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February 16, 2016

Mr. Mark Detterman
Alameda County Environmental Health
1131 Harbor Bay Parkway
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I, Reid Settlemier, hereby authorize ERAS Environmental, Inc. to submit the Vapor Mitigation Basis of Design Report for 3037-3115 Adeline St., Oakland in Oakland, California, dated February 5, 2016 to the Alameda County Health Care Services Agency.

I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge.

Signature: ______________________

Printed Name: B. Reid Settlemier

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Sustainable Technologies
for a sustainable future

VAPOR MITIGATION BASIS OF DESIGN REPORT

3037-3115 Adeline Street

Oakland, California

Mr. John Murray

John Murray Productions

1196 32nd Street

Oakland, CA 94608

February 5, 2016

VAPOR MITIGATION BASIS OF DESIGN REPORT

Tables

Figures

1.0 INTRODUCTION

ERAS Environmental, Inc. (ERAS) has prepared this *Vapor Mitigation Design Report* ("Design Report") on behalf of John Murray Productions for the site at 3037-3115 Adeline Street, Oakland, California. The location of the Property is shown on **Figure 1**.

This Design Report has been prepared in response to a December 10, 2015, letter from Alameda County Environmental Health (ACEH). The purpose of the Design Report is to describe and document the final design of the proposed mitigation actions at the site. A vapor mitigation system (VMS) is to be installed along the southern portion of the building which occupies the Property in the vicinity of previously detected elevated concentrations of methane.

A conceptual description of the VMS was proposed in the *Report of Soil Gas and Sub Slab Gas Investigation,* which was submitted to ACEH and was dated November 23, 2015 and acknowledged by ACEH in the December 10, 2015 letter.

The VMS will generally consist of the installation of a venting system that will mitigate the methane hazard by extracting and removing built up methane gas in the subsurface. ERAS proposes to install the VMS along the outside edge of the southwest corner of the building in the area of former sample locations PES-B2 and VP-1.

Prior to installation of the VMS, shallow diesel-range hydrocarbons (TPH-dro) will be removed and disposed offsite as described below. The removal of TPH-dro material will help reduce degradation of subsurface hydrocarbons, which is presumably the source of the methane soil gas in this vicinity of the site.

After the VMS is installed, concentrations of methane at the source area are expected to attenuate with time.

2.0 BACKGROUND and SUMMARY OF PREVIOUS INVESTIGATIONS

The locations of all borings on the Property are shown on the site map included as **Figures 1 and 2**. The analytical results for the soil samples collected are compiled on **Table 1** and **1a**. The analytical results for groundwater samples collected are compiled on **Table 2**. The analytical results for soil gas samples collected are compiled on **Table 3**.

May 2013: A Phase 2 soil and groundwater investigation was performed by Partner Engineering and Science, Inc. (Partner). A total of 5 soil borings were drilled on the Property in the general areas of the former foundry and machine shops and a furnace that was associated with the foundry.

Partner reported concentrations of total petroleum hydrocarbons as diesel range organics (TPH-dro[1]) and as oil range organics (TPH-oro) in Boring PES-B2 at 3 feet and 7 feet. Concentrations of TPH-dro and TPH-oro were 1,200 milligrams per kilogram (mg/Kg) and 950 mg/Kg at 3 feet and 1,600 and 860 mg/Kg at 7 feet. Concentrations of TPH-dro were above the California Regional Water Quality Control Board Environmental Screening Level (ESL) of 110 mg/Kg (Table A, RWQCB, December 2013). The sample from 3 feet also contained total petroleum hydrocarbons as gasoline (TPH-gro) at a concentration of 46 mg/Kg. Partner does not appear to have had the laboratory run silica gel cleanup on the samples prior to analysis to remove biogenic hydrocarbon interferences.

Naphthalene was detected at 5.3 mg/Kg in the sample from Boring PES-B2 at 3 feet. This concentration was above the ESL of 1.2 mg/Kg (Table A, RWQCB, December 2013). No other concentrations of TPH-dro, TPH-oro or naphthalene were detected in soil samples.

Lead and copper were detected in soil at 3 feet in borings PES-B1 and PESB-2 which appear to be above background concentrations. However, the maximum concentration of copper of 1,200 mg/Kg is below the ESL of 5,000 mg/Kg (Table A, RWQCB, December 2013). The maximum concentration of lead of 140 mg/Kg is below the ESL of 320 mg/Kg (Table A, RWQCB, December 2013).

No concentrations of TPH-dro or TPH-oro were detected in groundwater samples from Borings PES-B1 and PES-B2. Volatile organic compounds (VOCs) were not detected in the groundwater sample collected from PES-B1. Naphthalene was not detected in the groundwater sample from PES-B2. No groundwater samples were collected from borings PES-B3, PES-B4, or PES-B5.

The highest concentrations of contaminants appeared to be in the area of the former furnace.

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[1] TPH-gro, TPH-dro, and TPH-oro are methods that compare analytical results to standards for gasoline, diesel and motor oil, respectively. Therefore analytical results are estimates of quantities based on what would be expected for the range of hydrocarbon results for the standard. Gasoline range organics (gro) are those hydrocarbon compounds that are in the range of C6 to C10, diesel range organics (dro) are those hydrocarbon compounds that are in the range of C10 to C23, and oil range organics (oro) are those hydrocarbon compounds that are in the range of C18 to C36. There can be overlap in reporting methods as well as identification of compounds that fall within the standard that may not necessarily be derived from gasoline, diesel, or oil.

