HWA GeoSciences Inc.
DBE/MWBE

February 13, 2025
HWA Project No. 2023-157

GLY
14432 SE Eastgate Way, Suite 300
Bellevue, WA 98007

Attention: Dana Johnson, Design-Build Senior Project Manager

Subject: DRAFT Preliminary Landfill Closure Compliance Work Plan
Snohomish County Food and Farming Center
Snohomish County, Washington

Dear Dana Johnson,

HWA GeoSciences Inc. (HWA) has prepared this Draft Preliminary Landfill Closure Compliance Work Plan for the planned Snohomish County Food and Farming Center project. This work was performed under contract to GLY, to support Snohomish County (County) in development of the project.

INTRODUCTION

The planned Snohomish County Food and Farming Center project will be located near or over the former Emander Landfill, located at the current McCollum Park Site, at 600 128th Street SE, in Snohomish County, Washington. Cleanup activities and landfill closure at the site were completed around 1996 under an Agreed Order (AO) with Washington State Department of Ecology (Ecology), as implemented in a Cleanup Action Plan (CAP).

Cleanup actions included grading, landfill capping, landfill gas management, and compliance monitoring, as well as in situ solidification/stabilization of sludge in localized areas. The landfill cap (i.e., cover system) included a leveling course, a 60-mil textured high-density polyethylene (HDPE) liner, a protection/drainage soil layer, and a vegetated topsoil layer. There is no bottom liner at the landfill; all references to "liner" herein refer to the top cover. A landfill gas management system was installed around 1996 or 1997 that consisted of multiple gas extraction pipes/trenches connected to a vacuum blower that eventually routed the collected soil gas through a thermal oxidation system prior to discharge to atmosphere. This system was converted to a passive landfill gas system, reportedly approximately 15 years ago. The system is currently operated in a semi-passive mode where the blower is turned on when sufficient methane concentrations are detected, and gas is routed to a flare with an auto-igniter. Ongoing monitoring of the discharges from the landfill gas system is performed by Snohomish County. Groundwater, surface water, and sediment compliance monitoring were implemented after other cleanup actions were completed in accordance with the compliance monitoring plan. Compliance

monitoring is ongoing as part of the Site cleanup to confirm the cleanup action attains cleanup standards under the Model Toxics Control Act (MTCA).

OBJECTIVES

This work plan outlines measures to be taken during design and construction of the Food and Farming Center to ensure compliance with the intent of the CAP and AO with respect to landfill closure elements that may be impacted by the new development. These elements include: landfill closure system (cap), landfill gas control, stormwater/drainage, and monitoring (groundwater, surface water, and gas). This document is intended for review by the design team, County, County Health Department, and Ecology.

WORK PLAN OUTLINE

Preliminary layout of the facility is not yet finalized, but is anticipated to include structures both on and off the landfill. Figure 1 depicts one of several possible development configurations, as well as the estimated limits of the landfill impermeable cover. Limits of landfill waste are not entirely defined in all areas, particularly under the pool area where cover liner was only installed around the building, and presence of waste under the pool is unknown. Regardless of the presence of waste under the pool, new top liner will likely be required over that area due to the need for a contiguous landfill cap without an irregular perimeter, i.e., a "cut out" where the pool was would not adequately prevent infiltration of water into the waste or migration of landfill gas out of the waste, and might actually concentrate these pathways. Waste may exist outside of the liner in some areas. Elements of the planned design and construction which may impact landfill closure and cleanup requirements under the CAP and AO include:

Landfill Closure System

- Existing landfill cover system integrity will be maintained, i.e., any breaches or penetrations required for or caused by construction will be repaired or replaced to meet or exceed the original landfill CAP closure specifications, e.g., leveling course, 60 mil HDPE geomembrane or equivalent liner with welded connections, construction quality assurance meeting geomembrane manufacturer requirements, overlying protection/drainage soil layer (or liner-integrated drainage composite), and a vegetated topsoil layer. Alternative cover system designs may be considered that better accommodate predicted settlement due to the planned development, consistent with Chapter 173-351 WAC, e.g., low permeability soil barrier consisting of at least two feet of natural or amended soils with permeability of less than 1E-5 cm/sec, with minimum one foot of cover soils with minimum 6 inches of vegetated topsoil. Linear low-density polyethylene (LLDPE) liners, geosynthetic clay liners, or other alternative cover systems may also be considered, possibly in selected areas or for repairs of the existing cover.

- Final cover system design will be detailed in design documents (plans and specifications) or future submissions to Ecology or the County Health Department, as required.
- Any areas disturbed or modified by the project over landfill waste not formerly covered by liner (e.g., possibly the pool area) will be covered with new cover system, as described above.
- Any new capped areas will be sloped to maintain adequate drainage, membrane tension, plant establishment, etc., with the goal of no less than two to five percent slopes after settlement, per Chapter 173-351 WAC.
- Any structures, utilities and landscaped areas over waste will be hydraulically isolated from the waste with cover system (geomembranes, sealants, etc.) as appropriate to the structure.
- Building design and foundation systems will be compatible with landfill closure elements:
    - Impacts to the existing liner from settlement due to ground improvement (e.g., preloading or dynamic compaction) will be evaluated and mitigated as needed, to ensure integrity of the existing liner where present, as well as slopes and drainage. Measured and predicted settlements after ground improvement will be used to estimate strain (deformation) of the existing liner and compared to the expected yield strength of the liner plus some factor of safety. If liner failure is predicted (i.e., below the established factor of safety), repairs, patches, or new cover system will be installed as needed to maintain the integrity of the landfill cap.
    - Existing and new cover system will also be evaluated to accommodate predicted deformation from long term, post-construction settlement due to loading (primary or secondary consolidation) or longer-term settlement due to waste decomposition. Any areas where predicted deformations exceed the factor of safety for liner strength will be replaced with new cover system designed for the predicted long term settlements.
    - If piles are used to support structures, they will not be permeable (e.g., stone columns). Only solid (e.g., driven) piles would be used, and sealed (e.g., grouted or booted) at the liner.
    - Utility penetrations of the liner will be sealed, grouted, or booted. Outdoor enclosures, vaults, manholes, etc. will be designed for landfill gas mitigation.
    - Utility trenches that lie below the liner or intersect it will have appropriately spaced low-permeability check dams, pipe boots, or equivalent to prevent preferential migration of landfill gas through the trench backfill into buildings or off the landfill site.
- No new trees or plantings with deep roots are planned over landfill waste. Preliminary design includes shallow-rooted plants with no taproot, that can be safely installed above the liner where sufficient cover soil is present over the liner. Setbacks for trees off the liner will be based on maximum anticipated reach of the roots for the species planted.

