NWI-4212-001
Project No. 4200

Remedy Completion Report
DOE-LASO TA-73 Airport Landfill
SWMUs 73-001(a) and 73-001(d)

April 2007

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Prepared for the
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Approved by

Doug Jorgensen, Project Manager	Date
Berg Keshian, Engineer of Record	Date

CONTENTS

TABLES

ACRONYMS

CDRs	Construction deficiency reports
CFR	*Code of Federal Regulations*
DDA	Debris Disposal Area
DOE	United States Department of Energy
HASP	Health and Safety Plan
HDPE	high-density polyethylene
HP-2	Hangar pad #2
MSE	Mechanically-stabilized earth
NMED	New Mexico Environment Department
RCP	reinforced concrete pipe
RDWP	Remedy Design Work Plan
SSO	Site Safety Officer
TRM	turf reinforcement mat

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1. INTRODUCTION

This Remedy Completion Report describes construction of the final remedy for the U.S. DOE-LASO SWMUs 73-001(a) and 73-001(d), referred to as the Airport Landfill and Debris Disposal Area (DDA), respectively. The RCRA Facility Investigation (LANL 1998), the Voluntary Corrective Measures Plan (LANL 2002) and Remedy Design Work Plan (RDWP) (NWI 2006) for these SWMUs are available in the administrative record.

The completed remedy is summarized below. Field changes to the RDWP design are described in Appendix C and are incorporated on the final as-built drawings and specifications, provided in Section 4.

1.1 Report organization

This report provides the content required for a Remedy Completion Report as stated in the "Compliance Order on Consent" (NMED 2005), referred to hereinafter as the Consent Order, Section VII.E.6.a., and includes:

1. A summary of work completed
2. A statement, signed by a registered professional engineer, that the remedy has been completed in accordance with the Department approved work plan for the remedy
3. As-built drawings and specifications signed and stamped by a registered professional engineer.
4. Copies of the results of all monitoring, including sampling and analysis, and other data generated during the remedy implementation, if not already submitted in a progress report.
5. Copies of all waste disposal records, if not already submitted in a progress report.
6. Certification of the report, signed by a responsible official of both DOE and the co-operator.

Work completed is described in Section 2. The Engineers statement and certification by DOE are provided in Sections 3 and 4, respectively. As-built drawings and supporting calculations are provided in Section 5.

Test pads were required by NMED for the infiltration layer soils and for the MatCon cover (NMED 2006). Results of acceptance testing for these features are summarized in Section 6. Testing results are provided on the CD in Appendix A.

Appendices include:

- Appendix A: Results of testing (CD)
- Appendix B: Disposal manifest for Freon-113 container
- Appendix C: Field changes
- Appendix D: Photos.

2. SUMMARY OF WORK COMPLETED

The principal features of work completed as part of the TA-73 Airport Landfill closure include:

- Regrading and compaction of the main landfill surface, and the north and east slopes
- Construction of five concrete hangar pads on the main landfill surface
- Construction of a MatCon asphalt cap on the main landfill surface
- Construction of a gas collection system beneath the MatCon surface
- Construction of a stormwater collection system
- Construction of a lower concrete retaining wall and an upper mechanically-stabilized earth (MSE) wall at the toe of the east slope
- Construction of a low-permeability soil/geocomposite/vegetated soil cover on the upper east slope and the north slope
- Placement of additional cover soil, regrading and revegetation of the DDA.

Each of these features is discussed in detail below. Quality control, field changes, and construction deficiencies and resolutions are discussed for each.

2.1 Waste relocation and regrading

Extensive relocation of waste was required to achieve the final grades shown on Drawing 2002AB. Photos taken prior to construction and during waste relocation are provided in Appendix D. A preconstruction survey established the initial grades and locations of significant features. The existing interim soil cover was removed and stockpiled for use as common borrow prior to excavation of waste. The areal extent of waste, the volume of waste relocated and types of waste encountered are described below.

Quality assurance during waste relocation and regrading included visual observations by the QCSM that waste was placed in thin lifts and compacted as placed, as per Specification 02266. Waste was consistently compacted beyond the requirements of the specification using multiple passes with a 10 ton vibratory roller. Objects such as appliances were crushed with the trackhoe excavator or dozer before rolling. Tires were segregated and placed in deeper fill areas. Larger competent materials, e.g. concrete, etc. were bedded in softer materials where possible and were not stacked or piled. In general waste was relocated and compacted so as to provide as stable a subgrade as possible for the final closure cover.

2.1.1 Extent of waste

Potholes and trenches were excavated on the north, south and west sides of the landfill prior to the start of waste relocation and cap construction, to determine the areal extent of waste and to set the required final cover limits. Drawing 2002 AB shows the locations of the excavations, which were referenced in field drawings to the preconstruction survey stakes. The presence or absence of waste in the excavations was noted on the field drawings.

Locations shown on the north side of the landfill are the northern limits of waste prior to construction, as determined by trenching north to south. Waste observed in the northwest corner was relocated onto the main landfill with a minimum 1-ft offset from the final cover limits.

Waste was observed east of Wall 1 during construction of the wall foundation. Waste east of Wall 1 was excavated and relocated onto the main landfill after construction of the wall was complete. The west side of the Wall 1 foundation is the limit of waste in this area, and the east side of the wall foundation is the limit of the final cover.

