

**INTERIM REMEDIAL MEASURE OF A
RADIOLOGICAL AND HAZARDOUS WASTE LANDFILL
UTILIZING A GROUNDWATER DIVERSION BARRIER WALL
AND EXPOSED GEOMEMBRANE COVER SYSTEM**

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1.0 INTRODUCTION

The West Valley Demonstration Project is located on 3,345 acres of land known as the Western New York Nuclear Service Center (WNYNSC), owned by the State of New York. The site is located approximately 40 miles south of Buffalo, New York. The U.S. Department of Energy (DOE) has operational responsibility for approximately 165 acres near the center of the 3,345 acre site.

Historically, the West Valley site was used to reprocess spent nuclear fuel into reusable plutonium and uranium compounds. The site was operated as a nuclear fuel reprocessing center from 1966 to 1972, and radioactive waste was accepted for disposal until 1975. During the operation of the plant, 640 metric tons of spent reactor fuel was processed to recover reusable uranium and plutonium, resulting in 660,000 gallons of highly radioactive liquid waste. The liquid waste was stored in underground tanks. The facility operator also utilized a 15-acre area for the disposal of radioactive waste from commercial waste generators, now known as the State Disposal Area (SDA) under the control of the New York State Energy Research and Development Authority (NYSERDA). Another seven-acre landfill was used to dispose of radioactive waste generated from reprocessing, now known as the Nuclear Regulatory Commission Licensed Disposal Area (NDA) and managed by the DOE.

In 1980 the ownership and responsibility for the waste and facility was transferred to the State of New York. The state initiated talks with the Federal Energy Research and Development Administration to sort out ownership of the waste and environmental remediation responsibility. The West Valley Demonstration Project Act (Public Law 96-368) was signed into law in 1980. The Act directed the DOE to take the lead role in solidifying the liquid high-level waste and decontaminating and decommissioning the facilities at the West Valley site. Although NYSERDA remains as the site owner, the DOE has exclusive use and possession of approximately 200 of the 3,300 acres to complete the requirements of the Act.

In 1992, the U.S. Environmental Protection Agency (USEPA) and the New York State Department of Environmental Conservation (NYSDEC), pursuant to RCRA 3008(h), issued an Administrative Order on Consent, Docket No. II RCRA-3008(h)-92-0202, requiring, among other things, DOE to address mitigation of a potential release of hazardous constituents from the NDA. As an initial interim measure, an interceptor trench was installed on the down gradient side of the NDA, along with a pre-treatment building, to address the potential for organic hazardous constituents from the NDA. To date, there have been no levels of hazardous constituents requiring treatment in the pre-treatment building.

In 2007, the DOE initiated the development of a core team whose purpose was to bring the regulatory stakeholders together to address issues and concerns associated with the development of an Environmental Impact Statement for long-term stewardship at the West Valley site. Consistent with the intent of the core team, DOE volunteered to perform an interim measure under the RCRA 3008(h) at the NDA by installing a cap and groundwater barrier wall at the unit.

Primary goals of the NDA Cap and Groundwater Barrier Wall are to reduce infiltration and transport into the seven-acre radioactive waste burial ground. Two features were designed for the purposes of this interim measure, a groundwater barrier wall consisting of a low permeability soil-bentonite wall on the upgradient side of the burial ground, and a geomembrane cover over the surface of the burial ground.

In 2007, West Valley Environmental Services, LLC (WVES), the prime site contractor, engaged Butler Construction Company of WNY, Inc. (Butler) and McMahon & Mann Consulting Engineers, P.C. (MMCE) to design the groundwater barrier wall and cap for the NDA. This paper describes the design and construction of the NDA barrier wall and cap that were installed in 2008. A similar project was completed for the adjacent SDA (SDA) in 1994-1996 by NYSERDA.

2.0 SITE CONDITIONS

The NDA is nearly rectangular in plan and is about 7 acres. It is located near the south end of the West Valley Demonstration Project site. The West Valley Demonstration Project site is generally flat with ravines to the north and east of the site and hills to the west of the site.

As shown on Figure 1, the NDA is bounded to the north by Erdman Brook, which generally flows from west to east and discharges into Frank's Creek. The SDA is located immediately east of the NDA and a drainage swale separates the NDA from the SDA. Frank's Creek is located to the east of the SDA and generally flows from south to north and discharges into Buttermilk Creek. Both Frank's Creek and Erdman Brook are located in ravines with steep side slopes. Access roads are located along the north, west and south sides of the NDA.