November 2013: A Phase 1 Environmental Site Assessment (ESA) was conducted by Rincon Associates, Inc. (Rincon). Rincon identified the following information for the Property.

- A bronze foundry operated at part of the Property (3037 and 3101 Adeline Street) from at least 1928 to 1963.

- Machine shops operated at 3101 and 3115 Adeline Street from at least 1951 until 1959.

- Six nearby historic auto stations were listed on the environmental database. Rincon indicated these sites were located hydrologically up-gradient and there is potential that contamination from these sites could have impacted groundwater beneath the subject property.

Rincon concluded foundry operations can involve the use of heavy metals including copper, lead, nickel and zinc. Machine shop operations can involve the use of cutting oil and degreasing solvents. Rincon indicated the former use of the Property represented a potential recognized environmental condition (REC) and recommended a subsurface investigation.

November 2014: ERAS conducted a subsurface soil investigation and seven borings (B-1, B-2, B-3, B-4, B-6, B-7, and B-8) were advanced for sample collection.

Borings B-1, B-3, B-4, and B-7 were advanced to a depth of 12 feet bgs, borings B-2 and B-6 were advanced to 16 feet bgs, and boring B-8 was advanced to 4 feet bgs.

Soil samples were collected from the following depths from each boring:

B-1	1.5-2 feet bgs, 3-3.5 feet bgs, and 9-9.5 feet bgs
B-2	2-2.5 feet bgs, 3-3.5 feet bgs, 7.5-8 feet bgs, and 15.5-16 feet bgs
B-3	2-2.5 feet bgs, 3-3.5 feet bgs, 7.5-8 feet bgs, and 11.5-12 feet bgs
B-4	3-3.5 feet bgs, 7.5-8 feet bgs, and 9.5-10 feet bgs
B-6	1.5-2 feet bgs, 2.5-3 feet bgs, 7.5-8 feet bgs, and 15.5-16 feet bgs
B-7	2-2.5 feet bgs, 3-3.5 feet bgs, 7.5-8 feet bgs, and 11.5-12 feet bgs
B-8	1.5-2 feet bgs

The soil samples collected from the zone of 1.5-2.5 feet bgs and 2.5-3.5 feet bgs were analyzed for TPH-gro by EPA Method SW8021B/8015B, TPH-dro and TPH-oro by EPA Method SW8015B, and copper, lead, and tin by EPA Method SW6020 with the exception of borings B-1, B-4, and B-7 where the 2.5-3.5-foot sample was only analyzed for the three metals and not the hydrocarbons

The soil samples collected from depth greater than 3.5 feet bgs were analyzed for only the presence of the hydrocarbons.

The concentrations of the contaminants of concern above the ESL appeared to be limited to the area of borings B-2, B-3, B-6, and PES-B2 which is in the area of the former furnace. Concentrations of contaminants above the ESL were detected to a depth of approximately 8 feet bgs. Samples collected at depths of 12 feet bgs did not contain concentrations above the ESLs. Based on the depth to water (17.5 to 19.5 feet bgs), the lack of groundwater contamination in the prior borings (PES-B1 & -B2), the attenuation of the degree of contamination in the soil samples with depth above 12 ft bgs, and the concentrations of deeper soil samples in comparison to the ESLs, contaminants detected in the soil column did not appear to pose a risk of contamination to groundwater beneath the Property.

ERAS recommended that elevated concentrations of contaminants be removed to a depth of up to 10 feet and the soil be properly disposed. Following the completion of the soil excavation confirmation samples should be collected to determine what concentrations of the contaminants remain in the subsurface. However, ERAS later requested that the residual contamination be allowed to remain in place and the risk could be managed by engineering controls by maintaining a cap.

December 2014: As part of a consideration for site closure an additional soil sample was requested to be collected from the vicinity of former boring B-2 from a depth of 2-2.5 feet bgs (where elevated concentrations of contaminants were previously found) for analysis. The sample was analyzed for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) by EPA Method E1613, semi volatile organic compounds (SVOCs) by EPA Method SW8270C, poly chlorinated biphenyl's (PCBs) by EPA Method SW8082, and TPH-dro and oro by EPA Method SW8015B as requested by the ACHCSA.

No concentrations of PCDD's, PCDF's, or PCB's were detected above their respective ESLs. The only concentration of SVOCs detected was 2-methylnaphthalene at 31 mg/Kg which is above the ESL of 0.25 mg/Kg. TPH-dro and TPH-oro were also detected above their respective ESL's of 110 mg/Kg and 500 mg/Kg. TPH-dro was detected at 3,500 mg/Kg and TPH-oro was detected at 2,200 mg/Kg.

ERAS recommended that a Site Management Plan (SMP) and Deed Restriction be prepared since it is unlikely that all contaminant-impacted soil could be removed due to the location of the affected soil close to the building. Moreover, the results of the analyses indicated a relatively rapid decline in concentration of contaminants with distance from the source; indicating a low potential for exposure to human and ecological receptors, especially with the proposed institutional controls recommended to be implemented.

In response, the ACHCSA indicated that due to the high leachability of 2-methylnapthalene a remedial action plan and well survey was needed to outline remediation in the form of source removal to the extent feasible.

March 2015: As required by the ACHCSA ERAS prepared a remedial action plan including a well survey dated March 11, 2015. Institutional controls were determined to be the most cost and time efficient method since the concern of the ACHCSA is the high leachability of 2-methylnapthalene. The area impacted by the contaminants of concern is an asphalt paved parking lot with no landscaping. There is no recharge of water to the subsurface in this area due to a surface cap (parking lot), if the cap was maintained it was agreed to be little risk of leaching of 2-methylnapthalene.

