Submittal Transmittal & Response

Submittal Transmittal Number 030.02 **Date:** 6/3/22 **Due Date:**

Owner/Contract Name: Community Transit/Swift Orange Line **ITB #:** 2021-083 **Fed Aid #:**

The Contractor submits the following noted attachments to Engineer for review and response:

#	Bid Item #	Spec Sec #	DESCRIPTION	Response
1		SP8-36	Excavation, Trenching and HDPE Repair Plan (McCollum Park)	NE[1]
2				
3				
4				

Submitted by:

Cassie Brock	**Project Engineer**	**425-392-8016**
Name	**Title**	**Phone #**

The Engineer has reviewed the above noted documents and responded as noted above, under "**Response".**

Key:
- **NE** = NO EXCEPTIONS TAKEN
- **MC** = MAKE CORRECTIONS NOTED: No resubmittal required, but corrections noted are required
- **SI** = SUBMIT SPECIFIC ITEM: Resubmittal required – Not approved
- **RR** = REVISE AND RESUBMIT: Resubmittal required – Not approved
- **RJ** = REJECTED – see comments below

Note: Review is only for conformance with the general design concept of the Project and does not extend to consideration of structural integrity, safety, detailed compliance with Contract requirements and any other obligation of the Contractor. Any action shown is subject to the requirements of the construction Contract. Contractor is responsible for confirming and correlating all dimensions; fabricating and construction techniques; coordinating its work with that of all other trades; and the satisfactory performance of its entire work in strict accordance with the construction Contract. The review is undertaken solely to satisfy Engineer's obligations and does not relieve Contractor from its obligation fully to perform all Contract requirements, nor shall such review give rise to any right of action or suit in favor of Contractor or third persons, against the Owner.

- [X] **No Exceptions Taken**
- [ ] **Make Corrections Noted**
- [ ] **Rejected**
- [ ] **Revise and Resubmit**
- [ ] **Submit Item Specified**

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of construction, coordination of his work with that of all other trades, and the satisfactory performance of his work.

Engineer's Comments and Sign-off: Otak By: WAS Date: 6/16/2022

# (key to above)	Comment
1	Liner Repair Subcontractor Qualifications need to resubmitted and approved prior to excavation at McCollum Park site.
2	
3	
4	

Name	Title	Date

☐ See Attached Engineer's Comments ☐ See Mark-Up of Submittal Documents ☐ See Other Attachments

FOR REFERENCE ONLY

Submittal Transmittal & Response

Submittal Transmittal Number 030.01 **Date:** 5/11/22 **Due Date:**

Owner/Contract Name: Community Transit/Swift Orange Line **ITB #:** 2021-083 **Fed Aid #:**

The Contractor submits the following noted attachments to Engineer for review and response:

#	Bid Item #	Spec Sec #	DESCRIPTION	Response
1		SP8-36	Excavation, Trenching and HDPE Repair Plan (McCollum Park)	RR
2				
3				
4				

Submitted by:

Cassie Brock	Project Engineer	425-392-8016
Name	**Title**	**Phone #**

The Engineer has reviewed the above noted documents and responded as noted above, under "**Response**".

Key:
- **NE** = NO EXCEPTIONS TAKEN
- **MC** = MAKE CORRECTIONS NOTED: No resubmittal required, but corrections noted are required
- **SI** = SUBMIT SPECIFIC ITEM: Resubmittal required – Not approved
- **RR** = REVISE AND RESUBMIT: Resubmittal required – Not approved
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Note: Review is only for conformance with the general design concept of the Project and does not extend to consideration of structural integrity, safety, detailed compliance with Contract requirements and any other obligation of the Contractor. Any action shown is subject to the requirements of the construction Contract. Contractor is responsible for confirming and correlating all dimensions; fabricating and construction techniques; coordinating its work with that of all other trades; and the satisfactory performance of its entire work in strict accordance with the construction Contract. The review is undertaken solely to satisfy Engineer's obligations and does not relieve Contractor from its obligation fully to perform all Contract requirements, nor shall such review give rise to any right of action or suit in favor of Contractor or third persons, against the Owner.

- ☐ **No Exceptions Taken**
- ☐ **Make Corrections Noted**
- ☐ **Rejected**
- ☒ **Revise and Resubmit**
- ☐ **Submit Item Specified**

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of construction, coordination of his work with that of all other trades, and the satisfactory performance of his work.

Engineer's Comments and Sign-off: Otak By: KCK Date: 5/23/22

# (key to above)	Comment
1	Provide the following previously requested items: Submit proposed sources for all materials related to
2	liner repairs and off-gassing system adjustments/relocations.
3	
4	

see page 14

Matthew Matsumoto	Matthew Matsumoto, Resident Engineer	05/23/2022
Name	Title	Date

☐ See Attached Engineer's Comments ☐ See Mark-Up of Submittal Documents ☐ See Other Attachments

C.A. Carey Corporation

Excavation, Trenching and HDPE Repair Plan

Plan last updated: **6/3/2022**

Scope

This **Excavation and Trenching Plan (Plan)** addresses the requirements and safe practices to ensure the safety of employees and contractors who work in or around trenching, and excavation activities performed at **Swift Bus Rapid Transit (BRT) Orange Line ITB#2021-083**. These requirements apply to all work involving excavation, digging, handling and disposal of landfill material and trenching, grading, or ditching operations, as well as protection of existing landfill liner and off gassing system. Also repair of the liner and reconnection procedures for the off-gassing system.

Policy

C.A. Carey Corporation from here on known as **CAC,** will provide safe work areas for employees, visitors, and others who are or may be exposed to hazards in or around trenches and other excavation areas. All trenching and excavation activities will be evaluated to eliminate or minimize the potential of cave-ins, review environment contamination, and contact with underground utilities or other subsurface impediments. No digging, trenching, or excavation activities will be performed unless the requirements of this organization’s safety and environmental policies are met.

Plan Administration

Personnel Contact Information

Function	Name/Department	Contact Information
Plan Administrator	**Curtis Andrews/ Jimmy Lewing**	**425-392-8016 candrews@cacarey.com**
Supervisor(s)/Competent Person(s)	**Jimmy Lewing**	**207-254-9960 jlewing@cacarey.com**

Plan administrator. The plan administrator will be a competent person and will:

- Review and approve the digging, trenching, and excavation drawing and permit.
- Ensure that known underground utilities and structures have been identified and physically located and marked.
- Ensure that precautions will be taken to protect existing underground utilities and structures.
- Ensure that all responsible organizations have given their input for the proposed excavation site.
- Ensure that adequate safety control measures have been identified and implemented.
- Monitor the overall effectiveness of the program through audits and annual reviews.
- Provide or assist with arranging site worker training, competent person training, and retraining of those who may be involved in excavations.
- Conduct an audit of the trenching.
- Maintain records relating to training and audits.
- Investigate and document all reported accidents and/or near-miss accidents that are directly or indirectly related to trenching.

The plan administrator may designate a competent person with the authority to administer or implement one or more components of this Plan.

Competent person. The competent person must be able to demonstrate the training, experience, and knowledge of soil analysis, use of protective systems, and the requirements of this plan.

The competent person will be able to:

- Evaluate soil conditions and select appropriate protective measures.
- Construct protective systems in accordance with the excavation regulatory requirements.
- Preplan, such as contact utilities (gas, electric) to locate underground lines; plan for traffic control, if necessary; and determine proximity to structures that could affect choice of protective systems.
- Test for low oxygen, hazardous fumes, and toxic gasses, especially when gasoline engine–driven equipment is running, or the dirt has been contaminated by leaking lines or storage tanks.
- Ensure adequate ventilation or respiratory equipment, if necessary.
- Provide safe access into and out of the excavation.

