

5.0 Recommendations

The following recommendations are provided to help improve the performance and evaluation of the Shiprock remediation system:

- The floodplain extraction system appears to be functioning as expected. The addition of the two trenches at the base of the escarpment enhances the removal of contaminant mass from groundwater in the alluvium. However, given the success demonstrated in the previous evaluation of Trench 2 (DOE 2009b), DOE is proposing similar instrumentation and investigation for the Trench 1 area and the floodplain as a whole. These proposals are outlined below.
 - Alluvial wells near the river in the vicinity of well 1089 will be monitored (time frame and frequency to be determined) to demonstrate that groundwater pumping in this locale prevents discharge of contaminated water to the river and actually induces a moderate influx of surface water into the alluvial aquifer.
 - Alluvial wells located east and south of Trench 1 will also be monitored to assess the capacity of Trench 1 pumping to effect decreases in contaminant plume mass.
 - Using a combination of hydraulic, water chemistry, and temperature data collected at wells distributed throughout the entire floodplain and along the San Juan River, DOE will employ analytical techniques similar to those used previously in the Trench 2 evaluation (DOE 2009b) to: (1) better understand interactions between the alluvial aquifer and the river, and (2) evaluate the combined effectiveness of floodplain groundwater extraction components (well 1089, Trench 1 and Trench 2) in reducing contaminant mass. This work will culminate in the development of a floodplain-wide flow and fate and transport model.
 - The floodplain-wide groundwater model will be used to address key issues regarding management of the alluvial aquifer, including (1) the capacity of groundwater extraction components to prevent contaminant discharge to the river, (2) optimal pumping cycles for Trench 1 and Trench 2, (3) the relative benefits of a third trench between Trench 1 and the well 1089 area, and (4) the likely floodplain impacts of terminating flows from artesian well 0648.
- The terrace extraction system is operating adequately, and water levels are gradually declining. No additions to this system are recommended at this time (refer to DOE 2010a for further discussion). However, repairs to recent erosion damage around the Many Devils Wash diversion structure are recommended.
- As the remediation system continues to operate, it will become more important to monitor the fluid level in the evaporation pond. Between April 2009 and April 2010, an additional 3.5 ft of water was pumped into the 11-acre pond, leaving only about 2.2 ft of unfilled pond capacity. Pumping from Trench 2 was shut down periodically during 2009–2010 to increase pond capacity. Continued monitoring of the fluid level in the pond is recommended, along with periodic cessation of pumping as necessary to maintain sufficient freeboard.
- To mitigate potential ecological risks associated with the pond, in June 2010 DOE began adding dye to the evaporation pond to block sunlight as a way to kill algae and thus remove a potential food source to birds. This has been effective in reducing the algae, and DOE recommends that this practice continue.

- The performance of the terrace remedial action is currently tied to the reduction of flow from seeps 0425 and 0426 (which are now part of the remediation system) and from other seeps on the terrace, many of which are currently dry. Discharge from these seeps will continue to be monitored and included as part of the annual performance evaluation.
- Contaminant trends evaluated in this report indicate that at some locations on both the terrace and the floodplain, no trending is apparent. As shown in Figure 1–2, the sampling network at the Shiprock site is dense; for this reporting period, 118 monitoring wells were sampled (62 on the floodplain and 56 on the terrace). As discussed in the recently issued evaluation of the site remediation strategy (DOE 2010a), future work at the site will consist of more targeted characterization to address key areas (e.g., Many Devils Wash) and to better understand site conditions. Given this intent, DOE is considering using the Visual Sampling Plan (VSP) software to evaluate the current sampling regime and to assess potential temporal and spatial redundancies. Developed by Pacific Northwest National Laboratory, VSP is a widely used software tool that supports the development of site sampling plans based on statistical sampling theory and statistical analysis of sample results (<http://vsp.pnl.gov/>).