The original design called for all waste to be removed from the southeast corner of the landfill, in the expectation that natural ground would be encountered at shallow depths in that area. Initial excavation indicated deeper fills than anticipated, and the design was revised to extend the cover eastward until natural ground was encountered. Drawing 2002AB shows the final alignment of the southeast corner of the cap. Waste immediately adjacent to the taxiway was relocated onto the main landfill surface to achieve the required minimum 1-ft offset of waste within the final cover limits.

Potholing locations on the south side of the landfill are shown on drawing 2002AB. Debris was encountered at depths of 3 to 10 ft on the south side near the taxiway. This material appeared to be fill used in construction of the airport taxiway and runway, e.g. pieces of brick and asphalt, rather than the municipal solid waste observed elsewhere in the landfill. These observations were consistent with drilling logs for wells in this area (LP-1 through LP-4) as documented in the RFI Report (LANL 1998) Attachment 4-15, which also show 3 to 10 ft of fill. Fill was distinguished from landfill refuse in the drilling logs. This material was not relocated but was covered by the MatCon asphalt, and the liner under the drainage channel.

Potholing locations on the west side of the landfill are also shown on Drawing 2002AB. Additional excavation was done in this area prior to the start of cap construction to locate the existing storm sewer line and repair damaged areas, and to locate a possible existing water line which was not found. The occurrence or absence of waste in the excavations was noted. The storm sewer line and possible water line locations were found to be located in clean fill. The potholing results showed no waste within approximately 30 ft of the west end of the final cover limits.

2.1.2 Volumes of waste relocated

Approximately 50,000 cubic yards (cy) of waste were relocated during construction to achieve the required final grades and to consolidate waste within the capped area. Most of the material was removed from the east slope, placed on the upper landfill surface and compacted as it was placed. Lesser amounts were removed from the north slope and similarly placed on the upper landfill surface and compacted.

2.1.3 Types of waste encountered

Wastes encountered during construction were consistent with the RFI Report (LANL 1998) description of the TA-73 landfill as receiving only municipal waste. No hazardous, toxic or radioactive materials were observed during waste relocation, based on visual observations and on-site health and safety monitoring, as described in Section 2.1.4; with the exception of the discovery of two unknown containers and three compressed gas cylinders with valves missing during waste relocation. One container and the three compressed gas cylinders were inspected by the LANL Emergency Management Response Team. The cylinders were determined to be safe, but the unknown container was sealed and the contents were not evident. Rinchem Company from Albuquerque was contracted to determine the contents. After sampling and testing was performed, the container was determined to be empty and clean. The container was disposed of back into the landfill.

The second unknown container was suspected to contain Freon-113. Rinchem packaged, transported and arranged for disposal of the container. The container was accepted for stabilization and landfilling at the Veolia Environmental Services hazardous waste facility in Henderson, CO, and assigned wastestream number RC7641. Copies of the Uniform Hazardous Waste Manifest and the Waste Acceptance Notification are provided in Appendix B. This was the only waste disposed of off-site during the project.

2.1.4 On-site monitoring during relocation

Hazardous substances in air were monitored daily during waste relocation by the Site Safety Officer (SSO) as required by the Health and Safety Plan (HASP) (NWI 2006). Organic vapor concentrations, flammability, hydrogen sulfide, carbon monoxide, and oxygen were monitored using a Multi Rae Plus photoionization detector/specific gas monitoring instrument. A Sensidyne Model AP – 20S Gas Detection Pump was used throughout the project monitoring for specific gases such as benzene due to reported detection in soil gas during the RFI investigation, and very low OSHA permissible exposure limits. A Ludlum Model 12 count ratemeter was used to determine background radioactivity levels and for ongoing surveys of waste exposed during excavation and relocation.

Personal sampling pumps were placed on employees to collect actual exposure levels for benzene and metals, in particular cadmium and lead, over an eight hour work-shift to determine the actual employee exposures. Air sampling pumps were also placed on the perimeter fence around the project to monitor hazardous constituent concentrations at the fenceline.

Organic vapor concentrations in air during waste relocation were consistently below exposure limits stated in the HASP at all locations. Radiation levels were consistently at or below the background levels established prior to construction. Employee exposures were below the permissible exposure limits for benzene, cadmium and lead. All on-site monitoring results are available in the project file upon request.

2.1.5 Final grades

Final grades for the completed landfill surface are shown in Figure 2002AB. Grades range from about 0.5% across the hangar pads, and 1 to 2% across the MatCon surface and east slope drainage bench; to 3h:1v (33%) and 4h:1v (25%) on the vegetated north and east slopes.

2.2 Hangar pads

Five concrete hangar pads were constructed as shown on as-built Drawings 2002AB, 3003AB and 3004AB. Final as-built construction specifications are provided in Section 03300. Hangar pads 1 through 3 are 203 ft 7 in by 60 ft each, and vary from 6-in to 2-ft in thickness. Hangar pads 4 and 5 are 196 ft 1 in by 63 ft 1 in each, and vary from 9-in to 2-ft in thickness. All construction joints were sealed and the entire surface was sealed with Sealhard® concrete sealer on all pads. Product literature and certifications for all materials are available in the project submittal register.

