drilling did not start until second quarter.
- Quarterly sampling: the schedule was impacted by staffing limitations, training delays, Cerro Grande Fire, and SOPs.

The total cost of the Hydrogeologic Characterization Program from 1997-2000 is:
(Note: These figures have corrected the errors in the handout material.)

Alluvial wells	$ 431,747
Default	($ 12,858)
GIT	$ 102,573
Modeling	$ 837,012
R-12	$ 2,231,690
R-15	$ 1,630,357
R-19	$ 2,717,391
R-22	$ 724,535
R-25	$ 4,648,469
R-27	$ 12,672
R-31	$ 1,885,730
R-5	$ 25,444
R-7	$ 331,139
R-9	$ 2,792,725
R-9i	$ 277,683
Total	**$18,636,309**

The proposed budget for DP funding for FY01 is:

Modeling	$ 300,000
Information Management	$ 100,000
GIT Activities	$ 50,000
Wells:	
R-25 Quarterly Sampling	$ 250,000
R-31 Quarterly Sampling	$ 200,000
R-5 Construction	$1,819,000
R-8 Construction	$ 200,000
Total	**$2,919,000**

RCRA/HSWA Groundwater Monitoring Requirements Overview
Alice Barr (LANL) provided an overview of RCRA groundwater monitoring requirements. For regulated units after 1980, the requirements are in CFR 264 subpart F. LANL has regulated units, for example in TA-54 Areas G and H and Area P. For regulated units, monitoring is not required if there is no potential to impact groundwater, the unit has been clean closed, or a groundwater monitoring waiver has been granted. If monitoring is required, there are three structured sequential monitoring programs: detection, compliance, and corrective action.

Detection Monitoring Program
- Parameters or constituents are to be monitored based on the type, quantity, and concentration of waste constituents in the unit; mobility, stability, and persistence in unsaturated zone; and detectability in groundwater; and concentration in background.
- If "detected", institute compliance monitoring program.

- "Detected" is defined as statistically significant evidence of contamination based on comparison of groundwater quality upgradient and is unaffected by unit to groundwater that passes beneath the unit measured at the point of compliance.

Compliance Monitoring Program
- A groundwater protection standard is established that includes a list of constituents, concentration limits, point of compliance, and period of compliance.
- If concentration limits are exceeded, institute corrective action program.
- "Exceeded" is defined as statistically significant evidence of increased contamination.

Corrective Action Monitoring Program
- Requires action taken to prevent hazardous constituents from exceeding concentration limits and a groundwater monitoring program established to demonstrate effectiveness.

None of the groundwater monitoring requirements for regulated units is applicable until characterization is complete.

The groundwater monitoring requirements for other units are to characterize hydrogeology and, if present, characterize contaminant plume. Monitoring will not be required unless it is established that there has been an actual release that is a threat to human health or the environment.

Summary
- The performance standard for wells is to produce representative samples.
- The director has flexibility in applying requirements.
- LANL in characterizing mode --- no monitoring requirements established yet.
- The Hydrogeologic Characterization Program intends to locate and construct characterization wells such that they may be usable in a monitoring program should it be determined to be appropriate and necessary.

HSWA Permit Revisions and Well Construction Issues
Bob Hull (LATA) explained that over the past year LANL and NMED have worked in a cooperative manner to improve the language of the LANL Hazardous Waste Facility permit. Part of the effort to develop the new permit has focused on requirements for drilling and well construction. The original permit was developed at a time when groundwater investigations focused mostly on alluvial groundwater conditions. The construction of intermediate perched and regional aquifer wells necessitates the addition of requirements appropriate to drilling and well construction in these deeper systems.