Stormwater/drainage

- In areas over or near waste, stormwater facilities will be designed so that all precipitation and runoff (from roof drains, parking lots, ditches, swales, etc.) will be collected and conveyed off the landfill, i.e., not infiltrated into the landfill below the cap.
- Infiltration facilities, bioswales, biofioltration, treatment, or detention vaults will be located off waste, above the liner system, or otherwise hydraulically isolated from landfill waste. An appropriate setback will be established for unlined stormwater facilities near waste.

Landfill gas

- Per Snohomish County Board of Health Ordinance no. BOH23-01 Section 2.15.360 E., *Explosive Gas Monitoring and Control at and Near Landfills*: Any development within 1,000 feet of a closed landfill will require:
    - Documentation that demonstrates that levels of explosive gas are below the lower explosive limits (LEL) under all conditions. A description of the investigation methodology, analytical data, and conclusions shall be presented in a report submitted by a licensed professional engineer or professional geologist to the Health Officer and the local building department for review and approval.
    - Documentation that demonstrates that all enclosed structures are protected from potential explosive gas migration. The method for ensuring a structure's protection from explosive gas shall be addressed in a report submitted by a licensed professional engineer to the Health Officer and the local building department for review and approval. Such a report shall contain a description of the mitigation measures to prevent the accumulation of explosive concentrations of gas within or under enclosed portions of a building or structure. At the time of the final inspection, the engineer shall furnish a signed statement attesting that the building or structure has been constructed in accordance with her/his recommendations for addressing the explosive gas migration.
- The existing landfill gas control system will be maintained, e.g., any collection trenches, headers, vaults, etc. will be replaced in kind if disturbed or relocated during construction.
- As with the landfill cap, impacts to the existing gas collection system from settlement due to ground improvement (e.g., preloading or dynamic compaction) or long term, post-construction settlement will be evaluated and repaired or replaced as needed, to ensure integrity of the gas system.
- The gas system will be flow/pressure tested and re-balanced if any modifications are made. Any passive (i.e. not under induced vacuum) gas collection trenches intersected by new site improvements will be capped off, grouted or plugged to prevent migration of landfill gas into or near new structures.

- Any new buildings on or near the landfill will mitigate for landfill gas, including barrier systems, ventilation systems, passive or active venting/extraction systems, building methane detection and alarm systems, occupant notification, signage, emergency plans, periodic inspections, operation and maintenance, soil and ambient gas monitoring, and reporting. Typical design elements can be found in the *City of Los Angeles Methane Mitigation Standards*[1] (see standard plans, pages 1-8). Relevant excerpts of that document are attached as Appendix A. These design guidelines will be employed based on the type of structure, presence of waste, and soil landfill gas characterization studies in the areas to be developed.
- Compliance values for landfill gas will be based on Chapter 173-351 WAC, *Criteria For Municipal Solid Waste Landfills* and are:
    - 25% of the lower explosive limit (LEL) for gases in facility structures (excluding the gas control or recovery system components). The LEL for methane is 5% by volume; 25% of that is 1.25% methane by volume;
    - 100% of the LEL for gases in soil or in ambient air at the property boundary or beyond; and
    - 100 parts per million by volume of hydrocarbons (expressed as methane) in off-site structures (or 0.2% of the LEL).
- The minimum frequency of monitoring will be quarterly.

Construction

- Construction requirements will include dust and odor controls, erosion and surface water controls, construction health and safety requirements, dewatering procedures, construction performance monitoring, inspection, contingency plans, and proper handling of refuse excavated during construction, etc. These requirements will be detailed in construction contract documents (i.e., plans and specifications).
- Any landfill waste requiring removal will either be relocated under new liner or disposed of offsite in a Subtitle D landfill as municipal solid waste. Construction specifications will include provisions for waste profiling, worker health and safety, decontamination, transport, etc. for any landfill waste or regulated waste managed during construction. Excavated clean cover soils (above the liner) or native soils not containing waste may be reused based on structural or other requirements, or may be disposed of off site.

Monitoring (groundwater, surface water, and gas)

- Existing groundwater and gas monitoring systems (e.g., monitoring wells, gas probes) will be maintained or replaced in kind in consultation with Ecology if locations need to be adjusted.

[1] https://www.ladbs.org/services/core-services/plan-check-permit/methane-mitigation-standards

- New gas monitoring systems may be installed as needed for new structures

Details of the above-listed elements will be provided to Ecology and the Health Department in work plans and/or design documents (plans and specifications) as they become available.

We appreciate the opportunity to provide our services. Should you have any questions regarding this plan, please contact us at your convenience.

Sincerely,

HWA GEOSCIENCES INC.

