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Enclosed is the final External Advisory Group (EAG) Semi-Annual Report dated December 5, 2000. This report is based on the EAG's semi-annual review of Los Alamos National Laboratory's implementation of the Hydrogeologic Workplan during the Quarterly Meeting held October 3-5, 2000. If you have any question or comments, please contact Dr. Robert Charles by telephone at (307) 655-3128, by mail at 31 River Road, Box 904, Ranchester, Wyoming, 82839.

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Semi-Annual Report
to the
Groundwater Integration Team (GIT)
of the
Los Alamos National Laboratory
by the
External Advisory Group

meeting dates - 3-5 October 2000

December 5, 2000

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Executive Summary

The External Advisory Group (EAG) for the Groundwater Integration Team (GIT) of Los Alamos National Laboratory met 3-5 October in Pojoaque and Los Alamos, New Mexico. This was the fifth semi-annual review of activities proposed under the Hydrogeologic Workplan (Workplan) developed at the Laboratory. The current document is the deliverable that is provided by the EAG after each semi-annual meeting. This executive summary presents some of the major observations and recommendations, grouped into two categories, 1) Management and Global Issues, and 2) Technical Issues.

Management and Global Issues:

- Morale in the GIT appears high.
- Open, prompt communication of data/results/conflicts is practiced and desirable.
- R-25 should be sampled quarterly and its disposition determined in about one year.
- Contracting schedule slippage is a concern.
- A management working session will occur at the next meeting.
- Skills in matrix management need some development.
- Stakeholders value their opportunity to express their concerns.
- Stakeholders find the Program Manager to be frank and substantive.
- The EAG is pleased that the ER Quality Management Plan is being applied to the Workplan.
- The EAG concurs with the use of an external laboratory for ^{90}Sr analyses until which time the internal LANL laboratory can be certified capable of accurately performing these analyses.

Technical Issues:

- Good progress in data gathering has been made despite delays caused by the Cerro Grande fire.
- The EAG remains concerned that the ER documentation and QA requirements might be too general to fully address the specific data gathering needs of the relatively complex Workplan.
- Significant progress has continued to be made on development of the water quality database (WQDB) during the past year, again despite the Cerro Grande fire and the need to publish fire-related information on the web prior to the database.
- Recommend a meeting between EAG and GIT and ER Project management (and staff as appropriate) to discuss scope and integration of modeling activities in the HC and ER programs (preferably prior to the March 2001 Annual Meeting).
- Drilling costs continue to come down nicely.
- Efforts are being made to evaluate drilling costs.
- The EAG does not recommend suspending drilling operations as a response to QA concerns.
- The EAG commends the GIT for beginning the routine sampling of the completed wells as promptly as possible.
- The EAG cautions the GIT that investigators and stakeholders should make a significant effort to understand the relationships among the factors that influence sample quality and how these will impact their interpretations.
- Over-interpretation of, and over reliance on, sampling results from the early quarterly monitoring events should be avoided.
- The EAG commends the formation of a Risk-Based Decision Subcommittee.
- The EAG commends the use of a risk-based approach and the recognition of its importance, including the development of geochemical models and groundwater models.

1.0 Introduction

The Hydrogeologic Workplan (Workplan) describes activities proposed to be performed by Los Alamos National Laboratory to characterize the hydrologic setting beneath the Laboratory, and to enhance the Laboratory's groundwater monitoring program. In general, the strategy seeks to place the highest priority on the protection of all groundwater and, in particular, groundwater of the regional aquifer because of its beneficial use as a source of drinking water. Major drivers for the Workplan include the New Mexico Environmental Department's (NMED's) letter dated 17 August, 1995, which expresses concern (reiterated from previous letters) about groundwater contamination and protection at the Laboratory; and NMED's letter of 30 May, 1995, which denied the Laboratory's request for waivers of groundwater monitoring requirements at several regulated units. The Workplan provides a process for drilling up to 32 deep (aquifer penetrating) wells and shallower wells as needed, including 51 alluvial wells, to 1) reduce hydrologic uncertainties; 2) reduce stratigraphic and structural uncertainties; 3) detect contamination of the water supply system; and 4) assess the nature and extent of potential contamination of the groundwater. Funding for the program is from Environmental Restoration and Defense Programs, depending upon the location and objectives of the designated well. With its inception in FY1998, the Workplan is managed by the Program Manager and the Groundwater Integration Team (GIT). An External Advisory Group (EAG) was formed in August 1998. The purpose of the EAG is to function as an independent peer review body, comprised of professionals with expertise and experience germane to the Hydrogeologic Workplan activities. The EAG provides an objective review and appraisal of the Laboratory's scientific, technical, and economic approach to, and implementation of, the Workplan on a semi-annual basis.

The current document represents the fifth semi-annual report by the EAG based on the meetings held in Pojoaque and Los Alamos on 3-5 Oct. The EAG heard technical presentations; participated in subsequent discussions; and facilitated meetings with External Stakeholders and Senior Management of the Laboratory, DOE and NMED, and met separately with the Northern New Mexico Citizen's Advisory Board. Reference documents include the Hydrogeologic Workplan, the Groundwater Protection Management Program Plan, the Monitoring Well Installation Project, Project Execution Plan, the Groundwater Integration Team Implementation Plan, previous annual reports, interim and final completion reports for various wells, and correspondence among the various stakeholders. The reviewing team consisted of Elizabeth L. Anderson, Robert W. Charles, Charles F. McLane, Robert M. Powell, Jack D. Powers, and David C. Schafer. All participated in the review and the preparation of this document. This report summarizes the discussions, impressions, and recommendations of the EAG as of the date of the meeting.

2.0 Management and Global Issues

2.1 Program Management

Morale is an issue examined by the EAG. According to Reflections (a LANL newsletter), Laboratory morale is at an all time low. Problems in the operational setting due to the Cerro Grande Fire and security matters could possibly impinge upon the promulgation of the Workplan. The Fire did slight direct damage to material directly supporting the Workplan, however, several of the GIT members suffered great personal loss. The widely publicized security issues may affect the ability of the GIT to share information outside the security firewall. Our discussions with members of the GIT indicate, at least at this time, neither issue is having much of a negative impact on the program. The GIT members suffering great personal tragedy due to property loss seem to be weathering the ordeal. This is due to effective teaming of the Laboratory with various support agencies. The atmosphere during the review was on a par with the very favorable character of previous meetings. Relatively high morale is also due to a program mission that is

well understood with measurable, accountable, and understandable intermediate objectives attributable to sound Program Management.

While the management of technical aspects is complex and dealt with in succeeding sections, the continued development of trust among the various stakeholders is at least as complex and a critical goal for the success of the program. Lack of a desired broad-based trusting relationship among the extremely varied list of stakeholders during the initial phases of a large program is normal. Trust is won through consistent, predictable, timely, and open communication (i.e., do what you say you will do). Trust is seldom achieved by abruptly presenting reams of technical data that may or may not be believed by the various stakeholders anyway. We find the PM and the GIT patient, thorough, and exhaustive in effectively communicating among the stakeholders. Generating trust is a process that must be managed not solved.

Concurrently, Upper Management requested that the EAG give some advice concerning the handling of communications with the external stakeholders. An example is how to communicate data with stakeholders when, possibly sensitive, discoveries are made. While the course of action may be obvious to some, the EAG recommends the following: 1) Communicate data verbally, sooner rather than later to those most impacted. 2) Communications should be open, with what caveats one feels are necessary in communicating preliminary data. 3) Communications should be free of jargon (depending upon the stakeholder) and should place the observations in a context that the stakeholders understand. 4) Communicate regularly in some well accessible forum. Communicating only when some 'disaster' has appeared sets a bad precedent. 5) Joint communiqués by Lab and possibly the regulating bodies lends credence to the information. The Risk Assessment Team proposed for the Cerro Grande fire might be an effective model for this type of activity. 6) Continually ask for feedback from those to whom one communicates as to the effectiveness of the message and adjust as necessary.

Upper Management specifically requested advice on the disposition of well R-25. There have been numerous delays and consequent concern over the quality of the data to be generated in a system that may be contaminated by the drilling process. These concerns are expressed primarily by NMED. The EAG shares some apprehension in this matter, but feels that a decision to plug and abandon at this time is premature. With the emplacement of the Westbay system, we recommend sampling according to the planned schedule (quarterly) and reevaluation in one year.

The EAG has observed the schedule slippage due to delays in contracting drilling activities. The delays appear to result from an internal Los Alamos problem that needs management attention to be eliminated.

Upper management was given only an out briefing at this meeting. Desire was expressed for a return to the format of the previous two meetings, where a working session dealing with some pressing matter precedes the management out brief. The EAG suggests polling the attendees a month or so before the next meeting to get a consensus upon the most pressing topics and working them at the next meeting. The most recent topic was a definition of the general work products expected from the Workplan.

Program management in a matrix management system is a complex task in the best of circumstances. It is made doubly difficult with the added stimuli of budget restrictions and sometimes conflicting priorities of Environmental Restoration (ER) and Defense Programs (DP) with the Program Management. Program/Line/Quality conflicts are apparent in the promulgation of the Workplan. Such conflicts are normal and should be managed by open and frequent use of confrontation as a resolution mechanism. We find the Program Manager is skilled in highlighting and managing such conflicts. The recent management meeting revealed an apparent reluctance to use this approach across the board. All key managers (line, program, upper) must agree on a balance or sharing of power over resources. Matrix organizations are best suited to times of rapid expansion where budget/goal conflicts are minimal and the rapid response of the matrix is a plus. They tend to disappear in a situation of tight budgets.

Positives:

- Morale in the GIT appears high.
- The management of trust issues appears appropriate.
- Communication appears extensive.

Recommendations:

- Communications should continue to be prompt, open, and regular.
- R-25 should be sampled quarterly and its disposition determined in about one year.
- The contracting schedule slippage needs to be addressed.
- The next meeting will include a working meeting for managers.
- Skills in matrix management need some development.

2.2 Management of Stakeholder Issues

The external stakeholder meeting was held in the afternoon of 5 Oct. These meetings are intended to present stakeholder concerns directly to the EAG in the absence of the GIT. The GIT then responds to the enumerated concerns by convening with the EAG and stakeholders near the conclusion of the meeting. Attendees at this meeting included representatives of NMED, Pueblo of San Ildefonso, NM Attorney General's Office, and Concerned Citizens for Nuclear Safety (CCNS). Attendance was down from previous meetings.

The plan for the meeting was to present the issues of the last meeting and ask for any additions from new or old attendees. New issues added were: publication of models, status of wells, post-fire chemistry, the drilling contract, and long term stewardship. Attendees then voted on issues of greatest concern. Well Prioritization and Planning Involvement received no votes but had some short discussion. The issues were then addressed in the following ranked order determined by the number of votes.

Modeling vs. Monitoring: The stakeholders have some questions about the availability of the models for public examination, the treatment of uncertainty in the data and conclusions, the use of field observations to continually modify the models, how the models are tested, and the appropriateness of conceptual models. The concern continues that modeling will be out of balance with site-specific measurements and observations. Specific concern was expressed over non-simultaneous collection of water level data, use of production wells for water level measurements, and lack of weathered tuff hydraulic conductivity values for use in the modeling. In response, the Program Manager repeated that modeling does not obviate the need for monitoring and never will, and that the GIT is currently putting a plan in place to collect contemporaneous water levels. On the other hand, modeling is required to fill the gaps between specific point sources of data (i.e., wells). Demonstrations were presented at the meeting giving examples of how the models are validated using real data. These will be expanded. The annual report will be a good place to summarize these tests and subsequent modifications. The point about uncertainties is well taken. The GIT will better define uncertainties in the data, starting with infiltration, hydraulic conductivity, and porosity. The hydrologic parameters will be joined by defining the uncertainty in the geochemical and geologic parameters. The specific concern of using default numbers will be examined as to their appropriateness in each instance, but it is the goal at LANL to use measured site-specific data for model input parameters.

Data Distribution: NMED is concerned that, from a regulatory perspective, LANL is still not getting some data out for review soon enough and that the data may not be defensible at this point. Available data are coming back on line after the fire. General quality and quantity issues still exist. The Program Manager stated that 'regular' sampling has just started (May, 2000) with one, or at most two, regularly scheduled samples being taken from the *completed* wells. As wells are completed, quarterly sampling will occur. The data will be available on the web. He still plans to

communicate preliminary data, as needed, verbally, to those most concerned. Big packages of raw data will be available for NMED. Data summaries will also be found in the annual report.