Originally six pads were planned. Hangar Pad 6 (farthest east) as shown on the original Drawing 2002A was deleted as described in FCN-4200-008, due to potentially excessive differential settlement, as described in the Weston Solutions, Inc. elastic settlement calculations dated 04/19/06 and provided to NMED on 5/31/06. Potential settlement is greatest at the east end of the landfill where fills are deepest. Differential settlement from center to edge of Pad 6 could be as much as 4 inches, likely resulting in cracking. For this reason, Pad 6 was proposed to be deleted and replaced with aircraft tie-downs, in a 05/02/06 meeting with Bob Enz of DOE-LASO, Kyle Zimmerman of Los Alamos County, Berg Keshian of Weston Solutions, Inc. and Engineer of Record, and John Keck of North Wind, Inc. This proposal was accepted by both DOE-LASO and Los Alamos County. Utility poles required to supply each hangar with electricity were also added to the design at that time.

The pad design shown on Drawing 3003AB was modified during the course of construction to improve constructability. Hangar pads 1 through 3 were constructed using the original design, and pads 4 and 5 were constructed using the revised design shown on Drawing 3004AB. Other field changes related to hangar pad construction are documented in Appendix C.

Hangar pad construction began with relocating and compacting waste as discussed previously. When the required waste fill elevation was reached, the stockpiled interim cover material was placed, proofrolled and the grade beams excavated. A single lift of aggregate base course was then placed and compacted to a final thickness of 4-in.

The hangar pads were then formed and rebar installed. The hangar pads were poured in sections. Most of the pours were performed in early morning, when temperatures and the chance of rain were lower. Hangar pad #2 (HP-2) was the first of the five pads constructed at the airport landfill. A gap or void was observed on the west side at an expansion joint, where the cork had been displaced during the concrete pour. The resulting gap or void shown in Appendix D was identified as a construction deficiency and tracked as CDR-001.

The construction process was revised to better fasten the cork to the concrete, and the deficiency was not observed on subsequent hangar pads. Repair procedures and products were discussed with the concrete subcontractor, DOE-LASO and the USACE representatives. Comments were incorporated and the repairs were performed as per the procedure. The repairs were inspected and accepted by the QCSM and CDR-001 was closed.

Quality assurance during hangar pad construction by the QCSM included observing placement and compaction, checking final thickness of replaced interim cover material and aggregate base subgrade, and inspecting forming and rebar placement. The geotechnical lab subcontractor tested the subgrade for moisture and density using a nuclear gauge, under the oversight of the QCSM. On-site concrete testing during pouring included casting cylinders for 7-, 14- and 28-day break tests; and measuring slump, air content and temperature at random by the geotechnical lab subcontractor. The USACE provided on-site quality oversight for the DOE-LASO throughout the hangar pad construction.

The QCSM observed each concrete pour, and checked the concrete mix formulation on each weight ticket. Addition of water and water reducer on site and at the mix plant was controlled by the QCSM and field engineer to meet requirements for slump. All 28-day cylinder break tests exceeded the required 4000 psi. Results of testing are provided in Appendix A.

Sealhard® concrete sealer was applied to the exposed surfaces. Photos of the completed hangar pads are provided in Appendix D.

2.3 Gas collection system

Approximately 3400 linear feet of gas collection piping were installed, as shown on Drawings 2010AB and 2011AB. No significant field changes were required during construction. Quality assurance during construction included inspection of materials and certifications as received, and inspection of the installation, for compliance with drawings and Specification 02730. Product literature and certifications for all materials are available in the project submittal register. Photos of the construction are provided in Appendix D.

2.4 MatCon cover

4.87 acres (211,953 sq ft) of the main landfill were covered with a single 4-in lift (finished thickness) of MatCon pavement. Drawing 2002AB "Landfill Top of Cap Grading Plan" shows the extent of MatCon and finished slopes. No field changes were made to the MatCon design during construction. Photos of the construction are provided in Appendix D.

Cold joints occurred in two locations during MatCon placement and compaction, due to interruptions of the asphalt supply and cold ambient temperatures, resulting in CDR-003 and -004, respectively. Cold joints created during placement are required to be repaired under the MatCon guide specifications. The length of the cold joint was milled 2", tack coated and new material placed and compacted to achieve final grade. The repairs were inspected and accepted by the QCSM. The areas passed density testing requirements, and the CDRs were closed.

Quality assurance during the MatCon cover construction included inspection and observation by the QCSM, process oversight at the mix plant and on-site by the MatCon subcontractor, and mix plant and on-site testing by the geotechnical testing subcontractor. The USACE provided on-site quality oversight for the DOE-LASO throughout the MatCon construction. The QA/AC report for the MatCon installation including the mix design, mix plant inspection and approval, preliminary test pad, and testing and construction at the main landfill are provided in Appendix A. The MatCon installation and final surfaces are shown in photos provided in Appendix D.

The completed MatCon surface was cored at 12 locations as shown in the photos provided in Appendix D Cored locations were backfilled with MatCon hot mix. The hydraulic conductivity of the MatCon cores was below the limits of the ASTM D5084 procedure as performed by the testing laboratory, which has previously measured permeabilities below 1E-09 cm/sec for earthen materials using this method. The requirement that the test pad cores have a saturated hydraulic conductivity less than the value of 1E-08 cm/sec used in numerical modeling to establish RCRA Subtitle C cover equivalence, as described in the RDWP (NWI 2006), was therefore met. The laboratory test report is provided in Appendix A.