Arnie Sugar, LG., LHG.
Principal Hydrogeologist

Mike Bagley, LG, LHG
Senior Hydrogeologist

Figure 1- Preliminary Site Layout
Attachment A - City of Los Angeles Methane Mitigation Standards excerpts

ALTERNATIVE PROGRAM SITE DIAGRAMS

ALTERNATIVE PROGRAM - TWO BUILDING SCHEME

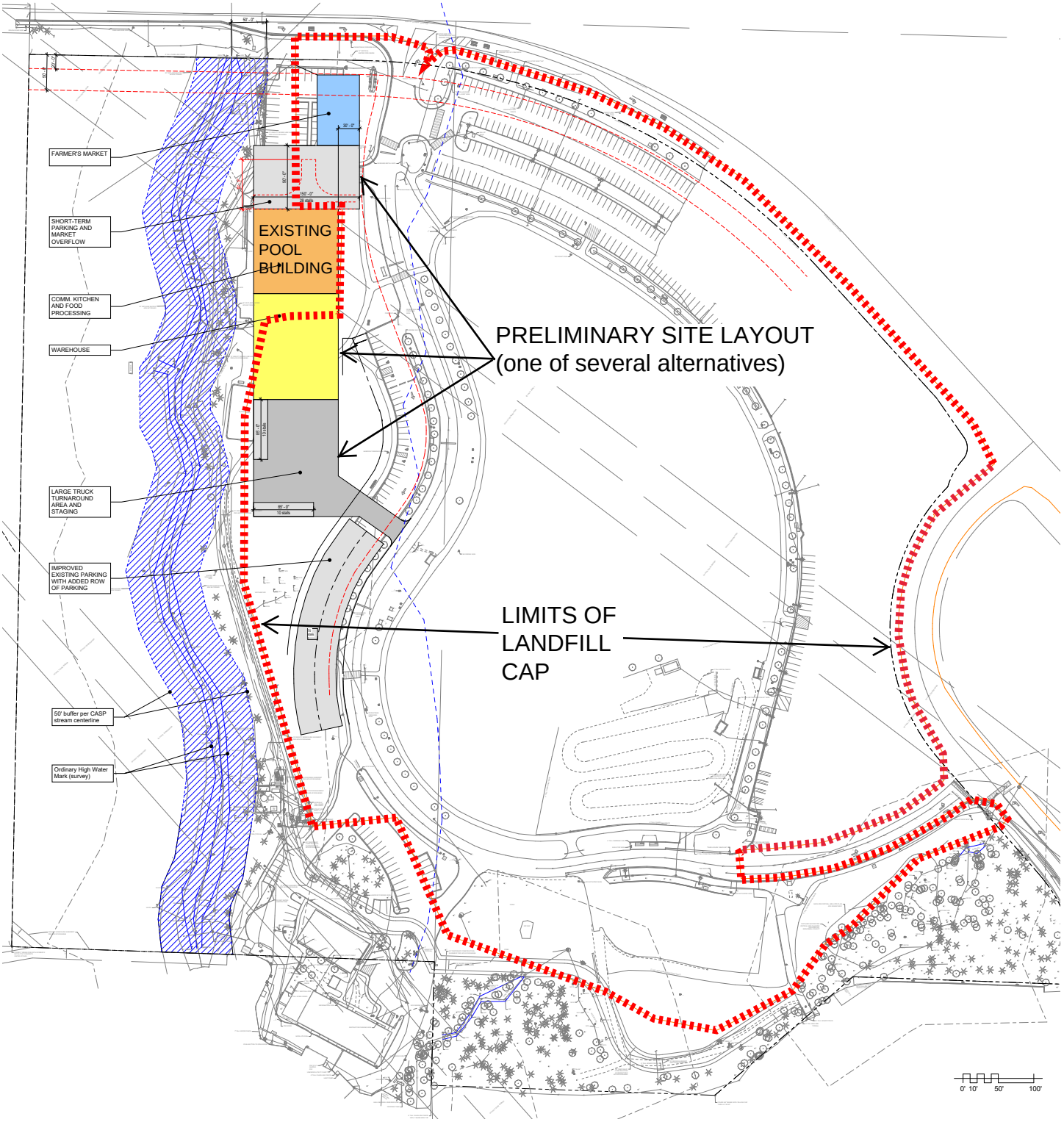

FIGURE 1
PRELIMINARY SITE LAYOUT
SNOHOMISH COUNTY FOOD AND FARMING CENTER

Attachment A

City of Los Angeles
Methane Mitigation Standards
excerpts

METHANE HAZARD MITIGATION STANDARD PLAN

I. PURPOSE

This Methane Hazard Mitigation Standard Plan provides standard details and specifications that maybe used to comply with the requirements of the Methane Seepage Regulations of Division 71 of the Los Angeles Building Code. The intent of methane mitigation systems described in this plan is to promote public safety and welfare by controlling methane intrusion emanating from geologic formations. These systems are not intended to regulate flammable vapors that may originate in and propagate from other sources, which include, but are not limited to, ruptured hazardous material transmission lines, underground atmospheric tanks, or similar installations.

II. HOW TO USE THIS STANDARD PLAN

To use this Standard Plan select either of the following:

1. Avoid Methane Soils Gas Site Testing and construct components for Site Design Level V shown on Tables 1A (Methane Zone) or 1B (Methane Buffer Zone) on Sheet 4.
2. Avoid Methane Soil Gas Site Testing by designing the building using one of the exceptions to Table 1A or 1B under Section IV B 1, 2 or 3 of this Standard Plan.
3. Conduct Methane Soils gas testing, complete Form 1 on sheet 3, and construct components listed in Tables 1A or 1B on Sheet 4.

NOTE: Identify the required Methane Hazard Mitigation components with a "circle" around the appropriate exception under Section IV B (Sheet 1) or the respective column in Tables 1A or 1B (Sheet 4).

III. GENERAL REQUIREMENTS

CODES:
All work shall be in compliance with the current version of the Los Angeles Building Code and policies of the Department of Building and Safety, and all applicable County, State, and Federal Codes.

INSPECTION:
All work, requiring inspection by the Department of Building and Safety, shall be available to the inspector prior to being covered by subsequent work.

IV. MITIGATION REQUIREMENTS

A. NEW BUILDINGS

All new buildings and paved areas located in a Methane Zone or Methane Buffer Zone shall comply with this Standard Plan and Division 71 of the Building Code.

B. EXCEPTIONS TO TABLE 1A and 1B

The provisions of the Building Code, Section 7104.3 are exceptions to the construction requirements of Table 1A and 1B based on the configuration of the building construction. The following exceptions may be used in lieu of full compliance with Tables 1A and 1B. For further information regarding the design of methane mitigation components, see Section V of this Standard Plan.