Risk Assessment: There has been some delay in the establishment of a risk assessment team that will include external (NMED) members. Stakeholders repeated the concern that realistic and culturally-appropriate scenarios be used as a basis for risk assessment at LANL. The terms 'low risk' and 'no risk' are not viewed as synonymous by the stakeholders. Until risk is defined, discomfort will be present in the stakeholders. The Program Manager stated that the risk assessment subcommittee is still being planned. He recognized that this is a key to the eventual establishment of a context for risk and the believability of the results.

Intermediate Wells: The number, location, and speed of the drilling of intermediate wells is still an issue. The Program Management response is that these issues are continually worked within budget constraints and the mission of the Workplan. Specifically, for FY00 one intermediate well is planned for Los Alamos Canyon; for FY01, two are planned for Mortandad Canyon. Concurrently, the intermediate zones in the R wells will be used and, possibly, an intermediate well adjacent to an R well.

Status of Wells: The comments here tie in, to some extent, with the issues on general data distribution. There was some question of distribution of information acquired from the wells including an evaluation of the quality of the data. The Program Manager had no difficulty with data being shown at public meetings. News releases can be used if the information is of interest to the public. As stated above, regular data sampling began in May. The well completion reports include data on water quality, geophysics, test results, etc. Data are assembled and sent to NMED: a summary sheet in 30 days and a complete report in 8 months. Interim reports or one-page summaries for each well appear doable, but the over-arching goal is to get the data into the database.

Post Fire Chemistry: NMED, in particular, feels the post fire chemistry field data collection effort is inadequate. They expressed an interest in seeing complete coverage of the watershed for post-chemistry of surface water and groundwater. They also expressed concern that no lead individual or group had been tasked with responsibility for fire-related studies. The program manager states that there is a need to coordinate data activities in this regard.

Long term Stewardship: The stakeholders requested that a view toward long-term stewardship be incorporated in all decision-making at LANL. They cited concerns for public safety, and stated that the issue may be particularly troublesome in light of the expanding operations at LANL. The issue is what happens to the wells, data, conclusions in the very long term - i.e., 50 years or greater. The Program Manager realizes this issue is in its infancy. Most long-term definitions have been 5 to 10 years, not the 50 years plus implied here. The surveillance group will be meeting to discuss this issue.

Publication of Models: This issue arose as a subset of the discussion of modeling vs. monitoring and timely dissemination of data and information. The New Mexico Attorney General's Office feels that the models must be presented in an iterative fashion to the public for comment and subsequent modification. The Program Manager feels that the modelers have been providing some demonstrations at the quarterly and semi-annual meetings showing how these models are coming together, but will endeavor to accelerate this activity. Each year detailed technical modeling reports are generated. Perhaps the essence of these reports should be extracted for the Annual Groundwater Status Report. ER provides releases of final modeling reports.

Standards/Action Levels: Many stakeholders felt that there was not a lot of jargon at this meeting which helped in the interpretation of data results. The concern is that when a 'hit' is found, what is the meaning to be inferred by individual stakeholders with many and varied backgrounds? There was concern that levels below 'action levels' may be ignored. The Program Manger was emphatic in stating that any hits are still investigated and considered significant in terms of

sources/risk/conceptual model. Hits above some action level trigger rapid attention. Most of the plume chasing, however, is done by the cognizant program office and not under the Workplan.

Funding Flexibility & Adequacy: The CCNS contact with Senator Domenici about possible funding increases was not fruitful. The stakeholders expressed some concern that, with the current cost of the deeper monitoring wells, the original budget may not be sufficient to cover the program outlined in the Workplan. The ER/DP dichotomy has continuing friction as each has a separate mission to be fulfilled in the promulgation of the Workplan. The Program Manager continues to work with the cognizant program offices to switch wells by program office and acquire additional funding from them or other sources. The issue is unlikely to go away, but will be constantly worked.

Drilling Contract: There is a lingering feeling that the wells are too costly, considering the results obtained. Where direct comparisons with drilling costs from other programs have been made, the R wells appear to be high. The stakeholders discussed at length concerns regarding perceived mistakes, delays, and cost overruns in the drilling program. The discussion was long and vehement which brought a lengthy response from the Program Manager. The Program Manager responded that cost tracking has demonstrated that there has been significant cost reduction in each succeeding well. For each completion method there is a learning curve that cannot be avoided. DOE has attempted some cost comparison of LANL costs vs. the Nevada Test Site (NTS) and White Sands but concluded that differing conditions among the programs and methods of cost tracking and reporting made direct comparison difficult. LANL costs are high because of the drilling method needed, escorts required, lab analytical processes (requiring full suites of tests), back filling requirements, and differing DQO's. The costs will continue to come down. LANL is pursuing the hiring of Schlumberger's Integrated Project Management Division to evaluate the approach to cost reduction. Efforts are being made to get the most experienced drillers available, but more supervision/oversight will be required. LANL will increase the efforts to recover costs for poor performance on the part of the drilling contractor. Contractors with slightly higher rates may be employed in an effort to improve performance and quality, thereby lessening overall costs. Perhaps two contractors should be employed. The contracting process itself will be modified to emphasize more directly the quality vs. incumbency and cost.

Drilling Methods: The stakeholders were relatively satisfied with this topic. They would like to see a varied toolbox of drilling methods applied depending upon the DQO's for a given well. The issue of additives indicates they would like to see better testing of the effects of the additive before use. The Program Manager is continuing to work this issue. It seems to have abated considerably from the situation a year ago.

Planning Involvement: CCNS asked if there is a formal process to submit comments to the EAG. Also, there is a strong feeling the NMED should be on the risk-based assessments team which will impact planning. In addition, as stated in one of the other issues, the stakeholders feel that without timely public dissemination of modeling reports and other information they cannot have meaningful input to the planning process. The Program Manager has no difficulty with the stakeholders contacting the EAG with further comments. He also feels that the addition of NMED to the risk assessment team is a good one.

Well Prioritization: The activity seems to be going reasonably well within the perturbations of the fire, although the regulators would like the opportunity to provide more input on changes in well locations.

The EAG and the Program Manager met with the Citizen's Advisory Board on the evening of the 4th of October. After a briefing on the mission and products of the EAG by the Program Manager and the Chair of the EAG, the floor was opened for discussion. The atmosphere was one of openness by all parties. The CAB appeared to appreciate the opportunity to discuss the mission of the Workplan and the activities with the principals. There were a number of questions about the

type and content of recommendations by the EAG which were addressed by EAG members with specific examples from the published reports.

Positives:

- There was open communication by all parties.
- There was frank response by all parties.
- The lowered level of jargon in the technical sessions was appreciated.

Recommendations:

- The EAG was remiss in not directly eliciting positives from the stakeholders as before.
- Definitions of modeling uncertainty are desirable.
- Institution of the Risk Assessment Committee is desirable.
- Displacement of Post-Fire sampling/analyses/activities is necessary.
- Long term stewardship of the Workplan activities is unclear.

2.3 Data Quality Objectives

It appears to the EAG that QA processes and procedures necessary to attainment of Workplan DQOs are being implemented via increased adherence to the ER divisions Quality Management Plan (QMP). Although many practitioners of environmental science and engineering perceive strict adherence to QA/QC protocols to be expensive and time-consuming, hence limiting their forward progress in achieving project goals, the experience of the EAG has been otherwise. A well-conceived QA/QC process will require practitioners to be fully cognizant of all the steps and processes needed to achieve project success, minimizing guesswork and missteps that can be far more costly and time-consuming than following QA procedures.

The EAG was pleased that ER QA personnel performed a drilling activity assessment of the Groundwater Investigations Focus Area (GWIFA). This resulted in the document "Management Assessment Report for Groundwater Investigations Focus Area" (ER2000-0434), as well as the positive response to this assessment from the GWIFA. This should result in fewer well installations with problems, such as those encountered at R-25 and CdV-R-15-3. The EAG would like to emphasize, however, that QA/QC processes should not merely be considered as training, documentation, and accountability exercises. The EAG believes that a well-conceived Quality Assurance Project Plan (QAPP) does indeed contain these components, but a primary objective should always be to create a coherent pathway to achievement of the data quality objectives. Training, accountability, and documentation alone cannot achieve this result. One means of creating such a pathway is to force the project practitioner to fully think through all steps of the project (or component of a larger project), including the required outcomes of each step, from beginning to end and document them. This process will often expose project weaknesses or unclear reasoning, allowing corrections to be made before the project begins. This tends to result in a higher percentage of successful project outcomes and reduces the need for changes and backtracking, hence increased expenses, during the course of the project. One approach is to develop a QAPP through a series of questions that must be answered prior to allowing the project to go forward. The practitioner or investigator must answer these questions in very specific, often detailed, terms. The responses are then subject to the approval or disapproval of both QA personnel and management before the project is allowed to proceed. Subsequent deviations from the QAPP during the project also require approval. Appendix A provides an example of such a questionnaire-designed QAPP process that was developed for research programs. Such an approach could be readily adapted for the Workplan and applied to its various DQO-driven project components.

One aspect of a QAPP that is critical to a successful project outcome is the designation of standard operating procedures (SOPs) that will be used to attain the project goals. In some instances, SOPs will be useful for a number of projects without modification, e.g., certain analytical laboratory SOPs. However, new SOPs often need to be created, or older ones modified, for projects (1) having different goals, (2) using different equipment, or (3) to address advances in technology. The EAG has long perceived that new and/or modified SOPs are needed for the Workplan, which has aspects of all three characteristics that distinguish it somewhat from other LANL projects. In the first category, the Workplan has as a major component the characterization of the deep subsurface across the laboratory. This is very different from other LANL environmental projects. Several aspects of the Workplan would fall into the second category, for example the use of Westbay well completion technologies. Within the third category are low-flow sampling methodologies and new geophysical techniques. These examples are for field implementation alone, without even addressing the differences and advances in modeling, database, GIS, etc., that could also drive SOP creation and modification. The EAG is extremely pleased that a review of existing SOPs is underway. We hope to be apprised of modifications to both existing and newly created SOPs following ER's scheduled date for completion in January 2001. We would appreciate being involved in the peer-review of the SOPs prior to their full adoption by the GIT for use in the Workplan. Subsequently, it would be useful to see a presentation on SOP implementation within the Workplan, including modifications and new SOP additions, during the Annual Meeting in March, 2001, if possible.

The EAG also favorably notes that problems with ^{90}Sr analyses have been alleviated by the use of an external laboratory. We recommend continued use of the external laboratory until problems with the internal LANL laboratory have been fully resolved via routine application of QA/QC guidelines and procedures. We note with some concern that our query regarding the status of Americium measurement quality was met with a refusal to comment. Data quality concerns for Americium should be quickly addressed if they are similar to the problems encountered with ^{90}Sr. Again, this is an area where delay in coping with a problem can do only harm and yield no positive outcome.

Positives:

- The EAG is pleased that the ER Quality Management Plan is being applied to the Workplan.
- The ER QA assessment of the Groundwater Investigations Focus Area (GWIFA) was needed and should result in improved drilling activities.
- The EAG appreciated the opportunity to read the "Management Assessment Report for Groundwater Investigations Focus Area" (ER2000-0434), as well as the positive response to this assessment from the GWIFA, in addition to hearing the presentation on this topic during the quarterly meeting.
- Applicability of ER SOPs to the Workplan is under evaluation and any necessary modifications will be accomplished by January 2001.
- The EAG concurs with the use of an external laboratory for ^{90}Sr analyses until which time the internal LANL laboratory can be certified capable of accurately performing these analyses.

Recommendations:

- The EAG continues to promote the use of a QAPP-type process for the Workplan that requires personnel to critically examine their portions of the Workplan to assure that DQOs are achieved efficiently and within budget (an example of such a QAPP approach is provided in Appendix A).
- The EAG would appreciate an involvement in peer-review of the new, or modified, SOPs prior to their full adoption by the GIT for use in the Workplan.
- A presentation on SOP implementation within the Workplan during the Annual Meeting in March, 2001, would be useful.

