Department of Energy
West Valley Demonstration Project
10282 Rock Springs Road
West Valley, NY 14171-9799

July 5, 2007

Mr. Keith I. McConnell, Deputy Director
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: U.S. Nuclear Regulatory Commission (NRC) Comment on 30% Design for the NRC Licensed Disposal Area (NDA) Cap and Slurry Wall

REFERENCE: Letter RW:2007:0024 (97352), K. I. McConnell to B. C. Bower, "U.S. Nuclear Regulatory Commission Comments on 30% Design for NDA Cap and Slurry Wall," dated May 22, 2007

Dear Mr. McConnell:

The U.S. Department of Energy (DOE) appreciates the NRC's review and comments on the 30% Design of the NDA Cap and Slurry Wall Project. The purpose of this project is to minimize the infiltration of surface water and groundwater into the NDA so that water contact with the buried wastes is minimized and the transport of any contamination through the soil is slowed. The design includes an impermeable geomembrane, slurry barrier wall, surface water detention basins, and appropriate drainage systems.

The NDA is a Resource Conservation and Recovery Act (RCRA) Corrective Action Solid Waste Management Unit. Any modification will also require approval from the New York State Department of Conservation (NYSDEC) Division of Solid and Hazardous Waste under the RCRA 3008(h) Administrative Order on Consent and the Division of Water (for storm water management requirements). As such, all construction work in the NDA will be performed under an NYSDEC approved Interim Measure Work Plan (IMWP).

The planned design life of the proposed NDA cap and barrier slurry wall is 30 years. Periodic inspections and maintenance of the membrane and drainage systems will be performed until such other long term decisions are made. Although the membrane is warranted by the manufacturer for only 10 years with direct exposure to the elements, actual experience with this material under similar conditions on the adjacent State-licensed Disposal Area (SDA) indicates this material should last longer than the 10 years. To the extent that some or all of the membrane may need to be replaced over this 30-year period, it is expected that this work will be addressed in accordance with the RCRA 3008(h) Administrative Order on Consent.

The final design review for the NDA Cap has been completed and the design documents updated with the comments received. Enclosed is a copy of the final design draft report document together with DOE's responses to NRC's comments on the 30% Design Review (Attachments A & B). Please note that DOE and its subcontractors are evaluating the final design based upon NRC's comments on extreme flood scenarios. Upon completion of this evaluation, a technical justification report will be provided to NRC.

If you have any questions regarding these responses, please contact Moira Maloney of my staff at (716) 942-4255.

Sincerely,

Bryan C. Bower, Director
West Valley Demonstration Project

Enclosures:
1. Attachment A: NRC Comments on 30% Design for NDA Surface Water Hydrology and Erosion Protection
2. Attachment B: DOE Responses to NRC Comments on 30% Design for NDA Surface Water Hydrology and Erosion Protection
3. Attachment C: Final Design Package

cc: R. Phaneuf, NYSDEC, Albany, w/enc.
P. Concannon, NYSDEC, Region 9, w/enc.
P. L. Piciulo, NYSERDA, AC-NYS, w/enc.

MNM:97582 - 439

Attachment A

NRC Comments on 30% Design for NDA Surface Water Hydrology and Erosion Protection

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 22, 2007

Recd.- Records
RW:2007:0024
June 25, 2007

Bryan C. Bower
U.S. Department of Energy
West Valley Demonstration Project
10282 Rock Springs Road
West Valley, NY 14171-9799

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION COMMENTS ON 30% DESIGN FOR NDA CAP AND SLURRY WALL

Dear Mr. Bower:

The U.S. Nuclear Regulatory Commission has reviewed the U.S. Department of Energy 30% design for the NRC-licensed Disposal Area cap and slurry wall, and is submitting the attached comments.

If you have any questions regarding the attached comments, please contact Chad Glenn of my staff at (301) 415-6722.

Sincerely,

for

Keith I. McConnell, Deputy Director
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Enclosure: Comments on Design

cc: G. Baker, NYSDOH
P. Giardina, US EPA
S. Hammond, NYSDEC
M. John, Seneca Nation of Indians
P. Piciulo, NYSERDA
B. Youngberg, NYSDEC

WEST VALLEY

NRC COMMENTS ON 30% DESIGN FOR NDA

SURFACE WATER HYDROLOGY AND EROSION PROTECTION

1. **Selection of Design Flood**: The US Nuclear Regulatory Commission (NRC) staff notes that the NRC Licensed Disposal Areas (NDA) cover has been designed for the 25-year, 24-hour rainfall event. However, the staff considers that this design approach may not be adequately protective of public health and safety, because it is not unlikely that a larger flood could occur and cause significant damage to the proposed design. It should be recognized that the 25-year flood has about a 70% probability of being equaled or exceeded during the 30-year interim stabilization period. If a lesser probability of occurrence, such as 5%, is selected, the design flood would have a probability of occurrence of about once in 600 years. Similarly, if a 10% probability of occurrence in 30 years (90% probability of non-occurrence) is used, the design flood would be a 300-year flood.

In its regulation of nuclear facilities, the NRC has generally required that licensees either design those facilities for very large flood events or show that erosion from such floods would not result in release of regulated materials. This practice has been applied in the recent past at sites such as uranium mill tailings facilities, and the NRC staff has developed guidance on the selection of design floods for such facilities. For a wide range of design conditions and risk considerations, NUREG-1623, "Design of Erosion Protection for Long-Term Stabilization" (available on the NRC website), provides the rationale and guidance for the selection of design floods.

The staff recommends that the US Department of Energy (DOE) follow the general guidance given in NUREG-1623 and that DOE select a design flood that has a relatively low probability of occurrence. As suggested in NUREG-1623, the design flood could be about ½ of the Probable Maximum Flood (PMF), which corresponds approximately to a 200-500 year flood (which would have a 5-10% probability of occurrence in the 30-year stabilization period). Due to the lack of historic data for very small drainage areas, such as those present at the West Valley site, runoff from ½ of the Probable Maximum Precipitation (PMP) is recommended. For information purposes, ½ of the 5-minute PMP for Buffalo, New York is estimated by the NRC staff to be about 3 inches. This estimate of 3 inches in 5 minutes is inconsistent with the proposed 25-year, 24-hour value of 4 inches in 24 hours.

We recognize: (1) that the design will provide only interim stabilization; (2) that the design intent is not to provide engineering measures that are elaborate and costly; and, (3) that the design should not convey a sense of permanence. Therefore, as an alternate measure, DOE could demonstrate that the design, as currently proposed, is capable of withstanding a much larger rainfall event (such as ½ of the PMP), even though it is actually designed only for the smaller event (25-year event). The NRC staff could concur in the latter course of action. See Comment 3, below.

2. **Design Questions and Comments**: The staff recognizes that the design is only conceptual and that many analyses have not yet been done. It is not clear how much additional information DOE intends to provide in future reports, but the NRC staff has several questions and comments related to how various design factors were considered.

a. Rainfall Intensity and Peak Flows: It is not clear how peak discharges were determined. For all aspects of the design where rainfall intensity and peak discharge are factors, DOE should discuss the basis for computation of the rainfall intensity. For

example, if the time of concentration for a specific design feature (such as a swale) was computed to be 5 minutes, DOE should provide information related to the 25-year, 5-minute rainfall and the basis for computation of flow rates and times of concentration (recognizing that they will be very short over the sloping smooth liner).

b. Berms: It is not clear if the berms have sufficient capacity to safely store and pass the design flood. Also, it is not clear if the berms are sufficient to prevent flood runoff from upstream drainage areas from overtopping the berms and flowing onto the lined cap area. More information, such as water surface profiles and peak discharges, should be developed to assess the adequacy of the diversion berms.

c. Liner: It is not clear that the liner, especially the field seams, is capable of withstanding the flow velocities in the swales along the outer edges of the liner. We note that the swales have slopes as great as 4.1%. Such slopes are considered to be hydraulically steep and are capable of producing very high velocities on the smooth liner. Additional information is needed to show that the flow velocities are not excessive.

d Effects on State Licenced Disposal Area (SDA): It is not clear if the new NDA design will have any adverse effects on the SDA. DOE should assess the effects of flooding and flow velocities at the NDA and how the NDA design could potentially affect the SDA.

3. **Recommendations:** If DOE chooses to provide an analyses to show that the design will not be adversely affected by floods larger than the chosen design flood, additional information and analyses should be developed to document the conclusions. These analyses should include detailed information related to the various design factors discussed in Comment 2, above. The information should show: (1) how the facilities were designed for the 25-year flood; and, (2) how the design is capable of providing adequate protection for larger floods.

The NRC staff believes that relatively simple measures can be provided that will protect the NDA from erosion during the occurrence of a large flood event, such as the ½ of the PMF. The staff recommends that DOE consider using several simple measures to prevent erosion.

a. Assuming that the berms at the retention basins will be overtopped by the large flood, DOE could provide overflow spillways and aprons constructed with large rock to prevent erosion by the overtopping flows. All of the basins appear to be vulnerable. The capacity of the discharge pipes could also be increased to prevent overtopping.

b. Assuming that the diversion berms (which appear to be only a few feet high) will be overtopped from flows outside the NDA, the berms could be raised several feet. Water surface profiles and velocity estimates may be needed to confirm the adequacy of the berm and the capacity of the drainage swales, both inside and outside the lined area.

c. Based on the need for recent placement of rock in eroded problem areas near the NDA, rock erosion protection is probably needed in those areas where flows will concentrate or where flow velocities may be excessive. Specifically, rock will likely be needed on steeper slopes (and the toes of those slopes) and in the area of the NDA near to Erdman Brook. For example, rock spillways could be used to minimize erosion potential if the retention basins were to be overtopped by large floods. Also, rock could be used to further stabilize specific areas of erosion (such as existing nickpoints, gullies, or eroding slopes).

4. **General Comment on Future Actions:** The NRC staff may have further comments on the NDA design after discussions with DOE and further review of additional information. In addition, the staff would like to make future recommendations regarding performance monitoring after a final design has been selected. The purpose of the performance monitoring would be to develop additional information during the 30-year interim stabilization period, in keeping with stated goals to collect more information and to improve erosion models. In addition, careful site monitoring during this period may result in design changes necessary to mitigate specific erosion problems.

Attachment B

DOE Responses to NRC Comments on 30% Design for NDA
Surface Water Hydrology and Erosion Protection

Comment 1: Selection of Design Flood

Response: The 25-year, 24-hour rainfall event using a 4.2 inch storm event was selected as the design criterion due to a number of factors:

- This criterion was used as the design basis for capping the State-licensed Disposal Area (SDA) immediately adjacent to the NDA with the identical XR-5 geomembrane and steeper slopes than planned for the NDA.
- The basis for the storm water design is from the New York State Codes of Rules and Regulations, 6 NYCRR 373-3.14(j) , "Interim Status Standards for Hazardous Waste Management Facilities, Landfills, Design and Operating Requirements, which identify the design and operating requirements as a 25-year, 24-hour storm.
- Criteria are also called out in the Project's State Pollutant Discharge Elimination System (SPDES) permit with the New York State Department of Conservation, Division of Water identifying the storm water activities related to construction activities to follow the requirement outlined in the "General Permit for Construction Activity – Permit No. GP-02-01.
- The Safety Analysis Report (SAR) for Waste Processing and Support Activities, WVNS-SAR-001, Revision 10 (current), has analyzed the site for a 24-hour probable maximum precipitation (PMP) event with a total precipitation of 24.9 inches with the consequences being flooding and erosion. The SAR indicates that the NDA and SDA will be above the 100-year floodwater elevation and such a flood will not impact any safety-related facilities but would be expected to erode the banks of the NDA and SDA including resulting gully head advancement. The SAR goes on to state that it is not necessary to provide flood protection measures anywhere on site.

The NDA will continue to be monitored during the proposed 30-year period and any erosion detrimental to the potential integrity of the NDA will be addressed. The Storm Water Pollution Prevention Plan (SWPPP), required by New York State Division of Water and included in the RCRA Interim Measure Work Plan, specifies the requirement to incorporate erosion and pollution prevention controls in the design. Also, as required by the NRC license, all waste has been buried with at least a 4-foot earthen cover. Due to the existence of this earthen cap, the application of NUREG-1623 is viewed as overly conservative.

DOE and its subcontractor agree to demonstrate that the final design is capable of withstanding the NRC-proposed one half of the 5-minute PMP or 3 inches of precipitation. The scope of work for this engineering analysis has been completed and is currently being prepared by the subcontracted design firm. DOE will provide the NRC with the final report when it is available, currently expected by July 31, 2007.

Comment 2: Design Questions and Comments

Response: Rainfall Intensity and Peak Flows: The completed Storm Water Pollution Protection Plan (SWPPP) addresses how peak discharges are computed from the rainfall intensity.

Berms: The SWPPP documents that the volume of the three detention basins is adequate for the 25-year, 24-hour storm event or 4.3 inches of rainwater. As outlined in the response to Comment 1, DOE will provide a supplemental report that will address the adequacy of the existing design to withstand the NRC-proposed ½ of the 5-minute PMP or 3 inches of precipitation. DOE will provide the NRC with the final report when it is available, currently expected by July 31, 2007.

Liner: The membrane covered slopes of the NDA are not as steep as some slopes of the adjacent SDA, which is covered with the same XR-5 geomembrane; and there have been no reported issues with the membrane or seams in the areas of the steeper slopes over the initial 12 years of service. Whenever possible, geomembrane seams will be aligned with the direction of surface water flow to minimize potential damage from high velocity storm water flow. DOE and its contractor will discuss the concern and impacts of high surface water velocities on the XR-5 geomembrane, including its factory and field welded seams, and provide a summary to the NRC at the same time that the supplemental storm water report described above is provided.

Effects on State Licensed Disposal Area (SDA): The completed design has been modeled and indicates no significant impact to the adjacent SDA. This is documented in the final design report and an ongoing supplemental report specifically addressing the modeling that was performed. This supplemental report will be provided to the NRC with the above deliverables.

Comment 3: Recommendations

Response: As mentioned in the response to Comment 1, DOE and its contractor agree to demonstrate that the final design is capable of withstanding the NRC-proposed ½ of the 5-minute PMP or 3 inches of precipitation. DOE will provide the NRC with the final report when it is available, currently expected by July 31, 2007. The report will show how the facilities were designed for the 25-year flood and how the design is capable of providing adequate protection for larger floods.

In addition and in response to the NRC's stated comments, the detention basin overflow drainage pipes were incorporated into the design in lieu of the recommended spillways. Rip rap is incorporated into the final design prevent erosion at the detention basin discharge pipes and specifically in the gully leading to Erdman Brook. As stated in WVNS-SAR-001, Revision 10, the presence of the deep gullies around the NDA and SDA formed by Erdman Brook and Frank's Creek drain flood waters quickly away from the two disposal units and

documents that both units are not in the 100-year flood plain. In addition, the final design incorporates drainage lines in the geomembrane anchor trench to divert surface water around the planned NDA bermed perimeter. Therefore, the need for high berms around the NDA is unnecessary.

Comment 4: General Comment on Future Actions

Response: DOE agrees with the need and desire for performance monitoring over the proposed 30-year design life. To facilitate this, this design incorporates:

- A series of groundwater monitoring wells upgradient and downgradient along the barrier slurry wall
- The ability to continue to monitor existing groundwater wells within the NDA, some of which are in the actual burial excavations
- The continued monitoring of the existing Interceptor Trench that is downgradient of the NDA along the northern and eastern edges

The RCRA Interim Measure Work Plan provides for an environmental monitoring plan that will be implemented to address:

- Landfill leachate elevation monitoring
- Groundwater elevation monitoring
- Groundwater sampling and analysis
- Surface water sampling and analysis
- Storm water sampling and analysis
- Gamma radiation monitoring
- Ground surface elevation
- Annual integrity certifications for the exposed geomembrane

In addition to the above, the NDA will be monitored for ongoing erosion - specifically in the gully leading to Erdman Brook. Appropriate actions will be taken to mitigate erosion that has the potential to impact the NDA cap, barrier slurry wall, and the release of sediment to Erdman Brook.

Attachment C

Final Design Package

NDA Cap Design

June 2007

NDA Cap Design

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Prepared By
West Valley Nuclear Services
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West Valley NY 14075-0191

FINAL DESIGN REPORT Rev. 0

WEST VALLEY NUCLEAR SERVICES
NDA CAP AND
GROUNDWATER BARRIER INTERIM MEASURE

JUNE 2007

Prepared for:

West Valley Nuclear Services Co., Inc.
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WEST VALLEY NUCLEAR SERVICES
NDA CAP AND
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FINAL DESIGN REPORT
WEST VALLEY NUCLEAR SERVICES
NDA CAP AND
GROUNDWATER BARRIER INTERIM MEASURE

1.0 INTRODUCTION

West Valley Nuclear Services Company (WVNSCO) has engaged Butler Construction Company of WNY, Inc. (Butler) and McMahon & Mann Consulting Engineers, P.C. (MMCE) to design a groundwater cutoff wall and a cap for the Nuclear Regulatory Commission Licensed Disposal Area (NDA) at the West Valley Demonstration Project in West Valley, New York. Figure 1 shows the site location.

This report and its appendices represent the project's final design stage.

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, but the ground surface rises to the west of the site. Several brooks and creeks flow across the site from west to east towards Frank's Creek and Buttermilk Creek located to the east. Figure 2 is a site plan.

The NDA is bounded to the north by Erdman Brook, which generally flows from west to east and discharges into Frank's Creek. The State Disposal Area (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. 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.

The ground surface on the NDA has two mounds, which are higher than the elevation of the access roads along the north, west and south sides. Therefore, the potential for surface water is to flow off the surface of the NDA towards the access roads and drainage swale along the east side and Erdman Brook on the north.

The NDA has buried wastes that were placed in pits, trenches and special holes. According to the United States Geological Survey (USGS), (Ref. 1), these pits are about 32 feet deep. The WVNSCO base map (Drawing 900E-4974) shows the trench depths ranging from 15 to 32 feet deep. However, Hole 48 is at least 50 feet deep. Waste is buried in 230 special holes that are typically 20 feet deep.

WVNSCO 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 trenches consist 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 (refer to WVNSCO Dwg. No. 913-D.0022). The drainage pipes along the east side slope down from south to north and also discharge into manhole 4. 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 located in the northeast corner of the NDA.

3.0 SUBSURFACE CONDITIONS

The USGS, (Ref. 1) studied the geology and hydrogeology at the West Valley Demonstration Project site and issued a report summarizing its findings in 1987. Additionally, WVNSCO has completed test borings, installed monitoring wells and collected water level measurements in those wells since their installation. We compiled the information published by the USGS (Ref. 1) and the data provided by WVNSCO to develop the following summary of the site geologic and geohydrologic conditions.

3.1 Soil Conditions

The USGS report (Ref. 1) contains figures showing the top of rock elevation beneath the NDA. That elevation decreases from west to east. The top of rock along the west side is about Elevation (Elev.) 1240 and about Elev. 1125 on the east side of the NDA. The ground surface in this area is about Elev. 1390, suggesting that overburden ranges from about 150 to 265 feet thick.

The USGS and WVNSCO have described the soil conditions in borings surrounding the NDA. The primary soil deposit affecting the behavior of the NDA site is the Lavery Till. This deposit 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. The fractures are the primary seepage path for groundwater, which the USGS refers to as a secondary porosity for groundwater transport.

Weathered Lavery Till

WVNSCO has drilled test borings and installed groundwater monitoring wells surrounding the NDA and has reported the thickness of the weathered Lavery Till as ranging from 6.4 to 16 feet thick. These measurements agree with the 10 to 13-foot thickness reported by USGS.

The USGS (Ref. 2) describes the uppermost till as being weathered and containing intersecting, oxidized horizontal and vertical fractures and root tubes. This condition extends to 13 feet deep, based on observations in boreholes and excavations. The number of fractures and the fracture width decrease with depth.

WVNSCO measured the horizontal permeability of the weathered Lavery Till using variable head tests in monitoring wells. The horizontal permeability ranges from 1.3×10^{-7} cm/sec (centimeters per second) to 7×10^{-4} cm/sec.

The USGS measured the vertical permeability using thin-walled tube samples in the laboratory. The vertical permeability data 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 (referred to as secondary porosity by the USGS) because the measured permeability was much greater in the wells than in the laboratory samples.

Unweathered Lavery Till

The unweathered Lavery Till extends to about 75 to 90 feet below the ground surface according to the USGS. Borings made by WVNSCO show the bottom of the till at 80 feet below the ground surface in boring 901 (El. 1310) and 65 feet in boring 902 (El. 1323) near the NDA.

The USGS measured the vertical permeability of thin-walled tube samples of the unweathered Lavery Till in the laboratory and reports the permeability of five samples ranging from 2.1×10^{-8} to 4.3×10^{-8} cm/sec. The USGS also measured the horizontal permeability using variable head tests in piezometers. The measurements range from 8×10^{-9} to 1×10^{-7} cm/sec.

Lacustrine Sand Silt

A deposit of lacustrine fine sand and silt, referred to as the Kent Recessional Sequence, lies below the Lavery Till. Some of the USGS wells and some of the WVNSCO wells extend into this deposit. The WVNSCO borings describe this soil as a silt with a trace of very fine sand. This deposit is deeper than the NDA trenches, deep holes and special holes. The USGS reports do not indicate that any permeability measurements were made in the Kent Recessional Sequence or on samples collected from this deposit. However, WVNSCO has measured the horizontal permeability in several wells and reports a permeability ranging from 7×10^{-6} to 1.5×10^{-3} cm/sec.

3.2 Groundwater

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

The USGS measured groundwater levels, modeled the conditions around the disposal areas and reported the results of the model in Ref. 2. This report shows groundwater levels following the topography. Therefore, since the ground surface in the NDA is higher than the adjacent ground surface, water flows out of the NDA (i.e., a groundwater mound exists in the NDA). Groundwater discharges into the interceptor trenches on the north and east sides, but the potential exists for groundwater to flow from the NDA along the south and west sides.

WVNSCO has prepared quarterly groundwater potentiometric maps for water in the weathered Lavery till deposit (Ref. 3). These maps show a horizontal gradient such that groundwater flows from west to east in the vicinity of the NDA.

The 2006 Annual Report for the SDA (Ref. 4) also presents potentiometric maps for the weathered Lavery Till water bearing zone. These maps show groundwater flowing from the west towards the NDA. 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.

The USGS reports (Ref. 1 and 2) show a vertical downward gradient in the unweathered Lavery Till, indicating a potential for groundwater to seep downward towards the Kent Recessional Sequence, although at a slow rate due to the low permeability of the unweathered till. This latter flow does not directly affect the NDA interceptor trench. Figure 3 depicts a groundwater flow in the weathered Lavery Till near the NDA from southwest to northeast.

MMCE has used the ModFlow groundwater program to model groundwater flow patterns around the NDA and to model the flow conditions following construction of the cap and groundwater barrier wall.

3.3 Groundwater Model

MMCE completed a groundwater flow model (using ModFlow) to evaluate the effect of constructing the barrier wall and geomembrane cover on the groundwater levels within and adjacent to the NDA. The model results provide an estimate of the flow of groundwater to the interceptor trench from upgradient of the NDA, and due to infiltration within the NDA. The results also provide an estimate of the long-term steady state groundwater levels and flow to the drain after construction of the NDA cap and barrier wall.

The following sections describe a previous groundwater model completed by the USGS in the vicinity of the NDA, calibration of the current model and estimates of future performance.

Previous Model

The USGS (Reference 2) evaluated groundwater flow within the till in the vicinity of the facility disposal area (i.e., the NDA). The USGS used a two-dimensional finite element model to evaluate groundwater flow conditions for two vertical cross sections. The first is an west-east trending section extending from the railroad through the NDA to Frank's Creek. The second section is a south-north trending section from the NDA north to Erdman Brook.

To calibrate their model, the USGS varied the recharge and the till's hydraulic conductivity until the model results were in relative agreement with observed groundwater levels. The calibration provides an indication of the area recharge conditions, and the hydraulic conductivity of the weathered and unweathered till. The USGS model results indicate relatively low hydraulic conductivity for the till units and corresponding relatively low lateral groundwater flow through the weathered till zone.

Methodology and Calibration

MMCE modeled groundwater conditions using ModFlow which was developed at theUniversity of Waterloo, and uses a finite difference technique to solve for unknown heads within the model domain. MMCE developed the site model considering existing geologic data, the site topography, drainage features and rainfall and recharge. Details of the modeling and a description for this program are in Appendix A.

The modeled area extends east from about midway between Rock Springs Road and the railroad embankment, north to Erdman Brook, and south and east to Frank's Creek, covering approximately 50 acres of land. The topography of the modeled area was input into ModFlow .

The weathered till zone was considered to be 16 feet thick and modeled with three layers of elements. The unweathered till at the bottom of the three layers was considered as an impermeable boundary.

Other features added to the model include the barrier wall west of the SDA and the interceptor trench along the north and east sides of the NDA. The SDA barrier wall was simulated by assigning a thickness of 2.5 feet and a hydraulic conductivity of $1x10^{-7}$ centimeters per second (cm/sec) along the alignment of the wall. The drain was simulated by assigning a conductance of approximately 25,000 ft^2/sec and elevations corresponding to the invert along the alignment of the NDA interceptor trench

The initial step in the modeling process was to calibrate the groundwater model so that model predictions agree with observations at the site. MMCE varied the soil hydraulic properties and infiltration until the model predicted groundwater contours and drain flow measurements similar to those that were observed.

The model calibration resulted in a hydraulic conductivity of $1x10^{-5}$ to $1x10^{-4}$ cm/sec and a recharge rate between 0.5 and 3 inches per year depending on location in the study area. This combination of parameters resulted in reasonable agreement between predicted and measured groundwater levels and flow in the interceptor trench . For this condition the flow in the interceptor trench was estimated to be 421,333 gallons per year.

The recharge rates used in the MODFLOW model are similar to the rates used in the USGS study. However, as indicated in Appendix A, the hydraulic conductivity of the weathered till zone is higher than that used in the USGS study. This could be due to the differences in the model configuration (3 dimensional compared with the USGS 2 dimensional model) or differences in the boundary conditions.

Results

Once the model was calibrated, the effect of the barrier wall along the west and south sides was considered by assigning a thickness of 3 feet and a hydraulic conductivity of $1x10^{-7}$ cm/sec along the planned alignment for the NDA barrier wall. Additionally we modeled the geomembrane by reducing the recharge in the NDA area to zero.

The model predicts no change in the groundwater levels west or south of the NDA due to installation of the barrier wall. The groundwater flow in these areas is toward existing drainage features. The model predicts a long-term flow to the interceptor trench of approximately 58,000 gallons per year; primarily from the area between the north side of the NDA and Erdman Brook.

4.0 PROJECT OBJECTIVES

The project objective is the reduction of risk to human health, safety and the environment. A reduction of groundwater flow into the interceptor trench is a benefit of the actions.

Construction of an upgradient groundwater barrier (refer to Figure 4) will divert groundwater infiltrating into the NDA or seepage out of the NDA if an outward gradient exists. Construction of

a low permeability cap on the NDA surface would reduce the amount of surface infiltration into the NDA and seeping into the interceptor trench.

A similar project was undertaken at the SDA facility several years ago.

5.0 DESIGN CRITERIA

WVNSCO has issued design criteria for the groundwater barrier and the cap. Appendix B includes the WVNSCO "Summary Design Criteria."

The design storm for the NDA cap, as requested by WVNSCO, is the 25-year, 24-hour storm event using a 4.2-inch storm event. 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.

The groundwater barrier wall must have a permeability of 1×10^{-7} cm/sec or less with a design life of 10 years. The barrier must extend into the underlying unweathered Lavery Till deposit. The geologic information along the barrier alignment must be identified with test borings before excavation for the barrier wall.

Design of the groundwater barrier requires an understanding of the geologic environment at the site and the site hydrogeology.

6.0 GROUNDWATER BARRIER DESIGN CONSIDERATIONS

The groundwater cutoff wall design must consider the existing groundwater flow pattern, anticipated changes to groundwater flow and constructability issues. The intent of the groundwater cutoff wall is to reduce the lateral groundwater flow through the weathered Lavery Till deposit into the interceptor trenches and to limit infiltration into the NDA area.

6.1 Barrier Location and Dimensions

Based on potentiometric groundwater maps and the topography surrounding the NDA, groundwater flow outside the influence of the NDA is expected to be towards Erdman Brook and Frank's Creek. Therefore, the cutoff wall should be located upgradient of the NDA, along the west and south sides of the NDA.

Permeability tests in boreholes or piezometers constructed in fractured media can provide misleading data because these tests consider that the groundwater flow is uniform. In fact, the groundwater in these deposits flows primarily through the fractures and secondarily through the soil mass. The resulting permeability calculation depends on the number of fractures that the borehole may have intersected. If the fractures are vertical, a wide range of permeability data can result that may not represent the actual subsurface conditions.

The USGS describes the unweathered Lavery Till as a massive soil deposit, without the fractures present in the weathered Lavery Till. Therefore, the groundwater cutoff wall should be keyed into the unweathered Lavery Till to cutoff flow in the weathered Lavery Till. We recommend a 5-foot key into the unweathered till to effectively cutoff groundwater flow along the barrier alignment for the following reasons:

1. Available test boring data show that the interface between the weathered Lavery Till and the unweathered Lavery Till is irregular and additional test borings planned along the barrier wall alignment will not likely identify all of these irregularities.

2. Construction imperfections often occur at the base of a soil-bentonite barrier wall and the key into the confining layer (unweathered Lavery Till) must contain the imperfections so that they do not affect the barrier wall performance.

3. The physical appearance of the weathered and unweathered Lavery till is similar and it is considered impractical to identify the interface between the two deposits by observing spoil from the barrier wall excavation. Groundwater barrier wall constructors often use this technique to identify the appropriate depth of the barrier wall in the field.

We recommend a cutoff wall at least 3 feet wide to limit the potential for future hydraulic fracturing of the groundwater barrier wall. The soil-bentonite backfill placed in the slurry trench will be soft and compressible and will likely have a high moisture content. Over time, the backfill will tend to consolidate under its own weight. As it consolidates, the backfill will settle and shear forces will develop between the soft soil-bentonite backfill and the hard adjacent ground. These shear forces effectively reduce the vertical stress applied to the backfill, preventing it from consolidating.

The groundwater levels along the barrier alignment are near the ground surface and therefore the hydrostatic stresses applied to the wall are comparatively high. This coupled with the potential for lower than geostatic stresses on the soil-bentonite backfill if the trench width is narrow, introduces the potential for hydraulic fracturing. This potential is reduced by building the wall wider. A 3-foot wide barrier wall is used in the industry when ground conditions similar to those at the NDA site are encountered.

6.2 Soil-Bentonite Backfill

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, MMCE recommends a soil-bentonite wall for this application.

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.

The soil borrow should be a well-graded soil with at least about 25 to 30 percent particles finer than a No. 200 sieve. Preferably, the fine soil fraction is either non-plastic or has a low plasticity. WVNSCO has a borrow pile placed south of the NDA and this may be suitable for use in mixing the soil-bentonite. Alternatively, the subcontractor will need to import suitable borrow for the soil-bentonite mix.

6.3 Working Platform

The 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, we recommend constructing a working platform along the cutoff wall alignment such that the platform surface is at least 5 feet above the adjacent groundwater elevation. This will result in a platform surface at about El. 1393. This platform will also serve to create a level surface for excavating the slurry trench.

The ground surface slopes down along the south side of the NDA and it appears that the groundwater level also decreases. Therefore, the surface of the working platform has been designed with a downward slope (to the east) to reduce the volume of the working platform and still maintain the required separation above the groundwater surface.

6.4 Additional Subsurface Explorations

The base of the weathered Lavery Till deposit has not been defined with sufficient accuracy along the proposed cutoff wall alignment for construction. Therefore, we propose to drill test borings 40 feet apart along the alignment. These test borings will extend sufficiently into the unweathered till to be able to define the base of the weathered till. The drilling contractor will collect split spoon soil samples at 2-foot intervals and will staff the drill rig with an experienced geologist that is capable of identifying the base of the weathered till.

The data collected from these borings will define the base of the cutoff wall, 5 feet below the lowest measurement of the base of the weathered till. Existing test boring data from nearby borings suggest that the base of the weathered till is as low as El. 1373. Therefore, the base of the wall has been preliminarily set at El. 1368.

The test boring data will be reviewed as they are developed. If the data suggest that the surface of the unweathered Lavery till is erratic, additional test borings may be needed to reliably estimate its surface.

6.5 Barrier Wall Monitoring

MMCE recommends installing pairs of piezometers 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 will allow the gradient across the wall to be estimated and the effect of the wall on surrounding ground conditions to be measured over the design life of the barrier wall

6.6 Additional Considerations

MMCE recommends mixing the soil and bentonite backfill on a concrete pad and transporting the mixed backfill to the trench. Unoccupied areas west and south of the NDA appear suitable for constructing this pad, storing the dry bentonite and for constructing the slurry mixing pond.

The soil-bentonite backfill mixing pad should be built within a temporary enclosure to limit the amount of airborne bentonite dust that will be generated when the dry bentonite is added to the borrow soil. This enclosure should be disassembled when the project has been completed. The pad will need sidewalls to contain the soil-bentonite as it is mixed.

The subcontractor can mix dry bentonite and water to form bentonite slurry in either a pond or a tank. The slurry is used to support the trench and is used in mixing the soil-bentonite backfill. The pond allows the slurry to hydrate before the subcontractor uses it in the trench or in the backfill mix. The pond can be an earthen dike and the bentonite filter cake that forms on the inside creates a low-permeability seal for holding the slurry in the pond.

MMCE recommends building the pond for mixing the bentonite slurry next to the mixing pad. The estimated volume of bentonite slurry is about 310,000 gallons, but will vary depending on the nature of the soil borrow used in the backfill mix.

Water for mixing the bentonite slurry is available from the utility room. The subcontractor will need to truck the water to the slurry pond area.

Existing well 908 will be removed and replaced west of the ground water barrier because the ground water barrier alignment will affect future data from it. Existing well 908, which is next to well 901, will be protected from damage by the ground water barrier contractor.

7.0 CAP DESIGN CONSIDERATIONS

The purpose of the cap is to limit infiltration of precipitation into the NDA and to direct precipitation to existing 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. The concrete pad, pre-cast concrete retaining walls and other temporary structures (e.g., storage shed) protruding from the cap in the northeast portion of the NDA will be removed before constructing the final grades.

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 5 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.

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 NDA will be filled with suitable embankment materials to create the cap grades. These soils will be placed in controlled lifts and each will be compacted such that in-place density tests on the compacted soil lift meet required criteria.

Soft areas may exist on the existing cap subgrade and therefore heavy equipment will be kept off the cap until these soft areas are identified. The contractor will proof roll the existing NDA cap surface to identify any soft/unstable areas before beginning to construct the final cap

grades. Any soft areas will be covered with a geogrid and a layer of crushed stone to create a stable surface for placing and compacting the cap embankment materials.

A cushion geotextile will be placed over the entire NDA following construction of the final cap grades. The purpose of the geotextile is to protect the overlying geomembrane.

The final surface of the NDA cap will be an Ethylene Interpolymer Alloy geomembrane, XR-5, model 8130, manufactured by Seaman Corporation. This model is 30 mils thick. Seaman Corporation makes a 40 mil thick XR-5, but its mechanical properties are similar to the 30 mil thick model. Thus the thicker liner's resistance to puncture is not improved.

WVNSCO evaluated other materials during design development and favors this due to 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.

Sand wedges encased in geomembrane will be welded to the geomembrane to resist uplift forces from the wind. The wedges are designed to resist an uplift pressure of 9 pounds per square foot, as requested, see Appendix B, "Summary Design Criteria."

8.0 EFFECT OF PROJECT ON THE SDA

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

8.1 Groundwater

MMCE modeled the groundwater flow patterns using the ModFlow program, as described in Section 3.3 and calibrated it using available groundwater level measurements in the monitoring wells. The barrier wall and cap over the NDA were added to the model and MMCE compared groundwater contours of the existing condition with those predicted after construction of the barrier wall and cap. 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.

8.2 Storm Water

Surface water drainage patterns shown on Figure 5 include drainage from the NDA cap and the SDA. 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.

Some of the surface water from the SDA flows through an 18-inch diameter pipe at outfall W-06 (S-31) located near the southeast corner of the NDA and into a pond within the NDA. This outfall is monitored. The water in the pond discharges into a 24-inch diameter pipe and flows to its discharge point located near the northeast corner of the NDA.

As part of the NDA cap construction, the 18-inch diameter pipe at W-06 will be shortened and connected to a catch basin. The measuring device at the outfall of the 18-inch diameter pipe will be installed at the end of the shortened 18-inch diameter pipe inside the catch basin. The water from W-06 will flow through a new 12-inch diameter pipe located along Basin # 2 and will discharge into the existing 24-inch diameter pipe.

Considering that the surface drainage of the cap is controlled to current levels and the drainage conditions outside the cap remain unchanged, the surface drainage from the NDA cap is not expected to compromise the SDA surface drainage conditions.

9.0 OTHER CONSIDERATIONS

WVNSCO indicates that wetlands are located near the NDA. Construction of this project is not expected to affect these wetlands.

10.0 REFERENCES

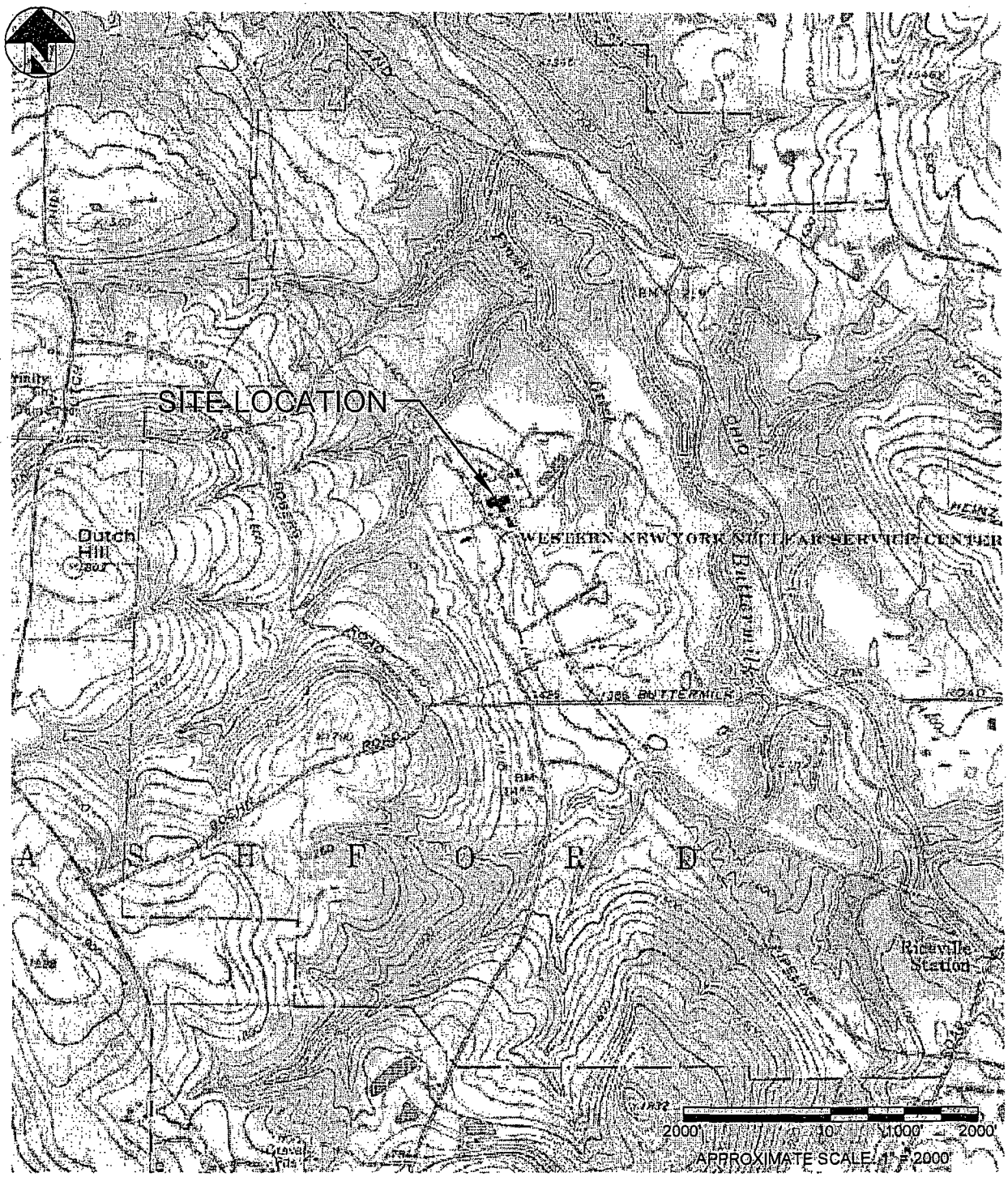
1. Bergeron, M.P., W. M. Kappel and R. M. Yager, "Geohydrologic Conditions at the Nuclear-Fuels Reprocessing Plant and Waste-management Facilities at the Western New York Nuclear Service Center, Cattaraugus County, New York," U.S. Geological Survey, Ithaca, New York, 1987.

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. First Quarter, Second Quarter, Third Quarter and Fourth Quarter 2006 Groundwater Elevation Contours of the Weathered Lavery Till West Valley Demonstration Project, West Valley, New York.

4. NYSERDA, "State-Licensed Disposal Area (SDA) at West Valley, 2006 Annual Report," March 2007.

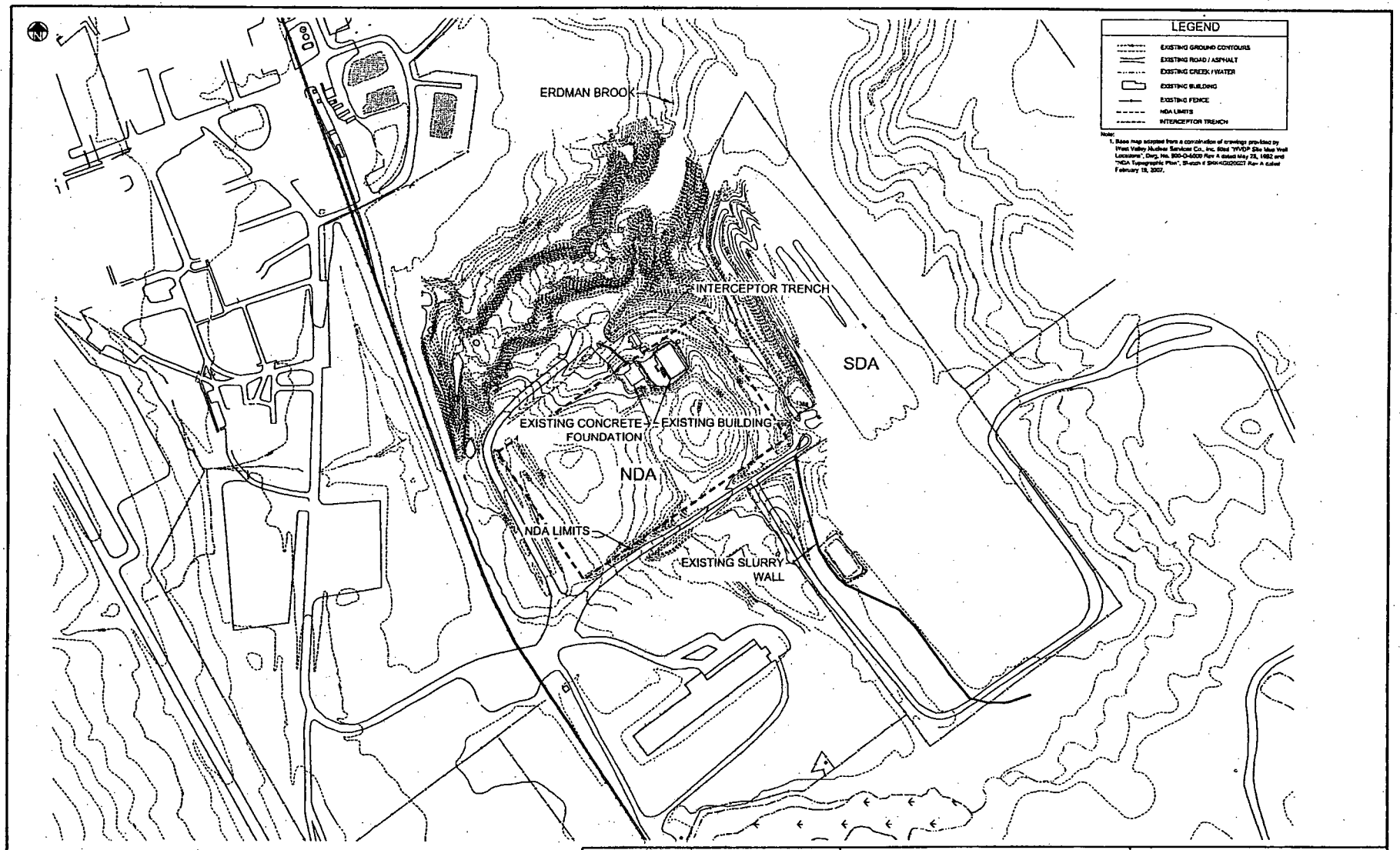
Figures



Note:

1. Base map adapted from USGS 7.5 minute series quadrangle map of Ashford Hollow, NY dated 1964.

McMahon & Mann *Consulting Engineers, P.C.* 2495 MAIN STREET, SUITE 432 BUFFALO, NY 14214 (716) 834-8932 FAX: (716) 834-8934	NDA CAP AND GROUND WATER BARRIER CONSTRUCTION WEST VALLEY NEW YORK	SITE LOCATION MAP DWG. NO. 07011-010 FIGURE 1



EXISTING CONDITIONS

SCALE: N.T.S.

NOTE:
UNAUTHORIZED ALTERATION OR ADDITION TO ANY SURVEY, DRAWING, DESIGN, SPECIFICATION, PLAN, OR REPORT IS A VIOLATION OF SECTION 7209 PROVISION 2 OF THE NEW YORK STATE EDUCATION LAW.

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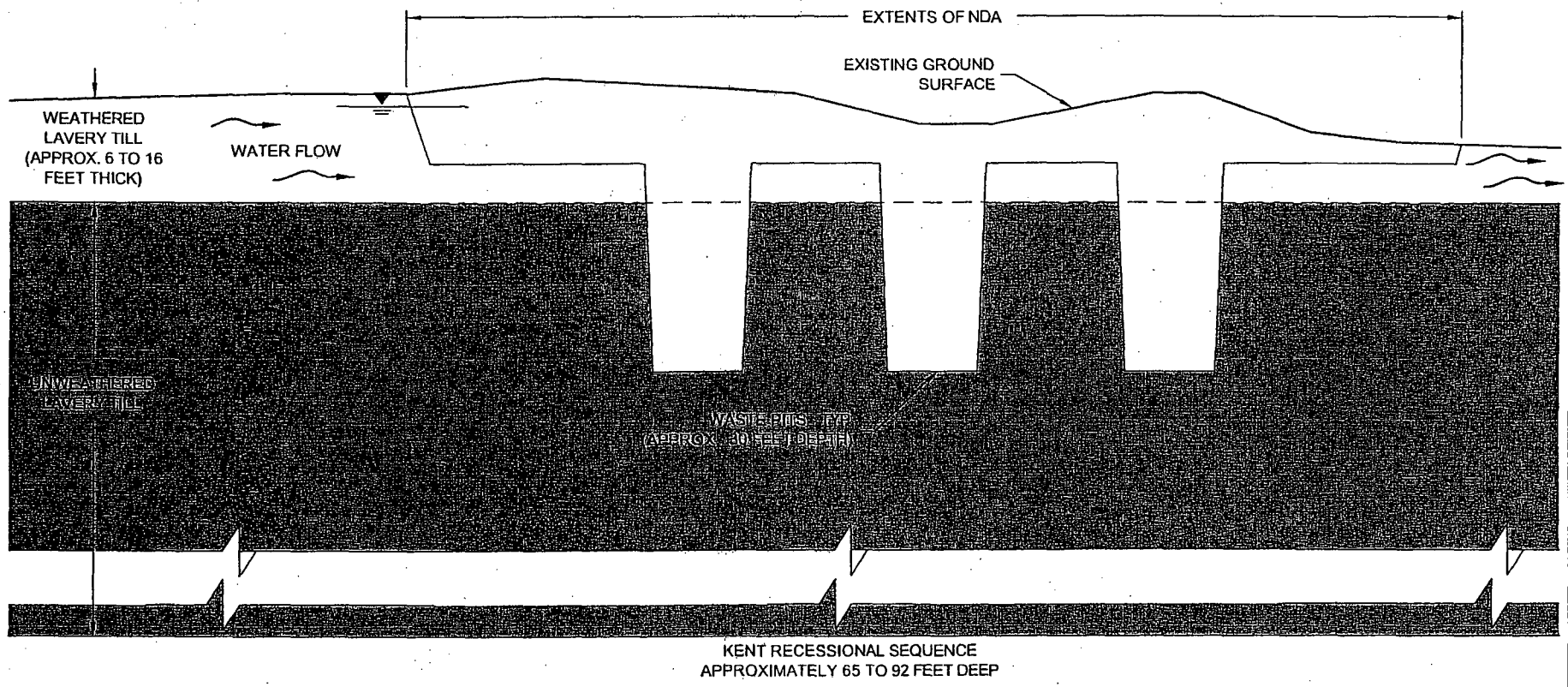
NDA CAP AND GROUND WATER BARRIER CONSTRUCTION
WEST VALLEY NEW YORK

SITE PLAN

DWG. NO. 07011-024

FIGURE 2



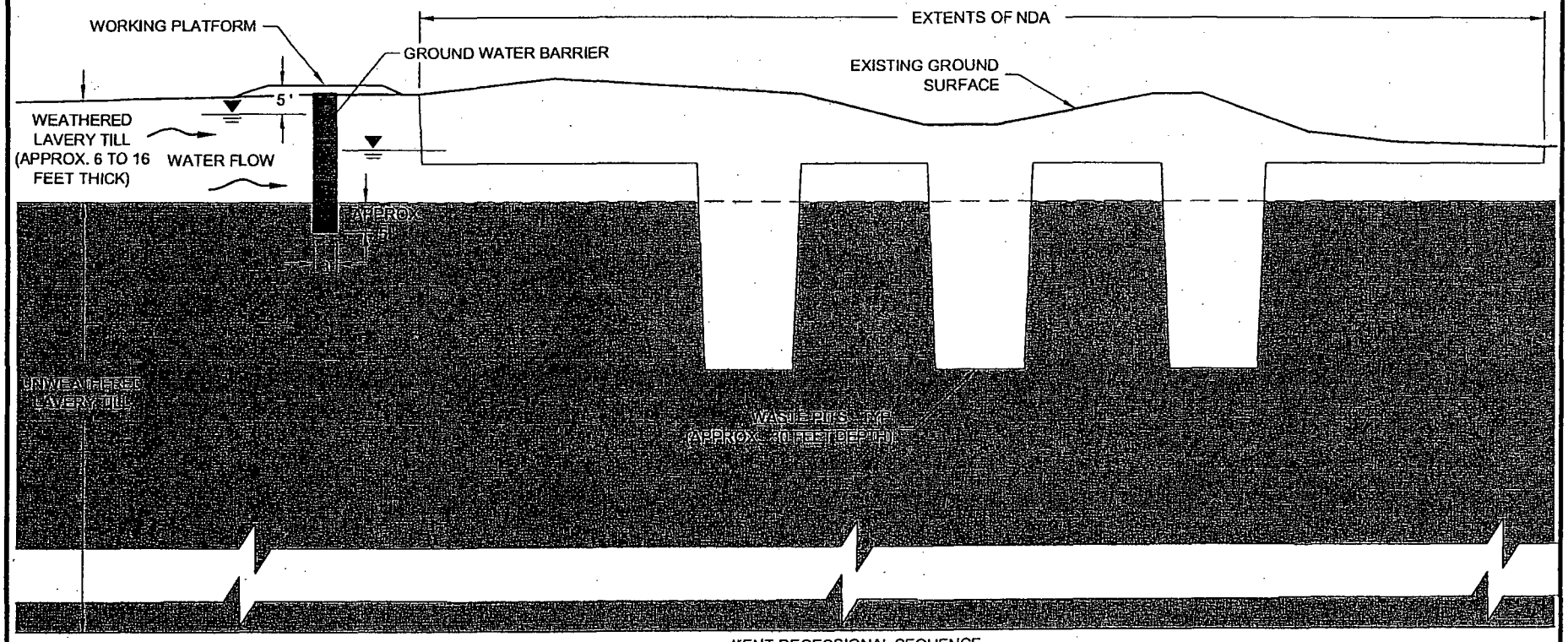
SUBSURFACE PROFILE THROUGH NDA - EXISTING CONDITIONS

SCALE: N.T.S.

LEGEND

- DIRECTION OF GROUND WATER FLOW IN STRATUM
- UNWEATHERED LAVERY TILL
- ESTIMATED PROFILE BELOW NDA

SUBSURFACE SECTION	NDA CAP AND GROUND WATER BARRIER CONSTRUCTION	McMahon & Mann Consulting Engineers, P.C.
DWG. NO. 07011-003b	WEST VALLEY NEW YORK	2495 MAIN STREET, SUITE 432 BUFFALO, NY 14214 (716) 834-8932 FAX: (716) 834-8934
FIGURE 3		



KENT RECESSIONAL SEQUENCE
APPROXIMATELY 65 TO 92 FEET DEEP

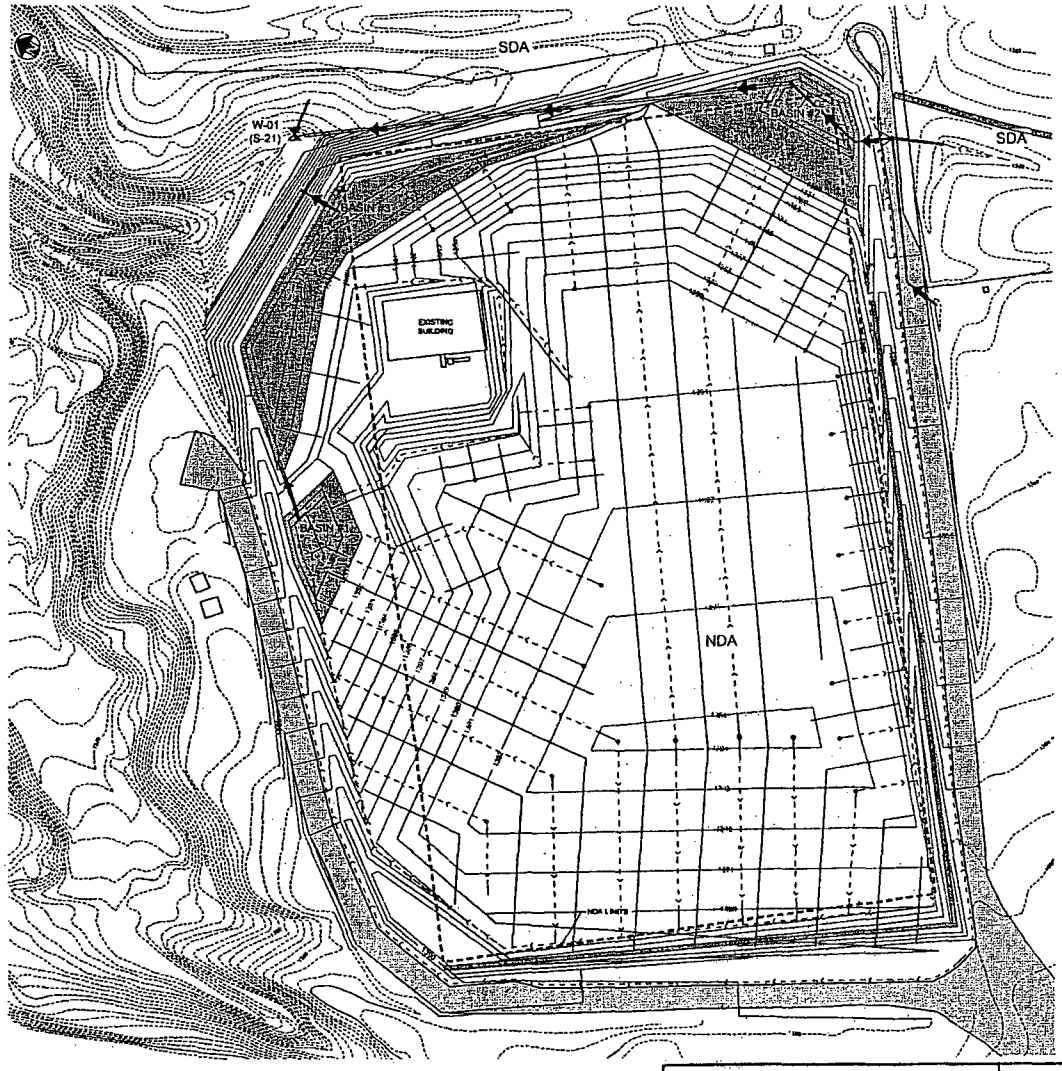
SUBSURFACE PROFILE TROUGH NDA - FOLLOWING INSTALLATION OF CUTOFF WALL

SCALE: N.T.S.

LEGEND

- DIRECTION OF GROUND WATER FLOW IN STRATUM
- UNWEATHERED LAVERY TILL
- ESTIMATED PROFILE BELOW NDA

SUBSURFACE SECTION	NDA CAP AND GROUND WATER BARRIER CONSTRUCTION	McMahon & Mann Consulting Engineers, P.C.
DWG. NO. 07011-003c	WEST VALLEY NEW YORK	2495 MAIN STREET, SUITE 432 BUFFALO, NY 14214 (716) 834-8932 FAX: (716) 834-8934
FIGURE 4		



LEGEND

- EXISTING GROUND CONTOURS
- PROPOSED CAP CONTOURS
- NDA LIMITS
- PROPOSED GEOMEMBRANE LIMITS
- PROPOSED DRAINAGE SWALE
- CENTERLINE OF PROPOSED ANCHOR BERM
- EXISTING FENCE LINE
- EXISTING BUILDING
- SURFACE WATER FLOW DIRECTION
- W-01 (S-21) X STORMWATER OUTFALL LOCATION AND DESIGNATION

Note:

1. Base map adapted from a combination of drawings provided by West Valley Nuclear Services Co., Inc. titled "WVDP Site Map Well Locations", Dwg. No. 900-D-5000 Rev A dated May 26, 1992 and "NDA Topographic Plan", Sketch # SKKKG020607 Rev A dated February 19, 2007.
2. Contractor provide markers to delineate the extents of NDA cap as directed by the Owner or Owner's Representative.
3. All SDA outfalls shall be maintained throughout construction.
4. The Contractor shall maintain access to all structures and buildings, as required by Contractor thoughout construction.
5. Subcontractor to provide ice breaks perpendicular to the slope at intervals not exceeding 100 ft. Subcontractors to submit product details, attachment detail, and location prior to installation ice breaks.
6. Subcontractor to provide permanent access walkways to each well as shown on this plan. The walkways shall be skid-resistant, weather resistant and design to be attached to geomembrane without damaging it. Subcontractor shall submit product and installation details prior to constructing the walkways.

SCALE: N.T.S.

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NDA CAP AND GROUNDWATER BARRIER CONSTRUCTION
WEST VALLEY NEW YORK

STORMWATER ROUTING PLAN

DWG. NO. 07011-025

FIGURE 5

APPENDIX A

GROUNDWATER MODEL

APPENDIX A

FINAL DESIGN REPORT
WEST VALLEY NUCLEAR SERVICES
NDA CAP AND
GROUND WATER BARRIER

APPENDIX A
GROUNDWATER MODEL

GROUNDWATER MODEL

MMCE completed a groundwater flow model to evaluate the effect of constructing the barrier wall and geomembrane cover on the groundwater levels within and adjacent to the NDA. The model results provide an estimate of the flow of groundwater to the drain from upgradient of the NDA and from infiltration within the NDA. The results also provide an estimate of the long-term steady state groundwater levels and flow to the drain after construction of the NDA cap and barrier wall.

The following sections describe a previous groundwater model completed by the USGS in the vicinity of the NDA, the model calibration and predictions of performance subsequent to construction of the NDA cap and barrier wall.

A. Previous Model

The USGS (Reference 2) evaluated groundwater flow within the till in the vicinity of the facility disposal area (i.e., the NDA). The USGS used a two dimensional finite element model to evaluate groundwater flow conditions for two vertical cross sections; an east-west trending section extending from the railroad through the NDA to Frank's Creek and a north-south trending section from the NDA north to Erdman Brook.

The USGS calibrated the model by varying the recharge and the till's hydraulic conductivity until the model results were in relative agreement with groundwater levels observed from monitoring wells. The calibration provides an indication of the area recharge conditions and the hydraulic conductivity of the weathered and unweathered till. The USGS calibration indicates relatively low hydraulic conductivity for the till units and corresponding relatively low lateral groundwater flow through the weathered till zone; about 80 cubic centimeters per day per cubic meter (cm3/day)/m^2 (0.72 gallons per year per square foot).

B. Methodology and Input

Groundwater conditions were modeled using ModFlow, which is a finite difference model for ground water flow developed at the University of Waterloo. ModFlow simulates heterogeneous flow in three dimensions. The program uses subroutines that permit examination of specific hydrologic features independently. The subroutine called Visual ModFlow was used to input the data and view the results. The model simulates flow associated with external stresses, such as wells, areal recharge, drains, and streams.

MMCE developed the model based on existing geologic data for the existing soils, topography, drainage and groundwater flow conditions.

Geometry

The area modeled extends west from about midway between Rock Springs Road and the railroad embankment, north to Erdman Brook, and south and east to Frank's Creek. The modeled area covers approximately 50 acres of land. The topography of the modeled area was input into ModFlow.

The weathered till zone was considered to be 16 feet thick within the model area. The weathered till was divided into three layers of elements. The unweathered till at the bottom of the three layers was considered as an impermeable boundary.

Other features added to the model include the barrier wall west of the SDA and the drain along the north and east sides of the NDA. The barrier wall was simulated by assigning a thickness of 2.5 feet and a hydraulic conductivity of $1x10^{-7}$ centimeters per second (cm/sec) along the alignment of the wall. The drain was simulated by assigning a conductance of approximately 25,000 ft^2/sec, and elevations corresponding to the invert along the alignment of the NDA drain.

Boundary Conditions

MMCE assigned a constant head boundary at El. 1400 to the elements along the ground contour at El. 1400 between the railroad embankment and Rock Springs Road. This value corresponds approximately to the groundwater levels measured in this area during 2006.

A no flow boundary was assigned along the north, south and east ends of the modeled area corresponding the location of Erdman Brook and Frank's Creek.

C. Calibration

The initial step in the modeling process was to calibrate the groundwater model so that model predictions agree with measurements at the site. MMCE varied the soil hydraulic properties and groundwater infiltration until the model predicted groundwater contours and drain flow measurements similar to those that were observed.

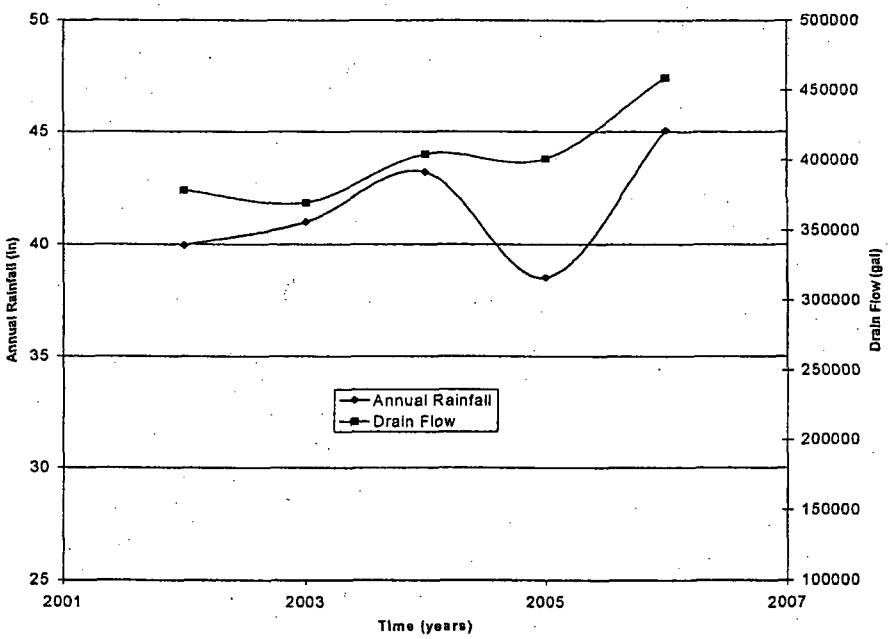
The hydraulic conductivity was varied between $1x10^{-4}$ cm/sec and $1x10^{-5}$ cm/sec. The model calibration resulted in a hydraulic conductivity of $1x10^{-5}$ cm/sec for the weathered till and $1x10^{-4}$ cm/sec for the fill within the NDA. Using a hydraulic conductivity of $1x10^{-6}$ cm/sec resulted in predicted groundwater levels approximately 20 feet or more above the ground surface.

The hydraulic conductivity for the weathered till zone is higher than that used in the USGS study, ($5x10^{-7}$ cm/sec). This could be due to the differences in the model configuration (3 dimensional compared with the USGS 2 dimensional model) or differences in the boundary conditions.

We reviewed rainfall data for the site, flow observed from the NDA drain, and recharge values used in the USGS study in calibrating the groundwater flow model. The annual rainfall at the site since 1990 is summarized on the following table. Also on the table is a summary the flow collected in the NDA drain annually since 2002.

Year	Rainfall (in.)	Year	Rainfall (in.)	Flow Collected in Drain (gallons)
1990	26.64	1999	30.97	
1991	32.76	2000	38.05	
1992	48.63	2001	31.02	
1993	37.35	2002	39.96	378,471
1994	40.13	2003	40.99	369,680
1995	34.17	2004	43.21	404,166
1996	44.89	2005	38.52	400,907
1997	43.23	2006	45.06	458,911
1998	42.76			

As indicated on the following chart, the rainfall and corresponding infiltration are well correlated to the flow collected in the NDA drain.



The recharge rates used in the ModFlow model calibration varied between 0.5 and 3 inches per year. These values are similar to the rates used in the USGS study and resulted in reasonable prediction of flow collected in the drain compared with measured values.

The flow in the drain for existing conditions was estimated to be 421,333 gallons per year, which compares well with the observations listed in the preceding table.

D. Results

Once the model was calibrated, the effect of the barrier wall along the west and south sides was considered by assigning a thickness of 3 feet and a hydraulic conductivity of $1x10^{-7}$ cm/sec along the planned alignment for the NDA barrier wall. Additionally we modeled the geomembrane by reducing the recharge in the NDA area to zero.

The model predicts no change in the groundwater levels west and south of the NDA due to installation of the barrier wall. The groundwater flow in these areas is toward existing drainage features. The model predicts a long-term flow to the drain of approximately 58,000 gallons per year primarily from the area between the north side of the NDA and Erdman Brook.

SUMMARY DESIGN CRITERIA

If the Summary Design Criteria is being developed for a component rather than a system or facility, see EP-3-002, Section 4.5 before proceeding. If HLW designation is "YES" this form cannot be used.	High Level Waste Designation?	Yes	NA	No

PROGRAMMATIC INFORMATION			
WVNS-SDC-127	Rev. No.: 1	Revision Date: 02/09/07	ER/ECN No.: 26605
Project Name:	NDA Impermeable Geomembrane Cover		
System Name & Number:	82		
Proposed Location:	NDA		
Statement of Problem or Description of Need:	Prepare a detailed design and plan for installing a cap over the NDA. Incorporate necessary permit conditions, state and federal regulatory requirements, and the stakeholder issues in recommending final design for DOE approval.		
Project Completion Date:	June 30, 2007		
Pertinent Milestone Dates:	June 30, 2007		

DESIGN INPUTS
(If a specific category listed below is not applicable, insert "NA" and explain why it is not applicable)

Functional Requirements (List all functions, except as listed below, that the finished system, structure or component must satisfy): The NDA cover shall be designed to:

Cover

1. Minimize surface water infiltration into the NDA..
2. Ensure a minimum of 4-feet cover of soil over the waste in the trenches.
3. Keep exposure to contamination As Low As Reasonably Achievable (ALARA)
4. Prepare sub-grade so as to promote drainage off the cover with minimal abrasion.
5. Function with minimum maintenance, optimal UV resistant, optimal puncture resistance, minimal thermal expansion/contraction and stress from temperature variations. Use XR-5 Geomembrane material properties as baseline.
6. Stabilize against uplift forces of the 70 mph wind with exposure C (minimum of 9 lbs. per sq. ft).
7. Accommodate settling and subsidence by ensuring proper and stable sub-grade so that the cover's integrity is maintained.
8. Minimize surface water infiltration into NDA by providing a geomembrane (permeability of $1E10^{-7}$ cm/sec or less).
9. Geomembrane thickness as required by codes, standards, landfill regulations, and best practices; minimum of 30 mil wall thickness, based on XR-5 material or equal.
10. Meet OSHA standards for worker foot traffic during construction, periodic inspection, and repairs.
11. Develop an inspection, maintenance and repair plan as per the geomembrane manufacturer's recommendations.

Storm Water Control

12. Estimate and maintain control of the peak stormwater run-off discharge to pre-geomembrane installation conditions for the 25-year, 24-hour storm. See Attachment A for existing precipitation data. Use site-specific data when provided.
13. Provide for sediment and erosion control during construction, as well as during post development. At minimum, meet applicable requirements of NY State.

14. Drainage design from geomembrane cover to existing waterways should avoid increased erosion along Erdman Brook and its tributaries.
15. Facilitate storm run-off monitoring including sample collection and flow monitoring in accordance with NYSDEC SPDES permit.
16. Ensure compliance with regulations applicable to wetland (see attached wetland map).

Slurry Wall

17. Minimize groundwater infiltration into the NDA for at least 10 years.
18. Slurry wall design shall be in accordance with Army Corp of Engineers Guidelines (CW-02214), EM 1110-2-1901 Chapter 9 §9.4 d Slurry Wall and Attachment A. Slurry wall shall meet design permeability requirement of $1X10^{-7}$ cm/sec or less.
    a. Design of Slurry wall needs consideration of buried waste locations and depths in the NDA.
    b. Control upgradient surface water infiltration as needed.
    c. Integrate cover and storm drainage design.
19. Bottom of Slurry wall shall be keyed into the competent natural silt clay (unweathered Lavery till) along entire length. Documentation of subsurface geology using geologic logs of existing borings and new borings if necessary to ensure presence of clay till.
20. Ground water monitoring shall be maintained around the NDA. Any modifications due to layout of slurry walls will be evaluated by Environmental Affairs (EA). EA shall make appropriate recommendation for relocation/restoration, addition; or removal of existing monitoring wells. Monitoring wells shall only be decommissioned as per WVNSCO approved procedures.
21. Instrumentation and monitoring system to measure piezometer reading from upstream and downstream of the slurry wall.

Considerations During Construction

22. Design must include allowable and recommended construction techniques, test procedures, field testing; (i.e., compaction modified proctor density, slurry consistency, slump, permeability, etc.), and testing equipment; QA/QC requirements and testing personnel/laboratory qualifications in the design report.
23. Minimize excavation in the NDA area due to the potential to encounter contaminated soil.
24. Minimize the size of heavy equipment on the NDA due to unknown bearing capacity of backfill material.

Operational Requirements (List all operational requirements that will be needed by the completed system, structure or component):

This is a passive system and will not have its own operational requirements. The design shall consider routine facility monitoring and maintenance programs as per SOP 040-04 :

1. Storm Water Management: periodic inspection and cleaning of silt, vegetation, and any other debris from drainage trenches.
2. Run-off discharge monitoring including sample collection and flow monitoring.
3. NDA Cap Inspection: All-weather foot traffic access to perform inspections, maintenance, and monitoring activities noted above.
4. SOP-040-04 Landfill Inspection and Maintenance Plan.
5. SOP-082-1 Routine NDA Operations

Note: There is an existing pumping station which pumps NDA discharge interceptor trench water to the Lagoon 2. This design will not affect capabilities or operational requirements of the pump station.

Performance Requirements (List all performance requirements that will be needed by the completed system, structure or component):

1. The surface runoff discharge water quality and quantity shall meet current discharge limits specified in the site SPDES permit.
2. Control 24-hour peak discharge from the 25-year storm to no more than predevelopment discharge rates to minimize site and storm channel erosion.

3. The geomembrane shall withstand WNY weather conditions and UV exposure for a minimum of 10 years. All geomembrane seams shall be tested using air lance/vacuum box methods as per ASTM D35.1.89, Standard Practice for Seam Evaluation, and the geomembrane manufacturer's recommendations.
4. 30-year life expectancy for the exposed membrane with periodic inspection, maintenance and repair procedures is required. Exposed geomembrane shall be tested at an interval of 5-years for predicting remaining life. A 50% degradation of physical properties will be allowed due to weathering of exposed geomembrane.
5. Slurry wall shall meet the design permeability values in the field.

Identifiable Hazards (See Attachment F) and Necessary Controls as can be determined at this stage of design:

Radioactive contamination and radiation dose rate limits need to be established prior to start of site work.

Regulatory Requirements (List all regulatory requirements that must be met by the completed system, structure or component):

SPDES Permit NY-0000973 West Valley Demonstration Project
6NYCRR Part 750 New York Codes, Rules and Regulations
6NYCRR Part 703 New York Codes, Rules and Regulations
6NYCRR Part 373-2 Hazardous Waste Management System
6NYCRR Part 373-3 Hazardous Waste Management System
Appendix-A NRC License No. CSF-1
3008 (h) Order on Consent.

Codes and Standards (List all codes and standards that govern the design of the system, structure or component):

NYS Storm Water Management Design Manual
WVDP-206, "Storm Water Pollution Prevention and Best Management Practices Plan"
Geosynthetic Institute -Geomembrane Service Life Prediction: www.geosynthetic-stitute.org/papers/paper6.pdf

DOE Directives (List all DOE Directives that govern the design of the system, structure or component. See list at S:\WP\FORMS\LISTS\DIRECTIV.WPD):

DOE 0 420.1A Facility Safety
DOE 0 435.1

Interfaces w/New or Existing Equipment (List interface conditions between the system, structure or component & new or existing equipment):

The NDA is nested with the SDA to east and south. The SDA is already capped and has its own slurry wall system. Present design shall be complementary in diverting storm drainage and shall not compromise SDA functions.

Radiological Requirements (List all radiological requirements the system, structure or component must satisfy):

NDA is posted as a contaminated area. A detailed radiological survey is required prior to start of construction work. Proposed slurry wall area shall be checked for the full depth for any migrated radiological contamination from the buried radiological waste. Although not expected, if any contaminated soil is encountered, the slurry wall may be rerouted to avoid excavating and unnecessary radiological work.

Fire Protection Requirements (List all Fire Protection requirements the system, structure or component must satisfy) (Refer to WVDP-177):

N/A

Applicable Limitations stated in applicable SARs, EAs or Permits:

SPDES Permit Table B and Notes, Special Requirements: 6 (no impact on NDA Cap Design).

Other Requirements (See Attachment G for other Requirements to Consider):

N/A

SUMMARY DESIGN CRITERIA

SYSTEM, FACILITY, COMPONENT OR SUBSYSTEM CLASSIFICATION (Note: If the system or facility has components with different Quality Levels or Safety Classes, the multiple levels are to be listed separately.
Hazard Classification or Hazard Category:
NOTE: For systems or components that are part of an existing facility, see WVDP-227 for facility classifications. For new facilities, see WV-365 and consult Safety Analysis and Integration.
Safety Class per QM-3: Level C
Rationale: Design Activity.
Quality Level per QM-2: QL-C
Rationale: Involves personnel/laboratories qualification and field measurements, testing, verification and the documentation.

REFERENCE OR INTERFACE DRAWINGS			
Drawing No.	**Sheet No.**	**Rev.**	**Title**
900-E-4974	1	1	NDA (NRC Licensed Disposal Area) Base Map
900-D-5000	Not a Engineering Released Drawing	A	WVDP Site Map Well Location
DM-023-103-92	1 to 6	As-Built	SDA Trench Infiltration Control
Map No 1	N/A	Not Engineering Released	Site Storm Water Drainage
Map No 3	Sheet 232 from SPDES Application	Map No 3 June 9, 2003	Site Storm Water Drainage Map
Plate 3	C	2006 Quarterly Reports	Groundwater Trend Analysis

Will the Q-List (WVDP-204) have to be Reviewed and Updated?	**Yes**	**No**

	Printed Name	**Signature**	**Date**
Prepared By:	**K. K. Gupta, Fellow Engineer**	***Signature and date on file in Records***	
Cognizant System Design Manager:	**D. C. Meess, Chief Engineer**	***Signature and date on file in Records***	

West Valley Demonstration Project

Doc. ID Number WVNS- CS-270

Revision Number 0

Revision Date 06/27/2007

Engineering Release 26628

CONSTRUCTION SPECIFICATION

NDA Cap and Groundwater Barrier Interim Measure

PREPARED BY _____
Cognizant Engineer

APPROVED BY DC Shum for Tom Wheeland
Cognizant System Engineer

APPROVED BY DC Shum
Cognizant System Design Manager

APPROVED BY _____
Quality Assurance Representative

WVNSCO
West Valley Nuclear Services Company

10282 Rock Springs Road
West Valley, New York USA 14171-9799

WVNSCO RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue Engineering Department impacted by this document.	All	6/27/2007

TABLE OF CONTENTS

DIVISION 1 – General Requirements

DIVISION 2 – Site Work

DIVISION 1

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work to be performed consists of furnishing full time project management/supervision, labor, material, tools, equipment, office and storage facilities, and any other materials, including those needed temporarily during construction; as required by the contract documents and these technical sections of this specification for the construction of the NDA Cap and Groundwater Barrier Interim Measure. The types of work to be performed include, but are not necessarily limited to, the following:

- Lines and Grades
- Temporary Facilities
- Subsurface Explorations and Piezometer Installation
- Erosion and Sedimentation Control
- Dust Control and Work Area Maintenance
- Site Preparation and Demolition
- Embankment
- Soil Bentonite Groundwater Barrier Wall
- Geotextiles
- Geomembrane
- Dewatering
- Storm Water Control Facilites
- Revegetation

1.2 WORK BY WVNSCO

A. Radiological Survey of Work.

1.3 OWNER FURNISHED PRODUCTS

Not Used

1.4 WORK SEQUENCE

A. Following is a general work sequence that must followed. Subcontractor must provide a schedule per requirements of Special Provisions.

1. Layout and Survey
2. Test Borings
3. Soil-Bentonite Ground Water Barrier Wall
4. Geomembrane

1.5 TECHNICAL DOCUMENT LIST

A. A Technical Document List containing the contract and reference drawings for this work is included as part of this purchase order document.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

DIVISION 1

SECTION 01012

UNDERGROUND UTILITY LINES/EXCAVATION and TRENCHING COORDINATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements for excavating at the WVDP site.

B. Subcontractor's responsibility for locating underground utility lines before starting excavation operations.

C. Subcontractor's responsibility for obtaining record drawing information for new and existing underground utility lines encountered during excavation operations.

1.2 RELATED SECTIONS

A. Section 02010 - Subsurface Explorations and Piezometer Installation

B. Section 02110 - Erosion and Sedimenation Control

C. Section 02150 - Site Preparation and Demolition

D. Section 02200 - Embankment

E. Section 02210 - Soil Bentonite Goundwater Barrier Wall

F. Section 02400 - Geomembranes

1.3 REFERENCES

Not Used

1.4 SUBMITTALS

Not Used

1.5 QUALITY CONTROL/ASSURANCE

Not Used

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PRE-GROUND DISTURBANCE REQUIREMENTS

A. The Subcontractor shall have the Ground Disturbance Permit(s) (GDP) (provided as an Exhibit(s) in this section) and all drawings listed on the permit(s) at the excavation location(s), and participate in a pre-ground disturbance activity briefing, when indicated

on the GDP, prior to beginning activity.

B. The Subcontractor shall layout the work area and WVNSCO, in conjunction with subcontractor, shall mark all underground utility lines and obstructions (foundations, deadmen, etc.) on the ground surface prior to starting any excavation operations. The lines shall be marked in such a way so that it is within the excavation equipment operator's view. The depth below grade of all the lines that will be encountered shall also be indicated. When it is not convenient to mark the information directly on the ground surface, survey lath or other acceptable means shall be employed to mark the location.

C. WVNSCO, in conjunction with the Subcontractor, shall sweep the area to be excavated using a metal detector and/or other acceptable equipment to locate underground utility lines prior to beginning excavation operations. If the findings from the sweep differ by more than ±18' from the information on the construction drawings, or if additional lines not shown on the construction drawings are detected, stop excavation operations until direction is received from the Cognizant Construction Engineer.

3.2 EXCAVATION REQUIREMENTS

A. The GDP will provide guidance for hand excavation and utility shutoff requirements, when subcontractor is within a specified distance of an underground utility line. Hand excavate a completely expose and protect the line where indicated before resuming machine excavation.

3.3 POST EXCAVATION REQUIREMENTS

A. Record drawing (As-built/as-constructed) information shall be obtained by WVNSCO, in conjunction with the subcontractor, for all new utility lines, and existing utility lines and underground obstructions exposed during excavation operations for the project. Record drawing information shall consist of the following:

1. At least 2 tie points and 2 tie distances from permanent fixed objects for all termination points, and each change in direction for new and existing lines.

2. Depth and elevations along the length of the new line, and on existing lines that are unearthed. The elevations and depths measurements generally will correspond with the tie points.

3. Coordinate data (northings and eastings) for each termination point, and/or angle point on the line. These points will generally correspond with the tie points and elevation and depth measurement points. A coordinate reference point will be supplied by the Cognizant Construction Engineer if one has not been provided as part of the contract.

4. WVNSCO will obtain photographs, in conjunction with subcontractor, which are to be labeled to show orientation and located on drawing markups.

B. Backfilling may not begin until record drawing information is obtained and the backfill release section of the GDP is signed by WVNSCO.

END OF SECTION

Ground Disturbance Permit

See S:\ wpforms for lastest revision

Ground Disturbance Permit (GDP)

GDP No: 2004-	Date Issued:	
This GDP must be renewed by the URC, if work is not started on or before:	Renewed By:	Renewed GDP Good Until:

Project Title:

GDP Scope Statement: The purpose of this GDP is to _____

Reference Document(s) (List WIPs, PO, etc.)

WVNSCo Person Responsible for Administering this GDP	Mail Stop:	Phone:

HAZARD RECOGNITION

A STOP WORK culture IS EXPECTED at all times during the performance of the work covered by this GDP. If differing site CONDITIONS, such as, encountering unknown utility lines, encountering utility line configurations that are different than depicted on the drawings & sketches in this GDP, encountering soil conditions or other conditions that could or are creating an unsafe condition, STOP WORK, secure the area & resolve the issue(s) before proceeding with the work. When a STOP WORK condition has been implemented, a GDP Hazard Release, signed by the PSOSS, Authorizing Signers & Other Signers if indicated is required before work can commence.

Element(s) Covered by this Permit

No.	Element Description	Width & Length Limitations	Depth Limitations	Disturbance Method

Permit Documents

Permit Requirements/Restrictions/Conditions

☐ See Sheet ___ (if checked) for Additional Permit Requirements/Restrictions/Conditions

☐ See Sheet ___ (if checked) for Utility Line Shut-Off Information

PERMIT AUTHORIZATION (All Signatures Required Before proceeding with the Work)
Document with Original Signatures Required in the Field

GDP Preparer (Printed Name) _____ (Signature) _____ (Date) _____

Site Operations Rep. (SOR) (Printed Name) _____ (Signature) _____ (Date) _____

Industrial Health & Safety (Printed Name) _____ (Signature) _____ (Date) _____

Underground Utility Coordinator (Printed Name) _____ (Signature) _____ (Date) _____

GDP HOLD POINTS (If items are checked)

☑	PSOSS signature required - before starting GDP activity(s)	Release Signature _____	Date _____
☐	Other Signature(s) if listed _____ before starting GDP activity(s)	Release Signature _____	Date _____
☐	Field layout of utility lines req'd - before starting GDP activity(s)	Release Signature _____	Date _____
☐	Pre-activity briefing required - before starting GDP activity(s)	Release Signature _____	Date _____
☐	Pre - backfill release req'd - before backfilling or covering	Release Signature _____	Date _____
☐	As-built measurements/ photographs req'd before backfilling	Release Signature _____	Date _____

GDP No: 2004 -	DATE ISSUED:

UNDERGROUND UTILITY COORDINATOR NOTIFICATION (URC) (NOTIFY URC EACH DAY, IN PERSON/VIA PHONE, THAT GDP WORK IS OCCURRING - RECORD BELOW)

DATE	PERSON NOTIFIED	TIME	NOTIFICATION MEANS	PERSON WHO NOTIFIED URC	SIGNATURE

PSOSS NOTIFICATION (NOTIFY URC EACH DAY, IN PERSON/VIA PHONE, THAT GDP WORK IS OCCURRING - RECORD BELOW)

DATE	PSOSS NOTIFIED	TIME	PERSON WHO NOTIFIED PSOSS	SIGNATURE

GDP WORK COMPLETION NOTIFICATION

NOTIFY THE **URC & PSOSS** UPON COMPLETION OF WORK ACTIVITIES ASSOCIATED WITH THIS **GDP**

NOTIFY IN PERSON OR VIA TELEPHONE/VOICE MAIL - RECORD BELOW

DATE	PERSON NOTIFIED	TIME	NOTIFICATION MEANS	PERSON WHO MADE NOTIFICATION	SIGNATURE
	URC -				
	PSOSS -				

FIELD CHANGE INFORMATION - (GIVE COPY OF EXECUTED FIELD CHANGE TO PSOSS AFTER SIGNED)

FIELD CHANGE: (FIELD CHANGE NOT VALID UNLESS SIGNED BY PSOSS, ORIGINAL AUTHORIZATION SIGNERS, & OTHERS SIGNERS IF INDICATED)

NOTE: A RE-BRIEFING FOR THIS FIELD CHANGE IS REQUIRED, INITIAL & DATE ORIGINAL BRIEFING SHEET

Preparer:	Date:	IH&S	Date:	URC:	Date:
PSOSS:	Date:	SOR:	Date:	Other:	Date:

FIELD CHANGE: (FIELD CHANGE NOT VALID UNLESS SIGNED BY PSOSS, ORIGINAL AUTHORIZATION SIGNERS, & OTHERS SIGNERS IF INDICATED)

NOTE: A RE-BRIEFING FOR THIS FIELD CHANGE IS REQUIRED, INITIAL & DATE ORIGINAL BRIEFING SHEET

Preparer:	Date:	IH&S	Date:	URC:	Date:
PSOSS:	Date:	SOR:	Date:	Other:	Date:

GDP HAZARD RELEASE SECTION

GDP HAZARD DESCRIPTION:

GDP HAZARD RESOLUTION:

Preparer:	Date:	IH&S	Date:	URC:	Date:
PSOSS:	Date:	SOR:	Date:	Other:	Date:

GDP HAZARD DESCRIPTION:

GDP HAZARD RESOLUTION:

Preparer:	Date:	IH&S	Date:	URC:	Date:
PSOSS:	Date:	SOR:	Date:	Other:	Date:

GDP No: 2004 -	DATE ISSUED:

AS-BUILT DRAWING REQUIREMENTS

It is the responsibility of the person listed below to generate as-built drawings for the work performed under this GDP. As a minimum, the drawings listed below must be As-Built. An open item has been created in OITS, for completion of the as-built process. the URC is required to sign FCNs or ECNs that incorporate As-Built drawing information, at which point, the URC will close the open item.

NAME	DEPT	ACTION MANAGER	MAIL STOP	AS-BUILT COMPLETION DATE	OPEN ITEM NO.

THESE DRAWINGS MUST BE AS-BUILT

ALL PERSONNEL INVOLVED WITH THIS GDP MUST SIGN BELOW, INDICATING THAT THEY HAVE READ & UNDERSTAND THE REQUIREMENTS OF THE GDP

NAME	COMPANY/DEPT	SIGNATURE	BADGE NO.	DATE

Reference Information

The following Drawings were Researched for this GDP:

The following personnel were interviewed for this GDP:

The following instruments were used for field location for this GDP:

→GDP COMPLETION - PERMIT RETURN←

WHEN WORK ON THIS GDP IS COMPLETE, SIGN BELOW AND RETURN TO THE URC

WORK COMPLETE: Print Name: _____ Signature: _____ Date: _____

GDP No: 2004 -	DATE ISSUED:

ADDITIONAL PERMIT REQUIREMENTS/RESTRICTIONS/CONDITIONS

UTILITY LINE SHUT-OFF INFORMATION

UTILITY SERVICE	LINE SIZE	MATERIAL TYPE	VOLTAGE/ PRESSURE

LINE DESCRIPTION:

VALVE LOCATION:

ALARM SYSTEM INTERFERENCE:

FACILITY/EQUIPMENT AFFECTED	THESE ITEMS ARE AFFECTED	CONTACT PERSON	RESTRICTIONS/CONDITIONS

ADDITIONAL INFORMATION:

UTILITY SERVICE	LINE SIZE	MATERIAL TYPE	VOLTAGE/ PRESSURE

LINE DESCRIPTION:

VALVE LOCATION:

ALARM SYSTEM INTERFERENCE:

FACILITY/EQUIPMENT AFFECTED	THESE ITEMS ARE AFFECTED	CONTACT PERSON	RESTRICTIONS/CONDITIONS

ADDITIONAL INFORMATION:

PRE-ACTIVITY BRIEFING SHEET SIGN-OFF

URC OR URC REP. CONDUCTING BRIEFING: BRIEFING	
WVNSCO SUPERVISOR	
IH&S TECHNICIAN	
WVNSCO FACILITY REPRESENTATIVE	
SUBCONTRACTOR SUPERINTENDENT	
SUBCONTRACTOR SAFETY REP.	

THE FOLLOWING, CHECKED ITEMS, WERE REVIEWED DURING THIS BRIEFING:

- ☐ Elements covered by this permit
- ☐ Ownership of the GDP
- ☐ Utility Lines in the area (Indicate which are known, & which are unknown)
- ☐ Trench and/or foundation excavation limits (width & depth)
- ☐ Pre-Backfill Release Requirements (Signature requirements)
- ☐ PSOSS and URC Notification Requirements (Signature requirements)
- ☐ Utility Service Shut-off requirements, Shut-off Locations,
- ☐ Hand Excavation vs. Machine Excavation Requirements - Distance Requirements
- ☐ Ground Grids around Buildings
- ☐ Additional Information Sheet (if used)
- ☐ Proper installation of tracer wires for gas lines
- ☐ Proper installation of locator tape in utility trenches (12" below finished surface) (2 tapes at outboard edges, for trenches over 2' wide)
- ☐ Re-installation of locator tape over existing utilities, if disturbed by this project
- ☐ Field Change Procedure
- ☐ Need for As-Built Information and Photographs

DIVISION 1

SECTION 01050

LINES AND GRADES

PART 1 - GENERAL

1.1 SCOPE

A. This section specifies the requirements for the control of the lines, grades and levels for the WVNSCO NDA Cap and Groundwater Barrier Interim Measure. The Subcontractor is responsible to establish field control and layout the project for construction. The Subcontractor will retain the services of a New York State licensed land surveyor (Surveyor) to measure the constructed dimensions of the facility and check the measurements against the project requirements.

B. Job Conditions:

1. The Subcontractor is responsible to establish field control and layout of the subgrade for construction.

2. Service of the Surveyor is intended for WVNSCO's verification of the Subcontractor's compliance with the requirements of the Contract Documents and shall in no way relieve the Subcontractor of his responsibilities to provide his own inspection and quality control.

3. The surveyor will provide the Subcontractor with a grid, with points spaced approximately 50 feet apart, and at key locations such as grade breaks. At each grid point, the grade elevation of the liner will be provided. The grade elevations are based on the design elevations and the tolerances as discussed in part 3.2 of this section. The Base Datum is the North American Datum (NAD) 1927- U.S. State, Plane Zone 3103-New York West.

4. The Subcontractor will be responsible for survey control and layout of the entire project. The project layout should be based on the grade elevations provided by the Surveyor plus the tolerances stated in part 3.2 of this section.

5. The Surveyor will measure the constructed dimensions to determine if the constructed facility is within the design tolerances. Any areas not in compliance with the project requirements shall be repaired or replaced until they are within the design tolerance, at no additional cost to the WVNSCO.

6. The Surveyor will establish horizontal and vertical control points for the site, prior to initiation of site work. The Subcontractor will be responsible for maintaining these control points during construction and establishing temporary baselines and survey control points during construction.

7. The Surveyor will check the construction of each component of construction including:

- The prepared surface prior to subgrade fill placement
- The final prepared subgrade surface;
- The top of the groundwater barrier wall;
- Along each pipe and at manholes and other drainage structures.

8. In the event of a discrepancy between measurements made by the Subcontractor and the Surveyor, the measurements by the Surveyor will govern.

1.2 Related Work Specified Elsewhere

A. Section 02150 - Site Preparation and Demolition

B. Section 02200 - Embankment

C. Section 02210 - Soil-Bentonite Groundwater Barrier Wall

D. Section 02530 - Dewatering

E. Appendix A - Construction Quality Assurance/Quality Control (QA/QC) Plan

1.3 Submittals

A. Submit plan for construction survey control including survey equipment and location of baselines for control of work.

B. As-built documentation.

PART 2 - MATERIALS

None

PART 3 - EXECUTION

3.1 General

A. Prior to commencement of earthwork, the Subcontractor shall establish all necessary baselines, and horizontal and vertical control points, necessary to accurately complete the construction.

B. Survey measurements are required to be within 0.01 feet in horizontal location and within 0.01 feet in elevation.

C. The Subcontractor shall provide survey control during construction and shall measure the as-constructed facility to determine if it is within the required tolerances. When, in the opinion of the Subcontractor, the construction of each layer of the liner system is complete, he shall notify the Geotechnical Engineer.

3.2 Tolerances

The facility shall be constructed to the tolerances shown in the following table.

TOLERANCE TABLE

LAYER	ELEVATION TOLERANCE (FEET)		
	MIN.	GRADE TO	MAX.
Top of Subgrade	-0.08	0.0	0.08
Pipes	-0.02	0.0	0.02

3.3 Surveyor's Measurements

A. The Surveyor will measure the facility using an approximate 50-foot grid and at 50-foot intervals along pipes where the slope is greater than 4 percent, 25-foot intervals in areas where the slope is less than 4 percent, and at other key locations such as changes in grade (in toe of slope), at changes in direction and at devices and structures like manholes, valves, etc.

B. The Surveyor will measure the As-Built constructed location of the slurry wall.

C. The Engineer will notify the Subcontractor of any locations that are outside the specified tolerances so that they can be repaired or replaced.

D. The Surveyor will prepare final record plans for the project based on its measurements and on the Geotechnical Engineer's measurements of the depth of the slurry trench.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.3 (A)	Survey Control Plan	15 days prior to start of construction
1.3 (B)	As-built Documentation	Upon project completion

DIVISION 1

SECTION 01090

REFERENCE STANDARDS

PART 1 - GENERAL

1.1 SCOPE

A. The standards under which the work scope of this specification is to be performed **or** tested are specified throughout the contract documents. Where such standards are specified, it shall be understood that the latest revision or edition at time of submission of bids shall apply. Other standards may be substituted for those specified provided prior approval is obtained from WVNSCO in writing. If it is desired to deviate from the specified or approved standards, a statement of the exact nature of the proposed deviation shall be submitted for approval. In referring to standards the following abbreviations have been used:

Name	Abbreviation
American Association of State Highway & Transportation Officials 444 North Capitol Street NW *Washington, D.C. 2001*	AASHTO
American Concrete Institute P.O. Box 4754, Redford Station Detroit, MI 48219	ACI
American Institute of Steel Construction 1221 Avenue of the Americas New York, NY 10020	AISC
American Iron and Steel Institute 1000 16th Street, N.W. Washington, D.C. 20036	AISI
American National Standards Institute 1430 Broadway New York, New York 10018, U.S.A.	ANSI
American Society of Mechanical Engineers 345 East 47th Street New York, New York 10017	ASMS
American Society for Testing and Materials 1916 Race Street Philadelphia, Pennsylvania 19103	ASTM
American Welding Society 2501 Northwest 7th Street Miami, FL 33125	AWS

Name	Abbreviation
Factory Mutual 1151 Boston-Providance Tp. P. 0. Box 9102 Norwood, MA 02062	FM
Federal Specification Board U.S. Fed. Spec. do Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402	Mil.Spec.
Federal Specification General Services Administration Specification and Consumers Information Distribution Section (WFS/5) Washington Navy Yard, Building 197 Washington, D.C. 20407	FS
National Electrical Code National Fire Protection Association 470 Atlantic Avenue Boston, MA 02210	NEC
National Electrical Manufacturers Assoc. 2101 "C" Street N. W. Washington, D.C. 20037	NEMA
New York State Department of Transportation Standard Specifications Building 5, State Campus Albany, NY 12232	NYSDOT
Occupational Safety & Health Administration 200 Constitution Avenue N. W. Washington, D. C. 20210	OSHA
Underwriters Laboratories 333 Pfingsten Road Northbrook, IL 60062	UL

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

DIVISION 1

SECTION 01410

SUBCONTRACTOR' S CONSTRUCTION VERIFICATION

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the basic construction verification standards required of the Subcontractor in the performance of this specification. These standards shall be implemented for construction/installation work activities and are applied minimum good commercial business and workmanship practices for the performance of work for WVNSCO.

B. The subcontractor shall perform construction verification of all work. Specific construction verification activities are specified in the individual sections of this specification under the paragraph headed [Subcontractors Construction Verification.)

1.2 PROGRAM

A. Document and Change Control

1. The Subcontractor shall assure that all drawings or other construction documents which he originates clearly define standards consistent with contract requirements.

2. The Subcontractor shall ensure that the latest applicable drawings, specifications, and change notices are available at the time and place of construction verification.

3. The Subcontractor's process of drawing and specification control shall provide for the removal of obsolete information upon receipt of revised documents.

4. The Subcontractor practices shall provide for, maintain, and submit "As-Built" documentation as defined in the special provisions. This documentation shall be made available for WVNSCO review during construction. Finalized as—built drawings and specifications shall be provided to WVNSCO at completion of the contract.

5. The subcontractor shall maintain a current set of contract drawings. A method of statusing construction work, including work planned, work in progress and accepted work shall be devised, utilized, and updated regularly by the subcontractor. These documents shall be available at WVDP for review with WVNSCO personnel.

B. Procurement Control

1. The Subcontractor shall use a documented system for procurement control and pass on all technical and quality requirements to suppliers and/or subtier vendors/subcontractors.

2. Material controls shall consist of inspection upon receipt and/or verification of certified inspection and test reports. The Subcontractor shall verify that all reports, certifications, and inspection records are in compliance with WVNSCO specified

requirements. Specific receipt inspection requirements shall be followed when specified in the Subcontractor Construction Verification paragraphs of the individual sections of this specification (reference paragraph I below)

C. Instructions, Procedures, and Drawings

1. When procedures are required to perform specific tasks(construction or verification) , they shall indicate who is responsible for performing the activity(ies) and the methods required to perform them. Submittal and approval requirements for these procedures shall be defined in the applicable technical section of the construction specification.

2. Construction verification activities shall be performed using WVNSCO furnished documents and drawings or those approved by the subcontractor if the Construction Specification requires the use of such documents for the work activity. WVNSCO approval of subcontractor generated documents and drawings, when such approval is required, will be specified in the appropriate technical section of the Construction Specification.

3. Instructions and procedures used for construction verification activities shall identify the subject, purpose, scope, procedure (methods used) , acceptance criteria, responsibilities, resulting records, and required actions to take if the activity verified is nor acceptable.

D. Material Control

1. The Subcontractor shall identify and control materials, parts or components by tagging or marking to insure traceability to the intended use. Material shall be stored as defined in the Special Provisions and the individual sections of this specification.

2. Material controls will consist of either inspection upon receipt or verification of certified inspection and test data. The Subcontractor shall verify that all reports, certification, and inspection records are in compliance with WVNSCO specified requirements. Specific receipt inspection requirements shall be followed when specified in the Subcontractor Construction Verification section of the individual sections of this specification (refer to paragraph I below)

E. Inspection, Measuring, and Test Equipment Control

1. The Subcontractor shall use calibrated inspection, measuring, and test equipment to verify design dimensions, contours, or locations. This equipment shall be traceable to a certificate of calibration and to a calibration standard traceable to the National Institute of Standards and Technology standard or other nationally recognized standard. A tag on the instrument shall indicate calibration status. If no nationally recognized standard exists, the basic for calibration shall be documented.

2. Calibration and control measures may not be required for rulers, tape measures, levels, and other such devices if normal commercial equipment provides adequate accuracy.

F. Inspection and Test Control

1. The Subcontractor shall perform any and all construction verifications required by

this specification and specified codes and standards to ensure conformance to this specification. The Subcontractor shall maintain complete records of construction verifications and tests performed on material or parts. These records shall contain positive evidence that applicable characteristics required by contractual documents have been verified and accepted. Status shall be maintained through indicators such as physical location tags, markings, travelers, or other suitable means. -

G. Nonconformance Control

1. The Subcontractor's Construction verification practices shall ensure that items not in conformance with the design requirements are not installed.

H. Personnel Qualifications

1. Personnel who perform construction verification activities shall be experienced and trained to the requirements of this section. They shall not be those who actually perform the work being verified. They shall be familiar with the technical specifications, the requirements for construction verification, and submittals that are included in this specification. Certified inspection shall be required if specified in individual paragraphs of this specification and if required by the different codes invoked by this specification.

I. Construction Verification

1. The Subcontractor shall perform construction verification of all work. Specific construction verification activities that need to be documented are specified in the individual sections of this specification under the paragraph headed "Subcontractor Construction Verification".

J. WVNSCO Inspections

1. In addition to the mandatory construction verifications identified in the individual sections of this Construction Specification, WVNSCO may perform in-process inspections and perform final inspections as determined necessary to verify that specified technical and quality practices are accomplished and documented by the subcontractor in accordance with contractual requirements.

2. Any inspections or tests performed by WVNSCO or their designated agent(s) during the work shall in no way relieve the Subcontractor of the responsibility to conform to the contract documents.

K. WVNSCO Stop-Work Action

1. WVNSCO will have the authority to initiate a stop-work action if the Subcontractor is not meeting the safety, technical and/or quality requirements of this specification. Such action will not result in any claims against WVNSCO.

L. WVNSCO Final Acceptance

1. Final acceptance of the Subcontractor's completed work will be acknowledged by WVNSCO only upon completion of WVNSCO verification and acceptance of field work and final contract documentation.

M. Construction Verification Documentation

1. When construction verification documents are required by the specifications, each construction verification document shall contain the following information:

   a. Name and location of Supplier originating the document (letterhead, stamped, or written entries are acceptable)

   b. Date of construction verification document (date operation/activity is performed or document certified)

   c. WVNSCO Purchase Order Number.

   d. Name or title of quality document (e.g., Liquid Penetrant Examination and Verification Report)

   e. Page Number.

   f. Preparer and/or reviewer identification, including title and dates of action.

   g. If the construction verification document records the result of verification or acceptance of an item, the specific identification of the component(s) verified or accepted must be in the documentation. Also, the document must be specific with regard to acceptance or rejection of the component(s).

2. The construction verification document for all categories of information required as defined in this document and elsewhere in the Procurement documents shall be available to the WVNSCO representative during the surveillance visit.

3. Each construction verification document shall identify the preparer and/or the reviewer including title and date of action.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

DIVISION 1

SECTION 01420

SUBCONTRACTOR'S QUALITY ASSURANCE REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE

A. This section describes the overall Quality Assurance Program Requirements that apply to the contract. These requirements are based on the ASME/ANSI NQA-1 (1989) basic (BR) and supplemental requirements (SR) that apply specifically to this contract scope of work. Hold and witness points that apply to this contract scope defined and summarized in Section 01430 and identified in the specific technical specification section.

CHECKED PARAGRPHS IN THE LEFT MARGIN APPLY TO THIS CONTRACT. IF THE PARAGRAPH IS NOT USED, IT WILL BE LEFT NUMBERED AND LABELED "N/A" NOT APPLICABLE.

1.2 PROGRAM

A. The subcontractor shall submit a controlled copy of their Quality Assurance Program Manual for approval prior to commencement of work. The following criteria as described in ANSI/ASME NQA-1 (1989) shall be included in the subcontractor's Quality Assurance Program.

[X] 1. BR 1 – Organization

[X] 2. BR 2 – Quality Assurance Program

[X] 3. BR 3 – Design Control

[X] 4. BR 4 – Procurement Document Control

[X] 5. BR 5 – Instructions, Procedures, and Drawings

[X] 6. BR 6 – Document Control

[X] 7. BR 7 – Control of Purchased Items and Services

[X] 8. BR 8 – Identification and Control of Items

[N/A] 9. BR 9 – Control of Processes

[X] 10. BR 10 – Inspection

[X] 11. BR 11 – Test Control

[X] 12. BR 12 – Control of Measuring and Test Equipment

[N/A] 13. BR 13 – Handling, Storage, and Shipping

[N/A] 14. BR 14 – Inspection, Test, and Operating Status

[X] 15. BR 15 – Control of Nonconforming items

[X] 16. BR 16 – Corrective Action

[X] 17. BR 17 – Quality Assurance Records

[N/A] 18. BR 18 – Audits

[X] 19. 1S-1 – Supplementary Requirements for Organization

[X] 20. 2S-1 – Supplementary Requirements for the Qualification of Inspection and Test Personnel

[X] 21. 2S-2 – Supplementary Requirements for Organization of Nondestructive Examination Personnel

[N/A] 22. 2S-3 – Supplementary Requirements for Organization of Quality Assurance Program Audit Personnel

[N/A] 23. 2S-4 – Supplementary Requirements for Personnel' Indoctrination and Training

[X] 24. 3S-1 – Supplementary Requirements for Design Control

[X] 25. 4S-1 – Supplementary Requirements for Procurement Document Control

[N/A] 26. 6S-1 – Supplementary Requirements for Document Control

[N/A] 27. 7S-1 – Supplementary Requirements for Control of Purchased Items and Services

[N/A] 28. 8S-1 – Supplementary Requirements for Identification and Control of Items

[N/A] 29. 9S-1 – Supplementary Requirements for Control of Processes

[N/A] 30. 10S-1 – Supplementary Requirements for Inspection

[N/A] 31. 11S-1 – Supplementary Requirements for Test Control

[N/A] 32. 11S-2 – Supplementary Requirements for Computer Program Testing

[N/A] 33. 12S-1 – Supplementary Requirements for Control of Measuring and Test Equipment

[N/A] 34. 13S-1 – Supplementary Requirements for Handling, Storage, and Shipping

[N/A] 35. 15S-1 – Supplementary Requirements for the Control of Nonconforming Items

[N/A] 36. 17S-1 – Supplementary Requirements for Quality Assurance Records

[N/A] 37. 18S-1 – Supplementary Requirements for Audits

[X] 38 Non-mandatory appendices as required this contract scope includes the following:

LIST OF ALL REQUIRED NON-MANDATORY APPENDICES

B. In addition to the above NQA-1 requirements, the Subcontractor shall prepare and submit for approval prior to commencement of work a plan to insure that the quality requirement of the contract drawings are met.

