PARCEL 2 OPERATIONS AND MAINTENANCE PLAN

Former L.D. McFarland Creosote Wood Treating Facility, Milwaukie, Oregon

Prepared for: Guardian Real Estate Services, LLC

Project No. AS210426A • June 18, 2024 FINAL

Aspect
A Geosyntec Company

earth + water

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1 Introduction

Aspect Consulting LLC (Aspect) has prepared this Operations and Maintenance Plan (OMP) for Parcel 2 as part of the Phase II Remedial Action (RA) for the Former L.D. McFarland Company, Ltd. (LDM) Creosote Wood Treating Facility in Milwaukie, Oregon (Figure 1). The Site consists of all areas where contamination from the Former LDM facility came to be located and includes portions of the Former LDM Property (herein referred to as the Property), the Union Pacific Railroad (UPRR) Property, and the Milwaukie Marketplace property (Figure 2). The RA for the Site is described in the March 2001 Record of Decision, Selected RA for Former L.D. McFarland Creosote Wood Treating Facility, Milwaukee, Oregon (ROD; DEQ, 2001). The Oregon Department of Environmental Quality (DEQ) provides oversight for the implementation of the ROD at the Site under the requirements of the August 14, 2001 Stipulation and Consent Decree No. CCV0108179 (Consent Decree).

The Property is divided into two parcels, Parcel 1 and Parcel 2 (Figure 2). A Phase I RA was completed in 2001 and consisted of placement of impacted soil excavated from Parcel 1, the Milwaukie Marketplace, and the UPRR Property on Parcel 2. Impacted soil is defined as soil with CPAH concentrations greater than the Parcel 1 soil protective level of 0.056 milligrams per kilogram (mg/kg), Parcel 2 soil protective level of 1.56 mg/kg, and Milwaukie Marketplace and UPRR Property soil protective level of 0.36 mg/kg. Parcel 1 and Milwaukie Marketplace were remediated to the DEQ soil protective levels goals but impacted soil remained on Parcel 2 and UPRR (Bridgewater Group, Inc. [Bridgewater], 2002a). A Certificate of Completion for the Phase I RA was received from DEQ in a letter dated July 11, 2002 (DEQ, 2002). An Easement and Equitable Servitude[1] (EES) was executed between DEQ and the LDM Site owner, following completion of the Phase I Remedial Action. The EES describes the restrictions on use of the Site.

The Phase II RA consisted of capping impacted soil on Parcel 2; excavating impacted soil from Parcel 2 primary utility corridors, consolidating the excavated soil in capped areas, and backfilling with clean import fill; and implementing vapor mitigation measures for the protection of vapor intrusion (VI). Impacted soil on Parcel 2 was capped with buildings, pavement, or a clean soil cap, collectively referred to as the "Final Cap." Additional elements of the Phase II RA include maintaining institutional controls with ongoing operation and maintenance of the cap, implementing long-term groundwater monitoring, and conducting protectiveness reviews (DEQ, 2001). Between 2021 and 2023, Parcel 2 was remediated to DEQ's occupational/commercial use exposure scenarios as part of the Phase II RA in accordance with the Phase II Design Report (Aspect, 2020a) and summarized in the Phase II Construction Closeout Report (Aspect, 2024a).

[1] Easement and Equitable Servitude between the Oregon Department of Environmental Quality and L. D. McFarland Company, Ltd., recorded by Clackamas County October 2001.

In accordance with Section III.K of the Scope of Work attached to the Consent Decree, this OMP sets forth the requirements for operation and maintenance of the Parcel 2 caps and reporting and records management.

1.1 Site Description and Background

Parcel 2 encompasses approximately 2.52 acres and is bordered on the north and west by Parcel 1, on the east by SE 37th Street, and on the south by the UPRR Property (Figure 2). On October 20, 2021, the Property was purchased from Tyee Management Company, LLC by Monroe Apartments Owner LLC, as documented in the Closing Notice to DEQ (Tyee, 2021). The Property was vacant until late October 2021, when the Phase II RA and construction began for the Seven Acres Apartments (formerly Monroe Apartments) development.

In addition to the placement of impacted soil onto Parcel 2, 13 groundwater monitoring wells were installed on Parcel 1, Parcel 2, the Milwaukie Marketplace, and the UPRR Property as part of the Phase I RA (Figure 2). The groundwater monitoring wells were used between completion of the Phase I RA in 2001 and commencement of the Phase II RA in 2021 to monitor groundwater flow and quality to ensure that contaminants in groundwater do not migrate to a City of Milwaukie (City) supply well (Well No. 7). Groundwater monitoring was conducted on a semi-annual basis in accordance with the Revised Groundwater Monitoring Plan (Bridgewater, 2002b).

Interim inspection on Parcel 2 following the Phase I RA consisted of semi-monthly inspections of the security fence, silt fence, and the gravel surface for evidence of unauthorized excavation. Maintenance consisted of repairs anywhere the gravel and fabric cover were compromised to prevent underlying residual soil from becoming windborne or eroding. Interim inspection and maintenance also included meeting applicable requirements of the EES detailed in Section 1.2.1.

1.2 Institutional Controls

Institutional Controls have been implemented on Parcel 2 to ensure protectiveness of the Phase I RA. Institutional controls consist of a deed restriction and the operations and maintenance procedures outlined in this OMP.

1.2.1 Restrictive Covenants

The use of restrictive covenants are required by DEQ under the Consent Decree. The restrictive covenants are property use restrictions that apply to all property owners (current and future) of Parcel 2. The restrictive covenants are described in the EES and have been agreed to by the Property owner and DEQ as executed on October 25, 2001. The use restrictions for Parcel 2 are as follows:

- No use shall be made of groundwater contained in any aquifer at the Property, by extraction through wells or by other means, which involves consumption or other beneficial use of the groundwater. This prohibition shall not apply to extraction of groundwater associated with remedial activities at the site and/or temporary dewatering activities related to construction, development, or the installation of sewer or utilities at the Property.

- No operation or uses shall be made on or of the Property that will or likely will jeopardize the cover's functional integrity. The owner of the Property shall maintain the surface cover and any other permanent feature of the remedy described in the ROD in accordance with this OMP approved in writing by DEQ.
- The Property shall remain zoned in a manner allowing for commercial use,
- The owner shall provide notice to site operators and employees of the presence of contamination at and under the Property and of the OMP.

There are no restrictions to development activities conducted above the Final Cap. Additional earthwork fill, pavement, or structures may be constructed above the Final Cap without limitation.

In addition to the use restrictions, DEQ reserves the right of entry, during reasonable hours and security requirements, upon any portion of Parcel 2 to determine whether the requirements of the EES are being complied with.

1.2.2 Notifications

Parcel 2 owners, operators, and employees must be notified of the presence of impacted soil beneath the Final Cap. The Final Cap features prevent direct contact with Parcel 2 impacted soil.

The Parcel 2 owner must be notified of DEQ's Protectiveness Review requirements. A Protectiveness Review is required every five years by the Property owner; however, DEQ may request a Protectiveness Review at any time a significant change in groundwater monitoring data is observed. The Protectiveness Review process is detailed in Section 6.1.

2 Components of Phase II Remedial Action

All of Parcel 2 was capped during the Phase II RA. Primary utility corridors were excavated and backfilled with clean import fill, and buildings constructed in areas where vapor intrusion is a concern include vapor barriers and/or subsurface venting systems.

2.1 Cap Features

The impacted soil on Parcel 2 is covered by features that together serve as the Final Cap to prevent direct contact with Parcel 2 soil (Figure 3). The Final Cap consists of the following:

- **Building Cap.** A 4-inch-thick concrete floor slab overlying at least 4-inches of clean imported fill structural subgrade underly the Clubhouse and Pool House. A 7-inch-thick concrete floor slab overlying at least 4-inches of clean imported fill structural subgrade underly Garage 2. The buildings were constructed without any penetrations extending through the Building Cap into underlying impacted soil, except for Garage 2. Garage 2's foundation includes micropile penetrations through the slab.
- **Pavement Cap.** At least 4-inches of clean imported gravel base course underlies at least 3-inches of roadway and parking lot asphalt or concrete pavement. A non-permeable woven geotextile exists beneath roadway base course to separate the base course from impacted soil. The Pavement Cap in roadways and parking stalls above the impacted soil fill area (north of Garage 2 and south of the Clubhouse) consists of at least 4-inches of asphalt concrete over 12-inches compacted thickness of clean imported gravel base course. A single layer of an upgraded woven geotextile was placed between the base course and impacted soil subgrade in this area.
- **Minimum 3-Foot Soil Cap.** In landscaped areas where deeper-rooted vegetation is planted, at least 3-feet of clean imported soil was placed over impacted soil. A high-visibility, orange, permeable geotextile marker separates the clean imported Soil Cap from impacted soil.
- **Minimum 12-Inch Soil Cap.** In all areas of Parcel 2 that are not capped by Building, Pavement, or Minimum 3-Foot Soil Cap, at least 12-inches of clean imported soil was placed over impacted soil. A high-visibility, orange, permeable geotextile marker separates the clean imported Soil Cap from impacted soil.

Additional details regarding Final Cap design and construction are provided in the Phase II Construction Closeout Report (Aspect, 2024a).

2.2 Primary Utility Corridors

Primary utility corridors (storm, sanitary, and water utilities) shown on Figure 4 were excavated and backfilled with clean imported fill. Impacted soil removed from the primary utility corridors was used to bring the roadway and parking stalls between Garage 2 and the Clubhouse up to pavement subgrade, in accordance with Final Cap

requirements described in Section 2.1. Excess impacted soil was managed as F034 Hazardous Waste and disposed offsite.

Primary utility corridors including storm, sanitary, and water, were excavated to varying depths ranging from 4 to 7 feet below final grade. Primary utility corridors were excavated at least 3-feet wide to allow future utility repairs to be completed within clean backfill. Secondary utility lines such as electrical and irrigation lines were installed within the upper, clean imported sand and gravel beneath the Final Cap.

2.3 Soil Vapor Intrusion Management

Vapor intrusion mitigation consists of a chemical vapor barrier membrane installed beneath the concrete slabs of the Garage 2 and the Clubhouse buildings as well as a radon mitigation system[2] (referred to as the passive venting system) installed beneath the Clubhouse, shown on Figure 5. The passive venting system was constructed such that it can be easily converted to an active sub-slab depressurization system (SSDS) if indoor air sampling indicates a potentially complete pathway for naphthalene to be impacting indoor air quality. Chemical vapor barrier specifications are included in Appendix A and B. Passive venting system specifications are included in Appendix C. Vapor intrusion will be routinely assessed in accordance with the Vapor Intrusion Assessment Workplan in Appendix D.

[2] As stated in the Phase II Design Report, the radon mitigation system is not required for the purpose of radon mitigation, since the Clubhouse does not meet the occupancy threshold of the 2019 Oregon Structural Specialty Code; however, it is a well-established technology for mitigating sub-slab soil vapor intrusion into structures, and is just as effective for volatile organic contaminants such as naphthalene as it is for radon.

3 Inspection and Maintenance

Inspection and maintenance will be completed on Parcel 2 to ensure the Phase II RA remains protective. The restrictive covenant prohibits operation or use of Parcel 2 that may jeopardize the Final Cap. Any proposed Parcel 2 activities that will disturb and/or penetrate below the Final Cap require DEQ's review and approval before implementation.

3.1 Cap Inspection

The Parcel 2 owner is responsible for conducting annual inspections to ensure that the Final Cap features remain intact and impacted soil remains isolated beneath the Final Cap. Annual Final Cap inspections shall be documented (Form 1), include a photographic log, and include:

- Visual inspection of hardscaped surfaces (buildings and pavement) condition, identifying any cracks or unsealed penetrations through the building slabs or pavement.
- Visual inspection of vegetation condition in landscape areas, identifying any vegetation loss.
- Photographic documentation of Final Cap integrity.
- An evaluation of drainage in both hardscaped and landscaped areas to ensure stormwater and irrigation water is properly managed and not creating a condition that could impact the Final Cap or adjacent UPRR and Parcel 1 properties.
- Visual inspection of flush-mounted monuments of groundwater monitoring wells (MW-3, IMW-3, DMW-3, DMW-10, IMW-10, DMW-14, and VDMW-14; Figure 2) to ensure they are accessible and in good condition.
- Documentation of any actions that may have compromised the Final Cap. Any mitigation measures to repair the Final Cap will be documented on a separate form described in Section 3.2.
- Inspection of the UPRR Property as described in the UPRR OMP (Aspect, 2024b).

The results of each inspection must be documented in an Annual Phase II RA Inspection Report that is submitted to DEQ within 60 days after completion of the inspection, or at a different time if submitted together with other reports, as described in Section 6.

3.2 Cap Maintenance

Routine Final Cap maintenance consists of annual sweeping and sealcoating the Pavement Cap every five years. Additional maintenance will be performed, such as filling surficial cracks with tar, on an as-needed basis during annual inspections or when a deficiency is determined to exist. Maintenance shall restore the Final Cap to meet the minimum requirements (thicknesses and material types) described in Section 2, or alternate requirements approved by DEQ.

The Parcel 2 owner shall notify DEQ within 48 hours of discovery of a protectiveness deficiency in the Final Cap. Maintenance should be performed within 30 days of discovery or as soon as practicable to preclude further system deterioration. All maintenance must be documented (Form 2) and include:

- A detailed description of the Final Cap breach or damage and maintenance performed.
- The location of the Final Cap maintenance as indicated on a figure or site plan markup, such as Figure 3.
- Photographic documentation both before and after Final Cap maintenance is performed.

The Final Cap Maintenance Records, marked-up site plans, and photographs must be submitted to DEQ within 30 days of the maintenance. The Final Cap Maintenance Record will be incorporated into the Annual Phase II RA Inspection Report (Section 6).

Any proposed work that may penetrate below the Final Cap must be reviewed and approved by DEQ before implementation. Requirements for performing invasive work in Parcel 2 soils in described in Section 4.

3.3 Utility Corridor Maintenance

Maintenance within primary utility corridors (Figure 4) should be conducted within the 3-foot wide, clean backfilled corridor unless approved by DEQ. DEQ does not require notification of work within the existing utility corridors. If new utilities are proposed outside of the utility corridors, DEQ must be notified and maintenance records must be submitted to DEQ within 30 days of the work. Requirements for performing work outside the utility corridors is described in Section 4.

4 Requirements for Soil Disturbance

Disturbance of impacted soil that is currently located beneath the Final Cap on Parcel 2 may occasionally be necessary. This section provides a summary of requirements for performing soil disturbing activities on Parcel 2 for workers and supervisors that have the potential to encounter or generate impacted soil.

4.1 Procedures

Examples of soil disturbing work include drilling; digging; penetrating the Final Cap or chemical vapor barrier membrane with a sampling device, post, or stake; grading; excavation; and installation or repair of underground utilities outside of the utility corridors; removal of the Final Cap.

The following requirements are applicable to all invasive work within the Final Cap:

- **DEQ Notification:** Provide notice to DEQ's project manager prior to performing the work.
- **Property Owner Supervision:** Ensure the work is supervised by a Property owner representative.
- **Worker Notification:** Notify any personnel with the potential for encountering impacted soil of subsurface conditions and the potential presence of contaminants.

The following requirements are applicable to all invasive work outside of the Final Cap or the utility corridors:

- **DEQ Notification:** Provide notice to and receive approval from DEQ's project manager prior to performing the work.
- **Property Owner Supervision:** Ensure the work is supervised by the Property owner representative.
- **Worker Health and Safety:** Use personnel with Hazardous Waste Operations and Emergency Response (HAZWOPER) training in accordance with the Occupational Safety and Health Administration Part 1910.120 of Title 29 of the Code of Federal Regulations and be in possession of a current HAZWOPER certification card.

  All workers with the potential to encounter impacted soil should be working under a site-specific health and safety plan (HASP) that has been developed, reviewed, and acknowledged by their employer.
- **Worker Notification:** Notify any personnel with the potential for encountering impacted soil of subsurface conditions and the potential presence of contaminants.

4.2 Excavation of Potentially Contaminated Materials

For invasive work in which potentially contaminated materials will be exposed/excavated, DEQ will likely require a project-specific work plan (separate from the contractor's HASP) describing the procedures and protocols to be followed in performing the work. Specific items that may need to be addressed in the work plan include the following:

- **Erosion, Sedimentation, and Dust Control.** When potentially contaminated materials are exposed/excavated, temporary erosion and sedimentation control (TESC) practices compliant with applicable state and local laws, regulations, ordinances, and permits must be followed. In addition, construction best management practices (BMPs) must be implemented to minimize generation of dust in accordance with applicable state and local laws, regulations, ordinances, and permits.
- **Materials Handling On-Site.** Potentially contaminated materials that are excavated and temporarily managed on-site must be stockpiled or placed into appropriate covered containers (e.g., drums). Access to stockpiles/containers must be restricted. Stockpiles must be constructed and maintained to prevent erosion, contact with stormwater runoff, dust generation, and worker contact. Each stockpile must be underlain and covered by a polyethylene geomembrane liner with a minimum thickness of 10 mils, or an equivalent means providing equal or improved containment, when not in use.
- **Testing and Final Disposition of Excavated Materials.** Samples will be collected from stockpiles/containers of potentially contaminated materials for chemical testing. For off-site disposal, the disposal facility will have specific waste profiling requirements that must be satisfied before transport and disposal is allowed. In the event that off-Site disposal of Parcel 2 soil is required, the soil will be managed as an F034 Hazardous Waste and subject to Resource Conservation and Recovery Act (RCRA) land disposal restrictions (LDRs). The Property owner will be the generator for all waste materials generated on their Property. Depending on project-specific circumstances and subject to DEQ approval, backfilling/reuse of excavated materials may also be pursued, in which case chemical testing to support on-site backfilling/reuse will be proposed in the work plan.

Additional construction safety requirements are provided in the Contaminated Media Management Plan (Aspect, 2021).

5 Indoor Air Monitoring and Vapor Intrusion Mitigation

Vapor intrusion assessments will be completed to confirm the protectiveness of the chemical vapor barrier membrane and passive venting system from vapor intrusion in the Clubhouse indoor air.

5.1 Indoor Air and Passive Venting System Effluent Monitoring

Vapor intrusion (VI) will be assessed seasonally for the first year following Phase II RA completion and annually for five years thereafter. The frequency of VI assessments may change at any time based on results of VI assessment sampling and following any future modifications to the Clubhouse slab and chemical vapor barrier membrane. The VI assessment will be completed in general accordance with DEQ's Guidance for Assessing and Remediating Vapor Intrusion in Buildings (DEQ, 2010). Results of each sampling event will be submitted to DEQ as described in Section 6. Indoor air and passive venting system effluent stack sampling procedures, laboratory analytical methods, reporting requirements, laboratory standard operation procedures and the laboratory quality assurance manual are included in Appendix D. Quality Assurance/Quality Control is described in the Phase II Sampling and Analysis Plan (Aspect, 2020c).

Monitoring results will be screened against DEQ's current urban residential and occupational risk-based concentrations (RBCs) for inhalation of naphthalene in air, shown in Table 1 of Appendix D. If naphthalene is detected at concentrations exceeding its RBC, corrective actions as described in Section 5.4 may be necessary.

5.2 Vapor Intrusion Mitigation System Inspection

The Parcel 2 owner is responsible for conducting annual VI mitigation system inspections in the Clubhouse and Garage 2. Annual VI mitigation system inspections shall be conducted on an inspection form (Form 1) and include a photographic log, and include:

- Visual inspection of concrete slab for new openings, cracks or unsealed penetrations impacting the Clubhouse and Garage vapor barrier.
- Visual inspection of the passive venting system effluent stack in the Clubhouse attic and termination above the roof for cracks or unsealed penetrations impacting the passive venting system integrity.
- Documentation of any actions that may have compromised the VI mitigation systems. Any mitigation measures to repair the chemical vapor barrier membranes or passive venting system will be documented on a separate form described in Section 5.3.

The results of each inspection must be documented in an Annual Phase II RA Inspection Report that is submitted to DEQ within 60 days after completion of the inspection, or at a different time if submitted together with other reports, as described in Section 6.

5.3 Vapor Intrusion Mitigation System Maintenance

The chemical vapor barrier membrane and passive venting system have no mechanical or electrical parts and require no regular maintenance; however, maintenance may be required if the integrity of the chemical vapor barrier membrane or the passive venting system is compromised. In the event the chemical vapor barrier membranes are disturbed, repairs must be conducted in accordance with the PrePrufe manufacturer specifications. An example of concrete slab penetration and chemical vapor barrier membrane repair is included in Appendix E.

The Parcel 2 owner shall notify DEQ within 48 hours of discovery of a deficiency in the VI mitigation systems. Maintenance should be performed within 30 days of discovery or as soon as practicable to preclude further system deterioration. Maintenance must be documented (Form 2) and include:

- A detailed description of the damage.
- A detailed description of the maintenance performed.
- The location of the maintenance as indicated on a figure or site plan markup, such as Figure 3.
- Photographic documentation both before and after VI mitigation system maintenance is performed.

The VI mitigation system Maintenance Records, marked-up site plans, and photographs must be submitted to DEQ within 30 days of the maintenance. The VI mitigation system Maintenance Record will be incorporated into the Annual Phase II RA Inspection Report (Section 6).

Any proposed work that may compromise the chemical vapor barrier membranes or passive venting system must be reviewed and approved by DEQ before implementation.

5.4 Vapor Barrier Corrective Actions

If naphthalene is detected in Clubhouse indoor air at a concentration exceeding the RBCs, then an evaluation must be conducted to identify the corrective actions, if any, that should be conducted to address the exceedance. Corrective actions may include modifications to the VI mitigation system such as converting the passive venting system to an active sub-slab depressurization system.

6 Reporting

6.1 Protectiveness Review

The Property owner will perform a Protectiveness Review every 5 five years following the completion of the Phase II RA. The review will be submitted in a report prior to January 31 of each year it is performed. Protectiveness Review requirements include:

- Review of the land use and land zoning on Parcel 2, the UPRR Property, and the Milwaukie Marketplace property.
- Review of the potential for, or presence of, groundwater development on the Milwaukie Marketplace property, the UPRR Property, and City of Milwaukie properties.
- Review of Oregon Water Resources records for changes in water rights and groundwater use within 200 meters of Parcel 2.
- Review of updated toxicology information and regulatory changes that may affect the protectiveness of the site remedy.
- Review of the effectiveness of the institutional controls to prevent or limit exposure to contaminated site media (e.g., operations and maintenance plan).

The results of each Protectiveness Review will be presented to DEQ in a Protectiveness Review Report. DEQ may request a Protectiveness Review at any time a significant change in groundwater monitoring data is observed. The next protectiveness review will cover 2023 to 2028 and will be due in 2029.

6.2 Annual Phase II Remedial Action Inspection and Maintenance Report

Annual inspections on Parcel 2, in conjunction with UPRR Property inspections, will be performed during similar seasonal conditions for a period of 5 years. The Annual Phase II RA Inspection and Maintenance Report will include a summary of site condition observations, field forms, and photographic logs. Any Final Cap, VI mitigation system, utility, and UPRR Property maintenance must be documented on maintenance forms and submitted to DEQ within 30 days of the maintenance. A summary of the Maintenance Records will be incorporated into the Annual Phase II RA Inspection and Maintenance Report.

Inspection and Maintenance reports will be submitted to DEQ within 60 days of completion of the Annual Inspection for review and comment. After 5 years of inspections, DEQ will review site conditions to determine if less frequent inspections are warranted.

6.3 Vapor Intrusion Assessment Report

VI Assessment Reports will be submitted to DEQ for review within 60 days of Clubhouse indoor air and passive venting system effluent stack monitoring events. The report will summarize sampling procedures, a comparison of analytical results to naphthalene RBCs for inhalation of naphthalene in indoor air, and any corrective actions implemented in response to detections above RBCs.

7 References

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Bridgewater Group, Inc. (Bridgewater), 2002a, Phase I Soil RA Closeout Report, Former L.D. McFarland Creosote Wood Treating Facility, Milwaukie, Oregon, April 26, 2002.

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Oregon Department of Environmental Quality (DEQ), 2001, Record of Decision, Selected RA for the Former L.D. McFarland Creosote Wood Treating Facility, Milwaukie, Oregon, March 2001.

Oregon Department of Environmental Quality (DEQ), 2002, Phase I Certification of Completion L.D. McFarland Milwaukie Project ECSI No. 887 and No. 3331 Letter between Matt McClincy of DEQ and Les Lonning of L.D. McFarland Company, July 11, 2002.

Oregon Department of Environmental Quality (DEQ), 2010, Guidance for Assessing and Remediating Vapor Intrusion in Buildings, March 2010.

Tyee Management Company, LLC (Tyee), 2021, Closing Notice to DEQ Re: State of Oregon v. L.D. McFarland Company, Ltd., Stipulation and Consent Decree (CCV0108179) (the "Consent Decree"); Closing of Conveyance to Monroe Apartments Owner LLC/Copy of Recorded Deed/Effectiveness of Assignment/Assumption and Release, October 20, 2021

8 Limitations

Work for this project was performed for Guardian Real Estate Services, LLC (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix F titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report.

FORMS 1 & 2

Property Address:_____ Date:_____

Tax Parcel ID:_____ Inspector's Name:_____

Project Name: _____ Inspector's Signature:_____

Project No.:_____ Inspector's Title/Affiliation:_____

Weather Conditions:_____

Barometric Pressure and Conditions:_____

Wind Speed and Direction:_____

Routine Inspection ☐ Non-Routine Inspection ☐

Provide the reason if conducting a non-routine inspection:

FORM 1 - INSPECTION RECORD	**Cap Inspection and Maintenance Plan, Parcel 2 and UPRR, Former L.D. McFarland Site, Milwaukie, Oregon**		
INSPECTION ITEM[1]	**None**	**Repair Needed**	**COMMENTS/NOTES**
1. Parcel 2 Soil/Landscaping Cap Areas			
a. Potholes, erosion, or settlement?			
b. Stormwater and irrigation water drainage condition?			
c. Exposed or visible geotextile fabric/notification layer?			
d. Evidence of soil or landscaping removal/disturbance/damage/unusual disturbance?			
e. Any modifications since last inspection?			
2. Parcel 2 Hard Cap Areas (e.g., Pavement, Building Slabs)			
a. Absence of pavement, open cracks and/or ruts? Evidence of pavement disturbance/deterioration/damage?			
b. Surface settlement, spills, standing water, or ponding?			
c. Stormwater and irrigation water drainage condition?			
d. Exposed subsurface adjacent to building foundation?			
e. Building or pavement modifications since last inspection?			
f. Have there been any tenant changes since the last inspection?			
3. Parcel 2 Vapor Mitigation Components (Clubhouse and Garage 2 Buildings)			
a. Any modifications to vapor barriers or radon mitigation system (Clubhouse only) since last inspection?			
b. Are there any new floor openings around pipes, wires, or other objects that penetrate the concrete slab? They shall be filled with a polyurethane caulk or equivalent sealant applied in accordance with manufacturer's recommendations.			
c. All joints in the concrete slab or between the slab and foundation walls are cleared of loose material and sealed with a caulk or sealant?			
d. (Clubhouse only) SUB-SLAB SOIL EXHAUST SYSTEM DUCTS (SSESDs) run continuous from below the soil gas retarder to the termination point, consist of a 3- or 4-inch-diameter solid pipe? Are all annular openings between the SSESD and floor slab or soil gas retarder sealed airtight? Are all SSESD joints sealed airtight?			
e. (Clubhouse only) SSESDs extend through the roof and terminate not less than 6 inches above the roof and not less than 10 feet from any operable openings or air intake?			
f. (Clubhouse only) All exposed and visible interior SSESDs are permanently identified with at least one label on each floor and in accessible attics? The label shall state: "RADON REDUCTION SYSTEM."			
g. (Clubhouse only) Visible pipes free of cracks			
h. (Clubhouse only) Any significant changes to the Clubhouse building's HVAC System?			
i. Any new vents or openings in the floors?			
j. Any odors?			
4. UPRR Soil/Landscaping Cap Areas			
a. Vegetation condition? Evidence of vegetation loss?			
b. Surface conditions for settlement or disturbance of railroad ballast?			
c. Stormwater and irrigation water drainage condition?			
d. Evidence of soil or landscaping removal/disturbance/damage/unusual disturbance?			
e. Any modifications since last inspection?			
5. Other			
a. Are all monitoring wells (MW-3, IMW-3, DMW-3, DMW-10, IMW-10, DMW-14, and VDMW-14) accessible?			
b. Evidence of well monument damage/tampering?			
Deficient <u>Action Items</u> & Other Comments:			

Notes

1) Inspect entire capped area and identify areas that represent potential for direct-contact exposure to or erosion of capped material. Attach a marked-up property sketch or aerial photograph, indicating areas inspected, locations of problem areas (examples above), and inaccessible areas. Include photos of problem areas, if observed.

Property Address:_____

Tax Parcel ID:_____

Project Name: _____

Project No.:_____

FORM 2 - CAP and VAPOR MITIGATION SYSTEM MAINTENANCE RECORD

Cap Operation and Maintenance Plan, Parcel 2
Former L.D. McFarland Site, Milwaukie, Oregon

SECTION 1

Problem Description:

Date Deficiency Observed:_____

Deficiency Reported By:_____

SECTION 2

Maintenance Performed:

Firm Performing Maintenance:_____

Maintenance Start Date:_____

Maintenance Completion Date:_____

Approved By Property Owner

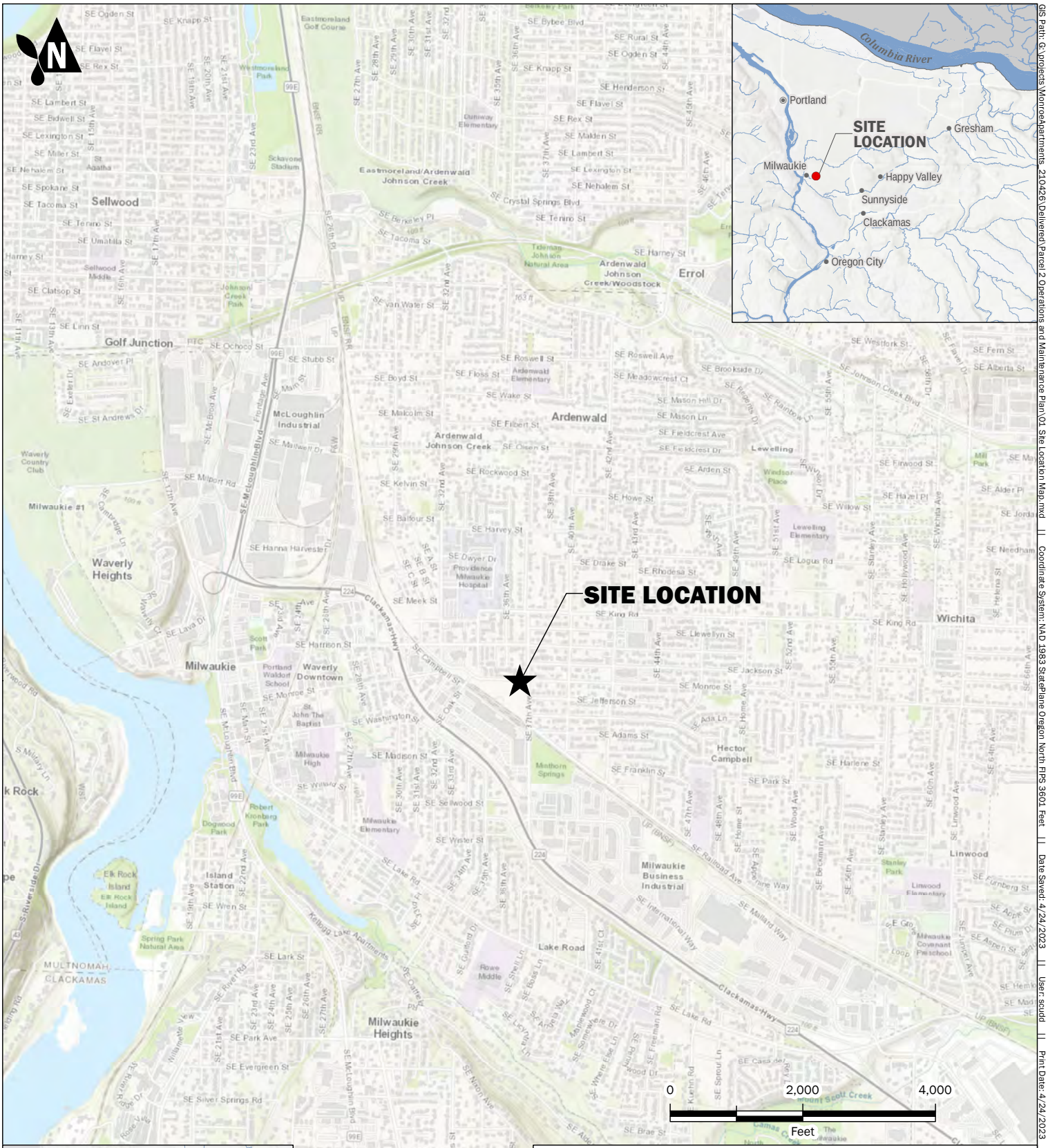
Printed Name:_____

Signature:_____

Title/Affiliation:_____

Date:_____

FIGURES

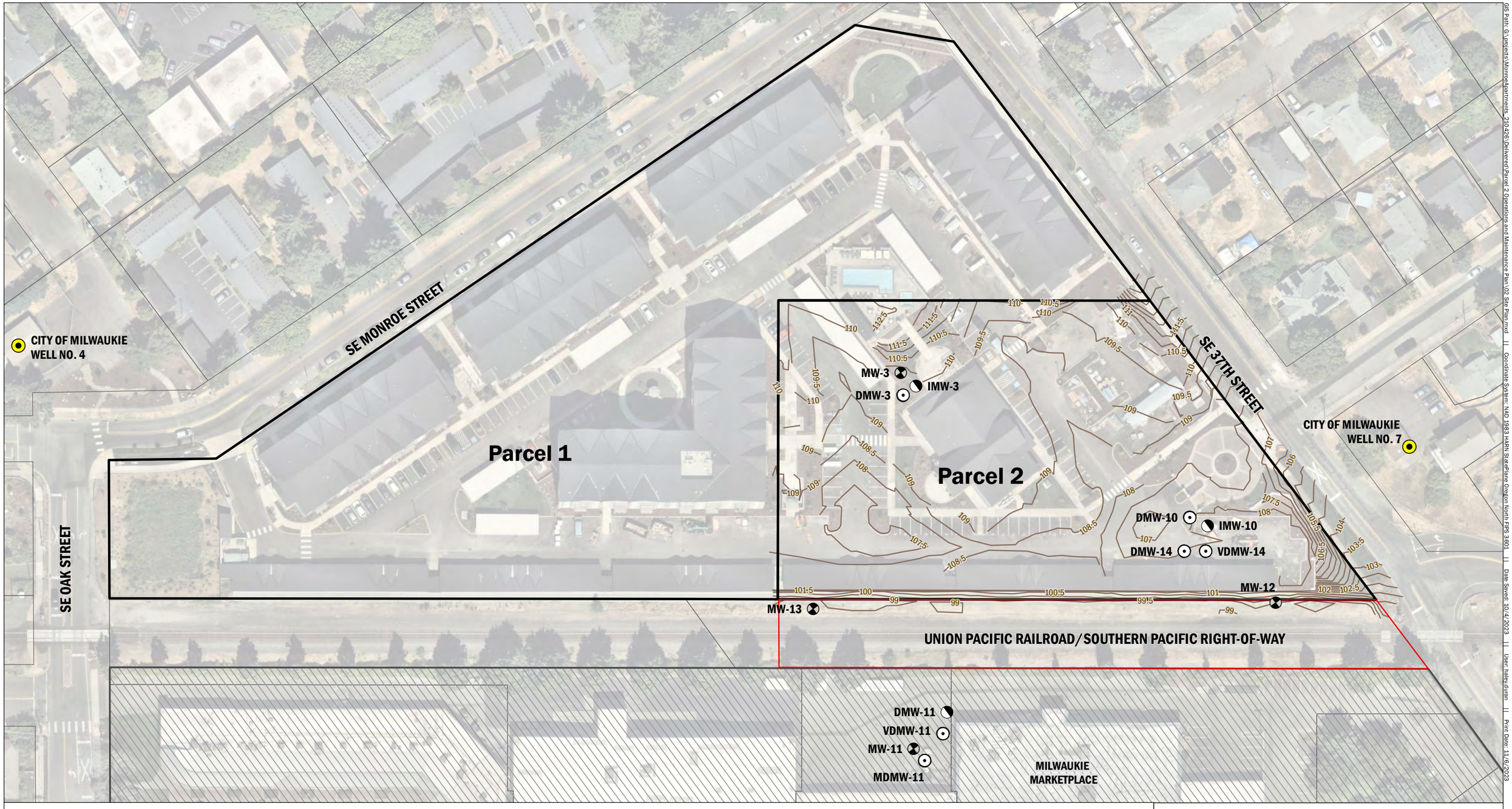


Site Location Map

Parcel 2 Operations and Maintenance Plan
Former L.D. McFarland Creosote Wood Treating Facility
Milwaukie, Oregon

Aspect CONSULTING	APR-2023	BY: MLK / RAP	FIGURE NO. 1
	PROJECT NO. 210426	REVISED BY: JST / SCC	

GIS Path: G:\projects\MonroeApartments_210426\Delivered\Parcel 2 Operations and Maintenance Plan\01 Site Location Map.mxd || Coordinate System: NAD 1983 StatePlane Oregon North FIPS 3601 Feet || Date Saved: 4/24/2023 || User: scudd || Print Date: 4/24/2023



- Monitoring Well - Shallow
- Monitoring Well - Intermediate
- Monitoring Well - Deep
- City Water Supply Well
- Post-Construction Topography Contours
- UPRR Property
- Parcel 1 and 2 Boundaries
- Milwaukie Marketplace
- Clackamas County Tax Parcel

Notes:
1. Monitoring Well locations are based on a survey conducted by TerraCalc Land Surveying, Inc. on February 6, 2023.

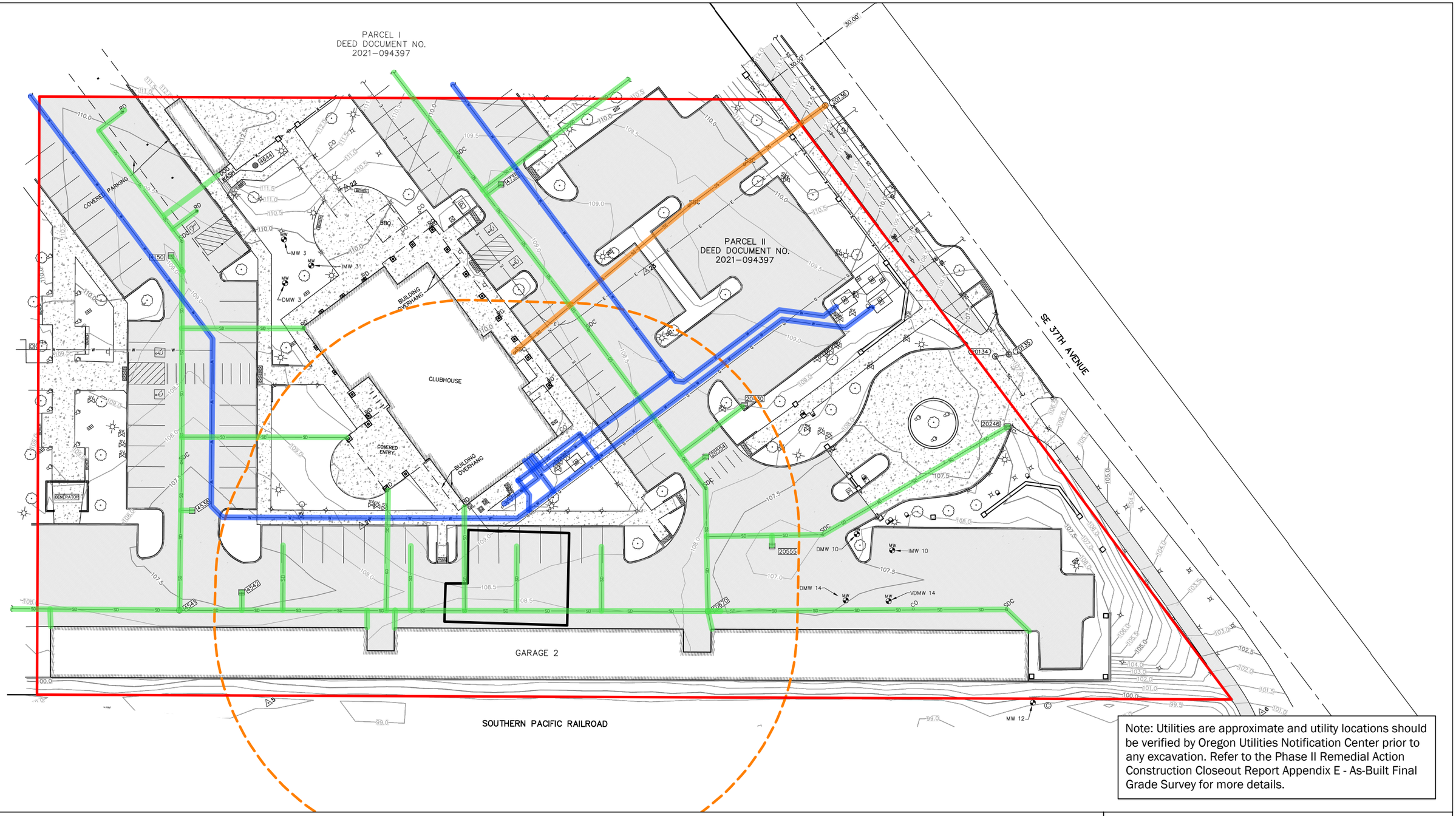
0 80 160
Feet

Site Plan

Parcel 2 Operations and Maintenance Plan
Former L.D. McFarland Creosote Wood Treating Facility
Milwaukie, Oregon

Aspect CONSULTING	OCT-2023	BY: DAH / SCC	FIGURE NO. 2
	PROJECT NO. 210426	REVISED BY: JST / SCC / HMD	

GIS Path: G:\projects\MonroeApartments_210426\Delivered\Parcel 2 Operations and Maintenance Plan\02_Site Plan.mxd || Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 || Date Saved: 10/4/2023 || User: haleyduran || Print Date: 11/6/2023



Note: Utilities are approximate and utility locations should be verified by Oregon Utilities Notification Center prior to any excavation. Refer to the Phase II Remedial Action Construction Closeout Report Appendix E - As-Built Final Grade Survey for more details.

Parcel 2 Boundary

Interim Action Excavation 5

Area of Potential Naphthalene Vapor Intrusion Concern

Primary Storm Utility Corridor

Primary Sanitary Utility Corridor

Primary Water Utility Corridor

0 40 80 Feet

Base CAD files provided by Terra Calc Land Surveying, dated 9/05/2023 and Arris Studio Architects, San Luis Obispo, California.

Utility corridors from DOWL, Utility Plan-South Side, Utility Plan-East Side, and Storm Plan-South Side.

Primary Utility Corridors

Parcel 2 Operations and Maintenance Plan
Former L.D. McFarland Creosote Wood Treating Facility
Milwaukie, Oregon

Aspect Consulting	Oct-2023	BY: JST/CMV	FIGURE NO. 4
	PROJECT NO. 210426	REVISED BY: -	

CAD Path: Q:\Monroe Street Apartments\210426 Parcel 2\2023-09 Construction CloseOut\210426-04.dwg Layout: O&M Fig 04 Primary Utility Corridors || Date Saved: 9/19/2023 1:57:49 PM || User: cvansyke

PARCEL I
DEED DOCUMENT NO.
2021-094397

PARCEL II
DEED DOCUMENT NO.
2021-094397

Pool House

Clubhouse

Garage 2

BUILDING OVERHANG

COVERED PARKING

COVERED ENTRY

GENERATOR

SE 37TH AVENUE

SOUTHERN PACIFIC RAILROAD

MW 12

Parcel 2 Capping Plan Legend

- Building Cap
- Asphalt Cap
- Concrete Cap
- Minimum 3-Foot Soil Cap
- Minimum 12-Inch Soil Cap
- Parcel 2 Boundary
- Interim Action Excavation 5
- Area of Potential Naphthalene Vapor Intrusion Concern

0 40 80 Feet

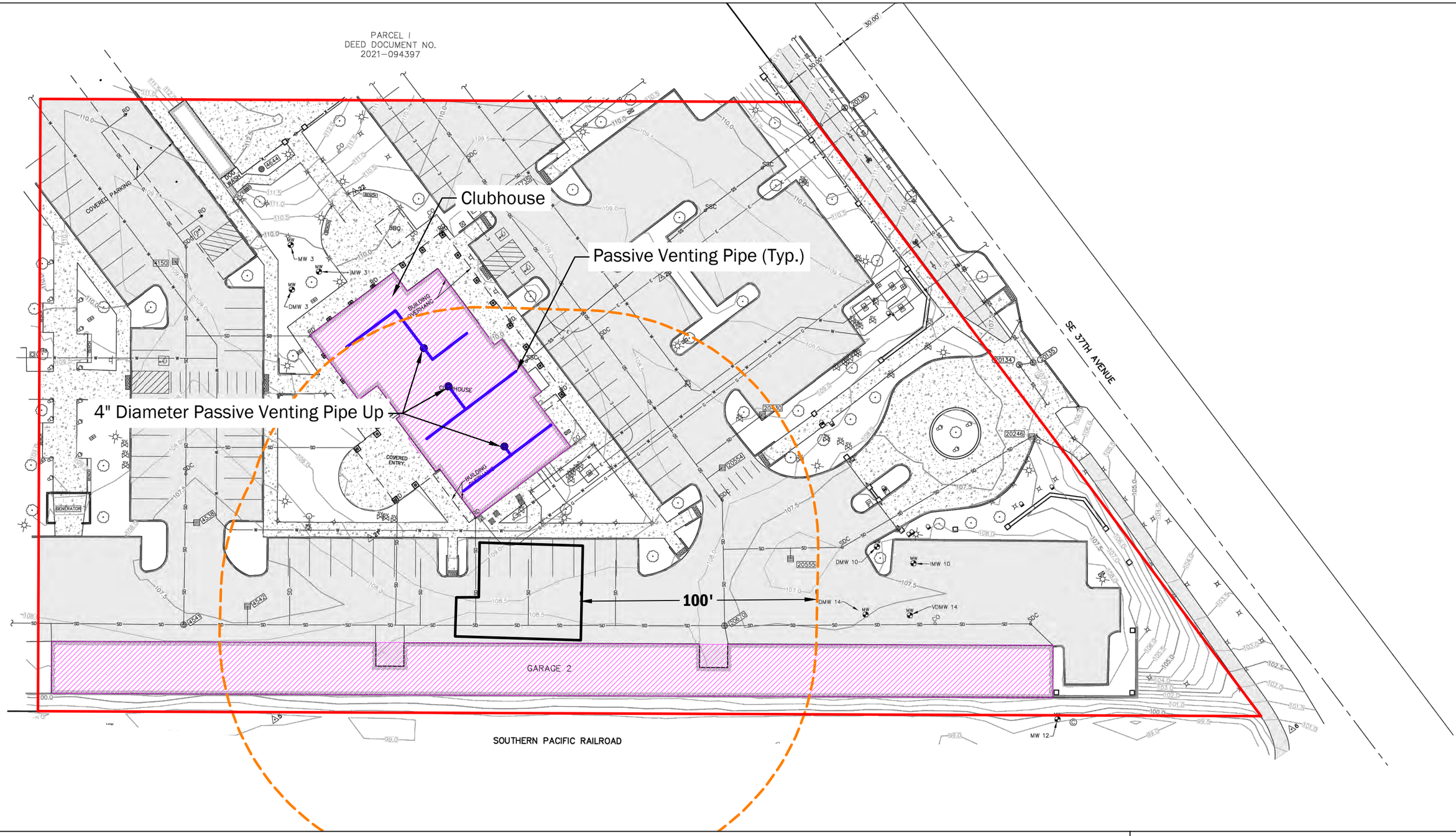
Base CAD files provided by Terra Calc Land Surveying, dated 9/05/2023 and Arris Studio Architects, San Luis Obispo, California.

Final Cap As-Built

Parcel 2 Operations and Maintenance Plan
Former L.D. McFarland Creosote Wood Treating Facility
Milwaukie, Oregon

Aspect Consulting	Oct-2023	BY: JST/CMV	FIGURE NO. 3
	PROJECT NO. 210426	REVISED BY: -	

CAD Path: Q:\Monroe Street Apartments\210426 Parcel 2\2023-09 Construction CloseOut\210426-04.dwg Layout: O&M Fig 3 Capping Plan || Date Saved: 9/19/2023 1:57:49 PM || User: cvanslyke



Parcel 2 Boundary

Interim Action Excavation 5

Area of Potential Naphthalene Vapor Intrusion Concern

PrePrufe Chemical Vapor Barrier Membrane

Passive Venting Pipe

0 40 80 Feet

Base CAD files provided by Terra Calc Land Surveying, dated 9/05/2023 and Arris Studio Architects, San Luis Obispo, California.

Radon Piping from *Clubhouse Underground Plan*, Arris Studio Architects and Robison Engineering, Inc., Lynnwood, Washington, 4/23/2021.

Vapor Mitigation System

Parcel 2 Operations and Maintenance Plan
Former L.D. McFarland Creosote Wood Treating Facility
Milwaukie, Oregon

Aspect Consulting	Oct-2023	BY: JST/CMV	FIGURE NO. 5
	PROJECT NO. 210426	REVISED BY: -	

CAD Path: Q:\Monroe Street Apartments\210426 Parcel 2\2023-09 Construction CloseOut\210426-04.dwg Layout: O&M Fig 05 Vapor Mitigation || Date Saved: 9/19/2023 1:57:49 PM || User: cvanslyke

APPENDIX A

GCP Vapor Barrier Specifications in Clubhouse

PREPRUFE® 275 / PREPRUFE® 275 LT Membrane

Blindside waterproofing membrane for both cast-in-place concrete or shotcrete foundation walls and cast-in-place concrete slabs

Product Description

The GCP PREPRUFE® 275 & PREPRUFE® 275 LT membrane is a composite sheet comprised of an HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Using patented Advanced Bond Technology™, PREPRUFE® 275 & PREPRUFE® 275 LT membrane provides a continuous seal to concrete or shotcrete resisting water ingress and migration between the membrane and the structure.

Product Advantages

- Forms a continuous adhesive bond to concrete poured against it
- Durable system designed specifically to withstand the force of shotcrete placement
- Its unique continuous and integral bond to the structure is specifically designed to reduce lateral water migration between the membrane and the concrete or shotcrete
- Designed with fully adhered adhesive to adhesive watertight ZipLap™ seams and easy to execute detailing
- Provides a barrier to water, moisture and soil gases physically isolating the structure from the surrounding substrate Release liner free, expedites installation and reduces construction site waste
- Can be applied to permanent formwork - allows maximum use of confined sites
- Installed membrane is unaffected by wet jobsite conditions – jobsite water will not cause premature activation Waterproofing is not reliant on confining pressures or hydration
- Installed membrane is unaffected by freeze/thaw or wet/dry cycles
- Chemical resistance - protects structure from salt or sulphate attack effective in most types of soils and waters

Product Applications

PREPRUFE® 275 & PREPRUFE® 275 LT membranes are designed for shotcrete walls as well as cast in place concrete with intermittent water and low or no hydrostatic condition. To provide long-term waterproofing performance in high-risk, hydrostatic and critical shotcrete conditions, PREPRUFE® SCS blindside waterproofing system is recommended. Complete product information and a Product Data Sheet for PREPRUFE® SCS blindside waterproofing system can be found at gcpat.com.

System Components:

Membrane

PREPRUFE® 275 & PREPRUFE® 275 LT waterproofing membrane is for horizontal use below concrete labs, or vertically against timber lagging or other soil retention systems. Intended for both cast-in-place and shotcrete applications.