- If data quality problems are occurring with Americium analyses, as they did for ^{90}Sr analyses, these should either be quickly addressed or turned over to an external laboratory.

2.4 Administrative

The EAG thanks Kelly Bitner, Suzanne Maes and, until her sojourn to Idaho, Sue Johnson, for the care with which the logistics of the meeting were performed. Preparing the meeting notes, copies of viewgraphs, viewgraphs, meeting logistics, and troubleshooting various requests are greatly appreciated.

The EAG finds itself more and more in the position of having to respond to requests both from the GIT and external stakeholders. Requests for deliverables made to the EAG from members of the GIT, as well as other stakeholders, will be reviewed by the Program Manager for suitability within budgetary constraints. In order to provide a better product we suggest some changes in the meeting structure. The EAG would like to meet for no more than one-half hour before commencement of the general meeting in order to clarify assignments and areas for special emphasis. The EAG would also like to caucus at the end of each day for one half hour to compare notes and plan for the next day's events. This is particularly important for the Stakeholder and Management meetings. The EAG recognizes the need for discussion in many areas of the presentations, but would like to see the meetings held to a schedule more representative of the published schedule. This will help those who need to meet with us later in the day. A meeting chairperson should manage the time constraints. When possible, the EAG recommends the use of morning and evening technical sessions, with the afternoon time for breakout technical discussions with subsets of the EAG and meeting of the EAG itself. The EAG would also like to receive the responses to previous recommendations at least one week before the subsequent meeting so that it can better prepare for the meeting.

The EAG is available for a meeting with ER representatives and the Program Manager at a mutually agreeable date before the next semi-annual review to explore the interrelationships between the two organizations.

Positives:

- The logistics of the meeting are carefully handled to the great credit of the staff.

Recommendations:

- The EAG would like to caucus for no more than 1/2 hour before the first meeting and at the end of each day.
- We request that the schedule be followed more closely.
- The EAG would like to receive comments on recommendations about a week before the next meeting.

3.0 Technical Issues

3.1 Data Gathering

General

Workplan data gathering activities have proceeded at a good rate during FY00 in spite of the delays resulting from the Cerro Grande fire. These activities included the initiation of quarterly sampling at some of the completed regional aquifer wells, including R-9, R-9i, R-12, and R-15 and the attainment of two rounds of data. This seems to be good progress and should provide a sense of accomplishment to the GIT members.

The last EAG report (June 26, 2000) discoursed expansively upon our concerns regarding the perceived informal GIT approach to modifications of monitoring well prioritization, locations, drilling techniques, and the drilling fluids to be used. The EAG delineated a series of factors that we believe need to be addressed, in the context of well decisions that influence the data gathering processes, hence attainment of Workplan DQOs. In addition to the delineation of factors, we proposed a relatively simple approach to documentation of these changes and decision processes. The response of the GIT to this issue was to indicate that "The hydrogeologic characterization program will adopt the documentation requirements of the ER Project QA program."

The EAG is pleased that the ER QA requirements are now being adopted by the GIT for the Workplan. However, we profess to not being very familiar with these requirements. Typically, such requirements are not project-specific and provide something of a skeletal approach to the types of procedures that must be followed. These usually include recording roles and responsibilities, training and qualifications of personnel, processes used and the results, tracking of purchasing, lessons learned, etc. In the context of the Workplan data gathering needs we remain somewhat concerned that more than these basic delineations might be needed to minimize the "lessons learned" aspect of the QA documentation. Due to the extreme complexity, lengthy time span, and project cost it behooves all involved to ascertain that, upon completion, the results attained sufficiently address the questions and concerns posed by the NMED in communications with LANL that resulted in the Workplan. It is, therefore, important that data gathering processes result in reliable and defensible data for input into the database, modeling, and risk assessment activities needed to address these questions and concerns. We believe this is a serious consideration and the processes of well prioritization, location, drilling technique, coring, well logging, well completion, and sampling need to be carefully examined with regard to the DQOs needed to adequately, and predictively, characterize the subsurface environment.

It is clear that NMED considers actual ground water monitoring data to be of greater value than modeling outputs, but will accede to the use of predictive modeling provided both input data and the modeling algorithms are of acceptable quality. The EAG suspects that the perceived failure of a relatively small subset of R wells to provide high quality data might be sufficient to cause concern with regard to adequate calibration of the models. This concern would likely be even greater when NMED is asked to accept the results of risk assessment methodologies that are somewhat more dependent on a range of probabilistic outcomes. Having stated our concerns, the EAG reiterates the possibility that following the ER QA requirements might minimize data gathering problems and fully qualify the requisite information needed for the Workplan. In short, it is difficult to comment further on these aspects with our limited knowledge of the ER QA requirements and how they are being applied to the Workplan data gathering processes. It would be very useful to the EAG to be given additional information on this subject. This could be either via review of the relevant documents or a detailed presentation of the requirements and their application to the specific data gathering processes at the March, 2001, Annual Meeting, or a combination of the two. This would allow us to evaluate and advise as to whether, in our opinion, the requirements seem sufficient as posed. In addition, it might be useful for the GIT to ask ER QA personnel to consider the EAG's June, 26, 2000 recommendations and approach in the context of the ER QA documentation requirements. They could then understand our concerns and make a determination as to whether current QA requirements are sufficient to address said concerns in the context of ongoing modifications to the well installations and other Workplan changes.

Hydraulic Information

Plans call for drilling R-5 near Otowi Well No. 1 (O-1), primarily to determine hydraulic, rather than chemical, information. This represents a huge dollar investment in attempted hydraulic data acquisition. As such, it is essential that the GIT clearly articulate testing plans and what it hopes to

determine from the tests. It will be important to plan the testing carefully to maximize the utility of the data obtained.

It is expected that O-1 is screened through several formations. When conducting a standard, constant-rate pumping test on a multiple-completion well such as this, it is not possible to know how much yield is contributed by each of the screened zones. Consequently, interpretation of the observation well data from such a test is problematic. The test data may be of little value, unless a spinner test log is conducted in O-1 to determine the relative yield contributions of the screened aquifers. Considerations such as this must be thought through carefully so that an appropriate testing plan can be devised to get the best information possible.

Information obtained from the modelers at the EAG meeting indicated that spinner log data from other existing municipal wells would be of great value. They already have abundant "bulk transmissivity" data, but lack information on how transmissivity is distributed with depth. Thus, as progress is made toward testing municipal wells in general, taking steps to conduct spinner tests will be important.

Standard constant-rate testing of municipal wells will also be useful. It was mentioned at the October, 2000, meeting that one deterrent to testing municipal wells was the inability for water levels to recover to static conditions in preparation for the test. This problem can be circumvented by conducting a *recovery* test rather than a *pumping* test. This would require maintaining an uninterrupted pumping rate for an extended period (days or, preferably, weeks) prior to the recovery test. Accomplishing this may take some planning and coordination with the well owner. However, these kinds of arrangements can usually be made successfully. For this kind of recovery test, the well would need to be taken out of service only during the data-monitoring period, probably just a few days. A solid recovery data set following extended uninterrupted pumping is just as useful as a constant-rate pumping test.

Indications at the EAG meeting were that it would be possible to test only about one or two municipal wells per year, when they were "available". This may not provide sufficient information on a timely basis for the modeling program, compared to what could be made available with a more aggressive schedule. A critical review of the restrictions on municipal well testing (e.g., well usage, budget, personnel, etc.) should be made to see if steps can be taken to accelerate the testing of those wells. For example, if budget is a factor, something to consider is that the budget for installing R-5 (primarily to obtain hydraulic data) would probably be sufficient to cover the costs of hydraulically testing all of the municipal wells in the county.

Positives:

- Good progress in data gathering has been made in spite of delays caused by the Cerro Grande fire.
- The GIT has adopted the documentation requirements of the ER Project QA Program.
- Positive steps are being taken to obtain hydraulic data (via the installation of R-5).

Recommendations:

- The EAG remains concerned that the ER documentation requirements might be too general to fully address the specific data gathering needs of the relatively complex Workplan.
- We recommend that the EAG be familiarized with specifics of the ER Project QA Program requirements relative to Workplan data gathering activities. This can be done via documentation to be provided to us, a detailed presentation at the March, 2001, Annual Meeting, or a combination of the two. This would allow the EAG to provide better advisory services.
- The EAG further recommends that ER QA personnel review our concerns and suggested approach from the data gathering section of the June 26, 2000 EAG report and make a

determination as to the sufficiency of current ER QA documentation requirements in the context of those concerns.

- The hydraulic testing approach and expectations for O-1/R-5 need to be articulated and reviewed by the EAG to verify that this significant expenditure of funds will yield valuable information.
- Spinner tests should be conducted on as many municipal wells as possible.
- The use of properly designed recovery tests, as opposed to constant-rate pumping tests, should be explored as a more pragmatic way of obtaining municipal well hydraulic data.
- Limiting factors should be reviewed to see if actions can be taken to obtain hydraulic data from municipal wells sooner, rather than later, to support model development.

3.2 Database

The Water Quality Database Project (WQDB) continues to make good progress. The EAG was pleased to hear, during the recent presentation at the October 2000 meeting, that the database was about to go online and that training in its use would begin in early November. We look forward to interacting with the WQDB, as users on the public side of the firewall, so that we can provide feedback on the user experience to the GIT. Please inform us of the web address when the database is available for access.

It appears from GIT responses to previous EAG reports that most, if not all, of the EAG database recommendations either have been or are being addressed during development of the database. We continue to hope that resources can be obtained to allow GIS front-end capabilities on the web interface to the WQDB. Such capabilities would clearly enhance the stakeholder user experience and clarify the informational content of the database. The EAG supports the development of import routines for chemistry and flow data to eliminate manual entry of earlier data. This should minimize data entry errors that are inherent during the relatively boring and repetitive processes of data transcription. Using such import routines, however, makes them critical to development of the database and requires that they be thoroughly tested with each type of data or each type of database from which they are expected to import.

The EAG would like additional clarification about a few aspects of the database. These include:

1. The data steward QA/QC tools -

   What are these tools and how are they used to validate the data and determine whether it is ready for release?

2. Lookup table standardization and maintenance -

   How do the lookup tables differ from the database import routines for migrating the data that were previously mentioned and what is required to maintain them? Does this mean that some of the legacy data within the older databases will not be migrated but will be imported into report tables on an inquiry-by-inquiry basis?

3. It was stated during the October, 2000, database presentation that the chemistry results would be screened against given standards

   What does this statement mean and what are the standards?

4. It was also indicated at the October, 2000, meeting that modeling results will also be stored in the database.

   How will this information be presented to the online user of the database? Will the online user be able to parameterize the model(s) and display output or will the user only have access to results previously modeled by LANL personnel?

The EAG would like to recommend, as we did at the October, 2000, meeting, that database queries be capable of output to formats that would allow evaluation within spreadsheets or standard statistical and geostatistical computer programs. Tabbed or comma-delimited text should be adequate in this regard.

Positives:

- Significant progress has continued to be made on development of the WQDB during the past year, again in spite of the Cerro Grande fire and the need to publish fire-related information on the web prior to the database.
- The GIT has been very responsive to EAG comments and recommendations about the WQDB.

Recommendations:

- The EAG still considers the GIS/map interface for the WQDB to be extremely important to the usability and overall quality of the database and encourage the GIT to locate resources allowing its implementation.
- The EAG has a need for increased understanding about certain aspects of the WQDB (listed above) and would appreciate additional information on these topics.
- The EAG encourages enabling the WQDB to output results to a tab or comma delimited text file following a database query.
- The EAG requests to be informed of the URL for the WQDB as soon as it is available online.

3.3 Modeling

Materials and Information Reviewed

The EAG received information on the status of the GIT modeling program from presentations at the October 2000 Semi-Annual Meeting, and from a breakout session with several GIT and ER Project members following the October 3 presentations. The EAG was also provided with a draft of Revised Section 3.0 of the Workplan that describes plans for information management and modeling under the HWP, and received a presentation on the key components of the document.