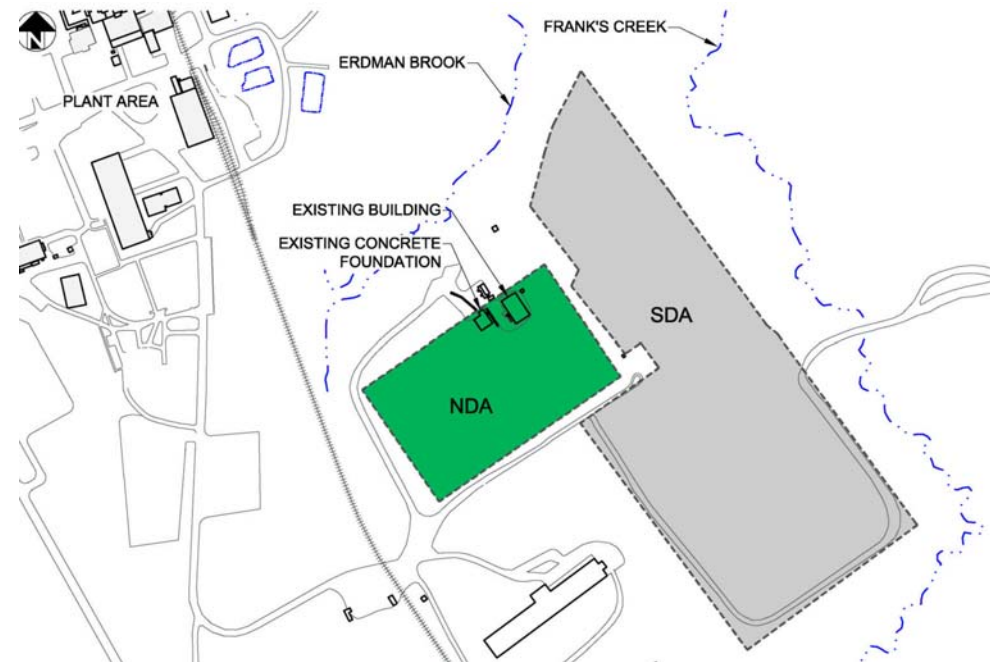


Fig. 1 Site Plan

The NDA has buried wastes that were placed in pits, trenches and special holes (see Figure 2). According to the United States Geological Survey (USGS), (Ref. 1), these pits are about 32 feet deep. Waste is also buried in 230 special holes that are typically 20 feet deep but as much as 50 feet deep.



Fig. 2 Photo of Excavated Disposal Trench

West Valley Nuclear Services Company (WVNSCO), the site prime contractor at the time, installed an interceptor trench as an interim measure under a RCRA 3008(h) Order on Consent along the north and east sides of the NDA to collect groundwater that was potentially seeping through the ground and discharging into Erdman Brook. The interceptor trench consists of pipes buried in drainage stone and connected by manholes. The drainage pipes along the north side slope down from west to east and discharge into manhole 4. The drainage pipes along the east side slope down from south to north and also discharge into manhole 4.

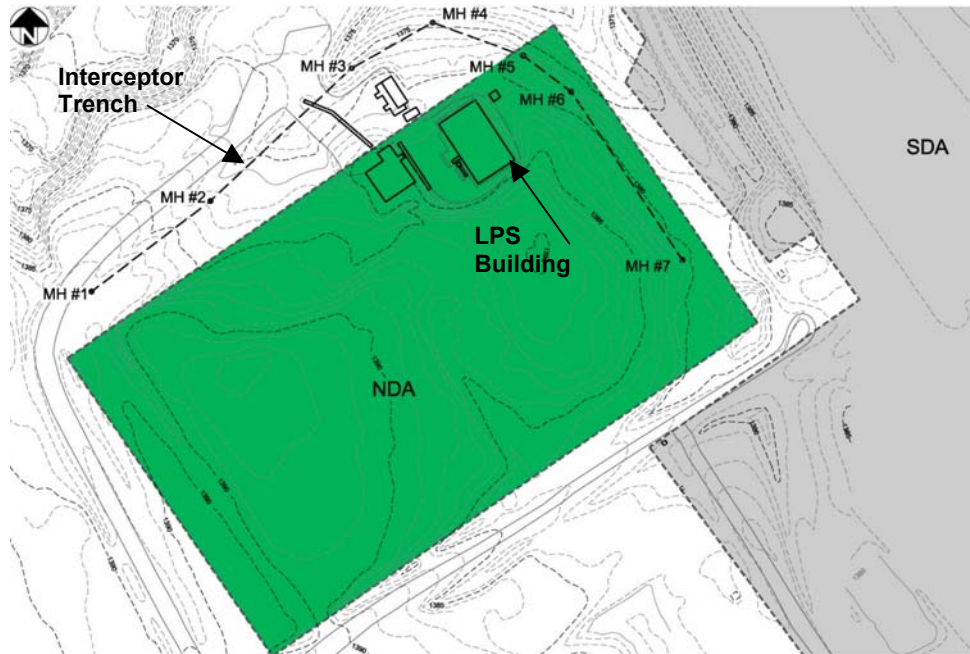


Fig. 3 Site Plan with Interceptor Trench

Manhole 4 is equipped with a pump that conveys the groundwater collected by the interceptor trench to Lagoon 2 if the water does not contain organic contaminants. If the water contains organic contaminants above specified action limits, it is pumped to the treatment building (LPS Building) located in the northeast corner of the NDA.

3.0 SUBSURFACE CONDITIONS

The USGS¹, studied the geology and hydrogeology at the West Valley Demonstration Project site and issued a report summarizing its findings in 1987. Additionally, WVNSCO completed test borings, installed monitoring wells and collected water level measurements. The following summary of the site geologic and geohydrologic conditions is based on the findings from these studies.

3.1 Soil Conditions

Figure 4 is a cross section through the NDA (i.e., the Facility Disposal Area) from the USGS report. The elevations shown on the figure are in meters, therefore the top of rock along the west side of the NDA is about Elevation (Elev.) 1240 feet and on the east side is about Elev. 1125 feet. The ground surface is about Elev. 1390 feet, therefore the overburden ranges from about 150 to 265 feet thick.

¹ Bergeron, M.P., W. M. Kappel and R. M. Yager, "Geohydrologic Conditions at the Nuclear-Fuels Reprocessing Plant and Waste-Management Facilities at the Western New York Nuclear Service Center, Cattaraugus County, New York," U.S. Geological Survey, Ithaca, New York, 1987.

