Section 4. Removal Action Activities

This section describes the preconstruction and removal action activities performed to (1) construct a permanent waste rock repository, (2) consolidate waste rock from WRP-1, WRP-2, WRP-3, and WRP-4 into the repository, (3) cap the repository, and (4) install reclamation features. Because the volume of waste rock found at WRP-1 and WRP-2 was nearly 50 percent more than planned, the Forest Service issued Work Order 8 dated October 15, 2010, followed by Contract Modification 8, to evaluate the remaining quantity of waste rock, determine the maximum capacity of the original repository design, and modify the design of the repository cap to accommodate the increased volume. The redesigned cap provided a maximum waste rock capacity of approximately 69,486 cubic yards (yd^3). The total volume of waste rock placed in the repository was 66,521 yd^3.

ERRG documented site activities in field logbooks and on field forms. Appendix A contains photographic logs documenting the work performed during the NTCRA. The following construction activities were conducted during the NTCRA:

- Preconstruction and site preparation
- Mobilization
- Construction of haul roads
- Construction of the repository
- Removal of waste rock
- Collection of field samples (i.e., XRF) of soil and waste rock
- Collection of confirmation samples of soil and waste rock
- Placement of waste rock in the repository
- Reclamation activities
- Construction of the temporary repository cover
- Construction of the final repository cover
- Winterization of the site and haul roads
- Installation of adit gates and polyurethane foam (PUF)
- Collection of additional sediment and water samples (resulting from the discovery of an unknown adit with unconfined water)

The following subsections describe each of the construction activities listed above.

4.1. PRECONSTRUCTION AND SITE PREPARATION ACTIVITIES

All ERRG personnel were briefed in the site-specific health and safety hazards (such as lead exposure and steep terrain) prior to the start of work. All precautions, practices, and PPE to mitigate hazards are specified in the Health and Safety Plan provided as Appendix D to the Removal Action Work Plan (ERRG, 2010a).

This section describes the following principal tasks that were performed prior to construction:

- Agency permitting and notifications
- Utility identification and clearance
- Preconstruction survey

4.1.1. Agency Permitting and Notifications

No permits were required for on-site activities because the NTCRA was conducted under CERCLA. However, all site activities complied with substantive requirements of federal, state, and local agencies. The Forest Service coordinated reviews of appropriate documents with federal, state, and local agencies, as needed.

4.1.2. Utility Identification and Clearance

Prior to conducting subsurface excavation activities, Northern California Dig Alert (Underground Service Alert) was contacted (at least 48 hours prior to initiating soil intrusive activities) to locate publicly owned underground utilities. Because of the site's remote location, no utilities were encountered.

4.1.3. Preconstruction Survey

During the mobilization phase, a preconstruction survey was performed to establish the repository excavation grade lines for construction. The repository clearing limits, haul road alignment, and temporary and permanent storage areas were delineated by flagging for acceptance by the Forest Service. The waste excavation areas were located using coordinates provided in the Design Drawings (URS Corporation, 2010a) using a global positioning system device and staked or flagged.

4.2. MOBILIZATION

ERRG mobilized the necessary equipment and supplies to the site to perform construction activities. All equipment was cleaned to remove dirt and eliminate the potential for noxious weeds prior to arriving at the site. All equipment was certified as clean and was made available for inspection by Forest Service personnel prior to initiating site work. The following equipment and supplies were mobilized to the site:

- Field trailers with support equipment
- Portable toilets
- Heavy earthmoving equipment (e.g., excavators, bulldozers, loader, compactor, grader, and articulated off-road dump trucks)
- Water pumping system
- Water truck
- Hand-held tools for manual excavations and equipment maintenance
- Hand-operated power tools
- Traffic controls (i.e., barricades, signs, flags, barrier tape, and traffic cones)
- PPE
- Decontamination supplies
- Safety equipment (e.g., eyewash, first-aid kit, ropes and harnesses, and personal dust monitor)
- Digital cameras and field logbooks

Site mobilization consisted of the following tasks:

- Setting up staging areas
- Delineating work zones
- Installing temporary offices, personal hygiene, sanitary, and first-aid facilities

The following subsections describe each task listed above.

4.2.1. Setup of Staging Areas

During mobilization, ERRG set up staging areas at the repository entrance road, at the project office trailer area, and at the Miner's Trail parking area to support construction of the haul roads, waste rock removal, and repository construction (see Figure 2). These staging areas included portable toilets and hand wash stations, trashcans, first-aid facilities, potable water, and served as temporary storage areas for materials and supplies.

4.2.2. Delineation of Work Zones

The following work zones were established for each stage of construction during the project: an exclusion zone, a contaminant reduction zone, and a support zone that included an equipment staging area. The work zones confined different work elements to specific areas and served to buffer the surrounding environment from potential chemical and physical hazards. The boundaries of the work zones were used to regulate entry into the work zones and to facilitate communication and emergency response between work activities and management support. The entry point to the work zones was monitored to prevent unauthorized access to the work area. The Site Safety and Health Officer and Site Superintendent monitored workers entering the exclusion zones containing waste rock to verify only authorized personnel were in the exclusion zone. Workers were required to make radio contact prior to entering the active work zone. The Site Safety and Health Officer defined the entry and exit point of the exclusion zone, which varied based on the progress of the work. As the work zones changed over the course of the project, all personnel were kept informed of the locations of the current work zones through tailgate safety meetings and on-site demarcation.

4.3. CONSTRUCTION OF HAUL ROADS

Existing Forest Service and mining roads were used as much as possible. Haul Roads 1, 2, and 3 were improved during the 2010 work season for use during the NTCRA. The roads were graded and trees were cut back for vision and width. Existing haul roads were not reworked to the embankment detail in the Removal Design, but were adequately improved for use during the NTCRA. Three temporary culverts were placed, one in Joe Creek and in two unnamed tributaries where the haul roads cross these live creeks. BMPs such as gravel surfacing, coarse rock surfacing, silt fence, and straw wattles were installed at temporary culvert crossings.

During the 2010 work season, two new haul roads were constructed following the general alignment as presented in the Removal Design (see Figure 2). Haul Road 4 was constructed to access WRP-3, and Haul Road 8 was constructed to access the bottom of WRP-4. Haul Road 8 was constructed through boulders and waste rock at the bottom of WRP-1; this haul road was completely removed in 2010 following removal of waste rock from WRP-1. Haul Road 5 and optional Haul Roads 6 and 7 as presented in the Removal Design were not constructed.

4.4. CONSTRUCTION OF THE REPOSITORY

ERRG constructed an on-site repository on private mine claim property, approximately 1 mile north of the WRPs and 0.25 mile up Forest Service spur road 1060-400 (Figure 2). The repository is designed to comply with the California Regional Water Quality Control Board's requirements in Title 27 California Code of Regulations, Environmental Protection--Division 2, Solid Waste.

In 2010, ERRG constructed the repository subgrade components, including a subgrade high-density polyethylene (HDPE) liner, pea gravel drainage layer, and a clean soil cushion layer to protect the liner from damage by waste rock (see Drawings B-1 and B-8 in Appendix B). The subgrade components were constructed prior to the removal of waste rock. Any waste rock removed during the 2010 work season was placed in the repository. At the end of the 2010 work season, a temporary plastic cover was placed over the repository to prevent water infiltration during winter 2011.