1. Buildings with Raised Floor Construction.

Provide all of the following methane mitigation components in lieu of the requirements in Table 1A and 1B.

a. The utilities shall be installed with Trench Dams, Detail 16 on Sheet 8, and Cable or Conduit Seal Fittings, Detail 8 on Sheet 7.

b. Four inch (4") thick gravel blanket shall be installed under and around the elevator pits, when there is an elevator pit constructed in the building.

c. In lieu of the underfloor ventilation requirements of The Building Code, Section 7104.3.2, the underfloor ventilation shall be provided using all of the following:

i. An approved mechanical ventilation system which is equivalent to providing one complete air change in the underfloor space once every 20 minutes, or

ii. An under-floor system with a clear height above grade of at least 12 inches to girder, 18 inches to floor joist, and 24 inches to structural floors.

iii. Openings for underfloor area or crawl space ventilation shall be located less than 6 inches below the bottom of the floor joists. The openings shall be located to provide cross ventilation and shall be the larger of:

- Openings of not less than 1.5 square feet for each 25 linear feet of exterior wall; or
- Openings shall be 1% of underfloor area.

iv. Openings for underfloor area or crawl space ventilation shall be approximately equally distributed along the length of at least two opposite sides of the building. They shall be covered with corrosion- resistant wire mesh with mesh openings not less than ¼ inch nor greater than ½ inch in dimension.

2. Buildings with Natural Ventilation

a. Buildings with Natural Ventilation are buildings with Unobstructed Openings or an opening with a wind-assisted system in exterior walls. Unobstructed Openings for Natural Ventilation shall be evenly spaced to prevent the accumulation of methane gases within the building and shall be constructed as follows:

i. Unobstructed Openings shall be permanently affixed in the open position.

ii. Unobstructed Openings shall be free of obstructions, except for screens of wire mesh with not less than ¼", or wind driven turbines.

iii. The aggregate size of Unobstructed Openings providing Natural Ventilation for an enclosed space shall be the larger of:

- 25% of total floor area of the lowest level of the building, or
- 25% of the total perimeter wall area of the lowest level of the building.

iv. Unobstructed Openings shall be located in walls or roofs to facilitate natural venting of methane gas to the atmosphere.

v. Locate uniformly distributed Unobstructed Openings on two or more exterior sides to provide cross ventilation as close to corners as practical.

vi. Unobstructed Openings shall comply with the provisions of the Los Angeles Building Code including location on property, openings adjacent to stairways and courts.

- a maximum of 6 inches below roof or ceiling joists in the space to be ventilated,
- no more than 50 feet from any point within the building and
- to provide cross ventilation utilizing either of the following:
  1. two opposing sides of the building or space to provide cross ventilation.
  2. two adjacent sides where at least 50% of the required area of vents are centered a distance of one half the diagonal of the space being ventilated.

vii. Unobstructed Openings in walls shall be located:

- to remove gases from the highest point in the room or enclosed space,
- at a minimum of two positions a maximum of 50 feet on center and
- evenly distributed throughout the enclosed space.

b. In lieu of the requirements of Table 1A and 1B, buildings with Natural Ventilation, such as, restrooms, gazebos, barns, attendant stations and other similar accessory buildings located in parks or buildings with lowest levels closest to grade having Group S, Division 2 occupancy, or detached buildings of Group U and Unenclosed Buildings shall be constructed with utilities installed with Trench Dams and either Conduit Seal Fittings or Cable Seals Fittings.

3. Enclosed Rooms or Spaces within Building.

Individual enclosed rooms or enclosed spaces with floor area less than 2,000 square feet maybe exempt from providing the Active System as required by Table 1A and 1B, provided the vent openings comply with all of the following:

a. Vent openings are Unobstructed Openings, except screens of wire mesh at least ¼ inch or wind driven turbines on the roof shall be permitted.

b. The aggregate size of vent openings shall be the larger of either five percent of the total floor area of the room or the area of enclosed space, or ten percent of the area of walls on the perimeter of the room or enclosed space.

c. The vent openings shall be located to prevent the accumulation of methane gases within the room or enclosed space.

d. The top of the vent opening shall be located not more than 12 inches below roof joists or ceiling joists if located in a wall of a building.

e. The vent openings shall be located on either two opposite walls or two adjacent walls of the room or enclosed space if located in a wall of a building.

f. The vent openings shall be located no more than 50 feet from any point within the room or enclosed space.

g. When using wind driven turbine, the area of the vent opening shall be calculated by the area of the opening at the attachment of the wind driven turbine at the roof.

h. When the vent opening is located in a wall of an adjoining room, then the adjoining room shall be constructed of either an Active System, or have Natural Ventilation as described in Subsection 2 above (Buildings with Natural Ventilation.)

4. Single Family Dwellings and Buildings Accessory to Single Family Dwellings, some or all of the following may be used in lieu of the requirements of Table 1A and 1B:

a. Single-Station Gas Detectors with battery-back up may be installed in lieu of an Alarm System and Gas Detection System. The battery shall be sized to operate the Single-Station Gas Detectors at least 20 hours in standby mode and 5 minutes in the alarm mode.

b. 6-mil thick Visquene may be used in lieu of an Impervious Membrane, when the site is located in the Methane Zone with Site Design Levels I or II.

c. Additional Vent Risers or Mechanical Ventilation may be omitted for buildings with a width less than 50 feet and footprints less than 6,000 square feet in area.

d. Vent Risers provided at a rate twice shown in Table 2 on Sheet 4 may be provided in lieu of a Mechanical Extraction System.

5. Buildings Located in the First Phase Playa Vista Project. The First Phase Playa Vista project, as approved by the City on September 21, 1993 and December 8, 1995, shall comply with the methane mitigation program as required by the Department pursuant to the Methane Prevention, Detection and Monitoring Program approved by the Department on January 31, 2001, in lieu of the requirements of the Building Code, Division 71.

C. NOTIFICATION PLACARD

1. A permanent notification placard is required to indicate the presence of the Impervious Membrane.
2. The notification placard shall be posted and maintained at the front of the building that is constructed with an Impervious Membrane, except that in residential buildings.
3. The notification placard shall be uncovered and located in conspicuous location. When cast in floors, shall also remain uncovered and in a conspicuous location.
4. The lettering shall be legible from 10 feet away and at least 1 inch high.