- Provide appropriate protection if water accumulation is a problem.
- Inspect the site daily at the start of each shift, following a rainstorm, or after any other hazard-increasing event.
- Keep excavations open the minimum amount of time needed to complete operations.

The competent person must be able to detect:

- Conditions that could result in cave-ins
- Failures in protective systems
- Hazardous atmospheres
- Other hazards, including those associated with confined spaces.

The competent person will have the authority to take prompt corrective measures to eliminate existing and predictable hazards and stop work when required.

Supervisor. A supervisor must be classified as a competent person and will be in charge of each excavation. The supervisor will:

- Successfully complete training for classification as a competent person for trenching operations.
- Implement the Excavation and Trenching Plan for work areas under their control.
- Act as the competent person for excavation sites under his or her control.
- Ensure that the equipment necessary to complete an excavation safely is available and in good condition.
- Determine soil type.
- Ensure that all underground utility installations are located and marked before excavation begins.
- Receive written approval from the relevant utilities and landowners for digging, trenching, or excavating operations.
- Ensure that underground installations are protected, supported, or removed while the excavation is open. Notify the appropriate agencies when utility systems are exposed during the excavation process to allow the location and condition of the utility to be evaluated.
- Ensure worker protection and compliance with other applicable safety plans or programs.
- Ensure protection of the public with appropriate barricades.
- Determine what protective systems will be used to prevent cave-ins.
- Conduct daily inspections of excavations, the adjacent areas, and protective systems for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.
- Immediately notify KBA if a utility system is damaged during the trenching or excavation process.

Employee. Each employee engaged in trenching or other excavation-related activities must:

- Complete training, and request assistance when uncertain about any activity he or she must perform.
- Use appropriate personal protective equipment (PPE).
- Adhere to the requirements of the Plan.
- Report all workplace injuries and unsafe conditions to the supervisor.

Emergency personnel contact information. See the *Emergency Contact Information* form for information about contacting the appropriate personnel during emergencies. Located in the field office.

Plan Review and Update

This Plan will be reviewed annually by the plan administrator or designee(s) to ensure the program's effectiveness and will be updated as determined by the review. This Plan will also be updated whenever:

- New types of protective systems or equipment are introduced to an excavation site.
- Evaluations of workplace hazards, injuries, and near misses demonstrate that the current plan is outdated or not effective.
- When regulatory or national consensus standards adopted as part of the Plan change.

Excavation and Trenching Safety Program

Hazard Assessment

Excavation and trenching work presents serious hazards to all workers involved. Cave-ins pose the greatest risk and are much more likely than other excavation-related accidents to result in worker fatalities. Other potential hazards include falls, falling loads, hazardous atmospheres, and incidents involving mobile equipment.

Before work begins on an excavation or trench, the competent person(s) will evaluate the specific hazardous conditions at the worksite through jobsite studies, observations, test borings for soil type or conditions, and consultations with local officials and utility companies. The following factors will be considered to determine the hazards associated with specific site conditions:

- Traffic
- Proximity and physical conditions of nearby structures
- Soil
- Surface water and groundwater
- Location of the water table
- Overhead and underground utilities
- Weather

Soil Classification

Before any work has begun on an excavation or trenching, the soil classification will need to be done to determine by the competent person what soil or material is present. There will be a visual inspection of the soil all the way to the liner and below to evaluate soil classification for digging conditions. Potholing with a Vac. truck may be conducted to determine the depth of the liner as well as soil, to be able to adjust as needed to the disposal location. This process will also help with actions needing to be taken for liner protection in the same area.

The supervisor or other competent person will determine the soil type using visual.

Visual Test

The entire excavation site, including the soil adjacent to the site, will be observed. During the visual test, the designated supervisor will check for crack-line openings along the failure zone that indicate tension cracks and observe the open side of the excavation for indications of layered geologic structuring. Other conditions to look for are signs of bulging, boiling, or sloughing, as well as signs of surface water seeping from the side of the excavation or from the water table.

Thumb penetration test. When the thumb is pressed firmly into the soil and penetrates no further than the length of the nail, it is probably Type B soil. If the thumb penetrates the full length of the thumb, it is Type C. This is the least accurate of the manual test methods.

Dry strength test. If a sample of dry soil is crumbled freely or with moderate pressure into individual grains, it is considered granular, or Type C. Dry soil that falls into clumps that subsequently break into smaller clumps is probably clay in combination with gravel, sand, or silt (Type B).

Plasticity or wet thread test. A moist sample of the soil is molded into a ball and then rolled into a thin thread approximately 1/8 inch in diameter by 2 inches in length. If the soil sample does not break when held by one end, it may be considered Type B. If the soil sample does break, it is considered Type C.

Surface Encumbrances

All surface encumbrances that are located so as to create a hazard to employees will be removed or supported, as necessary, to safeguard employees.

Liner Protection

CAC will exercise care when compacting materials of operating above the landfill liner at the McCollum Park, Park & Ride Terminus. The liner will be protected from damage and repaired where necessary per the details in the Plans. No construction equipment will be allowed to drive directly on the liner except for light ATVs. For heavier equipment, a minimum of 12 inches of cover soil is required under the tracks or tires of construction equipment with ground pressures of less than 5 pounds per square inch. The depth of cover soil shall be proportionally higher for heavier equipment.

Off-Gassing System

CAC will exercise care while any excavation is taking place as not to damage the off-gassing system. Proper depths of material will be placed or left alone over the top of the system. The pipe will be potholed when in the area to ensure the depth and location. Relocation of the off gasses vault will be performed per print. The as-built drawings provided will be referenced to the reinstallation of the system in its new location.

Underground Installations

The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, will be determined before opening an excavation.

Utility companies or owners will be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations before the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law) or cannot establish the exact location of these installations, the excavation work may proceed provided that such work is done with caution, and detection equipment or other acceptable means to locate utility installations are used.

When operations approach the location of underground utilities, excavation will progress with caution until the exact location of the utility is determined. While the excavation is open, underground installations will be protected, supported, or removed as necessary to safeguard employees.

Safety Procedures

General Requirements

If evidence of a situation that could result in possible cave-ins, slides, failure of protective systems, hazardous atmospheres, or other hazardous condition is identified, exposed workers will be removed from the hazard and all work in the excavation or trench stopped until all necessary safety precautions have been implemented.

Competent person. A competent person will oversee work performed at any excavation to ensure compliance with this Plan.

Worker training. Employees who work in or around excavations will be provided training according to their work activities. See the ***Training*** subsection of this Plan for specific training requirements.

Protective systems. The excavation or trench must either be sloped or supported as required to comply with OSHA worker protection requirements. See the ***Protective Systems*** subsection of this Plan for more information.

Personal protective equipment (PPE). Employees must use PPE as required by their job task.

Electrical installations. Work conducted on or around electrical utilization systems must be performed by the appointed electrical subcontractor.

Lockout/tagout. Work that may impact existing utilities that need to be locked and tagged out may be performed by appointed personnel per supervised safety protocols and procedures.

Exit route. The means of exit and the design specifications for such exit will be determined by the competent person and in accordance with the following guidelines:

- A stairway, ladder, ramp, personnel hoist, or other safe means of exit will be in trench excavations that are 4 ft (1.2 m) or more in depth.
- Exit route(s) will be placed within 25 lateral ft of workers.
- When two or more components form a ramp or runway, they must be connected to prevent displacement and be of uniform thickness.

- Cleats or other means of connecting runway components must be attached in a way that would not cause tripping (e.g., to the bottom of the structure).
- Structural ramps used in place of steps must have a nonslip surface.
- Earthen ramps may be used as a means of exit only if a worker can walk them in an upright position and only if they have been evaluated by a competent person.