After remobilization in 2011, the remaining waste rock was placed in the repository and the final repository cover system was constructed (see Drawings B-2 through B-8 in Appendix B), which included the following:

- A clean soil cushion layer over the waste rock finish grades
- An linear low-density polyethylene (LLDPE) geomembrane cover
- A pea gravel drainage layer on the perimeter slopes
- A geocomposite drainage layer on the top deck of the repository
- A minimum 3 feet of cover soil

The following sections describe the construction of the repository subgrade components, placement of waste rock, and construction of the temporary and final repository cover system.

4.4.1. Preparation of Repository Subgrade

The subgrade was prepared in accordance with the project design drawings (URS Corporation, 2010a) prior to placement of liner material in the repository. The subgrade was constructed to ensure that the following conditions were met:

- Construction staking was performed before work, and survey benchmarks with elevations were secured outside the work area.
- Lines and grades were smooth without excessive rutting.
- The subgrade was properly moisture conditioned and did not contain any harmful materials such as large stones, large clods, debris, or organic material.
- The subgrade was adequately proof-rolled to provide a uniform base. Compaction testing was not required by the Removal Design for construction of the repository subgrade.

During preparation of the repository subgrade, a ground water seep was discovered in the northeast corner of the repository floor. The water was pumped out using a portable pump, and a drain system consisting of perforated 6-inch-diameter Schedule 80 polyvinyl chloride (PVC) pipe was constructed to allow groundwater to flow under the repository floor without affecting the integrity of the repository liner system. The seep drainage pipe was embedded in 3/4-inch crushed drain rock, and the pipe trench was backfilled with 1.5 sack sand slurry. The drainage pipe discharges on the west side of Forest Service road 1060-400 into a gully area that contains an existing spring (see Drawings B-1 and B-6 in Appendix B). The drainage pipe was observed to discharge a continuous flow of water estimated at a few gallons per minute throughout the duration of the NTCRA.

4.4.2. Installation of Repository Liner

During the early phases of preparing the repository subgrade, ERRG identified that the specified geosynthetic clay liner was not compatible with the specified drainage layer (i.e., crushed limestone). Working with suppliers and the Forest Service COR, ERRG submitted a substitute repository liner system, which was approved by the Forest Service COR. Once the Site QC Specialist verified and the independent QA team confirmed the repository subgrade was complete, a bottom liner system was installed in accordance with the approved substitute repository liner system submittal (ERRG, 2010b). The completed bottom liner system (from bottom to top) consists of the following:

- Grading, prepared subgrade, and subgrade 60-mil textured HDPE liner to achieve a minimum hydraulic conductivity of 10^{-6} centimeters per second covering the bottom and side slopes of the repository.
- A leachate drain ditch was created in the prepared subgrade to serve as a low point to collect leachate. A 6-inch-diameter slotted HDPE drain pipe was installed in the drain ditch to collect leachate and convey it to a collection sump.
- A leachate collection sump to collect leachate from the pea gravel drainage layer and drain pipe.
- Drainage layer (1 foot thick of 3/8-inch pea gravel) covering the bottom of the repository.
- Upper geotextile layer (Type 1A geotextile fabric) covering the drainage layer.
- Cushion layer (1 foot thick of 1-inch minus screened soil) covering the 60-mil textured HDPE liner on the side slopes.

The Site QC Specialist and IQAT documented that construction of the bottom liner system met the approved substitute repository liner system submittal in photographs (Appendix A) and the Daily QC Reports (Appendix C). Appendix B contains the repository as-built drawings. Appendix D provides the repository geosynthetics QC and QA documentation.

4.5. REMOVAL OF WASTE ROCK

A total of 66,521 yd^3 (56,335 yd^3 during 2010 and 10,186 yd^3 during 2011) of waste rock was removed from the four WRPs and placed in the repository. Waste rock volumes were measured by incrementally surveying the waste rock surface after placement of the waste rock from each WRP into the repository. The volume was calculated by comparing the survey data from the completed repository bottom liner system prior to waste rock placement with the current surveyed waste rock surface.

Removal of waste rock began concurrently at WRP-1 and WRP-2 on July 26, 2010, using the spider excavator and hand-removal techniques. After removal activities at WRP-2 were completed, removal of waste rock at WRP-4 began concurrently with continued removal at WRP-1. Waste rock could not be completely removed from WRP-1 during the 2010 work season. As a result, approximately 5,328 yd^3 of remaining waste rock was removed from WRP-1 during the 2011 work season. Additionally, waste rock was removed from WRP-3 during the 2011 work season. Waste rock removal was completed on August 24, 2011.

The total amount of waste rock removed from each area is listed below.

- WRP-1 and WRP-2 combined: 59,563 yd^3
- WRP-3: 4,858 yd^3
- WRP-4: 2,100 yd^3
- Total: 66,521 yd^3

Waste rock was typically visually identified as orange-colored soil and rock that was not weathered or naturally occurring. In many instances, however, the color was not a consistent indicator of waste rock or high concentrations of metals. This inconsistency likely was related to moisture content, variations in minerals in the waste rock, naturally occurring mineralized soil that was not created by mining activities, variations in wood and organic debris, or other man-made sources.

The Removal Design describes functional removal targets for waste rock (URS Corporation, 2010c). The waste rock overlies either hard rock or native soil. The primary objective of the removal was to excavate and contain obvious waste rock. In general, reconnaissance data indicated that the elevated metals concentrations and acid generation potential decrease at a depth of approximately 1 foot into the underlying soil materials. In areas where waste rock was removed until hard rock surfaces were exposed, the maximum allowable residual depth of waste rock is 0.5 inches. As practical, waste rock that does not meet the removal goals was removed from depressions, cracks, or fissures greater than 2 inches wide and longer than 20 feet. Accordingly, removing waste rock to less than 0.5 inches from the rock surface constitutes removal of at least 98 percent of the waste rock, resulting in a de minimis residual source. Residual waste rock sediments in hard rock areas will wash to treatment basins or other reclamation features.

Waste rock that was removed until hard rock was exposed was cleaned by hand using hand tools and brooms to remove virtually all residual waste rock. The exposed hard rock surface, depressions, cracks, and fissures were cleaned well in excess of the 0.5-inch tolerance for residual waste rock. If removal of waste rock exposed underlying soil, then the soil was removed to approximately the native soil contours at the adjacent edges of the waste rock area and over-excavated approximately 1 foot into the underlying soil.

Based on the XRF results, waste rock was removed down to bedrock in most locations at WRP-1, WRP-2, and the upper portion of WRP-4. The steep slopes of the bedrock necessitated an increased use of spider excavators and hand-removal techniques. As the waste rock removal activities progressed down the mountain and the steepness of the slope decreased, heavy equipment could be used to move and load out the waste rock for transportation to the on-site repository. Waste rock on WRP-3 and the lower portion of WRP-4 was removed down to underlying soil plus approximately 1 foot of overexcavation.

In some instances, the Forest Service COR determined that no further excavation was required. This determination was generally based on (1) safety concerns regarding undermining large boulders or destabilizing slopes, (2) the physical constraints of removing residual soil from between large boulders or large trees, (3) the potential for encroaching on the historical preservation area at the bottom of WRP-1, or (4) the fact that only native soil undisturbed by mining activities and soil naturally high in metals remained at that location.