2.5 North and east slope covers

Approximately 3 acres of the north and east slopes were covered with the infiltration layer/drainage geocomposite/turf reinforcement mat (TRM) cover configuration shown in Drawings 2005AB and 2025AB. Drawing 2002AB shows the areas covered with TRM. Construction details for each element of slope cover construction are discussed below.

2.5.1 Infiltration layer and geosynthetic drainage composite

Approximately 3 acres of the north and east slopes were covered with infiltration layer soil and geosynthetic drainage composite as shown in Figure 2002D, 2005C and 2025A. A test pad was constructed for the infiltration layer soil as per Specification 02200 and tested prior to full-scale construction, as described in Section 5.2.1. Testing results were provided to NMED on 08/31/06, and are summarized in Section 6 and are provided in full in Appendix A. Saturated hydraulic conductivity for samples collected from each of the three lifts ranged from 3.1E-07 to 4.4E-08 cm/sec. The construction methods used to achieve the required permeability of less than 1E-05 cm/sec for the infiltration layer test pads were subsequently used for the full-scale construction.

Field changes during installation of the north and east slope covers included increasing the compaction requirement for infiltration layer soils to 100% of Standard Proctor dry density, to achieve the required 1E-05 cm/sec saturated hydraulic conductivity based on the results of test pad construction. Quality assurance during construction of the infiltration layer included visual inspection of received infiltration layer soils, monitoring material placement and compaction of soil in 6-inch lifts, and field moisture and density determinations by the geotechnical testing laboratory subcontractor.

Quality assurance during installation of the geosynthetic drainage composite included inspection of materials and certifications as received, and inspection of the installation as per specifications and drawings. Product literature and certifications for all materials are available in the project submittal register.

2.5.2 Topsoil

Topsoil used for the north slope was imported to the site from an off-site borrow source owned by Parker Construction Co. Topsoil analysis results are provided in Appendix A. This soil was amended with compost purchased from Los Alamos County, using a blend of about 1 part compost to 20 parts topsoil. The compost was comprised of biosolids from Los Alamos County wastewater treatment plants, mixed with wood chips and stable waste for composting. Composting is performed in a windrow about 6 feet high and 40 feet long which is built and mixed with a front end loader. The windrow was turned and monitored according to requirements under Title 40 of the *Code of Federal Regulations* [CFR], Part 503) to produce Grade A compost which was tested for bacteria before being released. Compost testing results are provided in Appendix A. No fertilizer was added.

The topsoil and compost sources used for the north slope were completely consumed and therefore topsoil used for the east slope and DDA consisted of a local silty sand, amended with Biosol fertilizer, at a rate of 200 lbs/acre.

No significant field changes were required during installation of the topsoil course. Quality control during installation of the topsoil course included monitoring lift thickness and compaction by wheel rolling and dozer tracking only.

2.5.3 Vegetative cover

Vegetative cover was applied to approximately three acres of the north and east slopes and five acres of the DDA. Specification 02932 provided seeding guidelines. Table 2-1 lists the actual mix applied, based on the guidelines. Seeding was performed by broadcasting on the north slope at approximately 35 lbs live seed per acre. Seeding was performed on the east slope and DDA at 30-37 lbs live seed per acre by hydroseeding and hydromulching. Approximately 2000/bs per acre mulch were applied.

Table 2-1. Seed mix applied to north and east slopes and DDA.

Species	Scientific name	% of mix
Blue grama	Bouteloua gracilis	10%
Sideoats grama	Bouteloua curtipendla	15%
Indian ricegrass	Oryzopsis hymenoides	15%
Mountain brome	Bromus marginatus	15%
Thickspike wheatgrass	Agropyron dasystachyum	20%
Sheep fescue	Festuca ovina	15%

Table 2-1 continued

Species	Scientific name	% of mix
Firewheel	Gaillardia pulchella	2%
Fringed sage	Artemisia frigida	1%
Blue flax	Linum perenne lewisii	4%
Palmer penstemon	Penstemon palmeri	2%
Prairie coneflower	Ratibida columnifera	1%

No field changes were required during installation of the vegetated cover. Quality assurance included visual inspection of the seed certification tags, and the application rate and compliance with Specification 02932.

2.5.4 Geosynthetic slope protection

Drawing 2002AB shows the coverage of geosynthetic slope protection. Due to availability of materials several types were used including:

- Western Excelsior PP5-8 permanent erosion control blanket on slopes shallower than 4h:1v
- Greenfix America CFG 2000 permanent erosion control mat on slopes steeper than 4h:1v

The areas receiving TRMs were broadcast seeded with the native plant mix listed in Table 2-1 before placing the geosynthetics. Photos of the construction are provided in Appendix D.

Field changes related to geosynthetic slope protection are documented in Appendix C. Quality assurance during construction included inspection of materials and certifications as received, and inspection of placement as per specifications and drawings. Product literature and certifications for materials are available in the project submittal register.

2.6 Stormwater system

A storm water management system was installed to drain the paved areas, including over 1700 feet of high-density polyethylene (HDPE) and reinforced concrete pipe (RCP), 10 precast concrete drop inlets, and 1000 ft of poured in place concrete trench drains adjacent to the hangar pads. A 500-ft lined riprap drainage channel was constructed between the completed landfill cover and the adjacent aircraft taxiway.