General Comments

The EAG has observed, in technical meetings and interactions with stakeholders, a wide range of responses to the proposed use of modeling in the LANL program. These range from an inherent distrust, or discounting, of model results to an optimistic over-reliance on models. A program of education and communication as part of the larger Workplan modeling program will be essential to ensuring the success and acceptance of the modeling efforts. Confidence in, and acceptance of, analysis results that form the basis for decisions that impact regulators and stakeholders will be a key factor in bringing the project to a successful conclusion. The EAG recommends that modeling education and communication elements be developed as part of the Workplan activities.

The EAG views the draft Revised Section 3.0 of the Workplan as a significant improvement over the original Section 3.0. The EAG feels, however, that this brief document lacks sufficient detail to support a level of understanding of the proposed modeling program necessary to form the basis for meaningful constructive comment. More specific comments regarding this document are provided in the Specific Comments section below.

LANL GIT responded to EAG comments both in the September 20, 2000 Action Plan for EAG March 2000 Recommendations and during technical presentations at the October 2000 Meeting.

The EAG appreciates the responses, and notes that many questions and recommendations were addressed. The most significant carry-over item is the continuing need for more detailed information on the planned modeling program. This item, and several lesser followup items, are addressed in the Specific Comments section below.

The modeling program continues to show progress. Several ongoing and recently completed Hydrogeologic Characterization (HC) and Environmental Restoration (ER) modeling tasks were reported during the meeting, as discussed below.

It appears that the Cerro Grande fire has disrupted many activities at LANL, including modeling. Modeling resources were diverted, or temporarily reassigned, to examine potential hydrogeologic and chemical impacts of the fire on the surface water and ground water systems in the vicinity of the laboratory. Reports on these fire-related modeling analyses were presented during the meeting and are discussed in more detail in the following section. The EAG feels that it currently lacks sufficient detail on the technical task schedule and key data transfer points of the modeling program. Because of this, it is not possible for the EAG to comment at this time on the potential impact that this diversion/redirection of resources may have on the overall modeling program schedule.

Specific Comments

Draft Revised Section 3.0 of the Workplan

The current draft of Revised Section 3.0 of the Workplan improves upon the original in that it provides an expanded description of the 3-D geologic model including inputs, outputs, links to hydrologic process modeling, and schedule and deliverables. It also provides a description of the plans for geochemical modeling.

In the Groundwater Process Model sections, however, the document appears to have difficulty finding an appropriate depth level in presenting the modeling plan. Some of the technical discussion contains a high level of detail (e.g., page 3-15 "To distribute this water spatially, we use a modified Maxy-Eakin method . . .," and page 3-16 "GoldSim also calculates risk figures-of-merit . . .") with no supporting background information explaining terminology or methods. Programmatically, however, there is only a general discussion regarding the intended uses of models (cf. pages 3-5 and 3-11), the specifics of modeling tasks and milestones (pages 3-17 to 3-19), and the proposed methodology for characterizing uncertainty as a basis for decision making (page 3-11). It might be beneficial to have slightly more information in the document regarding the specifics of the overall modeling program plan and individual modeling tasks.

The draft Revised Section 3.0 of the Workplan (p. 3-1) briefly mentions the relationship between modeling activities and the DQO process, but no attempt was made to update the original modeling-related DQOs (Workplan, Appendix 4). As the modeling program is implemented and matures, the modeling-related DQOs should be updated to correspond to the evolving program plan, recent technical findings from the program, and the intended ultimate use of modeling results in risk-based corrective action decision making.

LANL GIT Responses to March 2000 EAG Recommendations

In the September 20, 2000 Action Plan, the GIT responded to EAG modeling recommendations outlined in the June 26 EAG semi-annual report. A brief summary of the key modeling recommendations for which the EAG feels followup may be required is presented below (numbering follows Table 1 in the September 20, 2000 report):

Number 7-00-19:
Recommendation: EAG recommended clarification of links between models and data bases (geologic and hydrologic);
Response: GIT presented modeling demo during October 2000 Meeting illustrating links to data bases and use of pre- and post-processing software;
Followup: The EAG recommends that GIT modelers, in applying the approach demonstrated at the meeting, should clearly describe, in reports, any manipulations of geologic layer information used to derive hydrostratigraphic units for a hydrologic process model to ensure reproducibility of results. In addition, printed graphic output from pre- and post-processor software should be date stamped as a QA documentation measure.

Number 7-00-18:
Recommendation: EAG requested more information on the overall modeling program plan;
Response: GIT provided to EAG a copy of the HWP draft Revised Section 3.0;
Followup: The EAG requires additional information on the planned modeling program to support meaningful review and comment (see section below titled "EAG Need for Additional Information on Modeling Program").

Number 7-00-16:
Recommendation: EAG requested information on individual planned modeling tasks to permit early input and prevent "after the fact" review and comment;
Response: GIT provided to EAG a copy of HWP draft Revised Section 3.0;
Followup: The EAG requires additional information on plans for individual modeling tasks to support meaningful review and comment (see section below titled "EAG Need for Additional Information on Modeling Program").

Number 7-00-17:
Recommendation: EAG requested time to meet with GIT modeling staff to discuss activities and analyses;
Response: GIT hosted a breakout session on modeling topics at the conclusion of the regular meeting on October 3;
Followup: The EAG appreciated the opportunity to meet with GIT staff associated with the modeling effort and viewed the meeting as a good first step. The EAG believes additional, more structured, meeting(s) of greater length and depth would be beneficial. We recommend that such a meeting be planned at a time deemed appropriate by the GIT (but prior to the March 2001 Annual Meeting).

Number 7-00-20:
Recommendation: EAG recommended ensuring integration of modeling efforts to meet higher level DQOs;
Response: GIT is considering forming a Risk-Based Decision Support Subcommittee;
Followup: The EAG supports the concept of a Risk-Based Decision Support Subcommittee and recommends its formation. The EAG also recommends the continued refinement of modeling-related DQOs as discussed in the section above on draft Revised Section 3.0 of the HWP.

Modeling Activities Reported During the October 2000 Meeting

Numerous modeling activities were reported during the October 2000 Meeting. Many of the modeling studies had also been previously planned under the HWP, but it was clear that a significant effort had been expended in fire-related modeling analyses. A brief summary of the modeling studies, with EAG comments, follows. In the summary below, the EAG acknowledges as generally positive the progress demonstrated by the GIT in the area of modeling. Several recommendations are made, and these are restated in the Recommendations list at the conclusion of this modeling review section.

Table 1. Modeling Activities Presented During October 2000 Meeting

Item	Modeling Activity	EAG Comment
1.	Simulations of pumping test for Otowi unit were used as a basis for recommendations regarding siting of observation well R-5.	Good use of modeling to guide field activities.
2.	2-D simulations of stable isotope transport have been extended to 3-D.	The EAG views this linking of hydrologic modeling and geochemistry information as an important supplement to field data and other estimation methods in an attempt to characterize recharge as a critical model input.
3.	Modeling of HE transport from TA-16 is ongoing; will be reported at March annual meeting.	The EAG looks forward to receiving information regarding the results of this effort.
4.	MDA-L vapor-phase organic transport modeling report has been completed; EAG will receive copy when released.	The EAG looks forward to receiving this information, and will review the report when it is received.
5.	Los Alamos Canyon updated 2-D and 3-D flow models, and initial 3-D tritium transport simulations have been completed; "soft" information on perched water zones was used to estimate Kv reduction factors at interfaces; calibrated models represent mesa and canyon conditions well; initial tritium transport results show very low concentrations (well below MCL) at depth	The EAG congratulates the GIT on the successful calibration of the updated LA Canyon models. The EAG also requests additional information on this modeling effort via direct discussions with GIT staff or in the form of a report when it becomes available.
6.	GoldSim model of TA-54 described at the March 2000 Meeting has been completed.	The EAG requests additional information on this modeling effort via direct discussions with GIT staff, or in the form of a report when it becomes available.
7.	Modeling demonstration illustrated the integration of models and databases, and illustrated the use of pre- and post-processing software.	The EAG appreciated the demonstration, and noted the efficient use of powerful software to speed the modeling process and aid the modelers in interpreting data and results . We would welcome an opportunity for a more in-depth discussion with GIT staff regarding the practical details of day-to-day modeling operations and model application.
8.	Modeling analyses of Cerro Grande fire effects on infiltrating surface water from a Los Alamos Canyon retention structure examined hydrologic effects (changes in moisture profile) and chemistry effects (the possibility of using fire-related chemical changes as tracers for infiltrating water).	The EAG views this as a positive and timely application of existing or readily modifiable modeling tools to examine the potential affects of the fire on the chemistry and hydrology of the surface and ground water systems in the vicinity of LANL. The EAG is uncertain at this point regarding the impact that this redirection of resources will have on the schedule of HC and ER modeling program activities.
9.	Efforts to integrate models within the ER program to support risk-based corrective action decisions.	The EAG strongly favors this approach and notes the progress that GIT is making in this area. The EAG also recommends formation of the Risk-Based Decision Support Subcommittee that has been proposed by the GIT.

EAG Need for Additional Information on the GIT Modeling Program

It would assist the EAG in performing its reviews, if the GIT were to provide additional background information on the ongoing and planned modeling program to provide a context and basis for meaningful technical review and comment. Information might include:

- Intended uses of models;
- Discussion of relevant regulatory factors;
- DQOs to be met by modeling;
- Descriptions of modeling tasks/analyses;
- Schedule and integration plan;
- Stakeholder communication plan; and
- Plans for uncertainty characterization.

A further discussion of EAG modeling program information needs is presented in Appendix B.

Positives:

- Demonstrated integration of software tools for data preprocessing, model execution, results postprocessing, and static and animated graphical display of modeling results (as illustrated in the modeling demonstration presented at the October 2000 Meeting).
- Effective redirection of modeling resources, and application of existing modeling tools, to analyze potential hydrologic and water chemistry effects of Cerro Grande fire.
- Initiation of EAG dialog with GIT and ER Project modeling staff in brief first meeting targeted to modeling activities and issues.
- Continued progress in the areas of MDA modeling, canyon modeling, stable isotope modeling, use of modeling in aquifer test plan development, and system level risk assessment modeling.
- Continued progress in integrating risk management goals and responsibilities of ER Project with goals of the GIT hydrogeologic characterization program.

Recommendations:

- Develop a modeling education and communication program as part of Workplan activities and work with NMED to develop a mutual understanding of the role that modeling and analysis results are to play in risk and remedial response decision making for the LANL site.
- Modify draft Revised Section 3.0 of Workplan to include less technical detail, and more information on description, scheduling, and integration of planned modeling tasks.
- Revise modeling-related DQOs to correspond to the revised modeling work plan.
- Take steps to include in modeling reports information on any manipulations made to geologic layer data to form model hydrostatigraphic units to ensure reproducibility of results; and include date stamps on any graphic output generated during modeling analyses as a QA documentation measure.
- Provide EAG with more information on the ongoing and planned modeling program to provide a context and basis for meaningful technical review and comment.
- Evaluate the impacts that modeling the effects of Cerro Grande fire have had, and will have, on the planned modeling program, and adjust schedule as necessary.
- Arrange a meeting between EAG and GIT and ER Project management (and staff as appropriate) to discuss scope and integration of modeling activities in the HC and ER programs (preferably prior to the March 2001 Annual Meeting).
- Provide to the EAG, as committed to in the September 20, 2000 Action Plan, copies of reports documenting completed modeling studies when they have been cleared for release.Move forward with plans to form a Risk-Based Decision Support Subcommittee to ensure integration of hydrogeologic characterization (HC) activities, and HC and ER modeling efforts, to meet DQOs and provide necessary information for risk-based corrective action decisions.

3.4 Geochemistry and Geochemical Modeling

Significant progress continues on the acquisition of geochemical data, with data from the Cerro Grande fire also requiring collection and evaluation this year.

The GIT's geochemistry subcommittee remains concerned about the impacts of drilling additives (e.g., bentonite and EZMUD) on groundwater sample quality, as does the EAG. The quality of these samples is paramount since virtually all the results of modeling and risk assessment will be based on data from these samples. The EAG is heartened that the geochemistry subcommittee continues to investigate these issues, especially with regard to the currently used EZMUD. The elucidation of the EZMUD chemistry and its concomitant properties, such as having a 30% negative charge density, are of serious concern. This emphasizes the need for thorough, intensive well development when these additives are used in the drilling process. Even with development, one graphic presented during the October, 2000, quarterly meeting seems to indicate that collected samples still contained about 12 mg/L of carbon (measured as TOC) after nearly 14 hours. The last two data points on this graphic seemed to show that this concentration had nearly stabilized, implying that further removal might take very long periods of time. Hopefully this residual EZMUD will biodegrade over time but, based on these data, the EAG reiterates (as per our previous reports) that

1. the use of drilling additives is exerting a negative impact on groundwater sample quality, and
2. data users may not be able to consider ground water data reliable for several quarters of sampling from these wells, but trends should be carefully observed.

