Evolution of Groundwater Monitoring at Los Alamos National Laboratory - 9496

D. Katzman, P. Huber, Los Alamos National Laboratory,
Water Stewardship Program, P.O. Box 1663, MS M992,
Los Alamos, New Mexico, 87545

ABSTRACT

This paper describes recent advancements is the objectives and associated refinement of the deep groundwater monitoring network at Los Alamos National Laboratory. The recent updates were conducted on the heels of a multiyear groundwater characterization program that provided a hydrogeologic and geochemical framework for the approximately 40 square miles of facility property. This framework is used to support more detailed, site-specific characterization projects and to update to the facility-scale groundwater monitoring program. The assessment of the monitoring program was conducted through an evaluation of various attributes of the existing well network (e.g., location, groundwater quality, construction) in the context of a new set of objectives intended to bridge current monitoring objectives and pending project-specific monitoring objectives driven largely by corrective-measures performance monitoring.

INTRODUCTION

The scope and objectives of groundwater monitoring at Los Alamos National Laboratory (the Laboratory) has evolved during its 60-plus year history. This paper presents a review of past monitoring and discusses more recent advancements and the approach used to establish the current network. The progressive growth and refinement of the groundwater monitoring network at the Laboratory is consistent with advancement of new programs and operations at the Laboratory and associated monitoring needs.

BACKGROUND

The Laboratory property encompasses approximately 40 square miles. Three groundwater zones are present within and beneath the Laboratory property. Figure 1 is a simplified block diagram showing these zones and the stratigraphic context of each zone. The regional water table within the aquifer lies at depths ranging from approximately 1200 to 800 feet below ground surface (bgs). Monitoring in the early years was limited to a relatively small number (less than approximately 15) monitoring wells within the deep (regional) aquifer that is used for water supply.

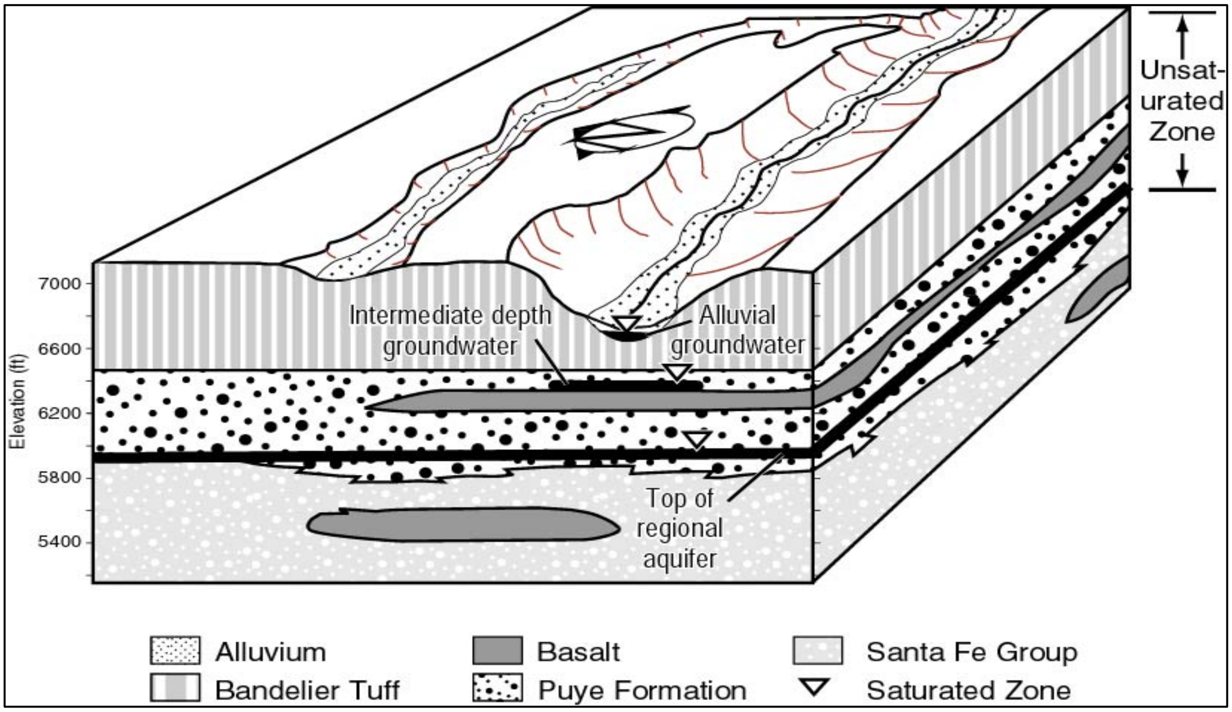

Figure 1. Simplified block diagram of the hydrostratigraphic setting at Los Alamos National Laboratory. Alluvial groundwater occurs generally ~20–40 feet bgs and is recharged by snowmelt, stormwater, and effluent. Perched-intermediate groundwater is known to occur predominantly beneath wet canyons and is generally 150–800 feet bgs. Deep or regional groundwater generally occurs from 800–1200 feet bgs. Hydrologic connection is known to exist among the three zones.