Ancillary Components (refer to the most current Data Sheets for all system components available on gcpat.com)

- PREPRUFE® Tape – 4 in. wide tape for covering cut edges, roll ends, penetrations and detailing
- PREPRUFE® CJ Tape – 8 in. wide tape for detailing, and may be used at construction joints for optional additional protection
- BITUTHENE® Liquid Membrane — for sealing around penetrations, etc.
- ADCOR® — Waterstop for joints in concrete walls and floors
- DE NEEF® INJECTO® Tube — groutable waterstop for non-moving concrete construction joints and penetrations
- PREPRUFE® Tieback Covers — preformed cover for soil retention wall tieback heads

Limitations of Use

- Approved uses include only those specifically detailed in this Product Data Sheet and other current Product Data Sheets that can be found at gcpat.com
- PREPRUFE® 275/LT membranes are not intended for any other use. Contact GCP Technical Services where any other use is anticipated or intended.
- PREPRUFE® 275/LT membranes are designed for in-service temperatures below 120°F (49°C).
- For hydrostatic and critical waterproofing applications consider PREPRUFE® SCS blindside waterproofing system for shotcrete applications and PREPRUFE® Plus for cast-in-place concrete applications.
  See separate Product Data Sheet at gcpat.com.

Safety and Handling

Users must read and understand the product label and Safety Data Sheets (SDS's) for each system component before use. All users should acquaint themselves with this information prior to working with the material. Carefully read detailed precaution statements on the product labels and SDS's before use. The most current SDS's can be obtained from our web site at gcpat.com.

Storage

- Observe 1 year shelf life and use on a first in first out basis
- Store In dry conditions between 40°F (4.5°C) -90°F (32°C)
- Store off ground under tarps or otherwise protected from rain and ground moisture
- See TL-0030 — "Shelf Life/Storage and Handling of GCP Waterproofing and Air Barrier Products" Technical Letter

Installation

Technical Support, Details and Technical Letters

The most up to date detail drawings and technical letters are available at gcpat.com. For complete application instructions, please refer to the current GCP Contractor Handbook and Literature on (gcpat.com). Documents in hardcopy as well as information found on websites other than gcpat.com may be out of date or in error. Before using this product it is important that information be confirmed by accessing gcpat.com and reviewing the most recent product information, including without limitation Product Data Sheets and Contractor Manuals, Technical Bulletins, Detail Drawings, and detailing recommendations. Please review all materials prior to installation of PREPRUFE® 275 membrane.

Support is also available by full-time technically trained GCP field sales representatives and technical service personnel, backed by a central research and development technical services staff. For technical assistance with detailing and problem solving please contact your local representative. A GCP Representative locater is available at www.gcpat.com.

Temperature Requirements

- PREPRUFE® 275 LT membrane can be applied between temperature 25ºF to 95ºF. Please use PREPRUFE® 275 membrane for application above 95ºF.
- PREPRUFE® Tape LT and PREPRUFE® CJ Tape LT can be applied between temperature 25ºF to 95ºF. Please use PREPRUFE® Tape HC and PREPRUFE® CJ Tape HC for application above 95ºF.

Substrate Preparation

- All surfaces — It is essential to create a sound and solid substrate to eliminate movement during the concrete or shotcrete placement. Substrates must be regular and smooth, with no gaps or voids greater than 0.5 in. (12 mm). Grout around all penetrations such as utility conduits, etc. for stability.
- Horizontal — The substrate must be free of loose aggregate and sharp protrusions. When installing over earth or crushed stone, ensure substrate is well compacted to avoid displacement of substrate due to traffic or concrete pour. The surface does not need to be dry, but standing water must be removed.
- Vertical — Use concrete, plywood, insulation, or other approved facing to sheet piling to provide support to the membrane. Board systems such as timber lagging must be close butted to provide support and not more than 0.5 in. (12mm) out of alignment.

Membrane Application

PREPRUFE® 275/LT membranes can be applied in horizontal applications to smooth prepared concrete, or well rolled and compacted earth or crushed stone substrate. Kick out or roll out the membrane, with the HDPE film side to the substrate with the green ZipStrip™ facing towards the concrete pour. End laps should be staggered to avoid a buildup of layers. Leave the green and blue ZipStrip™ on the membrane until the overlap procedure is completed. When completed, remove the release liner. Contact your local GCP representative for further details when installing over carton forms.

Accurately position succeeding sheets to overlap the previous sheet 3 in. (75 mm) along the marked selvedge with the blue ZipStrip™ on top of the green ZipStrip™. Ensure the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap. Peel back and remove both the green and blue ZipStrip™ in the overlap area to achieve an adhesive-to-adhesive bond at the overlap. Ensure a continuous bond is achieved without creases, and roll firmly with a heavy roller.

PREPRUFE® 275/LT membrane can be returned up the inside face of slab formwork. To attain a fully bonded system and to allow a tie in with BITUTHENE® self-adhered membrane or PROCOR® fluid-applied membrane to all vertical structural surfaces after removal of formwork. (See PREPRUFE® Technical Letter #TL-0013 "Forming Systems for Use with PREPRUFE® Membranes."). Terminate the membrane slightly below the top of concrete/shotcrete wall level in the formwork, no membrane hang-over is allowed (beyond final concrete pour level)

Roll ends and cut edges – Overlap all roll ends and cut edges by a minimum 3 in. (75 mm) and ensure the area is clean and free from contamination, wiping with a damp cloth if necessary. Allow surface to dry and apply PREPRUFE® Tape LT (or HC in hot climates) centered over the lap edges and roll firmly. Immediately remove tinted plastic release liner from the tape.

Membrane Repair

Inspect the membrane before installation of reinforcement steel, formwork, and final placement of shotcrete. The membrane can be easily cleaned by low pressure power washing if required. Repair damage by wiping the area with a damp cloth to ensure the area is clean and free from dust and other contaminants, and allow the membrane to dry. Repair small punctures and slices (0.5 in. (12 mm) or less by applying PREPRUFE® Tape centered over the damaged area. Repair punctures and holes larger than 0.5 in. (12mm) by applying a patch of PREPRUFE® membrane. Extend the patch 6 in. (150 mm) beyond the damaged area. Seal all edges of the patch with PREPRUFE® Tape. Where exposed selvedge has lost adhesion or laps have not been sealed, ensure the area is clean and dry and cover with fresh PREPRUFE® Tape. Any areas of damaged adhesive should be covered with PREPRUFE® Tape. All PREPRUFE® Tape must be rolled firmly and the tinted release liner removed.

Slices or relief cuts can be butted or overlapped and repaired by applying PREPRUFE® Tape centered over the edge of the overlap or center of the butt joint. Where it is not possible to create a butt joint or overlap, repair with fresh membrane and PREPRUFE® Tape as detailed above.

Reinforcing Steel Anchors

Only compatible rebar supports such as concrete dobies shall be placed against the PREPRUFE® 275/LT membranes. The steel should be tied to the shoring system using GCP approved anchors only.

Contact your local GCP representative for additional information.

Shotcrete Placement

Ensure the plastic release liner is removed from all PREPRUFE®Tapes.

Under most climatic conditions concrete should be poured within 56 days of membrane installation. Where ambient temperatures will exceed 100ºF (38°C) for more than a total of 7 days, concrete should be placed within 42 days of installation of the membrane. Concrete must be placed and compacted carefully to avoid damage to the membrane. Never use a sharp object to consolidate the concrete.

Important: Prior to concrete or shotcrete placement, ensure that the zip strip liner and any plastic release liner is completely removed from all areas of PREPRUFE® 275/LT membranes and PREPRUFE® Tapes.

It is highly recommended that the PREPRUFE® 275/LT membranes system be included in preconstruction test panels successfully meeting the project specifications. The test panel needs a mean core grade less than or equal to 2.5 as described and defined in ACI 506.2 shall be allowed to place shotcrete against the PREPRUFE® 275/LT membranes. Individual shotcrete cores greater than 3 are unacceptable.

Supply

DIMENSIONS (NOMINAL)	PREPRUFE® 275 MEMBRANE
Thickness	0.038 in. (0.95 mm)
Roll size	3 ft 10 in. x 120 ft (1.17 m x 36.6 m)[1]
Roll weight	102 lbs (46 kg)
Minimum side/end laps	3 in. (75 mm)

Note#1 Individual roll length may vary +/-1%

Physical Properties (PREPRUFE® 275/LT MEMBRANE)

PROPERTY	TYPICAL VALUE	TEST METHOD
Color	white	
Thickness	0.038 in. (0.95 mm)	ASTM D3767
Lateral Water Migration Resistance	Pass at 231 ft (71 m) of hydrostatic head pressure	ASTM D5385[1]
Low Temperature Flexibility	Unaffected at -20°F (-29°C)	ASTM D1970
Resistance to hydrostatic head	231 ft (71 m)	ASTM D5385[2]
Elongation	300%	ASTM D412[3]
Tensile strength, film	4000 psi (27.6 Mpa)	ASTM D412
Crack cycling at -9.4°F (-23°C), 100 cycles	Unaffected, Pass	ASTM C8364
Puncture resistance	135 lbs (600 N)	ASTM E154
Peel adhesion to concrete	4 lbs/in. (700 N/m)	ASTM D903[5]
Lap peel adhesion at 72°F (22°C)	7 lbs/in. (1225 N/m)	ASTM D1876[6]
Lap peel adhesion at 40°F (4°C)	7 lbs/in. (1225 N/m)	ASTM D1876[6]
Permeance to water vapor transmission	0.01 perms (0.6 ng/(Pa x s x m^2))	ASTM E96, method B

Footnotes:

1. Lateral water migration resistance is tested by casting concrete against membrane with a hole and subjecting the membrane to hydrostatic head pressure with water. The test measures the resistance of lateral water migration between the concrete and the membrane.
2. Hydrostatic head tests of PREPRUFE® membranes are performed by casting concrete against the membrane with a lap. Before the concrete cures, a 0.125 in. (3 mm) spacer is inserted perpendicular to membrane to create a gap. The cured block is placed in a chamber where water is introduced to the membrane surface up to the head indicated.
3. Elongation of membrane is run at a rate of 2 in. (50 mm) per minute at 72°F (22°C).
4. Concrete is cast against the PREPRUFE® membrane and allowed to cure (7-days minimum).
5. Concrete is cast against the PREPRUFE® membrane and allowed to cure (7-days minimum). Peel adhesion of membrane to concrete is measured at a rate of 2 in. (50 mm) per minute at 72°F (22°C).
6. The test is conducted 15 minutes after the lap is formed at evaluation temperature with rate of 2 in. (50 mm) per minute.

GCP Applied Technologies Inc., 2325 Lakeview Pkwy, Suite 450, Alpharetta, GA 30009 USA.

In Canada, GCP Canada, Inc., 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6.

GCP0083 PF-236-1221

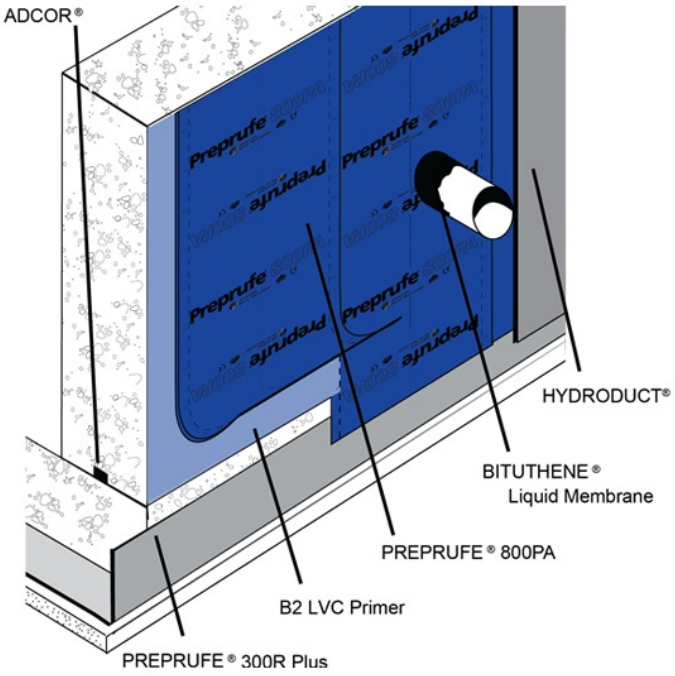
Last Updated: 2021-12-07
gcpat.com/solutions/products/preprufe-comprehensive-waterproofing-system/preprufe-275-preprufe-275-lt

PREPRUFE® 800PA Post-Applied Membrane

A self-adhered waterproofing membrane with an aggressive, synthetic non-asphaltic adhesive, for basement walls in open excavation.

Product Description

PREPRUFE® 800PA post-applied waterproofing membrane works seamlessly with PREPRUFE® pre-applied membranes to create a complete, fully integrated system for below-grade waterproofing. The self-adhesive waterproofing membrane is composed of a high performing HDPE film for resistance against punctures, and an aggressive, specially formulated fully synthetic, non-asphaltic adhesive.



Drawing is for illustrative purposes only. Refer to GCP standard details.

Product Advantages

- Aggressive Adhesion – Synthetic, non-asphaltic adhesive for aggressive adhesion and peel resistance
- Superior Performance - Tough, high strength, elongation, tear resistant properties
- Fully Bonded - Creates a watertight seal, especially when installed with PREPRUFE® pre-applied membranes, to form a complete, below-grade waterproofing system
- Enhanced Productivity - 4 ft. wide roll for increased worker efficiency & reduced opportunity for water migration with decreased critical entry points
- Quick Application - Improved release liner for quick and easy removal
- Elastomeric - Accommodates movements and bridges concrete shrinkage cracks

- Water and Vapor Barrier - Provides protection for all basements which need to be leak free
- Gas resistant - Contributes to methane, carbon dioxide and radon gas protection
- Sustainable - Made with Red List Free materials – meets the criteria for Living Building Challenge (LBC)

System Components

Membranes

- PREPRUFE® 800PA Membrane for application to surfaces at ambient temperatures of 40°F (5°C) or above
- PREPRUFE® 800PA Low Temperature Membrane for low temperature applications when surface and ambient temperatures are between 25°F (-4 °C) and 60°F (16 °C)

Ancillary Components

(the most current Data Sheets for all system components are available on gcpat.com)

- BITUTHENE® Liquid Membrane – Two component, elastomeric, liquid applied detailing compound
- BITUTHENE® Mastic – Rubberized asphalt-based mastic
- PREPRUFE® Detail Tape - Double sided self-adhesive tape
- HYDRODUCT® - High impact and creep resistant geo-composite and protection layer

Limitations of Use

- Approved uses only include those uses specifically detailed in this Product Data Sheet and other current Product Data Sheets that can be found at gcpat.com. PREPRUFE® 800PA membranes are not intended for any other use. Contact GCP Technical Services where any other use is anticipated or intended.
- PREPRUFE® 800PA membranes are designed where in-service temperatures will not exceed 130 °F (54°C).

Safety and Handling Information

Users must read and understand the product label and Safety Data Sheets (SDS's) for each system component before use. All users should acquaint themselves with this information prior to working with the material. Carefully read detailed precaution statements on the product labels and SDS's before use. The most current SDS's can be obtained from our web site at gcpat.com or by contacting GCP toll free at 1-866-333-3SBM (3726)

Storage

The rolls of PREPRUFE® 800PA membrane are to be transported only in boxes packed upright on shrink-wrapped pallets and must be stored upright on site. The stacking of membrane is not allowed. Before installation, the membrane must be protected from direct sunlight and moisture. Punctual or lineal loading and exposure to solvent vapor shall be avoided.

Installation

Technical Support, Details and Technical Letters

The most up to date detail drawings and technical letters are available at gcpat.com. For complete application instructions, please refer to the current GCP Applied Technologies Contractor Handbook and Literature on (www.gcpat.com). Documents in hardcopy as well as information found on websites other than www.gcpat.com may be out of date or in error. Before using this product it is important that information be confirmed by accessing www.gcpat.com and reviewing the most recent product information, including without limitation Product Data Sheets and Contractor Manuals, Technical Bulletins, Detail Drawings and detailing recommendations. Please review all materials prior to installation of PREPRUFE® 800PA Membrane. For technical assistance with detailing and problem solving please call toll-free at (866) 333-3SBM (3726).

Temperature

- Apply PREPRUFE® 800PA Membrane only in dry weather and when air and surface temperatures are 40°F (5°C) or above.
- Apply BITUTHENE® Adhesive Primer B2 LVC in dry weather above 25°F (-4°C). (See separate product information sheet.)

Surface Preparation

Surfaces should be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Concrete must be properly cured (minimum 7-days for normal structural concrete and 14-days for lightweight structural concrete).

If time is critical, BITUTHENE® Adhesive Primer B2 LVC may be used to allow priming and installation of membrane on damp surfaces or green concrete. Priming may begin in this case as soon as the concrete will maintain structural integrity. Use form release agents which will not transfer to the concrete. Remove forms as soon as possible from below horizontal slabs to prevent entrapment of excess moisture. Excess moisture may lead to blistering of the membrane. Cure concrete with clear, resin-based curing compounds which do not contain oil, wax or pigment. Except with BITUTHENE® Adhesive Primer B2 LVC, allow concrete to thoroughly dry following rain. Do not apply any products to frozen concrete.

Repair defects such as spalled or poorly consolidated areas. Remove sharp protrusions and form match lines. On masonry surfaces, apply a parge coat to rough concrete block and brick walls or trowel cut mortar joints flush to the face of the concrete blocks.

Priming

- Apply BITUTHENE® Adhesive Primer B2 LVC by a lamb's wool roller at a coverage rate of 325–425 ft2/gal (7.5–10.0 m2/L). Allow primer to dry one hour or until tack-free.
- Apply BITUTHENE® Primer WP-3000 by spray or roller at a coverage rate of 500–600 ft2/gal (12–15 m2/L). Allow to dry one hour or until concrete returns to original color.
- Apply PERM-A-BARRIER® Primer Plus by spray or roller at a coverage rate of 450-500 ft2/gal (11-12 m2/L) Allow to dry one hour or until concrete returns to original color. Allow PERM-A-BARRIER® Primer Plus to dry until surface becomes tacky. Drying times may vary depending on temperature and humidity conditions.
- Dry time may be longer in cold temperatures. Re-prime areas if contaminated by dust. If the work area is dusty, apply membrane as soon as the primer is dry.
- Do not apply any primer onto PREPRUFE® 800PA membrane.

Application on Vertical Surfaces

Apply membrane in lengths up to 8 ft. (2.5 m). Overlap all seams at least 2 in. (50 mm). On higher walls apply membrane in two or more sections with the upper overlapping the lower by at least 2 in. (50 mm). Roll all membrane with a hand roller.

Terminate the membrane at grade level. Press the membrane firmly to the wall with the butt end of a hardwood tool such as a hammer handle or secure into a reglet. Failure to use heavy pressure at terminations can result in a poor seal. A termination bar may be used to ensure a tight seal. Terminate the membrane at the base of the wall if the bottom of the interior floor slab is at least 6 in. (150 mm) above the footing. Otherwise, use appropriate inside corner detail where the wall and footing meet. A 1/8 in. (3 mm) x 1 in. (25 mm) aluminum termination bar aligned with the top of the membrane is recommended for terminations on CMU.

Membrane Repairs

PREPRUFE® 800PA film has an internal grey/black layer. When damage occurs, the grey/black layer is exposed on the white surface. Damaged areas should be repaired with a patch applied to a clean, dry surface extending 6 in. beyond damage in all directions and firmly rolled. Seal all edges of the patch with BITUTHENE® Liquid Membrane.

Drainage

HYDRODUCT® drainage composites and or protection boards are recommended for both active drainage and protection of the membrane. See HYDRODUCT® Product Data Sheet at gcpat.com

Insulation

Always apply PREPRUFE® 800PA membrane directly to primed or conditioned structural substrates. Insulation, if used, must be applied over the membrane. Do not apply PREPRUFE® 800PA membranes over lightweight insulation over concrete.

Protection of Membrane

- Protect PREPRUFE® 800PA membranes to avoid damage from other trades, construction materials or backfill. Place protection immediately in temperatures above 77°F (25°C) to avoid potential for blisters.
- On vertical applications, use HYDRODUCT® 220 Drainage Composite. Adhere HYDRODUCT® 220 Drainage Composite to membrane with PREPRUFE® Detail Tape. Alternative methods of protection are to use 1 in. (25 mm) expanded polystyrene or 1/4 in. (6 mm) extruded polystyrene that has a minimum compressive strength of 8 lbs./in.2 (55 kN/m^2). Such alternatives do not provide positive drainage to the system. If 1/4 in. (6 mm) extruded polystyrene protection board is used, backfill should not contain sharp rock or aggregate over 2 in. (50 mm) in diameter. Adhere polystyrene protection board with PREPRUFE® Detail Tape.

Backfill

Place backfill as soon as possible. Use care during backfill operation to avoid damage to the waterproofing system. Follow generally accepted practices for backfilling and compaction. Backfill should be added and compacted in 6 in. (150 mm) to 12 in. (300 mm) lifts.

Supply

PREPRUFE® 800PA OR PREPRUFE® 800PA LOW TEMPERATURE	
Roll Dimensions (Nominal)	4 ft. x 115 ft. roll (452 ft^2) [1.2 m x 35 m]
Roll weight	77 lbs. (35 kg) gross
Palletization	16 rolls per pallet
Storage	Store upright in dry conditions below 86°F (+30°C).

Note#1 Individual roll length may vary +/-1%

Ancillary Components (the most current Data Sheets for all system components are available on gcpat.com)

Physical Properties

(PREPRUFE®800PA & PREPRUFE®800PA Low Temperature Waterproofing Membranes)

PROPERTY	TYPICAL VALUE	TEST METHOD
Color	White	
Roll Dimensions	4 ft. x 115 ft. roll (452 ft^2)	
Thickness	30 mils (0.8 mm) nominal	ASTM D3767 — method A
Flexibility, 180° bend over 1 in. (25 mm) mandrel at -25°F (-32°C)	Unaffected	ASTM D1970

Tensile strength, membrane, die C	1000 psi (8274 kPa) minimum	ASTM D412[1]
Crack cycling at -25°F (-32°C), 100 cycles	Unaffected	ASTM C836
Lap Sheer Strength	30 lbs. minimum	ASTM D1002[2]
Peel strength	16 lbs./in (1927 N/m)	ASTM D903[3]
Puncture resistance, membrane	100 lbs. minimum (467 N)	ASTM E154
Resistance to hydrostatic head	>231 ft. (71 m) of water	ASTM D5385
Permeance	<0.1 perms	ASTM E96, section 12—water method
Water absorption	0.1%	ASTM D570

Footnotes:

1. The test is run at a rate of 2 in. (50 mm) per minute.
2. The test is conducted 15 minutes after the lap is formed and run at a rate of 50 mm (2 in.) per minute @ 40°F (5°C).
3. The 180-peel strength is run at a rate of 12 in. (300mm) per minute.

GCP Applied Technologies Inc., 62 Whittemore Avenue, Cambridge, MA 02140, USA

GCP Canada, Inc., 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6

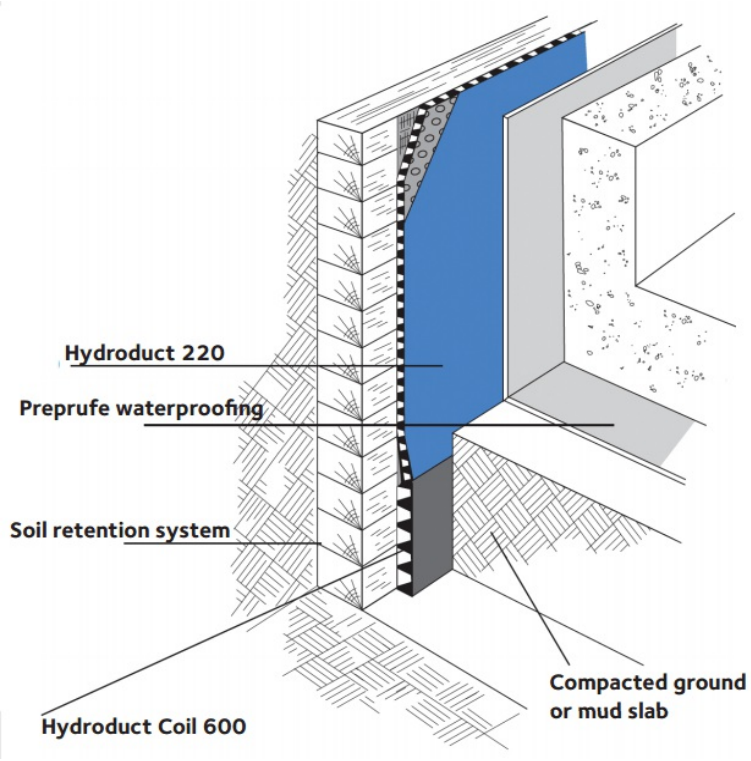
Last Updated: 2022-01-11

HYDRODUCT® 220 (US Version)

Pre-fabricated geocomposite drain for use as a combined drainage and protection layer with GCP waterproofing membranes

Product Description

HYDRODUCT® 220 is a strong, preformed 0.44 in. (11 mm) thick geocomposite drainage sheet system, comprising a hollow studded polystyrene core, covered on one side with a nonwoven, needle punched polypropylene filter fabric and on the other side with a smooth polymeric film.



Uses

HYDRODUCT® 220 is designed primarily for use with waterproofing materials in vertical installations.

HYDRODUCT® 220 has been specially developed to provide a simple and highly practical collector and deflector of unwanted ground water on foundation walls, retaining walls, tunnels and planters. It can be used with PREPRUFE®, PROCOR®, or BITUTHENE®waterproof membranes. When installed it protects the membrane from damage and minimizes the build-up of percolated surface water against the structure. The construction of the studded sheet also creates an air void to isolate the structure from the effects of the surrounding ground.

HYDRODUCT® 220 has been designed to withstand ground pressures and the compaction forces of wet concrete to maintain a high water flow capacity. The drainage sheet must be connected into the site drainage system to minimize hydrostatic build-up and collect infiltrated water using HYDRODUCT® Coil 600 or traditional perforated pipes wrapped and linked with the geotextile filter fabric to prevent clogging.

Product Advantages

- Enhances waterproofing—eliminates hydrostatic pressure build-up
- Efficient water collector/deflector—can be used as a sandwich drainage layer between lagging and the reinforced concrete structure
- Smooth polymeric sheet—compatible with PREPRUFE® , PROCOR® , or BITUTHENE® membranes
- Simple convenient drainage and protection layer—serves as robust membrane protection and drainage
- Geotextile fabric filter—allows ground water to pass into the drain core while restricting the movement of soil particles
- High flow capacity—drains 17 gals/min./ft (211 L/min./m) width
- Rot proof—unaffected by permanent immersion in water, bacteria, dilute acids and alkalis
- Economical—eliminates imported aggregate drainage layers
- Studded core—allows water to flow to designated drainage collection points

Application Procedures

Safety, Storage and Handling Information

All construction products must be handled properly. Safety Data Sheets (SDS) are available and users should acquaint themselves with this information. Carefully read detailed precaution statements on product labels and the SDS before use.

Installation

Position HYDRODUCT® so that the geotextile fabric filter is facing toward the groundwater, soil or overburden. The solid polymeric film provides extra protection for waterproofing such as PROCOR®or BITUTHENE®and should not be removed. In vertical applications, HYDRODUCT® 220 Drainage Composites can be applied to the substrate vertically but should extend from the perimeter discharge pipe to a point approximately 6 in. (150 mm) below the anticipated grade line.

When adhering HYDRODUCT® 220 directly to BITUTHENE®waterproofing membranes, PREPRUFE®Detail Tape should be used. When using PREPRUFE®Detail Tape, press firmly to ensure good adhesion.

Substrate and job site conditions will determine the attachment pattern. Additional consideration should be given in high wind exposures. Abut adjacent rolls with excess fabric overlapping in shingle fashion.

For inside and outside corners, abut adjoining drainage composite at the corner. Cover open core with extra geotextile filter fabric. The exposed core along the top terminations should be covered with a strip of geotextile to prevent intrusion of soil into core. At the bottom termination extend the HYDRODUCT® 220 Drainage Composite out from the structure so that it passes behind and under the perimeter discharge pipe. Additional geotextile should be wrapped over the pipe to prevent soil intrusion.

To secure HYDRODUCT® 220 around protrusions, apply PREPRUFE®Detail Tape around the protrusion in a picture frame configuration. Cut HYDRODUCT® 220 to fit snugly around the protrusion. Press the cut edge firmly into PREPRUFE®Detail Tape.

HYDRODUCT® 220 should be covered promptly. Do not leave HYDRODUCT® 220 exposed to sunlight for more than two weeks. Motor vehicles, construction equipment or other trades should not be allowed directly on the HYDRODUCT® 220.

Supply

HYDRODUCT®	
Roll size	4 ft x 50 ft (1.2 m x 15.2 m) 200 ft^2 (18.6 m^2)
Packaging	6 rolls/pallet
Weight	38 lbs (17.2 kg)/roll
Complimentary Materials	
PREPRUFE® Detail Tape	2 in. x 50 ft (50 mm x 15 m) rolls
HYDRODUCT® Coil	600 50 ft (15.2 m) roll

Physical Properties

PROPERTY	TYPICAL VALUE	TEST METHOD
Drainage Core		
Polymer	High impact polystyrene	
Thickness	0.44 in. (11 mm) nominal	ASTM C366 method B
Compressive strength	15,000 lbs/ft^2 (718 kPa)	ASTM D1621 (modified)
Flow rate (gradient 1.0, load 172 kPa)	17 gal/min./ft (211 L/min./m)	ASTM D4716
Geotextile	**Typical Value**	**Test Method**
Type	Nonwoven	
Polymer	Polypropylene	
Weight	4.0 oz/yd^2 (136 g/m^2)	ASTM D3776
Tensile strength	100 lbs (445 N)	ASTM D4632
Apparent opening size	70 U.S. sieve (0.21 mm)	ASTM D4751
Flow rate	165 gal/min./ft^2 (6724 L/min./m^2)	ASTM D4491
CBR puncture	275 lbs (1.22 kN)	ASTM D6241

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This document is only current as of the last updated date stated below and is valid only for use in the United States. It is important that you always refer to the currently available information at the URL below to provide the most current product information at the time of use. Additional literature such as Contractor Manuals, Technical Bulletins, Detail Drawings and detailing recommendations and other relevant documents are also available on www.gcpat.com. Information found on other websites must not be relied upon, as they may not be up-to-date or applicable to the conditions in your location and we do not accept any responsibility for their content. If there are any conflicts or if you need more information, please contact GCP Customer Service.

Last Updated: 2019-03-12
gcpat.com/solutions/products/hydroduct-drainage-composite/hydroduct-220

BITUTHENE® Adhesive Primer B2 LVC (US Version)

Specially formulated low VOC primer for use with GCP self-adhered membranes on green concrete or damp substrates

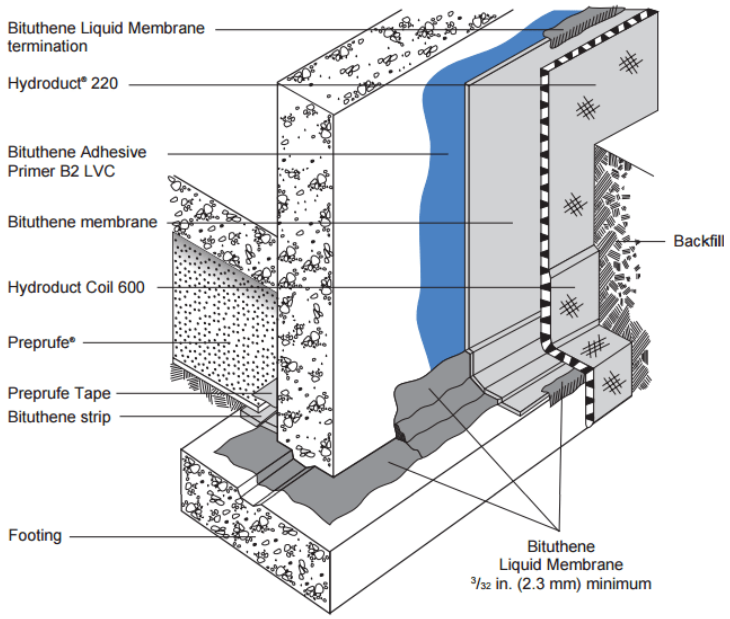
Product Description

BITUTHENE®Adhesive Primer B2 LVC is a low VOC primer in solvent specially formulated to provide good initial adhesion of GCP self-adhered membranes.

In addition, its formulation promotes the adhesion of GCP self-adhered membranes to green concrete and damp surfaces.

The VOC (Volatile Organic Compound) content is <200 g/L and is compliant with all state and local VOC requirements for adhesives and sealants.

Architectural and industrial maintenance regulations limit the VOC content in products classified as adhesive primers. Refer to technical letters at gcpat.com for the most current list of allowable limits.



Use

BITUTHENE®Adhesive Primer B2 LVC is used to prime green concrete (less than seven day cure for normal structural concrete). It is also used to prime damp concrete, masonry, gypsum sheathing or wood surfaces on which GCP self-adhered membranes will be applied.

BITUTHENE®Adhesive Primer B2 LVC is used for vertical and horizontal applications at 25 ºF (-4 ºC) or above.

Application Procedures

Safety, Storage and Handling Information

GCP products must be handled properly. Vapors from solvent-based primers and mastic are harmful and flammable. For these products, the best available information on safe handling, storage, personal protection, health andenvironmental considerations has been gathered. SDS (Safety Data Sheet) are available at gcpat.com and users should acquaint themselves with this information. Carefully read detailed precaution statements on product labels and the SDS before use.

Supply

BITUTHENE® PRIMER B2 PROPERTY	VALUE
Unit Size	5 gal (18.9 L) pail
Weight	44 lbs (20 kg)/pail
Units per pallet	48 pails
Coverage	325–425 ft^2/gal (7.5–10.0 m^2/L)

Product Application

BITUTHENE® Adhesive Primer B2 LVC may be applied by roller or brush. Use a heavy nap roller made of natural material, such as lamb's wool.

Stir until a uniform color and consistency is achieved.

Apply it to clean, dirt free, frost-free surfaces at an approximate coverage rate of 325–425 ft^2/gal (7.5–10.0 m^2/L). Do not apply to frozen concrete or to areas with standing or visible water. Do not use during wet weather. Allow BITUTHENE® Adhesive Primer B2 LVC to dry one hour or until tack-free. Dry time may be longer in cold temperatures Deep puddles of primer should be avoided as this will lengthen drying time. Rollers or brushes should be dipped into pans. Avoid pouring primer directly onto a horizontal substrate. Do not apply directly to GCP self-adhered membrane.

In general, priming should be limited to an area that can be covered with membrane within 24 hours. Areas that accumulate significant amounts of dust or dirt must be reprimed before membrane is applied.

Although it may be used on green concrete and damp surfaces, moisture may become trapped under the membrane. This may result in blistering, particularly on warm, sunny days. Therefore, cover the membrane as soon as possible to minimize blistering. If blistering occurs, allow membrane to cool and re-roll with heavy roller. Blisters over 4 in. (100 mm) in diameter should be cut and patched.

Clean tools with mineral spirits at the end of each day. Mineral spirits is a combustible liquid and should be used only in accordance with the manufacturer's safety recommendations. Do not use solvents to clean hands or skin.

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Last Updated: 2021-02-05
gcpat.com/solutions/products/bituthene-post-applied-waterproofing/bituthene-adhesive-primer-b2-lvc

PREPRUFE® TAPE and PREPRUFE® CJ TAPE

Product Description

Preprufe® Tape and Preprufe® CJ Tape are specially formulated two sided, reinforced pressure sensitive tapes. The bottom side of the tape has a highly aggressive pressure sensitive adhesive which is designed to adhere to penetrations, protrusions and GCP waterproofing membranes and accessories. The top side of the tape has a pressure sensitive adhesive, a weather resistant protective coating and a release liner. Concrete is cast directly against the protective white coating of the tape. The specially developed Preprufe adhesive layers work together to form a continuous and integral seal to the structure.

Preprufe Tape and Preprufe CJ Tape are provided in Low Temperature and Hot Climate Grades as follows:

- **Preprufe Tape LT Grade and Preprufe CJ Tape LT Grade** - or temperatures between 25°F (-4°C) and 86°F (+30°C).
- **Preprufe Tape HC Grade and Preprufe CJ Tape HC Grade** - for use in Hot Climates (minimum 50°F (10°C)).

Use

Preprufe Tape is a 4 in. (100 mm) wide tape used in detail areas including end laps, penetrations and various tie-ins. It is also used to patch damaged areas in the Preprufe membranes.

Preprufe CJ Tape is an 8 in. (200 mm) wide tape used at construction joints in the concrete that is cast against it or in critical areas where a wider tape is required.

Application

Wipe substrates to receive Preprufe Tape and Preprufe CJ Tape clean to remove any dirt, dust or moisture. Clean the surface of penetrations or protrusions with a wire brush to remove dirt, dust, rust and loose particles.

Unroll the tape and adhere the exposed pressure sensitive adhesive surface to the membrane or penetration. The protective coating surface of the tape should face toward the concrete to be cast onto the tape.

The use of rollers is required to maximize adhesion. Remove the release liner during application.

Ensure the plastic release liner is removed from all areas of Preprufe Tape and Preprufe CJ Tape. It is recommended that concrete be poured within 56 days (42 days in hot climates) of application of the Preprufe system. Following proper ACI guidelines, concrete must be placed carefully and consolidated properly to avoid damage to the membrane. Never use a sharp object to consolidate the concrete. Provide temporary protection from concrete over splash for areas of the tape that are adjacent to a concrete pour.

Dimensions (Nominal)	**Preprufe Tape (HC or LT)**	**Preprufe CJ Tape (HC or LT)**
Roll Size	4 in. x 49 ft. (100 mm x 15 m)	8 in. x 49 ft. (200 mm x 15 m)
Roll Weight	4.3 lbs (2 kg)	8.6 lbs (4 kg)

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GCP0083 PF-101-1216

gcp applied technologies

BITUTHENE® LIQUID MEMBRANE

Two component, elastomeric, liquid applied detailing compound for use with GCP waterproofing membranes

Product Description

Bituthene® Liquid Membrane is a two component, elastomeric, cold applied, trowel grade material designed for a variety of uses with the GCP waterproofing systems. The VOC (Volatile Organic Compound) content is 10 g/L.

Architectural and industrial maintenance regulations limit the VOC content in products classified as architectural coatings. Refer to Technical Letters at gcpat.com for the most current list of allowable limits.

Use

Bituthene® Liquid Membrane is ideally suited for the following uses:

- Fillet material at inside corners
- Reinforcement material at inside corners
- Flashing material around drains, protrusions, curbs and parapets
- Sealing material at terminations
- Repair material for defects on concrete surfaces
- Flashing material at corners

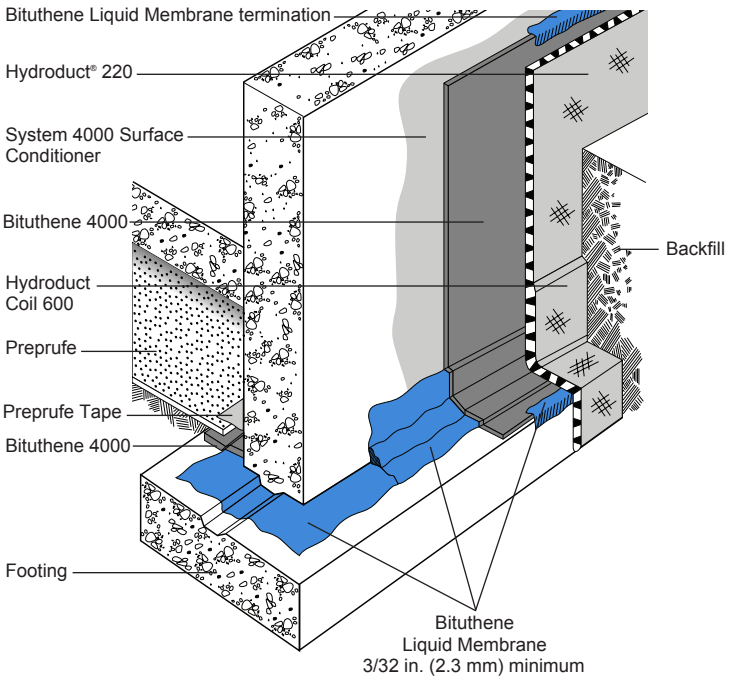
The two parts of Bituthene Liquid Membrane are mixed on site and troweled on to provide a simple and quick waterproofing detailing aid in conjunction with Bituthene, Preprufe® and Procor® systems.

Product Advantages

- Liquid applied
- Waterproof
- Tough, rubber-like
- Chemically cured
- Cold applied
- System compatible

Compatibility

Bituthene® Liquid Membrane is completely compatible with Bituthene, Preprufe and Procor, and with existing asphalt or coal tar-based waterproofing materials. It is also compatible with cured silicone and polyurethane sealants. It is not compatible with creosote, pentachlorophenol, linseed oil or polysulfide-based sealants.



Drawings are for illustration purposes only.
Please refer to gcpat.com for specific application details.

Supply

Bituthene® Liquid Membrane (Parts A & B)		
Unit size	1.5 gal (5.7 L)	4 gal (15.1 L)
Weight per unit	16 lbs (8 kg)	44 lbs (20 kg)
Units per pallet	100	24

Physical Properties

Property	Typical Value	Test Method
Color		
Part A	Black	
Part B	Clear	
Mixture of Parts A and B	Black	
Solids content	100%	ASTM D1644
Elongation	250% minimum	ASTM D412
Peel strength	5 lbs/in. (880 N/m) minimum	ASTM D903
Flexibility, 180° bend over 1 in. (25 mm) mandrel at -25°F (-32°C)	Unaffected	ASTM D1970

Application Procedures

Safety, Storage and Handling Information

Bituthene® products must be handled properly. Vapors from solvent-based primers and mastic are harmful and flammable. For these products, the best available information on safe handling, storage, personal protection, health and environmental considerations has been gathered. Safety Data Sheets (SDS) are available at gcpat.com and users should acquaint themselves with this information. Carefully read detailed precaution statements on product labels and the SDS before use.

Surface Preparation

All surfaces must be dry and free from dirt, grease, oil, dust or other contaminants. Bituthene® Liquid Membrane may be applied at temperatures of 25°F (-4°C) or above. Store in a dry place above 40°F.

Mixing

Add the entire contents of the Part B container to Part A and mix for 3 to 5 minutes until uniform. Part A is black and Part B is clear. Take care to scrape material from the side and bottom of the containers to ensure thorough mixing. A low speed (150 rpm) mechanical mixer with flat paddle blades is required. Do not apply any material if streaks can be seen due to insufficient mixing. Once mixed, Bituthene® Liquid Membrane must be applied by trowel within 1.5 hours. More time is available at lower temperatures. At high temperatures, thickening and curing will be faster. Material that has thickened must be discarded. The material will cure to a very flexible rubber-like material.

Bituthene Liquid Membrane must be applied at a minimum thickness of ⅜ in. (2.3 mm) unless otherwise noted on details. In fillet applications, the face of the fillet should be a minimum of ¾ in. (20 mm). In corner flashing application details, it should extend 6 in. (150 mm) in each direction from the corner. Bituthene Liquid Membrane will adhere to primed or unprimed concrete.

Bituthene Liquid Membrane should be allowed to cure at least 24 hours before flood testing.

Coverage

As a fillet material, 1 gal (3.8 L) will cover approximately 100 linear feet (30 m). As a flashing material, 1 gal (3.8 L) will cover approximately 17 ft^2 (1.6 m^2). As a fillet and reinforcement, 1 gal (3.8 L) will cover approximately 14 linear feet (4.3 m).

Cleaning

Clean tools and equipment with mineral spirits before Bituthene® Liquid Membrane has cured. Mineral spirits is a combustible liquid and should be used only in accordance with the manufacturer's safety recommendations. Do not use solvents to clean hands or skin.

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In Canada, GCP 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6.

GCP0083 BIT-230-1216

ADCOR® ES (US version)

Engineered swell hydrophilic waterstop strip

Product Description

ADCOR®ES is a specially engineered, swellable, conformable synthetic waterstop strip that expands when in contact with water. The engineered swell design of ADCOR®ES minimizes the potential for concrete spalling and cracking versus traditional hydrophilic waterstops. When fully encapsulated by poured concrete, the expansive forces form a seal against concrete faces. The seal resists hydrostatic pressure, stopping water from entering sub-structures. ADCOR®ES is a unique product that has been specifically developed to provide better performance than bentonite or conventional swellable rubber waterstops. Superior performance arises from:

- Controlled, reproducible, volumetric expansion
- Cohesive strength maintained after volumetric expansion and during wet-dry cycling
- Malleable and plastic, enabling easy application to a variety of concrete profiles.

Product Advantages

- Engineered swell reduces risk of concrete spalling
- Conformable — can be installed onto a variety of irregular substrates
- Controlled expansion reduces the need for product replacement due to premature expansion
- Retains cohesive strength at both original and expanded volume
- No need for protective steel mesh
- Volumetric expansion min 100%
- Simple overlap jointing on site
- Reproducible swell after wet-dry cycling
- Contains no sodium bentonite

Applications

- Horizontal and vertical construction joints in concrete structures
- Casting new concrete against existing
- Pipe penetrations through floors and walls

System Components

ADCOR® ES

1.0 in. x 1⁄2 in. (25.4 mm x 12.7 mm) waterstop strip, supplied in 16 ft (4.9 m) rolls.

ADCOR® ES Adhesive

A butyl based adhesive for securing ADCOR®ES to concrete, steel and plastic substrates. Supplied in 29 fl oz (0.85 L) tubes.

Design

GCP recommends the use of waterstops in all construction joints, subject to hydrostatic pressure. Waterstop networks must be continuous through all joints and penetrations if they are to be effective. Contact GCP regarding specific applications where movement is expected.

Installation

1. Concrete surfaces must be clean and free of all contaminants. Remove all debris and loose concrete.
2. On irregular concrete faces, apply a 1⁄2 in. (12 mm) bead of ADCOR® ES Adhesive as bedding for ADCOR® ES. Estimated coverage rate of ADCOR® ES Adhesive is 30 linear feet per tube on porous concrete or irregular surfaces when applied at a 1⁄2 in. (12 mm) bead.
3. Secure ADCOR® ES using masonry nails 1 1⁄2–2 in. (40 mm– 50 mm) long with a washer 3⁄4 in. (20 mm) in diameter. Hilti EM6-20-12 FP8 shot fired fixings with 1⁄4 in. (6 mm) nuts and 3⁄4 in. (20 mm) diameter washers may also be used. Fixings should be spaced at a maximum of 12 in. (300 mm) centers with a minimum spacing that ensures proper contact to substrate.
4. For pipe penetrations, ADCOR® ES Adhesive must be applied to dry substrates only. Apply a 1⁄2 in. bead of ADCOR® ES Adhesive and tool with a brush or trowel. Wait until surface is dry to touch, then press ADCOR® ES firmly into place. Estimated coverage rate of ADCOR® ES Adhesive is 60 linear feet per tube on smooth concrete or pipe surfaces when applied at a 1⁄2 in. (12 mm) bead.
5. ADCOR® ES joints should overlap a minimum of 4 in. (100 mm), ensuring full contact between jointed pieces.
6. ADCOR® ES can be bent around corners; however, on complex geometry, use ADCOR® ES Adhesive to fill any gaps.
7. Any damaged sections should be removed and repaired with a new section of ADCOR® ES.
8. Keep ADCOR® ES dry prior to pouring concrete.

Concrete Placement

1. Normal weight structural concrete should be placed carefully to avoid damage to the waterstop.
2. ADCOR® ES should be encapsulated with a 3 in. (76.2 mm) concrete cover minimum.

Health & Safety

ADCOR® ES

There is no legal requirement for a SDS (Safety Data Sheets) for ADCOR®ES. For health and safety questions on this product, please contact GCP.

ADCOR® ES Adhesive

Read the product label and SDS (Safety Data Sheets) before use. Users must comply with all risk and safety phrases.

Storage & Handling

ADCOR®ES should be stored in its original unopened packaging until ready for installation and kept dry prior to pouring concrete. Dispose of any materials in accordance with the requirements of local authorities having jurisdiction.

Limitations

Not suitable for use in movement joints.

Not suitable for use with pre-cast concrete components.

Physical Properties

PROPERTY	TYPICAL VALUE
Color	Green
Size	1.0 in. x 1/2 in. x 16 ft (25.4 mm x 12.7 mm x 4.9 m) rolls
Packaging	6 rolls per case
Hydrostatic Head Resistance	231 ft (70m)
Adhesion to Concrete using ADCOR® ES Adhesive	Excellent

WARRANTY

Preprufe® Waterproofing Membrane

Five Year Material Warranty

WARRANTY NO. _____
NAME OF BUILDING _____
LOCATION OF BUILDING _____
NAME OF OWNER _____
CONTRACTOR _____
PRODUCT _____
TOTAL AREA (SF) _____
DATE OF COMPLETED INSTALLATION _____

GCP Applied Technologies Inc. (GCP) hereby warrants that for a period of five (5) years from the date of completion of installation identified above:

1. Water will not leak directly through any individual Preprufe sheet as a result of deterioration of the sheet caused by ordinary wear and tear and the effects thereof.
2. The Preprufe sheet will bridge ruptures caused by cracking of the immediate substrate up to 1/16th of an inch wide.

If at any time during such five (5) year period the Preprufe sheet is found by GCP not to comply with this warranty, then GCP will supply to the owner replacement Preprufe sheet in a quantity equal to the material found to be nonconforming, with a value not to exceed the purchase price for the material paid to GCP for the original installation.

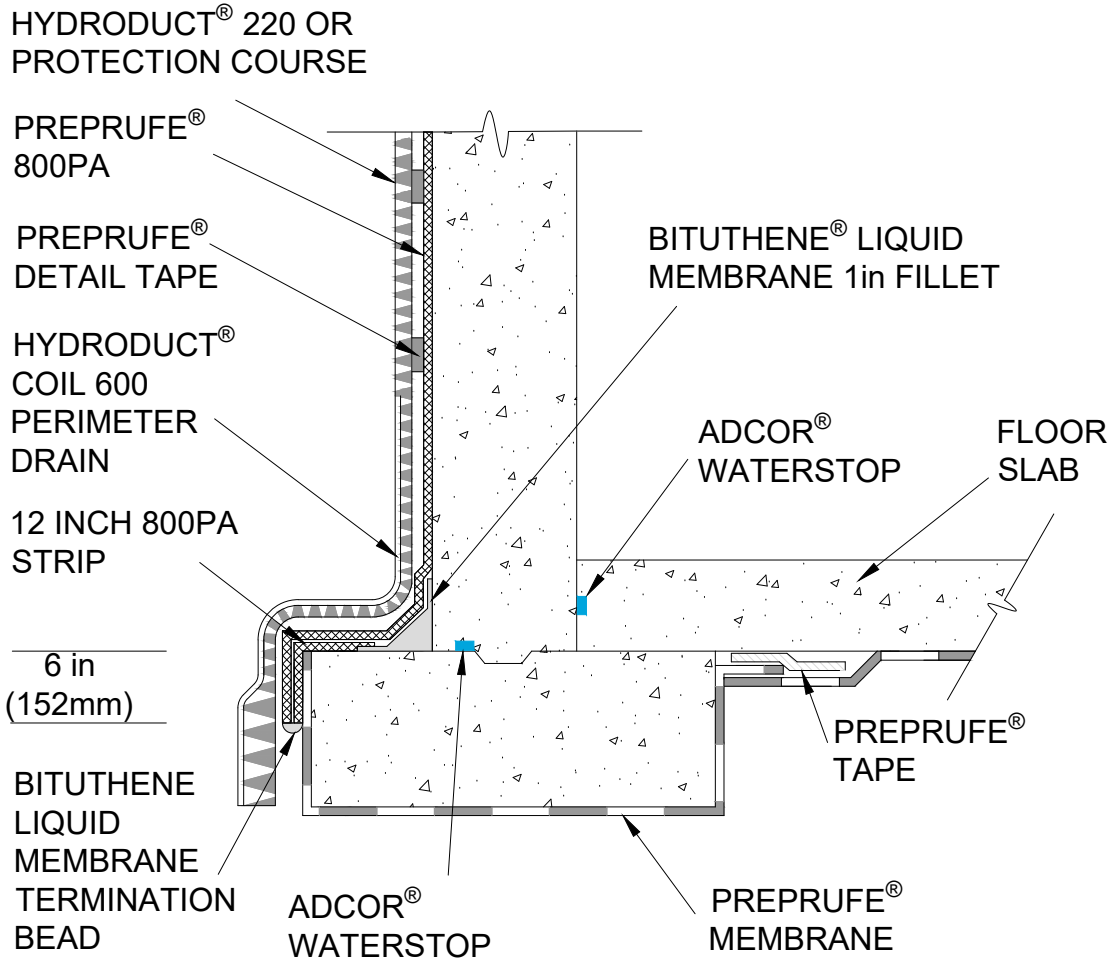
This warranty does not apply to any failure caused by or due to workmanship or improper installation of the Preprufe sheet, abuse of the Preprufe sheet, or chemical incompatibility with other materials, acts of God, inadequate or faulty design of the subject structure or to repairs or installations made by other persons. In addition, this warranty does not cover any costs or expenses associated with 1) the removal, excavation or replacement of any material in connection with the testing, repair, removal or replacement of the Preprufe sheet and, 2) damages or repairs of any kind or nature to the subject building or its' contents from leaking water or otherwise.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY AND ALL OTHER GUARANTEES OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES OF THE OWNER FOR ANY BREACH OF THIS WARRANTY SHALL BE LIMITED TO THOSE HEREIN PROVIDED TO THE EXCLUSION OF ANY AND ALL OTHER REMEDIES. GCP SHALL NOT BE LIABLE IN ANY CASE FOR ANY DAMAGE TO THE BUILDING OR THE CONTENTS THEREOF, NOR WILL IT BE RESPONSIBLE FOR SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR PENAL DAMAGES. NO AGREEMENT VARYING OR EXTENDING THE FOREGOING WARRANTY REMEDIES WILL BE BINDING UPON GCP UNLESS IN WRITING, SIGNED BY A DULY AUTHORIZED OFFICER OF GCP.