The following subsections summarize the removal activities at each of the WRPs. Figure 3 shows the extent of waste rock removed from July 2010 through August 2011.

4.5.1. Waste Rock Pile 1

The following waste rock removal activities were completed at WRP-1 during the 2010 work season:

- Waste rock was removed from the upper portions of WRP-1 near Adits A1S and A1N2 down to the switchback at Haul Road 1 (below Adit A5). All of the removed waste rock was transported to and deposited in the on-site repository.
- Waste rock was removed to bedrock in all but one area that is below Adit A1N2. In this area, clean soil was left in place. The area was reclaimed by applying native grass seed, fertilizer, and straw.
- Waste rock was removed from the drainage in the lower portions of WRP-1 from the edge of Joe Creek up to the area below the switchback on Haul Road 3 (the areas under Sediment/pH Treatment Basins 1A, 1B, and 1C; see Figure 2).

The following waste rock removal activities were performed at WRP-1 in 2011:

- Waste rock remaining on the middle portions of WRP-1, between the switchbacks of Haul Road 3 and Haul Road 1 and extending into the bottom of the gully, was excavated and transported to the on-site repository (see Figure 6).
- Sediment that was hand excavated from the two temporary settling basins and sediment/pH treatment basin 1C and placed into a temporary plastic-lined and covered stockpile in October 2010 was removed and placed into the repository. Additional sediment that collected in the sediment/pH treatment basins 1A, 1B, and 1C over the winter was hand excavated and placed in the repository. During the removal of sediment and the adjustment of riprap and the HDPE liner creating the sediment basin spillway at the three sediment/pH treatment basins, agricultural limestone used as the pH treatment medium was observed. No fouling of the agricultural limestone was noted.

The results of the waste rock removal activities performed at WRP-1 during the NTCRA are summarized below.

- Waste rock was successfully removed to the cleanup goals throughout the area of WRP-1, with only residual amounts of waste rock remaining in isolated areas as described below.
- Residual waste rock and soil with metals concentrations exceeding the project removal goals remains in areas on either side of the rock-lined drainage channel at the lower area of WRP-1 (see Figure 4). However, the metals concentrations are low, but not as low as the removal goals (see Table 1, Confirmation Sample Grids 15 through 17). The residual waste rock was left in place at the direction and concurrence of the Forest Service COR because of its proximity to the historic preservation site and to not destabilize the channel sideslopes by additional excavation, which satisfies the intent of the NTCRA. The residual waste rock was covered with geotextile and armored with riprap to create a rock-lined drainage channel and sediment/pH treatment basins 1A, 1B, and 1C (see photographic log in Appendix A, Photographs A-39 through A-41). The residual waste rock will not erode because it is confined by the geotextile and riprap armoring.
- Soil and residual waste rock with metals concentrations exceeding the project removal goals remains in isolated areas in the upper western portion of WRP-1 (see Figure 3 and Figure 5, Confirmation Sample Grids 18 and 33). However, the metals concentrations are low, indicating that human-created mine waste rock has been removed, but not as low as the removal goals (see Table 1). The Forest Service COR decided the soil should remain in place because of safety concerns and because the overlying and visibly different waste rock has been removed and only residual waste rock remains, which satisfies the intent of the NTCRA. The slope is steep and contains many massive non-mineralized boulders, some more than 20 feet in diameter (see photographic log in Appendix A, Photograph A-45). If additional soil had been removed, it is likely the boulders would have become unstable and rolled down the slope into workers and equipment below. Additionally, if the exposed boulders were to be dislodged by natural processes after the work was complete, they could damage or disrupt the installed reclamation features, drainage features, and sediment/pH treatment basins. The area contains mostly very large boulders with small quantities of native soil between the rocks.
- One field laboratory sample result is within the 15 percent tolerance limit for copper (see Figure 5, Confirmation Sample Grid 38).
- One field laboratory sample result is within the 15 percent tolerance limit for lead (see Figure 6, Confirmation Sample Grid 40).
- The area outside of the Confirmation Sample Grids 18 through 38 (see Figure 5), but within the theoretical waste rock boundary as defined by the Removal Design drawings (URS Corporation, 2010a), was not excavated or sampled at the direction of the Forest Service COR because it was determined to be clearly native forest material with large non-mineralized boulders and large trees (described as tree island), large non-mineralized boulders on nearly vertical slopes bordering the unnamed tributary of Joe Creek, or bedrock exposed in the drainage (see photographic log in Appendix A, Photograph A-34).

4.5.2. Waste Rock Pile 2

Removal of waste rock from WRP-2 was completed in 2010, and no additional removal activities were performed in 2011. The following waste rock removal activities were completed at WRP-2 in 2010:

- Waste rock was removed and transported to the on-site repository.

The results of waste rock removal activities performed at WRP-2 during the NTCRA are summarized below.

- Waste rock was successfully removed to the cleanup goals throughout the area of WRP-2, with only residual amounts of waste rock remaining in isolated areas as described below.
- Soil with residual waste rock exceeding the project removal goals remains. The top of the slope near the adits A2 and A2S is very steep and contains large non-mineralized boulders (see Figure 3). Waste rock over 18 feet thick was removed from this area, which exposed bedrock and undermined the boulders (see photographic log in Appendix A, Photograph A-49). If additional soil and residual waste rock had been removed, the boulders could have become unstable and rolled down the slope into workers and equipment below. This soil was left in place at the direction and concurrence of the Forest Service COR because the overlying visibly different waste rock has been removed, and only residual amounts of waste rock remain in a thin layer overlying bedrock or under boulders, which satisfies the intent of the NTCRA. No confirmation samples were collected from this area because the amount of residual soil was considered to be de minimis by the Forest Service COR.
- Soil with metals concentrations exceeding the removal goals is present at the bottom of WRP-2 (see Figure 7, Confirmation Sample Grids 13 and 14). However, the metals concentrations are low, indicating that human-created mine waste rock has been removed, but not as low as the removal goals (see Table 2). The XRF reading for lead in Confirmation Sample Grid 14 slightly exceeded the removal goal. Confirmation Sample Grid 14 was also randomly selected by the IQAT for laboratory analysis, and the lead result was within the removal goal plus 15 percent tolerance. This soil was left in place at the direction and concurrence of the Forest Service COR because all visible waste rock had been removed and only boulders intermixed with native soil and residual waste rock remained. Further excavation of soil was not possible because closely spaced boulders were present. This area was covered with geotextile and riprap, and sediment/pH treatment basin 2A was constructed over it (see photographic log in Appendix A, Photograph A-50).
- The Forest Service COR directed that a sample grid would not be further excavated to remove soil with low pH. NAG was tested as part of the confirmation sample analytical protocols (URS Corporation, 2010c). Confirmation Sample Grid 14 contained low pH soil, which causes the NAG result to be higher than the removal goals. This area was covered with geotextile and riprap, and sediment/pH treatment basin 2A was constructed over it (see photographic log in Appendix A, Photograph A-50).
- The area outside of the Confirmation Sample Grids 11 through 14, but within the theoretical waste rock boundary as defined by the Removal Design drawings (URS Corporation, 2010a), was

not excavated or sampled at the direction of the Forest Service COR because it was determined to be clearly native forest material with large non-mineralized boulders and large trees or exposed bedrock.