Perimeter Protection

Protection will be provided to prevent personnel, vehicles, and equipment from falling into excavations.

Fall Protection

All wells, calyx holes, pits, and shafts will be barricaded or covered. Excavations will be backfilled as soon as possible. Upon completion of exploration and similar operations, test pits, temporary wells, and calyx holes will be backfilled immediately. Walkways or bridges will be provided with standard guardrails where people or equipment are required or permitted to cross over excavations.

Falling Loads

Workers and other personnel must be prevented from passing or standing underneath loads handled by lifting or digging equipment. They must stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped to provide adequate protection for the operator during loading and unloading operations.

Falling Material

Employees will not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at lower levels are adequately protected from the hazard of falling material or equipment.

Employees will be protected by scaling, ice removal, benching, barricading, rock bolting, wire mesh, or other means from loose rock or soil that could create a hazard by falling from the excavation wall. Special attention will be given to slopes that may be adversely affected by weather, moisture content, or vibration.

Placement of excavated material. Excavated material will be placed at least 2 ft (0.6 m) from the edge of an excavation or will be retained by devices that are sufficient to prevent the materials from falling into the excavation. In any case, material will be placed at a distance to prevent excessive loading on the face of the excavation. Materials such as boulders or stumps that may slide or roll into the excavation will be removed or made safe.

Hazardous Atmospheres

Workers will not be permitted to work in or near hazardous atmospheres unless required testing and monitoring, worker precautions, and rescue services are in place. Work conducted in enclosed areas where hazardous atmospheres or gases could accumulate (e.g., landfills, manure pits, gas distribution lines, or hazardous materials storage locations) must be done in accordance with the **Confined Spaces Plan**.

Types of atmospheres. Such atmospheres include those with the following:

- Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent
- A combustible gas concentration greater than 10 percent of the lower flammable limit
- Concentrations of hazardous substances that exceed those specified in the threshold limit values (TLVs) for airborne contaminants established by the American Conference of Governmental Industrial Hygienists (ACGIH)

Atmospheric tests. Air quality tests will be taken before employees enter excavations more than 4 ft in deep when a hazardous atmosphere exists or could be expected to exist. If there is any possibility that the trench or excavation could contain a hazardous atmosphere, the supervisor or other competent person will ensure that:

- Atmospheric testing is conducted before worker entry and continuously during work.
- Where oxygen deficiency or a hazardous atmosphere exists or could reasonably be expected to exist, the atmospheres in the excavation will be evaluated before employees enter excavations greater than 4 ft (1.2 m) deep.
- Gas sniff testers will be worn by any person entering excavation. quality and quantity of the atmosphere, including checks for flammable gases and oxygen deficiency.

Worker precautions. Suitable precautions will be taken as necessary to protect workers in areas where hazardous atmospheres exist or potentially exist. These precautions will include the following:

- Engineering controls such as ventilation
- Respiratory protection
- Full body harnesses and lifelines

Rescue equipment. Where hazardous atmospheres exist or may reasonably be expected to exist, emergency rescue equipment will be on the worksite and readily accessible to rescue personnel. See the ***Emergency Rescue Operations*** subsection of this Plan for more information about emergency procedures.

Daily inspections. Daily inspections for hazardous atmospheres must be conducted by a competent person.

Walkways and Guardrails over Excavations

Walkways will be provided where workers or equipment are allowed to cross over excavations. Guardrails will be provided on walkways used by the general public regardless of the height above the excavation. Guardrails will be provided on walkways used only by on-site personnel if the walkway is 4 ft or more above lower levels. If workers pass below a walkway, guardrails and toe boards will be provided.

Confined Spaces

Employees entering excavations classified as confined spaces or that otherwise present the potential for emergency rescue, such as bell-bottom pier holes or similar deep and confined footing, will wear rescue equipment and maintain communication with the confined space attendant. See the **Confined Space Plan** for more information about safety procedures related to confined spaces.

Water Accumulation

Control measures. Employees will not work in excavations in which there is accumulated water or in which water is accumulating unless the water hazards posed by accumulation is controlled. Freezing, pumping, draining, and similar control measures will be planned and directed by a registered engineer. Consideration will be given to the existing moisture balances in surrounding soils and the effects on foundations and structures if the soil is disturbed.

Drainage. Diversion ditches, dikes, or other means will be used to prevent surface water entering an excavation and to provide good drainage of the area adjacent to the excavation.

Water control equipment. When continuous operation of groundwater control equipment is necessary, an emergency power source will be provided. Water control equipment and operations will be monitored by a competent person to ensure proper operation.

Dewatering. Magna has been subcontracted to perform sonic drilled vacuum well dewatering system per the contract drawings C4.306. They will be installing well points as per design and field conditions. Magna will provide the vacuum pumps and filter packs to the discharge piping to settlement tanks. As well as decommissioning of the wells once complete.

Mobile Equipment and Motor Vehicle Traffic Precautions

Traffic around the excavation or trench site must be controlled and barricades, signs, and/or flag persons used as needed to control both vehicular and pedestrian traffic.

High visibility PPE. Workers exposed to public vehicular traffic will be provided with and will wear warning vests or other suitable garments marked with or made of reflective or high-visibility material.

Barricades. When vehicles or mobile equipment are used or allowed adjacent to an excavation, substantial stop logs or barricades will be installed. The use of a ground guide is recommended.

Loading/unloading vehicles. Workers will stand away from vehicles being loaded or unloaded to avoid being struck by spillage or falling materials.

Hoisting operations. Excavating or hoisting equipment will not be allowed to raise, lower, or swing loads over or adjacent to personnel in the excavation without substantial overhead protection. Personnel will maintain a safe distance from a hoisting operation until the load has been placed.

Warning system. When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system will be utilized, such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

Stability of Adjacent Structures

Protective systems. If the stability of adjoining buildings or walls is endangered by excavations, shoring, bracing, or underpinning will be provided to ensure the stability of the structure and to protect employees.

Support systems. Sidewalks, pavements, and related structures will not be undermined unless a support system is provided to protect employees and the sidewalk, pavement, or related structure.

Excavation below the level of adjacent structures. Excavations below the level of the base of footing of any foundation or retaining wall will not be permitted unless:

- A support system, such as underpinning, is provided to ensure the stability of the structure and to protect employees involved in the excavation work or in the vicinity thereof; *or*
- The excavation is in stable rock; *or*
- A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation or determines that the excavation will not pose a hazard to employees.

Site Inspections

When personnel will be in or around an excavation, a competent person will inspect the excavation, the adjacent areas, and protective systems daily:

- Before each work shift
- Throughout the work shifts as dictated by the work being done
- After every rainstorm
- After other events that could increase hazards (e.g., snowstorm, windstorm, thaw, earthquake)
- When fissures, tension cracks, sloughing, undercutting, water seepage, bulging at the bottom, or other similar conditions occur
- When there is a change in size, location, or placement of the spoil pile
- Where there is any indication of change in adjacent structures

The competent person will use the attached *Excavation/Trench Inspection Checklist* or equivalent form when conducting inspections. All completed inspection forms will be maintained at the worksite during construction and stored at [insert location] after excavation work is completed.

Protective Systems

General Requirements

Excavations less than 5 ft deep. For excavations less than 5 ft (1.5 m) deep, the competent person will examine the excavation for potential cave-in hazards and determine if a protective system is needed.

Excavations 5 ft deep or deeper. All workers in an excavation or trench 5 ft deep or deeper will be protected from cave-ins by an adequate protective system. Protective systems will have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

Excavations more than 20 ft deep. Protective systems for all excavations more than 20 ft (6.0 m) deep will be designed and approved by a registered professional engineer.