The GIT should continue to measure parameters related to drilling additive contamination as quarterly samplings proceed.

The geochemistry subcommittee investigation of LANL background hydrogeochemistry during FY2000 was a good focus for this period, during which many or the regional aquifer wells were not yet on-line for routine sampling. This work should provide a foundation of understanding when more R-well data become available and will be especially important if contaminants are detected in these samples. This effort was also important to comprehending pre- and post-fire groundwater alterations.

The EAG recommends that the geochemistry subcommittee carefully consider and critically review the ER sampling SOPs that are being modified and/or created for use in the Workplan. This review should focus on the Workplan DQOs and whether or not the procedures being institutionalized are sufficient for attaining high quality representative groundwater samples.

Positives:

- The geochemistry subcommittee continues to make good progress on the acquisition and evaluation of data, including LANL background hydrogeochemistry.
- The EAG is pleased that the potential for drilling additives to detrimentally affect sample quality is being investigated.

Recommendations:

- Continue investigations of drilling additive effects on groundwater samples and progress with removal during development.
- Continue measuring and tracking parameters related to additive contamination when quarterly samples are collected.
- Carefully consider the ER SOPs being modified/developed for the Workplan in the context of Workplan DQOs.

- Attempt to create a first draft of the summary report requested in the last EAG report (June 26, 2000) by the Annual Meeting, 2001, if possible.

3.5 Drilling and Well Completion

Great progress continues to be made in drilling speed and efficiency. It appears that drilling is occurring at a faster rate than previously, bringing costs per foot steadily down.

At the EAG meeting, the Lab announced that it would consider hiring Schlumberger's Integrated Project Management Division to critique the Lab's drilling program. The EAG applauds this proposal as a worthwhile endeavor to learn from the experience of others familiar with performing similar tasks (complex-drilling project management). The EAG supports efforts in this regard.

To help ensure the continuation of the success that has been recently realized and to help minimize the possibility of future mishaps, attention to a few small details is still required. These are summarized below.

Filter Pack Design

The EAG addressed filter pack length requirements in its report following the March 2000 annual meeting. Recommendations were made to take a pragmatic approach to determining the filter pack "cushion" placed above and below the well screen sections. We suggested considering a minimum practical interval of 5 to 10 feet below the screen and 10 to 15 feet above the screen, whenever possible. This is to guard against settlement of the pack materials, exposing the screen to either the bentonite seal or the fine sand bridge between the filter pack and bentonite seal. It also allows for faster placement of backfill materials, which has been painfully slow on most of the R wells. Comments in the GIT's action plan for the EAG indicated concurrence with this recommendation.

However, it appeared at the recent (October 2000) EAG meeting that little progress had been made in this regard. First, information presented at the meeting regarding negotiations with NMED showed an apparently outdated recommendation to adopt a 5-foot filter pack overlap. Second, one of the GIT presentations proposed the use of shorter filter packs, rather than longer ones. Thus, it appears that there may be a lack of consensus among the GIT on the design of filter pack length and that recommended guidelines have not yet been presented to the State.

It will be important to resolve this issue to avoid mishaps that could result from using too short a filter pack.

Cement Grout

In completing the R wells, it is advisable to incorporate a zone of cement grout along the midpoint of the blank pipe areas, between screen sections. This serves to stabilize the well and prevent downward movement of annular backfill materials above the cement plug, in the event that the underlying backfill materials settle. Severe settlement of backfill materials could occur if the bentonite seal is exposed to the well screen and squeezes through the slot openings into the well, or if the backfill materials move outward into cavernous formation zones during well development and subsequent pumping. If a severe settlement problem occurred in a particular area of the well, the overlying screen zones would be protected from damage by the intervening cement grout seals between them and the area where the settlement had occurred. The length of the cemented area does not need to be excessive and, thus, it can be kept some distance away from the screened zones. Therefore, there should be no effect on the chemistry of the water samples taken from the well.

The EAG has not seen "as built" drawings of recently completed wells but is not aware of cement being placed routinely in the annular space during well completion. The EAG strongly recommends that this construction practice be adopted in future R well designs.

Casing/Screen Diameter

The EAG sensed frustration among some of the members of the GIT regarding the 4.5-inch ID casing size used for completing recent R wells. This is understandable because the small diameter limits the ability to perform certain types of development and hydraulic testing. For example, it is presently not possible to do packer pumping tests (isolating a single screen) and simultaneously measure water levels within the pumped zone.

The 4.5-inch ID by 5.5-inch OD design was selected as the only size that would a) allow installation of Westbay equipment, b) at the same time be installed inside 9 5/8-inch drill casing, and c) be backfilled using a suitably designed tremie pipe, such as A-size drill pipe. A larger casing size could not be filter packed using an adequate tremie pipe, while a smaller size would have precluded Westbay installation.

Use of a larger casing size would require a larger finished hole size. One place that this could occur is in areas where open hole can be drilled successfully. In certain formations, it has been possible to drill open hole through the 13 3/8-inch drill casing, resulting in a hole size near 12 inches in diameter.

Unfortunately, until the drilling takes place, it is generally not possible to know if open hole drilling can be accomplished. This makes it difficult to plan well completion materials for these instances. One way to do so would be to stock an additional size of casing and screen for these cases. This would require a significant capital investment in additional well construction materials. Another option would be to place rush orders for custom-built materials once the hole has been drilled. This approach would probably drive up the material costs and result in some down time for the drilling rig while waiting for the completion materials to arrive at the job site. Either option would result in significant additional costs.

The EAG recommends that the GIT remain cognizant of the costs associated with changing the casing design because they probably will not be trivial. It will be important to weigh the cost of the design change versus the value of the hydraulic information gained.

It is certainly a noble goal to try to complete larger diameter wells. In the interim, methods of conducting tests successfully in the 4.5-inch ID size should be explored. It may be possible to have equipment (packers and pressure transducers) custom built to accomplish the desired objectives. It is even possible that this alternative will be less costly than changing the well casing size.

Well Screen Design

Recent well completions have incorporated pipe base well screen designs. Based on comments received at the EAG meeting, there appears to be some misunderstanding of the properties of pipe base screens versus other types of screen designs and misunderstanding regarding the rationale for selecting the pipe base design. To clarify these issues, a brief summary of available well screen types is provided in Appendix C, along with an explanation of the choice of pipe base screens. As explained in Appendix C, pipe base screens provide the best performance for existing project requirements, while rod base wire wrapped screens would be the preferred choice if conditions were to change that would allow using a non-pipe base design.

Well Design Criteria

At this time, the strategy for selecting the screened zones in the R wells is not clear to the EAG. The designs seem to be made by consensus of the GIT members and possibly others. This begs the question as to the design criteria and if there is consistency of purpose from well to well in developing the designs. Perhaps the GIT could summarize the design/decision criteria that guide the selection of screened intervals for the R wells. These criteria may be well understood and just need to be articulated. On the other hand, if they have not yet been formalized, they need to be developed, clarified and documented.

Drilling Cost Benchmarking

There has been much discussion about the high cost of drilling wells at Los Alamos compared to other federal facilities, and the need for benchmarking costs for comparison. To that end, the EAG received cost summaries from DOE for review. These tabulations included costs for LANL wells and Nevada wells labeled Nye County, Yucca Mountain, and NTS.

The LANL well costs were broken down into several categories, although no explanation was provided to define what costs were included in each category. Costs for the Nevada wells, on the other hand, simply showed a lump sum dollar total without any information as to what costs were rolled into the indicated total. Without a cost component breakdown of the Nevada wells and better definition of the cost categories for the LANL wells, it is difficult to make a valid "apples to apples" comparison of the available costs.

It might be worthwhile for a couple of the EAG members to meet with DOE personnel to clarify this information and determine the origin of the various costs. This could be coordinated with the next semi-annual EAG meeting and perhaps could occur on the day after the conclusion of the regular EAG meeting.

It should be pointed out that drilling conditions in Los Alamos are probably more difficult than those at sites in Nevada. Therefore, analysis may show consistently higher costs for the LANL wells. A better comparison might be obtained using wells drilled in Idaho for INEL, because drilling conditions there are tougher, and may be more similar to conditions in Los Alamos.

LANL Recommendations to Shut Down Drilling Operations

Because of various drilling difficulties, including the R-25 construction problems as well as mis-measurement of the casing in CdV-R-15-3, an assessment was made recently of the ER Project Groundwater Investigations Focus Area's effectiveness in meeting the requirements of the ER Project Quality Management Plan. The results of the assessment were summarized in the September 15, 2000 report entitled *Management Assessment Report for Groundwater Investigations Focus Area.* In the cover letter accompanying the report, the Assessment Team recommended shutting down the drilling operations until quality concerns were resolved.

The EAG believes that suspending drilling operations is not justified at this time. Numerous steps have been taken to correct problems such as those that occurred in the construction of R-25. Other procedures are being put in place currently, and more will be soon, to address quality concerns. It would appear that losses, both financial and schedule-related, would be greater if drilling is suspended than if operations continue simultaneous to establishing appropriate quality control measures.

Positives:

- Drilling costs continue to come down nicely.

- Obtaining guidance from Schlumberger's Integrated Project Management Division may provide value.
- Efforts are being made to evaluate drilling costs.
- Steps are being taken to improve quality control measures.

Recommendations:

- Use longer filter pack overlaps.
- Use cement grout in the blank pipe sections between well screens.
- While striving to maximize well diameters, continue to be cognizant of the corresponding costs so that design changes are economically justified.
- Continue to use casing and screen designs that optimize well performance and are trouble free to install.
- Develop (or articulate) criteria for selecting screen zones in the R-wells.
- Meet with a subset of the EAG following the next semi-annual meeting to review and explain drilling cost categories and other available data.
- Consider examining drilling costs at INEL for benchmarking purposes.
- Do not suspend drilling operations.

3.6 Groundwater Monitoring

Several of the regional aquifer wells have been completed and quarterly sampling has begun. The EAG would like to commend the GIT for beginning the routine sampling of these wells as promptly as possible. A presentation on the methodology of well sampling at the 2001 Annual Meeting, so that the EAG can be fully informed, would be desirable. The commencement of routine sampling does bring up a number of issues related to the overall processes of groundwater monitoring. Among the processes that can affect sample integrity are:

1. Drilling approach
2. Well completion
3. Well development
4. Sampling methodology
5. Field parameter analysis
6. Sample filtration

These processes can impact sample integrity, hence affecting the sampling results in the context of understanding the subsurface chemistry at that spatial point and sampling time. The effects that these processes can exert are discussed in more detail in Appendix D. It is important that persons using the sample data have a thorough understanding of sample integrity compromises that can result from some of these processes.

Awareness and understanding of sample integrity compromises

The fact that sample integrity is compromised by the sampling process itself is known by most practitioners of ground water monitoring. Although the goal of sampling is to attain a sample representative of the water at that location in the subsurface, this ideal, given current technology, cannot be fully realized but only approached. Often, however, those persons using the data are not aware of the compromises of the chosen sampling methodology and assume that results from data that have been "verified" are representative. Sometimes there are nuances of ground water sampling effects not realized by either the samplers or the data users. Processes that are at first selected because they seem correct given a cursory examination, are based on water supply technology, or are based on "tradition" can become ingrained and incorporated into SOPs, irrespective of whether these are the best approaches. SOPs at least add a degree of consistency between samplers and sampling events, even if the results are not necessarily fully representative of the aquifer chemistry.