- Soil with zinc exceedances is present near the middle of WRP-2. However, the zinc concentrations are low (Table 2), and the Forest Service COR concluded this soil was outside the limits of waste rock and contained naturally occurring metals concentrations (see Figure 8 and Table 2, Confirmation Sample Grid 39). This area was tested to verify that waste rock that had accumulated during removal and loadout activities at this location on Haul Road 4 had been adequately removed.

4.5.3. Waste Rock Pile 3

Waste rock was not removed at WRP-3 in 2010 because of schedule and budget constraints associated with the additional volume of waste rock removed from WRP-1 and WRP-2. The following waste rock removal activities were performed in 2011:

- Removed all waste rock for transport to the on-site repository.
- Waste rock was removed down to underlying native soil. Bedrock is exposed in the drainage at the bottom of WRP-3 (see Figure 9).

The results of sampling and waste rock removal activities performed at WRP-3 during the NTCRA are summarized below.

- All confirmation sample results for metals were less than the removal goals (see Table 3). NAG was tested as part of the analytical protocols. If the sample grid met the removal goals for metals, the sample grid was not excavated further to remove low pH soil. Confirmation Sample Grid 46 contained low pH soil, which causes the NAG result to be higher than the removal goal. This grid was left in place with the concurrence of the Forest Service COR because all metals concentrations were less than the removal goals.

4.5.4. Waste Rock Pile 4

Removal of waste rock from WRP-4 was completed in 2010, and no additional removal activities were performed in 2011. The following waste rock removal activities were completed at WRP-4 in 2010:

- Waste rock was removed from the upper portions of WRP-4 near Adits A4N and A4S down to bedrock in approximately the upper one-third of the waste rock area (see Figure 3).
- Waste rock was removed down to native soil in the lower two-thirds of the waste rock area (see Figure 10).

The results of waste rock removal activities performed at WRP-4 during the NTCRA are summarized below.

- Field screening results could not define the boundary of waste rock. Many field screening samples were collected from native forest well outside the visual boundaries of the waste rock. These sample results showed the entire hillside to contain metals concentrations exceeding the removal goals, although the metals concentrations were low, indicating that human-created mine waste rock was not present. As a result, the Forest Service COR directed that waste rock in the lower two-thirds of the WRP-4 area be removed to an elevation that was approximately at the existing elevation of the adjacent native soil ground surface outside of the WRP-4 boundaries to the north and south, plus one foot of overexcavation. This decision was made because it was concluded that metals concentrations in the material were likely the result of naturally occurring metals and not anthropogenic sources.
- At the direction of the Forest Service COR, ERRG collected field laboratory samples from the remaining soil to evaluate whether metals concentrations met the removal goals. Nine of 16 field laboratory results exceeded the removal goals plus the 15 percent tolerance limit (Table 4). One field laboratory result is within the 15 percent removal tolerance for lead, and one field laboratory result is within the 15% removal tolerance for arsenic and cadmium. Six of the samples were randomly selected by the IQAT and sent for analysis by the off-site laboratory, and three results were determined to be within the 15 percent tolerance limit for arsenic and copper. Two of the six laboratory confirmation results slightly exceeded the removal goals and the 15 percent tolerance limit for arsenic and copper (Table 4, Confirmation Sample Grids 1 and 5). The Forest Service COR decided no further excavation should be performed because the overlying and visibly different waste rock has been removed and only residual waste rock remains, which satisfies the intent of the NTCRA.

4.6. COLLECTION OF FIELD SAMPLES OF SOIL AND WASTE ROCK

As the waste rock was removed, the Site QC Specialist used a field XRF device to screen soil beneath the waste rock to determine whether metals concentrations met the removal goals. If the field screening results were acceptable over an area large enough to establish a confirmation sample grid, the field samples were collected, composited, and tested in an on-site laboratory using the XRF to establish confirmation test results. Twenty percent of the total field confirmation test samples were split and sent to an off-site laboratory for analysis (as discussed in Section 4.7). Tables 1 through 4 summarize the field laboratory results and the analytical laboratory results for each WRP, and Appendix E provides the complete field XRF data.

The XRF device was calibrated against known standard metal concentration reference materials and against blank sample materials free of any analytes at concentrations greater than the lower limits of detection. The XRF device was used to screen the underlying soil for metals concentrations as waste rock was removed. Waste rock was excavated until XRF readings indicated that metals concentrations in the remaining soil were less than the removal goals. The Removal Design (URS Corporation, 2010c) defined the sample grid areas as approximately 900 square feet in area. The dimensions of each grid were adjusted in the field depending on the orientation and topography of the cleared area. Nine soil subsamples were collected within each 900-square-foot-grid, and each subsample was screened with the

XRF device. If readings for the nine subsamples indicated that metals concentrations were less than the removal goals, then the location of each subsample and the boundary of the sample grid were documented using a global positioning system. The nine soil subsamples were taken to the on-site laboratory for sample preparation and analysis to confirm the XRF readings in accordance with EPA Method 6200 (EPA, 2008).

The nine soil subsamples were properly prepared by drying and sieving through a 60-mesh (0.25-millimeter) sieve. The nine soil subsamples were then composited into one confirmation sample by mixing them together in a stainless steel bowl. The composite confirmation sample was then split and tested in the on-site field laboratory for pH by the Hageman-Briggs pH test and for metals by the XRF. If the results of field screening subsamples and the field laboratory confirmation samples were less than the removal goals, then no additional waste rock was excavated.

The XRF test results were validated by comparing calibration standards, field screening XRF readings, and field laboratory XRF results with the results of off-site laboratory confirmation samples. The XRF results were very consistent with the calibration standards and the off-site laboratory confirmation results and provide a high degree of confidence that the removal goals were achieved. Variations in field XRF readings were typically due to high moisture content in the soil. After the field screening soil sample was dried in accordance with the sample preparation procedure, the field laboratory XRF results were consistent with the off-site laboratory results.

4.7. COLLECTION OF CONFIRMATION SAMPLES OF SOIL AND WASTE ROCK

The IQAT randomly selected 20 percent of the grids for off-site laboratory confirmation analysis to confirm the field laboratory results. Overall, a total of 14 off-site laboratory confirmation samples were analyzed against a total of 68 on-site laboratory XRF confirmation samples, or 21 percent. Individual WRPs may have more or less than 20 percent of their grids analyzed by the off-site laboratory due to the random selection process. The nine field laboratory soil subsamples from a selected grid were dried, sieved, and composited onsite. The composited confirmation sample from a selected grid was then split and sent to the off-site laboratory for analysis. Laboratory tests included acid/base accounting (ABA) and net acid generation (NAG) in addition to total metals and pH analysis. The laboratory confirmation data documents the site concentrations after removal and provides confirmation that the XRF field screening and field laboratory confirmation testing was representative and accurate.