Protective System Selection

[*See the attached **App F Protective System Selection** guide for a graphic summary of the process for selecting a protective system for excavations and trenches 20 ft deep or less. A combination of protective systems may be used for an excavation or trench*.]

The competent person will select the method of protection that is most suitable for the particular excavation site, taking into consideration soil type and surrounding structures. See the *Soil Classification* subsection of this Plan for more information.

Types of protective systems. Excavations in which employees could potentially be exposed to cave-ins will be protected by:

1. Sloping or benching the sides of the excavation; *or*
2. Supporting or shoring the sides of the excavation; *or*
3. Placing a shield between the side of the excavation and the work area.

Exempt Excavations

The following excavations do not require protective systems:

- Excavations made entirely in stable rock; *or*
- Excavations are less than 5 ft (1.52 m) deep and examination of the ground by a competent person provides no indication of a potential cave-in.

A fixed means to safely exit exempt excavations will be provided for workers.

Sloping and Benching Systems

The competent person or supervisor will select and construct slopes and configurations of sloping and benching systems from one of four options.

[*The 4 options for sloping/benching configurations are listed below, the competent person or supervisor will select the appropriate option in accordance with the best site-specific option*.]

Option 1

Slope the walls of the excavation at an angle so that soil does not roll into the excavation. *The degree of the sloping angle needed depends on the stability of the soil at the site. The maximum allowable slopes for excavations less than 20 ft deep based on soil type and angle to the horizontal are as follows:*

Soil Type	*Height/Depth Ratio*	*Slope Angle*
B	*1:1 or less*	*45*
C	*11/2:1*	*34*

Examples:

In Type B soil, a 10-ft deep trench must be sloped to a 45-degree angle. The total distance across such a trench would be 20 ft plus the width of the trench.

In Type C soil, the 10-ft deep trench would be sloped at a 34-degree angle. The total width of the trench would be 15 ft in both directions, for a total of 30 ft across plus the width of the trench.

Sloping will be greater if the areas near the excavation are subject to heavy loads (e.g., soil piles and vehicles).

Excavation in an Unclassified Soil

Even If the soil is not classified, excavations extend into the landfill deposits, shoring is anticipated unless the landfill deposits have high soil content at excavation of site. Shoring will also be used where excavation extended below groundwater.

Option 2

Determine maximum slope with site-specific variables. *Determine the maximum slope on the basis of site-specific variables. Consult the attached* ***App A Soil Classification*** *and* ***App B Sloping and Benching*** *of the regulations about procedures for Option 2.*

Option 3

Use tabulated data to determine the slope. *Use tabulated data, such as tables and charts approved by a registered professional engineer, to design the excavation. These data will be in writing and include sufficient explanatory information to enable the user to make a selection, including the criteria for determining the selection and limits of the data. A copy of the information will be kept at the worksite during construction of the protective system.*

Option 4

Benching Systems

Benching is not permitted in Type C soil.

Benching may be one of two types:

- *Single level or step not exceeding 4 ft high; or*
- *Multiple levels or steps, each not exceeding 4 ft high.*

Benching may be used in conjunction with simple sloping. Benches must be below the maximum allowable slope for that soil type. For example, a 10-ft-deep trench in Type B soil must be benched back 10 ft in each direction with the maximum 45-degree angle.

Worker Safeguards

Workers must not work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

Shoring

Shoring is used when the location or depth of the trench makes sloping back to the maximum allowable slope impractical. Shoring will be used for unstable soil or depths greater than 5 ft (1.5 m) unless benching, sloping, or another acceptable plan is accepted by the competent person.

McCollum Park doesn't allow for benching. Shoring boxes will be installed and stacked to protect the excavation. The shoring boxes are certified and will be leased from a shoring company to ensure they have been properly inspected and certified to be used.

Installation and Removal of Shoring or Support Systems

Installation of a shoring or support system will be closely coordinated with the excavation of trenches. All shoring will be installed from the top down and removed from the bottom up.

Installation procedures. Members of shoring or support systems will be securely connected together to prevent sliding, falling, kick-outs, or other predictable failure.

Support systems will be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

Individual members of support systems will not be subjected to loads exceeding those that those members were designed to withstand.

Removal procedures. Before temporary removal of individual members begins, additional precautions will be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

Removal will begin at, and progress from, the bottom of the excavation. Members will be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

Backfilling procedures. Backfilling will progress together with the removal of support systems from excavations.

Excavation of material to a level no greater than 2 ft (0.6 m) below the bottom of the members of a support system will be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

Shields

A trench shield may be used as long as the protection it provides is equal to or greater than the protection that would be provided by the appropriate shoring system. The competent person or supervisor must follow manufacturer's instructions for premade boxes and shields once a design has been chosen.

Shields may be used in conjunction with sloping or benching.

Load requirements. Shield systems will not be subjected to loads exceeding those that the system was designed to withstand.

Installation requirements. Shields will be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

Worker protections. Workers will be protected from the hazard of cave-ins when entering or exiting the areas protected by shields. Workers will not be allowed in shields when shields are being installed, removed, or moved vertically.

Excavations below the depth of the shield. Excavations of earth material to a level not greater than 2 ft (.6 m) below the bottom of a shield will be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

Protective System Materials and Equipment

Maintenance of Materials and Equipment

Materials and equipment used for protective systems will be free from damage or defects that might impair their proper function. Manufactured materials and equipment used for protective systems will be used and

maintained in a manner that is consistent with the recommendations of the manufacturer and in a manner that will prevent employee exposure to hazards.

Damaged Materials and Equipment

When material or equipment that is used for protective systems is damaged, a competent person will examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot ensure that the material or equipment is able to support the intended loads or is otherwise suitable for safe use, such material or equipment will be removed from service and will be evaluated and approved by a registered professional engineer before being returned to service.

Materials sources

When material needs to be repaired or replaced, the sources that will be used are as follows: Oldcastle precast for any concrete vaults or lids. Ferguson will be used for any off gasses pipe or parts and pieces. NW linings will be used for the liner repair, and their suppliers for the liner repair material / parts and pieces are Solmax, Raven, Megaplast, and GSE. A competent person will examine the material and evaluate its suitability for use. Making sure it meets specifications.

Emergency Rescue Operations

In the event of an emergency requiring rescue from an excavation, workers will not attempt to enter an unprotected excavation or trench to perform rescue. Local emergency services will be notified using the standard reporting system.

Rescue operations that can be performed safely from outside the excavation, such as hoisting a harnessed victim, will be carried out. Other personnel in the excavation will exit immediately and may aid only when their own safety is ensured.

Contractors

All contractors and contractor employees must have their own excavation and trenching safety policies that are in compliance with federal and any applicable state and local regulations. They must also comply with the requirements of this Plan and any additional requirements stipulated by the plan administrator, competent person, or the *Contractor Safety Plan.*

Enforcement of Safety Procedures

All employees, including all levels of management, will be held accountable for obeying the worksite safety and health rules. The following four-step disciplinary policy will be applied to everyone by the appropriate level of supervisor:

- Oral warning
- Written reprimand
- Suspension
- Dismissal

Visitors, including contractors who violate safety and health rules and procedures, will be escorted from the site. Should the disciplined person request a review of the disciplinary action, the supervisor will review the situation and make a recommendation to management, which reserves the right for final decision.

Training

All employees, including contractors, involved in trenching or excavation work must be trained in the requirements of this Plan before any trenching- or excavation-related activities begin.

Supervisor Training

All supervisors of trenching and excavation activities must satisfy OSHA requirements for a competent person. Such supervisors must attend competent person training conducted by a trainer approved by the plan administrator or designee.