The best approach to acquiring ground water samples is to use, within physical limitations, the method of sample acquisition that least disturbs the water sample itself and the surrounding formation. This assumes, of course, that the sample is being obtained from a well that has been properly drilled, completed, and developed in the context of the information that needs to be obtained (e.g., relevant physical properties or analytes). The point of this discussion is to make certain that LANL, the NMED, and other stakeholders are acutely aware of the fact that compromises, of necessity, have had to occur throughout the well installation and sampling process. This doesn't mean that the samples are bad or the data unusable. It simply means that interested parties should attempt to understand the relationships among the factors that influence sample quality and whether these interactions will impact their interpretation of the results.

Process effects on sample data

The effects that well installation and monitoring processes can have on ground water sample data and its interpretation are discussed in more detail in Appendix D. Among the concerns that should be considered are

- Residual effects from the drilling fluid, including high organic carbon values and potential sorption of contaminants on these materials.
- Screen, sand pack and seal placement and the potential for errors in calculation and measurement of placement depths.
- Incomplete or inappropriate well development processes.
- Sample collection methods.
- Methods used for collection and analysis of field parameters.
- Sample filtration.

Residual drilling fluid effects should be transient, with most of the materials removed during well development, but residues might impact sampling results for several quarterly samplings. Therefore, caution should be exercised when evaluating data from the earlier sampling events following completion. Screen and seal placement errors can be more onerous since they could exert an ongoing, systematic, problem for understanding the samples both spatially and chemically. Because of this, the EAG urges that logical and consistent approaches are needed for determining where to screen the wells and the methods for calculating the depths of the screens, seals and sand packs. A single, highly trained individual with a background in hydrology or geology would be desirable for making placement decisions onsite as the wells are being completed. Well development is an important consideration for obtaining quality samples and numerous techniques are available. The EAG recommends that the GIT follow ASTM guidelines for well development, and encourages the last step of the process to be pumping of each of the screened intervals with a pump using packers to isolate the individual intervals.

Sampling methods are of obvious importance to sample quality and, as previously noted, the EAG is pleased that SOPs are being modified/created for the procedures. Sampling the Westbay systems, that is done at formation pressure (as we understand it), should yield quality samples for laboratory analysis. The EAG would like to request additional information before we can comment on sampling procedures for the single completion wells, such as R-9. We do have some concern about sampling and analysis of atmosphere-sensitive field parameters, such as dissolved oxygen (DO), Eh (oxidation/reduction potential), and pH. At this time, to our knowledge, the Westbay systems require pouring or draining the water from the sampling device into another container before measurements of field analytical parameters can be accomplished. It is known that this approach is highly inaccurate for parameters that are sensitive to rapid changes upon exposure to the atmosphere, notably DO and Eh, occasionally pH and alkalinity. Accurate analyses of these parameters require a flow-through cell with appropriate electrodes (i.e., no exposure to the atmosphere before analysis following removal from the well screen). Sample filtration is another aspect of sampling that requires consideration. Typically, samples collected by low-flow

techniques do not require filtration that, itself, can cause problems with the understanding of sample chemistry. This should also be true for samples collected with the Westbay systems. We encourage the GIT to consider eliminating filtration of samples from the Westbay systems to reduce analytical costs and conserve collected samples for additional analyses, if needed.

Positives:

- The EAG commends the GIT for beginning the routine sampling of the completed wells as promptly as possible.
- The GIT and ER are modifying old sampling SOPs and developing a new sampling SOP for the Westbay systems in a timely manner.

Recommendations:

- The EAG would appreciate a presentation dedicated solely to current and planned groundwater sampling methodologies at the next meeting we attend.
- The EAG cautions that investigators and stakeholders should make a significant effort to understand the relationships among the factors that influence sample quality and how these will impact their interpretations.
- Over-interpretation, and over reliance on, sampling results from the early quarterly monitoring events should be avoided.
- A logical and consistent approach is needed for determining where to screen the wells and the methods for calculating the depths of the screens, seals and sand packs. The EAG recommends that the GIT develop this approach and have a single individual, highly trained in geology and/or hydrology, make these onsite decisions for all the remaining R wells.
- For the wells drilled with bentonite and synthetic materials such as EZMUD, the EAG recommends great caution to ascertain that the wells are properly developed.
- The EAG recommends that the GIT follow ASTM guidelines for well development, and encourages the last step of the process to be pumping of each of the screened intervals with a pump using packers to isolate the individual intervals.
- With regard to sampling the single completion wells, such as R-9, the EAG would like to request additional information before we can comment.
- The EAG cautions that field analytical parameters that are sensitive to the atmosphere (e.g., DO, Eh, possibly pH) might not be accurate unless analyzed within a flow-through cell.
- The EAG recommends that the GIT consider eliminating filtration of samples from the Westbay systems to reduce analytical costs and conserve collected samples (see discussion, Appendix D).

3.7 Risk Assessment

The EAG is pleased to see the continued progress towards using a risk-based approach in the development and implementation of the Workplan. Continued progress in groundwater modeling and the use of probabilistic risk assessment modeling approaches are very important contributions to the risk-based approach.

The EAG was also pleased to be briefed on the continued progress of the database management system. The importance of an integrated data system to the risk-based approach has been previously stressed. Any risk characterization program will necessarily need to rely on validated data that are thoroughly characterized and immediately available for analyses.

Also, viewed very positively by the EAG is the proposed establishment of a Risk-Based Decision Subcommittee to be chaired by Diana Hollis. The membership of the committee seems well conceived. The EAG stresses that a stable support group of interdisciplinary scientists should be

assigned to help the subcommittee meet the identified objectives of the action plan for the External Advisory Group Semi-Annual Report, dated June 26, 2000. This would increase the subcommittee's potential for success. Further, the EAG sees the opportunity for a solidly functioning subcommittee to provide the necessary risk assessment overlay to help guide the many elements of the Hydrogeologic Workplan and the related activities. Risk assessment is embedded in the Hydrogeologic Workplan because the ultimate goal of the process is to evaluate potential risk concerning human health and environmental systems. In this context, it is not too early to design the important elements of this program. The EAG sees the Risk-Based Decision Subcommittee as the focal point for the design and implementation of this risk-based plan.

The EAG believes that the principal goal of the risk-based plan within the context of the Workplan is to address risk associated with any contaminants identified during the well sampling program and further to assist in guiding data collection and siting of wells. The EAG recognizes that, should contaminants be found in the regional aquifer, a timely response will be needed.

Having established an overall goal for this risk-based program, an implementation plan for reaching the goal is an important next step. Elements of this plan include the following:

1. Identification of the chemicals of potential concern and characterization of these chemicals.

    - Rank the chemicals according to chosen criteria, e.g., likelihood of occurrence and toxicity.
    - Characterize chemical/physical properties including persistence and mobility.
    - Identify health guidance levels, e.g., MCLs, health advisories, or develop health guidance levels where no guidance levels are available.

2. Guide geochemical modeling

    - Ensure that the most important chemicals of concern are the focus of the program.

    - Ensure that the program contributes data critical to the risk-based program, e.g., background, half-life, and related issues critical to the ultimate prediction of potential contaminant transport, if found, to supply wells.

3. Identify special issues important to risk-based considerations and assist in guiding the related research.

    - For example, colloidal affinity needs to be considered in a focused program for the principal chemicals of highest concern to identify both issues of transport and attenuation of dose that may affect potential toxicity.

4. The groundwater modeling is an essential part of the risk-based approach and needs to be considered in this context as the Hydrogeologic Workplan progresses. For use in risk-based decision making, the modeling approaches necessarily will need to be validated by selected monitoring data. Confidence in modeling predictions needs to be clearly stated in predicting contaminant transport. The EAG is pleased to note the progress in wedding modeling development to data collection. The EAG recognizes the importance of an iterative process to refocus the modeling program as monitoring data are collected. This process can help guide future well and data collection while the monitoring data can guide further model development.

5. For each step in the process, there needs to be clear considerations of uncertainty and variability.

The EAG believes that these and other elements of a risk-based approach can be successfully guided by the Risk-Based Decision Subcommittee if it is properly supported. This subcommittee should assist in the design and implementation of related programs as identified in the selected

issues above and keep the GIT informed of the relationships between the different efforts. The EAG has previously emphasized that while many approaches may be the same between the ER program and the Hydrogeologic Workplan as far as risk assessment is concerned, there certainly are differences as well. The urgency of needing to potentially address the significance of a contaminant found during well drilling is a special issue to the hydrogeologic workplan. To address this issue, toxicity, geochemistry, model development, and other special issues such as colloidal transport and attendant toxicity attenuation will need to be addressed expeditiously. The EAG also recognizes that the topic of "plume chasing" has been raised continuously. A well-coordinated program that has the support of the GIT and outside parties can greatly enhance the program's ability to handle these troubling issues. A well-conceived program can go a long way toward addressing the essential risk issues that will undoubtedly be triggered if contamination is found; such as the necessity to drill wells for plume chasing. A well-conceived approach that combines toxicity information with geochemical modeling, groundwater modeling, and understanding of other special issues may make plume chasing unnecessary or, if necessary at all, could help target where any additional wells should be drilled.

Positives:

- The EAG commends the formation of a Risk-Based Decision Subcommittee.
- The EAG commends the use of a risk-based approach and the recognition of its importance including the development of geochemical models and groundwater models.

Recommendations:

- Empower the Risk-Based Decision Subcommittee to develop a risk assessment plan for use in the Hydrogeologic Workplan. This plan should establish goals and define a plan to address issues such as those presented above.
- Provide information to the EAG on risk assessment approaches that go beyond the ER program, to address the special issues that must be addressed, should contaminants be found during well drilling.
- Possibly, find time during EAG meetings for EAG staff to meet with the risk assessment staff to review risk assessment approaches and methods.
- Use the Risk-Based Decision Subcommittee as a central focus for the development of a program to inform all the involved parties of potential risk that may be associated with the risk significance of finding contaminants in groundwater.

Appendix A: Example of a Questionnaire-Designed QAPP Process

A primary project objective should always be to create a coherent pathway to achievement of the data quality objectives. Training, accountability, and documentation alone cannot achieve this result. One means of creating such a pathway is to force the project practitioner to fully think through all steps of the project, including the required outcomes of each step, from beginning to end and document them. This process will often expose project weaknesses or unclear reasoning, allowing corrections to be made before the project begins. This tends to result in a higher percentage of successful project outcomes and reduces the need for changes and backtracking, hence increased expenses, during the course of the project. One approach is to develop a QAPP through a series of questions that must be answered prior to allowing the project to go forward. The practitioner or investigator must answer these questions in very specific, often detailed, terms. The responses are then subject to the approval or disapproval of both QA personnel and management before the project is allowed to proceed. Subsequent deviations from the QAPP during the project also require approval. This appendix provides an example of such a questionnaire-designed QAPP process that was developed for research programs. Such an approach could be readily adapted for the Workplan and applied to its various DQO-driven components.

PROJECT DESCRIPTION AND APPROVAL QUESTIONNAIRE

PROJECT DATA FORM

TITLE:

PRINCIPAL INVESTIGATOR:

WORK ASSIGNMENT NO:

INTERNAL PROJECT CODE:

WILL SAAMS BE REQUIRED? YES **NO**

If yes: Standard Format
Customized Format

WILL DRILLING RIG AND CREW BE REQUIRED? YES **NO**

IF yes, dates and duration:

Anticipated activities:

ARE POTENTIAL WASTE MATERIALS BEING IMPORTED? YES **NO**

If yes, describe materials including
volume and method of disposal:

ARE SOLVENTS OR OTHER HAZARDOUS MATERIALS BEING USED OR CREATED? YES **NO**

Quantity and type of waste produced during project, and method of disposal:

WORK PLAN

Distribution list for QA project plan:

Problem Definition (background):

Project Objective:

Approach:

Experimental Design (if possible, state the hypothesis to be tested in statistical terms):

How will you know when you have achieved the objective?

List procedures to be used and describe or reference. Indicate procedures to be developed (TBD).

How will the final results be calculated and/or graphed? Give equations, where appropriate, or include mathematical treatment by reference. If results will be graphed, specify the variables and curve fitting procedures, where appropriate. Include computer software that will be used.

List participants in the study, their positions, and their responsibilities for QA. Who is responsible for data or model assessment? Who is responsible for corrective actions, when needed? Who should be notified when problems persist?

Documentation and records:

Anticipated outputs with dates (include quality assurance reports to management):

Information to be reported:

___ raw data
___ instrument printouts
___ calibration and QC data
___ graphs
___ description of method (analysis or sampling)
___ computer codes
___ user's manual
___ other (describe briefly):

Normal holding time for data is 5 years. Specify where data will be stored.