C. Installation, inspection, and test procedures and work instructions specified in the contract shall be prepared and approved by the Subcontractor and submitted to WVNS for approval prior to the date that the document is required for use. These documents shall be kept current; revisions shall be submitted to WVNS for approval prior to implementation.

D. In the event a nonconforming item is identified by the Subcontractor, and dispositioned "use as is" or "repair" by the Subcontractor, a Supplier Nonconformance Report (SNR) form (Exhibit 01420-I) shall be submitted to WVNS for disposition review and concurrence. Work on the effected item(s) shall not continue until WVNS has concurred with or redispositioned the SNR.

E. When WVNS identifies a condition adverse to quality, WVNS will issue a request for corrective action (RCA) for (Exhibit 01420-II). The RCA will be directed to the Subcontractor via WVNS purchasing for identification of cause and actions taken by the Subcontractor to correct the adverse condition and corrective actions taken to prevent recurrence.

F. Quality Assurance Records shall be provided to WVNS by approval request at a minimum within two weeks of project completion or as otherwise defined in the contract documents.

G. WVNS will have the authority to initiate a stop-work action if the Subcontractor is not meeting the requirements of the contract, including the Quality Assurance requirements. Any such action will not result in any claim against WVNS. Work may resume when WVNS approves the Subcontractor's method of correction of any deficiencies.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not used

END OF SECTION

SUPPLIER NONCONFORMANCE REPORT (SNR)

(1) Page _____ OF _____

For Detailed instructions on filling out this report, see reverse side of document.

SNR No. _____

WVNSCO Distribution: QA Vendor File
Cognizant Engineer
Purchasing Representative (original)

AR No. _____

To: West Valley Nuclear Services Co. 10282 Rock Springs Road West Valley, New York 14171-9799 Attention:	(2) From:

(3) Item/Data Name and Serial Number(s)	(4) Drawing/Specification & Revision No.	(5) WVNSCO Purchase Order No.

(6) Quantity Nonconforming	(7) Date Discovered	(8) Next Higher Assembly (name/drawing)	(9) Related SNRs

(10) Identify Requirement(s) Violated

_____ Originator _____ Date

(11) Description of Nonconformance Attachments [ ] No [ ] Yes,

(12) Cause	(13) Recommended Disposition
[ ] Equipment/Material [ ] Procedure [ ] Personnel [ ] Design [ ] Training [ ] Management [ ] External Phenomena	[ ] Use-As-Is [ ] Scrap [ ] Repair [ ] Rework [ ] Conditional release requested. Conditional Release Justification: Rework/Repair Instruction attachment: _____

(14A) Supplier's Technical Justification	(14B) WVNSCO Justification	(17) Request For WVNSCO Action
		[ ] Approval [ ] Information

(15) Corrective Action Taken, Planned

(16) Planned Corrective Action Date: _____

(18) Supplier Signatures: _____ Engineering _____ Date _____ Quality Assurance _____ Date

(19) WVNSCO Disposition: *[ ] Approved (USQ screen required for Use-As-Is or Repair)
[ ] Disapproved
[ ] Conditional, List Attachments _____

SNR Affects Design: [ ] Yes, List ECN No. _____ [ ] No

_____ WVNSCO Cognizant Engineer _____ Date _____ Radiation Safety _____ Date

_____ WVNSCO Cognizant Manager _____ Date _____ Purchasing Date

_____ Quality Assurance _____ Date

(20) Disposition Action Completed and Approved	(21) SNR Completion Approval
Supplier QA Representative/WVNSCO Quality Assurance _____ Date	WVNSCO Quality Assurance _____ Date

*Is a USQD (USQP Form WV-3306, Sections V, VI, and VII) required? ☐ NO ☐ YES

*USQD Originator or Safety Analyst Signature _____ Printed _____ Date _____

*yes, attach the completed USQD (USQP Form WV-3306, Sections V, VI, and VII).

The issuance and acceptance of this report in no way limits or affects the warranty provisions of the order. This report shall not establish a precedent or obligation to accept similar conditions in the future.

Exhibit 01420-1

INSTRUCTIONS FOR COMPLETING THE SUPPLIER NONCONFORMANCE REPORT (SNR) FORM

Blocks (1) through (18) to be completed by Supplier and submitted to WVNSCO on a WVNSCO Approval Request (AR), form no. WV-19010.

If more space is required than provided, include the information on a supplement sheet, attach it to the SNR, and reference the attachment in the applicable block.

Correct number of pages to reflect number of attachments being included with SNR.
Supplier assigned SNR number, consisting of WVNSCO Purchase Order number and a sequential identifying number. (Example: 19-55555-1, 19-55555-2, etc.) Associated AR number on which SNR is being submitted to WVNSCO for approval. In "Mail To:" block: cognizant purchasing agent's name.

(2) Name, division, address, and telephone number of supplier originating SNR.

(3), (4), (5), (6), & (7)

(8) List the next higher assembly drawing to aid WVNSCO in identifying affected assembly or system.

(9) SNR number(s) which relate to item covered by SNR. (SNRs for items previously provided which have had similar causes or have affected other deliveries).

(10) Description of requirement which was violated by Nonconformance. Give sufficient detail such as drawing zone, specification paragraph number, tolerances, etc. Signature of supplier personnel responsible for discovering condition.

(11) Concisely describe Nonconformance as related to requirements violated in block(10). Additional supportive information such as inspection data sheets, sketches, pictures, etc., may be provided with SNR. If additional information is provided, check the"yes" block and list attachment description in list block.

(12) Check block which best identifies cause of Nonconformance.

(13) Check block which identifies recommended disposition of nonconforming item(s). If more than one disposition is being suggested, list quantity, serial numbers, or description of items associated with each disposition. If conditional release is being requested, check block and give full justification for request in block provided. If repair is recommended, attach sheet with suggested repair and re-inspection plan. Reference attachment in space provided.

The following are definitions of possible dispositions:

Use-As-Is (UAI) - Utilized when it can be established that nonconforming item or data is satisfactory for intended use and does not require any additional modification or correction.

Repair - Used when resolution of Nonconformance includes restoration of an item to a condition such that the capability of the item to function reliably and safely is unimpaired, even though that item does not conform to original specification requirements.

Scrap - Utilized to document a decision that a nonconforming item cannot be accepted as is, or economically repaired or reworked. Items with this disposition shall not be acceptable to WVNSCO and are to be discarded or returned to their source by Supplier.

Rework - Used when an item is made to conform to original requirements by completing correction action.

NOTE: SNRs with Use-As-Is or Repair disposition shall not be processed further until WVNSCO has provided written concurrence with the recommended disposition. SNRs with Scrap or Rework dispositions shall be sent to WVNSCO for information.

(14A) Technical justification for UAI and Repair dispositions only. Include technical reasons why it is to WVNSCO's advantage to approve requested disposition. Document justification on attachment sheet and reference attached sheet in block provided.

(15) Corrective Action Taken/Planned which defines action to be taken or planned in order to correct Nonconformance, and to prevent re-occurrence of like non-conformance.

(16) Expected corrective action completion date. If corrective action is already complete, state "completed on (date)."

(17) Self explanatory

(18) After review of form for content and correctness, provide Supplier signatures and date.

Blocks (14B) and (19) through (21) to be completed by WVNSCO personnel.

(14B) Describe effect on safety, reliability, performance, service life, site installation, maintainability, interfacing items, etc., supplier recommended disposition is to be accepted. Describe corrective actions taken to prevent recurrence of similar Nonconformance. Document effects and corrective action on attachment sheet and reference attached sheet in block provided.

(19) Check appropriate approval disposition block. If conditional block is checked, the conditions of approval shall be detailed in an attachment and be referenced in space provided. Check appropriate Engineering Change Notice (ECN) effect block. If "yes" block is checked, reference ECN No. and attach a copy of ECN, WVNSCO form No. WV-1839 to SNR. Check appropriate USQP block. If block (13) has been dispositioned either Use-As-Is or Repair, a USQP determination is required.

(20) Signed and dated by Supplier Quality Assurance Representative to indicate supplier **Repair**, **Rework**, or **Scrap** action is complete. *Signed and dated by WVNSCO Quality Assurance when disposition is Use As Is and requires no further action by supplier.* **Note**: Both signatures may be required in cases of multiple dispositions.

(21) When form is complete, all attachments as referenced are attached, and when final disposition is found acceptable, Quality Assurance shall sign and date to formally close-out SNR.

(22) Qualified USQ reviewer complete per WV-914.

After close-out, Quality Assurance shall forward the originals to the Purchasing Representative and copies to distribution list.

Exhibit 01420-2

DIVISION 1

SECTION 01430

QUALITY CONTROL REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE

A. This section includes the basic requirements for the quality control function that is to be performed by the Subcontractor including subtiers. Work shall not start in any phase of the contract scope until required submittals for that phase of work are submitted and approved by WVNS, including:

1. Requirements for inspection procedures.
2. Requirements for inspection personnel.
3. Requirements for testing laboratories.
4. Reporting of testing and inspection results.
5. Requirements for testing and inspection equipment.
6. Interface with WVNSCO QA/QC organizations.

B. Related Work

1. Each section of this specification contains a Quality Control paragraph. These paragraphs detail the specific inspection, testing, and acceptance requirements as they relate to that section of the specification.

1.2 RELATED SECTIONS

A. Each section of this specification contains a Quality Control paragraph. This paragraph details the specific inspection, testing and requirements as they relate to that section of the specification.

1.3 SUBMITTALS

A. The following shall be submitted as described under each individual specification section for approval. Submittal timing, content, and specification references shall be as shown in the individual sections.

1. All inspection and testing personnel. (As a minimum, a work and education history of quality control personnel shall be submitted to WVNSCO.)
2. Inspection and testing certifications issued by the Subcontractor or national agency.
3. Testing laboratories and agencies qualifications and certifications.
4. Inspection procedures and checklists.

5. Inspection reports.

6. Test reports.

7. NDE reports.

1.4 REFERENCES

A. Section 01420 – Subcontractor Quality Assurance Requirements

B. ASME NQA-1 (1989) – Quality Assurance Requirements for Nuclear Facilities

B. ASTM-E329 – Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

C. ASNT SNT-TC-1A (1980) – Recommended Practice for the qualification and certification of nondestructive testing personnel

1.5 QUALIFICATIONS

A. Construction Inspectors

1. Inspectors who follow the daily construction and verify that installation is in accordance with the contract documents shall have a minimum of five (5) years experience or three (3) years experience and an Associates Degree in the discipline they are inspecting. They shall be certified by the subcontractor to meet the basic and supplemental requirements of NQA-1 (1989).

B. Welding Inspectors

1 Weld Inspectors shall be familiar with manufacturer's field seam weld inspection requirements contained in the technical data and specifications for XR geomembranes.

C. Nondestructive Testing Personnel

1. Personnel performing NDT/NDE and interpreting results shall be qualified as NDT Level II in accordance with ASNT SNT-TC-1A (1980 or later).

2. NDT Level II and Level III personnel shall be certified in accordance with ASNT-SNT-TC-1a (1988 or later). Level III personnel performing inspection or test work shall meet the minimum requirements for NDT Level II.

3. All NDT Level II personnel shall work under an NDT Level III certified person.

D. Civil/Structural

1. Concrete and soils inspectors and technicians shall be certified by The American Concrete Institute or program approved by ACI Level I or II as appropriate. Or, the inspector shall be certified within a company program compliant to ANSI N45.2.6 or ASME NQA-1 (1989) Supplement 2S-1.

2. Nuclear density equipment operators shall be certified by the test equipment manufacturer.

E. Surveying

1. Party chief shall have five years experience in construction surveying and layout.

2. Instrument and rodmen shall have two years experience in construction surveying and/or layout.

F. Fire Protection

1. N/A

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Products used in the inspection or testing shall be certified by the manufacturer as meeting the requirements as specified by inspection standards, codes, or procedures, and this specification.

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS AND SURVEILLANCES

A. All permanent construction activities shall be inspected and documented.

B. Inspections shall be performed in accordance with approved procedures. The procedures shall include a checklist to ensure all items are properly inspected and documented.

C. Surveillances and other Quality Control activities shall be documented.

D. The inspection reports shall include as a minimum, the project, specification section, inspection procedure, inspector, codes and/or standards-used, deviations, and actions taken to resolve deviations.

E. Work shall not proceed beyond the Hold Points listed in Paragraph 4.1 without written authorization from WVNS.

3.2 TESTING AND EXAMINATION

A. Welding Inspection

1. Welding inspections shall be performed and documented in accordance with written procedures.

B. Nondestructive Testing (Hold Point)

1. NDT shall be performed and documented in accordance with procedures.

C. Testing (other than concrete)

1. All testing shall be conducted and documented in accordance with written procedures.

D. Concrete Testing

1. Concrete testing and inspections shall be performed in accordance with ASTM standards and/or ACI codes and standards.

2. Reports shall reference the proper standard as well as the specification requirements.

3.3 *TESTING AGENCY*

A. Testing agency may not approve or accept any portion of work and may not assume any duties of subcontractor whose responsibility it is to furnish materials and construction in full compliance with the contract documents.

B. Testing agency(s) shall promptly notify Subcontractor of any observed irregularities or nonconformance of work or products. Testing agency has no authority to stop work.

PART 4 - SUBCONTRACTOR HOLD AND WITNESS POINTS

A. The Hold Point prerequisites and inspections specified in this section and elsewhere in this specification shall be satisfied by the subcontractor. WVNS QA personnel shall verify the completion of these Hold Point prerequisites and inspections prior to issuing a written Hold Point release. The subcontractor shall notify WVNS of impending Hold Points as described below.

B. Hold Point Definition

1. A term used to describe mandatory point of <u>inspection</u> which <u>cannot</u> be passed until the Hold Point prerequisite(s) or inspections have been completed, verified, and signed off. In order for the inspection to be scheduled and the hold points released, notification is required a minimum of *24 hours prior to hold point preferably no later than two (2) hours before end of eight (8) hour* shift. The subcontractor shall not proceed without a written release from WVNSCO QA.

2. Hold Points for structural steel, stud welding, and pipe welding shall be considered released after the first weld of each process has been released. All subsequent welding of structural steel, pipe, and studs shall be considered Witness Points.

C. Inspection Definition

A phase of quality control which by means of examination, observation, or measurement determine the conformance of items, processes, or services to predetermined requirements. Inspection may involve the use of special equipment, tools, or procedures.

D. Witness Point Definition

1. Term used to describe point in an activity that WVNS may wish to observe. The witness point may be passed after WVNSCO has been notified, or later waived, or if WVNS fails to appear. Notification is required a minimum of 24 hours prior to witness point or five (5) working days when the location is in excess of 100 miles from WVNSCO. All witness points specified including those in vendor's or sub-tier contractor's facilities shall be witnessed by the subcontractor's Quality Assurance representative.

2. WVNS notification of the Witness Point inspections and tests specified in this section and elsewhere in this specification shall be the responsibility of the subcontractor. WVNSCO QA personnel may verify the witness point inspection or test after notification by the subcontractor.

4.1 SCHEDULE

A. *The subcontractor shall <u>hold</u> all work at the applicable hold points (when within the subcontractors*

work scope) until written release is obtained from WVNSCO. The reference after the hold point directs the Subcontractor to the section and paragraph describing the requirement.

SECTION	ARTICLE	REQUIREMENT
01420	1.2.B	Approval of Work Plan
01420	1.2.C	Approval of Installation, Inspection, Test Procedures, and Work Instructions

B. Witness Points - As applicable (when within the subcontractor's work scope).

SECTION	ARTICLE	REQUIREMENT

C. Additional inspection hold/witness points may be designated by WVNSCO during the review of the Subcontractor bid proposal and subsequent procedures including those submitted by subcontractors/suppliers/sub-tiers.

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES

PART 1 – GENERAL

1.1 SCOPE

A. This section describes the temporary facilities that the Subcontractor must provide for the Geotechnical Engineer as part of this contract.

B. Field Office and Geotechnical Testing Laboratory: This facility must have the following:

1. Independent structure, not shared
2. At least 300 square feet
3. Air conditioning and heating
4. Sink with tap for running water and countertop
5. Water holding tank with 500 gallon capacity
6. 120v, 15 ampere electrical service with ground fault interrupter protection
7. Windows and lighting
8. Waste water disposal
9. Cell phone service
10. Desk with two chairs
11. Table at least 30 inches by 60 inches working surface

C. Temporary Sanitary Facilities for the Geotechnical Engineer

D. The Subcontractor shall remove the temporary facilities at completion of the contract.

1.2 RELATED WORK ELSEWHERE

A. Section 02210: Soil-Bentonite Ground Water Barrier Wall

PART 2 – MATERIALS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
No Submittals Required		

DIVISION 2

SECTION 02010

SUBSURFACE EXPLORATIONS AND PIEZOMETER INSTALLATION

PART 1– GENERAL

1.1 SCOPE

A. The Subcontractor shall furnish all labor, material, and equipment to complete borings along the soil-bentonite slurry wall trench as shown on the Contract Drawings and as described in this Section.

B. The Subcontractor shall furnish all labor, equipment and materials to complete test borings and the installation of piezometers in the those borings located on both sides of the ground water barrier, as shown on the Contract Drawings.

C. The Subcontractor shall provide an experienced geologist, acceptable to the Geotechnical Engineer, to observe the soil samples as they are retrieved from the sampling spoon, to describe the soil samples and log the descriptions on a log for each boring. The geologist shall be familiar with the geology at the NDA site and be capable of distinguishing the weathered Lavery Till from the unweathered Lavery Till.

D. The Subcontractor shall prepare logs of the observations made in each boring and submit the logs for review to the Geotechnical Engineer.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02210: Soil-Bentonite Ground Water Barrier Wall

1.3 REFERENCE STANDARDS

A. The latest revision of the following standards of the American Society of Testing and Materials (ASTM) are hereby made a part of these specifications.

ASTM D 5434	Field Logging of Subsurface Explorations of Soil and Rock
ASTM D 420	Site Characterization for Engineering, Design, and Construction Purposes
ASTM D 1586	Test Method for Penetration Test and Split-Barrel Sampling of Soils
ASTM D 2487	Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 5092	Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers.

1.4 SUBMITTALS

A. The Subcontractor shall submit the qualifications of the geologist proposed for logging the test borings to the Geotechnical Engineer for approval at least 15 days before mobilizing the drilling rig to the site.

1.5 PROJECT RECORDS

A. Submit 3 copies of boring logs.

B. Accurately record:

1. Date of test boring (start and completion).
2. Depth of samples referenced to a consistent elevation.
3. Type of samples (Split spoon, Shelby tube, etc.).
4. Description of soils collected in the sampler, including major and minor components.
5. The length in inches of the sample recovered in the split spoon sampler or Shelby tube.
6. Classification according to ASTM D 2487 of soils removed from the split spoon sampler.
7. Blows per 6-inch interval of split spoon penetration following ASTM D 1586.
8. Blows required to advance the casing, if used.
9. Standard Penetration Test N-value.
10. Depths at which soil types change.
11. Elevations of ground surface within 6 inches of the test boring location, the Geotechnical Engineer will provide a benchmark on the project site for reference.
12. Depths to water levels in the test borings, the time that these measurements were made, the depth of the test boring when the measurements were made and the depth of the casing when the measurements were made.

PART 2 – MATERIALS

2.1 SLOTTED PVC WELL SCREEN

A. The well screen shall consist of flush threaded, 2-inch diameter, schedule 40, PVC pipe with 0.006-inch slot size.

2.2 SOLID PVC RISER PIPE

A. The well riser shall consist of 2-inch diameter, Schedule 40 PVC pipe with threaded flush joint fittings and a vented cap.

2.3 FILTER SAND

A. The filter sand surrounds the well screen and shall consist of Morie No. 00 quartz sand.

2.4 BENTONITE SEAL

A. The well seal shall consist of bentonite pellets such as BENTONITE PLUG, manufactured by Black Hills Bentonite, or equivalent approved by the Geotechnical Engineer. The bentonite pellets shall be hydrated upon backfilling.

2.5 CEMENT/BENTONITE GROUT

A. Cement/bentonite grout shall consist of 94 pounds of Portland cement and 3 to 4 pounds of powered sodium montmorillonite clay mixed with 6.2 gallons of potable water.

2.6 PROTECTIVE CASING

A. The protective casing shall be a 5-foot long, 6-inch diameter, locking stainless steel, casing schedule 80, such as that from Deitrich Drilling, or equivalent approved by the Geotechnical Engineer.

B. The protective casing shall be equipped with a 1/4–inch diameter vent hole near the ground surface.

C. A protective casing shall be installed at all monitoring locations.

PART 3 – EXECUTION

3.1 SURVEY

A. The Subcontractor's surveyor shall stake the boring locations along the soil-bentonite wall alignment. The borings shall be drilled within 12 inches of the locations shown.

The Subcontractor's surveyor shall measure the ground surface elevation at each boring location using optical survey techniques.

B. The Subcontractor's surveyor shall measure the location of each boring relative to the site coordinate system using optical survey techniques.

3.2 DRILLING TEST BORINGS

A. The Subcontractor shall furnish the labor, material, and equipment required to complete the test borings at the locations shown on the contract drawings.

B. The Subcontractor shall begin each boring by driving the standard split spoon sampler 24 inches, retrieving the sampler, opening it to remove the soil sample, advancing the hollow stem augers 24 inches (with the plug inserted in the center of the augers), removing the plug and inserting the split spoon sampler to collect the next soil sample. This process shall be repeated until the boring has reached 24 feet below the ground surface or 5 feet into the unweathered Lavery Till, whichever is deeper.

C. The Subcontractor shall make all reasonable attempts to collect a soil sample from each sampling interval.

D. The Subcontractor shall not collect more than one soil sample without advancing the augers.

E. If a sufficient size soil sample is not retrieved the Subcontractor shall make a second attempt to collect a sample from the same sampling interval.

F. The Geotechnical Engineer may, at his discretion, direct the Subcontractor to alter the techniques being used if soil sample recovery is inadequate to accurately identify the depth of the base of the weathered Lavery Till.

G. The Geotechnical Engineer will review the information collected from the test borings and may add borings to the subsurface exploration program if the planned program does not adequately define the base of the weathered Lavery Till elevation.

H. Alternatively, the Subcontractor may propose to use a Geoprobe to complete this work. In its proposal, the Subcontractor must submit information that demonstrates it can accurately identify the base of the weathered Lavery till with the Geoprobe.

3.3 PREPARING SOIL BORING LOGS

A. The Subcontractor's geologist shall carefully observe each soil sample retrieved with the split spoon sampler and not the soil type soil classification and all secondary features, such as, but not limited to, desiccation cracks, soil structure, filling in desiccation cracks, etc.

B. The logs must identify the depth at which the vertical cracks in the soil structure no longer appear.

C. The logs must include a verbal description of each soil sample and the USCS classification for each sample.

D. The logs must include the ground surface elevation measured by the Subcontractor's surveyor using optical survey techniques.

E. The logs must include the site coordinates of the respective boring.

F. The logs must include all water level measurement data.

3.4 MEASURING WATER LEVELS

A. The Subcontractor shall measure the depth below the ground surface of standing water in the hollow stem augers at the following intervals:

1. When first observing wet soil samples

2. At completion of the boring, but before beginning to backfill the boring.

3.5 BACKFILLING BORINGS

A. The Subcontractor shall fill the borings with spoil from the boring as the augers are withdrawn from the ground.

B. The Subcontractor shall tamp the surface of the backfill at the base of the augers at intervals no longer than 2 feet.

3.6 PIEZOMETER INSTALLATION

A. The Subcontractor shall place piezometer equipment into the completed borehole such that it is centered in the borehole. The Subcontractor shall equip the rise pipe with centralizers if necessary to maintain the alignment of the riser pipe.

B. The Subcontractor shall slowly tremie the filter pack material into the borehole so that it does not form a bridge. Tamping lightly may be required.

C. The Subcontractor shall construct the bentonite seal by slowly adding bentonite pellets into the borehole such that they do not bridge. The subcontractor shall add water to the borehole to cause the bentonite pellets to hydrate.

D. The Subcontractor shall backfill the well with cement/bentonite grout using the tremie method such that the piezometer conforms to the dimensions shown on the Contract Drawings.

3.7 SITE RESTORATION

A. All work areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Subcontractor shall clean up the entire work area to the satisfaction of the Geotechnical Engineer.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.4 (A)	Geologist Qualifications	15 days prior to mobilizing the drilling rig
1.5 (A)	Copies of boring logs	Upon completion and before payment

DIVISION 2

SECTION 02110

EROSION AND SEDIMENTATION CONTROL

PART I – GENERAL

1.1 SCOPE

A. The Subcontractor shall furnish all labor, material, and equipment to complete installation of and maintain Erosion and Sedimentation Control facilities and other construction in accordance with the Contract Drawings and these Specifications.

B. In addition to the erosion control measures shown on the Contract Drawings, the Subcontractor shall provide adequate means to prevent any sediment from entering any storm drains, drop inlets, ditches, streams, or bodies of water downstream of any area disturbed by construction and shall comply with the SWPPP for this project. Excavation materials shall be placed upstream of any trench or other excavation to prevent sedimentation of off-site areas. In areas where a natural buffer area exists between the work area and the closest stream or water course, this area shall not be disturbed.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Embankment

B. Section 02530 - Dewatering

C. Section 02930 - Revegetation

D. Appendix B - Stormwater Pollution Prevention Plan

1.3 REFERENCE STANDARDS

A. The latest revision of the following standards of the American Society of Testing and Materials (ASTM) are hereby made a part of these specifications.

ASTM D 3786	Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.
ASTM D 4355	Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.

ASTM D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

B. Note that the New York Guidelines for Urban Erosion and Sediment Control are also hereby referenced, as are relevant components of the Stormwater Pollution Prevention Plan (SWPPP) for the facility.

1.4 SUBMITTALS

A. Prior to mobilizing to the site, the Subcontractor shall submit a work plan identifying the specific measures to be taken to control erosion and sedimentation during construction. The work plan shall outline the construction sequence to address the steps that will be taken to limit the potential for erosion and prevent offsite sediment transport in each area of earthwork construction to include stockpiles, the NDA area, along the groundwater barrier wall and mixing area and along access roads. The plan shall be consistent with the SWPPP for this project. The SWPPP provides an outline for erosion and sediment control during the different phases of the work and minimum requirements for structural controls. The work plan shall follow the plan outlined in the SWPPP and provide specific details for stormwater structures necessary to meet the requirements outlined in the SWPPP and the SPDES Permit for this project. Controls in addition to those shown in the SWPPP shall be implemented, at no additional cost to WVNSCO, if necessary to comply with the requirements of the permit.

The work plan shall identify the Subcontractor's designated representative who will be responsible for implementing the steps outlined in the work plan and for performing the inspections of erosion and sediment control devices and for assuring that required maintenance of those devices is performed in a timely manner. This individual shall be a "licensed certified professional" meaning a person currently licensed to practice engineering in New York State or a person who is a Certified Professional in Erosion and Sediment Control (CPESC) or the geotechnical engineer (see Appendix A, paragraph 2.12).

B. The Subcontractor shall submit certification that the silt fence meets the required specifications at least 15 days prior to delivery of the material to the Site.

C. The Subcontractor shall submit manufacturer's data for the erosion control matting including specifications and installation instructions.

PART II – MATERIALS

2.1 SILT FENCE

A. Silt fences shall be constructed as shown on the Contract Drawings. Silt fence shall consist of geotextile, stretched, and supported by posts and wire mesh backing. Silt fence shall conform to the following properties:

1. Posts: Posts shall be 4 feet long.

2. Geotextile: Geotextile shall be a woven geotextile made specifically for sediment control. The geotextile shall conform to the properties tabulated below.

REQUIRED SILT FENCE FILTER FABRIC PROPERTIES

PROPERTY	TEST METHOD	UNITS	VALUE[1]
Grab Tensile Strength[2]	ASTM D 4632	lbs	100 x 100
Grab Elongation	ASTM D 4632	%	15 (Max.)
Trapezoidal Tear Strength[2]	ASTM D 4533	lbs	50 x 50
Burst Strength	ASTM D 3786	psi	265
Puncture Resistance	ASTM D 4833	lbs	55
Ultraviolet Resistance (500 hrs)	ASTM D 4355	%	Minimum 70% strength retained
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	20 (Max.)/40 (Min.)
Permittivity	ASTM D 4491	sec^{-1}	0.20 (Min.)

Notes:
1. Minimum Average Roll Value (MARV).
2. Values for machine and cross machine direction (MD x XD), respectively.

2.2 HAYBALES

A. Hay bales may be used by the Subcontractor in place of silt fence, or in addition to the silt fence. Hay bales shall consist of undecayed firmly-packed straw or hay, nominal size of 14 inches to 18 inches by 36 inches as prepared by any standard hay baling machine and firmly bound by at least 2 separate circuits of rope or band material which will withstand weathering for a minimum of 3 months.

2.3 SEPARATOR GEOTEXTILE

A. Separator geotextile shall conform to the requirements listed in Section 02300 of these Specifications.

2.4 EROSION CONTROL MATTING

A. Erosion control matting to be used in revegetation and for stabilization shall consist of Curlex I (.73) Fibrenet or equivalent product approved by the Geotechnical Engineer.

2.5 PRAP

A. Riprap shall conform to the requirements listed in Section 02610 of these Specifications.

2.6 MPORARY AND PERMANENT GROUND COVER

A. The Subcontractor shall provide temporary or permanent ground cover adequate to control erosion on slopes or other areas within 14 days following completion of grading unless it is expected that the construction activity will be resumed in 21 days.

PART III – EXECUTION

3.1 ESTABLISHMENT OF EROSION CONTROL DEVICES

A. All erosion control structures shall be constructed according to the Contract Drawings and these Specifications.

B. Due to the nature of the work the Subcontractor should anticipate that the location and nature of the erosion control devices might need to be adjusted on several occasions to reflect the current phase of construction.

C. Erosion control devices shall be established prior to the work in a given area. Where such practice is not feasible, the erosion control device(s) shall be established immediately following completion of the clearing operation.

D. Erosion control devices shall be established prior to the work in a given area. Where such practice is not feasible, the erosion control device(s) shall be established immediately following completion of the clearing operation.

E. Sediment barriers consisting of temporary berms, diversions, or other barriers that are constructed to retain sediment on-site by retarding and filtering storm water runoff shall be used at storm drain inlets and across minor swales and ditches as shown on the plans.

F. The construction schedule adopted by the Subcontractor will impact the placement and need for specific devices required for the control of erosion. The Subcontractor shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation.

G. The location and extent of erosion control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from construction areas. All deviations from the control provisions shown on the Contract Drawings shall have the prior approval of the Geotechnical Engineer.

H. The Geotechnical Engineer or subcontractor may order that additional erosion and sediment controls be installed at any time. The Subcontractor shall comply with Geotechnical Engineer's or WVNSCO's request and immediately install the required controls.

3.2 MAINTENANCE OF EROSION CONTROL DEVICES

A. The Subcontractor shall furnish the labor, material, and equipment required for maintenance of all erosion control devices. Maintenance shall be scheduled as required for a particular device to maintain the removal efficiency and intent of the device.

B. All erosion control devices shall be inspected immediately after each significant rainfall event, and appropriate maintenance conducted.

C. Maintenance shall include, but not be limited to:

1. The removal and satisfactory disposal of trapped sediments from basins or silt barriers;

2. Filter fabrics used as silt fence shall be replaced when the material is ripped or torn.

3. Replacement of any other components that are damaged or cannot serve the intended use.

D. Sediments removed from erosion control devices shall be disposed of in locations that will not result in off-site sedimentation as approved by the Geotechical Engineer.All erosion control structures shall be maintained to the satisfaction of the Geotechnical Engineer until the site has been stabilized.

E. The Subcontractor shall remove sediments in each detention basin each time the forebay is 50 % full and prior to demobilization from the site.

3.3 FINISH GRADING

A. All disturbed areas shall be uniformly graded to the lines, grades, and elevations shown on the Contract Drawings. Finished surfaces shall be reasonably smooth, compacted, and free from irregular surface changes. Unless otherwise specified, the degree of finish shall be that ordinarily obtainable from either blade or scraper operations. Areas shall be finished to a smoothness suitable for application of topsoil.

3.4 SEEDING

A. Seeding shall conform to the requirements of Section 02930 of these Specifications.

3.5 CLEANUP

A. The Subcontractor shall remove from the NDA site all subsoil excavated from his work and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.

B. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Subcontractor shall clean up the entire landscaped area to the satisfaction of the Geotechnical Engineer.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.4 (A)	Erosion and Sediment Control Work Plan	Prior to mobilization
1.4 (B)	Silt Fence Certification	15 days prior to delivery
1.4 (C)	Manufacturer's Data for Erosion Control Matting	15 days prior to delivery

DIVISION 2

SECTION 02140

DUST CONTROL AND WORK AREA MAINTENANCE

PART 1 - GENERAL

1.1 SCOPE

A. Dust control will be of importance during construction activities at the site. The Subcontractor shall conduct operations and maintain the project site, haul roads, and stockpile areas, so as to minimize the creation and dispersion of dust.

B. Airborne dusts shall be controlled toward protection of the respiratory health of subcontract personnel employed on the project and of any exposed staff of the project host organization.

PART 2 - MATERIALS

A. Water for dust control is available at the site from WVNSCO.

B. Chemical dust suppressants shall not be used.

PART 3 - EXECUTION

A. The Subcontractor shall implement strict dust control measures during active construction periods on site. These control measures will generally consist of water applications that shall be applied a minimum of once per day or more often during dry weather as required to prevent dust emissions or as directed by the Geotechnical Engineer or WVNSCO.

B. Existing access roads shall be used by the Subcontractor whenever possible. If new haul roads are required to access the work areas, then the Subcontractor shall obtain approval from the Geotechnical Engineer and WVNSCO prior to their construction. All haul roads used during execution of work, whether temporary haul roads created by the Subcontractor or existing site roads, shall be maintained by the Subcontractor. Unless otherwise approved by the WVNSCO, temporary haul roads will be restored by smooth grading and seeding to re-establish vegetation.

C. Monitoring wells and other permanent site features such as pump controllers, pipes and cleanouts have been installed and are located throughout the site. The Subcontractor shall protect the existing features from damage during construction. Measures taken to protect the existing features from damage will include flagging and construction of barricades. Any damage caused by construction activities will be repaired and damaged equipment will be replaced by WVNSCO at the Subcontractor's expense.

D. The subcontractor shall conduct air sampling to determine dust levels created by the construction activities. Background dust levels shall be measured upwind of the project worksite on a periodic basis using direct-reading optical/electronic instrumentation capable of size differentiation of particles sampled and of reporting results in real time. Size sorting capability shall be as follows (mean aerodynamic diameter):

% less than 10 micrometers
% less than 2.5 micrometers

Airborne dust will be measured downwind of the work on a periodic basis to evaluate for health and safety concerns. When downwind concentrations of airborne dusts exceed three times background, dust control measures shall be applied to control dust evolution. Dust control measures shall consist primarily of water spray.

All subcontract personnel employed on this project shall be medically evaluated for fitness to wear air-purifying respirators and shall be trained in respiratory protection. All subcontract personnel employed on this project shall be fit-tested for at least one type of respiratory protection device suitable for protection against mineral dusts, nuisance dusts, particulates not otherwise regulated. NIOSH-approved disposable dust respirators or re-usable air purifying respirators fitted with dust filtering cartridges will be considered acceptable.

If total dust levels exceed 50 mppcf* (15 mg/m^3), then respiratory protection will be donned and dust control measures will be further evaluated and strengthened.

If the respirable fraction of total dust exceeds 15 mppcf (5 mg/m^3), then respiratory protection will be donned and dust control measures will be strengthened.

Respirable dust shall be defined as that fraction of the total dust in which the particulate has a mean aerodynamic diameter of less than 10 micrometers.

*mmpcf – million particles (nuisance dust) per cubic foot (of air)

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
No Submittals Required		

DIVISION 2

SECTION 02150

SITE PREPARATION AND DEMOLITION

PART 1 - GENERAL

1. 1 SCOPE

A. The Subcontractor shall furnish all labor, materials, tools and equipment, and perform all operations necessary for site preparation, clearing, grubbing, stripping, demolition and stockpiling topsoil.

B. The structures located in the northeast sector of the NDA, except the LPTS building, shall be demolished to the existing ground surface elevation. WVNSCO will remove slabs on grade, but below grade structures such as foundations shall remain, as shown on the Contract Drawings.

C. Definitions

1. Topsoil: The surficial material consisting of organic, highly compressible soils.

1. 2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01050 - Lines and Grades

B. Section 02200 - Embankment

C. Section 02210 - Ground Water Barrier Wall

D. Section 02650 - Dewatering

E. Appendix A - Construction Quality Assurance/Quality Control (QA/QC) Plan

PART 2 – MATERIALS

None

PART 3 - EXECUTION

3. 1 CLEARING AND GRUBBING

A. The Subcontractor shall clear and grub according to Section 201 of the New York State Department of Transportation (NYSDOT) Standard Specifications.

3. 2 TOPSOIL REMOVAL

A. All of the topsoil shall be removed from the areas within the proposed construction of the ground water barrier wall, as shown on the Contract Drawings.

B. Topsoil shall be stockpiled onsite in an area designated by WVNSCO and Geotechnical Engineer.

C. Erosion and sediment control shall be provided downgradient of the topsoil stockpile as described in Section 02110.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
No Submittals Required		

DIVISION 2

SECTION 02200

EMBANKMENT

PART 1 - GENERAL

1.1 SCOPE

A. This section specifies the work required to construct the NDA cap grades, construct berms, construct the ground water barrier wall working platform and the haul roads and other incidental items shown on the plans.

B. Definitions

1. Excavation: the removal of earthen materials from the subgrade, the stockpile or previously placed soil that is unsuitable.

2. Backfilling: the placement and compaction of earthen materials on the prepared subgrade.

3. Authorized excavation: the excavation of soils to the limits shown on the plans. It includes excavation of soil considered unsuitable by the Geotechical Engineer.

4. Unauthorized excavation: excavation beyond the limits shown and not authorized by the Geotechnical Engineer.

5. Subgrade: the existing ground surface on the NDA.

6. Embankment Surface: the surface upon which the geomembrane cap system will be constructed and the surface of individual lifts of embankment material.

7. Embankment Material: the material used to grade the site area, construct berms, backfill excavations or raise site grades.

C. Job Conditions

1. The Subcontractor is required to strip topsoil from the ground water barrier wall alignment. Topsoil shall be stockpiled on site, at a location specified by WVNSCO.

2. The Subcontractor must coordinate work of all sub-subcontractors and with WVNSCO.

3. The Subcontractor shall strip all rip rap from the base of the storm water basins to allow construction of clay liners and embankment materials on a stable subgrade. Rip rap shall be placed on the surface of the NDA and buried as part of Embankment construction.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02150 - Site Preparation and Demolition

B. Section 02530 - Dewatering

C. Section 02400 - Geomembrane

D. Appendix A - Construction Quality Assurance/Quality Control (QA/QC) Plan

1.3 REFERENCE STANDARDS

ASTM D 1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft^3 (2,700kN-m/m^3))

NYSDOT Standard Specifications

1.4 SUBMITTALS

A. The Subcontractor shall submit the following:

1. At least two weeks before material placement, submit specifications for the proposed compaction equipment including weight (both static and dynamic) and dimensions of the pads on the roller drums.

2. The source of imported borrow materials and test data demonstrating that these materials meet specifications.

3. Preconstruction testing of clay liner samples.

PART 2 – MATERIALS

2.1 TYPE A EMBANKMENT MATERIAL

A. This material is used for filling to create the final grades on the NDA within 12 inches of the geomembrane.

B. The material shall be obtained from designated areas at the WVNSCO site or from an approved borrow source and shall be free of deleterious materials such as organics, roots, topsoil, ice, frozen soil, saturated soil or other matter considered unsuitable by WVNSCO.

C. The maximum particle size shall be limited to 1 inch.

2.2 TYPE B EMBANKMENT MATERIAL

A. This material is used for filling over the existing NDA cap from the existing ground surface to the base of the Type A Embankment Material, for building berms as part of the final cap grading plan and for the groundwater barrier working platform.

B. The material shall be obtained from designated areas at the WVNSCO site or from an approved borrow source and shall be free deleterious materials such as organics, roots, topsoil, ice, frozen soil, saturated soil or other material considered unsuitable by WVNSCO.

D. The maximum particle size is limited to 3 inches.

2.3 SAND AND GRAVEL FILL

A. Sand and gravel fill shall be used on the gravel access roads and shall consist of crushed stone, crushed gravel or screened gravel meeting the requirements of NYSDOT Specifications Section 304 Type 4. Slag will not be permitted.

B. Sand and gravel fill shall meet the physical requirements described in the NYSDOT Specifications Section 304.

C. The material shall be free of all deleterious matter such as ice, organics, frozen soil, saturated soil, or other matter considered unsuitable by the Geotechical Engineer.

2.4 GEOMEMBRANE BALLAST

A. Sand shall be used to weigh the geomembrane and hold it in place to resist uplift loads.

B. Sand used as geomembrane ballast shall comply with Section 703-07 "Concrete Sand" of the NYSDOT Standard Specifications.

2.5 ANCHOR TRENCH BACKFILL

A. The geomembrane anchor trench shall be backfilled with gravel to secure the geomembrane in place and to provide surface water drainage.

B. The anchor trench backfill shall conform with Section 703 "Fine Aggregate," Size Designation 1A (Table 703-4) of the NYSDOT Standard Specifications.

2.6 ANCHOR TRENCH CAP MATERIAL

A. This material shall be placed over the anchor trench backfill along the east side of the NDA.

B. Anchor trench cap material shall be crushed stone, crushed gravel or screen gravel, complying with Section 703-02 "Coarse Aggregate" of the NYSDOT Standard Specification, Size designation 3.

2.7 REMEDIATION STONE

A. Areas failing the proof rolling shall be covered with a 1-foot thick layer of remediation stone.

B. Remediation Stone shall be crushed stone meeting NYSDOT Standard Specifications section 703-4. Its gradation shall be an equal blend of stone meeting Size Designation 2 and Size Designation 3.

2.8 SUBGRADE GEOGRID

A. The subgrade in areas failing the proof rolling shall be covered with Subgrade Geogrid to the limits determined by the Geotechnical Engineer.

B. Subgrade geogrid shall be ACE GG 600-I manufactured by ACE Geosynthetics, or an equivalent approved by the Geotechnical Engineer.

2.9 CLAY LINER

A. Clay Liner shall be placed beneath the geomembrane in the storm water detention areas, as shown on the Drawings.

B. Preconstruction testing on samples of Clay Liner shall demonstrate that its permeability is equal or less than $1x10^{-6}$ centimeters per second when compacted to 90 percent of the maximum dry density measured in the modified Proctor test (ASTM D 1557) at a moisture content equal to optimum moisture content.

C. Clay Liner shall have a maximum particle size of 1 inch.

PART 3 - EXECUTION

3.1 SURFACE PROOF ROLLING

A. After the site is prepared in accordance with Section 02150, the Subcontractor shall proof roll the NDA subgrade as described in the Construction QA/QC Plan.

B. The Geotechnical Engineer will observe the proof rolling following the procedure described in the QA/QC Plan

C. The Subcontractor shall remediate areas that fail to meet the proof rolling criteria.

D. The Subcontractor shall cover subgrade areas that fail proof rolling with a subgrade geogrid to the limits identified by the Geotechnical Engineer.

E. The Subcontractor shall cover the subgrade geogrid with a layer of remediation stone, as shown on the Drawings.

3.2 TEST PAD-TYPE A EMBANKMENT MATERIAL

A. Purpose: The Subcontractor shall construct a test pad, using Type A Embankment Material, to verify the suitability of the Subcontractor's proposed equipment and methods to provide soil compaction characteristics to guide the Geotechnical Engineer and Subcontractor during construction of NDA cap, berms and ground water barrier wall working platform.

B. Frequency:

1. One test pad is required if soil properties and the Subcontractor's equipment do not change through the duration of the project.

2. If the Subcontractor changes compaction equipment or procedures, the test pad must be repeated.

C. Requirements: Test pad requirements follow:

1. Test pad dimensions: 20 feet wide (minimum) by 50 feet long (minimum). The loose lift thickness shall be the maximum for which the specified density may be achieved with a reasonable number of passes of the equipment (but no greater than 12 inches).

2. Soil moisture and placement density shall be within the range determined by the Geotechnical Engineer, based on pre-construction testing and evaluation.

D. Engineer's measurements:

1. The Field Technician shall measure the in-place dry density of each lift of the test pad.

2. The Subcontractor shall measure the thickness of the lifts in both the compacted and uncompacted states.

3. The minimum number of passes required to achieve the desired results will be evaluated by the Geotechnical Engineer.

3.3 PLACEMENT – TYPE A and TYPE B EMBANKMENT MATERIAL

A. The Subcontractor shall place embankment material in loose lifts, not exceeding the maximum allowable thickness determined from the results of the test pad. The maximum allowable loose lift thickness is 12 inches. The maximum thickness may be less depending on the Subcontractor's equipment.

B. The Subcontractor shall use equipment appropriate for spreading the embankment material in a uniformly thick layer across the lift.

C. The Subcontractor shall place the embankment material fill at a moisture content near the required moisture content, so that significant adjustment of the moisture content is not required on the cap. Significant moisture adjustment should be done at the borrow area.

3.4 EMBANKMENT COMPACTION

A. The Subcontractor shall compact each lift of embankment material with the same roller equipment approved before construction.

B. Each lift of embankment material shall be compacted sufficiently to destroy all clay clods and knead the soil mass together, producing a uniform, homogeneous mass free of all defects, cracks and fissures.

C. The Subcontractor shall compact the embankment material until all in-place density tests satisfy the following:

1. The dry density is 90 percent of the maximum dry density measured in the modified Proctor test (ASTM D1557).

2. The in-place moisture content is between -3 and +3 percent of the optimum moisture content measured in the modified Proctor test (ASTM D1557).

D. The surface of the embankment surface and any completed lift shall be scarified, a minimum depth of ½ inch or to the depth of desiccation cracks, whichever is greater, before placing a subsequent lift of embankment material. Scarification shall be done with the cleats of a bulldozer or a sheepsfoot roller, or using other equipment, as necessary, to scarify the lift to the depth of desiccation cracks.

E. The surface of the completed lift shall be moistened after scarifying if, in the opinion of the Geotechnical Engineer, the moisture content of the lower lift (embankment surface) is too low to create bonding between the two lifts.

3.5. PROTECTION-EMBANKMENT MATERIAL

A. The Subcontractor is responsible for protecting the embankment material that has been placed and/or compacted from degrading.

1. Embankment material, which has dried, shall be scarified, moistened, re-compacted and re-tested or removed. If removed, the soil shall be removed to the depth of unaffected soil, as determined by the Geotechnical Engineer.

2. The embankment material shall be protected from freezing. Any embankment material that has frozen shall be removed to a depth of previously unfrozen soil, as determined by the Geotechnical Engineer.

3. The Subcontractor shall prevent the embankment material from becoming saturated. Soil that becomes excessively wet shall be scarified, allowed to dry, re-compacted and re-tested or shall be removed. If soil is removed, the base of the excavation to remove the soil shall extend to a depth where, in the opinion of the Geotechnical Engineer, the embankment material has not been disturbed.

4. The Subcontractor shall repair any damage to the embankment surface from erosion by excavating and replacing embankment material to the depth of undisturbed embankment material to the satisfaction of the Geotechnical Engineer.

B. At the end of each working day, the Subcontractor shall compact the surface with a smooth drum roller to create a smooth surface, and the surface shall be graded to drain.

C. Following completion of the NDA cap, the Subcontractor shall remove all grade stakes and any other items penetrating the embankment surface and fill the holes with bentonite. This material shall be tamped into the holes.

3.6 SAND AND GRAVEL FILL

A. Sand and gravel fill shall be placed in loose lifts, not exceeding 6 inches.

B. The Subcontractor shall use equipment appropriate for spreading the fill in a uniform layer across the lift.

C. The Subcontractor shall compact the sand and gravel fill, with three or more passes of an approved roller until it provides a stable road surface, as determined by the Engineer.

3.7 GEOMEMBRANE BALLAST

A. The Subcontractor shall move geomembrane ballast to areas designated on the Drawings using equipment that will not damage the geomembrane. No heavy equipment will be allowed. Equipment shall be approved by the Geotechnical Engineer.

B. Any damage to the geomembrane shall be repaired by the Subcontractor at no cost to WVNSCO.

3.8 TEST PAD – CLAY LINER. Purpose: The Subcontractor shall construct a test pad, using Clay Liner, to verify the suitability of the Subcontractor's proposed equipment and methods to produce a liner having a permeability equal to or less than $1x10^{-6}$ centimeters per second and to provide soil compaction characteristics to guide the Geotechnical Engineer and Subcontractor during construction of NDA cap.

A. Frequency:

1. One test pad is required if soil properties and the Subcontractor's equipment do not change through the duration of the project.

2. If the Subcontractor changes compaction equipment or procedures, the test pad must be repeated.

B. Requirements: Test pad requirements follow:

1. Test pad dimensions: 20 feet wide (minimum) by 50 feet long (minimum). The loose lift thickness shall be the maximum for which the specified density may be achieved with a reasonable number of passes of the equipment (but no greater than 8 inches).

2. Soil moisture and placement density shall be within the range determined by the Geotechnical Engineer, based on pre-construction testing and evaluation.

C. Engineer's measurements:

1. The Field Technician shall measure the in-place dry density of each lift of the test pad.

2. The Subcontractor shall measure the thickness of the lifts in both the compacted and uncompacted states.

3. The minimum number of passes required to achieve the desired results will be evaluated by the Geotechnical Engineer.

4. The Geotechnical Engineer shall collect Shelby tube samples from the test pad. The Subcontractor shall provide assistance and equipment for collecting these samples. The Shelby tube samples will be tested for permeability to confirm that the clay liner has a permeability less than $1x10^{-6}$ centimeters per second.

3.9. PLACEMENT – CLAY LINER

A. The Subcontractor shall place clay liner in loose lifts, not exceeding the maximum allowable thickness determined from the results of the test pad. The maximum allowable loose lift thickness is 8 inches. The maximum thickness may be less depending on the Subcontractor's equipment.

B. The Subcontractor shall use equipment appropriate for spreading the clay liner in a uniformly thick layer across the lift.

C. The Subcontractor shall place the clay liner at a moisture content near the required moisture content, so that significant adjustment of the moisture content is not required on the cap. Significant moisture adjustment should be done at the borrow area.

3.10. COMPACTION – CLAY LINER

A. The Subcontractor shall compact each lift of clay liner with the same roller equipment approved before construction.

B. Each lift of clay liner shall be compacted sufficiently to destroy all clay clods and knead the soil mass together, producing a uniform, homogeneous mass free of all defects, cracks and fissures.

C. The Subcontractor shall compact the clay liner until all in-place density tests satisfy the following:

1. The minimum dry density is 90 percent of the maximum dry density measured in the modified Proctor test (ASTM D1557).

2. The in-place moisture content is acceptable based on the defined zone of acceptance.

D. The Subcontractor shall complete the clay liner by using a smooth drum soil compactor to compact the clay liner surface. The surface of the clay liner shall be smooth without indentations or stones protruding from it so that the overlying geomembrane will be lie smoothly on the clay liner surface.

3.11. PROTECTION – CLAY LINER

A. The Subcontractor is responsible for protecting the clay liner that has been placed and/or compacted from degrading.

1. Clay liner, which has dried or desiccated, shall be scarified, moistened, re-compacted and re-tested or removed. If removed, the soil shall be removed to the depth of unaffected soil, as determined by the Geotechnical Engineer.

2. The clay liner shall be protected from freezing. Any clay liner that has frozen shall be removed to a depth of previously unfrozen soil, as determined by the Geotechnical Engineer.

3. The Subcontractor shall prevent the clay liner from becoming saturated. Soil that becomes excessively wet shall be scarified, allowed to dry, re-compacted and re-tested or shall be removed. If soil is removed, the base of the excavation to remove the soil shall extend to a depth where, in the opinion of the Geotechnical Engineer, the clay liner has not been disturbed.

4. The Subcontractor shall repair any damage to the clay liner surface from erosion by excavating and replacing clay liner to the depth of undisturbed clay liner to the satisfaction of the Geotechnical Engineer.

B. At the end of each working day, the Subcontractor shall compact the clay liner surface with a smooth drum roller to create a smooth surface, and the surface shall be graded to drain.

C. Following completion of each clay liner, the Subcontractor shall remove all grade stakes and any other items penetrating the clay liner and fill the holes with bentonite. This material shall be tamped into the holes.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.4 (A) (1)	Compaction Equipment Specifications	1 week prior to material placement
1.4 (A) (2)	Imported Borrow Materials	1 week prior to material importation
1.4 (A) (3)	Clay Liner Test Data	1 week prior to material importation

DIVISION 2

SECTION 02210

SOIL-BENTONITE GROUNDWATER BARRIER WALL

PART 1 - GENERAL

1.1 SUMMARY

This section describes the work included in constructing a soil-bentonite ground water barrier wall along the south and west sides of the NRC Licensed Disposal Area (NDA) as shown on the project Drawings. The soil-bentonite ground water barrier wall shall be placed using the slurry method as shown on the Drawings and as described in this section.

The Subcontractor must design a concrete pad for mixing the soil-bentonite backfill. The Subcontractor must design a temporary enclosure to surround the mixing pad to limit dust excursions from the site.

The Subcontractor must construct a working platform, in the location shown on the drawings, to use for excavating and backfilling the slurry trench.

The Subcontractor shall construct a continuous soil-bentonite barrier wall having a maximum permeability of $1x10^{-7}$ centimeters per second to the limits shown on the Drawings. The wall will extend 5 feet into the unweathered Lavery Till deposit. The surface of the unweathered Lavery Till will be defined as the lowest elevation of the weathered/unweathered interface measured in the test borings drilled along the barrier wall alignment. The wall shall be free of defects (e.g., zones of sand and silt, slurry, excavation spoil, etc.) that can impair the ability of the wall to restrict the flow of ground water into, or out of, the NDA.

Upon completion of the barrier wall, the Subcontractor shall construct a containment dike on top of the NDA and dispose all excess soil-bentonite backfill and to solidify all remaining bentonite slurry in it.

The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials and of performing all operations in connection with constructing the soil-bentonite ground water barrier wall.

1.2 WORK SPECIFIED ELSEWHERE

A. Section 01050 - Lines and Grades

B. Section 02200 - Embankment

C. Section 02010 - Subsurface Explorations

D. Appendix A - Construction Quality Assurance/Quality Control (QA/QC) Plan

1.3 REFERENCE STANDARDS

A. The latest revision of the following standards are hereby made part of these specifications.

ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils

ASTM D 1140 – Standard Test Method for Amount of material in Soils Finer Than the No. 200 (75-μm) Sieve

ASTM D 4380 – Standard Test Method for Density of Bentonite Slurries

ASTM C 143 – Standard Test Method for Slump of Portland Cement Concrete

ASTM D 5084 – Standard Test Method for Measurement of Hydraulic Conductivity of saturated Porous Materials Using a Flexible Wall Permeameter

API RECOMMENDED PRACTICE 13B-1 – Recommended Practice Standard Procedure for Field Testing Water-Based Drilling Fluids

1.4 SUBMITTALS

A. Bentonite Manufacturer's Certificate of Compliance: For bentonite used in the slurry and soil-bentonite mix.

B. Soil-Bentonite Mixing Pad: The Subcontractor shall submit the design plans and design calculations for the soil-bentonite mixing pad.

C. Mixing Pad Enclosure: The Subcontractor shall submit its plans for the temporary enclosure around the mixing pad.

D. Soil-Bentonite Backfill Design Mix: The Subcontractor shall sample WVNSCO's stockpile or an off-site borrow pit and use the samples with varying amounts of bentonite to prepare a soil-bentonite backfill design mix. The design report shall include the results of the trial mix testing, the results of all permeability and gradation tests used to prepare the design mix and the proposed soil-bentonite design mix proportions. The report shall include the results of slump tests done on each of the trial mixes. The report shall indicate the methods the Subcontractor proposes to control proportions in the field when mixing the soil-bentonite backfill. This includes the amount of dry bentonite that will be added to the soil and the amount of bentonite that will be added via slurry.

E. As-Built Drawings: for final slurry wall location and depth.

1.5 QUALITY ASSURANCE

A. Bentonite: Shall be tested in accordance to the following method:

1. American Petroleum Institute (API) Specification 13A and 13B (2006)

B. Bentonite Slurry and Soil-Bentonite Backfill: Shall be tested in accordance to the following methods:

1. American Society of Testing and Materials (ASTM) C-143, D-1140, and D-4380.

C. Pre-installation Conference: A pre-installation meeting will be scheduled prior to commencing work on the project.

1.6 PROJECT CONDITIONS

A. Survey Work: Engage a qualified land surveyor or professional engineer to establish exact elevations at fixed points to act as benchmarks; establish and mark end points, turning points, and ground surface elevations along the proposed soil-bentonite wall alignment. Clearly identify benchmarks and record existing elevations.

1. Prior to commencing excavation of the slurry trench.

2. Following completion of the soil-bentonite wall for completion of the as-built plans and for final payment.

1.7 GEOTECHNICAL DATA

A. The Subcontractor will complete soil test borings at the locations indicated on the plans and in accordance with these specifications to identify the elevation of the top of the unweathered Lavery Till deposit, herein refereed to as the confining layer. The Subcontractor will submit these data to the Geotechnical Engineer who will use the data from the test borings to determine the depth of the barrier wall. The barrier wall will extend below the lowest elevation of the weathered/unweathered interface measured in the test boring.

PART 2 - MATERIALS

2.1 MATERIALS

A. Work Platform: Embankment materials as specified in Section 02200.

B. Bentonite Powder: Bentonite powder shall meet the specifications listed below. Each manufacturer shall provide a certificate of compliance for each lot of bentonite.

1. Moisture Content: less than 10 percent.

2. Residue larger than 75 micrometers: less than 4 percent.

C. Water: Water used in the slurry shall meet the following requirements:

1. pH: between 6 and 8.5

2. Hardness: less than 50 parts per million (ppm)

3. Total Dissolved Solids: less than 500 ppm.

D. Initial Bentonite Slurry: The bentonite slurry shall meet the following requirements prior to placement in the trench.

1. Viscosity: greater than 40 seconds

2. Density: greater than 64 pounds per cubic foot (pcf)

3. Filtrate Loss: less than 30 cubic centimeters in 30 minutes in a standard filter press at 100 psi

4. Bentonite Content: greater than 5 percent.

E. In-Trench Bentonite Slurry: Following placement into the trench, the bentonite slurry must meet the following requirements.

1. Unit Weight: between 64 and 85 pcf, but at least 20 pcf less than the soil-bentonite backfill unit weight

2. Viscosity: greater than 40 seconds

F. Borrow Soil

1. Gradation: Shall be a well-graded mixture of gravel, sand, silt and clay,

2. Maximum particle size: 3 inches

3. Fine grained soil fraction: Greater than 30 percent passing Standard No. 200 sieve

4. Plasticity: Maximum Plasticity Index of 10 for the fraction finer than the Standard No. 40 sieve

G. Soil-Bentonite Backfill Material: Material placed in the slurry trench to construct the soil-bentonite wall shall meet the following:

1. Slump: from 4 to 6 inches, measured by ASTM C 143.

2. Gradation: at least 30 percent passing a Number 200 sieve and 100 percent passing a 3-inch sieve, measured following ASTM D 422.

3. Unit Weight: the soil-bentonite mixture must have a unit weight at least 20 pcf greater than the in-trench bentonite slurry.

4. Bentonite Content: greater than 4 percent.

5. *Permeability: less than $1x10^{-7}$ centimeters per second*

2.2 TEMPORARY ENCLOSURE

A. The Subcontractor must design and construct the temporary enclosure surrounding the soil-bentonite mixing pad to comply with requirements of the New York State Building Code.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Working Platform

1. A working platform shall be constructed along the proposed alignment as shown on the Drawings.

2. The platform shall be constructed of embankment material placed in accordance with Section 02200.

B. Slurry Preparation

1. All slurry for use in the trench shall be prepared using a suitable mixer. No slurry is to be made in the trench. The slurry shall hydrate for a minimum of 8 hours and until the mixture appears homogeneous and all quality control tests meet specifications, demonstrating that the slurry is suitable for use.

2. Mixed slurry shall be stored in the slurry pond designated for such activity for storage and hydration.

C. Excavation

1. Excavate the trench for the soil-bentonite wall with equipment capable of making a 3-foot wide, vertical trench with one pass.

2. Extend the trench at least 5 feet into the confining layer, as shown on the Drawings and as measured in the subsurface explorations.

3. Slurry shall be placed in the excavation concurrently with excavation activities such that the slurry level is no more than 1 foot below the surface of the working platform at all times.

4. The Subcontractor shall maintain the stability of the trench at all times during construction.

5. Measure the depth of the trench at 10-foot intervals immediately following excavation.

D. Soil-Bentonite Backfill Mixing

1. Thoroughly mix the borrow soil on the designated concrete slab mixing platform and break soil clumps such that the maximum soil clump is less than 3 inches using a bulldozer or other approved equipment.

2. Add dry bentonite to the borrow soil in the proportions specified in the approved design mix and thoroughly blend the dry bentonite with the borrow soil by disk harrowing, bulldozing, blading, or by other approved methods.

3. Sluice bentonite slurry into the soil-bentonite backfill and thoroughly mix the slurry with the soil-bentonite backfill until reaching a homogeneous mixture meeting the slump requirements.

4. Bentonite slurry shall be added to the soil-bentonite mix from either the slurry pond or from the trench.

5. Soil and bentonite shall be thoroughly mixed and blended.

E. Backfilling

1. The backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench.

2. Measure the depth of the trench at the same locations as the post-excavation measurements before placing the soil-bentonite backfill and compare the measurement data to identify the presence of any sloughed soil or sediment in the bottom of the trench.

3. If the sounding data indicate the potential for sediment or sloughed spoil in the bottom of the trench, delay backfilling until the trench has been re-excavated to remove the sediment.

4. Remove all loose, disturbed, and settled material from the trench prior to placement of soil-bentonite backfill using an excavator, clam shell or air lifting equipment.

5. Begin backfill placement by lowering the soil-bentonite backfill into the trench using an excavator or other approved equipment. Free-falling backfill will NOT be allowed.

6. Continue initial backfill placement until the backfill surface breaks the slurry surface.

7. Subsequent backfill can be added by placing soil-bentonite backfill on the surface of backfill in the trench such that it causes the backfill in the trench to slough forward in the trench.

8. A distance not exceeding 40 feet shall be maintained between the toe of the excavation and the toe of the soil-bentonite backfill placed in the trench.

F. Slurry Collection, Disposal and Clean-Up

1. Upon completion of the soil-bentonite backfill placement, all slurry shall be disposed in a diked containment area on the cap of the NDA. The Subcontractor shall construct the dike on the NDA cap.

2. Mix lime or other stabilizing agent acceptable to the Geotechnical Engineer into the slurry until a stable condition is achieved.

3. Abandon the slurry ponds by mixing with a sufficient quantity of lime or other stabilizing agent acceptable to the Geotechnical Engineer to create a stable material. Excavate the pond and contents and dispose this material on the cap of the NDA, as shown on the Drawings.

4. Cover the stabilized bentonite slurry on the NDA cap with embankment material and compact the embankment material as specified.

5. Disassemble the soil-bentonite enclosure and demolish the concrete mixing pad. Dispose the concrete mixing pad on the NDA cap and cover it with embankment material, as specified in Section 02200.

6. Restore the abandoned slurry pond, concrete mixing pad and bentonite staging area to the original grade and soil conditions. Reseed the restored areas with grass and apply mulch to aid regrowth.

G. Capping

1. Upon completion of placement of the soil-bentonite backfill, the trench shall be capped in accordance to the project Drawings.

H. Restore the access roads to the preconstruction condition, or better.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.4 (A)	Bentonite Manufacturer's Certificate of Compliance	15 days prior to start of construction
1.4 (B)	Soil-Bentonite Mixing Pad	15 days prior to start of construction
1.4 (C)	Mixing Pad Enclosure	15 days prior to start of construction
1.4 (D)	Soil-Bentonite Backfill Design Mix	15 days prior to start of construction
1.4 (E)	As-built Documentation	Upon project completion

DIVISION 2

SECTION 02300

GEOTEXTILES

PART 1 – GENERAL

1.1 SCOPE

A. A cushion geotextile will be placed beneath the geomembrane cover to protect the geomembrane from puncture.

B. A separator geotextile will be used to line ditches and drainage features.

C. A road stabilization geotextile will be used beneath access roads.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02110 - Erosion and Sediment Control

B. Section 02200 - Embankment

C. Section 02400 - Geomembrane

D. Section 02610 - Storm water Control Facilities

E. Appendix A - Construction Quality Assurance/Quality Control (QA/QC) Plan

1.3 SUBMITTALS

A. The Subcontractor is required to submit the following:

1. At least two weeks prior to placement of geotextile, the Subcontractor shall provide a certificate from the material supplier that indicates the fiber type, manufacturing process and that the material meets or exceeds the specified physical requirements. The supplier shall provide quality control/quality assurance test reports in accordance with the applicable test standards outlined in this section. The reports shall be provided prior to using the material. Each geotextile roll delivered to the site must be labeled according to ASTM D4873, to indicate the manufacturer, style number and roll number, and documentation of this data provided to the Geotechnical Engineer for each roll.

PART 2 – MATERIALS

2.1 SEPARATOR GEOTEXTILE

The separator geotextile shall be a nonwoven polypropylene fabric, meeting the following minimum values:

PROPERTY	MINIMUM REQUIREMENT
Mass/Unit Area oz/yd^2 (min)	6.0
Grab Strength (lbs)	160 @ 50% elongation
Puncture Strength (lbs)	75
Trapezoidal Tear (lbs)	65
Apparent Opening Size	70 - 100 sieve
Permittivity	1.2 sec^{-1}

The separator geotextile shall be used below riprap in surface water drainage features as depicted on the design plans.

2.2 CUSHION GEOTEXTILE

The cushion geotextile shall be a nonwoven polypropylene fabric, meeting the following minimum values:

PROPERTY	MINIMUM REQUIREMENT
Mass/Unit Area oz/yd^2 (min)	12.0
Grab Strength (lbs)	200 @ 50% elongation
Puncture Strength (lbs)	125
Trapezoidal Tear (lbs)	100
Apparent Opening Size	no requirement

PART 3 – EXECUTION

3.1 GEOTEXTILES

A. Geotextiles shall be stored and placed in accordance with the manufacturer's recommendations. Geotextiles shall be protected from sunlight during transport and storage.

B. Geotextiles shall be placed loosely, so that placement of overlying materials will not damage the geotextile. The geotextile shall be laid smooth and free of tension stress, folds or wrinkles. On slopes the seams shall run uphill to downhill.

C. The Subcontractor will assist the Geotechnical Engineer whenever requested, to evaluate whether the geotextile has been damaged by placement of overlying materials. This assistance may include excavation of overlying material to allow evaluation of the geotextile.

D. Geotextile seams shall be made by continuous sewing. Overlap for adjacent panels of geotextile shall be a minimum of 4 inches for sewn seams. In areas where sewing may be impractical overlapping of geotextile a minimum of 18 inches may be allowed, as approved by the Geotechnical Engineer. Heat bonding (leistering) of geotextile may also be permitted by the Geotechnical Engineer in limited applications, such as around pipes or for small repairs if the Subcontractor can demonstrate that sewing is not possible.

E. Geotextiles will be rejected if during or after installation, any defects, holes, flaws or deterioration are detected. Geotextiles that are muddy shall be cleaned to the satisfaction of

the Geotechnical Engineer or they will be rejected. Rejected geotextile and any overlying materials shall be replaced by the Subcontractor at no additional expense to WVNSCO.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.3 (A)	Manufacturer's Data for Geotextile	Two weeks prior to placement of geotextile

DIVISION 2

SECTION 02400

GEOMEMBRANE

PART 1 - GENERAL

1.1 SCOPE

A. Description of Work

1. The Subcontractor shall furnish all labor, materials, tools, supervision, transportation and installation equipment necessary for the installation of the geomembrane cover as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance/Quality Control (QA/QC) Plan.

2. The Subcontractor shall be prepared to install the geomembrane in conjunction with earthworks and other components of the cover system.

B. Definitions

1. anchor trench - A trench, within which the end of a geomembrane is buried to hold it in place.

2. boot - A bellows-type covering to exclude dust, dirt, moisture, etc., from a geomembrane protrusion.

3. Construction Quality Assurance/Quality Control (QA/QC) Plan - A planned system of activities, whose purpose is to provide a continuing evaluation of the quality control program, initiating corrective actions where necessary. It is applicable to both manufactured products and field installations.

4. destructive tests - Tests performed on geomembrane samples, cut out of a field installation or test strip, to verify specification performance requirements, e.g., shear and peel tests of geomembrane seams, during which the specimens are destroyed.

5. environmental stress crack - External or internal stress propagation in a plastic caused by environmental conditions which are usually chemical or thermal in nature.

6. extrudate - The molten polymer, which is emitted from an extruder during seaming, using either extrusion fillet or extrusion flat methods. The polymer is initially in the form of a ribbon, rod, bead or pellets.

7. extrusion seams - A seam between two geomembrane sheets, achieved by heat extruding a polymer material between or over the overlap areas.

8. field seams - The seaming of geomembrane rolls or panels, together in the field making a continuous liner system.

9. fishmouth - The uneven mating of two geomembranes to be joined, wherein the upper sheet has excessive length, that prevents it from being bonded flat to the lower sheet. The resulting opening is referred to as a "fishmouth".

10. field panel - A geomembrane roll or a portion of a roll cut in the field.

11. geomembrane - An impermeable membrane liner or cover used in civil engineering projects.

12. geomembrane installer - An experienced liner installer, fully qualified to complete the work described in this section. The geomembrane installer may be the same as the geomembrane manufacturer and/or supplier.

13. grinding - The removal of oxide layers and waxes from the surface of a geomembrane in preparation for extrusion fillet or extrusion flat seaming.

14. heat fusion - The process of joining two or more thermoplastic geomembranes by heating areas in contact with each other to the temperature at which fusion occurs. The process is usually aided by a controlled pressure.

16. hot wedge - Common method of heat seaming of thermoplastic geomembranes, by a fusing process, wherein heat is delivered by a hot wedge passing between the opposing surfaces to be bonded.

17. nondestructive test - A test method which does not require the removal of samples from, nor damage to, the installed liner system. The evaluation is done in an insitu manner. The results do not indicate the seam's mechanical strength.

18. pinholes - Very small imperfections in sheets of seamed geomembranes.

19. seaming boards - Smooth wooden planks, placed beneath the area to be seamed, to provide a uniform resistance to applied roller pressure in the fabrication of seams.

20. test strips - Trial sections of seamed geomembranes, used to establish machine setting of temperature, pressure and travel rate, for a specific geomembrane, under a specific set of atmospheric conditions for machine-assisted seaming .

21. vacuum box - A commonly used type of nondestructive test method which develops a vacuum in a localized region of a geomembrane seam in order to evaluate the seam's tightness and suitability.

22. spark test - A commonly used type of nondestructive test method which checks the continuity of a geomembrane seam by seeking areas along the seam where arcing of electric current can occur.

C. Job Conditions

1. Numerous construction activities, such as subgrade preparation, geomembrane liner deployment and seaming and deployment of geotextiles will be ongoing simultaneously at the site. The Subcontractor is required to coordinate and schedule his work accordingly.

2. The surface of the subgrade shall be prepared by the Subcontractor prior to deployment of the geomembrane. The surface shall be smooth and free of stones, rocks, sticks, roots, sharp objects, or debris. The surface shall provide a firm, unyielding foundation for the geomembrane with no sudden, sharp or abrupt changes or break in grade. No standing water or excessive moisture will be allowed.

3. WVNSCO will provide a storage area for geomembrane panels delivered to the site. The subcontractor must furnish WVNSCO with complete written instructions for storage and handling, at least two weeks prior to delivery.

4. The QA/QC plan requires sampling and testing of the geomembrane and field seams by the Geotechnical Engineer. The Subcontractor shall assist the Geotechnical Engineer in collecting samples for laboratory testing, as described in the QA/QC plan.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Embankment

B. Section 02210 - Slurry Wall

C. Section 02300 - Geotextile

D. USEPA/530/SW-89/069 Technical Guidance Document: The Fabrication of Polyethylene FML Seams

E. USEPA/530/SW-91/051 Technical Guidance Document: Inspection Techniques for the Fabrication of Geomembrane Field Seams

F. USEPA/600/2-88/052 Method 90/90 Compatibility Test for Wastes and Membrane Liners

G. ASTM: American Society for Testing and Materials

H. Appendix A - Construction Quality Assurance/Quality Control (QA/QC) Plan

1.3 SUBMITTALS

A. Submit the following items, as directed by the Geotechnical Engineer. Submittals not received and approved within the required time frame may, at the Geotechnical Engineer's discretion, delay the project at no additional cost to WVNSCO.

B. Prior To Liner Material Procurement (with the bid)

1. The subcontractor shall indicate the geomembrane Manufacturer and Installer. If in the opinion of the Geotechnical Engineer, the Installer has a history of projects, where unacceptable performance can be documented, that Installer or Manufacturer may be disqualified from work on this project.

2. Geomembrane Manufacturer Information (Not required if the manufacturer has been previously approved for this site).

a. Corporate background and information, including name, address, phone number, contact person, year of incorporation and number of employees.

b. Manufacturing capabilities must include:

i. Daily production quantity available for this contract.

ii. Quality control procedures for manufacturing.

iii. List of material properties, including certified test results, to which geomembrane samples are attached. All test results must meet or exceed the minimum geomembrane properties indicated in Section 2.1 and 2.2 and Table 02400-1.

iv. Documentation demonstrating at least three years experience manufacturing the specified geomembrane.

c. A list of at least five different projects, totaling a minimum of 50 acres, for which the Geomembrane Manufacturer has manufactured the specified geomembrane. For each facility, the following information shall be provided.

i. Name and purpose of facility, its location and date of installation.

ii. Name of Owner, Designer, Fabricator (if any), Installer and the name of the contact person at the site who can discuss the project.

iii. Surface area of geomembrane manufactured and geomembrane material.

iv. Available information on the performance of the lining system and the facility.

3. Installer Information

a. The Geomembrane Installer must submit a project list, with references, that document experience on at least five different projects, totaling a minimum of 20 acres for which the Geomembrane Installer has installed the specified geomembrane. The following information will be provided for each facility:

i. Name and purpose of facility, its location and date of installation.

ii. Name of Owner, Geotechnical Engineer, Fabricator (if any), and the name and number of the owner's contact person.

iii. Type of geomembrane and surface area of geomembrane installed.

iv. Available information on the performance of the lining system and the facility.

4. Submit to the Geotechnical Engineer for approval by the Geotechnical Engineer and WVNSCO, a copy of the installed liner warranty, to be issued by the Installer upon completion of the liner installation.

C. Within 30 Days of WVNSCO-Subcontractor Agreement

1. Shop drawings including, geomembrane panel layout, as described in Part 3.3-B of this Section and details showing welding processes, pipe boots and seaming procedures at all liner penetrations. A minimum of two prints are required. Panel layout and orientation will be subject to approval by the Geotechnical Engineer.

1. A ballast installation plan showing how the contractor intends to install the geomembrane ballast without damaging the deployed geomembrane.

3. Access walkway material and installation procedures that will prevent damage to the deployed geomembrane.

4. Proposed Construction Schedule.

D. Prior to Liner Material Delivery to the Project Site

1. Certification that the manufactured sheet meets specifications as described in Part 2.1 of this Section.

2. Geomembrane QA/QC certification describing the manufacturing quality control plan, sampling frequency, test results and manufacturer's inspection certification described in Part 2.2 of this Section and Section 7 of the QA/QC plan. All test results must meet or exceed the minimum geomembrane properties indicated in Table 02400-1.

3. Certification stating geomembrane roll numbers and that shipped material meets required material properties and test data from rolls documenting compliance with specifications.

4. The Subcontractor shall furnish WVNSCO with complete written instructions for storage and handling of geomembrane rolls.

5. Resumes of all members of all liner crews, including prior geomembrane installation experience. Installer crew staff will be subject to approval by the Geotechnical Engineer and WVNSCO.

E. Prior to Installation

1. Statement of subgrade acceptance described in Part 3.1-A of this Section, for each specific area of work.

2. Submit to the Geotechnical Engineer for approval, a schedule of operations, including means and methods of installation, seam testing (procedures/equipment) and samples of standard daily report forms, panel and seam logs and any other standard forms to be used.

F. During Installation, Submitted Daily

1. Daily construction progress reports, described in Part 3.3-A of this Section clearly showing geomembrane placed by date.

2. Daily weld test records, including testing of trial seams.

3. Daily records of field seam testing (destructive and nondestructive) including seam samples for WVNSCO's archives and for independent laboratory testing.

4. Field test results for the Installer's destructive test samples.

G. Upon Completion, Prior to Final Payment

1. As-built 22" x 34" panel layout drawings (four (4) prints and a digital copy with panel identification described in Part 3.3-C and identification of all defects and repairs described in Part 3.4-J-5 of this Section. The scale shall be 1" = 50 feet.

2. Summary and log of all field quality control testing completed by the Installer.

3. Certification that the material installation is complete and in accordance with the specifications.

4. Material and Installation Warranties for the Project described in Section 3.9.

PART 2 - MATERIALS

2.1 GEOMEMBRANE

A. The geomembrane shall be a reinforced ethylene interpolymer alloy, Model No. 8130 XR-5 as manufactured by Seaman Corporation or approved equivalent. The manufacturer shall furnish geomembrane with properties that comply with the required property values shown in Table 02400-1 at the end of this Section.

B. The Manufacturer shall provide geomembrane panels sufficient to cover all areas, including appurtenances, as shown on the plans. The Manufacturer and Installer shall allow for shrinkage and wrinkling of field panels.

C. The geomembrane panels shall be custom fabricated for this project to minimize the number of field seams.

2.2 QUALITY CONTROL

A. Quality control requirements, including sampling frequency and testing, for the manufactured rolls of geomembrane are described in the QA/QC plan. The QA/QC plan requires certification documenting the manufactured sheets conform to the specifications, and that rolls were inspected for defects during manufacturing.

B. Panels:

1. The manufacturer shall continuously monitor geomembranes during the manufacturing process for inclusions, bubbles, or other defects.

2. No geomembrane shall be accepted which exhibits any defects.

3. The manufacturer shall continuously monitor the geomembrane thickness during manufacture.

4. No geomembrane shall be accepted which fails to meet the minimum thickness requirement.

2.3 DELIVERY, STORAGE AND HANDLING

A. The geomembrane shall be packaged and shipped by appropriate means, so that no damage is incurred. During shipment and storage, the geomembrane shall be adequately protected at all times from puncture, abrasion, excessive heat or cold, degradation of the material, or other damaging or deleterious conditions in accordance with instructions from the Manufacturer and his warranty conditions.

B. Materials shall be delivered only after the required submittals have been received and approved by the Geotechnical Engineer.

C. Appropriate handling equipment and techniques as recommended by the Manufacturer and approved by the Geotechnical Engineer shall be used. Handling, storage and care of the geomembrane, prior to and following installation at the site, is the responsibility of the Subcontractor. The Subcontractor shall be liable for all damages to the materials incurred prior to final acceptance of the liner system by WVNSCO. Any geomembrane damaged as a result of poor delivery, storage, or handling methods shall be repaired or replaced, as determined by the Geotechnical Engineer, at no additional cost to WVNSCO.

2.4 ACCESS WALKWAY MATERIAL

A. Access walkways shall be constructed using Tuff-Trac Walkway Pad as manufactured by Seaman Corporation or approved equivalent. The pad shall be supplied in a yellow color.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Surface Preparation

1. The Subcontractor shall provide certification in writing that the surface on which the geomembrane will be installed is acceptable. This certification of acceptance shall be given to the Geotechnical Engineer prior to commencement of geomembrane installation in the area under consideration.

2. Special care shall be taken to maintain the prepared soil surface.

3. No geomembrane shall be placed on loose soils or onto an area which has been softened by precipitation or which has cracked due to desiccation. The soil surface shall be observed, before deployment, to evaluate the effects of desiccation cracking and/or softening on the integrity of the soil liner. The Subcontractor shall correct the subgrade surface if desiccation cracks are measured to be 1/2 inch deep or greater or equipment causes ruts 1 inch deep or more, as determined by the Geotechnical Engineer.

4. Any damage to the soil surface caused by installation activities shall be repaired at the Subcontractor's expense.

B. Anchorage

1. The anchor trench shall be excavated to the lines, grades and configuration shown on the Drawings, prior to geomembrane placement. No loose soil shall be allowed beneath the geomembrane.

2. The geomembrane shall be secured in the anchor trench using sand bags, rolls of cushion geotextile or other means approved by the Geotechnical Engineer. The geomembrane shall be covered by a cushion geotextile in the anchor trench. After deployment of the cushion geotextile, the anchor trench shall be backfilled within 24 hours, taking care to protect the underlying geomembrane.

3. A wind anchorage system, designed to hold the liner in place during wind events, is shown on the Drawings. It consists of sand placed over the liner at regular intervals and encapsulated by an additional sheet of geomembrane. The sand placement and covering shall be done in a manner that does not damage the underlying geomembrane.

4. Gravel used to backfill the anchor trench and sand used in the wind anchorages is specified in Section 02200.

3.2 Conformance Testing

A. Upon delivery to the site, samples of the geomembrane shall be removed by the Subcontractor and sent to the laboratory selected by the Geotechnical Engineer for testing to ensure conformance with these specifications.

B. Samples shall be selected by the Geotechnical Engineer in accordance with the procedures outlined in the QA/QC plan. The Geotechnical Engineer may increase the frequency of sampling at his discretion, in the event that test results do not comply with Part 2.1 of this Section and the QA/QC plan. The additional testing shall be performed at the expense of the Subcontractor.

C. Any geomembranes that are not certified in accordance with Part 1.3, or that conformance testing indicates do not comply with Part 2.1 of this Section, or the QA/QC plan shall be rejected and replaced, with new material by the Subcontractor, at no additional cost to WVNSCO.

3.3 GEOMEMBRANE DEPLOYMENT

A. Record Keeping

1. The Subcontractor shall maintain daily reports and copies shall be provided to the Geotechnical Engineer daily. These reports will contain at a minimum:

   a. Date
   b. Hours worked
   c. Areas worked
   d. Daily production
   e. Manpower on site
   f. Equipment used
   g. Type and results of quality control testing completed by the Subcontractor
   h. Problems encountered during construction and resolution
   i. Daily statement of acceptance of the subgrade surface to which the liner is deployed.

B. Geomembrane Layout Drawings

1. The Installer shall produce layout drawings at least two weeks prior to geomembrane delivery at the site. These drawings shall be suitable for use as construction drawings and shall indicate the geomembrane configuration, dimensions, details, locations of seams, ballast wedges, etc. The drawings shall be on 22" x 34" sheets and at a scale of 1" = 50'. The geomembrane shall be configured to maximize the number of factory seams and minimize the number of field seams. The layout drawings must be approved by WVNSCO and Geotechnical Engineer, prior to the installation of any geomembranes. The layout drawings, as modified and/or approved by the Geotechnical Engineer, shall become part of these specifications.

2. Panels shall be laid out in a staggered configuration, such that the ends of adjacent panels do not result in a continuous seam.

3. In general, seams shall be oriented parallel to the line of maximum slope (i.e., down, not across, the slope). In corners and odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seams shall be less than five feet from the toe of the slope. No seams shall be located in areas of potential stress concentrations.

C. Field Panel Identification

1. A field panel is the unit area of liner which is to be seamed in the field (i.e. a field panel is a roll or a portion of a roll cut in the field). Field panels shall be installed at the location and positions indicated in the layout drawings, as approved or modified.

2. Each field panel must be given an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Geotechnical Engineer and Installer. The field panel identification code shall be related, through a table or chart, to the constituent rolls. The Installer shall document all "as constructed" field panels, destructive test samples, pipe penetration locations, repairs, etc. on the liner layout drawings.

D. Liner Deployment Procedures

1. Field panels shall be installed as approved or modified at the location and positions indicated in the layout drawings.

2. Field panels shall be deployed to create a shingle effect on the slope. The downslope sheet shall be overlapped by the sheet immediately upslope of it.

3. Geomembrane shall not be deployed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of winds in excess of 20 miles per hour.

4. Geomembrane shall not be deployed on frozen clay liner soils, as determined by the Geotechnical Engineer.

5. At the time of deployment, the geomembrane shall be inspected for defects, rips, holes, flaws deterioration or damage. Geomembrane sheets having any of the referenced features shall be repaired or rejected and removed from the site at the Subcontractor's expense.

6. The Installer shall employ placement methods which ensure that:

   a. Equipment used shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.

   b. Personnel working on geomembranes shall not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane.

   c. The method used to unroll and deploy the panels shall not scratch, crimp or puncture the geomembrane and shall not damage the supporting soil.

   d. The prepared surface underlying the geomembrane shall not be allowed to deteriorate after acceptance, and shall remain acceptable during and after geomembrane placement. Any rutting of the subgrade during installation shall be repaired prior to deployment of geomembrane in the areas where rutting occurred.

e. All subgrade, immediately underlying the liner, must be kept clean and free of debris.

f. The method used to place the panels shall minimize wrinkles and limit stress in the liner.

g. The placement of the panels shall be done in a manner to limit tension in the geomembrane.

h. Temporary loads and/or anchors (e.g., sandbags, tires), that will not damage the geomembrane, shall be placed on the geomembrane to prevent uplift by wind.

i. There shall be no fueling of any equipment on the geomembrane.

j. No equipment will be allowed on the geomembrane. All light weight equipment, including seaming equipment, shall be placed on rub sheets.

k. Direct contact with the liner shall be minimized; (i.e., the liner in excessively high traffic areas shall be adequately protected).

l. The geomembrane shall be installed in the anchor trench, as shown on the drawings. The Subcontractor shall be responsible for excavating and backfilling the anchor trench. Gravel used as backfill in the anchor trench shall be placed and compacted as specified in a manner that does not damage the geomembrane.

7. Any field panel or portion thereof, which becomes seriously damaged (torn, twisted, or crimped), shall be replaced with new material, at no cost to WVNSCO. Less serious damage may be repaired at the Geotechnical Engineer's option and at no cost to WVNSCO. Damaged panels or portions of damaged panels shall be removed from the work area.

3.4 FIELD SEAMING

A. Seam Layout

1. In general, seams shall be orientated parallel to the line of maximum slope, i.e., oriented down, not across the slope. In corners and at odd-shaped geometric locations, the number of field seams shall be minimized.

B. Weather Conditions for Seaming

1. Unless approved by the Geotechnical Engineer, seaming shall not be attempted, when either air or sheet temperature is below 32° F or during periods of precipitation. In all cases, the geomembrane shall be dry and protected from wind damage.

2. If the Subcontractor plans to use methods, which may allow seaming at air temperatures below 32° F, they shall submit a procedure for approval by the Geotechnical Engineer.

3. Air temperatures shall be measured six inches above the geomembrane surface.

C. Overlapping and Temporary Bonding

1. Geomembrane panels shall be overlapped a sufficient amount to meet the manufacturer's recommendations and to allow peel tests to be performed on destructive test samples of the seam.

2. The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane. The temperature of the air at the nozzle of spot welding apparatus shall be controlled, such that the geomembrane is not damaged.

D. Seam Preparation:

1. Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, debris of any kind and foreign material. Seaming shall not be conducted in the presence of standing water and/or soft subgrades, as determined by the Geotechnical Engineer. All wet surfaces shall be thoroughly dried and all soft subgrades compacted and approved by the Geotechnical Engineer prior to seaming.

2. If other seam preparation is required, the process shall be completed according to the manufacturer's instructions in a manner that does not damage the geomembrane.

3. Seams shall be aligned to prevent wrinkles and "fishmouths".

E. General Seaming Requirements

1. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

2. If required, a flat board can be used to create a firm substrate, or similar hard surface, directly under the seam overlap to achieve proper support.

3. If seaming operations are carried out at night, adequate illumination shall be provided. Night seaming will only be permitted if approved by the Geotechnical Engineer.

4. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion, where the overlap is inadequate, shall then be patched, with an oval or round patch of the same geomembrane that extends a minimum of 6 inches beyond the cut in all directions.

5. All welding apparatus shall be equipped with diagnostic gauges for operating temperatures, pressures, roller speeds, etc. (as applicable to the equipment type).

F. Seaming Process

1. Approved processes for seaming are extrusion welding and fusion welding. The primary method of welding shall be fusion. Seaming equipment shall not damage the geomembrane. Proposed alternative processes shall be documented and submitted to the Geotechnical Engineer for approval. All seaming procedures shall strictly adhere to the Manufacturer's Field Quality Control Manual as approved by the Geotechnical Engineer. The Installer shall also follow industry standards for seam fabrication, as outlined in the USEPA Technical Guidance Documents referenced in Part 1.2 of this specification section.

2. Extrusion Equipment and Procedures

   a. The Subcontractor shall maintain at least one spare operable seaming apparatus on site.

   b. Extrusion welding apparatus shall be equipped with gauges giving the temperature in the apparatus at the nozzle.

   c. Prior to beginning a seam, the extruder shall be purged until all heat degraded extrudate has been removed from the barrel. Whenever the extruder is stopped, the barrel shall be purged of all heat degraded extrudate.

   d. The Subcontractor shall provide documentation regarding the extrudate to the Geotechnical Engineer and shall certify that the extrudate is compatible with the specifications and consists of the same resins as the geomembrane.

   e. The electric generator shall be placed on rub or scrub sheets. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

3. Fusion Equipment and Procedures

   a. The Subcontractor shall maintain at least one spare operable seaming apparatus on site.

   b. Fusion-welding apparatus shall be automated vehicular-mounted devices equipped with gauges giving the applicable temperatures, pressures and seaming rate.

   c. Fusion cross seams shall be extrusion welded a minimum distance of 6 inches from the point of intersection.

   d. A moveable protective layer may be used directly below each geomembrane overlap to be seamed to prevent the buildup of moisture between the sheets.

   e. The electric generator shall be placed on rub or scrub sheets. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

G. Trial Seams

1. Trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. The QA/QC plan describes the size and frequency at which trial seams will be prepared.

2. A minimum of three samples shall be tested for peel strength and a minimum of three samples shall be tested for shear strength. All test specimens must fail by film tear and demonstrate that the seam meets the required material specifications before seaming can begin:

3. Testing details are described in the QA/QC plan. In general, the trial seams shall be welded under the same conditions as are found in the landfill construction area.

H. Nondestructive Seam Continuity Testing

1. The Subcontractor shall non-destructively test all field seams over their full length, as described in the QA/QC plan. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all seaming work. The Installer shall complete any required repairs in accordance with Part 3.4-J of this Section.

   a. If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.

   b. If the seam cannot be tested prior to final installation, the seaming operations shall be observed by the Geotechnical Engineer for uniformity and completeness. In the event that vacuum box or spark test methods can not be used to test a seam, other methods may be approved by the Geotechnical Engineer. The Geotechnical Engineer must approve all non-destructive test methods.

2. Procedures to be followed when a nondestructive test result is not accepted are described in the QA/QC plan. The Subcontractor will locate failed seam areas on the panel layout drawing.

I. Destructive Testing:

1. Destructive seam tests shall be performed on samples collected from selected locations to evaluate seam strength and integrity. Destructive tests shall be carried out as the seaming work progresses, not at the completion of all field seaming.

2. Sampling:

   a. Sample locations shall be determined during seaming. In general one sample will be taken per day for each operator and welding device. This applies to fusion welding machines and extrusion welders performing tie-in seams, cross seams or reconstructed seams; not minor patchwork. The Geotechnical Engineer will be responsible for choosing the locations. The Subcontractor shall not be informed in advance of the locations where the seam samples will be taken. The Geotechnical Engineer may increase the sampling frequency at his option.

   b. Samples shall be cut by the Subcontractor at the locations designated by the Geotechnical Engineer, as the seaming progresses. Each sample shall be numbered and the sample number and location identified on the panel layout drawing. All holes in the geomembrane resulting from the destructive seam sampling shall be immediately repaired in accordance with the repair procedures described in Part 3.4-J of this Section. The continuity of the new seams in the repaired areas shall be tested according to Part 3.4-H of this Section.

   c. Destructive seam samples shall be divided into two parts at least 2 feet long and provided to WVNSCO and Geotechnical Engineer.

3. Laboratory Testing:

   a. Destructive seam samples shall be tested for peel and shear strength by both the Subcontractor and an independent geosynthetics testing laboratory. The geosynthetics laboratory shall provide test results to the Geotechnical Engineer no

more than 48 hours after the samples are received at the laboratory. Criteria for acceptance are described in paragraph 3.4.I.4.

4. Criteria for Acceptance:

The Geotechnical Engineer shall determine acceptance of the destructive test sample according to the following criteria:

a. The sample must pass visual inspection by the Geotechnical Engineer and the specimens tested by the installer must fail by film tear bond (FTB).

b. Test results obtained by the geosynthetics laboratory must meet the specified criteria for the seams as listed in Table 02400-1.

J. Defects and Repairs:

1. The geomembrane will be inspected before and after seaming for evidence of defects, holes blisters, undispersed raw materials and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Subcontractor if surface contamination inhibits inspection. The Subcontractor shall ensure that an inspection of the geomembrane precedes any seaming of that section.

2. Each suspect location, both in seam and non-seam areas, shall be non-destructively tested using pressurized air channel or vacuum box methods as appropriate. Each location, which fails nondestructive testing, shall be marked by the Geotechnical Engineer and repaired by the Subcontractor. Repairs shall be made as the work progresses.

3. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the Geotechnical Engineer shall identify all excessive geomembrane wrinkles. The Subcontractor shall cut and reseam all wrinkles so identified. The seams thus produced shall be tested like any other seams.

4. Repair Procedures

a. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Subcontractor. The Subcontractor must submit a repair procedure plan to the Geotechnical Engineer for approval. The procedures available include:

- Patching to repair large holes (greater than 1/4 inch), tears, undispersed raw materials and contamination by foreign matter (patch extrusion welded to parent sheet);

- Extrusion cap welding to repair small tears, pinholes, or other minor localized flaws;

- Capping to repair large lengths of failed seams (cap strip/roll sheet extrusion welded); and

- Fusion weld reseaming: used to repair large lengths of failed seams by cutting out bad seam and replacing with a strip of new material fusion welded into place.

5. Repair Verification

   a. Each repair shall be numbered and logged and shall be non-destructively tested, using the methods described in the QA/QC plan. Repairs, which pass the nondestructive test, shall be taken as an indication of an adequate repair. Failed tests will require the repair to be redone and retested until a passing test results. At the discretion of the Geotechnical Engineer, sampling and destructive testing may be required on large caps.

3.5 PROTECTING THE GEOMEMBRANE

A. The Subcontractor is responsible for protecting the geomembrane and to correcting any damage to the geomembrane at its own expense until the geomembrane is accepted.

B. The geomembrane shall not be accepted until all destructive and non-destructive test data and conformance data are reviewed and accepted by the Geotechnical Engineer.

3.6 MATERIALS IN CONTACT WITH THE LINER

A. The Geomembrane Installer shall assist the Subcontractor, as necessary, to ensure that the geomembrane is not damaged during its installation or during the installation of other components of the stormwater drainage system or by other construction activities.

B. The Geomembrane Installer shall install the Tuff-Trac Walkway Pads upon completion of the geomembrane. The pads shall be continuously welded to the to the underlying geomembrane. Installation and welding procedures shall not damage the underlying geomembrane.

C. Appurtenances:

   1. Installation of the geomembrane in sump areas and connection of the geomembrane to appurtenances shall be made according to manufacturer's recommendations and specifications. The Subcontractor shall ensure that the geomembrane has not been visibly damaged while making connections to sumps and appurtenances. Spark testing shall be performed in instances where it is not possible to perform the vacuum test.

   2. All clamps, slips, bolts, nuts, or other fasteners used to secure the geomembrane to each appurtenance shall be at least as durable as the geomembrane.

3.7 GEOMEMBRANE ACCEPTANCE

A. The Subcontractor shall retain all ownership and responsibility for the geomembrane until accepted by WVNSCO.

B. The geomembrane shall be accepted by WVNSCO when:

   1. The installation is finished.

2. All documentation of installation is completed to the satisfaction of the Geotechnical Engineer, including all of the geomembrane related test data and certification materials referred to in these specifications and the QA/QC plan.

3. Verification of the adequacy of all field seams and repairs, including associated testing is complete.

4. Installer's record drawings of seam field panel locations, destructive sample locations, repair locations, pipe penetration locations, etc. are submitted to and approved by the Geotechnical Engineer.

5. Installer's daily construction progress reports and all field logs are submitted to and approved by the Geotechnical Engineer.

3.8 PRODUCT PROTECTION

A. The Subcontractor shall use all means necessary to protect all prior work and all materials and completed work of other sections.

B. In the event of damage, the Subcontractor shall make all repairs, replacements, sampling and testing necessary, to the satisfaction of the Geotechnical Engineer and at no additional cost to WVNSCO.

3.9 WARRANTY OF GEOMEMBRANE LINER

A. The Manufacturer of geomembrane liners shall warrant to WVNSCO that the geomembrane liner, for the herein referenced project, is free from manufacturing and installation defects and that the liner, when properly installed and maintained, will not suffer deterioration due to typical atmospheric and operating conditions, as intended by the design specification.

B. The warranty shall take effect upon final acceptance of the liner installation and when all terms and conditions of the contract documents are satisfied for this item and shall be for a period of one year.

C. The Installer shall make any replacement or necessary repairs to the liner and its components during the warranty period, at no additional cost to WVNSCO, for those situations where repairs by warranty shall apply.

D. The geomembrane liner shall perform in the manner for which it was designed. The warranty shall be submitted to and approved by the Geotechnical Engineer and WVNSCO prior to installation of the liner.

E. Warranty shall include agreements between the Installer and the Manufacturer, if they are not one and the same, that will make all terms binding and that will incur no additional costs to WVNSCO during the warranty period specified herein.

F. Warranty shall be written in accordance with the laws and jurisdiction of the courts of the State of New York. Should any dispute hereafter arise concerning the interpretation or enforcement of this warranty or any rights, obligations or remedies herein, then venue in all cases shall be exclusively vested in any Sate or Federal Court in the State of New York having proper jurisdiction.

TABLE 02400-1 REQUIRED GEOMEMBRANE PROPERTY VALUES

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Base Fabric Type			Polyester	
Base Fabric Weight	minimum	oz./yd^2	6.5	ASTM D751
Geomembrane thickness	minimum	mil	30	ASTM D751
Geomembrane weight	+/-	oz./yd^2	30 +/- 2	ASTM D751
Trapezoidal Tear Resistance	minimum	lb.	35/35	ASTM D4533
Grab Yield Tensile	minimum	lb.	550/550	ASTM D751 Grab Method Proc. A
Elongation at yield	minimum	%	20	
Adhesion – Heat Seam	minimum	lbs./in.^{2}	35	ASTM D751 Dielectric Weld
Adhesion – Ply	minimum	lbs./in.	15 or FTB	ASTM D751 Dielectric Weld
Hydrostatic Resistance	minimum	lbs./ in.^{2}	800	ASTM D751 Method A
Puncture Resistance	minimum	lbs.	250	ASTM D4833
Bursting Strength	minimum	lbs.	550	ASTM D751 Ball Tip
Dead Load Room Temp.	minimum	lbs.	210	ASTM D751
Dead Load 160 °F .	minimum	lbs.	210	ASTM D751
Bonded Seam Strength	minimum	lbs.	550	ASTM D751 Grab Test Method Procedure A
Low Temperature			Pass @ -30°F	ASTM D2136 4 hours-1/8 in. mandrel
Weathering Resistance	minimum	hrs.	8000	ASTM G153 Carbon Arc
Dimensional Stability	maximum	%	1.5	ASTM D1204 212°F 1 hr. each direction
Water Absorption	maximum	kg/m^2	0.025 @ 70°F 0.14 @212°F	ASTM D471 7 days
Abrasion Resistance		cycles	2000 before fabric exposure	ASTM D3389
Abrasion			50 mg/100	ASTM D3389

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Resistance H-18 Wheel, 100g load			cycles max. weight loss	
Coefficient of Thermal Expansion / Contraction	maximum	in./in.	$8x10^{-6}$	ASTM D696

Notes:

a. $oz./yd^2$ = ounces per square yard
b. kg/m^2 = kilograms per square meter
c. $lbs./in.^2$ = pounds per square inch

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.3 (B) (1)	Geomembrane Manufacturer and Installer	Prior to liner material procurement (with the bid)
1.3 (B) (2)	Geomembrane Manufacturer Information	Prior to liner material procurement (with the bid)
1.3 (B) (3)	Geomembrane Installer Information	Prior to liner material procurement (with the bid)
1.3 (B) (4) and G (4)	Geomembrane Warranty	Upon project completion
1.3 (C) (1)	Shop Drawings, Access Walkway Pads and Work Schedule	Within 30 days of contract agreement
1.3 (C) (2)	Ballast Installation Plan	Within 30 days of contract agreement
1.3 (D) (1) and (3)	Manufacturer's Certification Data	Prior to liner material delivery
1.3 (D) (2)	Geomembrane QA/QC Certification	Prior to liner material delivery
1.3 (D) (4)	Geomembrane Storage Instructions	Prior to liner material delivery
1.3 (D) (5)	Geomembrane Installer Resumes	Prior to liner material delivery
1.3 (E) (1)	Subgrade Acceptance	Prior to installation
1.3 (E) (2)	Schedule of Operations	Prior to installation
1.3 (F)	Daily Reports	Daily during installation
1.3 (G) (1)	As-built Documentation	Upon Completion, prior to final payment
1.3 (G) (2)	Installer QA/QC Documentation	Upon Completion, prior to final payment
1.3 (G) (3)	Installed Material Certification	Upon Completion, prior to final payment
1.3 (G) (4)	Material and Installation Warranty	Upon Completion, prior to final payment

DIVISION 2

SECTION 02530

DEWATERING

PART 1 - GENERAL

1.1 SCOPE

A. This section specifies the removal and control of surface and ground water from the work area. Dewatering consists of performing all work necessary to remove snow, ice, surface water and ground water to perform all work in the dry. The Subcontractor shall maintain and operate adequate surface and subsurface drainage methods to the satisfaction of the Geotechnical Engineer.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Embankment:

B. Appendix B - Stormwater Pollution Prevention Plan

1.3 SUBMITTALS

A. Submit proposed dewatering methods and equipment to the Geotechnical Engineer and Subcontractor for review prior to dewatering.

PART 2 - MATERIALS

None

PART 3 - EXECUTION

3.1 SURFACE WATER

A. Maintain and operate adequate surface drainage facilities to keep the construction site dry and excavation slopes and bottoms stable to allow the construction of earthen fills to proceed unhindered.

B. Surface water must be intercepted and diverted away from working areas.

C. Surface water shall not be allowed to collect and pond on subgrades or fill surfaces.

3.2 GROUNDWATER

A. The Subcontractor shall maintain on site pumps, hoses, etc. to control groundwater.

B. Some excavations may encounter groundwater at the time of construction. Where encountered, the Subcontractor shall use pumps, sumps, well points, etc. as required to produce a stable subgrade, before proceeding with construction of overlying structures.

3.3 DISPOSAL OF WATER

A. Surface water shall be diverted or pumped to WVNSCO supplied containment tanks located at the site. All surface water must be discharged in accordance with WVNSCO's Storm Water Pollution Prevention Plan and SPDES Permit .

B. Groundwater shall be pumped to WVNSCO supplied containment tanks, or otherwise managed in accordance with WVNSCO's requirements. As specified in special provisions.

3.4 RESTORATION

A. Upon completion of dewatering activities, the Subcontractor shall restore drainage ditches, settling basins and sumps to the satisfaction of the Subcontractor.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.3 (A)	Dewatering Methods	Prior to start of dewatering

DIVISION 2

SECTION 02610

STORM WATER CONTROL FACILITIES

PART 1 - GENERAL

1. 1 SCOPE

A. The storm water management system consists of constructing channels, culverts, sedimentation basins and constructing permanent linings to prevent erosion.

B. The construction of the channels and basin's will be completed during the embankment phase of the project. Materials and placement procedures for embankment materials are discussed in Section 02200 of these specifications.

C. Anchor Trench: a trench within which the ends of a geosynthetic are buried to hold it in place (e.g., along the top of a berm).

1. 2 JOB CONDITIONS

A. The Subcontractor will coordinate all site activities with sub-subcontractors and WVNSCO.

B Subcontractor is responsible for protection of all above ground and below ground structures and utilities or wells, whether shown on the plans or not. Subcontractor will replace any damaged items due to the Subcontractor's operations.

1. 3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01050 - Lines and Grades

B. Section 02200 - Embankment

C. Section 02630 - Dewatering

D. Section 02300 - Geotextile

E. Appendix A - Construction Quality Assurance/Quality Control (QA/QC) Plan

F. Appendix B - Stormwater Pollution Prevention Plan

1. 4 SUBMITTALS

A. At least two weeks prior to construction of any piping or installation of culverts, provide the following:

1. Quality control/quality assurance test reports in accordance with the applicable test standards outlined in this section and in the QA/QC Plan,

2. Shop drawings showing details of the pipe connections and other pertinent details and manufacturers written certification that the pipe complies with these specifications.

3. The Subcontractor's proposed procedures, equipment (including a relationship between hydraulic carriage pressure and fusion pressure) and names of certified individuals who will be performing the fusion welding prior to welding. Documents such as "Qualification Procedures for making PE 3408 Polyethylene Heat Fusion Joints" by Plexco or "Heat Fusion Qualification Guide" by Driscopipe shall be consulted to develop the butt fusion procedure.