Early investigations proposed that the deep groundwater was protected from impacts of Laboratory operations by a thick sequence of volcanic tuff. This assumption even led to a request to the State of New Mexico regulators for a groundwater monitoring waiver. In 1998, the Laboratory prepared and began implementation of a hydrogeologic work plan (HWP) to substantially advance knowledge of the stratigraphic, hydrologic, and geochemical setting beneath the Laboratory [1]. Implementation of the work plan involved drilling 32 additional deep wells between 1998 and 2004. This program focused on detailed characterization techniques, including analysis of core and vadose-zone pore water, comprehensive stratigraphic analysis, deep penetration beneath the water table, collection of a large suite of advanced geophysics data, and installation of multiple-screen wells in many cases. The wells were drilled at locations selected to build a framework of fundamental knowledge from which future investigations and monitoring wells could be based.

Beginning in 2007, the Laboratory prepared a series of area-specific groundwater monitoring well network evaluations (network evaluations) [2,3,4,5,6,7]. These evaluations were triggered by a requirement from state regulators and were seen as an opportunity to evaluate the adequacy of the network in the context of an updated set of objectives that were consistent with the current regulatory framework.

APPROACH AND OBJECTIVES

The network evaluations were conducted at a stage in the regulatory process that bridges to the next evaluation of potential additional monitoring requirements for sites undergoing corrective measures steps under the RCRA process. The network recommendations that derive from this first evaluation are intended to capture the monitoring requirements for the 2- to 4-year time frame, while field investigations at key sites continue and before selection and implementation of the final remedies and associated monitoring. Figure 2 is a schematic of this two-part process that shows the network evaluation process on the left side of the figure and the corrective measures process that follows on the right.