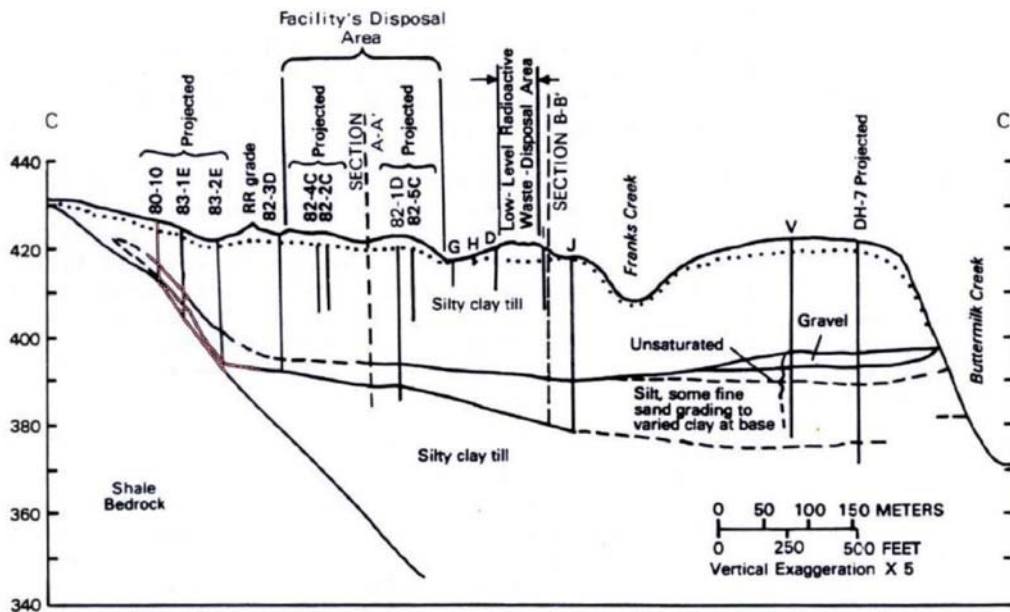


Fig. 4 USGS (1987) Cross Section Through NDA

The primary soil deposit affecting the behavior of the NDA site is the Lavery Till. The Lavery Till covers an underlying fine sand and silt deposit, referred to as the Kent Recessional Sequence. The USGS describes the Lavery Till as mainly silt and clay. The upper portion is weathered and fractured and is the primary seepage path for groundwater transport. The upper weathered portion of the Lavery Till contains intersecting, horizontal and vertical fractures that extend to about 16 feet deep. Measurements of the horizontal permeability of the weathered Lavery Till using variable head tests in monitoring wells range from 1.3×10^{-7} cm/sec (centimeters per second) to 7×10^{-4} cm/sec. Measurements of vertical permeability on thin-walled tube samples in the laboratory range from 2.5×10^{-8} to 1.2×10^{-7} cm/sec. The data suggest that some of the wells in which the permeability was tested encountered some of the more permeable fractures or hydraulic defects because the measured permeability was much greater in the wells than in the laboratory samples.

The unweathered Lavery Till extends to about 75 to 90 feet below the ground surface. Measurements of horizontal permeability using variable head tests in piezometers range from 8×10^{-9} to 1×10^{-7} cm/sec. Vertical permeability measurements on thin-walled tube samples of the unweathered Lavery Till in the laboratory range from 2.1×10^{-8} to 4.3×10^{-8} cm/sec.

The deposit of lacustrine fine sand and silt below the Lavery Till is described as silt with a trace of very fine sand. This deposit is deeper than the NDA trenches and special holes. Measurements of permeability in wells in this zone range from 7×10^{-6} to 1.5×10^{-3} cm/sec.

3.2 Groundwater

Groundwater affecting the NDA and the interceptor trench flows horizontally in the weathered Lavery Till. The majority of the flow through the weathered Lavery Till occurs through fractures (hydraulic defects) in the upper weathered zone. The fractures are likely filled with silt, which is more permeable than the silty clay that makes up the till deposit. Figure 5 is a schematic of groundwater flow in the vicinity of the NDA.