D. PAVED AREAS

The requirements for venting paved areas over 5,000 square feet in area and within 15 feet of the exterior wall of a commercial, industrial, institutional or residential building may be accomplished with either of the following:

1. If the site is located in the Methane Buffer Zone, then venting is not required for paved areas that qualify for Site Design Levels I, II, or III, or
2. Install vents in accordance with Detail 13 on Sheet 8, or
3. Install landscaping areas immediately adjacent to the building exterior walls at least two feet wide covering at least 80% of the building perimeter.

E. EXISTING BUILDINGS

Additions, alterations, repairs, change of use or change of occupancy to existing buildings shall comply with the methane mitigation requirements of the Building Code, Sections 7104.1 and 7104.2, when required by Division 34, 81, or 82 of the Building Code.

Approved methane mitigation systems in existing buildings shall be maintained in accordance with Building Code, Section 7106.

F. MAINTENANCE OF MITIGATION SYSTEM

1. All gas detection and mechanical ventilation systems shall be serviced and maintained in proper working condition.
2. The procedures for maintenance and service of gas detection and mechanical ventilation systems shall be in accordance with the equipment manufacturer written instructions and meet all the requirements of the Electrical and Mechanial Code.
3. Annual and Maintenance Testing is required to be performed in accordance with the Fire Prevention Bureau (F.P.B.) Requirement No. 71 and Fire Chief's Regulation 4, Section 4.I.
4. The testing of the gas detection and mechanical ventilation systems shall be performed by a person with a valid Certificate of Fitness for Gas Detection Systems as set forth in Los Angeles Municipal Code Section 57.06.01.

V. DESIGN CRITERIA

A. PASSIVE SYSTEM

1. De-Watering System

a. De-Watering System is required when the Historical High Ground Water Table Elevation is within twelve (12) inches from the lowest Perforated Horizontal Piping.

b. De-watering system is not required for either of the following: (1) if during the Site Testing, the groundwater level is deeper than 10 feet below the Perforated Horizontal Pipes, or (2) if the soil investigation or analysis, as approved by the Department, reveals the groundwater level is more than 12 inches below the bottom of the Perforated Horizontal Pipes.

c. De-watering rates shall be noted on the methane mitigation plans. The engineer or geologist responsible for determining the dewatering rates shall approve the plans.

d. Applications for water discharge location shall be approved and permitted by the Department of Public Works:

i. Bureau of Sanitation, Industrial Waste and
ii. Bureau of Engineering, Storm Water Management.

e. The de-watering pipe shall be minimum Schedule 40, slotted or perforated Polyvinyl Chlorid (PVC) pipe or other materials approved under LARR for the intended use.

f. De-watering pipes shall be installed as follows:

i. De-watering pipes shall be sloped at ¼ Inch vertical to 12 inch horizontal (2% slope). The slope may be reduced to 1% if the pipe size is increased one full size in pipe diameter.

ii. Combination de-watering and Sub-Slab vent piping system may be used when installed with a minimum nominal 4 inch diameter pipes.

g. Each sump pump pit shall contain a primary pump and a back-up pump.

2. Sub-Slab Vent System

Sub-Slab Vent System shall consist of Perforated Horizontal Pipes, Gravel Blanket Under Impervious Membrane, Gravel Around Perforated Horizontal Pipes and Vent Risers.

a. Perforated Horizontal Pipes:

i. Perforated Horizontal Pipes shall be approved and listed, minimum Schedule 40, slotted or perforated PVC pipe or other materials approved by a LARR for the intended use.

ii. Perforated Horizontal Pipe shall be installed as follows:

- Spacing and location of Perforated Horizontal Pipes shall be per Table 2 on Sheet 4.
- Pipes used only as vents may be installed in the horizontal position,
- Combination vent/dewatering pipes shall be sloped at ¼ inch vertical to 12 inch horizontal (2% slope) and
- Undulations in the Perforated Horizontal Pipes, which may impede the passage of gas, shall be avoided (e.g. Perforated Horizontal Pipes shall not be deformed to pass below interior footings).

b. Gravel Blanket Thickness Under Impervious Membrane:

i. The thickness of the Gravel Blanket under Impervious Membrane shall be per Table 1A and 1B shown on Sheet 4.

ii. The composition of gravel shall be washed particles that have no more than one fractured face.

iii. The gradations of gravel shall conform to Table 3 shown on Sheet 4.

iv. The gradations of sand shall conform to Table 4 shown on Sheet 4.

c. Gravel Thickness Around Perforated Horizontal Pipes:

i. Gravel thickness around Perforated Horizontal Pipes shall be per Table 1A and 1B shown on Sheet 4.

ii. When sand is used as the Gravel Blanket a geo-fabric to prevent sand from entering the Perforated Horizontal Pipes shall be placed around the Perforated Horizontal Pipes.

iii. Gravel shall be composed entirely of particles that have no more than one fractured face.

d. Vent Risers:

i. Vent Risers shall be connected to Perforated Horizontal Pipes and constructed of cast iron. Exception:

- Acrylonitile Butadiene Styrene (ABS) pipes may be allowed for residential buildings up to two (2) stories, or
- Any other material approved by a LARR for the intended use as methane Vent Riser.

ii. Vent Risers shall be spaced and located as per Table 2 on Sheet 4.

iii. Vent Riser outlets shall be located as shown in Detail 12 on Sheet 8.

iv. If rain guards are provided, they shall be non-restricting.