Stormwater system features are shown on as-built drawings 2003AB, 2021AB and 2022AB. Photos of the construction are provided in Appendix D. The existing storm sewer line shown on Figure 2002D was left in place, because it is located in clean fill and is still in use.

Quality assurance during construction included inspection of materials and certifications as received, and inspection of installation as per specifications and drawings. Field changes related to the stormwater system are documented in Appendix C. Product literature and certifications for materials are available in the project submittal register.

2.7 Retaining walls

2.7.1 Wall 1

Drawings 2006 AB and 3000AB through 3002AB show the final as-built condition of Wall 1, which is a cast in place reinforced concrete cantilevered wall. Wall heights shown on Drawing 3000AB (top of wall elevation – top of foundation elevation) can be compared to design heights shown on Drawing 3001AB to determine locations of sections. Section 03300 contains as-built construction specifications for Wall 1. Total completed length of Wall 1 is 290 feet. The maximum height is 24 ft. Photos of Wall 1 construction are provided in Appendix D.

Prior to construction, the Wall 1 alignment was cleared and graded sufficiently to allow access for a CME 75 rotary drilling rig. Borings were drilled along the alignment of Wall 1 to determine the depth, competency and bearing strength of the underlying strata. Boring logs and a location map are provided in Appendix A. The borings indicated approximately 10 to 15 feet of fill overlying soft nonwelded tuff, overlying dense welded tuff. Standard penetration tests and rock quality index were measured and visual observations recorded.

Based on the greater than expected depth to dense welded tuff, the Wall 1 design was revised to rest on the softer nonwelded tuff in some locations. The height of the wall was held constant, while the elevations at the bottom of the foundation and top of the wall were dropped 5 ft. The foundation was overexcavated until natural material was encountered. Structural fill was placed and compacted in the excavation prior to pouring the foundation of the wall. The Wall 1 design was otherwise unchanged. Supporting calculations for the Wall 1 redesign are provided in Section 5.

The Wall 1 construction sequence is shown in photos in Appendix D. A haul road was constructed to the toe of the east slope and the downhill edge was protected using jersey barriers with reinforcing steel. Waste and natural tuff was then excavated to establish required grades, and relocated to the main landfill surface and compacted. The Wall 1 foundation was then cut to the required elevations.

Wall 1 was constructed in sections, south to north. The foundation for each section was formed and poured and allowed to cure before the overlying wall was poured. Two concrete pumper trucks were used to deliver concrete to the foundation. The supply of concrete from the mix plant was interrupted twice during pours of the foundation, resulting in formation of cold joints. Construction deficiency reports (CDRs) were written for each occurrence and a repair method was submitted to DOE-LASO and approved by the ER. The uncured concrete was removed to at least 6 inches below the depth of the top mat of rebar and allowed to cure. The surface was cleaned to remove loose material and Weldcrete, a concrete bonding agent, was applied prior to the next pour. Supporting calculations to evaluate the required strength of the cold joint are provided in Section 5. Repairs were completed to the satisfaction of the ER and the QCSM. Product literature and certifications for materials are available in the project submittal register. Field changes related to Wall 1 construction are provided in Appendix C.

Quality assurance during Wall 1 construction included observing placement and compaction of structural fill in the foundation excavation and inspecting forming and rebar placement by the QCSM; and nuclear gauge testing of the subgrade for moisture and density by the geotechnical lab subcontractor. The USACE provided on-site quality oversight for the DOE-LASO throughout Wall 1 construction. On-site concrete testing during pouring included pouring cylinders for 7-, 14- and 28-day break tests; and measuring concrete slump, air content and temperature; at random at a minimum frequency of 1 truckload per every 10 truckloads, by the geotechnical lab subcontractor.

The QCSM observed each concrete pour, and checked the concrete mix formulation on each weight ticket. Addition of water on site and at the mix plant was controlled by the QCSM and field engineer to meet requirements for water:cement mix ratio and for slump. All 28-day cylinder break tests exceeded the required 3000 psi. Results of testing are provided in Appendix A.

2.7.2 Walls 2a and 2b

As-built Drawing 2006AB shows the as-built condition of Walls 2a and 2b, which are MSE walls. Design drawings and supporting calculations prepared by the vendor are provided in Section 5. Section 02273 contains as-built construction specifications for Walls 2a and 2b.

The MSE walls were redesigned during construction to accommodate the reduced elevation of the top of Wall 1, the occurrence of rock observed during the excavation of the Wall 1 foundation, and the final east slope configuration based on an assessment of the cut and fill balance. A continuous MSE wall was eliminated and two partial walls used instead. Field changes related to MSE wall construction are documented in Appendix C.

The total completed lengths of Walls 2a and 2b are 71 ft and 110 ft, respectively. Wall 2a rises in height from 7 ft at the south end to 15 ft at the north end. Wall 2b rises in height from 23 ft at the south end to 7.5 ft at the north end. Photos are provided in Appendix D.

Walls 2a and 2b were built on the compacted structural backfill behind Wall 1. Quality assurance during construction included observing and inspecting placement and compaction of the structural fill behind Wall 1 and the MSE wall backfill, and nuclear gauge testing of the subgrade and MSE wall backfill for moisture and density by the geotechnical lab subcontractor. Test results are provided in Appendix A.