In the existing 1994 permit, the "Guidance for Borehole and Well Construction for Groundwater Investigations" is covered in Special Permit Conditions within Module VIII in Section 1: Perched Water Monitoring and Section 4: Protection of the Main Aquifer. Section 1 specifies the installation of 14 wells in saturated alluvium of seven canyons. The well construction requirements are specifically for these 14 alluvial wells, but the permit is written such that these same requirements apply to any new monitoring well, including intermediate-depth and regional aquifer wells. The following well construction requirements should be modified for intermediate-depth and regional aquifer wells.
- borehole diameter
- well screen length
- filter pack length
- method of sealing off perched zones
- methods of well development
- basis for determining filter pack size
- materials used for constructing wells

Overall, there was a recommendation that the permit be revised to include performance standards for wells, rather than specifications.

Geochemical and Reactive Transport Modeling of Uranium in Upper Los Alamos Canyon
Bruce Robinson (LANL) said that uranium has been found in surface sediment, surface water, alluvial water, and perched intermediate zone water in Los Alamos Canyon. It is necessary to understand how the uranium moves through the environment. There is a strong possibility that uranium sorbed onto colloids may be why uranium is in the perched intermediate zone in R-9. The State has expressed concerns that colloids are under appreciated.

Members of the Geochemistry and Modeling GIT subcommittees have developed models for simulating the transport of uranium in upper Los Alamos Canyon. The modeling efforts have resulted in the following observations so far.

- Dissolved species of uranium (VI) are mobile in groundwater under alkaline pH conditions, and thus do not completely adsorb to hydrous ferric oxides.
- Transport of uranyl species under fracture flow conditions is a viable process.
- Colloidal transport is possible in which the uranyl cation (UO22+) adsorbs onto hydrous ferric oxide under near neutral pH conditions.
- Characterization at the Los Alamos Canyon low-head weir site and monitoring at R-9I shall provide additional geochemical data and information.
- Additional characterization of hydrous ferric oxide and other adsorbents (clay minerals) is warranted to further validate model simulations.

Los Alamos Canyon Low-Head Weir Monitoring
Gilles Bussod (LANL) explained that a low-head weir was installed for flood control purposes in Los Alamos Canyon where State Route 4 crosses the canyon. The structure is intended to temporarily pond water, but there are concerns that the ponded water may impact the underlying groundwater. Within the basin upstream of the low-head weir is a mound of fractured basalt that has been exposed by the excavation of the basin. This fractured basalt may provide a direct pathway to the intermediate perched water within the basalt found in R-9. It was determined that monitoring of the low-head weir site is warranted and has received funding. The monitoring objectives are:

- monitor infiltrating water and contaminant chemistry through vadose zone,
- monitor hydrologic and hydrochemical characteristics of perched water,
- characterize the hydrochemical evolution of the vadose zone and assess impact of flooding in LA Canyon,
- verify and validate models of flow and transport through the Cerros del Rio basalt,
- integrate findings with the regional well characterization,
- assess surface contaminant distribution and the impact on subsurface migration, and
- provide recommendation on viability of low-head weir.

The approach is to drill and install three wells: one vertical well to be completed with a single screen in the lower perched zone (defined at R-9) and two angled boreholes that would intercept water infiltrating from the low-head weir basin. The angled boreholes will be completed with an instrumented multi-layered membrane (FLUTe, Inc. and SEA). The monitoring system will be completely deployed by end of December 2000.

The State representatives expressed a concern that a similar monitoring system is needed in Pajarito Canyon associated with the flood retention structure.

Cerro Grande Fire Impact on Surface Water Chemistry
Bruce Gallaher (LANL) described the key trends in stormwater quality observed through August.

- Not detected so far: HE, mercury, dioxins, furans, PCBs, benzo(a)pyrene, hexachlorobenzene
- Few organic chemicals
- Metals and minerals elevated: manganese, calcium, potassium, phosphorus
- Radioactivity dissolved in water about same as pre-fire
- Radioactivity of sediment in the water is elevated compared to pre-fire levels: Pu-239, 240; Pu-238, Cs-137
- Cyanide detected
- pH increases (up to 1 unit) noted
- Cs-137 high at west Laboratory boundary

The Multi-Agency Flood Risk Assessment Team will review all of the stormwater data and other data collected on the Laboratory. This team consists of representatives from NMED, NM Department of Health, LANL, and assistance from pueblos and other agencies. Additionally, the NMED DOE Oversight Bureau has hired an outside contractor to conduct an independent risk assessment.