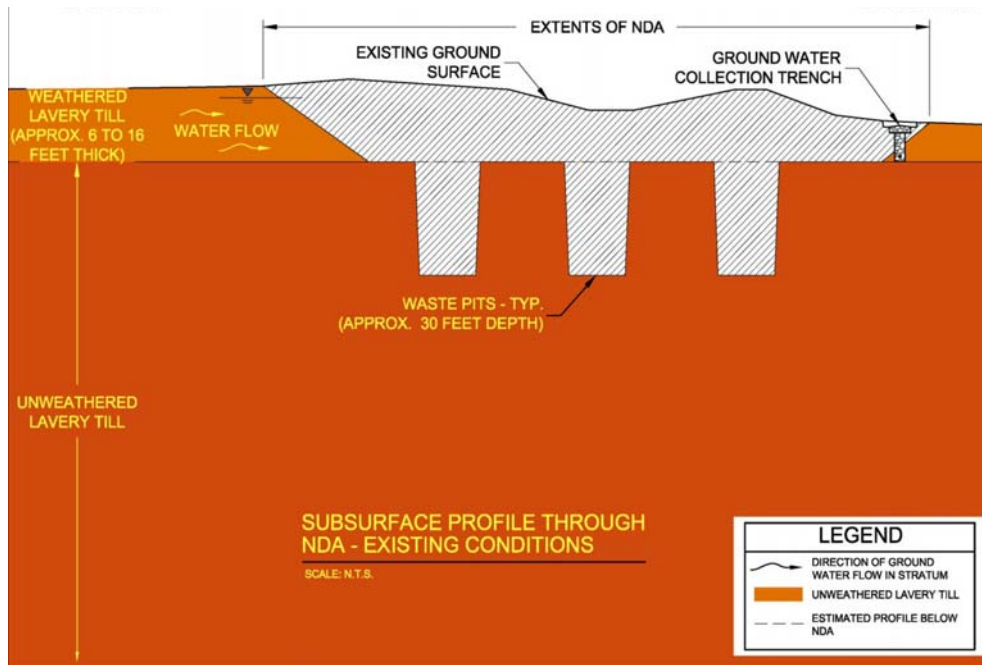
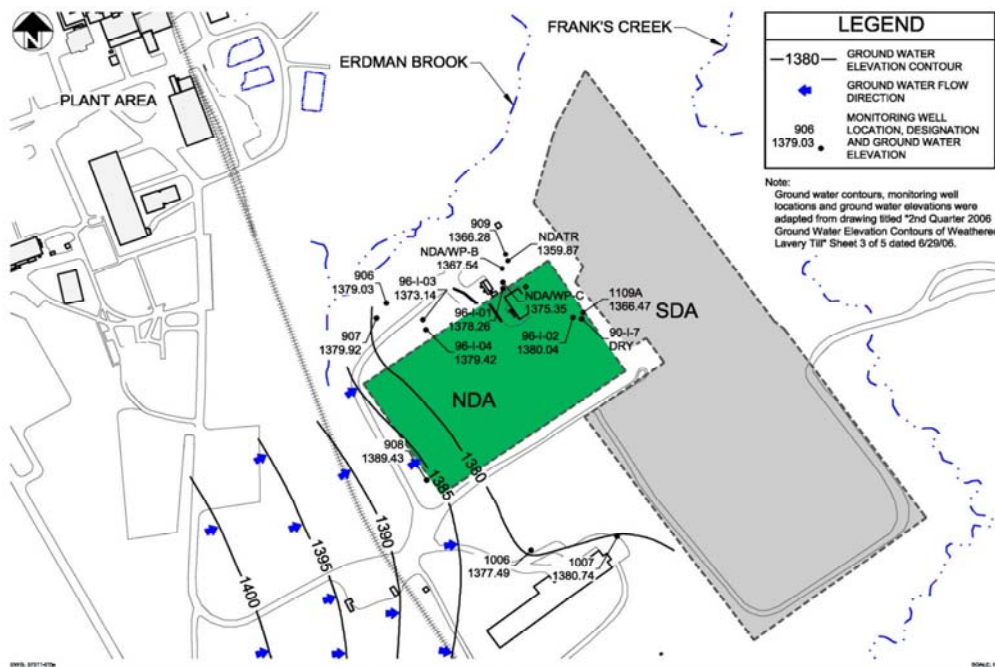


Fig. 5 Schematic of Subsurface Conditions and Groundwater Flow in Vicinity of NDA

The USGS² measured groundwater levels and modeled the conditions around the NDA and SDA disposal areas. The 2006 Annual Report for the SDA³ presents potentiometric maps for the weathered Lavery Till water bearing zone. These maps (see typical plot in Figure 6) show that groundwater flows from west to east in the vicinity of the NDA.



**Figure 6
 Groundwater
 Contours in the
 Vicinity of NDA**

² Bergeron, M.P., "Ground-Water Flow near Two Radioactive-Waste Disposal Areas as the Western New York Nuclear Service, Cattaraugus County, New York – Results of Flow Simulation," U.S. Geological Survey, Albany, New York, 1988.
³ NYSERDA, "State-Licensed Disposal Area (SDA) at West Valley, 2006 Annual Report," March 2007.

Water flow proceeds to the south once entering the parcel located directly south of the NDA, towards Frank's Creek. Groundwater also flows north, towards Erdman Brook beneath the NDA. These groundwater flow patterns are expected, based on the topography surrounding the NDA and the presence of the groundwater cutoff wall which was constructed along the west side of the SDA.

Sources of water to the interceptor trench include groundwater flowing horizontally in the weathered Lavery Till and infiltration that seeps through the NDA soil cover. Figure 7 is a plot of rainfall and groundwater collected in the interceptor trench. As shown on the plot, there is a direct correlation between rainfall and the amount of groundwater collected in the trench. This indicates that the majority of the groundwater collected in the trench is infiltration through the soil cover with comparatively little flow collected from groundwater flow in the Lavery Till.

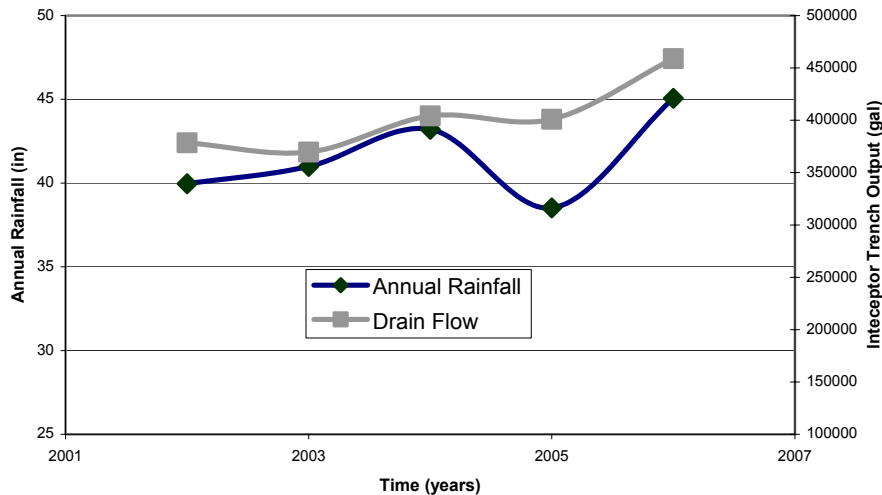


Fig. 7 Rainfall and Interceptor Trench Collection Quantity

4.0 PROJECT OBJECTIVES AND DESIGN CONSIDERATIONS

The project objective in managing the NDA is the reduction of risk to human health, safety and the environment. This is accomplished by minimizing infiltration into the NDA and groundwater transport into or out of the NDA. A groundwater barrier is utilized to limit groundwater flow into the NDA or seepage out of the NDA. The low permeability cap on the NDA surface is designed to reduce the amount of surface infiltration into the NDA and seepage into the interceptor trench. This design approach is the same as that implemented at the SDA in the mid 1990s.