The QCSM and site superintendent also inspected wall alignment and dimensions. The USACE provided on-site quality oversight for the DOE-LASO during Wall 2a and 2b construction. Structural fill used for Wall 1, 2a and 2b foundations and backfill was inspected visually on delivery and tested as required by as-built Specification 02200 and Section 2.0 of Tensar Construction Requirements.

2.7.3 Surface covers behind retaining walls

The original design assumptions included removing all waste from the area between Walls 1 and 2. This was not feasible due to the depth of waste encountered behind Wall 1 during construction. Therefore the bench between Walls 1 and 2 was covered using the geosynthetic liner and geotextile configuration used for drainage benches, in order to meet the requirement to cover all waste. Field changes required are described in FCN-4200-037 and shown on Drawing 2005AB Detail 5. The geosynthetic liner system as shown in the Drawing 2025AB detail, “Typical geosynthetic placement at retaining walls” was placed starting 2-ft behind face of Wall 2, at a depth of 2-ft below the bottom of the wall, to the back of Wall 1. A 3-ft wide strip of riprap was placed adjacent to Wall 1 and sloped laterally from the center of the wall to each end of the wall at 0.5%. The remainder of the surface was completed with 6” of topsoil with turf reinforcement mat. Photos of the construction are provided in Appendix D.

The bench and slopes behind Wall 2 are covered with the low-permeability soil/geocomposite/vegetated soil cover shown in Drawing 2025AB Section N. Quality assurance during construction of the surface covers included inspection by the QCSM of the geotextile and geosynthetic liner placement, placement of the riprap, placement of the topsoil and the turf reinforcement mat. Dimensions, materials and installation procedures were checked against Drawings 2005 and 2006 and specifications 06005 and 06020.

2.7.4 Final east slope configuration

The final east slope configuration changed from the original design as a result of lowering Wall 1, reconfiguring Wall 2 and realigning the drainage bench; and due to differences in the actual quantity of waste produced during relocation vs. preconstruction estimates. As a final check, slope stability was evaluated at two critical sections using geotechnical parameter values for the actual soils used and as-built grades. The factor of safety at the critical sections was determined to be greater than 1.5.

2.8 DDA cover

The extent of the DDA was initially surveyed and elevations were staked. Topsoil was added and the surface regraded over a total of five acres to achieve the minimum cover requirement of 12 inches. The finished surface was hydroseeded and hydromulched using the seed mix listed in Table 2-1. The final surface elevations are shown on Drawing 2015AB.

No field changes were required during installation of the DDA cover. Quality assurance included inspection of surveying and staking, inspection of topsoil addition as per Specification 02200, visual inspection of the seed certification tags, and checking the application rate and compliance with Specification 02932. Photos of the DDA cover construction are provided in Appendix D.

3. STATEMENT BY ENGINEER OF RECORD

This certification was prepared in accordance with generally accepted engineering principles and practice pursuant to the requirements of Section VII.E.6 of the March 1, 2005, Compliance Order on Consent signed by the New Mexico Environment Department (NMED) and the United States Department of Energy (DOE) and the Regents of the University of California for a registered professional engineer's certification. These activities have been performed with the care and skill ordinarily exercised by members of the profession practicing under similar conditions in the same manner or in a similar locality. I make no other warranty either expressed or implied. I certify that, the investigation and/or remediation was conducted in accordance with the Remedy Design Work Plan, approved by NMED on March 20, 2006. The information presented in this report is, to the best of my knowledge and belief, true, accurate, and complete.

Berg Keshian, PE
Engineer of Record
NM PE No. 8590

4. CERTIFICATION BY DOE

**CERTIFICATION BY THE ENVIRONMENTAL STEWARDSHIP–
ENVIRONMENTAL REMEDIATION & SURVEILLANCE PROGRAM
TECHNICAL REPRESENTATIVES**

Document Title: Remedy Completion Report DOE-LASO TA-73 Airport Landfill
SWMUs 73 001(a) and 73-001(d)

I certify under penalty of law that these documents and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

______________________________ Date: _______________
Robert Enz, Project Manager
Environmental Restoration Program
Department of Energy/Los Alamos Site Office

or

______________________________ Date: _______________

Assistant Area Manager of Environmental Projects
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5. AS-BUILT DRAWINGS AND SPECIFICATIONS

As-built drawings and specifications signed and stamped by the Engineer of Record are provided in this section. Changes to the original design, based on field conditions and other necessities, are incorporated in the as-built specifications and drawings. The most significant changes are described as Field Changes in Appendix C. None of the changes affect the required functions and performance of the final cover system.

6. RESULTS OF MONITORING, SAMPLING AND ANALYSIS

Monitoring, sampling and analysis performed for each feature of work are described in this section. Results are provided in Appendix A. The electronic laboratory reports from Kleinfelder, Inc. provided on CD are coded as shown in the example below:

71610.2 - ALB06TD013_08-21-06_A_C_S.pdf: Example report number from Appendix A

71610.2 - ALB06TD013: Report number generated by Kleinfelder, Inc.

08-21-06: date of report

A_C_S: Material types tested; C = concrete; A = aggregate; S = soil; M = MatCon

6.1 Main landfill cover

Monitoring, sampling and analysis results for the main landfill cover include on-site health and safety monitoring. Results are provided in Appendix A.