GCP Applied Technologies Inc.

By _____ Date _____
Title Warranty Administrator

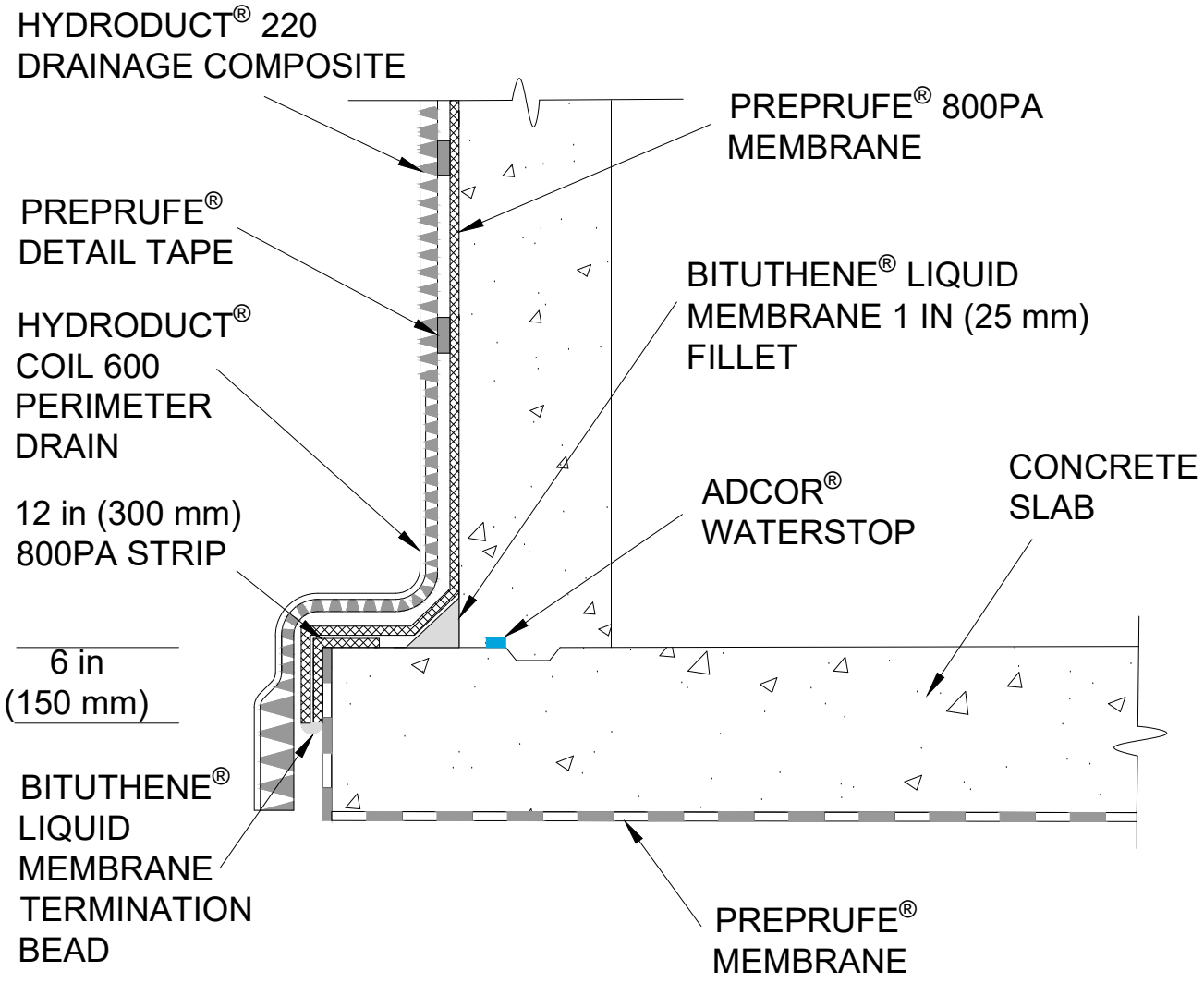
gcp applied technologies
GRACE CONSTRUCTION & PACKAGING



NOTE: GCP MAY REQUIRE AN ALTERNATE GCP WATERSTOP BASED ON DESIGN CONDITIONS

FOUNDATION WALL
FLOOR SLAB AT FOOTING LEVEL
PREPRUFE®800PA WATERPROOFING SYSTEM

DRAWING: 800PA-001
SCALE: Not to scale
EFFECTIVE DATE: 01/07/2019
SUPERCEDES: NEW



NOTE - GCP MAY REQUIRE AN ALTERNATE GCP WATERSTOP BASED ON DESIGN CONDITIONS

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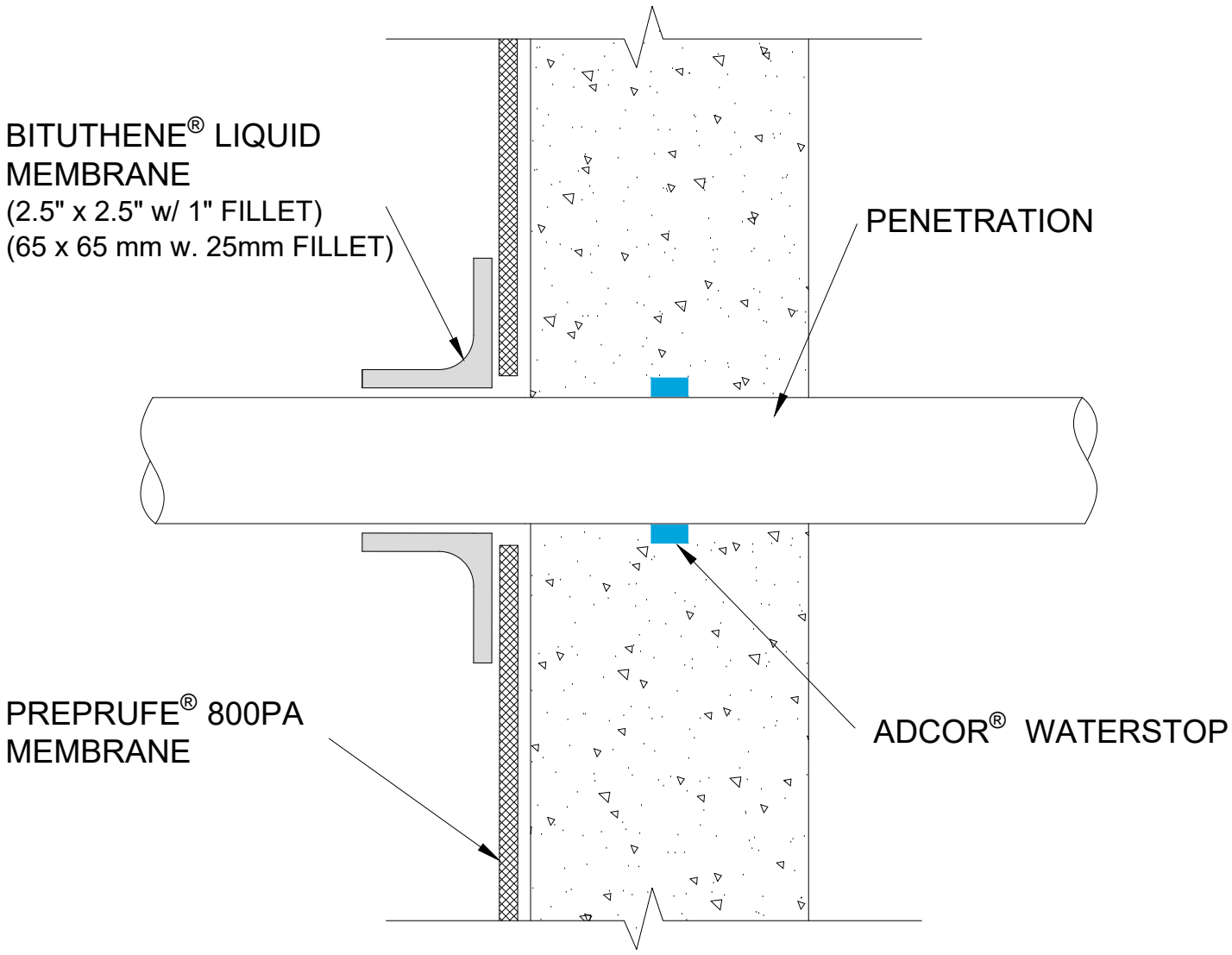
FOUNDATION WALL STRUCTURAL SLAB

PREPRUFE®800PA WATERPROOFING SYSTEM

DRAWING: 800PA-004
SCALE: Not to scale
EFFECTIVE DATE: 01/07/2019
SUPERCEDES: NEW

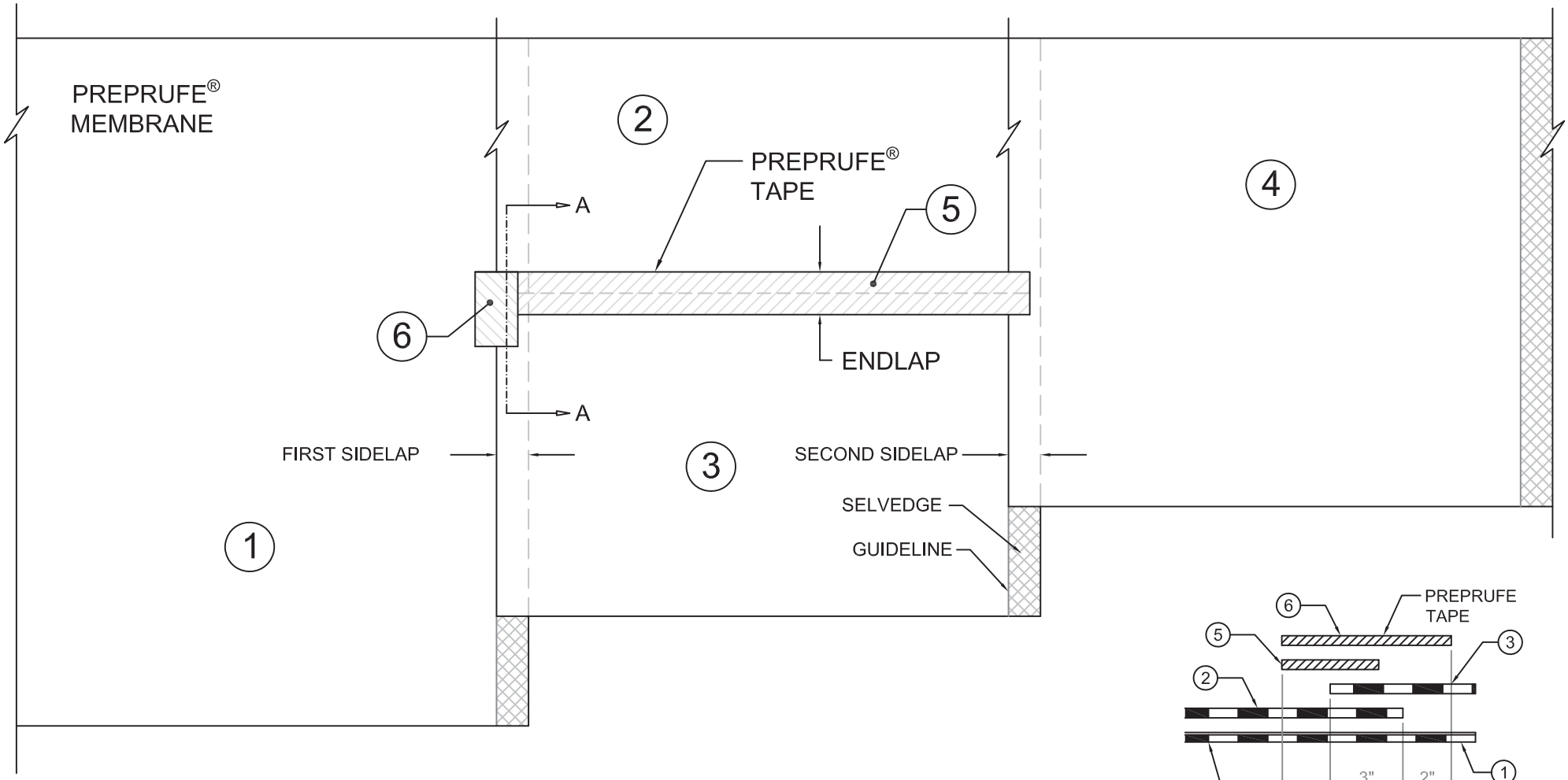


NOTES - HYDRODUCT® OR APPROVED PROTECTION COURSE NOT SHOWN FOR CLARITY
- GCP MAY REQUIRE AN ALTERNATE GCP WATERSTOP BASED ON DESIGN CONDITIONS

PENETRATION

PREPRUFE®800PA WATERPROOFING SYSTEM

DRAWING: 800PA-007
SCALE: Not to scale
EFFECTIVE DATE: 01/07/2019
SUPERCEDES: NEW



SECTION "A-A"

NOTES: - INSTALL PREPRUFE® MEMBRANE AND TAPE IN ORDER AS SHOWN BY NUMBERS
- DETAIL ALSO APPLICABLE FOR PREPRUFE PLUS

END LAP DETAIL FOR WALL OR SLAB - OPTION 1
TAPE APPLIED AFTER INSTALLATION OF SIDE LAPS
PREPRUFE® WATERPROOFING SYSTEM

DRAWING: PRE 031
SCALE: Not to scale
EFFECTIVE DATE: 07/01/2016
SUPERCEDES: 04012015

INSTALLATION INSTRUCTIONS

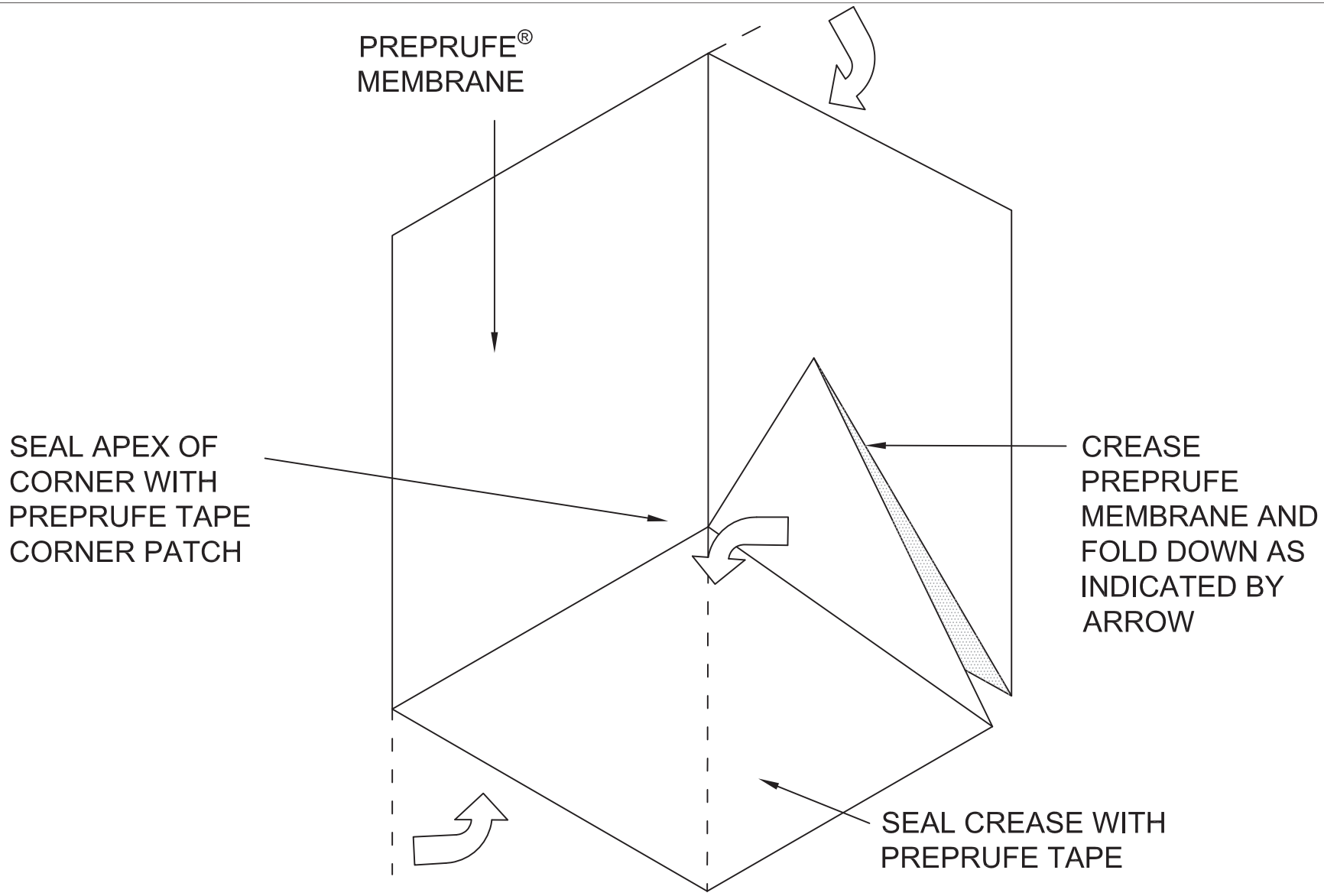
End Lap Detail for Wall or Slab Option-1

Tape applied after installation of the side laps
Prior to Membrane Installation, Review the Preprufe® Data Sheet

Surface Prep
All surfaces must be sound and solid to eliminate movement during the concrete pour. Substrate must be regular and smooth with no gaps or voids greater than ½ inch. The surface should also be free from loose aggregate and sharp protrusions as outlined in the Preprufe® Data Sheet section on Surface Preparation.

Detailing
1. Apply Hydroduct® according to Hydroduct Data Sheet.
2. Install Preprufe Membrane and tape in order as shown by numbers.
3. Overlap the ends of the membrane a minimum of 3 in (75 mm) and remove release liner from both membranes.
4. Apply Preprufe Tape over the end lap as shown and roll firmly.
5. Apply tape a minimum of 2 in (50 mm) beyond all edges of membrane that are not sealed by the selvedge.
6. Remove release liner from tape and discard.

Special Notes
Preprufe membranes should not be used in areas where they will be permanently exposed to sunlight, weather or traffic. Protect membrane from sunlight as quickly as possible after installation.



NOTES: - DO NOT TAPE FOLD ONTO EITHER VERTICAL SURFACE

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INSIDE CORNER - CUSTOM FORMED

PREPRUFE® WATERPROOFING SYSTEM

DRAWING: PRE 033
SCALE: Not to scale
EFFECTIVE DATE: 07/01/2016
SUPERCEDES: 06012010

INSTALLATION INSTRUCTIONS

Inside Corner

Prior to Membrane Installation, Review the Preprufe® Data Sheet

Surface Prep

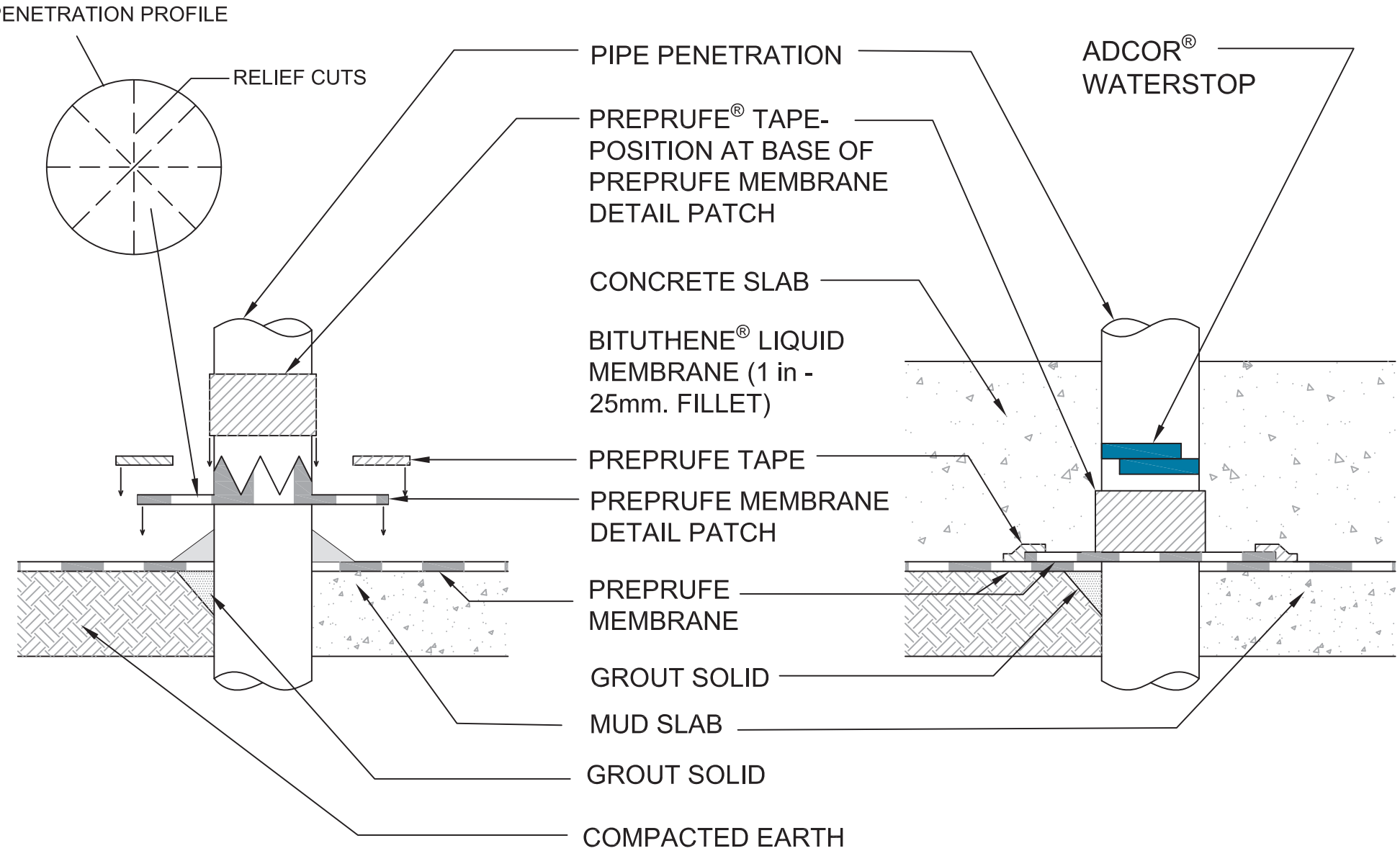
All surfaces must be sound and solid to eliminate movement during the concrete pour. Substrate must be regular and smooth with no gaps or voids greater than 0.5 in (15 mm). The surface should also be free from loose aggregate and sharp protrusions as outlined in the Preprufe® Data Sheet section on Surface Preparation.

Detailing

1. Precut a square section of Preprufe membrane, Minimum 12 in (300 mm) x 12 in (300 mm).
2. Fold membrane as indicated on detail drawing, with release liner on.
3. Crease the fold with nominal hand pressure to ensure a close fit to the substrate profile and avoid hollows.
4. With the white coating facing towards the concrete, ensure that the apex of the corner is covered and sealed with Preprufe Tape
5. Remove release liner and roll tape firmly using steel or vinyl cylindrical or Vee roller.
6. Seal corner detail to Preprufe field membrane using Preprufe Tape and roll firmly.
7. Apply Hydroduct® according to Hydroduct Data Sheet.

Special Notes

Preprufe membranes should not be used in areas where they will be permanently exposed to sunlight, weather or traffic. Protect membrane from sunlight as quickly as possible after installation.



NOTE: ALL PENETRATIONS TO BE GROUTED. A MINIMUM OF 6 IN. (150 mm) IS REQUIRED BETWEEN PENETRATIONS TO ENSURE PROPER DETAILING. AVOID PLACEMENT OF MULTIPLE PENETRATIONS.

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PIPE PENETRATION FOR WALL OR SLAB

PREPRUFE® WATERPROOFING SYSTEM

DRAWING: PRE-034
SCALE: Not to scale
EFFECTIVE DATE: 07/01/2016
SUPERCEDES: 06012010

INSTALLATION INSTRUCTIONS

Pipe Penetration

Prior to Membrane Installation, Review the Preprufe® Data Sheet

Surface Prep

All surfaces must be sound and solid to eliminate movement during the concrete pour. Substrate must be regular and smooth with no gaps or voids greater than 0.5 in (15 mm). The surface should also be free from loose aggregate and sharp protrusions as outlined in the Preprufe® Data Sheet section on Surface Preparation.

Detailing

1. All penetrations must be firmly secured and stable. Grout around all penetrations that are not stable. For compacted earth, extend grout a minimum of 3 in (75 mm) in all directions. Clean loose dust or dirt from the penetration surface using a clean, dry cloth or brush.
2. Cut the field membrane tight to the penetration and remove release liner. If membrane is not within 0.5 in (15 mm) of penetration and not more than 2 in (50 mm) from penetration, apply Preprufe Tape to cover the gap. Roll firmly into place and remove release liner. If the membrane is greater than 2 in (50 mm) from penetration, install more Preprufe Membrane to cover the gap repeating these instructions until Preprufe Membrane/ Tape is within 0.5 in (15 mm).
3. Mix and apply Bituthene Liquid Membrane around the penetration. Liquid Membrane should be placed to form a minimum 1 in (25 mm) continuous fillet between the Preprufe Membrane/ Tape and the base of the penetration. Cut “star” within trace of penetration to allow for patch to slide over penetration.
4. Cut a patch of Preprufe Membrane that is a minimum of 12 in (300 mm) larger than the diameter or width of the penetration so that the patch extends 6 in (150 mm) beyond the penetration in all directions. Remove the release liner and center the patch over penetration and trace/draw the penetration profile onto the patch. Using sheers or utility knife, make relief cuts through the membrane. Refer to relief cut profile on associated detail. Triangles formed by making a relief cut are not to exceed 2 in (50 mm) in height when placed over penetration, i.e. penetration diameters or widths greater than 4 in (100 mm) triangles will need to be trimmed. Remove and discard release liner.
5. Slide the patch over penetration and press into the partially cured Liquid Membrane. Ensure that the patch is pressed firmly into the Liquid Membrane and is positioned directly onto the Preprufe Field Membrane/ Tape below. Using a trowel, smooth out any Liquid Membrane that has flowed out of the relief cut.
6. Apply Preprufe Tape centered over the edges of the patch and roll firmly to form a tight seal to the Preprufe Field Membrane. Remove release liner from tape and discard.
7. Wrap the penetration with Preprufe Tape, positioning the tape at the base of the patch. Remove enough release liner to overlap Attach Tape onto itself and roll/press firmly into place. Remove remaining release liner and discard. Repair small fishmouths by pressing firmly against penetration and repair large fishmouths by patching with Preprufe Tape.

(Continued on next page)

APPENDIX B

GCP Vapor Barrier Specification in Garage 2

PREPRUFE® 275 / PREPRUFE® 275 LT Membrane

Blindside waterproofing membrane for both cast-in-place concrete or shotcrete foundation walls and cast-in-place concrete slabs

Product Description

The GCP PREPRUFE® 275 & PREPRUFE® 275 LT membrane is a composite sheet comprised of an HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Using patented Advanced Bond Technology™, PREPRUFE® 275 & PREPRUFE® 275 LT membrane provides a continuous seal to concrete or shotcrete resisting water ingress and migration between the membrane and the structure.

Product Advantages

- Forms a continuous adhesive bond to concrete poured against it
- Durable system designed specifically to withstand the force of shotcrete placement
- Its unique continuous and integral bond to the structure is specifically designed to reduce lateral water migration between the membrane and the concrete or shotcrete
- Designed with fully adhered adhesive to adhesive watertight ZipLap™ seams and easy to execute detailing
- Provides a barrier to water, moisture and soil gases physically isolating the structure from the surrounding substrate Release liner free, expedites installation and reduces construction site waste
- Can be applied to permanent formwork - allows maximum use of confined sites
- Installed membrane is unaffected by wet jobsite conditions – jobsite water will not cause premature activation Waterproofing is not reliant on confining pressures or hydration
- Installed membrane is unaffected by freeze/thaw or wet/dry cycles
- Chemical resistance - protects structure from salt or sulphate attack effective in most types of soils and waters

Product Applications

PREPRUFE® 275 & PREPRUFE® 275 LT membranes are designed for shotcrete walls as well as cast in place concrete with intermittent water and low or no hydrostatic condition. To provide long-term waterproofing performance in high-risk, hydrostatic and critical shotcrete conditions, PREPRUFE® SCS blindside waterproofing system is recommended. Complete product information and a Product Data Sheet for PREPRUFE® SCS blindside waterproofing system can be found at gcpat.com.

System Components:

Membrane

PREPRUFE® 275 & PREPRUFE® 275 LT waterproofing membrane is for horizontal use below concrete labs, or vertically against timber lagging or other soil retention systems. Intended for both cast-in-place and shotcrete applications.

Ancillary Components (refer to the most current Data Sheets for all system components available on gcpat.com)

- PREPRUFE® Tape – 4 in. wide tape for covering cut edges, roll ends, penetrations and detailing
- PREPRUFE® CJ Tape – 8 in. wide tape for detailing, and may be used at construction joints for optional additional protection
- BITUTHENE® Liquid Membrane — for sealing around penetrations, etc.
- ADCOR® — Waterstop for joints in concrete walls and floors
- DE NEEF® INJECTO® Tube — groutable waterstop for non-moving concrete construction joints and penetrations
- PREPRUFE® Tieback Covers — preformed cover for soil retention wall tieback heads

Limitations of Use

- Approved uses include only those specifically detailed in this Product Data Sheet and other current Product Data Sheets that can be found at gcpat.com
- PREPRUFE® 275/LT membranes are not intended for any other use. Contact GCP Technical Services where any other use is anticipated or intended.
- PREPRUFE® 275/LT membranes are designed for in-service temperatures below 120°F (49°C).
- For hydrostatic and critical waterproofing applications consider PREPRUFE® SCS blindside waterproofing system for shotcrete applications and PREPRUFE® Plus for cast-in-place concrete applications.
  See separate Product Data Sheet at gcpat.com.

Safety and Handling

Users must read and understand the product label and Safety Data Sheets (SDS's) for each system component before use. All users should acquaint themselves with this information prior to working with the material. Carefully read detailed precaution statements on the product labels and SDS's before use. The most current SDS's can be obtained from our web site at gcpat.com.

Storage

- Observe 1 year shelf life and use on a first in first out basis
- Store In dry conditions between 40°F (4.5°C) -90°F (32°C)
- Store off ground under tarps or otherwise protected from rain and ground moisture
- See TL-0030 — "Shelf Life/Storage and Handling of GCP Waterproofing and Air Barrier Products" Technical Letter

Installation

Technical Support, Details and Technical Letters

The most up to date detail drawings and technical letters are available at gcpat.com. For complete application instructions, please refer to the current GCP Contractor Handbook and Literature on (gcpat.com). Documents in hardcopy as well as information found on websites other than gcpat.com may be out of date or in error. Before using this product it is important that information be confirmed by accessing gcpat.com and reviewing the most recent product information, including without limitation Product Data Sheets and Contractor Manuals, Technical Bulletins, Detail Drawings, and detailing recommendations. Please review all materials prior to installation of PREPRUFE® 275 membrane.

Support is also available by full-time technically trained GCP field sales representatives and technical service personnel, backed by a central research and development technical services staff. For technical assistance with detailing and problem solving please contact your local representative. A GCP Representative locater is available at www.gcpat.com.

Temperature Requirements

- PREPRUFE® 275 LT membrane can be applied between temperature 25ºF to 95ºF. Please use PREPRUFE® 275 membrane for application above 95ºF.
- PREPRUFE® Tape LT and PREPRUFE® CJ Tape LT can be applied between temperature 25ºF to 95ºF. Please use PREPRUFE® Tape HC and PREPRUFE® CJ Tape HC for application above 95ºF.

Substrate Preparation

- All surfaces — It is essential to create a sound and solid substrate to eliminate movement during the concrete or shotcrete placement. Substrates must be regular and smooth, with no gaps or voids greater than 0.5 in. (12 mm). Grout around all penetrations such as utility conduits, etc. for stability.
- Horizontal — The substrate must be free of loose aggregate and sharp protrusions. When installing over earth or crushed stone, ensure substrate is well compacted to avoid displacement of substrate due to traffic or concrete pour. The surface does not need to be dry, but standing water must be removed.
- Vertical — Use concrete, plywood, insulation, or other approved facing to sheet piling to provide support to the membrane. Board systems such as timber lagging must be close butted to provide support and not more than 0.5 in. (12mm) out of alignment.

Membrane Application

PREPRUFE® 275/LT membranes can be applied in horizontal applications to smooth prepared concrete, or well rolled and compacted earth or crushed stone substrate. Kick out or roll out the membrane, with the HDPE film side to the substrate with the green ZipStrip™ facing towards the concrete pour. End laps should be staggered to avoid a buildup of layers. Leave the green and blue ZipStrip™ on the membrane until the overlap procedure is completed. When completed, remove the release liner. Contact your local GCP representative for further details when installing over carton forms.

Accurately position succeeding sheets to overlap the previous sheet 3 in. (75 mm) along the marked selvedge with the blue ZipStrip™ on top of the green ZipStrip™. Ensure the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap. Peel back and remove both the green and blue ZipStrip™ in the overlap area to achieve an adhesive-to-adhesive bond at the overlap. Ensure a continuous bond is achieved without creases, and roll firmly with a heavy roller.

PREPRUFE® 275/LT membrane can be returned up the inside face of slab formwork. To attain a fully bonded system and to allow a tie in with BITUTHENE® self-adhered membrane or PROCOR® fluid-applied membrane to all vertical structural surfaces after removal of formwork. (See PREPRUFE® Technical Letter #TL-0013 "Forming Systems for Use with PREPRUFE® Membranes."). Terminate the membrane slightly below the top of concrete/shotcrete wall level in the formwork, no membrane hang-over is allowed (beyond final concrete pour level)

Roll ends and cut edges – Overlap all roll ends and cut edges by a minimum 3 in. (75 mm) and ensure the area is clean and free from contamination, wiping with a damp cloth if necessary. Allow surface to dry and apply PREPRUFE® Tape LT (or HC in hot climates) centered over the lap edges and roll firmly. Immediately remove tinted plastic release liner from the tape.

Membrane Repair

Inspect the membrane before installation of reinforcement steel, formwork, and final placement of shotcrete. The membrane can be easily cleaned by low pressure power washing if required. Repair damage by wiping the area with a damp cloth to ensure the area is clean and free from dust and other contaminants, and allow the membrane to dry. Repair small punctures and slices (0.5 in. (12 mm) or less by applying PREPRUFE® Tape centered over the damaged area. Repair punctures and holes larger than 0.5 in. (12mm) by applying a patch of PREPRUFE® membrane. Extend the patch 6 in. (150 mm) beyond the damaged area. Seal all edges of the patch with PREPRUFE® Tape. Where exposed selvedge has lost adhesion or laps have not been sealed, ensure the area is clean and dry and cover with fresh PREPRUFE® Tape. Any areas of damaged adhesive should be covered with PREPRUFE® Tape. All PREPRUFE® Tape must be rolled firmly and the tinted release liner removed.

Slices or relief cuts can be butted or overlapped and repaired by applying PREPRUFE® Tape centered over the edge of the overlap or center of the butt joint. Where it is not possible to create a butt joint or overlap, repair with fresh membrane and PREPRUFE® Tape as detailed above.

Reinforcing Steel Anchors

Only compatible rebar supports such as concrete dobies shall be placed against the PREPRUFE® 275/LT membranes. The steel should be tied to the shoring system using GCP approved anchors only.

Contact your local GCP representative for additional information.

Shotcrete Placement

Ensure the plastic release liner is removed from all PREPRUFE®Tapes.

Under most climatic conditions concrete should be poured within 56 days of membrane installation. Where ambient temperatures will exceed 100ºF (38°C) for more than a total of 7 days, concrete should be placed within 42 days of installation of the membrane. Concrete must be placed and compacted carefully to avoid damage to the membrane. Never use a sharp object to consolidate the concrete.

Important: Prior to concrete or shotcrete placement, ensure that the zip strip liner and any plastic release liner is completely removed from all areas of PREPRUFE® 275/LT membranes and PREPRUFE® Tapes.

It is highly recommended that the PREPRUFE® 275/LT membranes system be included in preconstruction test panels successfully meeting the project specifications. The test panel needs a mean core grade less than or equal to 2.5 as described and defined in ACI 506.2 shall be allowed to place shotcrete against the PREPRUFE® 275/LT membranes. Individual shotcrete cores greater than 3 are unacceptable.

Supply

DIMENSIONS (NOMINAL)	PREPRUFE® 275 MEMBRANE
Thickness	0.038 in. (0.95 mm)
Roll size	3 ft 10 in. x 120 ft (1.17 m x 36.6 m)[1]
Roll weight	102 lbs (46 kg)
Minimum side/end laps	3 in. (75 mm)

Note#1 Individual roll length may vary +/-1%

Physical Properties (PREPRUFE® 275/LT MEMBRANE)

PROPERTY	TYPICAL VALUE	TEST METHOD
Color	white	
Thickness	0.038 in. (0.95 mm)	ASTM D3767
Lateral Water Migration Resistance	Pass at 231 ft (71 m) of hydrostatic head pressure	ASTM D5385[1]
Low Temperature Flexibility	Unaffected at -20°F (-29°C)	ASTM D1970
Resistance to hydrostatic head	231 ft (71 m)	ASTM D5385[2]
Elongation	300%	ASTM D412[3]
Tensile strength, film	4000 psi (27.6 Mpa)	ASTM D412
Crack cycling at -9.4°F (-23°C), 100 cycles	Unaffected, Pass	ASTM C8364
Puncture resistance	135 lbs (600 N)	ASTM E154
Peel adhesion to concrete	4 lbs/in. (700 N/m)	ASTM D903[5]
Lap peel adhesion at 72°F (22°C)	7 lbs/in. (1225 N/m)	ASTM D1876[6]
Lap peel adhesion at 40°F (4°C)	7 lbs/in. (1225 N/m)	ASTM D1876[6]
Permeance to water vapor transmission	0.01 perms (0.6 ng/(Pa x s x m^2))	ASTM E96, method B

Footnotes:

1. Lateral water migration resistance is tested by casting concrete against membrane with a hole and subjecting the membrane to hydrostatic head pressure with water. The test measures the resistance of lateral water migration between the concrete and the membrane.
2. Hydrostatic head tests of PREPRUFE® membranes are performed by casting concrete against the membrane with a lap. Before the concrete cures, a 0.125 in. (3 mm) spacer is inserted perpendicular to membrane to create a gap. The cured block is placed in a chamber where water is introduced to the membrane surface up to the head indicated.
3. Elongation of membrane is run at a rate of 2 in. (50 mm) per minute at 72°F (22°C).
4. Concrete is cast against the PREPRUFE® membrane and allowed to cure (7-days minimum).
5. Concrete is cast against the PREPRUFE® membrane and allowed to cure (7-days minimum). Peel adhesion of membrane to concrete is measured at a rate of 2 in. (50 mm) per minute at 72°F (22°C).
6. The test is conducted 15 minutes after the lap is formed at evaluation temperature with rate of 2 in. (50 mm) per minute.

GCP Applied Technologies Inc., 2325 Lakeview Pkwy, Suite 450, Alpharetta, GA 30009 USA.

In Canada, GCP Canada, Inc., 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6.

GCP0083 PF-236-1221

Last Updated: 2021-12-07
gcpat.com/solutions/products/preprufe-comprehensive-waterproofing-system/preprufe-275-preprufe-275-lt

DE NEEF® SWELLSEAL® WA

Gungrade Polyurethane Waterstop

Product Description

DE NEEF® SWELLSEAL® WA is a single component gungrade hydrophilic waterstop, designed for sealing smooth to very irregular construction joints and pipe penetrations. DE NEEF® SWELLSEAL® WA is supplied in cartridges or sausages. Material cures and swells in the presence of moisture or water. Curing time is dependent on temperature and humidity, i.e. curing time will decrease if temperature and relative humidity are higher. DE NEEF® SWELLSEAL® WA will become firm in 24-36 hours.

Product Application

- Sealing rough and smooth construction joints of cast in-place or precast concrete in wet and underwater applications.
- Sealing joints in pre-cast segments in wet or underwater applications (e.g. manholes, box culverts, cable ducts and pipes)
- Sealing joints between sheet piles.
- Creating good contact between Hydrophilic Waterstop Strips and rough concrete surfaces.

Product Advantages

- Solvent free
- Can be applied to wet surfaces or underwater when concrete is poured within 6 hours
- Adheres to concrete, PVC, HDPE, steel, & fiberglass
- Expands to more than 200% of original cured volume
- Flexible system, adapts to irregular surfaces
- Easy application with standard caulking guns
- Good chemical resistance.*

* Chemical Resistance Chart available upon request

Packaging & Handling

10.5 oz. Cartridge	20 oz. Sausage
12 per case 14 lbs	12 per case 25 lbs

Store in dry area for up to 12 months from date of production at temperatures between 40°F and 85°F for best performance. See shelf life details on the material packaging.

Installation Guidelines

DE NEEF ® SWELLSEAL ® WA should be applied onto a dust-free concrete surface. The surface can be rough or smooth, moist or dry.

Application Method

10.5 oz. Cartridges: Use a heavy duty single cartridge gun. Screw on the nozzle and cut diagonally at the appropriate position

20oz. Sausages: Put the sausage in the empty tube of the bulk caulking gun and cut 1/8 inch o the top of the sausage. Close the tube and install the nozzle. Nozzles are supplied with the appropriate opening.

DE NEEF ® SWELLSEAL ® WA must be applied in an uninterrupted band (minimum 3/8" bead), gunned in the middle of the joint or precast element. Concrete cover must be at least 3 inches on all sides, in order to avoid cracks from the pressure of material swelling.

If DE NEEF ® SWELLSEAL ® WA is to be installed under water or during heavy rain, the concrete operation should begin within 2 hours of application to provide confinement for the material or premature swelling may result lowering the effectiveness of the material.

Health and Safety

Always use protective clothing, gloves and goggles consistent with OSHA regulations during use. Avoid eye and skin contact. Do not ingest. Refer to Safety Data Sheet (SDS) for detailed safety precautions. SDS's can be obtained from GCP Applied Technologies or from our web site at gcpat.com.

Limitation

DE NEEF ® SWELLSEAL ® WA must be fully conned on all sides to perform properly. When used in precast or joints, minimum concrete cover is 3" on all sides.

If unconfined, material may expand much greater than 200% and develop an open celled structure, which may result in leaks.

DE NEEF ® SWELLSEAL ® WA is not suitable for surface caulking applications.

When applied at temperatures below 40 ºF, the material will have a significant cure time, possibly exceeding several days.

Properties

PROPERTY	VALUE	TEST
Solids	100%	
Uncured		
Vertical Slump	1/8"	
Skins over	6-10 hrs	
Flash Point	>266ºF	ASTM D93
Cured 7 days at 77oF (22oC) 3/8" thick		
Elongation at break	625%	ASTM D3574
Tensile Strength	312 psi	ASTM D412
Resistance to hydro-static pressure	>330 feet of head	DNCC
Swelling capacity in contact with water	200%	DNCC
Appearance	During application: pasty, Cured: rubbery; Color: Gray	
Coverage		

	Bead	Coverage
10.5 oz.	1/4"	25-35 ft.
	5/16"	12-15 ft.
	3/8"	approx. 10 ft.
20 oz	1/4"	50-70 ft.
	5/16"	24-30 ft.
	3/8"	approx. 20 ft.

GCP Applied Technologies Inc., 62 Whittemore Avenue, Cambridge, MA 02140, USA

GCP Canada, Inc., 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6

This document is only current as of the last updated date stated below and is valid only for use in the United States. It is important that you always refer to the currently available information at the URL below to provide the most current product information at the time of use. Additional literature such as Contractor Manuals, Technical Bulletins, Detail Drawings and detailing recommendations and other relevant documents are also available on www.gcpat.com. Information found on other websites must not be relied upon, as they may not be up-to-date or applicable to the conditions in your location and we do not accept any responsibility for their content. If there are any conflicts or if you need more information, please contact GCP Customer Service.

Last Updated: 2018-08-24

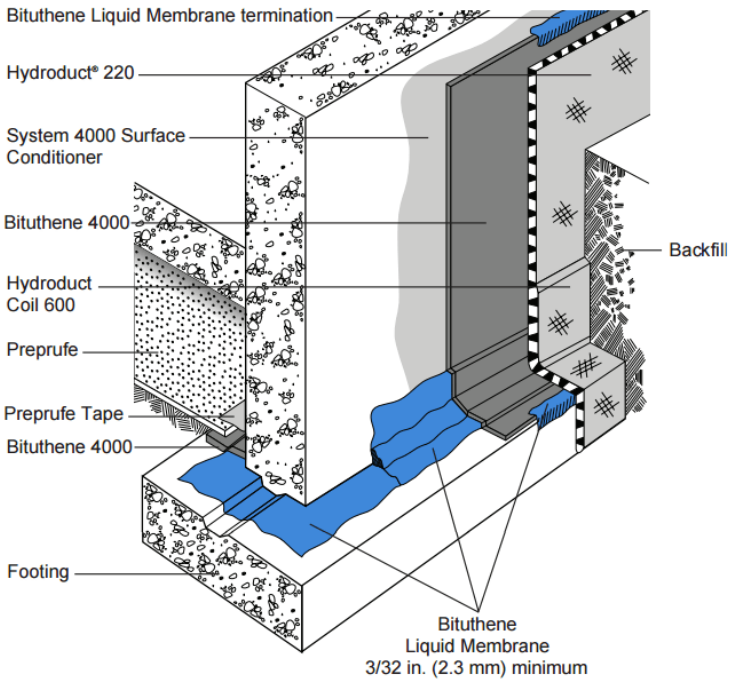
gcpat.com/solutions/products/de-neef-waterproofing-injection-solutions/de-neef-swellseal-wa

BITUTHENE® Liquid Membrane

Two component, elastomeric, liquid applied detailing compound for use with GCP waterproofing membranes

Product Description

BITUTHENE® Liquid Membrane is a two component, elastomeric, cold applied, trowel grade material designed for a variety of uses with the GCP waterproofing systems. The VOC (Volatile Organic Compound) content is 10 g/L. Architectural and industrial maintenance regulations limit the VOC content in products classified as architectural coatings. Refer to Technical Letters for the most current list of allowable limits.



Product Advantages

- Liquid applied
- Waterproof
- Tough, rubber-like
- Chemically cured
- Cold applied
- System compatible

Use

BITUTHENE® Liquid Membrane is ideally suited for the following uses:

- Fillet material at inside corners
- Reinforcement material at inside corners
- Flashing material around drains, protrusions, curbs and parapets
- Sealing material at terminations
- Repair material for defects on concrete surfaces
- Flashing material at corners

The two parts of BITUTHENE® Liquid Membrane are mixed on site and troweled on to provide a simple and quick waterproofing detailing aid in conjunction with BITUTHENE®, PREPRUFE® and PROCOR® systems.

Compatibility

BITUTHENE® Liquid Membrane is completely compatible with BITUTHENE®, PREPRUFE® and PROCOR®, and with existing asphalt or coal tar-based waterproofing materials. It is also compatible with cured silicone and polyurethane sealants. It is not compatible with creosote, pentachlorophenol, linseed oil or polysulfide-based sealants.

Supply

BITUTHENE® Liquid Membrane (Parts A & B)		
Unit size	1.5 gal (5.7 L)	4 gal (15.1 L)
Net weight per unit	16 lbs (8 kg)	44 lbs (20 kg)
Units per pallet	100	24

Physical Properties

PROPERTY	TYPICAL VALUE	TEST METHOD
Part A Color	Black	
Part B Color	Clear	
Mixture of Parts A and B Color	Black	
Solids content	100%	ASTM D1644
Elongation	250% minimum	ASTM D412
Peel strength	5 lbs/in. (880 N/m) minimum	ASTM D903
Flexibility, 180° bend over 1 in. (25 mm) mandrel at -25°F (-32°C)	Unaffected	ASTM D1970

Application Procedures

Safety, Storage and Handling Information

BITUTHENE® products must be handled properly. Vapors from solvent based primers and mastic are harmful and flammable. For these products, the best available information on safe handling, storage, personal protection, health and environmental considerations has been gathered. Safety Data Sheets (SDS) are available on the web site and users should acquaint themselves with this information. Carefully read detailed precaution statements on product labels and the SDS before use.

Surface Preparation

All surfaces must be dry and free from dirt, grease, oil, dust or other contaminants. BITUTHENE® Liquid Membrane may be applied at temperatures of 25°F (-4°C) or above. Store in a dry place above 40°F.

Mixing

Add the entire contents of the Part B container to Part A and mix for 3 to 5 minutes until uniform. Part A is black and Part B is clear. Take care to scrape material from the side and bottom of the containers to ensure thorough mixing. A low speed (150 rpm) mechanical mixer with flat paddle blades is required. Do not apply any material if streaks can be seen due to insufficient mixing. Once mixed, BITUTHENE® Liquid Membrane must be applied by trowel within 1.5 hours. More time is available at lower temperatures.

At high temperatures, thickening and curing will be faster. Material that has thickened must be discarded. The material will cure to a very flexible rubber-like material.

BITUTHENE® Liquid Membrane must be applied at a minimum thickness of 3⁄16 in. (2.3 mm) unless otherwise noted on details. 32 In fillet applications, the face of the fillet should be a minimum of ¾ in. (20 mm). In corner flashing application details, it should extend 6 in. (150 mm) in each direction from the corner. BITUTHENE® Liquid Membrane will adhere to primed or unprimed concrete.

BITUTHENE® Liquid Membrane should be allowed to cure at least 24 hours before flood testing.

Coverage

As a fillet material, 1 gal (3.8 L) will cover approximately 100 linear feet (30 m). As a flashing material, 1 gal (3.8 L) will cover approximately 17 f^2 (1.6 m^2). As a fillet and reinforcement, 1 gal (3.8 L) will cover approximately 14 linear feet (4.3 m).

Cleaning

Clean tools and equipment with mineral spirits before BITUTHENE® Liquid Membrane has cured. Mineral spirits is a combustible liquid and should be used only in accordance with the manufacturer's safety recommendations. Do not use solvents to clean hands or skin.

GCP Applied Technologies Inc., 62 Whittemore Avenue, Cambridge, MA 02140 USA.

In Canada, GCP 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6.

Last Updated: 2022-01-25

PREPRUFE® Tape and PREPRUFE® CJ Tape

Product Description

PREPRUFE®Tape and PREPRUFE®CJ Tape are specially formulated two sided, reinforced pressure sensitive tapes. The bottom side of the tape has a highly aggressive pressure sensitive adhesive which is designed to adhere to penetrations, protrusions and GCP waterproofing membranes and accessories. The top side of the tape has a pressure sensitive adhesive, a weather resistant protective coating and a release liner. Concrete is cast directly against the protective white coating of the tape. The specially developed PREPRUFE®adhesive layers work together to form a continuous and integral seal to the structure.