Confirmation samples were collected in accordance with the approved and established procedures outlined in the Field Sampling Plan provided in Appendix C to the Removal Action Work Plan (ERRG, 2010a). Appendix F contains the complete laboratory analytical reports and the on-site laboratory XRF confirmation sample results. The following confirmation sampling activities occurred at each WRP:

- WRP-1: Confirmation samples were collected at the bottom of WRP-1 in the rock channel prior to construction of the sediment/pH treatment basins (Grids 15, 16, and 17), in the area below Adit A1N2 (Grids 18, 19, 20, and 27 through 38), and in the middle portion of WRP-1 (Grids 40 and 41). Figures 4, 5, and 6 show the locations where confirmation samples were collected at WRP-1, and Table 1 summarizes the analytical results for the confirmation samples. Confirmation samples were not collected from waste rock excavation areas that exposed bedrock. The sample results verify that waste rock was successfully removed and only soil with low residual metals concentrations exceeding the removal goals remains in isolated areas at WRP-1.
- WRP-2: Confirmation samples were collected at the bottom and upper areas of WRP-2 prior to construction of the sediment/pH treatment basins (Grids 11 through 14, and 39). Figures 7 and 8 show the locations where confirmation samples were collected at WRP-2, and Table 2 summarizes the analytical results for the confirmation samples. Confirmation samples were not collected from waste rock excavation areas that exposed bedrock. The sample results verify that waste rock was successfully removed and only soil with low residual metals concentrations exceeding the removal goals remains in isolated areas at WRP-2.
- WRP-3: Confirmation samples were collected at WRP-3 in the 2011 work season (Grids 43 through 68). Figure 9 shows the locations where confirmation samples were collected, and Table 3 summarizes the analytical results for the confirmation samples. Confirmation samples were not collected from waste rock excavation areas that exposed bedrock in the drainage at the bottom of WRP-3. The sample results verify that all waste rock was successfully removed from WRP-3.
- WRP-4: Confirmation samples were collected from the exposed soil area in the lower two-thirds of WRP-4 (Grids 1 through 10 and 21 through 26). Figure 10 shows the locations where confirmation samples were collected, and Table 4 summarizes the analytical results for the confirmation samples. Confirmation samples were not collected from waste rock excavation areas in the upper one-third of the WRP area that exposed bedrock. The sample results verify that waste rock was successfully removed and only soil with low residual metals concentrations exceeding the removal goals remains in upper areas at WRP-4.

4.8. PLACEMENT OF WASTE ROCK IN THE REPOSITORY

In 2010 and 2011, waste rock was transported from WRP-1, WRP-2, WRP-3, and WRP-4 and brought to the on-site repository, where it was placed and compacted in accordance with the project plans and specifications included in Delivery Order No. AG-0489-D-10-0126 (Forest Service, 2010). The Site QC Specialist and IQAT monitored the placement of waste rock in the repository and verified the following tasks were completed:

- Waste rock material was placed in loose lifts atop the completed bottom liner system at thicknesses not to exceed 12 inches.
- Waste rock was compacted by either a smooth drum compactor making at least four passes per lift or by D4 or D6 Dozer and off-road haul truck traffic until no evidence of further consolidation was visible. Compaction testing of waste rock was not required.

- The extent of the waste rock material placed in the repository was approximately 35 feet thick and was maintained at a minimum distance of 10 feet from the National Forest property boundary to the west. Waste rock was graded to a 3:1 slope on the north, west, and south slopes of the repository. The top deck of the waste rock was graded to a 3 percent slope from the west slope hinge point to its intersection with the east repository boundary.
- The top of the waste rock and areal extent of the waste was adequately surveyed at the completion of waste rock placement activities to document the limits of placement and the volume of material placed.

The top of the waste rock was surveyed after grading and compaction were completed. The elevation of waste rock was compared with the elevation survey of the constructed repository liner system performed on August 2, 2010. The comparison results were used to determine the total in-place volume of waste rock placed in the repository. Based on the survey comparison, it was concluded that the total volume of waste rock placed in the repository was 66,521 yd^3. A total of 56,335 yd^3 was placed in the repository during the 2010 work season, and 10,186 yd^3 was placed in the repository during the 2011 work season.

The original design for the repository included a final cap and cover soil that was 10.5 feet thick and had a repository capacity of approximately 30,300 yd^3. ERRG provided an alternate cap design, as authorized by the Forest Service under Contract Modification 0008, dated March 16, 2011, that changed the slope configuration and included a 4-foot-thick cap that meets the minimum Regional Water Quality Control Board requirements in Title 27 California Code of Regulations, Environmental Protection, Division 2, Solid Waste. The alternate design provided a waste rock capacity of approximately 69,486 yd^3. The perimeter edges and slopes of the waste rock were constructed to the new design grades, and the completed top deck of the waste rock was slightly lower than the maximum design elevation because there was less waste rock (approximately 3,000 yd^3) than the maximum volume. The thickness of the final cover soil on the top deck was increased to achieve the design grade of the finished surface and to use up the maximum amount of previously excavated and stockpiled soil from the repository footprint excavation. Appendix B provides as-built drawings of the repository. Section 4.10 describes construction of the final repository cover.

4.9. RECLAMATION ACTIVITIES

At the conclusion of waste rock removal activities in each of the four WRPs, final reclamation activities were conducted in accordance with the project plans and specifications included in Delivery Order No. AG-0489-D-10-0126 (Forest Service, 2010). The following subsections summarize the reclamation activities performed at each of the WRPs and at each of the other areas disturbed by the project activities, including the North and South Storage Areas, the Rock Stockpile Area, and the Repository Stockpile Area. The location of each area is shown on Figure 2. A portion of the reclamation activities were started at certain areas in 2010, and all remaining reclamation activities were completed in 2011. The reclamation features will require O&M monitoring through the end of the contract period (i.e., May 31, 2015). Appendix G contains figures showing the reclamation features that were installed and will require monitoring and maintenance.

4.9.1. WRP-1

The following reclamation activities were completed at WRP-1 in 2010:

- Straw wattle was placed on exposed soil areas to be hydroseeded below Adit A1N2.
- Approximately 1 acre below Adit A1N2 was hydroseeded with native grass seed mix, fertilizer, and Flexterra.
- Slash was placed on upper excavation boundaries from bedrock to adjacent soil and forest.
- Native grass seed was hand cast on the soil transition to the face of the exposed bedrock slope.
- Sediment/pH treatment basins 1A, 1B, and 1C were constructed. Work Order 6 dated September 29, 2010, approved a modified design to consolidate the individual sediment basins and pH treatment basins into a hybrid design that will perform both functions at each location and eliminate low-flow features that the Forest Service COR determined were not beneficial to the RAOs. Figure 2 shows the locations of the sediment/pH treatment basins. Appendix A contains photographs taken during construction of the basins and after completion. Appendix H provides the modifications made to the basins, which are documented on red-line record drawings.
- A rock armor channel was constructed in the upper drainage area below Adit A1N2.
- A rock armor channel was constructed between sediment/pH treatment basins 1A, 1B, and 1C.

The following reclamation activities were performed at WRP-1 in 2011:

- Reclamation work was performed on the middle area of WRP-1 just above the upper sediment/pH treatment basin 1F after the remaining waste rock was removed. Clean soil imported from the repository excavation stockpile was placed on top of flat bedrock surfaces at the request of the Forest Service COR to create riparian reclamation habitat. Log wattles were installed horizontally across the slopes and at the perimeter of the adjacent armored channel to contain the soil. Woody debris and stumps were also placed within the reclamation area soil. The entire area was hydroseeded with Flexterra, native grass seed, mycorrhizae, and fertilizer. The area was then planted with riparian tree and shrub species. Weed barrier fabric was placed around the plants to limit competition from grass. The area was then covered with straw as an additional erosion control measure. In total, 241 plants designated as riparian species were installed in this 0.08-acre area. Appendix G provides figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at WRP-1.
- Sediment/pH treatment basins 1D, 1E, and 1F were constructed.
- Construction of rock armor channel between sediment/pH treatment basins 1C, 1D, 1E, and 1F was completed.
- Rock armoring was placed in two drainage channels above sediment/pH treatment basin 1F (the uppermost basin).