PART 2 - MATERIALS

2. 1 HDPE DRAINAGE PIPES

A. Each pipe section delivered to the site must be labeled to indicate the manufacturer, HDPE material type, size and SDR.

B The basin drainage pipes are shown on the Contract Drawings (smooth exterior and smooth interior walls). The pipes shall be of type PE3408 as manufactured by Phillips Driscopipe, Inc. or approved equivalent.

C. Exterior drainage pipes are shown on the Contract Drawings (corrugated exterior pipe with a smooth interior wall). The pipes shall meet the requirements stated in AASHTO M294 for Type S pipe, such as that manufactured by ADS Corporation, or approved equivalent.

D. Catch Basins and grates are shown on the Contract Drawings. The basins shall be constructed of PVC and allow for the creation of watertight connections, such as that manufactured by ADS Corporation, or approved equivalent. Grates shall be used in roadways shall have a solid cover capable of supporting H-25 traffic loads. Grates used in yard or cap areas shall perforated light duty grates, such as that manufactured by ADS Corporation, or approved equivalent

E. The anchor trench pipe shall be 4-inch diameter perforated, corrugated HDPE pipe, such as that manufactured by ADS Corporation, or approved equivalent.

2. 2 RIP-RAP STONE

A. The erosion protection stone shall consist of crushed stone or screened gravel meeting the material requirements in NYSDOT Section 620 and sizes as shown on the Contract Drawings.

Riprap shall generally meet the following gradation requirements:

TYPE I RIP RAP	
Sieve Size	**Percent Finer by Weight**
12-inch	100
8-inch	40 - 70
6-inch	20 - 40
2-inch	0 - 10

2. 3 PIPE BEDDING MATERIAL

A. The pipe bedding material shall consist of natural sand and gravel (not slag) meeting the material requirements in NYSDOT Section 304 Type 4.

PART 3 - EXECUTION

3. 1 DRAINAGE PIPES AND CULVERTS

A. Storm water drainage pipes, catch basins, standpipes and culverts shall be installed to the lines and grades shown on the Contract Drawings, subject to the tolerance in these specifications.

B. Pipe shall be handled and assembled in accordance with manufacturer's recommended procedures.

C. HDPE pipe shall be joined using butt fusion or electro-fusion welding techniques in accordance with manufacturer's recommendations and approved by the Geotechnical Engineer. The Geotechnical Engineer will observe the fusion welding of the pipe ends and will reject welds that do not conform to the manufacturer's recommendations. The Geotechnical Engineer reserves the right to submit sample joints to an independent laboratory for testing and to disqualify either welders, equipment or welding procedures that in the opinion of the Geotechnical Engineer are not suitable. Any defective welds will be repaired by the Subcontactor at no additional expense to WVNSCO.

D. Pipes shall be welded as close to the installation area as practical, dragging long lengths of welded pipe across the construction area is not permitted. If during movement or placement of the pipes, scratches or gouges occur, the Geotechnical Engineer will evaluate any damage caused to the pipes. Damages exceeding 10% of the wall thickness will require removal and replacement of the pipe by the Subcontractor at no additional cost to the Subcontractor.

A. The pipes shall be installed as shown on the plans. Care shall be taken so that the alignment or grade of the pipe is not altered by placement of the backfill material.

B. The Subcontractor shall place the pipe bedding material to the lines and grades shown on the plans. The Subcontractor shall place the pipe bedding in loose lifts not exceeding 6 inches. The Subcontractor shall compact the pipe bedding with suitable equipment, the compaction criteria will be established by the Geotechnical Engineer prior to placement.

G. The Subcontractor shall protect the pipes from damage at all times during and after installation. No equipment will be allowed to operate on the pipe unless there is sufficient cover material on the pipe to prevent damage to the pipe.

H. The Subcontractor will assist the Geotechnical Engineer whenever requested, in evaluating potential damage to the pipes. At a minimum, the pipe will be exposed and evaluated. This will include excavation of overlying backfill materials to expose the pipe prior to completion of construction. Any damaged pipe will be replaced at no additional expense to the Subcontractor.

3. 2 RIP-RAP STONE INSTALLATION

A. Rip-Rap stone shall be placed in one lift to the lines and grades shown on the Contract Drawings. Stone shall be placed in the manner specified in NYSDOT Standard Specifications Section 620. The stone shall be place in a manner that avoids segregation. Smaller stone shall be chinked into voids to provide a relatively smooth stable surface.

B. Prior to placing the Rip-Rap stone, a separation geotextile meeting the requirements of Item 02505 as stated in these specifications shall be placed on top of the *competed subgrade* as indicated on the Contract Drawings.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.4 (A)	Piping Installation	Two weeks prior to construction of any piping or culverts

DIVISION 2

SECTION 02930

REVEGETATION

PART 1 - GENERAL

1.1 SCOPE:

A. The Subcontractor shall furnish all labor, material, and equipment to complete revegetation in accordance with the Contract Drawings and these Specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Section 02220 - Embankment

1.3 WARRANTY:

A. The Subcontractor shall be responsible for the satisfactory establishment and growth of a permanent stand of vegetation for a period of one year following the final seeding as judged by the Geotechnical Engineer. During this period, the Subcontractor shall be responsible for the maintenance items described in Section 3.5 of this Specification.

1.4 SUBMITTALS:

A. The Subcontractor shall submit the following to the Geotechnical Engineer:

1. Certificates for each grass seed mixture, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed. Certify that each container of seed delivered is fully labeled in accordance with the Federal Seed Act and equals or exceeds specification requirements.

2. Copies of invoices for fertilizer, showing grade furnished and total quantity applied.

3. When hydroseeding is to be performed, submit a certified statement of the number of pounds of lime, fertilizer and seed to be used per 100 gallons of water and specifying the number of square feet that can be covered with the volume of solution in the sprayer.

PART 2 – MATERIALS

2.1 LIMESTONE

A. Unless otherwise defined by specific soil tests, supply agricultural grade ground limestone containing not less than 85 percent calcium and magnesium carbonates.

2.2 FERTILIZER

A. Unless otherwise defined by specific soil tests, supply commercial fertilizer of 5-10-10 analysis, meeting applicable requirements of State and Federal law. Do not use cyanamic compounds of hydrated lime. Deliver fertilizer in original containers labeled with content analysis.

2.3 GRASS SEED

A. Supply fresh, clean, new-crop seed for Permanent Seed as specified in Table 1 of this section. Each variety of seed shall have a percentage of germination of not less than 90, a percentage of purity of not less than 85 and shall have not more than 1 percent weed content. Do not use seed which is wet, moldy, or otherwise damaged. Seed shall be furnished and delivered in premixed proportions specified in Table 1. A supplier's certificate of compliance which includes the guaranteed purity, weed content, net weight and date of shipment shall be submitted for each seed type. Deliver seed in standard sealed containers labeled with producer's name and seed analysis, and in accordance with US Department of Agriculture Rules and Regulations under the Federal Seed Act.

B. When the seed mixture requires an inoculum, the inoculum shall be kept as cool as possible, at all times below 25°C (75°F) until used. Inoculated seed shall be protected from exposure to sunlight prior to sowing, and all seed not sown within 24 hours following inoculation shall be properly reinoculated.

C. When grass seed is to be sown dry, the seed mix shall be inoculated in accordance with the Supplier's instructions and allowed to dry. Seed shall be sown within 30 hours after inoculation.

D. When the seed is to be applied by the use of a hydraulic seeder, the inoculants may be added to the water and seed mixture, together with lime and/or fertilizer provided the pH of the solution does not exceed 8.0.

2.4 MULCH

A. Supply clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, or other locally available mulch material.

1. Do not use mulch containing a quantity of matured, noxious weed seeds or other species that will be detrimental to seeding, or provide a menace to surrounding land.

2. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.

2.5 WATER

A. Supply potable water, free of substances harmful to growth.

PART 3 – EXECUTION

3.1. CONSTRUCTION

A. The Subcontractor shall establish a smooth, healthy, uniform, close stand of grass from the specified seed. Prior to revegetation, the Subcontractor shall adequately test the soils to be revegetated to ensure the adequacy of the specified requirements. Any modifications to these requirements deemed necessary, after the review of soil test results, shall be at the Subcontractor's sole expense. The Engineer will perform the observations to determine when successful revegetation is achieved.

3.2. SOIL PREPARATION:

A. Limit preparation to areas which will be planted soon after preparation.

B. The subgrade of all areas to be seeded shall be fine graded and raked and all rubbish, sticks, roots and stones, larger than 3 inches, shall be removed. Subgrade surfaces in all areas shall be tracked immediately after fine grading and raking has been completed. Tracking is to be performed with bulldozers operating in the direction of water flow. The tracks of the bulldozers are to have grousers of sufficient height to leave visible depressions in the subgrade. The depressions are to be perpendicular to the direction of water flow to reduce erosion potential.

C. Application of fertilizer, lime, seed and mulch shall only be performed during those periods, within the seasons, that are normal for such work, as determined by the weather and as approved by the Geotechnical Engineer. Seeding and fertilizing shall be conducted between April 1 and May 20 or between August 15 and October 15, or as directed or permitted by the Geotechnical Engineer.

D. Spread lime and fertilizer uniformly over designated areas at the rates specified in Table 1 of this section.

E. Grade seeded areas to smooth, even surface with loose, uniformly fine texture.

1. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.

2. Fine grade just prior to planting.

3.3 SEEDING

A. Use approved mechanical power driven drills or seeders, mechanical hand seeders, or other approved equipment. Hydroseeding methods are also allowed.

B. Distribute seed evenly over entire area at the rate specified in Table 1 of this section.

C. Stop work, when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds, excessive moisture, or other factors.

D. Resume work only when favorable condition develops, or as directed by the Geotechnical Engineer.

E. Seeding shall be done within five (5) days following soil preparation. For hydroseeding, seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed onto an area, the lime, fertilizer and seed shall be equal in quantity to the specified rates. Prior to the start of work, the Geotechnical Engineer and Subcontractor shall be furnished with a certified statement for approval of the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder.

F. Immediately protect seeded areas against erosion by mulching, where applicable.

1 Spread mulch in a continuous blanket, at the rate specified in Table 1 of this section.

2 Immediately following spreading mulch, secure with evenly distributed binder at the rate specified in Table 1 of this section.

3.4 MAINTENANCE:

A. The Subcontractor shall be responsible for maintaining all seeded areas through the end of his warranty period. The Subcontractor shall provide, at his expense, protection of all seeded areas against damage at all times until acceptance of the work. Maintenance shall include, but not be limited to, the following items:

1. Regrade and revegetate all eroded areas until adequately stabilized by grass.

2. Remulch with new mulch in areas, where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.

3. Replant bare areas using same materials specified.

TABLE 1: SEEDING SCHEDULE

MATERIAL	SEED TYPE	APPLICATION RATE[1]
Lime	N/A	4,000 lbs/acre (or as required to provide a pH of at least 6.0)
Fertilizer	N/A	1,000 lbs/acre
Permanent Seed[(2)]	Birdsfoot Trefoil (Empire) Redtop (Common) Creeping Red Fescue (Ensylva)	16 lbs/acre 4 lbs/acre 40 lbs/acre

Notes:

1. Application rates and/or chemical analysis shall be confirmed or established by a soil test.
2. Inoculum specific to birdsfoot trefoil must be used with this mixture. The inoculum shall be a pure culture of nitrogen-fixing bacteria selected for maximum vitality and the ability to transform nitrogen from the air into soluble nitrates and to deposit them in the soil. The inoculum shall not be used later than the date indicated on the container or later than specified. The inoculum shall be subject to approval.

END OF SECTION

SCHEDULE OF SUBMITTALS

SPECIFICATION SECTION AND PARAGRAPH	SUBMITTAL TITLE	SUBMITTAL/APPROVAL SCHEDULE
1.4 (A) (1)	Seed Mixture	Two weeks prior to seeding
1.4 (A) (2)	Fertilizer Mixture	Two weeks prior to seeding
1.4 (A) (3)	Hydroseeding	Two weeks prior to seeding

APPENDIX A

CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PLAN

WVNSCO
NDA CAP AND
GROUNDWATER BARRIER INTERIM MEASURE

MAY 2007

CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PLAN

WVNSCO NDA CAP AND GROUNDWATER BARRIER INTERIM MEASURE

QUALITY ASSURANCE/QUALITY CONTROL PLAN
WEST VALLEY NUCLEAR SERVICES
NDA CAP AND
GROUNDWATER BARRIER INTERIM MEASURES

1.0 INTRODUCTION

This Quality Assurance/Quality Control (QA/QC) Plan has been prepared for the construction of the ground water barrier wall and cap for the Nuclear Regulatory Commission Licensed Disposal Area (NDA) at the West Valley Nuclear Demonstration Project in West Valley, New York. The plan describes the organizational structure of the Quality Control Team. It includes the reporting structure, personnel requirements, laboratory testing requirements and equipment required for field testing.

The plan presents the field and laboratory testing requirements for construction of the ground water barrier and cap, including the subgrade evaluation and fill testing and geomembrane testing. Testing and monitoring of construction under this QA/QC Plan must meet the requirements stated in the Technical Specifications.

2.0 PROJECT ORGANIZATION

2.1 Personnel

The QA/QC Project Organization Chart is presented on Page 3. Lines of authority and communication are shown in solid black and lines of communication are shown in light dash.

Prior to the initiation of construction, a preconstruction meeting will be held and attended by a representative of WVNSCO, the prime Subcontractor, the Geotechnical Design Engineer, and the QA/QC personnel. Purposes of the meeting include:

- Providing each involved entity with all relevant QA/QC documents and supporting information;
- Addressing the site-specific QA/QC Plan and its role relative to the design criteria, plans and specifications;
- Reviewing the responsibilities, authorities and lines of communication for each of the involved entities;
- Reviewing the established procedures for observation and testing including sampling strategies identified in the QA/QC Plan;
- Reviewing the established acceptance and rejection criteria, as specified in the QA/QC Plan and the approved specifications, along with methods and means for decision making and/or resolution of problems over data;
- Reviewing methods for documenting and reporting all inspection data;
- Discussing procedures for the storage and protection of construction materials on-site; and
- Conducting a site walk to review the project site layout and construction material and storage locations.

2.1.1 Geotechnical Design Engineer

The Geotechnical Design Engineer is responsible for the preparation of the construction design drawings and specifications for the project. Additionally, the Geotechnical Design Engineer will visit the site during construction to clarify the intent of the design depicted on the plans.

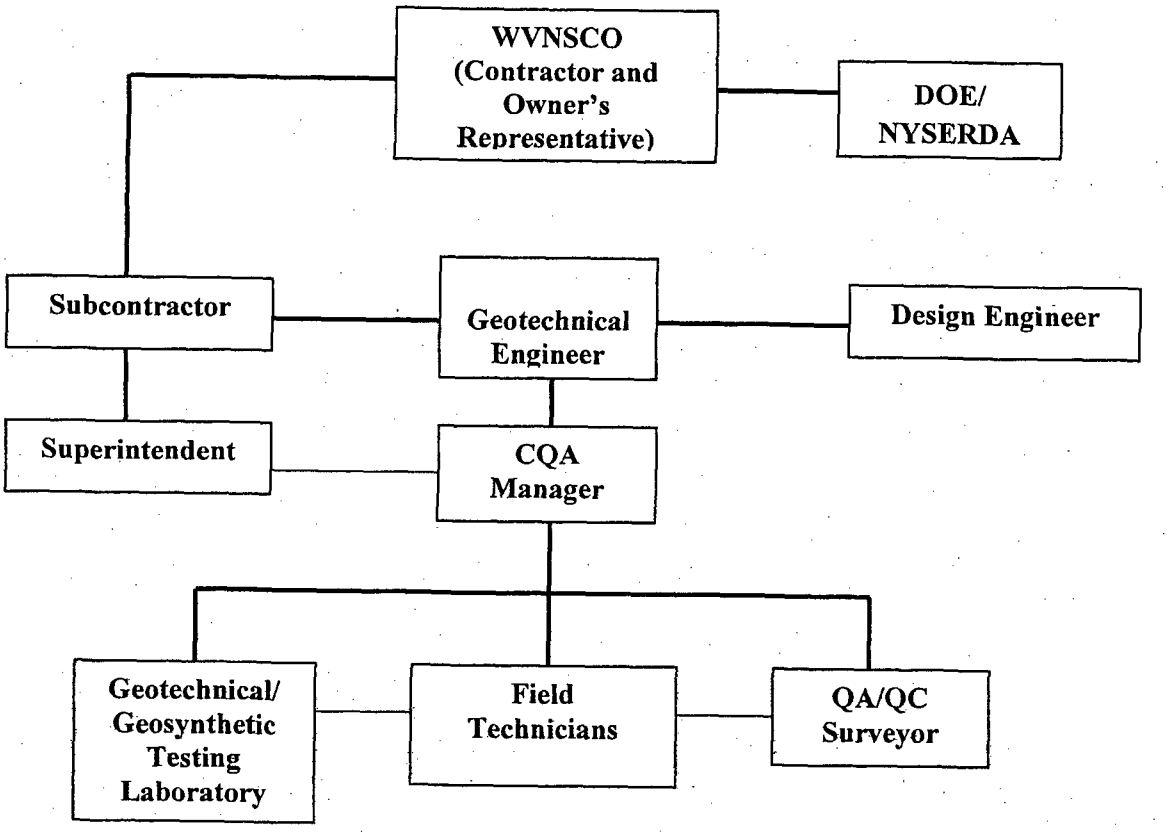
2.1.2 Geotechnical Engineer (field services)

The Geotechnical Engineer is responsible for all QA/QC plan activities, including the field technicians, and coordination with the geotechnical testing laboratory and the surveyor. Additionally, the Geotechnical Engineer will communicate directly with WVNSCO, the Geotechnical Design Engineer and the Subcontractor. The Geotechnical Engineer is to be a Licensed Professional Engineer, registered to practice in New York State, with 10 years experience in the design and construction of landfill caps, including experience with construction involving geosynthetics and ground water barriers.

2.1.3 Field Technicians

A Field Technician(s) will be assigned to the project to perform the actual field tests and to collect the samples as described elsewhere in this plan. The number of technicians assigned to the project will depend on the number of activities on-going concurrently. Field Technicians will have experience in the aspects of the construction they are assigned to monitor. Typically, such individuals will have a construction or civil technology degree. Since Field Technicians are required to operate a soil nuclear moisture density gauge, they will be required to have completed the certification course for the instrument before construction begins.

CQA/CQC Project Organization Chart



Legend

Lines of communication and authority

Lines of communication

When the project requires more than one Field Technician, one will be designated as the senior technician. This individual will report directly to the Geotechnical Engineer or his designee. This may be done by telephone (typically several times daily), when the Geotechnical Engineer is not on site and directly when the Geotechnical Engineer or his designee is on site. This individual is responsible for completing field reports documenting the field test locations and results and sampling locations. This individual can report the results of tests directly to the Subcontractor in the absence of the Geotechnical Engineer or his designee. Field Technicians will complete soil sampling, in-place density testing and testing and sampling tasks for the ground water barrier assigned by the Geotechnical Engineer or his designee.

2.1.4 QA/QC Surveyor

The Surveyor will measure the constructed dimensions of the facility and check the measurements against the project requirements. The Surveyor will be licensed in New York State and be independent of the Subcontractor. He will seal the record drawings for inclusion in the monitoring report.

2.1.5 Subcontractor

The Subcontractor will be required to demonstrate successful completion of at least two similar construction projects in which geosynthetics were used, in the past five years. The project superintendent will be required to demonstrate experience supervising construction of a geomembrane cap of similar magnitude.

The Subcontractor will establish field control and be responsible for layout of the project in the field. The Subcontractor will also measure the dimensions of the project components for payment, but will not overlap with the responsibilities of the Surveyor.

The Geosynthetics Installation Contractor and his personnel are required to demonstrate successful installation of at least 50 acres of geomembrane similar to that required for this project. Additionally, the Geosynthetics Installation Contractor will submit qualifications of individuals involved with supervision and the seaming activities. The geomembrane installation foreman must have supervised the installation of at least 50 acres of geomembrane similar to that required for this project. Documentation of experience seaming at least 10,000 feet of geomembrane must be provided for lead personnel involved with geomembrane seaming.

2.2 Laboratory

Geotechnical and geosynthetics testing laboratories are required to execute this QA/QC Plan. The geotechnical testing laboratory will test samples of soil used to construct this facility following ASTM and API standard methods. The geosynthetics testing laboratory will test geomembrane and geotextile samples. The laboratory will be managed by an individual with at least five years experience in the testing of soils; the geosynthetics laboratory will be managed by an individual with at least two years of experience testing geosynthetics. The Laboratory Manager is responsible for the results of all tests done in the laboratory and will report directly to the Geotechnical Engineer. Gauges and scales used by the laboratory must be part of a regular calibration program. If an on site laboratory is utilized for testing soil or the soil-bentonite barrier wall components, it shall meet the requirements cited above.

The following tests are required for the construction of this interim measure:

TEST	TEST DESIGNATION
Method for Particle Size Analysis of Soils	ASTM D 422
Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using a 10 Pound (4.54 kg) Rammer and 18 inch (457 mm) Drop	ASTM D 1557
Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures	ASTM D 2216
Practice for Wet Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants	ASTM D 2217
Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	ASTM D 4318
Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter	ASTM D 5084
Standard Test Method for Coated Fabrics	ASTM D 751
Standard Test Method for Measuring Core Thickness of Textured Geomembrane	ASTM D 5994
Standard Test Method for Tensile Properties of Plastics	ASTM D 638
Standard Test Method for the Density of Plastics by the Density Gradient Technique	ASTM D 1505
Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products	ASTM D 4833
Standard Test Method for Measuring Mass per Unit Area of Geotextiles	ASTM D 5261
Standard Test Method for Measuring Normal Thickness of Geotextiles and Geomembranes	ASTM D 5199
Bentonite Slurry Mud Weight	API RP 13B-1 Section 1
Bentonite Slurry Viscosity and Gel Strength	API RP-13B-1 Section 2
Bentonite Slurry Filtration	API RP-13B-1 Section 3
Soil-Bentonite Hydraulic Conductivity (Permeability, Constant Head), API Fixed-Ring Procedure	EPA/600/2-87/065, Appendix A

2.3 Testing Equipment

The following equipment is required for measuring compliance of earthwork, geomembrane installation activities and ground water barrier construction. Calibration certificates are required for equipment that is used to test soil, slurry, soil-bentonite and geosynthetics.

2.3.1 Soil Nuclear Moisture Density Gauge

This instrument will be used for measuring the in-place soil moisture content and unit weight. The gauge(s) used for this project will have been recently calibrated by factory-trained representatives and

leak tested. The operator (Field Technician) will operate the instrument in accordance with the manufacturer's recommendations.

2.3.2 Vacuum Box

This instrument will be used to check seams made using the extrusion welding methods for defects. The instrument must be similar to that described in ASTM D4437. The pressure gauge on the instrument must be clearly visible and calibrated before its use.

2.3.3 Field Pressure Gauges

Pressure gauges used in field tests such as geomembrane seam testing must be calibrated before their use is allowed.

2.3.4 Spark Test Equipment

Spark test equipment includes a Spy, Model #900-REG-726 detector, manufactured by Pipeline Inspection Company, Inc. or equivalent, as approved by the Geotechnical Engineer. This equipment is to be used to check seams made using extrusion welding methods that cannot be inspected using the vacuum box. This includes extrusion welds surrounding geomembrane penetrations, such as pipe boots. Necessary equipment includes copper wire, a wand for inspecting the weld, a power source capable of supplying the necessary voltage to the wand and copper wire, an earth ground, and an alarm to indicate when a defective weld is encountered with the wand. The instrument must be calibrated before its use.

2.3.5 Anemometer

A hand-held anemometer will be used to observe the wind speed in the area of geomembrane seaming operations. The instrument must be capable of operating at temperatures between 32°F and 120°F, and measure wind speeds up to 20 mph with an accuracy of ± 1 mph.

2.3.6 Thermometer

A calibrated thermometer will be used to record ambient temperatures and the temperature six inches above the geomembrane sheet prior to seaming.

2.3.7 Mud Balance

A standard mud balance will be used for measuring the unit weight of bentonite slurry. The instrument must provide accuracy within +/- 0.1 lb/gal. The instrument must be calibrated according to the instrument manufacturer's recommendations.

2.3.8 Marsh Funnel

A standard Marsh Funnel will be used to measure the viscosity of bentonite slurry. The marsh funnel must meet the dimensions in API RP-13B-1, Section 2.

2.3.9 Filter Press

A standard filter press will be used to measure the filtrate loss of bentonite slurry. The equipment must meet the requirements specified in API RP 13B-1, Section 3. This standard filter press will also be used to measure the permeability of soil-bentonite mixes.

3.0 EMBANKMENT CONSTRUCTION

3.1 Background

Soil fill (Embankment Material) will be placed and compacted in lifts on the surface of the NDA to build the cap grades, construct berms and groundwater barrier wall working platformshown on the contract drawings. Fill will be excavated from borrow stockpiles located on the West Valley Demonstration Project site and transported to the NDA cap. Fill for these structures may also be imported from a subcontractor's off-site borrow pit with WVNSCO and the Geotechnical Engineer's approval.

3.2 Pre-Construction Sampling and Testing

3.2.1 *Field Explorations*

WVNSCO has collected soil samples from prospective borrow stockpiles located on the West Valley Demonstration Project site and has tested these samples to assist in evaluating the suitability of the fill for use in the NDA cap and ground water barrier wall construction. In addition to these soil samples, the Geotechnical Engineer may collect soil samples during construction to estimate the variability of the soil properties.

The Subcontractor may be required to import soil from off-site borrow pit(s). In this case, the Subcontractor will be required to submit the results of soil tests completed on samples from these sources to estimate the suitability of soil from these sources for embankment and ground water barrier wall construction. During construction, the Geotechnical Engineer will collect samples from these off-site borrow sources and test them in the laboratory to confirm their properties and suitability for construction of the embankment and ground water barrier wall.

3.2.2 Laboratory Testing

Samples collected during the exploration program will be delivered to the soils laboratory for testing. The approximate testing frequency for fill type used in embankment and berm construction follows:

Test	Frequency
Particle Size Analysis (ASTM D422)	1 per 2,500 cubic yards
Moisture Content (ASTM D2216)	1 per 1,000 cubic yards
Liquid and Plastic Limits (ASTM D4318)	1 per 2,500 cubic yards
Moisture-Density Relationship of Soil (ASTM D1557)	1 per 2,500 cubic yards

Testing is to be performed on single samples. Testing, in addition to the above frequency, is to be performed if changes are noted in the soils in the borrow area.

3.3 Subgrade Surface Evaluation

3.3.1 Field Testing

For purposes of this QA/QC Plan, the subgrade surface is defined as that surface consisting of native soils that exist on the NDA. The surface of the NDA will be proof rolled, using a loaded 10-wheel or articulated dump truck. Alternatively, a smooth drum roller (Ingersoll Rand Pro-Pac SD100D or equivalent, as approved by the Geotechnical Engineer) may be used.

Proof rolling will be performed by driving the truck or smooth-drum roller slowly (about walking speed) over the subgrade surface. The Geotechnical Engineer or his designee will walk behind/beside the truck, observing the response of the subgrade to the proof rolling. Soft conditions, i.e., areas that weave under

load or that rut more than about 2 inches, are considered areas requiring remediation. The remediation needed will depend on the cause of the subgrade instability, which could be an elevated water content or soft soils.

Remediation activities include allowing the unstable area to dry or placing a geosynthetic (geotextile or geogrid) over the soft area and covering it with a layer of coarse crushed gravel. The aerial extent of the remediation includes the entire soft area. Remediated areas must be retested. Areas that are allowed to dry must be proof rolled after the drying. If soft areas are still detected, additional drying is required or placement of a geosynthetic on the subgrade and covering it with a layer of coarse crushed gravel, as necessary, to result in a firm subgrade during proof rolling.

There are exceptions to the use of the proof rolling. It should not to be used in areas where it could cause damage to underground structures, in confined areas, etc. The Geotechnical Engineer or his designee must visually inspect the subgrade surface and give approval before overlying material is placed.

3.4 Fill

3.4.1 Field Testing and Sampling

Suitable borrow from the WVDP site stockpiles or imported borrow will be used as fill to construct embankments and berms. All fill must be placed and compacted to a minimum dry density of 90 percent of the maximum dry density measured by the modified Proctor test. The moisture content is required to be within 3 percent (above or below) the optimum moisture content. Laboratory moisture-density tests will be performed before fill is placed so that, if there are different test results from different borrow areas, the appropriate value can be used for field control. A test pad will be constructed to evaluate the suitability of the Contractor's proposed equipment and methods of compaction.

The Subcontractor will be required to place fill within the specified moisture content range. It is expected that major changes to the moisture content of the fill will be made at the borrow area.

The Field Technician will measure the compacted fill moisture content and density, with the nuclear density gauge to estimate the suitability of the compacted fill. A nuclear density gauge probe depth of extending through the entire thickness of the lift being placed is recommended for testing the fill. In-place density tests locations will be measured relative to the site grid system.

The fill must be compacted so that all tests indicate the minimum density criteria and specified moisture content range are met for a lift to be considered acceptable. The lift must be considered acceptable, prior to placement of a subsequent lift. If the moisture content data suggest that the lift is too wet, the Subcontractor will be advised to either scarify the lift and allow it to dry or to remove the lift and replace it. If the moisture content data indicate that the lift is too dry, the Subcontractor will be advised and may scarify the lift, moisten it and recompact it before retesting it. If the density test data are low, the Subcontractor will be advised so that additional compactive effort may be applied.

If corrective measures are required for a soil lift, the lift must be retested, following the corrective measures. Retests must be performed within approximately two feet of the original test location.

After the results of all in-place density and moisture content tests indicate the soil has been compacted in accordance with the project specifications, the surface of the lift must be scarified to enhance bonding with the subsequent lift. The lift surface will be scarified using equipment necessary to adequately scarify the lift surface, which may include bulldozer tracks or a pad-foot roller.

Soil samples will to be collected from the borrow areas for laboratory testing before construction of the embankment, as described previously. However, there may be instances where the soil imported to the construction area appears to differ from that previously used. In these instances, the Field Technician will

collect a sample of this soil type for subsequent laboratory analysis. In the meantime, the soil in question will not be used for construction.

3.4.2 Laboratory Testing

On-site fill soils will be tested at the required frequency before construction, as described above. However, there may be instances where a different soil type appears at the construction area. In these instances, the soil will be sampled and delivered to the laboratory for testing for liquid and plastic limits and gradation using a sieve analysis. These data will be compared to the data from samples collected and tested during the pre-construction phase. If the data suggest the new soil is substantially different from the other samples tested and if the sample satisfies specifications, a laboratory moisture-density test will be performed. The data will be forwarded to the Geotechnical Engineer for distribution to the Field Technician.

3.4.3 Fill Evaluation

Areas of the fill where desiccation is observed will be scarified and recompacted to remove the desiccation cracks and meet the project requirements for density and moisture content, before the next lift is placed. At the completion of each shift and on weekends, the embankment and berm surfaces must be sloped to drain surface water. Additionally, the surface will be rolled with a smooth drum roller to enhance its ability to shed water.

Once the embankment has reached the final rough grade, the Geotechnical Engineer or his designee will observe the subgrade surface. All stones protruding more than ½ inch from the surface will be removed. Any resulting voids will be backfilled, using fine grained soil and mounded (over-filled) so that there is adequate material in the void, following roller compaction.

Following completion of the fine grading, the subgrade surface will be visually inspected a final time, to observe that loose stones or particles protruding more than ½ inch are removed. During this final inspection, any voids will be backfilled by hand and compacted with the smooth drum roller and will not require density testing.

The Geotechnical Engineer or his designee must visually inspect the subgrade surface and give approval before the overlying material is placed.

3.5 Reporting

Field Technicians will report their observations and the results of testing and sampling to the Geotechnical Engineer or his designee . The Geotechnical Engineer or his designee will assemble the individual reports and complete a field report for each day that construction occurs. The report will describe the Subcontractor's activities on that day, present the results of the field tests made that day and identify samples collected for laboratory analysis. The Geotechnical Engineer or his designee will file the daily field reports.

4.0 CLAY LINER

4.1 Background

A 6-inch thick compacted clay liner is part of the NDA cap. The clay liner underlies the geomembrane in the three storm water basins on the cap. The important features are as following:

- A permeability less than or equal to $1x10^{-6}$ centimeters per second (cm/sec) for clay liners;

- A maximum particle size of 1 inch; and
- A maximum compacted lift thickness of 6 inches.

Material for the compacted clay liner will be mined from designated locations at the site or imported from an off-site borrow pit. This soil can be a well-graded glacial till, having gravel, sand, silt and clay-sized particles or a glacial lacustrine deposit.

4.2 Pre-Construction Sampling, Testing and Measurements

This section describes the testing to be performed on samples collected from the borrow pit. The purpose of the pre-construction testing is to identify the soil type(s) and the variability of soil properties at the pit and to develop criteria for construction monitoring. The pre-construction testing program is expected to be performed in a phased approach, with certain areas of the borrow pit being explored and tested before others. Once samples from an area have been tested and found to be suitable, soil may be excavated from that area. Excavation from the borrow pit is to be limited to areas tested and found to be suitable.

4.2.1 Field Explorations

The soil used for construction of the clay liner may be mined from various locations at the facility. The area(s) to be mined will be identified in plan view. A Test Pit Program will be developed to evaluate soil conditions in the proposed borrow area and for collecting the soil samples necessary for laboratory testing.

Soil samples will be collected at a rate of least one sample for every 250 cubic yards of clay liner material. These samples will be obtained from the test pits, such that the overall sampling and testing frequency meets the requirements described below.

4.2.2 Laboratory Testing

Samples collected in the exploration program will be delivered to the soils laboratory for testing. The approximate testing frequency for clay liner soils follows:

Test	Frequency
Moisture Content (ASTM D2216)	1 per 250 cubic yards
Liquid and Plastic Limits (ASTM D4318)	1 per 250 cubic yards
Particle Size Analysis (ASTM D422)	1 per 250 cubic yards
Moisture-Density Relationship of Soil (ASTM D1557)	1 per 250 cubic yards
Remolded Permeability (ASTM D5084)	Note 1

Note 1: The number of remolded permeability tests depends on the number required to develop the moisture-density-permeability relationship.

Upon receipt of the initial test data, the Geotechnical Engineer will develop the moisture-density-permeability relationship (i.e., the zone of acceptance for construction). The zone of acceptance is defined as the moisture content and dry density combinations that produce a soil permeability of 1×10^{-6} cm/sec or less and acceptable strength and compressibility characteristics. The Field Technicians will use this information for acceptance of field dry density and moisture content measurements.

4.2.3 Test Pad Construction

The Subcontractor is to construct a test pad, using the clay liner to:

1. Assess the capability of the proposed compaction equipment to achieve the required soil compaction results, destroy clay clods and knead the clay mass together;

2. Measure the loose lift thickness that results in a 6-inch thick compacted lift; and

3. Measure the loose lift thickness that can be compacted with the proposed equipment and number of passes required to achieve the specified soil density.

Soils must be placed on the test pad under the same conditions they will be placed in the NDA basins.

The Subcontractor must use both pad foot and smooth drum rollers for this project and both roller types will be needed for the test pad construction. If the equipment proposed by the Subcontractor is the same as equipment used to construct other test pads at the site, then the Geotechnical Engineer may waive the requirement that a test pad be constructed.

Test data from soil samples taken from the clay liner soil as described in Section 4.2.2, are to be available prior to construction of the test pad. The Geotechnical Engineer will evaluate the zone of acceptance and establish compaction criteria for the clay liner. The Subcontractor must place soil for the test pad within the specified range of moisture content.

The Geotechnical Engineer will select an area about 50 feet by 20 feet, within the NDA cap footprint for construction of the test pad. Four stakes will be placed at a 15-foot spacing, along the edge of the test pad area. Additionally, four control points within the initial lift, will be established and these locations are to be referenced with respect to the stakes. The elevation of the control points will be measured. These elevations can be referenced to an arbitrary benchmark.

The Subcontractor will place a lift of clay liner along one edge of the designated area, next to the grade stakes. The first lift should have a uniform loose thickness of approximately 8 inches and be at least 50 feet long and 12 feet wide.

After the clay liner is placed with the bulldozer, the locations of the four control points, referenced to the stakes placed along the edge of the test pad, will be reestablished. The Field Technician will measure the soil moisture content and dry density at the four control point locations, using the nuclear density gauge, to obtain the uncompacted dry density. The nuclear density gauge probe length must be less than the lift thickness, with the gauge operated in the direct transmission mode. If the measured moisture contents are outside the zone of acceptance, the soil must be conditioned by adding water or allowing the soil to dry, as appropriate, so that the moisture content falls within the zone of acceptance.

Elevations of the lift, at the four control point locations, will be measured. These data will be compared to the subgrade elevation measurements to calculate the loose lift thickness. The Subcontractor should make four passes (two forward and two in reverse) over the test pad with the proposed pad foot roller and two passes, with the smooth drum roller. The rollers should be operated at the operating speed that will be used during the majority of the compaction.

The QA/QC Surveyor will measure the elevation of each control point. These data will be compared to the subgrade elevation data to calculate the compacted lift thickness. Next, the Field Technician will measure the soil density and moisture content at the four control point locations, with the nuclear density gauge. For density measurements, the nuclear moisture-density gauge probe should extend to near the bottom of the lift, but not through it. Following each test, the Field Technicians are to fill the hole left by the probe with bentonite powder or pellets and tamp that material in the hole.

The Geotechnical Engineer will compare the soil dry density and moisture content data to the proposed zone of acceptance data. If the required dry density has not been reached at all four test locations, the Subcontractor will make two additional passes with each type of compaction equipment (pad foot and smooth drum rollers).

Following the additional passes (making a total of ten), the Field Technician will measure the soil dry density, moisture content, and the ground surface elevation at the control points. Again, the Geotechnical Engineer will compare the in place density data to the proposed zone of acceptance. If all dry density data do not satisfy the minimum dry density criteria, the Subcontractor will make two additional passes, with each type of compaction equipment. The process of making four passes, measuring the soil dry density and moisture content and ground surface elevation should be continued until the dry density measurements, at all four control point locations, satisfy the minimum dry density (and moisture content) criteria.

Finally, the Field Technician(s) will retrieve at least four Shelby tube samples from the vicinity of the control points for subsequent laboratory tests. The Shelby tube samples will be delivered to the geotechnical testing laboratory for permeability testing and dry density and moisture content measurements, as described in Section 4.2.2. The geotechnical testing laboratory will report the test results to the Geotechnical Engineer.

The Geotechnical Engineer will review and analyze the field and laboratory test data to confirm that the results are consistent with the zone of acceptance. The Geotechnical Engineer will compare the initial and final lift thickness data. If the final lift thickness is thin, the process may be repeated with a thicker initial lift, the thickness of which will depend on the final lift thickness.

4.3 Tests During Construction

4.3.1 Optical Survey Measurements

The QA/QC Surveyor will use optical survey measurements to determine the thickness of the liner, as described in Section 6.0.

The Subcontractor is required to control the loose lift thickness to no greater than that determined from the test pad construction. The Subcontractor can use grade stakes marked at the loose lift thickness or laser equipment, attached to the bulldozer blade. If grade stakes are used, the Subcontractor must completely remove each grade stake and fill holes left by the grade stakes, with bentonite, when the stakes are removed.

4.3.2 Field Testing and Observations

a) In-Place Density Tests

The Geotechnical Engineer will establish the "zone of acceptance" for in-place density test results. The "zone of acceptance" will be established based on the results of laboratory testing prior to construction. The minimum percent compaction is 90% of the Modified Proctor maximum dry density.

The Field Technician will measure the in-place dry density and moisture content of the compacted clay liner using a nuclear moisture-density gauge in general accordance with ASTM D2922 and ASTM D3017. The nuclear density gauge probe will extend to the full depth of the lift. In-place moisture density test results must satisfy the established moisture and density criteria before the lift is accepted. Holes in the clay liner resulting from the test probe shall be backfilled with bentonite which is tamped into the hole using a rod.

The Geotechnical Engineer or Field Technician will advise the Subcontractor of the test data. If the in-place moisture content is acceptable but the dry density is too low, the Subcontractor must make more passes with the compactor until all in-place test results are satisfactory. If the in-place moisture content is too high to achieve the required compaction, the Subcontractor must scarify the clay and allow it to dry. If weather conditions are not favorable for drying, the Subcontractor may elect to remove the entire lift and replace it with drier soil. Scarifying, adding water and mixing, and recompaction must be done if the in-place moisture content is too low. This process is acceptable only for minor moisture content adjustments. Major moisture content adjustments should be made at the borrow pit (or stockpile), before moving the soil to the working area.

The compacted clay liner must be retested for moisture content and dry density following any remediation efforts. Tests following remediation should be within approximately two feet of the original tests.

b) Observations

Once all field in-place density tests indicate satisfactory results, the Field Technician will evaluate the condition of the lift to determine its acceptability, before the Subcontractor places the overlying lift. The lift will be checked for wet and dry zones. Saturated areas must be removed. Dried areas are to be checked for desiccation cracks. Lifts having desiccation cracks exceeding 1/2 inch in depth need to be remediated. The Subcontractor will either remove the unacceptable zones in the lift or remediate the areas by scarifying and moisturizing. The remediated areas will be tested as though they are a new lift, in accordance with the testing procedures described above.

4.3.3 Winter Shutdown

Prior to a winter shutdown, the clay liner must be sloped to drain surface water and rolled with a smooth drum roller to enhance its ability to shed water. Additionally, a sacrificial layer of fill (12 inches thick) is to be placed over the material. This lift is to be compacted to a firm condition, but not be tested.

At the start of construction in the following spring, the sacrificial layer must be removed and the clay liner surface evaluated. In-place density tests will be performed on the surface. The test results will be compared to results of tests made prior to winter shutdown, to assess the effect of winter conditions on the material. If test data indicate the material has been affected, the Subcontractor will be instructed to remove the uppermost lift and the in-place density test routine described above is to be repeated. This evaluation process is to continue for each lift until the test data indicate that the winter effects no longer exist at that depth.

The clay liner will reworked and recompacted to the depth necessary, so that results of in-place density tests meet the project requirements.

4.4 Reporting

Each Field Technician is to report observations and the results of testing and sampling to the Geotechnical Engineer. The Geotechnical Engineer will assemble the individual reports and will complete a field report for each day that construction occurs. The report is to describe the Subcontractor's activities on that day and present the results of field tests made that day and a list of samples collected for laboratory analysis. Plan drawings that show the approximate locations of acceptable in-place moisture and density tests for the clay liner will be included in the report.

5.0 GROUND WATER BARRIER WALL

5.1 Background

The ground water barrier wall will be a 3-foot wide soil-bentonite (SB) cutoff wall. The wall will extend from the surface of the working platform to 5 feet into the unweathered Lavery Till deposit, a height of about 25 feet. The barrier wall will have a maximum permeability of 1 x 10^{-7} centimeters per second. The approximate length of the barrier wall is 900 feet.

WVNSCO has two on-site stockpiles for use in the SB mix. WVNSCO has sampled these stockpiles and will provide laboratory test data from the samples. The Subcontractor will mine the soil from those stockpiles for the SB mix or provide soil from an off-site borrow pit. The subcontractor will purchase and store dry bentonite required for the slurry mix and the SB backfill.

The Subcontractor will be responsible for designing the SB backfill mix, the bentonite slurry, the mixing pad and enclosure for mixing the SB and the hydration/storage pond(s) for the slurry following this QA/QC plan and the technical specifications. The subcontractor is required to collect soil samples from the on-site stockpiles and off-site borrow pits for preparing the SB design mix.

The Geotechnical Engineer will maintain an on-site laboratory for completing all tests on the slurry and the SB backfill, except triaxial permeability tests, which will be performed in the off-site geotechnical laboratory.

5.2 Pre-Construction Sampling, Testing and Measurements

This section describes the testing to be performed on soil samples collected from the borrow area(s). The purpose of the pre-construction testing is to identify the soil type(s) and the variability of soil properties in the borrow area(s) and to prepare a design mix for the soil-bentonite backfill mix.

5.2.1 Field Explorations

The soil used for mixing the soil-bentonite backfill will be mined from various locations at the facility. WVNSCO has collected some soil samples for preliminary screening of the on-site stockpiles. The Subcontractor must collect soil samples from the borrow pit it intends to use for the SB backfill mix.

The Subcontractor will develop a test pit program to evaluate soil conditions in the proposed borrow area(s) (both on-site and off-site) and for collecting the soil samples necessary for laboratory testing. Soil samples must be collected at a rate of least one sample for every 500 cubic yards of barrier wall).

5.2.2 Laboratory Testing

The Subcontractor is required to laboratory test soil samples to evaluate the suitability of the planned borrow sources and measure the permeability of trial SB backfill mixes by varying the bentonite content.

Samples collected in the exploration program must be tested at the approximate testing frequency soils follows:

Test	Frequency
Moisture Content (ASTM D2216)	1 per 500 cubic yards
Liquid and Plastic Limits (ASTM D4318)	1 per 500 cubic yards
Particle Size Analysis (ASTM D422)	1 per 500 cubic yards

Upon receipt of the initial test data, the Subcontractor must evaluate the suitability of the borrow soil and notify WVNSCO if it is unsuitable for use as soil-bentonite backfill.

The Subcontractor's laboratory must prepare a design mix for the soil-bentonite backfill by varying the bentonite content and measuring the permeability of the trial mixes following ASTM D 5084. The permeability tests must be completed using effective confining pressures typical of those expected near the ground water surface of the constructed barrier wall.

5.2.3 SB Backfill Mix Design Report

Once the design mix has been prepared, the Subcontractor must prepare and submit a report to WVNSCO and the Geotechnical Engineer. The design report shall include the results of the trial mix testing, the results of all permeability and gradation tests used to prepare the design mix and the proposed SB design mix proportions. The report shall include the results of slump tests done on each of the trial mixes. This includes the amount of dry bentonite that will be added to the soil and the amount of bentonite that will be added via slurry.

The report must describe the methods that the Subcontractor proposes to use to control the mix proportions in the field.

5.3 Tests During Construction

This section presents the tests that the Geotechnical Engineer or his designee must complete during the ground water barrier wall construction on the bentonite slurry, the SB backfill and the trench.

5.3.1 Initial Bentonite Slurry

The Geotechnical Engineer or his designee will sample the initial mix of bentonite slurry from the hydration pond following mixing, but before introducing it into the trench. The Geotechnical Engineer or his designee will repeat these tests each morning and following the mixing of each new batch of bentonite slurry.

Each slurry sample must be tested for the following properties:

a) Unit Weight

b) Viscosity

c) Filtrate Loss

d) Bentonite Content

5.3.2 Trench Bentonite Slurry

The Geotechnical Engineer or his designee will collect a sample of bentonite slurry from the bottom of the trench at the beginning of each shift and when the slurry in the trench has not been disturbed for more than 30 minutes. The following tests must be completed before beginning excavation or backfill operations for that shift.

a) Unit Weight

b) Viscosity

The test results must comply with specifications before activities (excavating, backfilling, etc.) in the trench can begin. If the slurry doesn't comply with the specifications, the Subcontractor must propose methods (de-sanding, etc.) to make the slurry in compliance with specifications.

5.3.3 Soil-Bentonite Backfill

The Geotechnical Engineer or his designee will collect a sample of the mixed soil-bentonite backfill mix at a rate of one sample per 10 cubic yards and perform the following tests on each sample

a) Slump (ASTM C143)

b) Gradation (sieve only) (ASTM D422)

c) Constant Head Permeability

d) Triaxial Permeability

Note: All tests except the triaxial permeability tests will be completed in the on-site soils laboratory. The triaxial permeability tests will be performed in the off-site Geotechnical Testing Laboratory.

5.3.4 Trench Measurements

The Subcontractor must measure the working platform surface elevation and the Geotechnical Engineer or his designee will use a sounding tool to measure the depth of the trench. The depth will be measured at 10-foot intervals along its alignment. The trench depth will be measured immediately following excavation and again in advance of the backfill placement to identify the accumulation of sediment on the trench bottom.

The trench will be sounded on the surface of the backfill at the end of each shift and the beginning of each shift, before any additional backfill is placed.

The Geotechnical Engineer or his designee will notify the Subcontractor of any discrepancies in the sounding measurements so that the Subcontractor can take appropriate action, such as excavating in front of the backfill toe, sampling the backfill surface, etc.

5.4 Reporting

Each Field and Laboratory Technician will report observations and the results of testing and sampling to the Geotechnical Engineer or his designee. The Geotechnical Engineer or his designee will assemble the individual reports and will complete a field report for each day that construction occurs. The report will describe the Subcontractor's activities on that day and present the results of field tests made that day and a list of samples collected for laboratory analysis. The Geotechnical Engineer or his designee will file the daily field reports.

6.0 OPTICAL SURVEY MEASUREMENTS

6.1 Background

This section describes the survey measurements required for implementing the QA/QC Plan.

The Surveyor will develop a grid pattern, spaced at 50-foot intervals, to define elevation measurement locations. Measurements will also be made at changes in slope, such as the toe of containment berms.

6.2 Control

The Surveyor will set horizontal and vertical control for the project using the existing control at the site. The Subcontractor is to lay out subgrade below the geomembrane in the cap.

6.3 Cap Survey

The Surveyor will establish the grid in the field and make elevation measurements at the grid locations. The first set of elevations will be made on the subgrade surface.

The Surveyor will make another set of elevation measurements at the grid locations, following construction of the cap fill. These data are to be compared to the elevations measured before construction to determine the cap thickness..

6.4 Ground Water Barrier Wall

The Surveyor will measure the location of the ground water barrier wall and will plot the location on a topographic survey of the NDA site.

6.5 Reporting

The Surveyor will report observations to the Geotechnical Engineer or his designee.. The Surveyor will provide the final survey measurements to the Geotechnical Engineer or his designee for approval.

7.0 GEOMEMBRANE

7.1 Background

Plans for the NDA cap show an exposed XR-5 geomembrane covering a geotextile, which overlies the compacted embankment material used to create the constructed cap grades.

The QA/QC Plan described below specifies the methods used to check the quality of the geomembrane delivered to the site relative to the design requirements and specifications, and the field seams used to join the geomembrane sheets. In what follows, procedures that encompass QA/QC throughout the project are described, including manufacturing, delivery, storage and installation of the geomembrane sheets.

7.2 Preconstruction Sampling, Testing and Documentation

7.2.1 Supplier Requirements

The geomembrane supplier must provide a certification that the geomembrane manufactured for this project meets the material properties listed in the project specifications. Information and test results documenting that the geomembrane meets the specifications must be provided as described in the specification submittal requirements.

Manufactured Sheets. The supplier of the geomembrane must certify to the Geotechnical Engineer through the manufacturer's quality control documents that during manufacture, the geomembrane was continuously inspected for uniformity, damage, imperfections, holes, cracks, thin spots and foreign materials. Additionally, the geomembrane must have been inspected for defects. Documentation must be provided to demonstrate that all imperfections found were repaired and reinspected at the manufacturing facility.

The geomembrane supplier must also provide to the Geotechnical Engineer reports of tests taken to verify the integrity of the manufactured geomembrane. Results from the following tests must be submitted prior to installation of the geomembrane.

TEST	SPECIFICATION
Weight	ASTM D 751
Thickness	ASTM D 751
Tensile Properties	ASTM D 751
Bonded Seam Strength	ASTM D 751
Adhesion – Heat Seam	ASTM D 751

The tensile properties for the geomembrane, as measured by ASTM D 751, must include tensile strength at yield, tensile strength at break, elongation at yield and elongation at break.

The supplier must sample and test the geomembrane material for the properties listed above, at a frequency of at least once for every 50,000 square feet of manufactured geomembrane, and at least once, after each change in source of raw materials. A quantity of material shall be taken from each roll sampled to satisfy the requirements for testing, as described in each of the above referenced testing standards.

Testing shall be performed, at the indicated frequencies, on material and rolls specifically designated for use on this project. Test results supplied for rolls, which are not to be used on this project, are not to be accepted. Furthermore, sampling intervals shall be distributed throughout the rolls, every 50,000 square feet.

Samples found not to meet the specifications shall result in the rejection of the applicable rolls. At the Geotechnical Engineer's discretion, additional testing of individual rolls may be performed to more closely identify the non-complying rolls.

The supplier must submit all documentation required by this section to the Geotechnical Engineer before the geomembrane may be delivered to the project.

7.2.2 Installer and Geotechnical Engineer Requirements

Installer and Geotechnical Engineer requirements include, those for archive sampling and conformance testing and sampling.

Conformance Testing and Archive Sampling. The Geotechnical Engineer is to obtain conformance samples of the geomembrane panels produced for the project, at the minimum frequency of one sample per 100,000 square feet, and at least one sample per material lot. The samples are to be obtained either at the manufacturing plant, following production or after delivery of the panels to the site. If samples are obtained at the manufacturing plant, only samples on rolls actually delivered to the site are to be accepted, as meeting the above frequency requirement. Conformance samples are to be tested in accordance with the testing requirements listed below under *Conformance Testing.*

Archive Samples

The geomembrane installer is to take a set of samples for possible future fingerprinting from each panel sampled. Samples for possible future fingerprinting are to consist of 4 sheets, having dimensions of approximately 8.5 inches by 11.0 inches. Sample sheets are to be removed from a length of geomembrane taken from the panel, with none taken closer than 12 inches from the edge of the panel.

Sample sheets are not to be cut from the inner or outer wraps of a geomembrane roll. WVNSCO is to archive the samples, for possible future fingerprinting, in a light-free environment maintained at room temperature. The Geotechnical Engineer is to observe the archive location.

Conformance Testing

The Geotechnical Engineer or his field representative will obtain geomembrane conformance test samples for laboratory quality assurance testing. The samples are to be at least 3 feet wide by the and must encompass at least one factory seam. Material is not to be taken from the inner or outer wraps of a roll. The machine direction must be clearly marked on each laboratory sample. The Geotechnical Engineer is to deliver the set of laboratory samples to the geosynthetics testing laboratory. The geosynthetics laboratory is to prepare and test each sample in conformance with the following standards:

TEST	SPECIFICATION
Weight	ASTM D 751
Thickness	ASTM D 751
Tensile Properties	ASTM D 751
Bonded Seam Strength	ASTM D 751
Adhesion – Heat Seam	ASTM D 751

The geosynthetics testing laboratory will report the test results to the Geotechnical Engineer. If the laboratory samples do not meet specifications, two additional samples are to be collected for testing. The sample panel that failed initial testing is not to be included in the domain for resampling. An additional sample is only to be obtained from a panel having the same source of raw materials as the roll from which the sample not meeting the specifications was obtained. If additional laboratory testing indicates the specifications are not met, the Geotechnical Engineer is to instruct the installer to remove the geomembrane represented by the failed sample from the site. If the additional samples meet the specifications the panel the sample was collected from and panels between passing test results are deemed suitable for deployment. The panel with the failing results shall be removed from the site.

7.3 Construction Phase QA/QC Activities

7.3.1 Subgrade Surface Inspection

The Geomembrane Installer is to observe the condition of the surface on which the geomembrane will be deployed for smoothness and protrusions before deploying the geotextile and geomembrane. The strength of the subgrade must be sufficient to support the equipment that will be used for deploying the geomembrane, without experiencing permanent deformations, such as ruts. The maximum rut depth prior to deployment of the geomembrane shall be 1 inch. When the surface is acceptable, the Geomembrane Installer must submit a written notice to the Geotechnical Engineer stating that the surface satisfies the installer's requirements. No geomembrane is to be deployed until the Geotechnical Engineer indicates the subgrade is acceptable.

7.3.2 Deployment of Geomembrane

The geomembrane should remain dry until ready to be deployed. The material should not be deployed if the material temperatures are lower than 20°F, or in winds in excess of 20 miles per hour. The two geomembrane sheets to be joined must be properly positioned, such that sufficient overlap exists. No vehicles are to be allowed on the geomembrane during or after deployment. The geomembrane sheets are to be deployed on the cap to create a "shingle effect," i.e., the upslope sheet should overlap the downslope sheet. After the geomembrane has been deployed, the installer and the Field Technician shall

visually observe its condition for uniformity, damage, and imperfections that may include tears, punctures, etc. Any geomembrane containing imperfections shall be discarded at the discretion of the Field Technician.

7.3.3 Observations During Geomembrane Seaming

The Field Technician is to record ambient conditions during seaming, including air temperature, clouds and wind velocity. The Field Technician is to measure the wind velocity at the location of the geomembrane with an anemometer. Field seaming is prohibited when the ambient air temperature is below 32° F, during precipitation or when the underlying embankment material is frozen. Also, the Field Technician is to measure and record the temperature of the geomembrane sheet within five minutes prior to seaming. Sheet temperatures for seaming shall be above 32°F.

7.3.4 Preparation of Seam Test Strips

The Geomembrane Installer is to check the seaming performance by making test seams at:

1. each start of work, for each seaming crew,
2. after every five hours of continuous seaming,
3. every time seaming equipment is changed,
4. every time there is a change in equipment operator, and
5. when significant changes in ambient conditions or geomembrane temperature are observed.

Seaming crews may prepare test strips, two to three feet in length, from pieces of excess geomembrane. Test seams are to be welded under the same conditions as are found within the construction area. Equipment and materials for preparing test strips must be identical to those used subsequently to produce geomembrane seams. The seaming crew shall cut six random samples from the test strip, such that three may be tested in the peel mode, and three in the shear mode. The seaming crew is to perform peel and shear tests, and the Field Technician is to document that the testing was performed and the type of failure for each specimen tested. The Field Technician is to approve the test strip, only if all specimens tested for peel and shear strength fail by film tearing and meet the strength requirements presented in the project specifications. Seaming of the geomembrane is not to be permitted until the seaming crew produces a test strip that is accepted by the Field Technician.

7.3.5 Nondestructive Field Tests for Continuity

The Geomembrane Installer and the Geotechnical Engineer are to visually check all geomembrane seams for uniformity of width, and surface continuity. The Geomembrane Installer must check all field seams for continuity, using nondestructive test methods. Field seams must observed, with a vacuum box, as described in ASTM D5641. Seams that are not accessible for vacuum testing are to be tested by spark testing, following the procedure described at the end of this Section.

Testing must be carried out, as the seaming work progresses, not at the completion of all field seaming. All non-destructive testing must be witnessed by the Geotechnical Engineer or his designee . Any testing performed in the absence of the Geotechnical Engineer or his designee is to be repeated and witnessed by one of the above.

Extrusion seams, that are not accessible for vacuum testing, are to be tested by spark testing. The Installer will provide equipment for spark testing that meets the approval of the Geotechnical Engineer. Necessary equipment includes copper wire, a wand for inspecting the weld, a power source capable of supplying the necessary voltage to the wand and copper wire, an earth ground, and an alarm to indicate when a defective weld is encountered with the wand.

The Geotechnical Engineer or his designee , will monitor nondestructive testing and record the location, date, test unit number, name of tester and results of all testing. Based on results from nondestructive testing, the Geotechnical Engineer or his designee will inform the Installer of necessary corrective actions. Seams that leak and are repaired must be retested.

The Installer must repair the defective seam areas with a geomembrane patch, which extends at least 6 inches beyond the unbonded area, on all sides.

7.3.6 Sampling of Geomembrane Seams and Destructive Testing

Destructive test samples are to be marked and cut out at locations directed by the Geotechnical Engineer. Samples will be collected from the anchor trench area, which is outside of the limits of the NDA and will subsequently be covered. However other locations may be selected if in the opinion of the Geotechnical Engineer there is a suspicion of weld defects. A minimum of one sample per welder will be collected each day unless the welded is only completing minor patch work.

The Installer shall cut out four (4) foot long sections of fabricated seam, from each sample location marked on the geomembrane. The cutout section must be wide enough, such that there is sufficient sheet material on either side of the sampled seam for testing. The Installer is to identify each sample with a number and include the sample number and location on the panel layout drawing. The area, from which the geomembrane seam sample was taken, is to be patched, and then subjected to nondestructive testing, as described in Section 7.3.5.

The Installer shall divide the remaining seam sample into two parts. Each part must be at least two feet long. The Installer is to provide one part to WVNSCO and one to the Geotechnical Engineer. WVNSCO is to archive the sample for possible future testing. The archive shall be stored in a light free environment, maintained at room temperature. The Geotechnical Engineer shall observe the archive location.

The Geotechnical Engineer or his designee , is to deliver the remaining sample to the geosynthetics testing laboratory, for peel and shear testing, as described in ASTM D751. The geosynthetics testing laboratory is to report results of shear and peel testing to the Geotechnical Engineer, no more than 48 hours after they receive the samples.

The Geotechnical Engineer shall determine acceptance of the seam based on the laboratory shear and peel test results for the sample of the geomembrane material according to the criteria in the specifications and includes the strength of the seam, percent elongation (shear test), or separation (peel test) and break pattern.

Seam strength testing shall be performed, as the seaming work progresses, not at the completion of all field seaming.

Remediation is required when the laboratory sample does not meet the criteria stated above. The Installer is to be required to: (1) patch the seam in each direction, between the failed sample location and the location of the next acceptable sample, or (2) collect an additional destructive test sample from each side of the failed sample location, to identify the limits of the defective seam. A patch would then be placed over the seam between the two passing seam locations. All patch seams are to undergo nondestructive testing, as described in Section 7.3.5.

7.4 Summary

Table 7-1 is a summary of the testing required for the geomembrane cap. Details of other required observations and the sampling and testing protocols are described in the preceding discussion.

TABLE 7-1
SUMMARY of GEOMEMBRANE TESTING

MATERIAL	TEST	METHOD	FREQUENCY
Supplier Requirements			
Manufactured Sheet	Weight	ASTM D 751	Once per 100,000 square feet but at least once for each source of raw materials
	Thickness	ASTM D 751	
	Tensile Properties	ASTM D 751	
	Bonded Seam Strength	ASTM D 751	
	Adhesion – Heat Seam	ASTM D 751	
QA/QC Engineer Requirements			
Delivered Rolls	Weight	ASTM D 751	Minimum one sample per 100,000 square feet and at least one per lot
	Thickness	ASTM D 751	
	Tensile Properties	ASTM D 751	
	Bonded Seam Strength	ASTM D 751	
	Adhesion – Heat Seam	ASTM D 751	
Installed Geomembrane	Vacuum Box	ASTM D5641	Test all extrusion fillet weld seams
	Spark Test	per section 6.3.5 of QA/QC Plan	Extrusion welded seams not tested by vacuum box
	Bonded Seam Strength	ASTM D 751	Minimum one sample per day.
	Adhesion – Heat Seam	ASTM D 751	

7.5 Reporting

The Geotechnical Engineer or his designee is to complete a field report, for each day, that describes the Subcontractor's activities on that day, weather conditions during geomembrane installation, the condition of the geomembrane sheets, results of all required testing, and locations of geomembrane seam samples taken for destructive testing. The report is to contain documentation of any failed test results, descriptions of any necessary remedial activities including the locations of repairs, and all reinspection and testing performed.

The geomembrane Installer is to provide the Geotechnical Engineer with a record of the installation. The record shall include a plan view of the installed geomembrane, showing the panel dimensions, panel and seam identification numbers, panel locations, as well as the locations of destructive tests, samples, and necessary repairs.

8.0 GEOTEXTILES

8.1 Background

Geotextiles are used in a number of different locations throughout the cap. Geotextiles are used as separators between coarse and fine grained materials, and as a protective cushion for the geomembrane. The following table is a summary of the different geotextiles used and their associated function.

SYSTEM	LOCATION	FUNCTION
Cap	Beneath the geomembrane	Cushion / Protection
Anchor Trench	Above and below the geomembrane	Cushion / Protection
Surface Water Drainage	Beneath riprap	Separation
Access Road	Beneath Sand and Gravel	Separation

8.2 Preconstruction Sampling and Testing Requirements

8.2.1 Supplier Requirements

The Geotextile Supplier is to provide the Geotechnical Engineer with a certificate that indicates the fiber type, manufacturing process, and that the geotextile material meets or exceeds the specified physical requirements. Each manufactured roll must be labeled according to ASTM D4873, to indicate the manufacturer, style number and roll number.

The supplier must provide manufacturers' quality control/quality assurance test reports to the Geotechnical Engineer. Required manufacturers' quality control/quality assurance tests shall be conducted in accordance with applicable test standards, as shown in Table 8-1. The required sampling frequency is also indicated in Table 8-1.

All documentation required of the Supplier must be provided to the Geotechnical Engineer prior to using the geotextile on site.

8.2.2 Geotechnical Engineer Requirements

The Geotechnical Engineer will obtain conformance samples of the geotextile rolls produced for the project, at the minimum frequency of one sample per 100,000 square feet. The samples will be obtained either at the manufacturing plant, following production or after delivery of the rolls to the site. If samples are obtained at the manufacturing plant, only samples from rolls actually delivered to the site will be accepted as meeting the above frequency requirement. Samples are to be obtained by cutting at least a minimum 2-foot wide piece along the entire roll width and marked with the roll number, product, manufacturer and machine direction. Testing will be performed for the properties listed in Table 8-1 under " Geotechnical Engineer Requirements." If a sample does not meet the specifications, samples from adjoining roll numbers will be collected and tested until the extent of material failing to meet the specification is determined. Any rolls from which samples failing to meet the project requirements were obtained will be rejected for use on the project.

The Geotechnical Engineer will observe the storage of geotextile rolls delivered to the site and the procedures used to shelter them from sunlight, storm water and construction traffic.

8.3 Construction Requirements

All geotextiles must be protected from dirt and dust until they are installed. The Field Technician will observe the deployment of each geotextile roll and advise the Installer of any defects, punctures and tears so that repairs can be made. The Field Technician is to observe the overlaps and seams and check them against specifications. Defective overlaps and patches are to be called to the attention of the Installer, so that repairs can be made before covering. The maximum exposure time for geotextiles will be in accordance with the manufacturer's recommendations but is not to exceed 30 days unless results of testing indicate that the material meets the requirements of the specifications.

8.4 Summary

Table 8-1 is a summary of the testing required for geotextiles under this QA/QC Plan. Required physical properties for each geotextile application are summarized in Table 8-2.

TABLE 8-1
SUMMARY OF GEOTEXTILE TESTING

Material	Test	Method	Frequency
Supplier Requirements			
Rolls	Mass/Unit Area	ASTM D5261	once per 100,000 square feet of geotextile produced.
	Grab Strength	ASTM D4632	
	Puncture Strength	ASTM D4833	once per 400,000 square feet of geotextile produced.
	Trapezoidal Tear	ASTM D4533	
Geotechnical Engineer Requirements			
Delivered Rolls	Mass/Unit Area	ASTM D5261	Minimum one sample per 100,000 square feet

TABLE 8-2
SUMMARY OF GEOTEXTILE REQUIREMENTS

Property	Requirement	
(minimum unless noted otherwise)	**Cushion Geotextile**	**Separation Geotextile**
Mass/Unit Area	12 oz/yd^2	6 oz/yd^2
Grab Strength (lbs)	200	160
Elongation	>50%	>50%
Puncture Strength (lbs)	125	75
Trapezoidal Tear (lbs)	100	65

9.0 STORMWATER CONTROL STRUCTURES

9.1 Background

This section describes the testing requirements for the drainage layer materials. Testing requirements for the geotextiles are described in Section 7 of the QA/QC Plan, respectively.

9.2 Pre-Construction Evaluation of Riprap, Anchor Trench Backfill and Pipe Materials

The stone supplier will be required to submit data demonstrating that the stone products meet the project requirements for soundness.

Samples of the anchor trench backfill will be collected from the stockpiles, as they are constructed at a rate of about one sample for every 3,000 cubic yards. The samples are to be analyzed for particle size distribution.

9.3 Construction Observations

9.3.1 Field Observations

The Field Technician will collect samples of the anchor trench backfill, following placement, at the rate of about two for every 3,000 cubic yards, so that with the samples collected from the stockpiles, the total number of samples collected will be 1 for every 1,000 cubic yards of anchor trench drainage backfill used. The purpose of collecting samples from the placed material, is to assess the amount of the particle breakdown resulting from delivery and placement.

9.3.2 Optical Survey Measurements

The Surveyor is to use optical survey measurements to estimate the thickness of the drainage layers, as described in Section 5.0. These measurements will be reported to the Geotechnical Engineer.

9.4 Reporting

Each Field Technician will report observations and the results of testing and sampling to the Geotechnical Engineer or his designee. The Geotechnical Engineer or his designee will assemble the individual reports and complete a field report for each day that construction occurs. The report will describe the Subcontractor's activities on that day and present the list of samples collected for laboratory analysis. The Geotechnical Engineer or his designee will file the daily field reports.

APPENDIX B

STORMWATER POLLUTION PREVENTION PLAN

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

WEST VALLEY, NEW YORK

JUNE 2007

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ATTACHMENTS

1.0 INTRODUCTION

This Stormwater Pollution Prevention Plan (SWPPP) has been prepared to address construction activities related to the capping of the Nuclear Regulatory Commission Licensed Disposal Area (NDA). The NDA is a component of the West Valley Demonstration Project, operated by the West Valley Nuclear Services Company (WVNSCO). This facility is located at 10282 Rock Springs Road in West Valley, Cattaraugus County, New York (see Figures 1 and 2). The approximate 7-acre cap over the existing NDA will be constructed to reduce infiltration of precipitation into this disposal unit. In addition, a groundwater barrier (groundwater barrier wall) along the south and west sides of the NDA will be installed to reduce groundwater migration through the NDA area.

The proposed capping area and groundwater barrier wall installation are shown on Figures 3 and 4, and on Sheet 2 of the Engineering Drawings prepared by McMahon & Mann Consulting Engineers, P.C. (MMCE) and incorporated by reference.

A State Pollution Discharge Elimination System (SPDES) permit was issued for the West Valley Demonstration Project on July 27, 2006. The Special Conditions of the permit require that a Best Management Practices (BMP) Plan be developed, and identify 12 BMPs that are to be included in the plan. The BMP Plan (part of the site-wide SWPPP – Document ID # WVDP-206) was submitted to the New York State Department of Environmental Conservation (NYSDEC) on August 11, 1994, and is incorporated into this SWPPP by reference. The BMPs identified in the SPDES permit are listed below.

BMPs Identified in the SPDES Permit
a. BMP Committee
b. Reporting of BMP Incidents
c. Risk Identification and Assessment
d. Employee Training
e. Inspections and Records
f. Preventative Maintenance
g. Good Housekeeping
h. Materials Compatibility
i. Security
j. Spill Prevention and Response
k. Erosion and Sediment Control
l. Management of Runoff

This SWPPP should be considered a supplement to the existing site-wide SWPPP (which includes the BMP Plan) already prepared for the facility. Discharges of stormwater from the NDA Capping Construction area will be covered by the existing SPDES Permit.

2.0 OBJECTIVES

The objectives of this SWPPP are to identify potential sources of pollution in stormwater runoff at the NDA capping and groundwater barrier wall construction site, and to develop practices to limit potential impacts from stormwater runoff. The NDA facility is an inactive disposal area that contains radioactive waste.

An Erosion and Sediment Control Plan (ESCP) for this site has been prepared previously as part of the site-wide SWPPP (see Section 5.11 of Document ID # WVDP-206), and a project specific ESCP (Attachment A) has been prepared to address the construction of the NDA cap and groundwater barrier wall. The ESCP includes a description of the stormwater controls that will be implemented during the various phases of construction which are presented on Figures 3 and 4.

A Water Quality and Water Quantity Control Plan related to this project is provided as Attachment B. A discussion of pre-development site conditions and a description of the proposed development at the facility are provided in the Water Quality and Water Quantity Control Plan. Attachment B includes the stormwater calculations that provide the basis for comparison of the pre and post-development conditions. The final conditions are depicted on Figure 5.

3.0 POLLUTION PREVENTION TEAM

The stormwater pollution prevention team (which consists of the same individuals as the BMP Committee identified in the site-wide SWPPP) consists of a Team Coordinator (Coordinator), a Secondary Coordinator and members, who are responsible for developing, implementing, maintaining and revising this SWPPP. This team is responsible for identifying pollutant sources and risks, making decisions with respect to BMPs, directing implementation of BMPs, and evaluating the effectiveness of the Plan. Current team members and areas of responsibility are identified in the BMP Plan. The list of team members will be updated as necessary due to changes in assignments.

The Coordinator has primary responsibility for implementing the plan. Specific tasks include maintaining inspection schedules, records and employee training as well as coordinating responses to spill emergencies. In addition, the Coordinator will be responsible for keeping the plan current as needed based on changes in design, construction, operation or maintenance at the facility that have a significant effect on the potential for the discharge of pollutants to stormwater. Modifications may include, but are not limited to, the following items:

- Relocation or alteration of material storage or handling areas;
- Revision of BMPs;
- Alteration of drainage patterns;
- Addition of structural control measures; and
- Documentation of significant leaks or spill events.

The Coordinator is the point of contact for facility personnel and regulatory officials who wish to discuss the plan or obtain information concerning stormwater management. The Coordinator is to be familiar with all phases of the NDA Capping project so that potential sources of pollution are considered during implementation and periodic evaluations of the plan.

Team members are to conduct inspections, respond to spill events, maintain BMPs and direct employee training at regular intervals as well as new employee training. One training event should occur before commencement of construction activities for the NDA Cap and groundwater barrier wall, and should include key contractor personnel. Members are also to meet with the Coordinator at regular intervals and following spill events to evaluate and modify this SWPPP as needed. The site-wide SWPPP (wvdp-206)

requires at least one self-assessment of the activities performed under this SWPPP. In the event that a team member needs to be replaced, the Coordinator is to appoint a replacement.

4.0 DESCRIPTION OF POTENTIAL POLLUTANT SOURCES

This section of the SWPPP discusses potential pollutant sources that may contribute pollutants to stormwater. An inventory of exposed materials is developed and, from those, a summary of potential pollutant sources is established.

4.1 Site Maps

A map indicating current conditions at the site is provided as Figure 2. Areas where significant materials are exposed to precipitation such as, fuel storage, soil stockpiles, excavation areas, and waste disposal units, are identified on Figures 3 and 4. Outfall locations are designated on the figures consistent with the designations identified in the SPDES permit. Figure 5 shows the post-construction site map, including surface water flow directions.

4.2 Inventory of Exposed Materials

This section presents an inventory of various types of materials handled at the site that may potentially be exposed to precipitation. Potentially exposed materials and activities, which could become sources of pollutants at the NDA Capping site, include the following:

- Exposed soils during NDA Cap construction, including soil stockpiles and soils being placed on the NDA to achieve required grades;
- On-Site vehicle refueling of construction equipment;
- Fuel deliveries to any temporary or permanent on-site storage tanks;
- Solid waste generated during construction operations;
- Soils tracked out on tires, fenders and other parts of vehicles leaving the construction site, and
- Radiological waste in the NDA disposal area.

A list of the materials that may be exposed to precipitation that identifies their locations on-site, methods of on-site storage or disposal and material management practices that will be employed to minimize contact with stormwater runoff is provided in Attachment C.

4.3 Spills and Leaks

Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (see 40 CFR 110.10 and CFR 117.21) or Section 102 of CERCLA (40 CFR 302.4). Spills that could occur at the facility include releases of fuel from storage tanks during tank refilling or refueling of vehicles, or from leaking vehicle fuel tanks; and contaminated soils tracked outside the NDA site by construction equipment. Attachment D contains a copy of the "Policy and Procedures" document identified as WV-915, entitled "Spill/Release Notification and Reporting," which describes spill response procedures and reporting requirements.

4.4 Sampling Data

Surface water from the NDA cap construction site discharges to Erdman Brook to the north. WVNSCO has an established monitoring program (based on SPDES Permit requirements) that involves collecting surface water samples at various stormwater discharge outfalls around the site. This monitoring program has been implemented since 1994, and will continue to be used to monitor the quality of stormwater leaving the site. Data from these monitoring events has been provided to NYSDEC in accordance with the requirements of the SPDES Permit and is maintained at the facility. More information on stormwater monitoring is provided in Section 7.0.

4.5 Risk Identification and Assessment of Potential Sources

Potential pollutant sources resulting from various activities expected to occur at the facility are described below.

4.5.1 Fuel Loading and Unloading Operations

Delivery and transfer of diesel fuel and gasoline at the facility will occur during the NDA capping construction project. The potential for a spill exists during unloading of diesel fuel and gasoline from the tanker trucks to temporary or permanent above ground storage tanks (ASTs). Transfer of fuel from the ASTs to the construction vehicles and equipment can also result in spills.

In the event of a spill, the WVNSCO Construction Supervisor is to be notified and procedures in WV-915, "Spill/Release Notification and Reporting" (see Attachment D) will be implemented.

4.5.2 Outdoor Storage, Soil Stockpiles and Construction Activities

Materials stored on-site that could impact stormwater include fuel stored in the portable truck-mounted fuel tanks, construction materials, staging of vehicles and stockpiled soil materials. A release from the truck mounted fuel tanks would result in potential stormwater impacts. All truck-mounted tanks will be provided with required monitoring and spill kits.

Construction materials other than soil such as geosynthetics, soil additives, and concrete structures, may be stored on site. These have limited potential to impact stormwater quality. Cement, fertilizer or other construction chemicals could, if exposed to precipitation, contribute pollutants to surface water.

Erosion of soil stockpiles could be a source of sediment in runoff. The primary approach to control of sediment transport at this facility is to conduct operations and construction activities in a manner that limits the size of stockpiles and disturbed areas. All stockpiles and disturbed areas will be surrounded by silt fence as shown on Figures 3 and 4. To limit erosion, stockpiles or portions of stockpiles that are inactive for 14 days are to be seeded to establish vegetation unless they will be re-disturbed within 21 days. Additional information on sediment control is provided in the Erosion and Sediment Control Plan for this site which is part of the site-wide SWPPP (see Section 5.11 of Document ID # WVDP-206)

Oils and fluids which may leak from parked vehicles including construction material transport trucks and employee's cars, have the potential to impact stormwater. The oils that are contained in the vehicles include motor oil, lube oil, gear oil and hydraulic oil; and other fluids include hydraulic fluid, coolant/antifreeze, and transmission fluid. Potential leaks of fluids from parked vehicles will be identified during inspections as described in the BMP's (Attachment E) and spill kits will be utilized to contain and cleanup any spills of this nature.

4.5.3 Dust

Dust may be generated as a result of vehicle traffic on access roads and on the capping area during dry periods. Dust also may form on the paved facility access road as a result of soil that drops off of vehicles leaving the facility. Dust will be controlled by the use of road cleaning equipment and application of water during dry periods (truck mounted spray system or equivalent) as described in the BMP's (Attachment E).

4.5.4 Radiological Waste in NDA Area

The NDA area has been used in the past for the disposal radiological waste. During preparation of this area for capping, the potential for disturbing contaminated materials exists. To control the potential for transport of contaminated materials to areas where they could contaminate stormwater, no excavation of existing materials in NDA area will be permitted during construction.

5.0 MEASURES AND CONTROLS

BMPs for stormwater management controls have been identified for the potential pollutant sources listed in Section 4.5. As discussed generally below, these BMPs include measures and controls to promote good housekeeping, preventative maintenance, security, spill prevention and response, training, sediment and erosion control, and management of runoff. Specific BMPs for the various operations identified in Section 4.5 are presented in Attachment E.

5.1 Good Housekeeping

Good housekeeping involves maintaining areas that could contribute pollutants to stormwater in a clean, orderly manner. For the NDA capping project, this involves establishing routine and regular clean up procedures to include regular clean up of litter, sweeping the paved roads around the construction area, and establishing and maintaining well organized and contained work and supply storage areas.

5.2 Preventative Maintenance

Preventative maintenance involves timely inspection and maintenance of stormwater management devices such as drainage swales, silt fences and check dams. In addition, facility equipment is to be maintained to limit the potential for conditions that could result in breakdowns leading to discharges of pollutants. A key element of Preventative Maintenance is the establishment of standardized inspection and record keeping procedures with documented follow up to ensure deficiencies are addressed. Additional information on preventive maintenance procedures and documentation requirements is provided in the Preventive Maintenance section of the site-wide SWPPP (see Section 5.6 of Document ID # WVDP-206).

5.3 Security

Security measures are implemented at the site to limit the potential for accidental or intentional releases of materials to stormwater as a result of theft, vandalism, sabotage, or other improper use of the facility. Access to the entire site is controlled by fences and gates. Gates are closed and locked when operations are not taking place at the facility. Signs are to be posted indicating that access to the construction area is restricted to specified hours. Security measures also include requiring all visitors to the site to check in to limit the potential that unauthorized persons or vehicles enter the construction area.

5.4 Spill Prevention and Response Procedures

WVNSCO will ensure that training is provided for staff and contractor personnel in handling materials such as contaminated soils, fuels and lubricants to limit the potential for spills. Areas where potential spills can occur and introduce pollutants to stormwater discharges are to be identified. These areas include the fuel storage containers and vehicle refueling at the facility. In addition, tracking of contaminated soil outside the NDA area could impact stormwater.

In the event of a spill, the spill response procedures identified in WV-915, "Spill/Release Notification and Reporting," (Attachment D) are to be followed. WVNSCO is to take steps to contain and collect as much of the spilled material as possible. In the case of a liquid spill, absorbent booms may be used. Containment may also involve constructing temporary soil berms to limit the spread of the released liquid. After free liquids are collected, soil in the areas of the spill should be excavated to remove residual material.

Other spill prevention measures include providing regular training, and inspections of containers, valves and piping to identify early indications of leaks. More information on spill response is provided in the facility's Spill Prevention, Control and Countermeasures (SPCC) Plan. A copy of the SPCC Plan must be maintained on-site in the Contractor's trailer.

5.5 Employee Training

Employees and contractor personnel will receive training on the goals and objectives of this SWPPP before commencement of construction activities. Topics covered generally include, but are not limited to, a review of potential sources of stormwater pollution, spill prevention and response, good housekeeping, and material management and handling practices with a focus on vehicle refueling and soils management. In addition, training on erosion and sediment control is to be incorporated in facility training programs. A list of those who have attended the training, and topics covered in the training session, is to be maintained at the facility and updated as additional training is performed (see Attachment F).

5.6 Recordkeeping and Internal Reporting

The Team Coordinator is responsible for recordkeeping and reporting related to this SWPPP. The Coordinator is responsible to update the Spill List if necessary, and to maintain records of inspections and maintenance activities performed. Records of inspections that identify incidents affecting BMPs or where BMPs did not perform as intended are to be reported directly to the Team Coordinator. These records are to be considered in developing improvements to BMPs. Spills are to be reported in accordance with the requirements in Section 5.4 and using the procedures outlined in WV-915, "Spill/Release Notification and Reporting," (Attachment D). Records of employee training activities are also to be documented and maintained at the facility. In addition, the Coordinator will be responsible for documenting the Site Inspections (Section 6.0). The tables that have been prepared and included as appendices may be modified to facilitate recordkeeping and reporting.

The records generated under this SWPPP shall be retained for at least three years after completion of construction activities, or longer if required by WVNSCO. Monitoring results are to be retained for a minimum of 6 years from the date of sample collection or longer if required by WVNSCO.

5.7 Sediment and Erosion Control

Erosion and sedimentation may occur from disturbed areas as a result of placement and grading of soil materials used to achieve desired grades for the NDA cap, and during construction of the groundwater barrier wall. An Erosion and Sediment Control Plan (ESCP) has been prepared for this project, and is included in Attachment A. The ESCP describes the measures to be implemented during construction and establishes guidelines to be followed to limit erosion and sedimentation. Furthermore, contractors and

subcontractors working on projects involving excavation, stripping, filling, soil stockpiling and grading at the facility must sign the Contractor Certification provided in Attachment G.

5.8 Management of Runoff

Management of runoff from the NDA Cap was considered in the development of the Cap design. Although the entire 7 acre cap will be impervious, the design has been developed so that runoff from the capped area will not increase peak stormwater discharge rates from the site. A more detailed discussion of the design is provided in Attachment B. Soil descriptions are also provided in Attachment B.

6.0 SITE ASSESSMENT AND INSPECTIONS

An important component of this SWPPP is routine inspections of the facility. Regular visual inspections are the means to assure that all elements of this plan are in place and working properly. Areas to be inspected include, but are not limited to, areas surrounding temporary petroleum containers, material handling areas, vehicle storage areas, paved access roads for the presence of tracked soil, and the areas disturbed by construction of the NDA Cap, and groundwater barrier wall. Drainage swales, and erosion and sediment control devices are also to be inspected on a routine basis. Areas of deficiencies noted during inspections are to be promptly rectified. The inspections will include a Pre-Construction Inspection, Routine Inspections during construction, and a Post-Construction Inspection.

6.1 Pre-Construction Inspection

The Pre-Construction Inspection will include observations to identify areas where pollutants may be introduced into stormwater. Existing BMPs are to be evaluated to determine whether they are adequate and appropriately implemented or whether additional measures are warranted. Structural stormwater management measures and erosion and sediment control measures identified in this SWPPP and the ESCP (part of the BMP Plan) are to be observed to confirm that they are installed as intended. The Pre-Construction evaluation is to also include an inspection of equipment needed to implement this SWPPP such as spill response equipment.

6.2 Routine Inspections

Routine inspections are to be performed not less frequently than weekly to ensure that the BMPs identified on the Plans are properly maintained and performing as intended. An Inspection Form is included in Attachment H. This form should be completed each time an inspection is performed. Records of inspections are to be maintained at the facility.

6.3 Post-Construction Inspection

The Post-Construction Inspection will be performed to ensure that the disturbed construction areas have undergone final stabilization, and that all temporary erosion and sediment control measures (such as silt fencing) have been removed. The inspection should also ensure that the post construction controls are constructed as specified in the SWPPP. An Inspection Form is included in Attachment I, which is to be completed after completion of construction.

7.0 MONITORING AND REPORTING REQUIREMENTS

Stormwater flowing from the NDA capping construction area, is to be monitored in accordance with the SPDES Permit for the facility. The twenty stormwater outfalls at the West Valley Site have been divided into eight groups. Stormwater from the NDA capping construction area will pass Outfalls SO-17, SO- 20,

and SO-35. These outfalls are sampled in accordance with SPDES Permit requirements on a semi-annual basis. Samples will be analyzed for the parameters specified in the Permit.

The monitoring data are to be evaluated in accordance with the SPDES Permit, and provided to NYSDEC with the June and December Discharge Monitoring Reports. In the event that action levels are exceeded, the SPDES Permit requires additional monitoring and an evaluation as to the cause. Steps are to be taken to eliminate the source of impacts through appropriate operational changes and construction of additional measures to address the source of the elevated levels of contamination. In addition to providing the monitoring results to NYSDEC, the results are to be maintained with facility records.

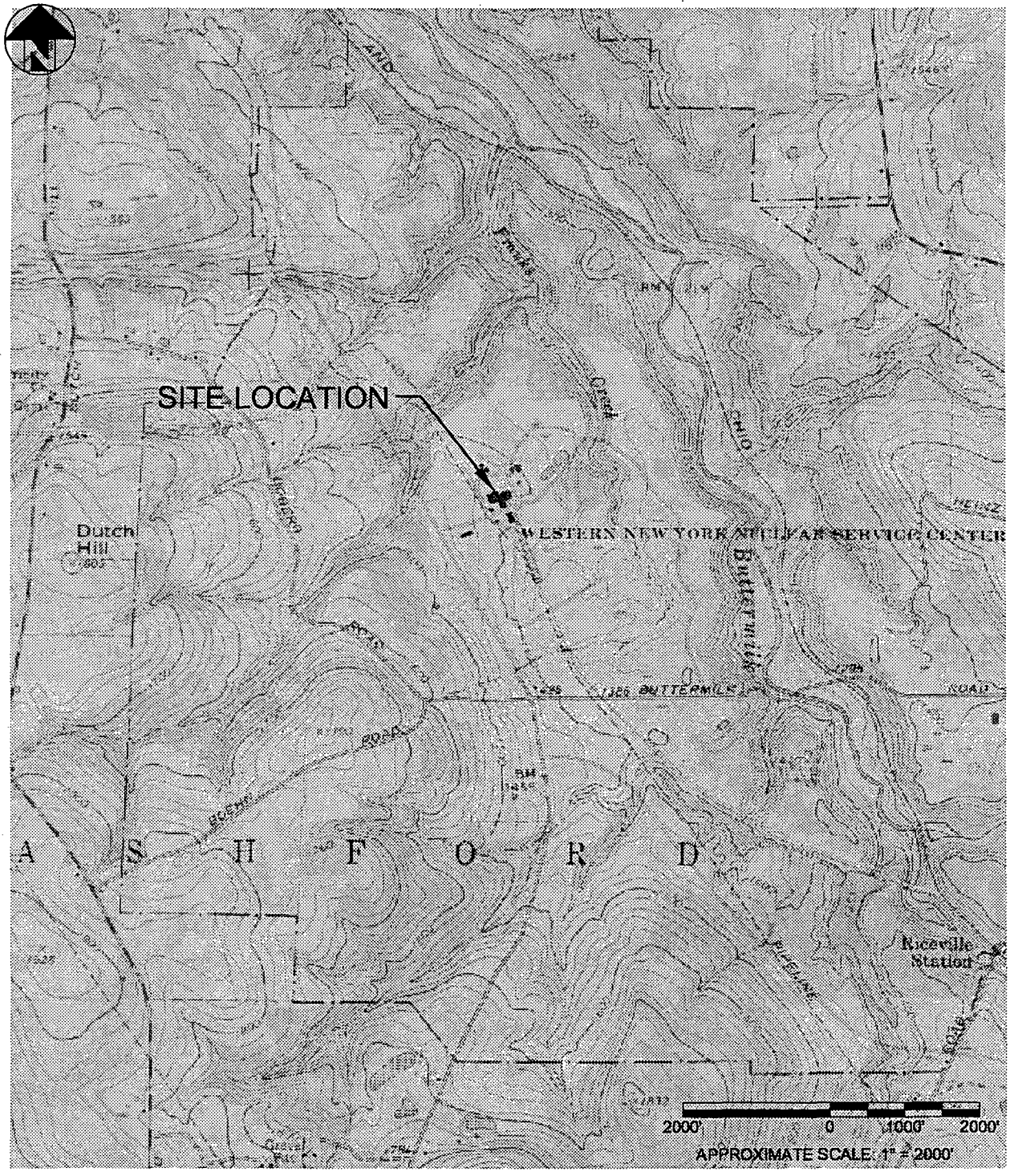
STORMWATER POLLUTION PREVENTION PLAN

FIGURES

WVNSCO

NDA CAP AND

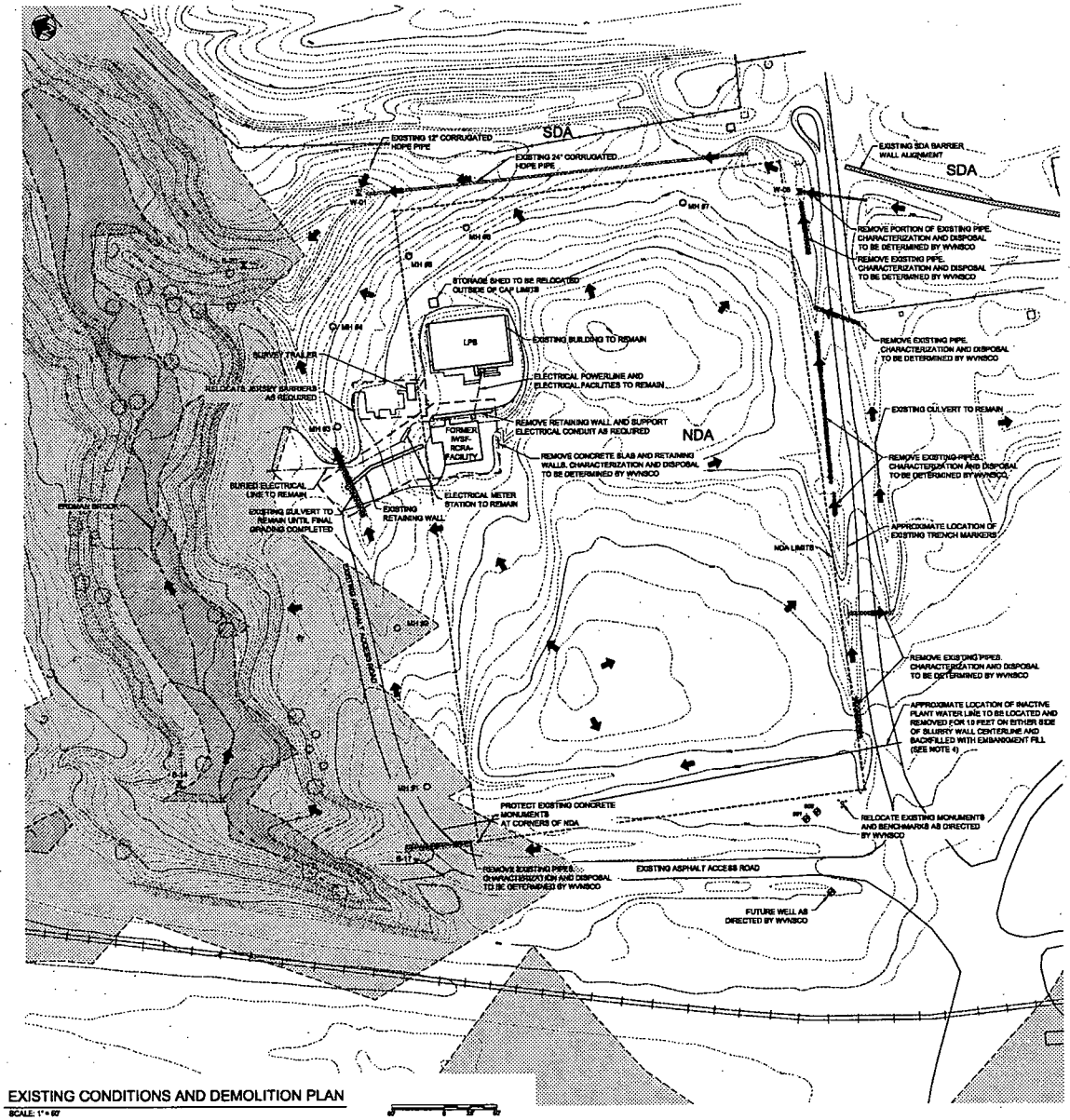
GROUND WATER BARRIER INTERIM MEASURE



Note:

1. Base map adapted from USGS 7.5 minute series quadrangle map of Ashford Hollow, NY dated 1964.

McMahon & Mann Consulting Engineers, P.C. 2495 MAIN STREET, SUITE 432 BUFFALO, NY 14214 (716) 834-8932 FAX: (716) 834-8934	NDA CAP AND GROUND WATER BARRIER CONSTRUCTION SWPPP WEST VALLEY NEW YORK	SITE LOCATION MAP DWG. NO. 07011-010a FIGURE 1



EXISTING CONDITIONS AND DEMOLITION PLAN

SCALE: 1" = 60'

SCALE: 1" = 60'

LEGEND

- EXISTING GROUND CONTOURS
- EXISTING ROAD / ASPHALT
- EXISTING BUILDING
- MH 84 — EXISTING MANHOLE LOCATION AND DESIGNATION
- EXISTING FENCE
- NDA LIMITS
- 608 — WELL LOCATION AND DESIGNATION
- S-14 — STORMWATER OUTFALL LOCATION AND DESIGNATION
- CULVERT TO BE REMOVED
- SURFACE WATER FLOW DIRECTION
- DELINEATED WETLAND
- WETLAND BUFFER ZONE

Note:

1. Base map adapted from a combination of drawings provided by West Valley Nuclear Services Co., Inc. titled "WVDP Site Map Well Locations", Dwg. No. 900-C-2000 Rev A dated May 25, 1992 and "NDA Topographic Plan", Sketch # SK00K0020507 Rev A dated February 19, 2007.
2. Jersey barriers shall be removed and stored for placement at completion of project.
3. Locations of groundwater interceptor trench manholes based on "Solvent Control Project Interceptor Trench NRC Licensed Disposal Area", 001 through 008 by Dames & Moore, dated January 25, 1980.
4. Inactive waterline shown based on drawing number 900-E-54874 Rev. 1 titled "NDA (NRC Licensed Disposal Area) Base Map" dated January 28, 1993.
5. Contractor to perform a topographic survey of site and existing facilities including buildings, electrical facilities and stormwater drainage structures prior to construction. This information will be used to calculate actual quantities for payment.

STORMWATER OUTFALLS

SITE ID	DESCRIPTION	INVERT ELEVATION	OWNER
S-14	WEIR	1378.78	DOE
S-17	36" CMP	1370.98	DOE
S-20	8' x 8' RECTANGLE	1369.35	DOE & NYSERDA
W-01	12" CORRUGATED HDPE	1363	NYSERDA
W-09	18" CMP	—	NYSERDA

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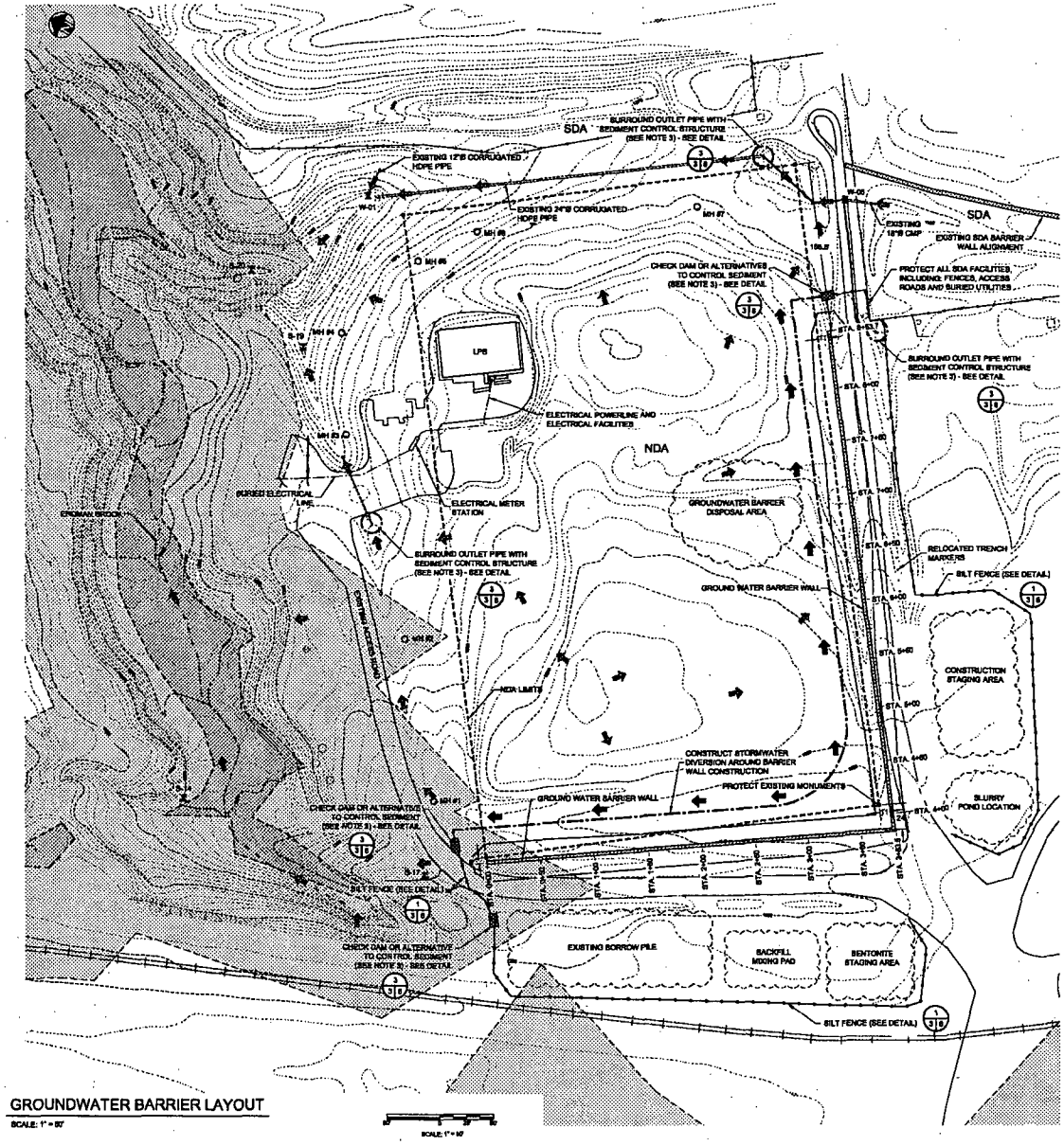
NDA CAP AND GROUNDWATER BARRIER CONSTRUCTION SWPPP - EXISTING CONDITIONS AND DEMOLITION PLAN

WEST VALLEY NEW YORK

P.O. 19-108339-C-CA	
DRAWN BY: C.R.G.	
CHECKED BY: D.R.M.	
SCALE: 1" = 60'	
DATE: MAY 2007	
JOB NO. 07-011	
FIGURE 2	
MMCE DWG. NO. 07011-030 SK	
REVISION NUMBER - 0	



GROUNDWATER BARRIER LAYOUT

SCALE: 1" = 50'

SCALE: 1" = 50'

LEGEND

- EXISTING GROUND CONTOURS
- NDA LIMITS
- EXISTING ROAD / ASPHALT
- EXISTING FENCE LINE
- EXISTING BUILDING
- MH #4 — EXISTING MANHOLE LOCATION, DESIGNATION
- EXISTING MONUMENT
- S-14 — EXISTING SDA STORMWATER OUTFALL LOCATION AND DESIGNATION
- SEDIMENT CONTROL STRUCTURES
- SILT FENCE / HAYBALE DIKE
- SURFACE WATER FLOW DIRECTION
- CHECK DAM
- DELINEATED WETLAND
- WETLAND BUFFER ZONE

Note:

1. Base map adapted from a combination of drawings provided by West Valley Nuclear Services Co., Inc. titled "NWCP Site Map Well Locations", Dwg. No. 800-D-5000 Rev A dated May 25, 1982 and "NDA Topographic Plan", Sketch # SK00GG020507 Rev A dated February 18, 2007.
2. All SDA outlets shall be maintained throughout construction.
3. The Contractor is responsible for erosion and sediment control during construction. This plan and other SWPPP drawings show minimum requirements for stormwater diversion and erosion & sediment control during construction. The Contractor shall submit its plan prior to construction providing details for the stormwater diversion, erosion protection and for sediment control structures.

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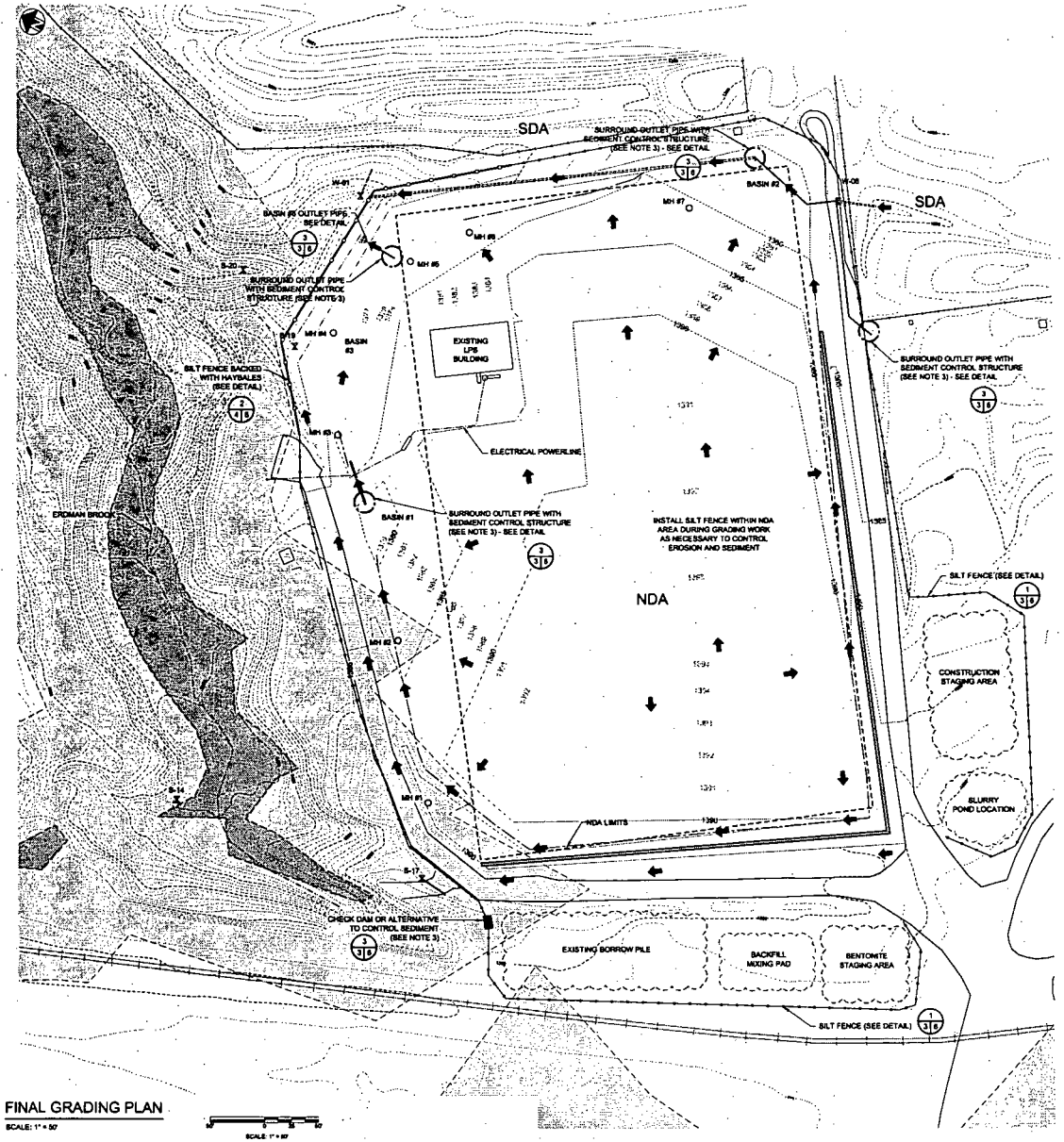
NDA CAP AND GROUNDWATER BARRIER CONSTRUCTION SWPPP-GROUNDWATER BARRIER WALL PHASE

WEST VALLEY NEW YORK

P.O. 19-108939-C-CA	
DRAWN BY:	C.R.G.
CHECKED BY:	O.R.M.
SCALE:	1" = 50'
DATE:	MAY 2007
JOB NO.	07-011
FIGURE:	3
MMCE DWG. NO.	07011-032 BK
REVISION NUMBER - 0	



FINAL GRADING PLAN

SCALE: 1" = 50'

SCALE: 1" = 50'

LEGEND

- EXISTING GROUND CONTOURS
- 1390 CAP CONTOURS
- NDA LIMITS
- GEOMEMBRANE LIMITS
- DRAINAGE SWALE
- MH #4 EXISTING MANHOLE LOCATION AND DESIGNATION
- EXISTING FENCE LINE
- EXISTING BUILDING
- JERSEY BARRIER
- SILT FENCE
- SILT FENCE / HAYBALE DIKE
- SEDIMENT CONTROL STRUCTURES
- DELINEATED WETLAND
- WETLAND BUFFER ZONE
- SURFACE WATER FLOW DIRECTION
- S-14 EXISTING SDA STORMWATER OUTFALL LOCATION AND DESIGNATION
- CHECK DAM

Note:

1. Base map adapted from a combination of drawings provided by West Valley Nuclear Services Co., Inc. titled "WVDP Site Map Well 900-D-5000 Rev A dated May 28, 1992 and "NDA Topographic Plan", Sketch # SKKKG020807 Rev A dated February 19, 2007.
2. All SDA outfalls shall be maintained throughout construction.
3. The Contractor is responsible for erosion and sediment control during construction. This plan and other SWPPP drawings show minimum requirements for stormwater diversion and erosion & sediment control during construction. The Contractor shall submit its plan prior to construction providing details for the stormwater diversion, erosion protection and for sediment control structures.
4. All silt fences are to be backed by steel wire mesh as required.