6.1.1 Aggregate subgrade

Sampling and analysis for the aggregate subgrade for both the hangar pads and the MatCon cover included prequalification testing of aggregates and acceptance testing of the compacted subgrade, as per Specification 02200. Results are provided in Appendix A. Those reports containing results for aggregates include an "A" in the filename.

6.1.2 Hangar pads

Sampling and analysis for the hangar pads include prequalification mix design and testing, and acceptance testing of concrete as received, as per Specification 03300. Results are provided in Appendix A. Those reports containing results for concrete include a "C" in the filename.

6.1.3 MatCon cover

Sampling and analysis for the MatCon cover included prequalification mix design and testing, acceptance testing as per MatCon specifications provided with the RDWP, and coring the completed cover and testing cores for saturated hydraulic conductivity. Results are provided in Appendix A. Those on-site test reports that contain results for MatCon testing include an "M" in the filename.

The completed MatCon surface was cored at 12 locations as shown in the photos provided in Appendix D Cored locations were backfilled with MatCon hot mix. Six of the cores were archived as duplicates while six were submitted to Kleinfelder's geotechnical laboratory in Pleasanton, California, for testing for saturated hydraulic conductivity using ASTM D5084 Method C. Results for the first six cores ranged from 1.5E-07 to 3.2E-09 cm/sec. Sidewall leakage was believed responsible for the variability, as evidenced by very low final water content values indicating little or no effective porosity. These low porosity measurements corroborated the very low field void content estimates based on correlation to field densities measured with a nuclear gauge.

Sidewall leakage in permeameter testing of very low permeability asphalt concrete specimens has been previously reported. Bowders et al. (2002) (available at http://www.missouri.edu/~geotech/html/Asphalt%20Barrier%20Papers/ASTM%20GTJ%20Sidewall%20Leakage.pdf) studied sidewall leakage during this type of testing and recommended modifications to ASTM D5084 including coating the sides of the asphalt concrete test cylinders with silicone vacuum grease and increasing the confining pressure. These modifications were used for testing the next six MatCon test cylinders. The sides of the cylinders were coated with silicone vacuum grease and the confining pressure was increased from 3 psi to 10 psi. The tops and bottoms of the cylinders were not coated. The result was no measurable flow through any of the cylinders after 10 days of testing.

Lengths of the four untrimmed test cylinders ranged from 3.5 to 4.1 inches, with an average of 3.8 inches. The hydraulic conductivity of the MatCon cores was apparently below the limits of the ASTM D5084 procedure as performed by the testing laboratory, which has previously measured permeabilities below 1E-09 cm/sec for earthen materials using this method. The requirement that the test pad cores have a saturated hydraulic conductivity less than the value of 1E-08 cm/sec used in numerical modeling to establish RCRA Subtitle C cover equivalence, as described in the RDWP (NWI 2006), was therefore met. The laboratory test report and photos of the test cylinders are provided in Appendix A, "MatCon Ksat testing".

6.2 North and East slope covers

6.2.1 Infiltration layer

Sampling and analysis for the north and east slope covers included prequalification testing of infiltration layer soils and topsoil, acceptance testing as per Specification 02200, and constructing and coring a test pad for the infiltration layer soils and testing the cores for saturated hydraulic conductivity. Results are provided on a disk labeled "Kleinfelder Test Results" in the last section of Appendix A. The test pad results were reported to NMED on 8/31/06 and are discussed below.

6.2.1.1 Background

Portions of the final closure cover for the DOE-LASO TA-73 Airport Landfill include low-permeability soil layers (also called infiltration layer), as shown in RDWP Revision 2 Drawing 2005 and others. In response to comments by NMED in the "Notice of Disapproval for the Remedy Design Work Plan for the Las Alamos Site Office TA-73 Airport Landfill, Revision 1" (NMED 2006), DOE-LASO stated that as-built permeability for the low-permeability soil courses would be determined in a certified geotechnical laboratory on cores collected from test pads and verified against the design requirements. The materials and procedures used to construct the test pad to obtain the required permeability would then be used to construct the infiltration layer material. The design requirement for saturated hydraulic conductivity of the low-permeability soils was 1E-05 cm/sec, based on the value used in numerical modeling described in the RDWP, to demonstrate RCRA Subtitle C Minimum Technology Guidance (MTG) closure cover equivalence.

An infiltration layer soil borrow source was identified and sampled. Standard Proctor curves were determined as reported in Appendix A, Kleinfelder report no. 71610.2 - ALB06TD001_5-26-06_A_S.pdf. Compaction required to achieve the desired permeability was determined as reported in Appendix A, Kleinfelder report no. 71610.2_ALB06TD010_7-31-06_S_A.pdf. 100% of the maximum dry density using Standard Proctor compaction was needed to achieve the required permeability. Maximum dry density is 108.8 pcf and the optimum moisture content is 14.2%.

6.2.1.2 Construction and Testing

An 18-inch thick low-permeability soil test pad was constructed in three lifts on 08/03/06, and core samples were collected and tested to meet the NMED request. Construction and sampling of the test pad were witnessed by Philip Meehan, P.E. (Quality Control System Manager, North Wind, Inc) and

Berg Keshian, P.E. (Engineer of Record, Weston Solutions, Inc.). The test pad was constructed and sampled as follows:

1. A 6-in minimum layer of interim cover material was placed and wetted. The surface of the interim cover material was compacted with a smooth drum vibratory compactor and then scarified by dozer tracking prior to placing infiltration material.