Institutional controls involving a deed restriction or covenant to the Property would prohibit any excavation activities in the affected area for the purpose of renovation, construction, or improvements involving intrusive ground work without notification of the City of Oakland and County of Alameda, approved engineering controls during the proposed earthwork, and the maintenance of the parking lot (cap).

October and November 2015: Due to the elevated concentration of naphthalene in boring B-3, the ACHCSA requested soil gas and sub slab soil gas sampling. A work plan was subsequently prepared by ERAS dated October 12, 2015 and was approved by ACHCSA. Ross Tinline with SVC Environmental of San Carlos, California was contracted to collect samples per the work plan and the samples were collected on October 23, 2015.

The results of the sampling indicated detectable vapor concentrations of naphthalene in the soil vapor from the boring outside the building at 60 micrograms per cubic meter ($\mu g/m^3$), below the Regional Water Quality Control Board Environmental Screening Level of 360 $\mu g/m^3$. The concentration naphthalene under the building was at a much lower concentration of <5 $\mu g/m^3$.

A concentration of methane was detected in the outside sample at a concentration of 9% which is above the lower explosive limit (LEL) for methane. The presence of the methane at the measured concentration represents degradation of the heavy hydrocarbons in soil and represents a future hazard to structures or to occupants of that area of the Property just outside the building.

December 2015: The ACHCSA submitted a letter response dated December 10, 2015 that requested the preparation of a Vapor Mitigation System (VMS) Basis and Design Report which includes system construction plans and specifications. ACHCSA also requested the SMP be modified to include the VMS.

2.1 Corrective Actions

The absolute and functional corrective action objectives (CAOs) for the Property for the protection of human health and the environment and are listed below:

- Mitigate potential vapor intrusion risks to future site occupants.
  1) Obtain soil gas analytical results in the vicinity of the vent riser following the installation of the VMS.
  2) Comply with institutional controls (ICs) regarding Property use, mitigation measures, and monitoring.

- Mitigate potential exposure to future construction and maintenance workers to methane-impacted soil vapor.
  1) Comply with a site management plan, which will provide guidance for worker protection and safety measures to be employed during site construction and maintenance.
  2) Excavate and remove soil 10 x 10 x 3 (11 cubic yards) in the vicinity of previous boring B-2 to remove the highest known concentrations of contaminated soil.
  3) Soil will be pre-profiled prior to being off hauled to the appropriate location

To address the first CAO and mitigate the risk to future site occupants from potential vapor intrusion of methane in soil vapor to indoor air, a VMS will be installed along the southern portion of the building which occupies the Property in the vicinity of previously detected elevated concentrations of methane.

Additionally, ICs are recommended. Collectively the ICs and VMS comprise the mitigation of exposure hazards.

The ICs are being addressed in the deed restriction and site management plan and are not part of the scope of this document. The ICs will provide legal and administrative controls and methods for dissemination of information to minimize risk during future below-ground construction and long-term site use. Key components of the ICs include the following:

- Included in deed restriction is a land use covenants (LUCs) and activity use limitations (AULs), along with codes, covenants, and restrictions (CCRs). This also sets forth requirements for notifications of work potentially impacting the VMS, prohibitions on activities that could encounter/breach the VMS without the express knowledge of ACEH and other regulatory agencies.

- Language to specify in lease documents for site tenants.

- A Site Management Plan (SMP), which provides for communication primarily with contractors who will be performing future construction and maintenance activities at the site. The SMP will provide details regarding the location and construction of the remedies, precautions for working on site, and notifications procedures.

A SMP and deed restriction that includes the LUCs, AULs, and CCRs will be provided to ACEH under separate cover.

3.0 PROJECT FRAMEWORK

This section presents a summary of the design criteria and regulatory requirements that collectively form the project requirements framework for the VMS design and installation.

3.1 Project Goals and Objectives

The overall goal for this project is to mitigate potential vapor intrusion risks to future site occupants in the area of residual contamination. This risk will be mitigated by installing a VMS along the southern portion of the building which occupies the Property in as close of a vicinity to the building slab foundation as feasibly possibly in areas where elevated methane concentrations have been measured in soil vapor. The objectives of each of these elements are discussed in more detail in the following sections.

3.1.1 VMS Objectives

The objectives of the VMS are as follows:

- Mitigate the potential for soil vapor in the area of concern contributing to potentially unacceptable risk in indoor air by installing vapor collection piping along the slab foundation to passively vent sub-slab vapors above the roofline.

- Provide a VMS that is passive and requires minimal operations and maintenance.

- Design the system such that it could be converted from a passive system to an active system, if needed.

3.2 Project Regulatory Requirements

The design and installation of the VMS will be completed within the regulatory framework discussed in the following sections.

3.2.1 ACEH

The site is listed as Fuel Leak Case No. RO0003142 and consists of one parcel containing a single commercial building. ACEH reviews and approves all documents related to environmental conditions at the site. The framework for the corrective actions for the site is presented in the December 10, 2015, letter from ACEH to John Murry Productions.

3.2.2 City of Oakland

Based on the scale of the VMS to be installed permitting for the construction of the VMS is not required by the City of Oakland (City).

3.2.3 San Francisco Bay Regional Water Quality Control Board

Based on the oversight agency for the Property, ACEH, and the known distribution of contamination associated with this site and the lack of impacted groundwater the San Francisco Bay Regional Water Quality Control Board is not required to be consulted for the installation of the VMS.