- Sediment that collected over winter 2011 was hand excavated from sediment/pH treatment basins 1A, 1B, and 1C and placed into the repository.
- Native grass seed, mycorrhizae, fertilizer, straw, and slash were hand cast to the native soil area exposed near Adit A1N2.
- Hydroseed was applied to disturbed soil areas adjacent to the rock armored channel. The hydroseed included Flexterra bonded fiber matrix, native grass seed, mycorrhizae, and fertilizer in accordance with the project plans and specifications and the manufacturer's installation recommendations.

4.9.2. WRP-2

The following reclamation activities were completed at WRP-2 in 2010:

- Slash was placed on upper excavation boundaries from bedrock to adjacent soil and forest.
- Native grass seed was hand cast on the soil transition to the face of the exposed bedrock slope.
- Sediment/pH treatment basins 2A and 2B were constructed (see Figure 2).
- Rock armor channel leading into the sediment/pH treatment basins 2A and 2B was constructed.

The following reclamation activities were performed at WRP-2 in 2011:

- Sediment that collected over the winter 2011 was hand excavated from sediment/pH treatment basins 2A and 2B and placed into the repository.
- Sediment/pH treatment basin 2B was reconstructed after the fill soil of Haul Road 4 was removed. A rock armored crossing was created across this drainage for future Haul Road 4 maintenance access to WRP-3.
- Reclamation work was performed on the lower area of WRP-2 just above the lower sediment/pH treatment basin 2A where Haul Road 1 crosses the gully. A rock armored crossing was created across this drainage for Haul Road 1. The area was planted with riparian tree and shrub species. The area was hand-seeded with native grass seed, mycorrhizae, and fertilizer. The area was then covered with straw as an additional erosion control measure. Twenty-four plants designated as riparian species were installed in this 0.01-acre area. Appendix G provides figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at WRP-2.

4.9.3. WRP-3

All required reclamation work at WRP-3 was performed in 2011. The following reclamation activities were performed at WRP-3:

- Reclamation work was performed on WRP-3 after waste rock was removed. Because of the steep, rocky, raveling, and unstable condition of the subgrade soil, at the request of the Forest Service COR (see Work Order 16, dated September 14, 2011, followed by Contract Modification

12, dated September 16, 2011), additional log and straw wattles were installed instead of adding topsoil imported from the repository excavation. Log wattles were installed horizontally across the slope at approximately 50-foot spacings, and two straw wattles were placed at approximately 16-foot spacings between the log wattles to contain the soil. Woody debris, rocks, and stumps were also placed within the reclamation area soil in locations that are subject to concentrated water runoff.

- The area was planted with reclamation tree and shrub species. Because soil underlying WRP-3 is low pH, the plants were installed with agricultural limestone as a buffer against the low pH soil, blended with compost and native soil, and a fertilizer tablet was added. The area was hand seeded with acid-tolerant grass seed, mycorrhizae, and fertilizer. The area was then covered with straw as an additional erosion control measure. In total, 1,067 plants were installed in this 0.80-acre area. Appendix G provides figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at WRP-3.
- Sediment/pH treatment basin 3 was constructed.

4.9.4. WRP-4

The following reclamation activities were completed at WRP-4 in 2010:

- Slash was placed on upper excavation boundaries from bedrock to adjacent soil and forest.
- Native grass seed was hand cast on the soil transition to the face of the exposed bedrock slope.

The following reclamation activities were performed at WRP-4 in 2011:

- Because of the steep, rocky, raveling, and unstable condition of the subgrade soil, at the request of the Forest Service COR (see Work Order 16, dated September 14, 2011, followed by Contract Modification 12, dated September 16, 2011), additional log and straw wattles were installed instead of adding topsoil imported from the repository excavation. Log wattles were installed horizontally across the slope at approximately 50-foot spacings, and two straw wattles were placed at approximately 16-foot spacings between the log wattles to contain the soil.
- Hydroseed was applied to disturbed soil areas above the armored gully at the bottom of WRP-4 that were too steep to plant. The hydroseed included Flexterra bonded fiber matrix, native grass seed, mycorrhizae, and fertilizer in accordance with the project plans and specifications and the manufacturer’s installation recommendations.
- Per Work Order 16 (dated September 14, 2011) and Contract Modification 12 (dated September 16, 2011), reinforced slope stability fabric was installed on the steep slope at the toe of WRP-4. Approximately 5,400 square feet of Macmat R8P reinforced fabric was installed over the hydroseeded surface. The top edges were anchored in a trench. The fabric was pinned to the subgrade surface using 12-inch galvanized spikes and washers as anchor pins. The anchor pins were drilled and hammered into decomposed bedrock along the lower portion of the fabric, where they could not be installed by a hammer alone. The fabric was installed at the direction of the Forest Service COR to only cover the exposed steep soil surface and not the exposed decomposed bedrock at the toe of the slope. Therefore, a 10- to 15-foot gap exists between the reinforced

slope stability fabric and the armored channel below. Appendix A includes photographs A-64 and A-65 of the reinforced slope stability fabric.

- The area was planted with reclamation tree and shrub species. Because soil underlying WRP-4 is low pH, the plants were installed with agricultural limestone as a buffer against the low pH soil, blended with compost and native soil, and a fertilizer tablet was added. The area was hand seeded with acid-tolerant grass seed, mycorrhizae, and fertilizer. The area was then covered with straw as an additional erosion control measure. In total, 768 plants were installed in this 0.40-acre area. Appendix G provides figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at WRP-4.

4.9.5. North Storage Area

The following reclamation activities were performed at the North Storage Area in 2011 after the stockpiled soil from the repository excavation was removed and used as cushion soil and cover soil on the repository:

- The area was regraded to approximately the original grades and contours. Salvaged logs from clearing operations were installed horizontally across the south-facing slope at approximately 20-foot staggered spacing as log wattles. Silt fence was restored at the toe of the disturbed area. Woody debris was used to create a filter windrow at the toe of the disturbed area.
- Excess oversized rock segregated from the repository excavation soil was stockpiled for possible future maintenance use or emergency applications.
- Excess logs from clearing activities were stockpiled for future project maintenance use or as firewood.
- The area was planted with reclamation tree and shrub species. Bark mulch was placed around the plants to prevent competition from grass. In total, 1,366 plants were installed in this 1.37-acre area. Appendix G provides figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at North Storage Area.
- The area between the plants and bark mulch was hydroseeded with Flexterra, native grass seed, mycorrhizae, and fertilizer.

4.9.6. South Storage Area

The following reclamation activities were performed at the South Storage Area in 2011 after stockpiled soil and rock was removed:

- The area was regraded to approximately the original grades and contours.
- The area was planted with riparian and wetland tree and shrub species. Bark mulch was placed around the plants to prevent competition from grass. In total, 490 plants were installed in this 0.14-acre area. No hydroseed was installed at this area because the continuous bark mulch covered the area around the closely spaced riparian and wetland plants. Appendix G provides

figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at the South Storage Area.