Employee Training

Personnel who perform work in trenches or excavations must comply with the requirements of this Plan and receive appropriate training that will include:

- Safe work practices during work in excavations
- The use of personal protective equipment (PPE) that will typically be required during work in excavations
- Procedures to be followed if a hazardous atmosphere exists or could reasonably be expected to develop during work in an excavation
- Emergency and nonentry rescue methods and procedures for calling rescue services

Hazardous Material Disposal

Contaminated/Hazardous Waste materials generated in McCollum Park will be fully evaluated to determine what class of waste it is. Per the advice of Snohomish County Solid waste, All material dug out of the liner will be taken in a solo dump truck to Snohomish County's Solid waste transfer station located at 10700 Minuteman Dr. Everett WA. Any contamination in groundwater will be disposed of at Mar-Vac in Seattle. Water will be loaded into storage holding tanks until they can be removed for proper disposal in Mar-Vac tanker trucks.

Any material dug from below the liner will be treated as hazardous waste. All precautions will be taken to ensure that no material will enter any storm system or noncontaminated dirt. If weather is not dry, due to rain or snow, excavation will not be performed, and any material has not been removed for disposal from the site will be covered with Vis-queen to protect it from rainwater.

NORTHWEST LININGS AND GEOTEXTILES HDPE/LLDPE-FIELD QUALITY CONTROL MANUAL

I. INTRODUCTION

A. This manual describes the Quality Control Procedures utilized by Northwest Linings (NWL)

Installation Personnel to assure quality workmanship and installation integrity of HDPE/LLDPE Geomembranes.

B. Geosynthetic components of lining systems which are addressed in this manual are HDPE/LLDPE Geomembranes. NWL recognizes that specific documentation of the specific installation is required to substantiate this Quality Control Program.

II. HDPE/LLDPE GEOMEMBRANE INSTALLATION

A. Earth Work

1. The general and/or earthwork contractor shall be responsible for preparing and maintaining the subgrade in a condition suitable for liner installation unless agreed otherwise.

2. Surfaces to be lined shall be smooth and free of debris, roots, and angular or sharp rocks to a depth of four (4) inches. All fill shall consist of well-graded material free of organics, trash, clayballs or other harmful matter. No sharp edged stones, stones larger than one (1) inch diameter or hard objects shall be allowed within the top four (4) inches of the subgrade. The surface shall be compacted in accordance with project specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the surface without causing rutting or other harmful effects. The subgrade shall have no sudden sharp or abrupt changes in grade.

3. The earthwork contractor shall protect the subgrade from becoming too dry, flooding and freezing. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the engineer) installed over the subgrade until the placement of the liner begins. Subgrade found to have cracks greater than 1/2 inch in width or depth or which exhibit swelling, heaving or other similar conditions shall be reworked by the general contractor to remove these defects.

4. Surface acceptance: Upon request, NWL will provide the Owner's Representative with a written acceptance of the surface to be lined. This acceptance will be limited to an amount of area that NWL is capable of lining in a particular work shift. Subsequent repairs to the subgrade and the surface shall remain the responsibility of the earthwork contractor.

B. Crest Anchorage System

1. The anchor trench shall be excavated by the earthwork contractor to lines and widths shown on the design drawings prior to geomembrane placement.

2. Anchor trenches excavated in clay soils susceptible to desiccation cracks should be excavated only the distance required for that days liner placement to minimize the potential for cracking of the clay soils.

3. Corners in the anchor trench shall be slightly rounded where the geomembrane enters the trench to minimize sharp bends in the liner.

C. Preparation for Geomembrane Deployment

1. Panel Layout: Prior to liner deployment, layout drawings shall be produced to indicate the panel configuration and location of seams.

2. Identification: Each panel used shall be given a numeric or alpha-numeric identifier consistent with the layout drawing. This identification number shall be related to a manufacturing roll number.

D. Field Panel Placement

1. Location: NWL will attempt to install field panels at the location indicated on the layout drawing. If

panels are positioned in a location other than that indicated on the layout drawings, the revised location shall be noted in the field on a layout drawing which will be modified at the completion of the project to reflect actual panel locations.

2. Weather Conditions: Geomembrane deployment shall not be done during any precipitation, in the presence of excessive moisture (i.e. fog, dew), in an area of standing or ponded water, or during high winds.

3. Method of Deployment:

    1. The method and equipment used to deploy the panels must not damage the geomembrane or the supporting subgrade surface. The supporting sub-grade must be prepared and maintained in a condition to support the equipment needed for the installation.

    2. The rolls of liner will be deployed from a spreader bar apparatus supported by a fork lift, loader or other piece of heavy equipment that can safely lift and move the rolls. Heavy equipment will not be allowed to operate directly on geomembrane.

    3. No personnel working on the liner will smoke, wear shoes that can damage the geomembrane, or engage in actions which could result in damage to the geomembrane.

    4. Adequate temporary ballast and/or anchoring, (i.e. sandbags,) which will not damage the geomembrane, will be placed to prevent uplift of the liner by wind.

    5. The geomembrane will be deployed in a manner to minimize wrinkles.

    6. Rubber tired and tracked ATV's and similar equipment are acceptable to operate on the geomembrane with ground pressure less than 8 psi. Tires and tracks will be checked for sharp edges, rocks or debris that may damage the liner before operating on the geomembrane. Driving paths will be as straight as possible avoiding sharp turns, sudden stops and starts.

    7. Any damage to a panel of geomembrane will be repaired in accordance with Section IV. Any area of a panel seriously damaged (torn, twisted, or crimped) will be marked, cut out, and removed from the work area with resulting seaming and/or repairs performed in accordance with Section IV of this document.

E. Field Seaming

1. General Requirements:

    1. Layout: In general, seams shall be oriented parallel to the slope, (down hill) not across the slope. Whenever possible, horizontal seams should be located not less than five (5) feet from the toe of the slope. Each seam shall be numbered in a manner compatible with the panel layout drawing for documentation of seam testing results.

    2. Personnel: All personnel performing seaming operations shall be trained in the operation of the equipment being used and will qualify by successfully welding a test seam as described herein. The project foreman will provide direct supervision of all personnel seaming to verify proper welding procedures are followed.

F. Equipment:

1. Fusion Welding: Fusion Welding consists of placing a heated wedge, mounted on a self propelled vehicular unit, between two (2) overlapped sheets such that both sheets are heated to temperatures ranging from 600 degrees F. to 950 degrees F. After being heated by the wedge, the overlapped edges pass through a set of preset pressure rollers which compress the panels together forming a continuous homogenous fusion weld. The fusion welder is equipped with a temperature readout device which continuously monitors the temperature of the wedge.

2. Extrusion Fillet Welding: Extrusion welding consists of introducing a ribbon of molten resin along the edge of the seam overlap to the two sheets to be welded. The molten polymer causes some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the sheets. The extrusion welder is equipped with gauges giving the temperature in the apparatus and the preheat temperature at the nozzle.

G. Seam Preparation:

1. Fusion Welding:

    1. Overlap the panels approximately four (4) inches.

    2. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt and debris.

    3. No grinding is required for fusion welding.

    4. Adjust the panels so that seams are aligned with the fewest possible number of wrinkles and "fishmouths".

2. Extrusion Welding:

    1. Overlap the panels a minimum of three (3) inches.

    2. Temporarily bond the panels to be welded taking care not to damage the geomembrane.

    3. Grind seam overlap prior to welding within 15 minutes of welding operation in manner that does not damage the geomembrane.

    4. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust dirt and debris of any kind.

    5. Purge the extruder prior to beginning the seam to remove all heat-degraded Extrudate from the barrel.

    6. Keep welding rod clean and off the ground.

H. Test Seams:

Test seams shall be performed at the beginning of each seaming period and at least once each five hours for each seaming apparatus used that day. Test seams shall be made on fragment pieces of the liner and under the same conditions as actual seams.