3.3 Mitigation Objectives

In order to accomplish the project goals, the corrective actions will be designed and implemented to meet site-specific mitigation objectives for soil vapor. The mitigation objectives are based on the Lower Explosive Limit (LEL). As described by the National Institute for Occupational Safety and Health (NIOSH) the LEL for Methane is 5%.

The applicable mitigation objectives are discussed in the following sections.

3.3.1 Indoor Air

The objective of the VMS is to maintain concentrations of methane, potentially present in soil vapor, at concentrations below the LEL in indoor air adjacent to the current building. The specific treatment objectives for methane is to maintain methane concentration below 5%.

3.3.2 Groundwater

The corrective actions outlined in this document do not specifically address impacts to groundwater; therefore, there are no specific treatment objectives for groundwater discussed in this document.

3.3.3 Soil

The corrective actions outlined in this document do not specifically address impacts to soil; therefore, there are no specific treatment objectives for soil discussed in this document. However during excavation activities for the VMS soil will be removed in the area of concern to a depth of 3 feet and will be properly disposed off-site.

3.3.4 Soil Vapor

The objective of the VMS is to maintain concentrations of methane, potentially present in soil vapor, at concentrations below the LEL. By removing highest concentrated soil with methane the specific treatment objectives for methane is to maintain methane concentration below 5%.

4.0 VMS PRE-DESIGN INVESTIGATION

To further characterize soil vapor issues on this site and to support the design of the proposed VMS, ERAS conducted a pre-design investigation in October and November of 2015 which included the following:

- Ross Tinline with SVC Environmental of San Carlos, California was contracted to collect samples per the work plan and the samples were collected on October 23, 2015.
- The sample collected in the vicinity of PES-B2 was collected at a depth of 5 feet below the bottom of the foundation for the building (approximately 6 feet bgs).
- The sample just inside the building was collected from just below the concrete slab foundation of the building.
- A shroud was utilized during sample collection and a sample of the shroud contents was collected during sample collection.
- The samples were submitted to a state certified laboratory for analysis for benzene toluene, ethylbenzene, and xylenes (BTEX), naphthalene, and 2-propanol (isopropyl alcohol) by EPA Method TO-15. The samples were also analyzed for methane (CH_4)/CO_2/O_2 by ASTM D-1946.
- The shroud sample was analyzed for 2-propanol (isopropyl alcohol) by TO-15.

4.1 Results

The results of the sampling indicated detectable vapor concentrations of naphthalene in the soil vapor from the boring outside the building at 60 micrograms per cubic meter ($\mu g/m^3$), below the Regional Water Quality Control Board Environmental Screening Level of 360 $\mu g/m^3$. The concentration naphthalene under the building was at a much lower concentration of <5 $\mu g/m^3$.

A concentration of methane was detected in the outside sample at a concentration of 9% which is above the lower explosive limit (LEL) for methane. The presence of the methane at the measured concentration represents degradation of the heavy hydrocarbons in soil and represents a possible future hazard to structures or to occupants in the area of the Property just outside the building.

A map showing the sample soil gas sample locations is included as **Attachment A**. The sampling results are summarized in the soil gas analytical results table included as **Table 3**.

4.2 Conclusions of VMS Pre-Design Investigation

ERAS recommended the installation of a venting system that will mitigate the hazard by extracting and removing built up methane gas in the subsurface. ERAS proposed the installation of a trench along the outside edge of the southwest corner of the building foundation in the area of PES-B2 and VP-1. A perforated PVC pipe would be installed and would be connected to a riser to be attached to the building that would extend a minimum of 10 feet above the ground surface. The trench would be backfilled with clean coarse sand and the area re-paved.

Based on the density of methane (0.656 kg/m^3) in comparison to the density of air (1.285 kg/m^3), it is considered that this passive system would sufficiently mitigate the mobile and light methane gas in the subsurface on an on-going basis. This could be confirmed by testing of effluent from the mitigation system or by additional soil gas sampling. Should the venting system be shown to be less than the predicted effectiveness, then an in-line fan could be installed into the vent riser to promote a negative air pressure and induce additional flow of methane out of the system.

The SMP for the Property would be amended to include the on-going maintenance of the system to ensure continued proper operation.

5.0 VAPOR MITIGATION SYSTEM DESIGN

The proposed VMS consists of a passive sub-slab venting system that will be installed along the outside edge of the southwest corner of the building in the area of former sample locations PES-B2 and VP-1. Correct installation of a properly designed VMS would be sufficient to mitigate the risks of vapor intrusion to possible indoor air. The soil vapor will be passively vented to limit the accumulation of soil vapors in the subsurface and maintaining the concentration of methane below the LEL.

Performance monitoring also will be performed to verify that the VMS is functioning as designed (Section 8). The VMS is designed such that it could be converted to an active venting system in the future, with the addition of powered ventilators, if performance monitoring results indicate that the passive VMS is not performing as intended.

The VMS design consists of subsurface collection piping within a permeable base layer beneath the slab, which will be passively vented through.

The general extent and layout of the VMS system are shown on **Figure 2**. Detailed design drawings to support the VMS construction are included on **Figures 2 & 3**. Development of the VMS system design is discussed in the following sections.