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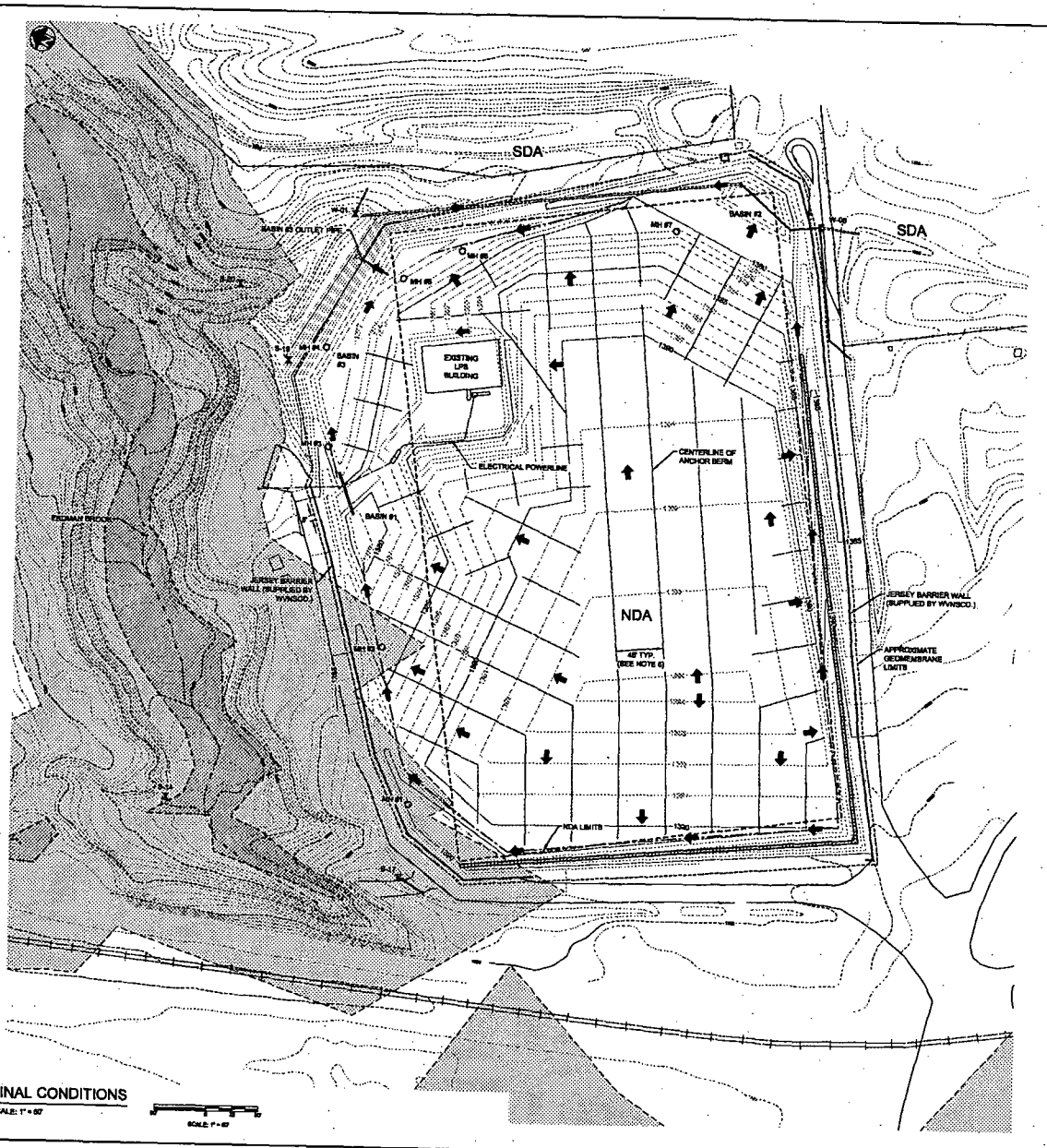
NDA CAP AND GROUNDWATER BARRIER CONSTRUCTION SWPPP - GRADING PHASE

WEST VALLEY NEW YORK

P.O. 19-108938-C-CA	
DRAWN BY: C.R.G.	
CHECKED BY: D.R.M.	
SCALE: 1" = 50'	
DATE: JUNE 2007	
JOB NO. 07-011	
FIGURE 4	
MMCE DWG. NO. 07011-031 SK	
REVISION NUMBER - 0	



LEGEND

- EXISTING GROUND CONTOURS
- 1380 CAP CONTOURS
- NDA LIMITS
- GEOMEMBRANE LIMITS
- DRAINAGE SWALE
- CENTERLINE OF ANCHOR BERM
- MH #4 EXISTING MANHOLE LOCATION AND DESIGNATION
- EXISTING FENCE LINE
- EXISTING BUILDING
- JERSEY BARRIER
- SURFACE WATER FLOW DIRECTION
- S-14 EXISTING SDA STORMWATER OUTFALL LOCATION AND DESIGNATION
- DELINEATED WETLAND
- WETLAND BUFFER ZONE

Note:

1. Base map adapted from a combination of drawings provided by West Valley Nuclear Services Co., Inc. titled "WVDP Site Map Well 900-D-5000 Rev A dated May 29, 1992 and "NDA Topographic Plan", Station # 9000X020807 Rev A dated February 19, 2007.
2. All SDA outfalls shall be maintained throughout construction.

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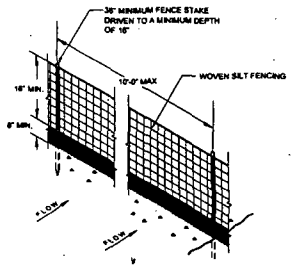
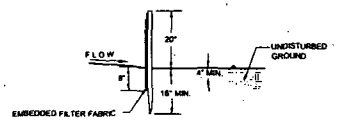
NDA CAP AND GROUNDWATER BARRIER CONSTRUCTION SWPPP- FINAL CONDITIONS

WEST VALLEY NEW YORK

P.O. 19-108939-C-CA	
DRAWN BY:	C.R.G.
CHECKED BY:	D.R.M.
SCALE:	1" = 80'
DATE:	JUNE 2007
JOB NO.	07-011
FIGURE	8
MMCE DWG. NO.	07011-033 BK
REVISION NUMBER -	0

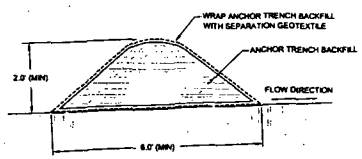




1/3/6 SILT FENCE
SCALE: N.T.S.

SILT FENCE / HAY BALE NOTES:

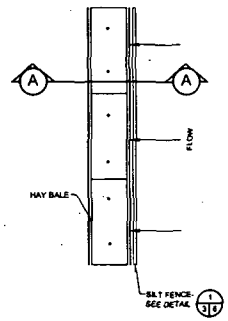
1. Contractor shall provide erosion protection and sediment control downstream of ALL stockpiles and disturbed areas. The contractor should inspect all devices following each runoff event. All damage should be corrected / repaired immediately. In areas where silt fence alone is not sufficient, back up silt fence with haybales as shown on this sheet.
2. All silt fences are to be backed by steel wire mesh as required.



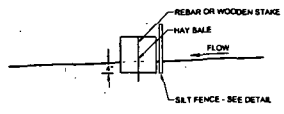
3/3/6 TYPICAL CHECK DAM SECTION
SCALE: N.T.S.

Note:

1. Contractor to install additional sediment control measures around culverts as necessary to control sediment discharge to levels required under the SPDES permit.



2/4/6 SILT FENCE DETAIL BACKED BY HAY BALE
SCALE: N.T.S.



A SECTION THRU BALES AND SILT FENCE
SCALE: N.T.S.

HAY BALE CONSTRUCTION NOTES:

1. Bales shall be placed at the toe or on the contour and in a row with ends tightly abutting the adjacent bales.
2. Each bale shall be embedded in the soil a minimum of 4 inches, and placed so the bindings are horizontal.
3. Bales shall be securely anchored in place by either two stakes or re-bars driven through the bale. The first stake in each bale shall be driven toward the previously laid bale at an angle to force the bales together. Stakes shall be driven flush with the bale.
4. Inspection shall be frequent and repair or replacement shall be made promptly as needed.
5. Bales shall be removed when they have served their usefulness so as not to block or impede storm flow or drainage.

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NDA CAP AND GROUNDWATER BARRIER CONSTRUCTION SWPPP - DETAILS AND SECTION

WEST VALLEY NEW YORK

P.O. 19-108838-C-CA	
DRAWN BY:	C.R.G.
CHECKED BY:	D.R.M
SCALE:	AS NOTED
DATE:	MAY 2007
JOB NO.	07-011
FIGURE	8
MMCE DWG. NO.	07011-034 SK
REVISION NUMBER - 0	

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT A

EROSION AND SEDIMENT CONTROL PLAN

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

WEST VALLEY, NEW YORK

JUNE 2007

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ATTACHMENT A

EROSION AND SEDIMENT CONTROL PLAN
and
CONSTRUCTION SEQUENCING NARRATIVE

WVNSCO
NDA Cap and Groundwater Barrier Interim Measure
West Valley, New York

1. Introduction

This Erosion and Sediment Control Plan (ESCP) describes the measures to be implemented during construction of the groundwater barrier and NDA cap, and establishes the guidelines to be followed to limit erosion and sedimentation. Erosion and sedimentation control measures should be implemented for activities where excavation, stripping, filling, soil processing and stockpiling, and grading take place.

Proposed erosion and sediment controls to be implemented during construction of the groundwater barrier wall and NDA cap include silt fencing, perimeter diversion structures, stone check dams within drainage swales, outlet stabilization, seed and mulch, detention basins, and dust control. These controls limit the potential for erosion of exposed soils, and for sediment to be transported from the site with stormwater. Specific control measures are discussed below.

The Contractor is responsible for erosion and sediment control during construction. Figures 2 through 6 of the Stormwater Pollution Prevention Plan (SWPPP) show minimum requirements for erosion and sediment control and indicate that the Contractor is required to submit details showing how the erosion and sediment controls will be implemented.

Reference is also made to the "New York State Standards and Specifications for Erosion and Sediment Control" and the New York State Department of Environmental Conservation Guidance document entitled "Reducing the Impacts of Stormwater Runoff from New Development" for additional discussion regarding erosion and sediment control practices.

2. Erosion Control

Silt Fence will be installed generally parallel to the elevation contours, downgradient of stockpiles and areas to be disturbed, as shown on Figures 3 and 4. Silt fence serves to reduce runoff velocity. As the water passes through the material, the sediment is deposited upgradient. The silt fence geotextile is to be keyed a minimum of 6 inches into the ground to limit the potential for runoff to undermine the barrier. Details of the silt fence installation are shown on Figure 6. In the northeast corner of the NDA, where the ground slope is steeper, the silt fence and reinforcing steel wire mesh will be backed up by hay bales, see Figures 4 and 6.

Perimeter Diversion Structures are to be constructed to divert stormwater runoff from the NDA areas away from the area of the groundwater barrier wall construction, as shown on Figure 3. The contractor is required to submit a plan and detail of the diversion. These temporary structures will be removed after the groundwater barrier wall construction is complete and the cap placement begins.

Stone Check Dams or other sediment control structures are to be installed to limit the potential for erosion within swales by dissipating the energy generated as stormwater runoff flows through the swales. As stormwater concentrates within the swale, the dams slow the velocity and therefore decrease its energy potential. Sediment being carried by stormwater is deposited as the energy (and velocity) decreases. These dams are typically not more than two feet high and extend across the entire width of

the swale. The use of swales and check dams will be limited to discharge points from the groundwater barrier wall construction area, as shown on Figure 3.

Outlet Stabilization consists of riprap aprons to be installed at the outlet of discharge structures from the detention basins built along the perimeter of the NDA Cap, to dissipate energy and prevent scour. Locations of the discharge structures from the detention basins and the associated riprap aprons are shown on Figure 5.

Seed and Mulch will be applied to establish vegetation in disturbed areas as soon as possible but no longer than 14 days after construction is completed and areas are final graded. Well-established vegetation is key to limiting erosion.

Permanent Detention basins will be constructed along the perimeter of the NDA Cap, as shown on Figure 5. The basins (and outlet structures) have been designed to limit post-construction peak stormwater flowrates from the cap area to less than pre-construction values.

Dust Control is to be achieved through watering of the site access roads as required.

3. Construction Sequence

A general construction sequence schedule has been developed for construction of the groundwater barrier wall and NDA cap. The sequence incorporates the phased installation of the erosion prevention, sediment control, water quality, and water quantity measures, devices and features. In general, the steps outlined in the general sequence presented below are to be followed for each new phase of the project.

General Construction/Operational Sequence

1. Identify the proposed limit of work. Maintain downgradient vegetative buffers to the degree practical.

2. Install silt fences downgradient of areas to be disturbed for excavation and construction of the groundwater barrier wall, grading and construction of the NDA cap, and related soil storage, processing, and stockpile areas, as shown on Figure 3. Silt fences should be installed parallel to the elevation contours.

3. Construct diversion structure at edge of NDA area as shown on Figure 3 to divert runoff away from areas to be disturbed during groundwater barrier wall construction. If earthen diversion structures are constructed they shall be stabilized in accordance with the New York State Standards and Specifications for Erosion and Sediment Control.

4. Construct groundwater barrier wall.

5. Install additional silt fence or other barriers as required during grading and construction of the NDA cap to limit erosion and sediment transport.

6. Remove diversion structure in increments and commence grading and placement of the NDA cap, and construction of the permanent detention basins.

7. Fine grade and provide permanent seeding in those areas that are not covered by the impervious NDA cap.

4. Maintenance/Inspections

During construction projects, contractors will be held responsible for temporary measures they install and construction-related impacts to preventive measures. The SWPPP Team Coordinator is responsible to see that inspections are performed and required maintenance measures are implemented. Inspections will include the following activities:

1. Inspect erosion and sediment control measures following every rainfall event greater than 0.5 inches and not less than weekly.
2. Stabilize areas of erosion and take action to repair damaged erosion and sediment control measures as soon as possible.
3. Remove accumulated sediment from behind check dams and in swales when capacity has been filled to not more than 50 percent.
4. Remove accumulated sediment from behind silt fence when it becomes 0.5 feet deep at the fence. Repair Silt fence as needed to maintain an effective barrier.
5. Vegetated areas are to be fertilized, reseeded as necessary, and mulched to maintain vigorous dense stand of grass.

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT B

WATER QUALITY AND WATER QUANTITY CONTROL PLAN

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

WEST VALLEY, NEW YORK

JUNE 2007

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ATTACHMENTS

ATTACHMENT B

WATER QUALITY AND WATER QUANTITY CONTROL PLAN
WEST VALLEY NUCLEAR SERVICES
NDA CAP AND GROUND WATER BARRIER INTERIM MEASURE

1.0 INTRODUCTION

This Water Quality and Water Quantity Control Plan has been prepared to demonstrate that the New York State Department of Environmental Conservation's (NYSDEC's) sizing criteria and pollutant removal goals are met with the design of the stormwater management practices proposed for the NDA Cap and Groundwater Barrier Interim Measure. The design of the NDA Cap and associated erosion and sediment control measures have been developed to meet the criteria identified in the "New York State Stormwater Design Manual."

2.0 SITE CONDITIONS

As shown on Figures 1 and 2 of this SWPPP, 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, but the ground surface rises to the west of the site. Several brooks and creeks flow across the site from west to east towards Frank's Creek and Buttermilk Creek located to the east.

As shown on SWPPP Figures 1 and 2, the NDA is bounded to the north by Erdman Brook, which generally flows from west to east and discharges into Frank's Creek. The State Disposal Area (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. Both Frank's Creek and Erdman Brook are located in ravines with steep side slopes. Access roads and surface drainage culverts are located along the north, west and south sides of the NDA.

The NDA has buried wastes that were placed in pits. The NDA is currently covered with soil and vegetation. WVNSCO installed an interceptor trench as an interim measure 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 trenches consist of pipes buried in drainage stone and connected by manholes (see SWPPP Figure 2). The drainage pipes along the north side slope from west to east and discharge into manhole 4. The drainage pipes along the east side slope from south to north and also discharge into manhole 4. 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, it is pumped to the treatment building located in the northeast corner of the NDA. To date, no organic contaminants have been detected.

The proposed NDA Cap and Barrier Wall are shown on the Engineering Drawings prepared by McMahon & Mann Consulting Engineers, P.C., under the cover sheet, "West Valley Nuclear Services NDA Cap and Groundwater Barrier, West Valley New York." The project consists of two components, a groundwater barrier wall along the west and south sides of the NDA and a cap over the NDA. The groundwater barrier is a low permeability soil bentonite wall designed to limit groundwater migration into the NDA and the geomembrane cover is designed to reduce infiltration into the NDA.

3.0 STORMWATER MANAGEMENT OBJECTIVES AND METHODOLOGY

The goal of the drainage design is to limit the post-development flowrates leaving the site to levels that are equal to or less than flowrates that were predicted for pre-development site conditions, and to maintain (or improve) existing water quality conditions. MMCE utilized the HydroCAD computer model (HydroCAD Software Solutions LLC) to estimate the pre- and post-development runoff from the NDA. HydroCAD is a computer aided design program for modeling the hydrology and hydraulics of stormwater runoff. The program is based on hydrologic methods developed by the Natural Resources Conservation Service (formerly the Soil Conservation Service). The pre-development runoff estimate and post-development design runoff estimate have been computed for the 25 year, 24-hour storm.

Given the topography and limited area of impact associated with the NDA Capping project, the goal of maintaining or reducing peak stormwater discharge flowrates is achieved primarily through the development of small detention ponds around the perimeter of the cap, which have been designed to detain the stormwater runoff from the capped area and release it slowly through discharge control structures. Using the design flows, culverts have been sized and entrance conditions and outlet protection have been specified as indicated on the Engineering Drawings. The goal of maintaining or improving stormwater quality will be achieved by eliminating the direct contact of precipitation with the surficial soils on the NDA cap area. These soils have the potential of being eroded and transported by stormwater runoff, which could degrade stormwater quality.

4.0 PRE-DEVELOPMENT CONDITIONS

Pre-development watershed delineations were developed based on existing topographic information for the site. The ground surface on the NDA has two mounds, which are higher than the elevation of the access roads along the north, west and south sides. Therefore, the potential for surface water is to flow off the surface of the NDA towards the access roads and drainage swale along the east side and Erdman Brook on the north.

Figure 2 of the SWPPP depicts the existing stormwater runoff flow directions. Runoff from the south side of the NDA flows through a series of culverts to the southeast corner of the NDA. From there, a 24 inch diameter drainage culvert drains the stormwater from the south side of the NDA and from a portion of the SDA toward the north, eventually passing SPDES Outfall S-20. Runoff from the west and north sides of the NDA flows through a series of ditches and culverts to Erdman Brook.

Soils at the site are classified as glacial till soils with relatively low hydraulic conductivity and poor drainage characteristics. The USDA Natural Resources Conservation Service Map (see Attachment B-1) indicates that the surficial soils in the area of the NDA Capping project are Churchville Silt loam. This soil type is described as poorly drained soil high in silt and clay with low permeability.

A map of the pre-development conditions showing the drainage areas used in the evaluation is in Attachment B-1. The HydroCAD computer model results in Attachment B-1 indicate that the calculated peak pre-development runoff flowrate from the NDA area from the 25-year 24-hour event is 24 cubic feet per second (cfs).

5.0 PROPOSED DEVELOPMENT

Attachment B-2 shows the hydrologic conditions used for the post development analyses. The sketch in Attachment B-2 shows the subareas and basin configurations used for the analyses. As shown on the sketch, runoff is controlled by three stormwater basins constructed on the NDA Cap. The flow from the SDA area, south of the NDA, is routed via a new pipe into the existing 24 inch drainage culvert which also serves as the drain for Basin No. 2.

The routing calculations indicate that the perimeter ponds should safely pass the flow from the 25-year 24-hour event without overtopping the basin embankments. The discharge pipes from the basins discharge to riprap aprons designed to reduce the energy of the water flow. Swales will then convey the flow to Erdman Brook. The calculated post-development runoff flowrate to Erdman Brook from the NDA area for the 25-year 24-hour event is 21 cubic feet per second (cfs). The calculated post-development discharge is therefore less than the pre-development flow, which means that erosive conditions in the natural channel downgradient of the site should not be increased by the proposed NDA Cap.

ATTACHMENT B-1

PRE-DEVELOPMENT CONDITIONS

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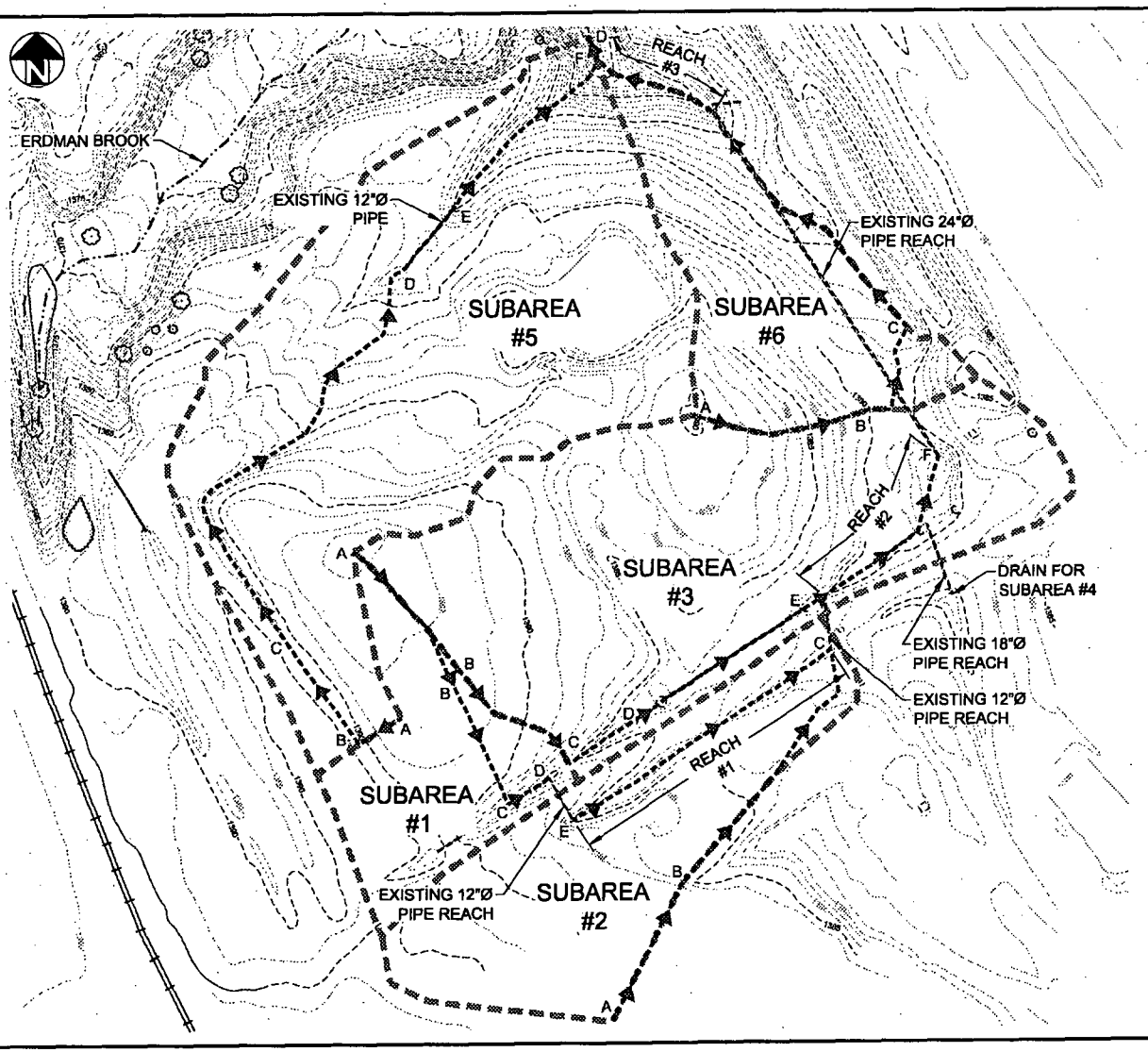
BY AJN DATE 6/1/07 SUBJECT WVNS – NOA SHT. NO. 1 OF 9
CHKD. BY ASK DATE 6/4/07 CAP DESIGN JOB NO. 07-011
PRE-CAP STORMWATER ANALYSIS

PRE CAP STORMWATER ESTIMATE – USE HYDROCAD SOFTWARE

- ESTIMATE DRAINAGE AREA TO ERDMAN BROOK (SEE ATTACHED FIGURE FOR SUBAREAS)

- USE 25 YR STORM EVENT P = 4.2" (ATTACHED FIGURE B-6 FROM TR 55)
  - WVDP SITE SPECIFIC DATA SHOWS HIGHEST DAILY EVENT TO BE 3.75" (FROM 1990 TO 2007), TR55 GIVES A HIGHER VALUE
    - USE 4.2" FOR DESIGN

- STORMWATER ROUTING RATIONAL
  - 6 SUBAREAS WHICH EITHER DRAIN ON THE SURFACE OR VIA PIPES TO ERDMAN BROOK
  - SEE ATTACHED FIGURE FOR SUBAREAS AND REACHES
  - TOTAL FLOW FOR 25 YR STORM IS 24.07 CFS



LEGEND

1365	EXISTING GROUND CONTOURS
	SUBAREA BOUNDARY EXTENTS
	SURFACE WATER DRAINAGE PATH AND FLOW DIECTION

Note:

1. Base map adapted from a combination of drawings provided by West Valley Nuclear Services Co., Inc. titled "WVDP Site Map Well Locations", Dwg. No. 900-D-5000 Rev A dated May 26, 1992 and "NDA Topographic Plan", Sketch # SKKKG020607 Rev A dated February 19, 2007.

100' 0 50' 100'

SCALE: 1" = 100'

NOTE:
UNAUTHORIZED ALTERATION OR ADDITION TO ANY SURVEY, DRAWING, DESIGN, SPECIFICATION, PLAN, OR REPORT IS A VIOLATION OF SECTION 7209 PROVISION 2 OF THE NEW YORK STATE EDUCATION LAW.

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NDA CAP AND GROUND WATER BARRIER CONSTRUCTION
WEST VALLEY NEW YORK

EXISTING DRAINAGE AREAS

DWG. NO. 07011-051 | FIGURE 1

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BY AJN DATE 6/1/07 SUBJECT WWNS - NOA SHT. NO. 3 OF 9
CHKD. BY AJK DATE 6/4/07 CAP DESIGN JOB NO. 07-011
PRE-CAP STORMWATER ANALYSIS

SUBAREA #1 (SOUTH WEST CORNER OF EXISTING LANDFILL)

AREA = 31,741 SF = 0.73 ACRES

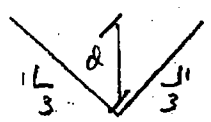
CN = 80
- FROM TABLE 2-2G (TR55)

DRAINAGE PATH

- A - B (SHEET FLOW)
  LENGTH = 150 LF
  SLOPE = (1393.5 - 1391.5)/150 = 1.3%
  SHORT GRASS W/ n = 0.15 P_2 = 2.5" (2 YR STORM)

- B - C (SHALLOW CONCENTRATED FLOW)
  LENGTH = 115 LF
  SLOPE = (1391.5 - 1386.25)/115 = 4.6%
  UNPAVED (SHORT GRASS)

- C - D (CHANNEL FLOW)
  LENGTH = 43 LF
  SLOPE = (1386.25 - 1385)/43 = 2.9%
  ASSUMED X-SECTION



d x 2'
A = 12 SF
WP = 12.65'
n = 0.05 (MOWED GRASS)

- D - E (PIPE FLOW)
  LENGTH = 42 LF
  SLOPE = SAY 1%
  12" Φ CMP

TREAT THIS AS A REACH

SUBAREA #2 (OUTSIDE SOUTH AREA DRAINS TO 12" PIPE)

AREA = 58,655 SF = 1.35 ACRES

CN = 80
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

- A - B (SHEET FLOW)

  LENGTH = 150 LF

  SLOPE = (1391 - 1385.75)/150 = 3.5%

  SHORT GRASS W/n = 0.15 P_2 = 2.5" (2 YR STORM)

- B - C (SHALLOW CONCENTRATED FLOW)

  LENGTH = 244 LF

  SLOPE = (1385.75 - 1379.5)/244 = 2.6%

  UNDAMED SURFACE

SUBAREA #3 (SOUTHSIDE OF EXISTING LANDFILL)

AREA = 111,102 SF = 2.55 ACRES

CN = 80
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

- A - B (SHEET FLOW)

  LENGTH = 150 LF

  SLOPE = (1393.5 - 1391.5)/150 = 1.7%

  SHORT GRASS W/n = 0.15 P_2 = 2.5" (2YR STORM)

- B - C (SHALLOW CONCENTRATED FLOW)

  LENGTH = 127 LF

  SLOPE = (1391.5 - 1386.5)/127 = 3.9%

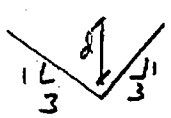
  UNDAMED (SHORT GRASS)

- C - D (CHANNEL FLOW)

  LENGTH = 71 LF

  SLOPE = (1386.5 - 1383)/71 = 4.9%

  ASSUMED X-SECTION



d = 2'
A = 12 SF
WP = 12.65'
n = 0.05 (MOWED GRASS)

• D – E (PIPE FLOW)

LENGTH = 177 LF

SLOPE = (1383 – 1381.5)/177 = 0.85 %

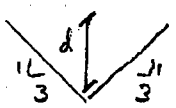
12" ϕ CMP

• E – F (CHANNEL FLOW)

LENGTH = 193 LF

SLOPE = (1381.5 – 1375.38)/193 = 3.2 %

ASSUMED X-SECTION



d ≈ 2'.
A = 12 SF
WP = 12.65'
n = 0.05 MOWED GRASS

SUBAREA #4 (FROM SDA)

- LIMITED INFO ON THIS, WVNSCO STATES THAT IT IS:

AREA = 0.56 ACRES

• SHEET FLOW

LENGTH = 150 LF

SLOPE = 2 %

SMOOTH W/ n = 0.011 P_2 = 2.5" (24 HR STORM)

CN = 98 ASSUMED
– FROM TABLE 2-2a (TR55)

• SHALLOW CONCENTRATED FLOW

LENGTH = 50 LF

SLOPE = 2 %

PAVED SURFACE

* LENGTHS AND SLOPES ASSUMED BASED ON LIMITED INFO FOR DRAINAGE AREA

• PIPE FLOW

18" DIA (CMP)

INV. START 1378.5

INV. END 1378

LENGTH = 65 LF

SLOPE = (1378.5 – 1378)/65 = 0.77 %

THINK THIS IS A REACH

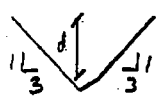
SUBAREA #5 (NORTH AND WEST SIDES OF EXISTING LANDFILL)

AREA = 144,947 SF = 3.33 ACRES

CN = 80
FROM TABLE 2-2a (TR55)

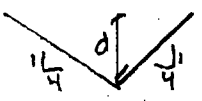
DRAINAGE PATH

- A - B (SHEET FLOW)
  - LENGTH = 44 LF
  - SLOPE = (1391.5 - 1389.5)/44 = 4.5%
  - SHORT GRASS n/A = 0.15 P2 = 2.5" (24HR STORM)
- B - C (SHALLOW CONCENTRATED FLOW)
  - LENGTH = 119 LF
  - SLOPE = (1389.5 - 1384)/119 = 0.42%
  - UNPAVED (SHORT GRASS)
- C - D (CHANNEL FLOW)
  - LENGTH = 428 LF
  - SLOPE = (1384 - 1378)/428 = 2.6%
  - ASSUMED X-SECTION



d ≈ 1.5'
A = 6.75 SF
WP = 9.5'
n = 0.05 (MOWED GRASS)

- D - E (PIPE FLOW)
  - 12" ϕ CMP
  - LENGTH = 71 LF
  - SLOPE = (1378 - 1375)/71 = 4.2%
- E - F (CHANNEL FLOW)
  - LENGTH = 204 LF
  - SLOPE = (1375 - 1353.5)/204 = 10.5%
  - ASSUMED X-SECTION



d ≈ 3' MIN
A = 36 SF
WP = 24.74'
n = 0.03 (RIPRAP)

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BY AGN DATE 6/1/07 SUBJECT WYNS - NDA SHT. NO. 7 OF 9
CHKD. BY AJK DATE 6/4/07 CAP DESIGN JOB NO. 07-011
PRE-CAP STORMWATER ANALYSIS

SUBAREA #6 (WEST SIDE OF EXISTING LANDFILL)

AREA = 44,775 SF = 1.03 ACRES

CN = 30
FROM TABLE 2-2a (TRSS)

DRAINAGE PATH

- A - B (SHEET FLOW)

LENGTH = 150 LF

SLOPE = (1398.5 - 1381)/150 = 6.3%

SHORT GRASS $n/n = 0.15$ $P_2 = 2.5''$ (24hr STORM)

- B - C (SHALLOW CONCENTRATED FLOW)

LENGTH = 110 LF

SLOPE = (1381 - 1376.5)/110 = 4.1%

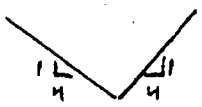
UNPAVED (SHORT GRASS)

- C - D (CHANNEL FLOW)

LENGTH = 397 LF

SLOPE = (1376.5 - 1353.5)/397 = 5.8%

ASSUMED X-SECTION



$d \approx 3'$ MIN
$A \sim 36$ SF
WP = 24.74'
$n = 0.03$ (RIP-RAP)

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PRE-CAP STORMWATER ANALYSIS

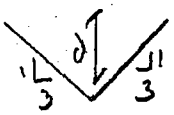
REACH FOR AREA #1 TO 12" CULVERT (REACH #1)

CHANNEL

LENGTH = 275 LF

SLOPE = (1384.58 - 1379.5)/275 = 1.85 %

ASSUMMED X-SECTION



d = 1.5
A = 6.75 SF
WP = 9.5'
n = 0.05 (MOWED GRASS

REACH FOR AREA #1 AND #2

PIPE FLOW

12" Ø CMP

LENGTH = 47 LF

SLOPE = SAY 1 %

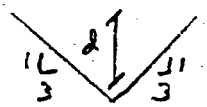
REACH FOR AREA #1 AND #2 (REACH #2)

CHANNEL (USE E TO F FROM SUBAREA #3)

LENGTH = 193 LF

SLOPE = (1381.5 - 1375.38)/193 = 3.2 %

ASSUMMED X-SECTION



d = 2'
A = 12 SF
WP = 12.65'
n = 0.05 (MOWED GRASS

REACH FOR AREAS #1, #2, #3 AND #4

PIPE FLOW

24" Ø (SMOOTH WALL)

LENGTH = 362 LF

SLOPE = (1375.38 - 1366)/362 = 2.6 %

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BY AJW DATE 6/1/07 SUBJECT UWNS - NOA SHT. NO. 9 OF 9
CHKD. BY AJK DATE 6/4/07 CAP DESIGN JOB NO. 07-011
D&R - CAP STORMWATER ANALYSIS

REACH FOR OUTLET OF 24" PIPE TO END (REACH #3)

CHANNEL

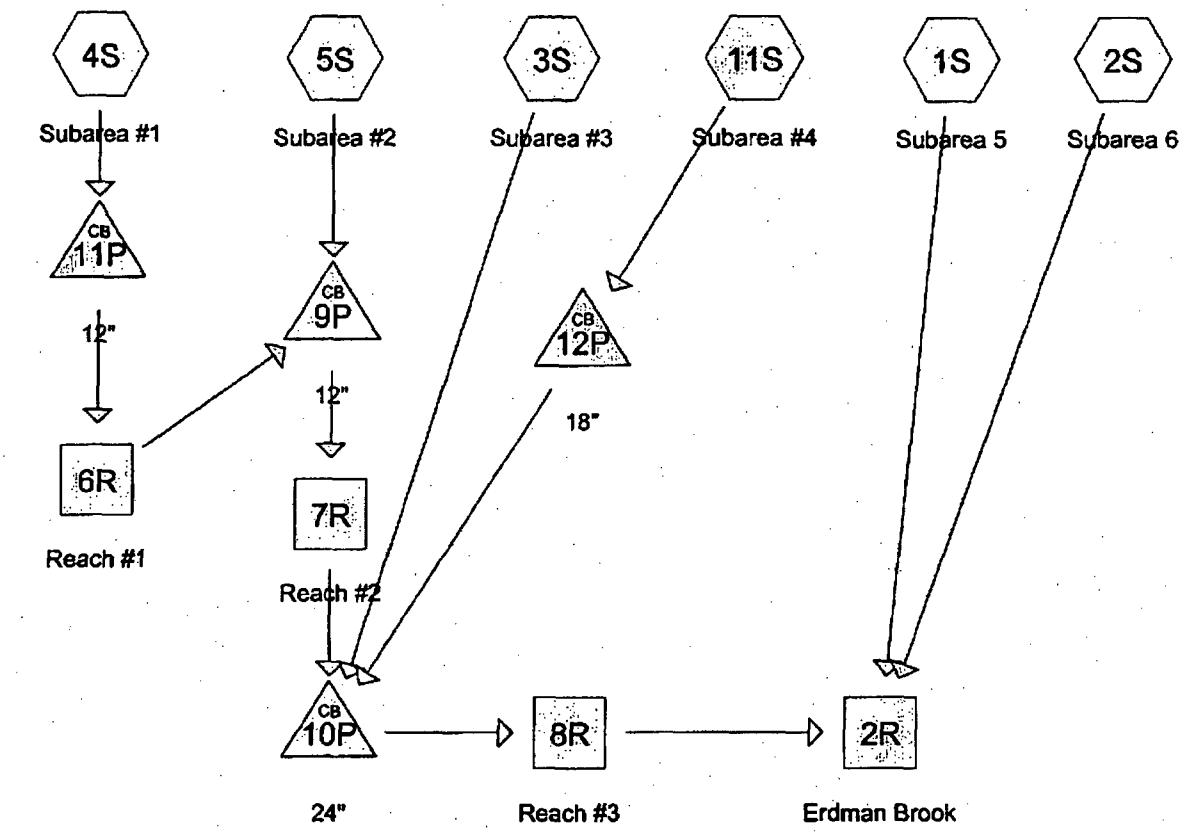
LENGTH = 137 LF

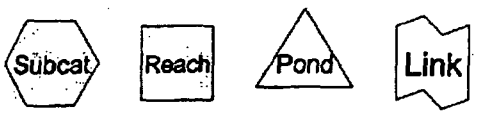
SLOPE = (1366 - 1353.5) / 137 = 9.1%

ASSUMED X - SECTION

d ≈ 3' MIN
A = 36 SF
WP = 24.74'
n = 0.03 (RIP-RAP)

EXISTING CONDITIONS
HYDROCAD RESULTS





Drainage Diagram for Existing Conditions
Prepared by McMahon & Mann Consulting Engineers, P.C. 6/5/2007
HydroCAD® 7.10 s/n 003326 © 2005 HydroCAD Software Solutions LLC

Time span=1.00-48.00 hrs, dt=0.05 hrs, 941 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Subarea 5 Runoff Area=3.330 ac Runoff Depth=2.21"
Flow Length=866' Tc=10.9 min CN=80 Runoff=10.80 cfs 0.613 af

Subcatchment 2S: Subarea 6 Runoff Area=1.030 ac Runoff Depth=2.21"
Flow Length=657' Tc=11.4 min CN=80 Runoff=3.29 cfs 0.190 af

Subcatchment 3S: Subarea #3 Runoff Area=2.550 ac Runoff Depth=2.21"
Flow Length=718' Tc=21.9 min CN=80 Runoff=5.91 cfs 0.469 af

Subcatchment 4S: Subarea #1 Runoff Area=0.730 ac Runoff Depth=2.21"
Flow Length=308' Tc=19.6 min CN=80 Runoff=1.80 cfs 0.134 af

Subcatchment 5S: Subarea #2 Runoff Area=1.350 ac Runoff Depth=2.21"
Flow Length=394' Tc=13.9 min CN=80 Runoff=3.97 cfs 0.248 af

Subcatchment 11S: Subarea #4 Runoff Area=0.560 ac Runoff Depth>3.96"
Flow Length=200' Tc=2.2 min CN=98 Runoff=3.51 cfs 0.185 af

Reach 2R: Erdman Brook Peak Depth=0.73' Max Vel=11.1 fps Inflow=24.07 cfs 1.839 af
n=0.030 L=5.0' S=0.2000 '/' Capacity=1,024.08 cfs Outflow=24.07 cfs 1.839 af

Reach 6R: Reach #1 Peak Depth=0.58' Max Vel=1.7 fps Inflow=1.80 cfs 0.134 af
n=0.050 L=275.0' S=0.0185 '/' Capacity=21.73 cfs Outflow=1.76 cfs 0.134 af

Reach 7R: Reach #2 Peak Depth=0.80' Max Vel=2.8 fps Inflow=5.41 cfs 0.383 af
n=0.050 L=193.0' S=0.0317 '/' Capacity=61.32 cfs Outflow=5.38 cfs 0.383 af

Reach 8R: Reach #3 Peak Depth=0.65' Max Vel=6.9 fps Inflow=11.51 cfs 1.037 af
n=0.030 L=137.0' S=0.0912 '/' Capacity=691.69 cfs Outflow=11.50 cfs 1.037 af

Pond 9P: 12" Peak Elev=1,387.68' Inflow=5.40 cfs 0.383 af
12.0" x 47.0' Culvert Outflow=5.41 cfs 0.383 af

Pond 10P: 24" Peak Elev=1,377.29' Inflow=11.51 cfs 1.037 af
24.0" x 362.0' Culvert Outflow=11.51 cfs 1.037 af

Pond 11P: 12" Peak Elev=1,386.03' Inflow=1.80 cfs 0.134 af
12.0" x 42.0' Culvert Outflow=1.80 cfs 0.134 af

Pond 12P: 18" Peak Elev=1,379.74' Inflow=3.51 cfs 0.185 af
18.0" x 65.0' Culvert Outflow=3.51 cfs 0.185 af

Total Runoff Area = 9.550 ac Runoff Volume = 1.839 af Average Runoff Depth = 2.31"

Subcatchment 1S: Subarea 5

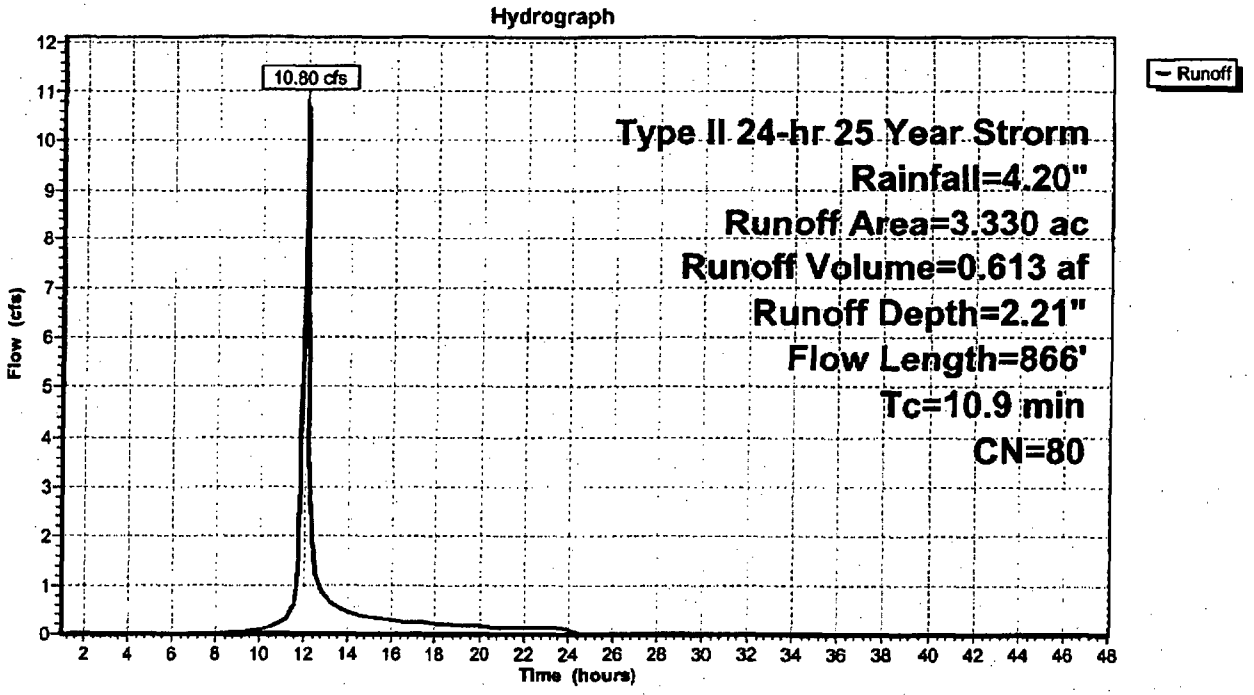
Runoff = 10.80 cfs @ 12.03 hrs, Volume= 0.613 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
3.330	80	North and west side of existing landfill

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	44	0.0450	0.2		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
4.4	119	0.0042	0.5		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
1.9	428	0.0260	3.8	25.44	**Channel Flow, C to D** Area= 6.7 sf Perim= 9.5' r= 0.71' n= 0.050
0.2	71	0.0420	4.8	3.80	**Circular Channel (pipe), D to E** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.025 Corrugated metal
0.2	204	0.1050	20.6	742.79	**Channel Flow, E to F** Area= 36.0 sf Perim= 24.7' r= 1.46' n= 0.030
10.9	866	Total			

Subcatchment 1S: Subarea 5



Subcatchment 2S: Subarea 6

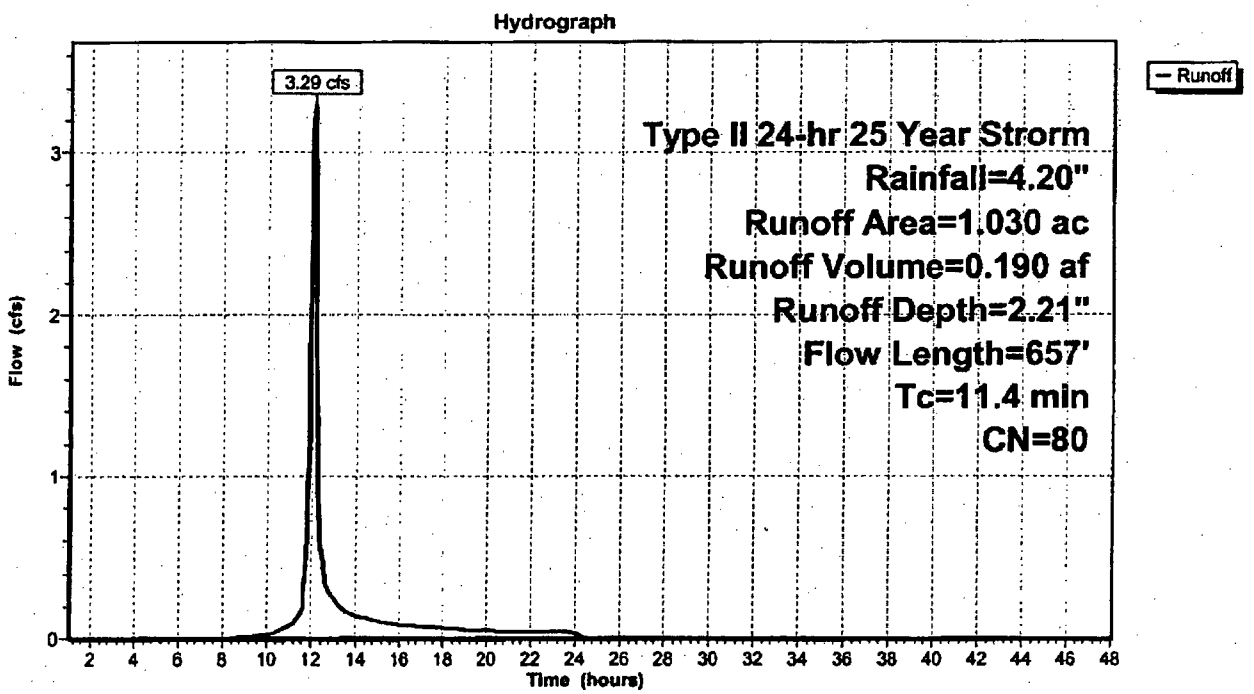
Runoff = 3.29 cfs @ 12.03 hrs, Volume= 0.190 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
1.030	80	West side of exisiting landfill

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	150	0.0630	0.3		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
1.3	110	0.0410	1.4		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
0.4	397	0.0580	15.3	552.06	**Channel Flow, C to D** Area= 36.0 sf Perim= 24.7' r= 1.46' n= 0.030
11.4	657	Total			

Subcatchment 2S: Subarea 6



Subcatchment 3S: Subarea #3

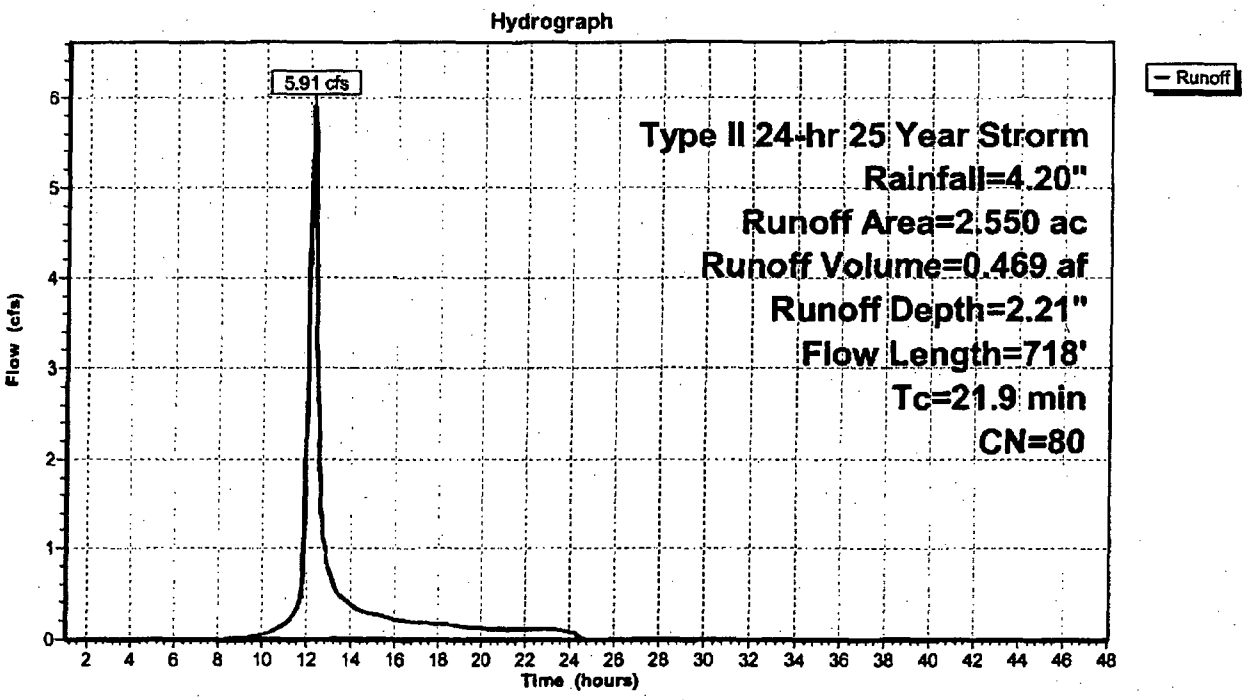
Runoff = 5.91 cfs @ 12.15 hrs, Volume= 0.469 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
2.550	80	Southside of existing landfill

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.2	150	0.0130	0.1		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
1.5	127	0.0390	1.4		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
0.2	71	0.0490	6.4	76.42	**Channel Flow, C to D** Area= 12.0 sf Perim= 12.6' r= 0.95' n= 0.050
1.4	177	0.0085	2.2	1.71	**Circular Channel (pipe), D to E** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.025 Corrugated metal
0.6	193	0.0320	5.1	61.76	**Channel Flow, E to F** Area= 12.0 sf Perim= 12.6' r= 0.95' n= 0.050
21.9	718	Total			

Subcatchment 3S: Subarea #3



Subcatchment 4S: Subarea #1

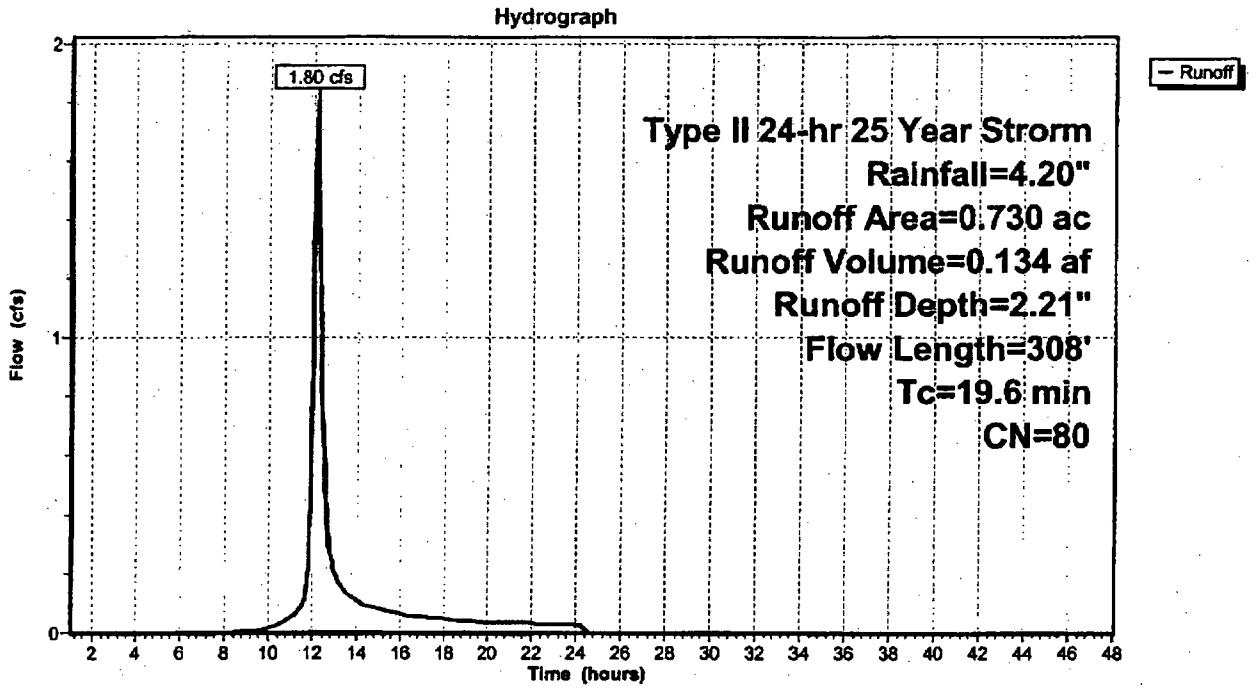
Runoff = 1.80 cfs @ 12.12 hrs, Volume= 0.134 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
0.730	80	Southwest corner of Existing Landfill

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.2	150	0.0130	0.1		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
1.3	115	0.0460	1.5		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
0.1	43	0.0290	4.9	58.79	**Channel Flow, C to D** Area= 12.0 sf Perim= 12.6' r= 0.95' n= 0.050
19.6	308	Total			

Subcatchment 4S: Subarea #1



Subcatchment 5S: Subarea #2

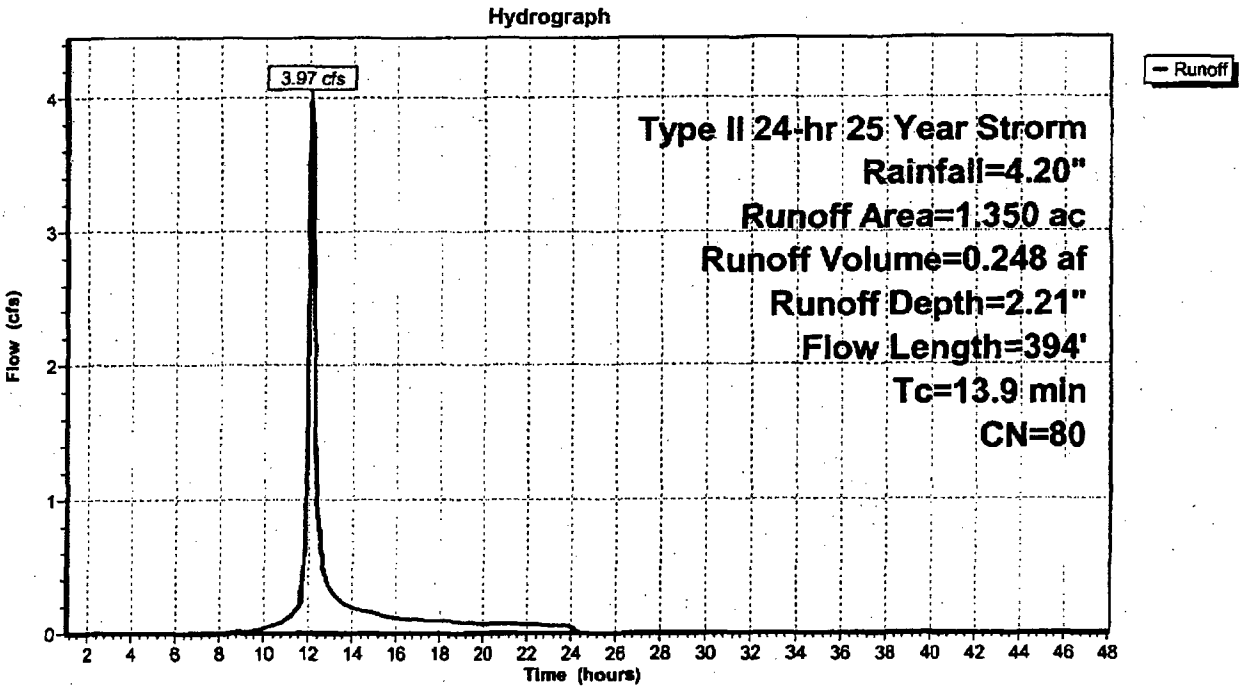
Runoff = 3.97 cfs @ 12.06 hrs, Volume= 0.248 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
1.350	80	Outside south area draing to 12" pipe

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	150	0.0350	0.2		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
1.6	244	0.0260	2.6		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
13.9	394	Total			

Subcatchment 5S: Subarea #2



Subcatchment 11S: Subarea #4

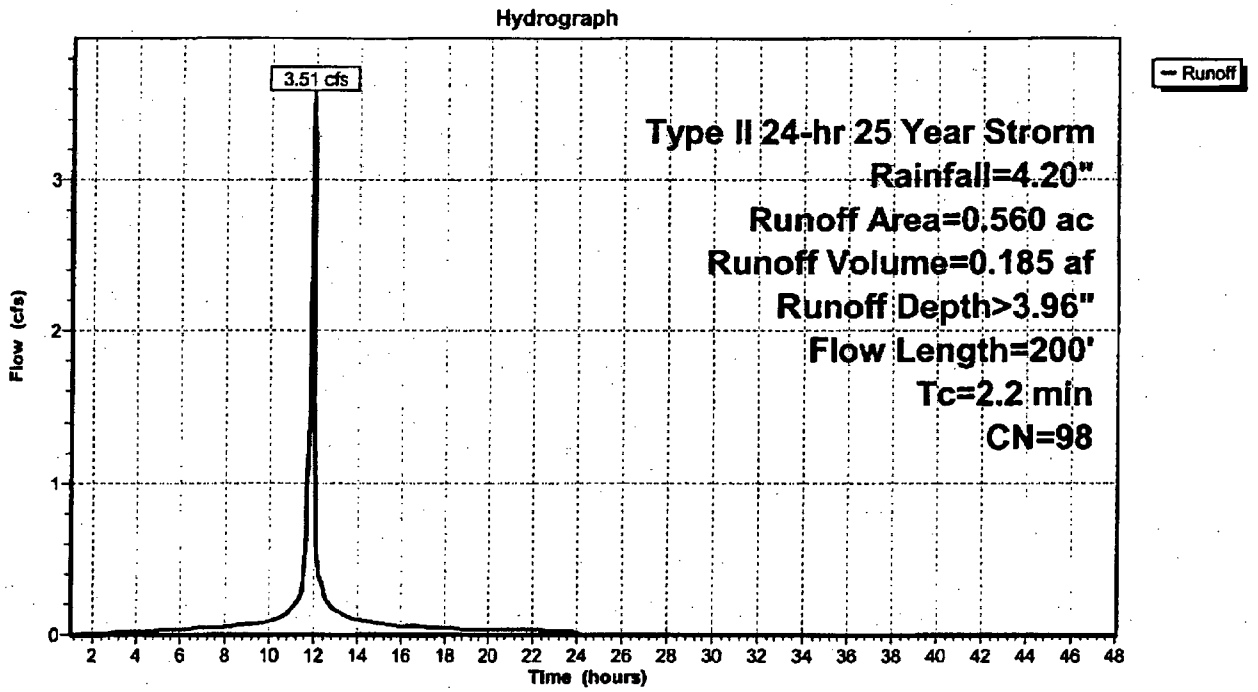
Runoff = 3.51 cfs @ 11.92 hrs, Volume= 0.185 af, Depth> 3.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
0.560	98	From SDA

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	150	0.0200	1.3		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 2.50"
0.3	50	0.0200	2.9		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
2.2	200	Total			

Subcatchment 11S: Subarea #4



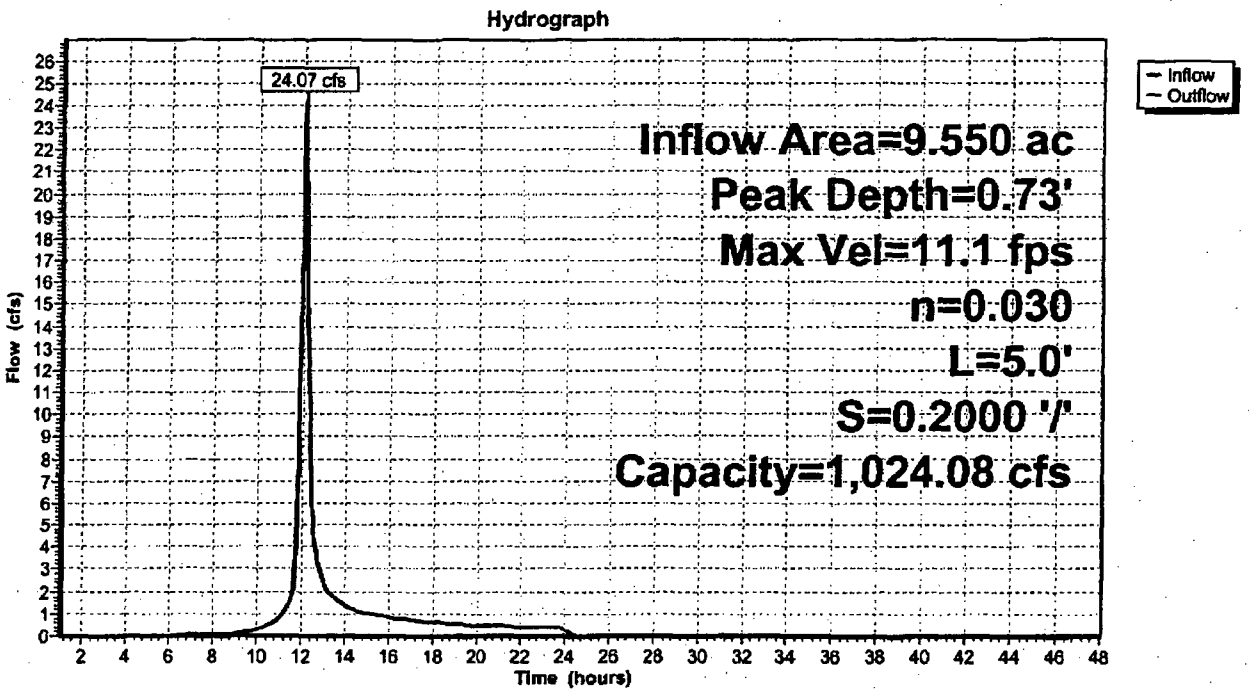
Reach 2R: Erdman Brook

Inflow Area = 9.550 ac, Inflow Depth = 2.31" for 25 Year Stroom event
Inflow = 24.07 cfs @ 12.04 hrs, Volume= 1.839 af
Outflow = 24.07 cfs @ 12.04 hrs, Volume= 1.839 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.1 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.7 fps, Avg. Travel Time= 0.0 min

Peak Depth= 0.73' @ 12.04 hrs
Capacity at bank full= 1,024.08 cfs
Inlet Invert= 1,353.50', Outlet Invert= 1,352.50'
0.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 '/' Top Width= 24.00'
Length= 5.0' Slope= 0.2000 '/'

Reach 2R: Erdman Brook



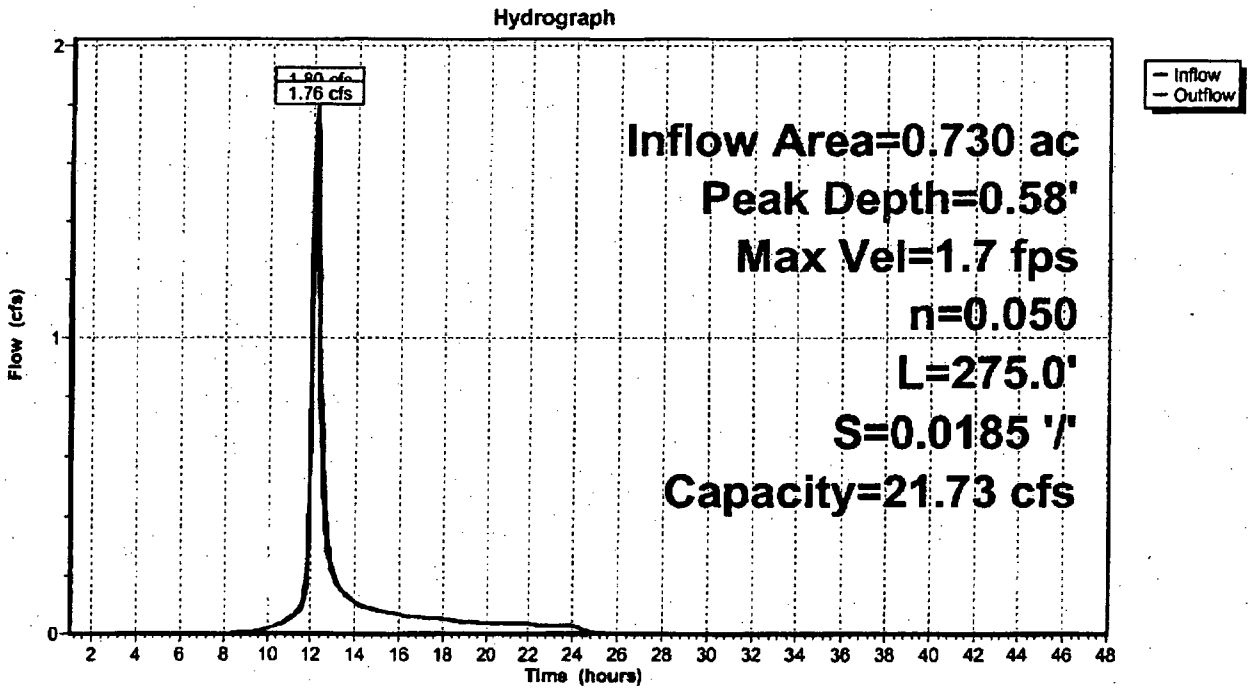
Reach 6R: Reach #1

Inflow Area = 0.730 ac, Inflow Depth = 2.21" for 25 Year Strorm event
Inflow = 1.80 cfs @ 12.12 hrs, Volume= 0.134 af
Outflow = 1.76 cfs @ 12.16 hrs, Volume= 0.134 af, Atten= 3%, Lag= 2.1 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.7 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 7.0 min

Peak Depth= 0.58' @ 12.16 hrs
Capacity at bank full= 21.73 cfs
Inlet Invert= 1,384.58', Outlet Invert= 1,379.50'
0.00' x 1.50' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.00'
Length= 275.0' Slope= 0.0185 '/'

Reach 6R: Reach #1



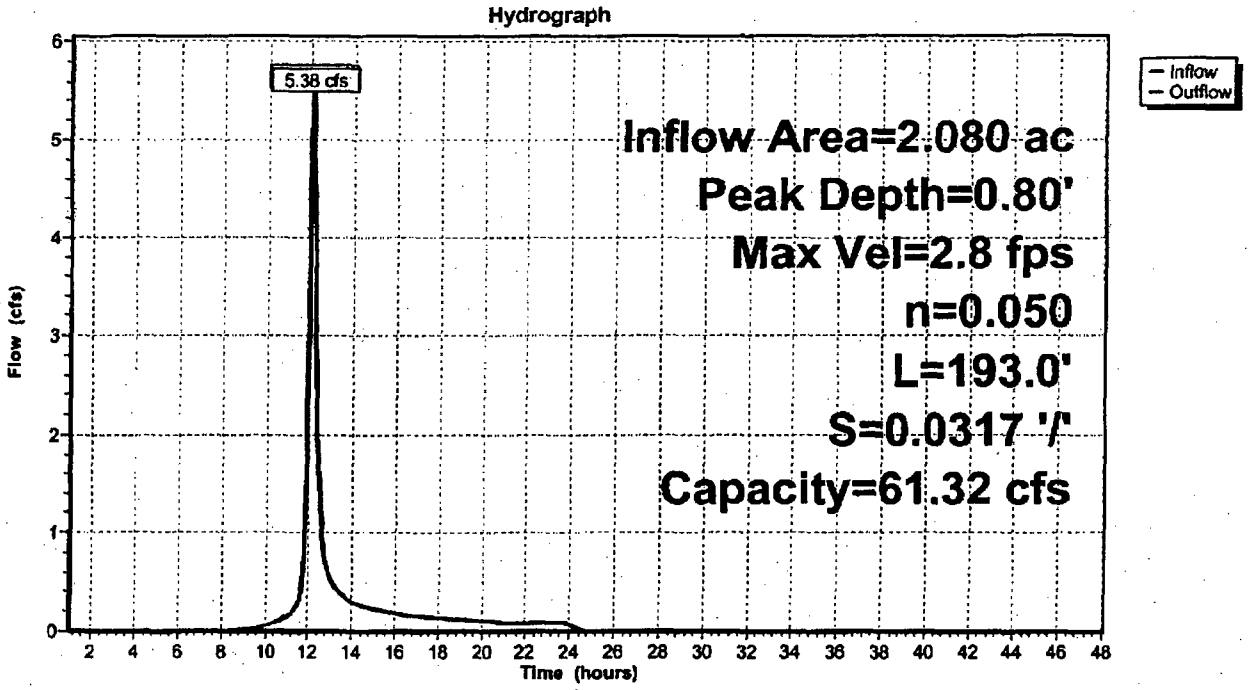
Reach 7R: Reach #2

Inflow Area = 2.080 ac, Inflow Depth = 2.21" for 25 Year Strorm event
Inflow = 5.41 cfs @ 12.08 hrs, Volume= 0.383 af
Outflow = 5.38 cfs @ 12.10 hrs, Volume= 0.383 af, Atten= 0%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.8 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 3.1 min

Peak Depth= 0.80' @ 12.10 hrs
Capacity at bank full= 61.32 cfs
Inlet Invert= 1,381.50', Outlet Invert= 1,375.38'
0.00' x 2.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 193.0' Slope= 0.0317 '/'

Reach 7R: Reach #2



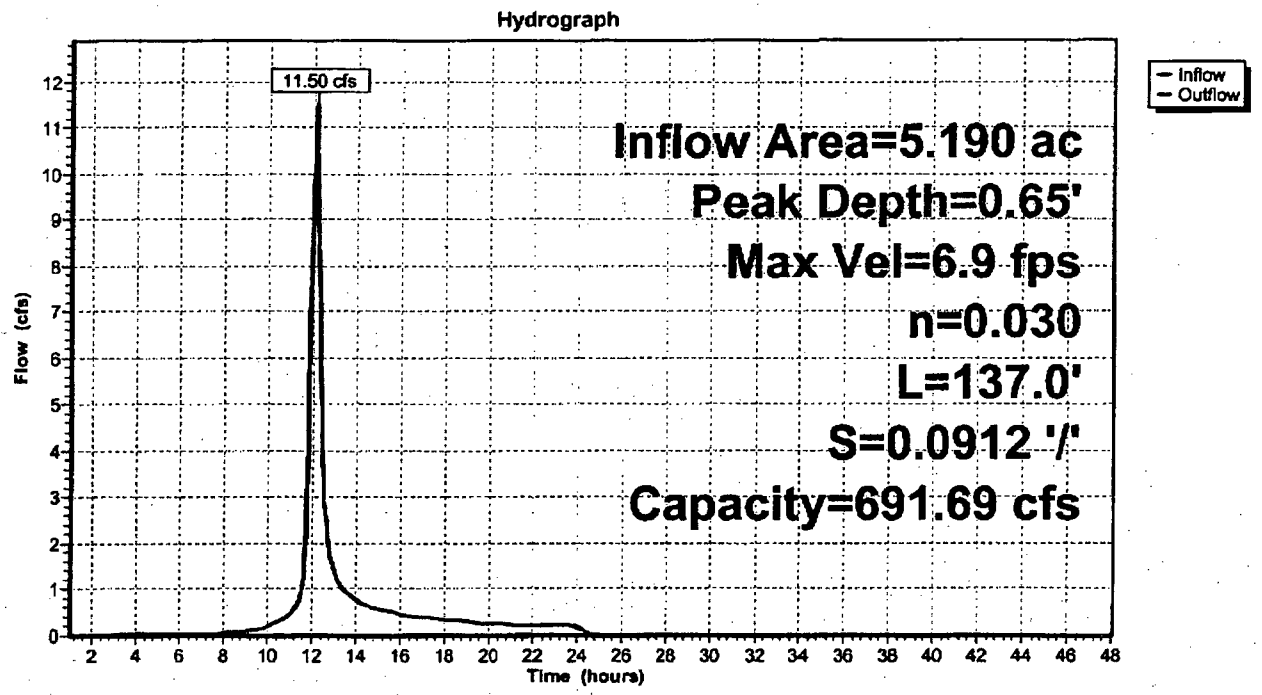
Reach 8R: Reach #3

Inflow Area = 5.190 ac, Inflow Depth > 2.40" for 25 Year Strorm event
Inflow = 11.51 cfs @ 12.12 hrs, Volume= 1.037 af
Outflow = 11.50 cfs @ 12.12 hrs, Volume= 1.037 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.9 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.5 fps, Avg. Travel Time= 0.9 min

Peak Depth= 0.65' @ 12.12 hrs
Capacity at bank full= 691.69 cfs
Inlet Invert= 1,366.00', Outlet Invert= 1,353.50'
0.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 '/' Top Width= 24.00'
Length= 137.0' Slope= 0.0912 '/'

Reach 8R: Reach #3



Pond 9P: 12"

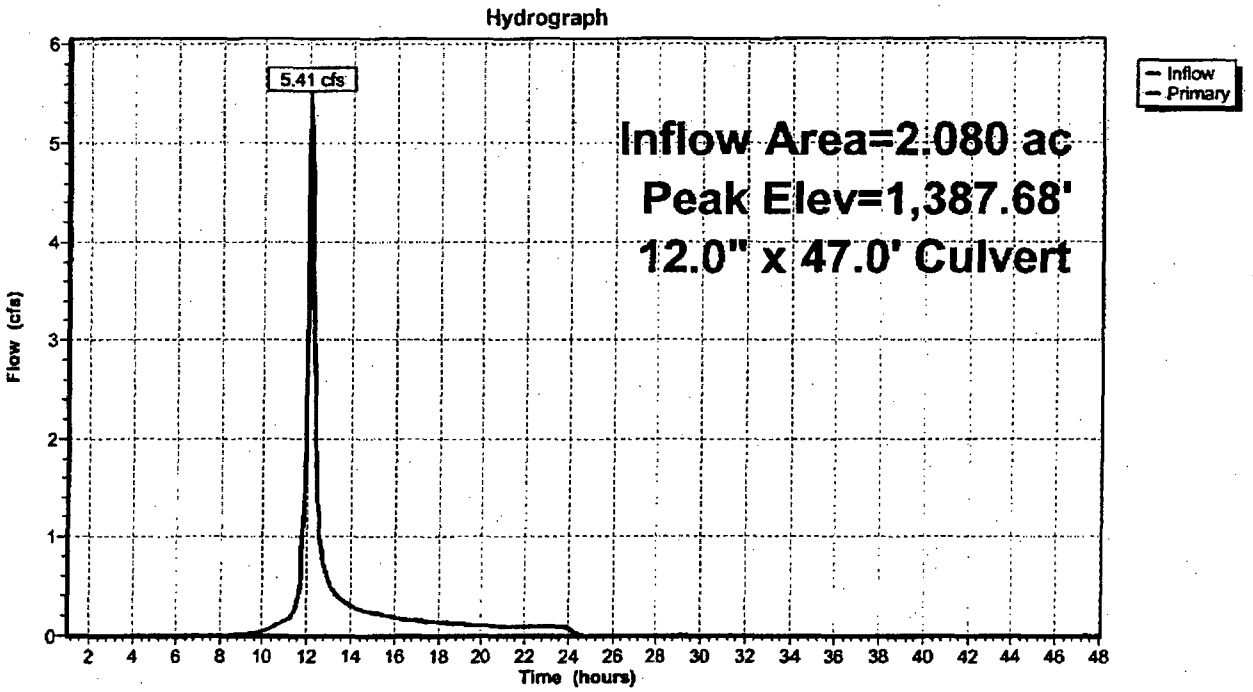
Inflow Area =	2.080 ac,	Inflow Depth =	2.21"	for	25 Year Stroom event
Inflow =	5.40 cfs @	12.08 hrs,	Volume=	0.383 af	
Outflow =	5.41 cfs @	12.08 hrs,	Volume=	0.383 af,	Atten= 0%, Lag= 0.1 min
Primary =	5.41 cfs @	12.08 hrs,	Volume=	0.383 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,387.68' @ 12.08 hrs
Plug-Flow detention time= 0.3 min calculated for 0.383 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (837.2 - 837.2)

Device	Routing	Invert	Outlet Devices
#1	Primary	1,379.50'	**12.0" x 47.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 1,379.00' S= 0.0106 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=5.31 cfs @ 12.08 hrs HW=1,387.51' TW=1,382.30' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 5.31 cfs @ 6.8 fps)

Pond 9P: 12"



Pond 10P: 24"

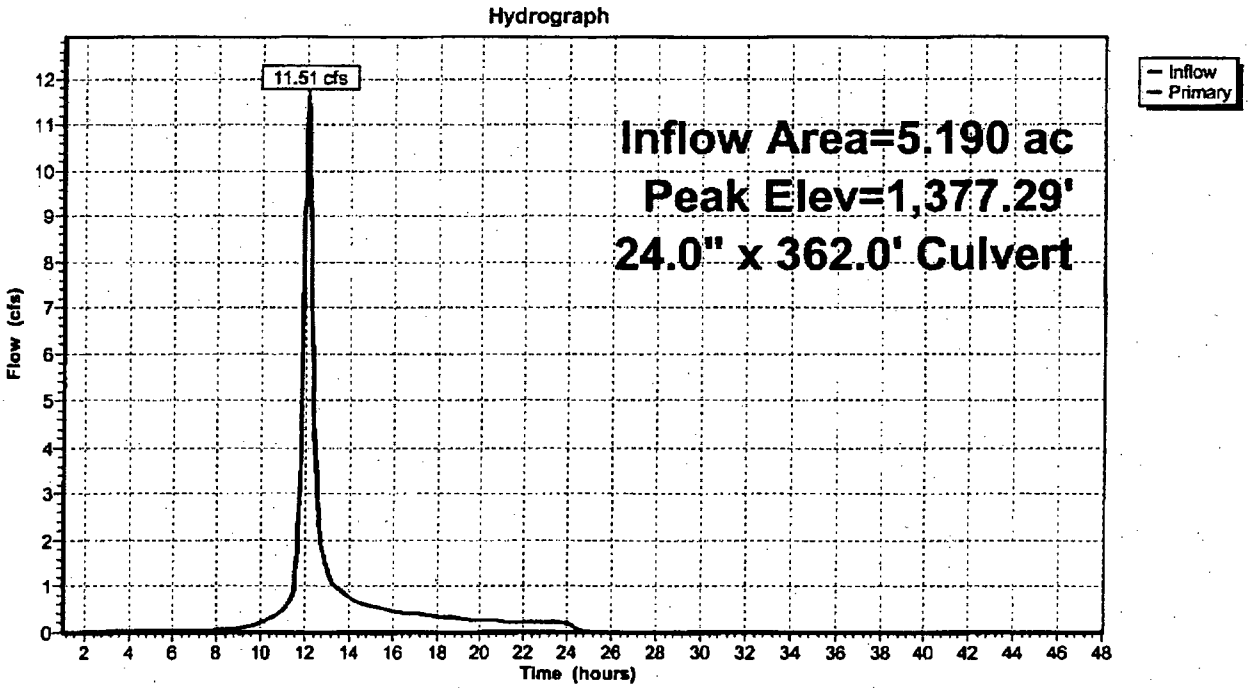
Inflow Area =	5.190 ac,	Inflow Depth >	2.40"	for	25 Year Strorm event
Inflow =	11.51 cfs @	12.12 hrs,	Volume=	1.037 af	
Outflow =	11.51 cfs @	12.12 hrs,	Volume=	1.037 af,	Atten= 0%, Lag= 0.0 min
Primary =	11.51 cfs @	12.12 hrs,	Volume=	1.037 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,377.29' @ 12.12 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (823.0 - 823.0)

Device	Routing	Invert	Outlet Devices
#1	Primary	1,375.38'	**24.0" x 362.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 1,366.00' S= 0.0259 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Primary OutFlow Max=11.37 cfs @ 12.12 hrs HW=1,377.27' TW=1,366.64' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 11.37 cfs @ 3.7 fps)

Pond 10P: 24"



Pond 11P: 12"

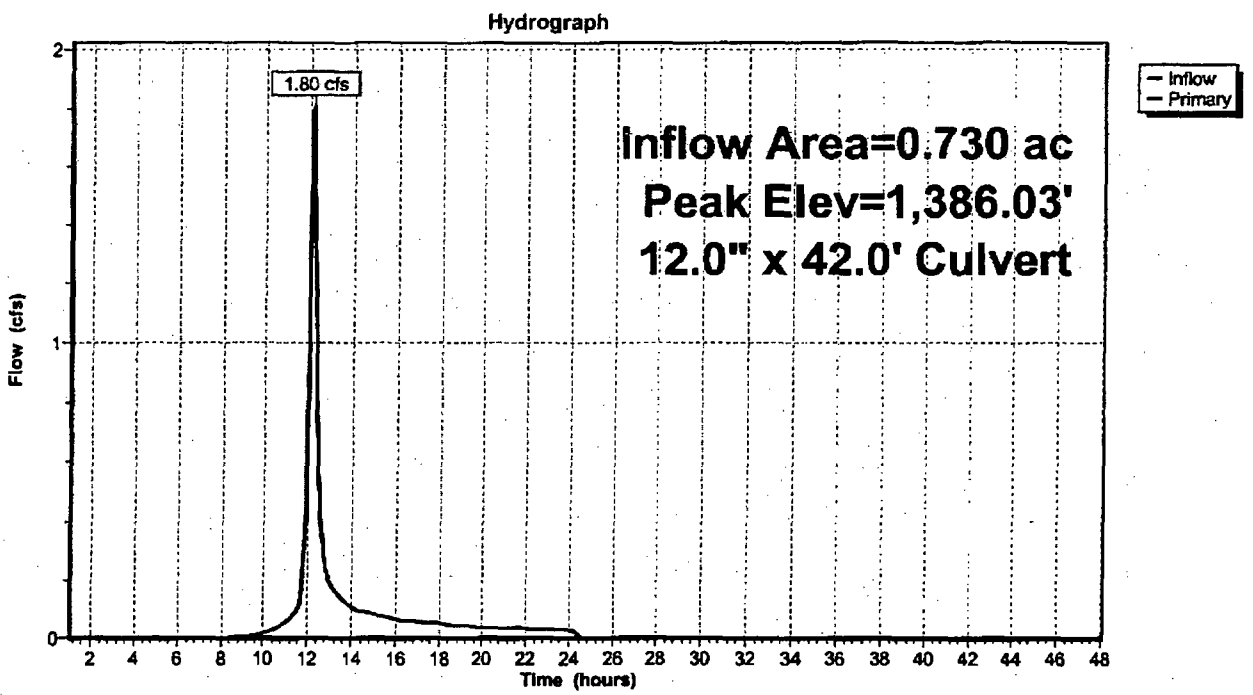
Inflow Area =	0.730 ac,	Inflow Depth =	2.21"	for	25 Year Stroom event
Inflow =	1.80 cfs @	12.12 hrs,	Volume=	0.134 af	
Outflow =	1.80 cfs @	12.12 hrs,	Volume=	0.134 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.80 cfs @	12.12 hrs,	Volume=	0.134 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,386.03' @ 12.12 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (839.0 - 839.0)

Device	Routing	Invert	Outlet Devices
#1	Primary	1,385.00'	**12.0" x 42.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 1,384.58' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=1.78 cfs @ 12.12 hrs HW=1,386.02' TW=1,385.15' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 1.78 cfs @ 2.8 fps)

Pond 11P: 12"



Pond 12P: 18"

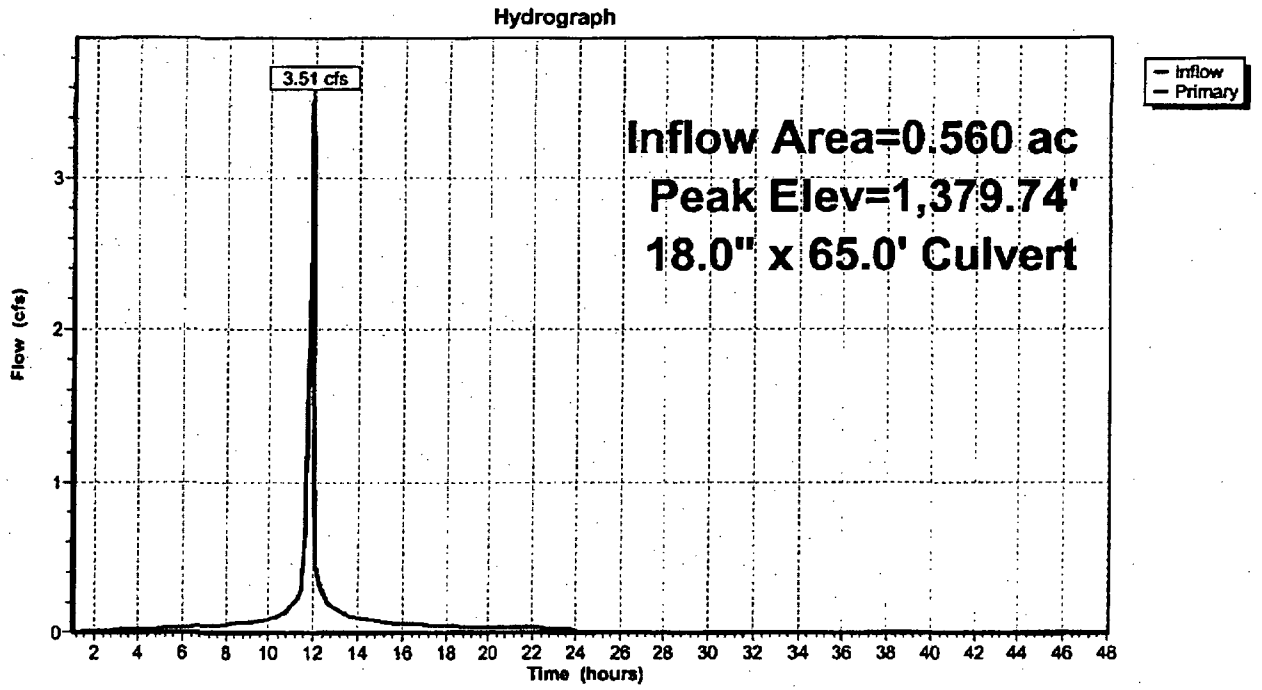
Inflow Area =	0.560 ac,	Inflow Depth >	3.96"	for	25 Year Strorm event
Inflow =	3.51 cfs @	11.92 hrs,	Volume=	0.185 af	
Outflow =	3.51 cfs @	11.92 hrs,	Volume=	0.185 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.51 cfs @	11.92 hrs,	Volume=	0.185 af	

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,379.74' @ 11.92 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (743.5 - 743.5)

Device	Routing	Invert	Outlet Devices
#1	Primary	1,378.50'	**18.0" x 65.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 1,378.00' S= 0.0077 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=3.41 cfs @ 11.92 hrs HW=1,379.72' TW=1,376.82' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 3.41 cfs @ 3.0 fps)

Pond 12P: 18"



STORMWATER ANALYSIS
REFERENCE INFORMATION

Figure B-3 2-year, 24-hr rainfall

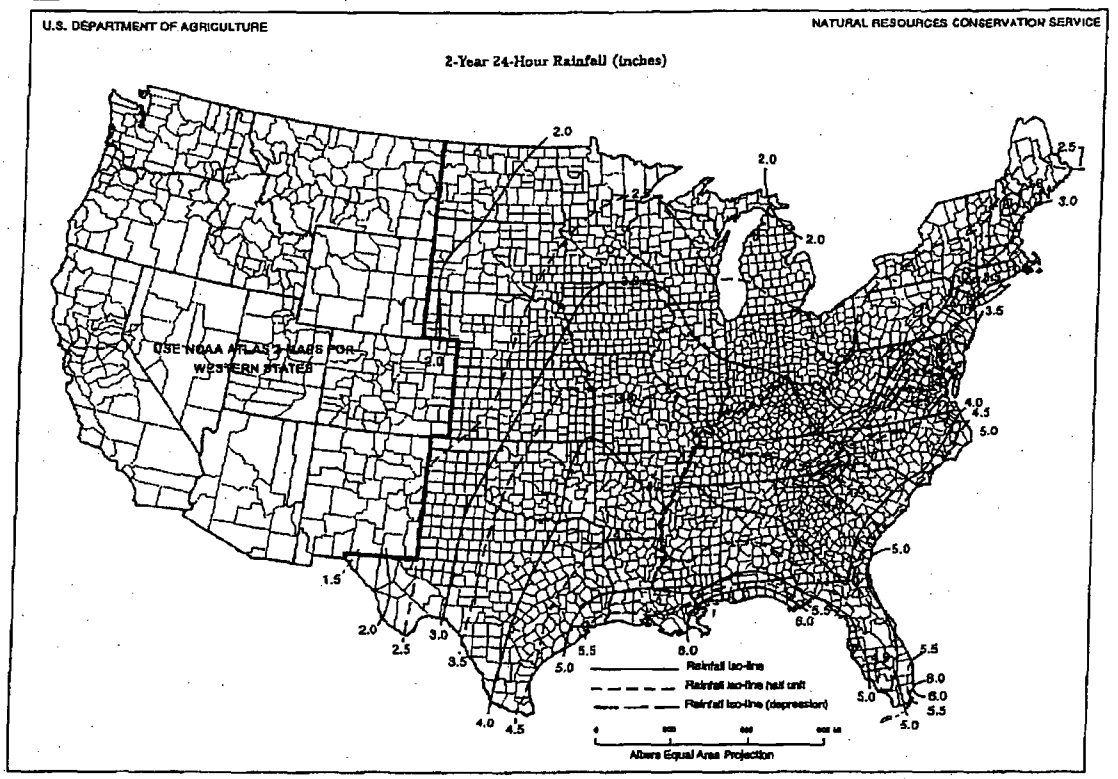


Figure B-4 5-year, 24-hour rainfall

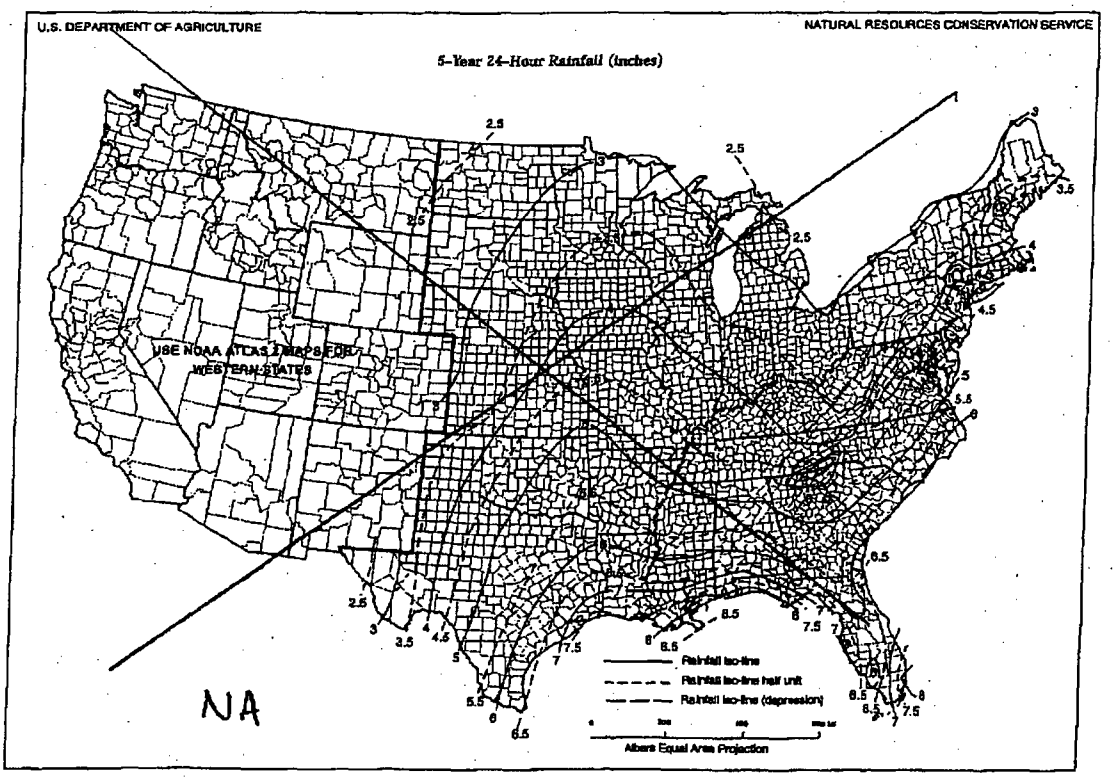


Figure B-5 10-year, 24-hour rainfall

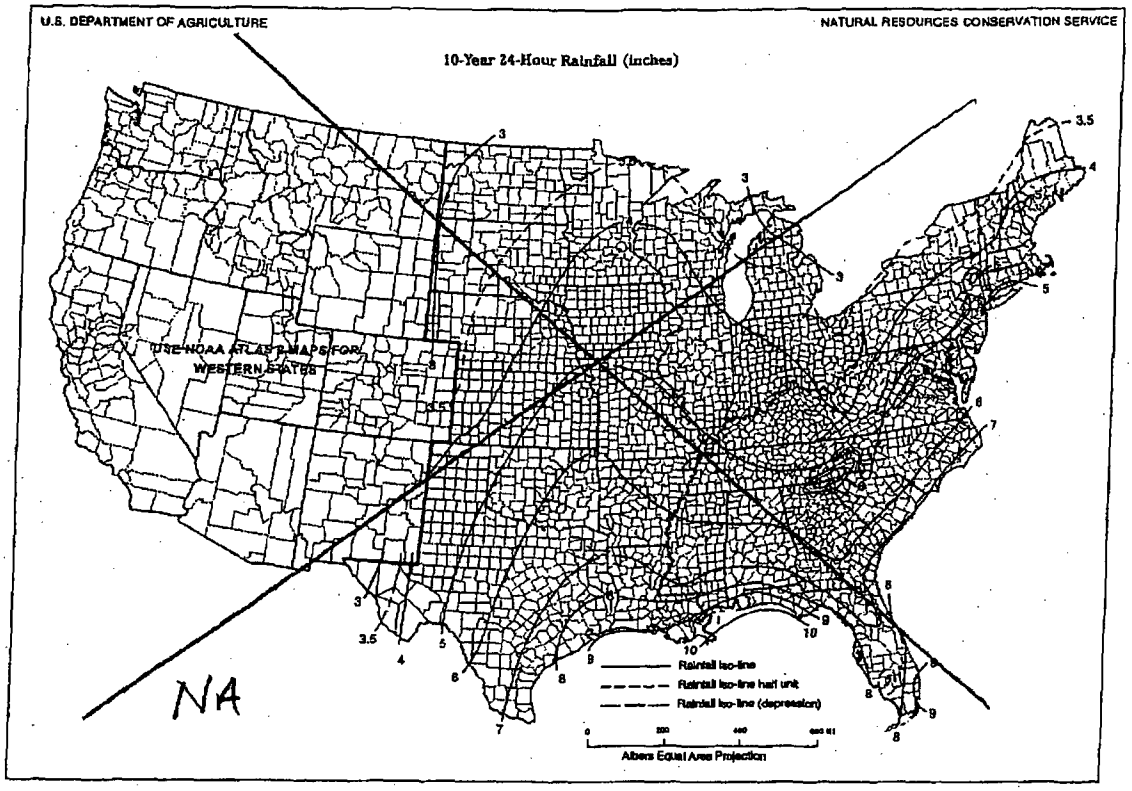
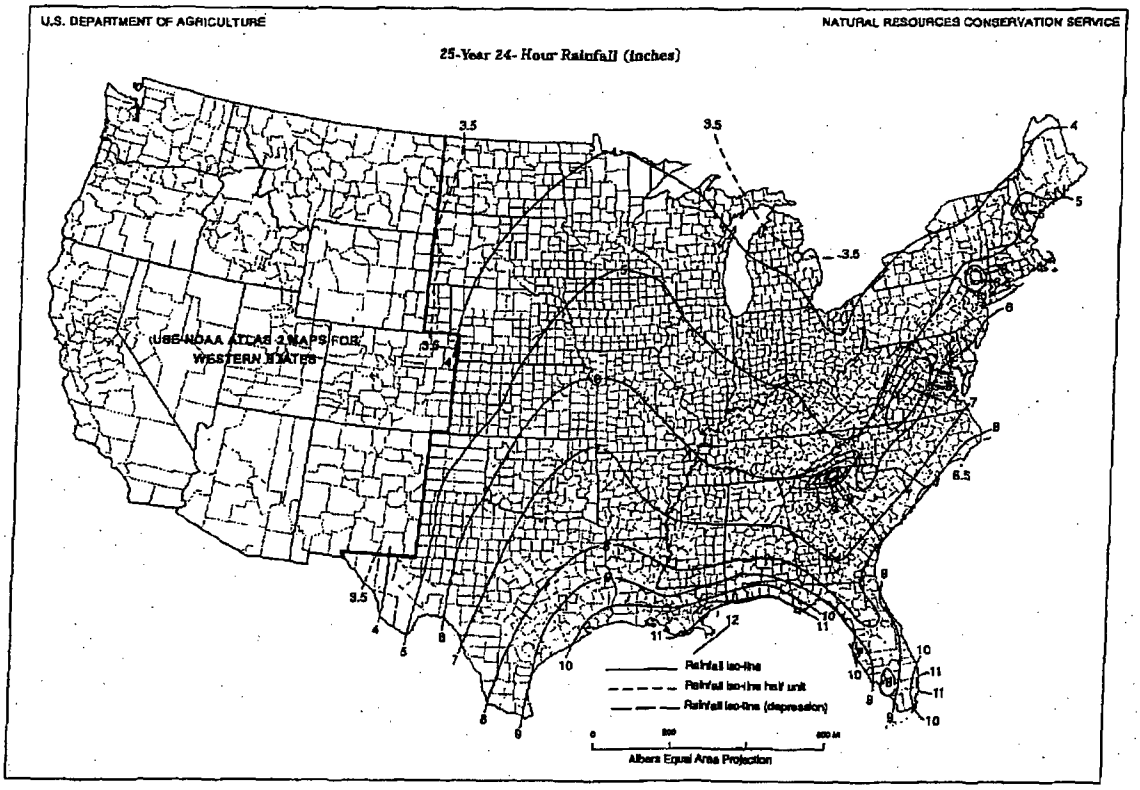


Figure B-6 25-year, 24-hour rainfall



WVDP Annual/Daily Maximum Rain Fall Data
Period: 1990-2007

	1990 (Inches)	1991 (Inches)	1992 (Inches)	1993 (Inches)	1994 (Inches)	1995 (Inches)	1996 (Inches)	1997 (Inches)	1998 (Inches)	1999 (Inches)	2000 (Inches)	2001 (Inches)	2002 (Inches)	2003 (Inches)	2004 (Inches)	2005 (Inches)	2006 (Inches)	2007 (Inches)
Yearly Total	26.64	32.76	48.63	37.35	40.13	34.17	44.89	43.23	42.76	30.97	38.05	31.02	39.96	40.99	43.21	38.52	45.06	3.55
Daily Maximum	1.84	1.45	1.64	1.43	1.90	1.22	1.57	1.70	3.75	1.86	1.47	1.40	1.33	1.39	1.99	2.25	1.56	0.83

- USED TO CALCULATE TO 25 YR STORM RAINFALL AMOUNT

Don McMahon

From: "KK Gupta" <KK.Gupta@wvnsco.com>
To: <ckeipper@butlerstc.com>; <dmcmahon@mmce.net>
Cc: "Chris Avery" <Chris.Avery@wvnsco.com>
Sent: Monday, May 21, 2007 1:59 PM
Attach: TA Out Fall W06 Calculations.pdf
Subject: SDA Cal for out fall W06

Chuck:

Attached is NYSERDA SPDES outfall W06 Calculations. Use this information for developing bypass line around basin 2. I will issue this information via TA.

K. K. Gupta, Fellow Engineer
WVNSCO

- THIS IS INFORMATION USED FOR SUBAREA #4

Drainage Area 06 and Outfall WNSTM06

Drainage Area 06 encompasses 0.56 acres located on the western side of the southern set of SDA trenches. Drainage Area 06 is grass covered with some gravel fill. Snow melt and storm water in Drainage Area 06 is conveyed to the north via sheet flow and a shallow channel which leads to a 12-inch CMP which is used to convey the storm water discharge from the area, under a site roadway, to Outfall WNSTM06 (see Photograph 2-18 and 2-19) in DOE Drainage Area 20. Storm water is not detained prior to discharge to the outfall.

The outfall discharge pipe discharges storm water to a grassed channel into DOE Drainage Area SO-20 (see Photograph 2-20) where it combines with storm water discharges from DOE Outfall SO-18 (upstream). DOE Outfall SO-20 discharges to Erdman Brook.

U.S. EPA Form 2F, Item VII, Part D - Outfall WNSTM06

1. Date of Storm Event	2. Duration of Storm Event (Minutes)	3. Total Rainfall During The Storm Event(Inches)	4. Number of Hours between the beginning of the storm and the end of the previous rain event	5. Maximum Flow Rate During the Storm Event, gallons per minute (gpm)	6. Total Flow from the Rain Event
8/11/95	135 minutes	0.54 inches	143.25 hours	16 gpm	2200 gallons

Part D, Item 7 for Outfall WNSTM06:
Part D, Items 1, 2, 3, and 4 were obtained from the actual storm event data for a monitoring event at former storm water discharge Outfall SO-19.
Item no. 5, maximum flow rate was estimated as follows:

Maximum flow rate = (Total flow identified in Part D, Item No. 6)/(Duration identified in Part D. Item No.2)
= (2200 gallons)/(135 minutes)
= 16.30gallons per minute (gpm)

Rounded to two(2) significant figures = 16 gpm.

Item No.6 (i.e., total flow) was estimated as follows:

R = (C)(P)

P = Precipitation 0.54 in(1 ft/12 in.) 0.045 ft.

R = Total rainfall excess, in ft.

C = Run-off coefficient estimated as follows:

= 0.90 for impervious area (concrete, pavement, etc.)

= 0.25 for impervious area (gravel, #3 stone and smaller, and unimproved areas)

Rainfall excess:
Impervious Area: R = (0.90)(0.045 ft) = 0.0405 ft

Pervious Area: R = (0.25)(0.045 ft) = 0.01125 ft
From Attachment 2-1 for Outfall WNSTM06,

Impervious Area 0.02 acres = 871.2 sq. ft.

Pervious Area = 0.56 acres - 0.02 acres = 0.54 acres =23522 sq. ft.

Total runoff flow (871.2 sq. ft.)(0.0405 ft.) + (23522.4 sq. ft.)(0.01125 ft.) = 35.28 cu. ft. + 264.63 cu. ft = 299.91 cu. ft. = 2243.63 gallons.

Rounding is necessary to correspond to the limiting, two (2) significant figures identified for the run-off coefficients (i.e., C).

Therefore, Total flow = 2200 gallons.