1. Test Seam Length:

The test seam shall be at least three feet long, made by joining 2 pieces at least 9" in width.

2. Sample Procedures:

    1. Visually inspect the seam for squeeze out, footprint, pressure and general appearance.

    2. Two samples one inch wide shall be cut from the test seam. The samples shall then be tested in peel and shall not fail in the seam. Failure shall be a film tear bond (FTB). If a sample fails, the entire procedure shall be repeated. ASTM D6392 will be method of testing samples GRI GM19 will be used for strength and locus of break.

    3. If any of the second set of samples fail, the machine shall not be accepted and used for seaming until the problem is corrected and 2 passing tests are achieved.

4. After completion of the test the remaining portion of the test seam shall be discarded. Documentation of the test seams will be maintained by listing machine I.D. number, operators name, temperature control setting and test results.

5. Passing test results records shall be maintained on NWL's test weld report form.

6. If test samples are to act as destructive samples then the sample shall be marked, logged and saved. If samples are to be cut from the actual finished seam for Lab Testing, the test seams shall be discarded per above.

I. General Seaming Procedures:

1. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

2. While welding a seam, monitor and maintain the proper overlap.

3. Inspect seam area to assure area is clean and free of moisture, dust, dirt and debris of any kind.

4. While welding a seam, monitor temperature gauges to assure proper settings are maintained and that the machine is operating properly.

5. Align wrinkles at the seam overlap to allow welding through a wrinkle.

6. Fishmouths or wrinkles at seam overlaps that cannot be welded through shall be cut along the ridge in order to achieve a flat overlap. The cut area shall be seamed. Any portion where the overlap is inadequate shall be patched with an oval or round patch extending six inches beyond the cut in all directions.

7. All cross/butt seams between two rows of seamed panels shall be welded during the coolest time of the day to allow for contraction of the geomembrane.

8. All "T" joints shall have the overlap from the wedge welder seam trimmed back to allow an extrusion fillet weld. Then grind two inches on either side of the seam and extrusion weld all of the area prepared by grinding.

J. Weather Conditions:

NWL relies on the experience of the Project Superintendent and the results of test seams to determine seaming restriction by weather. Many factors, such as ambient temperature, humidity, wind, sunshine, etc., can effect the integrity of field seams and must be taken into account when deciding whether or not seaming should proceed. Test seams are required prior to daily production seaming to determine if the weather conditions will effect NWL's ability to produce quality seams.
Additional non-destructive and destructive testing of production seams substantiate the decision made by the Project Superintendent to seam on any given day.

SECTION III Seam Testing-Quality & Control-Geomembranes

A. Concept:

NWL installation crews will non-destructively test all field seams over their full length using air pressure testing, vacuum testing or other approved method, to verify the continuity and integrity of the seams.

B. Air Pressure Testing:

The weld seam created by the fusion welding process is composed of two welded seams separated by an unwelded channel approximately 3/8 of an inch wide. This channel permits seams to be tested by inflating the sealed channel

with air to a predetermined pressure and observing the stability

of the pressurized channel over time. Method of test ASTM D5820 Practice for Pressurized Air Channel Eval of Dual Seamed Geomembranes.

C. Equipment for air testing:

1. An air pump (manual or motor driven) capable of generating and sustaining a pressure of 30 PSI.
2. A rubber hose with fittings and connections.
3. A sharp hollow needle with a pressure gauge capable of reading and sustaining a pressure of 30 PSI.
4. Procedure for air testing:
5. Seal both ends of the seam to be tested.
6. Insert needle in the sealed channel.
7. Inflate the test channel to a pressure between 25 to 30 PSI, in accordance with the following schedule, close valve, and allow 2 minutes for the injected air to come into equilibrium in the channel. Observe initial pressure after approximately 2 minutes.

INITIAL PRESSURE SCHEDULE*			MAX. PRESSURE DIFF. MATERIAL (MIL)
MIN. PSI		MAX. PSI	AFTER 5 MINUTES
40	25	30	4
50	26	30	4
60	27	30	4
80	30	30	4
100	30	30	4

* Initial pressure settings are read after a two minute relaxing period. The purpose of this period is to permit the air temperature and pressure to stabilize.

8. Observe and record the air pressure five minutes after the relaxing period ends. If loss of pressure exceeds the value above or if the pressure does not stabilize, locate the faulty area and repair.
9. Upon completion of the pressure test the end of the seam opposite the pressure gauge is cut. A decrease in gauge pressure must be observed or the air channel will be considered blocked and the test will be repeated after the blockage is corrected.
10. Remove needle and seal resulting hole by extrusion welding.
11. Record test results on non-destructive test form
12. In the event of a Non-Complying Air pressure test, the following procedure shall be followed.
13. Check seam-end seals and retest seams.
14. If non-compliance reoccurs, cut one inch samples from each end of the seam and additional samples at the distance specified.
15. Perform destructive field peel test on the samples.
16. If all samples pass destructive testing remove the overlap left by the wedge welder and perform an

Air Pressure/Soap Test or vacuum test.

17. If a leak is detected by the air pressure/soap or the vacuum test, repair by extrusion welding. Test repair by vacuum testing.
18. If no leak is discovered air pressure/soap testing, the seam will pass non-destructive testing.
19. If no leak is discovered by vacuum testing, the seam will pass non-destructive testing.
20. If one or more samples fail the peel test, additional samples will be taken.
21. When two passing samples are located, the seam between these two locations will be considered complying. The area outside of this length will be considered non-complying and the entire length extrusion welded.
22. Test the entire length of the repaired seam by vacuum testing.

D. Air Pressure Testing/Soap Testing:

This test is used when the seam fails the air pressure test due to slow pressure loss. The procedure is to constantly supply pressure to the seam air channel while spraying the length with a soap and water solution and visually examining the seam for bubbles. Note: This option is not recommended during high wind conditions.

1. Equipment for Air Pressure/Soap Testing:
    1. The same equipment as the air pressure test.
    2. A soap solution and means to apply the solution.
2. Procedure for Air Pressure/Soap Testing:
    1. Trim excess overlap material off at edge of seam
    2. Insert needle gauge assembly in opposite ends of the seam to be tested to show that pressure is continuous throughout the channel.
    3. Maintain 30 psi
    4. Apply soap solution to the weld edge and visually examine for bubbles.
    5. If no bubbles appear the problem is with the inside track "secondary weld". This seam is acceptable providing it has passed peel tests.
    6. If any bubbles appear on the outside track “Primary weld”, repair defect by extrusion welding and vacuum test the repair.

E. Vacuum Testing:

This test is used when the geometry of the weld makes air pressure testing impossible or impractical or when attempting to locate the precise location of a defect believed to exist after air pressure testing. Method of testing is based on ASTM D5641 Practice for Geomembrane Seam Eval by Vacuum Chamber.

1. Equipment for vacuum testing:
    1. Vacuum box consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly and a vacuum gauge.

2. Vacuum pump assembly or compressor with a venturi equipped with a pressure controller and pipe connections.

3. A rubber pressure/vacuum hose with fittings and connections.
4. A soap solution with a means to apply the solution.

2. Procedure for Vacuum Testing:

1. Trim excess overlap from seam.

2. Apply soap solution to the area to be tested.

3. Place the vacuum box over the area and apply sufficient downward pressure to seal the box against the liner.

4. Open the vacuum valve and apply a minimum of 5 in. Hg vacuum to the area as indicated by the gauge on the box.

5. Ensure that a leak-tight seal is created.

6. For a period of not less than five seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

7. If no bubbles appear after five to ten seconds, close the valve and move overlap and repeat the process.

3. Procedure for non-complying test:

1. Mark all areas where soap bubbles appear and repair the marked areas.

2. Retest repaired areas.

4. Procedure for non-destructive testing of extrusion welds that are not on flat surfaces or accessible for the equipment: ASTM D6365 Practice for Nondestructive Testing of Geomembranes Seams using the Spark Test.