5.1 Key Design Parameters

The following key parameters were used for the design of the vapor collection system:

- Types of soil vapor contaminants and concentrations.
- Commercially available vapor mitigation systems (venting) and their expected performance.
- Building foundation design.
- Building footprint area.
- Collection piping head losses.
- Piping Protection.
- Wind-turbine fan manufacturer specifications.
- Regulatory permitting.
- Regulatory advisories; the VMS will be installed in general accordance with the recommendations outlined in the *Vapor Intrusion Mitigation Advisory* published by the California Department of Toxic Substances Control (DTSC, 2011a).

5.2 Sub-Slab Venting System Design

A passive venting (SSV) system will be installed in the subsurface of the parking lot near the slab building foundation. In accordance with the objectives for the VMS, the SSV system is intended to be passive and long lasting, and to require minimal operations and maintenance activities. The SSV system consists of a trench, a layer of permeable material, a horizontal vapor collection pipe installed within the permeable material layer, vent risers attached to the vapor collection pipes that run to the roof, with the potential for a wind-driven turbine fans installed at the top of the vent risers.

The purpose of the SSV is to provide protection by extracting soil vapor that may accumulate in the subsurface. The SSV system passively extracts accumulated soil vapors and vents the extracted soil vapors to atmosphere. A description of the selected flow rate for the SSV system and a description of each component are presented below.

5.2.1 Maximum Allowable Design Flow Rate

SSV systems generally do not require abatement for the vapors being vented to the atmosphere due the relatively low concentrations and flow rates and, therefore, low mass loading. Furthermore, passive venting systems often operate at very low pressures such that addition of abatement equipment can have a significant effect on the system's venting performance. Regulatory requirements set forth by the Bay Area Air Quality Management District (BAAQMD) exempt passive soil vapor extraction operations with operations with total emission of less than one pound per day per BAAQMD Regulation 8, Rule,47, Section 8-47-113 (BAAQMD, 2005).

Therefore, to maintain the intent of the VMS objectives of a passive system that requires minimal maintenance, the VMS will be designed to operate below the threshold requiring abatement. The methodology used to estimate the maximum allowable design flow rate is described below.

The maximum allowable design flow rate for the SSV system was determined based on the historical soil vapor concentrations and estimated future concentrations after TPH-dro source removal. The use of the estimated soil vapor concentrations for the SSV influent (as opposed to the maximum detected soil vapor concentrations to estimate the maximum flow rate through the vents) is representative of expected subsurface soil vapor concentrations and is conservative based on the following: 1) soil vapor concentrations are expended to reduce following the removal of source material, 2) contaminant concentrations are expected to attenuate as soil vapor travels from subgrade soils to the soil vapor collection system; and 3) soil vapor concentrations are expected to diminish due to mixing with cleaner air during extraction by the soil vapor collection system.

The following soil vapor samples (ERAS, 2015) and estimated future concentrations of methane were used to calculate the maximum allowable flow rate per vent to meet BAAQMD 8-47-113 exemption:

- 9.0% methane (VP-1)
- <0.00024% methane (SS-1)
- 4.5% average before soil removal and SSV installation
- Estimate 90% reduction of average for SSV system influent following soil removal
- Estimated 0.45% methane average influent of SSV system

Based on these soil vapor concentrations, the maximum allowable flow rate calculated for each vent is 3.7 cubic feet per minute (ft3/min) vents to remain under the pound per day emission limit per BAAQMD Regulation 8, Rule 47, Section 8-47-11. The maximum allowable vent flow rate calculation is as follows:

Ideal gas law yields: ppmv x MW/24 = ug/L

Assume initial average methane concentration: 0.45% = 4,500 ppmv
MW methane = 16 g/mole

4,500 ppmv x 16/24 = 3,000 ug/L methane

Mass Removal Calculation:

__X__ug/L x _Y_ cfm x 0.00009 (conversion to yield lbs/day) = 1 lbs/day (BAAQMD limit)
3,000 ug/L x _Y_ cfm x 0.00009 (conversion to yield lbs/day) = 1 lbs/day (BAAQMD limit)

Y = 3.7 CFM

Performance monitoring and system controls for measuring and adjusting the system flow rate and contingency plans are provided below.

5.2.2 Permeable Base

The permeable base layer will consist of a minimum of 4 inches of gravel or crushed rock placed continuously around the VMS piping below grade.

The permeable base layer will be placed next to building foundation slab and near sample location PES-B2 and VP-1. The permeable material will surround the vapor mitigation piping. The permeable base will provide a continuous, highly permeable zone that allows advective flow of soil vapor to the collection piping.

5.2.3 Vapor Collection Piping

The vapor collection piping will be 4" slotted pipe 0.010 Slotted PVC well casing pipe. Slotted pipe consists of highly perforated, round, and Schedule 40. The 4" piping is chosen to be large enough to allow vapor flow. The slotted pipe will connect to 4" Schedule 80 pipe prior to grade. The layout for the vapor collection piping was designed to cover the area of high concentrations.

The layout of the vapor collection piping is presented on **Figure 2**.

5.2.4 Vapor Collection Risers

The horizontal vapor collection piping will be connected to a vertical vent riser, 4-inch Schedule 80 PVC. The piping will be installed at a minimum of 10' from the property line, as shown on the Construction Drawings. The 4-inch Schedule 80 PVC pipe will be mounted to the building and secure every four feet. The vent will continue past the roof and terminate approximately 1 foot above the building parapet elevation.

The selected 4-inch vent piping is capable of conveying in excess of 350 ft3/min of air with minimal pressure drop (CRANE, 1980) and has more than sufficient capacity to convey the initial maximum allowable design flow rate of 3.7 ft3/min.