3. Impervious Membrane

a. Impervious Membrane Installation:

i. Impervious Membrane shall be a product approved by the LADBS Engineering Research Section with a valid Los Angeles Research Report (LARR) Number. Installation shall comply with the conditions of approval specified in a LARR and manufacturer's specification of the Impervious Membrane.

ii. Impervious Membrane shall be installed at the following locations:

- Below the building slab surrounded by the inner face of the exterior footings
- On the exterior surface of walls from the finished grade level to a minimum of 6 inches below the bottom of the adjoining building slab
- Around sides of pile caps and caisson caps

Exception:

- Impervious Membrane shall not be installed under exterior or interior footings.

iii. Impervious Membranes at elevator and sump pits shall be installed as follows:

- Two layers of Impervious Membrane below slabs and footings of all elevator pits, sump pits and holding tanks.
- Impervious Membrane does not need to be placed below elevator pistons.
- Impervious Membrane shall be attached to the elevator piston cylinder casing or at the sump pit floor slab to prevent methane intrusion.

iv. The individual certified by the manufacturer of the Impervious Membrane shall certify on the Impervious Membrane Installation Certificate (see Sheet 3) that the Impervious Membrane was installed per approved plans.

v. The completed Form 3 shall be given to the inspector prior to placement of parts or the whole concrete floor slab.

b. Seals at Impervious Membrane Penetrations:

i. Where footings, plumbing pipes, electrical conduits and other materials penetrate the Impervious Membrane, the penetrations shall be sealed by using sleeves or boots composed of the same material or other approved materials and methods in accordance with the specifications of the manufacturer for the Impervious Membrane.

ii. A gas tight seal shall be provided where the Impervious Membrane is attached to all interior footings and exterior wall footings.

iii. All elevator piston shaft casing shall be constructed of a material allowed by the elevator code and sealed at the elevator pit floor slab level in accordance with the specifications of the Impervious Membrane manufacturer.

iv. The bottom of the elevator piston casing shall be sealed to prevent gas migration into the building.

c. Impervious Membrane Protection Prior to Floor Slab Placement

i. Installation Sequence for Protection Material Below the Impervious Membrane:

- Finish the Gravel Blanket smooth using mechanical means (e.g. roller).
- Place geotextile filter fabric over the Gravel Blanket to protect the smooth finish of the Gravel Blanket and prevent sand migration into the Gravel Blanket.
- Prepare protective course for Impervious Membrane.

Option A: If Sand is used as Gravel Blanket, then the Impervious Membrane may be placed directly on the geotextile, or
Option B: If Gravel is used as for the Gravel Blanket, then place a minimum 1-inch thick Sand layer directly over the geotextile.
Option C: If Gravel is used as for the Gravel Blanket, then place a geotextile with a minimum weight of 16 ounces per square yard.

ii. Installation Sequence for Protection Material Above the Impervious Membrane:

- Place 2-inch thick sand directly over the Impervious Membrane, or a minimum 1-inch thick lean concrete mix (slurry as specified in the Standard Specifications for Public Works Construction, Green Book)
- Place geotextile fabric if sand is used in the prior step. If lean concrete mix is used, geotextile is not required.
- Place concrete, reinforcing steel, piping and other forms so as not to be supported directly on the Impervious Membrane. Equipment shall not be driven over the Impervious Membrane or its protective covering.

B. ACTIVE SYSTEM

The Active System consists of the Sub-Slab System, Lowest Occupied Space System and Control Panel.

1. Sub-Slab System

Sub-Slab System shall consist of a Mechanical Extraction System.

The Mechanical Extraction System shall consist of Detectors in Vent Risers, Gas Detection and Gas extraction powered devices and shall be designed in consideration for the migration of subsurface gas from adjacent properties.

i. Vent Risers for the Active System shall be located as follows:

- 10 feet above grade,
- 10 feet away from any window, doors, roof hatch, opening or air intake into the building,
- 3 feet above highest point of roof within a 10' radius of outlet,
- 3 feet away from any parapet,
- 4 feet away from the property line and
- 5 feet away from any electrical device.

ii. Detectors in Vent Risers

- Detectors and associated transmitters shall be listed by a recognized testing laboratory for the intended use.
- Detectors and associated wiring shall be immune to radio frequency and infrared remote-transmitters frequency interference.
- Detector shall be fitted within the vent pipe so that no gas may leak through the fittings.
- The associated wiring and associated raceways shall be:
  - Mounted to a secure surface independent of detectors and their associated transmitter.
  - Protected from physical damage.

iii. Gas Extraction Powered Devices

- Gas extraction powered devices shall consist of fans, blowers, or other powered devices to exhaust or provide make-up air into the space below the Impervious Membrane and shall be capable of ventilating the Gravel Blanket and Perforated Horizontal Pipes spaces at a rate of 3 air changes per hour.
- The total volume Gravel Blanket used to size the Gas Extraction Powered Devices shall include the volume of air (pore space) in the Gravel Blanket.
- Unless porosity of the gravel blanket material is established by a test report prepared by a licensed engineer or registered geologist, porosity of the gravel blanket material may be taken as 25%.

2. Lowest Occupied Space System

The Lowest Occupied Space System shall consist of Gas Detection System, Mechanical Ventilation System and Alarm System.

a. Gas Detection System

i. The specifications for Detectors shall be the same as specified for Detectors in Vent Risers except as modified in Table 5 - Activation Thresholds for Active System.

ii. Detectors in lowest occupied spaces shall be installed in accordance with manufacturers' requirements and listing agency approvals.

- Detectors shall be located with respect to airflow in rooms, location of probable gas leaks and the recommendations of the manufacturer.
- Number of required Detectors shall be based on Table 6 - Detector Spacing.

SITE ADDRESS:
LEGAL DESCRIPTION:
OWNER:

STANDARD PLAN:
METHANE HAZARD MITIGATION
Not to be used for Playa Vista Phase I Projects

CITY LADBS DEPARTMENT OF BUILDING AND SAFETY

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b. Mechanical Ventilation System

i. Mechanical Ventilation System shall consist of blowers, fans or other powered devices for exhaust or make-up air as approved by Mechanical Plan Check Section.

ii. The make-up air shall be 100% outside air.

iii. Mechanical Ventilation System shall be provided using one of the following options for garage lowest occupied and unoccupied spaces:

Option #1: Activated Mechanical Ventilation - Mechanical Ventilation System shall be capable of removing methane gas at a rate of 4 air changes per hour when activated by the Gas Detection and Control Panel, at 10% LEL (5,000 ppmv). Back-up power is not needed for mechanical ventilation in this option. Parts of fans in this Option shall be of nonferrous or non-sparking materials or their casing shall be lined or constructed of such material.