Ensuring Acceptable Risk: The Ultimate Data Quality Objective
Diana Hollis (LANL) described the ER Project organization and the Analysis & Assessment Focus Group, which includes Data Analysis, Data Acquisition, Strategic Decision Analysis (including risk-based decision support), Integrated Modeling, Risk Assessment (human health and ecology), and Peer Review.

The Risk-Based Decision Support Team has the following responsibilities within ER.

- Ensure and enable a risk-based approach to corrective actions, as endorsed by EPA and NMED.
- Use risk assessment as the ultimate data quality objective (DQO) for decisions regarding site characterization and site remediation.
- Address groundwater contamination in both site-specific and cumulative (multiple sites) risk assessments.
- Keep pace with conceptual model revisions under HWP.
- Implement processes and tools developed by the international radioactive waste repository community to document and justify conceptual and simulation models.
    - Hazard Identification
    - Decision Logic
    - F(eatures), E(vents), P(rocesses) lists
    - Interaction Matrix
- Employ risk-based corrective actions borrowed from EPA for contamination in groundwater.
- Focus attention and resources on groundwater contamination that poses the greatest risk.
- Understand the system to ensure that remediation decisions provide the greatest risk reduction within the system.
- Make decisions that provide the greatest real risk reduction per dollar invested.
- "Decouple" corrective actions for surface, vadose-zone, and shallow groundwater from corrective actions for deep groundwater to ensure parallel progress.
- Integrate investigations of regional aquifer contamination with hydrogeologic characterization project (R-wells).
- Assimilate R-well data with all other ER data into a conceptual exposure model to support risk assessment.

Integrated Modeling goals are as follows.

- Ensure that "models" used to support risk-based corrective-action decisions are Documented.
  - validated (to the extent possible)
  - transparent
  - based on site-specific data
- Ensure integrated development of data models and simulation models.
- Ensure documented and reproducible ("third-party implementable") processes and procedures for the following.
  - data collection (with risk-based DQOs)
  - data management (FIMAD, ERDB, 2D hydrology atlas)
  - data modeling (geochemistry, geology, hydrology)
  - fate and transport modeling (CAD-based grid generation, FEHM, GoldSim)
  - risk modeling (RAGS, RAGS3)
- Ensure integration of geologic, hydrologic, geochemical, and contaminant data.
  - 2D hydrogeology atlas
  - 3D geology model
  - geochemical data model (e.g., uranium reactive transport model)
- Begin with vadose zone processes and work down stratigraphically.
- Ensure development of calibrated (validated) site-specific groundwater models.
  - Injection Well Test, TA-50
  - Vapor Plume, TA-54
  - Los Alamos Canyon
- Ensure development of models that provide information to support risk-based decisions.
  - MDA G, TA-54
  - MDA AB, TA-49
  - GoldSim

ER Integration with GIT includes the following.

- Risk-Based Decision Support subcommittee of GIT could ensure necessary integration.
- Risk-Based Decision Support subcommittee could include ER Team Leader(s), GIT Chair, GIT Subcommittee Chairs, and NMED, DOE-OB, and Pueblos,
- DP and EM must support subcommittee financially and philosophically.
- Without risk "endpoint", when is characterization done?

Stakeholder Session

Notes from the stakeholder session shall not be published.

The stakeholder session provides the EAG the opportunity to hear stakeholder concerns. The session conducted without Laboratory represena5tives present in order to encourage candid responses from stakeholders. Notes are used by the EAG in their analysis of the HWP and in formulating recommendations on improving its implementation.

During the stakeholder session, the EAG chairman (Bob Charles) summarizes the concerns and presents them to the HWP program manager (Charlie Nylander) who then responds in the presence of stakeholders and Laboratory representatives.