SOIL SURVEY OF CATTARAUGUS COUNTY, NEW YORK

WVNSCO NDA Capping Project

Meters
0 35 70 140

Feet
0 100 200 400 600 800

WVNSCO NDA Capping Project

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
- Roads
- Rails
- Water
- Hydrography
- Oceans
- Escarpment, bedrock
- Escarpment, non-bedrock
- Gulley
- Levee
- Slope
- Blowout
- Borrow Pit
- Clay Spot
- Depression, closed
- Eroded Spot
- Gravel Pit
- Gravelly Spot
- Gulley
- Lava Flow
- Landfill
- Marsh or Swamp
- Miscellaneous Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Perennial Water
- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 17

Soil Survey Area: Cattaraugus County, New York
Spatial Version of Data: 3
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
3/28/1995

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend Summary

Cattaraugus County, New York

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
32A	Churchville silt loam, 0 to 3 percent slopes	30.6	50.8
32B	Churchville silt loam, 3 to 8 percent slopes	20.1	33.3
36	Canadice silty clay loam	1.2	2.0
75	Alden mucky silt loam	1.1	1.8
135E	Hudson silt loam, 25 to 35 percent slope	7.3	12.1

ATTACHMENT B-2

POST -DEVELOPMENT CONDITIONS

McMahon & Mann
Consulting Engineers, P.C.

BY AJN DATE 5/11/07 SUBJECT WWNG - NOA SHT. NO. 1 OF 13
CHKD. BY AJK DATE 6/5/07 CAP DESIGN JOB NO. 07-011
POST-CAP STORMWATER ANALYSIS

POST CAP STORMWATER ESTIMATE
- USE HYDROCAD SOFTWARE (2006)
- USDA - TR55 (JUNE 1986)

- ESTIMATE DRAINAGE AREAS TO ERDMAN BROOK (SEE ATTACHED FIGURE FOR SUBAREAS

- USE 25 YR. STORM EVENT P = 4.2" (ATTACHED FIGURE B-6 FROM TR55)
  - WWDP SITE SPECIFIC DATA SHOWS HIGHEST DAILY EVENT TO BE 3.75" (FROM 1990 - 2007), TR55 GIVES A HIGHER VALUE
  ∴ USE 4.2" FOR DESIGN

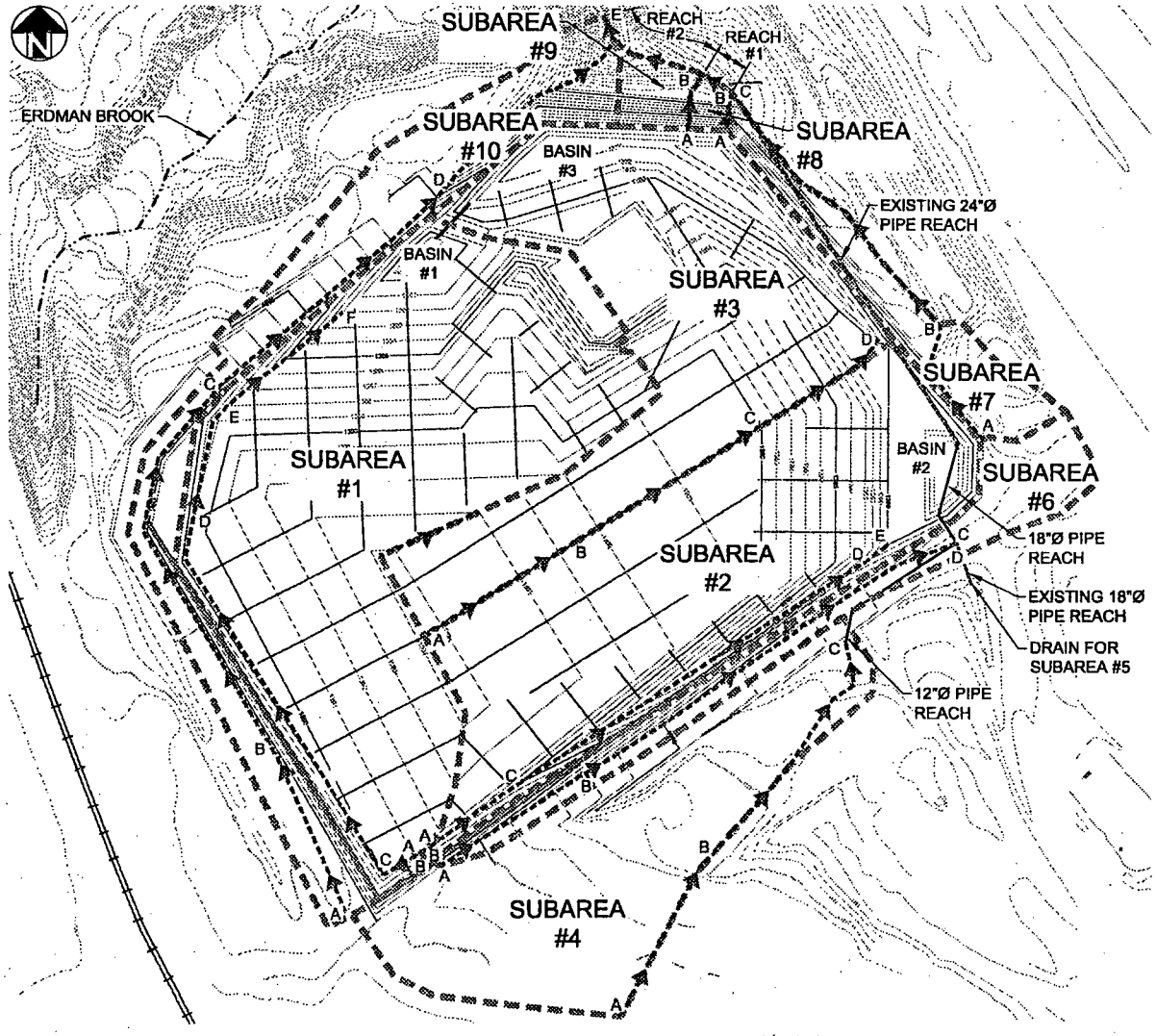
STORMWATER ROUTING RATIONAL,

- 3 - SUBAREAS ON CAP, EACH DRAIN TO A BASIN. THE BASINS THEN DRAIN TO EITHER A SECOND BASIN OR THROUGH A PIPE TO THE OUTSIDE OF THE CAP.
- 4 - SUBAREAS OUTSIDE THE CAP, THESE COLLECT WATER FROM OUTSIDE OF BERMS, BASIN DRAINS AND EVENTUALLY MEET AT ERDMAN BROOK. (SEE ATTACHED FIGURE)
- PRECAP STORMWATER ESTIMATE FOR THE SAME RAINFALL YIELDED

  Q = 24.07 CFS AT ERDMAN BROOK

  ∴ THESE CALCULATIONS WILL BE PREPARED TO LIMIT POST CAP RUNOFF TO THIS MAXIMUM FLOW.

  CALCULATIONS YIELD Q = 20.95 CFS < 24.07 CFS ∴ OK



LEGEND

- EXISTING GROUND CONTOURS
- SUBAREA BOUNDARY EXTENTS
- SURFACE WATER DRAINAGE PATH AND FLOW DIECTION

Note:

1. Base map adapted from a combination of drawings provided by West Valley Nuclear Services Co., Inc. titled "WVDP Site Map Well Locations", Dwg. No. 900-D-5000 Rev A dated May 26, 1992 and "NDA Topographic Plan", Sketch # SKKKG020607 Rev A dated February 19, 2007.

100' 0 50' 100'

SCALE: 1" = 100'

McMahon & Mann
Consulting Engineers, P.C.
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BUFFALO, NY 14214

NDA CAP AND GROUND WATER BARRIER CONSTRUCTION
WEST VALLEY NEW YORK

PROPOSED DRAINAGE AREAS

DWG. NO. 07011-052 | FIGURE 2

CAP SUBAREA #1 (NORTH AND WEST SIDES OF CAP)

AREA = 116,042 SF = 2.66 ACRES

CN = 98 (IMPERVIOUS)
-FROM TABLE 2-2a (TR55)

DRAINAGE PATH A

- A-B (SHEET FLOW)

LENGTH = 22 LF

SLOPE = (1391.25 - 1391)/2 = 12.5%

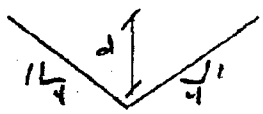
SMOOTH W/ n = 0.011 P_2 = 2.5" (24hr STORM)

- B-C (CHANNEL FLOW)

LENGTH = 37 LF

SLOPE = (1391 - 1390)/37 = 2.7%

ASSUMED X-SECTION



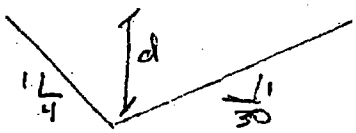
d x 1'
A = 4 SF
WP = 8.2'
n = 0.011 (SMOOTH)

- C-D (CHANNEL FLOW)

LENGTH = 357 LF

SLOPE = (1390 - 1384)/357 = 0.28%

ASSUMED X-SECTION



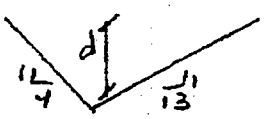
d x 1'
A = 17 SF
WP = 34.1'
n = 0.011 (SMOOTH)

- D-E (CHANNEL FLOW)

LENGTH = 104 LF

SLOPE = (1384 - 1380)/104 = 0.47%

ASSUMED X-SECTION



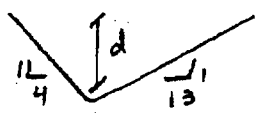
d x 1'
A = 8.5 SF
WP = 17.2'
n = 0.011 (SMOOTH)

• E - F (CHANNEL FLOW)

LENGTH = 129 LF

SLOPE = (1388 - 1382)/129 = 4.66 %

ASSUMED X-SECTION



d ≈ 2'
A = 34 SF
WP = 34.3'
n = 0.011 (SMOOTH)

CAP SUBAREA #2 (SOUTH SIDE OF CAP)

AREA = 82,170 SF = 1.89 ACRES

CN = 98 (IMPERVIOUS)
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

• A - B (SHEET FLOW)

LENGTH = 2 LF

SLOPE = (1391.25 - 1391)/2 = 12.5 %

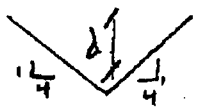
SMOOTH w/ n = 0.011 P2 = 2.5" (2YR STORM)

• B - C (CHANNEL FLOW)

LENGTH = 102 LF

SLOPE = (1491 - 1490)/102 = 1 %

ASSUMED X-SECTION



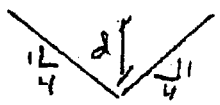
d ≈ 1'
A = 4 SF
WP = 8.2'
n = 0.011 (SMOOTH)

• C - D (CHANNEL FLOW)

LENGTH = 360 LF

SLOPE = (1390 - 1351)/360 = 2.5 %

ASSUMED X-SECTION



d ≈ 2'
A = 16 SF
WP = 16.5'
n = 0.011 (SMOOTH)

• D - E (CHANNEL FLOW)

LENGTH = 22 LF

SLOPE = (1381 - 1380) / 22 = 4.5%

ASSUMED X-SECTION

d ≈ 2'
A = 16 SF
WP = 16.5'
n = 0.011 (SMOOTH)

CAP SUBAREA # 3 (NORTH AND EAST SIDES OF CAP)

AREA = 75,463 SF = 1.73 ACRES

CN = 98 (IMPERVIOUS)
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

• A - B (SHEET FLOW)

LENGTH = 150 LF

SLOPE = (1394.22 - 1392.35) / 150 = 1.2%

SMOOTH w/n = 0.011 P_2 = 2.5" (24 HR STORM)

• B - C (SHALLOW CONCENTRATED FLOW)

LENGTH = 193 LF

SLOPE = (1392.35 - 1390) / 193 = 1.2%

PAVED SURFACE

• C - D (SHALLOW CONCENTRATED FLOW)

LENGTH = 130 LF

SLOPE = (1390 - 1378) / 130 = 8.5%

PAVED SURFACE

EXTERIOR SUBAREA #4 (SOUTH AREA DRAINS TO 12" Ø PIPE)

AREA = 56,320 SF = 1.29 ACRES

DRAINAGE PATH

• A-B (SHEET FLOW)

CN = 80
- FROM TABLE 2-2a (TR-55)

LENGTH = 150 LF

SLOPE = (1391 - 1385.75)/150 = 3.5%

SHORT GRASS W/n = 0.15 P_2 = 2.5" (24HR STORM)

• B-C (SHALLOW CONCENTRATED FLOW)

LENGTH = 241 LF

SLOPE = (1385.75 - 1379.5)/241 = 2.6%

UNPAVED SURFACE

• C-D (PIPE FLOW)

12" Ø AT 0.5% (SMOOTH WALL)

136 LF

INV. 1379.5 (START)

INV. 1378.82 (END)

TREAT THIS AS A REACH

EXTERIOR SUBAREA #5 (FROM SDA)

- LIMITED INFO FOR THIS, WVNSCO STATES THAT IT HAS:

AREA = 0.56 ACRES

CN = 98) ASSUMED
- FROM TABLE 2-2a (TR-55)

• SHEET FLOW

LENGTH = 150 LF

SLOPE = 2%

SMOOTH W/n = 0.011 P_2 = 2.5" (24HR STORM)

• SHALLOW CONCENTRATED FLOW

LENGTH = 50 LF

SLOPE = 2%

PAVED SURFACE

* LENGTHS AND SLOPES ASSUMED BASED ON LIMITED INFO FOR DRAINAGE AREA

1 PIPE FLOW

18" DIA (CMP)

38 LF

INV. 1378.5 (START)

INV. 1378 (END)

TREAT THIS AS A REACH

SLOPE = (1378.5 - 1378)/38 = 1.3%

EXTERIOR SUBAREA #6 (SOUTH AREA ALONG EDGE OF CAP)

AREA = 20,530 SF = 0.47 ACRES

CN = 90
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

- A - B (SHEET FLOW)
  LENGTH = 150 LF
  SLOPE = (1391 - 1387)/150 = 2.7%
  SMOOTH w/n = 0.011 P_2 = 2.6" (24HR STORM)

- B - C (SHALLOW CONCENTRATED FLOW)
  LENGTH = 380 LF
  SLOPE = (1387 - 1381)/380 = 1.6%
  UNPAVED SURFACE

EXTERIOR SUBAREA #7 (EAST SIDE)

AREA = 14,723 SF = 0.34 ACRES

CN = 80
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

- A - B (SHEET FLOW)

LENGTH = 117 LF

SLOPE = (1381 - 1378)/117 = 2.6%

SHORT GRASS w/ n = 0.15 P_2 = 2.5" (24H STORM)

- B - C (CHANNEL FLOW)

LENGTH = 273 LF

SLOPE = (1378 - 1366)/273 = 4.4%

ASSUMMED X - SECTION

d ≈ 3' MIN
A = 36 SF
WP = 24.94'
n = 0.03 (RIP-RAP)

EXTERIOR SUBAREA #8 (NORTH SIDE, FROM 24" OUTLET TO BASIN #3 OUTLET)

AREA = 1378 SF = 0.032 ACRES

CN = 80
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

- A - B (SHEET FLOW)

LENGTH = 33 LF

SLOPE = (1379 - 1366)/33 = 39%

SHORT GRASS w/ n = 0.15 P_2 = 2.5" (24H STORM)

EXTERIOR SUBAREA #9 (NORTH SIDE, FROM BASIN #3 OUTLET TO FINAL REACH)

AREA = 37675 SF = 0.086 ACRES

CN = 80
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

- A-B (SHEET FLOW)

LENGTH = 50 LF

SLOPE = (1379 - 1364.5)/50 = 29%

SHORT GRASS n/n = 0.15 P_2 = 2.5" (24HR STORM)

EXTERIOR SUBAREA #10 (NORTH SIDE)

AREA = 44,673 SF = 1.03 ACRES

CN = 80
- FROM TABLE 2-2a (TR55)

DRAINAGE PATH

- A-B (SHEET FLOW)

LENGTH = 150 LF

SLOPE = (1390 - 1380)/150 = 0.7%

SHORT GRASS n/n = 0.15 P_2 = 2.5" (24HR STORM)

- B-C (SHALLOW CONCENTRATED FLOW)

LENGTH = 367 LF

SLOPE = (1389 - 1388)/367 = 0.3%

UNPAVED SURFACE

· C-D (SHALLOW CONCENTRATED FLOW)

LENGTH = 260 LF

SLOPE = (1388 − 1379)/260 = 3.5 %

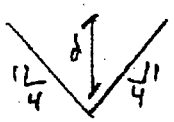
UNPAVED SURFACE

· D-E (CHANNEL FLOW)

LENGTH = 221 LF

SLOPE = (1374 − 1353.5)/221 = 11.5 %

ASSUMED X-SECTION



d ≈ 3' MIN
A = 36 SF
WP = 24.74'
n = 0.03 RIP-RAP

REACH FOR EXTERIOR AREAS #4, #5 AND #6

PIPE FLOW

18" ϕ (SMOOTH WALL)

93 LF

INV. 1378 (START)

INV. 1375.5 (END)

SLOPE = (1378 − 1375.5)/93 = 2.7%

REACH FOR EXTERIOR AREAS #4, #5 AND #6 COMBINED W/ BASIN #2 (CAD AREA #2)

PIPE FLOW

24" ϕ (SMOOTH WALL)

362 LF

INV. 1375.38 (START)

INV. 1366 (END)

SLOPE = (1375.38 − 1366)/362 = 2.6%

REACH FOR EXTERIOR AREAS #4, #5, #6, #7 AND #8 COMBINED W/BASIN #2 (REACH #1)

CHANNEL

LENGTH = 30LF

SLOPE = (1366 - 1364.5)/30 = 5%

ASSUMED X-SECTION

d ≈ 3' MIN
A = 36SF
WP = 24.74'

n = 0.03 (RIP-RAP)

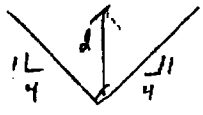
REACH FOR EXTERIOR AREAS #4, #5, #6, #7, #8 AND #4 COMBINED W/BASIN #2 AND #3 (REACH #2)

CHANNEL

LENGTH = 107LF

SLOPE = (1364.5 - 1353.5)/107 = 10.3%

ASSUMED X-SECTION



d ≈ 3' MIN
A = 36SF
WP = 24.74'
n = 0.03 (RIP-RAP)

By: A.J.N.
Date: 6/1/2007

WVNS - NDA Cap
Volume of Stormwater Basins

A. Basin #1- *Used AutoCad to trace contours and to obtain area*

Dwg. No.07011-006

Contour Elevation	Area (ft^2)	Change in Elevation (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
1379	562.59	0	0	0
1380	1726.40	1	1144.50	1144.50
1381	3591.33	1	2658.87	3803.36
1382	5810.35	1	4700.84	8504.20

B. Basin #2 - *Used AutoCad to trace contours and to obtain area*

Dwg. No.07011-006

Contour Elevation	Area (ft^2)	Change in Elevation (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
1377	985.63	0	0	0
1378	1613.91	1	1299.77	1299.77
1379	2372.02	1	1992.97	3292.74
1380	8153.48	1	5262.75	8555.49

C. Basin #3 - *Used AutoCad to trace contours and to obtain area*

Dwg. No.07011-006

Contour Elevation	Area (ft^2)	Change in Elevation (ft)	Volume (ft^3)	Cumulative Volume (ft^3)
1376	787.20	0	0	0
1377	4310.26	1	2548.73	2548.73
1378	9553.38	1	6931.82	9480.55
1379	13690.26	1	11621.82	21102.37

By: A.J.N.
Date: 6/1/2007

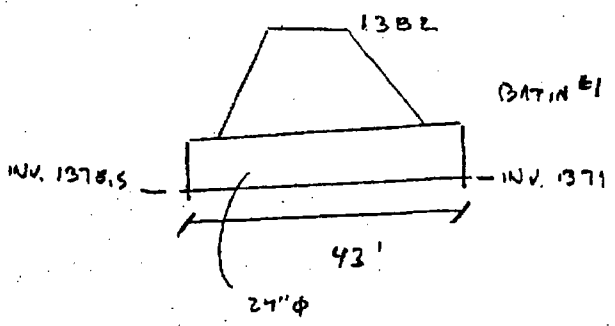
DETERMINE THE DISCHARGE THROUGH THE OVERFLOW PIPE

1. Esitimate the Discharge based on Full Pipe Flow for Basin #1

Use Bernoulli Equation - See Attached Sheet for Sample Calculation
See Attached Sketch for Layout and Components

g (ft/sec^2)= 32.174
d_{pipe} (ft) = 1.750 (I.D. FOR SDR17, 24"ϕ PIPE)
A_{pipe} (ft^2) = 2.40528
Pipe Outlet Ele = 1378.5
Pipe Length (ft) = 43.0
Ke (entrance) = 1.0
f = 0.011

ν = 1.41E-05
ε = 0.000005
ε / d = 0.000003



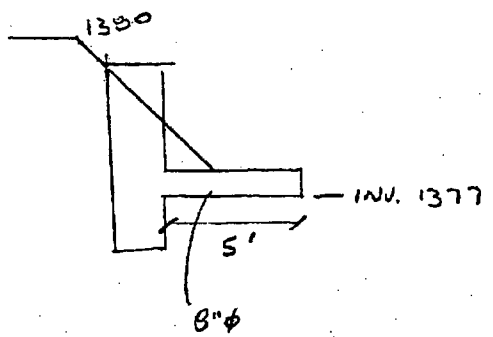
Discharge Elevation (ft)	ΔH (ft)	Q (cfs)	V (fps)	Re
1379.0	0.5	9.05	3.76	467231
1380.0	1.5	15.68	6.52	809267
1381.0	2.5	20.25	8.42	1044759
1382.0	3.5	23.96	9.96	1236176

2. Esitimate the Discharge based on Full Pipe Flow for Basin #2

Use Bernoulli Equation - See Attached Sheet for Sample Calculation
See Attached Sketch for Layout and Components

g (ft/sec^2)= 32.174
d_{pipe} (ft) = 0.630 (I.D. FOR SDR17, 8"ϕ PIPE)
A_{pipe} (ft^2) = 0.31172
Pipe Outlet Ele = 1375.4
Pipe Length (ft) = 5.0
Ke (entrance) = 1.0
f = 0.0146

ν = 1.41E-05
ε = 0.000005
ε / d = 0.000008



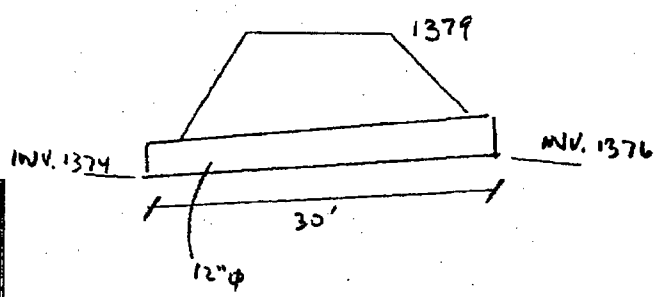
Discharge Elevation (ft)	ΔH (ft)	Q (cfs)	V (fps)	Re
1377.0	1.6	2.19	7.02	313618
1378.0	2.6	2.78	8.93	398836
1379.0	3.6	3.27	10.49	468812
1380.0	4.6	3.70	11.85	529621

3. Esitimate the Discharge based on Full Pipe Flow for Basin #3

Use Bernoulli Equation - See Attached Sheet for Sample Calculation
See Attached Sketch for Layout and Components

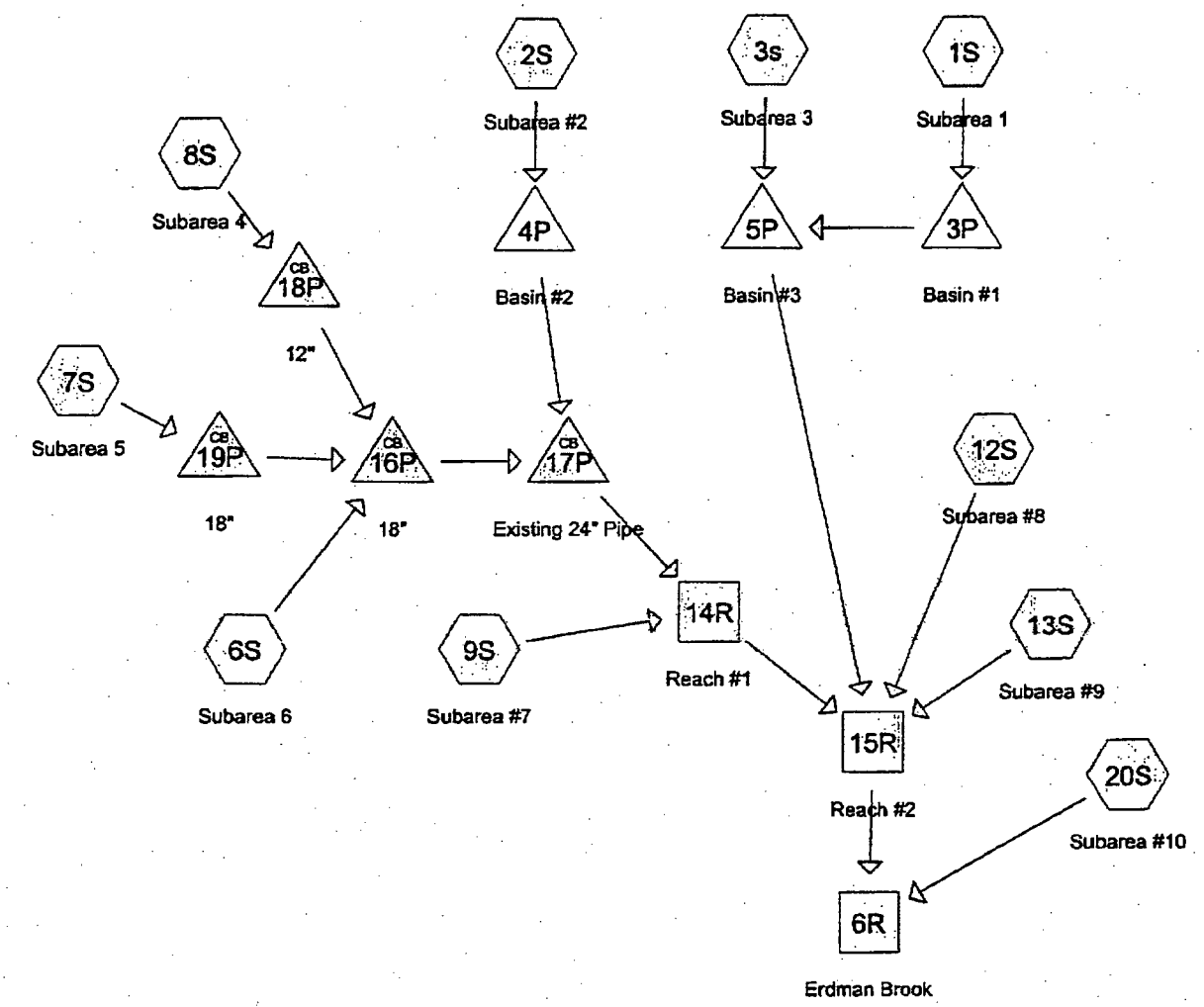
g (ft/sec^2)= 32.174
d_{pipe} (ft) = 0.930 (I.D. FOR SDR 12"ϕ PIPE
A_{pipe} (ft^2) = 0.67929
Pipe Outlet Ele = 1374.0
Pipe Length (ft) = 30.0
Ke (entrance) = 1.0
f = 0.012

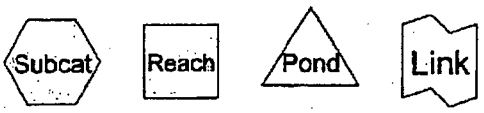
ν = 1.41E-05
ε = 0.000005
ε / d = 0.000005



Discharge Elevation (ft)	ΔH (ft)	Q (cfs)	V (fps)	Re
1376.0	2.0	4.99	7.34	484297
1377.0	3.0	6.11	8.99	593140
1378.0	4.0	7.05	10.38	684899
1379.0	5.0	7.89	11.61	765740

PROPOSED CONDITIONS
HYDROCAD RESULTS





Drainage Diagram for Proposed Conditions
Prepared by McMahon & Mann Consulting Engineers, P.C. 6/5/2007
HydroCAD® 7.10 s/n 003326 © 2005 HydroCAD Software Solutions LLC

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Subarea 1 Runoff Area=2.660 ac Runoff Depth=3.96"
Flow Length=629' Tc=1.6 min CN=98 Runoff=18.18 cfs 0.879 af

Subcatchment 2S: Subarea #2 Runoff Area=1.890 ac Runoff Depth=3.96"
Flow Length=486' Tc=0.5 min CN=98 Runoff=13.27 cfs 0.624 af

Subcatchment 3s: Subarea 3 Runoff Area=1.730 ac Runoff Depth=3.96"
Flow Length=473' Tc=4.1 min CN=98 Runoff=10.96 cfs 0.572 af

Subcatchment 6S: Subarea 6 Runoff Area=0.470 ac Runoff Depth=3.11"
Flow Length=530' Tc=4.8 min CN=90 Runoff=2.57 cfs 0.122 af

Subcatchment 7S: Subarea 5 Runoff Area=0.560 ac Runoff Depth=3.96"
Flow Length=200' Tc=2.2 min CN=98 Runoff=3.76 cfs 0.185 af

Subcatchment 8S: Subarea 4 Runoff Area=1.290 ac Runoff Depth=2.21"
Flow Length=391' Tc=13.8 min CN=80 Runoff=3.84 cfs 0.237 af

Subcatchment 9S: Subarea #7 Runoff Area=0.340 ac Runoff Depth=2.21"
Flow Length=390' Tc=11.6 min CN=80 Runoff=1.09 cfs 0.063 af

Subcatchment 12S: Subarea #8 Runoff Area=0.032 ac Runoff Depth=2.21"
Flow Length=33' Tc=1.4 min CN=80 Runoff=0.15 cfs 0.006 af

Subcatchment 13S: Subarea #9 Runoff Area=0.086 ac Runoff Depth=2.21"
Flow Length=50' Tc=2.2 min CN=80 Runoff=0.39 cfs 0.016 af

Subcatchment 20S: Subarea #10 Runoff Area=1.030 ac Runoff Depth=2.21"
Flow Length=998' Tc=31.8 min CN=80 Runoff=1.90 cfs 0.190 af

Reach 6R: Erdman Brook Peak Depth=0.70' Max Vel=10.8 fps Inflow=20.95 cfs 2.893 af
n=0.030 L=5.0' S=0.2000 '/' Capacity=1,024.08 cfs Outflow=20.95 cfs 2.893 af

Reach 14R: Reach #1 Peak Depth=0.75' Max Vel=5.6 fps Inflow=12.69 cfs 1.231 af
n=0.030 L=30.0' S=0.0500 '/' Capacity=512.04 cfs Outflow=12.69 cfs 1.231 af

Reach 15R: Reach #2 Peak Depth=0.78' Max Vel=8.3 fps Inflow=20.38 cfs 2.703 af
n=0.030 L=107.0' S=0.1028 '/' Capacity=734.21 cfs Outflow=20.38 cfs 2.703 af

Pond 3P: Basin #1 Peak Elev=1,380.09' Storage=1,383 cf Inflow=18.18 cfs 0.879 af
Outflow=16.09 cfs 0.879 af

Pond 4P: Basin #2 Peak Elev=1,379.64' Storage=6,667 cf Inflow=13.27 cfs 0.624 af
Outflow=3.55 cfs 0.624 af

Pond 5P: Basin #3	Peak Elev=1,378.52' Storage=15,558 cf	Inflow=27.03 cfs	1.450 af
		Outflow=7.49 cfs	1.450 af
Pond 16P: 18"	Peak Elev=1,380.32'	Inflow=8.42 cfs	0.544 af
	18.0" x 93.0' Culvert	Outflow=8.42 cfs	0.544 af
Pond 17P: Existing 24" Pipe	Peak Elev=1,377.37'	Inflow=11.92 cfs	1.169 af
	24.0" x 362.0' Culvert	Outflow=11.92 cfs	1.169 af
Pond 18P: 12"	Peak Elev=1,382.11'	Inflow=3.84 cfs	0.237 af
	12.0" x 136.0' Culvert	Outflow=3.84 cfs	0.237 af
Pond 19P: 18"	Peak Elev=1,380.57'	Inflow=3.76 cfs	0.185 af
	18.0" x 38.0' Culvert	Outflow=3.76 cfs	0.185 af

Total Runoff Area = 10.088 ac Runoff Volume = 2.893 af Average Runoff Depth = 3.44"

Subcatchment 1S: Subarea 1

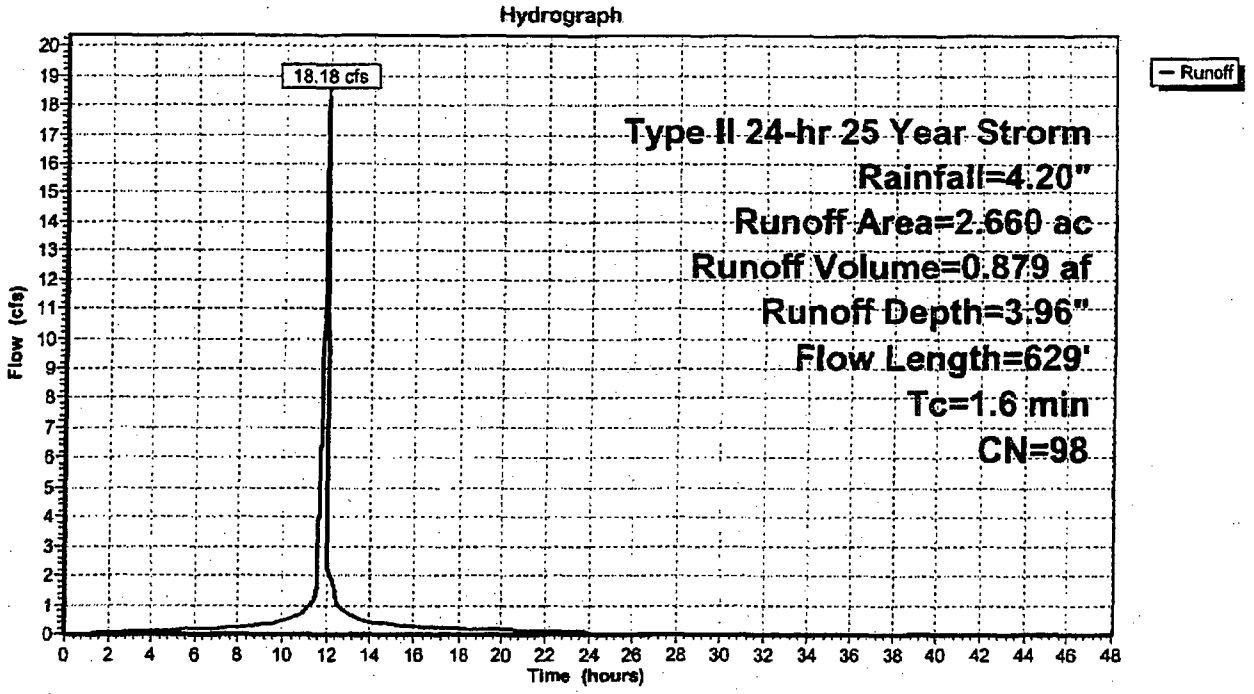
Runoff = 18.18 cfs @ 11.92 hrs, Volume= 0.879 af, Depth= 3.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
2.660	98	North and West Sides of Cap

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0	2	0.1250	1.2		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 2.50"
0.0	37	0.0270	13.8	55.02	**Channel Flow, B to C** Area= 4.0 sf Perim= 8.2' r= 0.49' n= 0.011
1.3	357	0.0028	4.5	76.40	**Channel Flow, C to D** Area= 17.0 sf Perim= 34.1' r= 0.50' n= 0.011
0.2	104	0.0097	8.3	70.69	**Channel Flow, D to E** Area= 8.5 sf Perim= 17.2' r= 0.49' n= 0.011
0.1	129	0.0466	29.0	985.72	**Channel Flow, E to F** Area= 34.0 sf Perim= 34.3' r= 0.99' n= 0.011
1.6	629	Total			

Subcatchment 1S: Subarea 1



Subcatchment 2S: Subarea #2

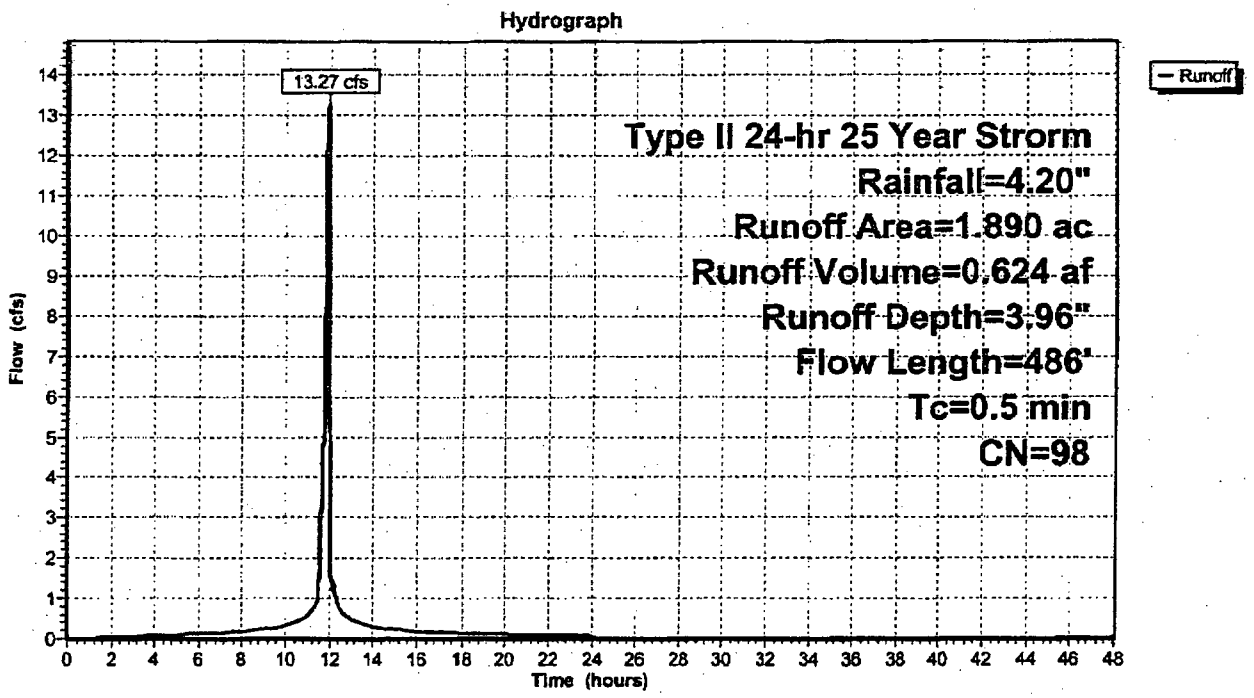
Runoff = 13.27 cfs @ 11.91 hrs, Volume= 0.624 af, Depth= 3.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
1.890	98	South Side of Cap

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.0	2	0.1250	1.2		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 2.50"
0.2	102	0.0100	8.4	33.48	**Channel Flow, B to C** Area= 4.0 sf Perim= 8.2' r= 0.49' n= 0.011
0.3	360	0.0250	20.9	334.82	**Channel Flow, C to D** Area= 16.0 sf Perim= 16.5' r= 0.97' n= 0.011
0.0	22	0.0450	28.1	449.20	**Channel Flow, D to E** Area= 16.0 sf Perim= 16.5' r= 0.97' n= 0.011
0.5	486	Total			

Subcatchment 2S: Subarea #2



Subcatchment 3s: Subarea 3

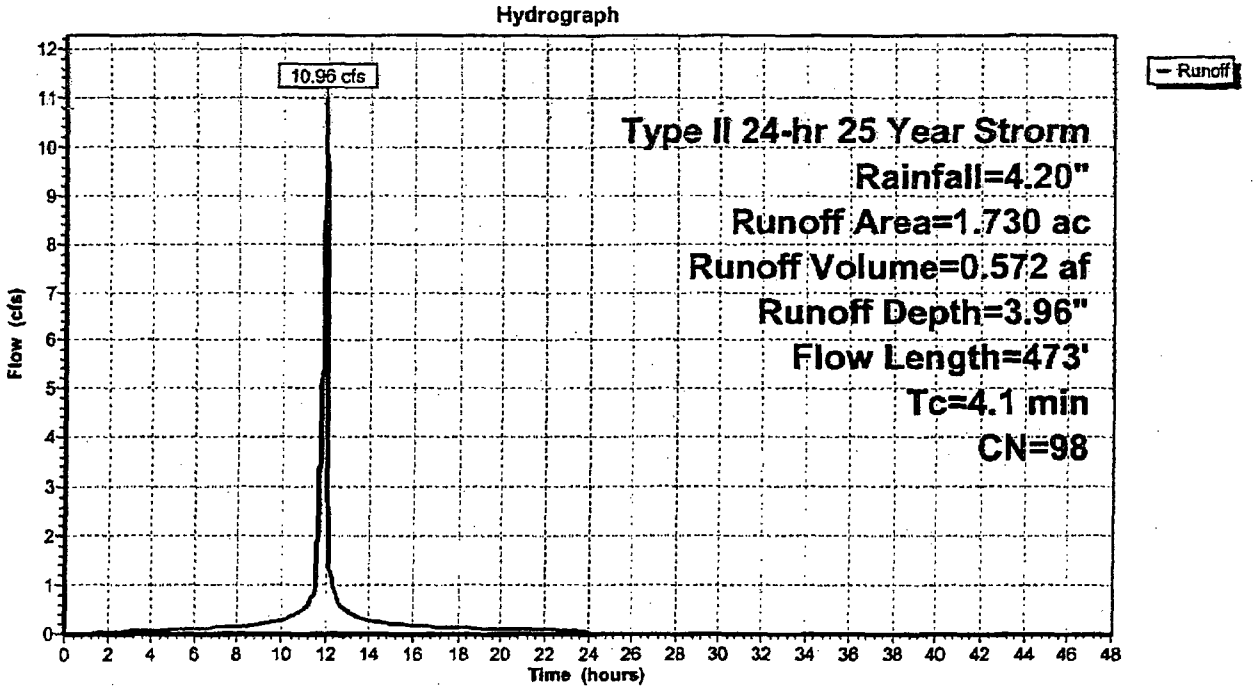
Runoff = 10.96 cfs @ 11.95 hrs, Volume= 0.572 af, Depth= 3.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
1.730	98	North and East Sides of Cap

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	150	0.0120	1.1		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 2.50"
1.4	193	0.0120	2.2		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
0.4	130	0.0850	5.9		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
4.1	473	Total			

Subcatchment 3s: Subarea 3



Subcatchment 6S: Subarea 6

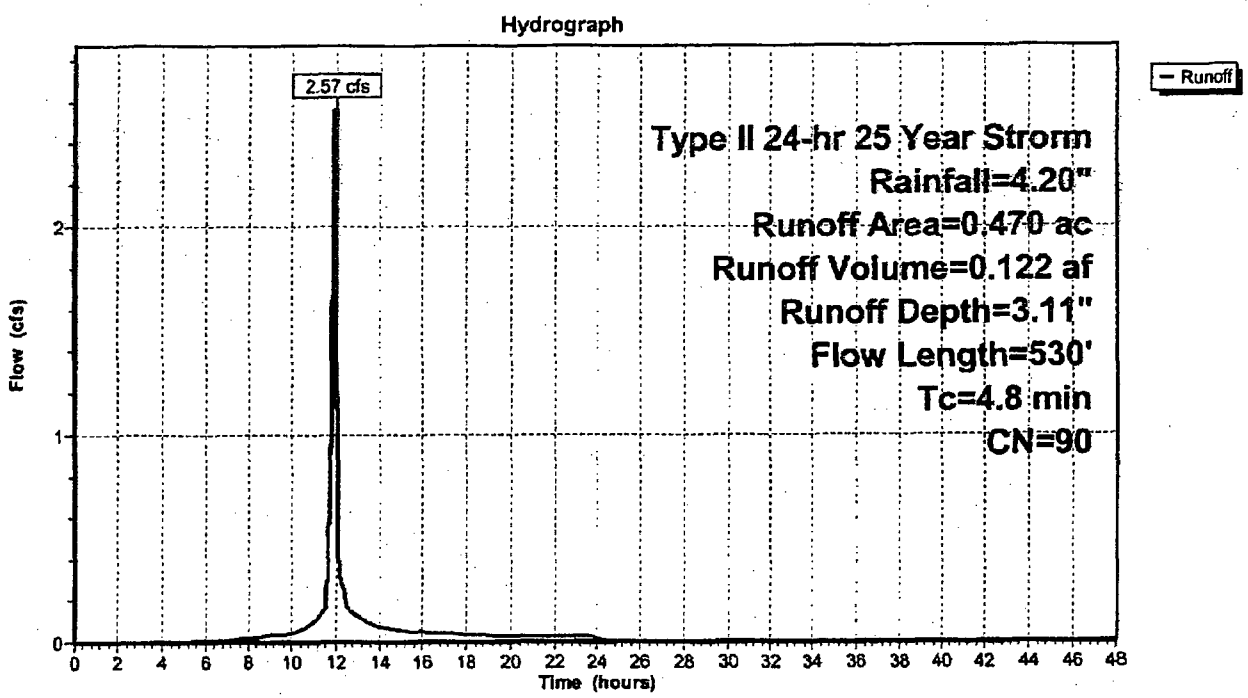
Runoff = 2.57 cfs @ 11.96 hrs, Volume= 0.122 af, Depth= 3.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
0.470	90	South area along edge of cap

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	150	0.0270	1.5		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 2.50"
3.1	380	0.0160	2.0		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
4.8	530	Total			

Subcatchment 6S: Subarea 6



Subcatchment 7S: Subarea 5

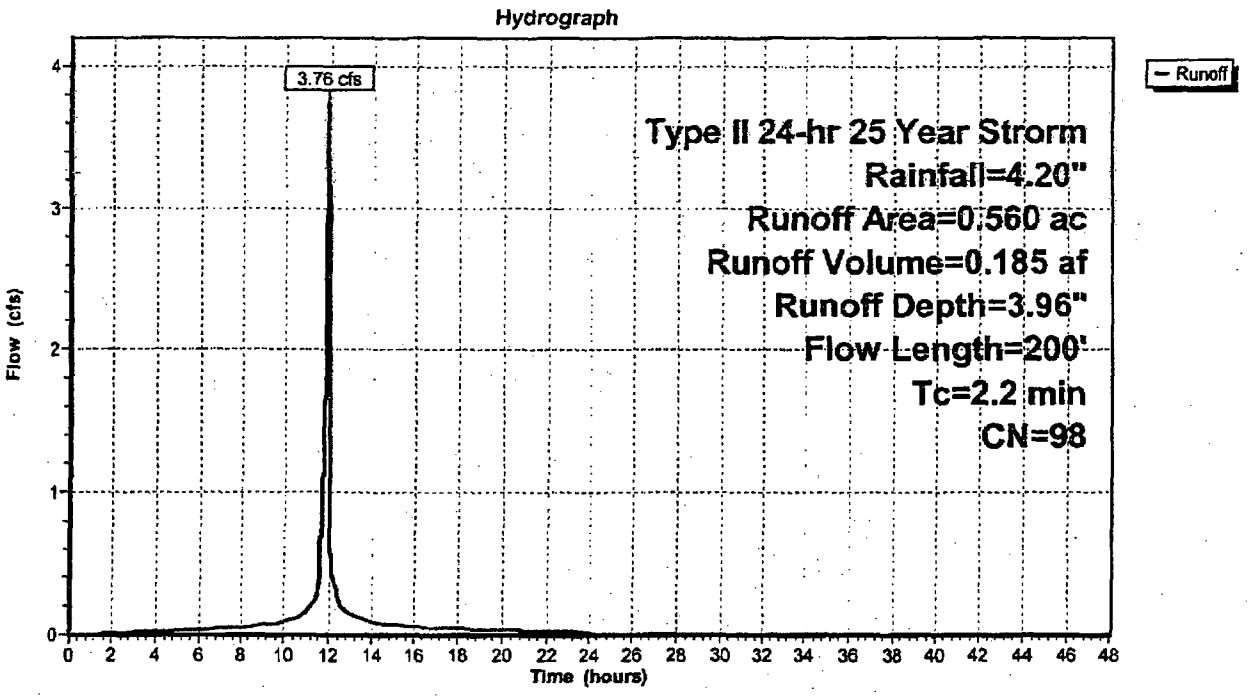
Runoff = 3.76 cfs @ 11.92 hrs, Volume= 0.185 af, Depth= 3.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
0.560	98	Area draing from SDA

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	150	0.0200	1.3		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 2.50"
0.3	50	0.0200	2.9		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
2.2	200	Total			

Subcatchment 7S: Subarea 5



Subcatchment 8S: Subarea 4

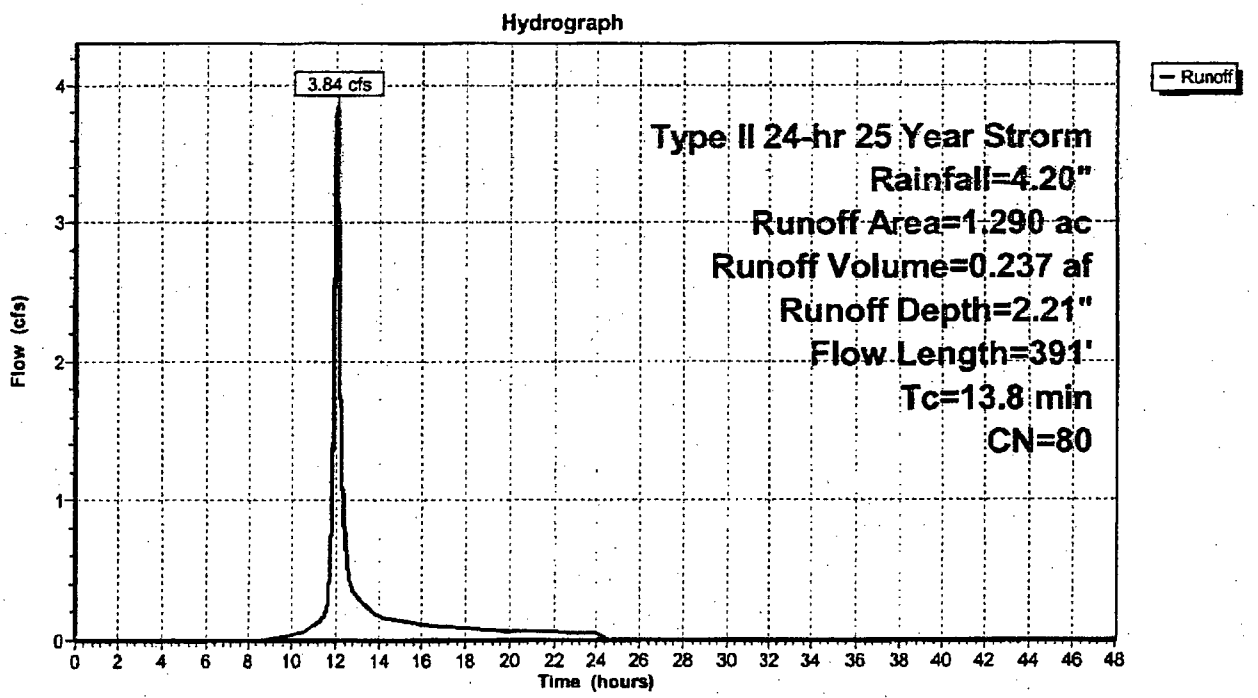
Runoff = 3.84 cfs @ 12.06 hrs, Volume= 0.237 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
1.290	80	South area draining to 12" pipe

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	150	0.0350	0.2		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
1.5	241	0.0260	2.6		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
13.8	391	Total			

Subcatchment 8S: Subarea 4



Subcatchment 9S: Subarea #7

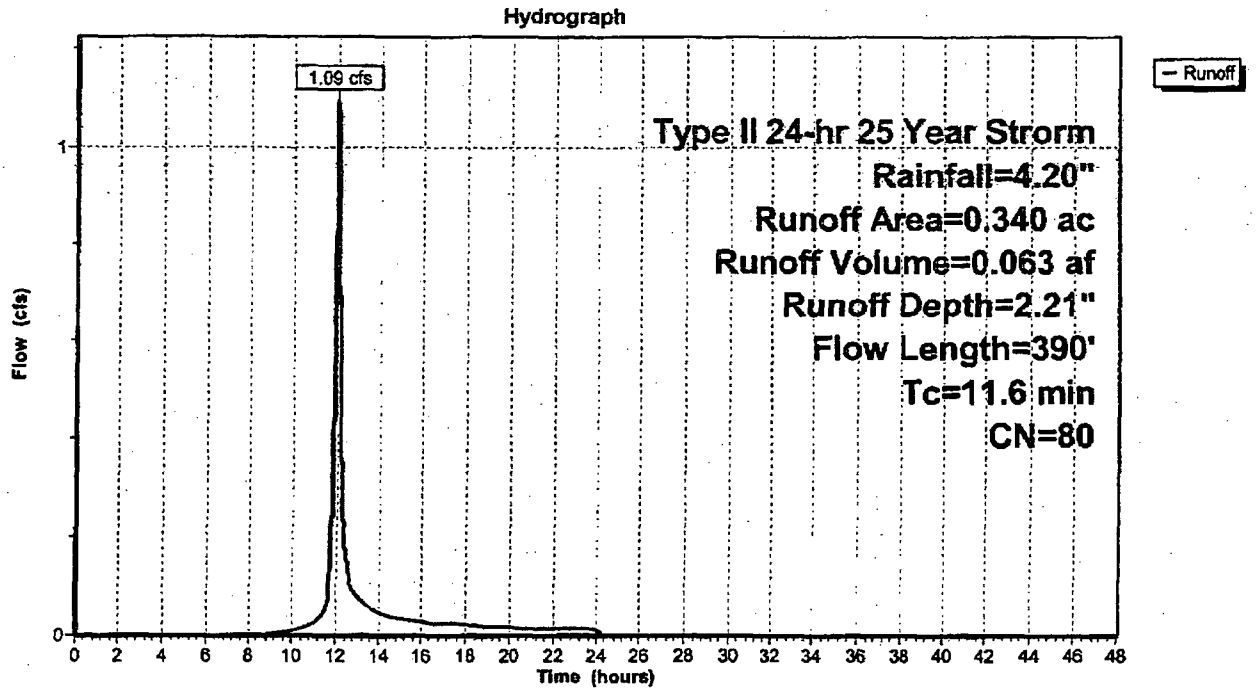
Runoff = 1.09 cfs @ 12.03 hrs, Volume= 0.063 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
0.340	80	Exterior east side of cap

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	117	0.0260	0.2		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
0.3	273	0.0440	13.4	480.84	**Channel Flow, B to C** Area= 36.0 sf Perim= 24.7' r= 1.46' n= 0.030
11.6	390	Total			

Subcatchment 9S: Subarea #7



Subcatchment 12S: Subarea #8

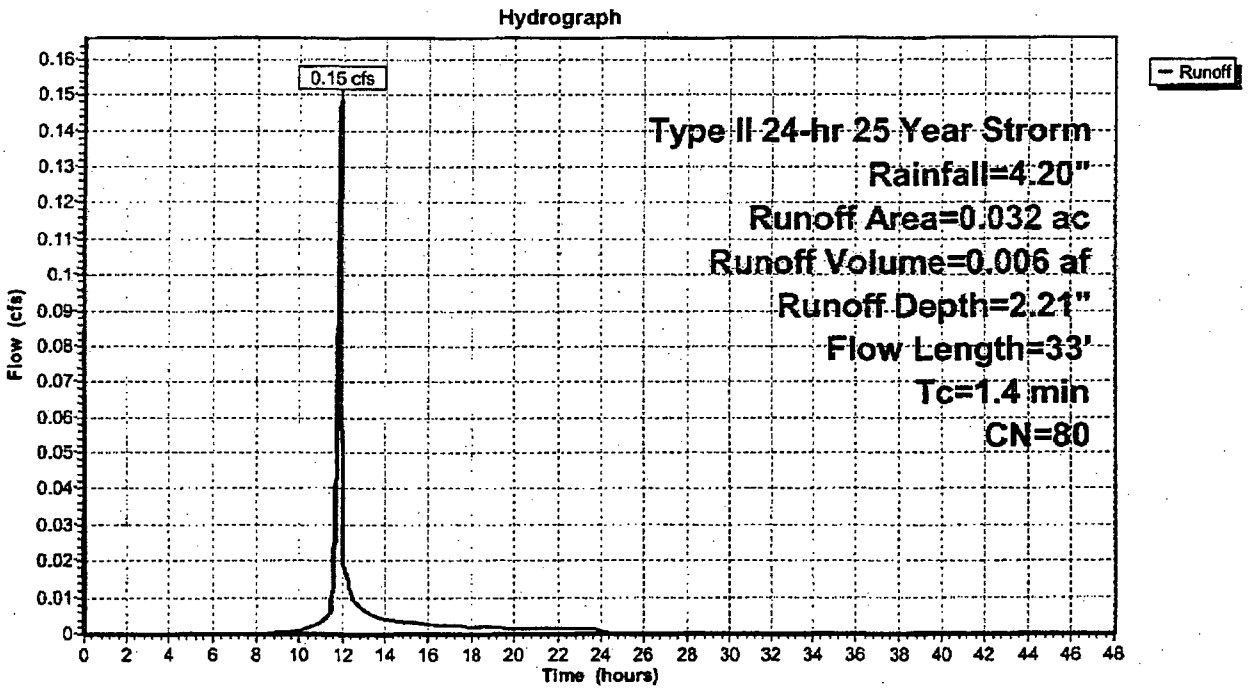
Runoff = 0.15 cfs @ 11.92 hrs, Volume= 0.006 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
0.032	80	Northside from 24" to Basin #3 outlet

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	33	0.3900	0.4		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"

Subcatchment 12S: Subarea #8



Subcatchment 13S: Subarea #9

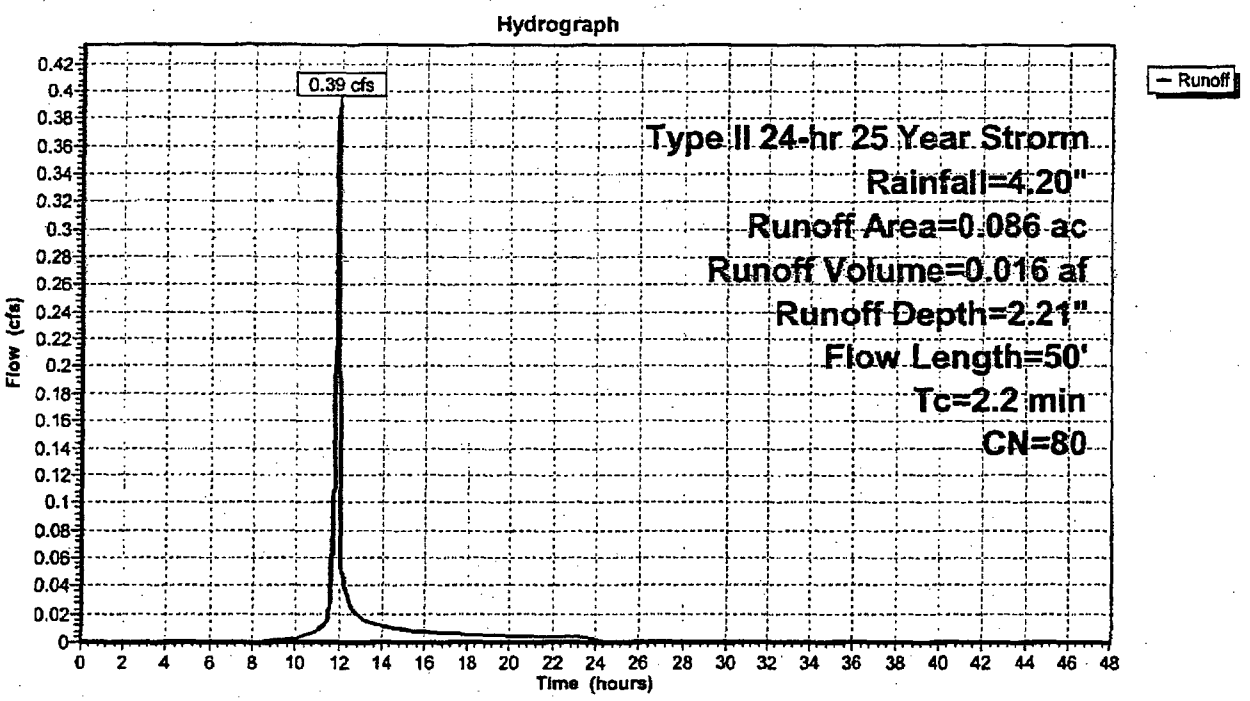
Runoff = 0.39 cfs @ 11.93 hrs, Volume= 0.016 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
0.086	80	Northside from Basin #3 outlet to final reach

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	50	0.2900	0.4		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"

Subcatchment 13S: Subarea #9



Subcatchment 20S: Subarea #10

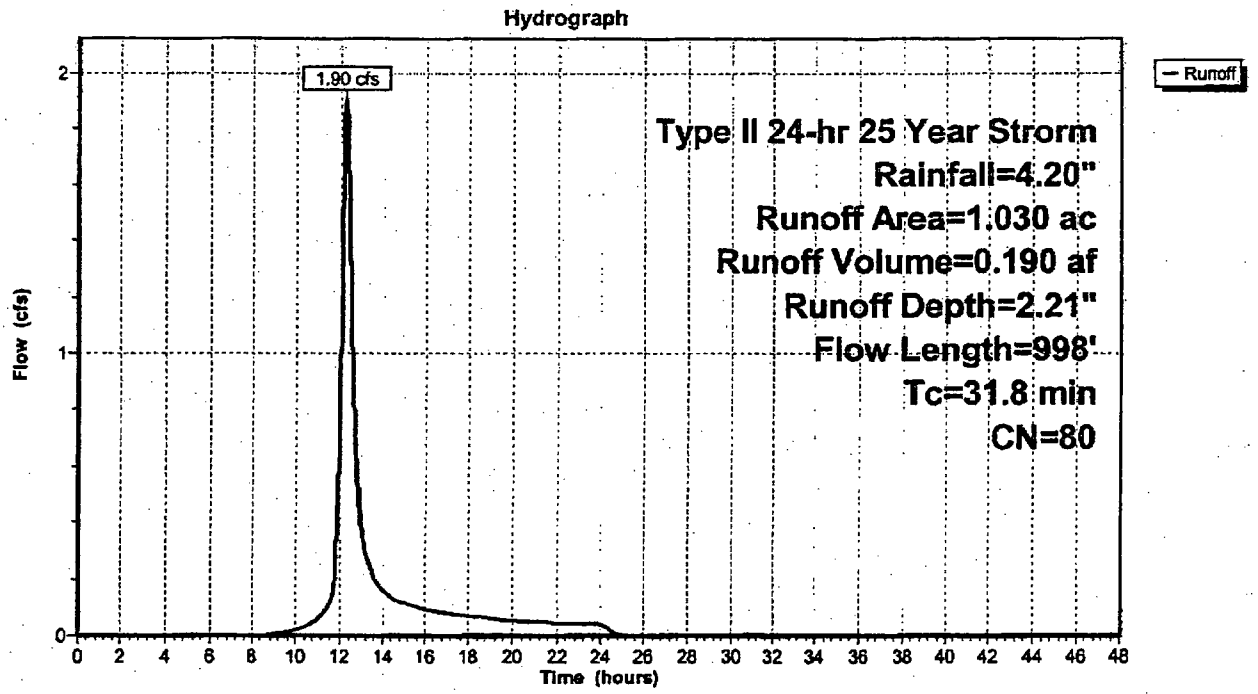
Runoff = 1.90 cfs @ 12.26 hrs, Volume= 0.190 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
1.030	80	Northside along edge of cap

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.3	150	0.0070	0.1		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
6.9	367	0.0030	0.9		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
1.4	260	0.0350	3.0		**Shallow Concentrated Flow, C to D** Unpaved Kv= 16.1 fps
0.2	221	0.1150	21.6	777.35	**Channel Flow, D to E** Area= 36.0 sf Perim= 24.7' r= 1.46' n= 0.030
31.8	998	Total			

Subcatchment 20S: Subarea #10



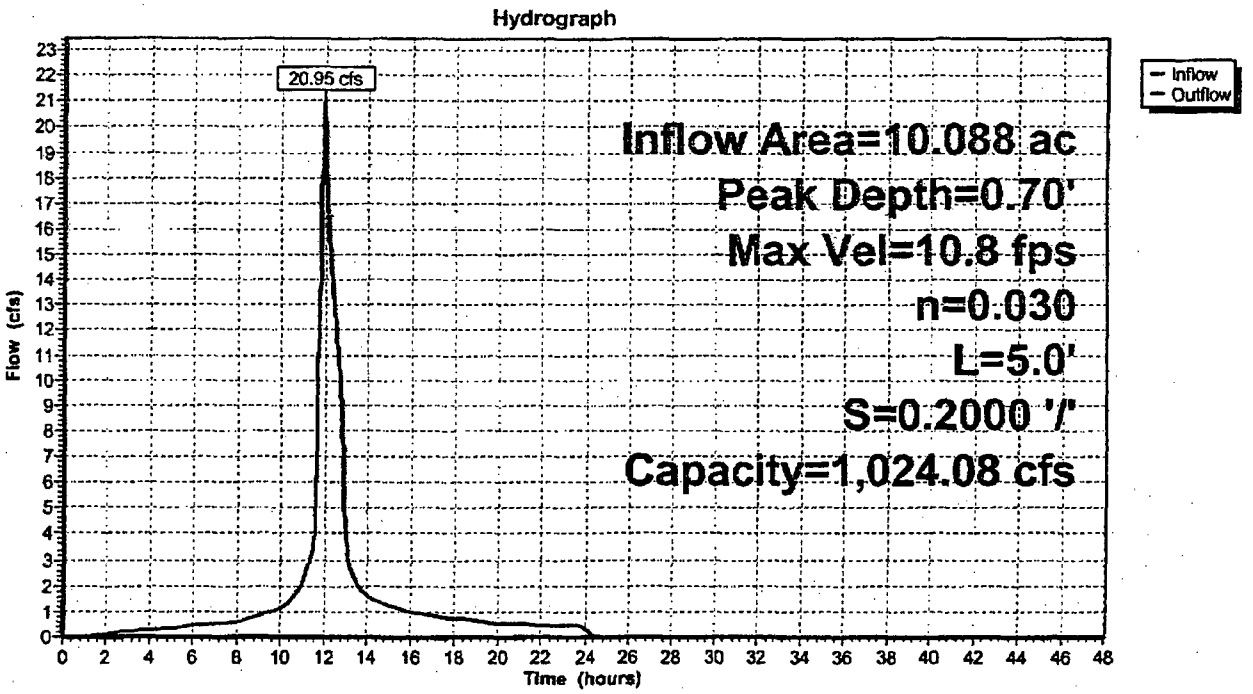
Reach 6R: Erdman Brook

Inflow Area = 10.088 ac, Inflow Depth = 3.44" for 25 Year Strorm event
Inflow = 20.95 cfs @ 11.96 hrs, Volume= 2.893 af
Outflow = 20.95 cfs @ 11.96 hrs, Volume= 2.893 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.8 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 4.6 fps, Avg. Travel Time= 0.0 min

Peak Depth= 0.70' @ 11.96 hrs
Capacity at bank full= 1,024.08 cfs
Inlet Invert= 1,353.50', Outlet Invert= 1,352.50'
0.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 '/' Top Width= 24.00'
Length= 5.0' Slope= 0.2000 '/'

Reach 6R: Erdman Brook



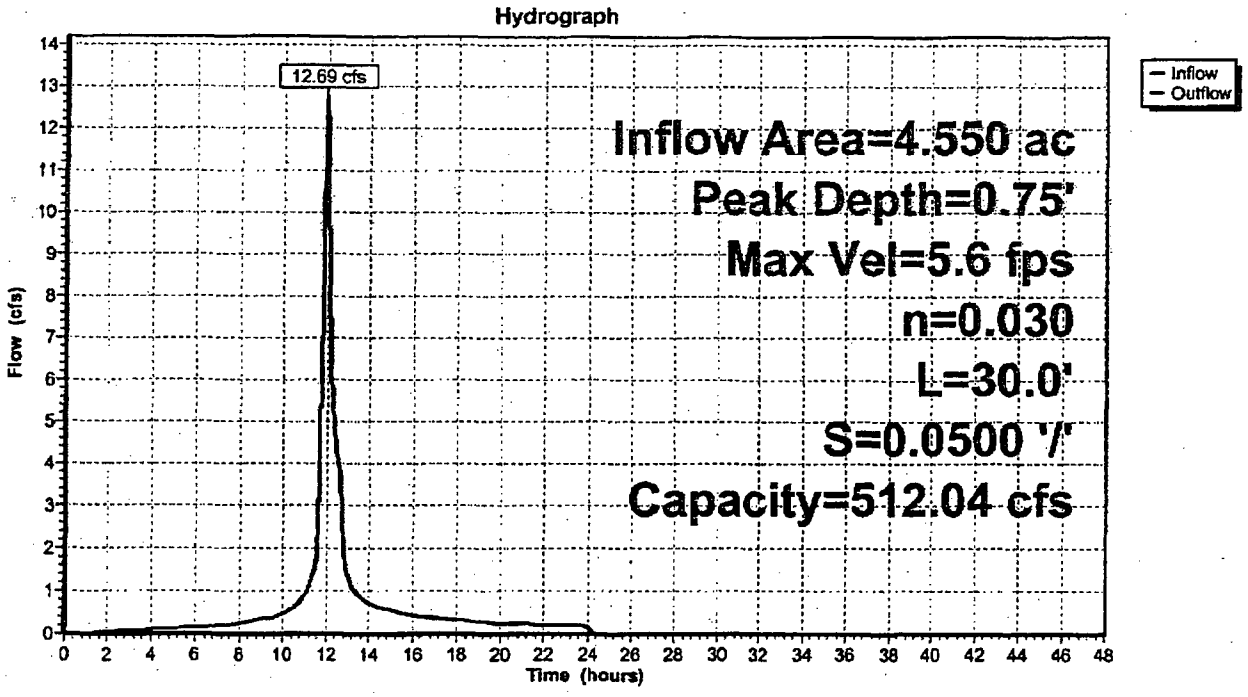
Reach 14R: Reach #1

Inflow Area = 4.550 ac, Inflow Depth = 3.25" for 25 Year Stroom event
Inflow = 12.69 cfs @ 11.95 hrs, Volume= 1.231 af
Outflow = 12.69 cfs @ 11.95 hrs, Volume= 1.231 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.6 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.2 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.75' @ 11.95 hrs
Capacity at bank full= 512.04 cfs
Inlet Invert= 1,366.00', Outlet Invert= 1,364.50'
0.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 '/' Top Width= 24.00'
Length= 30.0' Slope= 0.0500 '/'

Reach 14R: Reach #1



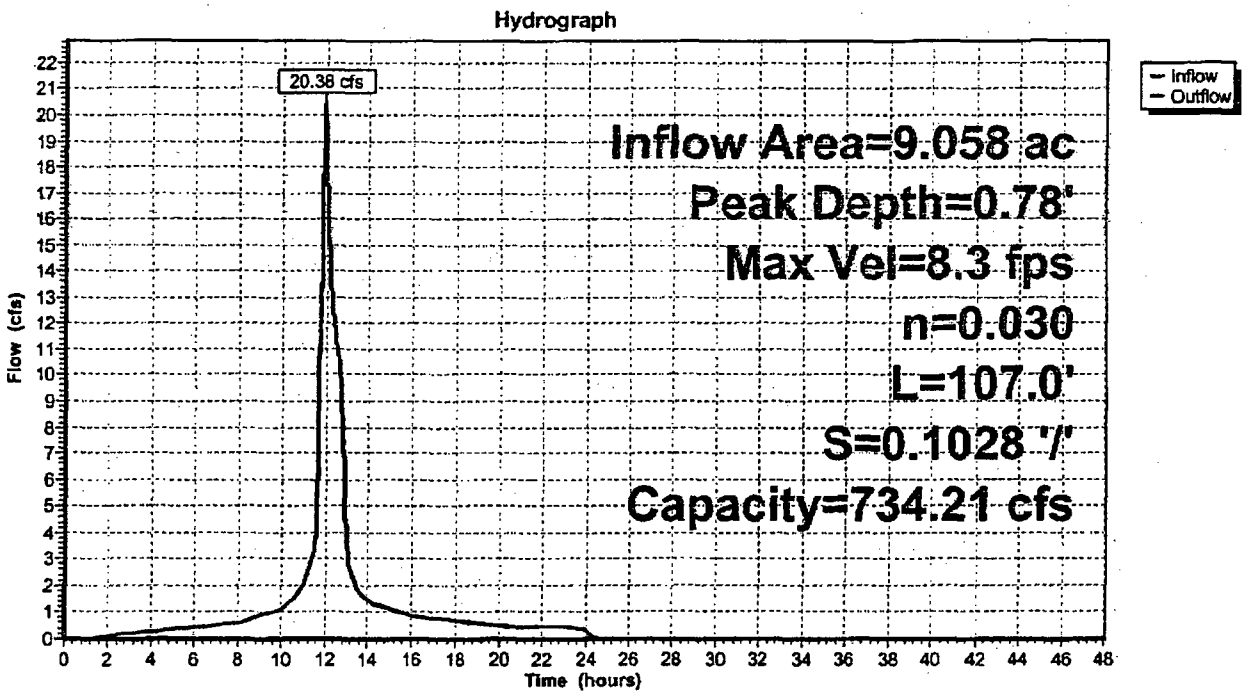
Reach 15R: Reach #2

Inflow Area = 9.058 ac, Inflow Depth = 3.58" for 25 Year Strorm event
Inflow = 20.38 cfs @ 11.95 hrs, Volume= 2.703 af
Outflow = 20.38 cfs @ 11.95 hrs, Volume= 2.703 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.3 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.6 fps, Avg. Travel Time= 0.5 min

Peak Depth= 0.78' @ 11.95 hrs
Capacity at bank full= 734.21 cfs
Inlet Invert= 1,364.50', Outlet Invert= 1,353.50'
0.00' x 3.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 '/' Top Width= 24.00'
Length= 107.0' Slope= 0.1028 '/'

Reach 15R: Reach #2



Pond 3P: Basin #1

Inflow Area =	2.660 ac,	Inflow Depth =	3.96"	for	25 Year Strorm event
Inflow =	18.18 cfs @	11.92 hrs,	Volume=	0.879 af	
Outflow =	16.09 cfs @	11.94 hrs,	Volume=	0.879 af,	Atten= 11%, Lag= 1.4 min
Primary =	16.09 cfs @	11.94 hrs,	Volume=	0.879 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,380.09' @ 11.94 hrs Surf.Area= 0 sf Storage= 1,383 cf
Plug-Flow detention time= 1.2 min calculated for 0.879 af (100% of inflow)
Center-of-Mass det. time= 1.2 min (744.2 - 743.0)

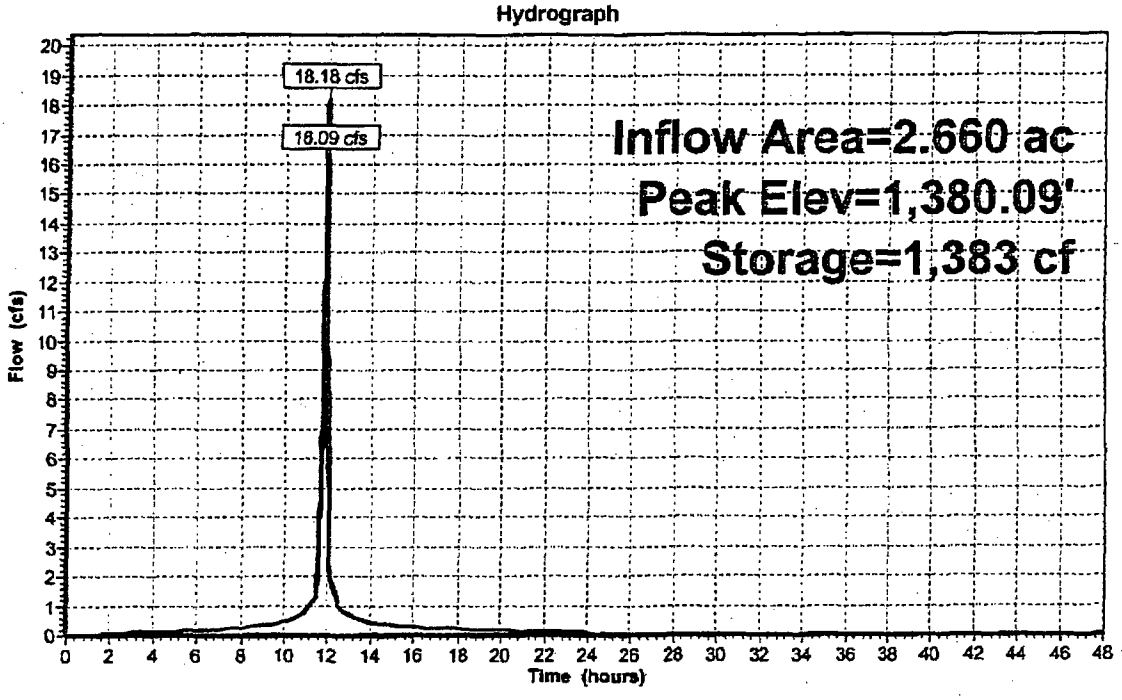
Volume	Invert	Avail.Storage	Storage Description
#1	1,379.00'	8,505 cf	**Custom Stage Data** Listed below

Elevation (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,379.00	0	0
1,380.00	1,145	1,145
1,381.00	2,659	3,804
1,382.00	4,701	8,505

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 1,379.00 1,380.00 1,381.00 1,382.00 Disch. (cfs) 0.000 15.680 20.250 23.960

Primary OutFlow Max=16.09 cfs @ 11.94 hrs HW=1,380.09' TW=1,378.14' (Dynamic Tailwater)
└─**1=Special & User-Defined** (Custom Controls 16.09 cfs)

Pond 3P: Basin #1



LESS THAN ELEV. 1382, ∴ NO OVERTOPPING DURING 25 YR STORM

Pond 4P: Basin #2

Inflow Area =	1.890 ac,	Inflow Depth =	3.96"	for	25 Year Stromm event
Inflow =	13.27 cfs @	11.91 hrs,	Volume=	0.624 af	
Outflow =	3.55 cfs @	11.99 hrs,	Volume=	0.624 af,	Atten= 73%, Lag= 5.2 min
Primary =	3.55 cfs @	11.99 hrs,	Volume=	0.624 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,379.64' @ 11.99 hrs Surf.Area= 0 sf Storage= 6,667 cf
Plug-Flow detention time= 13.0 min calculated for 0.624 af (100% of inflow)
Center-of-Mass det. time= 13.0 min (754.9 - 741.9)

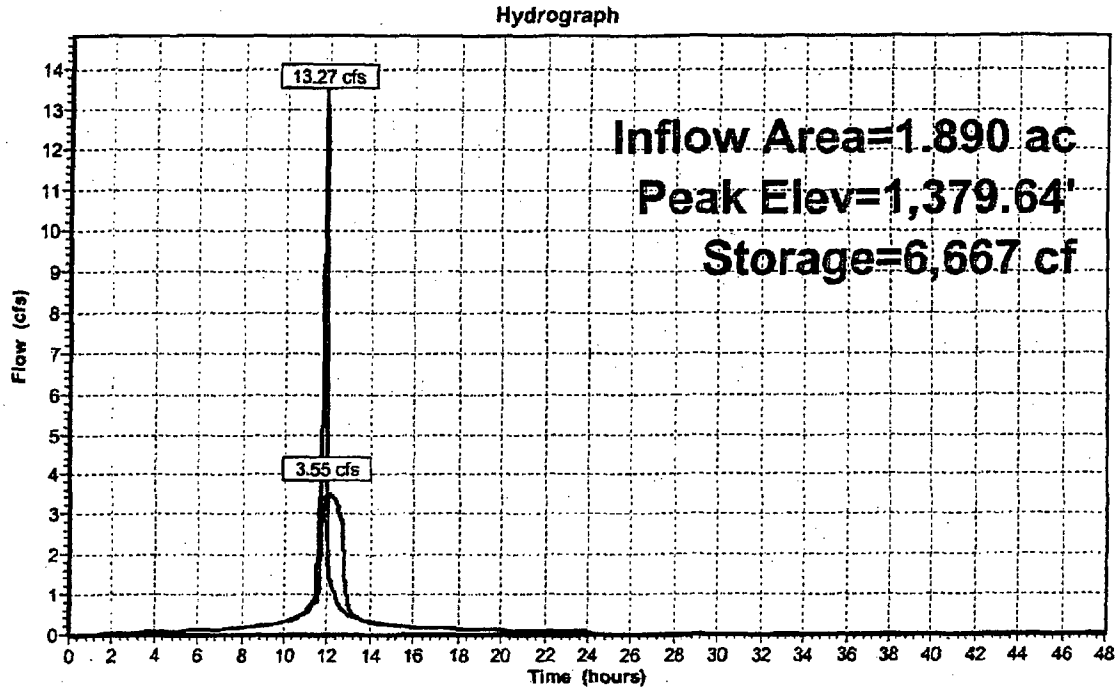
Volume	Invert	Avail.Storage	Storage Description
#1	1,377.00'	8,556 cf	**Custom Stage Data** Listed below

Elevation (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,377.00	0	0
1,378.00	1,300	1,300
1,379.00	1,993	3,293
1,380.00	5,263	8,556

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 1,377.00 1,378.00 1,379.00 1,380.00 Disch. (cfs) 0.000 2.780 3.270 3.700

Primary OutFlow Max=3.55 cfs @ 11.99 hrs HW=1,379.64' TW=1,377.21' (Dynamic Tailwater)
└─**1=Special & User-Defined** (Custom Controls 3.55 cfs)

Pond 4P: Basin #2



LESS THAN ELEV. 1380, ∴ NO OVERTOPPING DURING 25 YR STORM

Pond 5P: Basin #3

Inflow Area =	4.390 ac,	Inflow Depth =	3.96"	for	25 Year Strorm event
Inflow =	27.03 cfs @	11.94 hrs,	Volume=	1.450 af	
Outflow =	7.49 cfs @	12.05 hrs,	Volume=	1.450 af,	Atten= 72%, Lag= 6.1 min
Primary =	7.49 cfs @	12.05 hrs,	Volume=	1.450 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,378.52' @ 12.05 hrs Surf.Area= 0 sf Storage= 15,558 cf
Plug-Flow detention time= 13.6 min calculated for 1.450 af (100% of inflow)
Center-of-Mass det. time= 13.6 min (758.2 - 744.6)

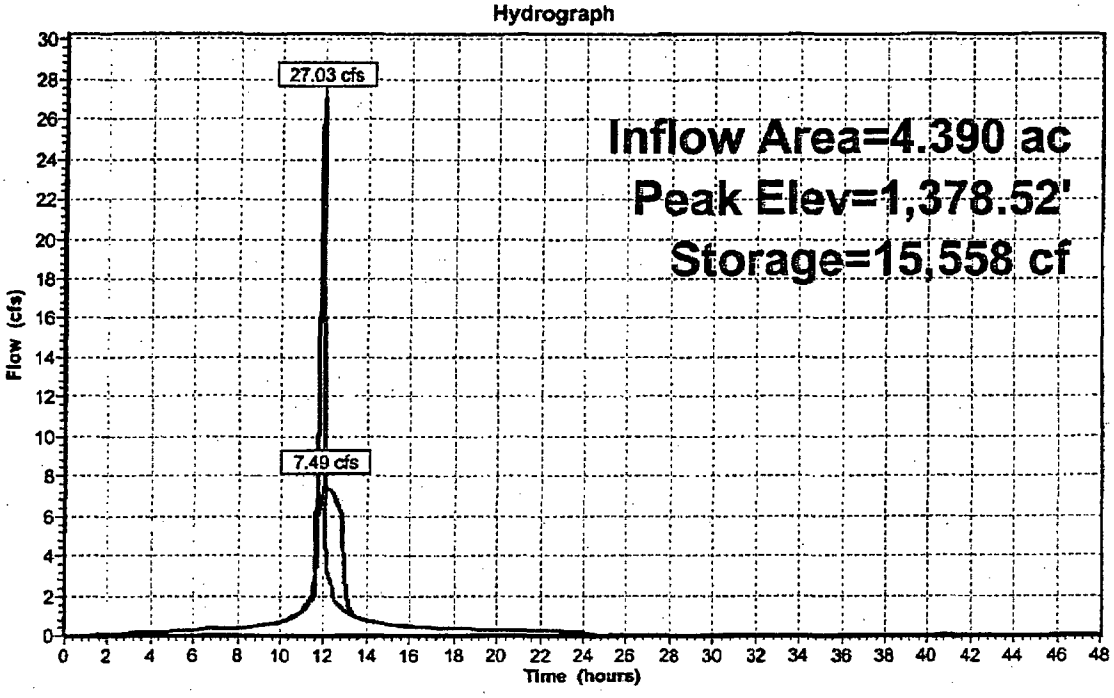
Volume	Invert	Avail.Storage	Storage Description
#1	1,376.00'	21,103 cf	**Custom Stage Data** Listed below

Elevation (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,376.00	0	0
1,377.00	2,549	2,549
1,378.00	6,932	9,481
1,379.00	11,622	21,103

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**Special & User-Defined** Elev. (feet) 1,376.00 1,377.00 1,378.00 1,379.00 Disch. (cfs) 0.000 6.110 7.050 7.890

Primary OutFlow Max=7.49 cfs @ 12.05 hrs HW=1,378.52' TW=1,365.24' (Dynamic Tailwater)
└─**1=Special & User-Defined** (Custom Controls 7.49 cfs)

Pond 5P: Basin #3



LESS THAN ELEV. 1379, ∴ NO OVERTOPPING DURING 25YR STORM

Pond 16P: 18"

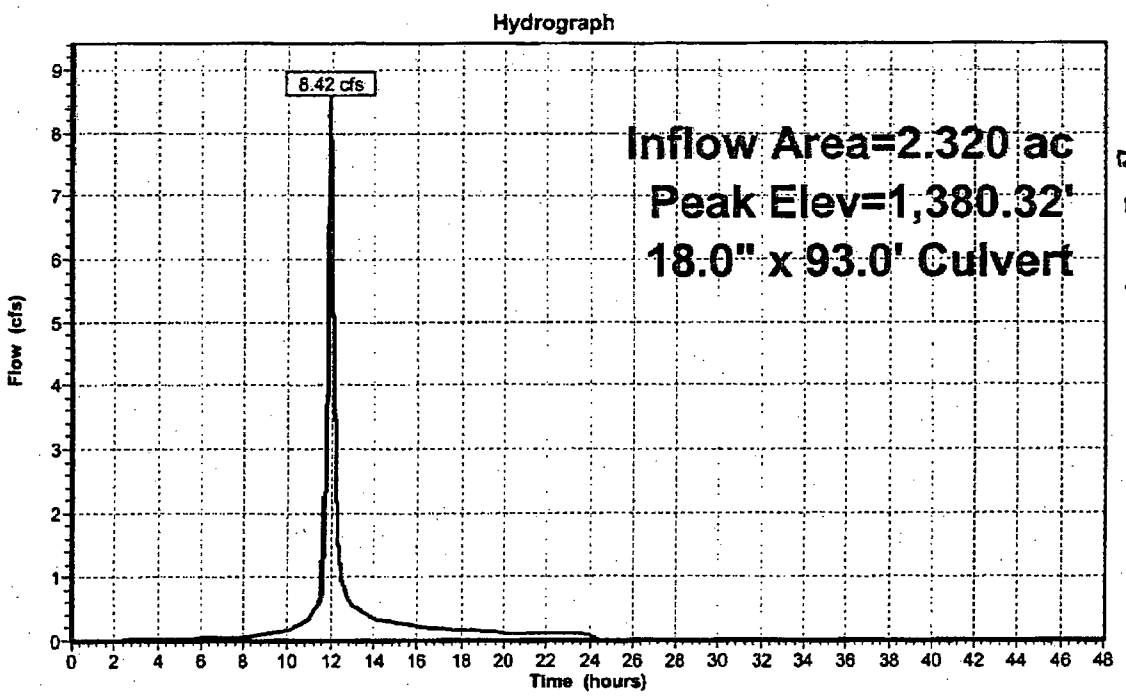
Inflow Area =	2.320 ac,	Inflow Depth =	2.81"	for	25 Year Strorm event
Inflow =	8.42 cfs @	11.94 hrs,	Volume=	0.544 af	
Outflow =	8.42 cfs @	11.94 hrs,	Volume=	0.544 af,	Atten= 0%, Lag= 0.0 min
Primary =	8.42 cfs @	11.94 hrs,	Volume=	0.544 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,380.32' @ 11.94 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (793.8 - 793.8)

Device	Routing	Invert	Outlet Devices
#1	Primary	1,378.00'	**18.0" x 93.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 1,375.50' S= 0.0269 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Primary OutFlow Max=8.40 cfs @ 11.94 hrs HW=1,380.31' TW=1,377.37' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 8.40 cfs @ 4.8 fps)

Pond 16P: 18"



ROADWAY IS AT ELEV 1381, ∴ NO OVERTOPPING DURING 25YR STORM

Pond 17P: Existing 24" Pipe

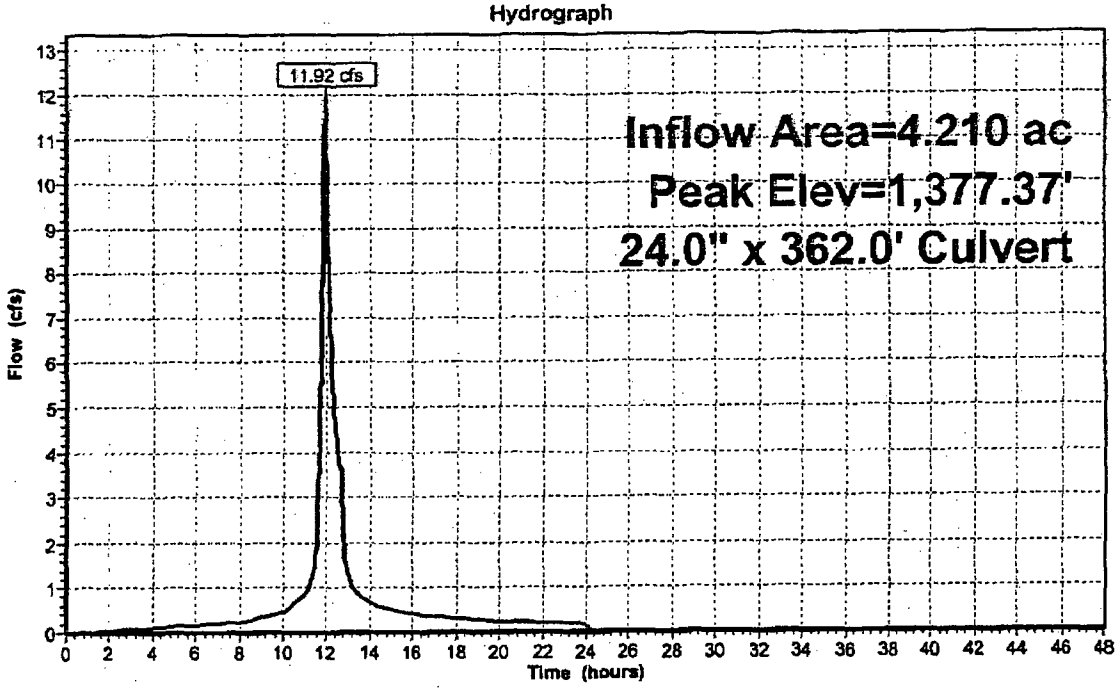
Inflow Area =	4.210 ac,	Inflow Depth =	3.33"	for	25 Year Storm event
Inflow =	11.92 cfs @	11.94 hrs,	Volume=	1.169 af	
Outflow =	11.92 cfs @	11.94 hrs,	Volume=	1.169 af,	Atten= 0%, Lag= 0.0 min
Primary =	11.92 cfs @	11.94 hrs,	Volume=	1.169 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,377.37' @ 11.94 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (773.0 - 773.0)

Device	Routing	Invert	Outlet Devices
#1	Primary	1,375.38'	**24.0" x 362.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 1,366.00' S= 0.0259 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Primary OutFlow Max=11.90 cfs @ 11.94 hrs HW=1,377.37' TW=1,366.75' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 11.90 cfs @ 3.8 fps)

Pond 17P: Existing 24" Pipe



BERM IS AT ELEV. 1380, ∴ NO OVERTOPPING DURING 25YR. STORM

Pond 18P: 12"

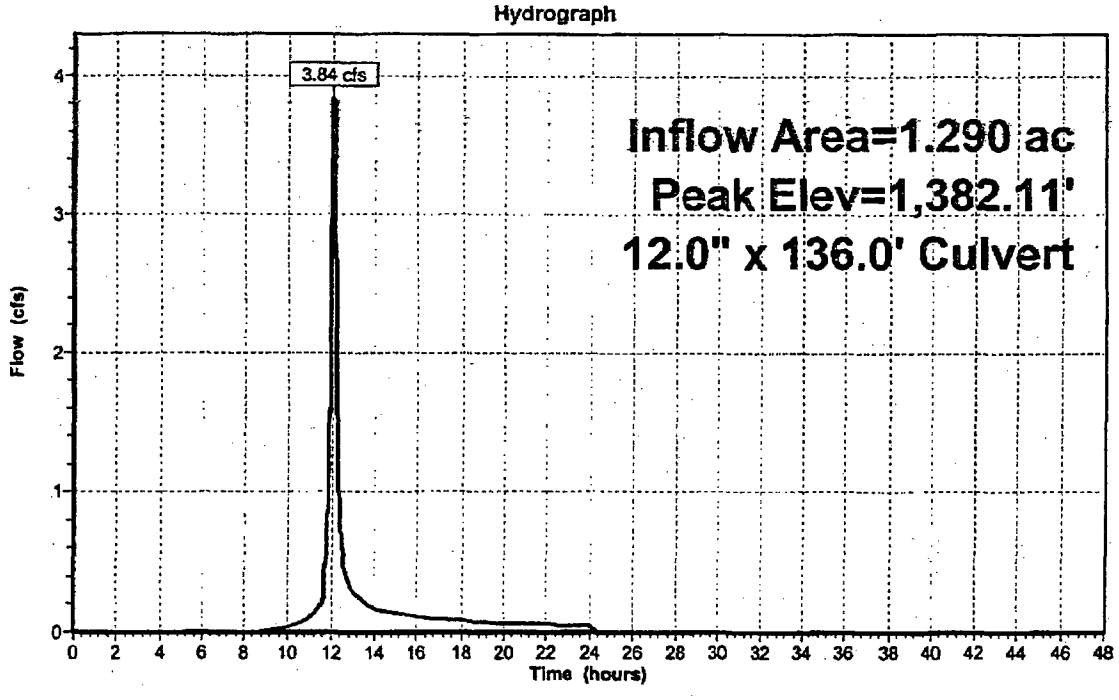
Inflow Area =	1.290 ac,	Inflow Depth =	2.21"	for	25 Year Storm event
Inflow =	3.84 cfs @	12.06 hrs,	Volume=	0.237 af	
Outflow =	3.84 cfs @	12.06 hrs,	Volume=	0.237 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.84 cfs @	12.06 hrs,	Volume=	0.237 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,382.11' @ 12.06 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (833.6 - 833.6)

Device	Routing	Invert	Outlet Devices
#1	Primary	1,379.50'	**12.0" x 136.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 1,378.82' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Primary OutFlow Max=3.84 cfs @ 12.06 hrs HW=1,382.11' TW=1,379.35' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 3.84 cfs @ 4.9 fps)

Pond 18P: 12"



ROAD IS AT ELEV 1382.5, ∴ NO OVERTOPPING DURING 25 YR STORM

Pond 19P: 18"

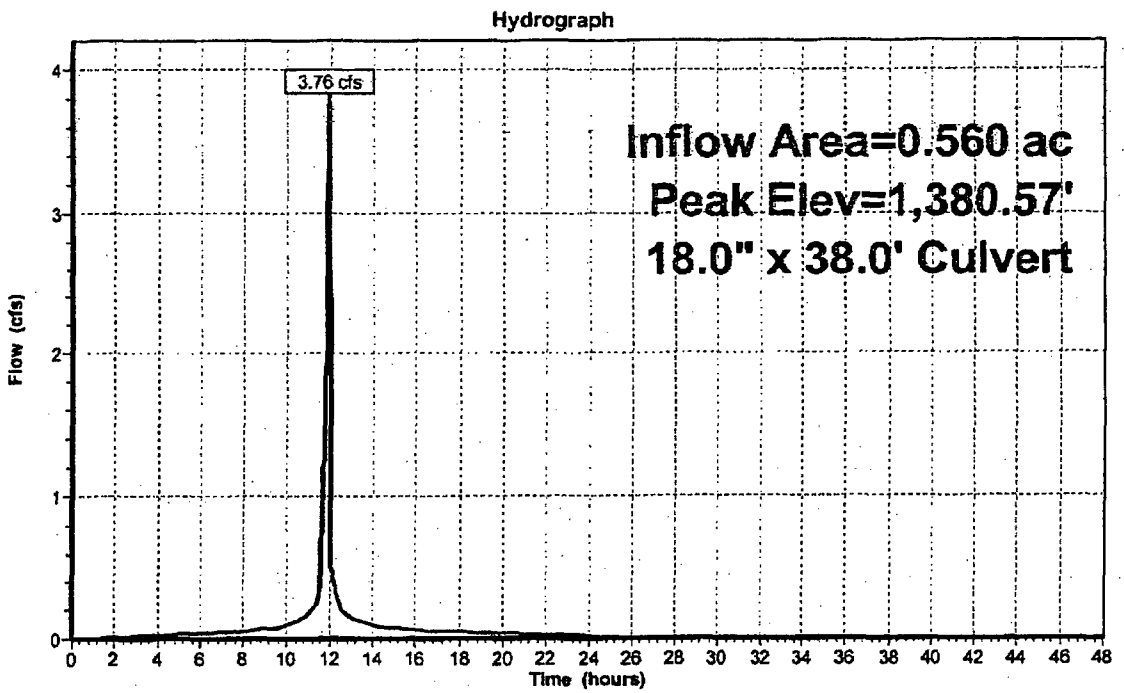
Inflow Area =	0.560 ac,	Inflow Depth =	3.96"	for	25 Year Strorm event
Inflow =	3.76 cfs @	11.92 hrs,	Volume=	0.185 af	
Outflow =	3.76 cfs @	11.92 hrs,	Volume=	0.185 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.76 cfs @	11.92 hrs,	Volume=	0.185 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,380.57' @ 11.94 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (743.5 - 743.5)

Device	Routing	Invert	Outlet Devices
#1	Primary	1,378.50'	**18.0" x 38.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 1,378.00' S= 0.0132 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=2.98 cfs @ 11.92 hrs HW=1,380.43' TW=1,380.23' (Dynamic Tailwater)
↳**1=Culvert** (Inlet Controls 2.98 cfs @ 1.7 fps)

Pond 19P: 18"



ROAD IS AT ELEV. 1381, ∴ NO OVERTOPPING DURING 25YR STORM

BASIN #2 OULET PIPE PROTECTION

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Consulting Engineers, P.C.

BY AJN DATE 6/5/07 SUBJECT WVNS - NOA SHT. NO. 1 OF 1
CHKD. BY ASK DATE 6/5/07 CAP DESIGN JOB NO. 07-011
POCT - CAP STORMWATER ANALYSIS

CHECK OUTLET PROTECTION FOR BASIN #3

- 12" Φ DISCHARGE PIPE

$S = 6.67\%$
$n = 0.013$
$Q = 7.5$ CFS

- USING PARTIALLY FLOWING PIPES, ESTIMATE d AND Q

$$\frac{Qn}{D^{8/3} S^{1/2}} = \frac{(7.5)(0.013)}{(1)^{8/3}(0.0667)^{1/2}} = 0.377$$

- USING ATTACHED CHART

$A/D^2 = 0.5733$ $\quad d/D = 0.685$

$A = 0.5733(1)^2$ $\quad d = 0.685(1)$

$A = 0.5733$ FT^2 $\quad d = 0.685$ FT

$V = Q/A = 7.5/0.5733 = 13.08$ FPS (VELOCITY AT OUTLET)

- NOW ADJUST Q

$$Q = VA = 13.08\left(\pi\frac{(0.685)^2}{4}\right) = 4.82 \text{ CFS}$$

ASSUME $T_W < 1/2 D_O$ USE FIGURE 5B.12 FROM NEW YORK GUIDELINES FOR URBAN EROSION AND SEDIMENT CONTROL

$\therefore D_{50} = 0.25$ FT $\quad L_a = 9$ FT $\quad W = 1 + 9 = 10'$

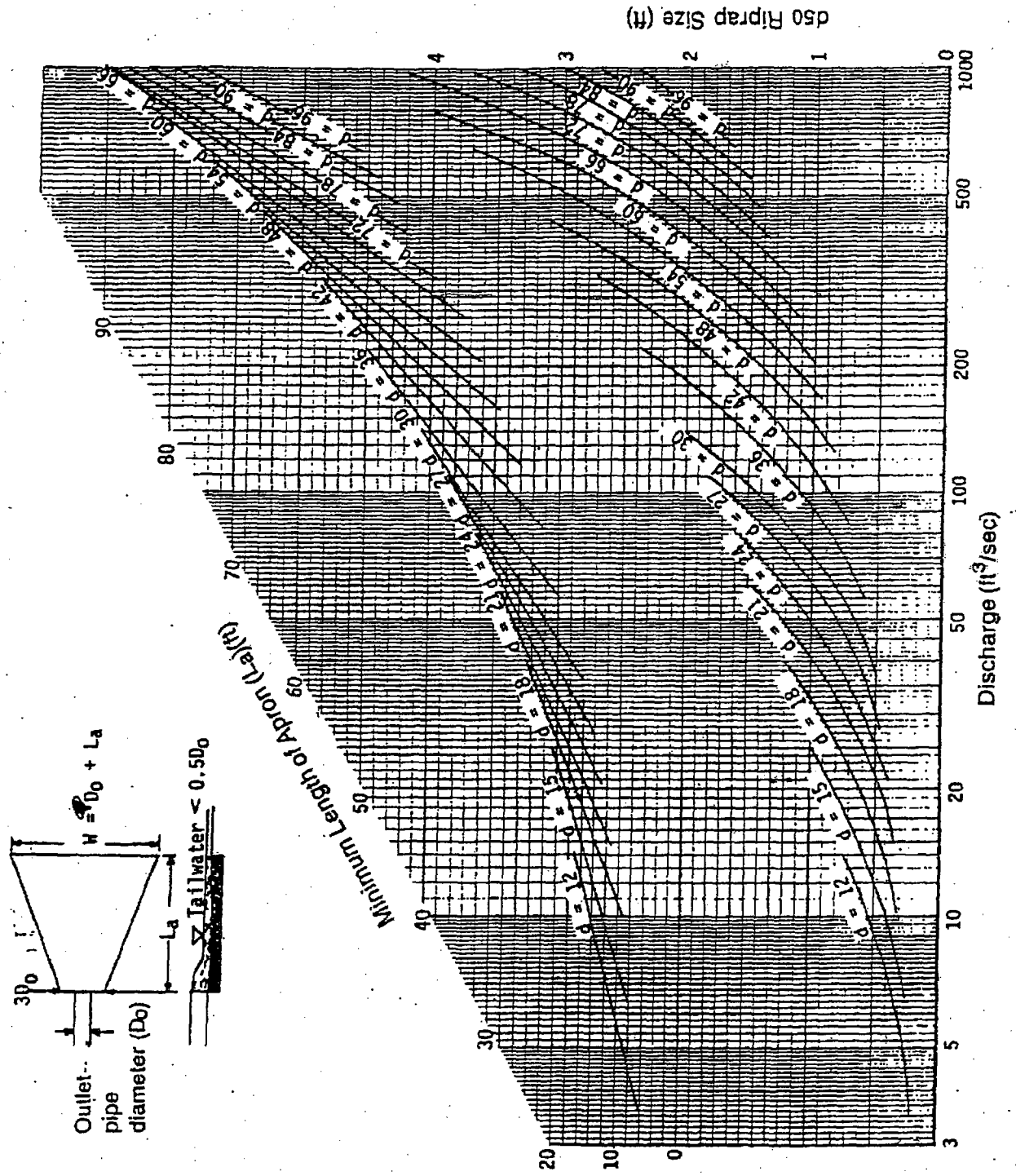
- WE WILL USE $d_{50} = 12"$, WITH THICKNESS OF 27" AND WIDTH OF 12 FT
RIP RAP WILL EXTEND TO THE TOE OF THE REGRADED SLOPE

Table 4-17. Hydraulic Elements of Pipes (n constant)[a]

$\frac{d}{D}$	$\frac{A}{D^2}$	$\frac{Qn}{D^{8/3}S^{1/2}}$	$\frac{Qc}{D^{5/2}}$	$\frac{d}{D}$	$\frac{A}{D^2}$	$\frac{Qn}{D^{8/3}S^{1/2}}$	$\frac{Qc}{D^{5/2}}$
0.01	0.0013	0.00007	0.0006	0.51	0.4027	0.239	1.4494
0.02	0.0037	0.00031	0.0025	0.52	0.4127	0.247	1.5041
0.03	0.0069	0.00074	0.0055	0.53	0.4227	0.255	1.5598
0.04	0.0105	0.00138	0.0098	0.54	0.4327	0.263	1.6166
0.05	0.0147	0.00222	0.0153	0.55	0.4426	0.271	1.6741
0.06	0.0192	0.00328	0.0220	0.56	0.4526	0.279	1.7328
0.07	0.0242	0.00455	0.0298	0.57	0.4625	0.287	1.7924
0.08	0.0294	0.00604	0.0389	0.58	0.4724	0.295	1.8531
0.09	0.0350	0.00775	0.0491	0.59	0.4822	0.303	1.9147
0.10	0.0409	0.00967	0.0605	0.60	0.4920	0.311	1.9773
0.11	0.0470	0.01181	0.0731	0.61	0.5018	0.319	2.0410
0.12	0.0534	0.01417	0.0868	0.62	0.5115	0.327	2.1058
0.13	0.0600	0.01674	0.1016	0.63	0.5212	0.335	2.1717
0.14	0.0668	0.01952	0.1176	0.64	0.5308	0.343	2.2886
0.15	0.0739	0.0225	0.1347	0.65	0.5404	0.350	2.3068
0.16	0.0811	0.0257	0.1530	0.66	0.5499	0.358	2.3760
0.17	0.0885	0.0291	0.1724	0.67	0.5594	0.366	2.4465
0.18	0.0961	0.0327	0.1928	0.68	0.5687	0.373	2.5182
0.19	0.1039	0.0365	0.2144	0.69	0.5780	0.380	2.5912
0.20	0.1118	0.0406	0.2371	0.70	0.5872	0.388	2.6656
0.21	0.1199	0.0448	0.2609	0.71	0.5964	0.395	2.7416
0.22	0.1281	0.0492	0.2857	0.72	0.6054	0.402	2.8188
0.23	0.1365	0.0537	0.3116	0.73	0.6143	0.409	2.8977
0.24	0.1449	0.0585	0.3386	0.74	0.6231	0.416	2.9783
0.25	0.1535	0.0634	0.3667	0.75	0.6319	0.422	3.0606
0.26	0.1623	0.0686	0.3957	0.76	0.6405	0.429	3.1450
0.27	0.1711	0.0739	0.4259	0.77	0.6489	0.435	3.2314
0.28	0.1800	0.0793	0.4571	0.78	0.6573	0.441	3.3200
0.29	0.1890	0.0849	0.4893	0.79	0.6655	0.447	3.4111
0.30	0.1982	0.0907	0.5226	0.80	0.6736	0.453	3.5051
0.31	0.2074	0.0966	0.5569	0.81	0.6815	0.458	3.6020
0.32	0.2167	0.1027	0.5921	0.82	0.6893	0.463	3.7021
0.33	0.2260	0.1089	0.6284	0.83	0.6969	0.468	3.8062
0.34	0.2355	0.1153	0.6657	0.84	0.7043	0.473	3.9144
0.35	0.2450	0.1218	0.7040	0.85	0.7115	0.477	4.0276
0.36	0.2546	0.1284	0.7433	0.86	0.7186	0.481	4.1466
0.37	0.2642	0.1351	0.7836	0.87	0.7254	0.485	4.2722
0.38	0.2739	0.1420	0.8249	0.88	0.7320	0.488	4.4057
0.39	0.2836	0.1490	0.8672	0.89	0.7384	0.491	4.5486
0.40	0.2934	0.1561	0.9104	0.90	0.7445	0.494	4.7033
0.41	0.3032	0.1633	0.9546	0.91	0.7504	0.496	4.8724
0.42	0.3130	0.1705	0.9997	0.92	0.7560	0.497	5.0602
0.43	0.3229	0.1779	1.0459	0.93	0.7612	0.498	5.2727
0.44	0.3328	0.1854	1.0929	0.94	0.7662	0.498	5.5182
0.45	0.3428	0.1929	1.1410	0.95	0.7707	0.498	5.8119
0.46	0.3527	0.201	1.1900	0.96	0.7749	0.496	6.1785
0.47	0.3627	0.208	1.2400	0.97	0.7785	0.494	6.6695
0.48	0.3727	0.216	1.2908	0.98	0.7817	0.489	7.4063
0.49	0.3827	0.224	1.3427	0.99	0.7841	0.483	8.8261
0.50	0.3927	0.232	1.3956	1.00	0.7854	0.463	—

FROM HANDBOOK OF STEEL DRAINAGE AND ALUMINUM CORRUGATED PRODUCTS

Figure 5B.12
Outlet Protection Design - Minimum Tailwater Condition
(Design of Outlet Protection from a Round Pipe Flowing Full, Minimum Tailwater Condition: $T_W < 0.5D_O$)



Thickness

The minimum thickness of the riprap layer shall be 1.5 times the maximum stone diameter for d_{50} of 15 inches or less; and 1.2 times the maximum stone size for d_{50} greater than 15 inches. The following chart lists some examples:

D_{50} (inches)	d_{max} (inches)	Mimimum Blanket Thickness (inches)
4	6	9
6	9	14
9	14	20
12	18	27
15	22	32
18	27	32
21	32	38
24	36	43

Stone Quality

Stone for riprap shall consist of field stone or rough unhewn quarry stone. The stone shall be hard and angular and of a quality that will not disintegrate on exposure to water or weathering. The specific gravity of the individual stones shall be at least 2.5.