The upgradient barrier wall and cap design criteria include the following:

- The groundwater barrier wall must have a permeability of 1×10^{-7} cm/sec.
 - The barrier must extend into the underlying unweathered Lavery Till deposit.
 - The design storm for the NDA cap, is the 25-year, 24-hour storm event (4.2-inches of rainfall).
 - The post-construction surface discharge must not exceed the pre-construction storm water discharge rate.
 - The storm water drainage design must control erosion and sediment during construction and following construction and must comply with the existing State Pollutant Discharge Elimination System (SPDES) permit.
 - Excavation of the existing soils within the NDA must be avoided, final grades must be established by filling only.
 - The cap must be designed for wind uplift loads.
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4.1 Groundwater Barrier Design Considerations

The groundwater cutoff wall design considered the existing groundwater flow pattern, anticipated changes to groundwater flow and constructability issues. Considering the groundwater maps and the topography surrounding the NDA, groundwater flow is towards Erdman Brook and Frank's Creek. Therefore, the cutoff wall is located upgradient of the NDA, along the west and south sides of the NDA.

Figure 8 is a schematic of the groundwater barrier wall. As shown in Figure 8, the barrier wall is designed with a 5-foot key into the unweathered till to effectively cutoff groundwater flow along the barrier alignment. This is deeper than the typical 2 or 3 foot key to account for variability in the depth to the unweathered till.

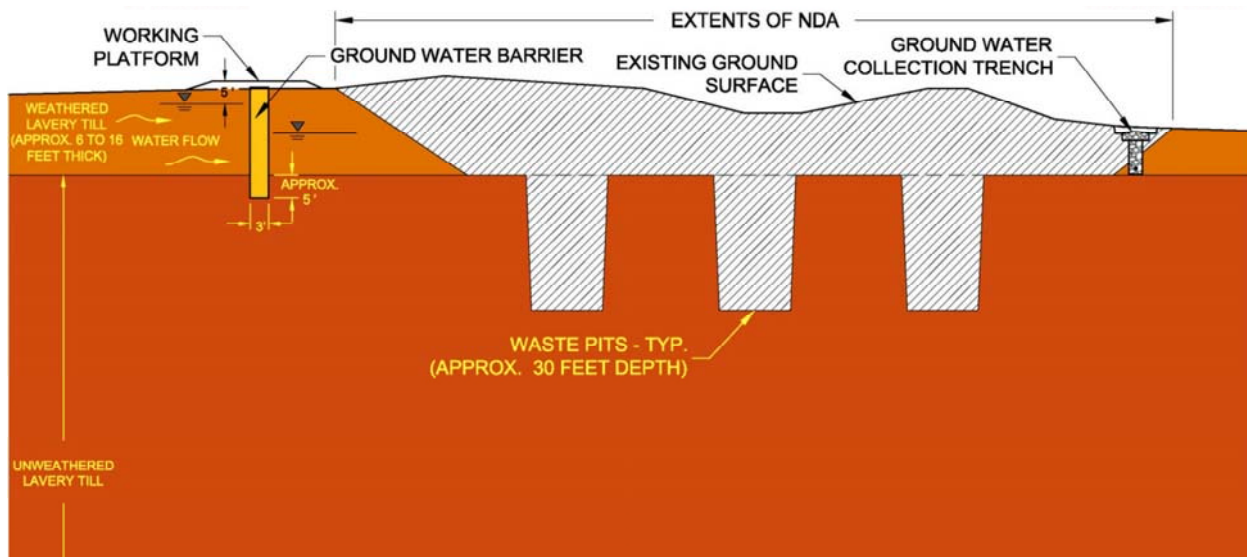


Fig. 8 Schematic of Groundwater Barrier Wall

Soil-bentonite backfill in groundwater cutoff walls typically has a permeability of less than 1×10^{-7} cm/sec, which is lower than other types of cutoff walls constructed using the slurry technique such as cement-bentonite and concrete cutoff walls. Therefore, the barrier wall was designed as a soil-bentonite wall. A soil-bentonite wall remains plastic throughout its life and deforms according to the stresses applied. It is crack resistant, except for the hydraulic fracturing susceptibility described above.

Groundwater monitoring wells along the west side of the NDA show groundwater levels within a few feet of the ground surface. Since the excavated trench derives its stability from the slurry level in the trench remaining several feet above the adjacent groundwater elevation, a working platform along the cutoff wall alignment was included in the design so that the platform surface is at least 5 feet above the adjacent groundwater elevation. The working platform also creates a level surface for excavating the barrier wall.

The design includes a provision for the Contractor to drill test borings 40 feet apart along the alignment of the wall to define the depth to the unweathered Lavery Till. Pairs of piezometers are also included along the barrier wall such that one of each pair is located inside of the wall and the other is located outside of the wall. This allows the gradient across the wall to be estimated and the effect of the wall on surrounding groundwater conditions to be measured over the design life of the barrier wall

4.2 Cap Design Considerations

The purpose of the cap is to limit infiltration of precipitation into the NDA and to direct precipitation to storm water discharge locations. The cap for the NDA consists of, from the existing grade to the final surface of subgrade, embankment fill soils, a geotextile and a geomembrane. The geomembrane will remain exposed. Figure 9 is a schematic cross section of the NDA cap. The concrete pad, pre-cast concrete retaining walls and other temporary structures protruding from the cap in the northeast portion of the NDA need to be removed before constructing the final grades. The LPS Building remains in place and the cap is attached to it.