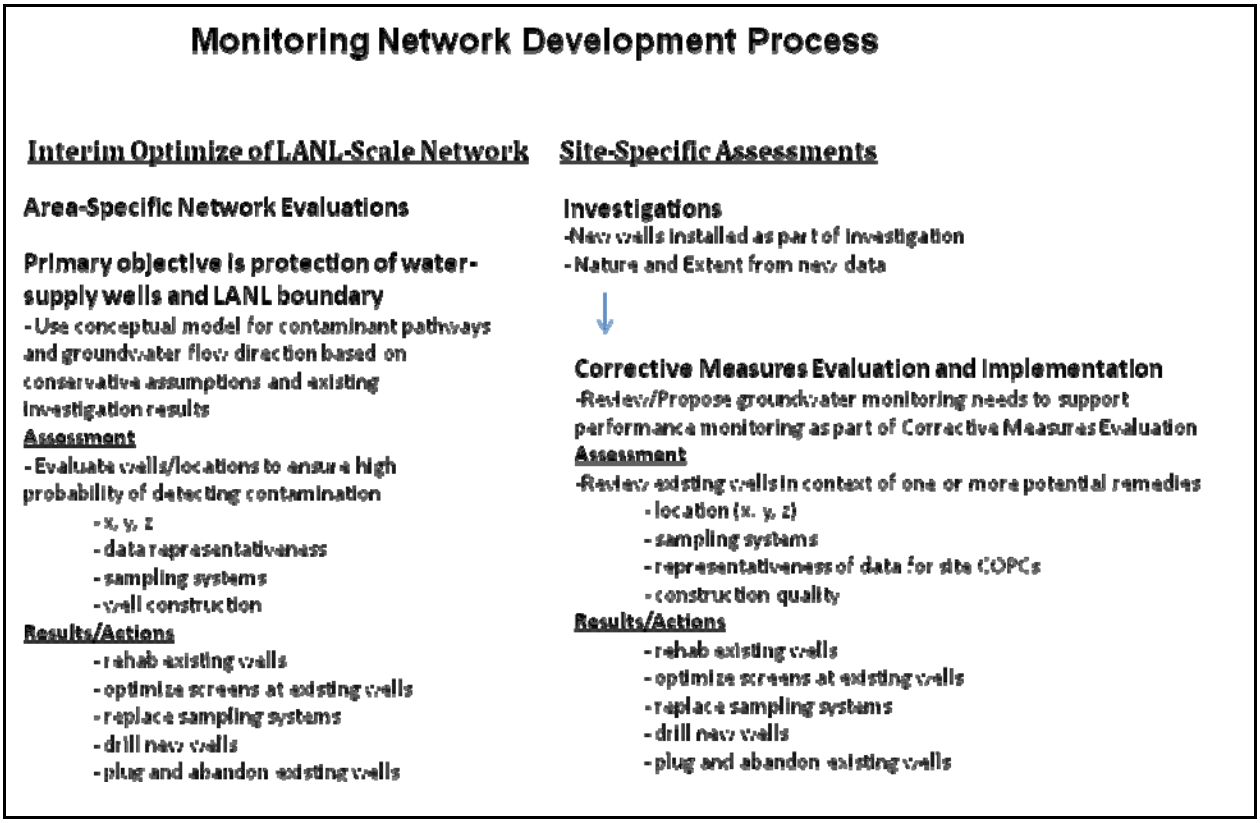

Figure 2. Process flow diagram showing area-specific network evaluation process on the left and project-specific performance-monitoring network evaluation process on the right.

A very important aspect of the network evaluations was the assessment of the utility of existing wells, including the older wells and the characterization wells more recently installed under the HWP, in the context of newly identified network objectives and updated conceptual models. Although the HWP wells were installed primarily as characterization wells, the Laboratory had a “next-phase” objective to evaluate the utility of each well in the context of project-specific objectives, such as implementation of corrective measures and subsequent performance monitoring.

The approach used to evaluate the monitoring networks involved examining well and network performance in three main categories—physical, hydrologic, and geochemical—and are all considered in the context of the monitoring objectives and conceptual models of contaminant pathways as they relate to groundwater systems in each specific area. The physical and hydrologic criteria include the effectiveness of sampling systems to provide representative groundwater data; well construction; isolation of sampling zones; and a review of factors such as well locations, screen positions, and screen lengths evaluated in the context of the conceptual model and monitoring objectives. Geochemical criteria include an assessment of whether there are conditions present in the aquifer around the well screen that inhibit sample data from key site-specific contaminants from meeting monitoring or project objectives.

To date, six network evaluations have been conducted effectively encompassing the majority of potential sources and existing wells. Figure 3 shows colored polygons representing the spatial domain of each network evaluation and the group of wells included in each.