Data review, validation, and verification requirements (state criteria used to accept, reject or qualify data): (If this is discussed in Section I, II or III, refer to that section.)

For projects with possible policy implications describe:

Instrument/equipment testing, inspection and maintenance requirements

Data management

Data Validation and Verification methods

The project involves:

_Laboratory measurements (see Section I)
_Field samples or measurements (see Section II)
_Model application (see Section III)
_Model development (see Section IV)
_No measurements or modeling (skip Section I-IV)

Section I. Laboratory Measurements

What accuracy and precision in the measurements is required to achieve acceptable final results in order to answer the experimental question? If the final results are calculated from more than one measurement, consider the total uncertainty.

What are the samples intended to represent?

How will it be determined that the data are complete?

What comparisons will be made and what criteria will be used to determine that these comparisons are valid?

Describe the types of blanks and controls that will be used for QC (if not included in a referenced procedure).

How many replicate samples and/or measurements are planned?

Describe procedures for data quality assessment. Assessments may include inspections, QC checks, Performance Evaluation (PE) Studies, QA reviews, statistical tests (e.g. control charts, checks for linearity or goodness of fit), etc.

For method development projects, describe criteria for assessment of the method. These criteria should be determined by the objectives (in terms of accuracy, precision, sensitivity, specificity, robustness, or whatever is appropriate).

Describe corrective actions to be taken when data quality is not acceptable. Details may be referenced. (Instrument manuals, SOPs, or referenced procedures may discuss common problems and corrective actions. SOPs to be developed should include corrective actions for common problems.)

Section II. Field Projects

Describe the sampling scheme. Will probability sampling be used to assure representativeness?

Describe or reference sampling procedures, sample preservation methods, and procedures to ensure sample identification and integrity.

If no sample is taken, describe field measurements, including calibration of instruments.

Describe procedures for assessment of data and procedures.

Describe corrective actions to be taken, or reference. (Instrument manuals, SOPs, or referenced procedures may discuss common problems and corrective actions.)

Section III. Model Application

What criteria and testing will be used to determine the appropriateness of the model to the proposed application?

How will input data be obtained/selected?

How will uncertainty in the data and the calculated results be quantified?

Identify the hardware to be used.

Section IV. Model/Algorithm Development

Describe procedures that will be used for model evaluation, including:

1) Mass balance
2) Stability
3) Numerical dispersion
4) Verification of analytic solutions
5) Use of analytic solutions for verification of numerical algorithms
6) Sensitivity analysis

What hardware, languages, and operating system will be used?

What input parameters are required and how will they be obtained?

NOTE: During the course of the project, documentation of the conceptual model, derivations, numerical procedures, and comments within the code will be required. If the model is intended for external distribution, a user's manual must be included.

ARE RADIO ISOTOPES BEING USED IN THIS PROJECT? YES **NO**

If yes, which isotopes?

Isotope Amount

ARE STANDARD LABORATORY PROCEDURES PLANNED FOR RADIO ISOTOPES USE? YES **NO**

If not, explain deviation:

IS THIS PART OF AN EXTRAMURAL PROJECT? YES **NO**

FOR EXTRAMURAL PROJECTS

PROJECT NO;

EXTRAMURAL PROJECT PERIOD FROM TO

INHOUSE PROJECT PERIOD FROM TO

EXTRAMURAL FUNDS $K

INHOUSE FUNDS FOR SUPPLIES AND EQUIPMENT PER FY $K

ALL PERSONNEL

NAME FY FY FY SIGNATURE

MANYEARS

ANALYTICAL REQUIREMENTS

TYPE OF ANALYSIS TOTAL NUMBER--FREQUENCY
FY FY FY

Appendix B: EAG Need for Additional Information on the GIT Modeling Program

The EAG has been tasked in part with providing technical peer review and recommendations for improvement in the Workplan and Monitoring Well Installation Project activities. The EAG review function is to provide an objective appraisal of the scientific, technical, economic and value engineering aspects of the currently planned seven-year, $50 million project. In order to accomplish its role effectively, the EAG should be provided with sufficient information on the planned modeling program to be able to independently and critically evaluate modeling analyses and work products in the context of the overall program.

As part of its ongoing dialog with the GIT, the EAG continues to seek information regarding planned modeling activities. It would assist the EAG in performing its assigned reviews, if the GIT were to provide information on as many of the following components of the modeling program as possible prior to the March 2001 Annual Meeting.

Table 2. Modeling Program Information Requested by EAG

Item	Requested Information	Comment
1.	Intended uses of models/modeling results.	Draft Revised Section 3.0 of the Workplan does not provide a concise and comprehensive list of planned uses of modeling. Identification of uses should form the core of the modeling program plan. (See discussion below of possible uses of modeling for LANL GIT program.)
2.	Regulatory factors governing the use of modeling in the LANL program.	HC and ER program elements are being conducted as required by RCRA regulations and the facility's HSWA permit. There may be requirements of the regulatory programs that can, practically or economically, best be met by the use of modeling. There may be other aspects of the regulations that prohibit modeling in meeting certain requirements, or that require collection of specific field data or monitoring in addition to, or in support of, modeling. The implications of these regulatory requirements should be considered and discussed in the modeling program plan.
3.	Specific DQOs that will be met by the use of models.	As discussed in the June 26, 2000 EAG recommendations report, the DQO process initially presented in Appendix 4 of the Workplan was not clear, in some instances, on the use of modeling in developing the required data. The EAG report also stated that the DQO process would require refinement and redefinition as the modeling progresses. This should be acknowledged in the modeling program plan, and the process for accomplishing a refining of modeling-related DQOs should be described.
4.	List of individual modeling tasks/activities.	Information for each modeling task should include (1) title, and (2) brief descriptions of (a) task scope, (b) purpose, (c) tools and approach, (d) objectives of study and decisions (or DQOs) being supported, (e) required outputs.
5.	Plans for scheduling and integrating sequential and interrelated modeling tasks, including identification of group/entity responsible for each modeling task.	Plans should include identification and prioritization of data "handoffs" from field teams to modeling teams for model inputs, from modeling teams to field teams to guide field program activities and decisions, and from modeling team to modeling team to support timely completion of interrelated modeling tasks. Of particular importance is the identification of interdependencies among modeling activities that fall under the direction and funding of different functional entities within the LANL organization.
6.	Plan for communications with stakeholders regarding	These two activities are closely related and will have a large impact on the success or failure of the modeling program

	modeling technology and methods, and plan for use of models as a communication tool with stakeholders to convey the results of modeling analyses.	efforts regardless of the technical merits of modeling activities as perceived by the GIT or EAG.
7.	Plan for characterizing uncertainty in modeling results and for communicating with stakeholders regarding the concept of decision-making based on scientific and engineering analyses and the consideration of uncertainty.	These two activities are closely related and will have a large impact on (1) the cost and level of effort expended in attempting to satisfactorily characterize uncertainty (e.g., within the scope of individual modeling tasks), and (2) the scope, duration, and cost of the overall HC and ER combined project because resolution of issues, and termination (or scaling back) of project activities, will depend on an acceptable level of confidence in the technical bases for site characterization and corrective action decisions

Intended uses of models and modeling results will be among the most important factors in determining the framework for the GIT modeling program. Based on a review of the draft Revised Section 3.0 of the Workplan, modeling discussions with GIT staff and management, and the EAG members' experience at similar sites, the list of possible model uses for the LANL HC and ER projects might include:

- Interpretation of data and development and testing of a hydrogeologic conceptual model;
- Siting and prioritization of monitoring wells under the Monitoring Well Installation Project;
- Design and management of the monitoring well network;
- Identification of field data needs and prioritization of field data collection activities;
- Prediction tools for risk assessment;
- Remedial engineering analyses for design and performance assessment;
- Analysis of regional water supply issues;
- Analyses to support long-term stewardship; and
- Communication tools for conveying technical results to stakeholders.

Tools (model codes, pre- and post-processing software, etc.) and tasks should be identified in the modeling program plan to address each of these categories of intended uses. As stated in the table above, regulatory requirements and constraints should be considered when formulating methods and scoping individual analysis tasks. The modeling program plan should identify all planned modeling tasks and should describe them in sufficient detail to permit review and comment by the EAG. Table 3-4 of the draft Revised Section 3.0 of the HWP lists categories of modeling activities, but does not identify and describe individual modeling analysis tasks. The abbreviated description of each category of modeling effort is not sufficient to allow a reviewer to develop an understanding of the modeling program at a level that would permit meaningful comment on individual modeling tasks in the larger context of the program.

The approach to developing the technical scope for the various modeling tasks also should be included in the modeling program plan. A statement during the October 2000 Meeting indicated that there were approximately 2000 waste management units that will require some level of characterization and corrective action decision-making. Detailed modeling of each potential source would be impractical. The modeling program plan should discuss how modeling would be applied in a focused, efficient program for this large number of potential sources. This will undoubtedly involve a mix of analytical models, system models, and hydrologic process models to conduct analyses that will range from screening level to sophisticated and detailed process simulations. The plan should discuss the method for systematically applying these various levels of tools and analyses to most efficiently achieve the desired result.

Integration of modeling efforts across groups at LANL should also be addressed in the plan. The EAG is aware that interrelated modeling activities are ongoing, and are planned, in both the GIT program and ER Project, but the EAG is not clear on the responsibilities and degree of integration between the projects. Differing group priorities and funding levels could delay modeling tasks that are on the critical path, which in turn would have the effect of delaying the overall project schedule. A statement was made at the October 2000 meeting that, while the regional modeling schedule was established through FY 2006, the vadose zone modeling portion of the program was difficult to plan beyond about FY 2003. This may represent a disconnect in the schedule between the two interrelated modeling efforts, at least in out years. Statements were also made about possible funding reductions that could postpone modeling efforts currently scheduled for FY 2001. Without a more complete understanding of the modeling program, it is difficult for the EAG to comment on the likely impact this could have on the technical reliability of other related modeling tasks, or on the overall project schedule.

The EAG has observed, in technical meetings and interactions with stakeholders, a wide range of responses to the proposed use of modeling in the LANL program. These range from an inherent distrust, or discounting, of model results to an optimistic over-reliance on models. A program of education and communication will be essential to ensuring the success and acceptance of the modeling efforts. If not discussed within the technical modeling work plan, this program should be conceptualized, formalized and documented in some other form. Similarly, the modeling plan should outline the proposed approach for characterizing and communicating uncertainty in the modeling results with respect to corrective action decision making. Confidence in, and acceptance of, analysis results that form the basis for decisions that impact regulators and stakeholders will be a key factor in bringing the project to a successful conclusion.

The EAG requests that the information identified above be provided in the form that can be most easily assembled and transmitted by GIT and ER Project management and staff; e.g., conference calls, meetings, or in written form as may be appropriate.

Appendix C: Well Screen Design

Four types of well screen are commonly available:

I. Rod base, profile wire (continuous slot) screen.
II. Pipe base, profile wire (continuous slot) screen.
III. Slotted pipe (saw cut slots).
IV. Punched pipe (louvers).

Rod base screens incorporate a V-shaped wrap wire welded to a circular array of vertical rods. Rod base screens can be manufactured in high strength designs suitable for any well depth (up to about a mile). Advantages include high open area (high efficiency) and availability in any slot size. Disadvantages are that the end fittings (such as threads) must be welded to the screen body, resulting in crooked ends and oval fittings (from heat effects). If threaded ends are used, this can make it difficult to assemble the screen sections in the field. On the other hand, if the screen sections are assembled by welding, slightly crooked or oval ends are not usually a significant problem. An additional disadvantage of rod base screens is imperfect tolerance of the inside diameter dimension because of the inner weld bead where the end fittings are attached to the screen body.

Pipe base screens incorporate a rod base screen sleeve slipped over a perforated pipe. Advantages are availability in any slot size and straight, strong and true end connections. Open area is adequate, being better than that of slotted pipe and punched pipe, but not as good as that of rod base screen.

Slotted pipe can be provided with end connections equivalent to those available on pipe base screens. Disadvantages are that small slot sizes are not available and open area is low.