A single 4-inch vent is capable of servicing a vapor mitigation membrane that covers an area ranging from 4,000 square feet (ft2) (NAVFAC, 2011, and Hatton, 2010). Considering the small area requiring ventilation, one vertical riser shall be sufficient.

5.2.5 Wind-Driven Turbine Fan

A wind-driven turbine fan will be installed at the top of the riser vent to provide wind siphoning flow from the vent. The selected wind-driven turbine fan creates a vacuum that draws air out from the Vapor Mitigation System. The Air Flow for the 6" diameter fan is 110 cfm at 4 mph wind. The fan requires no power to operate. Performance monitoring described below will determine if the fan flow rate requires reduction, or if fan removal is required to allow passive ventilation without a fan.

5.2.6 Piping Protection
The above ground piping is in an open parking lot. To prevent a vehicle from impacting the piping two 4" bollard (crash post) will be placed in front of the piping. See **Figures 2 and 3.**

5.2.7 SSV System Layout
The layout of the soil vapor collection system is design to extract vapors from the high concentration area of methane remaining from the old foundry. The layout is design to mitigate any vapors from going into the nearby structure. See **Figures 2 and 3.**

6.0 VMS IMPLEMENTATION
The following sections describe the activities associated with the construction of the VMS, including preconstruction activities and installation.

6.1 Preconstruction Activities
A preconstruction meeting with property owner or representatives are required for the installation of the VMS.

6.1.1 Health, Safety and the Environment
Daily site safety meeting will be conducted to discuss potential hazards. Gas monitoring devices will be recalibrated for LEL. Personal will be required to have respirator fit test. All staff are required to have HAZ-Wopper training. Installation of the VMS will be performed under general construction health and safety procedures. If required additional environmental control procedures will be implemented if the vapors are excessive.

6.1.2 Regulatory Approvals, Permitting, and Notifications
The following approvals and permits are required for the installation of the VMS:

- ACEH approval of this Design Report.

6.2 VMS Installation
The following sections describe the major activities required for the installation of the VMS.

6.2.1 Mobilization and Site Preparation
Site preparation will include identification of appropriate locations for the final riser vent stub ups and developing a layout of the horizontal piping. Locate any and all utilities near work zone. Establish exclusion zone. Mobilize heavy equipment to excavate soil and soil bin.

6.2.2 Environmental Controls for Stormwater and Dust
All nearby storm drains will be protected from sediment. Minimal visible dust generation is expected during excavation. The site will be swept every day. As necessary, general construction dust controls, including

spraying/misting with water during grading, minimizing material drop height during placement, and protection of material stockpiles, will be implemented during installation of the VMS. Minimal dust is expected to be generated during installation of the above-ground piping for the vent risers.

6.2.5 Waste Management

Removed pavement will be recycled. Minimal construction debris will be generated. Soil excavate for the installation will be properly disposed of at a suitable disposal facility.

6.2.6 Site Restoration, Project Closeout, and Demobilization

After VMS installation, the area that has been disturbed will be re-paved. The contractor will demobilize from the site after receiving approval by the owner and project engineer of the installed work. The aboveground piping contractor will demobilize from the site upon completion of the vertical vent risers. As necessary, contractors may be required to return to the site to address deficiencies identified at startup/commissioning of the VMS.

General project closeout procedures will include owner and project engineer inspections and approvals of the installations. Closeout documents will include as-built markups of design drawings, documentation of installed materials and equipment, available operation and maintenance manuals, and written warranties (as applicable) for work and installed products.

6.2.7 Survey

As-built alignments of installed horizontal piping and locations of the vent riser slab penetrations shall be clearly marked on the design drawings. No survey will be required to be conducted.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

For the VMS construction, the contractors will be required to document installation prior to backfilling and finishing the job.

7.1 Construction Quality Assurance Coordination

The CQA coordination will include a preconstruction meeting between the owner, project engineer, construction quality manager (CQM), and contractor. These preconstruction meetings will serve to introduce all parties and establish the chain of command and lines of communications for the project.

During the construction of the VMS, The client and consultant will be updated daily at which time variances to the design and schedule will be discussed.

7.2 Quality Control for VMS Installation

General quality control requirements for the VMS installation are described below.

7.2.1 VMS Materials Quality Control

The contractor will inspect all material prior to installation. All materials used shall be free of defects and damages.

7.2.2 VMS Construction Quality Control

Construction of the subsurface piping will be a certified hazard material handling contractor. The contractor shall possess a current contractor license issued by the CA CSLB.

Regularly scheduled inspections will be performed by the CQM during construction of the VMS to verify conformance with design drawings and specifications. Prior to completion of the vent risers at roof levels, the vent setback and clearance will be verified for conformance with the requirements.

8.0 PERFORMANCE MONITORING, OPERATIONS, AND MAINTENANCE

Operations, maintenance, and monitoring (OMM) activities will support the objectives of the VMS design. The VMS constitute a long-term, passive approach to remediating and mitigating risks to indoor air. Routine operations and maintenance activities are generally not required. Non-routine maintenance activities may be required if unexpected maintenance needs are observed during routine performance monitoring. Monitoring of the VMS will be conducted to verify that it is functioning as intended at the time of installation.

A Performance Monitoring phase will occur shortly after installation to verify that each mitigation measure is functioning as intended.

Following installation of the VMS, the owner will retain the services to performance monitoring, operations, and maintenance. The Primary Operator will be responsible for performing site inspection, sampling, and data evaluation.