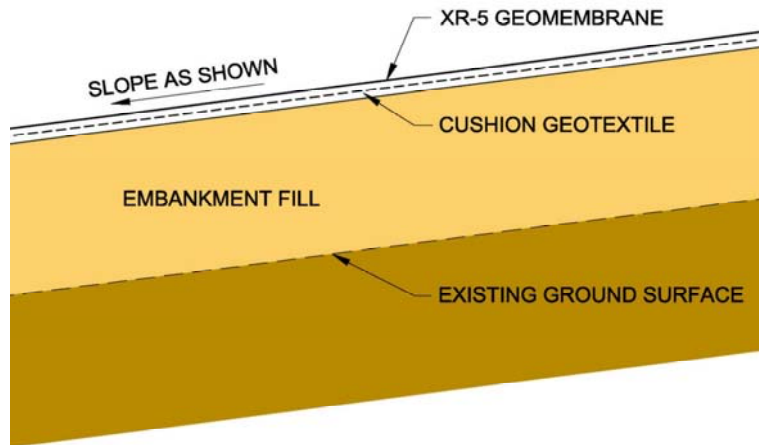


Fig. 9 Schematic of NDA Cap

The NDA cap grading plan includes berms to contain the storm water and three detention basins to store the storm water so it may be released into existing storm water outfalls at controlled rates without exceeding the existing discharge rates for a 25-year, 24-hour storm. Figure 10 shows the storm water flow patterns and the basin locations. The proposed cap slopes at least 1.25 percent, except in the detention pond areas, where the slopes may be less.

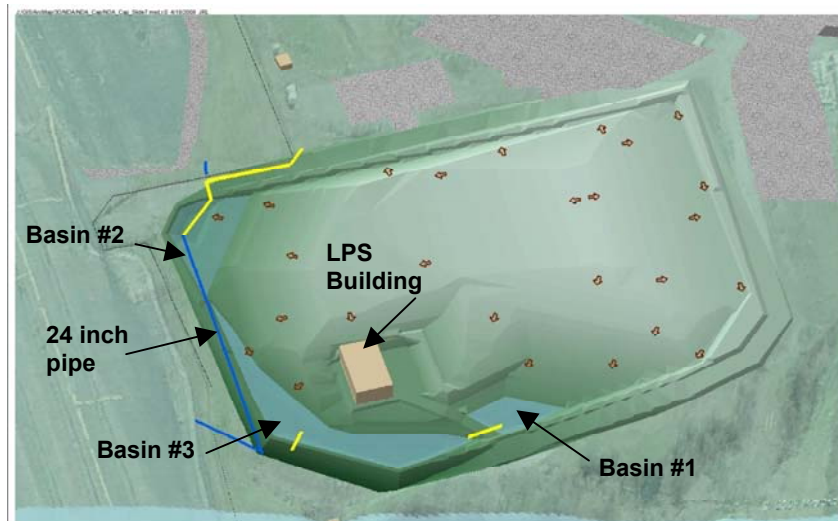


Fig. 10 NDA Cap Drainage and Stormwater Basins

Each of the three storm water basins has a 6-inch thick layer of compacted clay directly beneath the geomembrane (the cushion geotextile is not included in these areas). The purpose of the compacted clay layer is to provide a composite cap in areas where the final grades are flatter than the remainder of the cap. The composite cap helps reduce infiltration in the event that the geomembrane contains defects.

The design includes filling the NDA with suitable embankment materials to create the cap grades. The design requires a cushion geotextile over the entire NDA following construction of the final cap grades, except in the three stormwater basins. The purpose of the geotextile is to protect the overlying geomembrane.

The final surface of the NDA cap is a 30 mil thick Ethylene Interpolymer Alloy geomembrane, XR-5, model 8130, manufactured by Seaman Corporation. Other materials were evaluated during design development however the XR-5 was selected because of its low thermal expansion property, high ultra-violet resistance and high puncture resistance. This material was used to cover part of the SDA and it has performed well.

Sand wedges encased in geomembrane are welded to the geomembrane to resist uplift forces of nine pounds of pressure per square foot, from the wind.

4.3 Effect of Project on SDA

The design criteria include complementing the capped SDA storm water drainage and not compromising the SDA functions.

Groundwater flow patterns were modeled using the ModFlow program to evaluate post construction groundwater conditions. The model was calibrated to existing conditions using available groundwater level measurements, then the barrier wall and cap were added to the model to allow a comparison of pre and post groundwater contours. The results indicate that the groundwater contours south of the NDA remain unchanged after the barrier wall is in place. Therefore, the model predicts that the NDA barrier wall will not have a detrimental effect on the SDA and its barrier wall.

As shown on Figure 10, the surface drainage from the NDA cap flows to three storm water basins located on the cap. The basins and discharge pipes from the basins are sized so that the surface water runoff from the 25-year, 24-hour storm does not exceed the discharge from this event for the existing conditions. The outlets of the basin discharge pipes are protected with rip rap as shown on the design plans. The discharge pipe for Basin #2 is a 24-inch diameter pipe that existed prior to construction and drained a pond that was located in the southeast corner of the NDA.

4.4 Stormwater Pollution Prevention Plan

As part of the Interim Measure, a Storm Water Pollution Prevention Plan (SWPPP) was prepared to address stormwater management during construction of the cap and groundwater barrier wall. Because the project was being performed under the Corrective Action Authority of RCRA, a State Pollutant Discharge Elimination System (SPDES) General Permit for Storm Water Discharges from Construction Activity (GP-0-08-001) was not required. However, a SWPPP was prepared to meet the substantive requirement of the permit and to be consistent with the New York State Standards and Specifications for Erosion and Sediment Control.