2. The infiltration layer soil stockpile was wetted. An 8 inch loose lift of infiltration material was placed and wetted. The lift was rolled with four passes of the sheep's foot compactor, followed by two additional passes with the smooth drum vibratory compactor.

3. The lift was tested for moisture content and density using a nuclear gauge. Results are reported in Table 1 and compared to maximum dry density and optimum moisture content

4. The next two lifts were placed, compacted and field tested as described for the first.

5. A core sample was obtained from each lift from the completed pad as per ASTM D 2937 "Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method". The overlying material was excavated to access the top surface of the lift, at different locations on the test pad for the 6-11 inch sample and for the 11-16 inch sample. The 1-6 inch sample was obtained from the completed test pad surface, also at a separate location on the test pad.

6. Samples were packaged and transported as per the specification. Samples were tested as per ASTM D 5084 "Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter:"

6.2.1.3 Results and Discussion

Results for each sample are reported in Table 6-1 and the complete laboratory report is provided in Appendix A "Infiltration layer test pad results". Saturated hydraulic conductivity (Ksat) values reported ranged from 3.1E-07 cm/sec to 4.4 E-08 cm/sec. All of these values are at least one order of magnitude below the required value of 1.0E-05 cm/sec.

Note that the 1 to 6 inch sample was reported as remolded by the lab, due to additional handling during preparation required to hold the sample together. This sample showed the highest Ksat of the three samples, at 3.1E-07 cm/sec. These results indicate that compaction of the infiltration layer material to a dry density greater than 109 pcf will ensure Ksat values well below the design criterion.

Table 6-1. Results for infiltration layer soil field density and moisture testing, and laboratory Ksat.

	Field density			
Lift	**Density, pcf**	**Percent of optimum**	**Field moisture, %**	**Ksat, cm/sec**
1-6 inches	119.4	109.7	11.8	3.1E-07
6-11 inches	111.0	102.0	14.2	6.8E-08
11-16 inches	109.0	100.2	15.3	4.4E-08

6.2.2 Topsoil

Sampling and analysis for topsoil included prequalification and acceptance testing as per Specification 02200. Results are provided in Appendix A. Those reports containing results for soil including topsoil include an “S” in the filename.

6.3 Retaining walls

Sampling and testing for the retaining walls included drilling and coring along the alignment of Wall 1 prior to construction, and prequalification and acceptance testing during construction, as discussed below.

6.3.1 Concrete wall

Borings were drilled along the alignment of Wall 1 to determine the depth, competency and bearing strength of the underlying strata. Boring logs, location maps and rock unit descriptions are provided in Appendix A. The borings indicated approximately 10 to 15 feet of waste overlying about 10 feet of soft nonwelded tuff, overlying dense welded tuff. Standard penetration tests and rock quality index were measured and visual observations recorded.

Sampling and analysis for the concrete wall included prequalification testing of the concrete mix design and acceptance testing of concrete received, as per Specification 03300; and prequalification and acceptance of the aggregate subgrade material as per Specification 02200. Results are provided in Appendix A. Those on-site test reports that contain results for concrete testing include a “C” in the filename. Those on-site test reports that contain results for Russells gravel aggregate used for MSE wall subgrade and backfill include an “A” in the filename.

6.3.2 MSE walls

Sampling and analysis for the MSE wall included prequalification and acceptance testing of aggregate, as per Specification 02200. Results are provided in Appendix A. Those on-site test reports that contain results for Russells gravel aggregate used for MSE wall subgrade and backfill include an “A” in the filename.

6.4 DDA cover

Sampling and analysis for the DDA cover included prequalification and acceptance testing of topsoil, as per Specification 02200. Results are provided in Appendix A. Those on-site test reports that contain results for topsoil and other soils include an “S” in the filename.

7. REFERENCES

NMED 2005, "Compliance Order on Consent in the Matter of the United States Department of Energy and the Regents of the University of California, Los Alamos National Laboratory, Los Alamos County, NM, Respondents, Proceeding Under the New Mexico Hazardous Waste Act § 74-4-10 and the New Mexico Solid Waste Act § 74-9-36(D)", March 1, 2005.

"Notice of Disapproval for the Remedy Design Work Plan for the Las Alamos Site Office TA-73 Airport Landfill", NM0890010515, HWB-LANL-05-015, January 4, 2006

NWI 2006, "Remedy Design Work Plan for the Los Alamos Site Office TA-73 Airport Landfill", NW-ID-2004-031, Revision 2, April 2006.

LANL 1998, "RFI Report for Potential Release Sites 73-001 (a, b, c, d), 73-004(d), Airport Landfill Areas", LA-UR-98-3824, Los Alamos National Laboratory, November 1998.

LANL 2002, "Voluntary Corrective Measure Plan for Potential Release Sites 73-001(a)-99 and 73-001 (b)-99", LA-UR-02-4433, Los Alamos National Laboratory, October 2002.

Bowders, John J., Deepak Neupane and J. Erik Loehr, "Sidewall Leakage in Hydraulic Conductivity Testing of Asphalt Concrete Specimens" ASTM *Geotechnical Testing Journal,* June 2002.