8.1 VMS Performance Monitoring

Performance monitoring will be conducted to confirm the efficacy of the installed VMS and to demonstrate that methane concentrations are below established LEL. The performance of the VMS will be evaluated by conducting vent riser and soil gas sampling as proposed.

8.1.1 Vent Riser Sampling

Vent riser performance monitoring will consist of collection of flow rate data and collection of samples of vented soil vapor from the riser. The flow rate data and vapor samples will be collected from pre-installed ¼ port at 4' from grade and at roof level. The collected vented soil vapor sample will be sent for laboratory analysis for the presence of methane. Flow rate and vented soil vapor concentrations will be used to calculate the emissions from each vent riser.

Adjustments to the vent riser flow rate will be performed as necessary to maintain total combined emissions (aggregate of all vents) to less than 1 pound per day as required by BAAQMD regulations for unabated sources (BAAQMD, 2005). A valve or restriction can be provided to reduce vapor flow as merited.

The vent monitoring and sampling is currently scheduled to be conducted shortly after VMS installation.

The monitoring frequency may be revised in order to comply with monitoring requirements (if any) in the BAAQMD-issued permit to operate the SSV system. The owner will notify ACEH of any proposed changes to the monitoring or sampling schedule. With ACEH concurrence, monitoring during the O&M phase may be simplified to rely on PID readings rather than laboratory analyses if the results demonstrate steady or decreasing concentrations over time.

9.0 SCHEDULE AND REPORTING

A description of the documentation and reporting of the VMS installations and a preliminary schedule are provided in the following sections.

9.1 Documentation and Reporting

Following installation of the VMS, the Consultant or owner will prepare and submit a construction completion report to ACEH for review and approval. Upon ACEH concurrence with the completion report findings and observations made during construction, the manager and Design Engineer will prepare a certification that the completed project conforms to the Construction Documents, including the Design Drawings, Specifications, and CQA Plans.

Following certification, performance monitoring activities will commence for the VMS. Monitoring and inspection activities will be documented. The VMS will be retained by the Primary Operator.

Following completion of each site inspection and monitoring event, including the initial performance monitoring, the Primary Operator will provide ACEH with a monitoring report. The monitoring report will document site inspections, address corrective actions, and provide evaluations and recommendations as needed. Copies of the site inspection forms and laboratory reports will be attached to the monitoring report. The CQA manager and Primary Operator will prepare a certification that all IC objectives have been maintained during the reporting period. The submittals for the VMS may be coordinated and submitted together to simplify reporting. The initial data and subsequent data collected during the initial baseline monitoring period will be evaluated by the Primary Operator and discussed with ACEH to finalize reporting requirements for the site's OMM Phase.

Additional reporting requirements beyond routine reporting will apply when any site conditions out of compliance with IC restrictions are identified. Upon determining lack of compliance with
IC restrictions, the Primary Operator will notify ACEH with a written explanation that describes the nature of the specific, inconsistent action, and the efforts or measures that have been or will be taken to correct the action. The associated time frame to correct the inconsistent action will also be provided.

9.2 Preliminary Scheduling

The anticipated schedule for the activities described in this Design Report is presented below.
This schedule is approximate, and the actual dates will depend on the timing and acquisition of applicable permits, subcontractor availability, and field conditions.

- February 2016
  - Design Report provided to ACEH.
- February 2016
  - ACEH approval of Design Report.
  - VMS installation.
- Approximately 1 months after final completion of the VMS
  - VMS Construction Completion Report and Certification.

Performance monitoring activities for the VMS will commence once constructed has been completed.

10.0 REFERENCES

Alameda County Environmental Health Services, Request for Vapor Mitigation System Design Documents; Site Cleasup Program (SCP) Case No. RO0003142, Adeline Foundry, 3037-3115 Adeline Street, Oakland, CA 94608, December 10, 2015.

ERAS Environmental, Inc., Subsurface Soil Investigation Report, 3037-3115 Adeline Street, Oakland, California, November 13, 2014.

ERAS Environmental, Inc., Additional Limited Soil Investigation. 3037-3115 Adeline Street, Oakland, California, December 23, 2014.

ERAS Environmental, Inc., Report of Soil Gas and Sub Slab Soil Gas Investigation, 3037-3115 Adeline Street, Oakland, California, November 23, 2015.

ERAS Environmental, Inc., Remedial Action Plan**,** 3037-3115 Adeline Street, Oakland, California, March 11, 2015.

Partner Engineering and Science, Inc., Limited Phase II Subsurface Investigation, 3037, 3101, and 3115 Adeline Street, Oakland, California 94608, Client Project Number WF-SF-13-005073-03-1, May 24, 2013.

Rincon Consultants, Inc., Phase 1 Environmental Site Assessment, 3037, 3101, and 3115 Adeline Street, Oakland, California, November 15, 2013.

This report was prepared for ERAS environmental based on information provided and a site visit.

I declare, under penalty of perjury, that the information and/or recommendation contained in the attached document or report is true and correct to the best of my knowledge.