Recycled concrete equivalent may be used provided it has a density of at least 150 pounds per cubic foot, and does not have any exposed steel or reinforcing bars.

Filter

A filter is a layer of material placed between the riprap and the underlying soil surface to prevent soil movement into and through the riprap. Riprap shall have a filter placed under it in all cases.

A filter can be of two general forms: A gravel layer or a plastic filter cloth. The plastic filter cloth can be woven or non-woven monofilament yarns, and shall meet these base requirements: thickness 20-60 mils, grab strength 90-120 lbs; and shall conform to ASTM D-1777 and ASTM D-1682.

Gravel filter blanket when used shall be designed by comparing particle sizes of the overlying material and the base material. Design criteria are available in Standard and Specification for Riprap Slope Protection, page 5B.55.

Gabions

Gabions shall be made of hexagonal triple twist mesh with heavily galvanized steel wire. The maximum linear dimension of the mesh opening shall not exceed 4 1/2 inches and the area of the mesh opening shall not exceed 10 square inches.

Gabions shall be fabricated in such a manner that the sides, ends, and lid can be assembled at the construction site into a rectangular basket of the specified sizes. Gabions shall be of single unit construction and shall be installed according to manufacturers recommendations.

The area on which the gabion is to be installed shall be graded as shown on the drawings. Foundation conditions shall be the same as for placing rock riprap and filter cloth shall be placed under all gabions. Where required, a key may be needed to prevent undermining of the main gabion structure.

Maintenance

Once a riprap outlet has been installed, the maintenance needs are very low. It should be inspected after high flows to see if scour beneath the riprap has occurred, or any stones have been dislodged. Repairs should be made immediately.

Design Procedure

1. Investigate the downstream channel to assure that non-erosive velocities can be maintained.
2. Determine the tailwater condition at the outlet to establish which curve to use.
3. Enter the appropriate chart with the depth of flow and discharge velocity to determine the riprap size and apron length required. It is noted that references to pipe diameters in the charts are based on full flow. For other than full pipe flow, the parameters of depth of flow and velocity must be used.
4. Calculate apron width at the downstream end if a flared section is to be employed.

Examples

Example 1: Pipe Flow (full) with discharge to unconfined section.

Given: A circular conduit flowing full.

Q = 280 cfs, diam. = 66 in., tailwater (surface) is 2 ft. above pipe invert (minimum tailwater condition).

Find: Read d_{50} = 1.2 and apron length (L_a) = 38 ft.

Apron width = diam. + L_a = 5B.5 + 38 = 43.5 ft.

Use: d_{50} = 15", d_{max} = 22", blanket thickness = 32"

Example 2: Box Flow (partial) with high tailwater

Given: A box conduit discharging under partial flow conditions. A concrete box 5.5 ft. x 10 ft. flowing 5.0 ft. deep,

Q = 600 cfs and tailwater surface is 5 ft. above invert (max. tailwater condition).

Since this is not full pipe flow and does not directly fit the nomograph assumptions, it is necessary to compute the

McMahon & Mann
Consulting Engineers, P.C.

BY _____ DATE _____ SUBJECT _____ SHT. NO. _____ OF ____

CHKD. BY _____ DATE _____ _____ JOB NO. _____

STORMWATER ANALYSIS
REFERENCE INFORMATION

Figure B-3 2-year, 24-hr rainfall

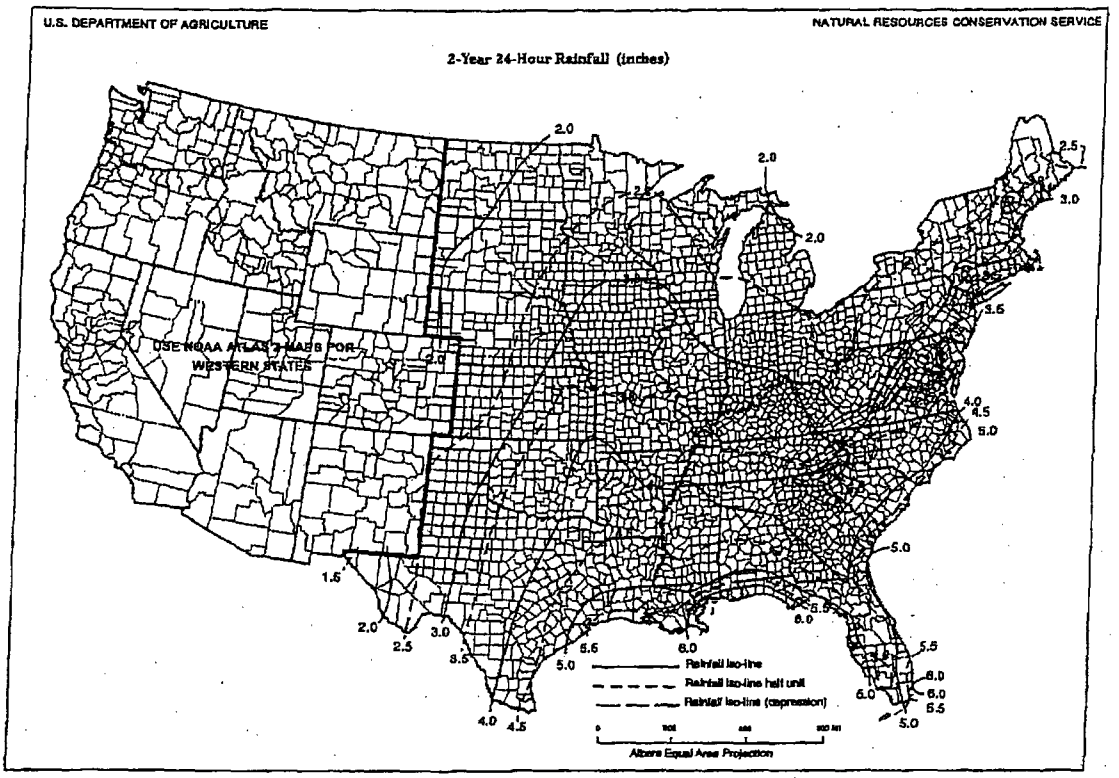


Figure B-4 5-year, 24-hour rainfall

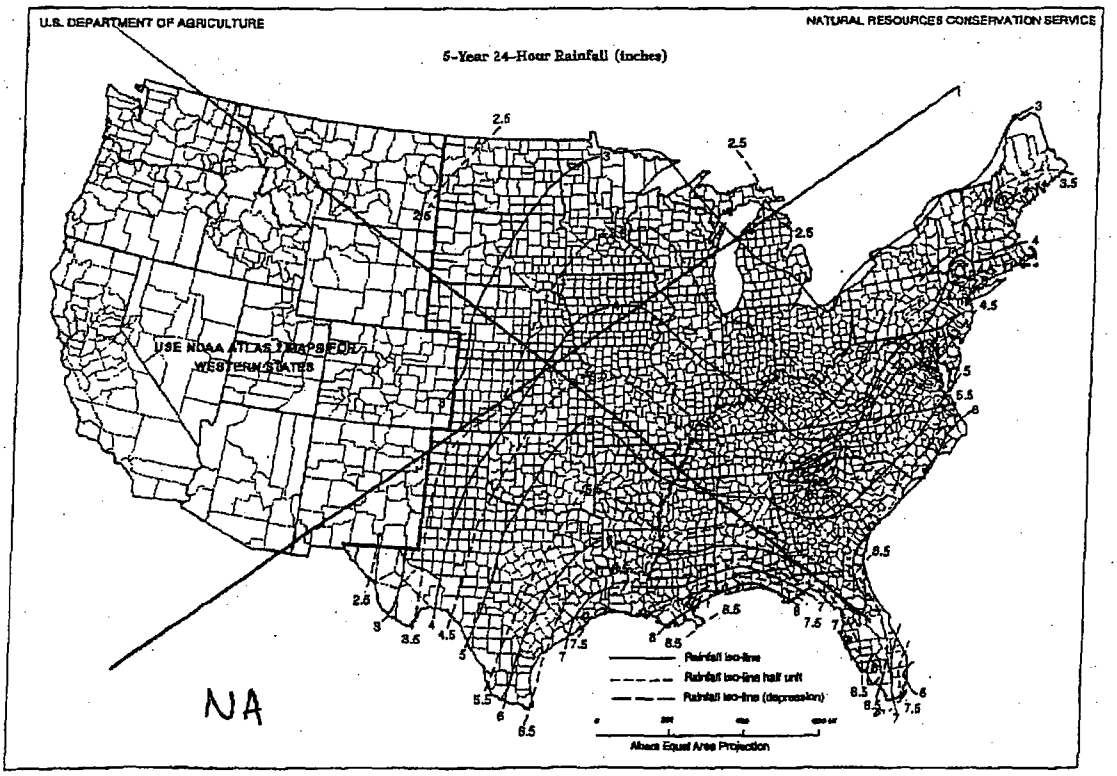


Figure B-5 10-year, 24-hour rainfall

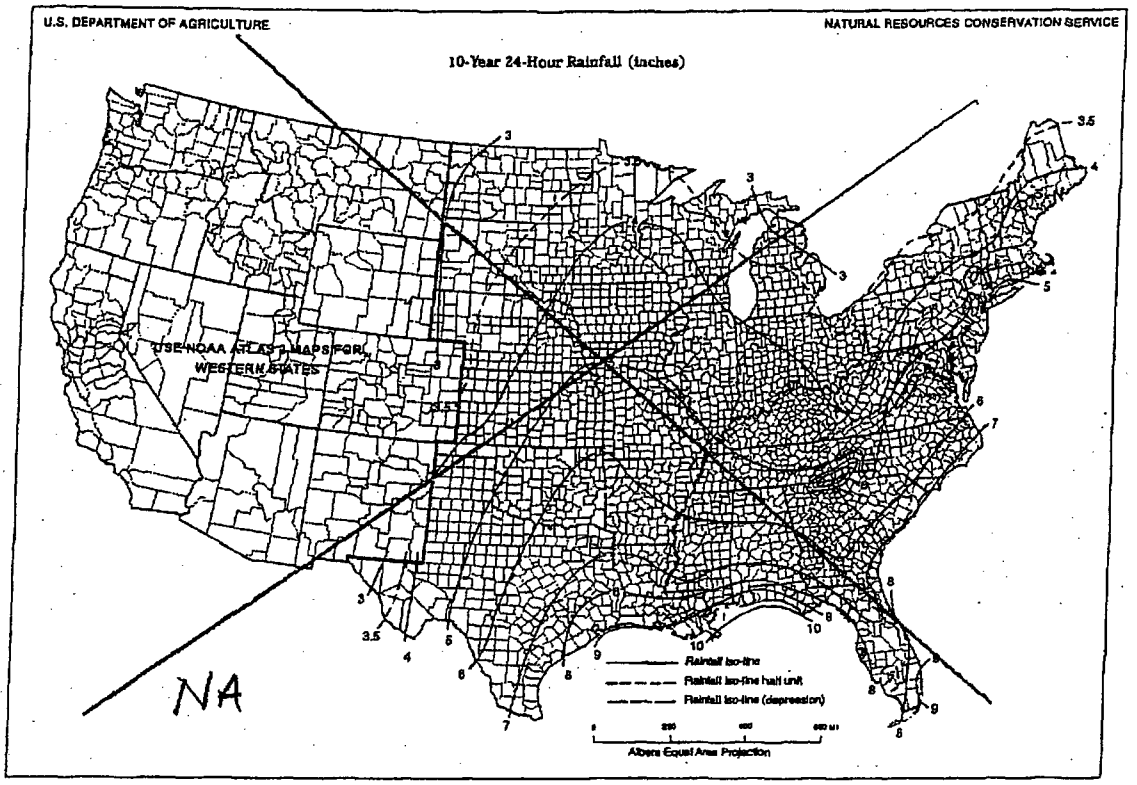
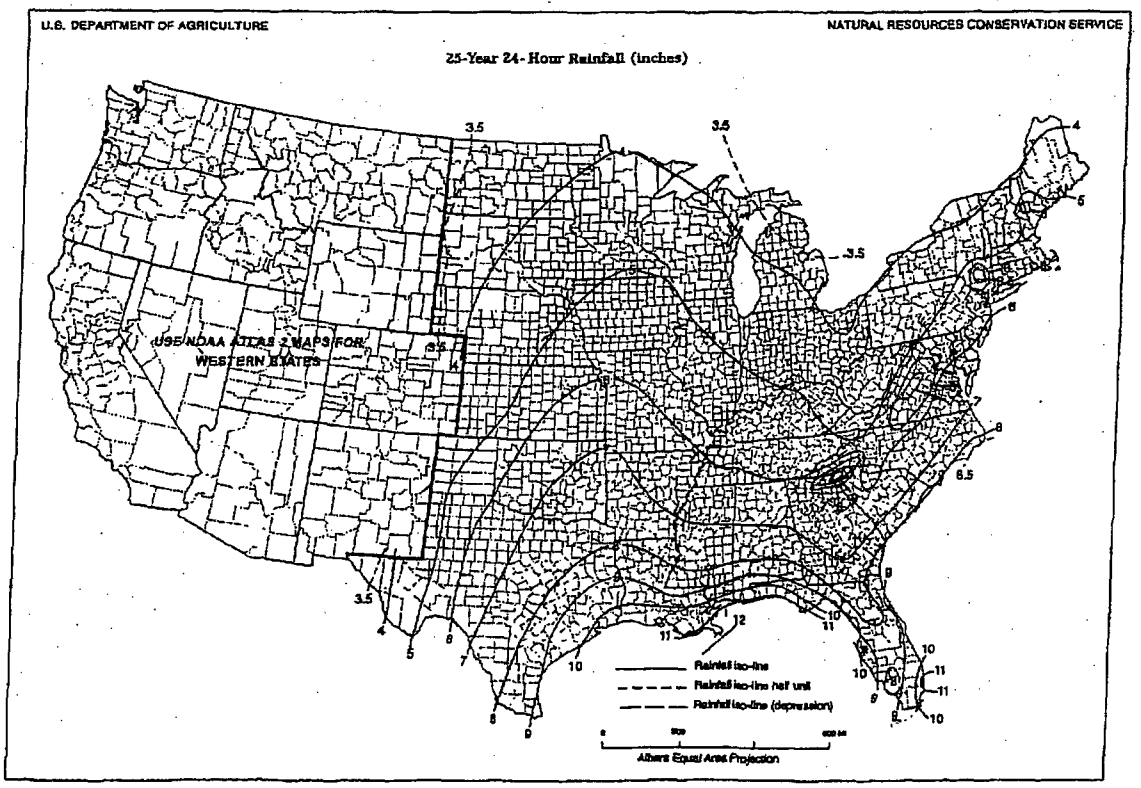


Figure B-6 25-year, 24-hour rainfall



WVDP Annual/Daily Maximum Rain Fall Data
Period: 1990-2007

	1990 (Inches)	1991 (Inches)	1992 (Inches)	1993 (Inches)	1994 (Inches)	1995 (Inches)	1996 (Inches)	1997 (Inches)	1998 (Inches)	1999 (Inches)	2000 (Inches)	2001 (Inches)	2002 (Inches)	2003 (Inches)	2004 (Inches)	2005 (Inches)	2006 (Inches)	2007 (Inches)
Yearly Total	26.64	32.76	48.63	37.35	40.13	34.17	44.89	43.23	42.76	30.97	38.05	31.02	39.96	40.99	43.21	38.52	45.06	3.55
Daily Maximum	1.84	1.45	1.64	1.43	1.90	1.22	1.57	1.70	3.75	1.86	1.47	1.40	1.33	1.39	1.99	2.15	1.56	0.83

- USED TO COMPARE TO 2542 STORM RAINFALL AMOUNT

Don McMahon

From: "KK Gupta" <KK.Gupta@wvnsco.com>
To: <ckeipper@butlerstc.com>; <dmcmahon@mmce.net>
Cc: "Chris Avery" <Chris.Avery@wvnsco.com>
Sent: Monday, May 21, 2007 1:59 PM
Attach: TA Out Fall W06 Calculations.pdf
Subject: SDA Cal for out fall W06

Chuck:

Attached is NYSERDA SPDES outfall W06 Calculations. Use this information for developing bypass line around basin 2. I will issue this information via TA.

K. K. Gupta, Fellow Engineer
WVNSCO

-THIS IS INFORMATION USED FOR SUBAREA #5

Drainage Area 06 and Outfall WNSTM06

Drainage Area 06 encompasses 0.56 acres located on the western side of the southern set of SDA trenches. Drainage Area 06 is grass covered with some gravel fill. Snow melt and storm water in Drainage Area 06 is conveyed to the north via sheet flow and a shallow channel which leads to a 12-inch CMP which is used to convey the storm water discharge from the area, under a site roadway, to Outfall WNSTM06 (see Photograph 2-18 and 2-19) in DOE Drainage Area 20. Storm water is not detained prior to discharge to the outfall.

The outfall discharge pipe discharges storm water to a grassed channel into DOE Drainage Area SO-20 (see Photograph 2-20) where it combines with storm water discharges from DOE Outfall SO-18 (upstream). DOE Outfall SO-20 discharges to Erdman Brook.

U.S. EPA Form 2F, Item VII, Part D - Outfall WNSTM06

1. Date of Storm Event	2. Duration of Storm Event (Minutes) .	3. Total Rainfall During The Storm Event(Inches)	4. Number of Hours between the beginning of the storm and the end of the previous rain event	5. Maximum Flow Rate During the Storm Event, gallons per minute (gpm)	6. Total Flow from the Rain Event
8/11/95	135 minutes	0.54 inches	143.25 hours	16 gpm	2200 gallons

Part D, Item 7 for Outfall WNSTM06:
Part D, Items 1, 2, 3, and 4 were obtained from the actual storm event data for a monitoring event at former storm water discharge Outfall SO-19.
Item no. 5, maximum flow rate was estimated as follows:

Maximum flow rate = (Total flow identified in Part D, Item No. 6)/(Duration identified in Part D. Item No.2)
= (2200 gallons)/(135 minutes)
= 16.30gallons per minute (gpm)

Rounded to two(2) significant figures = 16 gpm.

Item No.6 (i.e., total flow) was estimated as follows:

R = (C)(P)

P = Precipitation 0.54 in(1 ft/12 in.) 0.045 ft.

R = Total rainfall excess, in ft.

C = Run-off coefficient estimated as follows:

= 0.90 for impervious area (concrete, pavement, etc.)

= 0.25 for impervious area (gravel, #3 stone and smaller, and unimproved areas)

Rainfall excess:
Impervious Area: R = (0.90)(0.045 ft) = 0.0405 ft

Pervious Area: R = (0.25)(0.045 ft) = 0.01125 ft
From Attachment 2-1 for Outfall WNSTM06,

Impervious Area 0.02 acres = 871.2 sq. ft.

Pervious Area = 0.56 acres - 0.02 acres = 0.54 acres =23522 sq. ft.

Total runoff flow (871.2 sq. ft.)(0.0405 ft.) + (23522.4 sq. ft.)(0.01125 ft.) = 35.28 cu. ft. + 264.63 cu. ft = 299.91 cu. ft. = 2243.63 gallons.

Rounding is necessary to correspond to the limiting, two (2) significant figures identified for the run-off coefficients (i.e., C).

Therefore, Total flow = 2200 gallons.

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT C

INVENTORY OF EXPOSED MATERIALS

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

ATTACHMENT C
INVENTORY OF EXPOSED MATERIALS
WVNSCO NDA CAP AND GROUND WATER BARRIER INTERIM MEASURE

Instructions: Describe the significant materials that are expected to be exposed to stormwater. "Significant Materials may include: Raw Materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under section 101(14) of CERCLA; any chemical the facility is required to report to EPCRA, Section 313; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges [40 CFR 122.26(b)(12)]."

Description of Exposed Significant Material	Period of Exposure	Location	Method of Storage	Description of Material Management Practice
SOILS	Continuous during Cap Const.	Capping and Stockpile Areas	Stockpiles	Silt fence, ditches, berms, swales. Establish vegetation in disturbed areas as soon as possible.
VEHICLE REFUELING (diesel, gasoline)	Daily	ASTs	Fuel tanks	Re-fueling procedures and spill kits
FUEL DELIVERIES (diesel, gasoline)	Periodically during Const.	ASTs	ASTs	Delivery procedures and containment system for the tanks.
VEHICLE TRACKING (soil, waste)	Daily	Facility Roads	NA	Use road cleaning equipment and application of water (truck mounted spray system or equivalent).
Radiological Contamination	Daily	NDA Area	Existing subgrade fill	No excavation of existing materials in NDA area will be permitted during construction.

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT D

WV-915 SPILL / RELEASE NOTIFICATION AND REPORTING

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

WVNSCO
West Valley Nuclear Services Company

POLICY AND PROCEDURES

TITLE: Spill/Release Notification and Reporting

1.0 PURPOSE

It is the policy of West Valley Nuclear Services Company (WVNSCO) to ensure that all spills/releases be properly managed, reported, documented, and remediated in accordance with all state and federal regulations.

This policy applies to all spills/releases occurring at the West Valley Demonstration Project (WVDP) site and establishes the requirement for WVNSCO to develop and implement a systematic approach for evaluating and documenting any spill or release occurring at the WVDP and for the proper notification and reporting to all appropriate WVDP personnel and applicable regulatory agencies.

2.0 REQUIREMENTS, REFERENCES, AND FORMS

Refer to E-Docs for the latest version of WVNSCO Controlled Documents

2.1 Requirements

2.1.1 DOE Order 450.1, " Environmental Protection Program"

2.1.2 DOE Order 231.1, "Environmental, Safety, and Health Reporting"

2.1.3 DOE Order 0151.1,"Comprehensive Emergency Management System"

2.1.4 40 CFR 302, "Designation, Reportable Quantities, and Notification"

2.1.5 40 CFR 261.3, "Definition of Hazardous Waste"

2.1.6 40 CFR 355, "Emergency Planning and Notification"

2.1.7 6 NYCRR Part 371.1, "Identification and Listing of Hazardous Wastes"

2.1.8 6 NYCRR Part 595, "Releases of Hazardous Substances"

2.2 References

2.2.1 WVDP-022, "WVDP Emergency Plan"

2.2.2 WVDP-043, "Spill Prevention, Control & Countermeasures Plan"

2.2.3 WVDP-139, "WVDP Emergency Management Implementing Procedures"

2.2.4 WVDP-340, "Spill/Release Evaluation, Management, and Reporting Program"

2.2.5 SOP 300-07, "Waste Generation, Packaging, and On-Site Transportation"

2.2.6 SOP 09-12, "Solid Waste Management and Material Reuse and Recycling"

2.3 Forms

None

3.0 DEFINITIONS & ACRONYMS

3.1 Emergency - any unwanted operational, civil, natural-phenomenon, or security occurrence that could endanger or adversely affect people, property, or the environment.

3.2 Emission - The release of any air contaminant into the outdoor atmosphere.

3.3 Facility-Specific Spill Response and Reporting Protocol - the approved spill-reporting procedure for incidental or routine spills having no environmental impact associated with operations of a specific facility.

3.4 Hazardous Material - any solid, liquid, or gaseous material that is toxic, flammable, radioactive, corrosive, chemically reactive, or unstable that could pose a significant risk to life, property, or the environment. This definition is applicable to DOE Order 151.1; it is an omnibus term used to include both "hazardous materials" as defined by the Hazardous Materials Transportation Act and "hazardous substances" as defined by CERCLA.

3.5 Hazardous Waste - a waste is identified as hazardous if it meets the criteria specified in 40 CFR 261.3 and/or 6 NYCRR 371.1(d).

3.6 Petroleum - oil or petroleum of any kind and in any form including, but not limited to, oil, petroleum, fuel oil, oil sludge, oil refuse, oil mixed with other wastes and crude oils, gasoline and kerosene.

3.7 Reportable Quantity (RQ) for a Non-Petroleum Substance - quantity of a hazardous substance that if released may be harmful as set forth in 40 CFR 117.3, 40 CFR 302, 40 CFR 355 and 6 NYCRR Part 597.

3.8 Reportable Quantity (RQ) for Petroleum Substances - quantity of a hazardous substance that if released may be harmful as determined by the New York State Department of Environmental Conservation (NYSDEC).

NOTE *Any discharge of an RQ or more of a non-petroleum substance during a 24-hour period must be reported to the National Response Center (NRC) within two hours of discovery of the discharge.*

3.9 Spill or Release - any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or otherwise disposing of substances from the ordinary containers employed in the normal course of storage, transfer, processing, or use.

4.0 GENERAL INFORMATION

All employees at the WVDP are responsible for complying with this policy and implementing procedures.

It is the responsibility of all employees to notify the Plant Systems Operations Shift Supervisor (PSOSS) of any spills or releases as defined in section 5.1 below. The PSOSS then notifies the appropriate departments per Section 5.3. Spills/releases will be properly evaluated, managed, and reported as necessary in accordance with WVDP-340, "Spill/Release Evaluation, Management, and Reporting Program," which implements this policy.

Petroleum spills which are not cleaned up within two (2) hours of discovery must be reported to the New York State Department of Environmental Conservation (NYSDEC) on the quarterly petroleum spill report.

4.1 Responsibilities

4.1.1 Individual Spill/Release Discoverer - shall be responsible for initiating appropriate notifications as outlined in this procedure.

4.1.2 Plant Security - shall be responsible for coordinating with Plant Systems Operations (PSO) when a spill/release is discovered to establish access control in the immediate vicinity.

4.1.3 Plant Systems Operations (PSO) - shall be responsible for coordinating responses to the spill/release. The Plant Systems Operations Shift Supervisor (PSOSS) or designee shall obtain all pertinent information, mitigate immediate emergencies or threats of emergencies, notify Environmental Affairs (EA) as soon as practical but at least within one hour of the discovery of the spill/release, and clean up the spill/release as appropriate based on guidance provided by WVNSCO support groups by contacting the operations group responsible for the area, or Waste Shipping and Disposal (WSD), or requesting the assistance of the Off-Site HAZMAT Team if necessary.

4.1.4 Operations Group - shall be responsible for determining if an approved facility-specific spill response and reporting protocol is applicable, and is also responsible for training regarding the implementation of the protocol/procedure. The Operations Group is responsible for proper clean-up of the spill/release material as appropriate based on guidance provided by WVNSCO support groups for their area and completing applicable data sheets from SOP 300-07, unless the spill/release generates a hazardous condition which they are not trained to handle. In this case, the Off-Site HAZMAT Team may be activated at the discretion of the PSOSS.

4.1.5 Waste Facilities - shall be responsible for proper cleanup of the spill/release material as appropriate based on guidance provided by WVNSCO support groups in areas under its cognizance and designation of temporary storage of spill/release cleanup materials. Additionally, Waste Facilities will support cleanups in the event operations groups do not have enough trained manpower. When the cleanup activities create a hazardous condition that Waste Facilities is not trained to handle, the PSOSS will be contacted to coordinate cleanup activities. Waste Facilities shall also be responsible for completing the applicable data sheet from SOP 9-12 and SOP 300-07 if necessary.

4.1.6 Generator of Spill/Release - shall be responsible to initiate (SOP) 300-07 and for contacting Waste Shipping and Disposal (WSD) for characterization and disposal of the wastes.

4.1.7 Environmental Affairs (EA) - shall be responsible for environmental regulatory reporting and evaluation of all spills/releases for environmental impacts as per WVDP-340, "Spill/Release Evaluation, Management, and Reporting Program, completing a WVNSCO Environmental Affairs Substance Spill/Release Report Form, completing an Environmental Affairs Notification Information Form, if necessary, approving all facility-specific spill response and reporting protocols, and performing all required notifications. EA is responsible for review and update of this procedure as required.

4.1.8 Industrial Safety and Medical - shall be responsible for providing information concerning industrial hygiene and safety issues as requested.

4.2 Other

4.2.1 A spill or release is defined as "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or otherwise disposing of substances from the ordinary containers employed in the normal course of storage, transfer, processing, or use."

4.2.2 Spill/release reporting is required under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), the Emergency Planning and Community Right-to-Know Act (EPCRA), the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the Clean Air Act (CAA), the Toxic Substance Control Act (TSCA), and the New York State Department of Environmental Conservation (NYSDEC) spill/release reporting regulations.

5.0 PROCEDURE

5.1 Spill/Release Discoverer

5.1.1 Should a spill/release result in an emergency or potential emergency situation, it is the responsibility of all personnel to immediately notify the Plant Systems Operations Shift Supervisor (PSOSS) by the most expedient way possible. This includes use of the 812 "all page" system, radio, telephone, or face-to-face communications (per WVDP-139). Upon notification of the emergency, the PSOSS assumes the position of the Incident Commander (IC) and the WVDP Emergency Plan (WVDP-022) and WVDP Emergency Management Implementing Procedures (WVDP-139) will be initiated.

5.1.2 The Operations Group responsible for the area in which the spill occurred shall determine if a facility-specific spill response and reporting protocol is applicable.

NOTE *If a facility-specific spill response and reporting protocol applies, follow the applicable procedure. If not, continue with step 5.1.3.*

5.1.3 In the event that the spill/release does not result in an emergency or a potential emergency situation, it is the responsibility of the person discovering the release to immediately notify the area supervisor and the PSOSS at extension 4239 directly or via plant security at extension 4330 and remain available to speak to the PSOSS.

5.1.4 The person discovering the spill/release shall warn other personnel in the immediate vicinity. The discoverer shall then implement the SWIMS technique if he/she is familiar with the spilled/released material, or the WIN technique if he/she has little or no familiarity with the spilled/released material.

NOTE *The SWIMS technique is defined as follows: STOP the spill; WARN others and notify immediately; ISOLATE the area, MINIMIZE exposure to the spill; and SECURE ventilation.*

The WIN technique is defined as follows: WARN others of the affected area; ISOLATE the area; and NOTIFY immediately.

5.2 Security Department

5.2.1 When notified of a spill/release, security shall immediately contact the PSOSS.

5.2.2 Security shall establish access control in the immediate vicinity of the spill/release to prevent unauthorized personnel from entering the spill/release area as requested by the PSOSS.

5.3 Plant Systems Operations

5.3.1 The PSOSS shall obtain all pertinent information regarding the spill/release (i.e., spill/release material, quantity, location of spill/release).

5.3.2 The PSOSS shall assess the situation and initiate appropriate actions to secure emergencies and initiate actions to cleanup the spill/release.

5.3.3 The PSOSS or designee shall notify EA as soon as practical but within one hour of the discovery of a spill/release. During the off-shift, EA will be notified through the use of a call list provided to PSO by EA.

5.3.4 The PSOSS or designee will contact Industrial Safety and Medical for support as needed.

5.3.5 The PSOSS or designee will notify the Radiation Protection Department in the event of a spill/release of radioactive material.

5.3.6 During regular work hours, the PSOSS will evaluate and initiate appropriate actions based on guidance provided by WVNSCO support groups and to notify appropriate trained personnel to clean up the spill/release. All cleanup material will be placed in proper storage as directed by WSD.

5.3.7 During the off-shift, PSO will evaluate and initiate appropriate actions based on guidance provided by WVNSCO support groups to clean up the spill/release or notify appropriate trained personnel to clean up the spill/release, and place the clean-up material in the designated temporary storage area as directed by WSD to facilitate characterization. In the event of an emergency situation, the PSOSS/Incident Commander may activate the Off-Site HAZMAT Team.

5.4 Environmental Affairs

Upon notification of a spill/release, EA personnel shall perform an evaluation to determine environmental impacts and regulatory reporting requirements per WVDP-340, "Spill/Release Evaluation, Management, and Reporting Program." A WVNSCO Environmental Affairs Spill/Release Report Form shall be completed for each spill or release.

5.5 Generator

The designated generator of the spill/release material shall initiate SOP 300-07, if necessary, and contact WSD for characterization of the cleanup material. Waste Facilities will initiate SOP 09-12.

6.0 RECORDS

No records are generated as a result of implementing this document.

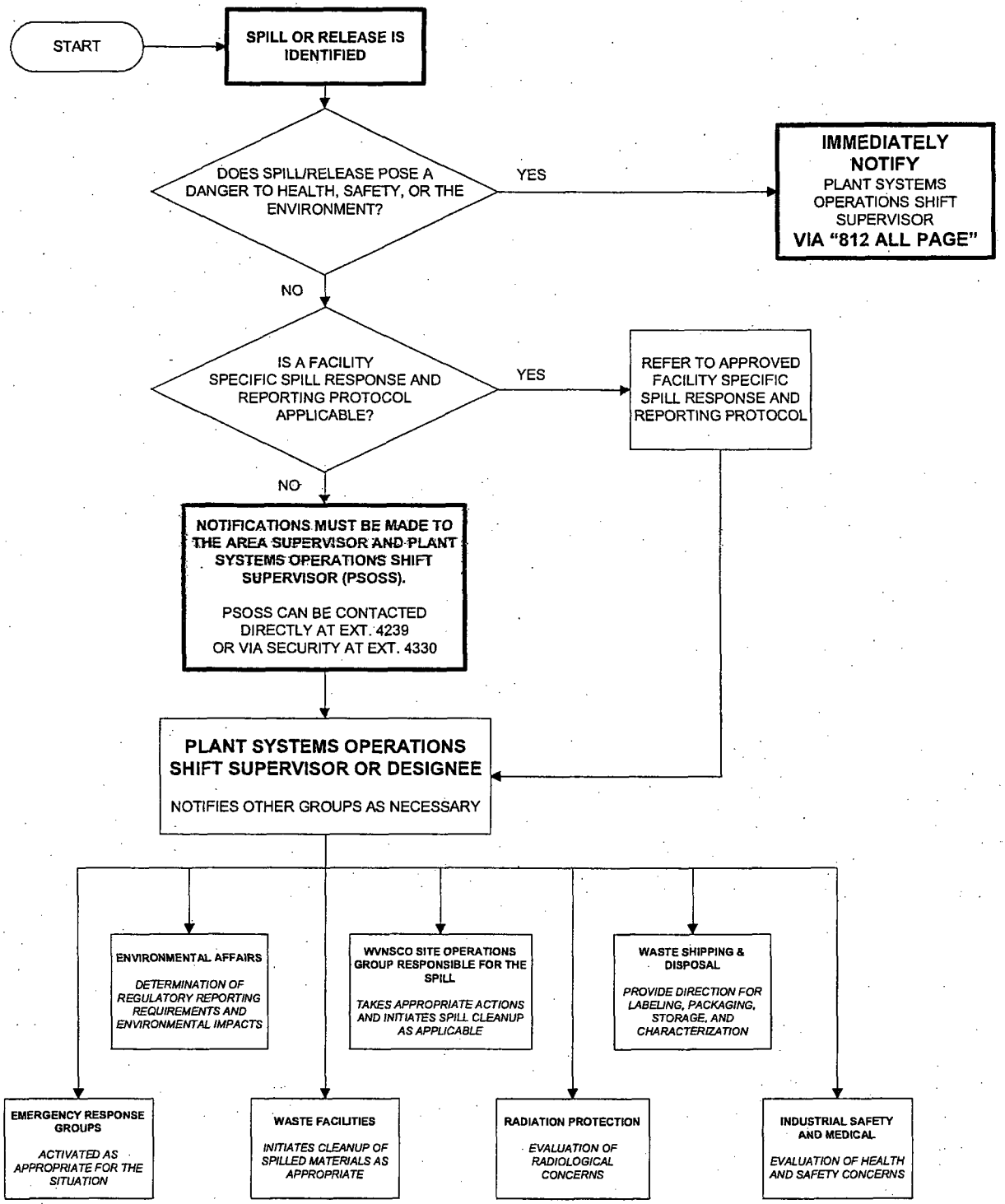
7.0 ATTACHMENTS

All attachments are the latest revision unless otherwise specified.

Attachment A - Spill Response Flow Chart

SPILL RESPONSE

(AWARENESS LEVEL) ALL EMPLOYEES



WVNSCO RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
6	Updated logo Updated references to SOP 300-07 to reflect title change EA is affected by these changes.	1 1	02/28/02
7	General Revision		01/21/04
	This change was made to update the procedure to the requirements of DCIP-100	All	
	Detailed changes are as follows:		
	In Section 2.1, Requirements, DOE Order 5400.1 was replaced with DOE Order 450.1	1	
	Department titles were updated throughout the procedure	All	
	Changes were made to reflect the use of an Off-Site HAZMAT Team	3,5	
	The Spill Response Flowchart was updated to reflect the above referenced revisions	7	
	All personnel are affected by these changes.		
8	The definition of "petroleum" was changed to be consistent with the New York State navigational law	2	03/16/05
	Added statement to Section 4.0 regarding petroleum spills not cleaned up within two hours of discovery	3	
	Added the words "as appropriate based on guidance provided by WVNSCO support groups" in Sections 4.1.3, 4.1.4, and 4.1.5	3	
	Added the words "evaluate and initiate appropriate actions based on guidance provided by WVNSCO support groups and to notify appropriate trained personnel" in Section 5.3.6.	5	
	Added the words "evaluate and initiate appropriate actions based on guidance provided by WVNSCO support groups to" in Section 5.3.7.	5	
	All personnel are affected by these changes.		

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT E

MEASURES AND CONTROLS

BEST MANAGEMENT PRACTICES

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

ATTACHMENT E

Measures and Controls
Best Management Practices (BMPs)
WVNSCO
NDA Cap and Groundwater Barrier Interim Measure
West Valley, New York

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the BMPs, describe actions to be incorporated into facility operations.

Good Housekeeping	**Programs, practices, policies and procedures that maintain a clean and orderly facility**
BMPs	**Brief Description of Activities**
Good Housekeeping	• Routine clean-up of windblown trash; • Routine and regular clean-up schedules and clean-up procedures; • Maintain well-organized work areas; • Keep dust levels on ground to a minimum, sweep roadways and apply water as required; • Post reminders in appropriate locations regarding good housekeeping procedures; • Include reminders regarding good housekeeping practices in SWPPP training programs.

ATTACHMENT E

Measures and Controls
Best Management Practices (BMPs)
WVNSCO
NDA Cap and Groundwater Barrier Interim Measure
West Valley, New York

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Preventive Maintenance	**Regular Inspections and testing of equipment and operational systems**
BMPs	**Brief Description of Activities**
Preventative Maintenance	• Periodic review of equipment used for stormwater management or control; • Maintain stormwater management devices such as silt fence, check dams, and other structural or treatment BMPs; • Maintain equipment exposed to stormwater to limit breakdowns and failures by adjusting, repairing or replacing equipment components, i.e., pipes, pumps, storage tanks, hoses, etc. • Implement standardized inspection and recordkeeping procedures including follow-up to ensure deficiencies are rectified. Inspections should be directed toward identifying conditions such as cracks, or slow leaks which could cause breakdowns or failures resulting in discharges of chemicals to surface waters.

ATTACHMENT E

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Spill Prevention and Response	**Identify areas where spills can occur and the anticipated drainage pattern of such spills**
BMPs	**Brief Description of Activities**

Spill Prevention and Response	• Incorporate by reference existing SPCC Plan into SWPPP and SWPPP training;
	• Develop and review potential spill scenarios to generate ideas for eliminating or minimizing the spill or impact and prioritize and adopt spill scenario solutions according to effectiveness, cost, feasibility, and ease of implementation;
	• Incorporate activities that help reduce the potential for spills that could impact stormwater such as:
	  • Adopting effective housekeeping plans
	  • Performing regular visual inspections to identify signs of wear on tanks, drums, containers, storage shelves, and berms
	  • Performing preventive maintenance on storage tanks, valves, pumps, pipes, and other equipment
	  • Developing and using filling procedures for fuel tanks and other equipment that minimizes spills
	  • Ensuring appropriate site security

ATTACHMENT E

Measures and Controls
Best Management Practices (BMPs)
WVNSCO
NDA Cap and Groundwater Barrier Interim Measure
West Valley, New York

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the BMPs, describe actions to be incorporated into facility operations.

Inspections	**At appropriate intervals, inspections of equipment and areas of potential stormwater contamination should be conducted.**
BMPs	**Brief Description of Activities**

Inspections	• Identify qualified personnel to conduct the inspections, track results and maintain records. Routine inspections are not intended to be a comprehensive evaluation of the entire SWPPP, but a routine "look-over" of the facility to identify conditions that may give rise to contamination of stormwater runoff with pollutants from the facility;
	• Examples of areas to include in a visual inspection:
	  • erosion and sediment control devices
	  • drainage swales
	  • areas around petroleum storage tanks
	  • areas where spills have occurred in the past
	  • cap and slurry wall construction areas
	  • soil stockpiles
	  • outdoor material handling areas, (i.e., loading, unloading areas)

ATTACHMENT E

Measures and Controls
Best Management Practices (BMPs)
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West Valley, New York

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the BMPs, describe actions to be incorporated into facility operations.

Inspections	**At appropriate intervals, inspections of equipment and areas of potential stormwater contamination should be conducted.**
BMPs	**Brief Description of Activities**
	• Perform inspections of construction areas on a weekly basis and following each rainfall event of 0.5 inches or more. • Promptly rectify deficiencies

ATTACHMENT E

Measures and Controls
Best Management Practices (BMPs)
WVNSCO
NDA Cap and Groundwater Barrier Interim Measure
West Valley, New York

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the BMPs, describe actions to be incorporated into facility operations.

Employee Training	**Stormwater plans, programs, practices, and policies can be incorporated into existing training programs to reduce administrative burdens**
BMPs	**Brief Description of Activities**

Employee Training	• Incorporate stormwater training into existing training programs such as safety meetings, team meetings, or informational meetings
	• Training considerations to include:
	  • Purposes and goals of the SWPPP
	  • Potential sources of contamination to stormwater
	  • Vehicle refueling practices
	  • The BMPs at the site and the role of employees in pollution prevention
	  • Good housekeeping practices
	  • Material storage practices and inventory controls
	  • Record keeping procedures

ATTACHMENT E

Measures and Controls
Best Management Practices (BMPs)
WVNSCO
NDA Cap and Groundwater Barrier Interim Measure
West Valley, New York

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the BMPs, describe actions to be incorporated into facility operations.

Employee Training	**Stormwater plans, programs, practices, and policies can be incorporated into existing training programs to reduce administrative burdens**
BMPs	**Brief Description of Activities**

	• Training considerations to include (cont.):
	  • Spill Prevention
	  • Use of spill response and containment equipment
	  • Inspection procedures
	  • Review of environmental incidents and/or spills and critique
	  • Erosion and Sediment Control
	• Document training using form in Attachment F:

ATTACHMENT E

Measures and Controls
Best Management Practices (BMPs)
WVNSCO
NDA Cap and Groundwater Barrier Interim Measure
West Valley, New York

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the BMPs, describe actions to be incorporated into facility operations.

Recordkeeping and Reporting	**Changes to the facility that can result in additional stormwater contaminant potential are to be rapidly identified and communicated through appropriate internal recordkeeping, reporting procedures and policies**
BMPs	**Brief Description of Activities**

Recordkeeping and Reporting	• Records should be maintained on site and available for review
	• Specific records which should be retained include:
	  • Inspection forms
	  • Updated copy of the SWPPP
	  • SWPPP roster to reflect changes in personnel and responsibilities
	  • A Site Plan that is accurate and reflects facility
	  • Inventory of exposed materials that is updated whenever operations, usage or storage changes
	  • Employee training records

ATTACHMENT E

Measures and Controls
Best Management Practices (BMPs)
WVNSCO
NDA Cap and Groundwater Barrier Interim Measure
West Valley, New York

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the BMPs, describe actions to be incorporated into facility operations.

Sediment and Erosion Control	**Identify specific areas within the facility that may be subject to erosion**
BMPs	**Brief Description of Activities**

Sediment and Erosion Control	• Provide training for employees to regarding the importance of erosion and sediment control and to identify deficiencies and remedy erosion control measures
	• Develop control measures prior to initiating construction activities
	• Develop and implement erosion control measures including;
	  • vegetative covering of barren areas
	  • slope and grade control
	  • use of hay bales and silt fencing for control devices
	  • use of rip rap protective channel lining
	• Promote landscape maintenance to sustain natural erosion control measures

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT F

TRAINING DOCUMENTATION FORM

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

ATTACHMENT F POLLUTION PREVENTION TEAM TRAINING RECORD	WVNSCO Completed by:..... Title:..... Date:.....

Instructions: A SWP3 Team Training Record must be completed at each training session, and retained in the SWPPP. It lists the name, job title, and phone number for each trained individual.

Attendees	Job Title	Phone Number

ATTACHMENT F EMPLOYEE TRAINING PROGRAM	WVNSCO

Instructions: This list of training topics for storm water pollution prevention provides a minimum list of topics to be covered in each training session.

Training Topics Discussed	**Comments**
Goals and Components of the SWP3	
Potential sources of contamination	
Spill Response Procedures	
Spill Prevention	
Previous Spill Response Critique	
Perform regular visual inspections and review procedures to identify areas of spills or leaks (i.e. trucks, personal vehicles, ASTs, etc).	
Good housekeeping practices	
Proper vehicle fueling operations	
Baseline BMPs	
Material storage practices and inventory controls	
Record keeping procedures	
Advanced BMPs	
Sediment and Erosion Controls	
Name & Title of Trainer:	Phone No.:
Signature:	Date Signed:

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT G

CONTRACTOR CERTIFICATION

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

CONTRACTOR CERTIFICATION

(To be completed commencement of any construction work by contractor.)

CERTIFICATION

Company Name: _____

I, _____(responsible corporate official), certify under penalty of law that I understand and agree to comply with the terms and conditions of the SWPPP for the construction site identified in such SWPPP as a condition of authorization to discharge stormwater. I also understand that the operator must comply with the terms and conditions of the New York State Pollutant Discharge Elimination System (SPDES) Individual Permit for discharges from this site, and that it is unlawful for any person to cause or contribute to a violation of water quality standards.

A. Name	B. Title
C. Signature	D. Date Signed

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT H

INSPECTION FORM - WEEKLY

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

ATTACHMENT H

INSPECTION FORM - WEEKLY

WVNSCO
NDA CAP AND GROUND WATER BARRIER INTERIM MEASURE
West Valley, New York

Instructions: **This form should be completed during facility inspections (to occur at least once per week) and included with the SWPPP. If action is required, then this form and form for next inspection must reflect the actions taken.**

Date	Inspected by	Others Present

Area Inspected	Procedure	Comments	Action Required
Silt Fences	Check condition of fence, to see that base of geotextile is embedded in soil and for accumulation of sediment behind fence.		
Diversion swales, berms pavement and pads	Check for obstructions, cracking, and breaks.		
Soil Stockpiles	Note that stockpiles are stabilized and contained.		
Vegetated swales	Check condition of plants and for evidence of erosion in the channel.		
ASTs	Check for staining or spillage in containment area, on tank and near dispenser. Inspect locks, spill kits and make sure hose is secure and away from vehicle path.		
Check Dams	Check condition of check dam and for accumulated sediments behind the dam.		
Stormwater Outfalls	Check stormwater Outfalls for operation, i.e. open and clean. Note water quality by checking for odors, sheen's, and clarity, floating solids.		

ATTACHMENT H

INSPECTION FORM - WEEKLY

WVNSCO
NDA CAP AND GROUND WATER BARRIER INTERIM MEASURE
West Valley, New York

Instructions: This form should be completed during facility inspections (to occur at least once per week) and included with the SWPPP. If action is required, then this form and form for next inspection must reflect the actions taken.

Truck, Construction Equipment and Employee Parking Areas	Check for signs of leaking fluids or previous staining.		
Vegetated Areas	Check for evidence of erosion requiring repair.		
Entire site area	Check that good housekeeping measures are being employed. For example, check that trash and litter are picked up, work areas are well maintained and dust levels are kept to a minimum.		
Entire site area	Check that preventative maintenance is being done on all stormwater management devices.		

STORMWATER POLLUTION PREVENTION PLAN

ATTACHMENT I

INSPECTION FORM – POST CONSTRUCTION

WVNSCO

NDA CAP AND

GROUND WATER BARRIER INTERIM MEASURE

ATTACHMENT I

INSPECTION FORM – POST CONSTRUCTION

WVNSCO
NDA CAP AND GROUND WATER BARRIER INTERIM MEASURE
West Valley, New York

Instructions: **This form should be completed during post-construction facility inspection. If action is required, then this form should be used again to confirm the actions taken.**

Date	Inspected by	Others Present

Area Inspected	Procedure	Comments	Action Required
Silt Fences	Check to see that silt fences have been removed.		
Diversion swales, berms	Check for final grading, stabilization.		
Soil Stockpiles	Check that stockpiles have been removed and area is vegetated or stabilized by other means such as covering with non-erosive material.		
Vegetated swales	Check condition of vegetation and for evidence of erosion in the channels.		
ASTs	Check that temporary (truck mounted) fueling facilities are gone and no residual surface contamination remains.		
Check Dams	Check condition of any permanent check dams in swales and for accumulated sediments behind the dam.		
Stormwater Outfalls	Check stormwater Outfalls for operation, i.e. open and clean. Note water quality by checking for odors, sheen's, and clarity, floating solids.		

ATTACHMENT I

INSPECTION FORM – POST CONSTRUCTION

WVNSCO
NDA CAP AND GROUND WATER BARRIER INTERIM MEASURE
West Valley, New York

Instructions: This form should be completed during post-construction facility inspection. If action is required, then this form should be used again to confirm the actions taken.

Truck, Construction Equipment and Employee Parking Areas	Check that construction equipment has been removed and for signs of residual staining.		
Vegetated Areas	Check for evidence of erosion or failure of vegetation to grow, requiring repair or reseeding.		
Stormwater Basins	Check that stormwater basins are constructed as specified on the plans and in the SWPPP		

Storm Water Pre-existing Condition

McMahon & Mann
Consulting Engineers, P.C.

BY TWS DATE 4.12.07 SUBJECT WEST VALLEY BARRIER WALL ESTIMATED GROUNDWATER FLOW SHT. NO. 1 OF 1
CHKD. BY AJN DATE 4/16/07 JOB NO. 07-011

ESTIMATE THE GROUNDWATER FLOW THROUGH THE WEATHERED LAVERTY TILL.

FLOW THROUGH AN AQUIFER CAN BE ESTIMATED USING DARCY'S LAW (DARCY, 1856):

$$Q = kiA$$

WHERE: Q = RATE OF FLOW (L^3/T)
K = HYDRAULIC CONDUCTIVITY OF STRATUM (L/T)
i = HYDRAULIC GRADIENT IN STRATUM (L/L)
A = FLOW AREA (L^2)

BASED ON EXISTING DATA, WE ESTIMATE THE FOLLOWING:

K RANGES FROM 1.65×10^{-4} cm/s TO 9.14×10^{-8} cm/s W/ A GEOMETRIC MEAN OF 1.28×10^{-6} cm/s IN WEATHERED LAVERTY TILL (1)

i = 0.025 TO 0.03 BASED ON GROUNDWATER CONTOURS IN WEATHERED LAVERTY TILL (2)

A = FLOW AREA IS DEPENDENT ON DEPTH OF GROUNDWATER IN WEATHERED LAVERTY TILL WHICH RANGES FROM 1.4' TO 10.5' DEEP (3) AREA = WATER DEPTH × LENGTH

USE $K = 1.28 \times 10^{-6}$ cm/s, i = 0.03 (CONSERVATIVE), AND WATER DEPTH = 10.5' (CONSERVATIVE)

$$Q = kiA = 1.28 \times 10^{-6} \frac{cm}{sec} \cdot 0.03 \frac{ft}{ft} \cdot 10.5\ ft \cdot L \cdot \frac{1in}{2.54cm} \cdot \frac{1ft}{12in} \cdot \frac{7.48\ gal}{ft^3} \cdot \frac{3600\ sec}{1\ hr} \cdot \frac{24\ hr}{day} \cdot \frac{365\ days}{yr}$$

$$= 3.12 \cdot LENGTH \cdot \frac{GAL}{YR}$$

WITH A 900' LONG BARRIER WALL

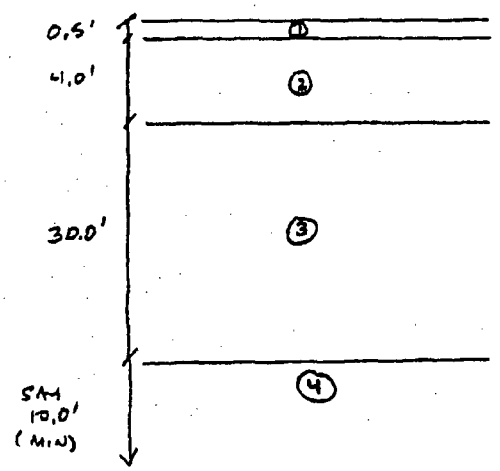
$$Q = 3.12 \cdot 900' = \boxed{2800\ GAL/YR}$$ PASS THROUGH PLANE OF WALL

REFERENCES:
(1) - SLUG TEST RESULTS FROM WELLS SCREENED IN WEATHERED LAVERTY TILL - TECHNICAL ADVISORY No 2 (3-22-2007) FROM WEST VALLEY NUCLEAR SERVICES COMPANY (WVNSCO)
(2) 4th QUARTER & 2nd QUARTER 2006 GROUNDWATER ELEVATION CONTOURS OF THE WEATHERED LAVERTY TILL - PLATE 3 (12.29.06 & 6.29.06)
(3) WATER LEVEL DATA - TECHNICAL ADVISORY NO. 1 (3-20-2007) FROM WVNSCO

McMahon & Mann
Consulting Engineers, P.C.

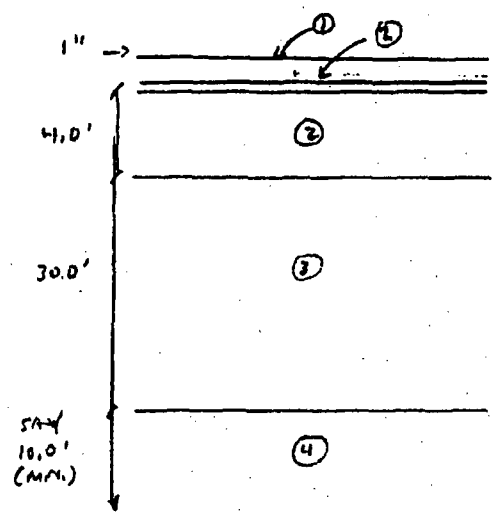
BY AJN DATE 3/30/07 SUBJECT WVNS - NDA SHT. NO. 2 OF 16
CHKD. BY TWS DATE 4/6/07 CAP DESIGN JOB NO. 07-011
"HELP" MODEL ANALYSIS

CASE #1 - EXISTING COVER CONDITIONS



	LAYER	LAYER TYPE	SOIL TEXTURE
1	0.5' TOPSOIL	1	6
2	4' SOIL COVER	3	12
3	30' OF WASTE	1	18
4	NATIVE SOIL	3	18

CASE #2 - PROPOSED COVER CONDITIONS



	LAYER	LAYER TYPE	SOIL TEXTURE
1	GRANULAR DRAINAGE	2	1
2	30 MIL GEOMEMBRANE	4	41
3	4' SOIL COVER	3	12
4	30' OF WASTE	1	18
5	NATIVE SOIL	3	16

- HAD TO INPUT AN ASSUMED DRAINAGE LAYER ON TOP OF THE MEMBRANE FOR HELP MODEL TO RUN
- USE A 320 FT DRAINAGE PATH WITH 3% SLOPE FOR LAYER #1 LATERAL DRAINAGE

4 of 16
07-011

CASE #1 - EXISTING COVER CONDITIONS

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\PRE1.D4
TEMPERATURE DATA FILE:        C:\HELP3\TEMP1.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\SOLAR1.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\EVAPO1.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\SOIL1.D10
OUTPUT DATA FILE:             C:\HELP3\OUT1.OUT


TIME:  10:34     DATE:   3/30/2007


******************************************************************************

     TITLE:  WVNS - NDA Existing Cap

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   6
          THICKNESS                  =      6.00   INCHES
          POROSITY                   =      0.4530 VOL/VOL
          FIELD CAPACITY             =      0.1900 VOL/VOL
          WILTING POINT              =      0.0850 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.3418 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.720000011000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                         TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =     48.00   INCHES
          POROSITY                   =      0.4710 VOL/VOL
          FIELD CAPACITY             =      0.3420 VOL/VOL
          WILTING POINT              =      0.2100 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.4710 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.499999987000E-04 CM/SEC
```

6 of 16
D7-21

3.02	2.40	2.97	3.06	2.89	2.72
2.96	4.16	3.37	2.93	3.62	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK
AND STATION LATITUDE = 42.93 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.01	2.36	2.93	2.88	2.65	2.63
	2.84	3.88	3.12	2.98	3.74	3.20
STD. DEVIATIONS	1.00	0.90	0.99	1.18	1.08	1.05
	1.53	1.92	1.39	1.30	1.48	0.78
RUNOFF						
TOTALS	0.887	1.199	4.437	1.781	0.027	0.005
	0.012	0.036	0.012	0.006	0.013	0.224
STD. DEVIATIONS	1.068	1.019	2.562	2.023	0.140	0.022
	0.039	0.109	0.030	0.019	0.054	0.410
EVAPOTRANSPIRATION						
TOTALS	0.458	0.416	0.436	1.592	2.394	2.345
	2.355	2.966	2.143	1.493	1.140	0.643
STD. DEVIATIONS	0.084	0.088	0.122	0.750	0.877	0.761
	1.230	1.081	0.799	0.400	0.176	0.151
PERCOLATION/LEAKAGE THROUGH LAYER 2						
TOTALS	0.0232	0.0000	0.2307	1.3162	0.3342	0.3881
	0.4613	0.8591	0.8672	1.3162	2.1646	1.2516
STD. DEVIATIONS	0.1015	0.0000	0.5794	0.5151	0.4167	0.4937
	0.5455	1.0508	0.8632	1.1844	1.3546	0.8234
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.3227	0.2935	0.3217	0.3120	0.3237	0.3134
	0.3241	0.3248	0.3152	0.3269	0.3184	0.3321
STD. DEVIATIONS	0.0961	0.0878	0.0962	0.0929	0.0952	0.0920
	0.0951	0.0947	0.0910	0.0937	0.0895	0.0909

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	2.55	9256.500
RUNOFF	4.160	15101.1436
PERCOLATION/LEAKAGE THROUGH LAYER 2	1.428540	5185.60205
AVERAGE HEAD ON TOP OF LAYER 2	2.596	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.013606	49.39007
AVERAGE HEAD ON TOP OF LAYER 4	360.000	
SNOW WATER	7.84	28464.0410

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4099
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0850

****

CASE #2 - PROPOSED COVER CONDITIONS

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\PRE2.D4
TEMPERATURE DATA FILE:        C:\HELP3\TEMP2.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\SOLAR2.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\EVAPO2.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\SOIL2.D10
OUTPUT DATA FILE:             C:\HELP3\OUT2.OUT


TIME:  10:31      DATE:   3/30/2007


******************************************************************************

     TITLE:  WVNS - NDA Existing Cap

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =      1.00   INCHES
          POROSITY                   =      0.4170 VOL/VOL
          FIELD CAPACITY             =      0.0450 VOL/VOL
          WILTING POINT              =      0.0180 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.3550 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  10.0000000000      CM/SEC
          SLOPE                      =      3.00   PERCENT
          DRAINAGE LENGTH            =    320.0    FEET


                                  LAYER  2
                                  --------

                       TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  41
          THICKNESS                  =      0.03   INCHES
          POROSITY                   =      0.0000 VOL/VOL
          FIELD CAPACITY             =      0.0000 VOL/VOL
          WILTING POINT              =      0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.199999999000E-11 CM/SEC
          FML PINHOLE DENSITY        =      1.00   HOLES/ACRE
          FML INSTALLATION DEFECTS   =      1.00   HOLES/ACRE
          FML PLACEMENT QUALITY      =  3 - GOOD
```

MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	126
END OF GROWING SEASON (JULIAN DATE)	=	285
EVAPORATIVE ZONE DEPTH	=	1.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	12.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	76.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	68.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.02	2.40	2.97	3.06	2.89	2.72
2.96	4.16	3.37	2.93	3.62	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BUFFALO NEW YORK
AND STATION LATITUDE = 42.93 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.01	2.36	2.93	2.88	2.65	2.63
	2.84	3.88	3.12	2.98	3.74	3.20
STD. DEVIATIONS	1.00	0.90	0.99	1.18	1.08	1.05
	1.53	1.92	1.39	1.30	1.48	0.78
RUNOFF						
TOTALS	1.074	1.394	4.637	2.166	0.826	0.991
	1.223	1.857	1.378	1.198	1.328	0.743
STD. DEVIATIONS	1.183	1.108	2.657	1.902	0.557	0.662
	0.908	1.297	0.921	0.798	0.921	0.583
EVAPOTRANSPIRATION						
TOTALS	0.449	0.414	0.403	0.704	0.910	0.730
	0.625	0.846	0.689	0.647	0.724	0.575
STD. DEVIATIONS	0.079	0.089	0.120	0.412	0.400	0.319
	0.366	0.482	0.308	0.276	0.161	0.096

14 oct 6
07-011

CHANGE IN WATER STORAGE	-0.004	(1.2763)	-14.36	-0.011

****

BASICALLY 0 GALLONS/ACRE
- LEACHATE PRODUCTION

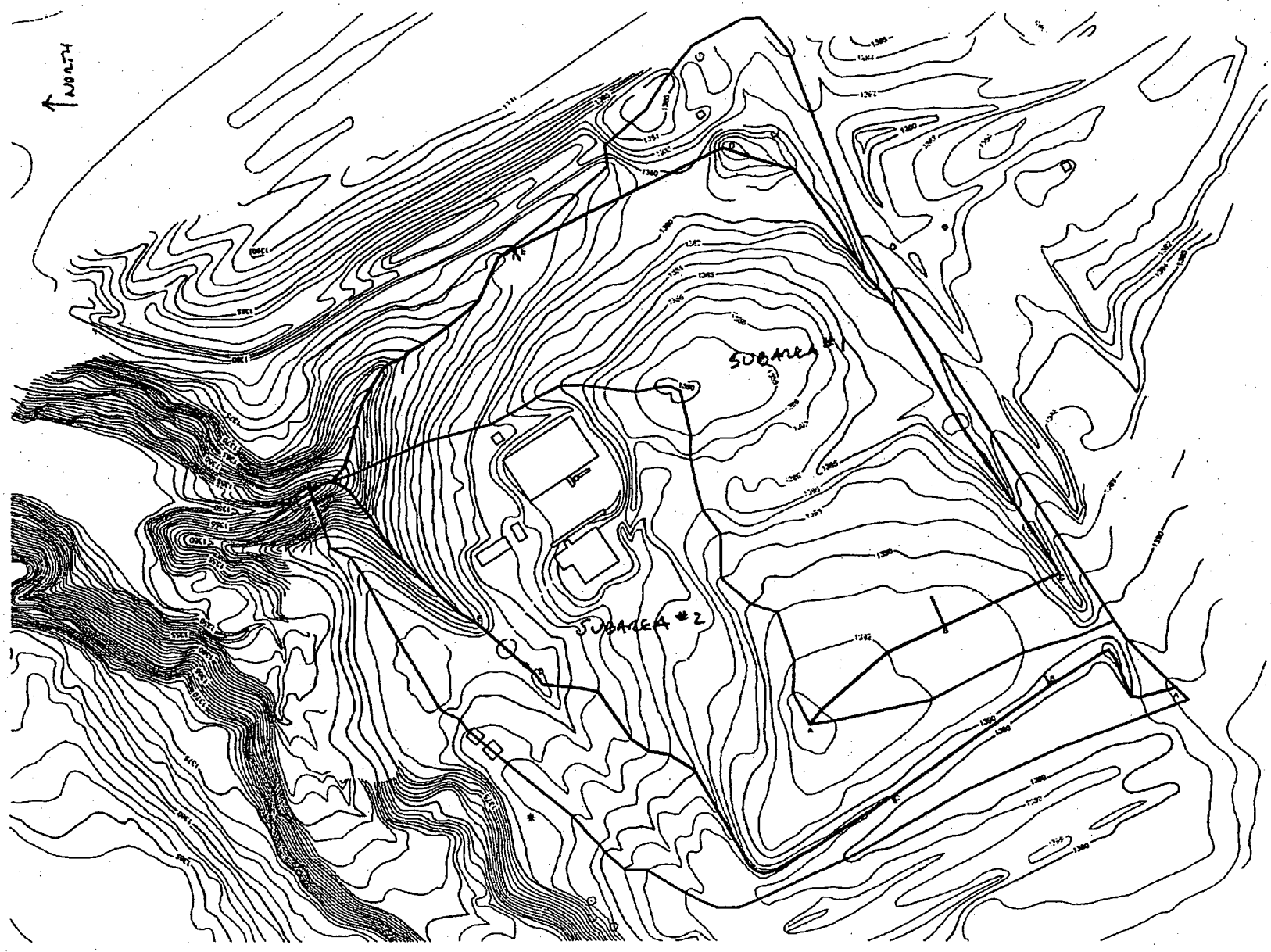
****

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	0.0569	0.0569
2	0.0000	0.0000
3	22.6080	0.4710
4	105.1200	0.2920
5	51.2400	0.4270
SNOW WATER	0.179	

****
****

DWG 07011-003
SCALE: 1" = 120'

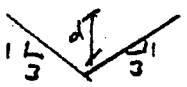


• C - D (CHANNEL FLOW)

LENGTH = 425 LF

SLOPE = (1385 - 1378)/425 = 2.6%

ASSUMED X-SECTION



d ≈ 1.5'
A = 6.75 SF
WP = 9.5 FT
R = 0.71 FT
n = 0.05 (MOWED GRASS)

• D - E (12" Φ CULVERT)

LENGTH = 70 LF

SLOPE = (1378 - 1375)/70 = 4.3%

INLET INV. = 1378

OUTLET INV = 1375

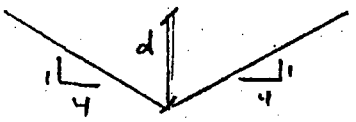
ASSUME 12" Φ CMP → PROJECTING ENDS
n = 0.024

• E - F (CHANNEL FLOW)

LENGTH = 207 LF

SLOPE = (1375 - 1353.5)/207 = 10.4%

ASSUMED X-SECTION



d ≈ 3' MIN
A = 36 SF
WP = 24.74 FT
R = 1.46 FT
n = 0.03 (RIP-RAP)

60-12
07-01

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subarea 1 Runoff Area=4.010 ac Runoff Depth>2.02"
Flow Length=1,279' Tc=23.2 min CN=80 Runoff=8.99 cfs 0.677 af

Subcatchment 2S: Subarea #2 Runoff Area=3.620 ac Runoff Depth>2.02"
Flow Length=1,026' Tc=26.3 min CN=80 Runoff=7.51 cfs 0.610 af

Reach 2R: Erdman Brook Inflow=16.39 cfs 1.287 af
Outflow=16.39 cfs 1.287 af

Total Runoff Area = 7.630 ac Runoff Volume = 1.287 af Average Runoff Depth = 2.02"

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Subcatchment 2S: Subarea #2

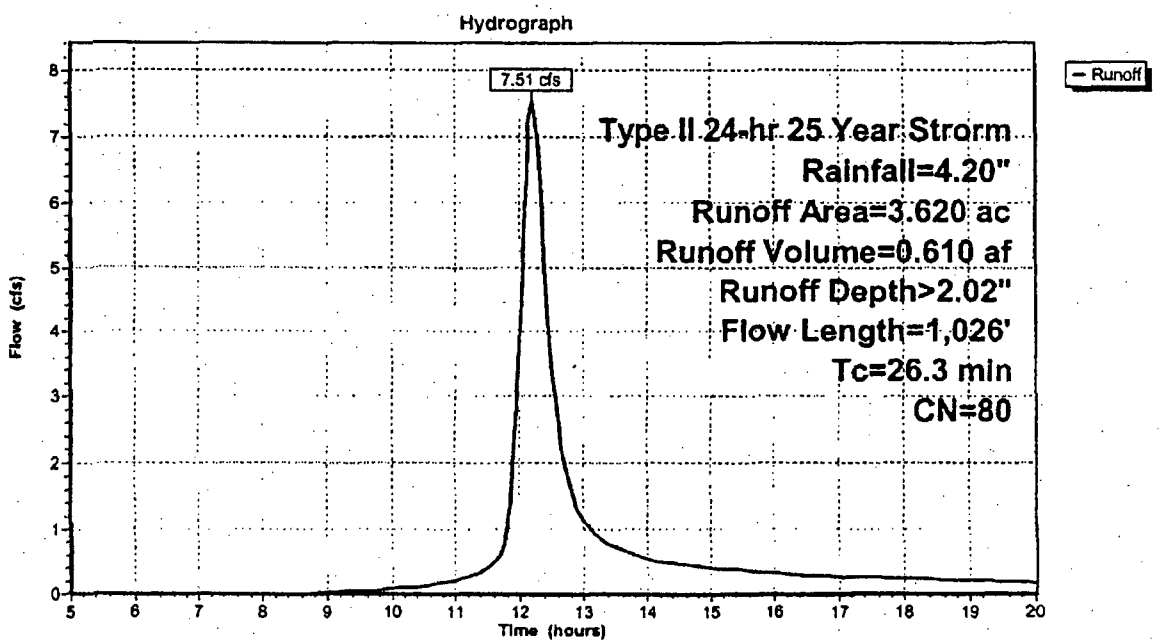
Runoff = 7.51 cfs @ 12.20 hrs, Volume= 0.610 af, Depth> 2.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Year Strorm Rainfall=4.20"

Area (ac)	CN	Description
3.620	80	North half of existing cap

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	150	0.0170	0.2		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 2.50"
7.6	174	0.0030	0.4		**Shallow Concentrated Flow, B to C** Short Grass Pasture Kv= 7.0 fps
1.9	425	0.0260	3.8	25.44	**Channel Flow, C to D** Area= 6.7 sf Perim= 9.5' r= 0.71' n= 0.050
0.2	70	0.0430	5.1	4.00	**Circular Channel (pipe), D to E** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.024
0.2	207	0.1040	20.5	739.24	**Channel Flow, E to F** Area= 36.0 sf Perim= 24.7' r= 1.46' n= 0.030
26.3	1,026	Total			

Subcatchment 2S: Subarea #2



10 0C.2
07-011

Figure B-3 2-year, 24-hr rainfall

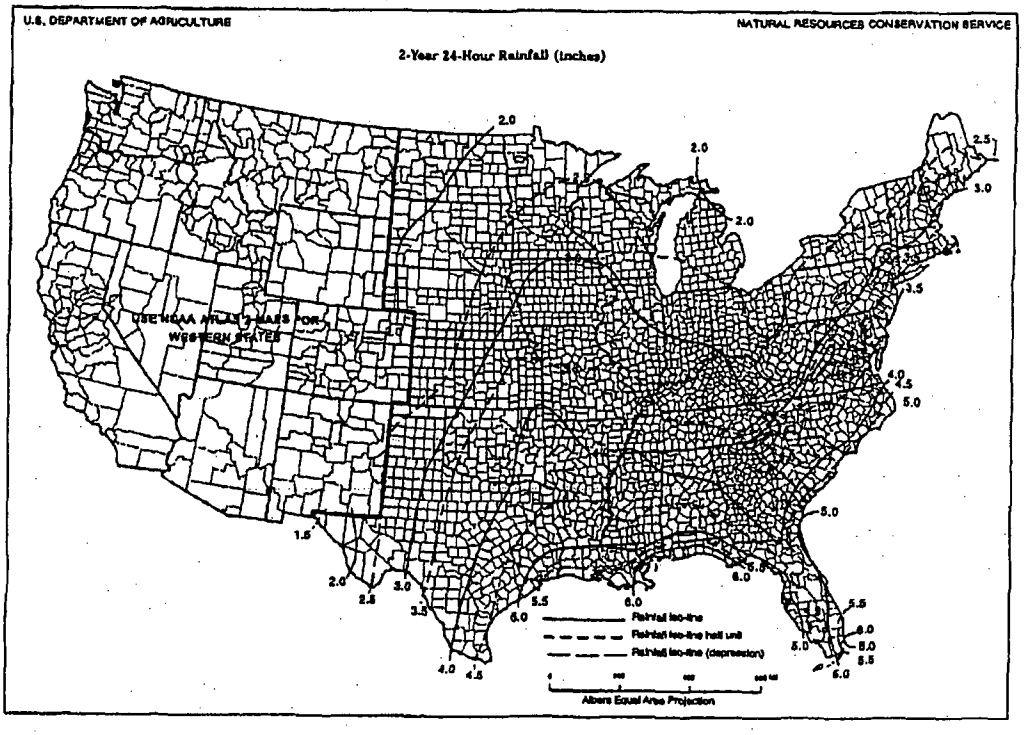
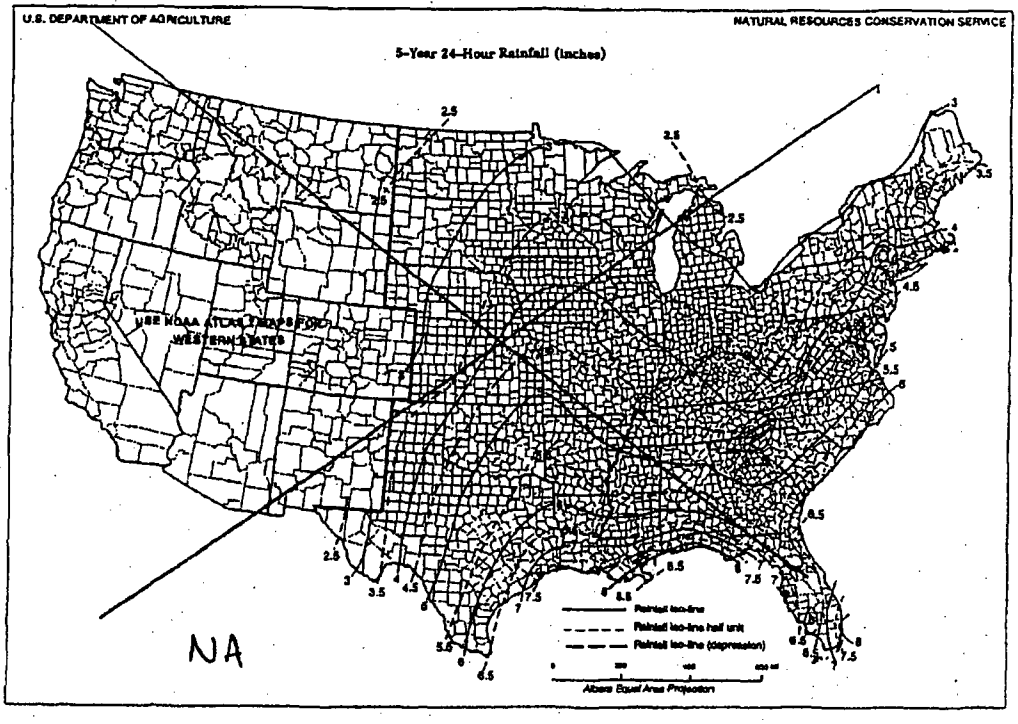


Figure B-4 5-year, 24-hour rainfall



WVDP Annual/Daily Maximum Rain Fall Data
Period: 1990-2007

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)	(Inches)
Yearly Total	26.64	32.76	48.63	37.35	40.13	34.17	44.89	43.23	42.76	30.97	38.05	31.02	39.96	40.99	43.21	38.52	45.96	3.55
Daily Maximum	1.84	1.45	1.64	1.43	1.90	1.22	1.57	1.70	3.75	1.86	1.47	1.40	1.33	1.39	1.99	2.25	1.56	0.83

Anchor Trench and Sand Berm

McMahon & Mann 2495 Main Street, Suite 432 • Buffalo, New York 14214
Consulting Engineers, P.C.

Donald R. McMahon, P.E.
Michael J. Mann, P.E.
Kenneth L. Fishman, Ph.D., P.E.
James Bojarski, P.E.
Shawn W. Logan, P.E
Andrew J. Nichols, P.E.
Todd W. Swackhamer, P.E.

May 31, 2007
File: 07- 011

Mr. Charles C. Keipper
STC Construction, Inc.
P. O. Box 459
Springville, New York 14141-0459

RE: Response to Comments on Anchor Trench and Sand Berm Anchor Calculations, West Valley NDA Slurry Wall and Cap, West Valley, New York

Dear Mr. Keipper;

McMahon & Mann Consulting Engineers, P.C. (MMCE) has received Approval Request (AR) comments from West Valley Nuclear Services, Co. (WVNSCO) regarding our calculations supporting the design of the anchor trenches and sand berm anchors for the NDA cap at the West Valley facility. This letter summarizes our responses to the comments. The original comments are included as italicized text followed by MMCE's response.

Comment No. 1 – Please provide a Factor of Safety (FS) for the ballast fill on the slope, provide basis

MMCE has provided a stability analysis of the "Typical Anchor Trench Section for 3H:1V Slope" (as shown on Sheet 11 of 13 of Revision 3 of the West Valley Nuclear Services NDA Cap and Groundwater Barrier Drawings). This analysis is included on Sheet 5 of 5 of Revision B of the attached calculations.

Comment No. 2 – Please confirm that the 14% yield for berm anchors is acceptable yield for XR-5. Provide documentation from the geomembrane manufacturer.

Sheet 3 of 4 of the calculations show a 0.14 percent strain rather than a 14 percent strain.

Comment No. 3 – Review use of geotextile between geomembrane and trench anchor back fill on the slope. It may reduce coefficient of friction and allow sliding.

We concur with this comment and will remove the cushion geotextile that covers the geomembrane in the "Typical Anchor Trench Section for 3H:1V Slope" (Sheet 11 of 13 of the drawings).

Sincerely yours,

McMAHON & MANN CONSULTING ENGINEERS, P.C.

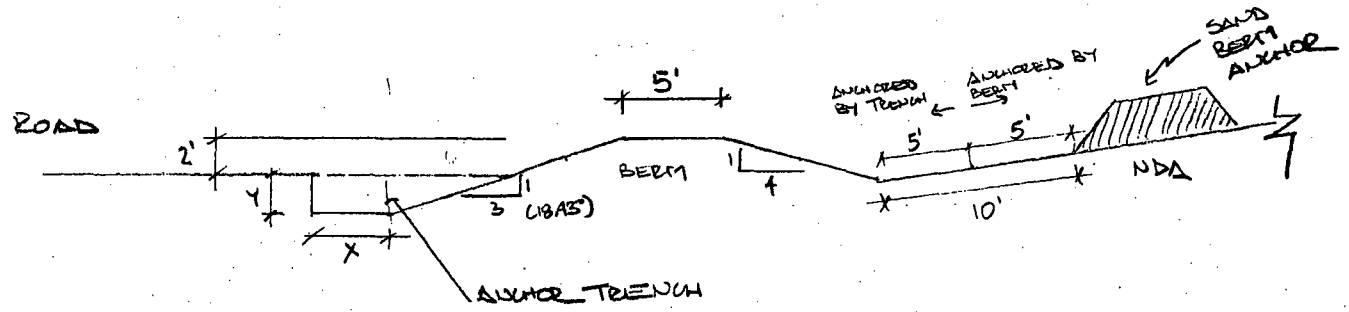
Todd Swackhamer, P.E.

Donald R. McMahon, P.E.

Attachment

cc – K.K. Gupta (WVNSCO)

IDEALIZED BERM SECTION - NTS



ANCHOR TRENCH NEEDS TO ANCHOR XR-5 LINER OVER BERM AND HALF DISTANCE TO CLOSEST "SAND BERM ANCHOR" ON CAP.

SAY BOTTOM ROW OF "SAND BERM ANCHORS" ARE 10' FROM TOE OF CAP

EXPOSED LINER (PER LINEAR FOOT) $= 5' + 2' \cdot \sqrt{1^2 + 4^2} + 5' + 2' \cdot \sqrt{1^2 + 3^2}$

$= 5' + 8.25' + 5' + 6.32'$

$= 24.6'$

FROM WVNS-SDC-127 - SUMMARY DESIGN CRITERIA THE LINER SHALL BE STABILIZED AGAINST UPLIFT FORCES OF 70 MPH w/ EXPOSURE C (9 lbs/ft²)

THEREFORE, THE ANCHOR TRENCH MUST BE ABLE TO ANCHOR A FORCE OF $= 24.6' \cdot 9\ \text{lb/ft}^2 = 221.4\ \text{lb/ft} = T$

FROM SEAMAN'S REPRESENTATIVE INTERFACE FRICTION ANGLE BETWEEN SAND AND XR-5 LINER HAS BEEN MEASURED TO BE 33.8° δ_L

IF THE ANCHOR TRENCH WILL BE Y = 2' DEEP, ESTIMATE THE REQ'D LENGTH, X OF EMBEDMENT IN THE TRENCH.

$$X = \frac{T - \gamma'_{BALLFILL} \cdot Y^2 \cdot 3/2 \cdot \tan\delta'_L \cdot \cos 18.8^\circ}{\gamma'_{BALLFILL} \cdot Y \cdot \tan\delta'_L}$$

THIS TERM ACCOUNTS FOR THE WEDGE ALONG THE TOE OF THE BERM

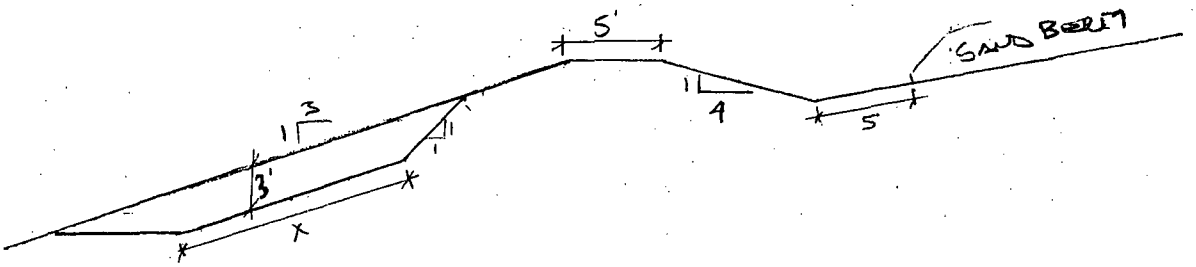
SAY $\gamma'_{BALLFILL} = 115\ \text{pcf} - 62.4\ \text{pcf} = 52.6\ \text{pcf}$ $\quad Y = 2'$

$\delta'_L = \delta_L/2 = 33.8^\circ/2 = 16.9^\circ$

$$X = \frac{221.4\ \text{lb/ft} - (52.6\ \text{pcf})(2')^2\, 3/2 \cdot \tan 16.9^\circ \cdot \cos 18.8^\circ}{52.6\ \text{pcf} \cdot 2' \cdot \tan 16.9^\circ} = \frac{221.4\ \text{lb/ft} - 91.0\ \text{lb/ft}}{32.0\ \text{pcf}} = 4.075'$$

SAY 4.5'

IDEALIZED CROSS SECTION AT
3:1 SLOPE



FROM SHEET 1, T = 221.4 lb/FT

THE VERTICAL DEPTH OF STORE AT ANY POINT ON THE LINER = 3'

THE NORMAL PRESSURE ALONG THE SLIDING SURFACE

$= 3' \cdot \cos 18.43° \cdot 52.6 \text{ pcf} = 149.7 \text{ lb/ft}^2$

ASSUME (CONSERVATIVELY) THAT THE TRENCH RETAINS WATER
∴ USE EFFECTIVE UNIT WEIGHT.

$$X = \frac{T}{\gamma'_{BACKFILL} \cdot 2.85 \cdot \tan \delta_L'}$$

$\delta_L' = 16.9°$

$\gamma'_{BACKFILL} = 52.6 \text{ pcf}$

$$= \frac{221.4 \text{ lb/ft}}{(149.7 \text{ lb/ft}^2) \cdot \tan 16.9°}$$

$= 4.86'$ SAY 5'

SIZE AND SPACE SAND ANCHOR BERMS BASED ON MAXIMUM ALLOWABLE TENSION IN THE XR-5 LINER

BASED ON GEOMEMBRANE SPECIFICATIONS FOR XR-5 8130 THE GRAB YIELD STRENGTH OF A 4"x6" SAMPLE IS 550 lb IN EITHER DIRECTION (MINIMUM). ADDITIONALLY, THE BONDED SEAM STRENGTH MUST BE GREATER THAN THE PARENT MATERIAL.

THEREFORE TENSION IN LINER SHOULD BE LIMITED TO

$$\frac{550\ \text{lb}}{4''} \cdot 12''/1 = 1650\ \text{lb/FT}$$

SAY, THE MAXIMUM ACCEPTABLE UPLIFT DURING THE MOST EXTREME WINDSTORM BETWEEN SAND BERMS IS 1 FT W/O THE LINER YIELDING.

ASSUME THAT LINER ACTS AS A PARABOLIC CABLE UNDER A UNIFORMLY DISTRIBUTED LOAD (THE WIND PRESSURE) IN THESE CASES

THE TENSION IN SUCH A CABLE IS ESTIMATED BY THE FOLLOWING EQUATION:

$$H = \frac{wa^2}{2S}$$

WHERE H = MAX. TENSION, lb
w = DISTRIBUTED VERTICAL LOAD, lb/FT
a = DISTANCE FROM END OF CABLE TO CENTER, FT
S = VERTICAL SAG IN CABLE, FT

ASSUME ONE FOOT UNIT WIDTH OF LINER ACTING AS A PARABOLIC CABLE

$$1650\ \text{lb} = \frac{9\ \text{lb/FT} \cdot a^2}{2 \cdot 1\ \text{FT}} \quad \text{SOLVE FOR } a$$

$$a = 19.1\ \text{FT}$$

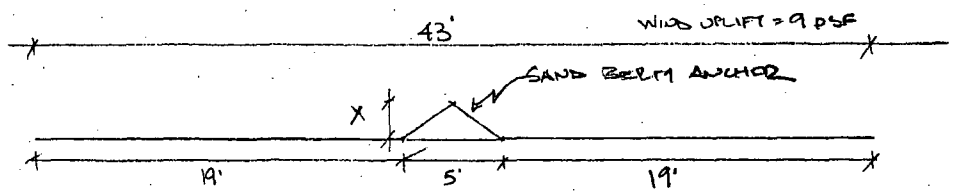
SPACING BETWEEN EDGES OF ADJACENT BERMS IS $2a = 19.1 \times 2 = 38.2$ SAY 38 FT

CHECK STRAIN IN THE LINER DURING THIS CASE

$a = 19.1485'$ $S = 1'$ $L = \sqrt{(19.1485)^2 + (1)^2}$ (IDEALIZED TRIANGLE)
$= 19.1746$ FT

$$\text{STRAIN, \%} = \frac{19.1746 - 19.1485}{19.1485} \times 100\% = 0.14\ \%$$

SAY THE SAND BERM ANCHORS WILL BE FIVE FEET WIDE TO ACCOMODATE CONSTRUCTION. THEREFORE DESIGN FOR THE FOLLOWING CONFIGURATION:



SAY SAND BERM ANCHOR IS IDEALIZED AS TRIANGULAR IN CROSS-SECTION. WITH A FACTOR OF SAFETY OF 1.5 TO ALLOW FOR VARIATIONS DURING CONSTRUCTION ESTIMATE THE REQ HEIGHT, X, OF THE SAND FILLED BERM.

$\gamma_{SAND} = 100$ PCF (LIGHTLY TAMPED IN PLACE)

$$43' \cdot 9\ lb/ft^2 = \frac{\frac{5'}{2} \cdot X \cdot 100\ pcf}{1.5} \Rightarrow X = 2.3' \text{ SAY } 2.5'$$

NOT REASONABLE FOR CONSTRUCTABILITY. SLOPE OF TRIANGLE = 1:1

TRY WITH DIFFT BERM WIDTHS

$$6' \Rightarrow 43' \cdot 9\ psf = \frac{\frac{6'}{2} \cdot X \cdot 100\ pcf}{1.5} \Rightarrow X = 1.98' \text{ SAY } 2.0'$$

SIDE SLOPE = 1.5:1

$$7' \Rightarrow 43' \cdot 9\ psf = \frac{\frac{7'}{2} \cdot X \cdot 100\ pcf}{1.5} \Rightarrow X = 1.73 \text{ SAY } 1.75'$$

SIDE SLOPE = 2:1

USE THIS CONFIGURATION

McMahon & Mann
Consulting Engineers, P.C.

BY TWS DATE 5.30.07 SUBJECT WEST VALLEY NUCLEAR SERVICES SHT. NO. 5 OF 5
CHKD. BY DRM DATE 5/31/07 NDA CAP DESIGN JOB NO. 07-011
ANCHOR TRENCH & SAND BERM CHECK REV. B.

ALTERNATE ANCHOR TRENCH (SHEET 2 OF 4)
WILL HAVE A MAXIMUM SLOPE OF 3H:1V

THE TRENCH WILL BE BACKFILLED W/ DRAINAGE STONE THAT WILL HAVE A FRICTION ANGLE OF 30° (MIN.) BASED ON EXPERIENCE WITH THIS MATERIAL.

THE MOST CONSERVATIVE ANALYSIS IS INFINITE SLOPE STABILITY WHERE

$$FS = \frac{\tan \phi}{\tan i}$$

$$= \frac{\tan 30^\circ}{\tan 18.43^\circ}$$

$$= 1.73 > 1.5 \checkmark$$

Existing Soil Piles Analysis and Report

McMahon & Mann 2495 Main Street, Suite 432 • Buffalo, New York 14214
Consulting Engineers, P.C.

Donald R. McMahon, P.E.
Michael J. Mann, P.E.
Kenneth L. Fishman, Ph.D., P.E.
James Bojarski, P.E.
Shawn W. Logan, P.E
Andrew J. Nichols, P.E.
Todd W. Swackhamer, P.E.

May 30, 2007
File: 07-011

Mr. Charles C. Keipper
Butler Construction Co. of WNY, Inc.
63 Zoar Valley Road
P. O. Box 550
Springville, NY 14141-0550

RE: Review of Borrow Source Sample Test Data,
WVNSCO NDA Cap and Barrier Wall,
West Valley, New York

Dear Mr. Keipper;

McMahon & Mann Consulting Engineers, P.C. (MMCE) has reviewed the results of tests completed on soil samples collected from two prospective borrow piles and considers one pile suitable for the groundwater barrier construction.

West Valley Nuclear Service Company (WVNSCO) engaged Empire Geo Services, Inc. (Empire) to collect six soil samples from each of two prospective borrow piles at the West Valley Demonstration Project site and test those samples for particle size distribution, moisture content, Atterberg limits and moisture-density relationship. Empire furnished the test data to MMCE to allow MMCE to estimate the suitability of these borrow piles for construction of the NDA groundwater barrier and cap.

MMCE has prepared technical specifications for this project. We have specified that the soil for the soil-bentonite backfill in the groundwater barrier wall must have 100 percent of the soil finer than a 3-inch sieve and must have at least 30 percent finer than a No. 200 sieve. We specified that embankment material for construction of the final grades on the cap and the groundwater barrier working platform must have 100 percent finer than the 1-inch sieve.

South Stockpile:

Empire collected six soil samples from the soil stockpile located south of the drum cell area and labeled these soils samples as 110S-1 through 110S-6. The following table summarizes the test data.

Sample Identification	Moisture Content, %	Liquid Limit, %	Plasticity Index	Fraction Passing 1-inch Sieve, %	Fraction Passing No. 200 Sieve, %
110S-1	18.3	32	18	94.1	47.0
110S-2	18.1	34	19	98.1	67.1
110S-3	16.5	34	19	94.7	58.4
110S-4	15.2	28	15	96.1	66.6
110S-5	18.2	30	15	92.6	52.7
110S-6	19.2	31	15	65.3	34.4

Discussion:

Soil-Bentonite Backfill: The test data for the samples collected from the stockpile south of the drum cell meet the technical specifications for the soil-bentonite backfill. However, the moisture content data indicate that the soil is moist and is not friable. The soil should be dried before attempting to mix it with bentonite for the soil-bentonite backfill so that the fine grained soil fraction can be evenly mixed into the soil-bentonite backfill.

The soil samples do not meet the specification for embankment material because the fraction coarser than the 1-inch exceeds that allowed. However, the specification for embankment material could be adjusted to allow use of this soil except for the uppermost lift, the lift closest to the geomembrane. The specification could also be adjusted to allow it for construction of the groundwater barrier working platform.

North Stockpile:

Empire collected six soil samples from the stockpile located west of the NDA and labeled them as 110N-1 through 110N-6. The following table summarizes that test data from those samples.

Sample Identification	Moisture Content, %	Liquid Limit,%	Plasticity Index	Fraction Passing 1-inch Sieve, %	Fraction Passing No. 200 Sieve, %
110N-1	13.9	30	16	87.8	35.4
110N-2	10.8	27	10	89.7	32.1
110N-3	10.0	28	13	78.6	24.5
110N-4	7.1	--	NP	87.7	15.3
110N-5	7.7	--	NP	87.6	17.6
110N-6	6.2	--	NP	85.0	9.8

Discussion:

Four of the soil samples tested do not meet the specification for the soil-bentonite backfill in that the fraction passing the No. 200 sieve is less than the minimum specified. A fine-grained soil fraction as low as that measured in these four samples when mixed with bentonite would likely not meet the permeability requirements for the groundwater barrier.

Each of the six soil samples tested has a soil fraction greater than 1 inch, which is more than the specifications allow for embankment material. However, as stated for the south stockpile, the specifications could be adjusted to allow this soil for embankment material except for the lift closest to the geomembrane. The specifications could also be adjusted to allow this material for construction of the groundwater barrier working platform.

Sincerely yours,

McMAHON & MANN CONSULTING ENGINEERS, P.C.

Donald R. McMahon

Donald R. McMahon, P.E.

cc: K. K. Gupta - WVNSCO

NDA Cap and Groundwater Barrier Interim Measure

Table of Onsite Soil Quantities
Available for Construction

June 01, 2007

Stockpile	Approx Quantity	Remarks
110 South South of Drum Storage Building	6,000 – 7,000 CY	Suitable for Soil-Bentonite Mix, Lower strata NDA Embankment, Groundwater Barrier Working Platform
110 North West of NDA	4,000 – 5,000 CY	Suitable for Lower strata NDA Embankment, Groundwater Barrier Working Platform
Barrier Wall Excavated Soils	2000 CY	Suitable for Lower strata NDA Embankment Clay Layer at NDA Retention Basins

It is estimated that approximately 21,000 CY of material will be required to complete the proposed drainage contours. This is an estimated quantity that should be confirmed by the Contractor during the bid stage.

EMPIRE GEO SERVICES, INC.

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Fax: (716) 649-8051

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PO Box 2199
Ballston Spa, NY 12020

5 Knabner Road
Mechanicville, NY 12118
Phone: (518) 899-7491
(518) 899-7496

☐ CORTLAND OFFICE
60 Miller Street
Cortland, NY 13045
Phone: (607) 758-7182
Fax: (607) 758-7188

☐ ROCHESTER OFFICE
535 Summit Point Drive
Henrietta, NY 14467
Phone: (585) 359-2730
Fax: (585) 359-9668

May 30, 2007
Project No. BE-06-067

Mr. KK Gupta
West Valley Nuclear Services Company, LLC
10282 Rock Springs Road
West Valley, New York 14171-9799

Re: Soil Sampling and Geotechnical Laboratory Testing Results
Stockpile 110 North and 110 South
West Valley Nuclear Services Company
West Valley, New York

Dear Mr. Gupta:

Empire Geo-Services, Inc. (Empire) is pleased to submit the following soil sampling summary and attached geotechnical laboratory test results for the above referenced soil stockpiles. Empire was on site to observe and document the soil sampling of the two soil stockpiles, completed by West Valley Nuclear Services Company, on May 9, 2007.

110 South Stockpile

The first soil stockpile is identified as 110 South and is located near the Drum Cell. Six samples were collected from the 110 South stockpile at the approximate locations shown on the attached sketch. The samples were designated 110S-1 through 110S-6.

The soil in the 110 South stockpile consisted mainly of silty clay with varying amounts of sand and gravel. The upper 12 to 18 inches of soil at each sample location consisted mainly of gravel and sand. The top of the sample interval ranged between 24 and 30 inches and the bottom of the sample interval ranged between 36 and 40 inches. Based on visual observations and the reported origin of the silty clay soils (rail spur), they appear to consist of Lavery till. The upper 1.0 to 1.5 feet of gravel and sand may have originated from the area of the Remote Handled Waste Facility (RHWF) on the north plateau.

It is roughly estimated that the 110 South stockpile contains about 6,000 to 7,000 cubic yards. A more accurate estimate could be obtained by surveying the pile.

110 North Stockpile

Six samples were collected from the 110 North stockpile at the approximate locations shown on the attached sketch. The samples were designated 110N-1 through 110N-6.

The soils in the 110 North stockpile consisted mainly of gravel, sand, and cobbles with varying amounts of silty clay and boulders. The top of the sample interval ranged between 24 and 30 inches and the bottom of the sample interval ranged between 36 and 40 inches. The granular nature of these soils is consistent with their reported origin from the north plateau, in the area of the RHWF. It is roughly estimated that the 110 North stockpile contains about 4,000 to 5,000 cubic yards. A more accurate estimate could be obtained by surveying the pile.

Geotechnical Laboratory Testing

The collected soil samples were transported to SJB Services, Inc. (SJB's) geotechnical testing laboratory and tested for: moisture content, particle size analysis, liquid and plastic limits, and organic content. In addition, two composite soil samples from each stockpile were tested for modified proctor. The laboratory data are attached.

Closing

Please contact the undersigned should you have any questions or wish to discuss this report. Thank you for considering Empire for this work and we look forward to working with you in the future.

Sincerely,

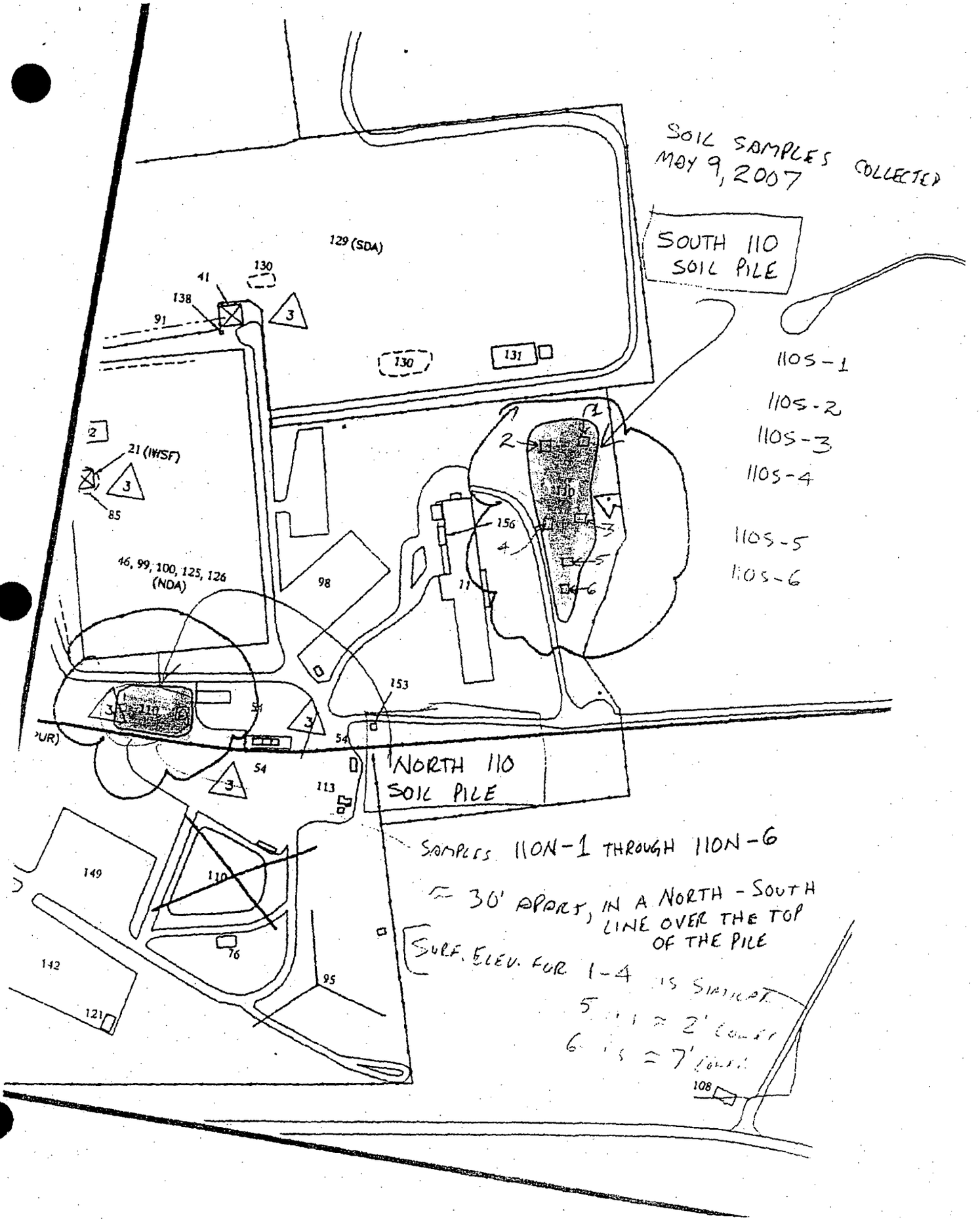
EMPIRE GEO-SERVICES, INC.

David Steiner
Senior Engineering Geologist

Thomas R. Seider, P.E.
Senior Geotechnical Engineer

Attachments:

- Soil Sample Location Sketch
- Geotechnical Laboratory Test Results


SOIL SAMPLES COLLECTED MAY 9, 2007
SOUTH 110 SOIL PILE
110S-1
110S-2
110S-3
110S-4
110S-5
110S-6
129 (SDA)
130
41
138
91
131
21 (IWSF)
85
46, 99, 100, 125, 126 (NDA)
98
156
11
153
54
113
NORTH 110 SOIL PILE
SAMPLES 110N-1 THROUGH 110N-6
≈ 30' APART, IN A NORTH - SOUTH LINE OVER THE TOP OF THE PILE
SURF. ELEV. FOR 1-4 IS SIMILAR
5 IS ≈ 2' LOWER
6 IS ≈ 7' LOWER
149
142
121
76
95
108

EMPIRE GEO SERVICES, INC.

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May 30, 2007
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Sincerely,

EMPIRE GEO-SERVICES, INC.