Response to Stakeholder Concerns

Concern 1: Modeling Versus Monitoring
The stakeholders had some questions concerning uncertainties, how models will be applied, how they will be tested, how data will be acquired, whether the conceptual models are right, and the question of simultaneous water level measurements. Charlie Nylander (LANL) responded to the questions with the following comments.

- Modeling does not obviate the need for field measurement; it is not a case of either/or.
- The lab always has monitored and always will.
- If decisions are made to leave contaminants in place, monitoring will still be done.
- Dialogue is just now beginning regarding long-term monitoring.
- Efforts will be made to validate models using real data. Examples include the use of NO3 and ClO4 data in Mortandad Canyon and the finding of high explosives in R-25 resulting in drilling two new down gradient wells.
- Regarding water level data, the lab will develop a lab-wide approach to data collection, possibly automating data collection using transducers in some R wells and alluvial wells. Water level data are available in well completion reports, the Annual Groundwater Status Report, surveillance reports, and the database.
- Regarding uncertainties, attempts will be made to better refine the more sensitive model parameters such as infiltration, hydraulic conductivity, and porosity. Attempts will be made to get better field data for better verification.
- Regarding default numbers, in some areas of the lab it is necessary to rely on literature values. However, as much site-specific data will be gathered as possible.

Concern 2: Publication of Modeling Results
Charlie comments regarding the publication of modeling results are as follows.

- Modeling demonstrations at this meeting have provided some information.
- Each year, very detailed reports are generated. Perhaps the essence of these reports should be extracted for the Annual Groundwater Status Report.
- ER generates releases on their entire final modeling reports.

Concern 3: Risk Assessment
Stakeholders expressed concerns that risk assessment may not be appropriately incorporated into the Hydrogeologic Characterization Program. Charlie Nylander (LANL) responded to the concerns by stating that formulation of the risk assessment subcommittee is still being assessed and planned.

Concern 4: Intermediate Wells
The consensus of the stakeholders was that they want more locations and faster completion of these wells. Charlie Nylander (LANL) responded as follows.

- Funding is limited.
- For FY00, one intermediate well is planned for Los Alamos Canyon, and two intermediate wells are planned for Mortandad Canyon for FY01.
- Most of the emphasis is on the R wells since they pass through the intermediate zone and thus provide some data. When appropriate, an intermediate well will be added adjacent to an R well.

Concern 5: Status of Wells
There was some question of distribution of information acquired from the wells including an evaluation of the quality of the data. Charlie Nylander (LANL) responded:

- Data can be shown at public meetings.
- News releases can be used if the information is of interest to the public.
- Data have only recently become available; for example, the R well sampling only started in May 2000.
- We now have two quarters of sampling.
- Well completion reports will include data on water quality, geophysics, test results, etc.
- Typically, data are assembled and sent to NMED (the raw analyses are quite bulky).
- The over-arching goal is to get the data into the database.
- Data will be summarized in the Annual Groundwater Status Report.
- Presently, NMED gets a summary sheet in 30 days and a complete, voluminous report in eight months. Perhaps an intermediate report needs to be created by the lab to fill in between these extremes, such as an interim well completion report.
- A periodic one-page summary for each well would be do-able.

Concern 6: Post-Fire Chemistry
Stakeholders expressed concerns that the LANL response to evaluating the impacts of post-fire water chemistry is hampered by different Laboratory groups "ownership" of wells, making access to wells more cumbersome. Charlie Nylander (LANL) concurred that this is a concern and committed to working with the various groups to develop better coordination.

Concern 7: Long-Term Stewardship
Stakeholders expressed concerns that the long- term stewardship lessons learned from other DOE facilities are not being incorporated into the groundwater program. Charlie Nylander (LANL) responded:

- Diana Hollis has attended a conference on this issue.
- Addresses the long term, such as 50 years or more.
- This effort is in its infancy.
- Present, or at least recent, thinking is in the five to ten year time frame.
- The surveillance group will be meeting to talk about this.