At the request of NYSDEC, a courtesy Notice of Intent (NOI) for the General Permit for Stormwater Discharges from Construction Activity (GP-0-08-001) was filed with NYSDEC Division of Water in Albany. Upon NYSDEC concurrence with the SWPPP, the document was incorporated into the Interim RCRA Measure Work Plan that was submitted to NYSDEC for review and approval.

5.0 BARRIER WALL AND CAP CONSTRUCTION

Construction of the NDA Cap and Groundwater Barrier Wall brought together many partners. Entities associated with the design and construction on this project and their respective roles included:

U.S. Department of Energy at West Valley – Project oversight
New York State Energy Research and Development Authority – Site owner
New York State Department of Environmental Conservation – Regulatory oversight
U.S. Nuclear Regulatory Commission – Advisory capacity
West Valley Environmental Services – Prime contractor for design and construction support
URS – Field environmental monitoring, consulting, and oversight
McMahon & Mann Consulting Engineers, P.C. – Design engineer, field geotechnical engineer
Pangea-Group Inc. – Subcontractor for earthwork, construction quality control
E & M Engineers and Surveyors, P.C. – Site survey, construction layout
Geo-Solutions, Inc. – Groundwater barrier wall subcontractor
Lange Containment Services, Inc. – Geomembrane subcontractor
Quality Inspection Services, Inc. – Construction quality assurance – soil testing
TRI Environmental Inc. – Construction quality assurance – geomembrane testing
Geotechnics Inc. – Construction quality assurance – soil testing

5.1 Barrier Wall Construction

The first step in the barrier wall construction was to collect soil samples at approximate 40 foot intervals along the wall alignment. The information from the borings was used to set the wall depth.

Borings were drilled and sampled continuously to define the depth of the weathered till zone. Figure 11 shows the contractor retrieving the soil samples.

Construction of a soil-bentonite groundwater barrier wall is a two step process. The first step involves excavating a trench and filling it with a bentonite-water slurry. The second step is to backfill the slurry trench with a low permeability mixture of soil and bentonite that displaces the slurry.



Fig. 11 Drilling Test Borings

The bentonite slurry is designed to keep soil particles in suspension and to maintain stability of the trench. A certain amount of water from the slurry mix can escape into the surrounding soil walls, but a bentonite filter cake forms on the walls and becomes impermeable. This impermeable layer allows the hydraulic pressure of the slurry to support the trench walls. During construction, it is essential that the slurry level be maintained about 1 foot from the top of the trench to prevent collapse.

The contractor mixed bentonite with water to create the slurry for the trench construction. The initial slurry was required to have a bentonite content of 5 percent. The contractor used a batch plant to mix the slurry (Figure 12) and circulated it into a series of portable tanks (Figure 13). From the tanks the slurry was pumped either to the trench or to the mixing pad for use in the soil-bentonite mix. The slurry was tested several times per day to check its unit weight, viscosity and filtrate loss characteristics.



Fig. 12 Slurry Batch Plant



Fig. 13 Bentonite Superbags and Portable Tanks

The contractor constructed a working platform along the length of the wall to provide a relatively level surface from which to excavate the wall. The working platform also allows the slurry to be several feet above the groundwater level as necessary to maintain stability of the trench during construction. Figure 14 shows the working platform under construction.



Fig. 14 Working Platform Under Construction

Excavation of the slurry trench began in June 2008. The contractor used a Komatsu PC400 excavator to excavate the trench (see Figure 15). Spoil from the excavation was placed in off road dump trucks and hauled to the soil mixing area to be used in the soil-bentonite backfill.

The backfill mix consisted of powdered bentonite, bentonite slurry and soil that was excavated from the trench. The contractor mixed the soil with bentonite slurry on a concrete mixing pad as shown on Figure 16. The resulting trench backfill is a low permeability mixture of soil and bentonite that creates the groundwater barrier. The backfill displaces the bentonite slurry as it is placed.



Fig. 16 Backfill Mixing Operation

Establishing effective stormwater pollution prevention controls was a crucial construction issue and one that evolved as the project progressed. Initial efforts included placing silt fence (backed with straw bales in slope areas), constructing earthen dikes to direct runoff in a controlled path, and water control check dams to slow water and retain silt. During the wall construction period, from mid June and the end of July, 10.5 inches of rain fell, exacerbating stormwater control issues.

The contractor enacted additional methods to deal with the stormwater issues. These included construction of a temporary retention basin to contain sediment laden runoff. The temporary basin outlet structure was modeled after the stone outlet and riprap outlet sediment traps pursuant to New York State Standards and Specifications for Erosion and Sediment Control. This structure was designed to release stormwater from the sediment basin without causing erosion. Monitoring of the controlled release was required to determine when maintenance was necessary to restore stormwater conveyance and sediment deposition capabilities.



Fig. 17 Maintenance to Temporary Basin Outlet Structure



Fig. 15 Slurry Trench Excavation

Bentonite mixed with water will stay in suspension for prolonged periods of time. It will also promote suspension of other soil particles that may be introduced into the slurry. This is an essential property to avoid sedimentation during the excavation of the groundwater barrier wall. This property (i.e., to keep soil in suspension) is at odds with stormwater controls which are designed to clarify turbid runoff. This situation resulted in some challenging stormwater control issues.

In addition to constructing a stable outlet structure, redundant temporary structures were constructed downstream from the outlet to decrease discharge velocities and promote sediment deposition.

As a result of SWPPP training, routine inspections, and diligence of individuals involved in the execution of day-to-day operations, potential impacts from stormwater runoff during construction activities were minimized. Field geotechnical and environmental monitoring personnel frequently identified potential stormwater quality and erosion concerns before they occurred. This enabled maintenance and modifications to erosion and sediment controls to be performed before problems could cause pollution in downstream waterways.