David Steiner
Senior Engineering Geologist

Thomas R. Seider, P.E.
Senior Geotechnical Engineer

Attachments:

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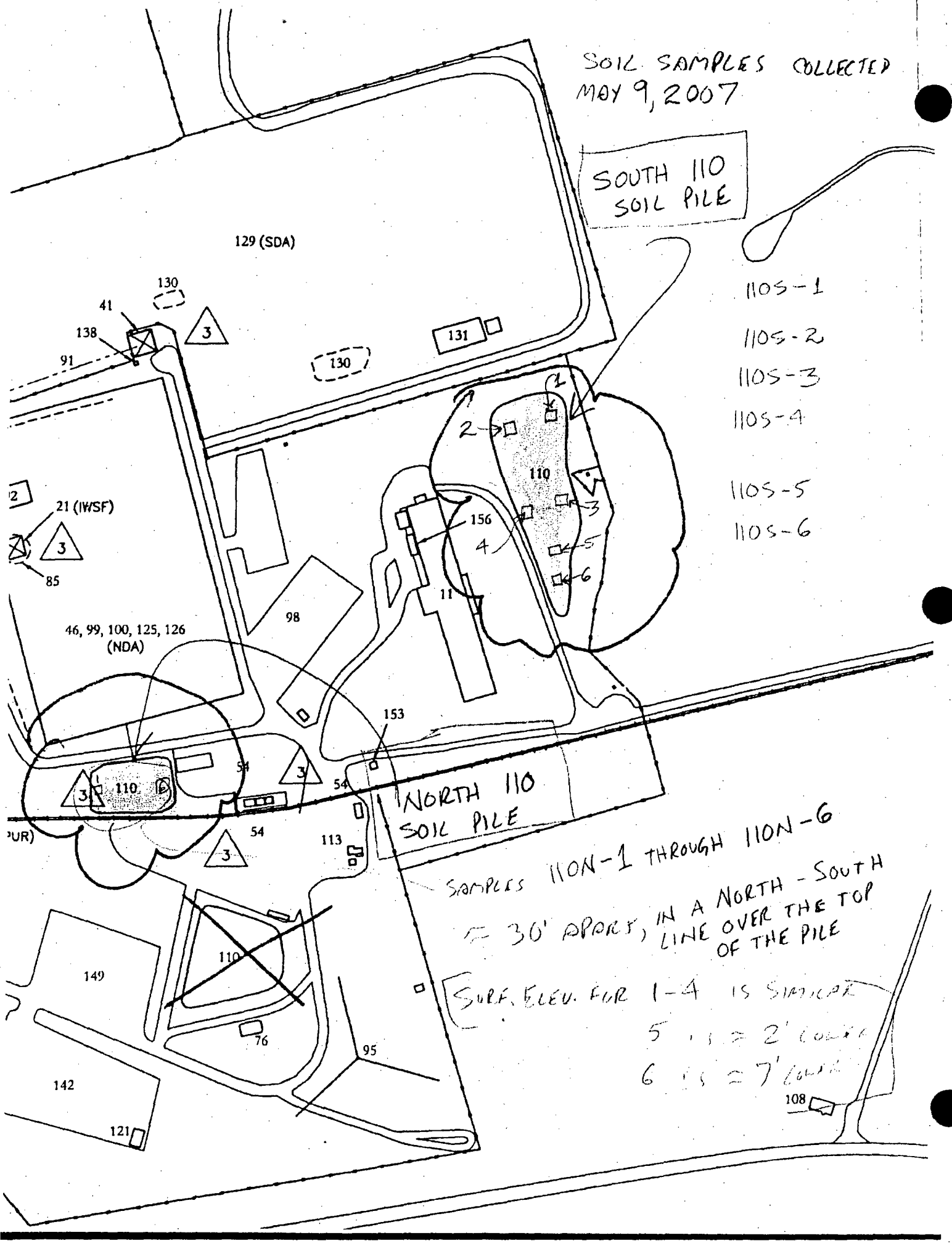
SOIL SAMPLES COLLECTED
MAY 9, 2007
SOUTH 110
SOIL PILE
110S-1
110S-2
110S-3
110S-4
110S-5
110S-6
129 (SDA)
130
41
138
91
131
21 (IWSF)
85
46, 99, 100, 125, 126
(NDA)
98
156
11
110
153
54
113
NORTH 110
SOIL PILE
SAMPLES 110N-1 THROUGH 110N-6
≈ 30' APART, IN A NORTH - SOUTH
LINE OVER THE TOP
OF THE PILE
SURF. ELEV. FOR 1-4 IS SIMILAR
5 " " = 2' LOWER
6 " " = 7' LOWER
149
142
121
76
95
108

Contract
Drilling
and
Testing

SJB SERVICES, INC.

BUFFALO OFFICE
5167 South Park Avenue
Hamburg, NY 14075
Phone: (716) 649-8110
Fax: (716) 649-8051

Laboratory Test Report

PROJECT: **WVNSCO**

CLIENT: **WVNSCO**

DATE: **May 29, 2007**

PROJECT NO.: BE-07-067
REPORT NO.: LTR-1

Sample Number: 07-445
Sample Identification: 110S-1

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	96.4
1"	94.1
¾"	90.4
½"	82.5
¼"	73.3
#4	70.0
#10	57.9
#20	54.9
#40	53.0
#100	49.7
#200	47.0

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
30.0%	23.0%	20.0%	27.0%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
18.3 %	32	14	18

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.3 %

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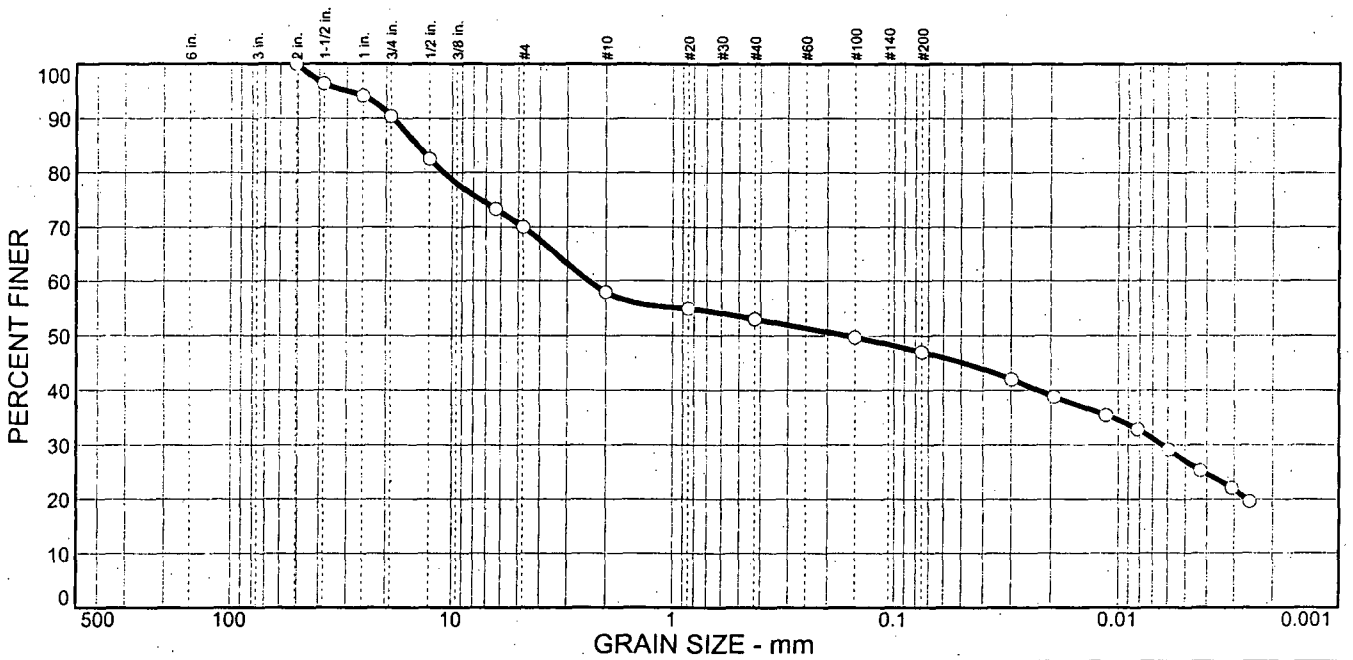
Particle Size Distribution Report

Project: WVNSCO

Project No.: BE-07-067

Client: WVNSCO

Sample No: 07-445 **Source of Sample:** 110S-1 **Date:** 5/29/07
Location: 110S-1 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	30.0	23.0	20.0	27.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	96.4		
1 in.	94.1		
.75 in.	90.4		
.5 in.	82.5		
.25 in.	73.3		
#4	70.0		
#10	57.9		
#20	54.9		
#40	53.0		
#100	49.7		
#200	47.0		

* (no specification provided)

Soil Description

SAMPLE 110S-1
ORGANIC CONTENT = 2.3 %
MOISTURE CONTENT = 18.3 %

Atterberg Limits

PL= 14 LL= 32 PI= 18

Coefficients

D_{85}= 14.4 D_{60}= 2.41 D_{50}= 0.164
D_{30}= 0.0064 D_{15}= D_{10}=
C_u= C_c=

Classification

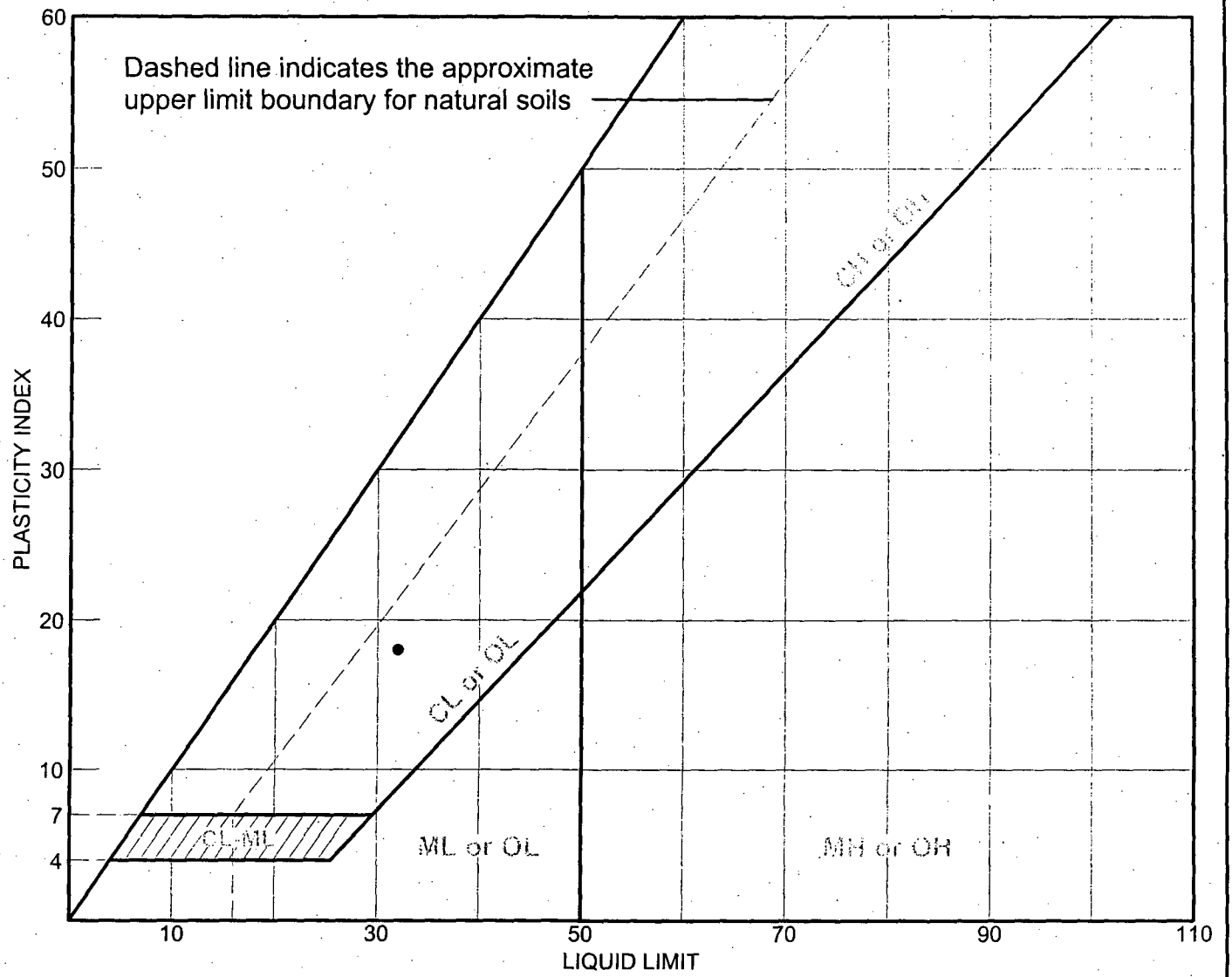
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-445

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110S-1	07-445		18.3 %	14	32	18	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

Contract Drilling and Testing
SJB SERVICES, INC.

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Hamburg, NY 14075
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Laboratory Test Report

PROJECT: WVNSCO

CLIENT: WVNSCO

DATE: May 29, 2007

PROJECT NO.: BE-07-067
REPORT NO.: LTR-2

Sample Number: 07-446
Sample Identification: 110S-2

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
4"	100.0
3"	99.2
2"	99.2
1 ½"	99.2
1"	98.1
¾"	96.6
½"	95.4
¼"	90.8
#4	88.3
#10	85.1
#20	80.4
#40	77.7
#100	70.7
#200	67.1

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
10.9%	21.2%	24.4%	42.7%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
18.1 %	34	15	19

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.1 %

Contract Drilling and Testing
SJB SERVICES, INC.

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Hamburg, NY 14075
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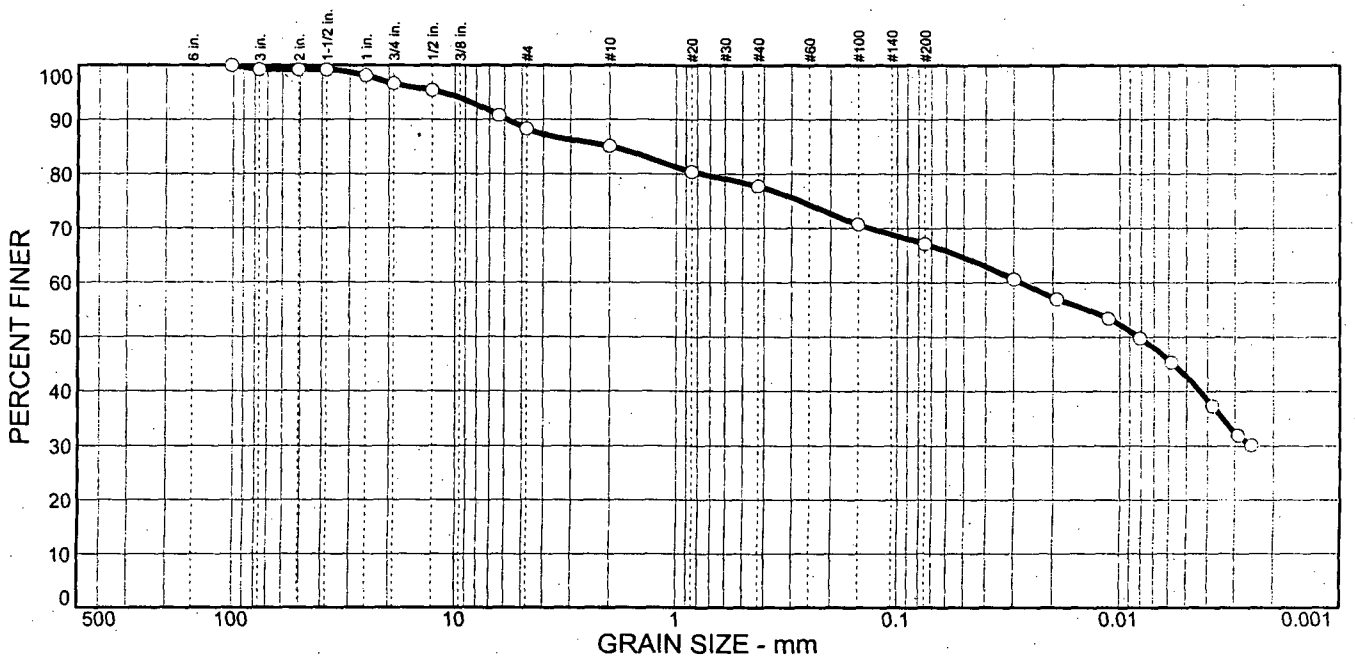
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-446 **Source of Sample:** 110S-2 **Date:** 5/29/07
Location: 110S-2 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.8	10.9	21.2	24.4	42.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4 in.	100.0		
3 in.	99.2		
2 in.	99.2		
1.5 in.	99.2		
1 in.	98.1		
.75 in.	96.6		
.5 in.	95.4		
.25 in.	90.8		
#4	88.3		
#10	85.1		
#20	80.4		
#40	77.7		
#100	70.7		
#200	67.1		

* (no specification provided)

Soil Description

SAMPLE 110S-2
ORGANIC CONTENT = 2.1 %
MOISTURE CONTENT = 18.1 %

Atterberg Limits

PL= 15 LL= 34 PI= 19

Coefficients

D_{85}= 1.95 D_{60}= 0.0278 D_{50}= 0.0082
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

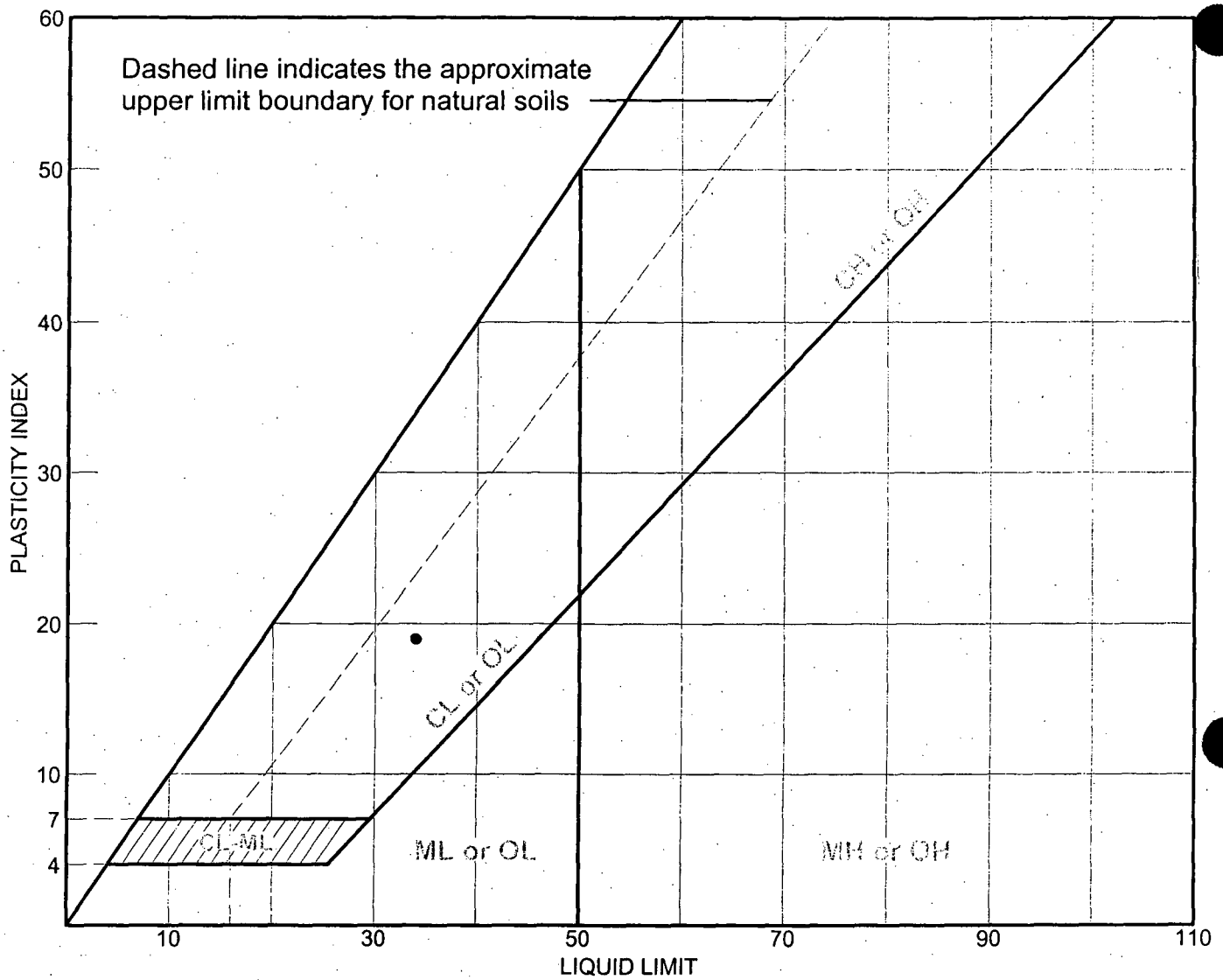
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-446

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110S-2	07-446		18.1 %	15	34	19	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

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Laboratory Test Report

PROJECT: **WVNSCO**

CLIENT: **WVNSCO**

DATE: **May 29, 2007**

PROJECT NO.: BE-07-067
REPORT NO.: LTR-3

Sample Number: 07-447
Sample Identification: 110S-3

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	98.6
1"	94.7
¾"	92.1
½"	87.2
¼"	80.7
#4	77.4
#10	72.1
#20	68.2
#40	66.0
#100	61.4
#200	58.4

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
22.6%	19.0%	22.2%	36.2%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
16.5 %	34	15	19

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.3 %

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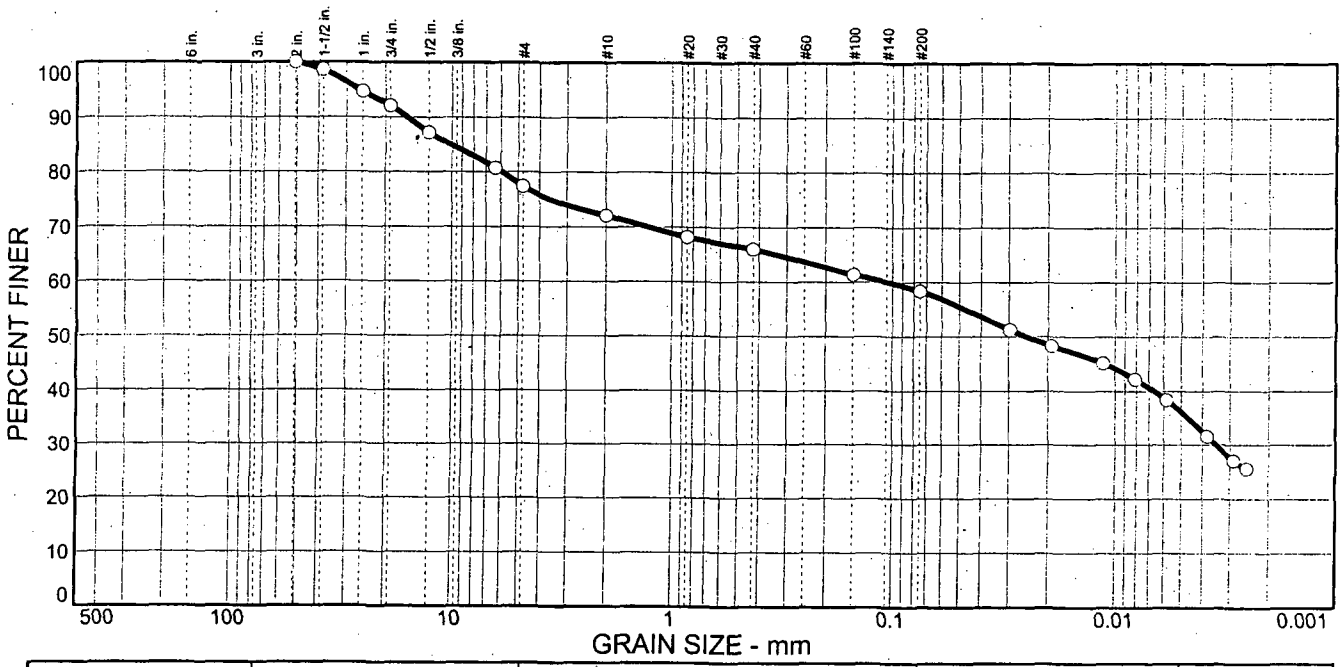
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-447 **Source of Sample:** 110S-1 **Date:** 5/29/07
Location: 110S-3 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	22.6	19.0	22.2	36.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	98.6		
1 in.	94.7		
.75 in.	92.1		
.5 in.	87.2		
.25 in.	80.7		
#4	77.4		
#10	72.1		
#20	68.2		
#40	66.0		
#100	61.4		
#200	58.4		

* (no specification provided)

Soil Description

SAMPLE 110S-3
ORGANIC CONTENT = 2.3 %
MIOSTURE CONTENT = 16.5 %

Atterberg Limits

PL= 15 LL= 34 PI= 19

Coefficients

D_{85}= 10.2 D_{60}= 0.105 D_{50}= 0.0250
D_{30}= 0.0035 D_{15}= D_{10}=
C_u= C_c=

Classification

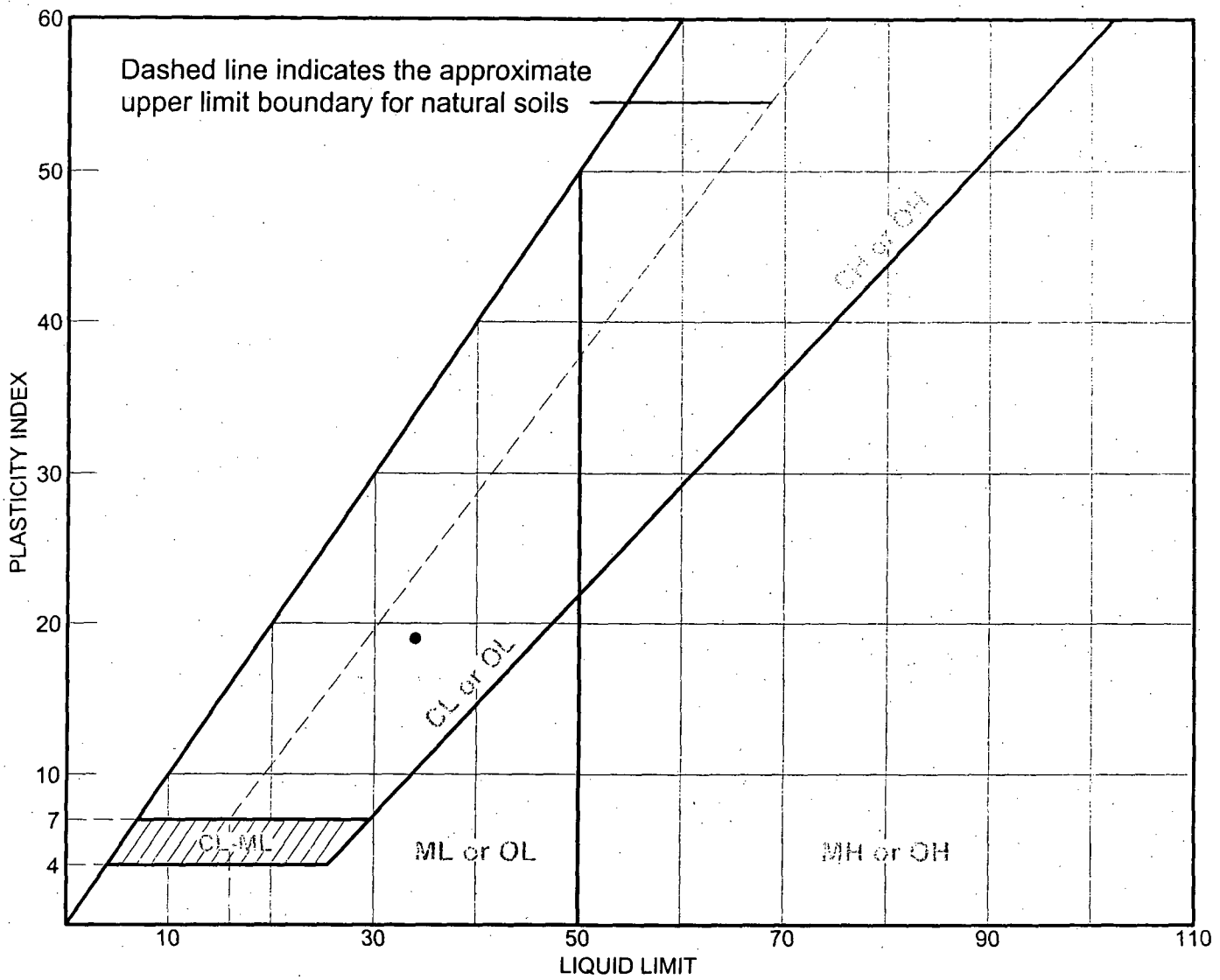
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-447

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110S-3	07-447		16.5 %	15	34	19	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

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Laboratory Test Report

PROJECT: WVNSCO

CLIENT: WVNSCO

DATE: May 29, 2007

PROJECT NO.: BE-07-067
REPORT NO.: LTR-4

Sample Number: 07-449
Sample Identification: 110S-4

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
3"	100.0
2"	98.7
1 ½"	98.7
1"	96.1
¾"	93.7
½"	89.3
¼"	83.6
#4	81.0
#10	77.8
#20	75.2
#40	73.1
#100	69.5
#200	66.6

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
19.0%	14.4%	25.1%	41.5%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
15.2 %	28	13	15

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.0 %

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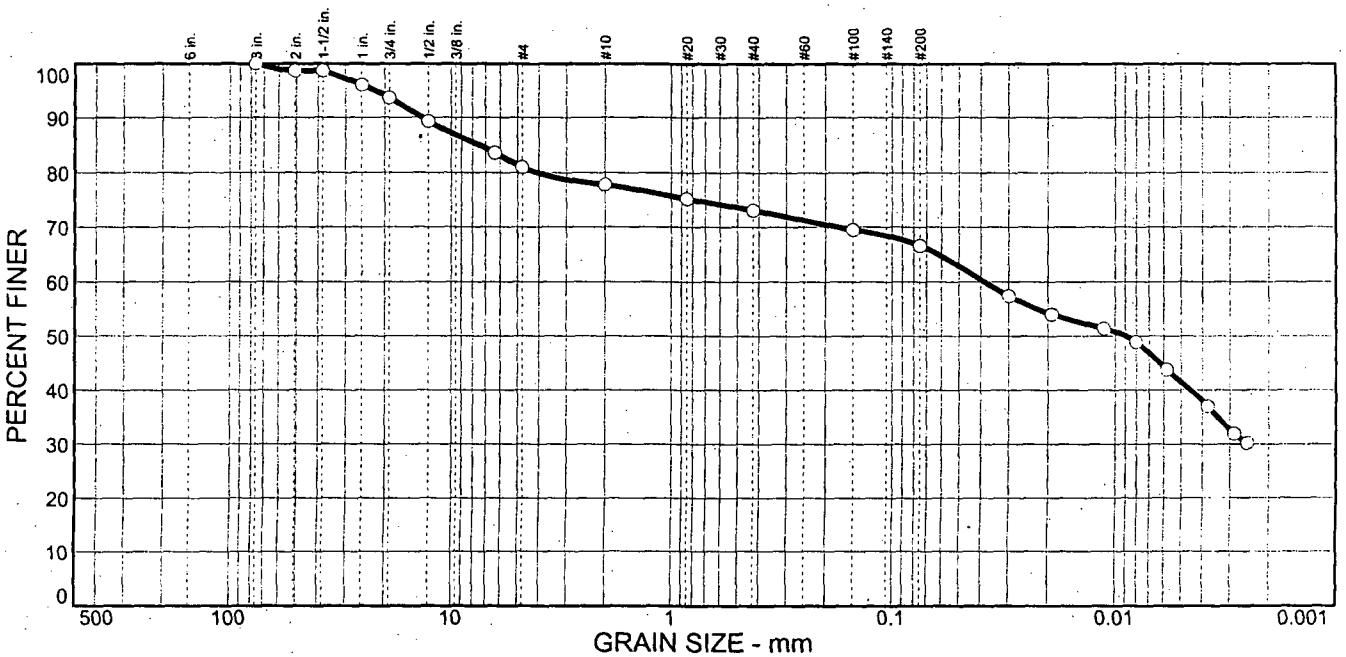
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-449 **Source of Sample:** 110S-4 **Date:** 5/29/07
Location: 11S-4 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	19.0	14.4	25.1	41.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	98.7		
1.5 in.	98.7		
1 in.	96.1		
.75 in.	93.7		
.5 in.	89.3		
.25 in.	83.6		
#4	81.0		
#10	77.8		
#20	75.2		
#40	73.1		
#100	69.5		
#200	66.6		

* (no specification provided)

Soil Description

SAMPLE 110S-4
ORGANIC CONTENT = 2.0 %
MOISTURE CONTENT = 15.2 %

Atterberg Limits

PL= 13 LL= 28 PI= 15

Coefficients

D_{85}= 7.53 D_{60}= 0.0384 D_{50}= 0.0089
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

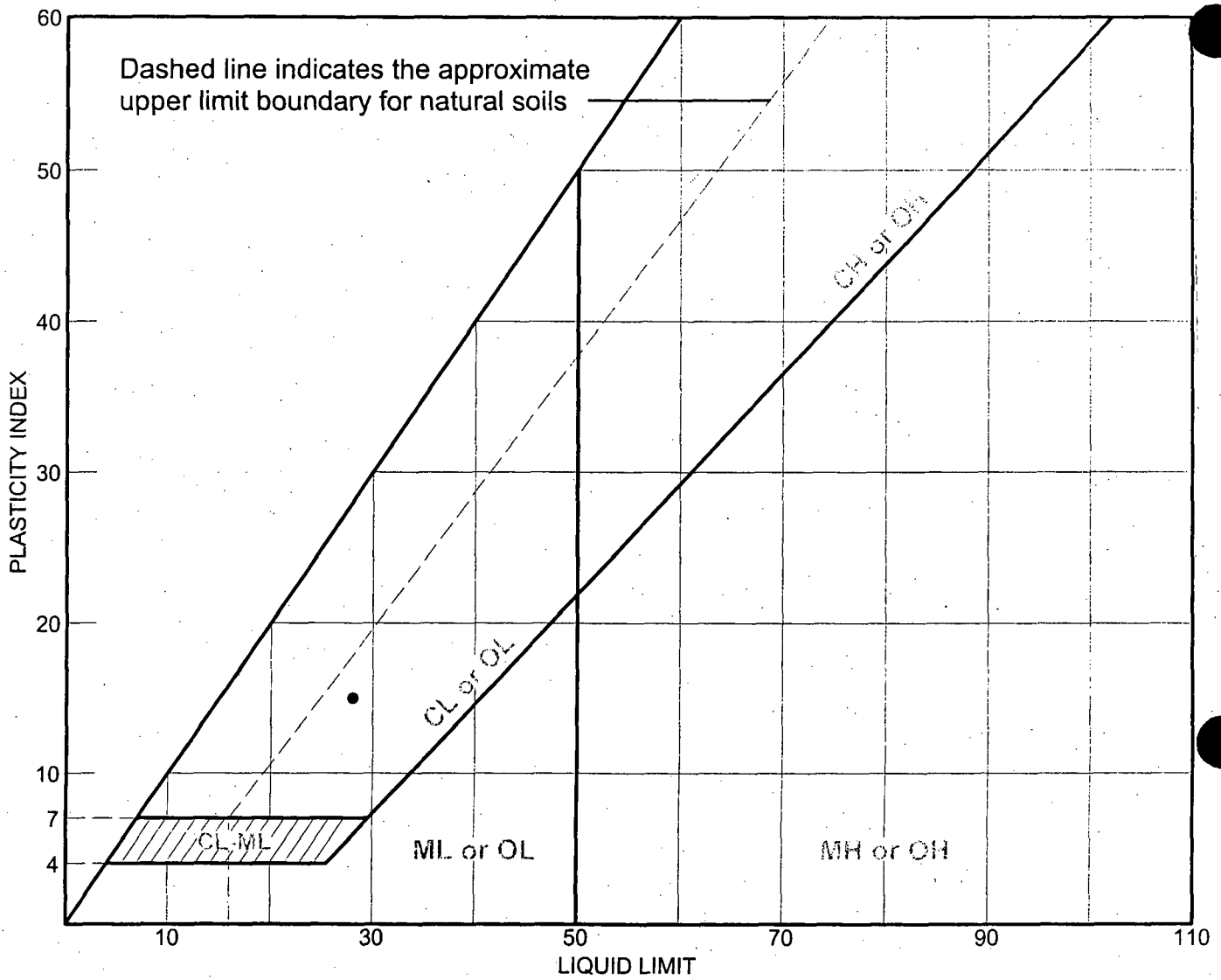
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-449

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110S-4	07-449		15.2 %	13	28	15	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

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Laboratory Test Report

PROJECT: WVNSCO

CLIENT: WVNSCO

DATE: May 29, 2007

PROJECT NO.: BE-07-067
REPORT NO.: LTR-5

Sample Number: 07-450
Sample Identification: 110S-5

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	95.1
1"	92.6
¾"	90.7
½"	88.4
¼"	84.3
#4	81.5
#10	63.5
#20	60.9
#40	59.0
#100	55.5
#200	52.7

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
18.5%	28.8%	22.1%	30.6%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
18.2 %	30	15	15

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.1 %

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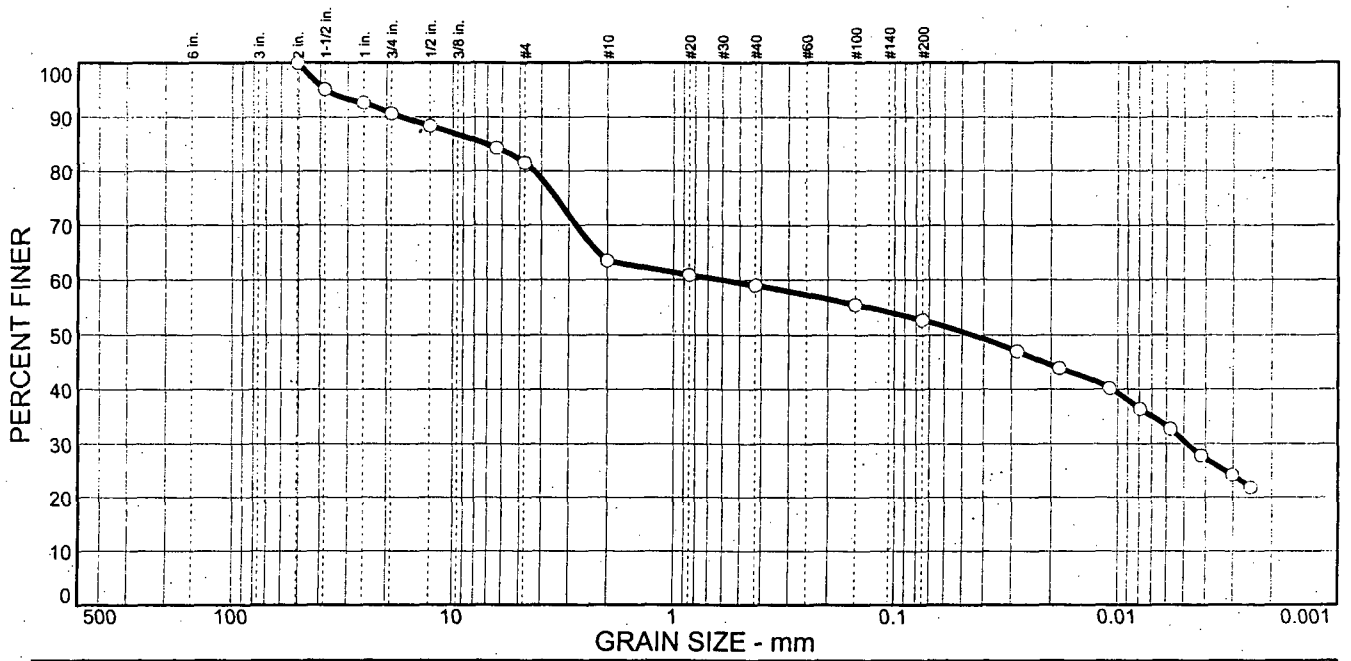
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-450 **Source of Sample:** 110S-5 **Date:** 5/29/07
Location: 110S-5 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	18.5	28.8	22.1	30.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	95.1		
1 in.	92.6		
.75 in.	90.7		
.5 in.	88.4		
.25 in.	84.3		
#4	81.5		
#10	63.5		
#20	60.9		
#40	59.0		
#100	55.5		
#200	52.7		

* (no specification provided)

Soil Description

SAMPLE 110S-5
ORGANIC CONTENT = 2.1 %
MOISTURE CONTENT = 18.2 %

Atterberg Limits

PL= 15 LL= 30 PI= 15

Coefficients

D_{85}= 7.04 D_{60}= 0.608 D_{50}= 0.0448
D_{30}= 0.0048 D_{15}= D_{10}=
C_u= C_c=

Classification

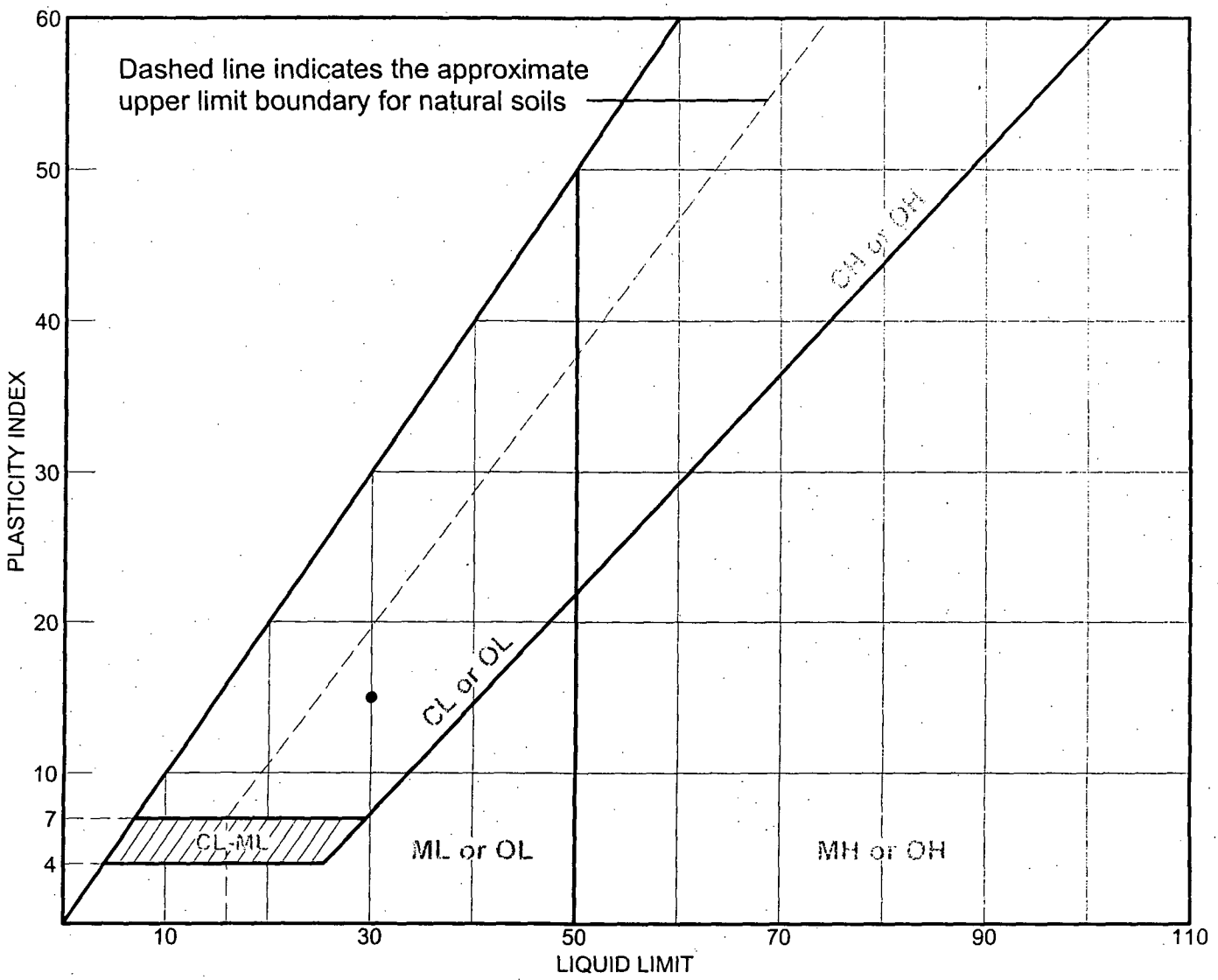
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-450

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110S-5	07-450		18.2 %	15	30	15	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

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Laboratory Test Report

PROJECT: WVNSCO

CLIENT: WVNSCO

DATE: May 29, 2007

PROJECT NO.: BE-07-067
REPORT NO.: LTR-6

Sample Number: 07-451
Sample Identification: 110S-6

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
3"	100.0
2"	89.9
1 ½"	80.6
1"	65.3
¾"	57.3
½"	56.0
¼"	54.3
#4	53.0
#10	42.4
#20	39.9
#40	38.6
#100	36.2
#200	34.4

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
47.0%	18.6%	14.0%	20.4%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
19.2 %	31	16	15

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.0 %

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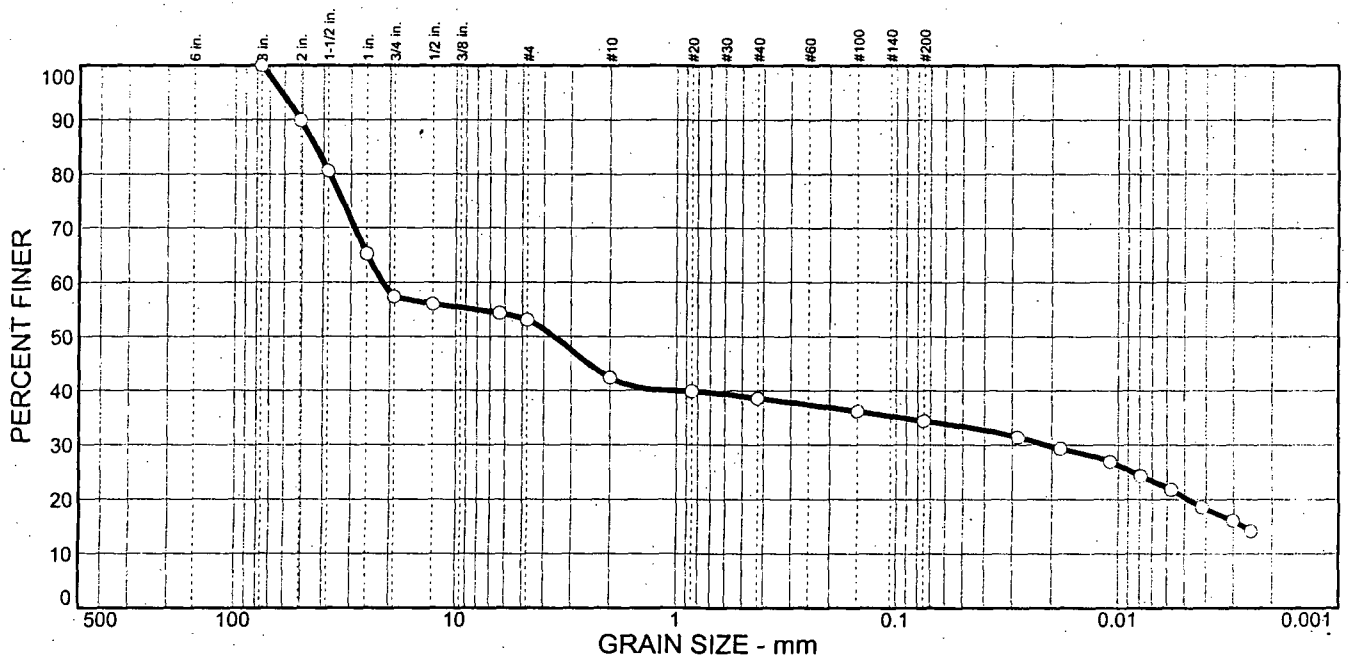
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-451 **Source of Sample:** 110S-6 **Date:** 5/29/07
Location: 110S-6 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	47.0	18.6	14.0	20.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3 in.	100.0		
2 in.	89.9		
1.5 in.	80.6		
1 in.	65.3		
.75 in.	57.3		
.5 in.	56.0		
.25 in.	54.3		
#4	53.0		
#10	42.4		
#20	39.9		
#40	38.6		
#100	36.2		
#200	34.4		

* (no specification provided)

Soil Description

SAMPLE 110S-6
ORGANIC CONTENT = 2.0 %
MOISTURE CONTENT = 19.2 %

Atterberg Limits

PL= 16 LL= 31 PI= 15

Coefficients

D_{85}= 43.3 D_{60}= 21.5 D_{50}= 3.59
D_{30}= 0.0213 D_{15}= 0.0027 D_{10}=
C_u= C_c=

Classification

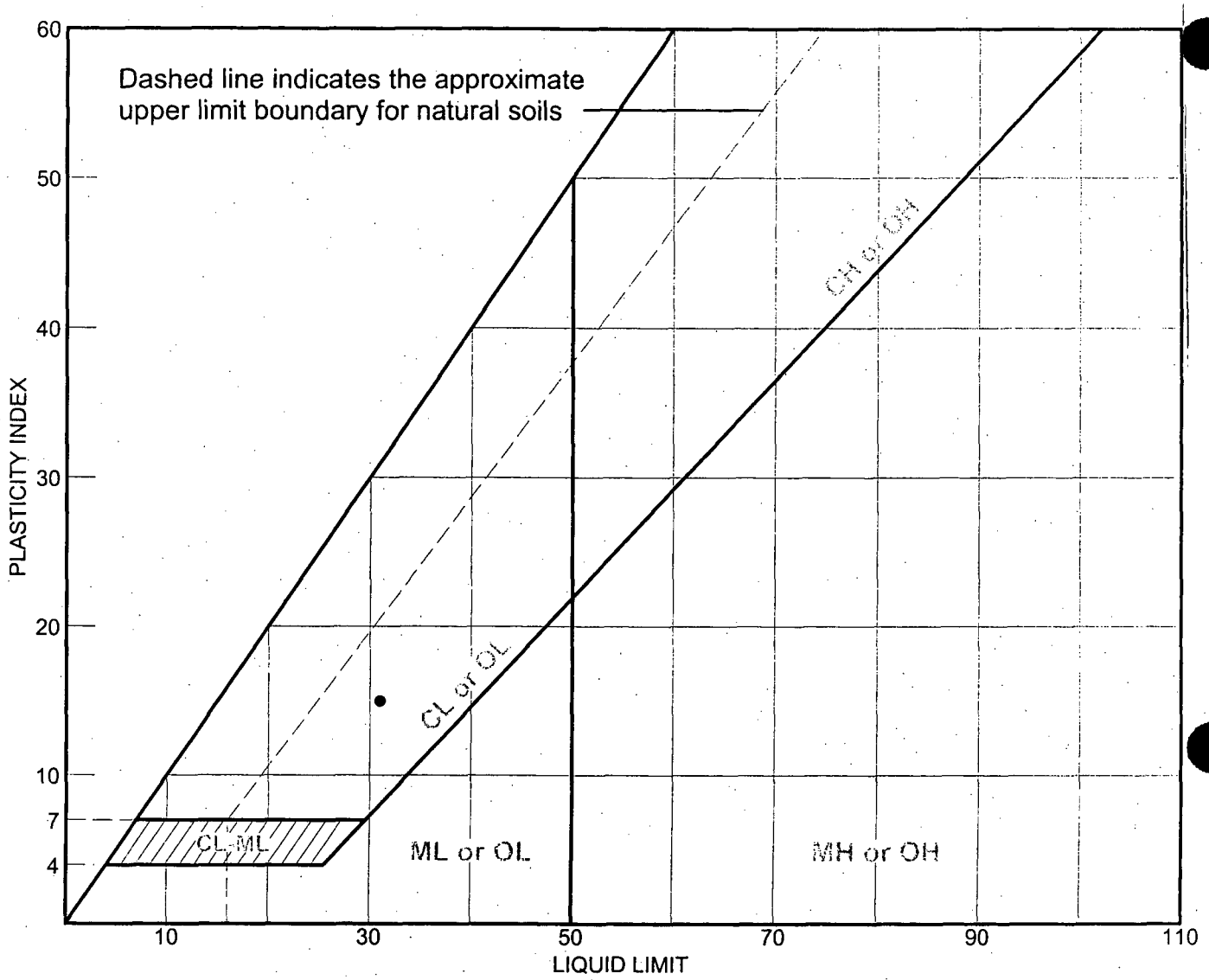
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-451

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110S-6	07-451		19.2 %	16	31	15	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

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Laboratory Test Report

PROJECT: **WVNSCO**

CLIENT: **WVNSCO**

DATE: **May 29, 2007**

PROJECT NO.: BE-07-067
REPORT NO.: LTR-7

Sample Number: 07-453
Sample Identification: 110N-1

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	89.9
1"	87.8
¾"	84.4
½"	78.4
¼"	67.3
#4	62.5
#10	50.6
#20	45.2
#40	42.6
#100	38.7
#200	35.4

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
37.5%	27.1%	19.0%	16.4%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
13.9 %	30	14	16

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content: 2.3 %

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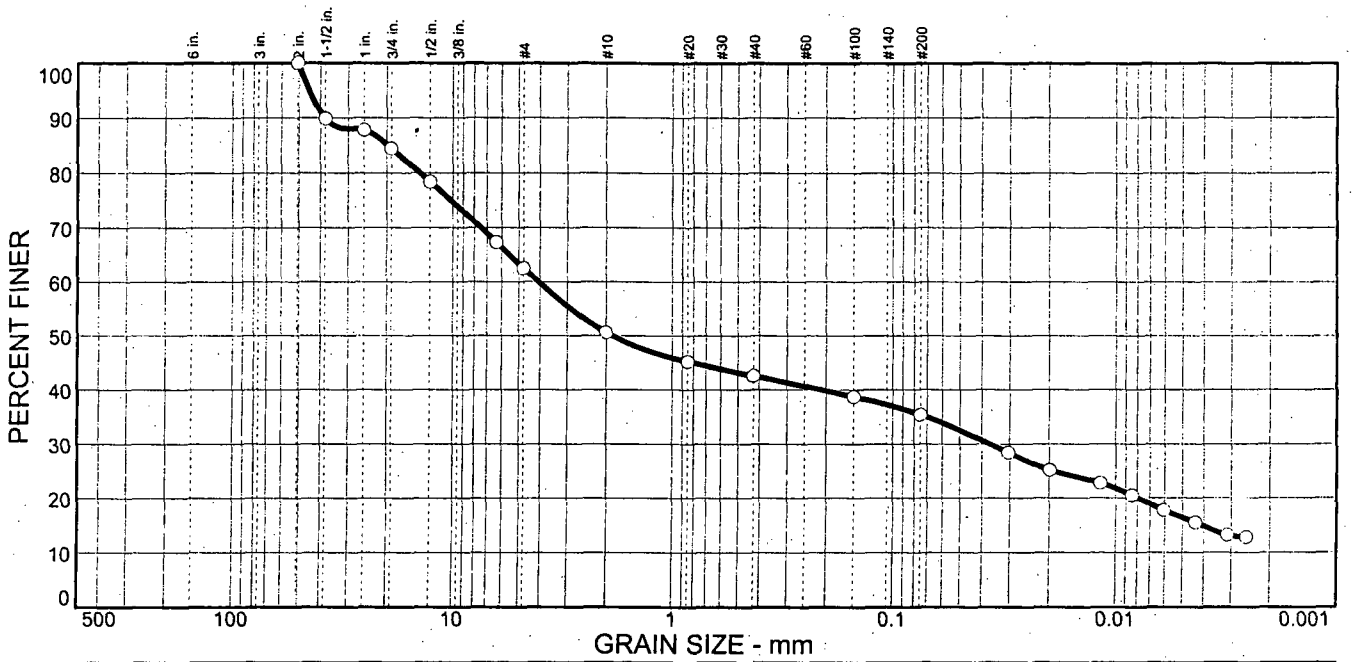
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-453 **Source of Sample:** 110N-1 **Date:** 5/29/07
Location: 110N-1 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	37.5	27.1	19.0	16.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	89.9		
1 in.	87.8		
.75 in.	84.4		
.5 in.	78.4		
.25 in.	67.3		
#4	62.5		
#10	50.6		
#20	45.2		
#40	42.6		
#100	38.7		
#200	35.4		

* (no specification provided)

Soil Description

SAMPLE 110N-1
ORGANIC CONTENT = 2.3 %
MOISTURE CONTENT = 13.9 %

Atterberg Limits

PL= 14 LL= 30 PI= 16

Coefficients

D_{85}= 19.8 D_{60}= 4.06 D_{50}= 1.88
D_{30}= 0.0369 D_{15}= 0.0041 D_{10}=
C_u= C_c=

Classification

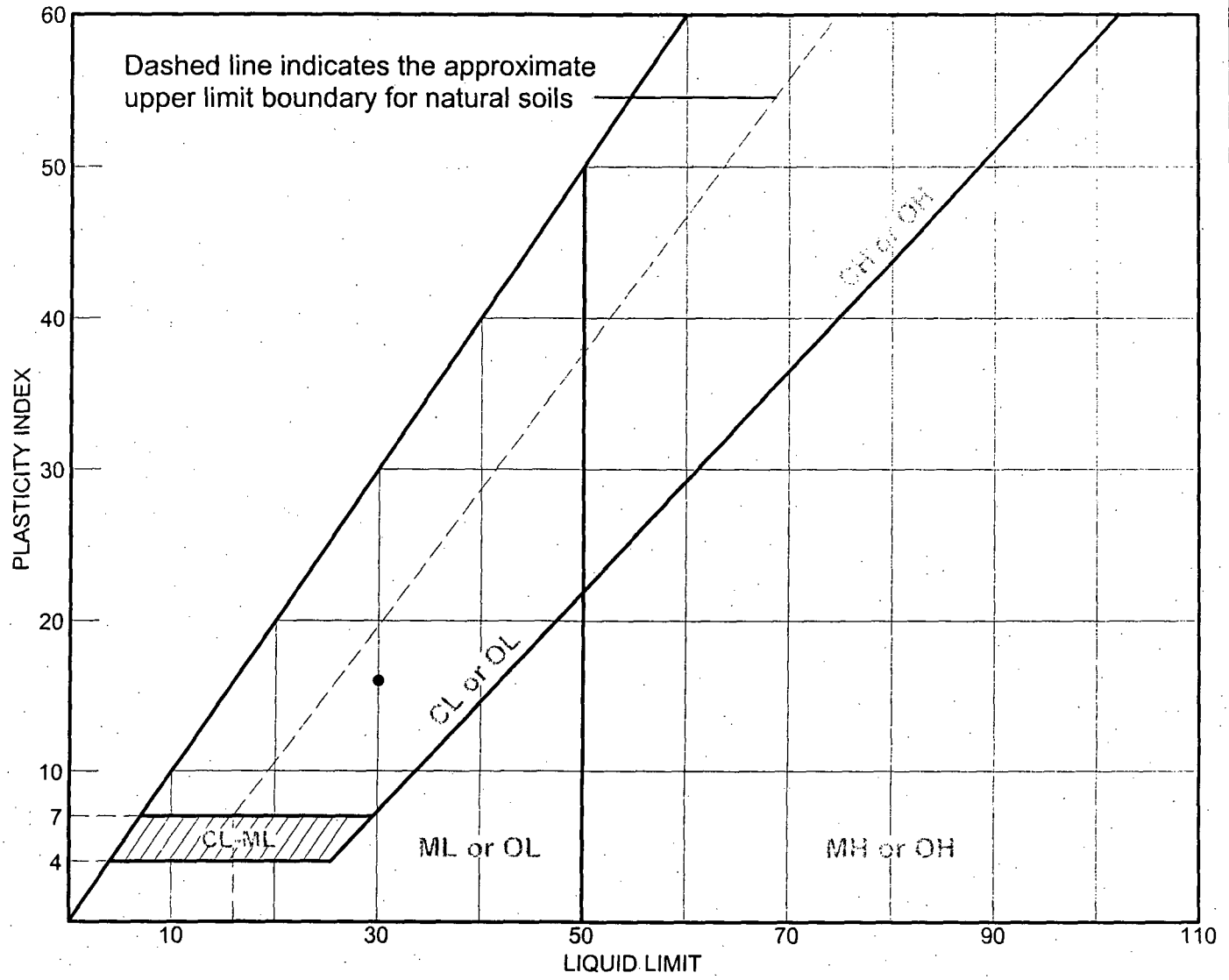
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-453

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110N-1	07-453		13.9 %	14	30	16	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

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Laboratory Test Report

PROJECT: WVNSCO

CLIENT: WVNSCO

DATE: May 29, 2007

PROJECT NO.: BE-07-067
REPORT NO.: LTR-8

Sample Number: 07-454
Sample Identification: 110N-2

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	93.5
1"	89.7
¾"	86.4
½"	79.6
¼"	68.0
#4	63.5
#10	47.1
#20	42.2
#40	39.0
#100	35.3
#200	32.1

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
36.5%	31.4%	16.3%	15.8%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
10.8 %	27	17	10

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.2 %

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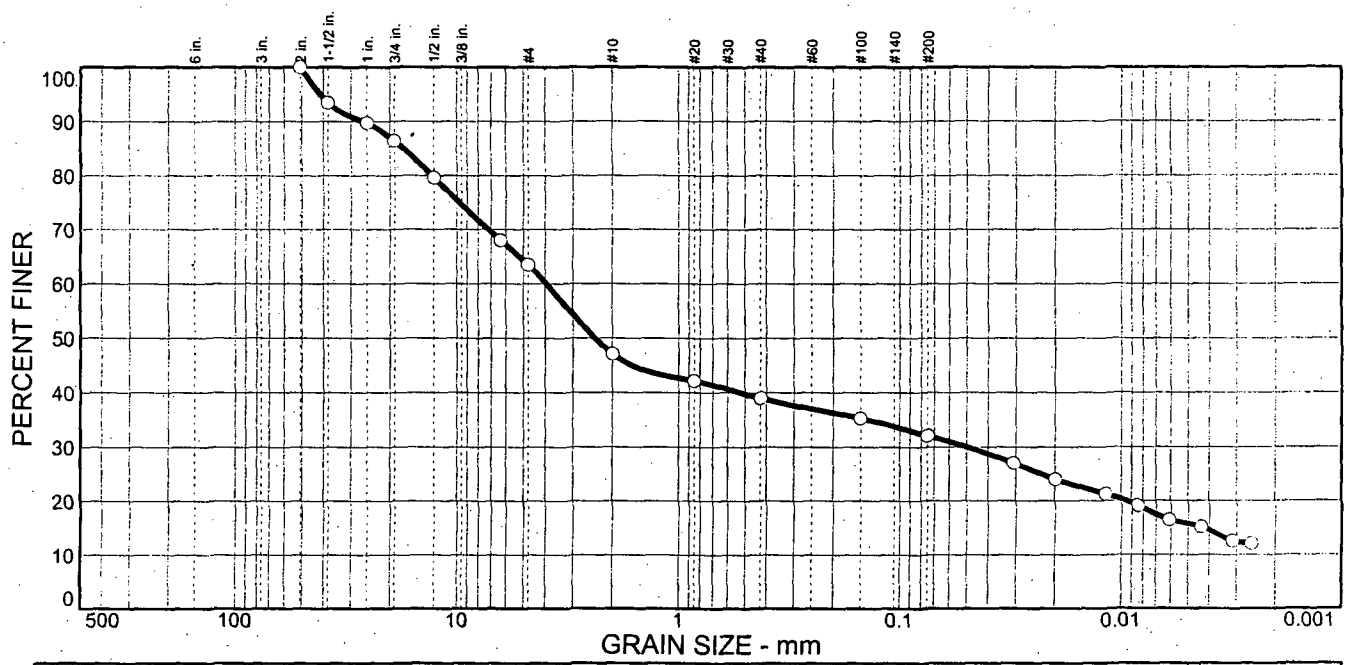
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-454 **Source of Sample:** 110N-2 **Date:** 5/29/07
Location: 110N-2 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	36.5	31.4	16.3	15.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	93.5		
1 in.	89.7		
.75 in.	86.4		
.5 in.	79.6		
.25 in.	68.0		
#4	63.5		
#10	47.1		
#20	42.2		
#40	39.0		
#100	35.3		
#200	32.1		

* (no specification provided)

Soil Description

SAMPLE 110N-2
ORGANIC CONTENT = 2.2 %
MOISTURE CONTENT = 10.8 %

Atterberg Limits

PL= 17 LL= 27 PI= 10

Coefficients

D_{85}= 17.4 D_{60}= 3.94 D_{50}= 2.40
D_{30}= 0.0499 D_{15}= 0.0042 D_{10}=
C_u= C_c=

Classification

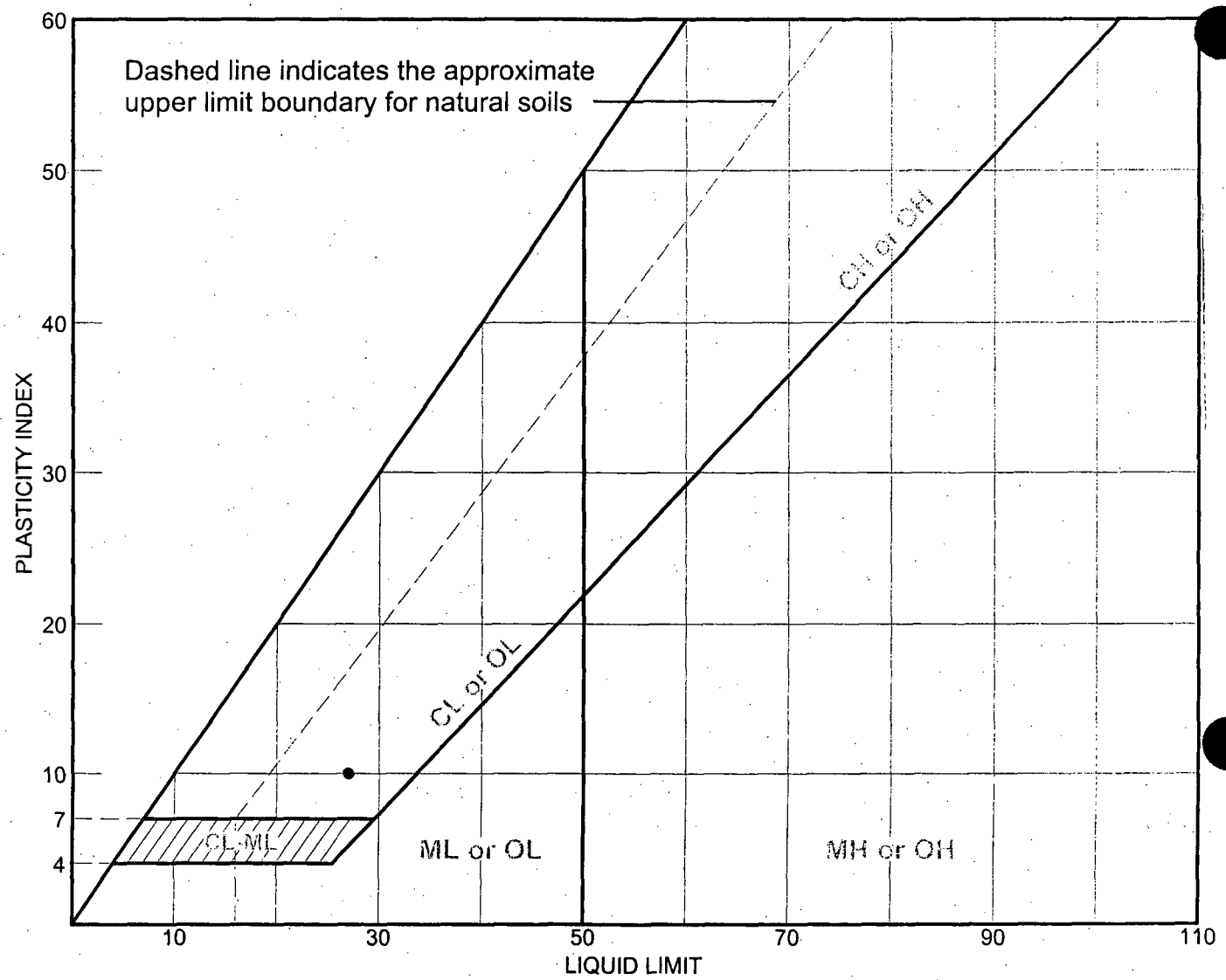
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-454

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110N-2	07-454		10.8 %	17	27	10	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

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Laboratory Test Report

PROJECT: **WVNSCO**

CLIENT: **WVNSCO**

DATE: **May 29, 2007**

PROJECT NO.: BE-07-067
REPORT NO.: LTR-9

Sample Number: 07-455
Sample Identification: 110N-3

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	82.2
1"	78.6
¾"	73.6
½"	65.4
¼"	50.2
#4	44.3
#10	35.7
#20	31.8
#40	28.7
#100	25.9
#200	24.5

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
55.7%	19.8%	13.2%	11.3%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
10.0 %	28	15	13

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.6 %

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Hamburg, NY 14075
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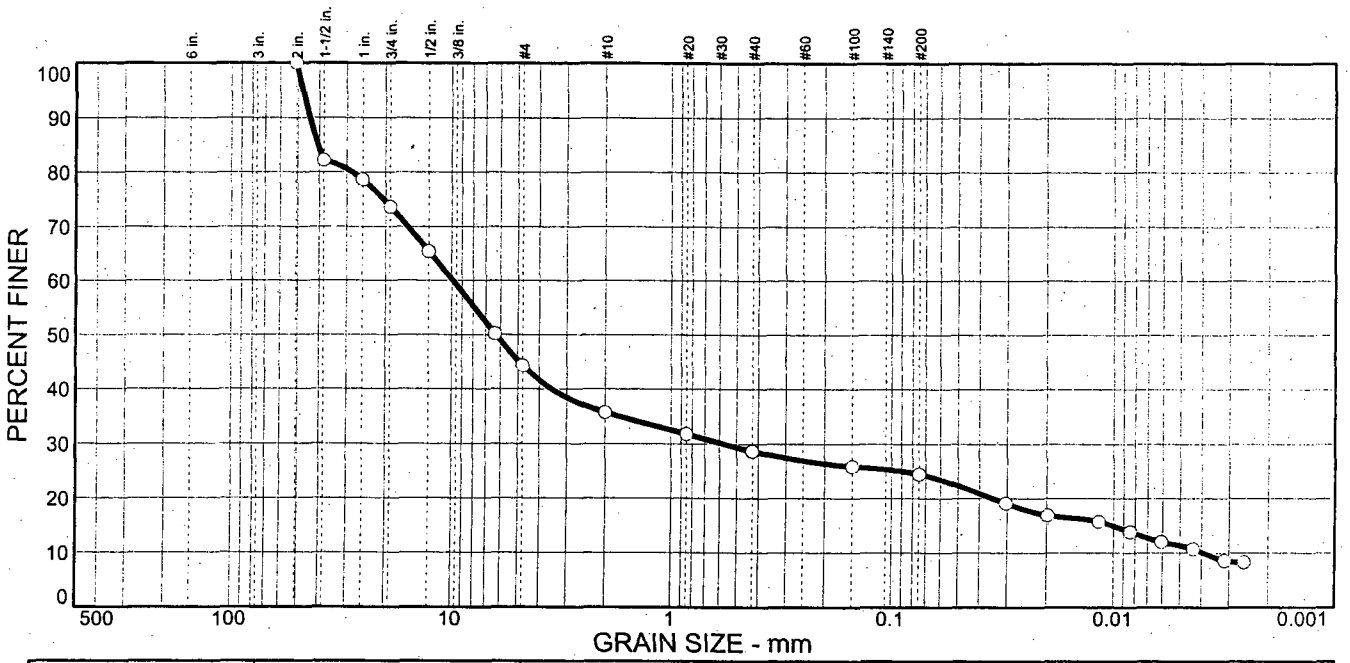
Fax: (716) 649-8051

Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-455 **Source of Sample:** 110N-3 **Date:** 5/29/07
Location: 110N-3 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	55.7	19.8	13.2	11.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	82.2		
1 in.	78.6		
.75 in.	73.6		
.5 in.	65.4		
.25 in.	50.2		
#4	44.3		
#10	35.7		
#20	31.8		
#40	28.7		
#100	25.9		
#200	24.5		

* (no specification provided)

Soil Description

SAMPLE 110N-3
ORGANIC CONTENT = 2.6 %
MOISTURE CONTENT = 10.0 %

Atterberg Limits

PL= 15 LL= 28 PI= 13

Coefficients

D_{85}= 40.6 D_{60}= 9.90 D_{50}= 6.29
D_{30}= 0.574 D_{15}= 0.0102 D_{10}= 0.0039
C_u= 2522.52 C_c= 8.49

Classification

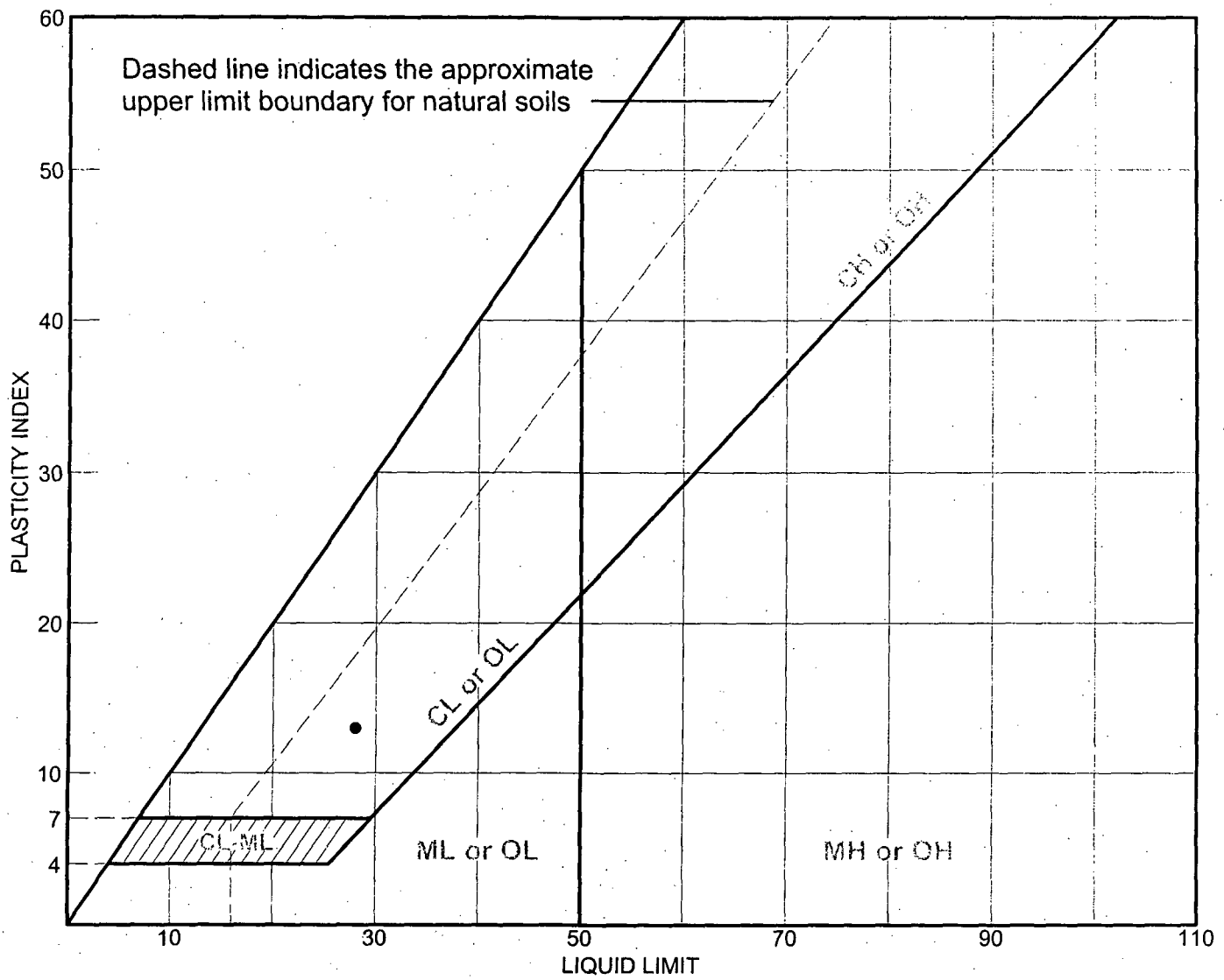
USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-455

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	110N-3	07-455		10.0 %	15	28	13	

LIQUID AND PLASTIC LIMITS TEST REPORT **SJB SERVICES, INC.**	**Client:** WVNSCO **Project:** WVNSCO **Project No.:** BE-07-067 **Plate**

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Laboratory Test Report

PROJECT: WVNSCO

CLIENT: WVNSCO

DATE: May 29, 2007

PROJECT NO.: BE-07-067
REPORT NO.: LTR-10

Sample Number: 07-457
Sample Identification: 110N-4

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	94.8
1"	87.7
¾"	80.1
½"	69.0
¼"	53.0
#4	47.9
#10	34.7
#20	28.0
#40	22.8
#100	17.7
#200	15.3

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
52.1%	32.6%	10.7%	4.6%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
7.1 %	unable to perform	--	non-plastic

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.0 %

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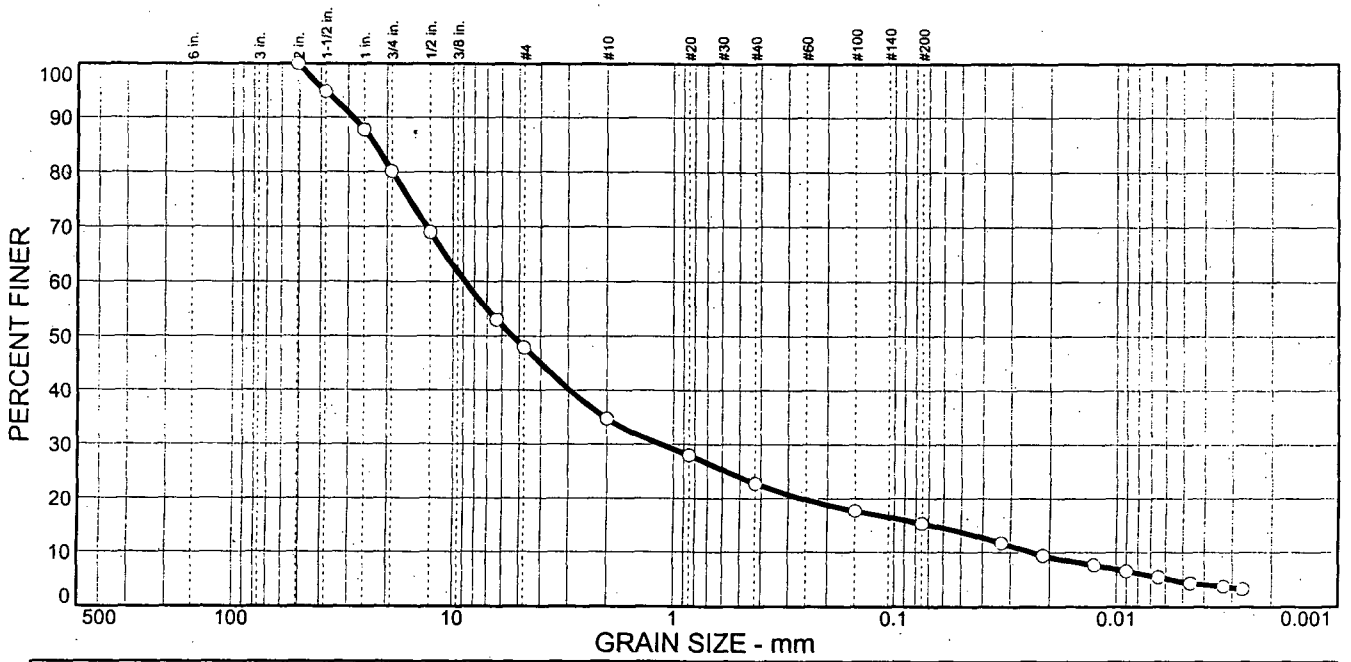
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-457 **Source of Sample:** 110N-4 **Date:** 5/29/07
Location: 110N-4 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	52.1	32.6	10.7	4.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	94.8		
1 in.	87.7		
.75 in.	80.1		
.5 in.	69.0		
.25 in.	53.0		
#4	47.9		
#10	34.7		
#20	28.0		
#40	22.8		
#100	17.7		
#200	15.3		

* (no specification provided)

Soil Description

SAMPLE 110N-4
ORGANIC CONTENT = 2.0 %
MOISTURE CONTENT = 7.1 %

Atterberg Limits

PL= NP LL= PI= NP

Coefficients

D_{85}= 22.7 D_{60}= 8.84 D_{50}= 5.37
D_{30}= 1.14 D_{15}= 0.0691 D_{10}= 0.0242
C_u= 365.09 C_c= 6.12

Classification

USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-457

Plate

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Laboratory Test Report

PROJECT: **WVNSCO**

CLIENT: **WVNSCO**

DATE: **May 29, 2007**

PROJECT NO.: BE-07-067
REPORT NO.: LTR-11

Sample Number: 07-458
Sample Identification: 110N-5

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	95.1
1"	87.6
¾"	79.4
½"	69.4
¼"	54.2
#4	49.8
#10	42.4
#20	34.1
#40	27.1
#100	20.8
#200	17.6

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
50.2%	32.2%	12.0%	5.6%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
7.7 %	unable to perform	--	non-plastic

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 2.3 %

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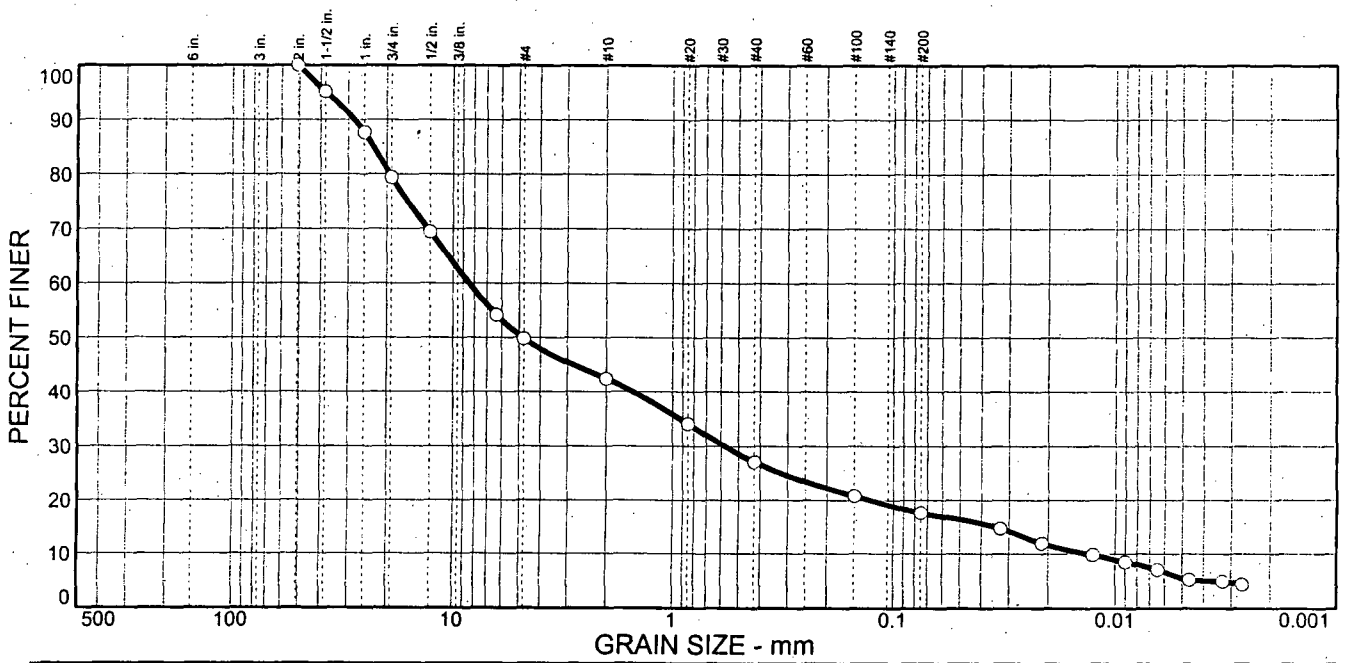
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-458 **Source of Sample:** 110N-5 **Date:** 5/29/07
Location: 110N-5 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	50.2	32.2	12.0	5.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	95.1		
1 in.	87.6		
.75 in.	79.4		
.5 in.	69.4		
.25 in.	54.2		
#4	49.8		
#10	42.4		
#20	34.1		
#40	27.1		
#100	20.8		
#200	17.6		

* (no specification provided)

Soil Description

SAMPLE 110N-5
ORGANIC CONENT = 2.3 %
MOISTURE CONTENT = 7.7 %

Atterberg Limits

PL= NP LL= PI= NP

Coefficients

D_{85}= 23.1 D_{60}= 8.46 D_{50}= 4.83
D_{30}= 0.578 D_{15}= 0.0347 D_{10}= 0.0133
C_u= 637.15 C_c= 2.97

Classification

USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-458

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Laboratory Test Report

PROJECT: WVNSCO

CLIENT: WVNSCO

DATE: May 29, 2007

PROJECT NO.: BE-07-067
REPORT NO.: LTR-12

Sample Number: 07-459
Sample Identification: 110N-6

ASTM D-422: Particle Size Analysis of Soils

Sieve Size	*Percent Passing*
2"	100.0
1 ½"	91.0
1"	85.0
¾"	79.7
½"	68.5
¼"	52.7
#4	47.4
#10	31.6
#20	22.2
#40	16.2
#100	11.5
#200	9.8

PERCENT COMPONENTS

GRAVEL	SAND	SILT	CLAY
52.6%	37.6%	7.0%	2.8%

ASTM D-2216: Laboratory Determination of Water (Moisture) Content of Soil &Rock
ASTM D-4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soil

Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
6.2 %	unable to perform	--	non-plastic

ASTM D-2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Organic Content : 1.7 %

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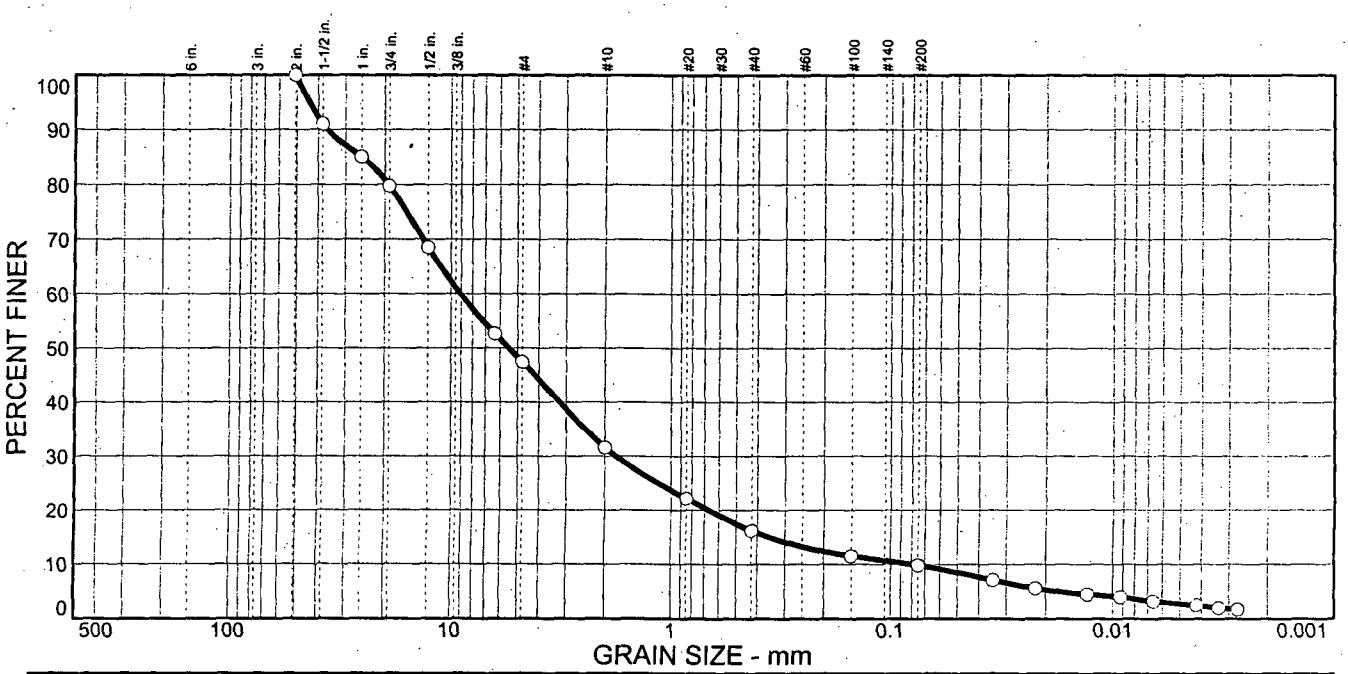
Particle Size Distribution Report

Project: WVNSCO **Project No.:** BE-07-067

Client: WVNSCO

Sample No: 07-459 **Source of Sample:** 110N-6 **Date:** 5/29/07
Location: 110N-6 **Elev./Depth:**



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	52.6	37.6	7.0	2.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	91.0		
1 in.	85.0		
.75 in.	79.7		
.5 in.	68.5		
.25 in.	52.7		
#4	47.4		
#10	31.6		
#20	22.2		
#40	16.2		
#100	11.5		
#200	9.8		

* (no specification provided)

Soil Description

SAMPLE 110N-6
ORGANIC CONTENT = 1.7 %
MOISTURE CONTENT = 6.2 %

Atterberg Limits

PL= NP LL= PI= NP

Coefficients

D_{85}= 25.4 D_{60}= 9.05 D_{50}= 5.48
D_{30}= 1.79 D_{15}= 0.355 D_{10}= 0.0807
C_u= 112.22 C_c= 4.37

Classification

USCS= AASHTO=

Remarks

SAMPLE NUMBER: 07-459

Plate

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Laboratory Test Report

PROJECT: **WVNSCO**

CLIENT: **WVNSCO**

DATE: **May 29, 2007**

PROJECT NO.: BE-07-067
REPORT NO.: LTR-13

ASTM D-1557-91: Laboratory Compaction Characteristics of Soil Using Modified Effort

Sample Number: 07-448
Sample Identification: Combination of 110S-1, 110S-2 & 110S-3

Maximum Dry Density: 119.4 pcf
Optimum Moisture: 8.4 %

Sample Number: 07-452
Sample Identification: Combination of 110S-4, 110S-5 & 110S-6

Maximum Dry Density: 125.1 pcf
Optimum Moisture: 9.8 %

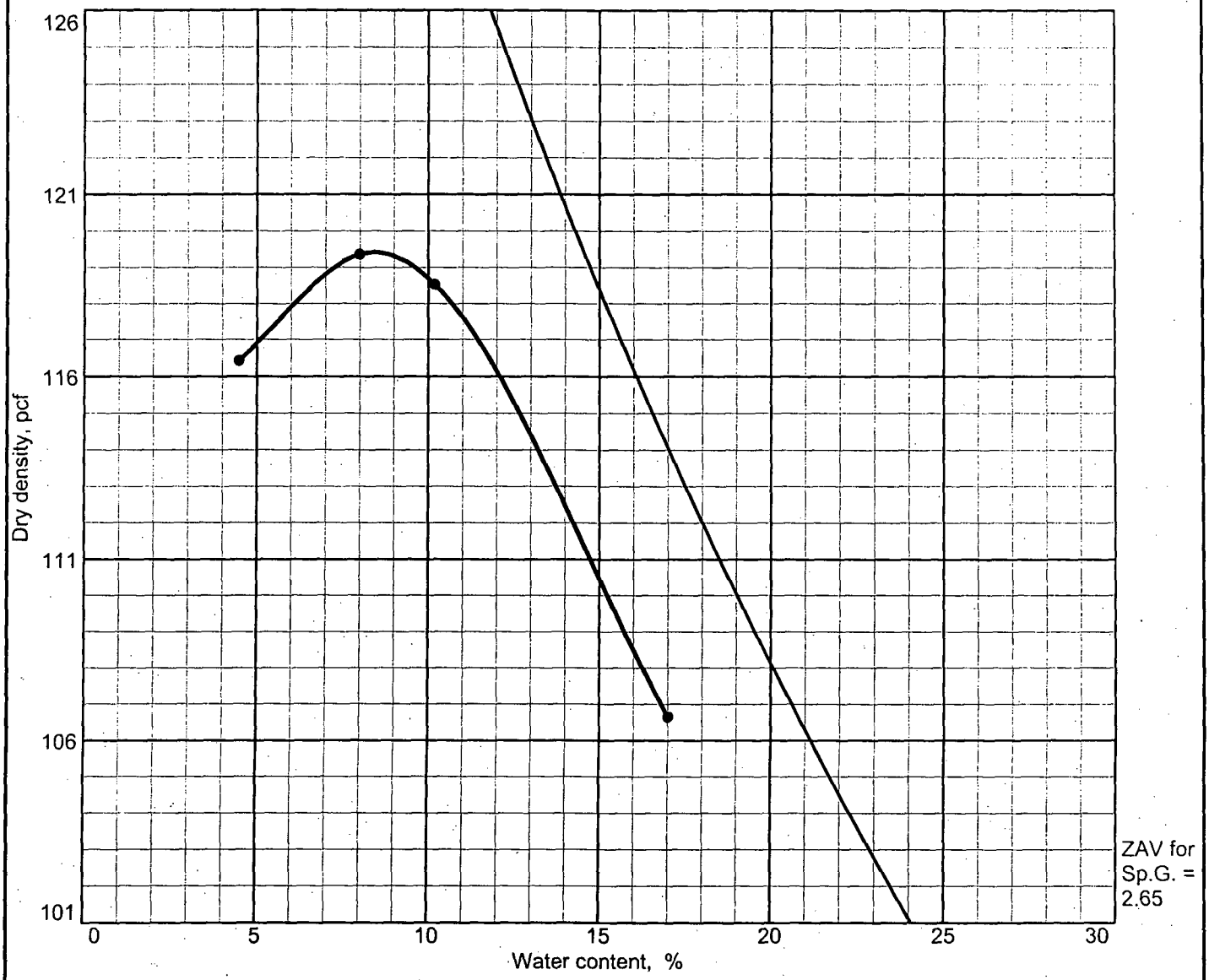
Sample Number: 07-456
Sample Identification: Combination of 110N-1, 110N-2 & 110N-3

Maximum Dry Density: 128.6 pcf
Optimum Moisture: 7.3 %

Sample Number: 07-460
Sample Identification: Combination of 110N-4, 110N-5 & 110N-6

Maximum Dry Density: 137.0 pcf
Optimum Moisture: 6.1 %

COMPACTION TEST REPORT

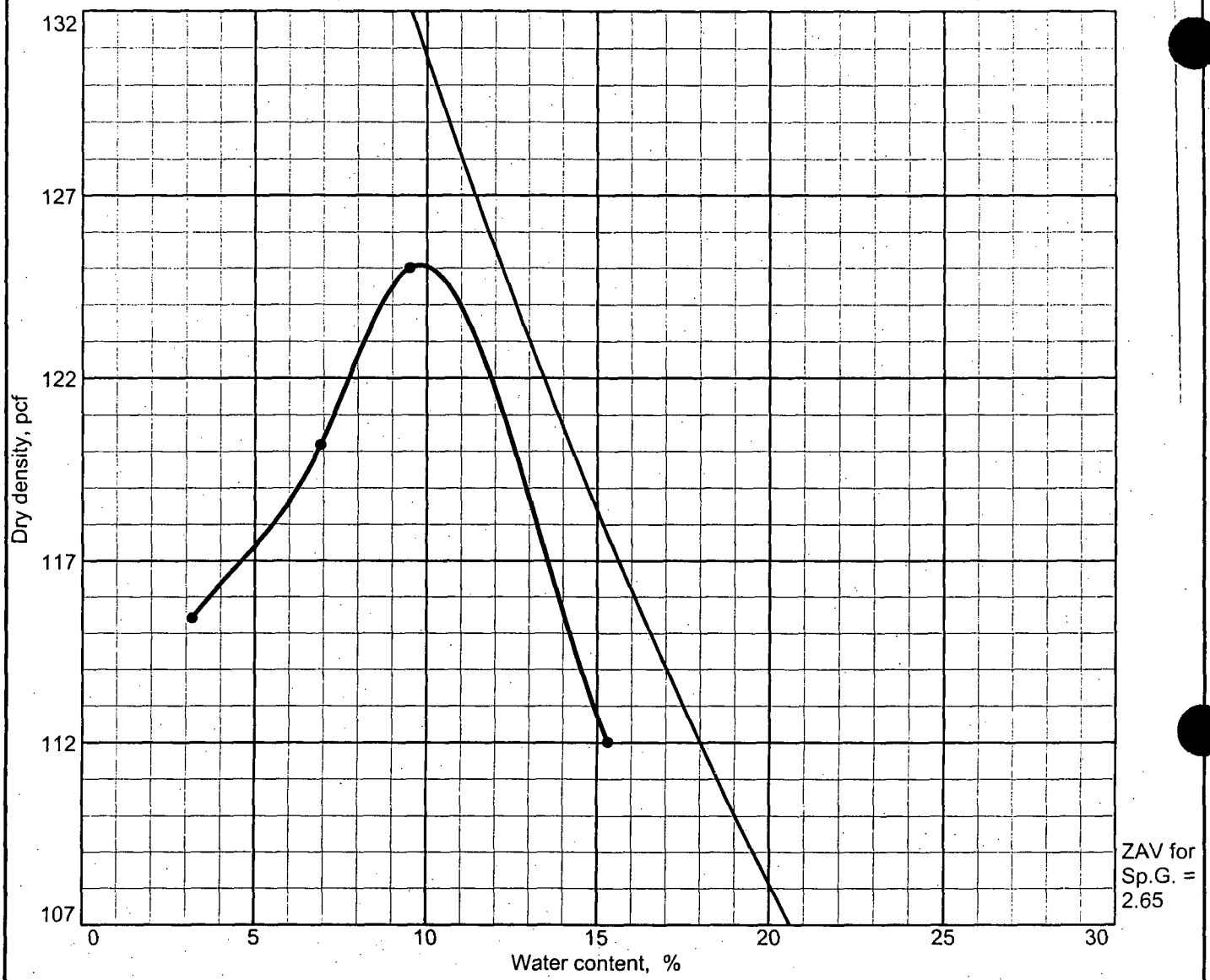


Test specification: ASTM D 1557-91 Procedure C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
				2.65				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 119.4 pcf Optimum moisture = 8.4 %	COMBINATION OF 110S-1, 110S-2, 110S-3
Project No. BE-07-067 **Client:** WVNSCO **Project:** WVNSCO • **Location:** COMBINATION OF 110S-1,2,3	**Remarks:** SAMPLE NUMBER: 07-448
COMPACTION TEST REPORT **SJB SERVICES, INC.**	**Plate**

COMPACTION TEST REPORT

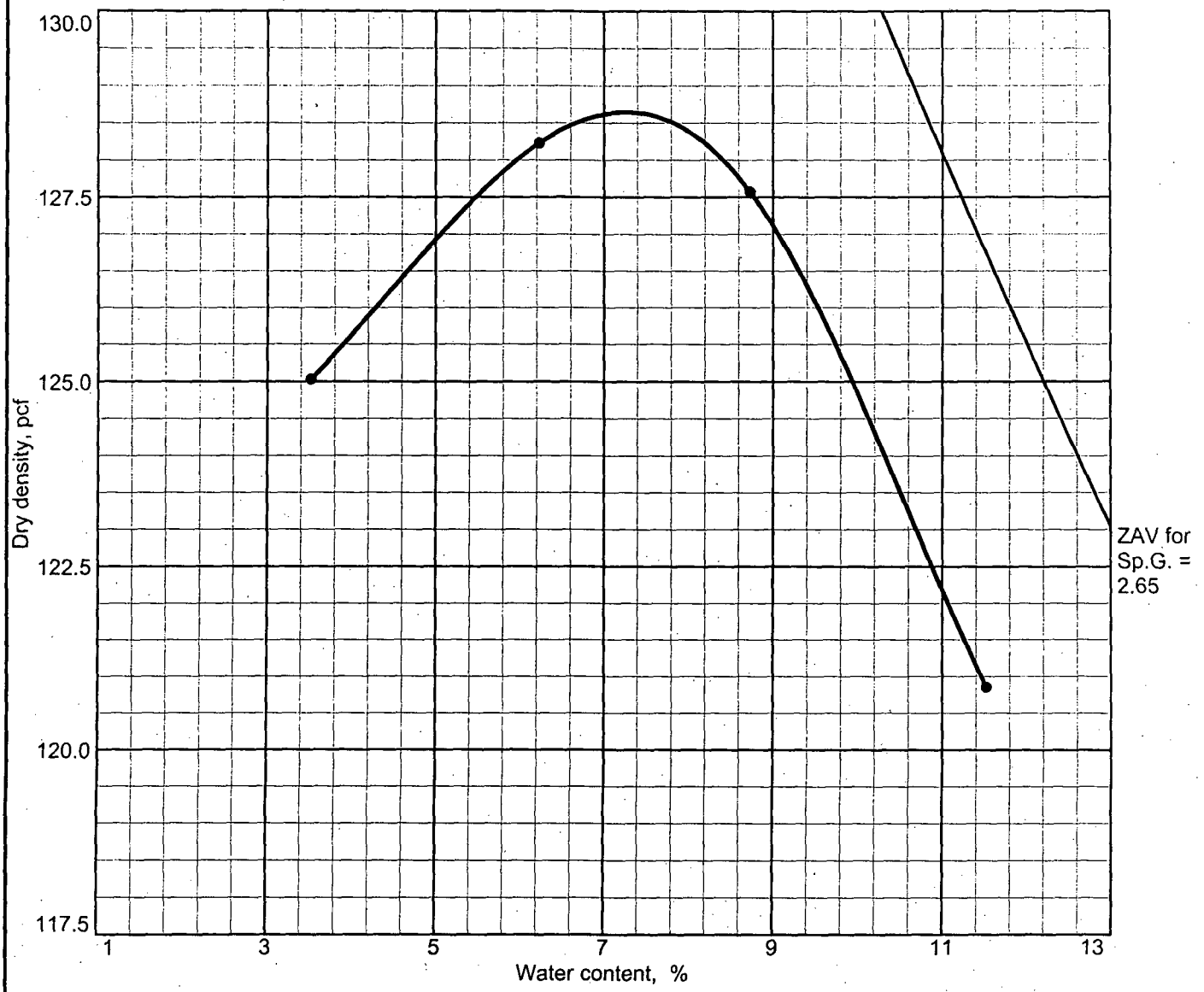


Test specification: ASTM D 1557-91 Procedure C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
				2.65				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 125.1 pcf Optimum moisture = 9.8 %	COMBINATION OF 110S-4, 110S-5, 110S-6
Project No. BE-07-067 **Client:** WVNSCO **Project:** WVNSCO • **Location:** COMBINATION 110S-4,110S-5, 110S-6	**Remarks:** SAMPLE NUMBER: 07-452
COMPACTION TEST REPORT **SJB SERVICES, INC.**	**Plate**

COMPACTION TEST REPORT



Test specification: ASTM D 1557-91 Procedure C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
				2.65				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 128.6 pcf Optimum moisture = 7.3 %	COMBINATION 100N-1, 110N-2, 110N-3

Project No. BE-07-067 **Client:** WVNSCO
Project: WVNSCO

- **Location:** COMBINATION 100N-1, 110N-2, 110N-3

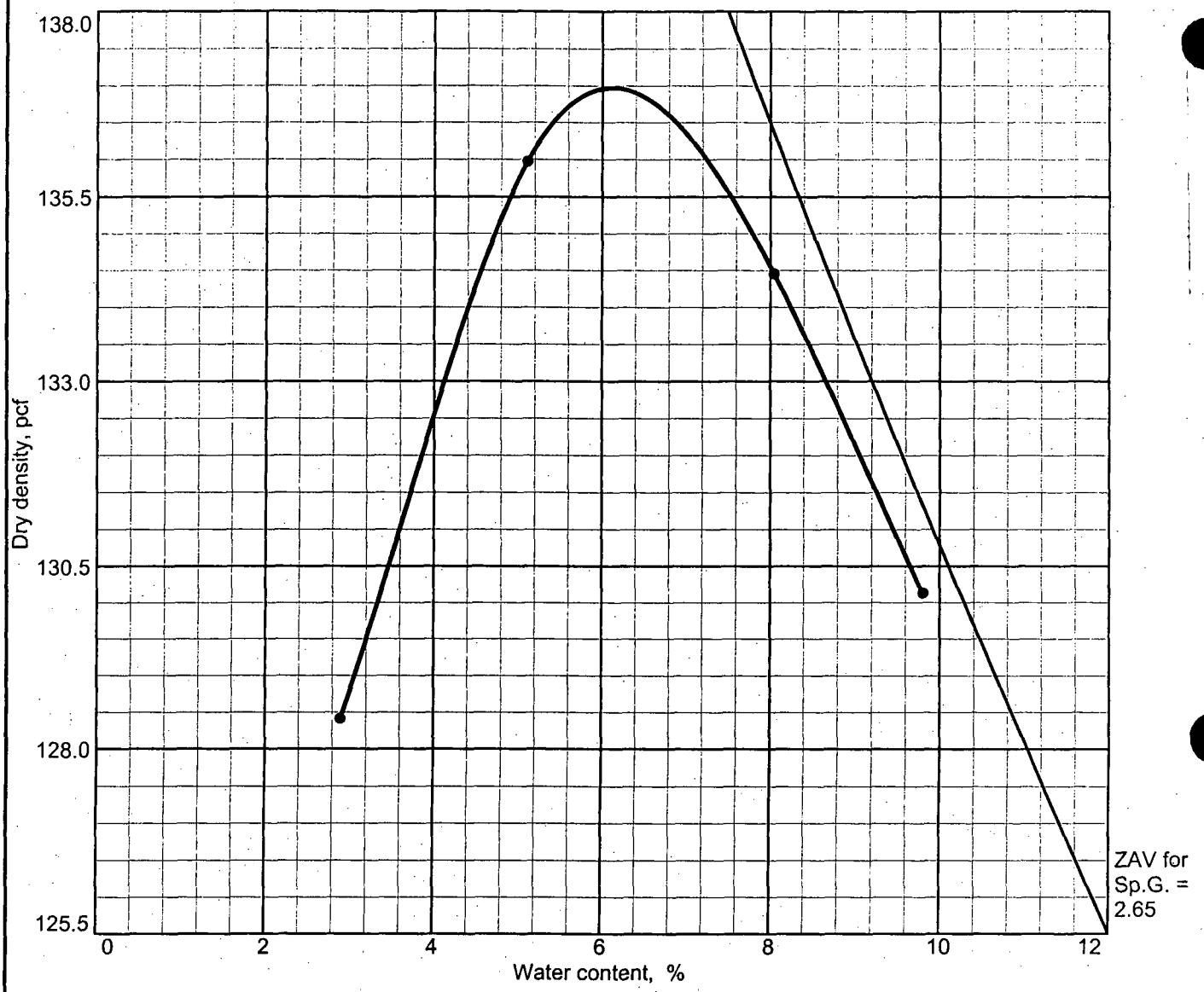
Remarks:
SAMPLE NUMBER: 07-456

COMPACTION TEST REPORT

SJB SERVICES, INC.