Concern 8: Standards/Action Levels
This topic has taken on a new definition, from the previous confusion over jargon to present concerns that contaminants below action levels may be ignored. Charlie Nylander (LANL) provided the following comments.

- Any hits, even those below the MCL or action level are still investigated and considered significant in terms of sources/risk/conceptual model. They are not discounted.
- Hits above MCL or advisory limits trigger more rapid action. Detailed response criteria on what action to take for the R wells have been disseminated previously.
- Examples of due concern are the fact that non-detects down gradient of R-25 have not caused dismissal of the potential problem of high explosives in groundwater; and contaminants in R-15 were below the MCL and yet two down gradient wells are planned.

Concern 9: Drilling Contract
There were concerns about costs, delays, benchmarking the costs, QA/QC, and "open wallet" policy. Charlie Nylander (LANL) responded to the stakeholders comments.

- Tracking costs has demonstrated that there has been significant cost reduction with each well drilled.
- For each completion method attempted, there seems to be a learning curve. Once the learning has taken place, the costs come down rapidly.
- DOE is benchmarking LANL costs versus NTS and White Sands, but the comparison is "apples versus oranges" because of different conditions.
- Lab costs are high because of the drilling method needed, escorts required, lab analytical processes (full suites of tests), backfilling requirements and different DQO's.
- Costs will continue to come down in the future, as we get better at drilling and completing the wells.
- The lab is striving to get experienced drillers.
- The lab is pursuing hiring Schlumberger's Integrated Project Management Division to evaluate the approach to project management and investigate cutting out non-productive time.
- The procurement process leaves little "wiggle room" for hiring more expensive contractors; i.e., usually the low bid is accepted.
- More supervision/oversight will likely be required.
- Efforts will be made to get the most experienced help.
- Timely efforts will be made to recover costs when the contractor is at fault.
- There may be possibilities to negotiate with other contractors, even if they are higher priced, to try out their services so that the relative quality of their work can be judged.

October 5, 2000

External Advisory Group Closeout with GIT
Bob Charles (EAG) discussed the management closeout session. There was concern that morale might be low, based on stories in the Lab "Reflections" publication which stated that morale is at all time low. However, it was found that this operation has high morale. The fact that there are definite goals seems to help. The EAG has been working with management to agree on high level products. Now there needs to be agreement at the working level, e.g. modeling discussion. John Young requested to see a sample example: parameters, level of confidence in parameters, output, and confidence. The EAG urges management to make the modeling an effective communication tool.

David Schafer (EAG) stated five points.

- In the last year the GIT has been successful in streamlining well construction and drilling. Reached good compromise on size and schedule. Sensed frustration that holes are still too small to do some sorts of testing. When evaluating changes in hole size, be cautious of costs and other verifications and implications –casing orders; will help as requested.
- Filter packs: Recommended lengthening filter pack. Discussion with State about changing from two ft to five ft. Recommended longer. Takes more time to place. Settlement of filter pack can result in filter pack below the screen. At CDV-15 very lucky not a worse problem. Heard statement that filter packs short-target certain zones. There is still water getting into screen zones from natural materials.
- Conversations with various people suggest that cement is not being placed in every blank segment. That should be standard practice. Helps keep filter pack in place.
- There appears to be no set criteria for screened placement, and this depends on who is here. David Broxton tried to address in well completion reports. Looking for permeable zones and perched zones. Geophysics on open holes has been good. Decisions take place after all the data for the well is here. Tried to document on completion report, but need to have procedure for doing that.
- Keep the EAG more in the loop for hydraulic tests. Example, R-5 as an observation well for pumping tests. Without spinner log in 0-1, can not nail all parameters. Would like to see rationale, what is planned, and what is anticipated to come out of it.

Jack Powers (EAG) said the program got flack from NMED on their concerns regarding sufficient funds to complete project, but still feels the schedules can be met even though the fire slowed drilling down. The package that the driller takes to field is multiple: casing advance, air lift, and mud. Sufficient equipment and supplies to support any type of drilling now back up this package. The drilling is very tough. Those with experience get better at it, but the EAG is comfortable with having more than one drilling company. MK can run more than one drilling company successfully. I believe we can meet schedule. Anticipate that the current driller will have an improved record. It is recommended that the GIT demand that the driller bring in the best people, which will probably increase production.