PREPRUFE®Tape and PREPRUFE®CJ Tape are provided in Low Temperature and Hot Climate Grades as follows:

- **PREPRUFE® Tape LT Grade and PREPRUFE® CJ Tape LT Grade** - or temperatures between 25°F (-4°C) and 86°F (+30°C).
- **PREPRUFE® Tape HC Grade and PREPRUFE® CJ Tape HC Grade** - for use in Hot Climates (minimum 50°F (10°C)).

Use

PREPRUFE®Tape is a 4 in. (100 mm) wide tape used in detail areas including end laps, penetrations and various tie-ins. It is also used to patch damaged areas in the PREPRUFE®membranes.

PREPRUFE®CJ Tape is an 8 in. (200 mm) wide tape used at construction joints in the concrete that is cast against it or in critical areas where a wider tape is required.

Application

Wipe substrates to receive PREPRUFE®Tape and PREPRUFE®CJ Tape clean to remove any dirt, dust or moisture. Clean the surface of penetrations or protrusions with a wire brush to remove dirt, dust, rust and loose particles.

Unroll the tape and adhere the exposed pressure sensitive adhesive surface to the membrane or penetration. The protective coating surface of the tape should face toward the concrete to be cast onto the tape.

The use of rollers is required to maximize adhesion. Remove the release liner during application.

Ensure the plastic release liner is removed from all areas of PREPRUFE®Tape and PREPRUFE®CJ Tape. It is recommended that concrete be poured within 56 days (42 days in hot climates) of application of the PREPRUFE® system. Following proper ACI guidelines, concrete must be placed carefully and consolidated properly to avoid damage to the membrane. Never use a sharp object to consolidate the concrete. Provide temporary protection from concrete over splash for areas of the tape that are adjacent to a concrete pour.

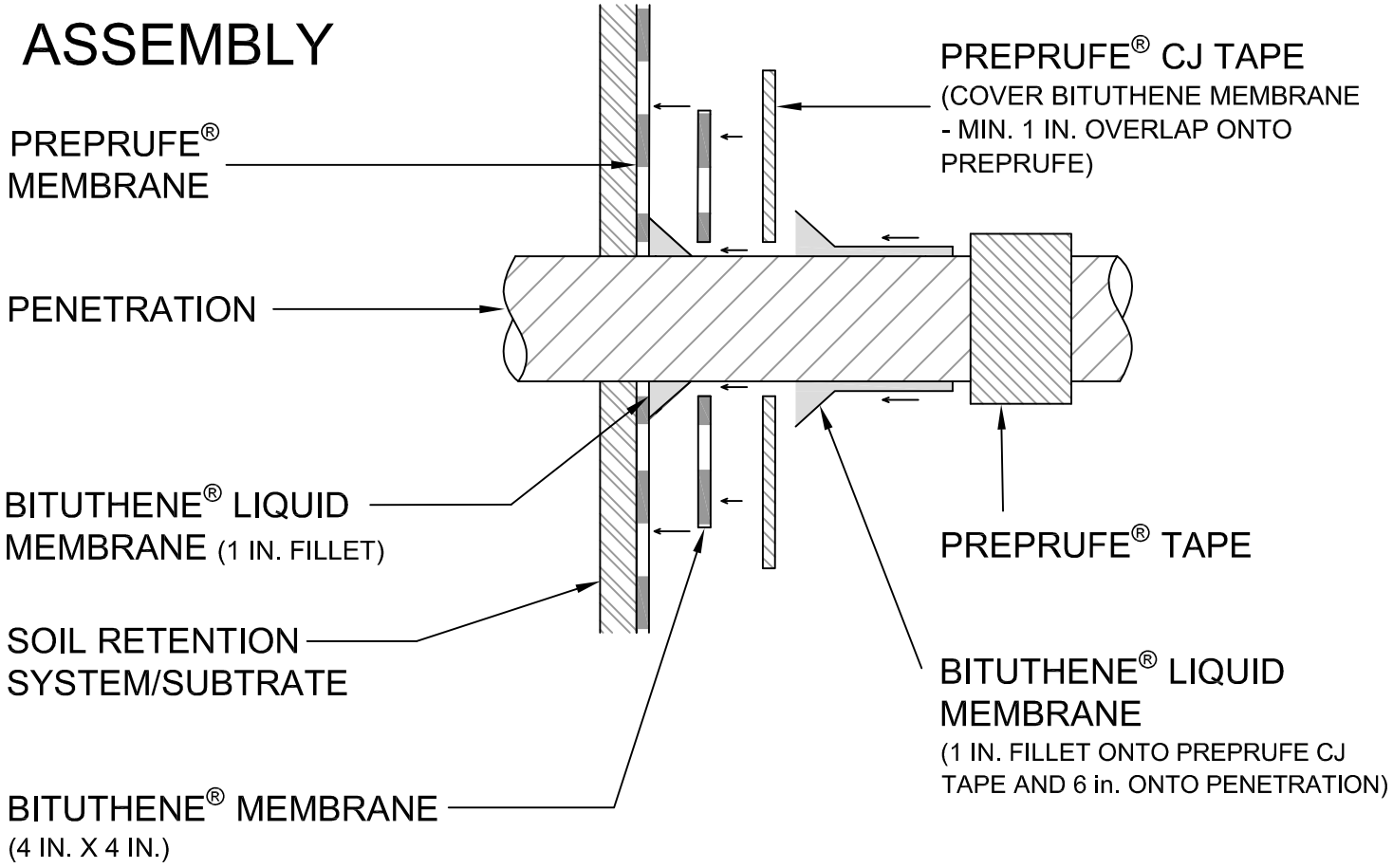
DIMENSIONS (NOMINAL)	PREPRUFE® TAPE (HC OR LT)	PREPRUFE® CJ TAPE (HC OR LT)
Roll Size	4 in. x 49 ft. (100 mm x 15 m)	8 in. x 49 ft. (200 mm x 15 m)
Roll Weight	4.3 lbs (2 kg)	8.6 lbs (4 kg)

GCP Applied Technologies Inc., 62 Whittemore Avenue, Cambridge, MA 02140 USA.

In Canada, 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6.

Last Updated: 2022-01-11
gcpat.com/solutions/products/preprufe-comprehensive-waterproofing-system/preprufe-tape-and-preprufe-cj-tape

ASSEMBLY



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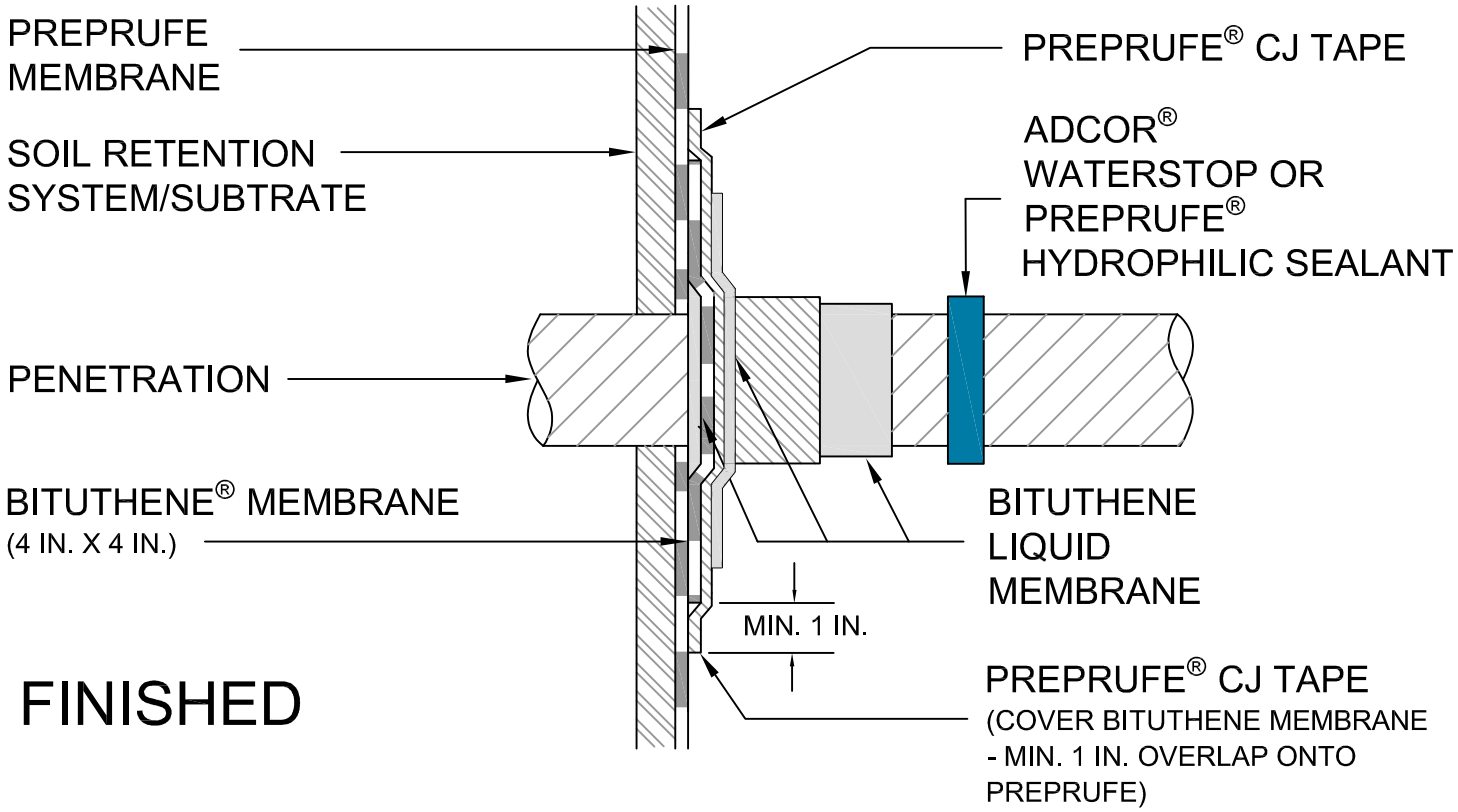


gcp applied technologies

REBAR, DOWEL & ALL-THREAD PENETRATION

PREPRUFE® WATERPROOFING SYSTEM

DRAWING: PRE-049
SCALE: Not to scale
EFFECTIVE DATE: 07/01/2016
SUPERCEDES: 04012015

INSTALLATION INSTRUCTIONS

Wall Penetration

(Rebar, Dowel, All-Thread)

Prior to Membrane Installation, Review the Preprufe® Data Sheet

Surface Prep

All surfaces must be sound and solid to eliminate movement during the concrete pour. Substrate must be regular and smooth with no gaps or voids greater than 0.5 in (15 mm). The surface should also be free from loose aggregate and sharp protrusions as outlined in the Preprufe® Data Sheet section on Surface Preparation.

Detailing

1. All penetrations must be firmly secured and stable. Grout around all penetrations that are not stable. Clean loose dust or dirt from the penetration and the surrounding substrate surface using a clean, dry cloth or brush.
2. Cut the field membrane tight to the penetration and remove release liner. If membrane is not within 0.5 in (15 mm) of penetration and not more than 2 in (50 mm) from penetration, apply Preprufe Tape to cover the gap. Roll firmly into place and remove release. If the membrane is greater than 2 in (50 mm) from penetration, install more Preprufe Membrane to cover the gap repeating these instructions until Preprufe Membrane/ Tape is within 0.5 in (15 mm).
3. Install appropriate shallow head fasteners within 2 in (50 mm) of penetration as necessary to ensure Preprufe Membrane remains tight to substrate.
4. Mix and apply Bituthene Liquid Membrane around the penetration. Liquid Membrane should be placed to form a minimum 1 in (25 mm) continuous fillet at the base of the penetration.
5. Slide a 4 in (150 mm) x 4 in (150 mm) patch of Bituthene centered over the penetration and press firmly into the partially cured Liquid Membrane.
6. Install an 8 in (200 mm) x 8 in (150 mm) patch of Preprufe CJ Tape over the penetration ensuring that it completely covers the Bituthene Membrane patch and overlaps a minimum of 1 in (25 mm) onto the field Preprufe Membrane.
7. Apply Liquid Membrane to form a minimum 1 in (25 mm) continuous fillet between the Preprufe CJ Tape and the base of the penetration. Extend a 90-mil (2.2 mm) continuous coating of Liquid Membrane minimum of 6 in (150 mm) out onto the penetration.
8. Wrap the penetration with Preprufe Tape, positioning the tape at the base of the penetration. Remove enough release liner to overlap tape on to itself and roll/ press firmly into place. Remove remaining release liner and discard.

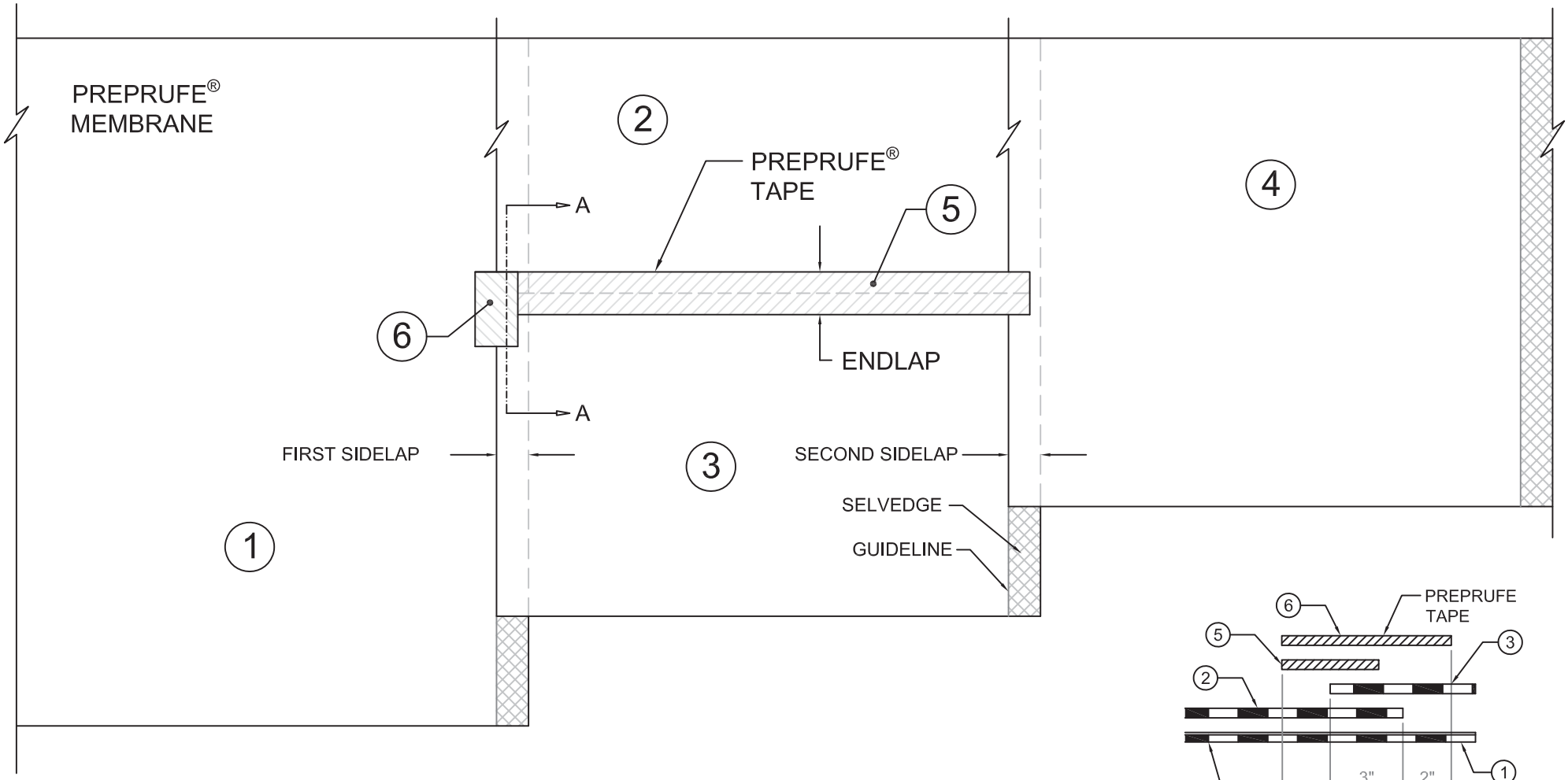
Special Notes

Preprufe membranes should not be used in areas where they will be permanently exposed to sunlight, weather or traffic. Protect membrane from sunlight as quickly as possible after installation.

Ensure Adcor® waterstop is encapsulated with 3 in (75 mm) of concrete cover minimum.

Apply Adcor® waterstop according to the installation instructions found on the data sheet.

GCP may require an alternative GCP waterstop based on design conditions, at GCP's discretion.



SECTION "A-A"

NOTES: - INSTALL PREPRUFE® MEMBRANE AND TAPE IN ORDER AS SHOWN BY NUMBERS
- DETAIL ALSO APPLICABLE FOR PREPRUFE PLUS

gcp applied technologies

END LAP DETAIL FOR WALL OR SLAB - OPTION 1
TAPE APPLIED AFTER INSTALLATION OF SIDE LAPS
PREPRUFE® WATERPROOFING SYSTEM

DRAWING: PRE 031
SCALE: Not to scale
EFFECTIVE DATE: 07/01/2016
SUPERCEDES: 04012015

INSTALLATION INSTRUCTIONS

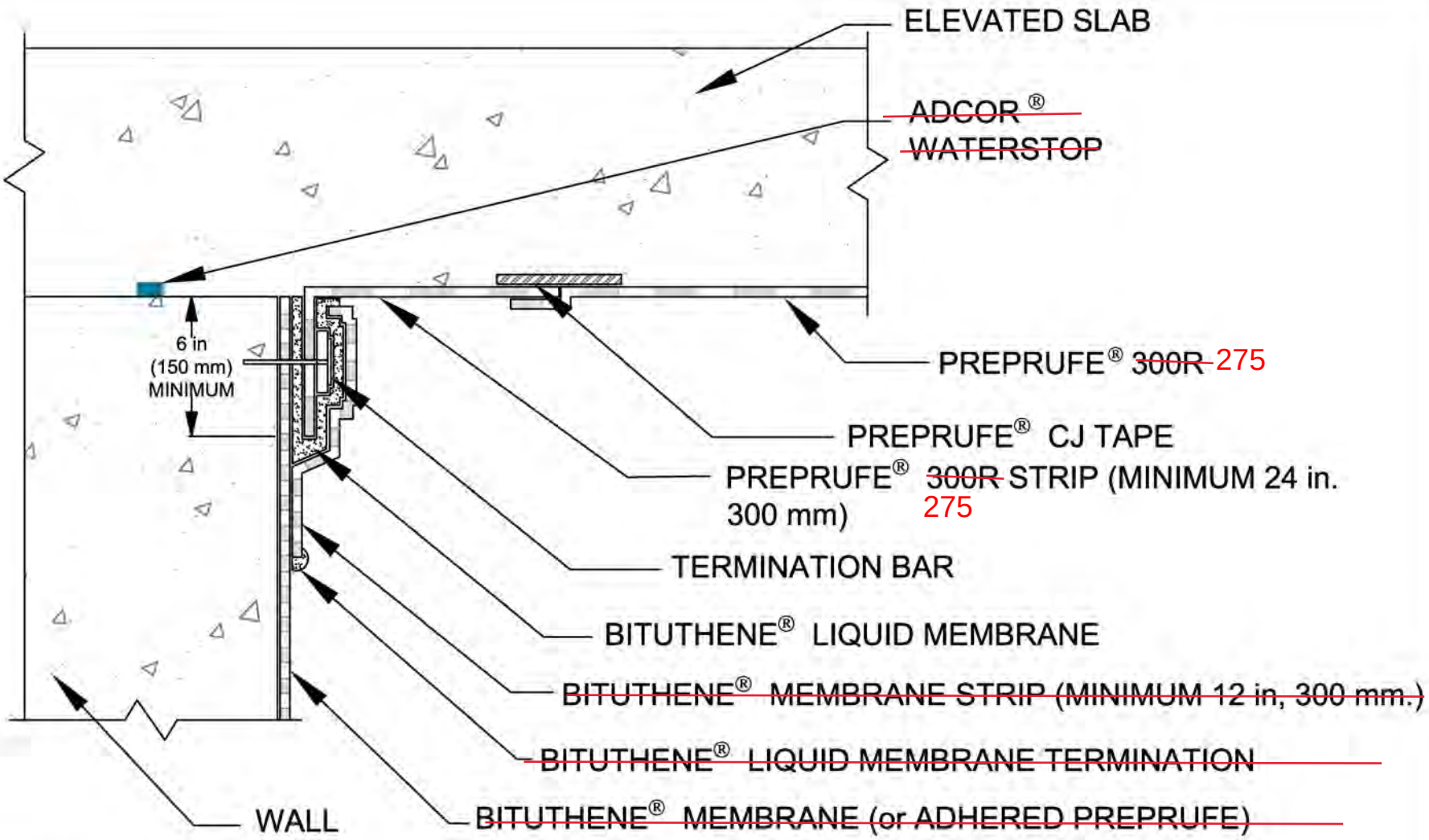
End Lap Detail for Wall or Slab Option-1

Tape applied after installation of the side laps
Prior to Membrane Installation, Review the Preprufe® Data Sheet

Surface Prep
All surfaces must be sound and solid to eliminate movement during the concrete pour. Substrate must be regular and smooth with no gaps or voids greater than ½ inch. The surface should also be free from loose aggregate and sharp protrusions as outlined in the Preprufe® Data Sheet section on Surface Preparation.

Detailing
1. Apply Hydroduct® according to Hydroduct Data Sheet.
2. Install Preprufe Membrane and tape in order as shown by numbers.
3. Overlap the ends of the membrane a minimum of 3 in (75 mm) and remove release liner from both membranes.
4. Apply Preprufe Tape over the end lap as shown and roll firmly.
5. Apply tape a minimum of 2 in (50 mm) beyond all edges of membrane that are not sealed by the selvedge.
6. Remove release liner from tape and discard.

Special Notes
Preprufe membranes should not be used in areas where they will be permanently exposed to sunlight, weather or traffic. Protect membrane from sunlight as quickly as possible after installation.



NOTES:

- PREPRUFE STRIP SHOULD BE PROTECTED DURING BACKFILL PLACEMENT AND COMPACTION
- FOLD PREPRUFE STRIP BACK ONTO COMPACTED EARTH/GRAVEL FOR TIE-IN WITH PREPRUFE MEMBRANE UNDERSLAB
- PROTECTION COURSE/DRAINAGE & BACKFILL NOT SHOWN FOR CLARITY
- DETAIL ALSO APPLICABLE TO TIE PREPRUFE INTO PREVIOUSLY INSTALLED (ADHERED) PREPRUFE
- GCP MAY REQUIRE AN ALTERNATE GCP WATERSTOP BASED ON DESIGN CONDITIONS

gcp
applied technologies

BITUTHENE® TIE-IN WITH ELEVATED SLAB

PREPRUFE® WATERPROOFING SYSTEM

DRAWING: PRE-061
SCALE: Not To Scale
Effective Date: 07/01/2016
Supersedes: 04012015

INSTALLATION INSTRUCTIONS

Bituthene Tie-In with Elevated Slab

Prior to Membrane Installation, Review the Preprufe® Data Sheet

Surface Prep

All surfaces must be sound and solid to eliminate movement during the concrete pour. Substrate must be regular and smooth with no gaps or voids greater than 0.5 in(15 mm). The surface should also be free from loose aggregate and sharp protrusions as outlined in the Preprufe® Data Sheet section on Surface Preparation.

Detailing

1. Install Preprufe membrane in accordance with the Preprufe data sheet section on installation.
2. Install Bituthene® Liquid Membrane from the top of the wall over the existing Bituthene® Membrane, extending down a minimum of 6 in (150 mm).
3. While the Bituthene Liquid Membrane is still “wet” (uncured), embed 6 in (150 mm) of a min. 24 in (600 mm) Preprufe 300R strip.
4. Install a termination bar through the Preprufe 300R securely into the vertical wall.
5. Re-flash over the edge of the Preprufe 300R with Bituthene Liquid Membrane and extend up over the termination bar ensuring the Preprufe 300R and the termination bar are fully encapsulated with Bituthene Liquid Membrane.
6. Install a 12 in (300 mm) strip of Bituthene Membrane from the top of the wall extending down over the Bituthene Liquid Membrane/ termination bar and onto the existing Bituthene Membrane.
7. Terminate the bottom edge, top edge and all seams of the Bituthene strip with Bituthene Liquid Membrane.
8. Protect the Preprufe 300R strip during backfill, placement and compaction.
9. Fold the Preprufe 300R strip back onto the compacted earth/gravel for tie-in with Preprufe 300R underslab.
10. Ensure that the Bituthene and vertically installed Preprufe are protected with an approved protection course prior to backfill.

Special Notes

Preprufe membranes should not be used in areas where they will be permanently exposed to sunlight, weather or traffic. Protect membrane from sunlight as quickly as possible after installation.

Hydroduct or approved protection course not shown for clarity.

GCP may require an alternative GCP waterstop based on design conditions, at GCP’s discretion.

APPENDIX C

Clubhouse Passive Venting System Specification

SLAB NOTES

A. SEE STRUCTURAL PLANS FOR SLAB & FOOTING INFORMATION.
B. COORDINATE ADDITIONAL PENETRATIONS WITH PLUMBING, ELECTRICAL, & MECHANICAL PLANS.
C. SEE OVERALL FLOOR PLANS FOR DIMENSIONS.
D. COORDINATE WITH CIVIL PLANS FOR FINISH FLOOR ELEVATIONS AND DRAINGE INFORMATION AND DETAILS. NOTIFY ARCHITECT WITH ANY DISCREPANCIES.
E. SEE SHEET A9.12 FOR TYPICAL SLAB ON GRADE WATERPROOFING DETAILS.

LEGEND

AREA OF R-2 OCCUPANCY GROUP AT LEVEL 1 (DIRECT CONTACT WITH GROUND) REQUIRES TO INSTALL RADON MITIGATION SYSTEM, SEE *RADON MITIGATION NOTES* FOR MORE INFORMATION AT BUILDINGS 1-5.

6" CONCRETE CURB, U.N.O.

SLAB ON GRADE, S.S.D.

SLAB ON PATIO, S.S.D.

REFERENCE NOTES

060 CONCRETE PAD AT ELECTRICAL SWITCHGEAR. CONFIRM AND COORDINATE WITH ELECTRICAL DRAWINGS FOR SWITCHGEAR SIZING. CONCRETE PAD TO BE WIDER THAN GEAR ON ALL SIDES, SEE PLAN (GEAR SHOWN DASHED). REFER TO MANUFACTURER'S SPECIFICATIONS FOR ANCHORAGE AND CONCRETE SLAB THICKNESS, WITH #4 BARS @ 18" O.C. EACH WAY.

113 RADON MITIGATION VENTILATION PIPE. EXTEND UP TO AND THROUGH ROOF PER OSSC REQUIREMENTS. COORDINATE WITH PLUMBING DRAWINGS. PROVIDE ELECTRICAL CONNECTION FOR FUTURE INSTALLATION OF EXHAUST FAN.

115 RADON CONVEYANCE PIPE. COORDINATE WITH PLUMBING DRAWINGS AND REQUIREMENTS OF OSSC.

299 STRUCTURAL COLUMN, S.S.D.

RADON MITIGATION

RADON MITIGATION SYSTEM TO BE INSTALLED PER 2019 OREGON STRUCTURAL SPECIALTY CODE (OSSC)

1811.1 SCOPE
THE PROVISIONS OF THIS SECTION APPLY TO NEW PUBLIC BUILDINGS, AS DEFINED IN SECTION 202, WHICH ARE BUILT IN BAKER, CLACKAMAS, HOOD RIVER, MULTNOMAH, POLK, WASHINGTON AND YAMHILL COUNTIES, FOR WHICH INITIAL BUILDING PERMITS ARE ISSUED ON OR AFTER APRIL 1, 2013.

EXCEPTION: PUBLIC BUILDINGS OF GROUP R-2 OR R-3 OCCUPANCY CLASSIFICATIONS SHALL COMPLY WITH SECTION 1812.

PER OSSC SECTION 202'
PUBLIC BUILDING.
ANY BUILDING OR STRUCTURE THAT IS PUBLICLY OWNED.

THE CLUBHOUSE IS PRIVATELY OWNED, THEREFORE OSSC SECTION 1811 DOES NOT APPLY.

SECTION 1812 - RADON CONTROL METHODS - GROUP R-2 AND R-3 OCCUPANCIES

1812.1 SCOPE
THE PROVISIONS OF THIS SECTION APPLY TO NEW GROUP R-2 AND R-3 OCCUPANCIES CONSTRUCTED IN BAKER, CLACKAMAS, HOOD RIVER, MULTNOMAH, POLK, WASHINGTON AND YAMHILL COUNTIES FOR WHICH INITIAL BUILDING PERMITS ARE ISSUED ON OR AFTER APRIL 1, 2011.

THE CLUBHOUSE DOES NOT CONTAIN R OCCUPANCIES, THEREFORE OSSC SECTION 1812 DOES NOT APPLY.

PLEASE NOTE: MITIGATION PLANS WILL STILL BE UTILIZED, BUT FOR VENTING OR CONTAMINATED SOIL (NOT RADON) AT THE CLUBHOUSE.

RADON MITIGATION SYSTEM TO BE INSTALLED PER 2019 OREGON STRUCTURAL SPECIALTY CODE (OSSC)

1812.2.1 SUBFLOOR PREPARATION.
A LAYER OF GAS-PERMEABLE MATERIAL SHALL BE PLACED UNDER ALL CONCRETE SLABS AND OTHER FLOOR SYSTEMS THAT DIRECTLY CONTACT THE GROUND AND ARE WITHIN THE WALLS OF THE LIVING SPACES OF THE BUILDING TO FACILITATE FUTURE INSTALLATION OF A SUBSLAB DEPRESSURIZATION SYSTEM, IF NEEDED.

1812.2.2 SOIL-GAS RETARDER.
A MINIMUM **6-MIL (0.15 MM) [OR 3-MIL (0.075 MM) CROSS-LAMINATED]** POLYETHYLENE OR EQUIVALENT FLEXIBLE SHEETING MATERIAL SHALL BE PLACED ON TOP OF THE GAS-PERMEABLE LAYER PRIOR TO CASTING THE SLAB OR PLACING THE FLOOR ASSEMBLY TO SERVE AS A SOIL-GAS RETARDER BY BRIDGING ANY CRACKS THAT DEVELOP IN THE SLAB OR FLOORASSEMBLY AND TO PREVENT CONCRETE FROM ENTERING THE VOID SPACES IN THE AGGREGATE BASE MATERIAL. THE SHEETING SHALL COVER THE ENTIRE FLOOR AREA WITH SEPARATE SECTIONS OF SHEETING LAPPED AT LEAST **12 INCHES** (305 MM). THE SHEETING SHALL FIT CLOSELY AROUND ANY PIPE, WIRE OR OTHER PENETRATIONS OF THE MATERIAL. ALL PUNCTURES OR TEARS IN THE MATERIAL SHALL BE SEALED OR COVERED WITH ADDITIONAL SHEETING.

1812.2.3.1 FLOOR OPENINGS.
OPENINGS AROUND BATHTUBS, SHOWERS, WATER CLOSETS, PIPES, WIRES OR OTHER OBJECTS THAT PENETRATE CONCRETE SLABS OR OTHER FLOOR ASSEMBLIES SHALL BE FILLED WITH A POLYURETHANE CAULK OR EQUIVALENT SEALANT APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

1812.2.3.2 CONCRETE JOINTS.
ALL CONTROL JOINTS, ISOLATION JOINTS, CONSTRUCTION JOINTS AND ANY OTHER JOINTS IN CONCRETE SLABS OR BETWEEN SLABS AND FOUNDATION WALLS SHALL BE SEALED WITH A CAULK OR SEALANT. GAPS AND JOINTS SHALL BE CLEANED OF LOOSE MATERIAL AND FILLED WITH POLYURETHANE CAULK OR OTHER ELASTOMERIC SEALANT APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

1812.2.3.8 DUCTS.
DUCTWORK PASSING THROUGH OR BENEATH A SLAB SHALL BE OF SEAMLESS MATERIAL UNLESS THE AIR-HANDLING SYSTEM IS DESIGNED TO MAINTAIN CONTINUOUS POSITIVE PRESSURE WITHIN SUCH DUCTING. JOINTS IN SUCH DUCTWORK SHALL BE SEALED TO PREVENT AIR LEAKAGE. DUCTWORK LOCATED IN CRAWL SPACES SHALL HAVE ALL SEAMS AND JOINTS SEALED BY CLOSURE SYSTEMS IN ACCORDANCE WITH SECTION 603.9 OF THE MECHANICAL CODE.

1812.2.6 SUBSLAB SOIL EXHAUST SYSTEM DUCTS (SSESD).
SSESDS SHALL BE PROVIDED IN ACCORDANCE WITH THIS SECTION AND SHALL RUN CONTINUOUS FROM BELOW THE SOIL-GAS RETARDER TO THE TERMINATION POINT DESCRIBED IN SECTION 1812.2.6.5. SSESDS SHALL CONSIST OF ONE 3- OR 4-INCH DIAMETER SOLID PIPE OR MULTIPLE PIPES PROVIDING THE SAME CROSS-SECTIONAL AREA. ALL ANNULAR OPENINGS BETWEEN THE SSESD AND FLOOR SLABS OR SOIL-GAS RETARDERS SHALL BE SEALED AIRTIGHT. IN ADDITION, ALL SSESD JOINTS SHALL BE SEALED AIRTIGHT. PENETRATIONS OF SSESDS THROUGH FIRE-RESISTIVE CONSTRUCTION SHALL COMPLY WITH THE APPLICABLE SECTIONS OF CHAPTER 7 OF OSSC. SSESDS SHALL BE LOCATED WITHIN THE BUILDING'S INSULATED ENVELOPE AND MAY BE COMBINED ABOVE THE SLAB WHERE THECROSS-SECTIONAL AREA OF ALL COMBINED SSESDS IS MAINTAINED TO THE REQUIRED TERMINATION POINT.

1812.2.6.1 LOCATION.
ONE SSESD SHALL BE INSTALLED FOR EVERY **2,000 FT² (186 M²)**, OR PORTION THEREOF, OF BUILDING SUBSLAB OR CRAWL SPACE AREA SERVED. WHERE SUBSLAB AREAS ARE ISOLATED BY SUBSLAB WALLS, EACH SUBSLAB AREA SHALL BE PROVIDED WITH SEPARATE SSESDS.

1812.2.6.2 MATERIALS.
SSESD MATERIAL SHALL BE AIR DUCT MATERIAL LISTED AND LABELED TO THE REQUIREMENTS OF UL 181 FOR CLASS 0 AIR DUCTS, OR ANY OF THE FOLLOWING PIPING MATERIALS THAT COMPLY WITH THE PLUMBING CODE AS BUILDING SANITARY DRAINAGE AND VENT PIPE: CAST IRON; GALVANIZED STEEL; BRASS OR COPPER PIPE; COPPER TUBE OF A WEIGHT NOT LESS THAN THAT OF COPPER DRAINAGE TUBE, TYPE DWV; AND PLASTIC PIPING.

1812.2.6.5 TERMINATION.
SSESDS SHALL EXTEND THROUGH THE ROOF AND TERMINATE NOT LESS THAN **6 INCHES (152 MM)** ABOVE THE ROOF AND NOT LESS THAN **10 FEET (3048 MM)** FROM ANY OPERABLE OPENINGS OR AIR INTAKE.

1812.2.6.6 IDENTIFICATION.
ALL EXPOSED AND VISIBLE INTERIOR SSESDS SHALL BE PERMANENTLY IDENTIFIED WITH AT LEAST ONE LABEL ON EACH FLOOR AND IN ACCESSIBLE ATTICS.THE LABEL SHALL BE BY MEANS OF A TAG, STENCIL OR OTHER APPROVED MARKING THAT STATES: **"RADON REDUCTION SYSTEM."**

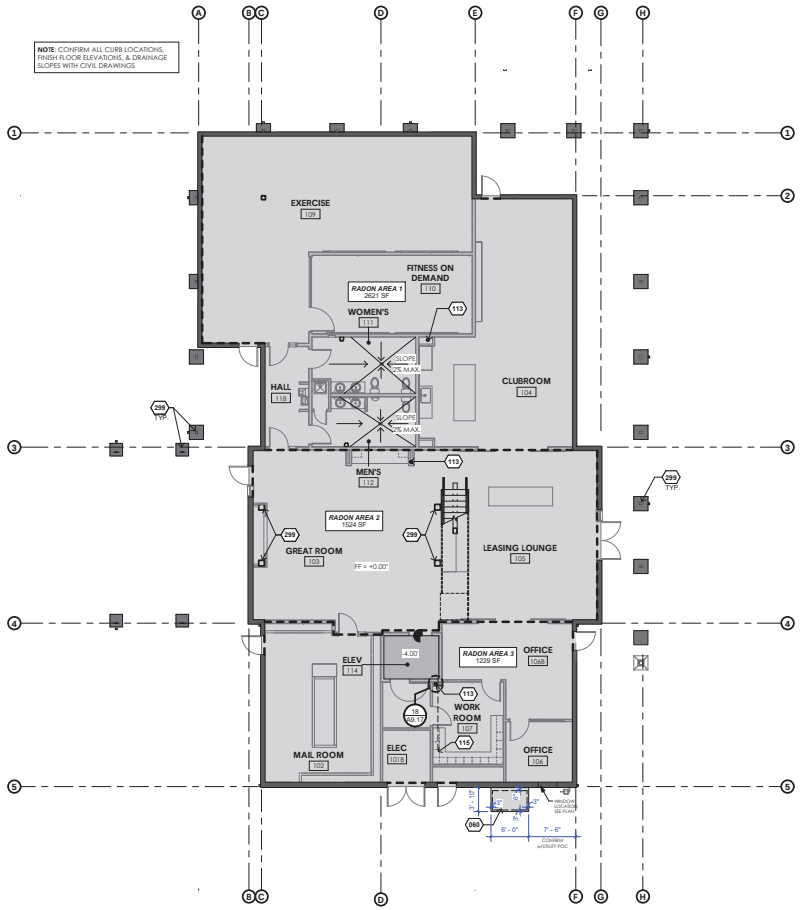
1812.2.8 POWER SOURCE. TO PROVIDE FOR FUTURE INSTALLATION OF AN ACTIVE SUBMEMBRANE OR SUBSLAB DEPRESSURIZATION SYSTEM, AN ELECTRICAL CIRCUIT TERMINATED IN AN APPROVED BOX SHALL BE INSTALLED DURING CONSTRUCTION IN THE ATTIC OR OTHER ANTICIPATED LOCATION OF VENT PIPE FANS. AN ELECTRICAL SUPPLYSHALL ALSO BE ACCESSIBLE IN ANTICIPATED LOCATIONS OF SYSTEM FAILURE ALARMS.

PARCEL II - ENVIRO NOTES

USE DETAIL **F2/A9.01** FOR SLAB ASSEMBLY DETAIL. FOR ANY SLAB PENETRATIONS LOCATED ON PARCEL II (CLUBHOUSE AND GARAGE 2 BUILDING) SEE RADON MITIGATION NOTES - 1812.2.3.1, 1812.2.3.2, AND 1812.2.3.8.

VAPOR BARRIER TO BE USED IN LIEU OF THE 6 MIL POLYETHYLENE RADON MITIGATION

1 NOTES:
PREPRUFE® 275 MEMBRANE OR EQUIVALENT WILL BE INSTALLED TO PROVIDE VAPOR INTRUSION MITIGATION IN THE FORM OF A ROBUST VAPOR BARRIER, MANUFACTURED BY GCP APPLIED TECHNOLOGIES. PREPRUFE 275 MEMBRANE CONSISTS OF COMPOSITE SHEETS COMPRISED OF THICK HIGH-DENSITY POLYETHYLENE (HDPE) FILM, PRESSURE-SENSITIVE ADHESIVE, AND WEATHER-RESISTANT PROTECTIVE COATING.



1 CLUBHOUSE - SLAB PLAN & RADON MITIGATION
1/8" = 1'-0"

TRUE NORTH PROJECT NORTH

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Project
MONROE APARTMENTS
10999 SE 37TH AVENUE, MILWAUKIE, OR 97222
CLUBHOUSE - SLAB PLAN & RADON MITIGATION

NO.	REVISION	DATE
1	PLAN CHECK RESPONSE	06/04/2021
2	DSG REV SET ISSUE	07/16/2021
3	CONSTRUCTION SET	11/05/2021

Project A20070
Date 12/21/2020
Sheet **A4.01**

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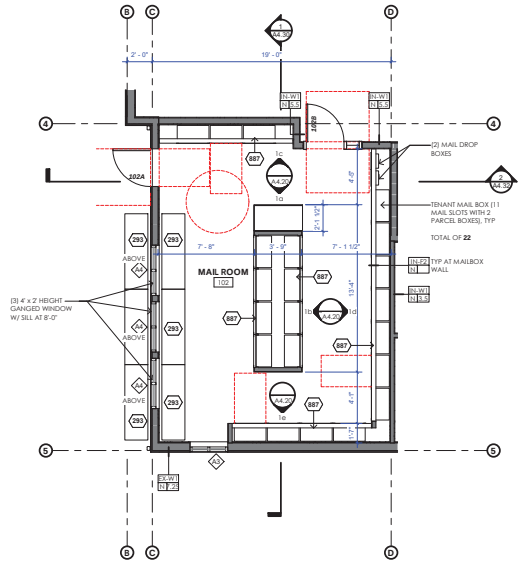
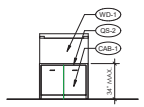


1 ENLARGED FLOOR PLAN - MAIL ROOM
1/4" = 1'-0"



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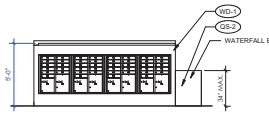

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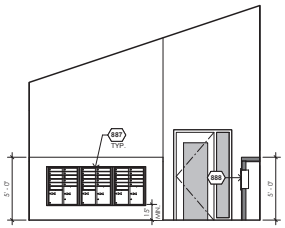

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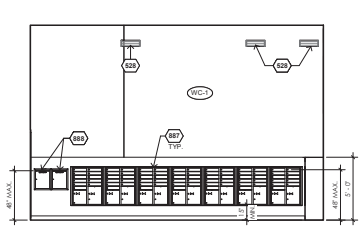

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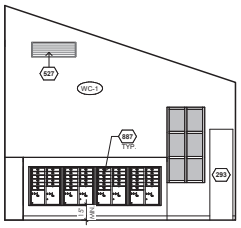

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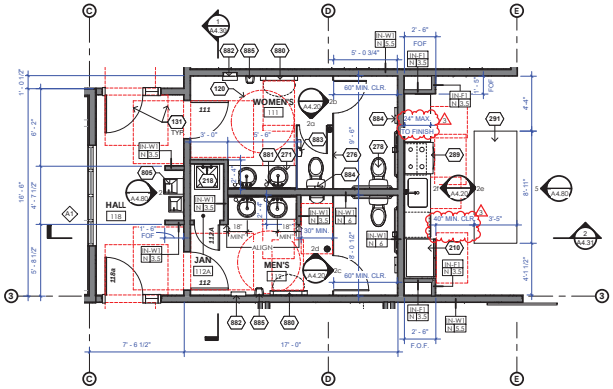
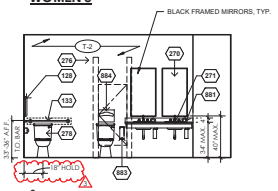


2 ENLARGED FLOOR PLAN - CLUBROOM KITCHEN & RESTROOMS
1/4" = 1'-0"

WOMEN'S



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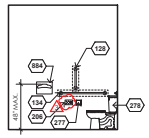

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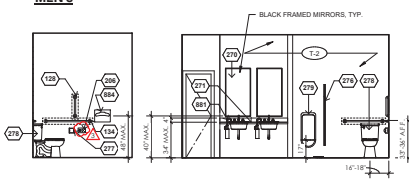
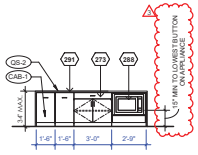
MEN'S



2c 2d

CLUBROOM KITCHEN



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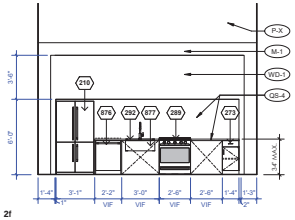

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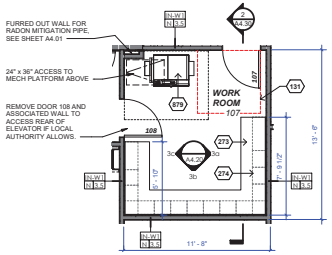
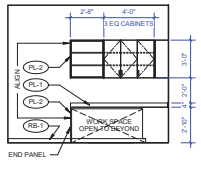
3 ENLARGED FLOOR PLAN - WORK ROOM
1/4" = 1'-0"





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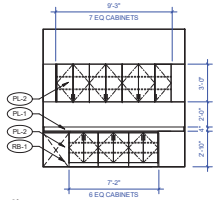

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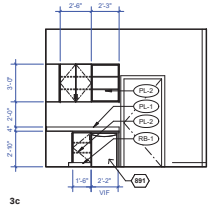

3c

GENERAL NOTES

A. SEE 1/#" PLANS FOR ENLARGED PLAN LOCATIONS, ORIENTATIONS, PERIMETER WALL TYPES, AND BUILDING INFORMATION.
B. SEE A1.X SHEETS FOR CODE COMPLIANCE INFORMATION.
C. SEE A0.20 & A0.21 SHEET FOR STANDARD MOUNTING HEIGHTS AND REQUIREMENTS UNO.
D. ALL DIMENSIONS ARE TO FACE OF STUD U.O.N OR CENTER OF COLUMN OR GRID. DIMENSIONS INDICATED AS "CLR MIN" ARE TO FACE OF FINISH.
E. ALL DOOR OPENINGS PERPENDICULAR TO A WALL ARE 4" TO THE WALL U.O.N. ALL CLOSET DOOR OPENINGS ARE CENTERED ON INSIDE OF CLOSET U.O.N.
F. WINDOWS AND EXTERIOR DOORS SHOWN FOR REFERENCE ONLY. SEE 1/#" BUILDING PLANS AND ELEVATIONS FOR LOCATIONS AND TYPES.
G. ALL GRAY DASHED RECTANGLES AND CIRCLES REPRESENT ICC/ANSI A117.1-2003 CLEAR FLOOR AREAS AND ARE SHOWN FOR REFERENCE ONLY.
H. FURNITURE SHOWN FOR REFERENCE ONLY.
I. SEE STRUCTURAL DRAWINGS FOR PLYWOOD SHEATHING LOCATIONS AT SHEAR WALLS.
J. CONTRACTOR TO CONFIRM ALL CLEARANCE DIMENSIONS WITH MANUFACTURER PRIOR TO CONSTRUCTION. NOTIFY ARCHITECT OF ANY ADJUSTMENTS TO STUD LOCATIONS PRIOR TO INSTALL.

FINISH PLAN LEGEND

P-1 PAINT TAG
INDICATES FINISH DIRECTION
CPT-1 FLOOR FINISH TAG

TAG	MATERIAL
ACC	ACCESSORY
APP	APPLIANCE
CAB	CABINETRY
CPT	CARPET
CONC	CONCRETE
FRP	FIBERGLASS-REINFORCED PANEL
L	LIGHTING
LVP	LUXURY VINYL PLANK
M	METAL
P	PAINT
PL	PLASTIC LAMINATE
QS	QUARTZ SURFACE
RB	RUBBER BASE
RF	RESILIENT FLOORING
SC	SEALED CONCRETE
SDT	STATIC DISSAPATIVE TILE
T	TILE
TR	TRIM
UPH	UPHOLSTERY
WC	WALL COVERING
WD	WOOD
WOM	WALK-OFF MATT
WT	WINDOW TREATMENT

SEE FINISH SCHEDULE ON SHEET A4.90 FOR MORE INFORMATION

WALL TYPES LEGEND

WALL TYPE	1 HR RATING (SEE FLOOR PLANS)	WALL TYPE (SEE A1.WALL SHEETS FOR FLOOR PLANS)	DETAIL
NON-RATED			
		EX-W1 EXTERIOR WALL	1/A 9.00
		EX-W2 EXTERIOR WALL	2/A 9.00
		IN-F1 INTERIOR WOOD FURRED WALL	F1/A 9.00
		IN-F2 INTERIOR METAL FURRED WALL	F2/A 9.00
		IN-W1 INTERIOR WALL	A/A 9.00
1-HR RATED			
		EX-W3 EXTERIOR WALL	3/A 9.00
		EX-W4 EXTERIOR DBL STUD WALL	4/A 9.00
		IN-W3 INTERIOR WALL	C/A 9.00

EX: EXTERIOR IN: INTERIOR W: WOOD F: FURRED

SEE **A1.00** CODE SERIES SHEETS FOR ADDITIONAL INFORMATION

REFERENCE NOTES

120 5'-0" DIA. CLEAR ACCESSIBLE TURNING SPACE.
128 12" LONG VERTICAL GRAB BAR. PROVIDE REINFORCED BLOCKING.
131 DOOR MANUEVERING CLEARANCES
133 36" LONG HORIZONTAL GRAB BAR. PROVIDE REINFORCED BLOCKING.
134 42" LONG HORIZONTAL GRAB BAR. PROVIDE REINFORCED BLOCKING.
204 EMERGENCY CALL TYP.
A 270 REFRIGERATOR. SEE FIXTURES & FINISHES SCHEDULE. COMBINATION REFRIGERATOR/FREEZER SHALL HAVE AT LEAST 50% OF THE FREEZER COMPARTMENT SHELVES, INCLUDING THE BOTTOM OF THE FREEZER, 34 INCHES MAXIMUM ABOVE THE FLOOR WHEN THE SHELVES ARE INSTALLED AT THE MAXIMUM HEIGHTS POSSIBLE IN THE COMPARTMENT.
218 MOP SINK, S.P.D.
270 MIRROR. BOTTOM OF REFLECTING SURFACE EDGE SHALL BE 40" MAX. A.F.F., SEE FIXTURE & FINISH SCHEDULE.
271 LAVATORY COUNTERTOPS @ 34" A.F.F. WITH 4" BACKSPLASH, SEE FIXTURES & FINISHES SCHEDULE.
273 24" DEEP BASE CABINET, SEE FIXTURES & FINISHES SCHEDULE.
276 TOILET WALL PARTITION.
277 TOILET PAPER HOLDER, SEE FIXTURES & FINISHES SCHEDULE.
278 TOILET, S.P.D. AND SEE FIXTURES & FINISHES SCHEDULE. FLUSH CONTROLS SHALL BE LOCATED ON THE OPEN SIDE OF THE TOILET, CENTERLINE SHALL BE MEASURED FROM FINISH FACE OF WALL.
279 WALL MOUNT URINAL, S.P.D.
288 MICROWAVE. SEE FIXTURES & FINISHES SCHEDULE.
289 SLIDE IN RANGE. SEE FIXTURES & FINISHES SCHEDULE.
291 KITCHEN ISLAND WATERFALL COUNTERTOP @ 34" A.F.F. PROVIDE AIR ADMITTANCE VALVE UNDER CABINET. SEE PLAN FOR DIMENSIONS AND SEE FIXTURES & FINISHES SCHEDULE FOR MORE INFORMATION.
292 COFFEE BAR. SEE B/A4.80 AND FIXTURES & FINISHES SCHEDULE.
293 AMAZON APARTMENT LOCKER, SEE 2/A4.20.
527 42" X 14" LOUVER VENT.
528 18" X 6" LOUVER VENT.
805 DRINKING FOUNTAIN, SEE FIXTURES & FINISHES SCHEDULE.
876 DISHWASHER, SEE FIXTURES & FINISHES SCHEDULE.
877 KITCHEN SINK, SEE FIXTURES & FINISHES SCHEDULE.
879 EQUIPMENT SHOWN FOR REFERENCE ONLY
880 BABY CHANGING STATION, SURFACE MOUNTED, 4" MAX. DEPTH. SEE FIXTURES & FINISHES SCHEDULE.
881 LIQUID SOAP DISPENSER, SEE FIXTURES & FINISHES SCHEDULE.
882 TOWEL DISPENSER/WASTE RECEPTACLE. SEE FIXTURES & FINISHES SCHEDULE.
883 SANITARY NAPKIN DISPENSER.
884 TOILET SEAT COVER DISPENSER.
885 AUTOMATIC HAND DRYER, SEE FIXTURES & FINISHES SCHEDULE.
887 FLORENCE MANUFACTURING RECESSED MOUNTED, FRONT-LOADING MAILBOX, MODEL #CADD-10, COLOR: DARK BRONZE. INSTALL PER MANUFACTURER SPECIFICATIONS.
888 FLORENCE MANUFACTURING RECESSED MOUNTED, COLLECTION BOX, MODEL #1200RA.COLOR: DARK BRONZE. INSTALL PER MANUFACTURER SPECIFICATIONS.
891 AREA FOR COFFEE MAKERS, SHOWN DASHED, PROVIDE ELECTRICAL OUTLET, S.E.D.