Plate

COMPACTION TEST REPORT



Test specification: ASTM D 1557-91 Procedure C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
				2.65				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 137.0 pcf Optimum moisture = 6.1 %	COMBINATION 110N-4, 110N-5, 110N-6

Project No. BE-07-067 **Client:** WVNSCO
Project: WVNSCO

● **Location:** COMBINATION 110N-4, 110N-5, 110N-6

Remarks:
SAMPLE NUMBER: 07-460

COMPACTION TEST REPORT

SJB SERVICES, INC.

Plate

Operation and Maintenance Plan for the Geomembrane

Operations and Maintenance Plan
Nuclear Regulatory Commission-Licensed Disposal Area
Cap and Groundwater Barrier at the
West Valley Demonstration Project

Operations and Maintenance Plan

1.0 INTRODUCTION

This Operations and Maintenance (O&M) Plan identifies and describes the tasks necessary to operate and maintain the Nuclear Regulatory Commission Licensed Disposal Area (NDA) within the West Valley Demonstration Project (WVDP) site in West Valley, New York after the completion of the cap improvement and slurry installation interim measure is complete. Currently the operation and maintenance of the NDA is covered under the following existing WVDP procedures:

- NDA Inspection and Maintenance – Under Standard Operating Procedure (SOP) SOP 40-04, "Landfill Inspection and Maintenance Plan";
- Groundwater Monitoring – Under WVDP-239, "Groundwater Monitoring Plan";
- Leachate Monitoring – Under SOP 82-01, "Routine NDA Operations";
- Storm Water Monitoring – Under the storm water monitoring provisions of the site SPDES Permit and as stated in WVDP-206 –"CWA/SPDES Storm Water Pollution Prevention Plan for the West Valley Project," and WVDP-233, "Monitoring Plan for Storm water Discharges at the West Valley Demonstration Project";
- Environmental Radiological Monitoring – WVDP-098, "Environmental Monitoring Program Plan"; and
- Training and Safety – Under WVDP-126, "Performance-Based Training Program Manual Preface," WVDP-11, "Industrial Hygiene and Safety Manual," and WVDP-010, "Radiological Controls Manual."

After approval of the Interim Measures Work Plan (IMWP) and upon completion of the Interim Measure (IM), these procedures will be revised to address changes in the operation and maintenance of the NDA resulting from the installation of the cap and slurry wall.

This document presents the changes to the respective operations and maintenance procedures and is organized as follows:

- Section 1 includes a brief summary of the objectives of this O&M Plan.
- Section 2 presents the operations that include groundwater, leachate, storm water, and radioactivity monitoring for the NDA. It also includes inspection and integrity evaluation of the cap and associated structures, as well as ground surface/settlement monitoring.
- Section 3 presents the potential maintenance needed that includes maintenance of the cap and associated structures, as well as the storm water controls.
- Section 4 includes the reporting requirements.
- Section 5 includes the training and safety requirements.
- Section 6 includes the schedule for the O&M.

This plan has been prepared to meet the overall O&M objectives of the NDA site. West Valley Nuclear Services Company (WVNSCO) has operated and maintained the NDA since the closure of the disposal unit in 1986. Therefore, many of the elements to maintain and monitor the site are

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in place. Operation and maintenance activities are necessary to assure the interim measures meet performance standards. The primary objectives of the NDA O&M plan are to:

- Inspect/maintain/repair the re-graded cap surface and associated structures to assure the effectiveness of the cap;
- Clean/maintain/repair storm water control areas as needed;
- Monitor and remove groundwater as needed from the interceptor trench;
- Monitor groundwater in and around the NDA;
- Monitor storm water associated with the NDA;
- Identify and repair the cap and associated structures as needed; and
- Acquire data that can be used to evaluate the effectiveness of the IM.

The overall O&M elements for the NDA that include the IM (cap and slurry wall) have been identified in this plan and will be included in existing revised site procedures upon completion of the implementation of the IM. The revisions to the respective site procedures are presented in the following sections.

2.0 OPERATIONS

The operation of the NDA upon completion of the IM will include:

- Groundwater monitoring;
- Leachate monitoring;
- Storm water monitoring;
- Radiological monitoring;
- Integrity inspection of the cap and associated structures; and
- Ground surface monitoring (for subsidence and erosion)

2.1 Groundwater Monitoring

Groundwater wells and piezometers near the NDA are currently routinely monitored for environmental and regulatory compliance under the Groundwater Monitoring Program (GMP). Groundwater wells are sampled and samples analyzed for both chemical and radiological parameters. Water and solvent levels are also routinely measured at groundwater wells, piezometers, and standpipes as part of the routine NDA operations and inspections. Table F-1 lists the active NDA wells, piezometers, and standpipes, along with the corresponding analyses and frequency of sampling and analysis. The locations are shown on Figure F-1.

TABLE F-1
NDA Monitoring Wells and Piezometers With Corresponding Analyses

	Well ID	Analyses	Comments
NDA Locations Monitored Under the GMP (WVDP-239, rev. 9, 09-19-2005)			
1	901	RI,I - 2/yr	
2	902	RI,I - 2/yr	
3	903	RI,I - 2/yr	
4	906	RI,I - 2/yr	
5	908	RI,I - 2/yr	
6	909	RI,I - 2/yr, M,R.SV,V - 1/yr	
7	910	RI,I - 4/yr, R - 1/yr	Recent special ongoing evaluation
8	1005	RI,I - 2/yr	
9	1006	RI,I - 2/yr	
10	1008C	RI,I - 2/yr	
11	NDATR (MH#4)	RI,I,M,SV,V - 4/yr, R - 2/yr	
12	8610	RI,I - 2/yr	
13	8611	RI,I - 2/yr	
1	904	WL only, quarterly	
2	905	WL only, quarterly	
3	907	WL only, quarterly	
4	1001	WL only, quarterly	
5	1002	WL only, quarterly	
6	1003	WL only, quarterly	
7	1004	WL only, quarterly	
8	96-I-01	WL only, quarterly	
9	96-I-02	WL only, quarterly	
10	96-I-03	WL only, quarterly	
11	96-I-04	WL only, quarterly	
12	NDA/WP-B	WL only, quarterly	
13	NDA/WP-C	WL only, quarterly	
14	90-I-7	WL only, quarterly	
15	MH#2	WL only, quarterly	
16	1109A	WL only, quarterly	owned and sampled by NYSERDA
NDA Locations Monitored Under Routine NDA Operations (SOP 82-01, rev. 6, 01-23-2007)			
1	84-I-17*	WL and SL, monthly	
2	85-I-11*	WL and SL, monthly	
3	85-I-9	WL and SL, quarterly	
4	86-I-8	WL and SL, monthly	
5	89-13-W	WL and SL, monthly	
6	89-14-N*	WL and SL, monthly	

2.2 Leachate Monitoring

Leachate monitoring in the NDA is currently being performed at the locations and at the frequency listed in Table F-1 (see Figure F-1 for the respective locations). These include wells, piezometers, standpipes, and NDA Interceptor Trench manholes. The monitoring is being performed in accordance with the site procedure EM-6, "Groundwater Sampling." Water level and solvent measurements are collected in accordance with the procedures outline in Standard Operating Procedure (SOP) 82-01, "Routine NDA operations." Analytical samples are also routinely collected from the NDA trench as part of this SOP to ensure that potentially solvent-contaminated water captured by the interceptor trench is handled in a safe and timely manner while being transferred.

The only anticipated revision to these procedures will be to address access to the monitoring locations and special considerations due to the presence of the geomembrane cap and storm water structures.

2.3 Storm Water Monitoring and Analysis

Storm water monitoring at the WVDP is currently conducted at 20 storm water outfalls in accordance with the site's SPDES permit. Two of the outfalls monitored, S-17 and S-20, are within the drainage area for the NDA. Outfall S-20 drains to the north from the drainage area located between the NDA and the SDA into Erdman Brook. Outfall S-17 also drains to the north from the road on the west side of the NDA, and eventually into Erdman Brook. However, after completion of the IM, storm water from the NDA will no longer go to S-17. All of the NDA storm water runoff will be directed to S-20. Storm water directly adjacent to the NDA (to the west) will, however, still be directed to S-17.

The WVDP is required to conduct semi-annual monitoring on the storm water outfalls: one storm event during the period January 1 through June 30 and another event from July 1 through December 31. The sampling is performed in accordance with WVDP-233, "Monitoring Plan for Storm Water Discharges at the West Valley Demonstration Project." The following information must be collected during each storm event sampled:

1) Date of storm event;
2) Duration of storm event;
3) Total Rainfall during event;
4) Number of hours between the storm event sampled and the end of the previously measurable (>0.1 inches rainfall) storm event;
5) Total flow from the rain event; max flow rate during the storm event; and
6) A description of the method of flow measurement.

S-20 is sampled twice per year and S-17 is sampled every third semi-annual monitoring period. S-17 outfall is in a storm water group of 3 outfalls, whereby one outfall from each group is sampled during each semi-annual period. S-17 was last sampled on June 19, 2006, and is scheduled to be sampled again in the fall of 2007. Please see Figure F-1 for the

	Well ID	Analyses	Comments
7	89-27-N	WL and SL, quarterly	
8	89-27-W*	WL and SL, monthly	
9	89-28-W*	WL and SL, monthly	
10	89-29-E	WL and SL, monthly	
11	89-29-N	WL and SL, monthly	
12	89-5-N	WL and SL, quarterly	
13	90-I-4	WL and SL, quarterly	
14	B-84-8*	WL and SL, monthly	
15	B-88-11	WL and SL, quarterly	
16	NDA/WP-A	WL and SL, quarterly	
17	MH#4/NDATR	WL, SL, flow volume, daily: pH, TOC, gross alpha, gross beta, weekly	
NDA Locations Monitored Under landfill Inspection and Maintenance (SOP 40-04, rev. 3, 03/27/2007)			
	WVTR-11-B-1	WL and SL, semiannually	
	WVTR-11-I-1	WL and SL, semiannually	
	WVTR-11-I-2	WL and SL, semiannually	

*	=	Locations where solvent has been detected.
RI	=	radiological Indicator Parameters (gross alpha, gross beta, tritium)
I	=	Indicator Parameters (pH, specific conductance)
M	=	appendix 33 metals
V	=	appendix 33 volatile organic compounds
SV	=	appendix 33 semivolatile organic compounds
R	=	radioisotopes
SL	=	solvent level (top and bottom level of solvent)
WL	=	water level
TOC	=	Total Organic Carbon

After completion of the IM for the NDA, the monitoring of these existing locations will continue unchanged. However, as part of the IM, in order to monitor and evaluate the effectiveness of the slurry wall, 21 new piezometers will be installed adjacent to the slurry wall in locations as shown on Figure F-1. Twelve of these piezometers will be outside of the wall (outside of the NDA), and nine will be inside the wall (between the NDA and the wall). Groundwater levels will be monitored in these piezometers to determine if the groundwater inside the wall (in the NDA) is decreasing, and thereby creating an inward gradient. These new piezometers will be included as part of the GMP.

Groundwater sampling and water level measurements at GMP wells will be sampled and analyzed in accordance with the procedures outlined in WVDP-239, "Groundwater Monitoring Plan." WVDP-239 will be revised to include the new piezometers and procedures that address access to the monitoring locations and account for the presence of the new geomembrane cap and storm water structures. Access will be via established walkways, and monitoring activities will include precautions so as not to damage or impact the cap.

location of these outfalls. Table F-2 includes a list of parameters monitored at outfall S-20, and Table F-3 lists the parameters monitored for at S-17.

A grab sample will be collected during the first 30 minutes of the discharge and a flow-weighted composite (with the exception of pH and oil and grease) will be taken for the entire discharge or for the first 3 hours of the event.

Storm water monitoring for the NDA will continue through the existing SPDES permit and the sampling of outfalls S17 and S-20.

TABLE F-2
Parameters Monitored at Outfall S-20

GROUP A	GROUP B	GROUP C
pH	Aluminum	Total Nitrogen (as N), TKN
oil & grease,	Iron	Nitrate, Nitrogen (as N)
BOD_5	Copper (TR)	Nitrite, Nitrogen (as N)
TSS TDS	Lead (TR)	Ammonia, Nitrogen (as NH_3)
Phosphorus, T	Zinc (TR)	Sulfide, Surfactant (as LAS)

TABLE F-3
Parameters Monitored at Outfall S-17

GROUP A	GROUP B	GROUP C
pH	Aluminum	Total Nitrogen (as N), TKN
oil & grease	Iron	Nitrate, Nitrogen (as N)
BOD_5	Copper (TR)	Nitrite, Nitrogen (as N)
TSS TDS	Lead (TR)	Ammonia, Nitrogen (as NH_3)
Phosphorus, T	Zinc (TR)	Sulfide, Surfactant (as LAS)
		Vanadium (TR)
		Settleable Solids

2.4 Radiological Environmental Monitoring

Direct radiation measurements at the WVDP are obtained using an array of thermoluminescent dosimeters (TLDs) affixed to cards deployed at locations on and around the site. On site, TLDs are deployed near operational or storage facilities that have the potential to produce measurable external radiation. One such TLD location is DNTLD36, just south of the NDA as shown on Figure F-1, in the area referred to as the NDA Hardstand. This TLD is read on a quarterly basis and is included in the site environmental monitoring program under EM-098, "Environmental Monitoring Program Plan."

Since the NDA IM will further isolate the sources of radiation in the NDA, it is assumed that the resultant impact on the radiation levels in the area will be none, or possibly a

reduction in these levels. Therefore, there are no plans to modify the existing direct radiological monitoring program due to the implementation of the NDA IM.

2.5 Regular Integrity Inspection and Evaluation of the Geomembrane Cap

A new geomembrane cap will be installed as part of the NDA IM and consists of soils and exposed synthetic materials. Currently there are no NDA procedures that include inspection and maintenance of an exposed geomembrane cap. Monitoring of the NDA grounds, including inspections of the interceptor trench manholes and Trench 11 standpipes will continue to be performed in accordance with procedures outlined in SOP 40-04, "Landfill Inspection and Maintenance Plan."

SOP 40-04 will be revised to include procedures for inspecting the geomembrane cap. Anticipated checklist items to add to SOP 40-04, Appendix B, "NDA Inspection Data Sheet," include observation of the exposed cap for damage, holes, cracking, splitting of seams, deterioration, exposed geotextiles and underlining soils, areas of uplift or wrinkles, and undercutting or release of cap anchor. Also included will be requirements for integrity testing as described below.

2.5.1 Cap Integrity Testing

In addition to routine visual inspections, the cap material will be tested for integrity. Integrity testing will include testing for tensile strength and puncture resistance; field seam integrity testing in critical areas; and a microscopic evaluation to evaluate the impact of aging. All but the field seam integrity testing will be performed every five years. The field seam testing will be performed every two years.

2.5.1.1 Tensile Strength

Tensile strength will use on-site archived samples of the geosynthetic materials, or samples from an exposed portion of the geothentic material not part of the cap (i.e., a portion that is exposed and outside the limits of the anchor trench), to test for strength and elongation. Tension strength and elongation data are material properties and specifications used in engineering design. The limit on service life will be determined by those parameters that have reduced by 50% of the design property. Enough samples to conduct integrity testing for 30 years will be appropriately accounted for.

2.5.1.2 Puncture Resistance

Puncture resistance of the geomembrane will be tested in accordance with the test procedure FTMS 101C (Method 2065). As with the tensile strength testing, the limit on the service life will be determined when 50% of the

initial design property of the material is reached. This is a simple test that tests a specimen for resistance (in pounds) to puncture.

2.5.1.3 Microscopic Evaluation

Microscopic evaluations test for signs of oxidation of membrane stabilizers in the ethylene interpolymer alloy that provides water-tightness while protecting the polyester fiber from ageing due to the exposure to harsh environments. The microscopic evaluation provides an indication of degradation and long-term stability of the EIA before weakening and failure of the polyester. As long as the composite material remains watertight and the polyester is protected by the ethylene interpolymer alloy, the cover should continue to function properly.

The test for microscopic evaluation will be consistent with ASTM D 5596. However, it may be modified for use with the XR-5 on the appropriate recommendations by the testing laboratory.

2.5.2 Field Seam Integrity Testing

The cap will function as a barrier to storm water infiltration, and except in the storm water detention areas, will shed the water quickly resulting in a minimal head of water on the cap for limited time periods (e.g., only during storm events). Therefore, small holes or defects that may develop over time in the cap area (outside of the detention areas) would result in an insignificant amount of water infiltration into the underlying soil cover. A hole that would result in a significant leak would be large enough to be visible during the planned inspections, and would be repaired. However, since there will be a head over the cap for a longer period of time in the storm water detention areas, small holes in these areas have more of a potential to result in water infiltration that could be of concern. In addition, the highest potential for developing holes in the geomembrane material is along panel field seams. Therefore, as part of the operation and maintenance of the cap, testing of field seams in the storm water detention areas will be performed.

The testing of the field seams in the storm water detention areas will be done once every 2 years by the air lance testing method (included as part of ASTM D4437). An air lance test method is a field test that directs a nozzle of compressed air at the seam overlap. Any defects will show as an inflated channel through the seam. Defects are then marked and repaired. The test will be performed by a qualified and experienced subcontractor.

2.5.3 <u>Ground Surface Monitoring</u>

Ground surface monitoring of the NDA is currently being performed over the general NDA site on a quarterly basis. The monitoring performed in accordance with SOP 40-04 is for a vegetated cap and includes a visual inspection for

depressions, settlement, ponding, cracks, leaching, bare areas, burrowing animals, exposed materials, grades, erosion, signs and fencing, storm water transport, and creek integrity.

The existing cap will be reinforced as part of the NDA IM with additional soil to promote cover thickness and drainage and ultimately topped with a geosynthetic material. The visual inspections covered under SOP 40-04 still apply for inspection of the NDA site, but will include those additional items as mentioned above for the exposed geosynthetic material. Anticipated revisions to SOP 40-04 will address new survey locations and include special considerations due to the presence of the geomembrane cap.

In addition to a visual inspection for settlement, the cap will be monitored by survey of settlement markers and benchmarks. The survey for settlement and integrity of grade assures that the cap and cap materials are functioning properly and are not being exposed to extreme stresses. Locations of significant settlement that have compromised the integrity of the cap will be repaired and maintained according to the following maintenance section.

3.0 MAINTENANCE

Maintenance of the NDA site has been established according to SOP 40-04. Currently, routine maintenance includes upkeep of the existing soil and vegetated cover and storm water controls. Installation of a geosynthetic cap will discontinue the need for maintenance procedures involving a vegetated cap. SOP 40-04 will be revised to consider the installation of the exposed geomembrane and current maintenance items, such as grading, topsoil placement, seeding, and fertilizing, will remain explicitly to handle soil and vegetated areas outside the geomembrane limits.

3.1 Geomembrane Cap

In order to maintain the integrity of the geomembrane, care must be taken to limit the traffic and loads on the geosynthetic material and remove objects and debris that may cause damage. Special consideration should be made for areas where soil acts as the anchoring system for the geosynthetic cap. Routine maintenance to assure anchor stability would include items currently listed in the SOP 40-04 (i.e., compaction of soils, grading, and seeding of eroded areas, etc.).

In locations where the geomembrane has been penetrated or compromised, a patch will be cut from like materials and seamed over the damaged area. Repairs will be performed in accordance with the geosynthetic manufacturer's procedure and specification. Non-destructive testing of the repair area will be done as specified in the record construction specifications.

The following tasks must be performed for proper repair of the geosynthetic cap:

- Remove damaged geomembrane;
- Remove damaged cushion geotextile and inspect underlying subgrade (remove objectionable materials, if necessary);
- Backfill, grade, and compact subgrade to form a uniform surface for placement of new geosynthetics;
- Clean and dry geosynthetic surfaces in areas of weld or seam;
- Place and seam cushion geotextile according to manufactures specification;
- Place and weld geomembrane according to manufactures specification;
- Perform required quality assurance/quality control testing, in accordance with the record construction specifications, to provide certification that the cover has been repaired adequately; and
- Perform other tasks that may be required based on geosynthetic manufacture's specifications

3.2 Storm Water Control Structures

Storm water controls are routinely monitored and maintained as part of SOP 40-04. Currently damaged pipe and eroded areas are replaced or repaired and drainage ditches are cleaned and maintained as vegetated lined ditches. This will also include new drain pipes and culverts installed as part of this IM.

New drainage basins and storm water control swales will be constructed and lined as part of the new cap system with geosynthetic materials. Similar maintenance procedures apply (i.e., remove debris and repair damaged pipe and eroded areas), but SOP 40-04 will be revised to include inspection and repairs of geosynthetic materials as required.

3.3 Liquid Pretreatment System Access Road

The existing access road to the Liquid Pretreatment System (LPS) is an improved road. The road and existing facilities are visually inspected under SOP 40-04 for integrity and overall condition. The roadway will continue to be inspected and maintained according to SOP 40-04.

4.0 REPORTING AND DOCUMENTATION

The reporting and documentation for the O&M of the NDA will be as contained in the following procedures.

- NDA Inspection and Maintenance: SOP 40-04, "Landfill Inspection and Maintenance Plan"
  - NDA Inspection Data Sheet
  - IWPs and RWPs as well as standard work orders administered through a Work Instruction Package
  - 3008(h) Quarterly Progress Report (provided to NYSDEC)
- Groundwater Monitoring: WVDP-239
  - Annual Groundwater Trend Analysis Report
  - RCRA Quarterly Groundwater Exception Report (provided to NYSDEC)

    - Quarterly Water Levels at the NRC-Licensed Disposal Area Report (pursuant to the 3008[h] Order and provided to NYSDEC)
    - Annual Site Environmental Report
- Leachate Monitoring: SOP 82-01
    - Inspection Data Sheet
    - (To be added to) 3008(h) Quarterly Progress Report
- Storm Water Monitoring – Under the storm water monitoring provisions of the site SPDES Permit
    - June and December Discharge Monitoring Reports (provided to NYSDEC)
- Environmental Radiological Monitoring: WVDP-098
    - Annual Site Environmental Report
- Training and Safety: WVDP-126, "Performance-Based Training Program Manual Preface," WVDP-11, "Industrial Hygiene and Safety Manual," and WVDP-010, "Radiological Controls Manual"
    - The project Training Records Management System
    - IWPs
    - RWPs

5.0 TRAINING AND SAFETY REQUIREMENTS

General training requirements for work at the WVDP are covered under WVDP-126, "Performance-Based Training Program Manual Preface." Specific training for work in radiological areas is covered in WVDP-290, "WVDP Radiation Training Program Manual," and WVDP-010, "Radiological Controls Manual," and requires radiation worker training. Work in hazardous areas and with hazardous materials is controlled through the implementation of WVDP-11, "Industrial Hygiene and Safety Manual," and will require OSHA 40-hour HAZWOPER training.

All personnel working at the site require a general employee training to provide them with a general overview of the health, safety, and emergency procedures at the site. However work specific to the NDA will require training on potential radiological and chemical contamination hazards. Personnel performing work within the NDA will have OSHA 40-hour HAZWOPER and radiological worker training. The work will also be planned and controlled through the use of radiation and industrial work permits. Each work task will have its own Industrial Work Permit that identifies the potential hazards and appropriate measures taken to mitigate the hazards. If the work is in the controlled NDA radiological area, then a Radiation Work Permit will be used to identify the radiological hazards and respective controls and mitigative measures.

Since the operation and maintenance work for the NDA falls within work that can be covered under the existing training and safety controls and procedures for the site, no modification of the respective procedures is anticipated.

6.0 SCHEDULE

The following Table F-4 summarizes the frequency of the respective operation and monitoring activities identified for the NDA.

Table F-4
Annual O&M Schedule for the NDA

O&M Activity	Frequency	Governing Procedure
Groundwater Monitoring	Quarterly	WVDP-239
Leachate Monitoring	Quarterly	SOP 82-01
Storm Water Monitoring	Semi-annually	SPDES Permit & WVDP-233
Radiological Monitoring	Quarterly	WVDP-098
Integrity Inspection of the Cap	Quarterly	SOP 40-04
Geomembrane Integrity Testing (Tensile strength, puncture resistance, and microscopic analysis)	Every 5 years	SOP 40-04
Field Seam Integrity Testing	Every 2 years	SOP 40-04
Ground Surface Monitoring	Annually	SOP 40-04

The respective procedures will be revised as necessary to include the monitoring of the NDA IM components once the IM work is complete. The implementation of the revised procedures will start the within 4 months of completing the IM.

The data generated will be included with the project file records and will be stored in accordance with the procedures outlined in QM-6, "Document Control," and WV-730, "Records Management and Storage Program." Copies of final data and reports associated with the NDA IM will be maintained in the Master Records Center (MRC) per WVDP-262, "WVNSCO Manual for Records Management and Storage."

Health and Safety Plan

Subcontractor

Safety, Health and Environmental Protection Program Manual

May 2007

West Valley Demonstration Project (WVDP)

Provide Cap for NRC Disposal Area (NDA)

Provide Slurry Wall to Minimize Surface and Ground Water Infiltration to NDA Trenches

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SAFETY, HEALTH and ENVIRONMENTAL PROTECTION PROGRAM OVERVIEW

(Subcontractor) expects that work will be performed safely, with no resultant injury or illness to employees. To accomplish this expectation, first-line supervision, with the support of the safety director, is responsible for safety planning and for its integration into the work process. Integrating safety into the work process includes the following concepts:

1. Defining the work scope
2. Analyzing the hazards inherent in the tasks
3. Developing and implementing controls to eliminate or reduce the hazards
4. Performing work safely
5. Reviewing completed tasks by workers and supervisors for ideas to improve job safety
6. Evaluating task performance and oversight information to identify improvement opportunities

By providing safe workplace conditions, explicit instructions to workers relevant to identified hazards, controls to mitigate the hazards such as personal protective equipment, soliciting worker input regarding safety improvements, and evaluating information gathered by management assessment and oversight, Subcontractor will continue to maintain an exemplary company safety record.

Subcontractor's Safety and Health program shall continue to:

1. Ensure construction equipment furnished for use is certified to be, and is maintained in, safe operating condition and operated by qualified operators.
2. Ensure adequate emergency aid is provided and/or is available at job sites, and emergency preparedness actions are recognized and communicated to personnel.
3. Provide routine review of work sites by management official(s) and/or safety representative(s) to recognize and correct unsafe conditions or practices.
4. Assure that all Company personnel attend an initial safety orientation and continue to conduct safety meetings for all employees on a biweekly basis or more often.
5. Provide and ensure use of personal protective equipment (PPE) as needed to protect against work hazards, where they cannot be removed by built-in protection (i.e.- by engineering controls). Instructions for proper use and maintenance shall be communicated to all affected employees.
6. Include safety considerations in work planning that recognize worker safety requirements for the planned task. Exceptions to recognized standards should be reviewed and approved before being implemented. Permits or clearances shall be initiated for specialized activities, e.g., involvement with other contractor operations, high-voltage electrical power, etc.
7. Recognize the contract workplace as the "Establishment" for recording all work-related injuries and illnesses on an Occupational Safety and Health Administration (OSHA) Log 300.
8. Provide for notification to the owner's representative(s) of all accidents, injuries, fires, or serious safety violations/problems, as required by contract.
9. Ensure that all hazardous materials/wastes are handled and disposed of in accordance with all federal, state, and local laws, and in accordance with contract requirements.

1.0 INTRODUCTION:

1.1 Company management and field supervision are charged with the responsibility for planning safety into each work task, thus avoiding incidents and conditions that could lead to occupational injuries or illnesses. While the ultimate success of safety depends on the full cooperation of each individual employee and Subcontractor employee, it is our management's responsibility to see that effective safety procedures are implemented and enforced and that beneficial training programs are established on a regimented basis.

1.2 For on site work, Subcontractor and their Subcontractors, suppliers, and vendors shall be responsible for adhering to this Safety and Health Manual as well as to any applicable federal, state or local requirements, including applicable OSHA Standards.

1.3 Prevention of accidents and injuries, as well as prevention of environmental pollution, is achieved through control of the working environment and people's actions. Procedures and guidelines set forth in this document and those of the reference documents describe those controls for the work environment and worker safety. Employee actions are directed by instituting a viable training program, introducing a positive safety culture and, when necessary, disciplining those employees not adhering to the requirements established within Subcontractor's Safety and Health Program.

1.4 Each employee is responsible not only for his or her own safety but for the safety of his/her fellow workers as well. Each employee has a responsibility to his/her family and to his/her employer to work in a safe manner. In the performance of his/her duties, the employee is expected to observe safety practices, and to follow instructions relating to the safe and efficient handling of the work.

1.5 If, during the performance of any job or task, an employee is exposed to, or observes a condition that may endanger him or others, or the environment, the employee is empowered to "STOP WORK", inform the area supervisor, and seek a resolution to the condition.

2.0 PURPOSE and SCOPE

2.1 This manual describes safety and health requirements for all site work and provides requirements for task level safety planning and work performance.

2.2 The requirements of this manual apply to work conducted at the job site by Subcontractor employees and Subcontractors.

3.0 RESPONSIBILITIES

The responsibilities of those in specific positions are as follow. Performance of the activities here associated with one position may be delegated to subordinate positions, but the responsibility for implementation remains with the identified position. In all activities, assurance of employee safety is the responsibility of that employee's first-line supervisor or manager.

3.1 The President and/or the Vice Presidents shall ensure implementation of the requirements of this program for all projects as required by contract.

3.2 The Project Manager (PM)/Construction Manager (CM), reports to the President and Vice Presidents and shall ensure implementation of the requirements of this program and maintain overall responsibility for the project safety program.

3.3 The Safety Director reports directly to the President and Vice Presidents, communicates directly with the CM, and shall be directly responsible for ensuring day-to-day implementation of the requirements of this manual, conducting required inspections of work site areas, conducting safety meetings, training personnel in the requirements of job-site safety programs and procedures, maintaining record files of employee safety training, performing Job Safety Analyses and otherwise assisting first-line supervision in identifying hazards and in developing controls to mitigate the identified hazards, and planning assessments of the safety program implementation. The Safety Director shall report all stop work actions to the Subcontractor construction manager immediately, and assist in identifying corrective actions, conduct critiques of accidents and/or incidents resulting from unsafe work, and coordinate with the Owner for reporting job-related injuries and illnesses.

3.4 First-Line Supervision, including Construction, Engineering, Quality Assurance, and Administration, is responsible for the safety of their employees and of the environment and for integrating controls into work activities that ensure this safety.

3.5 All Subcontractor employees and Subcontractors are responsible for conducting themselves in a safe and professional manner. They shall follow instructions in the construction documents and have the responsibility and authority to stop work whenever there is the possibility that the work being performed is unsafe to staff, to the public or to the environment. Unsafe working conditions shall be reported to the employee's first-line supervisor and corrected prior to the work continuing.

3.6 In those cases in which Subcontractor has delegated field supervision of the work to the

Subcontractor, the Subcontractor shall designate a Safety Director for the project who shall have responsibility for all of the duties normally assumed by the Subcontractor Safety Director. Likewise, the Subcontractor shall designate Competent Persons as necessary and shall abide by all of the applicable provisions of this safety and health manual and all applicable federal and state regulations pertaining to employee safety and environmental protection including but not limited to those promulgated by the Occupational Safety and Health Administration and the Environmental Protection Agency.

4.0 PERSONNEL SAFETY ORIENTATION AND TRAINING

4.1 Each employee assigned to the project shall be provided initial orientation and continued safety program training to enable him or her to work in a safe manner.

4.1.1 all employees (including Subcontractor employees) shall be trained to the requirements of this Safety and Health Project manual. This training shall be conducted prior to the employee performing work at the project site and shall be documented.

a. Evidence of training shall include a signature of the employee indicating that he or she has received instruction or read, understands, and will implement the requirements of this manual.

4.1.2 Subsequent safety and health training provided to employees and Subcontractor employees shall be documented.

4.2 Operation of equipment and machinery shall be permitted only if the employee is qualified by training or experience.

4.3 Each employee shall be instructed in the recognition and avoidance of unsafe conditions and regulations applicable to that employee's work environment in order to control or eliminate hazards or other exposure to illness or injury.

4.4 All employees that are required to handle or use flammable liquids, gases, or toxic materials shall be instructed in the safe handling, storage, disposal, and use of these materials and in related specific requirements for protection of the employees.

4.5 Employees shall be properly trained in the use of each type of fall protection device. The instruction shall include proper use, inspection, and maintenance procedures. This training shall be documented for each fall protection device used.

4.6 Training shall be required for all personnel prior to the use of respirator equipment. This training will include classroom instruction and at minimum, a qualitative fit testing. Documentation of this training shall be maintained at the job site.

4.7 Training in other safety topics shall be identified by the Safety Director and provided to project personnel using project procedures that meet requirement of 29CFR1910/1926 applicable to the job-site personnel (e.g. - Hazard Communication, Lock and Tag, Hearing Conservation, and Confined Space Entry, etc.).

4.7.1 Training in the content of written procedures shall be given prior to employees conducting the work for which the procedure was written.

4.8 Use of asbestos and lead is prohibited.

5.0 CHEMICAL HAZARD COMMUNICATION

5.1 Purpose:

It is the policy of Subcontractor that the first consideration in the performance of work shall be the protection of the safety and health of all employees. The company has developed this Chemical Hazard Communication Program to ensure that all employees receive adequate information relevant to the possible hazards that may be involved with the various hazardous substances used in the company's operations and processes. The following program outlines how we will accomplish this objective.

5.2 Scope:

This policy covers all potential workplace exposures involving hazardous substances as defined by federal, state and local regulations.

This program has been prepared to comply with the requirements of the Federal OSHA Standard 1910.1200 and to ensure that information necessary for the safe use, handling, and storage of hazardous material is provided to and made available to employees.

5.3 Definitions:

5.3.1 Hazardous Chemical means any chemical that poses a physical hazard or health hazard.

5.3.2 Health Hazard means a chemical for which there is significant evidence that acute or

chronic health effects may occur in exposed employees.

5.3.3 Physical Hazard means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, or flammable.

5.3.4 Material Safety Data Sheets (MSDS) are printed material concerning a hazardous chemical that are prepared in accordance with OSHA regulations. The MSDS must include the following information

5.3.4.1 Identity of the chemical.
5.3.4.2 Physical and chemical characteristics for the hazardous chemical.
5.3.4.3 Known acute and chronic health effects and related health information.
5.3.4.4 Exposure limits.
5.3.4.5 Whether the chemical is considered to be a carcinogen, mutagen or teratogen
5.3.4.6 Precautionary measures for safe use and handling of the substance.
5.3.4.7 Emergency and first aid procedures.
5.3.4.8 Identification of the organization responsible for preparing the MSDS.
The date the MSDS was prepared or the date of the last change to the sheet.

5.4 Hazard Determination:
The company does not intend to evaluate hazardous substances purchased from suppliers and/or manufacturers, but has chosen to rely upon the evaluation performed by the suppliers or by the manufacturers of the substances to satisfy the requirements for hazard determination.

5.5 Container Labeling:
The project manager shall ensure that all containers of hazardous substances on the job site are labeled with the identity of the substance—and appropriate wording, pictures or symbols -- to convey a warning of the health and physical hazards of the substances. Labels must conform to the following criteria: The identity appearing on the label must match identity shown on the MSDS.

Subcontractors shall be required to provide MSDS for any hazardous substances brought to the jobsite.

5.6 Employee Training
Employees shall be made aware of any operations in their work area where hazardous chemicals are present and the procedure for obtaining MSDS information.

New employees shall receive orientation and training on the Haz-Com. program in effect. This shall include:

5.6.1 Information on the Hazard Communication Standard including an explanation of labeling, how to read material safety data sheets (MSDS), and how the employee can obtain and use pertinent hazard information.
5.6.2 Methods that may be used to detect the release of a hazardous material in the workplace.
5.6.3 The physical and health hazards associated with hazardous material.
5.6.4 The proper procedure for handling hazardous materials including information/instruction regarding the wearing of the appropriate personal protective equipment.

6.0 SAFETY MEETINGS

6.1 The Safety Director or his/her designee shall conduct safety meetings (Toolbox Talks) at least once biweekly to keep all craftsmen abreast of site changes and lessons learned during work activities. Meeting topics and discussions shall include job safety, review of changes to the Safety Program, and coverage of other subjects relative to safety and health, as applicable.
6.1.1 An attendance sheet shall be signed by all personnel attending the meeting.
6.1.2 Record of biweekly safety meetings shall be maintained by the Safety Director.

7.0 REPORTING of INJURIES, ILLNESSES, ACCIDENTS, FIRES

7.1 Subcontractor employees and its Subcontractors are required to report immediately (i.e. - at the time of occurrence) each work-related injury, illness, accident or fire to their supervisor, who will also notify the Safety Director. The Owner's field coordinator will be promptly notified of all injuries, work-related illnesses, accidents, or fires, regardless of severity, without delay.
7.1.1 Any Subcontractor or Subcontractor employee who becomes injured or ill while working on the job site shall immediately (i.e. – at the time of occurrence) notify his/her supervisor, who will also notify

the Safety Director. A foreman will escort the affected employee to the local community hospital/healthcare organization.

7.1.2 If a life threatening injury has occurred, the supervisor shall summon community Emergency Medical Services (EMS) personnel by dialing "911" and communicating the nature of the injury and the response location. Ambulance services will be requested if emergency transportation is required. For all non-emergency situations, Subcontractor or its Subcontractor(s) shall provide needed transportation.

7.1.3 Properly trained Subcontractor and/or Subcontractor personnel will administer first aid and, if necessary, then transport the injured or affected employee to the local community hospital emergency room, as indicated by the nature of the illness or injury.

7.1.4 A Report of Occupational Injury or Illness shall be initiated on all reportable incidents.

7.2 If a physician prohibits or restricts an employee from immediately returning to work, the Safety Director will be promptly notified.

7.2.1 The employee, upon returning to work, shall report to the project construction superintendent with the following documentation from the treating physician or from their personal physician.
diagnosis of injury/illness;
date first seen by the physician;
release date the employee may return to work;
any work restrictions issued and length of time of restriction.

7.3 An employee injury or illness shall require an accident or incident investigation be conducted by the Subcontractor Safety Director or his designee (e.g. - Subcontractor safety director).

7.4 Facts surrounding the incident/accident shall be accurately established and reported, and corrective actions shall be taken to prevent recurrence of the injury or illness.

7.5 Accidents causing property damage shall be reported to the Owner's representative.

7.6 The Safety Director shall be responsible for documenting all injuries and /or job related illnesses involving Subcontractor and Subcontractor-direct employees on the Subcontractor OSHA 300 log.

7.6.1 Subcontractors shall be responsible for documenting all injuries and /or job related illnesses involving their employees on the Subcontractor's OSHA 300 log.

7.6.2 A composite project log of injuries and/or job related illnesses shall be maintained by the Subcontractor Safety Director.

8.0 REPORTING of INCIDENTS, NEAR MISSES and UNSAFE CONDITIONS

8.1 All safety or security incidents, including near misses, even those that haven't caused injury, must be reported to your supervisor immediately so that corrective action may be taken to prevent re-occurrence and to prevent the injury that was narrowly avoided.

8.2 Unsafe conditions, certain or uncertain, must be reported to your supervisor immediately so that they may be investigated and corrected if necessary. Remember that if you perceive a situation to be unsafe, it may well be. Raise the question.

9.0 EMERGENCY ACTION PLANS and EVACUATION

9.1 Project Managers, Superintendents and Foremen shall be responsible for establishment of an emergency action plan for each jobsite.

9.2 Emergency action plans shall include

9.2.1 Response to fires
9.2.2 Emergency escape routes and procedures
9.2.3 Procedures to account for all employees after emergency evacuation has been completed
9.2.4 Rescue
9.2.5 First aid and medical duties
9.2.6 Methods for reporting of fires and other emergencies
9.2.7 Methods for sounding or otherwise communicating an evacuation alarm

9.3 Employees shall be responsible for learning and knowing the emergency action plans and for carrying out their roles within those plans.

10.0 SAFETY SURVEILLANCE and INSPECTIONS

10.1 The on-site Construction Superintendent or the Subcontractor's designee will perform daily safety inspections of the project construction areas.

10.1.1 Daily safety checks will ensure that means of egress from work areas and emergency exits remain free from accumulation of rubbish or debris.

10.1.2 Blocking of emergency exits shall not be allowed prior to approval of an alternate emergency egress plan, reviewed by the Subcontractor Safety Director and submitted to the Owner for approval.

10.2 The Safety Director or his designee will perform weekly inspection of the job site work and storage areas for compliance with the documents referenced in this manual and will work with the project construction manager and construction superintendent toward prompt remediation of identified hazards.

10.3 All supervisory personnel (Superintendents/Foremen) will be responsible for inspecting their work place for safety and health hazards and shall take the necessary steps to correct the deficiencies identified. These hazards may be conditions of the work place, unsafe tools/equipment, or unsafe actions committed by the employees. The Subcontractor Safety Director may be called upon to assist in correcting any deficiencies found in the work place.

10.4 Employee feed back regarding safety issues or areas for improvement relative to the hazard controls applied to the work will be collected and acted upon by the Safety Director.

11.0 DRUG AND ALCOHOL FREE WORKPLACE

The project worksite shall be drug and alcohol free. All project personnel, including all subcontract personnel, shall be observed for signs of drug and alcohol use by project management at all times. All project personnel shall be tested for drugs and alcohol as follows:

11.1 Type of drug test: NIDA-like 9-panel drug screen via urinalysis.

11.2 Type of alcohol test: Evidentiary breath alcohol test (EBT).

11.3 Frequency of testing:

11.3.1 Pre-employment - responsibility of respective Subcontractor

11.3.2 Post-accident

11.3.3 Reasonable suspicion

11.4 Definition of sobriety, regarding alcohol: Less than or equal to 0.02 percent breath alcohol

12.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

12.1 Hardhats shall be required to worn by all Subcontractor employees, Subcontractor employees and visitors while in construction areas and when current activities dictate their necessity. The lead person will decide when hardhats are necessary. All hardhats shall meet the American National Standards Institute Safety (ANSI) Requirements for Industrial Head Protection, Z89.1-1969.

12.2 Work boots: Substantial work boots shall be worn by all Subcontractor and Subcontractor employees while in construction areas.

12.3 Adequate work clothing shall be required for all employees; with the torso fully covered, legs covered to the ankle, and arms covered over the shoulders. Shorts, tank tops, shirts cut off at the midriff, cutoffs, moon boots, sandals, sneakers, jogging shoes, etc., shall NOT be worn at any time in construction areas.

12.4 Eye and Face Protection equipment provided shall meet the requirements specified in American National Standards Institute (ANSI) 87.1-1968 (includes side shields).

12.4.1 Safety glasses with side shields shall be worn in all areas posted as a "Safety Glasses Area" or for all activities, which pose an eye injury hazard.

Employers shall supply their employees with ANSI-approved safety glasses including over-the-prescription-eye-wear types for those wearing vision-corrective lenses.

Visitors shall be supplied with safety glasses at the entrance to each posted construction site for use while in the work site.

Other types of eye or face protection equipment, such as face shields, goggles, etc., shall be provided as identified as required.

12.5 Personal Fall Arrest (PFA) Systems ---Harness, Lanyards, Anchor Points

Fall protection measures - General: Fall protection measures will be used whenever feasible and whenever required by OSHA regulations when working at unprotected heights in excess of six feet and at

lesser heights when additional/special hazards exist at lower levels, such as impalement hazards, engulfment hazards, and so on. Safety measures to be utilized will include: guardrail systems; personal fall arrest systems PFAs) [(safety harnesses/lanyards/anchor points; horizontal and vertical lifelines /harnesses/lanyards/anchor points]; work positioning belts; nets; controlled access zones, controlled decking zones, control lines; warning lines; safety monitoring systems and appropriate combinations of these will be used to prevent falls. Specific equipment requirements will be determined by the site-specific risks inherent to the task and site-specific and task-specific protective measures available. Protective measures and all equipment associated with and necessary to implement them will be provided by Subcontractor.

Where and when personal fall arrest systems (PFAs) are the fall prevention measures of choice, the following guidelines shall apply in their selection and use:

12.5.1 The full body harness will be the personal fall protection device of first choice when guardrails cannot be utilized. Construction Foremen, Superintendents and Managers will have the authority to select these as PPE for fall protection.

12.5.2 The full body harness will be used at all times whenever an employee requires fall protection in confined spaces.

12.5.3 The full body harnesses will be used whenever an employee must climb structures on which a ladder cannot be used. The employee will employ a two-lanyard system in which at least one lanyard is secured at all times.

12.5.4 The positioning belt, which is used to allow workers to have their hands free while working, will be a limited-use item. Only the Safety Director shall identify the proper use and restrictions for this method of fall restraint/work positioning.

12.6 Hearing Protection Devices (ear plugs, muffs) shall be provided and utilized when it is not feasible to reduce noise levels or duration of exposure to acceptable OSHA Standards.

12.6.1 Employees will be fitted and instructed in the use of hearing protection devices prior to their use. Such training will be documented.

12.6.2 Employees routinely exposed to noise levels above 85 Decibels on the A scale (dBA) shall have baseline audiometric examinations and shall be re-examined at intervals as determined by the Subcontractor Safety Director or by the Subcontractor's safety director.

12.7 Respirators may be needed when the work involves hazardous chemicals, dust, welding fumes, confined space entry, or painting. Subcontractors shall provide respirator training and equipment to their employees and provide evidence of training to Subcontractor for approval.

12.7.1 Employers will ensure that training is provided to their employees and that Subcontractor employees are provided commensurate training as respirator users. All respirator users are required to be clean-shaven. Respiratory equipment specified in the task hazard analysis shall be used.

12.7.2 Employers will ensure that medical clearance, including pulmonary function testing, is completed with results submitted to the Safety Director prior to the testing and wearing of respiratory equipment.

12.7.3 Respiratory protection will be specified by the Subcontractor Safety Director in writing. Subcontractor employees and Subcontractors will use the PPE specified without modification of any kind, and shall maintain the equipment (cleaning and inspection) in conformance with the manufacturer's specifications.

12.7.4 When the work requires workers who normally wear prescription eyeglasses to wear a full-face respirator, prescription safety glasses of the insert or clip-in type (mounted in such respirators allowing a positive seal for the respirator) will be provided by the employing contractor.

12.7.4.1 The affected worker shall bring in a recent prescription (no older than one year) to the supervisor who will give it to the contractor's Safety Director for processing.

12.7.4.2 Use of contact lenses with full-face respirators is approved for individuals required to wear respiratory protection devices. Contact lenses are prohibited when half-face respirators are required.

12.8 Hand Protection: Employees, including Subcontractors, when hands are exposed to physical or chemical hazards, will wear Gloves. Selection of protective gloves shall conform to the requirements of OSHA Standard 29 CFR 1910.138, Hand Protection.

12.9 High Visibility Clothing orange or high visibility lime green shirts or vests will be worn continuously by members of the immediate work crew working around heavy equipment or engaged in or observing lifting/hoisting/rigging while work is in progress.

12.9.1 The work crew is defined as anyone directly associated with the work to be performed (i.e.. signaler, rigger, laborer, safety observer, supervisor, etc.).

12.9.2 Any visitor to the immediate work area, but not involved in the work cycle, shall don a vest if deemed appropriate in the opinion of the supervisor.

13.0 FIRE PREVENTION and SUPPRESSION

13.1 Portable fire extinguishers suitable for the hazard shall be provided and spaced such that travel distance to the extinguisher does not exceed 50 ft.

13.1.1 All fire extinguishers shall be conspicuously located. The Safety Director or his/her designee shall inspect all fire extinguishers at intervals not to exceed 30 days. Records of these inspections shall be documented

13.1.2 All employees that are expected to use fire extinguishers shall be properly trained. This training shall be documented.

13.2 Fire prevention methods shall be implemented at the work site. These methods shall include the following.

13.2.1 Smoking shall not be permitted in a construction area or in the vicinity of any area that constitutes a fire hazard.

13.2.2 Materials shall be stored, handled, and stacked with regard to their fire characteristics.

13.2.3 Only approved containers shall be used for storage and handling of flammable and combustible liquids and other materials.

13.2.4 During welding, cutting, or grinding operations, a fire extinguisher shall be in the immediate area. A "Fire Watch" shall be assigned for any welding, cutting, or grinding located outside designated welding areas.

13.3 Wood used in permanent or temporary construction, except formwork, shall have an NFPA Flame Spread Index of less than 25 and Fuel Contributed and Smoke Generation indices of less than 50.

14.0 SIGNS AND BARRICADES

14.1 Warning signs shall be used to indicate potential for serious injury or property damage and shall be placed to provide adequate warning of hazards to workers and to the public.

14.2 Signs shall be used to designate the required PPE for the work areas and shall be posted and visible to anyone approaching the area. Signs shall be promptly removed when the hazard no longer exists or upon completion of the work.

14.3 Danger signs shall be used only when an immediate hazard exists. Caution signs shall be used to warn against unsafe practices.

14.4 Barricades shall be used whenever a potential hazardous condition exists and shall serve as an obstruction to deter people or vehicles from the work areas, excavations and trenches as necessary.

14.4.1 Yellow or yellow and black colored rope or plastic tape shall be used to barricade hazardous areas.

14.4.2 When the need arises for a more permanent barricade, orange fencing or crossbar road barricades shall be used.

14.4.3 Flashing yellow lights shall be installed on barricades in high traffic areas.

15.0 MATERIAL HANDLING

15.1 Workers shall be trained in the proper way to lift and carry loads.

15.2 Material handling workers shall be trained in the safe use of all mechanical aids with which they are supplied. This training shall include hand tools, carts of all types, lifting devices, etc. The Safety Director shall maintain records of the qualifications on file.

16.0 WELDING, CUTTING, AND GRINDING:

16.1 Welding screens and/or portable flash curtains shall be used to the maximum extent feasible for field welding, cutting, and grinding operations. They shall be constructed of noncombustible materials, adequate to contain any weld sparks or spatter, and shall shield personnel at all approaches to the operation.

16.2 A trained fire watch shall be assigned in the immediate work area whenever welding, cutting, or grinding is being conducted outside designated welding areas. The documented training shall be in accordance with the requirements for fire watch contained in 29 CFR 1910.252(a)(2)(iii) Fire watch. At a minimum the following shall apply:

16.2.1 The fire watch shall have no other responsibilities and perform no other duties while acting as the fire watch.

16.2.2 The fire watch shall cover or protect all material and equipment that could be damaged during

the welding, cutting, or grinding operation.

16.2.3 The fire watch shall have a fire extinguisher in the immediate area at all times.

16.2.4 The fire watch shall remain in the work area at least 30 minutes after completion of the work to guard against flash fires.

16.3 Welding, burning, and grinding is permitted only in areas designated by the on-site construction superintendent.

17.0 LADDERS (No Wooden Ladders)

17.1 All ladders shall be inspected upon arrival at the worksite to ensure that they are in good condition. Each inspection shall include checks for the following:

17.1.1 Missing, cracked, split, decayed, or otherwise defective steps or rungs.

17.1.2 Cracked, split, decayed, or otherwise defective side rails.

17.1.3 Loose, broken, or missing nails, screws, bolts, rivets, or other metal parts.

17.1.4 Grease, oil, or other slippery material.

17.1.5 Inoperable or loose metal support bars or spreader bars on stepladders.

17.1.6 Missing or damaged safety feet on straight and extension ladders.

17.1.7 Defective ropes, pulleys, locks, or loose or missing guide rails on extension ladders.

17.1.8 Adequate condition of bearing of locks, wheels, pulleys, etc.

17.1.9 All ladders found to be defective in any way shall immediately be tagged "unsafe" and removed from the worksite.

17.2 The following general rules apply to safe use of ladders at the worksite:

17.2.1 Ladders shall be inspected daily before use for possible defects using the inspection criteria described in 17.1.

17.2.2 Do not use a portable ladder as a platform or as a brace for using a hoist.

17.2.3 Do not use a portable ladder on a scaffold or on top of boxes, barrels, etc. Use only on a fixed floor or platform.

17.2.3 Do not permit more than one person at a time on a portable ladder.

17.2.4 Place the ladder on a firm, level surface and do not use the ladder on slippery surfaces.

17.2.5 Do not place a ladder in front of doors that can open towards the ladder unless the door is blocked open, guarded, or locked.

17.2.6 Ladders (except stepladders) shall be tied off at the top and bottom. In the event a ladder cannot be tied off, have another employee hold the ladder securely in place when in use.

17.2.7 Ladders greater than 24 feet in length shall be moved using two employees.

17.2.8 Three-point contact shall be maintained with the ladder at all times.

17.2.9 Keep your body centered between the rails of the ladders at all times. Any tools or materials needed should be safety stored in a belt while climbing; never held in your hands.

17.2.10 Use both hands while climbing up or down. Place hands on the ladder rungs or side rails.

17.2.11 Do not reach out from the side of the ladder more than your arms length when your body is centered between the rails. If you cannot reach something from that position, move the ladder so you can.

17.2.12 Do not use metal ladders or ladders with metal parts while doing electrical work or where the ladder may come into contact with electrical conductors.

17.2.13 Always face the ladder while climbing up or down.

17.2.14 Do not use a ladder in an environment where corrosives may attack any of its components.

17.3 Stepladders

17.3.1 Before climbing the stepladder, open it fully and lock the spreader bars.

17.3.2 Place all stepladder feet firmly on a level supporting base.

17.3.3 Never use a stepladder as a straight ladder.

17.3.4 Do not stand or climb on the top platform or the top step (i.e., the top two levels).

17.3.5 Do not store material on the top platform of the ladder.

17.3.6 Do not climb the back side of a stepladder.

17.4 Extension and Straight Ladders

17.4.1 Never separate or use separate sections of an extension ladder as a straight ladder.

17.4.2 Always erect the ladder so that the top section (the fly) is above and resting on the bottom section (the base), with the rung locks engaged.

17.4.3 Set the ladder at the proper angle (75) by placing the ladder base a distance from the vertical support equal to one quarter the total working length of the ladder.

17.4.4 Always ensure that extension or straight ladders are equipped with non-skid safety feet.

17.4.5 The top of a straight or extension ladder shall extend at least three feet above the supporting object when used as access to an elevated work area.

17.4.6 Do not work from the top three rungs.

17.4.7 Do not overextend an extension ladder. The minimum acceptable overlap of sections is:

3 feet for ladders up to 32 feet long
4 feet for ladders up to 36 feet long
5 feet for ladders up to 48 feet long.

17.5 Job-made ladders will not normally be used at the worksite. Should it become necessary to build and use a job-made ladder, prior approval must be given by the Safety Director, and the ladder shall be built in accordance with ANSI standard A14.4-1979, Safety Requirements for Job-made Ladders.

17.6 Store portable ladders in a clean, dry location free of excessive heat, chemicals, or solvents where physical damage will not occur. Do not store portable ladders where they may be contaminated, corroded, or deteriorated by chemicals.

18.0 SCAFFOLDING

18.1 Scaffolding ten feet or more in height (four feet in confined space or near hazardous areas as defined by the Safety Director) must be fully planked on working surfaces and have standard guardrail, mid-rails, and toe boards on all open sides. Planking shall be selected and positioned in accordance with the applicable OSHA Regulations.

18.2 Scaffolds shall be braced and tied off both horizontally and vertically at sufficient intervals to assure a safe working platform.

18.3 Rolling scaffolds shall have locking wheels and the wheels must be attached to the scaffold to prevent the wheels from leaving their position in the frame if the scaffold is tipped.

18.4 All scaffolds used at the worksite shall comply with the standards set forth in 29CFR 1926.451which serves as the guide for erecting and using scaffolds. In addition, the following work practices shall apply for all scaffolds:

18.4.1 The contractor's or Subcontractor's Safety Director or Competent Person for scaffolds shall INSPECT and APPROVE all scaffolds after assembly is complete and before "INITIAL USE".

18.4.2 Scaffolds of the tube and clamp type shall be designed and inspected by an engineer competent in that field prior to use.

18.4.3 After the initial inspection, providing there has been no structural change to the scaffold or it has not been dismantled, the Competent Person shall perform re- inspections once each shift and approve them for continual use.

18.4.4 If recommendations for change result from an assessment or initial inspection performed by the competent person, a follow-up inspection will be required before scaffold use.

19.0 WALL, FLOOR, CEILING and ROOF OPENINGS

19.1 Openings in walls, floors, ceilings and roofs shall be protected to the extent necessary to prevent a fall by a worker or the striking of a worker by falling objects such as tools, materials or debris.

19.2 A hole shall be defined as any gap of two inches (2") in its least dimension.

19.3 All holes in walking/working surfaces shall either be protected by a guardrail system or a cover. When a cover is utilized, it shall be capable of supporting twice the anticipated load, it shall be secured against movement and it shall be marked "HOLE" with high visibility paint.

19.4 Roof penetrations, including those over which a permanently installed skylight is installed, shall be protected by a guardrail system or a complete protective enclosure such as may be fabricated from plywood and framing.

20.0 MAN LIFTS

20.1 Scissors type lifts and their uses shall comply with the applicable provisions of 29CFR1926.453(w) - Mobile Scaffolds.

20.2 Articulating Boom and Extensible Boom type lifts and their uses shall comply with the applicable provisions of 29CFR1926.453 - Aerial Lifts.

20.3 Alarms: While OSHA does not specifically require audible alarms on man lifts, when the equipment manufacturer provides an audible alarm (be that alarm for descending in a scissors lift, rotation of the boom

on an articulating boom lift or for motion at the wheels in any type of man lift), then that alarm will be maintained in a functional state throughout the time that the equipment is kept on the jobsite.
Some man lifts, depending upon manufacturer and date of production, may have audible alarms and some may not.

20.4 Backing: When a man lift is being driven on its wheels in a rearward direction (based on the present orientation of the operator), and the operator has an obstructed view to the rear, then an observer will be used to direct the operator and to signal when it is safe to move.

20.5 Inspection and Testing: All Butler and Subcontractor-provided man lifts shall be inspected and functionally tested at the work site prior to initial use.

a. The functional test of the controls shall include both the operator controls and the emergency override controls.
b. Periodic inspections shall be performed and documented throughout the life of this equipment at the job site.

21.0 FALL PROTECTION for STEEL ERECTION:

21.1 All steel erection operations shall require the use of safety nets or of a tie-off system when the potential fall distance exceeds 10 feet. The tie-off system should not create a hazard in itself.

21.2 Safety nets shall be installed per the requirements outlined in OSHA 1926.105©, (d), (e), and (f). Every precaution shall be taken to control risks from falling objects.

21.2.1 Unless protected by safety nets, workers will not be allowed to walk on steel (i.e., walking on girders or I-beams) without protective equipment. Crawling or crabbing is the method to be used for moving on steel.

21.2.2 When a torch or other flame device is to be used during steel erection, all safety lines and lanyards shall be of wire cable or other flame resistant construction.

22.0 HOUSEKEEPING

22.1 Storage of materials shall be such that access to and egress from work areas and the facility are not compromised.

22.2 Waste shall be properly disposed of on a daily basis.

22.2.1 Economically recoverable scrap, as determined by the on-site construction superintendent, shall be separated and recycled as appropriate.

22.2.2 Construction wastes and debris including demolition wastes shall be placed in on-site waste containers provided for the purpose of waste disposal.

22.2.3 Liquid or liquid-containing wastes shall not be disposed of in waste containers (dumpsters) or to the ground, to storm sewers, or to ditches. Liquids shall be disposed in accordance with applicable procedures.

22.3 Hoses and electrical lines shall be consolidated and supported to protect them and to prevent their interfering with work and posing a tripping hazard. They must be off of the floor and/or out of walkways and passageways or contained in a cable/hose tray or ramp.

22.4 Areas within 15 feet of buildings shall not be used for the storage of combustible material and shall be regularly policed to keep the areas free from accumulation of debris.

23.0 HAND-HELD POWER TOOLS

23.1 Switches for operation of hand-held power tools shall comply with the provisions of Subpart I (Tools - Hand and Power) of 29 CFR 1926 - the OSHA Construction Industry Regulations.

23.2 All such tools shall be double insulated or equipped with a functional three-wire grounding cord set and supplied by a Ground Fault Circuit Interrupter (GFCI) protected power source.

23.3 Portable electric tools shall have been listed by Underwriter's Laboratories (UL) or approved by an equivalent recognized testing agency.

24.0 ELECTRICAL SAFETY

24.1 When an electrical box or panel, normally provided with a cover or door, contains energized components and is without a cover or door, an appropriate protective temporary cover of nonconductive material shall be placed over the open face of the box or panel. Insulating blankets are preferred. Cardboard shall not be used.

24.1.1 Work on live electrical circuits of greater than 50 volts shall not be performed unless de-energizing the circuit would introduce additional hazards or is not feasible due to equipment design. Live electrical work shall be performed in accordance with approved procedures, using properly

insulated tools, and under the authorization of a Live Electrical Work (LEP) permit.

24.1.2 Troubleshooting of electrical circuits of 480 volts or less may be conducted with the circuit live without a Live Electrical Work Permit provided the Safety Director is informed and the craftsman is properly trained and qualified.

24.2 Power distribution boards, when used, shall be rated for the environment (i.e. - shall be weatherproof, etc.), of rugged construction, and shall be rated at 480 VAC with an amperage rating appropriate for the intended load.

24.3 Cords, plugs, and receptacles are required to mate with the power boards and extension cords. Straight blade plugs, etc., are not authorized.

24.3.1 All plugs will be dead front, phenolic, or nylon with cord grip.

24.3.2 Cords, plugs and receptacles shall be UL listed.

24.3.3 Receptacles shall be GFCI protected.

24.3.4 Extension cords used for hand tools and temporary power shall be kept off of floors and away from personnel and equipment traffic unless guarded with a cable ramp. Extension cords, which could become buried with dirt or snow, that are not in conduit or guarded with a ramp, shall have the route prominently marked.

24.4 Trouble lamps of the non-grounded, double- insulated type, where not otherwise restricted, may be used if the lamp guards are of non-conducting material. Conductive lamp guards, even if covered with insulation material, shall be grounded.

24.5 Particular attention shall be paid to the safety of electrical equipment. Ground fault circuit interruption (GFCI) devices shall be used on all 120-volt, single-phase circuits serving outdoor and construction areas or other areas where personnel grounding is probable.

24.6 Portable GFCIs shall be trip-tested by the user each day before use to assure that the device is functional.

24.7 SUBCONTRACTOR management shall be responsible for ensuring that the formal training-for/qualification-of all electricians (apprentices and journeymen) and line workers is in order before they are permitted to perform electrical work.

24.7.1 Training shall include both classroom and practical aspects, and applied demonstrations and tests. Qualifications shall be recorded. This training shall be as prescribed by recognized agencies (i.e., technical schools, unions, etc.).

24.8 Temporary Wiring

24.8.1 Temporary wiring shall be installed in accordance with the National Electrical Code, which is adopted into the OSHA regulations.

24.8.2 It shall be installed such that workers may not contact energized electrical conductors or components.

24.8.3 Temporary lighting, such as string-lights, shall have lamps adequately protected against breakage by non-conductive guards and lighting strings shall be powered via a GFCI (hardwired or cord-and-plug type) breaker.

24.8.4 Insulated conductors of temporary wiring components shall be suspended/supported/attached using electrically non-conductive ties only.

25.0 LOCK-OUT/TAG-OUT

This procedure establishes a lockout practice for securing machinery and equipment during periods of assembly, repair and maintenance work. It is designed to ensure that equipment and machinery is rendered completely inoperative during these operations. This includes shutdown of all electrical, hydraulic, air, steam or other energy or pressurized sources that would cause the equipment to operate.

Basic rules for the procedure are as follow:

25.1 The prime responsibility for immobilizing a piece of equipment rests with the equipment owners or operators. They are the only individuals with sufficient knowledge of that equipment to render it completely inoperable. Their shutdown procedure may include bleeding pressure from air or hydraulic sources or shutting off multiple electrical sources. After proper shutdown, they are responsible for placing the first lock and tag on all panels, switches or operating stations.

25.2 Many manufacturing or industrial plants have their own specific written lock-out/tag-out procedures which should be followed.

25.3. We should never attempt to shutdown or lock-out industrial equipment, conveyor systems, or equipment that is owned and operated by others, except in the case of an emergency.

25.4. After the equipment owner or operator has provided the equipment in a completely shutdown mode, we should put our lock and tag on the same equipment to prevent inadvertent starting during our operations. Therefore, the minimum number of locks and tags on any equipment that we do not own is 2 (the owner's lock and our lock).

25.5 Other trades working on or near the equipment may also be asked to, or they may request to, place their lock and tag on the same equipment. It is important to remember that a machine or piece of equipment may have several power panels or operating stations that must all be locked out to ensure that it is completely inoperable.

25.6 Tags that are placed on the equipment with the locks are used to identify the persons or contractors who may be involved in maintenance or operations around the shutdown equipment.

25.7 All locks and tags must be removed by the contractors and equipment owner or operator before it can be restarted.

26.0 HOISTING AND RIGGING

26.1 All lifting and rigging performed at the jobsite shall be done in accordance with the applicable OSHA regulations.

26.1.1 All Subcontractor and Subcontractor-provided mobile cranes and rigging accessories shall be inspected and functionally load-tested at the work site prior to initial use.

26.1.2 All lifting operations performed at the job site shall receive prior review and concurrence by a "Designated Leader"/ "Person in Charge". This person shall be responsible for reviewing all aspects of all lifts.

a. Specific procedures are not required for normal day-to-day lifting operations unless specified by the Safety Director.

b. Periodic inspections shall be performed on all hoisting and rigging equipment with records maintained by the Safety Director.

With regard to mobile cranes and forklifts: Daily external inspections of items related to safe operation of the equipment (e.g. brakes, clutch, horn, lights, linkage, back-up alarms, steering, etc. shall be made by the operator prior to use.

With regard to mobile cranes: Inspections conducted by a qualified mechanic shall be made at intervals not to exceed six months or 120 hours operating time. Records of these inspections and any associated maintenance, including manufacturer's preventive maintenance, shall be kept on the job site and made available to the Owner at their request.

26.2 All hoisting/rigging equipment or accessories existing on site shall be at all times in good repair and currently inspected. The Safety Director shall ensure hoisting/rigging equipment and accessories are maintained in acceptable condition. Any hoisting/rigging equipment or accessory found to be in an unacceptable condition shall be immediately tagged UNSAFE and removed from the work site until such time as it completely repaired.

26.3 Prior to use on site, all hoisting/rigging equipment or accessories shall be inspected and approved for operation by the Safety Director. If a piece of hoisting equipment (mechanical device used to lift a load, i.e., crane, forklift, etc.) has been removed from the project site and then returned to the site, it shall be re-inspected and functionally load-tested prior to making any lift.

26.4 The inspection shall include, at a minimum, the criteria for initial inspection for the type of hoisting equipment. The inspection shall include any additional inspection criteria deemed necessary by the Safety Director.

26.5 Rigging equipment and accessories will bear tags showing the date of last inspection. Initial load test documentation for rigging equipment and accessories shall be available.

26.6 Prior to lifting material or equipment over elevated objects (fences, buildings, etc.) an inspection of the

area under the lift shall be performed to ensure safe lifting conditions.

26.7 The Person In Charge shall be present for the first load lowered over the elevated area to assure all safety requirements are met.

26.8 A list of mobile and/or stationary cranes brought on site, complete with manufacturer data and serial number, shall be maintained by the Safety Director. Such equipment shall be properly serviced, maintained, and in safe operating condition.

27.0 MOBILE EQUIPMENT OPERATION

27.1 Operators of motor vehicles shall have in their possession a valid vehicle operator's license when driving at the work site, and shall obey posted speed limits.

27.2 Subcontractor and Subcontractor operators shall be properly trained and qualified for the equipment to be operated. A record of operator qualifications, for heavy equipment (heavy equipment shall be defined as wheeled and tracked equipment intended primarily for the movement of other items, materials, earth, etc. and having a capacity of greater than 1 ton) and materials-handling equipment shall be maintained.

27.3 Operators who drive vehicles or transport materials subject to Department of Transportation (DOT) regulations shall meet all the requirements of those regulations. Records of their qualification shall be maintained.

27.4 The applicable provisions of 29CFR1926 Subpart O, the OSHA Construction Industry Standards regarding Motor Vehicles and Mechanized Equipment will be complied with. The most applicable of these regulations are addressed in sections 21.5 through 21.10 as follow. Neither the provisions of 29CFR1926 Subpart O nor of this section of the Subcontractor's Safety and Health Manual apply to man lifts.

27.5 Mobile equipment, except for equipment designed for stand-up operation, is required to have seat belts and shall only be operated with those seat belts in use. Equipment designed for stand-up operation shall have operator restraint devices or harnesses, where feasible.

27.6 Horns: All heavy equipment, and all motor vehicles used on public roads as well as on construction sites, will have an audible alarm, that is, a horn, to allow the operator to signal others as needed.

27.7 Back-up Alarms: For all heavy equipment, and for all motor vehicles used on public roads as well as on construction sites, that may have an obstructed rear view, either an audible back-up alarm will be installed and maintained in functional condition or such equipment will not be backed without an observer signaling that it is safe to do so.

27.8 Rollover overhead protective structures (ROPS) shall be provided for material handling equipment as required by 29CFR1926.1000; for designated scrapers, loaders, dozers, graders and crawler tractors as required by 29CFR 1926.1001; for wheel-type agricultural and industrial tractors used in construction as required by 29CFR1926.1002 and 1003.

27.9 All vehicles carrying loads that obstruct the forward and or side-to-side view of the operator shall be accompanied by (a) flag person(s) to warn pedestrians and to guide the vehicle operator.

27.10 Passengers shall not ride on fork truck tines, in buckets of end loaders, in pickup beds, on flat beds, or on single seat vehicles.

28.0 FLAMMABLE AND COMBUSTIBLE LIQUIDS USE AND STORAGE

28.1 The Safety Director shall ensure that use and storage requirements described in 29 CFR 1926.152 are implemented. In addition, the following are additional requirements shall be implemented.

28.1.1 Only a single shift (8-hour) supply of paint or flammables shall be located at work sites within the facility under construction. Excess quantities shall be stored in an area that is well detached from the facility (a minimum of 50 feet) unless they are stored in UL-listed flammable liquid storage cabinets.

28.1.2 Flammable liquid safety cans shall be equipped with a self-closing cap, automatic pressure relief, and flame arrester. Safety cans shall be constructed of metal and properly labeled. The capacity of the safety cans shall not exceed 5 gallons. All safety cans shall be UL approved.

28.1.3 Solvents used for cleaning buildings shall be nonflammable or have a flashpoint above 100°F. Exceptions to this will require specific approval, in writing, from the Safety Director before

work using the solvent begins.

29.0 COMPRESSED GAS CYLINDERS

29.1 Subcontractor and/or its Subcontractors shall provide for the proper transport, storage, and use of compressed gas cylinders. The requirements of OSHA 29 CFR 1926/1910, subpart J and the following shall be implemented.

29.1.1. Cylinders stored out-of-doors shall be protected from the weather to prevent overheating and icing. Minimum protection shall be an all-weather noncombustible floor and roof.

29.1.2 The signs on cylinder storage racks shall identify the contents of the cylinders and whether they are full or empty.

29.1.3 On welding carts and manifolds, the regulators on both acetylene and oxygen cylinders shall have fusible, hydraulic, or mechanical reverse gas flow prevention to prevent back-flash. Cylinder valves shall be shut off and regulators backed-off at the end of each shift and removed from the cylinders before weekends or like periods when the cylinders will not be used.

29.1.4 Cylinders (regardless of size); whether in use, in storage, or in transit; shall be fastened securely by a chain, rigid retaining bar, or other approved strapping devices (i.e., nylon strapping) to prevent the cylinders from falling or being knocked over. All cylinders containing flammable gasses will be retained by noncombustible means.

30.0 EXCAVATION AND TRENCHING

30.1 Excavation, trenching, and shoring requirements shall be in accordance with the OSHA Construction Standard for Excavations, 29 CFR 1926, Subpart P.

30.1.1 Slopes and stepping-back of excavations and trenches shall be in accordance with applicable OSHA regulations for the type of soil (Type A minimum slope of ¾:1, Type B minimum slope of 1:1or Type C minimum slope of 1.5:1). Sloping or stepping back shall be required whenever the excavation or trench exceeds 48" in depth.

30.1.2 When excavations require shoring, commercial trench boxes or custom shoring, designed and approved by a professional engineer prior to use, shall be used.

30.1.3 Prior to excavation, an Underground Utility Review shall be provided for the entire construction site. This will be the responsibility of Subcontractor or of its designated Subcontractor.

30.1.4 A Competent Person trained and qualified (ref. 29CFR1926 subpart P - Excavations) shall be designated to conduct daily inspections of all excavations, regardless of depth.

a. Excavations greater than 5 feet in depth shall have the inspection documented, using a daily trench and excavation log.

30.2 When employees or equipment are required to cross over open excavations, adequate walkways or bridges with standard guardrails shall be used.

Utility lines exposed during excavation shall be labeled immediately to identify the type of line or utility (e.g. gas, potable water, drain, etc.) and whether it is an active or abandoned line.

31.0 HAZARDOUS MATERIAL/WASTE USE, STORAGE, and DISPOSAL

31.1 Hazardous wastes shall be disposed of in accordance with approved procedures. Hazardous Waste shall not be disposed of in waste/trash containers, dumpsters, or roll-offs reserved for non-hazardous waste.

31.1.1 Disposal of any liquid or liquid-containing wastes in dumpsters, on the ground, into storm sewers, into ditches, to the site wastewater treatment facilities, or otherwise inappropriately disposing of liquids is prohibited unless authorized by Subcontractor and the Owner.

31.2 Personnel generating hazardous wastes on-site must manage their waste in accordance with applicable site procedures and are not permitted to transport hazardous wastes off-site.

31.3 Personnel shall take precautions to minimize the generation of hazardous wastes, utilize materials with the lowest toxicity wherever possible, and prevent spills or releases from occurring.

31.3.1 Spill response supplies shall be located in the vicinity of the work area for immediate accessibility.

31.3.2 Any/all spill(s) will be reported to the owner's representative (i.e. – the cognizant engineer) at the time of occurrence.

31.3.3 Cleanup of tools and/or equipment using hazardous materials (e.g., solvents, petroleum products, etc.) shall be controlled. Subcontractor shall take precautions to prevent any spillage of the

cleaning materials to the environment. Any rags, wipes or debris contaminated with solvents, flammable or combustible waste must be disposed in accordance with applicable project procedures.

31.3.4 Hazardous wastes are those identified as hazardous in 40CFR261.3 and 6NYCRR371. The following table lists commonly used materials that may be considered hazardous wastes upon disposal. Compliance with project disposal procedures is essential, will ensure proper waste management and will reduce the potential for harm to personnel and to the environment.

Paints
Solvents [paint thinner, xylene, toluene]
Penetrants [WD-40, Lock-Ease, PB Blaster]
Corrosives [acids and caustics, chlorine, sodium hypochlorite solution]
Poisons [cyanide, arsenic]
Non-refillable compressed gas cylinders [propane, butane]
Pesticides, herbicides, biocides
Medical wastes [contaminated first aid supplies]
Items containing mercury [certain electrical switches]
Lead or lead-containing wastes [paints, batteries]
Polychlorinated Biphenyls (PCBs) [light ballasts, transformers]
Petroleum products [oils, gasoline, diesel]
Aerosol cans

The preceding list represents some typical examples of items that may be considered hazardous waste and will require proper waste management prior to disposal. Subcontractors having any questions regarding proper management of hazardous materials/wastes should immediately contact the Safety Director for assistance.

31.4 Subcontractor and its Subcontractors shall provide Material Safety Data Sheets (MSDS) to the Safety Director for approval for all listed hazardous materials (49CFR171.8) prior to bringing the material onto the project site.

31.5 All hazardous materials brought on site shall be: 1) stored in accordance with approved procedures and removed from site upon completion of the work; 2) totally consumed; or 3) removed from the interior of the construction site by the end of the work day.

31.6 Mercury shall not be used when suitable substitutes can be utilized. The contractor shall request owner's approval prior to bringing mercury or mercury-containing equipment to the project site.

31.7 Subcontractor shall survey for lead content before employees perform dust-generating work (cutting, sanding, burning, etc.) on painted surfaces that are suspected of having been coated with lead-containing paint.

32.0 PESTICIDES

32.1 No pesticide application will be made without the expressed consent of the owner of the property upon which the project is proceeding.

32.2 Pesticides shall include insecticides, rodenticides, vegetation killers and microbial biocides.

32.3 Integrated Pest Management (IPM) shall be practiced. The safety director shall give prior approval for any/all pesticide applications.

32.4 Whenever possible, selective pesticides will be used as opposed to broad-spectrum/non-selective chemical agents. Selective biological controls, such as pheremones, hormones, insect growth regulators (IGRs), plant-specific toxins and so forth will be first considered prior to application of non-selective chemical pesticides. All appropriate environmental protection measures will be taken into consideration.

32.5 Non-restricted Use pesticides (i.e. - 'over-the-counter' pesticides) shall be used in strict accordance with the provisions of their USEPA-approved label. Any worker properly trained by his/her supervisor or by the safety director may apply these.

32.6 Restricted Use pesticides shall be applied only by certified commercial pesticide applicators approved to make such applications in the state in which the project is progressing. Certified commercial applicators shall be employed by a Subcontractor licensed or registered as a pesticide application business in the host state of the project.

32.7 Workers will be protected in accordance with the MSDSs for the chemical. Proper training in safe use, to include appropriate PPE, will be provided.

33.0 ASBESTOS

33.1 No asbestos containing materials will be installed.

33.2 Subcontractor workers will not remove or otherwise disturb asbestos containing materials or presumed asbestos containing materials.

33.3 Certified workers employed by contractors licensed to perform asbestos abatement in the state in which the project is being executed will be hired for work that involves disturbance of ACM.

33.4 If material is encountered that is suspected/presumed as containing asbestos, do not disturb it. Contact the safety director immediately so that he may examine it and have it analyzed as necessary. PACM will be tested. Work involving disturbance of verified ACM will be subcontracted.

34.0 LEAD

34.1 No lead containing materials will be installed.

34.2 Paint that must be removed to facilitate new attachment such as by welding or to facilitate removal of old surfacing material including the paint itself shall be first examined and/or analyzed as necessary before dust-producing methods are used to remove applied paint.

34.3 Paint removal methods that do not produce dust are available (chemical stripper systems) and may be utilized for removal of small amounts of lead paint. Consult with the safety director for guidance and assistance in these regards.

34.4 Where abrasive blasting is required for paint verified to contain lead, this work will be performed by certified workers employed by contractors licensed to perform lead abatement in the state in which the project is being executed.

34.5 For determination of lead content of paint that must be removed, contact the safety director.

35.0 INCLEMENT WEATHER

35.1 Weather provides additional challenges to working safely outdoors. For hazards created by weather, often we have no control and the only safe response is to temporarily stop work activities until conditions become more favorable, that is, until workers and their leadership can once again take active control over hazards.

35.2 Hoisting and rigging shall be ceased whenever winds make such lifting unsafe.

35.3 Scaffolds, ladders, elevated work platforms; roofs and other walking/working surfaces shall be free of ice and shall provide secure footing or shall be avoided until they can be made safe to work upon.

35.4 Work at elevated positions shall cease in high winds.

Lightning shall be cause to stop outdoor work.

36.0 WORKING ALONE

36.1 Area supervisors shall be informed of personnel working alone in construction areas isolated from other activities and shall be cognizant of the employee's safety precautions and work progress.

36.1.1 A communication device (i.e.- radio) shall be carried by personnel working in construction areas isolated from other activities.

36.1.2 The area supervisor shall ensure that the Safety Director is informed prior to commencement of isolated work.

37.0 REFERENCE DOCUMENTS

29 CFR 1910, OSHA General Industry Standards, Current Regulation

29 CFR 1926, OSHA Construction Standards, Current Regulation

10 CFR 851, Worker Safety and Health Programs Governing Contractor Activities at Department of Energy (DOE) Sites, Current Regulation

DOE Hoisting and Rigging Manual, Current Edition

WVDP-010, WVDP Radiological Controls Manual, Current Edition

WVDP-011, WVDP Industrial Hygiene and Safety Manual, Current Edition

Contamination Control Plan

RADIOLOGICAL WORK REQUIREMENTS

Operations and activities at the West Valley Demonstration Project (WVDP) frequently involve the use of radioactive and radioactively contaminated materials. Strict compliance with radiological controls is required to eliminate or minimize personnel exposure to radiation and contamination and to control the undesirable spread of radioactive contamination. Therefore, the following requirements are imposed on all work activities involving radiological conditions.

1.0 GENERAL

1.1 The radiation protection standards and controls as set forth in the WVDP Radiological Controls Manual (WVDP-010) are made part of this specification and adherence to these controls is the responsibility of the Subcontractor and all personnel. Requirements from Title 10, Code of Federal Regulations, Part 835 (10 CFR 835), *Occupational Radiation Protection*, have been implemented by WVNSCO in WVDP-010.

The requirements of 10 CFR 835 are DOE nuclear safety requirements that are enforceable under the Price-Anderson Amendments Act (PAAA) which DOE has promulgated in 10 CFR 820. The *Procedural Rule for DOE Nuclear Activities*, 10 CFR 820, sets forth the procedures to implement provisions of the PAAA which subjects DOE contractors and subcontractors to potential civil and criminal penalties for violations of DOE rules, regulations, and orders relating to nuclear activities (i.e., those activities that may cause radiological harm). Additional information may be found in WVNSCO form WV-19012(b), ASpecial Safety, Health and Security Rules for On-Site Services.@

1.2 Subcontractors shall obtain a Radiation Work Permit (RWP) (WVNSCO form WV-4515) for activities described in WVDP-010 Article 322, such as, working in radiological areas, opening or contact with process piping or equipment and associated systems, work above the seven foot level, excavation within the WVDP (no matter where it occurs), and when required to perform the scope of work. Job-specific RWPs are issued for nonroutine activities or work in changing radiological conditions and only remain in effect for the duration of the job. General RWPs, which are valid for a period of up to one year, are allowed under circumstances where the radiological conditions are stable and well characterized.

1.3 WVNSCO reserves the right to stop work when WVNSCO personnel consider an unsafe condition to exist and/or when Subcontractor work is not being performed in accordance with WVNSCO requirements and procedures. Work will continue when the unsafe situation or noncompliance is resolved by WVNSCO and the Subcontractor.

WVNSCO also reserves the right to withhold from radiological work any person who has not satisfied radiological training requirements or has demonstrated unsatisfactory knowledge of radiological controls during work. Such a person shall not be allowed to return to work until the person=s radiological controls knowledge has been upgraded to a satisfactory level as approved by WVNSCO.

Work stoppage caused by any of the above will not result in any claim against WVNSCO.

1.4 WVNSCO will provide radiological surveillance as required for all work in radiologically posted areas. The Subcontractor is required to provide a minimum of twenty-four hours notice for Radiation Protection coverage.

1.5 All equipment in the radiologically contaminated area shall be monitored by Radiological Control Operations personnel for radioactive contamination before it can be released for uncontrolled use. WVNSCO Radiological Control Operations should be contacted at least one (1) hour in advance to allow for this monitoring for one or two items. For numerous items or in support of demobilization effort, Radiological Control Operations should be notified twenty-four hours in advance to arrange for survey.

2.0 RADIOLOGICAL WORKER TRAINING

2.1 General Employee Radiological Training (GERT) is a portion of the overall General Employee Training (GET) that is received for unescorted access to the WVDP site. Work of short duration (less than 40 hours per year) may be performed by individuals for which a Radiation Work Permit (RWP) is required if they successfully complete GET and are continuously escorted by a qualified radiological worker while working under the RWP or in a radiologically posted area.

2.2 Entry into radiological areas to perform work requires that subcontractor personnel receive radiological worker qualification training. Two levels of training are offered by WVNSCO. The level of training (Radiological Worker I or II) is dependent on the work that is expected to be performed, with the Level II Radiological Worker training for those who require a suit up in anti-contamination clothing or handling of radioactive material. It is recommended that personnel attend GERT (GET) prior to receiving RWI or II training. The training consists of classroom lectures, practical demonstration of work skills, and a written examination. Level I training requires 8 hours of classroom, while Level II training requires an additional 4 hours of training (i.e., total of 12 hours). An additional hour for a practical factors (only one practical) is required to complete RW I or II. RW I and II training is conducted over a two-day period plus a scheduled hour for the practical in the following days.

2.3 WVNSCO conducts radiological worker training as scheduled based on demands by the Project. A five working-day notice is required to schedule class attendance. Maximum class size is 25. **TRAINEE REGISTRATION IS TO BE CONDUCTED THROUGH THE DESIGNATED WVNSCO COGNIZANT ENGINEER**. Special classes can be conducted on a one-time basis. This requires a ten day notice to WVNSCO.

2.4 Subcontractors who fail to perform satisfactorily on the examinations will be tested no more than one additional time. All retraining time and cost shall be at the Subcontractor's expense. Failure of the second exam results in the retaking of the entire course.

2.5 Radiological worker qualification training (Level I and II) is valid for two years. Requalification involves approximately four hours of computer-based training (CBT), and a practical demonstration. Each year personnel are required to complete a briefing on the changes to the site safety standards. This briefing must be read and the attached attendance sheet signed and returned to the WVNSCO Records Management Department.

3.0 RESPIRATORY PROTECTION REQUIREMENT

3.1 Subcontractor personnel who will be in potential airborne radioactivity areas shall qualify for the use of respiratory protection equipment. This qualification includes respiratory protection training, respiratory fit test, and medical examination for respirator wearers, as described below.

3.2 A medical assessment certifying that the individual is capable of using respiratory protection equipment is necessary prior to qualification as a respirator wearer. The medical requirements are presented in detail in "Special Safety, Health, and Security Rules for On-Site Subcontractors," (Form WV-19012(b)).

3.3 WVNSCO respiratory protection training is required initially and annually for all respirator wearers. The training consists of approximately four hours of classroom instruction, practical and written examination. WVNSCO conducts this training per specific request or arrangement.

3.4 A successful respirator fit test is required prior to qualification as a respirator wearer. The fit test is performed at the WVDP by WVNSCO personnel and will require approximately 30 minutes per individual. Scheduling of tests should be coordinated through the cognizant engineer with a least twenty-four hour notification.

3.5 All respirator wearers shall be clean shaven.

3.6 Respirator wearers will be allowed to wear contact lenses while wearing the respirator and will not be allowed to wear corrective lenses that break the seal of the respirator when it is being worn. If corrective lenses are needed by a respirator wearer, they shall be furnished by WVNSCO.

4.0 MEDICAL REQUIREMENTS

4.1 All applicable medical requirements, as detailed in Special Safety, Health, and Security Rules for On-Site Services (Form WV-19012(b)), shall be met prior to qualification as a qualified worker.

5.0 DOSIMETRY REQUIREMENTS

5.1 In Vivo Counting

5.1.1 An in vivo (whole body) count is required prior to the issuance of a dosimetry badge.

5.1.2 In vivo counts shall be performed by WVNSCO and require approximately 20 minutes per individual.

5.1.3 In vivo counts are performed weekdays (except holidays) between the hours of 8:00 and 4:30 p.m.

5.1.4 Scheduling is on a first come, first served basis. Only one in vivo count can be performed at a time.

5.1.5 Upon termination, a final in vivo count shall be performed by WVNSCO. Subcontractor shall ensure that all Subcontractor personnel and lower tier personnel receive the final in vivo count. All time and costs incurred by the Subcontractor to have all personnel properly terminated shall be borne by the Subcontractor.

5.2 In Vitro Sampling

If respiratory protection qualification is required (Paragraph 5.0), a 24-hour, or as specified by WVNSCO Radiation and Safety Department staff, urine collection sample must be submitted by the individual prior to the issuance of a dosimetry badge. A urine sample will also be required periodically (e.g., annually), and upon termination. The terms of Paragraph 5.1.5 shall also apply to the final urine sample. Urine samples may also be required based upon work assignment, regardless of respiratory protection qualification (RPQ) status.

5.3 Dosimetry Record-Keeping and Reports

5.3.1 WVNSCO will provide unofficial dosimetry reports for the Subcontractor on an annual basis.

5.3.2 Official dosimetry reports are available from the Idaho National Laboratory and should be requested through WVNSCO Radiation and Safety. Request forms are available in the Radiation and Safety Dosimetry Office. Official exposure reports may be requested upon termination. Approximately 90 days are required to process the request.

6.0 PROTECTIVE EQUIPMENT

6.1 WVNSCO Radiological Control Technicians will specify the necessary radiological protective equipment on the RWP.

6.2 WVNSCO will supply all radiological personal protective equipment unless stated otherwise. This equipment includes both anti-contamination clothing and respiratory protection equipment. Since wearing anti-contamination clothing may require the removal of personal outer clothing, appropriate Amodesty@ garments (shorts, T-shirt, etc.) should be worn by personnel anticipating entry into radiological areas.

6.3 All clean radiological personal protective equipment is available in the Laundry facility change room on the east side of the main plant.

7.0 WVNSCO RESPONSIBILITY

7.1 WVNSCO is responsible to review and approve work designs of equipment and structures and grant appropriate work permits for all work performed. WVNSCO will provide radiological coverage for Subcontractor personnel doing work in contaminated areas. Radiological Control Operations is to be notified twenty-four hours in advance for radiological coverage.

7.2 Radiological control monitoring, surveys, and technicians in support of this contract will be provided by WVNSCO. WVNSCO shall provide appropriate training and radiation dosimetry devices to Subcontractor personnel while they work at the WVDP.

7.3 WVNSCO will provide and maintain the following items:

7.3.1 Thermoluminescent Dosimeters (TLDs)

7.3.2 Supplemental Dosimeters, such as Electronic Dosimeters

7.3.3 Continuous Air Monitors (CAMs)

7.3.4 "Friskers"

7.3.5 Radiation Work Permit Forms (RWPs)

8.0 SUBCONTRACTOR RESPONSIBILITY

8.1 The Subcontractor is responsible to adhere to WVNSCO policy and procedures in the area of radiation protection that are established in or referenced in WVDP-010. The Subcontractor shall provide WVNSCO the results of medical examinations and work restrictions for personnel working at the WVDP. The Subcontractor is responsible to maintain personnel exposure as low as reasonably achievable (ALARA) and to comply with all aspects of the "WVDP Radiological Controls Manual," (WVDP-010).

8.2 The Subcontractor shall provide WVNSCO with an estimated or official radiation exposure record (see WVNSCO Form WV-1101) of the current annual exposure status for each individual being hired to work at the site prior to beginning work.

8.3 The Subcontractor shall provide additional certified radiation exposure records each time an employee is used at a different site and then returns to the WVDP before restart of work. In the absence of formal records of previous occupational exposure during the year, a written estimate signed by the individual may be accepted.

8.4 Maximum exposure at the time workers arrive on site should be less than 500 mrem Total Effective Dose Equivalent (TEDE) for the exposure year, including previous employment. Exemptions are approved on a case-by-case basis, such as, for those individuals receiving radiation dose from other DOE facilities not exceeding 1500 mrem TEDE for the calendar year. While on the WVDP site, radiation dose from WVDP activities may not exceed 500 mrem TEDE for the calendar year, unless assigned to projects where the authorization for 1000 mrem TEDE has been granted.

8.5 It will be the Subcontractor's responsibility to protect equipment and tools from radiological contamination. If any tools or equipment of the Subcontractor do become radiologically contaminated, the Subcontractor shall, at his own expense, decontaminate the tools or equipment. If acceptable levels cannot be obtained, WVNSCO will purchase the tools or equipment (provided WVNSCO procedures were not violated) at a price which represents the fair value thereof and such tools or equipment shall become the property of WVNSCO. The fair value of such tools or equipment shall be based on the replacement cost, age, and condition of the item without regard to levels of contamination.

8.6 Subcontractors planning to use, at the WVDP, equipment, protective clothing, and/or miscellaneous tools or items that have been previously utilized at another nuclear facility shall notify the WVNSCO Radiological Control Operations Department prior to arrival at the WVDP. Such items must be surveyed by WVNSCO for radiological contamination. WVNSCO will determine if the surveyed items may be brought on the WVDP site.

Additionally, individuals who have previously worked at another nuclear facility must notify the WVNSCO Radiological Control Operations Department prior to their arrival at the WVDP. These individuals must be surveyed for radiological contamination prior to entering the WVDP.

8.7 The Subcontractor is to request Radiological Control Operations manpower support 24 hours in advance of the work.

8.8 The subcontractor must ensure that when using moisture-density gauges at the WVDP, the authorized operator must not leave the gauge unattended at any time (10 CFR 20.207(b)). When personnel are finished using the device, they must properly secure the moisture-density gauge (10 CFR 20.207(a)) to prevent damage, loss, or theft. Properly securing moisture-density gauges will prevent damage to gauges at the WVDP.

8.9 The WVDP Radiological Controls Manual (WVDP-010) requires that for work activities that exceed the following trigger levels, a formal radiological review of the activity be conducted and a pre-job briefing (see WVNSCO form WV-3745) be held. The trigger levels are as follows:

8.9.1 Estimated individual or collective dose greater than 100 person-mrem;

8.9.2 Predicted airborne radioactivity concentrations in excess of one Derived Air Concentration (DAC) to a worker taking into account assigned respiratory protection factors;

8.9.3 General work area removable contamination greater than 100 times the contamination levels in Table 2-2 of WVDP-010;

8.9.4 Entry into areas where dose rates exceed 1 rem/hour;

8.9.5 Potential radioactive releases to the environment of radioactive liquids or airborne materials $\geq$ one Derived Concentration Guideline (DCG) for an individual radionuclide or $\geq$ one as the sum of the fractions of the DCGs for a mixture of radionuclides, per DOE Order 5400.5, or an offsite member of the public to receive greater than 0.1 mrem per year.

ALARA pre-job briefings are to be held prior to the conduct of work anticipated to exceed the trigger levels and are to be conducted by the cognizant work supervisor. Policy and Procedure WV-984, "ALARA Program," discusses requirements and appropriate documentation for ALARA pre-job briefings (see WVNSCO form WV-3745).

ALARA post-job reviews (see WVNSCO form WV-3118) for radiological work activities are to be held for jobs that were estimated or that actually exceeded the trigger levels. Formal post-job reviews are held in the form of a critique and are meetings of the personnel knowledgeable about an event (either a success or an abnormal event) to document a chronological listing of the facts. The purpose of the post-job review or critique is not to assign blame, but to establish and record the facts. WVNSCO Project Document WVDP-242, AEvent Investigation and Reporting Manual,@ discusses requirements and appropriate documentation for critiques.

9.0 CONTAMINATED WASTE DISPOSAL

Any material (i.e., solids, semisolids or liquids) generated by the activities of the subcontractor which are determined by WVNSCO to be radiologically contaminated shall be disposed of in accordance with the directions in the specification or technical document and in accordance with WVNSCO waste management procedures (WVNSCO SOP 9-series and 300-series).

10.0 EXCAVATION

10.1 All excavation within WVDP, no matter where it occurs, requires the issuance of a RWP. NYSERDA shall be informed whenever any excavation work is to be completed in areas under their direct control (this excludes the area currently under DOE control). The Subcontractor should be aware that he may unearth soils which are low-level radioactively contaminated in the course of excavation and may be delayed while WVNSCO monitors the area. All excavation is subject to monitoring by WVNSCO and a Radiological Control Technician will be present at all times or intermittently during excavation operations to monitor soil for radiological contamination.

10.2 If the excavation is being performed in an area where background radiation interferes with the monitoring efforts, the Radiological Control Technician may have to take "grab" samples from the bucket or shovel and remove them to an area where the background radiation is acceptable. In areas of spotty contamination, the equipment operator may be requested to take only partial buckets to allow for an accurate survey.

10.3 In the event radiologically contaminated soil is discovered, Subcontractor shall follow WVNSCO policies and procedures for handling such materials. If the specification or technical documents require the Subcontractor to remove contaminated soil, the Subcontractor personnel involved in the excavation will be required to be radiological worker II qualified. WVNSCO will rope off area and place step off pads, hamper, and approved WVNSCO waste container (with lid) at entrance of radiologically contaminated area. All Subcontractor personnel and equipment shall be monitored when leaving the radiologically contaminated area. It will take approximately 3 minutes for personnel and 25 minutes for hand-carried items to be monitored. Larger items will require more monitoring time depending on size. Materials such as rope, step off pads, drum, hamper, etc., shall be furnished by WVNSCO.

10.4 Contaminated soil to be excavated shall be placed in 4' x 4' x 6' disposal boxes or 55-gallon drums provided by WVNSCO. All transport, sealing, and survey of boxes will be done by WVNSCO. Subcontractor shall ensure that any filled or partially filled boxed are covered at the end of each work day.

10.5 Excavation equipment may be surveyed by Radiological Control Operations prior to its use on site to establish that it is radiologically clean. If equipment becomes contaminated to the extent that it cannot be decontaminated, WVNSCO will purchase said equipment for fair market price as agreed between the Subcontractor and WVNSCO Purchasing.

11.0 RADIOGRAPHY REQUIREMENTS

The following radiological requirements apply to radiography subcontractors performing radiography at the WVDP. All requirements must be satisfied before radiography can commence. These requirements are in addition to any other radiography requirements that may appear elsewhere in subcontract documents. Subcontractors shall comply with the requirements established by Radiation and Safety in WVDP-292, AWVDP Radiation-Generating Device and Radiography Work Operations Program Manual.@

11.1 Submittals

The radiography subcontractor shall submit copies of the following information for WVNSCO review and approval prior to the start of radiography operations:

11.1.1 Current state or federal license to perform radiography.

11.1.2 Certificate of calibration of radiographic survey devices. This calibration shall be performed no more than 30 days prior to the submittal.

11.1.3 Current records of leak test inspection reports (performed within the last six months) for exposure devices (cameras) and radioactive sources to be used and any updates.

11.1.4 Certification by the subcontractor's Radiation Safety Officer (RSO) that the cameras have been inspected and maintained in accordance with the subcontractor's radioactive materials license and the manufacturers requirements and any updates.

11.1.5 Procedure to inspect for obvious defects in exposure devices, storage containers, mechanical devices and any cables prior to use each day including provisions to supply WVNSCO with completed copies of daily inspections on a daily basis.

11.1.6 Personnel exposure records as required by paragraph 8.2 through 8.4.

11.1.7 The subcontractor's plan or procedure that ensures that the exposure of a radiographer, working at the WVDP as well as other facilities during the period of the contract, does not exceed the WVNSCO Administrative Control Level of 0.5 rem TEDE in the calendar year, including previous employment unless specifically granted authorization for a higher Administrative Control Level.

11.1.8 Personnel qualifications or resumes detailing recent radiography job experience, radiation safety training in accordance with 10 CFR 34.31, and radiography qualifications for the personnel performing the radiography. As a minimum, resumes shall be submitted for the following individuals:

A. Radiation Safety Officer

B. Radiographer

C. Assistant Radiographer

D. Radiography Trainee

11.1.9 Procedures detailing radiography operation and emergency actions.

11.1.10 Make, model, and manufacturer of the camera and radioactive source being used including the radioactive source information, the radioisotope, curie content, decay curve, and the date the curie content was assayed or measured.

11.1.11 A map of the affected area showing barrier locations to controlled access at 5.0 and 100 mrem/hr at 30 cm, including supporting calculations and technical basis (i.e., dimensions, shielding, source position). Area maps, type and thickness of walls should be coordinated with the cognizant engineer.

11.2 Mechanical Connection Demonstration

The subcontractor shall perform a test of the mechanical device which connects the control cable and the radiographic source. This test shall demonstrate the integrity of the device under all anticipated positions, forces, and angular deflections to which the device may be subjected during radiography operations. This test must be repeated for each cable/source combination that will be used on the subcontract.

11.3 Dosimetry Qualified Worker

All radiographic operations require WVNSCO Radiological Worker Level II qualification.

11.4 Notification

The Radiation and Safety Department must be notified at least 24 hours in advance of any arrival of a radiography source and at least 24 hours prior to each actual radiographic operation.

The WVNSCO Security Department must be notified of the location and planned duration of all radiography operations.

11.5 Radiological Controls

11.5.1 The contractor shall, upon arrival at the gatehouse, identify himself as possessing radioactive material. The Radiation and Safety Department will survey the equipment and ensure that WVNSCO source controls for incoming sources are met.

11.5.2 An RWP is required for all radiographic operations at the WVDP.

11.5.3 Radiography Emergency Instructions: All subcontract personnel are required to review WVNSCO Radiological Control Procedure RC-ADM-8, including WVNSCO Radiography Emergency Instructions. The subcontract personnel will document by signature that he understands and will comply with these instructions. This review will be completed at least annually.

11.5.4 Radioactive Source Control: The camera shall be marked with the exposure rate at contact, and the source isotope and curie content as of the date of calibration.

Radiography sources shall be secured or locked in the radiographic exposure device after each source retraction by use of a key lock or other mechanical device providing a positive indication that the source has been fully retracted. The radiographer shall demonstrate to the Radiological Control technician the method used.

Areas in which sources that are "on" or exposed shall not be left unattended by either the radiographer or the Radiological Control Technician. Sources within secured and locked cameras may be left unattended within the posted area for short periods of time (e.g., breaks, lunch) provided the key is removed and the camera is chained to a permanently installed fixture. Cameras shall not be left unattended outside the posted area under any circumstance. When not in use for extended periods (e.g., a few hours), the source shall be secured within the camera, locked with the key removed, and the camera, with Radiological Control Operations Supervisor approval, stored in a posted, locked or guarded area.

The radiography source shall not be moved within the radiographic equipment unless the radiographer is in the immediate vicinity to operate or directly supervise the operation of the radiographic equipment.

Radiography Checklist: The radiographer shall complete the appropriate parts of section I and II of the WVNSCO Field Radiography Checklist (see WVNSCO form WV-2428) prior to the start of any radiographic operations. Section III shall be completed and signed at the completion of the radiography. The completed Radiography Checklist is filed with the Radiation and Safety Department.

Source Survey Check sheet: The radiographer and Radiological Control Technician shall maintain a Radioactive Source Survey Checksheet (see WVNSCO form WV-2429) during radiography operations. Part I shall be completed prior to the start of radiography and the appropriate entries shall be made in Part II for each exposure. The completed Radioactive Source Survey Checksheet shall be filed with the Radiation and Safety Department.

11.6 Dosimetry: Additional dosimetry, beyond that provided by the radiography subcontractor for his own use, will be specified and provided by WVNSCO. These will include but not be limited to WVNSCO TLDs and electronic audible/alarming dosimeters.

11.7 Radiation Survey Instruments: The radiographer shall maintain at least one calibrated, source checked, and operable radiation survey instrument with each camera at each job site. The survey instruments shall be source checked daily. The radiography operation shall be discontinued if in the opinion of either the radiographer or Radiological Control Technician the survey meter malfunctions or appears to malfunction.

11.8 Postings

11.8.1 The radiographic subcontractor shall provide a map of the affected area showing barrier locations to controlled access at 5.0 and 100 mrem/hr at 30 cm including supporting calculations and technical basis (i.e., dimensions, shielding, source position). Area maps, type and thickness of walls should be coordinated with the cognizant engineer.

11.8.2 The radiographer subcontractor shall erect barriers with warning rope or ribbon and signs as indicated below: WVNSCO Radiation and Safety shall provide oversight of the barrier erection.

Post conspicuously and highly visible from any avenue of approach or access any area which will increase to 5.0 mrem/hr (at 30 cm) or greater with a warning rope or ribbon and signs bearing the radiation caution symbol and words similar to those shown below:

CAUTION

RADIATION AREA

Post conspicuously and highly visible from any avenue of approach or access any area which will increase to 100 mrem/hr (at 30 cm) or more (based on calculated dose rates) with a sign bearing the radiation caution symbol and words similar to those shown below:

CAUTION

HIGH RADIATION AREA

11.9 The radiography subcontractor shall perform a thorough search of the posted area to ensure that only those personnel necessary for radiographic work (as determined by the Radiographer) remain, and shall announce verbally the commencement of radiography.

The radiographer shall maintain visual surveillance of the posted High Radiation Area during the radiography operation to ensure that no inadvertent entries or exposures occur. The radiographer shall also perform a radiation survey during radiography operations to assure proper placement of boundaries. WVNSCO Radiological Control Technician shall also conduct surveys to verify boundary limits.

The radiographer shall survey (with a gamma survey instrument) the camera and source guide tube after each exposure. The source shall also be secured within the camera and locked after each exposure. Appropriate log entries for these requirements for each survey will be made on the Radioactive Source Survey Checksheet (see WVNSCO form WV-2429). The camera shall be surveyed at the completion of the job to ensure that the sealed source has been retracted to the shielded position. WVNSCO Radiological Control Technician shall conduct radiation surveys as necessary to verify survey results. These actions are completed by verifying that the post-exposure reading is the same as the pre-exposure readings within the accuracy of the survey meter. In addition to any permanent instrumentation that may be installed, initial entry into a radiographic enclosure or cell also requires the use of a hand held radiation detection instrument provided by the radiography subcontractor.

11.10 WVNSCO Radiation and Safety Coverage: All radiography operations shall require that a WVNSCO Radiological Control Technician be physically present at all times.

The Radiological Control Technician shall verify that the radiographer has completed the search of the surrounding area and that no unnecessary personnel are present.

The Radiological Control Technician shall personally verify, by performing back-up surveys, all radiological surveys performed by the radiography subcontractor including surveys of the radiography exposure device and guide tube to assure that the source is properly housed.

The Radiological Control Technician shall be the first individual to approach the camera after source exposure to assure that the source is properly stowed. The Radiological Control Technician shall verify that the source is properly housed by initialing the appropriate block of the Radioactive Source Survey Checksheet (WVNSCO form WV-2429). Radiography operations may not proceed until the Radiological Control Technician verification is complete. The Radiological Control Technician (or other WVNSCO representative) may terminate radiographic operations at any time.

11.11 Defective Equipment

Should any part of the radiographic equipment become defective, all radiographic operations will be terminated immediately. All personnel will exit the exposure area, prohibit entrance into the area, and notify Radiation and Safety management. No repairs of any radiographic equipment will be made at the WVDP without prior written authorization of the Radiation and Safety Manager.