Bob Powell (EAG) has praise for the job being done. Impressed with accomplishments: wells completed, sampling done. However, SOPs need to be in place. On completed wells, need to use more techniques. Develop each zone independently. Some will be over-developed and some under-developed when not done separately. Good in the inclusion of QA. Suggest focus on where this program will end up, need to develop end points and confidence levels. Looking at it in a simple manner: 32 wells, 4 points in each; and 51 alluvial wells - can use this to develop a level of confidence. Start negotiating now on what is acceptable.

Charlie Nylander (LANL) said based on observations from presentations, the EAG received information that is a direct response from the last EAG report. The fire did sidetrack modeling and redirected the types of modeling, so the EAG will have to wait until March 2001 for additional regional aquifer modeling.

Charlie Mclane (EAG) asked, programmatically, does modeling make sense and are work products acceptable? EAG has asked for more programmatic information and has received the revised Section 3 of the Hydrogeologic Workplan. That was helpful, but more detail is needed. Also, need a corresponding plan for ER modeling. Diana Hollis (LANL) responded that all of the ER modeling is in the revised Section 3. There will be site specific decisions for ER, but the modeling process and plans for using modeling are the same. Charlie Mclane (EAG) has kept trying to understand the differentiation between site-wide modeling and remedial action decisions. The characterization of site will only go so far, and ER is going beyond that to look at fate, transport. It is a dense document. Tried to be comprehensive, but have clear differentiation. Julie Canepa (LANL) said an effort was made to separate the Hydrogeologic Workplan from site-by-site decisions. Although an integrated modeling program is desired, it is used for different decisions. Charlie Mclane (EAG) has had concerns early on, but can see that progress is being made. Questions regarding progress versus budget have been raised. The focus is on 32 wells, but there are other factors. The wells are just the data, the analysis and modeling are going to provide the tools to find the answer.

Betty Anderson (EAG) said that the EAG has some suggestions about risk assessment. Early in the process, recommendations were made stating that risk must be addressed. The focus is on how past, present, and future activities will impact human health. The Risk-Based Subcommittee and ER support are to be applauded. However, the subcommittee must have resources that are institution-wide and access to stable interdisciplinary technical team. This program has challenging risk issues. The subcommittee must identify what is same as ER and what is different. Include in report elements for framework for approach. It is never too early to allow risk assessment overlay to guide program activities. This could help address remediation information. What role can modeling play; when to do exposure assessment - - what observations in a well would propel further work. Special issues that must be addressed are:

- the role of colloidal transport, and
- toxicity:
  - -totality column to rank chemicals that could be encountered. Screened ready to go
  - -use to guide geochemistry
  - -validating models to predict

-set to go on issue of finding contamination
-role of uncertainty and variability.

Gene Turner (DOE/LAAO) asked if the EAG thought the costs are reasonable. There is some benchmarking at NTS and other sites, but our sites are higher. Bob Charles (EAG) noted that a benchmarking study is recommended. Will provide some structure on our reports on a comparison with drilling costs. Jack Powers (EAG) has older cost from NTS. The problem is comparing apples to apples would like to be able to compare holes. There is a lot of good drilling at NTS, as well as bad. And there is bad drilling here. Have lots of problems here that outsiders do not see; e.g., working behind the fence. David Broxton (LANL) said there must be caution on how comparisons are made. Costs are often rolled up different ways. Compare contractor-drilling costs to contractor-drilling costs. Julie Canepa (LANL) has paid $150,000 just for escorting people. Jack Powers (EAG) said also stated that the program can not just get water from a hydrant. Disposal of water is another issue.

Los Alamos National Laboratory
Hydrogeologic Characterization Program
Quarterly Meeting
October 3-5, 2000
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Los Alamos National Laboratory
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