F. Destructive Testing:

The purpose of destructive testing is to determine and evaluate seam strength. These tests require direct sampling and thus subsequent patching. Therefore, destructive testing should be held to a minimum to reduce the amount of repairs required.

1. Procedure for Destructive Testing:

1.1. Destructive test samples shall be marked and cut out randomly at a minimum average frequency of one test location every 700 feet of seam length.

1.2. Additional test may be taken in areas of contamination, offset welds, visible crystallinity or other potential cause of faulty welds.

1.3. ASTM D6392 will be method of testing samples GRI GM19 will be used for strength and locus of break standards.

1) Sample Size:

a) The sample should be twelve inches wide with a seam fourteen inches long centered lengthwise in

the sample. The sample may be increased in size to accommodate independent lab testing by the owner or by specific project specifications.

b) A one inch sample shall be cut from each end of the test seam for field testing on a calibrated field tensiometer.

2) The one inch wide samples shall be tested in the field for peel. If any field sample fails to pass FTB, it will be assumed the sample fails destructive testing. The procedures outlined in Section 2 shall be followed to locate passing samples to send to the laboratory.

a) If the sample passes the field test, the remaining portion of the sample test strip may be sent to Northwest Linings for laboratory testing to evaluate seam strength and confirm field testing.

1. Procedure in the event of Destructive Test Failure:

1. Cut additional field samples for testing. In the case of a field production seam, the samples must lay a minimum of ten feet in each direction from the location of the failed sample. Perform a field test with the tensiometer for peel strength. and confirm field testing.

2. If the laboratory samples pass, then reconstruct the seam up to the two passing sample locations.

1. Heat tack the overlap along the length of the seam to be reconstructed and extrusion weld.

2. Vacuum test the extrusion weld.

3. If either of the samples fails then additional samples are taken in accordance with the above procedure until two passing samples are found to establish the zone in which the seam should be reconstructed.

4. All passing seams must be bounded by two locations from which samples passing destructive test have been taken.

5. In the case of reconstructed seams exceeding 150 feet, a sample must be taken and pass destructive testing.

6. All destructive seam samples sent to Northwest Linings shall be numbered and recorded on a destructive seam test form.

3. Northwest Linings Quality Assurance Laboratory Testing:

The remaining destructive sample will be sent to a qualified laboratory and will be tested in "Seam Strength" and "Peel Adhesion" (ASTM D6392 will be method of testing samples GRI GM19 will be used for strength and locus of break). Five specimens shall be tested for each test method with data recorded. Four out of the five specimens must pass for each test in order for the seam to pass the destructive test.

SECTION IV Defects and Repairs

A. Inspection

1. Northwest Linings Project Superintendent shall conduct a detailed walk through and visually check all seams and non-seam areas of the geomembrane for defects, holes, blisters and signs of damage during installation.

2. All other NWL installation personnel shall at all times be on the lookout for any damaged areas. Damaged areas shall be marked and repaired.

B. Procedure

1. Repair procedures: Any portion of the geomembrane showing a flaw, or failing destructive or non-destructive test shall be repaired. Several methods exist for repairs, and the decision as to the appropriate method shall be made by NWL's Project Superintendent. Methods available for repair:

1. Patching - used to repair large holes, tears and destructive sample locations. All patches shall extend at least six inches beyond the defect and all corners of patches shall be rounded.

2. Grinding and welding - used to repair sections of extruded seams.

3. Spot welding or seaming - used to repair small tears, pinholes or other minor localized flaws.

4. Capping - used to repair lengths of failed extruded areas.

5. Removal of a bad seam and replacement with a strip of new material seamed into place.

C. Verification of Repairs:

1. Every repair shall be non-destructively tested using the methods set out in this manual Repairs which pass the non-destructive test shall be deemed adequate. Large repairs may require a destructive test. Repair test results shall be logged on a repair report form. The repair location shall be recorded on a record drawing.

Off-Gasses system sub-contractor qualifications

CAC will be subcontracting to Hawk Mechanical Contractors to perform the off-gassing system relocation. Their service includes work performed on Commercial Buildings, Hospitals and Clinics, Laboratories, Research and Development, High-rise Offices and Mixed-Use Projects, Industrial Facilities and Chemical Plants, Wastewater and Water Treatment Facilities

Since 1996, Hawk Mechanical has served western Washington’s commercial, industrial, medical, and public works sectors. Hard work, innovation, and customer service are the core values that play a vital role in Hawks company’s success. Over the years they have evolved into a multi-faceted mechanical contracting firm, serving their clients throughout the state. Their expertise covers a wide range of disciplines, which include:

- Piping and Plumbing Fabrication and Installation
- Process Piping
- Medical Gas Piping
- Equipment Installation
- Service, including certified back flow testing
- 3D Coordination and Building Information Modeling
- LEED Installation and Energy modeling

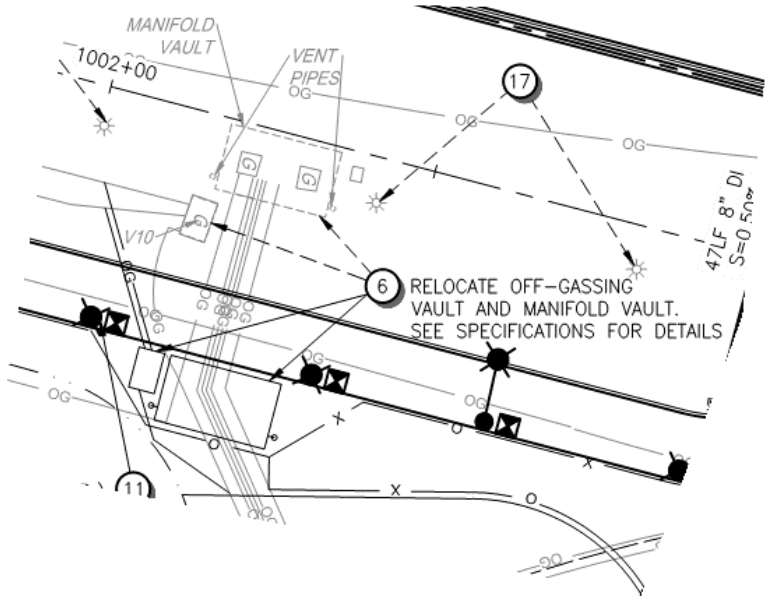
They are experienced in the installation of the following types of plumbing and piping:
Cast Iron Soil Pipe (Hubless and bell and spigot), Ductile Iron Pipe (Flanged, grooved, and mechanical joint), Copper Tube (Sweat, sil-brazed, flared, grooved, and press-fit) Carbon Steel (Welded, grooved, flared, and screwed), Stainless Steel (Welded, grooved, flared, and screwed), PEX,PVC, CPVC, ABS, Polyethylene, Kynar, Polypropylene (Solvent welded, fused, screwed, grooved, and mechanical joints), Aluminum Tube (Compression or flared) Fiberglass (Hand lay-up, flanged, and grooved)

They continue to maintain their reputation for excellent customer satisfaction through quality workmanship, teamwork, dedication, and safety.