Option #2: Continuous Ventilation - Mechanical Ventilation System sized to ventilate the building spaces at a rate of one (1) air change per hour on a continuous basis. Mechanical ventilation in this option shall be provided with 24 hours of back-up power when Detectors are not provided.

Option #3: Scheduled Start-up Ventilation - Mechanical Ventilation System shall start-up at least once every (6) six hours to provide a minimum of 24 air changes per day. Mechanical ventilation in this option shall be provided with 24 hours of back-up power when Detectors and are not provided.

Option #4: Alternate Natural Ventilation - Alternate method of ventilation may be utilized in lieu of mechanical ventilation in Options #1, #2 and #3 when designed in accordance with the Natural Ventilation requirements of this Standard Plan.

c. Alarm Systems

i. Alarm Systems shall consist of audible and visual signals to notify occupants of significant levels of methane intrusion into the building and shall be designed with the Sequence of Operation shown in Table 5 of this Standard Plan.

ii. Audible alarms shall be at least 15dB above ambient noise level in all areas subject to methane gas intrusion.

iii. Visual alarms shall be a minimum of 15-candela output and be located at each audible device.

iv. The audible signal warning building occupants of significant levels of methane gas shall be distinctively different from the fire alarm system.

v. Signs shall be posted adjacent to each alarm signaling device indicating, "Methane Alarm-Evacuate Building."

3. Control Panel

a. General Installation

i. Control Panel shall be listed by a recognized testing laboratory.

ii. Control Panel shall have the following characteristics:

- Designed not to override the building fire alarm, smoke control and ventilation systems.
- A manual shall be provided with the Control Panel describing the installation, wiring, operation, maintenance and testing.

b. Power Source

i. Primary Power Source

- Control Panel shall be hard wired to the building normal power.
- The circuits supplying power to the Control Panel shall be lockable in the open position.

ii. Back-Up Power Supply

- Control Panel shall monitor the power to Detectors, annunciator and associated components.
- Back-Up battery or emergency power shall be rated for a minimum of 24 hours for standby mode plus 5 minutes of alarm under full load condition.
- This Back-Up power shall be available within 60 seconds of primary power loss.

c. Panel Operation

i. Device Activation

- Control Panel shall recognize alarm conditions, and then activate required audible devices, visual devices and Gas Extraction Powered Devices.
- Components of the Active System shall be activated as shown in the Table 5 on Sheet 4 - Activation Thresholds For Active Systems.

ii. Trouble Annunciation

- Control Panel or annunciator shall indicate each trouble or alarm condition by a visual alarm.
- Control Panel shall supervise and identify fault and trouble conditions with the following:
  - Main supply circuits,
  - Rechargeable battery circuits,
  - Initiating device circuits,
  - Alarm device circuits,
  - Supplementary or auxiliary signaling circuits and,
  - Signaling line circuits.

C. MISCELLANEOUS SYSTEMS

1. Trench Dam

Trench dams are intended to prevent travel of underground gas into buildings or structures along the trench backfill.

a. A Trench Dam shall be installed in all electrical, plumbing, gas, or other trenches beneath the building foundation.

b. If piping and conduits are placed before certified compacted soil as part of the site preparation for the building pad, then trench dams will not be required.

c. Trench dams shall be installed in the trench immediately adjacent to the exterior perimeter of the building foundation.

d. A Trench Dam shall have a minimum length of twice the width of the trench or a minimum of 36 inches in length.

e. Trench dams may be of the following:

i. Bentonite Cement Slurry - A mixture of 4% Type II Cement, and 2% Powdered Bentonite, or

ii. Compacted Native Soil Backfill - Native soil shall be compacted to at least 90% relative compaction in accordance with ASTM D-1557 Testing Procedures.

f. The entire cross section of trenches shall be backfilled to provide a minimum of 6 inches of trench dam material around all conduits and pipes.

2. Hazardous Area Classification

For the purpose of determining the appropriate electrical wiring method and equipment, boundaries of the hazardous area classification are specified in Tables 7, 8 and 9. The Hazardous Area Classification, except as noted below, is based on the measured gas concentration and pressure as indicated in Site Investigation report:

a. In the absence of pressure reading in a site investigation report, the area classification shall be based on soil gas pressure that is greater than 2 inches of water.

b. In the absence of a site investigation report, the area classification shall be based on Methane Design Level V.

3. Wiring

The wiring system shall be in accordance with the Los Angeles Electrical Code and as required herein.

a. Depressurization Enclosure

i. Wiring system between a classified area and a non-classified area shall be supplemented by a Depressurization Enclosure when the Design Methane Pressure is greater than 6 in. of water.

- Depressurization enclosure is not required when each continuous underground wiring duct bank system supplied from an approved vented manhole is less than 500 linear ft. (152.4 m.) from a termination point and the total load does not exceed 80% of the rating of the conductors. Longer duct bank run may be permitted when justified by engineering analysis.
- Depressurization enclosure is not required when the maximum-recorded pressure does not exceed the rating of a listed and approved seal fitting.

ii. The wiring system supplied from the Depressurization Enclosure shall be installed above ground.

iii. The Depressurization Enclosure shall be suitable for the location and shall contain only electrical wiring. The depressurizing enclosure shall be located outdoors and shall comply with one of the following options:

- A standard pull box fitted with a breather suitable for Class I, Group D locations where:
  - The breather shall be located on the side of the enclosure within 2 inches from the top of the pull box.
  - The breather shall have minimum dimensions of 1.5 inches long and 15/16 inch diameter; or
- A standard pull box fitted with louvered ventilation where:
  - The louvered openings shall be within 2 inches from the top of the box.
  - The minimum total enclosure ventilation opening shall be 1.41 square inches. A louvered pull box shall be installed in a non-classified area.

b. Outdoor Enclosures

All outdoor enclosures with open bottoms, when installed on grade or finished floors, shall be mounted on a minimum 2-in. (5.08 cm.) thick concrete pad over a 30 mil (0.076 cm.) High Density Polyethylene (HDPE) or equivalent approved impervious membrane. All membrane penetrations shall be suitably sealed against transmission of gas into the enclosure.