4.9.7. Rock Stockpile Area

The following reclamation activities were performed at the Rock Stockpile Area in 2011 after stockpiled rock and logs were removed:

- The area was regraded to approximately the original grades and contours.
- The area was planted with reclamation tree and shrub species. Bark mulch was placed around the plants to prevent competition from grass. In total, 237 plants were installed in this 0.27-acre area. Appendix G provides figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at Rock Stockpile Area.
- The area between the plants and bark mulch was hydroseeded with Flexterra, native grass seed, mycorrhizae, and fertilizer.
- Haul Road 1 adjacent to the area was covered with straw and slash.

4.9.8. Repository Stockpile Area

The following reclamation activities were performed at the Repository Stockpile Area in 2011 after stockpiled soil from the repository excavation was removed and used as cover soil:

- The area was graded to direct surface water away from the repository. Log wattles were installed horizontally across the toe of the slope. Woody debris and slash were also placed in locations that are subject to concentrated water runoff.
- The area was planted with reclamation tree and shrub species. Bark mulch was placed around the plants to prevent competition from grass. In total, 443 plants were installed in this 0.27-acre area. Appendix G provides figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at Repository Stockpile Area.
- The area between the plants and bark mulch was hydroseeded with Flexterra, native grass seed, mycorrhizae, and fertilizer.

4.10. CONSTRUCTION OF THE TEMPORARY REPOSITORY COVER

Because waste rock could not be completely removed in 2010, ERRG installed a temporary winterization cover, consisting of 6-mil plastic sheeting, as a protective measure until waste rock removal activities continued in 2011. Prior to placement of the temporary cover on the repository, a temporary anchor trench was constructed for the repository liner system on the north, east, and south perimeter edges. The 6-mil plastic cover was placed on top of the waste rock and was secured using sandbags and nylon rope. The repository excavation soil stockpiled at the North Storage Area was also covered with 6-mil plastic and was secured using sandbags and nylon rope. The temporary plastic covers were removed in 2011 and properly disposed of at the Dry Creek Landfill.

The waste rock was adequately sloped and covered by plastic to prevent rain and snow melt from leaching through the material. However, the south edge of the repository cushion soil channeled water during the winter that seeped through seams in the plastic cover or under the edge of the plastic. This allowed rain and snow melt to enter the repository drainage layer from the edge without leaching through the overlying waste rock. Water was observed to be collected in the sump after the winter period. The water was clear and determined to be a pH of 6.8, indicating the water was from rain and snowmelt and had not leached through the waste rock. The water was pumped out during the 2011 work season. The sump capacity is only 500 gallons, so it is quickly drained by pumping. A trickle of water was observed to be entering the sump, which over time accumulates into a quantity that can be removed. At the end of the 2011 work season, the added weight of the final cover soil increased pressure on the underlying drainage layer, and residual water was again collected in the sump and removed. Future removal of residual stormwater from the sump is likely to be required. The sump contents will be monitored during the Operations and Maintenance activities. The presence of water is documented in this RACR so that future O&M activities are not surprised to find water in the sump.

4.11. CONSTRUCTION OF FINAL REPOSITORY COVER

The final repository cover was constructed over the waste rock at the completion of the removal activities. Appendix B provides as-built drawings of the repository. Appendix D contains geosynthetics QC and QA documentation for the repository, and Appendix I provides the results of compaction testing. The repository cover included the following work activities:

- The surface of the waste rock was graded to the final design contours.
- A cushion layer of clean soil stockpiled from the repository excavation was screened to 1 inch minus, then placed and compacted in a 1-foot-thick lift over the waste rock. The cushion layer was compacted by either a smooth drum compactor making at least four passes per lift or by a D4 or D6 Dozer and off-road haul truck traffic until no evidence of further consolidation was visible. Compaction testing of the cover soil was performed at the center of the west slope and at the center and south end of the top deck. These compaction tests were performed at the recommendation of the ERRG engineer as part of the redesign of the final repository cover. The tests document that the cushion soil is adequately compacted to at least 90 percent relative density to achieve the soil density required for slope stability (see Appendix I).
- 60-mil LLDPE geomembrane was installed over the cushion layer. The eastern (uppermost) edge of the geomembrane was backfilled in an anchor trench and compacted using 3-inch-minus soil. The soil was compacted by either a smooth drum compactor making at least four passes per lift or by a D6 dozer until no evidence of further consolidation was visible. Compaction testing of the anchor trench was not required.
- A drainage trench was installed along the northwest, west, and southwest edges at the toe of the repository cover slopes to collect and discharge water that may penetrate the cover soil and collect on the geomembrane cover. The drainage trench is lined with the 60-mil LLDPE geomembrane cover and includes a 4-inch-diameter Schedule 80 PVC collection pipe with 1/8-

inch-diameter holes. The trench is backfilled with pea gravel. The collection pipe discharges clean water that has infiltrated the cover soil to the adjacent forest through five laterals along the west toe of the repository cover.

- A 1-foot-thick pea gravel drainage layer was installed over the geomembrane along the north, west, and south slopes. The pea gravel is covered with a Type 1-A 8-oz. geotextile.
- A geocomposite drainage layer was installed over the geomembrane on the top deck of the repository. The geocomposite drainage layer conveys water that penetrates the soil cover to the pea gravel drainage layer on the side slopes.
- A 7-oz. geotextile was placed over the geocomposite drainage layer on the top deck as additional protection against rocks within the final cover soil (see Work Order 18, dated October 12, 2011).
- Cover soil was screened to 8 inch minus, then placed and compacted in 1-foot-thick lifts over the drainage layer. The upper 6 inches of the cover soil was screened and hand-picked to 6 inch minus. The soil was compacted by either a smooth drum compactor making at least four passes per lift or by a D6 dozer until no evidence of further consolidation was visible. Compaction testing of the anchor trench was not required.
- A riprap perimeter drainage ditch was constructed to convey surface water along the eastern edge of the repository to discharge into the adjacent forest to the north and south of the repository.
- A perimeter road was constructed using 3/4-inch-minus aggregate road surface placed 6 inches thick over Type II geotextile (see Work Order 18, dated October 12, 2011). The thickness of the aggregate base of the perimeter road was reduced from 12 inches to 6 inches. The aggregate base was compacted by a smooth drum compactor making at least four passes per lift. Compaction testing of the aggregate base was not required.
- Large logs from the repository and haul road construction clearing activities were placed along the inside edge of the repository road as a barrier to vehicles and ATVs (i.e., all-terrain vehicles) from leaving the road and driving on the repository cover.
- The repository sump is a 500-gallon HDPE tank installed at the bottom of the repository liner to collect leachate water. An HDPE cap with a steel locking rod and padlock was installed on the 24-inch-diameter HDPE repository sump riser.
- Reclamation of the repository cover and adjacent disturbed areas included installing shrubs and fertilizer tablets, placing bark around the shrubs to prevent competition from grass, and hydroseeding with Flexterra, native grass seed, mycorrhizae, and fertilizer. In total, 4,992 shrubs were installed on the 2.78-acre repository. Slash was placed on the slope below the sump riser. A filter windrow of woody debris was constructed along the west toe of the repository at the Forest Service property boundary. Appendix G provides figures showing the location of the reclamation features and tables listing the actual species and numbers of plants installed for reclamation at the repository.