Punched (louvered) pipe is generally supplied with end connections that must be welded. Other disadvantages are that small slot sizes are not available and open area is low. A final disadvantage is imperfect tolerance on the outside diameter dimension because of the protrusion of the louvers.

The rationale for selecting pipe base screens for the R wells was based on the stated requirements of the job. Requirements included:

I. Small slot size.
II. Tight tolerance on the OD dimension (had to be run inside 9 5/8-inch drill pipe along with a suitable tremie pipe).
III. Tight tolerance on the ID dimension (had to allow installation of 4.3-inch OD Westbay packers).
IV. Threaded end connections (no welding allowed)
V. Round (not oval) threads.
VI. Straight threaded connections.
VII. Strong threaded connections.

The use of pipe base screens was the only option that could satisfy all of these requirements. Pipe base screens were not selected for their strength characteristics; high strength was just a corollary benefit of using them.

At the EAG meeting, it was proposed, if a larger screen diameter was used in well completion (such as 6-inch), that louvered screens be used as an efficiency improvement over pipe base screens. It was suggested that because some of the open area of pipe base screens lies behind the blank portions of the inner pipe base, the tortuous path of fluid passing through the screens would contribute to inefficiency compared to punched pipe. A careful analysis of the designs of

these screens, however, shows that pipe base screens are, in fact, superior from an efficiency standpoint.

Consideration of louvers presupposes that a relatively large slot size would be used. It is instructive to compare the open area characteristics of pipe base screens and louvered pipe. As a basis of comparison, consider a 60-slot (0.060-inch) screen in each design. The inner pipe base of the screens currently specified by the Lab contain 8.75 percent open area. The open area of the outer screen sleeve in 60 slot is 50 percent, resulting in a net open area of 4.375 percent (8.75 percent times 50 percent) where the outer sleeve overlaps the perforations in the base pipe. This constitutes the so-called "direct access" open area. In addition to this, the remaining 91.25 percent of the screen surface can provide some indirect flow, associated with a more tortuous path for the fluid entering the well. In this area, fluid enters the outer screen sleeve and moves vertically or laterally to a perforation in the base pipe, resulting in a somewhat tortuous path. Keep in mind though, that the head loss associated with the tortuous path is negligible, because it is open channel flow. This portion of the screen contributes another 45.625 percent open area (91.25 percent times 50 percent).

As a comparison, a 60 slot louvered pipe offers a direct access open area of approximately 2 to 4 percent, depending on the slotting pattern specified. The balance of the screen surface, 96 to 98 percent, is completely blank and provides zero access for flow. Thus, because a tortuous flow path is better than no flow path at all, the pipe base screen is more hydraulically efficient. It has more "direct access" open area (4.375 percent versus 2 to 4 percent) and more indirect access open area (45.625 percent to zero). Furthermore, for a slight additional cost, the pipe base can be provided with 11.25 percent open area in lieu of the currently specified 8.75 percent. This would result in a direct access open area rating of 5.625 percent and an indirect access open area of 44.375 percent.

The proposed use of louvered pipe also presupposes that welded joints would be satisfactory and thus, that some imperfection in roundness and straightness of the joints could be tolerated and that OD/ID tolerance would not be critical. Under these circumstances, the GIT's interests would be better served by specifying rod base screen. Rod base screens constitute a better choice for the GIT because they provide vastly more open area and hydraulic efficiency than punched pipe. Thus, the use of punched pipe as a completion material appears to have no particular merit because of the other superior alternatives available.

Appendix D: Processes Potentially Affecting Ground Water Sample Integrity

Numerous factors involved with the processes of installation and sampling of a ground water monitoring well can impact understanding of the subsurface and the interpretation of data with regard to system chemistry, contaminant detection, and contaminant transport and fate. Some of these, and their potential impacts, are addressed below:

Drilling Approach

The approach to drilling the deep regional aquifer wells has been discussed extensively (dry versus bentonite fluids versus synthetic fluids) and will not be reiterated here. It seems reasonable that the synthetic fluids, currently being used in relatively small concentrations, have an advantage relative to bentonite since they should biodegrade over time whereas bentonite will not. In either case, well development should be rigorous to remove as much of the material from the screened intervals as is possible. Air rotary, casing advance, without these fluids should still be considered for drilling the wells in Mortandad and Los Alamos canyons, as was stated in the June 26, 2000, EAG report. There are several factors related to drilling that could affect the ground water sample quality, including:

- Analyte sorption by residues of either bentonite or synthetic fluids such as EZMUD.
- Higher turbidity values due to entrained bentonite.
- High organic carbon values due to EZMUD.
- Increased biomass on and around well screen due to EZMUD degradation (plugging potential).
- Sorption/transformation of contaminants due to increased biomass (EZMUD).

These influences would be expected to be transient, with the effects decreasing over time as sorption capacity is exceeded, degradation is completed, etc. However, data users should be aware that changes in parameters might be noted for an unknown number of quarterly sampling events. Caution is warranted and over-interpretation of, and over-reliance on, sampling results from the early quarterly monitoring events should be avoided.

Well Completion

That well completion can have a large number of effects on samples collected from the well is obvious. Clearly, the location of the well screens within the aquifer is critical to both acquiring typical ground water information and detecting contaminants. For example, if a short screened interval is placed across a clay lens in an aquifer that is predominantly sand and gravel, a biased view of the overall ground water chemistry will result from samples taken in that interval. If a contaminant plume is moving in the gravel zones, rather than atop the clay, then the contaminant detection might be missed altogether. Measurement errors that mislocate the screened intervals, the bentonite seals or the sand packs can also impact understanding of the ground water chemistry and flow characteristics, influencing modeling results if the data are incorporated as though they are correct. Because of these considerations, the EAG encourages the GIT to ascertain that a logical and consistent approach is taken for determining where to screen the wells and the methods for calculating the depths of the screens, seals and sand packs. To accomplish this consistency, the EAG recommends that a single individual, highly trained in geology and/or hydrology, make these decisions for all the remaining R wells.

Well Development

Well development is needed both for water supply wells and for monitoring wells, but for somewhat different reasons. For water supply wells, development is critical for obtaining sufficient ground water flow into the well to support the pumping rate. Development is, therefore, often very vigorous and intended to remove all fines and small-grained materials from around the screened interval for a significant distance into the aquifer itself. Although ground water flow into a

monitoring well is also important, the primary value of well development is to return the zone around the screened interval to some semblance, both physical and chemical, of what it was prior to drilling disturbance. In practice, monitoring wells that have been drilled without mud-based fluids do not usually require as extensive development efforts. These can sometimes be developed by pumping alone, but this is still not usually recommended. Monitoring wells drilled with mud-based drilling fluids (including both bentonite and synthetic compounds) often require a significant, time-consuming, and potentially expensive development effort. For the deep regional aquifer wells that have been drilled with bentonite, EZMUD, etc., the EAG recommends great caution to ascertain that the wells are properly developed. There must be no hurry to set the pumps or Westbay systems until proper well development has been completed and confirmed.

The development process attempts to remove particulate debris, clay smears across sandy, water-yielding zones, and both the liquid and solid residues in the borehole resulting from the drilling fluids. It should be noted, however, that the methods of developing monitoring wells could themselves exert a negative impact on sample quality for some period following the development process.

Since the methods used to develop a monitoring well can impact sample quality following development, it is useful to consider what some of these effects might be. There are numerous well development techniques available and to discuss them would be far beyond the scope of this document. Published descriptions of these development techniques are available[1].

According to the presentation on well development at the October 2000, Quarterly Meeting, various combinations of four development methods are being used in the R wells. The four methods being used at LANL include forms of jetting, bailing airlifting, and pumping. Proper development of these wells is important for removing as much of the drilling fluid and residues as possible, hence reducing the time (or number of quarterly sampling intervals) for the water chemistry to return to the natural background formation status. The EAG recommends that the GIT read, consider, and attempt to follow the well development guidelines provided in the ASTM "Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers" (Designation: D5521-94). This document, in addition to discussing the development techniques, also considers some of the impacts of development on sample quality.

Irrespective of which method, or combination of methods, is chosen for well development, the EAG encourages the last step of the process to be pumping of each of the screened intervals using packers to isolate the intervals individually. This provides a final opportunity for the removal of loose fines from the zones of interest and allows water quality to be measured at the surface. The EAG recommends that a pumping system be developed or acquired that can develop the screened intervals independently (or sections of the screened intervals in long completions). This will require the use of inflatable packers that straddle the pumping interval, thus allowing isolation of the interval to be developed. Without packers, the water pumped will come from the more permeable screened zones and less permeable zones might be poorly developed. Even should all the screened intervals have equal permeability and flow, the flux of water created by pumping would be distributed across them all, resulting in very slow flow rates and the likelihood of poor final development.

Sampling Methodology

The EAG understands that ER Division sampling SOPs are being developed and/or modified for use under the Workplan. We commend this effort and look forward to reviewing these SOPs. The EAG is aware that the multiple-completion Westbay wells are the first of their type to be used at LANL and that a new SOP is under development for sampling these wells. The Westbay samplers will acquire samples at formation pressure, essentially a low-flow sampling technique, and the EAG believes that high-quality information should be obtained from these provided the wells have

[1] Driscoll, F.G. (1989). Groundwater and Wells. 2nd Edition. Johnson Filtration Systems Inc. St. Paul, MN

been properly completed and developed. With regard to sampling the single completion wells, such as R-9, the EAG would like to request additional information before we can comment. It is noted from the October 2000, presentation on the status of the wells that a pump has been installed in Well R-9. The use of a pump is certainly preferable to sampling with a bailer. We anticipate that sampling protocols will be developed for these wells that seek to minimize disturbance to the formation, to the stagnant water above the screened interval (since the pump is dedicated), and the collected water samples themselves.

Field Parameter Analysis

Parameters that are typically analyzed in the field include pH, Eh, DO, specific conductance, temperature, turbidity and occasionally alkalinity, although other parameters are sometimes also measured. The first four of these (and sometimes turbidity) are used as indicator parameters of sufficient purging when using low-flow purging and sampling techniques. Accurate analysis of these parameters (excepting alkalinity and, perhaps, turbidity) requires the use of a flow-through cell containing sensors for the parameters. Temperature readings must be taken in the water very close to the wellhead (downhole is better) if one hopes to get even an approximation of the actual water temperature. The sensor-containing flow-through cell is connected directly to the output from the pump to eliminate the possibility of exposing the well water to atmospheric gases at the surface. Exposure to the atmosphere causes nearly instantaneous changes in Eh and DO, which simply cannot be accurately measured without using a flow-through system. Changes in pH are somewhat slower but can still be significant with certain groundwater chemistries, especially those that evolve CO_2.

The EAG is not familiar with the methods that are currently being used to analyze these parameters at LANL, but hopes that flow-through methods are being used on pumped wells. To our knowledge, there is no way to analyze these sensitive field parameters in an undisturbed manner using the Westbay sampling system collection devices. Essentially the device must be opened and the sample exposed to the atmosphere. Therefore the EAG cautions data users that the values of these sensitive field parameters obtained from the Westbay wells might not be representative of aquifer conditions. If flow-through sensor systems are not being used for the pumped wells, caution should also be observed for the atmosphere-sensitive data from these wells.

Sample Filtration

When groundwater sample filtration is needed and done properly, it is done in the field using a flow-through filter cartridge. As for the field parameters (above), this eliminates atmospheric reactions and yields a more representative sample. Filtration by pouring the sample into a filtration device can result in serious changes in the chemistry of some groundwater samples, a discussion of which is beyond the scope of this document.

Generally, when sampling using low-flow purging and sampling techniques, filtration is neither necessary nor desirable. If the completion and development of the wells containing Westbay installations has been properly accomplished, samples collected from these wells would not be expected to require filtration to remove solids. This should be a positive aspect of the Westbay systems and could be used to minimize duplication of analyses, hence reducing expenses and conserving more of the captured samples for other tests and analyses. Therefore, the EAG recommends that the GIT consider eliminating filtration of samples from the Westbay systems to reduce analytical costs and conserve collected samples. If samples appear excessively turbid, then both filtered and unfiltered samples can be collected but it should be realized that the open vessel filtration itself might not provide accurate results. If samples are excessively turbid, this condition might clear up over time as the well becomes established.