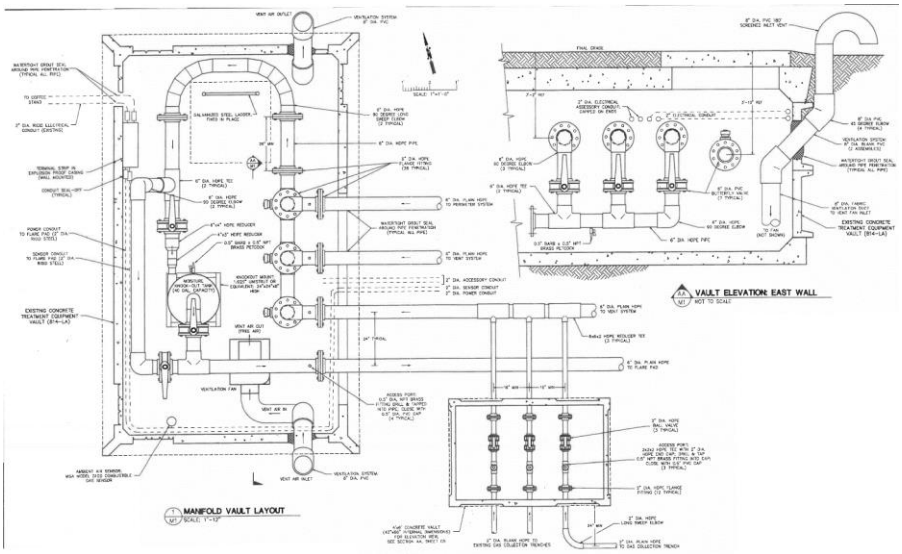
At Hawk Mechanical they make every effort to ensure that their job sites are clean and safe so that their employees can perform their work effectively and efficiently. they strive to recognize and eliminate all safety hazards without impacting job schedules. In addition to their comprehensive safety program, Hawk conducts regular training seminars and safety meetings, weekly toolbox talks, weekly site inspections, and daily pre-task planning.

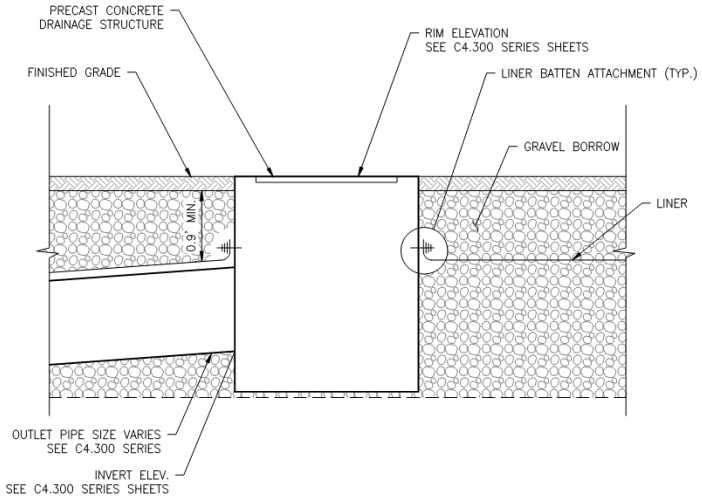
Hawk Mechanical is a member of the AGC Safety Team and has been awarded AGC's Top EMR and "As low as you can go" Awards for 2019, 2018 & 2017.

Off-Gasses System relocation details and Liner repair details around structures



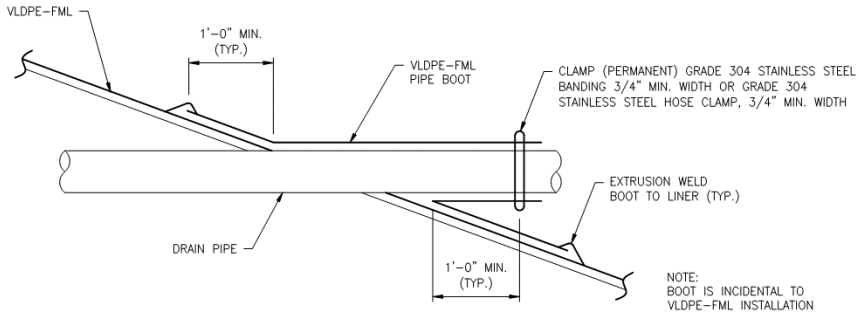
Off-Gasses vault will be relocated to the new location per detail above. Mechanical Sub will be following the as-built detail below on proper assembly.





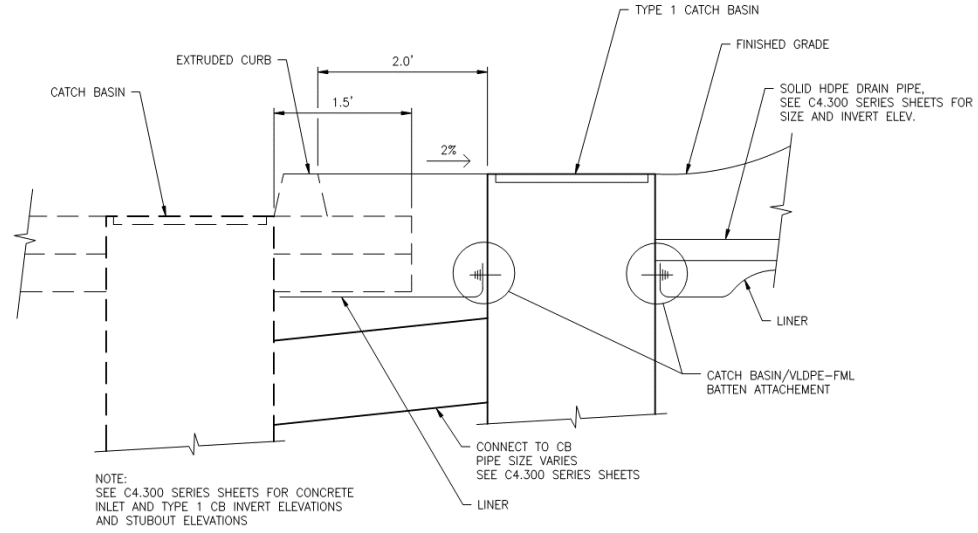
STRUCTURE LINER REPAIR

NOT TO SCALE



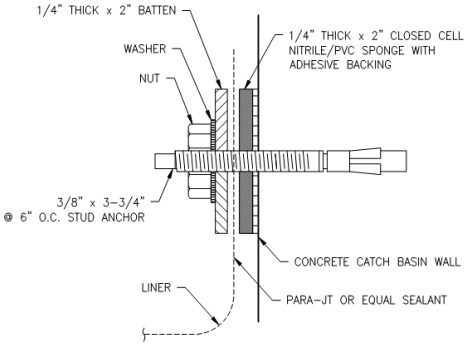
PIPE OUTLET LINER REPAIR

NOT TO SCALE

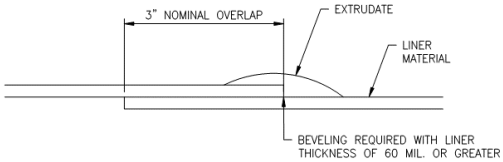


CATCH BASIN CONNECTION AND LINER REPAIR

NOT TO SCALE



NOTE:
BATTEN ATTACHMENT IS INCIDENTAL TO VLDPE-FML LINER INSTALLATION



NOTES:
1. LINER SHEETS TACK WELDED TOGETHER AT OVERLAP TO FORM TEMPORARY BOND PRIOR TO WELDING.

2. GRINDING NOT TO EXCEED $\frac{1}{4}$" PAST "SQUEEZE-OUT" ON EITHER SIDE. PROPER CARE SHOULD BE TAKEN IN NOT REMOVING TOO MUCH MATERIAL WHEN GRINDING.

3. VACUUM TESTING IS THE NONDESTRUCTIVE SEAM TEST METHOD FOR EXTRUSION WELDS.

LINER BATTEN ATTACHMENT SECTION AND EXTRUSION WELD

NOT TO SCALE