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Architect of Record/Consultant
Thomas E. Jess — Registered Architect — State of California
Consultant

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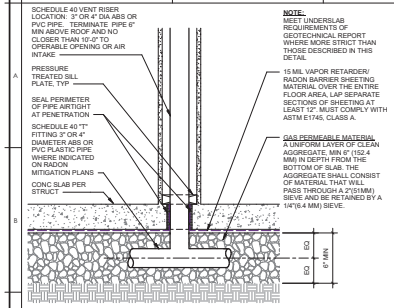
MONROE APARTMENTS
10999 SE 37TH AVENUE, MILWAUKIE, OR 97222
CLUBHOUSE - CLUBROOM, RESTROOMS, MAIL ROOM, AND WORK ROOM

NO.	REVISION	DATE
1	PLAN CHECK RESPONSE	06/04/2021
2	DSD RFI #1 ISSUE	07/16/2021
3	CONSTRUCTION SET	11/05/2021

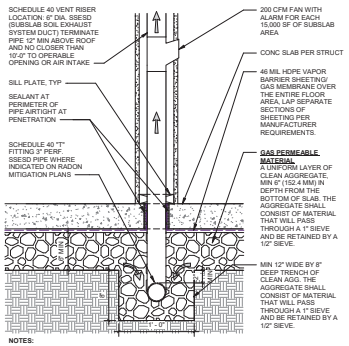
Project A20070
Date 12/21/2020
Sheet **A4.20**



17. RADON MITIGATION - RESIDENTIAL BLDG

SCALE: 1 1/2" = 1'-0"

BLDG 1 - Yes BLDG 2-4 - Yes BLDG 5 - Yes CH -No GARAGE -No



NOTES:

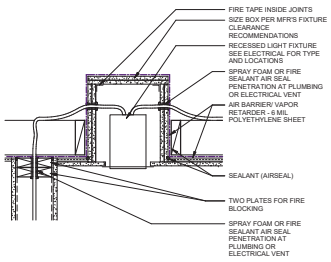
1. BUTT JOINTS, CONTROL JOINTS, CONTRACTION JOINTS, OR POST CONSTRUCTION CRACKS: PROVIDE 1/4" X 1/4" SEALANT JOINT MIN IN CROSS SECTION

2. ISOLATION JOINTS, CONSTRUCTION JOINTS, OR LAP JOINTS: PROVIDE 1/2" X 1/2" SEALANT JOINT MIN IN CROSS SECTION

18. RADON MITIGATION

SCALE: 1 1/2" = 1'-0"

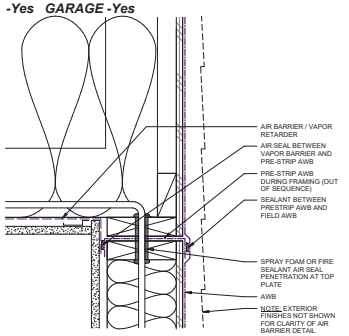
BLDG 1 - No BLDG 2-4 - No BLDG 5 - No CH -Yes GARAGE -No



5. AIR BARRIER @ CEILING FIXTURE

SCALE: 1 1/2" = 1'-0"

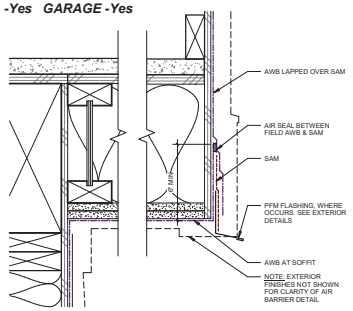
BLDG 1 - Yes BLDG 2-4 - Yes BLDG 5 - Yes CH -Yes GARAGE -Yes



14. AIR BARRIER @ EXTERIOR WALL/ATTIC

SCALE: 3" = 1'-0"

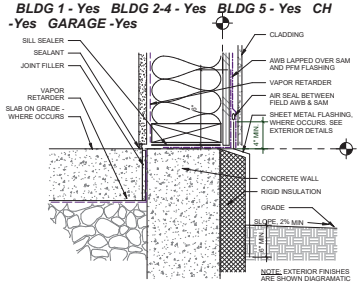
BLDG 1 - Yes BLDG 2-4 - Yes BLDG 5 - Yes CH -Yes GARAGE -Yes



15. AIR BARRIER @ SOFFIT/EXTERIOR WALL

SCALE: 3" = 1'-0"

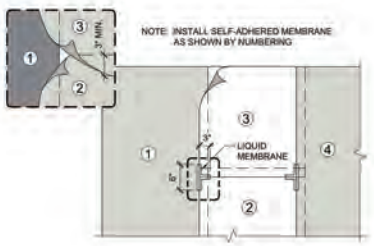
BLDG 1 - Yes BLDG 2-4 - Yes BLDG 5 - Yes CH -Yes GARAGE -Yes



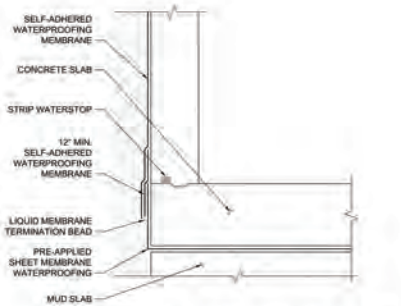
16. AIR BARRIER @ FOUNDATION/WALL

SCALE: 3" = 1'-0"

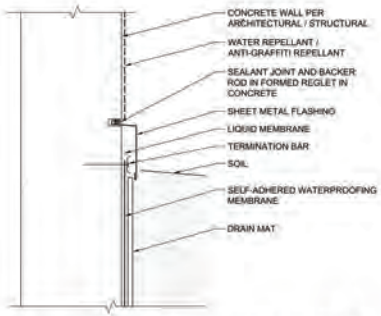
BLDG 1 - Yes BLDG 2-4 - Yes BLDG 5 - Yes CH -Yes GARAGE -Yes



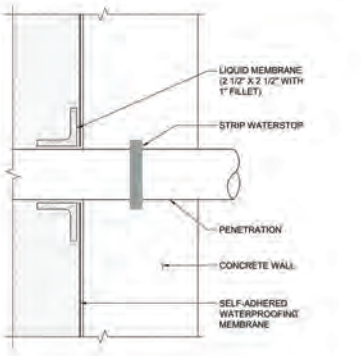
SELF-ADHERED END LAPS AND T-JOINTS (4)
SCALE: N.T.S.



SELF-ADHERED BASE OF WALL TIE-IN TO SLAB (1)
SCALE: N.T.S.



SELF-ADHERED TERMINATION AT GRADE (5)
SCALE: N.T.S.



SELF-ADHERED WALL PIPE PENETRATION WITHOUT SLEEVE (2)
SCALE: N.T.S.

INSTALLATION INSTRUCTIONS

Bituthene Tie-In with Elevated Slab

Prior to Membrane Installation, Review the Preprufe® Data Sheet

Surface Prep

All surfaces must be sound and solid to eliminate movement during the concrete pour. Substrate must be regular and smooth with no gaps or voids greater than 0.5 in (15 mm). The surface should also be free from loose aggregate and sharp protrusions as outlined in the Preprufe® Data Sheet section on Surface Preparation.

Detailing

1. Install Preprufe membrane in accordance with the Preprufe data sheet section on installation.
2. Install Bituthene® Liquid Membrane from the top of the wall over the existing Bituthene® Membrane, extending down a minimum of 6 in (150 mm).
3. While the Bituthene Liquid Membrane is still "wet" (uncured), embed 6 in (150 mm) of a min. 24 in (600 mm) Preprufe 300R strip.
4. Install a termination bar through the Preprufe 300R securely into the vertical wall.
5. Re-flash over the edge of the Preprufe 300R with Bituthene Liquid Membrane and extend up over the termination bar ensuring the Preprufe 300R and the termination bar are fully encapsulated with Bituthene Liquid Membrane.
6. Install a 12 in (300 mm) strip of Bituthene Membrane from the top of the wall extending down over the Bituthene Liquid Membrane/ termination bar and onto the existing Bituthene Membrane.
7. Terminate the bottom edge, top edge and all seams of the Bituthene strip with Bituthene Liquid Membrane.
8. Protect the Preprufe 300R strip during backfill, placement and compaction.
9. Fold the Preprufe 300R strip back onto the compacted earthgravel for use with Preprufe 300R underslab.
10. Ensure that the Bituthene and vertically installed Preprufe are protected with an approved protection course prior to backfill.

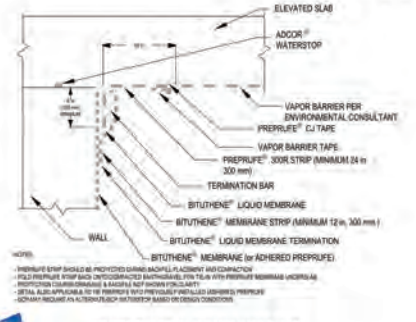
Special Notes

Preprufe membranes should not be used in areas where they will be permanently exposed to sunlight, weather or traffic. Protect membranes from sunlight as quickly as possible after installation.

Hydrostud to approved protection course not shown for clarity.

GCP may require an alternative GCP waterstop based on design conditions, at GCP's discretion.

PRE-04trinst.doc



BITUTHENE® TIE-IN WITH ELEVATED SLAB
PREPRUFE® WATERPROOFING SYSTEM

BITUTHENE TIE-IN WITH ELEVATED SLAB (3)
SCALE: N.T.S.

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Consultant

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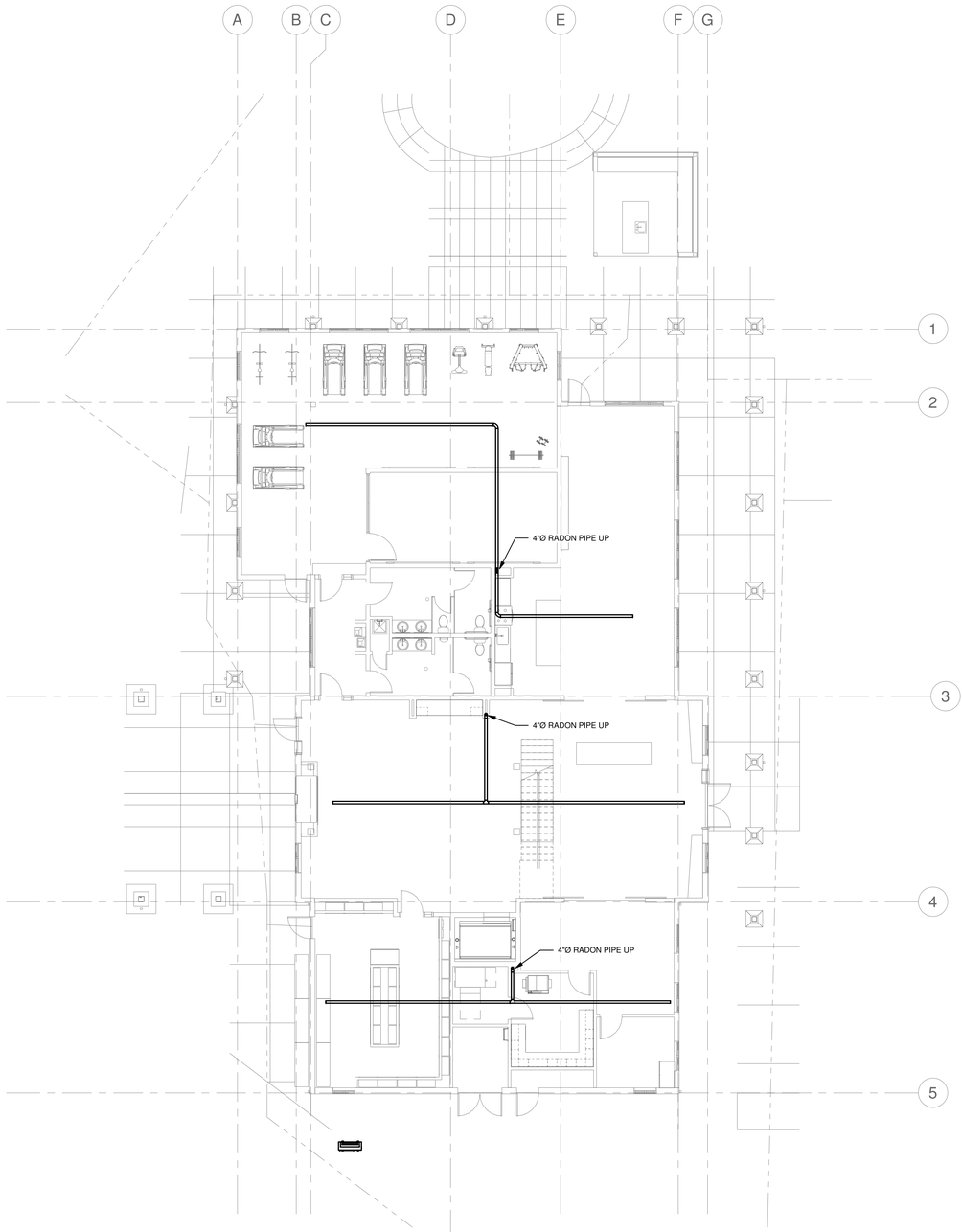
10999 SE 37TH AVENUE, MILWAUKIE, OR 97222
DETAILS - AIR BARRIER / RADON

NO.	REVISION	DATE
	PLAN CHECK SUBMITTAL	06/05/2021
1	CDC RFI 01 ISSUE	01/19/2021
2	CONSTRUCTION SET	11/02/2021

Project: A20070
Date: 12/21/2020
Sheet: **A9.17**



1 FLOOR PLAN - LEVEL 1 - MECHANICAL

0' 4' 8' 16'

1/8" = 1'-0"

arris
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REGISTERED PROFESSIONAL ENGINEER
MARK R. ROBISON
12/15/20

Consultant

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JOHNSON DEVELOPMENT ASSOCIATES
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(310) 600 - 0439

Project

MONROE APARTMENTS

10999 SE 37TH, MILWAUKIE, OR 97222

CLUBHOUSE UNDERGROUND PLAN

NO.	REVISION	DATE
1	100% SET	4/23/21

Project 20070

Date 4.23.21

Sheet M410

9/23/2022 5:36:59 PM C:\Users\jobrien\Documents\MONROE CLUBHOUSE_MEP_R21_CENTRAL_jobrienY9BRN.rvt

SUBMITTAL COVER SHEET

Date: 10/25/2021
Project Name: Monroe Apartments
Attention: Adriana Cook
Architect: Arris Studio Architects

Submittal #: 334000-12.0

Description: Radon Piping

Subcontractor: Lauzon Contracting

This review is for general conformance with plans and specifications only. Any deviations from same not clearly noted by the subcontactor/supplier have not been reviewed. Review shall not constitute a complete check or detailed dimensions or count or serve to relieve the subcontractor/supplier of contractual responsibility for any error or deviation from contract requirements.

PROJECT #	20708
SPEC. SECTION #	33 40 00
REVIEWED BY	Roger Dong, Senior Project Engineer

☑ Reviewed ☐ Reviewed w/Comments
☐ Rejected ☐ Revise & Resubmit

Transmitted: ☑ Procore ☐ Hand Deliver
☐ Email ☐ Other

ADS SINGLE WALL HIGHWAY PIPE SPECIFICATION

Scope

This specification describes 3- through 24-inch (75 to 600 mm) single wall high density corrugated polyethylene highway pipe, for use in gravity-flow land drainage applications.

Pipe Requirements

ADS single wall high density corrugated polyethylene highway pipe shall have annular interior and exterior corrugations.

- 3- through 10-inch (75 to 250 mm) pipe shall meet AASHTO M252, Type C or CP.
- 12- through 24-inch (300 to 600 mm) pipe shall meet AASHTO M294, Type C or CP.

Joint Performance

Joints for 3- to 24- inch (75 – 600 mm) shall be made with split or snap couplings. Standard connection shall meet the soil-tightness requirements of AASHTO M252 or M294. Gasketed connections shall incorporate a closed-cell synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2. Gaskets, when applicable, shall be installed by the pipe manufacturer.

Fittings

Fittings shall conform to AASHTO M252 or AASHTO M294.

Material Properties

Pipe and fittings shall be made of polyethylene compounds that comply with the cell classification 424420C for 4- through 10-inch (100 to 250mm) diameters, or 435400C for 12- through 24-inch (300 to 600mm) diameters, as defined and described in ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 24-inch (300 to 600mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 of AASHTO M294.

Installation

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines with the exception that minimum cover in trafficked areas for 3- through 24-inch (75 to 600 mm) diameters shall be one foot (0.3 m). Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.03. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

Pipe Dimensions

	Nominal Diameter, in (mm)									
Pipe I.D. in (mm)	3 (75)	4 (100)	5 (125)	6 (150)	8 (200)	10 (250)	12 (300)	15 (375)	18 (450)	24 (600)
Pipe O.D.* in (mm)	3.6 (91)	4.6 (117)	5.8 (147)	7.0 (178)	9.5 (241)	12.0 (305)	14.5 (368)	18.0 (457)	22.0 (559)	28.0 (711)

*Pipe O.D. values are provided for reference purposes only, values stated for 12 through 24-inch are ±1 inch. Contact a sales representative for exact values
**All diameters available with or without perforations.

ADS FILTER SOCK SPECIFICATION

Scope

This specification describes 2- through 48-inch (50- to 1200 mm) ADS SOCK synthetic wrap.

Filter Fabric Requirements

The ADS SOCK shall meet the requirements of ASTM D6707.

ADS sock products as listed on this specification meet Ontario Provincial Standard Specification 1860, Material Specifications for Geotextiles, dated March 1998.

Filter Fabric Properties

Property	Test Method	
Material	-	Polyester
Fabric	-	Knitted
Permitivity (min.)	ASTM D4491	5.5 sec^{-1}
Puncture Resistance (min.)	ASTM D6241	1000 N
AOS (max.)	ASTM D4751	0.600 mm 30 U.S. Sieve
FOS (max.)	CAN/CGSB-148.1, M10-94	450 microns
Mass (relaxed)	ASTM D3887	3.0-3.9 oz/yd^2 101.7-132.2 g/cm^2
Mass (applied minimum)		2.7-3.5 oz/yd^2 91.5-118.7 g/cm^2
Thickness (min.)	ASTM D4491	24.0 mils 609.6 microns
Permeability (K) (min.)	ASTM D4491	0.390 cm/sec
Burst Strength (min.)	ASTM D3786	760 kpa
Air Permeability (min.)	ASTM D737	700 $ft^3/ft^2/min$ 213 $m^3/m^2/min$
Water Flow Rate (min.)	ASTM D4491 (2" constant head)	300 $gal/min/ft^2$ 12,224 $L/min/m^2$
Yarn Denier	-	150
Specific Gravity	-	1.3
Melt Temperature	-	450° F 232° C

4" PERF PIPE WITH SOCK FOR RADON PIPING

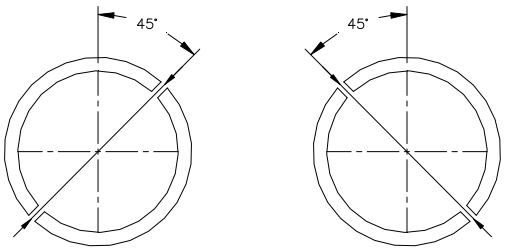
TECHNICAL NOTE

Single Wall HDPE Perforation Patterns

TN 1.02
October 2008

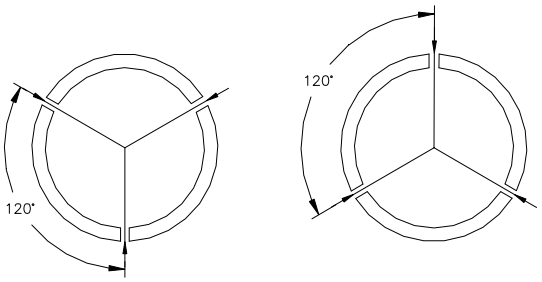
Nominal I.D.		Perforation Type	Maximum Slot Length or Diameter		Maximum Slot Width		Minimum Inlet Area		Pattern Type
in	mm		in	mm	in	mm	in^2/ft	cm^2/m	
3	75	Slot	0.875	22	0.120	3	1.0	21	A
4	100	Slot	0.875	22	0.120	3	1.0	21	B
5	125	Slot	0.875	22	0.120	3	1.0	21	B
6	150	Slot	0.875	22	0.120	3	1.0	21	B
8	200	Slot	1.18	30	0.120	3	1.0	21	B
10	250	Slot	1.18	30	0.120	3	1.0	21	B
12	300	Slot	1.50	38	0.118	3	1.5	32	B
12	300	Circular	0.313	8	-	-	1.5	32	C
15	375	Circular	0.313	8	-	-	1.5	32	C
18	450	Circular	0.313	8	-	-	1.5	32	C
24	600	Circular	0.313	8	-	-	2.0	42	D

TYPE A PATTERN



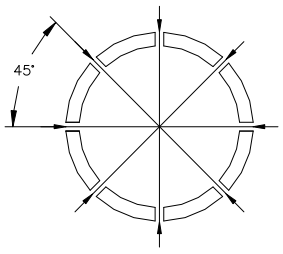
2 SLOT PATTERN
PERFORATIONS
ROTATED 90° EVERY
OTHER VALLEY

TYPE B PATTERN



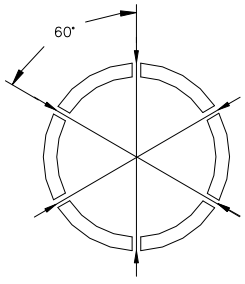
3 SLOT PATTERN
PERFORATIONS
ROTATED 60° EVERY
OTHER VALLEY

TYPE C PATTERN



8 HOLE PATTERN

TYPE D PATTERN



6 HOLE PATTERN

4" SCHEDULE 40 PVC TEE FOR VENT TEE

CHARLOTTE PIPE AND FOUNDRY COMPANY

SUBMITTAL FOR CHARLOTTE PIPE®
PVC SCHEDULE 40 PRESSURE PIPE AND FITTING SYSTEM

Date: _____

Job Name: _____ Location: _____

Engineer: _____ Contractor: _____

Scope:
This specification covers PVC Schedule 40 pipe and fittings for pressure applications. This system is intended for pressure applications where the operating temperature will not exceed 140° F.

Specification:
Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a cell class of 12454 as identified in ASTM D 1784.

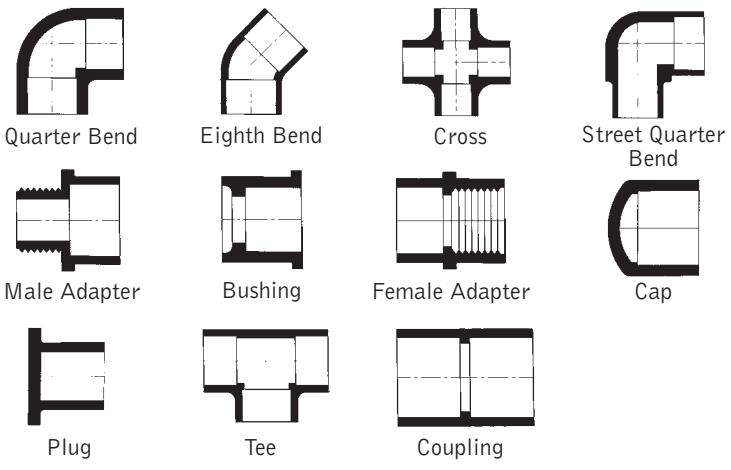
PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785. Injection molded PVC Schedule 40 fittings shall conform to ASTM D 2466. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to NSF International Standard 61 and the health-effects portion of NSF Standard 14.

Installation:
Installation shall comply with the latest installation instructions published by Charlotte Pipe and Foundry and shall conform to all applicable plumbing, fire, and building code requirements. Buried pipe shall be installed in accordance with ASTM F 1668. Solvent cement joints shall be made in a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire-stopping materials, thread sealant, plasticized-vinyl products or other aggressive chemical agents not compatible with PVC compounds. The system shall be hydrostatically tested after installation. **WARNING!** Never test with or transport/store compressed air or gas in PVC pipe or fittings. Doing so can result in explosive failures and cause severe injury or death.

Referenced Standards:

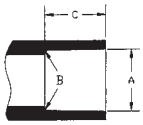
ASTM D 1784: Rigid Vinyl Compounds
ASTM D 1785: PVC Plastic Pipe, Schedule 40
ASTM D 2466: PVC Plastic Fittings, Schedule 40
ASTM D 2564: Solvent Cements for PVC Pipe and Fittings
ASTM F 1668: Procedures for Buried Plastic Pipe
NSF Standard 14: Plastic Piping Components & Related Materials
NSF Standard 61: Drinking Water System Components – Health Effects

MADE IN U.S.A.



Not all fitting patterns shown

Schedule 40
Tapered Socket Dimensions



PVC SCHEDULE 40 - ASTM D 2466

Nominal Size	Schedule 80 and Schedule 40 Socket Diameter Entrance A	Bottom B	Tolerance	Schedule 80 Socket Length C (Minimum)	Schedule 40 Socket Length C (Minimum)
½	0.848	0.836	±0.004	0.875	0.688
¾	1.058	1.046	±0.004	1.000	0.719
1	1.325	1.310	±0.005	1.125	0.875
1¼	1.670	1.655	±0.005	1.250	0.938
1½	1.912	1.894	±0.006	1.375	1.094
2	2.387	2.369	±0.006	1.500	1.156
2½	2.889	2.868	±0.007	1.750	1.750
3	3.516	3.492	±0.008	1.875	1.875
4	4.518	4.491	±0.009	2.250	2.000
6	6.647	6.614	±0.011	3.000	3.000
8	8.655	8.610	±0.015	4.000	4.000
10	10.780	10.735	±0.015	5.000	5.000
12	12.780	12.735	±0.015	6.000	6.000

PIPE REFERENCE GUIDE

Product	Sizes Available ½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10	12	14	16
PVC Schedule 40	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Charlotte Pipe and Foundry Company • P.O. Box 35430 Charlotte, NC 28235 • (800) 438-6091 • www.charlottepipe.com

FO-SUB-PVC-40 (5-30-19)

APPENDIX D

Vapor Intrusion Assessment Work Plan

VAPOR INTRUSION ASSESSMENT WORK PLAN

Former L.D. McFarland Creosote Wood Treating Facility, Milwaukie, Oregon

Prepared for: Guardian Real Estate Services, LLC

Project No. 210426-A • June 18, 2024 FINAL

Aspect
A Geosyntec Company

earth + water

VAPOR INTRUSION ASSESSMENT WORK PLAN

Former L.D. McFarland Creosote Wood Treating Facility, Milwaukie, Oregon

Prepared for: Guardian Real Estate Services, LLC

Project No. 210426-A • June 18, 2024 FINAL

Aspect Consulting

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V:\210426 Monroe Apts_Env Peer Review\Deliverables\O&M Plans\Parcel 2\Final\Attachments\Appendices\Appendix D\Appendix D VI Assessment Work Plan_2024.docx

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E Air Sampling Forms

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1 Introduction

This work plan describes the vapor intrusion (VI) assessment to be completed for the Former L.D. McFarland Company, Ltd. (LDM) Creosote Wood Treating Facility in Milwaukie, Oregon following completion of the Phase II Remedial Action (RA). The Phase II RA was completed concurrently with redevelopment of the Former LDM Property, consisting of Parcel 1 and Parcel 2. Parcel 1 was remediated to DEQ residential use exposure scenarios as part of the Phase I RA, completed in 2001. Parcel 2 was remediated to DEQ occupational/commercial use exposure scenarios as part of the Phase II RA between 2021 and 2023 in accordance with the Phase II Design Report (Aspect, 2020a). The completed Phase II RA activities are described in the Phase II Construction Closeout Report (Aspect, 2024).

The Clubhouse building is constructed within a 100-foot radius of the Parcel 2 naphthalene source area.[1] To manage Parcel 2 soil vapors and ensure protection of indoor air,[2] a chemical vapor barrier membrane and a radon mitigation system[3] (referred to as the passive venting system) is installed beneath the Clubhouse. The existing passive venting system was constructed such that it can be easily converted to an active sub-slab depressurization system (SSDS) if a VI concern is identified in the Clubhouse.

The purpose of the VI assessment is to evaluate the protectiveness of the chemical vapor barrier membrane and passive venting system at the Clubhouse (Figure 1). The VI assessment will be completed in general accordance with the DEQ's Guidance for Assessing and Remediating Vapor Intrusion in Buildings (DEQ, 2010). This VI work plan presents indoor air sampling procedures, passive venting system effluent sampling,

[1] Soil vapor management is implemented in response to a soil gas investigation (Bridgewater, 2018) conducted within Interim Action Excavation 5 (Parcel 2 Operation and Maintenance Plan, Figure 5) which is assumed to be the naphthalene source area. The soil gas investigation naphthalene detection exceeded DEQ's risk-based concentrations (RBCs) for urban residential exposure (39 micrograms per cubic meter [µg/m^3]) and occupational exposure (360 µg/m^3) and is, therefore, of potential concern with respect to VI into buildings within 100-feet of the excavation. As documented in Bridgewater's soil gas investigation technical memorandum, the naphthalene concentration in a soil gas sample collected just outside the excavation footprint (sample HS1) did not exceed DEQ's RBCs. This result supports the assumption that the naphthalene source area is limited to the Interim Action Excavation 5 footprint.

[2] The Consent Decree states that PAH soil concentrations protective of indoor building workers will be developed during remedial design using DEQ human health risk assessment guidance and DEQ acceptable risk levels. DEQ developed soil gas RBCs for vapor intrusion into buildings. DEQ guidance states that the seven individual CPAHs identified as primary Site COCs are considered "nonvolatile" for purposes of vapor intrusion exposure calculations. Naphthalene is the only PAH for which soil gas RBCs have been developed.

[3] As stated in the Phase II Design Report, the radon mitigation system is not required for the purpose of radon mitigation, since the Clubhouse does not meet the occupancy threshold of the 2019 Oregon Structural Specialty Code; however, it is a well-established technology for mitigating sub-slab soil vapor intrusion into structures, and is just as effective for volatile organic contaminants such as naphthalene as it is for radon.

laboratory analytical methods, reporting requirements, laboratory standard operation procedures (Appendix A) and the laboratory quality assurance manual (Appendix B). Quality Assurance/Quality Control is described in the Phase II Sampling and Analysis Plan (Aspect, 2020b).

2 Sampling Procedure

Clubhouse air, ambient air, and passive venting system effluent stack will be sampled semi-annually for the first year following completion of the Phase II RA and annually for five years thereafter. Sampling frequency will be reassessed if:

- There are significant structural changes to the Clubhouse that have the potential to adversely impact the effectiveness of the VI mitigation system, or
- A contaminant of concern (COC) detection exceeds a risk-based concentration in indoor air.

Reassessment of sampling frequency will be included in vapor intrusion assessment summary reports for DEQ's review.

2.1 Site Walk and Building Evaluation

A pre-sampling site assessment will be conducted two weeks prior to collecting samples to identify building construction characteristics, heating and ventilation systems, and background sources of possible chemical contaminants that may influence the results of indoor sampling (Appendix C). The existing construction drawings will be used to complete a building evaluation form. The site assessment will provide adequate time to minimize potential background sources prior to sampling. Instructions for building occupants will be provided to the Site owner at least 48 hours prior to the sampling event (Appendix D). The building evaluation will be included in a VI assessment report, described in Section 3.

2.2 Indoor Air Sampling Procedure

Indoor air sampling will consist of collecting two samples inside Parcel 2's Clubhouse Building (Figure 1). One ambient (outdoor) air sample will be collected outside the Clubhouse. Indoor air sampling will be collected in accordance with the following general field procedures:

- Clubhouse samples will be collected in areas with the greatest potential for VI, similar to sample locations during the initial VI assessment (Aspect, 2023). One sample (CH-IA1) will be collected near the center of the building. The second sample (CH-IA2) will be collected in the south portion of the building within the work room between offices and the maintenance room, nearest Interim Action Excavation 5.
- The samples will be collected in the breathing zone, about 3 to 5 feet off the ground. The sample locations will be visibly assessed for potential sources of cross-contamination prior to sample collection. A photoionization detector (PID)

will be used to screen for potential sources of contaminants near the sampling locations that may affect sampling results. Any background sources identified may need to be removed before sampling begins.

- Time-integrated, 24-hour samples will be collected over the course of a full day and night. The samples will be collected in 6-liter-vacuum canisters that are individually certified clean by the analytical laboratory. Each indoor and ambient air canister will be outfitted with a 0.2 micrometer (µm) filter, a vacuum gage, and dedicated flow regulators set at a fill rate for a 24-hour sampling event The canister number will be recorded on the sampling log.
- Once the canisters have been placed, the initial vacuum on each canister will be recorded, and the valve on each canister will be opened. The sampling start time will also be recorded.
- After sampling begins, the operation of the flow rate controller will be verified by measuring the rate of change on the canister vacuum gauge. Samples will be monitored during the monitoring event to ensure the flow regulators are functioning properly, and the canisters have not been disturbed.
- Before, during, and after the sampling period, the meteorological conditions will be recorded, including:
    - A general description of the weather
    - Barometric pressure
    - Wind speed and direction
    - Temperature
    - Humidity
    - Precipitation
- Sampling will be complete after approximately 24 hours or when the vacuum gauge on the canister reaches -5 inches of mercury. The final pressure and time will be recorded.

The final recorded vacuum prior to sample delivery will be submitted to the laboratory for verification that the canister did not leak in transit. Samples will be delivered as soon as possible following collection.

Parameters that should be noted at the time of sampling include ambient temperature, precipitation, barometric pressure, wind direction and speed, odors, field instrument readings, significant activities in the vicinity (e.g., maintenance or operation of heavy equipment), sample location and height, and canister vacuum pressure at the beginning and end of sampling. Notes regarding the usage of each building, including windows, doorways, and HVAC, will also be recorded during sampling.

2.3 Ambient Air Sampling Procedure

An ambient (outdoor) air sample (CH-AA) will be collected outside of the Clubhouse, in a representative upwind location and/or at the intake to the HVAC system, away from wind obstructions (e.g., trees or buildings), and at breathing zone height, coincident with the indoor sampling event. Ambient air sampling will be conducted in accordance with the general field procedures outlined for indoor air sampling.

2.4 Passive Venting System Effluent Sampling Procedure

Effluent samples from the passive venting system will consist of collecting one sample directly from the sample port installed in the exposed passive venting system piping prior to discharge to atmosphere by connecting PFTE tubing to the sample port with silicone tubing. The sample will be collected in accordance with general field procedures outlined for indoor air sampling, except the sample will be a grab sample instead of a time-weighted sample, collected in a 1-liter-vacuum canister that is individually certified clean by the analytical laboratory supplying them. The effluent sample canister will be outfitted with a 0.2 µm filter, a vacuum gage, and a dedicated flow regulator set at a fill rate of 150-200 milliliter per minute (mL/min) for a 6-minute sampling event.

2.5 Sample Identification

Sample locations will be recorded on a site map and described in field notes. Samples will be assigned a consistent nomenclature. Sample names will contain location building labels, CH for Clubhouse, followed by indoor, ambient, or passive venting system effluent air labels, (IA, AA, or RMSE). Following the initial labels, sample names will contain a number corresponding to locations shown on a site map and described in the summary report. Sample names will end with the date of sample collection. For example, an indoor air sample collected at the Clubhouse location #2 and conducted on April 14, 2023, would be named "CH-IA2-041423."

2.6 Sample Custody

Upon completion of sampling, the vacuum canisters will be packed in their original shipping containers and maintained under chain-of-custody (COC) procedures until they are delivered to the laboratory. After collection, samples will be maintained in the consultant's custody until formally transferred to the analytical laboratory.

A COC record provided by the laboratory will be initiated at the time of sampling for all samples collected. The record will be signed by the field representative and others who subsequently take custody of the sample. Couriers or other professional shipping representatives are not required to sign the COC form; however, shipping receipts will be collected and maintained as a part of custody documentation in project files. A copy of the COC form with appropriate signatures will be kept on file.

Upon sample receipt, the laboratory will fill out a cannister receipt form to document sample delivery conditions. A designated sample custodian will accept custody of the shipped samples and verify that the COC form matches the samples received. The laboratory will notify the project manager, as soon as possible, of any issues noted with the sample shipment or custody.

2.7 Field Documentation

While conducting field work, the field representative will document pertinent observations and events, specific to each activity, on field forms and/or in a field notebook, and, when warranted, provide photographic documentation of specific sampling efforts. Field notes will include field conditions, sample identification, sample

location, date and time of collection, sampling height, starting and ending vacuums, and chain-of-custody records. Field documentation forms are included in Appendix E.

3 Laboratory Analysis and Reporting

Samples will be analyzed for naphthalene by Environmental Protection Agency (EPA) Method TO-15 in accordance with Friedman & Bruya's Standard Operating Procedures (Appendix A). Indoor air sampling results will be screened against DEQ's current urban residential and occupational risk-based concentrations (RBCs) for inhalation of naphthalene in air, shown in Table 1 below. Analytical results should be normalized to background conditions, as detected in the Clubhouse ambient air sample.

If naphthalene is detected in indoor air samples at a concentration exceeding the RBCs, then an evaluation must be conducted to identify the corrective actions, if any, that should be conducted to address the exceedance. Corrective actions may include modifications to the VI mitigation system such as converting the passive venting system to an active sub-slab depressurization system. Any identified corrective actions must be implemented promptly.

Table 1. Air Inhalation Risk-Based Concentrations

Naphthalene (ug/m^3)		
Receptor Scenario	Urban Residential	Occupational
Risk-Based Concentration	0.20	0.36

Following receipt, validation, and compilation of the analytical results, Aspect will submit results of the assessment in a summary memorandum to DEQ describing sampling procedures and results of the Initial VI Assessment. The memo summarizing the completed VI assessment will include, at a minimum:

- A description of existing site conditions observed during the site assessment prior to sampling.
- A description of the sampling procedures and analysis.
- A description of analytical data results.
- Contingent actions taken in response to a VI concern, if any.

4 References

Aspect Consulting, LLC (Aspect), 2020a, Phase II Design Report, Former L.D. McFarland Creosote Wood Treating Facility, Milwaukie, Oregon, Prepared for: Johnson Development Associates, November 24, 2020.

Aspect Consulting, LLC (Aspect), 2020b, Phase II Sampling and Analysis Plan, Former L.D. McFarland Creosote Wood Treating Facility, Milwaukie, Oregon, Prepared for: Johnson Development Associates, December 21, 2020.

Aspect Consulting, LLC (Aspect), 2023, Initial Vapor Intrusion Assessment Results, Former L.D. McFarland Wood Treating Facility, Milwaukie, Oregon (ECSI #887), October 2, 2023.

Aspect Consulting, LLC (Aspect), 2024, Phase II Construction Closeout Report, Former L.D. McFarland Creosote Wood Treating Facility, Milwaukie, Oregon, June 18, 2024.

Bridgewater Group, Inc. (Bridgewater), 2018, Results of Naphthalene Soil Gas Sampling at Former L.D. McFarland Wood Treating Site Milwaukie, Oregon, January 23, 2018.

Oregon Department of Environmental Quality (DEQ), 2010, Guidance for Assessing and Remediating Vapor Intrusion in Buildings, March 2010.

Tyee (Tyee Management Company LLC), 2021. Closing Notice to DEQ Re: State of Oregon v. L.D. McFarland Company, Ltd., Stipulation and Consent Decree (CCV0108179)(the “Consent Decree”); Closing of Conveyance to Monroe Apartments Owner LLC/Copy of Recorded Deed/Effectiveness of Assignment/Assumption and Release. October 20, 2021.

5 Limitations

Work for this project was performed for the Guardian Real Estate Services, LLC (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

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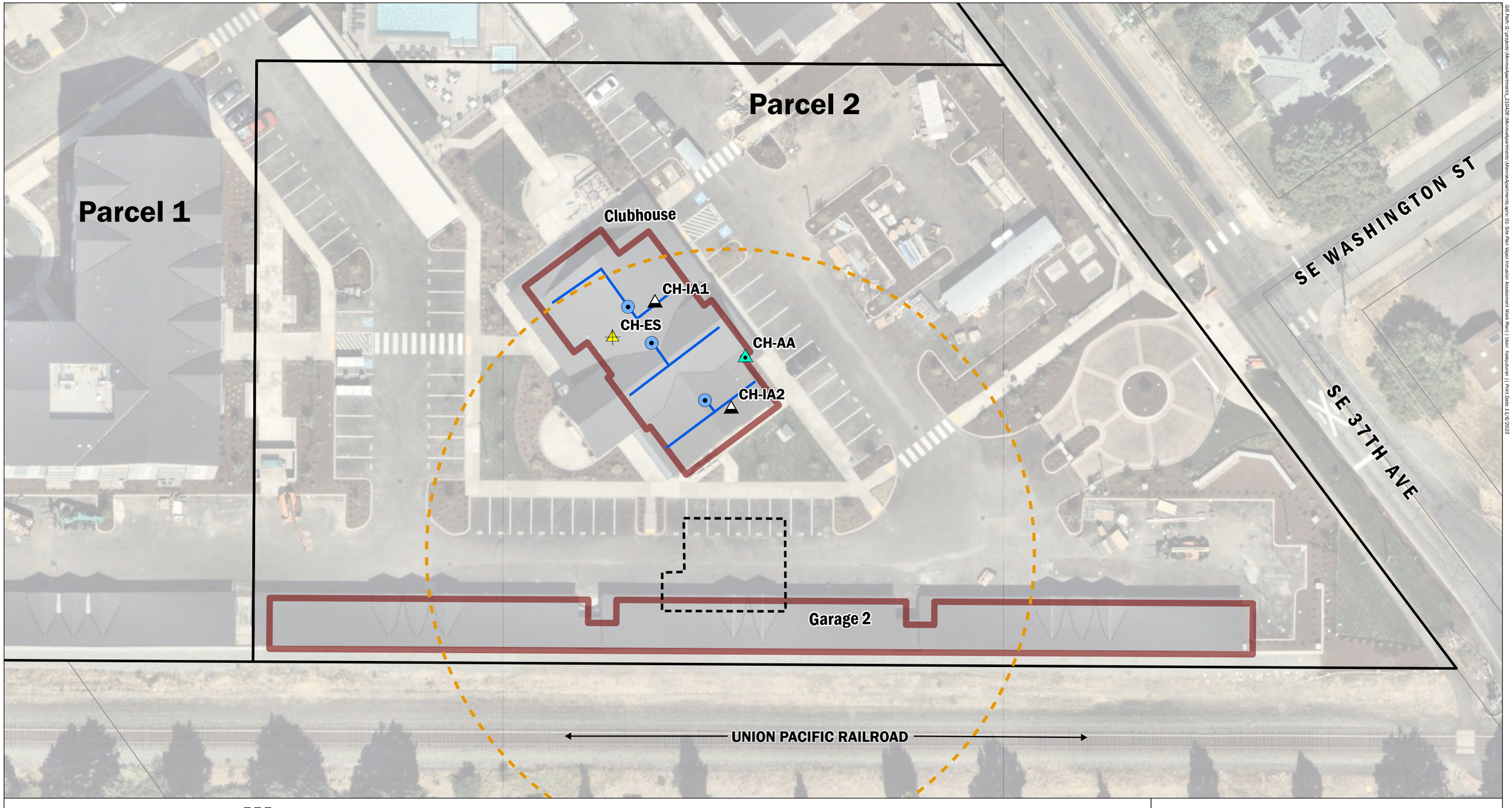
Please refer to Appendix F titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report.

FIGURES



Ambient air sampling locations
Effluent Stack Sample location
Indoor air sampling locations
Passive Venting Piping Up
Passive Venting Piping

Interim Action Excavation 5
Area of Potential Naphthalene Concern
Parcel 1 and 2 Boundaries
Clackamas County Tax Parcel

Notes:
1. Site features are approximate.
2. Passive/Radon Piping from Clubhouse Underground Plan, Arris Studio Architects and Robison Engineering Inc., Lynnwood, Washington, 4/23/2021.

N

0 20 40
Feet

Site Plan

Vapor Intrusion Assessment Work Plan
Former L.D. McFarland Creosote Wood Treating Facility
Milwaukie, Oregon

Aspect CONSULTING	NOV-2023	BY: JT / HMD	FIGURE NO. 1
	PROJECT NO. 210426	REVISED BY: ---/---	

APPENDIX A

TO-15 Standard Operating Procedures

VOLATILE ORGANIC COMPOUNDS IN AMBIENT AIR BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS) BY EPA METHOD TO-15

(VOCs by TO-15)

Friedman & Bruya, Inc.
Standard Operating Procedure

Revision Number 3
July 10, 2019

Approved by

GC/MS Supervisor: 

Yelena Aravkina

Quality Assurance Manager: 

Arina Podnozova

Document Control Number: 13

Note: The following procedures are restricted to use by analysts who have completed the Demonstration of Capability for this method within the last 12 months.

1.0 SCOPE, APPLICATION, AND SUMMARY

1.1 This SOP is used by Friedman and Bruya, Inc. (F&BI) to conduct analyses of air samples in specially prepared stainless steel canisters for the occurrence of volatile organic compounds. The samples are analyzed using procedures based on EPA method TO-15.

1.2 A known volume of sample is directed from a specially prepared stainless steel canister into the gas chromatograph using using a preconcentrator such as the Entech Model 7200-CTS. The analytes are introduced to a narrow-bore fused-silica capillary column. The GC column is temperature-programmed to separate the analytes.

1.3 Analytes eluted from the capillary column are introduced into the mass spectrometer via a direct connection. Identification of target analytes is accomplished by comparing their mass spectra with the electron impact (or electron impact-like) spectra of authentic standards. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using a minimum of five-point calibration curve.

1.4 These data, including those generated for quality assurance samples, are processed in order to quantify volatile organic compounds in air samples. The associated quality assurance is used to provide a measure of the precision and accuracy of these measurements.

1.5 The method detection limits (MDL) and reporting limits (RL) for this analysis are on file in the laboratory and are available upon request. These limits are based on MDL studies conducted, at a minimum, when a change in the test method, maintenance activities, or introduction of new equipment warrant.

1.6 Deviation from the procedures outlined in this SOP may sometimes be needed, due to specific project requirements, or due to laboratory circumstances. Deviations are documented using the extraction worksheet, sequence tables, injection logs, and/or other documents such as the non-conformance report form.

2.0 METHOD BASIS

The following regulatory methods serve as the basis for this standard operating procedure. Adherence to the minimum criteria set forth in these methods is a general data quality objective of this SOP.

2.1 EPA method TO-15 can be found in Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS).

3.0 DEFINITIONS

3.1 A list of definitions for terms used in this SOP may be found in the F&BI Quality Assurance Manual, appendix F.

4.0 SAFETY

4.1 The most important safety measure is to handle all samples and equipment in an appropriate manner to ensure a minimum of personal danger and exposure to potentially hazardous chemicals.

4.2 When samples are handled, appropriate personal protection equipment (PPE) should be used. Gloves, lab coat, and goggles are all available for use.

4.3 MSDSs for all chemicals in the lab are available to all employees. They are located in the GC room, and all employees are strongly encouraged to read them.

4.4 Analysts are required to complete general safety training prior to performing any analysis. Details of initial and on-going safety training are provided in the F&BI Quality Assurance Manual and "Training" SOP.

4.5 If uncertain about the safety of a material or procedure or in the event that a spill or other potentially hazardous situation arises, notify your supervisor or any chemist immediately.

5.0 INTERFERENCES

5.1 Very volatile compounds can display peak broadening and co-elution with other species if the compounds are not properly delivered to the GC. Adjusting preconcentrator sample focusing parameters may help mitigate these issues.

5.2 Interferences in canister samples may result from improper use or from contamination of: (1) the canisters due to poor manufacturing practices, (2) the canister cleaning apparatus, and (3) the sampling or analytical system. Attention to the following details will help to minimize the possibility of contamination of canisters:

The sample canisters, cleaning apparatus, sampling system, and analytical system should be assembled of clean, high quality components and each system should be shown to be free of contamination.

Canisters should be stored in a contaminant-free location and should be capped tightly during shipment to prevent leakage and minimize any compromise of the sample.

Impurities in the calibration dilution gas (if applicable) and carrier gas, organic compounds out-gassing from the system components ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system should be demonstrated to be free from contamination under the conditions of the analysis by running humidified air blanks. The use of non-chromatographic grade stainless steel tubing, non-PTFE thread sealants, or flow controllers with Buna-N rubber components should be avoided.

System carryover can be a potential problem, particularly for heavier molecular weight hydrocarbons such as naphthalene. Carryover can occur after the analysis of high concentration standards or samples. Measures to address system contamination can include the analysis of multiple blanks, the use of humidified air through the system, and occasional bake out or replacement of the concentrator system components.

High methane levels and/or carbon dioxide levels may interfere with the chromatography. Dilution may be performed on samples to minimize this effect; however, the RLs for diluted samples will be proportionately increased. It should be noted that the concentrator systems are designed to minimize elevated levels of carbon dioxide interference..

In cases when solid sorbents are used to concentrate the sample prior to analysis, the sorbents should be tested to identify artifact formation.

APPARATUS AND EQUIPMENT

Sampling and preconcentration systems

Electronic mass flow controllers
Vacuum pump
Stainless steel tubing and stainless steel fittings
Stainless steel cylinder pressure regulators
Stainless steel cylinder pressure regulators
Silica coated stainless steel canisters
Gas purifiers
Six-port gas chromatographic valve
Entech Model 7200-CTS Preconcentrator or equivalent
Entech Model 7016 Canister Autosampler or equivalent
Digital Dilution System (DDS) Entech Model PG-7 or equivalent
Entech 3100D Canister Cleaning System or equivalent

6.2 The typical GC/MS system is composed of the following major components (or equivalent):
GC: Agilent6890 GC System, fully programmable.
Column: Agilent J&W DB-1 60 x 0.32 x 2 µm
MS: Agilent 5975C MSD.
Data System: Enviroquant.

7.0 REAGENTS AND CHEMICALS

NOTE: When a standard or reagent is created, it is documented in the standards logbook and on the container. The standard or reagent is logged in the Standards Logbook and assigned the next available ID number as follows:

"current logbook-next standard number available-dilution letter" (e.g. 16-160A).

Each container of the standard or reagent is labeled with the logbook ID number, the name of standard/reagent, the concentration, the date it was made, the date that it expires and the analyst's initials.

If the standard or reagent has not been made before, then the recipe to be used is reviewed by a chemist and initialed.

7.1 Helium, UHP grade or equivalent

7.2 Nitrogen

7.4 Humidified Air

7.5 Standards: Standards are prepared using a DDS.

7.5.1 Calibration Gas Standards: Example preparation practices are as follows: Commercially prepared certified gas standards containing nominally 100 ppbv of each target compound are used to prepare three working stocks at concentrations of 0.1, 1, and 50 ppbv using the DDS.

7.5.2 Calibration standards: A minimum of five calibration standards are prepared at five different concentrations. At least one of the calibration standards should be at or below the reporting limit (RL). The remaining standards should correspond to the range of concentrations found in actual samples, but should not exceed the working range of the GC/MS system. Each standard contains each analyte to be reported by this method, however, more than one set of calibration standards may be prepared in order to include reported analytes. Example calibration curve standard preparations are shown in Table 1.

Table 1: Example Calibration Standards (250 cc nominal volume)

Final Concentration (ppbv)	Volume of 0.1 ppbv Working Stock (cc)	Volume of 1 ppbv Working Stock (cc)	Volume of 25 ppbv Working Stock (cc)
0.01	25	0	0
0.02	50	0	0
0.05	125	0	0
0.1	250	0	0
0.2	0	50	0
0.4	0	100	0
1	0	250	0

2.5	0	0	25
5.0	0	0	50
10	0	0	100
25	0	0	250

7.5.2.1 Continuing calibration verification (CCV) standards are typically analyzed at 5 ppbv for the majority of compounds. The CCV may be used as a laboratory control sample (LCS).

7.5.2.2 Second source calibration verification will be performed using a standard from an alternate supplier, manufacturing lot, or preparation by a second technician.