c. Conduit Seal Fittings and Cable Seal Fittings

Conduit Seal Fittings and Cable Seal Fittings are designed to prevent the passage of gases, vapors, or flames inside the electrical conduits.

i. Conduit or Cable Seal Fittings are required where conduits or cables pass through a classified hazardous area per the Los Angeles Electrical Code and as required in this Standard Plan.

ii. Any conduit or cable that penetrates the Impervious Membrane shall be provided with a conduit or cable seal.

iii. Conduit Seal Fittings shall be installed in the vertical portion of conduit where the PVC conduit emerges from a classified location. Rigid material shall be rigid metal that has the same trade size as conduit runs.

d. Grounding Electrical Systems

Electrical systems required by the Los Angeles Electrical Code to be grounded shall be connected to earth using the prescriptive or performance (Soil Resistance) method.

i. Prescriptive Method

When a Ground Ring is not used as part of the Grounding Electrical Systems required by the Los Angeles Electrical Code at least one of the following supplemental grounding electrodes shall be used:

- Rod and Pipe Electrodes
- Plate Electrodes

The supplemental grounding electrode conductor shall not be reduced in size.

ii. Soil Resistance Method

Grounding systems other than specified in the Prescriptive Method shall be based on Soil Electrical Resistivity Test as follows:

- Soil Electrical Resistance
  - The soil resistivity shall be measured by the four-point method as described in IEEE Standard 81-1983.
  - The measurement of soil resistance shall take into account the geological features of the soil as determined by the engineer.
  - Whenever driven ground rods are to be used, the soil resistivity measurement shall correlate with the installed effective depth of the ground electrodes.
  - The engineering analysis of the data shall take into account the expected soil temperature, moisture and gas or soluble chemical contents.tion
  - The engineering analysis shall reflect the uniformity of soil resistivity using not less than ten readings based on the test pin electrode spacing.
  - The soil resistivity measurement shall be based on embedment of the electrodes below the permanent moisture level, when such installation is possible.
- Measurement
  - For installations of multiple rod and pipe or plate electrodes in a single row, measurement shall be in a straight line at the location were these electrode(s) are intended to be installed.
  - For installations of ground ring (circular or square), grids, grid beds, radial, etc, the area that is to be used for grounding shall be divided into rows. Each row shall be equally spaced apart. The measurement shall be started at the corner of the first row and then continued through each pre-determined point in the row. This measurement is then repeated through the last row. The measurement shall be performed until all pre-determined points are covered.
  - These measurements shall account for water table, soil layers, corrosion, etc. when applicable.
- Soil Electrical Resistance Design:
  - For multiple rod and pipe or plate electrodes installed in a straight line, the measured current and voltage shall be used to calculate the average soil resistivity.
  - For an area, the measured current and voltage shall be used to calculate the average soil resistivity for each row. The highest calculated average soil resistivity of any row shall be used to calculate the soil resistivity.
  - In the event the soil in the area or location under consideration is found to be non-uniform, the soil shall be modified and the test(s) shall be repeated. Ground Resistance (Impedance) Limitation - The overall ground resistance (Impedance) of a grounding electrode system shall not exceed 25 ohms for 600 volts or less low voltage systems and not to exceed 5 ohms for over 600 volts high voltage systems.

4. Manholes and Other Underground Electric Enclosures Intended for Personnel Entry

The provisions of this section are applicable to all manholes and other underground electric enclosures that are intended for personnel entry. These enclosures herewith will be referred to as underground electrical enclosures.

a. Vent System

i. Underground electrical enclosures shall be naturally ventilated at all time to open air in an approved manner to prevent the build-up of methane.

ii. Mechanical ventilation in lieu may be used when back-up power sufficient to run the system for 24 hours is provided and a visual and audible main power failure alarm at a readily accessible location.

b. Enclosure Exterior

i. Approved seals shall be used to prevent water and methane gas from entering the sides of the underground electrical enclosures.

ii. Underground electrical enclosures personnel entry access cover shall be provided with an approved restraining system.

iii. Soil gases under the underground electrical enclosures shall be vented in a manner shown in the Standard Plan Details.

c. Enclosure Interior

i. All wiring terminations, equipment and insulating materials within the enclosure shall be suitable for wet location.

ii. Approved duct seals shall be used to prevent water from the conduits entering or leaving the manholes and other underground electrical enclosures intended for personnel entry. The seal shall have a depth of not less than the diameter of the conduit.

5. Additional Vent Risers

The total quantity of installed Vent Risers shall be increased to double the rate for the Passive System.

VI. SYSTEMS MAINTENANCE

A. PROCEDURES

The maintenance and service procedures for each gas detection and mechanical ventilation systems shall be in accordance with the manufacturers written instructions and the Fire Prevention Bureau (F.P.B.) Requirment No. 71 Fire Chief's Regulation 4, Section 4J.

B. SCHEDULE

1. The maintenance schedule shall be as recommended by the manufacturer of each gas detection and mechanical ventilation system component.
2. Notwithstanding the recommendations of the manufacturer, testing, maintaining, and servicing of each system shall be in accordance with the schedule required by the Fire Department.

C. REPAIRS

All components required to mitigate methane hazards shall be repaired or replaced to the manufacturer's original specification.

D. OCCUPANT NOTIFICATION

A permanent notification shall be provided at each building indicating the presence of the methane impervious Membrane. This notification shall be at the front entrance, be visible and be legible as approved by the Engineer and LADBS. See Detail 14 on Sheet 8.

VII. EMERGENCY PLAN

An emergency plan outlining emergency procedures shall be established for all buildings with a gas-detection system, with the exception of buildings with R3 or U Occupancies. The procedures shall include, but not limited to, the identification of the responsible person assigned to manage the contingency plan, posting of the contingency plan and the approval process of the contingency plan.

A. RESPONSIBLE PERSON

The assigned responsible person shall work with the Fire Department in the establishment, implementation and maintenance of an emergency plan.

B. POSTING

A sign shall be posted in a conspicuous location designated by the Fire Department with the Fire Department's telephone number.

C. APPROVAL

All contingency plans for emergency procedures shall be approved by the Fire Department.

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LEGAL DESCRIPTION:

OWNER:

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