4.12. WINTERIZATION OF THE SITE AND HAUL ROADS

ERRG winterized the site prior to demobilization at the end of each work season. ERRG implemented the following controls at each work area:

- Project Office Area
  - Previously disturbed areas at the project office location were covered with straw.
  - Culvert pipe, agricultural limestone, straw, and miscellaneous other maintenance supplies are stored at the project office area for future use.
- WRP-1
  - Grass seed, fertilizer, mycorrhizae, straw, and slash were placed on the maintenance access path to sediment/pH treatment basins 1A, 1B, and 1C.
  - Haul Road 2 beyond the Miner's Trail parking area was decommissioned. The shoulder of the road was excavated and placed against the cut slope, and the surface was graded to shed water across the road. Water bars were installed on the road. Grass seed, fertilizer, mycorrhizae, straw, slash, and log barriers were placed on the road and fill slope surface.
  - Haul Road 3 to the bottom of WRP-1 was graded to shed water off the shoulder of the road and water bars were installed. Grass seed, fertilizer, mycorrhizae, straw, and slash were placed on the road surface and fill slope.
- WRP-2
  - A rock drainage crossing and silt fencing were placed in the seasonal runoff drainage channel across Haul Road 1 above sediment/pH treatment basin 2A and across Haul Road 4 above sediment/pH treatment basin 2B.
  - Grass seed, fertilizer, mycorrhizae, straw, and slash were placed on the maintenance access ramp to sediment/pH treatment basin 2A.
  - Silt fence and straw wattles were installed at the seasonal runoff drainage channel crossing Haul Road 4 above sediment/pH treatment basin 2B.
- WRP-3
  - Haul Road 4 above sediment/pH treatment basin 3 was decommissioned. The waste rock loading platform at the base of WRP-3 was removed to restore the natural drainage. The soil was spread and compacted onto Haul Road 4. The shoulder of the road was excavated and placed against the cut slope, and the surface of the road was graded to shed water across the road. Water bars were installed on the road. Grass seed, fertilizer, mycorrhizae, straw, and slash were placed on the road surface.
  - Haul Road 4 below sediment/pH treatment basin 3 was graded to shed water off the shoulder of the road and water bars were installed. Grass seed, fertilizer, mycorrhizae, straw, and slash were placed on the road surface and fill slope.
- WRP-4
  - No winterization was required for WRP-4. Reclamation was performed over the entire area as previously described.
- North Storage, South Storage, and Repository Stockpile Areas
  - Silt fence was placed at the toe of the reclaimed stockpile areas.
- Repository

- Straw wattles were placed on the repository perimeter road to dissipate surface water runoff.

▪ Haul Roads

- Water bars were installed on all project haul roads, and energy dissipation rocks were placed at the water bar outflows.
- Native grass seed, fertilizer, mycorrhizae, and straw were placed on the disturbed side slopes, and the straw was crimped in using an excavator with compaction wheel attachment.
- Slash was placed on the side slopes.
- Straw and small slash were placed on the road surface.
- Permanent culverts were opened and confirmed to be functioning.

▪ Stream Crossings

- The three temporary culverts that were installed where the haul roads cross live streams at the beginning of the construction activities were removed, and the stream crossings were reconstructed with geotextile and riprap to provide free-flowing stream conditions.
- Silt fence was placed at both sides of the stream crossings.

▪ Forest Service Roads 1050 and 1060 and repository access spur road 1060-400

- The roads were graded and compacted, and rolling water bars were restored as needed.
- Culverts were marked with paint or flagging and confirmed to be functioning.
- In total, 4 inches of aggregate road surface material was placed and compacted to restore the driving surface on Forest Service Road 1060 from the project office area to the repository access spur road intersection and on Forest Service spur road 1060-400 to the repository.

4.13. INSTALLATION OF ADIT GATES AND POLYURETHANE FOAM

The plans and specifications included in Delivery Order No. AG-0489-D-10-0126 (Forest Service, 2010) required that adit gates be installed on up to six adits at the direction of the Forest Service COR. Eight adits were known; however, two of the adits were shallow and did not require gates, as directed by the Forest Service COR. During removal of waste rock, ERRG discovered four previously unknown adits and one vertical shaft on WRP-1 and one unknown adit on WRP-2, bringing the total number of mine openings to 14. The Forest Service COR determined that 10 adits required gates: A1S, A1N, A1N2 (new adit), A1S2 (new adit), A1S3 (new adit), A1S4 (new adit), A3, A4S, A5, and A6. Adits A2 and A4N were shallow, so no gate was installed at the direction of the Forest Service COR.

The adit gates were prefabricated into pieces that could be assembled by hand at the adit entrance. The pieces were flown by helicopter to each of the adits. A small welder was transported by hand crews to each adit. Steel pins were drilled and epoxied into the rock surface, and the adit gate components welded into place. In a few instances where the adit entrance was irregularly shaped, additional angle iron pieces were installed across the horizontal gate bars to provide additional strength to resist tampering. A keyed padlock was installed on each adit gate. Appendix A includes photographs A-67 through A-70 of the typical adit gate installations.

The new adit A2S on WRP-2 and the vertical mine shaft on WRP-1 were closed using PUF techniques. Adit A2S slopes downward at a 45 degree angle. A temporary plug was installed, and the opening to the adit was filled with PUF. The adit opening was covered with rocks and soil. A steel frame was fabricated and bolted into the vertical mine shaft to contain the PUF. The shaft entrance was filled with PUF and the surface was covered with rocks and soil. Appendix A includes photographs A-71 and A-72 of the typical PUF installation at the vertical shaft.

4.14. COLLECTION OF ADDITIONAL SEDIMENT AND WATER SAMPLES

On August 18, 2010, an unknown adit was uncovered on WRP-1 downhill from Adit A1N. The adit has been designated as A1N2. The adit was full of water, which was released when the entrance to the adit was exposed during removal of waste rock. The water gushed down the WRP-1 tributary and washed waste rock and sediments into Joe Creek. At the direction of the Forest Service COR, ERRG collected sediment and water samples from locations at the Joe Creek bridge before it enters Elliott Creek, at the Elliott Creek bridge, and at the bridge crossing the Middle Fork of the Applegate River. Samples were collected on August 18, August 19, and September 2, 2010. ERRG provided the sampling results to the Forest Service COR via e-mail, and the results are also provided in Table 5 and in Appendix J to this Removal Action Completion Report. The sampling results indicated that concentrations of metals or pH were not elevated significantly, thus no further action was taken.

Additional stream water samples were collected on September 19, 2010, and October 28, 2010, after rain events, and on March 11, 2011, when the site was accessible in the spring. These samples were collected to spot check the status of the stream water at the Joe Creek confluence with Elliott Creek, at the Joe Creek bridge, at the Elliott Creek bridge, and in Joe Creek immediately below the tributary from WRP-1 and WRP-4. These sample results were consistent with other samples from Joe Creek and Elliott Creek (Table 5).

The water from the adit was controlled after the initial release and allowed to trickle into the waste rock, where it was contained within the waste rock limits and absorbed by the waste rock until the adit was drained. Another unknown adit was discovered on the face of WRP-1, designated A1S4, which also was full of water. This water was able to be controlled and allowed to drain into the waste rock. No adit water left the site after the initial release from Adit A1N2.