Fig. 18 Barrier Wall Excavation and Backfilling

The 950-foot long wall was constructed in two sections, a southern and a western section. The barrier wall is 3 feet wide, and extends 5 feet into the unweathered Lavery Till. Preconstruction explorations revealed that the unweathered till extends to about 10 to 15 feet below the ground surface, therefore the barrier wall was constructed to a depth of 15 to 20 feet.

Figure 18 shows barrier wall excavation and backfilling and Figure 19 shows the area after wall construction was complete.



Fig. 19 Completed Barrier Wall Area

5.2 Cap Construction

The NDA cap construction began with preparing the surface of the NDA for installation of the geomembrane cap. This involved removing the existing vegetation and proofrolling the area with a 10-ton smooth drum roller. In general the area was suitable for fill placement, however, one depressed area in the soil cover had to be remediated. This area was stabilized by filling it with stone and covering it with a geogrid and finer stone prior to fill placement. Modifications were made to monitoring wells and manholes that would protrude through the cap to accommodate grade changes.

Approximately 23,000 cubic yards of soil were placed to construct the NDA cap grades. In addition to the existing on-site surplus soil piles, approximately 8,000 cy were brought in by ten-wheel dump trucks from a nearby New York State highway project. The soil was screened to remove aggregate that exceeded the maximum size, and sampled to verify it met requirements for moisture content, plasticity, organic content, and compaction.

The geomembrane was fabricated by Lange Containment of Denver, CO. Lange fabricated the 29 panels in August 2008 from 30-mil thick XR-5™ ethylene polymer alloy. The panels were manufactured to fit the features and contours of the NDA. Their irregular length and configuration necessitated a numbered delivery and installation pattern to ensure proper placement of each panel. The first panels began arriving during the first week of September 2008. Prior to panel deployment, a geotextile cushion material was placed over the prepared subgrade to provide a cushion between the soil and geomembrane cap.



Fig. 20 Geomembrane Panel Placement

Geomembrane placement began September 22 and was completed November 8, 2008. Exceptionally wet weather impacted the installation schedule. Rainfall saturated the subgrade soil requiring much of it to be reworked prior to geomembrane placement.

The geomembrane was attached to a concrete pad surrounding the LPS Building. The attachment was made using stainless steel batten plates and anchors.



Fig. 21 Detention Basin No. 3

Three detention basins were constructed along the north side of the NDA to collect and manage stormwater runoff from the covered NDA. The basins were lined with a minimum of 6 inches of clay, immediately beneath the geomembrane, to provide a composite liner in the basins.

An important design consideration for the exposed geomembrane is anchoring it to counteract wind uplift forces. This was accomplished by placing sand over a sacrificial layer of geomembrane and then wrapping the sand in geomembrane as shown in Figure 22.



Fig. 22 Sand Tubes Placed on Geomembrane

Construction of the cap was completed by installing slip resistant walkways on the geomembrane to provide access to manholes and monitoring wells and to protect the geomembrane from abrasion caused by foot traffic.



Fig. 23 Completed Cap With Sand Tubes and Access Walkways

6.0 SUMMARY

In 2007 and 2008 an interim measure was designed and constructed at the NDA to reduce infiltration and groundwater transport into the seven-acre radioactive waste burial ground. Two features were designed for the purposes of this interim measure, a groundwater barrier wall consisting of a low permeability soil-bentonite wall on the upgradient side of the burial ground, and a geomembrane cover over the surface and beyond the burial ground.

A soil-bentonite wall, constructed using the slurry trench method, was selected for the barrier wall because of its low permeability and because it remains plastic throughout its life and is crack resistant. A 3-foot wide soil bentonite wall was constructed to a depth of 15 to 20 feet. This resulted in a wall that extends 5 feet into unweathered Lavery Till, a low permeability aquitard.

Establishing effective stormwater pollution prevention controls was a crucial construction issue and one that evolved as the project progressed. Initial efforts included placing traditional erosion and sediment control devices such as silt fence backed with straw bales and water control check dams to slow water and retain silt. During the wall construction period, from mid June and the end of July, 10.5 inches of rain fell, requiring the contractor to deal with some extreme stormwater control issues.

The contractor enacted additional methods to deal with the stormwater issues including construction of a temporary retention basin to contain sediment laden runoff. The temporary basin outlet structure was modeled after the stone outlet and riprap outlet sediment traps pursuant to New York State Standards and Specifications for Erosion and Sediment Control. As a result of SWPPP training, routine inspections, and diligence of individuals involved in the execution of day-to-day operations, potential impacts from stormwater runoff during construction activities were minimized.

The NDA surface was stabilized and graded to meet the final design grades. The final surface of the NDA cap is a 30 mil thick Ethylene Interpolymer Alloy geomembrane, XR-5, model 8130, manufactured by Seaman Corporation. Other materials were evaluated during design development, however the XR-5 was selected because of its low thermal expansion, high ultra-violet resistance and high puncture resistance. This material was used to cover part of the SDA and it has performed well. The geomembrane was manufactured in 29 panels specifically for the NDA site configuration.

Three detention basins were constructed along the north side of the NDA to collect and manage stormwater runoff from the covered NDA. The basins were lined with a minimum of 6 inches of clay beneath the geomembrane to provide a composite liner beneath the basins.

A similar project was completed for the adjacent SDA in 1994-1996 by NYSERDA. Based on NYSERDA's operating experience with the SDA and the demonstrated effectiveness of the water control barriers in place at the state-owned disposal area, it is expected that the slurry wall and cap will greatly reduce water infiltration into the NDA. Due to the moderately high level of saturation in the till and the slow drainage properties of the clay soil, it is expected that the area will experience a prolonged period of de-watering. It is expected that the barrier wall and cap will eliminate re-charge and effluent volumes are expected to decrease as the soil is dewatered.