7.5.2.3 Second source calibration verification standards are typically analyzed at 5 ppbv.

7.5.3 Internal Standard (IS) Solution/Surrogate/Tuning Mix: Typical preparation practices are as follows: A commercially prepared and certified internal standard solution/surrogate/tuning mixture containing bromochloromethane, chlorobenzene-d5, 1,4-difluorobenzene, and bromofluorobenzene (BFB) at a concentration of 1000 ppbv is used to prepare a working stock at a concentration of 50 ppbv using the DDS. 50 cc of this 50 ppbv IS/Surrogate/Tuning Mix is introduced into the GC (based on 250 cc nominal sample volume).

7.5.4 The analyst stores the standards in pressurized cylinders or canisters. The following maximum expiration dates are used:

Table 2: Expiration Times of Standards for Analysis by TO-15

Standard	Expiration Date
Primary Stock Standard	1 year in cylinder
Working Stock Standards	30 days (in canister)

The expiration dates are listed in both the Standards Logbook and on each container of the standard. When the standard expires, the analyst disposes of it and makes or orders a replacement.

8.0 CLEANING AND CERTIFICATION PROGRAM

8.1 Canister Cleaning

8.1.1 Canisters are marked or placed in a designated area when ready to be cleaned.

8.1.2 Operation of the cleaning system, such as the Entech 3100D, is performed per the manufacturer recommendations.

8.1.3 With canister valves closed, connect canisters to oven manifold and verify the vacuum reaches less than 50 mTorr. If not, check fittings for leaks and repeat the leak check procedure.

8.1.4 Open canister valves, close oven door and run the applicable Entech 3100 cleaning method.

Example Cleaning Method:

Unheated cycles - canisters are evacuated to <100 mTorr and held for 5 minutes at vacuum. A diluent, such as humidified air, is added to 15 psia. Samples are held at 15 psia for 10 minutes.
Heated cycles – a minimum of 2 heated cycles are performed as described in section 8.1.4.1.1 with the oven at 80C. Following the cleaning cycles, samples are evacuated to <50 mTorr and held for a minimum of 10 minutes.

8.2 Canister Certification

8.2.1 Canisters may be "batch certified" or "individually certified." To certify a canister, humidified diluent is added to the canister prior to analysis. For batch certification, one canister per cleaning event is analyzed. If the certification results are unacceptable to meet project reporting goals, the entire batch should be re-cleaned and certified.

8.2.2 If the cleanliness check is satisfactory, the certification date and individual or batch certification data file are recorded in a canister cleaning log and/or on the applicable extraction or quality assurance paperwork.

8.2.3 Prior to use, canisters are evacuated to <50 mtorr. Canister vacuums (in inches of Hg) are verified prior to sending canister out to the field..

8.2.5 The canisters are considered clean for a period of 6 months after being certified clean. If upon recertification, the cleanliness check is not satisfactory, repeat the procedures described in section 8.1.

9.0 SAMPLE HANDLING, PRESERVATION, AND PREPARATION

9.1 Upon receipt at the laboratory, the canister information, including date of receipt, canister and flow controller IDs and current vacuum, are recorded. The method recommended holding time is 30 days. If this holding time is not met, the data are flagged with an appropriate qualifier.

9.2 Example Preparation of Method Blank: The method blank is prepared in a silica coated 6L canister. The canister is pressurized and filled with humidified air to a final canister pressure between 1 and 2 atm.

9.3 The analyst should check the extraction paperwork and ensure that it includes necessary extraction information.

10.0 ANALYTICAL PROCEDURE

10.1 The following instrument conditions routinely provide the resolution and sensitivity needed. The GC/MS supervisor is responsible for maintaining this capability.

10.1.1 Typical GC Parameters

Injector temp.: 150°C
Detector temp.: 220-250 °C
Helium carrier gas: 0.9 to 3 mL/min
Split Ratio: 30:1
Initial temp: 35 °C, hold for 2 minutes
3°C per minute to 65°C, hold for 0 minutes
15°C per minute to 200°C, hold for 6 minutes
20°C per minute to 260°C, hold for 0 minutes

10.1.2 If the needed resolution and sensitivity cannot be met, the GC/MS supervisor will notify the laboratory director.

10.2 Initial Calibration

10.2.1 Prior to the analysis of calibration standards, introduce into the GC 50 cc of 50 ppbv (based on nominal 250 cc volume) Internal Standard/Surrogate/ Tuning Mix and acquire mass spectra for m/z 35-260 at 70 eV (nominal). Use the same mass spectrometer conditions as those used for samples. Tuning criteria are given in Table 3. A tuning standard evaluation report for BFB is generated once per 24 hour time period of operation and is included in every data package.

Table 3: BFB Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	8.0 to 40.0% of m/e 95
75	30.0 to 66.0 % of m/e 95
95	Base peak, 100% relative abundance
96	5 - 9% of mass 95
173	Less than 2% of mass 174
174	50.0 to 120.0 % of m/e 95
175	4.0 to 9.0 % of m/e 174
176	93.0 to 101.0 % of m/e 174
177	5 - 9% of mass 176

If tune criteria are not met, instrument maintenance is performed.

10.2.2 A minimum of five concentration levels are needed to determine the instrument sensitivity and linearity. At least one of the calibration standards is at or below the method reporting limit

10.2.3 Relative Response Factor: Calculate the relative response factor (RRF) for each target compound relative to the appropriate internal standard (i.e. the standard with the nearest retention time) using the following equation:

$$RRF = \frac{A_x * C_{is}}{A_{is} * C_x}$$

where:
RRF = Relative response factor
A_x = Area of the primary ion for the compound to be measured, counts.
A_{is} = Peak area of the primary ion for the internal standard, counts.
C_{is} = Concentration of the internal standard spiking mixture, ppbv.
C_x = Concentration of compound in the calibration standard, ppbv.

[Note: The equation above is valid under the condition that the volume of the internal standard spiking mixture added in field and QC analyses is the same from run to run, and that the volume of field and QC sample introduced into the preconcentrator is the same for each analysis. C_{is} and C_x should be in the same units.]

10.2.4 Mean Relative Response Factor: Calculate the mean RRF for each compound by averaging the values obtained at the five concentrations using the following equation:

$$\text{Mean RRF} = \sum_{i=1}^{n} \frac{x_i}{n}$$

where:
Mean RRF = Mean relative response factor
x_i = RRF of the compound at concentration I
n = Number of concentration values

10.2.5 Percent Relative Standard Deviation (% RSD). Using the RRFs from the initial calibration, calculate the % RSD for target compounds. The acceptance criteria for the %RSD or RRF for each compound is 30%. Additionally, a maximum of two analytes may have a %RSD or RRF of <40%.

$$\%RSD = \frac{RRF_c - \text{Mean } RRF_i}{\text{Mean } RRF_i} \times 100$$

10.2.6 Relative Retention Times (RRT) and Mean of the Relative Retention Times (Mean RRT):

10.2.6.1 Relative Retention Times (RRT): Evaluate the RRTs for each target

compound over the initial calibration range.

$$RRT = \frac{RT_c}{RT_{is}}$$

where:
RT_c = Retention time of the target compound, seconds
RT_{is} = Retention time of the internal standard, seconds

10.2.6.2 The RRT of each target analyte in each calibration standard should agree within 0.06 RRT units.

10.2.6.2.1 Evaluate the Delta RT, which appears on the quantitation page, for the internal standards in each calibration standard. If the Delta RTs are close to the same value, then the above criteria is assumed to be met. The necessary data to complete the calculation of the RRT is available both in hard copy and electronic format.

10.2.7 Primary Ion Area Response (Y) and Mean Area Response (Mean Y) for Internal Standard:

10.2.7.1 Tabulate Primary Ion Area Response (Y) for Internal Standard: Tabulate the area response (Y) of the primary ions and the corresponding concentration for each compound and internal standard.

10.2.7.2 Mean Area Response (Mean Y) for Internal Standard: Calculate the mean area response (Mean Y) for each internal standard compound over the initial calibration range.

10.2.7.3 The allowable deviation in area response Y at each internal standard calibration level is 40% of the area response Y in the mid-point calibration standard of the most recent calibration. Alternatively, the allowable deviation in area response Y at each calibration level should not exceed 40% of the mean area response Y over the initial calibration range for each internal standard.

10.2.8 Mean Retention Times (Mean RT): The internal standard retention time may vary up to 20 s from the RT in the mid-point calibration standard. Alternatively, the retention time shift for each of the internal standards at each calibration level may vary up to 20 s from the mean RT of the calibration..

10.2.9.1 If initial calibration criteria are not met, the following options may be considered. Any reported data associated with failing criteria is qualified.

10.2.9.1 If the problem appears to be associated with a single standard, then reanalyze (replace the standard if necessary) that one standard once, within the same tuning period of the original analysis and before any samples are analyzed. The results from the original analysis of the standard in question are discarded.

10.2.9.1 Remove the highest or lowest point from the curve. In this case the reporting limits of the analysis are affected accordingly. Mid-range standards should not be removed from the curve. A minimum of five points are needed for a valid curve.

10.2.9.1 Perform instrument maintenance and/or make new calibration standards, repeat the entire calibration and reanalyze any affected samples if possible.

10.2.10 Initial Calibration Verification Standard (ICV) - The ICV is analyzed after an initial calibration and prior to sample analysis using a second source calibration verification standard – see 7.5.2.2. The ICV concentration should correspond with a mid-point calibration standard. The concentration of each analyte should be within 30% of the expected concentration.

10.2.11 Some compounds may be simultaneously acquired in scan and sim modes. Collection groups are set up based on retention time. The primary ion is used for quantitation and at least one secondary ion is used for confirmation. Old software versions rounded to the nearest whole number amu while newer versions round to the nearest 0.1 amu. Either value may be used for quantitation purposes.

10.3 Calibration Verification

Prior to the analysis of samples or calibration standards, introduce 50 cc of 50 ppbv (based on nominal 250 cc volume) of the internal standard/surrogate/tuning standard into the GC/MS system and evaluate as described in section 10.2.1.

If time remains in the 24-hour period in which an initial calibration is performed, samples may be analyzed without analysis of a continuing calibration verification standard (CCV).

10.3.3 Acceptance Criteria for Continuing Calibration: The initial calibration for each compound of interest is verified once every 24 hours prior to sample analysis, using the introduction technique and conditions used for samples. This is accomplished by analyzing a CCV correlating to a midpoint standard in the calibration curve. A CCV may be used as an LCS. It is responsibility of the analyst to ensure that the following criteria are met, and the calibration verification report is included in every data package.

10.3.3.1 Calculate a relative response factor (RRF) for each target compound using the equation in 10.2.4.

10.3.3.2 Calculate the percent difference (%D) in the RRF of the daily RRF (24-hour) compared to the mean RRF in the most recent initial calibration. Calculate the %D for each target compound using the following equation:

$$\%D = \frac{RRF_c - \text{Mean } RRF_i}{} \times 100$$

Mean RRF_i

Where:
RRF_c = RRF of the compound in the continuing calibration standard
Mean RRF_i = Mean RRF of the compound in the most recent initial calibration

10.3.3.3 The acceptance criteria for RRF %D (percent drift if using a regression fit) is ≤30%.

10.3.3.4 The EICP (extracted ion current profile) area for any of the internal standards (IS) in the calibration verification standard should be within 40% of the IS areas of the mid-point standard level of the most recent initial calibration sequence.

10.3.3.5 The retention time for any IS in the calibration verification standard should be within 20 s of the IS retention time in the mid-point standard level of the most recent valid initial calibration.

10.3.4 If the daily calibration technical acceptance criteria are not met, determine if a corrective action is needed. It may be necessary to clean the ion source, change the column, or take other corrective actions to meet the daily calibration technical acceptance criteria. If daily calibration acceptance criteria are not met prior to the analysis of field samples, the affected data should be reported with applicable data qualifiers.

10.3.5 Results associated with a failing CCV may be reported without data qualifiers in the following situations:

10.3.5.1 If the CCV fails high, then associated samples with non-detect results may be reported without qualification.

11.0 SAMPLE ANALYSIS/QUANTITATION

11.1 Instrument Analysis

An example method blank preparation is as follows: Fill a cleaned and evacuated canister with humidified diluent using the Entech 3100. Pressurize contents to between 1.5 and 2 atm.

11.1.2 Example Sample Introduction: An aliquot of the air sample from a canister (typically 250 cc) is preconcentrated using an Entech 7016 autosampler and Entech 7200 CTS preconcentrator and analyzed using GC/MS.

Example Procedure for Instrumental Analysis:

11.1.3.1 Canister samples should be at temperature equilibrium with the

laboratory.

11.1.3.3 Preconcentrate volatile constituents using the Entech 7200-CTS equipment or equivalent.

11.1.3.4 The GC/MS is setup to scan the atomic mass range from 35 amu to 300 amu. At least 10 scans per eluting chromatographic peak should be acquired.

11.1.3.5 If saturation is observed, reanalyze the sample at a dilution or report affected analytes with a data qualifier.

11.1.4 If the response for any quantitation ion exceeds the initial calibration range of the GC/MS system, the analyst will either analyze a diluted sample extract or flag the result as being over the calibration range. Secondary ion quantitation may be used when interferences affect quantitation of the primary ion.

11.1.4.1 When ions from a compound in the sample saturate the detector, it may be appropriate to follow the analysis by the analysis of a blank. If the blank analysis shows the presence of carryover, then decontaminate the system.

11.1.5 If the EICP area for any of the internal standards in samples, spikes, and blanks changes by 40% from the areas determined in the calibration verification standard analyzed that day or the most recent mid-range calibration standard, corrective action is taken. The samples, spikes, or blanks are reanalyzed or the data are qualified.

11.1.6 The retention time for any internal standard in the method blank and samples may not change by more than 20 s from that in the mid-point standard level of the most recent valid initial calibration or daily CCV. Alternatively, the retention time shift for each of the internal standards in the method blank and samples should be within 20 s of the mean retention time over the initial calibration range for each internal standard.

11.2 Before processing the data, the analyst will evaluate the initial and continuing calibration recoveries, internal standards RRTs, surrogate recoveries, and the results of the method blank and QC samples. If any of the criteria are not met, corrective actions are taken in accordance with section 13 of this SOP.

11.3 Compound Identification: The qualitative identification of compounds determined by this method is based on retention time and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum is generated using the conditions of this method. The characteristic ions from the reference mass spectrum are defined as the three ions of greatest relative intensity, or any ions over 30% relative intensity, if less than three such ions occur in reference spectrum. Compounds are identified when the following criteria are met:

11.3.1 The intensities of the characteristic ions of a compound maximize in the same

scan or within one scan of each other. (Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.)

11.3.2 The RRT of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

11.3.2.1 First RT evaluation is based on Delta RT, which appears on the detailed spectrum report for the identified compound and on the result summary page for the internal standards. Delta RT is the difference in retention time between the expected and actual. If Delta RT for identified compound and associated internal standard varies significantly, RRT is calculated. The necessary data to complete the calculation of the RRT is available both in hard copy and electronic format.

11.3.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.

11.3.4 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of the average of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. The resolution should be verified on the mid-point concentration of the initial calibration, as well as the continuing calibration verification if closely eluting isomers are to be reported.

11.3.5 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When GC peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important.

11.3.6 If a compound cannot be verified by the above criteria, but in the technical judgment of the analyst the identification is correct, the analyst may report that identification and proceed with quantitation.

11.4 Quantitative Analysis: Once a compound has been identified, the quantitation of that compound will be based on the integrated abundance of the primary characteristic ion from the EICP.

11.4.1 It is recommended to use the integration produced by the software if the integration is satisfactory. However, manual integrations may be necessary when the software does not produce satisfactory integrations. The analyst will

use professional judgment to determine if manual integration is needed.

11.4.2 An example calculation procedure is included as appendix 1.

12.0 DATA REVIEW

12.1 Before final results are forwarded to the project manager identified on the Chain of Custody, a review is completed of the data meeting the following criteria.

12.1.1 The reviewer is a different analyst than the person that calculated the data.

12.1.2 It is the reviewer's responsibility to confirm the data by checking that both the requirements for the method are met, and that the sample values reported are correct.

12.1.3 Reviewed results are documented in the GC/MS Data Daily Checklist, which is included in every data package.

12.1.4 Double check data that has been modified by the analyst.

12.1.5 Upon completion of review, initial and date the extraction worksheet.

12.2 If non-conformances or errors are found during review the calculation analyst is notified and any corrections needed are made. If any reported results fall outside normal criteria, a non-conformance report is filled out by the reviewer or analyst.

13.0 Method Performance

Method performance requirements are described in the F&BI Quality Assurance Manual. Laboratory specific acceptance limits for precision and accuracy, as well as method detection limits and reporting limits, for analytes reported by this method are on file in the laboratory. Procedures outlined in the QA Manual are followed, with method specific requirements included as given below.

Method Detection Limit (MDL) results are documented in the TO-15 method manual. Documentation will include, at a minimum, the extraction paperwork and an excel sheet clearly stating the following information: matrix, instrument, date of analysis, the MDL calculations, and the MDL value. If the MDL does not meet the project reporting goals, the analyst will notify the QA officer or Lab Manager before conducting any additional analysis.

13.2 The replicate precision for each of the target compounds should be +/- 25%.

13.3 The acceptance criteria for LCS/CCV percent recovery is +/- 30%.

14.0 QUALITY CONTROL AND CORRECTIVE ACTIONS

Additional F&BI QC procedures are described in sections 12 and 13 of the QA Manual. If, following corrective actions, quality control results still fail, or if corrective actions are not possible, then affected results are reported with appropriate qualifying flags.

The minimum requirements for QC samples in each preparation batch (within 24 hours) of up to 20 samples are:
1 method blank
1 LCS.

15.0 Preventive Maintenance and Trouble Shooting

15.1 It is responsibility of the supervisor to ensure the performance of routine instrument maintenance. Preventive maintenance and corrective maintenance is documented in the instrument maintenance logbook. In addition, a separate log is maintained which contains the description of the problem, possible cause, and solution. Also, appendix C in the F&BI QA Manual provides general guidance for routine maintenance.

16.0 DATA ARCHIVAL

16.1 The hardcopy of raw instrument data with analyst notations and re-integrations are kept on-site in archived banker boxes in the data storage area. It is separated by both date and instrument. The data are saved for a minimum of five years.

16.2 An electronic copy of the raw instrument data is copied onto CD/DVD media and archived in the storage folder located next to the Scanning Computer. A duplicate copy is stored in the company safe. This backup of data is performed on a monthly basis. The data are saved for a minimum of five years.

17.0 HAZARDOUS WASTE MANAGEMENT AND POLLUTION PREVENTION

17.1 Hazardous waste management procedures are found in the F&BI QA Manual section 10, and the “Disposal” SOP.

17.2 Actions that can result in the reduction or elimination of chemical wastes and chemical pollutants associated with this SOP are strongly encouraged. Such actions should be discussed with the Executive Committee for approval prior to implementation.

END OF DOCUMENT

APPENDIX 1

Example Calculation and Review Procedure for Volatiles by Gas Chromatography/Mass Spectrometry by EPA Method TO-15 (Windows NT Version)

1.0 SETUP

1.1 Load Enviroquant on GCMS7 computer while in Windows NT
1.1.1 **Start Menu** - **Programs** - MSD ChemStation – Instrument#1 - Data Analysis
1.2 Network to: SWCOMP E:\drive (SWCOMP\GcData).

2.0 BFB TUNE EVALUATION

2.1 Load Tune data file
2.1.1 **File** - **Load Data File**...(D:\GCMS7\DATA\)
2.1.2 Load Method : **File** - **Load Method**... (D:\ GCMS7\METHODS\)
2.2 Select Tuner - Evaluate BFB - Autofind BFB to Screen
2.3 If tune passes, then print
2.4 If fails, then average BFB peak
2.5 Then, do **Evaluate BFB to printer**
Note: Only one scan will appear on the tune evaluation report.
2.6 **If averaging fails,** do one of the following:
2.6.1 Double click with right mouse button on the apex of peak, then do background correction.
2.6.2 Double click with right mouse button on the apex of peak, then on both downslopes of peak, summarize the spectra, then do background correction.
2.7 **Tuner** - **Evaluate BFB**...- **Evaluate BFB to printer**

3.0 STANDARD EVALUATION

3.1 Load CC file : **File**...- **Load Data File**...C:\GCMS7\DATA\mm-dd-yy\datafile.d
3.2 Load Method : **File**...- **Load Method**...C:\GCMS7\METHODS\(Choose TO-15 method)
3.2.1 Calculate file : **Quant**...- **Calculate and Generate**...(select results to screen or no output then OK.)
3.2.2 Examine individual peaks : **Quant**...- **Qedit**...
3.2.3 Then **Spectrum** - **Display Reference Spectra**
3.2.3.1 Run "Peak by Peak Macro" : Click on Start and watch for poor integration, mismatched spectra and ratios.
3.2.3.2 When compounds have been examined, Click Stop and Exit. Click Yes to save changes.
3.3 Evaluate Continuing Calibration
3.3.1 **ConCal**...- **Evaluate Data File as Continuing Calibration** - (to printer)
3.3.2 Percent deviations ≤30%
3.3.3 Internal Standard area +/- 40%

3.3.4 Retention Time Deviation Maximum of 0.5 minutes.
3.3.5 Minimum RRF of 0.2.
3.3.6 Scroll to Bottom and if SPCC's Out = 0 and CCC's Out = 0, then print.
3.3.7 If requirements not met, determine failure, take corrective action.

4.0 SAMPLE CALCULATION

Note : Process data files using the method corresponding to the latest ICAL.

4.1 Gather paperwork for projects run on sequence date(s)
4.2 **File** - **Load File** - datafile.d
4.3 **Quant**...- **Calculate and Generate**...
4.3.1 **Quant**...- **Qedit Quant Results**... (to view each peak individually)
4.3.1.1 Run "Peak by Peak" macro as described earlier for samples requiring normal list reporting
4.4 **Quant**...- **Generate Report** (to file and printer)
4.5 If any hits, **Quant**...- **Generate Report**
4.5.1 Detailed, (to printer)
4.5.2 Examine printout for each compound to determine the presence of correct ions at the correct retention time and in the correct ratio.
4.5.2.1 Re-enter QEdit mode and Qdel any false positives.
4.5.2.1.1 Double click on compound name and click Qdel.
4.5 After samples in a shift have been calculated create the Internal Standard/Surrogate Report
4.5.1 Concal - Save Continuing ISTD Responses
4.5.2 Concal - QA Check Report…

5.0 REPORT CREATION

5.1 Open Microsoft Excel. The file Personal.xls should appear.
5.2 Select Tools - Macro - ProcessDetailXls - Run
5.3 Click on "Choose Directory." Select the sequence date you want to process by double clicking on it. Then highlight the data files you want to process including any QA/QC related files and click "Add." Then click "OK."

For Air samples:
Select "Air"
Check sample name and data is correct → OK

6.0 PART REPORT CREATION

6.1 Use the following steps to create a part report.
6.1.1 Open Word.
6.1.2 Create a new document.
6.1.3 Run the GCMSTransfer Macro.
Enter correct dates for received and extracted.
Run the "ReportTO-15Analytes_____" macro, which selects the analytes the client has requested
6.1.6 Attach appropriate method blank and QC pages.

6.1.7 Save report and print. Label with project name and extension. Initial paperwork and submit for review.

7.0 QAQC PAGE CREATION

7.1 In Enviroquant, quantitate and Qedit LCS, LCSD, MB files, if applicable. Select **Tools--Matrix Spike/Duplicate Recovery Report--Select MB for non-spiked sample, LCS for spiked sample, and LCSD for spiked duplicate.** This also should be done with the sample, MS, and MSD if these are part of the QC batch.

7.1.1 The report will be created. Save as a text file Also print the report to include with the data package.

7.2 If there was a sample/sample duplicate in the QC batch, quantitate and Qedit both files.

7.3 Creating QAQC report

7.3.1 Open new blank word document

7.3.2 Run the GCMSQAQC macro

7.3.3 Select LCS associated with the QAQC

In Word, open the text file previously saved in the Enviroquant program.

Select OK to the file converter. Run the CleanUpQA macro.

Copy the % recovery columns and paste them into the QAQC file.

Run CompleteQA macro.

APPENDIX B

Quality Assurance Manual

QUALITY ASSURANCE MANUAL

Friedman & Bruya, Inc.

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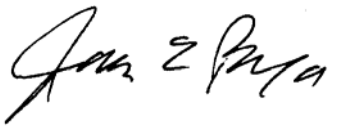
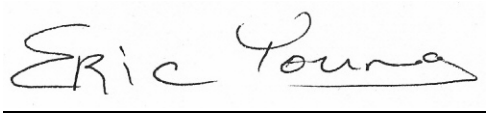
Revision Number 18
December 9, 2022

Approved by

Executive Committee Representative: 
James E. Bruya

Laboratory Director: 
Eric Young

Quality Assurance Officer: 
Stephanie Pham

Document Control Number: 209

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3.0 QUALITY SYSTEM POLICY STATEMENT

Quality Assurance/Quality Control (QA/QC) is of fundamental importance to any chemical testing program. It is the goal of Friedman & Bruya, Inc. (F&BI) to provide analytical data which is scientifically sound and of known and documented quality. To achieve this objective, a quality system has been established to ensure that adequate QA/QC procedures are followed and documented, from sample receipt through to the final report provided to the client. The quality system has been established to meet the requirements of the National Environmental Laboratory Accreditation Program (NELAP). The policies and procedures established are designed to meet the quality requirements of our clients, as well as those of accrediting authorities.

F&BI laboratory management is committed to following good professional practices, and to providing the highest quality of environmental testing services to our clients. An important part of this commitment is the requirement that all F&BI personnel involved with environmental testing activities, including management, are familiar with the established quality system, and implement the policies and procedures of the system in their work.

4.0 ETHICS POLICY STATEMENT

Friedman & Bruya, Inc. (F&BI) believes the practice of chemistry requires training, care, attention to detail and personal integrity that must withstand significant pressure from interested parties. We believe we stand firmly for the chemist's right to practice his/her profession with the highest level of support. For this reason, fraud or the falsification of analytical data by an employee is grounds for immediate dismissal. Management shall review data and perform internal audits to ensure ethical conduct on the part of its employees.

Waste of our clients' time and money, as well as natural resources, is strongly discouraged. Environmental analyses can be very costly and their results exponentially more so. Friedman & Bruya, Inc. was formed to provide our clients with analytical information that met their chemical and analytical needs, while at the same time minimizing cost wherever possible.

Friedman & Bruya, Inc. is proud of its employees. Upon employment, a manual is issued to each employee that describes the policies of Friedman and Bruya, Inc. with regards to employee conduct, fraud, waste and abuse. We believe abuse or harassment is degrading to our employees and our clients. Such behavior is not condoned by Friedman & Bruya, Inc. This covers interactions amongst our employees, as well as those between us and our clients. Where abuse or harassment can be documented, a written warning is issued. If the action or behavior continues, dismissal may result.

All employees of Friedman & Bruya, Inc. are charged with the task of reporting any occurrence of fraud or data falsification to the highest authority within our organization. Management will continually look for fraud and data falsification through standard review practices such as those conducted during the course of data review and internal audits. Management will not attempt to create policies that conflict with our fraud policy. If any employee feels or believes that a management policy conflicts with our fraud policy or that any such policy encourages fraudulent practices on the part of employees, they are encouraged to bring these issues to the attention of their supervisor or to the highest authority within our organization.

5.0 LABORATORY ORGANIZATION

5.1 Ownership and Facility Description

F&BI is a privately owned corporation. No other business affiliations or external business entities exist. The F&BI laboratory is comprised of one building, with approximately 12,000 square feet, which is located at 3012 16 Ave. W., Seattle WA. This laboratory was built with safety, efficiency and quality control in mind. Separate rooms are designated for inorganic, organic and volatiles extractions. Fume hoods are located in each of these rooms as well as in standard storage and preparation rooms. Separate areas are also designated for sample storage, instruments/analysis, office space and records storage. Floor plans of the building can be furnished upon request.

5.2 Personnel Organization

The qualifications and responsibilities for key personnel are listed below. An organizational chart is provided in Figure 5-1.

Laboratory/Technical Director

Qualifications:
The Laboratory/Technical Director should be an individual who has a history of laboratory and personnel management. She/He should have a knowledge of all analyses performed by the laboratory and of QA/QC standards of performance. This person should have a bachelors degree in chemical, environmental, biological sciences, physical sciences or engineering, with at least 24 college semester credit hours in chemistry and with at least 2 years of relevant experience. (A masters or doctoral degree may be substituted for 1 year experience.)
Responsibilities:
The Laboratory/Technical Director reports directly to the Executive Committee.
He/She has overall responsibility for the technical operation of the laboratory. Specific responsibilities include the following:
Monitor standards of performance in quality control and quality assurance.
Monitor the validity of the analyses performed and data generated to assure reliable data.
Ensure sufficient numbers of qualified personnel are employed.
Provide educational direction to laboratory staff.
Assign workloads and arranges schedules of Project Leaders.
Evaluate overall effectiveness of the laboratory activity.
Propose new methods and modifications as needed. Institute new programs and procedures as directed by the Executive Committee.
Review all new work to ensure that appropriate facilities and resources are available.
Fill in for the QA Officer in her/his absence.

Quality Assurance Officer

Qualifications:
The Quality Assurance Officer should be an individual who has a history of establishing inter-laboratory and intra-laboratory quality assurance programs. She/He should be capable of evaluating analytical data to distinguish between sample variability, instrument variability and method errors. This person is expected to have a degree in chemistry plus several years practice as an environmental chemist evaluating analytical data for technical validity.
Responsibilities:
The Quality Assurance Officer reports to the Executive Committee and Laboratory/Technical Director. She/He has the responsibility of overseeing the inter-laboratory, intra-laboratory studies, non-conformance report reviews, and demonstration of capability program. She/He also works in a team with other qualified staff to complete all of the quality assurance tasks conducted at F&B. These specific responsibilities include the following:
Training and documentation of F&B staff with regards to QA policy and procedures including coordinated quarterly meetings.
Evaluate data for compliance with standard operating procedures and acceptance criteria.
Conduct internal audits on the entire technical operation annually.
Propose changes in the Quality Assurance Program to improve the quality, efficiency, and/or defensibility of the data generated.
Manage laboratory participation in inter-laboratory comparisons and proficiency programs.
Maintain or modify laboratory accreditation.
Notification of laboratory management and project managers, in writing, of any changes to accreditation.
Assist in training of analysts in analytical quality control procedures.
Maintaining the QA manual, DOCs, and SOPs.

Project Leader

Qualifications:
Project Leaders should be individuals who have a history of analyzing environmental samples. They should have knowledge of quality assurance and how it relates to the validity of analytical data. They should also have knowledge of the specific analytical testing requirements for the needs of our clients. They should be able to recognize problems which can arise when analyzing samples, and be able to discuss with the client proper analytical techniques for meeting the clients' goals. This person is expected to have a degree in chemistry or several years experience in the environmental chemistry field.
Responsibilities:
The Project Leaders report directly to the Quality Assurance Officer on all quality assurance matters. They report directly to the Technical/Laboratory Director on all other matters such as project status and projected work loads. Specific responsibilities include the following:
Support the quality assurance program within the project.

Determine effectiveness of the quality assurance program in the project.
Recommend to the Quality Assurance Officer changes in the quality assurance program.
Document for the client any quality control problems which could not be resolved.
Provide technical overview of laboratory activities.

Laboratory Analysts

Qualifications:
Laboratory Analysts should be individuals who have a history of analyzing environmental samples. They should have knowledge of quality assurance. They should recognize quality assurance results which are out of conformance and be able to determine and remedy possible causes. Laboratory Analysts are expected to have a degree in chemical, environmental, biological sciences, physical sciences or engineering and/or experience in the environmental chemistry field.
Responsibilities:
Specific responsibilities include the following:
Perform analytical procedures and data recording in accordance with accepted methods.
Consult with the Quality Assurance Officer to verify that the laboratory is meeting stated quality control goals.
Evaluate new analytical techniques, procedures, instrumentation and quality control methods, and provide recommendations to the Technical/Laboratory Director and Quality Assurance Officer.
Lead the training of new analysts in laboratory operations and analytical procedures.
Evaluate instrument performance and implement instrument calibration and preventive maintenance program.
Perform data processing and validation.
Initiate non-conformance report forms for out-of-control situations, instrument malfunction, calibration failure, or other non-conformances as appropriate.
Prepare and maintain laboratory quality control records.

General Personnel

Qualifications:
General personnel include all other staff, such as laboratory technicians, sample check-in technicians and office personnel. General personnel should be individuals that pay very close attention to detail and follow written and oral instructions precisely.

Responsibilities:
General personnel are responsible for following established procedures and reporting any quality control problems or questions.

Figure 5-1
Laboratory Organization

Executive Committee/Technical Director:
Responsibilities: Appointed by owner to oversee all operations and functions of the laboratory.

Laboratory Director:
Responsibilities: Reports directly to the Executive Committee.

Quality Assurance Officer:
Responsibilities: Reports directly to The Executive Committee and Laboratory/Technical Director.

Project Leaders:
Responsibilities: Report directly to the Quality Assurance Officer on QA/QC matters and to the Technical/Laboratory Director on all other matters.

Laboratory Analysts/Calculations Chemists:
Responsibilities: Report directly to the Quality Assurance Officer on QA/QC matters and to the Technical/Laboratory Director and/or Executive Committee on all other matters.

Laboratory Analyst/Extraction Manager:
Responsibilities: Reports directly to the Quality Assurance Officer on QA/QC matters and to the Technical/Laboratory Director and/or Executive Committee on all other matters.

Technicians:
Responsibilities: Report directly to the Extraction Manager.

Safety Officer/Committee:
Responsibilities: Reports directly to the Technical/Laboratory Director and/or Executive Committee.

General Personnel:
Responsibilities: Reports directly to the Executive Committee.

6.0 STANDARD OPERATING PROCEDURES

Standard operating procedures (SOPs) are maintained which accurately reflect current laboratory activities. These documents may include, for example, equipment manuals provided by the manufacturer, published analytical methods with any changes or specifications documented, or internally written documents. Hardcopies of all SOPs are organized in folders which are easily accessible to all personnel. (The exception is equipment manuals, which are kept with the corresponding equipment.) There are two general types of SOPs; method SOPs and administrative SOPs. A list of administrative SOPs, along with other quality system documents, is included in Appendix A.

Method SOPs

Method SOPs are generated for each accredited method performed by F&BI. They provide detailed, laboratory specific, procedures for analytical testing methods. Each method SOP references the published analytical procedure upon which it is based. When the referenced analytical procedure has stated QA/QC requirements, the SOP meets the stated requirements. Any additional, laboratory specific, QA/QC requirements are detailed in the method and/or administrative SOPs.

Administrative SOPs

Administrative SOPs provide detailed procedures for all activities of the quality system not included in specific analytical methods, such as sample receiving, personnel training, and creating client reports. Administrative SOPs may be separate documents, or may be included in this document.

6.1 Deviation from SOPs

When a client (or project) has specific requirements of the laboratory, a deviation from existing procedures may be necessary. Typical examples include addition of target analytes and project specific reporting limits. If a deviation is requested, the project manager is responsible for discussing the request with the manager in charge of the analysis and obtaining her/his approval to accept the project. The project manager is also responsible for documenting the request on the appropriate analysis extraction worksheets, and on the final report if necessary.

Deviations from SOPs are documented using the extraction worksheet, sequence tables, injection logs, and/or other documents such as the non-conformance report form as discussed in section 13.3. Frequent departure from policy is not encouraged. However, if frequent departure from a particular policy is noted, the technical/laboratory director will address the possible need for a change in the policy.

7.0 TRAINING

Our company is designed around the idea that our employees are our most valuable asset. We are committed to the professional development of our employees. Since we are a relatively small laboratory, many of our employees wear several hats, and cross training is critical.

7.1 Quality System, Data Integrity, and Safety Training

When hired, each employee receives a company policy manual, data integrity SOP, quality assurance manual, and any SOPs relevant to their responsibilities. She/he also receives a safety training form and an employee attestation form, including data integrity training, to fill out and sign. The office manager is responsible for providing each new employee with copies of the policy manual and quality assurance manual. Each new employee is also provided with safety and general training forms, and copies of the relevant SOPs. Each employee is responsible for completing the required training documents, and for complying with all QA/QC and data integrity requirements. Each employee is also responsible for maintaining the current quality system documents which are relevant to their position, in their individual document file.

7.2 Initial Demonstration of Capability

The first step in training for analytical procedures is to familiarize the trainee with the method. This is achieved through a combination of reading the method SOP and observing an experienced analyst performing the method. The trainee then performs the method under close supervision. Prior to independently performing an analysis, each analyst completes an initial demonstration of capability (DOC). The DOC is performed as follows:

Obtain a quality control sample from an outside source. If not available, the QC sample may be prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.
Dilute/prepare enough of the QC sample to make 4 separate aliquots (samples) of the specified concentration. If the concentration is not otherwise specified, it should be approximately 10 times the MDL. Laboratory control samples or MDL study samples may be used to meet this requirement.
Extract and/or analyze each of the 4 samples either concurrently or over a period of days.
Use all of the results to calculate the mean recovery (accuracy) and the standard deviation (precision) for each parameter/analyte. Compare the mean and standard deviation to method acceptance criteria.
If all parameters/analytes meet the acceptance criteria, the DOC is complete and independent analysis of actual samples can begin. If one or more of the parameters/analytes fail at least one of the acceptance criteria, then locate and correct the source of the problem and repeat the entire test (above) for either all of the parameters/analytes or just the parameter(s)/analyte(s) that failed.

7.3 Continuing Demonstration of Capability

At least one of the following, once per year, is completed by each analyst to demonstrate continuing proficiency.

Acceptable performance of a blind sample
Another demonstration of capability
At least four consecutive laboratory control samples with acceptable levels of precision and accuracy (calculated as for DOC above).
Successful analysis of a blind performance sample on a similar test method using the same technology (e.g. GC/MS volatiles by methods 624 and 8260 are considered equivalent).
If none of the above can be performed, analysis of authentic samples with results statistically indistinguishable from those obtained by another trained analyst.

7.4 Continuing Quality System, Data Integrity, and Safety Training

Company wide training meetings are held at least once a quarter. At these meetings quality system, data integrity, and/or safety topics are discussed by the QA officer, technical/laboratory director, and/or safety officer/committee respectively. Employees are also encouraged to participate in relevant external training, such as seminars and instrument training courses.

7.5 Documentation of Training

Documentation of education, experience and training prior to employment at F&BI is kept on file with personnel records. The office manager is responsible for maintaining personnel records. All employees document on the Employee Attestation Form that they have read, understood and will follow the Policy Manual, QA Manual and each SOP distributed to him/her. The attendance at each quarterly training meeting is documented using the Quarterly Training Meeting form. These and other completed training documents, including DOC certificates, are filed. In addition a database summarizing DOC training is maintained. The QA officer is responsible for maintaining the DOC database. The office personnel are responsible for maintaining training files. Additional details of training documentation are found in the "Training" SOP.

8.0 MATERIAL PROCUREMENT AND CONTROL

The quality of reagents, solvents, gases, water, and laboratory vessels used in analyses should be known so that their effect upon analytical results can be defined and anticipated. Materials and equipment purchased by F&BI should meet the requirements stated below or as denoted in specific analytical procedures, and be controlled as stated.

The following general guidelines are used for purchasing and using materials and equipment. More specific requirements can be found in section 9 below, and in administrative and method SOPs.
Specify within the purchase requests the suitable grades of materials.
Verify upon receipt that materials meet requirements and that, as applicable, material certificates/records are provided and maintained in the laboratory record system.
Date all chemicals, standards and reagents with date of receipt, date opened and expiration date.
Store reagents and solvents in accordance with manufacturer's recommendations.
Verify that material storage is properly maintained, and remove materials from use when shelf life has expired.
Record the date put into service for equipment such as balances and analytical instruments.
Record preventive and corrective maintenance procedures performed on equipment.
Verify that equipment, including analytical balances, thermometers, volumetric glassware etc., is properly calibrated prior to use.
Clearly mark any equipment which has been taken out of service.

8.1 Requirements for Reagents, Solvents, and Gases

Chemical reagents, solvents, and gases are available in a variety of grades of purity, ranging from technical grade to ultrapure grades. The purity required varies with the type of analysis and project requirements. For many analyses analytical reagent (AR) grade is satisfactory. Other analyses, such as trace organic analyses, frequently require special ultrapure reagents, solvents, and gases.

General Inorganic Analyses
In general, AR grade reagents and solvents are adequate for inorganic analyses.
Primary standard reagents should be used for standardizing all volumetric solutions.
All prepared reagents should be checked for accuracy.

Trace Metals Analyses
All standards used for emission spectroscopy should be spectro-quality. It is recommended that other reagents and solvents also be spectro-quality. In many cases, AR grade may be satisfactory. Standards are prepared by the analyst, or purchased provided that purchased materials meet the requirements of the analytical method.
Gases used for emission spectroscopy should be high purity.

Organic Chemical Analyses

AR grade is generally the minimum acceptable grade for materials used for organic analyses. Reference grade standards should be used as necessary. Pesticide-quality solvents are generally required for low-concentration work. AR grade solvents are adequate for analyzing industrial waste samples. However, the contents of each solvent lot should be checked to determine suitability for the analyses.

For sample cleanup procedures, the adsorbents most commonly used are florisil, silica gel, and alumina. These are pre-activated according to the analytical method requirements and checked for interfering constituents.

Water

Deionized water is used for dilution and preparation of reagent solutions. Deionized water prepared in the laboratory should be ASTM Type I or better. For trace level inorganic work, Type I Reagent grade is required. Organic-free water is required for organic analyses. Organic-free water may be verified by GC or GC/MS. However, when determining trace organics by solvent extraction and gas chromatography, specialty water such as HPLC grade water with sufficiently low background may need to be used.

8.2 Requirements for Laboratory Containers

Containers used in the laboratory can affect the quality of results. Material composition and volumetric tolerances are discussed below.

Material Composition of Laboratory Vessels

The glass recommended for general use is chemically resistant borosilicate glass, such as that manufactured under the trade names of Pyrex or Kimax. The use of plastic vessels, containers and other apparatus made of Teflon, polyethylene, polystyrene, and polypropylene is desirable for certain specified applications.

Volumetric Tolerances of Laboratory Vessels

All volumetric measurements are made using measuring devices with tolerances appropriate to the level of accuracy needed.

Glassware Cleaning Requirements

All glassware used for sample extraction and analysis is cleaned sufficiently to meet the sensitivity of the method. This is tested on an ongoing basis with method blank samples. The same types of glassware and glassware cleaning techniques are used for method blank samples and client samples. In general, the following glassware cleaning procedures are followed.

Beakers - wash with laboratory grade soap, triple rinse with water

Separatory funnels - remove stopcock, wash stopcock, cap and funnel with laboratory grade soap, triple rinse with water, triple rinse with extraction solvent

KD flasks - wash with laboratory grade soap, triple rinse with water, triple rinse with extraction solvent

Snyder columns - triple rinse with extraction solvent

Concentrator tubes - wash with laboratory grade soap, triple rinse with water, triple rinse with extraction solvent

Syringes - triple rinse with extraction solvent
If lower than normal reporting limits are required or if highly contaminated samples have been extracted, glassware may need additional cleaning such as acid rinsing.

9.0 MEASUREMENT TRACEABILITY AND CALIBRATION

All measuring operations and testing equipment having an effect on the accuracy or validity of analytical results are calibrated and/or verified prior to being put into service and on a continuing basis. Wherever possible, reference standards (such as Class 1 weights and traceable thermometers) and analytical reagent calibration standards are traceable to national standards of measurement. For accredited analyses, where traceability to national standards is not applicable, correlation of results is confirmed using proficiency testing and/or independent analysis.

All equipment and reference materials necessary for correct performance of analysis are under the permanent control of F&BI. A list of major analytical equipment is given in Appendix B.

9.1 Support Equipment Calibration

Support equipment includes devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, thermometers, ovens, refrigerators, freezers, water baths and volumetric dispensing devices such as autopipetes and syringes. In cases where quantitative results are dependent on their accuracy, these devices are calibrated as described below.

Calibration/Verification Prior to Use

When new support equipment is purchased, it is the responsibility of the extraction manager to verify its calibration and traceability prior to putting it into service. Each piece of equipment is numbered, or otherwise identified, and the date put in service is recorded. Any certificates provided by the manufacturer are marked with the equipment identification and kept on file. Specific procedures for calibration (including on-going calibration) of specific types of support equipment are detailed in the “Support Equipment Monitoring and Calibration" SOP. These procedures include:
reference standard(s) used for calibration
specific calibration technique employed
acceptable performance tolerances
calibration frequency
documentation procedures

On-Going Calibration

Requirements for on-going calibration are provided in the specific equipment SOPs. The requirements are based on the type of equipment, stability characteristics of the equipment, and required accuracy. Some equipment is calibrated each working day, some monthly and some less frequently. All support equipment is calibrated annually, using nationally traceable reference standards if possible, over the entire range of use. It is the responsibility of the extraction manager to complete all on-going calibrations.

Corrective Actions

If equipment does not meet the calibration requirements, it is taken out of service unless and until necessary repairs have been made. All such equipment is marked as "out of service" and, if possible, placed in a different location until repaired. Records of all repairs, including service calls, are kept with the equipment records. When a piece of equipment is repaired another initial calibration is performed prior to being put back into service. If equipment cannot be repaired, it is discarded as appropriate. It is the responsibility of the laboratory manager to mark out of service equipment, arrange for repairs, re-calibrate and document all such activities.

In addition, if equipment goes outside the direct control of the laboratory, it is the responsibility of the extraction manager to verify satisfactory function and calibration status before the equipment is returned to service.

If an item of equipment is found to be defective, the effect of the defect on previous calibrations or analyses is examined, and corrective actions are taken if necessary. It is the responsibility of the person who finds a defect to inform the QA officer, Technical Director, or Executive Committee.

9.2 Instrument Calibration

Initial instrument calibration and continuing instrument calibration verification of all analytical instruments is performed to ensure that the data are of known quality. Specific method SOPs describe detailed calibration requirements for each method. It is the responsibility of each analyst to follow and document established calibration procedures. The following sections describe the calibration requirements for all accredited analyses performed by F&BI.

Initial Calibration

The following are essential elements of initial instrument calibration:
Sufficient raw data records are retained to permit reconstruction of the calibration.
Sample results are quantitated against the initial calibration, and may not be quantitated from any continuing instrument calibration verification.
Initial calibrations are verified with a second source standard (a standard obtained from a second manufacturer or lot, if the lot can be demonstrated from the manufacturer as prepared independently from other lots), unless a different requirement is specified in the method.
Appropriate criteria for the acceptance of an initial calibration are established.
If the initial calibration results are outside of the established acceptance criteria corrective action is taken (see below).
Any reported sample results which fall outside of the calibration range are reported as having less certainty.
At least one calibration standard is at or below the method reporting limit.
The lowest calibration standard is above the method detection limit (MDL), with the following exception:
For instrument technology (such as ICP/MS) with validated techniques which use a zero point and a single point calibration standard, the following apply:
Prior to analysis of samples the linear range is established.

Zero point and single point calibration standard are analyzed with each analytical batch. Additional standards may also be analyzed.
A standard corresponding to the limit of quantitation is analyzed with each analytical batch.
The linearity is verified at a frequency established by the method and/or the manufacturer.

Continuing Instrument Calibration Verification
When the initial instrument calibration is not performed on the day of analysis, the validity of the initial calibration is verified prior to sample analysis by a continuing instrument calibration verification (CCV). The following items are essential elements of continuing instrument calibration verification:
A CCV is repeated at the beginning and end of each analytical batch. The concentrations of the calibration verification are varied within the established calibration range. If an internal standard is used, only one CCV is analyzed per batch.
Sufficient raw data records are retained to permit reconstruction of the CCV. These records explicitly connect the continuing verification data to the initial instrument calibration.
Criteria for the acceptance of a CCV are established.
If the CCV results are outside established acceptance criteria, corrective actions are performed (see below).

Corrective Actions
Specific corrective actions are included in method SOPs. Following are general corrective action guidelines:
If the initial calibration results are outside established acceptance criteria, corrective actions are performed. This may include preparation of new standard solutions or instrument maintenance. Data associated with an unacceptable initial instrument calibration should not be reported. However, if such data are reported (usually due to insufficient sample for reanalysis) then it is reported with appropriate qualifiers.
If a CCV falls outside of established acceptance criteria, then corrective actions are performed. This may include preparation of new standard solutions or instrument maintenance. If routine corrective action procedures fail to produce a second consecutive (immediate) CCV within acceptance criteria, then either acceptable performance is demonstrated after corrective action with two consecutive CCVs, or a new initial calibration is performed. If possible, samples associated with a failing CCV are reanalyzed. If reanalysis is not performed, then results are qualified. In the following two situations, results may be reported, even if reanalysis is possible.
a) If the CCV fails high, then associated sample results which are non-detect may be reported.
b) If the CCV fails low, then associated sample results which are above a level which provides sufficient data for client use (if known) may be reported.

9.3 Maintaining Traceability of Standards, Solvents, and Reagents

The following steps are taken to maintain traceability of standards:

All standards are logged into the Standards Logbook and given a Date Code which is written on each container and certificate (if included). Also recorded are description, supplier and manufacturer's Lot # (if provided). The sample check-in technician is responsible for logging in standards.
When opened, all original containers (as provided by the vendor) are labeled with the date opened and an expiration date (based on the date opened). The extraction analyst is responsible for labeling original containers when opened.
Documentation of standards prepared from purchased stocks or neat compounds is maintained in the Standards Prep Logbook. Information recorded includes the Date Code, the preparation date, the expiration date, the amount used, and the preparer's initials. The person preparing the standard is responsible for proper documentation.
Containers of prepared standards are labeled with a unique Standards Prep Logbook ID linking them to the above preparation documentation. They are also labeled with the preparation and expiration dates. The expiration date of a prepared standard may not exceed the expiration date of any of the primary standards used in its preparation. The person preparing the standard is responsible for labeling correctly.
Whenever a standard is used for sample extraction or analysis (e.g. calibration standard, surrogate, etc.) the Standards Prep Logbook ID is written in the sample extraction and analysis records. The extraction analyst is responsible for recording the Logbook ID.
Standards are not used past their expiration dates.

The following steps are taken to maintain traceability of solvents and reagents.

All solvents and reagents are logged into the Solvents and Reagents Logbook and assigned a Solvent Code which is written on each container and certificate (if included). Also recorded are description, supplier and manufacturer's Lot # (if provided). The sample check-in technician is responsible for logging in solvents and reagents.
When a solvent or reagent is used to prepare a standard, the Solvent Code is recorded in the Standards Prep Logbook. The person preparing the standard is responsible for proper documentation. Note: If a reagent solution is prepared, then that is documented in the Standards Prep Logbook as described above.
When a solvent or reagent is used for extraction or analysis, the Solvent Code is recorded in the sample extraction and analysis records. The extraction analyst is responsible for recording the Solvent Code.

9.4 Equipment Maintenance

Preventive maintenance is an important part of the F&BI quality system. A maintenance program has been outlined to provide an organized program of actions to maintain proper instrument performance which will ensure reliability of the measurements and prevent instrument failure during use. This equipment maintenance program is included as Appendix C. Additional information about routine

and special maintenance activities can be found in instrument manuals and troubleshooting guides, and in method SOPs.

Implementation

The implementation of the preventive maintenance program is dependent upon the specific instruments and equipment used. The extraction manager is responsible for performing and/or coordinating all support equipment maintenance. The GC, GC/MS, and inorganics supervisors are responsible for performing and/or coordinating all analytical instrument maintenance.

Documentation

Preventive maintenance is documented in maintenance log books. Each instrument has its own maintenance logbook which is updated each time any type of work is performed on the instrument.

10.0 SAMPLE HANDLING PROCEDURES

10.1 Sampling and Sample Acceptance Policy

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples. Factors that are taken into account to ensure accurate, reliable results include:
Type of container used
Sample preservation
Amount of sample taken
Sample storage (holding) time
Proper sample labeling/identification
Proper chain-of-custody (COC) documentation

Container, volume, preservation and holding time information for selected analyses for water and soil samples is included in Appendix D. F&BI provides sample containers, including preservative, to our clients when requested.