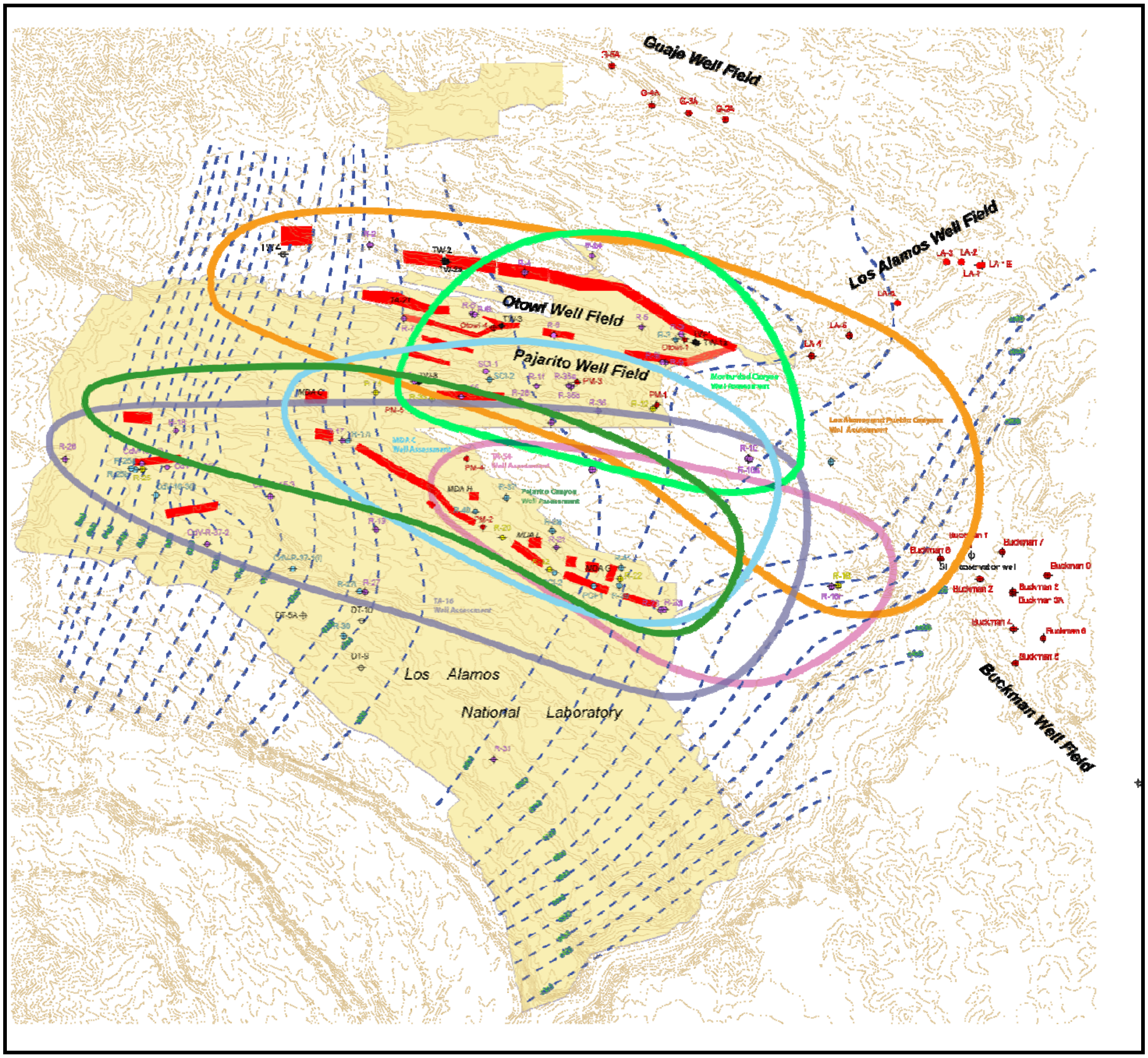

Figure 3. Los Alamos National Laboratory footprint shown in light shading. Spatial domain of each area-specific network evaluation is represented by each colored polygon. The angular red polygons are the hypothetical “infiltration windows” used in the numerical model as the starting point for particle migration.

The specific objectives differed slightly for each area evaluated but are generally summarized as follows:

1. Demonstrate that wells in the existing network provide an understanding of nature and extent of contamination sufficient to support pending corrective measures evaluations. This objective is area-specific, but generally refers to confident detection of contaminants or reliable and spatially representative monitoring of contaminant temporal trends.

2. Evaluate the configuration of the monitoring network to confidently protect (at 95% detection confidence) nearby water-supply wells and to detect potential contaminant migration beyond the Laboratory boundary. This objective is met using groundwater-transport models and tracing the path of a hypothetical mobile contaminant from locations where contaminants might conceptually enter the regional groundwater system. These entry points or “infiltration windows” are depicted in Figure 3 as angular red polygons typically aligned along the canyon floors where infiltration is most likely. Some represent potential infiltration beneath large material disposal areas at the Laboratory.

RESULTS AND CONCLUSIONS

The results of each network evaluation led to a set of recommendations that includes (1) plugging and abandoning existing older wells because of the potential for annular leakage, (2) rehabilitation and reconfiguration of existing wells that have conditions around the well that could compromise representativeness of data necessary for area-specific decisions, and (3) drilling new wells to fulfill the 95% confidence goal for detecting potential contaminants.

The update in the monitoring network represented by successful implementation of these actions will result in a network capable of providing necessary characterization information to advance site investigations. It will also provide key protection of nearby water-supply wells and the Laboratory boundary pending the evaluation of monitoring needs associated with corrective measures and more local-scale performance monitoring.

REFERENCES

1. LANL (Los Alamos National Laboratory), “Hydrogeologic Workplan,” Los Alamos National Laboratory document LA-UR-01-6511, Los Alamos, New Mexico. (1998)

2. LANL (Los Alamos National Laboratory), “Mortandad Canyon Groundwater Monitoring Well Network Evaluation, Revision 1,” Los Alamos National Laboratory document LA-UR-07-6435, Los Alamos, New Mexico (September 2007)

3. LANL (Los Alamos National Laboratory), “Technical Area 54 Well Evaluation and Network Recommendations, Revision 1,” Los Alamos National Laboratory document LA-UR-07-6436, Los Alamos, New Mexico (October 2007)

4. LANL (Los Alamos National Laboratory), “Technical Area 54 Well Evaluation and Network Recommendations, Revision 1,” Los Alamos National Laboratory document LA-UR-07-6436, Los Alamos, New Mexico (October 2007)

5. LANL (Los Alamos National Laboratory), “Pajarito Canyon Investigation Report,” Los Alamos National Laboratory document LA-UR-08-6436, Los Alamos, New Mexico (October 2007)

6. LANL (Los Alamos National Laboratory), "Fate and Transport Modeling Report for Chromium Contamination from Sandia Canyon," Los Alamos National Laboratory document LA-UR-07-6018, Los Alamos, New Mexico (September 2007)

7. LANL (Los Alamos National Laboratory), "Evaluation of the Suitability of Wells Near Technical Area 16 for Monitoring Contaminant Releases from Consolidated Unit 16-021(c)-99," Los Alamos National Laboratory document LA-Ur-07-2370, Los Alamos, New Mexico (April 2007)