Each sample container should be labeled, using a durable label and indelible ink, to identify the following:
Client name
Client project name
Sampling date and time
Sample name/number
Sample preservation

A chain-of-custody (COC) form should be filled out for every client project. An example COC form is shown in Figure 10-1. The following information should be included on the COC:
Client (company) name and contact information
Client project name/number
Sampler's name
Sample ID (name/number)
Date and time sampled
Type of sample (e.g. soil, water, etc.)
Requested analysis

Sample Acceptance Policy
It is the client's responsibility to follow proper sampling and documentation protocol. If any samples are received with incomplete documentation, unclear sample labeling, incorrect or damaged sample containers, expired holding time, insufficient sample volume, incorrect sample preservation or any other circumstances that could affect data quality, the sample custodian and/or project manager will notify the client. If the problem can be resolved (e.g. documentation provided) normal analysis will be initiated. If not, data will be reported with qualifiers if necessary. The sample acceptance policy is posted at the sample receiving area, and copies are available upon request.

10.2 Sample Receipt Protocols

Chain-of-Custody
Evidence of sample collection, shipment, laboratory receipt, and laboratory custody until disposal is documented to maintain quality control. Documentation is accomplished through the COC records, shipping records and sample check-in and disposal records.

Sample Condition
Upon receipt, the condition of the samples is recorded. A copy of the sample condition receipt checklist is included in Figure 10-2. If a sample does not meet the sample receipt acceptance criteria the client is consulted for further instructions before proceeding. A record of the client's request is retained.

Sample Tracking
A permanent chronological sample receipt logbook is used to document receipt of all samples. The laboratory project number assigned is recorded on the sample condition checklist and on the COC, providing an unequivocal link to the laboratory and field ID's, the sample collection and analysis information provided on the COC, and the sample condition record.

Each sample received is assigned a unique laboratory ID that maintains an unequivocal link with the unique field ID assigned to each container. The laboratory ID is placed on the sample container as a durable label and is recorded on the COC. The laboratory ID is the link that associates the sample with subsequent laboratory activities such as sample preparation or calibration.

Sample Check-In
Upon sample receipt, the sample custodian completes the following steps (more details are found in the "Sample Receiving" SOP):
Sign and date the COC and attach the waybill (if applicable) to the COC.
Examine all samples and accompanying paperwork, using the Sample Condition Upon Receipt Checklist as a guide.
Verify that sample holding times have not been exceeded and are not close to their limit.
Notify the Project Leader if there are any samples that should be analyzed immediately because of holding time or client request.

The sample custodian then logs the samples into the Sample Check-In Logbook, which contains the following information:
Date received in laboratory
Name of client
Client project name/number
Type and condition of samples as received
Analyses requested
F&BI project number
Initials of person logging in samples

Container size(s) and cooler/sample temperature

The sample custodian then initiates sample analysis by:
Completing the COC documentation
Labeling each container with the unique laboratory ID
Placing the samples in proper laboratory storage
Notifying the project leader of sample arrival by placing copies of the COC and all other project documents in the project leader bin.

10.3 Sample Storage

Samples and sample extracts are stored according to the conditions specified by preservation protocols. The temperatures of sample storage refrigerators are monitored each working day and recorded in the refrigerator temperature logbook. Samples and sample extracts are stored away from all standards, reagents, food and other potentially contaminating sources, and are stored in such a manner to prevent cross contamination. In addition, samples and sample extracts are stored in a secured area in order to protect sample condition and integrity. Placing of samples in the proper storage environment is the responsibility of the sample custodian. Placing of extracts in the proper storage environment is the responsibility of the extraction analyst.

10.4 Sample Disposal

There are several possibilities for sample disposition:
The sample may be consumed during analysis.
Samples may be returned to the client for disposal.
Samples are incorporated into the laboratory waste streams.

The samples may be stored for 30 days after arrival. Proper environmental control and holding times are observed if reanalysis is anticipated. If reanalysis is not anticipated, environmental conditions for storage may not be observed.

The project leader and/or sample custodian determine disposition of samples if not specified on the COC. In general, F&BI will not maintain samples and extracts longer than one month beyond completion of analysis, unless otherwise requested.

After the appropriate storage time, the samples and extracts are disposed of by following approved disposal procedures. All materials known contain hazardous substances are disposed of as a separate waste streams. F&BI has identified 4 primary waste streams; solid waste, organic liquid waste, PCB (HazMat) waste, and acid waste. Disposal procedures are in compliance with all EPA, DOT, and Washington State waste disposal regulations. The extraction manager is responsible for overseeing sample and waste disposal.

Figure 10-1
Chain of Custody Form

SAMPLE CHAIN OF CUSTODY

Page # _____ of _____

Send Report To _____ SAMPLERS *(signature)*

Company _____ PROJECT NAME/NO. PO #

Address _____

City, State, ZIP _____ REMARKS

Phone # _____ Fax # _____

TURNAROUND TIME
- ☐ Standard (2 Weeks)
- ☐ RUSH

Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Dispose after 30 days
- ☐ Return samples
- ☐ Will call with instructions

Sample ID	Lab ID	Date	Time	Sample Type	# of containers	ANALYSES REQUESTED									Notes
						TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260	SVOCs by 8270	HPS				

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Friedman & Bruya, Inc.	Relinquished by:				
3012 16th Avenue West					
Seattle, WA 98119-2029	Received by:				
Ph. (206) 285-8282	Relinquished by:				
Fax (206) 283-5044	Received by:				

Figure 10-2

SAMPLE CONDITION UPON RECEIPT CHECKLIST

PROJECT # _____ **CLIENT**_____ **INITIALS/ DATE:**_____

If custody seals are present on cooler, are they intact?	☐ NA	☐ YES	☐ NO
Cooler/Sample temperature		_____ °C	
Were samples received on ice/cold packs?		☐ YES	☐ NO

How did samples arrive?

☐ Over the Counter
☐ Picked up by F&BI
☐ FedEx/UPS/GSO

Number of days samples have been sitting prior to receipt at laboratory _____ **days**

Is there a Chain-of-Custody* (COC)? *or other representative documents, letters, and/or shipping memos	☐ YES	☐ NO
Are the samples clearly identified? (explain "no" answer below)	☐ YES	☐ NO

Is the following information provided on the COC* ? (explain "no" answer below)

Sample ID's	☐ Yes	☐ No	# of Containers	☐ Yes	☐ No
Date Sampled	☐ Yes	☐ No	Relinquished	☐ Yes	☐ No
Time Sampled	☐ Yes	☐ No	Requested analysis	☐ Yes	☐ No

Were all sample containers received intact (i.e. not broken, leaking etc.)? (explain "no" answer below)		☐ YES	☐ NO
Were appropriate sample containers used? (explain "no" answer below)		☐ YES	☐ NO
If custody seals are present on samples, are they intact?	☐ NA	☐ YES	☐ NO
Are samples requiring no headspace, headspace free?	☐ NA	☐ YES	☐ NO

Explain "no" items from above (use the back if needed)

11.0 QUALITY CONTROL OBJECTIVES

F&BI follows a comprehensive internal quality control (QC) program to insure precision, accuracy, and reliability of data. QC objectives are established to determine if data generated is acceptable. These objectives are either specified by the method, or are statistically derived from historical laboratory data. Individual method SOPs include details of method QC requirements, which may supersede those given here.

11.1 Demonstration of Capability

Prior to using any test method, and at any time there is a significant change in instrument type or test method, a demonstration of capability (see section 7.2) is performed. In general, this does not test the performance of the method in real world samples, but in the applicable clean matrix.

11.2 Precision

Precision is a measure of the reproducibility of a result. Except as otherwise specified by an accredited method, the QC objective for precision is 20% as measured by Relative Percent Difference (RPD), as determined by duplicate analyses. It is recognized that for analytes at concentrations of less than five to ten times the method detection limit (MDL), it may be difficult to meet this objective.

Precision is usually expressed as Relative Percent Difference (RPD) based on duplicate analyses of a sample. The RPD is calculated as:

$$RPD = \frac{|X1 - X2|}{[(X1+X2)/2]} \times 100$$

where X1 and X2 are, respectively, the first and second values obtained for the analysis. Precision may be evaluated from duplicate sample, matrix spike and/or laboratory control sample analyses.

11.3 Accuracy

Accuracy is a measure of the closeness of a result to the true or expected value. It is generally determined using matrix spike and/or laboratory control sample recoveries. Control charts (see section 11.4) are generated to calculate laboratory specific accuracy objectives. For accredited analysis without enough QC data, or where the method specifies accuracy objectives, method prescribed limits are used. If the method does not specify control limits, then reasonable default limits are used. It is recognized that, for matrix spike samples, unless the sample is homogeneous and the spike concentration is greater than or approximately equal to the native concentration and greater than five to ten times the reporting limit, this objective may be difficult to meet, and therefore such samples will not be used to generate new QA/QC objectives/criteria. Alternatively, accuracy may be assessed through the analysis of

appropriate standard reference materials or certified standards or samples, as available.

Accuracy is usually expressed as percent recovery (%R). The %R is calculated as:

$$\%R = ((Xs - Xa)/Ct) \times 100$$

where Xs is the observed concentration of the spiked sample, Xa is the observed concentration of the unspiked sample, and Ct is the concentration of the spike.

11.4 Uncertainty

Laboratory generated control limits (see below) for laboratory control samples represent an estimation of the uncertainty of measurement for a particular analysis.

Control Limits
Control limits are the acceptance criteria used for evaluating the accuracy and precision of results. F&BI has established control limits for precision of 0% to 30% for all accredited analyses, unless method specified limits are more stringent. Initial control limits for accuracy are taken from the method or regulatory requirements. If no method or regulatory criteria exist, control limits are assigned default values. These default values are assigned using the following guidelines.

For laboratory control samples default control limits are 70% to 130%, and default warning limits are 80% to 120%.
For matrix spike samples and surrogate compounds default control limits are 50% to 150%, and default warning limits are 65% to 135%.
Established control limits for a similar method/matrix may be used instead of default limits.

When sufficient data has been generated, the laboratory specific acceptance limits for accuracy are usually used. After a minimum of 20 samples have been analyzed for a particular matrix/method, the mean and standard deviation of the results are calculated. Warning limits are set at 2 standard deviations from the mean, and control (action) limits are set at 3 standard deviations from the mean. Control limits are generally reviewed at least monthly, or when sufficient data has been generated to warrant review, and updated annually.

Control Charts
Control charts are prepared for accredited analytical methods to document the trends in percent recoveries (accuracy) for laboratory control samples, matrix spike samples and surrogates. Results are monitored routinely by the analyst. If 10 consecutive results fall outside of warning or control limits (either all 10 above, or all 10 below), the cause is investigated and necessary corrective actions are taken.

11.5 Completeness

Completeness is determined as the percentage of the sample data for which the associated QC data are found to be acceptable. The QC goal for completeness, as determined by the percentage of valid data generated, is 100%. Precision and accuracy determinations, if outside the QA objectives due to sample-related causes, may be regarded as qualifying, rather than invalidating, the associated data.

11.6 Representativeness

Representativeness is the degree to which the field sample represents the overall sample site or material. F&BI will make every reasonable effort to assure that the samples are adequately homogenized prior to taking aliquots for analysis, so that the reported results are representative of the sample received. However, F&BI does not represent that the samples submitted for analysis are representative of the conditions in the field. Of particular importance is that mixing may substantially lower the measured levels of volatile components. (For this reason, mixing is avoided as much as possible for samples being analyzed for those compounds.)

11.7 Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. To ensure comparability, standard operating procedures as defined in the quality system are used for handling and analysis of all samples.

11.8 Method Detection Limits and Reporting Limits

Method Detection Limits

The method detection limit (MDL) is the minimum concentration that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. For each applicable test method and matrix, MDLs are determined for the compounds of interest by spiking the analyte(s) at a level approximately 5 times the expected MDL into a clean matrix and processing as a sample. A minimum of seven replicates are processed and the mean result is multiplied by the applicable students' value to obtain the MDL. MDLs are determined for each new test method (prior to sample analysis), annually, and each time there is a change in the test method that affects how the test is performed, or when a change in instrumentation occurs that affects the reliability of the analysis.

Reporting Limits

Reporting limits (RL), or practical quantitation limits (PQL), are the routinely reported lower limits of quantitation. RLs are calculated from the MDL and are typically 2 to 10 times the MDL, or equal to or greater than the concentration of the lowest calibration standard. The RLs take into account the day-to-day fluctuations in instrument reliability and other factors. These RLs are the levels to which F&BI routinely reports results. If a result below the RL is reported, typically due to client request, it is qualified as an estimated value.

12.0 ANALYSIS AND EVALUATION OF QUALITY CONTROL SAMPLES

Quality control samples are routinely analyzed with each analytical batch (see below) of field samples to demonstrate that the laboratory is operating within the QC objectives. QC samples are evaluated on an on-going basis, and QC acceptance criteria are defined and used to determine the validity of the data. Specific types of QC samples are described below. Individual method SOPs include details of method QC requirements. A summary of frequency and acceptance limit requirements for QC elements described in this and previous sections is given in Table 12-1. If method requirements are different than those given here, the method requirements will be followed.

12.1 Preparation Batch

The preparation batch is the basic unit for quality control. To ensure that QC results for accredited analyses are representative, all of the samples in a batch, both field and QC samples, are extracted, analyzed and calculated in the same way. In the absence of specific program or method requirements, the requirements for a preparation batch are as follows:

A maximum of 20 (field) samples are in a batch.
All samples in a batch are the same matrix.
QC samples (see below) processed with a batch are; 1 method blank, 1 LCS, 1 MS (if suitable), and either 1 MSD or 1 matrix duplicate (if suitable, if not, then 1 LCSD).
The same reagent lot(s) are used to process the batch.
The same analyst(s) process the entire batch.
The maximum time between the start of processing of the first and last sample in a batch is 24 hours.
QC samples are prepared and analyzed with the associated field samples. However, if field samples in the batch are reanalyzed for a reason not affecting the QC samples (e.g. dilution, surrogate recovery etc.), the QC samples do not require analysis each time a field sample from the preparation batch is analyzed.
Each batch is assigned a unique ID which links it to the associated field samples.

12.2 Method Blank Samples

Purpose
The method blank is used to assess the preparation batch for possible contamination during the preparation and processing steps. It is processed along with and under the same conditions as the associated samples.

Frequency
One method blank is analyzed with each preparation batch.

Composition

The method blank consists of a matrix that is similar to the associated samples and is free of the analytes of interest.

Evaluation Criteria and Corrective Action
The goal is to have no detectable contaminants. If contamination is detected in the method blank sample, the nature of the interference and the effect on the analysis of each sample in the batch is evaluated. The source of contamination is investigated and measures taken to minimize or eliminate the problem. Affected samples are reprocessed, or data are appropriately qualified if:
The concentration of a targeted analyte in the blank is at or above the reporting limit AND is greater than 1/10 of the amount measured in the sample.
The blank contamination otherwise affects the sample results as per the test method requirements or the individual project data quality objectives.
Results of method blank analyses are maintained with the corresponding analytical data set and reported with project results.

12.3 Laboratory Control Sample (LCS)

Purpose
The LCS is used to evaluate the performance of the total analytical system, including all preparation and analysis steps.

Frequency
One LCS is analyzed with each preparation batch. Exceptions are for analytes for which no spiking solutions are available such as total suspended solids, pH or turbidity.

Composition
The LCS is a controlled matrix, free of the analytes of interest, spiked with known and verified concentrations of analytes. Alternatively the LCS may consist of a media containing known and verified concentrations of analytes or as Certified Reference Material (CRM). All analyte concentrations are within the calibration range of the methods. The components spiked are specified in individual method SOPs.

Evaluation Criteria and Corrective Action
LCS results are calculated in percent recovery (see section 11.3). Results are compared to established acceptance criteria. A LCS that is determined to be within the criteria effectively establishes that the analytical system is in control and validates system performance for the samples in the associated batch. If a LCS result is found to be outside the criteria, this indicates that the analytical system is "out of control". Any affected samples associated with an out of control LCS are reprocessed and re-analyzed (if possible), or the results reported with appropriate data qualifying codes. LCS results are reported on the quality control data summary forms.

12.4 Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Samples

Purpose

Matrix specific QC samples indicate the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. The information from these controls is sample/matrix specific and is not normally used to determine the validity of the entire batch.

Frequency
One MS sample is analyzed with each preparation batch, if a sufficient amount of sample is provided.

Composition
MS/MSD analysis is performed on aliquots of actual samples. The composition is not usually known. Samples are spiked with known and verified concentrations of analytes. All analyte spiking concentrations are within the calibration range of the methods. The components spiked are specified in individual method SOPs.

Evaluation and Corrective Action
The results from MS/MSD analyses are primarily designed to assess the precision and accuracy of analytical results in a given matrix and are expressed as percent recovery (%R) and relative percent difference (RPD) (see section 11). Results are compared to the established acceptance criteria. If results are outside the criteria, the cause is investigated and corrective actions are taken if necessary, or the MS/MSD data are reported with appropriate qualifiers. MS/MSD results are reported on the quality control data summary forms.

12.5 Matrix Duplicate Samples

Purpose
Matrix duplicates are replicate aliquots of the same sample taken through the entire analytical procedure. The results from this analysis indicate the precision of the results for the specific sample using the selected method.

Frequency
One duplicate sample is analyzed with each preparation batch. If sufficient sample is provided, this will be either a MSD or a matrix duplicate. If not, a laboratory control sample duplicate (LCSD) is analyzed.

Composition
Matrix duplicates are performed on replicate aliquots of actual samples. The composition is not usually known.

Evaluation and Corrective Action
The results from matrix duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as RPD. Results are compared to established acceptance criteria. If results are outside the criteria, the cause is investigated and corrective actions are taken if necessary, or the matrix duplicate data are reported with appropriate qualifiers. Duplicate analysis results are summarized on the quality control data summary forms.

12.6 Surrogate Standard Analyses

Purpose
Surrogates are used most often in organic chromatography test methods and are chosen to reflect the chemistries of the targeted components of the method. Added prior to sample preparation/extraction, they provide a measure of recovery for every sample matrix.

Frequency
Except where the matrix precludes its use or when not available, surrogate compounds are added to all samples, standards, and blanks for all appropriate test methods.

Composition
Surrogate compounds are chosen to represent the various chemistries of the target analytes in the method. Individual method SOPs specify the surrogate compound(s) used.

Evaluation Criteria and Corrective Action
Surrogate results are calculated in percent recovery (see section 11.3). Results are compared to established acceptance criteria. Surrogates outside the acceptance criteria are evaluated for the effect indicated for the individual sample results. Corrective actions are taken if necessary, or affected results are reported with appropriate qualifiers. Surrogate results are reported with associated sample results.

12.7 Proficiency Testing (PT) Samples

Purpose
PT samples are blind samples purchased from a certified provider. They are used to evaluate the performance of the total analytical system, including all preparation and analysis steps. They are processed under the same conditions and in the same manner as client samples.

Frequency
F&BI participates in certified proficiency testing programs at a frequency required by accrediting agencies. PT samples are analyzed twice a year for each analyte, method and matrix, when available, for which F&BI is accredited.

Composition
PT samples are either prepared in a clean matrix by the provider, or are prepared in a clean matrix at the laboratory according to the provider's instructions. The specific analyte spiking levels are unknown to the laboratory.

Evaluation Criteria and Corrective Action
PT results are evaluated by the provider and reported directly to the regulatory agency as well as to the laboratory. Any PT results which are reported as not acceptable are reviewed and corrective actions implemented as needed. Reports received from PT sample providers and corrective action documentation are kept on file.

F&BI does not send any PT sample, or portion of a PT sample, to another laboratory for any analysis. Also, F&BI does not knowingly receive any PT sample, or portion of a PT sample, from another laboratory, or communicate with another laboratory concerning PT samples.

Table 12-1
QC Frequency and Acceptance Limits Summary
(For Accredited Analysis, Method requirements may supersede these.)

Quality Control Element	Frequency	Acceptance Limits
Method Detection Limit (MDL)	Initially, quarterly, and with substantial change to method or instrument.	40CFR Part 136, Appendix B calculations.
Demonstration of Capability (DOC)	Annually for each analyst.	Average of replicates within method established control limits of true value, and not >20% RSD for each analyte.
Initial Calibration	Initially and if ICV or CCV fail.	Per method specific requirements.
Initial Calibration Verification (ICV/Second Source)	Following every initial calibration, prior to sample analysis.	Per method specific requirements.
Continuing Calibration Verification (CCV)	When an initial calibration has not been performed: i) At the beginning and end of analysis of 20 samples (max). Concentrations vary. ii) At the beginning of 12 hour shift if internal calibration used.	Per method specific requirements.
Method Blank (MB)	1 per preparation batch of 20 (or fewer) samples.	Concentration for each analyte below RL or method specific.
Laboratory Control Sample (LCS)	1 per preparation batch of 20 (or fewer) samples.	Per laboratory established control limits (or default limits.)
Matrix Spike (MS)	1 per preparation batch of 20 (or fewer) samples.	Per laboratory established control limits (or default limits.) Does not control batch.
Duplicate Analysis (Sample Duplicate (Dup), MSD or LCSD)	1 per preparation batch of 20 (or fewer) samples. i) Dup or MSD if sufficient sample. ii) LCSD if not.	Percent recovery per laboratory established control limits (or default limits.) RPD 0% to 30%. Dup and MSD do not control batch.
Surrogate	Each field and QC sample for accredited organic analyses.	Per laboratory established control limits (or default limits.)
Proficiency Testing (PT)	Twice per year per accredited	Per PT provider.

Samples	method/analyte/matrix.	

13.0 CORRECTIVE ACTIONS

Corrective actions may be implemented as a result of failure of quality control results to meet established criteria, failure of reported results to meet client's needs, or deviation from established policies and procedures in the SOPs and this QA manual. These are documented with the non-conformance report form which includes an investigation of the root cause, identification of possible corrective actions, and a description of the corrective action taken.

The QA officer reviews each non-conformance report form. This documentation is kept on file with each affected client report, and a copy is kept by the QA officer. During the annual internal audit (see section 16), the QA officer or other qualified F&B staff reviews all non-conformance report forms to look for chronic systematic problems that need more in-depth investigation and alternative corrective action consideration.

In addition, corrective actions may be implemented as a result of internal or external audit findings, or management review (see section 16). These are documented with the internal audit corrective action form, external audit correspondence, and the management review corrective action form respectively.

If corrective action procedures do not resolve or identify the problem, personnel will notify management for direction to take. The findings and actions taken are documented and sent to the QA officer or Technical Director for follow-up during an internal audit.

13.1 QC Analysis Failure

If any quality control results fail to meet established criteria, corrective action procedures are immediately implemented if possible. Corrective actions are identified by the individual responsible for a particular analytical method or instrument. In addition, the analyst performing data calculation or review may initiate corrective actions if needed. Corrective actions may include a review of calculations, a check of instrument maintenance, a review of analytical techniques, and reanalysis of affected samples. Table 13-1 has a general summary of QC analyses and corrective actions. Individual method SOPs detail method specific corrective actions. Corrective actions are documented by the analyst in the analysis records.

If, following corrective actions, quality control results still fail, then affected results are reported with appropriate qualifying flags and the analyst may use a non-conformance report form to further document the causes of the qualified data. In some cases it may not be possible to follow standard QC procedures and/or corrective actions. For example, if insufficient sample is provided, duplicate sample analysis, matrix spike analysis and/or sample re-extraction may not be possible. In these cases, all possible QC procedures are followed, reported data are qualified if needed, and the analyst uses the extraction worksheet, sequence tables, injection logs, and/or non-conformance report form to document.

If the quality control failure may require that analysis is halted for a particular method and/or instrument, it is the responsibility of the analyst to notify his/her supervisor. The supervisor then determines the required action and notifies the laboratory/technical director if analysis should be halted. The analysis can then be resumed only after approval from the laboratory/technical director.

13.2 Client Complaints

Any client complaints are resolved promptly. The project manager has primary responsibility for handing client complaints. Complaints which are not able to be resolved by the project manager may be referred to the laboratory/technical director or executive committee. Complaints are documented by the project manager using the non-conformance report form, client communication form, project notes macro, or a printed record of an e-mail correspondence.

13.3 Deviation from SOPs or QA Manual

Deviations from established policies and procedures as written in laboratory SOPs and this QA manual are documented using the extraction worksheet, sequence tables, injection logs, and/or other documents such as the non-conformance report form. A deviation may occur due to a specific client request, or due to laboratory circumstances.

13.4 Audit Findings

Corrective actions needed as a result of audit findings (internal or external) are initiated by the quality assurance manager or the laboratory/technical director. Audit related corrective actions may include providing additional staff training, updating SOPs or establishing new procedures. Internal audit corrective action documentation is kept on file with internal audit findings. External audit corrective actions are documented through correspondence with the auditor(s).

13.5 Record-Keeping Errors

Entries in records are not obliterated by methods such as erasures, overwritten files or markings. Corrections to record-keeping errors are made by one line marked through the error. The individual making the correction initials and dates the correction, and writes a brief explanation as needed. These criteria are also followed for electronically maintained records as applicable.

13.6 Corrective Actions Which Affect Reported Results

If audits or further data review indicate a substantial error in any data which has already been issued in a final report, the client is notified within 30 days and an amended report is issued if necessary.

Table 13-1
QC Corrective Actions
(For Accredited Analysis, Method requirements may supersede these.)

Quality Control Element	Corrective Action(s)	Documentation
Method Detection Limit (MDL)	Determine source of problem, correct, reanalyze (re-extract if necessary).	Instrument raw data.
Demonstration of Capability (DOC)	Determine source of problem, correct, reanalyze (re-extract if necessary).	Instrument raw data. DOC Certificate
Initial Calibration	Determine source of problem and recalibrate. Reanalyze any affected samples.	Instrument raw data. Flag sample results if not corrected. Non-Conformance Form if not corrected.
Initial Calibration Verification (ICV/Second Source)	Re-inject ICV. If ICV fails a second time, a new initial calibration is required. Reanalyze any affected samples.	Instrument raw data. Flag sample results if not corrected. Non-Conformance Form if not corrected.
Continuing Calibration Verification (CCV)	Determine source of problem and re-inject CCV. If second CCV fails, either correct problem and pass two consecutive CCVs, or a new initial calibration is required. Reanalyze any affected samples unless: i) CCV is high and sample is ND. ii) CCV is low and sample result is above regulatory/action limit.	Instrument raw data. Flag sample results if not corrected. Non-Conformance Form if not corrected.
Method Blank (MB)	Reduce background contamination. Re-extract and reanalyze MB and all affected samples in batch. Sample result can be reported if MB is <1/10 of sample result, or if sample is ND.	Instrument raw data. Flag MB and sample results if not corrected. Non-Conformance Form if not corrected.
Laboratory Control Sample (LCS/LCSD)	Determine source of problem. Correct and: i) If instrument related, reanalyze LCS and all affected samples in batch. ii) If spike related, re-extract and reanalyze LCS. iii) If other, re-extract and reanalyze LCS and all affected samples in batch.	Instrument raw data. Flag LCS and sample results if not corrected. Non-Conformance Form if not corrected.

Note: Verify calculations prior to other corrective actions.

Table 13-1
QC Corrective Actions (continued)
(For Accredited Analysis, Method requirements may supersede these.)

Quality Control Element	Corrective Action(s)	Documentation
Matrix Spike (MS)	Determine source of problem. i) If instrument related, reanalyze MS and all affected samples in batch. ii) If spike related, re-extract and reanalyze MS. iii) If LCS passes, flag failing MS result as matrix effect.	Instrument raw data. Flag MS result if not corrected. Non-Conformance Form if not corrected.
Duplicate Analysis (Sample Duplicate (Dup), or MSD)	Determine source of problem. i) If instrument related, reanalyze duplicate and all affected samples in batch. ii) If other, re-extract and reanalyze sample and duplicate (or MS and MSD). iii) If LCS passes, flag failing result as matrix effect.	Instrument raw data. Flag duplicate result if not corrected. Non-Conformance Form if not corrected.
Surrogate	Determine source of problem. i) If instrument related, reanalyze sample. ii) If spike related, re-extract and reanalyze sample. iii) If matrix related, flag failing result as matrix effect.	Instrument raw data. Flag surrogate result if not corrected. Non-Conformance Form if not corrected.
Proficiency Testing (PT) Samples	Determine and correct source of problem. Pass minimum of 2 of last 3 for each accredited method/analyte/matrix.	PT provider report. Corrective action letters to regulatory agency.

Note: Verify calculations prior to other corrective actions.

14.0 DATA PROCESSING, VALIDATION, AND REPORTING

All analytical data reported by F&BI to a client in a final report is calculated, reviewed and validated, following established quality system procedures. Individual method SOPs describe specific calculation procedures. The following describes our general data reduction, validation and reporting procedures.

14.1 Data Processing and Review

Analytical results are generated from raw data by the analyst, using procedures specific to the analytical methods, and described in the appropriate method SOP. Results for most analyses are generated by computer. However, analysts usually enter data, such as sample volume/weight, to complete the calculations. Summary pages containing these entries are printed for review. Data generated is electronically transferred into the proper electronic form(s) for reporting. These forms are also printed for review.

For analyses which do not have computer generated data, results are hand entered into the computer for reporting. These results are printed and a 100% review of calculations and data entry is completed. If a particular result, which would normally be computer generated, is manually calculated (usually due to a manual integration) then the entire calculation is documented clearly so that the review analyst can perform a complete review.

Manual Integrations

Integration settings are adjusted to minimize the need for manual integrations. However, a manual integration is necessary if the automatic integration of the peak or integration area (for TPH analyses) is clearly affected (e.g. does not extend from baseline to baseline, peak is split, integration is inconsistent between full strength and diluted peak).

If manual integration is performed, this is clearly documented. The raw data affected by the re-integration is printed and included in the instrument data package along with the original integration, and any manual calculations which are done as a result, are documented. The analyst records his/her initials and the date the manual integrations were made. In addition, all manual integrations are reviewed carefully to check for bias.

Quality Control Results

The analyst also calculates and evaluates all quality control results. Analytical data for quality control samples (e.g. method blank, LCS, MS) are calculated and reviewed in the same manner as for all other samples. Results are evaluated using established acceptance criteria, and corrective actions are taken prior to releasing, as final, any associated sample results. After all calculations and QC evaluations are complete, the analyst signs the worksheet(s) and gives it to the calculation review analyst.

Calculation Review

An analyst, independent from the person performing the analysis, is responsible for a 100% review of all raw data, calculations, transcriptions (if needed) and results. Each worksheet reviewed is initialed. Corrections are reviewed by the calculations analyst, and any disagreements are resolved by the QA officer or Technical Director. Upon completion of review, worksheets are given to the project manager to generate a final report.

14.2 Analytical Data Reports

Analytical data and quality control data are summarized in standard report formats, either designed by F&BI or supplied by the client. The project manager combines the electronic files of reviewed analytical results to generate a final report. Prior to release of the report to the client, the project manager reviews and approves the entire report for completeness, and to ensure that any client-specified objectives were successfully achieved. The project manager then authorizes and electronically releases the final report file to office personnel to generate a hardcopy report. Specific procedures for generating a final analytical report are provided in the "Creating Reports" SOP. The following information is included in each final analytical data report issued by F&BI.
The F&BI name, address and phone number, and project manager's name and electronic signature.
The client's project number/name, the F&BI project number, and date of issue (all on each page).
The sample identification provided by the client and the sample identification number assigned by F&BI
Chemical parameters analyzed, reported values, and units of measurement
Reporting limit of the analytical procedure
The dates the samples were received and analyzed
A summary of quality control sample results
Footnotes referenced to specific data if required to explain/qualify reported values

Explanatory text or the cover letter may also include:
Person(s) receiving and transmitting the data
Documentation of samples which did not meet acceptance criteria when received
Brief discussion of samples analyzed and the analytical program
Discussion of any apparent data anomalies
Reference to specific accreditation requirements

<u>Reports for Additional Results</u>
If additional analysis is requested after a final report for a specific laboratory project has been issued, then those additional results are issued in a separate report. A statement that these are additional results for the project is included in the cover letter.

<u>Reports Including Subcontracted Analysis</u>
If any analysis is subcontracted to another laboratory, a statement is included in the cover letter and/or case narrative indicating the subcontracting laboratory and the analysis they performed. The original copy of the subcontracting laboratory's report is

provided to the client and a copy is kept with the F&BI project file. No subcontracted work is ever reported as being F&BI data.

Report Review

After the hardcopy data report is prepared, the report is subject to a complete review by another reviewer. Entries such as dates, sample IDs, names and addresses are reviewed. The reviewer completes a report review checklist and attaches it to the report. If any errors are found, they are noted and the report is given back to the project leader to correct.

The final draft is reviewed by the executive committee or its designee to assure that all of the steps listed to this point have been followed. He/She then initials the draft which is filed. After approval, a final report bearing the appropriate signatures is issued to the client.

Amending Issued Final Reports

After issuance of a final report, the laboratory report remains unchanged. If a report which has already been issued as final to the client is amended, the amended report is issued separately. A cover letter is included, which states that amended results are being provided. If needed, further explanation of the amendment is included in the cover letter. All amended reports receive final approval before being released to the client.

15.0 DOCUMENT CONTROL AND RECORDS MANAGEMENT

15.1 Document Control

Internally generated documents which are used to define and implement the quality system are controlled. This includes the Quality Assurance Manual, all SOPs and laboratory logbooks. Documents are controlled in two ways. Each document clearly indicates the effective date of the document, the revision number, and the signature(s) of the approving authority (revision number and signature may not be applicable for logbooks). In addition, a record is kept of who received a signed copy of each document.

Preparation of Controlled Documents

Quality system documents are written by the personnel most familiar with the procedures described. The author of the document is responsible for including the correct revision number and date. The documents are reviewed and released by the QA officer, laboratory/technical director and/or executive committee representative as applicable. They are implemented on the revision date indicated on the document. More specific procedures for writing and organizing quality system documents are described in the "Quality System Document Organization" SOP.

Office personnel are responsible for controlling logbooks. Laboratory logbooks are sequentially assigned a number, which is clearly written on the logbook. The name/use and starting date of the logbook are also written on the logbook and are recorded in the Master Log of Laboratory Logbooks. Completed logbooks are filed with office records, or with the associated instrument, if applicable.

Revision of Controlled Documents

Currently existing quality system documents are reviewed annually during the internal laboratory audit (see section 16). Documents may be revised due to changes initiated by an internal or external audit; or due to changes such as new instrumentation, updated instrument parameters, updated concentrations used for chemical standards etc. A new quality system document is generated if a new quality system procedure is implemented.

To ensure that the beginning and ending effective dates for a document are clearly documented, revision numbers are always whole numbers (starting with revision 1) which are increased by one whole number for each document revision. Therefore the beginning date of a particular revision is the ending date for the immediately previous revision.

Documentation of Controlled Documents

Office personnel are responsible for keeping a record of who received each signed controlled document. The Controlled Document Record includes the document name, a sequentially assigned number which is written on the document before releasing, the person (or company) the document was released to, and the date released. Unsigned copies of documents are not considered controlled.

15.2 Records Management

The purpose of the Records Management system is to standardize the organization, storage and retrieval of all data and documents pertinent to quality and the analytical process. Also, in many cases, F&BI project files must be legally defensible, that is, admissible by the courts and believed as fact. To fulfill these documentation requirements, F&BI maintains a Records Management System which meets the following criteria:

Data and documents are indexed and easily retrievable.
Files are secure.
A formal document inventory can be produced if required by the contract/project.
Laboratory operation/QC documents are cross referenced to applicable projects.
The system is documented in the Quality Assurance Manual and Standard Operating Procedures.
Specific regulatory or contractual requirements can be accommodated.

Analysis Records
Data generated using instruments driven by computers is stored on computer disks coded by the instrument number and date the samples were analyzed. Hard copies of all of the electronic data are also kept. For each instrument, a list of all samples analyzed for each date is kept for easy sample searching. For instruments not controlled by a computer, data are recorded in individual instrument logbooks.

Worksheets are documents filled out by extraction analysts as a sample is processed. These sheets contain measurements such as the weight of the sub-sample, identification and volume of solvent used for any extraction, and documentation of any dilutions or concentrations made. These worksheets are kept with our file copy of any report that is sent to a client.

Laboratory Files
Laboratory records/documents are of two types:
1) Project/Client Files - Documents which are specific to a project/client. All records pertaining to a specific project contain a reference to the laboratory project number which is assigned during sample check-in.
2) Laboratory Files - Documents which pertain to the overall functioning of the laboratory

Project/Client files contain the following:
Chain-of-Custody documents for the project
Extraction worksheets for the project
Electronic file of data generated by Analyst for each sample delivery group and analysis
Electronic file of compiled data for the results of analyses for each sample delivery group generated by Project Manager
Non-conformance report forms for the project
Contract files pertinent to a client
Communication records between project management and the client

Final reports submitted to the client

Laboratory files contain the following:
Sample Check-in Logbook
Raw instrument data, including calibration data
Instrument maintenance records
Internal and external audit records
Training records
QA Manual and SOPs
Any other QA/QC documents pertaining to the overall functioning of the laboratory
General office/business records

15.3 Archived Records

All files are stored at F&BI, in a safe and secure area, for a minimum of 5 years. Access to archived information is documented with an access log. After 5 years, records are purged only with approval from the executive committee representative.

15.4 Change of Ownership

If there is a change of ownership, records will be retained, and details of record availability will be specified in the transaction.

16.0 QUALITY SYSTEM AUDITS

Quality audits are an essential part of F&BI's quality system program. Two types of audits are used: system audits which qualitatively evaluate the operational details of the quality system program, and performance audits which quantitatively evaluate the outputs of the various measurement systems.

16.1 System Audits

Internal Audits

The QA officer arranges for annual internal audits to verify that laboratory operations continue to comply with the requirements of the quality system. These audits are carried out by trained and qualified personnel who are, wherever possible, independent of the activity to be audited. An internal audit of all or part of the system may also be performed at any time due to any circumstance which raises concern regarding compliance with established policies or procedures, or with the data quality.

Target dates for completion of any corrective action investigations resulting from an internal audit are set within a reasonable time frame so that, if necessary, laboratory practice can be changed and/or clients can be contacted. Where the audit findings indicate a substantial error in calibrations or test results, immediate corrective action is taken and any client whose work was involved is notified within 30 days in writing.

Audit findings and any corrective actions that arise from them are documented using the Internal Audit forms, which are included in Appendix E.

External Audits

F&BI is audited on a regular basis by state and independent auditors, as required for accreditation and by client contracts. External audits are documented through correspondence with the auditors.

Managerial Review

The laboratory/technical director conducts an annual review of the quality system and testing and calibration activities to ensure their continuing suitability and effectiveness, and to introduce any necessary changes or improvements in the quality system and laboratory operations.

The review takes account of reports from managerial and supervisory personnel, the outcome of recent internal and external audits, the results of interlaboratory comparisons or proficiency tests, any changes in the volume and type of work undertaken, feedback from clients, corrective actions, and other relevant factors. In addition, pro-active suggestions for preventive actions are included. These include either technical or quality system improvements which will reduce the likelihood of potential non-conformances.

Review findings and any corrective actions that arise from them are documented using the Managerial Review forms, which are included in Appendix E.

16.2 Performance Audits

In addition to periodic system audits, the quality of results is ensured through ongoing checks which monitor the quality of the laboratory's analytical activities. Examples of such checks are:
Internal quality control procedures, as described in section 12 above
Participation in proficiency testing programs, as described in section 12 above
Use of second source standards and/or certified reference materials
Replicate analysis using the same or different test methods
Re-testing of retained samples
Correlation of results for different but related analysis of a sample
Review of historical data from the same sample

17.0 CLIENT COMMUNICATION

17.1 Client Confidentiality

Strict client confidentiality is maintained at all times. No records or results are discussed with, or provided to, anyone other than the client unless the client has given specific permission. Clients are notified by the project manager or office personnel whenever any other party requests information about their records.

In addition, when clients require transmission of test results by facsimile, email or other electronic or electromagnetic means, care is taken to ensure that client confidentiality is maintained. To avoid accidental transmission to a different party, commonly used email addresses are included in an email address book, and commonly used fax numbers are pre-programmed. Also, in case of accidental transmission to the wrong party, email messages and facsimile cover sheets contain a message which states that the information is privileged, confidential, and intended only for the addressee named. Office personnel are responsible for maintaining email addresses and pre-programmed fax numbers.

17.2 Review of Requests, Tenders, and Contracts

Before agreeing to a written or oral contract to provide a client with environmental testing services, a review is conducted to ensure that F&BI has the capability and resources necessary to meet the client's requirements. For routine and other simple tasks, the project leader can provide an oral agreement. For more complex tasks, the laboratory/technical director conducts a review. This may include items such as review of previous proficiency testing results, and running trial testing to determine detection limits or other essential quality control requirements. The laboratory's current accreditation status, and any subcontracted work are also reviewed. The client is informed if, at any time before and during the agreement, F&BI is unable to fulfill the requirements of the contract. Records of written contracts, and other communication regarding the contract, are documented in the Client Report Template, and/or kept in the project/client files.

17.3 Specific Project Communication

After samples have been received, the F&BI project manager communicates with the client, when necessary, regarding sample receipt conditions, specific analysis needs, laboratory capability, and integrity of reported results. Communication is documented in the Project Notes macro, and/or with the Client Communication Record form, which is kept in the project/client files. In addition, any fax or email communication is also kept in the project/client files.

18.0 SUBCONTRACTING ANALYTICAL SAMPLES

It is the policy of F&BI not to subcontract work which we are normally able to perform. For requested analyses which we do not normally perform, the project manager informs the client of the need to subcontract. Work may also be subcontracted if we are temporarily unable to perform one of our normal analyses due to instrument malfunction, or if the client requires certification which we do not have. In these cases the same procedures are followed.

In those cases where we subcontract work, the results reported by the outside laboratory appear under the letterhead of the laboratory reporting the data. Data generated by another laboratory is never reported under our company letterhead. The original report from the contracted laboratory is provided to the client, and a copy is kept with the F&BI project file.

END OF DOCUMENT

APPENDIX A

LIST OF ADMINISTRATIVE SOPS AND QUALITY SYSTEM DOCUMENTS

LIST OF ADMINISTRATIVE SOPS AND QUALITY SYSTEM DOCUMENTS

ADMINISTRATIVE STANDARD OPERATING PROCEDURES	
Title	**Location**
Creating Reports	sops\admin\Reports
Data Integrity	Sops\admin\Data Integrity
Project Manager Procedure (includes Client Communication Record form)	sops\admin\Project Manager
Qualifiers	Sops\admin\Qualifier
Quality System Document Organization	sops\admin\Document Organization
Sample, Extract, and Waste Disposal	sops\admin\Disposal
Sample Receiving	sops\admin\Sample Receiving
Support Equipment Monitoring and Calibration	sops\admin\Support Equipment
Training Records (includes training forms)	sops\admin\Training
ADDITIONAL QUALITY SYSTEM DOCUMENTS	
Archive Access Log	forms\office\archive
Controlled Document Record	sops\Controlled Document Record
DOC Training Summary Database	fbi\nelap\doc_sum
F&BI Certifications/Accreditations	office records
Final Report Checklist	forms\chklist
Internal Audit/Managerial Review Forms	QAM Appendix E
Laboratory Organization/Personnel Qualifications	fbi\nelap\Lab Organization Chart – Personnel Qualifications
Master Log of Laboratory Logbooks	forms\logbooks\ Master Log
Non-Conformance Report Form	forms\nonconformance
Policy and Health & Safety Manual	sops\Policy and Health & Safety Manual
Quality Assurance Manual	sops\QAM
Sample Condition Upon Receipt Checklist Form	forms\checkin\ SampleCondition
Signature List	office records

APPENDIX B

MAJOR ANALYTICAL EQUIPMENT

MAJOR ANALYTICAL EQUIPMENT

Make/Model	Type	Identifier	Software
Agilent 5890	GC/FID	GC 1	ChemStation
Agilent 5890 with Varian Archon and OI 4560	GC/FID/PID Autosampler Purge & Trap	GC 2	 ChemStation
Agilent 5890 with Varian Archon and OI 4560	GC/FID/PID Autosampler Purge & Trap	GC 3	 ChemStation
Agilent 5890	GC/FID	GC 4	ChemStation
Agilent 5890	GC/TCD	GC 5	ChemStation
Agilent 5890	GC/FID	GC 6	ChemStation
Agilent 6890	GC/ECD/ECD	GC 7	EnviroQuant
Agilent 5890 with Tekmar 7000	GC/FID Headspace Autosampler	GC 8	ChemStation
Agilent 6890	GC/ECD/ECD	GC 9	EnviroQuant
Agilent 6890 with Agilent 5973	GC MSD	GC/MS 3	 EnviroQuant
Agilent 6890N with Agilent 5973N and OI 7361 and OI 4660	GC MSD Autosampler Purge & Trap	GC/MS 4	 EnviroQuant
Agilent 6890 with Agilent 5973	GC MSD	GC/MS 6	 EnviroQuant
Agilent 7890A with Agilent 5975C Entech Model #7200 CTS and Entech Model #7016D and Entech Model #3100D and Entech Model #31-350ER and Entech Model #39-FP-01 and Entech DDS Model #PG7-50.00-PSIA	GC MSD Preconcentrator Autosampler/ Vacuum Cleaning System Oven/Vacuum Flow Professor Digital Dilution System (DDS)	GC/MS 7	 EnviroQuant Maveric Entech Entech Entech 3100D Entech Flow Professor

MAJOR ANALYTICAL EQUIPMENT
(Continued)

Make/Model	Type	Identifier	Software
Agilent 6890N with Agilent 7975C Entech Model #7200 CTS and Entech Model #7016D and Entech Model #3100D and Entech Model #31-350ER and Entech Model #39-FP-01 and Entech DDS Model #PG7-50.00-PSIA	GC MSD Preconcentrator Autosampler/ Vacuum Cleaning System Oven/Vacuum Flow Professor Digital Dilution System (DDS)	GC/MS 8	 EnviroQuant Maveric Entech Entech Entech 3100D Entech 3100D Entech Flow Professor
Agilent 7890 with Agilent 5975C	GC MSD	GC/MS 9	 EnviroQuant
Agilent 7890B with Agilent 5977A and Markes Model # TD- 100	GC MSD Autosampler/ Concentrator	GC/MS 10	EnviroQuant Maveric
Agilent 7890B with Agilent 5977B and OI 4100 and OI 4760	GC MSD Autosampler Purge & Trap	GC/MS 11	 EnviroQuant
Agilent 7890B with Agilent 5977B	GC MSD	GC/MS 12	EnviroQuant
Agilent 7890B with Agilent 5977B and OI 4100 and OI 4760	GC MSD Autosampler Purge & Trap	GC/MS 13	 EnviroQuant
Agilent 8890	GC	GC10, GC13, GC14	EnviroQuant
Agilent 8890 with OI 4100	GC Autosampler	GC11	

and OI 4760	Purge & Trap		EnviroQuant
PerkinElmer NexION 300D	ICP/MS	ICP/MS	PerkinElmer Syngistix
PerkinElmer S10 Autosampler	ICP/MS Autosampler	ICP/MS	PerkinElmer S10 Utility
PerkinElmer SC4DX Autosampler	ICP/MS Autosampler	ICP/MS	ESI SC
Tekran 2600	CVAFS	CVAFS	Tekran
Hach TL2300	Turbidimeter	Turbidimeter	N/A
Mettle-Toledo Seven Compact	pH Meter	pH Meter	N/A
Rae Systems, Model# PGM-30 (2)	Hand Held PID	Hand Held PID	N/A
Buck Scientific, Model# HC-404 (1)	IR analyzer	IR analyzer	N/A
Beckman Model TJ-6 (2)	Centrifuge	Centrifuge	N/A
Vortex Genie 2, Model G-560 (3)	Vortex Mixer	Vortex Mixer	N/A
Buchi Syncore	Concentrator	Concentrator No.1	N/A
Buchi Syncore	Concentrator	Concentrator No.2	N/A
Buchi Syncore	Concentrator	Concentrator No.3	N/A
Thermo Scientific Precision Water Bath, Model #2849	Water Bath	Water Bath	N/A
Organomation Associates, Inc. Model #120 (1)	Water Bath	Water Bath	N/A
Sonics VibraCell	Sonicator	Sonicator No.1	N/A

MAJOR ANALYTICAL EQUIPMENT
(Continued)

Make/Model	Type	Identifier	Software
Branson Ultrasonics Corporation, Sonifier Model# 450	Sonicator	Sonicator No.2	N/A
Branson Ultrasonics Corporation, Sonifier Model# 450	Sonicator	Sonicator No.3	N/A
Sonics VibraCell	Sonicator	Sonicator No.4	N/A
Marathon Electric, Model 0523-N191Q-G588 (1)	Sonicator	Sonicator	N/A
Sonics and Material, Inc. Model# VC600 (1)	Sonicator	Sonicator	N/A
Brenson Ultrasonic Bath, Model #M3800	Cavitator	Cavitator No.1	N/A
Brenson Ultrasonic Bath, Model #M3800	Cavitator	Cavitator No.2	N/A
Torbal, Fulcrum Inc., Model #AGCN 100	Analytical Balance	Analytical Balance	N/A
AND Model #HA-120M (1) (white)	Analytical Balance	Analytical Balance	N/A
AND Model #EK-1200A (1)	Analytical Balance	Analytical Balance	N/A
Mettler Toledo, Model #ML1502E/03 (2)	Analytical Balance	Analytical Balance	N/A
Denver Instrument Model #XP-1500 (1)	Analytical Balance	Analytical Balance	N/A
AEAdams CoreBalance	Analytical Balance	Analytical Balance	N/A
US Electrical Motors, Model #E438 (1)	Tumbler	Tumbler	N/A
Emerson Electric Co. (2)	Vacuum Pump	Vacuum Pump	N/A
ThermoScientific Isotemp 100L Oven FA 120V	Oven	Oven	N/A
Stabil-Therm Gravity Oven Model# OV-484A (1)	Oven	Oven	N/A
Thermolyne Corporation, Model # F6000 (1)	Muffle Furnace	Muffle Furnace	N/A

MAJOR ANALYTICAL EQUIPMENT
(Continued)

Make/Model	Type	Identifier	Software
Barnstead/Thermolyne Model#1415M (1)	Muffle Furnace	Muffle Furnace	N/A
Thermolyne Corporation, Model # HPA2245M (2)	Hot Plate	Hot Plate	N/A
Corning Laboratory, Model#PC-300 (1)	Hot Plate	Hot Plate	N/A
Corning Laboratory Model #PC-420 (1)	Hot Plate/Stirrer	Hot Plate/Stirrer	N/A
CPI-MOD Block (70 mL) Digest Heater Block with Controller (2)	Digester/Heater Block	Digester/Heater Block	N/A
Julabo Labortachnik, Model#FC600 or equivalent (2)	Chilling Unit	Chilling Unit	N/A
PolyScience 6000 Series Chiller Model #0772046	Chilling Unit	Chilling Unit	N/A

APPENDIX C
EQUIPMENT MAINTENANCE PROGRAM
(GENERAL GUIDANCE)

EQUIPMENT MAINTENANCE PROGRAM
(GENERAL GUIDANCE)

Instrument	Activity	Approximate Frequency
GC 1, GC 4, and GC 6 *(Semivolatile TPH)* Agilent 5890 Series II	Clean FID	Weekly or as needed
	Check Gases	Replace at 200 PSI
	Change Liner	Every 200 injections or as needed due to response change
	Change Septum	Every 200 injections
	Replace Syringe	As needed if clogged or broken
	Clip Column	As needed to improve chromatography
	Replace Column	As needed
	Change Gold Seal	As needed
GC 2 and GC 3 *(Volatile TPH and BTEX by 8021B)* Agilent 5890 Series II	Clean FID	Weekly or as needed
	Check Gases	Replace at 200 PSI
	Clean PID	As needed
	Replace PID Lamp	As needed to improve sensitivity
	Replace Column	As needed
OI 4560/4660 Concentrator (GC 2, GC 3, GC/MS 4, GC/MS 9, and GC/MS 7)	Check Purge Flow	Monthly
	Replace Trap	As needed
	Clean Sparge Cell	As needed
	Clean Sparge Filter	As needed if clogged
4552/4551 Autosampler (GC 2, GC 3, GC/MS 4, GC/MS 9, and GC/MS 7)	Tighten Syringe Nut	Once a week
	Autocalibrate	As needed
GC 7 *(PCBs, Organic Lead, Canadian Pulp, EDB)* Agilent 5890 Series II	Check Gases	Replace at 200 PSI
	Change Liner	Every 200 injections or as needed due to response change
	Change Septum	Every 200 injections
	Replace Syringe	As needed if clogged or broken
	Clip Column	As needed to improve chromatography
	Replace Column	As needed
	Change Gold Seal	As needed
	Clean ECD	As needed to improve chromatography

EQUIPMENT MAINTENANCE PROGRAM
(GENERAL GUIDANCE)

Instrument	Activity	Approximate Frequency
GC 5 *(Helium Analyzer)* Agilent 5890 Series II	Clean TCD	As needed
	Check Gases	As needed
	Change Liner	As needed
	Change Septum	As needed
	Replace Syringe	As needed
	Clip Column	As needed
	Replace Column	As needed
GC/MS 3, GC/MS 6, GC/MS 8, and GC/MS 10 *(Semivolatiles and Methamphetamine)*	Check Gases	Replace at 200 PSI
	Change Liner	Every 200 injections or if tune fails due to degradation of DDT > 20
	Change Septum	Every 200 injections
	Replace Syringe	As needed if clogged or broken
	Clip Column	As needed to improve chromatography
	Replace Column	As needed
	Change Gold Seal	As needed
	Change Pump Oil	Every 6 months
	Clean Source	As needed
GC/MS 4, GC/MS 9, and GC/MS 7 *(Volatiles)*	Check Gases	Replace at 200 PSI
	Replace Column	As needed
	Change Pump Oil	Every 6 months
	Clean Source	As needed
CVAFS *(Mercury)*	Clean Liquid Gas Separator	Before each run
	Clean Cuvette	As needed
	Replace Lamp	As needed
	Change Tubing	As needed
ICP/MS *(Metals)*	Change Torch	As needed
	Change Tubing	As needed
	Change Coolant	As needed
	Clean Cones	As needed

APPENDIX D

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Method	Matrix	Minimum Sample Volume	Container	Preservation	Maximum Holding Time
Organic Analysis						
Diesel Range Organics (Extractable TPH)	8015M NWTPH-Dx	Water	500 mL	500 mL glass	*Cool, ≤6°C	*7 days to extract, 40 days after extr.
	AK 102	Water	1 L	1 L glass		
	8015M NWTPH-Dx AK102/103	Soil	50 grams	4 oz glass	Cool, ≤6°C	14 days to extract, 40 days after extr.
Gasoline Range Organics (Purgable TPH)	8015M NWTPH-Gx AK101	Water	40 mL	40 mL VOA	Cool, ≤6°C, HCl to pH<2, no headspace	14 days
	8015M NWTPH-Gx	Soil	20 grams	3 x 5035 kit or MeOH pres. vial	Cool, ≤6°C/Freeze <-7°C	14 days
	AK101	Soil	app. 50 g	4 oz glass septum top	Methanol	28 days
HCID	NWTPH-HCID	Water	500 mL	500 mL glass	Cool, ≤6°C	7 days to extract, 40 days after extr.
		Soil	50 grams	4 oz glass	Cool, ≤6°C	14 days
HEM (O&G), SGT-HEM	1664	Water	1 Liter	1 L glass	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
PCBs	8082A	Water	1 Liter	1 L glass	Cool, ≤6°C	none
	8082A	Soil	50 grams	4 oz glass	Cool, ≤6°C	none
PNAs (PAHs)	8270D or 8270D SIM	Water	500 mL	500 mL glass	Cool, ≤6°C	7 days to extract, 40 days after extr.
	8270D or 8270D SIM	Soil	50 grams	4 oz glass	Cool, ≤6°C	14 days to extract, 40 days after extr.
Purgable Aromatic Hydrocarbons (BTEX, MTBE)	8021B or AK101	Water	40 mL	40 mL VOA	Cool, ≤6°C, HCl to pH<2, no headspace	14 days
	8021B	Soil	20 grams	3 x 5035 kit or MeOH pres. vial	Cool, ≤6°C/Freeze <-7°C	14 days
	AK101	Soil	app. 50 g	4 oz glass septum top	Methanol	28 days
Semivolatile Organic Compounds (SVOCs, BNAs)	8270D	Water	1 Liter	1 L glass	Cool, ≤6°C	7 days to extract, 40 days after extr.
	8270D	Soil	50 grams	4 oz glass	Cool, ≤6 °C	14 days to extract, 40 days after extr.

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Method	Matrix	Minimum Sample Volume	Container	Preservation	Maximum Holding Time
Organic Analysis (Continued)						
Volatile Organic Compounds (VOCs)	8260C	Water	40 mL	40 mL VOA	Cool, ≤6°C, HCl to pH<2, no headspace	14 days
	8260C	Soil	10 grams	40 mL VOA	Freeze within 48 hrs., ≤0°C	14 days

* For NWTPH-Dx and AK102 methods, if preserved with HCl or H_2SO_4 to pH<2, holding time is 14 days to extract.

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Method	Matrix	Minimum Sample Volume	Container	Preservation	Maximum Holding Time
Inorganic Analysis						
Alkalinity	SM2320B	Water	100 mL	500 mL poly	Cool, ≤6°C	14 days
BOD	405.1	Water	1 Liter	1 L glass	Cool, ≤6°C	48 hours
Chloride	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	28 days
COD	410.4	Water	100 mL	500 mL poly	H_2SO_4 to pH<2	28 days
Conductivity	120.1	Water	100 mL	500 mL poly	Cool, ≤6°C	28 days
Cyanide, total	335.2	Water	1 Liter	1 L glass	NaOH to pH 12	14 days
Fluoride	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	28 days
Hardness	SM2340B	Water	100 mL	500 mL poly	HNO_3 to pH,<2	6 months
Nitrate	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	48 hours
Nitrite	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	48 hours
Nitrate-Nitrite	353.2	Water	100 mL	500 mL poly	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
pH	9040/150.1	Water	20 mL	500 mL poly	None	As soon as possible
	9045	Soil	20 grams	4 oz glass	None	28 days
Phosphorus, total	365.2	Water	100 mL	500 mL poly	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Sulfate	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	28 days
Sulfide	376.2	Water	500 mL	500 mL poly	Cool, ≤6°C ZnAcetate plus NaOH to pH>9	7 days
Sulfite	377.1	Water	100 mL	500 mL poly	None	24 hours
Total Dissolved Solids (TDS)	SM2540C/ 160.1	Water	500 mL	500 mL poly	Cool, ≤6°C	7 days
Total Organic Carbon (TOC)	415.1/ 9060M	Water	100 mL	500 mL poly	H_2SO_4 to pH<2	28 days
Total Suspended Solids (TSS)	SM2540D	Water	250 mL	500 mL poly	Cool, ≤6°C	7 days
Turbidity	SM2130B	Water	20 mL	500 mL poly	Cool, ≤6°C	48 hours
Metals Analysis						
Metals (except Cr VI and Mercury)	200.8/6020 or 6010	Water	200 mL	500 mL poly or glass	HNO_3 to pH<2 at least 24 hours prior to analysis	6 months
	200.8/6020 or 6010	Soil	20 grams	4 oz glass	Cool, ≤6°C	6 months
Chromium VI	SM3500Cr	Water	100 mL	500 mL poly	Cool, ≤6°C	24 hours
	7196A	Soil	50 grams	4 oz glass	Cool, ≤6°C	30 days
Mercury	1631/200.8/ 6020/7040	Water	125 mL	250 mL poly, fluoropolymer, or glass	HNO_3 to pH<2	28 days (48 hours if not preserved)
	1631/200.8/	Soil	50 grams	4 oz glass	Cool, ≤6°C	28 days

	6020/7041					

APPENDIX E

INTERNAL AUDIT/MANAGERIAL REVIEW FORMS

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Summary

Areas audited

1. Quality System:

Quality Assurance Manual and SOPs reviewed
(attach "List of Current SOPs" with reviewed documents marked)

2. Support Equipment

3. Non-Conformance reports (review)

4. Project Management/Reports

5. Sample receiving, storage, disposal

6. Document Control/Training

7. Extractions:

Organic	Inorganic	Volatiles
3510	200.8	5030
3550	1631	5035
3580	3005	3580
3630	3050	

8. Analysis/Calculations:

8260	RSK-175	TPHD	200.8
8270	1664	TSS	6020
8082	Methamphetamine	pH	1631
524.2	Hardness	Spec. Grav.	TO-15
8011	TPHG/BTEX	Turbidity	TO-17
8081	Other		

Total number of corrective actions_____

Comments:_____

Does any non-conformance/corrective action require further notification?

Yes No (If yes, explain)

_____

Attach all internal audit checksheets and corrective action forms and file in the internal QA/QC audit folder.

QA Officer's Signature_____

Date Audit Review Completed_____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Sample receiving, storage, disposal

Date:_____ Auditor:_____ Person(s) Audited:_____

	YES	NO
Is the Master Sample Log-In book in order?	_____	_____
Are COCs filled out correctly during sample check-in?	_____	_____
Are all samples/projects traceable, i.e. labeled?	_____	_____
Are samples stored in the correct refrigerators?	_____	_____
Are refrigerator temperatures recorded daily?	_____	_____
Are standards/solvents logged in?	_____	_____
Are sample disposal records kept?	_____	_____
Disposal Area:		
Does each drum have an up to date contents list?	_____	_____
Are drums properly labeled?	_____	_____
Are waste materials contained properly in each drum?	_____	_____
Are waste disposal records kept?	_____	_____
Are all prior external and internal findings addressed?	_____	_____

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:_____ COMMENTS_____

_____

_____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Extractions

	Organic	Inorganic	Volatiles
Method(s):	_____	_____	_____
	_____	_____	_____

Date:_____ Auditor:_____ Person(s) Audited:_____

	YES	NO	N/A
Are waste containers properly labeled and stored?	_____	_____	_____
Was any new equipment properly validated prior to use?	_____	_____	_____
Are manufacturer's certificates which verify calibration/accuracy available?	_____	_____	_____
Are analytical balances checked daily?	_____	_____	_____
Are autopipets calibrated at least monthly?	_____	_____	_____
Are bottle top dispensers calibrated at least monthly?	_____	_____	_____
Is the oven temperature recorded daily?	_____	_____	_____
Is the water bath temperature recorded daily?	_____	_____	_____
Is the hot block temperature recorded daily?	_____	_____	_____
Is equipment which falls out of calibration repaired or taken out of service?	_____	_____	_____
Are all prior external and internal findings addressed?	_____	_____	_____

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:_____ COMMENTS_____

_____

_____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Analysis/Calculations Method:_____

Date:_____ Auditor:_____ Person(s) Audited:_____

	YES	NO
Are standards traceable to a certified source?	_____	_____
Are standards labeled with an expiration date?	_____	_____
Are standards taken out of use after the expiration date?	_____	_____
Do initial calibrations meet the method requirements?	_____	_____
Are initial calibrations verified with a second source standard?	_____	_____
Are initial calibrations verified with continuing calibration verification standards?	_____	_____
Do QC sample results (method blanks, LCS, MS) meet the method requirements?	_____	_____
Are corrective actions taken for any result which falls outside of acceptance criteria?	_____	_____
Is the SOP up to date?	_____	_____
Are instrument maintenance logs up to date?	_____	_____
Are MDLs up to date?	_____	_____
Are reporting limits based on MDLs?	_____	_____
Are data calculations based on the initial calibration?	_____	_____
Is data flagged with qualifiers if necessary?	_____	_____
Are all prior external and internal findings addressed?	_____	_____

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:_____ COMMENTS_____

_____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Project Management/Reports

Date:_____ Auditor:_____ Person(s) Audited:_____

	YES	NO
Are extraction worksheets filled out completely and clearly?	_____	_____
Are capability issues communicated to the client and clearly documented?	_____	_____
Are any changes to the COC initialed/dated with the name of the person requesting the change clearly indicated?	_____	_____
Are the subcontracted samples documented to client?	_____	_____
Is the Non-Conformance form used to document client complaints?	_____	_____
Are subcontract lab reports forwarded without change to the client, and clearly identified in our final report?	_____	_____
Are amended reports clearly identified?	_____	_____
Are additional reports clearly identified?	_____	_____
Are draft results/reports clearly identified?	_____	_____
Are flags from analysts left as is?	_____	_____
Is data flagged in an unambiguous manner?	_____	_____
Is there a case narrative when the validity of the data is in question?	_____	_____
Are all prior external and internal findings addressed?	_____	_____

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:_____ COMMENTS_____

_____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Document Control/Training

Date:_____ Auditor:_____ Person(s) Audited:_____

	YES	NO
Is the employeed signature list up to date?	_____	_____
Are all logbooks numbered and listed in the Master Log of Laboratory Logbooks?	_____	_____
Is the Controlled Document Record used to track distribution of controlled documents?	_____	_____
Is the Archive Access Log used?	_____	_____
Is the List of Current SOPs up to date?	_____	_____
Are the Current SOP binders up to date?	_____	_____
Do Employee Attestation forms list current SOPs and revision numbers?	_____	_____
Have employees initialed Attestation forms for the current revision of all applicable SOPs?	_____	_____
Are DOCs complete and clearly identified?	_____	_____
Is the DOC training summary database up to date?	_____	_____
Are Laboratory Organization and Personnel Qualifications summaries up to date?	_____	_____
Is current accreditation summary up to date?	_____	_____
Are all prior external and internal findings addressed?	_____	_____

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:_____ COMMENTS_____

_____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Support Equipment

Date:_____ Auditor:_____ Person(s) Audited:_____

	YES	NO
Are primary reference weights and thermometers clearly labeled?	_____	_____
Are standards NIST traceable?	_____	_____
Are daily standards referenced in logbooks?	_____	_____
Are logbooks (refrigerator, water bath, hot block, oven, balance autopipete, etc.) completed as required?	_____	_____
Are logbooks (refrigerator, water bath, hot block, oven, balance autopipete, etc.) bound or in a 3 ring binder?	_____	_____
Is all calibrated support equipment (thermometers, autopipetes, bottle top dispensers, hot blocks, etc.) clearly labeled?	_____	_____
If any equipment is out of specifications, is it taken out of service and clearly labeled as such?	_____	_____
Are all prior external and internal findings addressed?	_____	_____

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:_____ COMMENTS_____

_____

_____

INTERNAL QA/QC AUDIT CORRECTIVE ACTION

Area/Analysis_____

Corrective action given to (name):_____

Given by (name):_____
(Keep a copy of this form for tracking)

Date given:_____ Target response date:_____
(set based on potential need to notify clients and on work load)

Description of non-compliance:_____

_____

_____

Description of root cause and required corrective action:_____
_____

_____

_____

_____

Specific documentation required: (Return this form to the auditor with the required documentation attached.)

_____

_____

_____

Corrective action reviewed and approved:

QC Officer (or designee):_____ Date:_____

(Return this form to QC officer along with attached documentation)

QUALITY SYSTEM
MANAGERIAL REVIEW

Date:_____ Auditor:_____

Review of Calendar Year 20___

Write comments, as needed, in a separate file and attach.

1. Review of most recent internal audit (Date(s)_____)

All areas audited	Yes	No
Corrective actions implemented and documented	Yes	No

2. Review of non-conformance reports

Corrective actions implemented and documented	Yes	No

3. Review of proficiency testing (PT) samples

Analysis completed two times per year per analyte per matrix (for NELAP accredited analyses)	Yes	No
Corrective actions implemented and documented	Yes	No

4. Review of current accreditation status.

5. Review of recent audits/assessments by external bodies.

External audit(s) by: State/Company_____ Date_____

Corrective actions implemented and documented.	Yes	No

6. If audits or data review resulted in changes to previously reported data, were affected clients notified within 30 days? Yes No n/a

7. Changes in volume and/or type of work undertaken which may affect quality.

8. Feedback from clients regarding quality. (Include review of any client complaints.)

9. Other relevant factor(s) which may affect quality.

10. Pro-active preventive actions to avoid potential non-conformances.

MANAGERIAL REVIEW CORRECTIVE ACTION

Area/Analysis_____

Corrective action given to (name):_____

Given by (name):_____
(Keep a copy for tracking)

Date given:_____ Target Response Date:_____
(set based on potential need to notify clients and on work load)

Description of non-compliance:_____

_____

_____

Root Cause:_____

_____

Description of required corrective action:_____

_____

Specific documentation required: (Return this sheet to the auditor with the required documentation attached.)

_____

_____

Corrective action reviewed and approved:

Name:_____ Date:_____
(Technical/Laboratory Director or designee)

File along with attached documentation in the management review folder.

APPENDIX F

DEFINITIONS

DEFINITIONS

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accrediting Authority: the Territorial, State, or federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation. (NELAC)

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: the designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Audit: a systematic evaluation to determine the conformance to quantitative *and qualitative* specifications of some operational function or activity. (EPA-QAD)

Batch: environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. (NELAC Quality Systems Committee)

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. Blanks include:
Equipment Blank: a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)
Field Blank: blank prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)

Instrument Blank: a clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)
Method Blank: a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)
Reagent Blank: (method reagent blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Blind Sample: a sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. (NELAC)

Calibration: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve: the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Standard: a substance or reference material used to calibrate an instrument. (QAMS)

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30 - 2.2)

Chain of Custody Form: record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses. (NELAC)

Confirmation: verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: Second column confirmation, Alternate wavelength, Derivatization, Mass spectral interpretation, Alternative detectors or, Additional cleanup procedures. (NELAC)

Conformance: an affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Corrective Action: the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Demonstration of Capability: a procedure to establish the ability of the analyst to generate acceptable accuracy. (NELAC)

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

Holding Times (Maximum Allowable Holding Times): the maximum times that samples may be held prior to analysis and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: a known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. (NELAC)

Laboratory: a body that calibrates and/or tests. (ISO 25)

Laboratory Control Sample (LCS): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (NELAC)

Laboratory Control Sample Duplicate (LCSD): a second replicate LCS prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (QAMS)

Matrix: the substrate of a test sample.

Laboratory Duplicate: aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Matrix Spike (MS): a sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (QAMS)

Matrix Spike Duplicate (MSD): a second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (QAMS)

Method: see Test Method

Method Detection Limit: the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

National Institute of Standards and Technology (NIST): an agency of the US Department of Commerce's Technology Administration that is working with EPA, States, NELAC, and other public and commercial entities to establish a system under which private sector companies and interested States can be accredited by NIST to provide NIST-traceable proficiency testing (PT) to those laboratories testing drinking water and wastewater. (NIST)

National Environmental Laboratory Accreditation Conference (NELAC): a voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

National Environmental Laboratory Accreditation Program (NELAP): the overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC)

National Voluntary Laboratory Accreditation Program (NVLAP): a program administered by NIST that is used by providers of proficiency testing to gain accreditation for all compounds/matrices for which NVLAP accreditation is available, and for which the provider intends to provide NELAP PT samples. (NELAC)

Performance Audit: the routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS): a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting measurement processes which will meet those needs in a cost-effective manner. (NELAC)

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation: refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Proficiency Testing: a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC)

Proficiency Testing Study Provider: any person, private party, or government entity that meets stringent criteria to produce and distribute NELAC PT samples, evaluate study results against published performance criteria and report the results to the laboratories, primary accrediting authorities, PTOB/PTPA, and NELAP. (NELAC)

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Protocol: a detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed. (EPA-QAD)

Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance [Project] Plan (QAPP): a formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EPA-QAD)

Quality Control: the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample: an uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quality Manual: a document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI/ASQC E-41994)

Quantitation Limits: levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported at a specified degree of confidence. (NELAC)

Range: the difference between the minimum and the maximum of a set of values. (EPA-QAD)

Raw Data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted. (EPA-QAD)

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so. (NELAC*)*

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.08)

Replicate Analyses: the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Reporting Limits: routinely reported lower limits of quantitation, typically 2 to 10 times the MDL.

Sample Tracking: procedures employed to record the possession of the samples from the time of sampling until analysis, reporting, and archiving. These procedures include the use of a Chain of Custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples. (NELAC)

Selectivity: the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity: the capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Spike: a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes. (NELAC)

Standard Operating Procedures (SOPs): a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standardized Reference Material (SRM): a certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Supervisor (however named): the individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. (NELAC)

Surrogate: a substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. (QAMS)

Technical Director: individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory. (NELAC)

Test: a technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2-12.1, amended)

Test Method: an adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP or published by a recognized authority. (NELAC)

Testing Laboratory: a laboratory that performs tests (ISO/IEC Guide 2-12.4)

The NELAC Institute (TNI): A non-profit organization whose mission is to foster the generation of environmental data of known and documented quality through an open, inclusive and transparent process that is responsive to the needs of the community. (TNI)

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

United States Environmental Protection Agency (EPA): the federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. (US-EPA)

Validation: the process of substantiating specified performance criteria. (EPA-QAD)

Verification: confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

Sources:
40CFR Part 136

American Society for Quality Control (ASQC), Definitions of Environmental Quality Assurance Terms

American National Standards Institute (ANSI), Style Manual for Preparation of Proposed American National Standards, Eighth Edition, March 1991

ANSI/ASQC E4, 1994

International Standards Organization (ISO) Guides 2, 30, 8402

International Vocabulary of Basic and General Terms in Metrology (VIM): 1984. Issued by BIPM, IEC, ISO and OIML

National Institute of Standards and Technology (NIST)

National Environmental Laboratory Accreditation Conference (NELAC), July 1998 Standards

The NELAC Institute (TNI), Web site, January 2009.

US EPA Quality Assurance Management Section (QAMS), Glossary of Terms of Quality Assurance Terms, 8/31/92 and 12/6/95

US EPA Quality Assurance Division (QAD)

APPENDIX C

Building Evaluation

Complete this form for each building involved in indoor air testing

Preparer's Name: _____ Date/Time Prepared: _____
Preparer's Affiliation: _____ Work Phone:_____
Purpose of Investigation: _____

1. OCCUPANT:

Interviewed: Y/N

Last Name:_____First Name:_____

Address:_____

County:_____

Home Phone:_____ Alternate Phone:_____

Number of Occupants/persons at this location:_____

Age of Occupants:_____

2. OWNER OR LANDLORD: (Check if same as occupant_____)

Interviewed: Y/N

Last Name:_____ First Name:_____

Address:_____

County:_____

Home Phone:_____ Alternate Phone:_____

3. BUILDING CHARACTERISTICS:

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other:_____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouse/Condos
Modular	Log Home	Other:_____

If multiple units, how many?_____

If the property is commercial, type?

Business Type(s)_____

Does it include residences (i.e., multi-use)? Y/N If yes, how many?_____

Other characteristics:

Number of floors_____ Building age_____

Is the building insulated Y/N? How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns & qualitatively describe:

Airflow between floors

_____

_____

_____

Airflow near source

_____

_____

Outdoor air infiltration

_____

_____

Infiltration into air ducts

_____

_____

5. BASEMENT & CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction: wood frame concrete stone brick

b. Basement type: full crawlspace slab other_____

c. Basement floor: concrete dirt stone other_____

d. Basement floor: unsealed sealed
covered with _____

e. Concrete floor: unsealed sealed
sealed with _____

f. Foundation walls: poured block stone
other_____

g. Foundation walls: unsealed sealed
sealed with _____

h. The basement is: wet damp dry moldy

i. The basement is: finished unfinished partially finished

j. Sump present? Y / N

k. Water in sump? Y / N not applicable

Basement/Lowest level depth below grade:_____(feet)

Identify potential soil vapor entry points & approximate size (e.g., cracks, utility ports, drains)

_____

_____

6. HEATING, VENTING & AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard
Space heaters	Steam radiation	Radiant floor
Electric baseboard	Wood stove	Outdoor wood boiler

Other_____

The primary type of fuel used is:

Natural gas	Fuel oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by:_____

Boiler/furnace located in: Basement Outdoors Main Floor
Other_____

Air conditioning: Central air Window units Open windows
Heat Pump None

Are there air distribution ducts present? Y / N

Describe the supply & cold air return ductwork & its condition where visible, including whether there is a cold air return & tightness of duct joints. Indicate the locations on the floor plan diagram.

_____

_____

_____

_____

7. OCCUPANCY

Is basement/lowest lever occupied? Full-time Occasionally Seldom Almost never

Level General use of each floor (e.g., familyroom, bedroom, laundry, workshop, storage)

Basement:_____

1st Floor_____

2nd Floor_____

3rd Floor_____

4th Floor_____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car) Y/N Please specify _____

d. Has the building ever had a fire? Y / N When_____

e. Is a kerosene or unvented gas space heater present? Y / N Where & Type?_____

f. Is there a workshop or hobby/craft area? Y / N Where & Type?_____

g. Is there smoking in the building? Y / N Frequency?_____

h. Have cleaning products been used recently? Y / N When & Type?_____

i. Have cosmetic products been used recently? Y / N When & Type?_____

j. Has painting/staining been done in the last 6 months? Y / N Where & When?_____

k. Is there new carpet, drapes or other textiles? Y / N Where & When?____

l. Have air fresheners been used recently? Y / N When & Type?_____

m. Is there a kitchen exhaust fan? Y / N If yes, where vented?_____

n. Is there a bathroom exhaust fan? Y / N If yes, where vented?_____

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?_____

Are there odors in the building Y / N If yes please describe:_____

Do any of the building occupants use solvents or volatile chemicals at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide applicator, cosmetologist, carpet installer)

If yes, what type of solvents are used? _____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (circle appropriate response)

Yes, use dry-cleaning regularly (weekly)
Yes, use dry-cleaning infrequently (monthly or less)
Yes, work at a dry-cleaning service
No
Unknown

Is there a radon mitigation system for the building/structure? Y / N Date of Installation:_____

Is the system active or passive? Active/Passive

9. WATER & SEWAGE

Water Supply: Public water Drilled well Driven well Dug well
Other:_____

Sewage Disposal: Public sewer Septic tank Leach field Dry well
Other:_____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended:_____

_____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

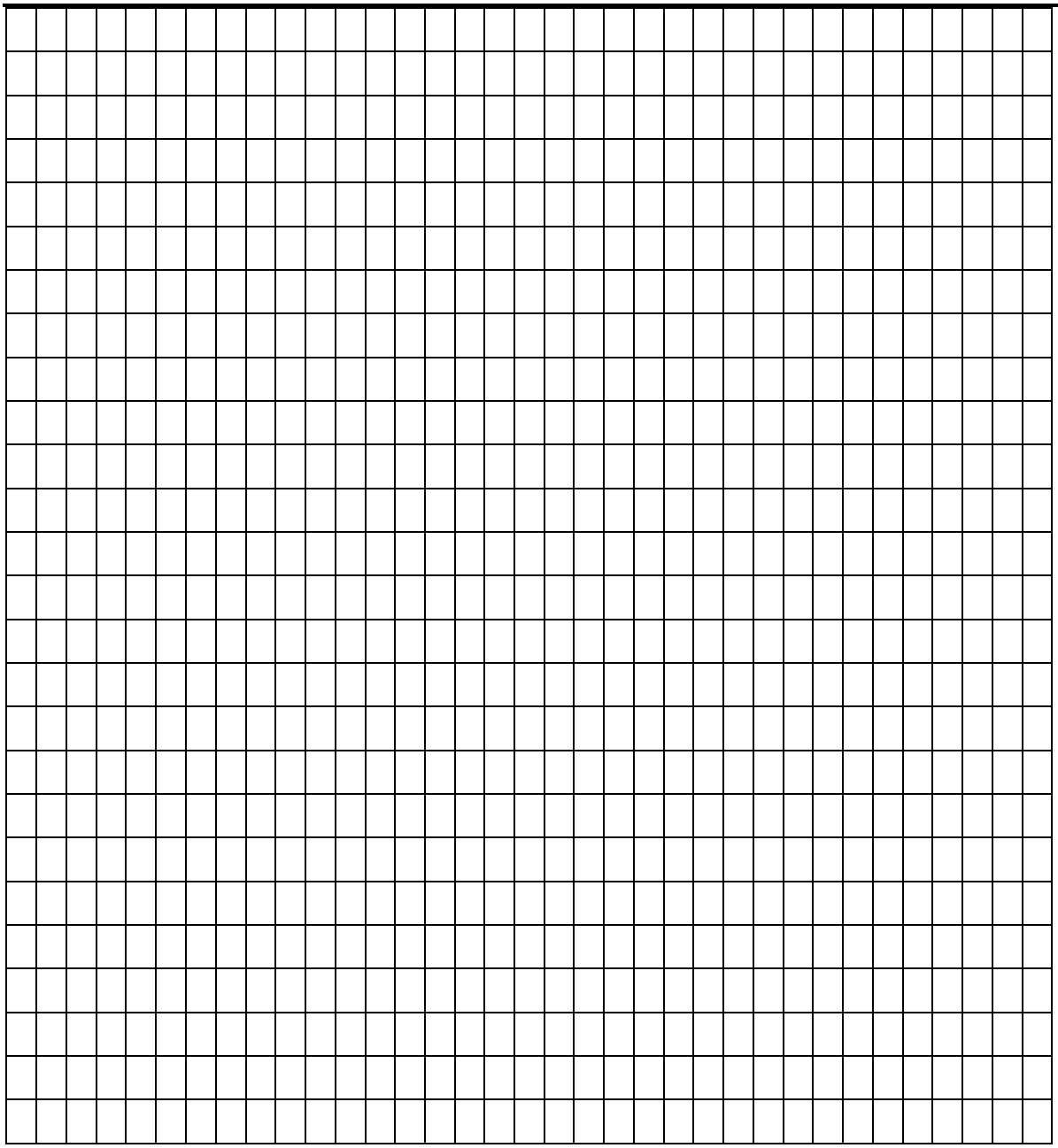
c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided & explained to residents? Y / N

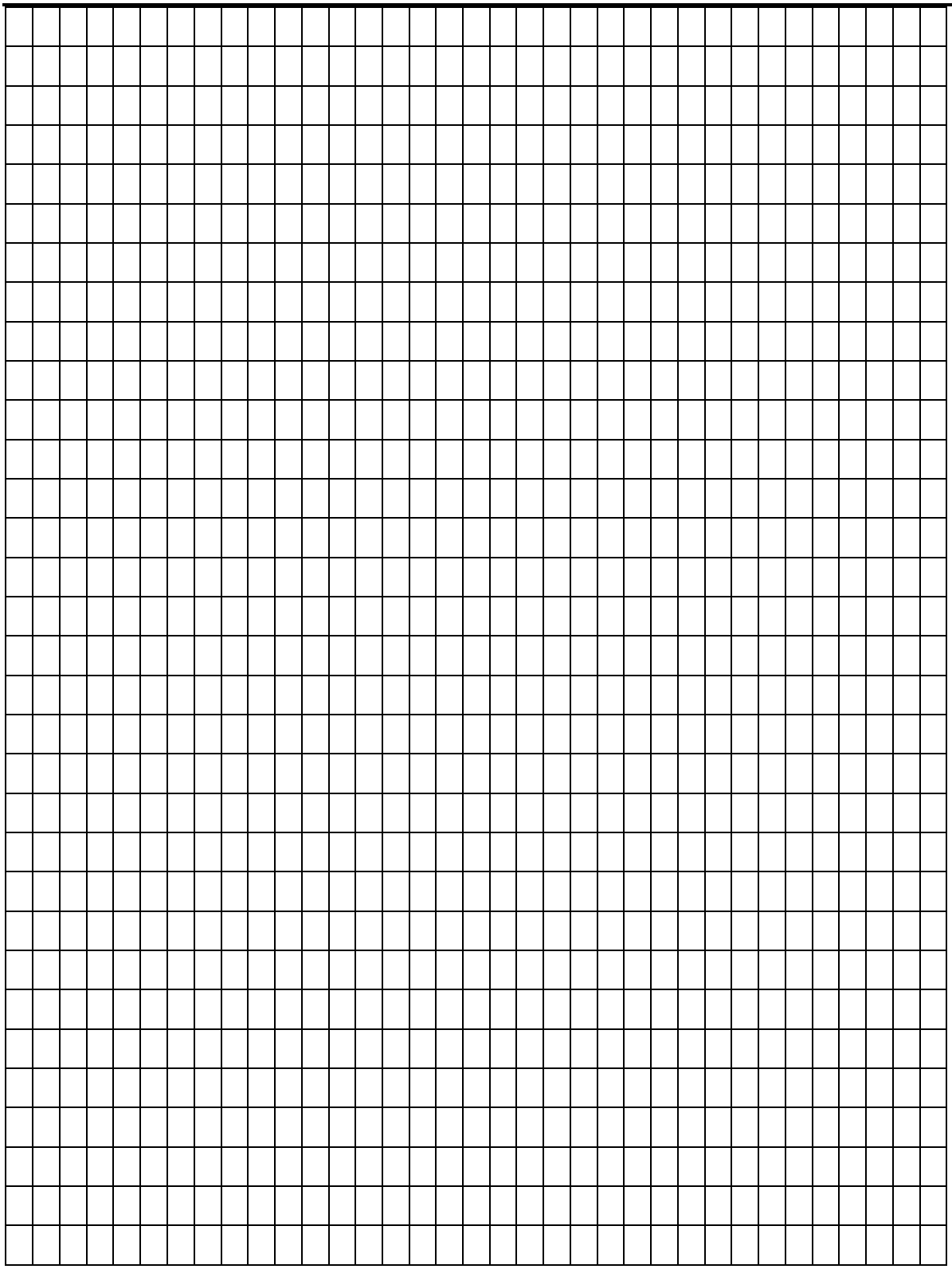
11. FLOOR PLANS

Draw a plan view sketch of the basement & first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

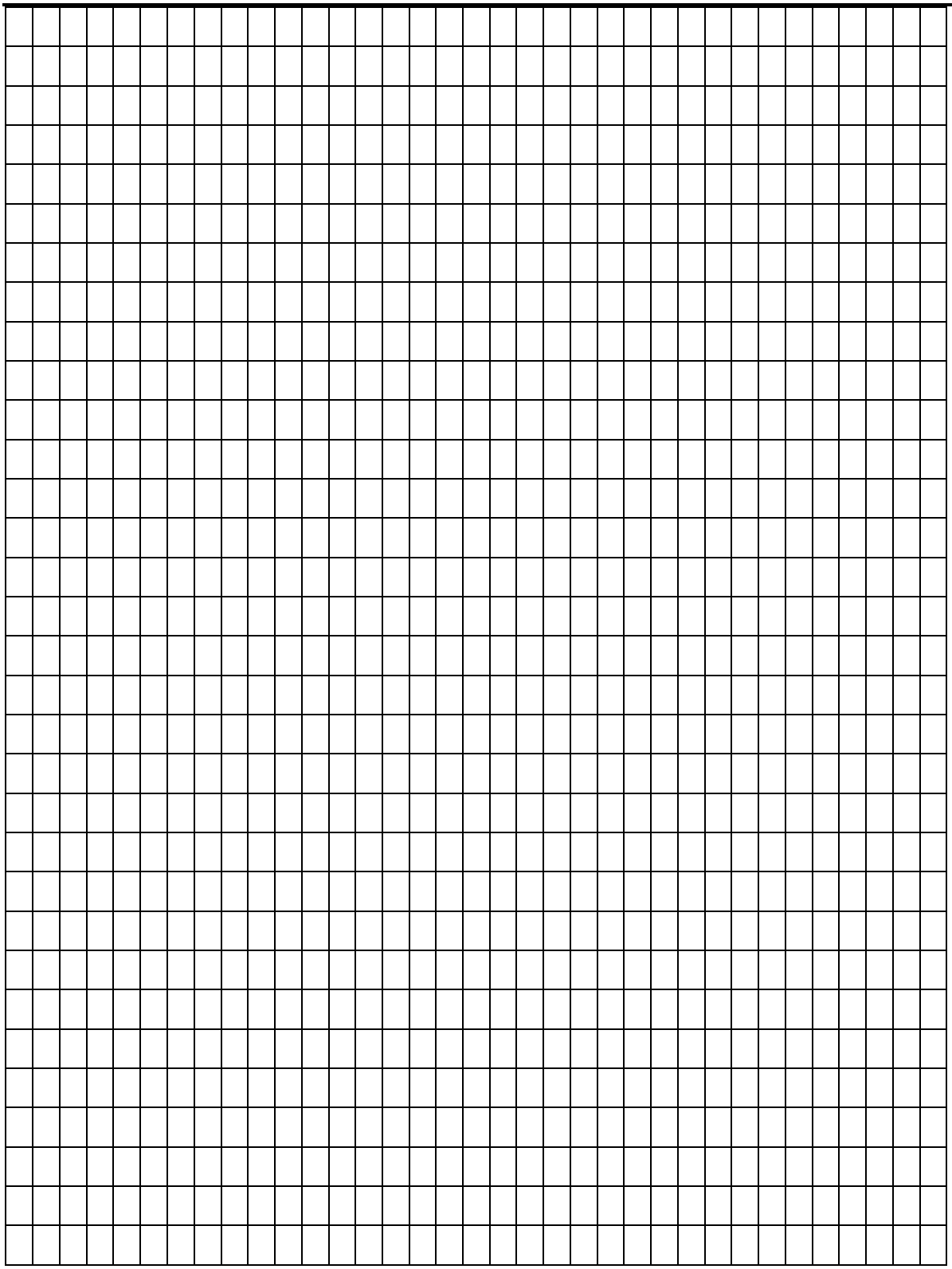
Basement:



First Floor:



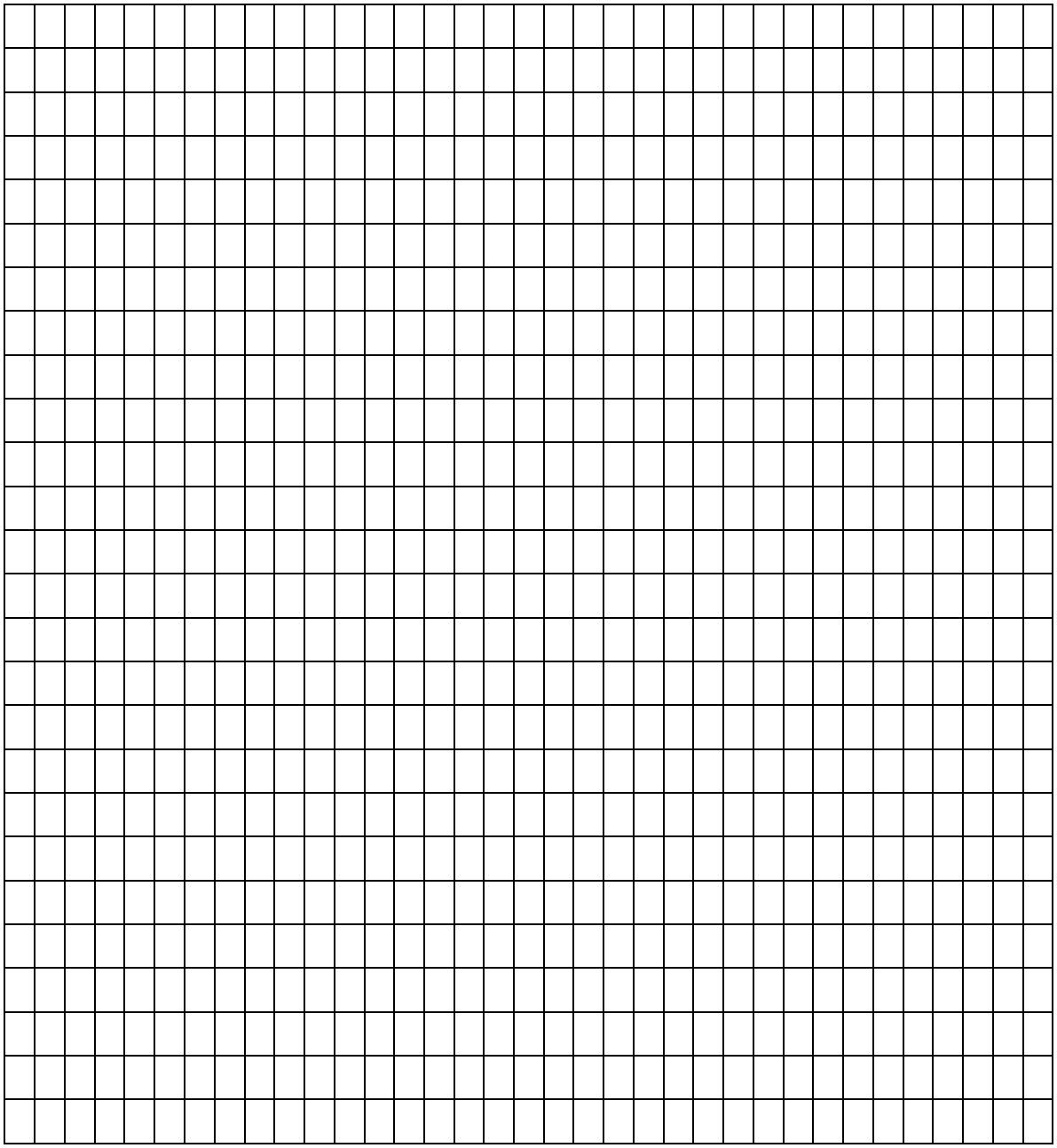
Second Floor:



12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc), outdoor air sampling location(s) & PID meter readings.

Also indicate compass direction, wind direction & speed during sampling, the locations of the well & septic system, if applicable, & a qualifying statement to help locate the site on a topographic map.



13. PRODUCT INVENTORY FORM

Make & Model of field instrument used:_____

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo** Y / N

***Describe the condition of the product containers as Unopened (UO), Used (U), or Deteriorated (D)**
**** Photographs of the front & back of the product containers can replace the hand written list of chemical ingredients. However, the photographs must be of good quality & ingredient labels must be legible.**

APPENDIX D

Occupant Instructions Prior to Sampling

Instructions for Building Occupants Prior to Sampling Event

(starting at least 48 hours prior to and during the sampling event)

- Do not open windows, fireplace openings or vents.
- Do not keep doors open.
- Do not operate ventilation fans or air conditioning.
- Do not use air fresheners or odor eliminators.
- Do not smoke in the building.
- Do not wear or bring dry cleaned clothing or other articles into the space.
- Do not use paints or varnishes.
- Do not use cleaning products (e.g., bathroom cleaners, furniture polish, appliance cleaners, all-purpose cleaners, floor cleaners).
- Do not use cosmetics, including hair spray, nail polish, nail polish remover, perfume, etc.
- Do not partake in indoor hobbies that use solvents.
- Do not apply pesticides or mothballs.
- Do not store containers of gasoline, oil or petroleum–based or other solvents within the house or attached garage (except for fuel oil tanks).
- Do not use wood stoves, fireplace or auxiliary heating equipment (e.g., kerosene heater).
- Do not operate or store automobiles in an attached garage.

APPENDIX E

Air Sampling Forms

Air Sample Collection Form

Project Name: _____ Address: _____ Aspect Project No.: _____

Date: _____ Field Representative: _____

Completed Building Evaluation Form? _____

Provided Occupants with Pre-Sampling Instructions? _____

Photoionization Detector (Brand and Model): _____

Weather Data	
START	**END**
Barometric Pressure (in Hg):	Barometric Pressure (in Hg):
Wind Direction (from the):	Wind Direction (from the):
Wind Speed (mph):	Wind Speed (mph):
Temperature (deg F):	Temperature (deg F):
Humidity (%):	Humidity (%):
Precipitation (inches):	Precipitation (inches):

Weather Description:

Air Sample Name:		Canister ID:	Gauge/Controller ID:	
Sample Type (check all that apply):	[ ] Indoor [ ] Outdoor	[ ] Ambient or Background Source	[ ] Crawlspace	[ ] Basement
Sample Location:		**Sample Intake Height:**		
Sample Readings				
START		**END**		
Date:		Date:		
Time:		Time:		
PID Reading (ppm):		PID Reading (ppm):		
Canister Vacuum (in Hg):		Canister Vacuum (in Hg):		

Notes:

HVAC operation/other ventilation considerations during sampling period:

Air Sample Name:		Canister ID:	Gauge/Controller ID:	
Sample Type (check all that apply):	[ ] Indoor [ ] Outdoor	[ ] Ambient or Background Source	[ ] Crawlspace	[ ] Basement
Sample Location:		**Sample Intake Height:**		
Sample Readings				
START		**END**		
Date:		Date:		
Time:		Time:		
PID Reading (ppm):		PID Reading (ppm):		
Canister Vacuum (in Hg):		Canister Vacuum (in Hg):		

Notes:

HVAC operation/other ventilation considerations during sampling period:

Aspect CONSULTING

APPENDIX F

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND USE GUIDELINES

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on this report or the product of our services without the express written consent of Aspect Consulting, LLC (Aspect). This limitation is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual conditions or limitations and guidelines governing their use of the report. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and recognized standards of professionals in the same locality and involving similar conditions.

Services for Specific Purposes, Persons and Projects

Aspect has performed the services in general accordance with the scope and limitations of our Agreement. This report has been prepared for the exclusive use of the Client and their authorized third parties, approved in writing by Aspect. This report is not intended for use by others, and the information contained herein is not applicable to other properties.

This report is not, and should not, be construed as a warranty or guarantee regarding the presence or absence of hazardous substances or petroleum products that may affect the subject property. The report is not intended to make any representation concerning title or ownership to the subject property. If real property records were reviewed, they were reviewed for the sole purpose of determining the subject property's historical uses. All findings, conclusions, and recommendations stated in this report are based on the data and information provided to Aspect, current use of the subject property, and observations and conditions that existed on the date and time of the report.

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- Not prepared for the specific real property assessed
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Geoscience Interpretations

The geoscience practices (geotechnical engineering, geology, and environmental science) require interpretation of spatial information that can make them less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Use Guidelines" apply to your project or site, you should contact Aspect.

Discipline-Specific Reports Are Not Interchangeable

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

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Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time (for example, Phase I ESA reports are applicable for 180 days), by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope failure or groundwater fluctuations. If more than six months have passed since issuance of our report, or if any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Phase I ESAs – Uncertainty Remains After Completion

Aspect has performed the services in general accordance with the scope and limitations of our Agreement and the current version of the "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process", ASTM E1527, and U.S. Environmental Protection Agency (EPA)'s Federal Standard 40 CFR Part 312 "Innocent Landowners, Standards for Conducting All Appropriate Inquiries".

No ESA can wholly eliminate uncertainty regarding the potential for recognized environmental conditions in connection with subject property. Performance of an ESA study is intended to reduce, but not eliminate, uncertainty regarding the potential for environmental conditions affecting the subject property. There is always a potential that areas with contamination that were not identified during this ESA exist at the subject property or in the study area. Further evaluation of such potential would require additional research, subsurface exploration, sampling and/or testing.

Historical Information Provided by Others

Aspect has relied upon information provided by others in our description of historical conditions and in our review of regulatory databases and files. The available data does not provide definitive information with regard to all past uses, operations or incidents affecting the subject property or adjacent properties. Aspect makes no warranties or guarantees regarding the accuracy or completeness of information provided or compiled by others.

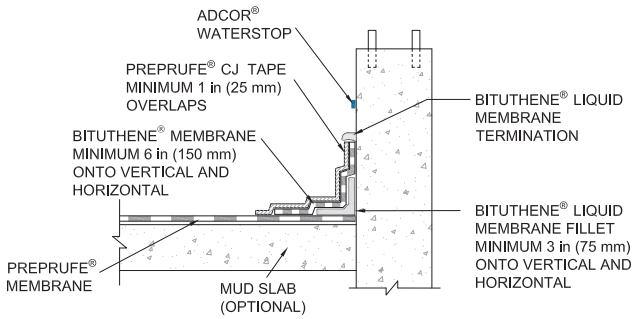
Exclusion of Mold, Fungus, Radon, Lead, and HBM

Aspect's services do not include the investigation, detection, prevention or assessment of the presence of molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts. Accordingly, this report does not include any interpretations, recommendations, findings, or conclusions regarding the detection, assessment, prevention or abatement of molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts. Aspect's services also do not include the investigation or assessment of hazardous building materials (HBM) such as asbestos, polychlorinated biphenyls (PCBs) in light ballasts, lead based paint, asbestos-containing building materials, urea-formaldehyde insulation in on-site structures or debris or any other HBMs. Aspect's services do not include an evaluation of radon or lead in drinking water, unless specifically requested.

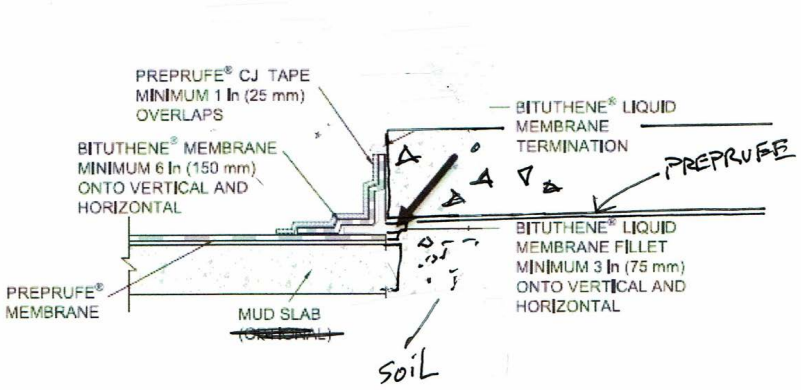
APPENDIX E

GCP Straight Edge Penetration Detail

35
STRAIGHT EDGE PENETRATION –
(WHALERS, RAKERS, STEEL H-BEAM)



NOTE: All penetrations to be grouted.



12/12/22 Kevin Vaughn, GCP representative updated repair drawing

Prior to membrane installation, review the PREPRUFE® data sheet.

Surface Prep
All surfaces must be sound and solid to eliminate movement during the concrete pour. Substrate must be regular and smooth with no gaps or voids greater than 0.5 in. (15 mm). The surface should also be free from loose aggregate and sharp protrusions as outlined in the PREPRUFE® data sheet section on "Surface Preparation."

Detailing
1. All penetrations must be firmly secured and stable. Grout around all penetrations that are not stable. Clean loose dust or dirt from the penetration and the surrounding substrate surface using a clean, dry cloth or brush.
2. Cut the PREPRUFE® Field Membrane tight to the penetration and remove release liner.
3. Apply BITUTHENE® Liquid Membrane to form a minimum 1 in. (25 mm) continuous fillet between the PREPRUFE® membrane and the base of the penetration. Extend a 90-mil (2.2 mm) continuous coating of BITUTHENE® Liquid Membrane overlapping a minimum of 3 in. (75 mm) onto the surface of the PREPRUFE® membrane and 3 in. (75 mm) onto the penetration.
4. Install a minimum 12 in. (300 mm) strip of BITUTHENE® membrane centered over the BITUTHENE® Liquid Membrane fillet so that the BITUTHENE® membrane extends 6 in. (150 mm) onto the penetration and PREPRUFE® membrane. For concrete penetrations, apply BITUTHENE® Primer as per standard GCP instructions prior to installation of BITUTHENE® membrane.
5. Apply a strip of PREPRUFE® CJ Tape onto the BITUTHENE® membrane and overlap onto the PREPRUFE® Field Membrane by a minimum of 2 in. (50 mm). Apply a second strip of PREPRUFE® CJ Tape starting at the top leading edge of the BITUTHENE® membrane and overlap onto the first strip of PREPRUFE® CJ Tape by a minimum of 2 in. (50 mm).
6. Terminate the top leading edge of PREPRUFE® CJ Tape and BITUTHENE® membrane with a bead of BITUTHENE® Liquid Membrane.
7. Seal apex of all outside corners with PREPRUFE® tape, corner patch as necessary.

Special Notes
- PREPRUFE® membranes should not be used in areas where they will be permanently exposed to sunlight, weather or traffic. Protect membrane from sunlight as quickly as possible after installation.
- Ensure ADCOR® waterstop is encapsulated with 3 in. (75 mm) of concrete cover minimum.
- Apply ADCOR® waterstop according to the installation instructions found on the data sheet.

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Aspect has relied upon information provided by others in our description of historical conditions and in our review of regulatory databases and files. The available data does not provide definitive information with regard to all past uses, operations or incidents affecting the subject property or adjacent properties. Aspect makes no warranties or guarantees regarding the accuracy or completeness of information provided or compiled by others.

Exclusion of Mold, Fungus, Radon, Lead, and HBM

Aspect's services do not include the investigation, detection, prevention or assessment of the presence of molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts. Accordingly, this report does not include any interpretations, recommendations, findings, or conclusions regarding the detection, assessment, prevention or abatement of molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts. Aspect's services also do not include the investigation or assessment of hazardous building materials (HBM) such as asbestos, polychlorinated biphenyls (PCBs) in light ballasts, lead based paint, asbestos-containing building materials, urea-formaldehyde insulation in on-site structures or debris or any other HBMs. Aspect's services do not include an evaluation of radon or lead in drinking water, unless specifically requested.