Contractor :

By: ______________________

Name: Ernesto Montenero

Title: Principal

Date: February 5, 2016

Engineer:

By: ______________________

Name: Bob Clark-Riddell

Title: Engineer

Date: February 5, 2016

REGISTERED PROFESSIONAL ENGINEER
ROBERT G. CLARK-RIDDELL
No. C 049629
Exp. SEPT 2016
CIVIL
STATE OF CALIFORNIA

TABLE 1. ANALYTICAL RESULTS - SOIL

3037-3115 Adeline Street, Oakland

Sample ID	Date	TPH-gro	TPH-dro	TPH-dro*	TPH-oro	TPH-oro*	Copper	Lead	Tin
		(mg/Kg)							
PES-B1-3	1-May-13	NA	NA	NA	NA	NA	160	43	NA
PES-B2-3	1-May-13	46	**1,200**	NA	**950**	NA	**1,200**	140	NA
PES-B2-7	1-May-13	NA	**1,600**	NA	**860**	NA	15	<3.0	NA
PES-B2-12	1-May-13	NA	<10	NA	<10	NA	11	8	NA
PES-B2-18	1-May-13	NA	<10	NA	<10	NA	17	<3.0	NA
PES-B3-3	1-May-13	<10	<10	NA	<10	NA	17	<3.0	NA
PES-B4-3	1-May-13	NA	NA	NA	NA	NA	11	<3.0	NA
PES-B4-11	1-May-13	<10	<10	NA	<10	NA	NA	NA	NA
PES-B5-3	1-May-13	NA	NA	NA	NA	NA	18	44	NA
PES-B5-7	1-May-13	<10	<10	NA	<10	NA	NA	NA	NA
B-1, 1.5-2	21-Oct-14	<1	<1.0	NA	<5.0	NA	210	25	<5.0
B-1, 3-3.5	21-Oct-14	NA	NA	NA	NA	NA	22	6.7	<5.0
B-1, 9-9.5	21-Oct-14	<1	11	NA	100	NA	NA	NA	NA
B-1, 10.5-11	21-Oct-14	<1	<1.0	NA	<5.0	NA	NA	NA	NA
B-2, 2-2.5	21-Oct-14	**540**	**17,000**	**20,000**	**8,700**	**11,000**	**1,200**	**650**	78
B-2, 3-3.5	21-Oct-14	190	**270**	NA	<250	NA	24	7.8	<5
B-2, 7.5-8	21-Oct-14	200	**2,700**	NA	**1,700**	NA	NA	NA	NA
B-2, 15.5-16	21-Oct-14	4.1	49	NA	38	NA	NA	NA	NA
B-3, 2-2.5	21-Oct-14	<1	**480**	NA	430	NA	31	7.0	<5
B-3, 3-3.5	21-Oct-14	150	**370**	NA	<250	NA	22	8.8	<5
B-3, 7.5-8	21-Oct-14	<1	**120**	NA	100	NA	NA	NA	NA
B-3, 11.5-12	21-Oct-14	<1	<5.0	NA	<5.0	NA	NA	NA	NA
B-4, 3-3.5	21-Oct-14	NA	NA	NA	NA	NA	18	5.8	<5
B-4, 7.5-8	21-Oct-14	<1	<5.0	NA	<5.0	NA	NA	NA	NA
B-4, 9.5-10	21-Oct-14	<1	1.2	NA	<5.0	NA	NA	NA	NA
B-6, 1.5-2	21-Oct-14	55	**1,400**	NA	**1,200**	NA	**380**	120	20
B-6, 2.5-3	21-Oct-14	180	**670**	NA	280	NA	22	7.1	<5
B-6, 7.5-8	21-Oct-14	40	**480**	NA	280	NA	NA	NA	NA
B-6, 15.5-16	21-Oct-14	<1	<1.0	NA	<5.0	NA	NA	NA	NA
B-7, 2-2.5	21-Oct-14	<1	<1.0	NA	<5.0	NA	87	18	<5
B-7, 3-3.5	21-Oct-14	NA	NA	NA	NA	NA	18	7.1	<5
B-7, 7.5-8	21-Oct-14	<1	3.1	NA	14	NA	NA	NA	NA
B-7, 11.5-12	21-Oct-14	<1	<1.0	NA	<5.0	NA	NA	NA	NA
B-8, 1.5-2	21-Oct-14	NA	NA	NA	NA	NA	23	10	<5
ESL <3m		500	110	110	500	500	230	320	-
ESL >3m		770	110	110	1000	1000	5,000	320	-

Notes
NA = Not Analyzed
(mg/Kg) = Miligrams per Kilogram
TPH-gro = Total petroleum hydrocarbons quantified as gasoline range organics
TPH-dro = Total petroleum hydrocarbons quantified as diesel range organics
TPH-oro = Total petroleum hydrocarbons quantified as oil range organics
TPH-dro* = Total petroleum hydrocarbons quantified as diesel range organics run without silica gel cleanup
TPH-oro* = Total petroleum hydrocarbons quantified as oil range organics run without silica gel cleanup
ESL <3m = environmental screening limits set forth by the RWQCQ for soil shallower than 3 meters on a commercial Property where groundwater is considered a potential source of drinking water
ESL >3m = environmental screening limits set forth by the RWQCQ for soil deeper than 3 meters on a commercial Property where groundwater is considered a potential source of drinking water
Bold Type Indicates Reported Value Above the ESL.

TABLE 1a. ANALYTICAL RESULTS - SOIL

3037-3115 Adeline Street, Oakland

PCDD's & PCDF's	B-2-2.5 Results in pg/g	WHO-TEF	ESL pg/g
1,2,3,4,6,7,8-HpCDD	4.16	0.01	180
OCDD	8.42	0.0003	6,000
2,3,4,7,8-PeCDF	4.1	0.3	60
1,2,3,4,7,8-HxCDF	5.42	0.1	18
1,2,3,6,7,8-HxCDF	5.42	0.1	18
2,3,4,6,7,8-HxCDF	8.82	0.1	18
1,2,3,4,6,7,8-HpCDF	31.9	0.01	180
Total tetradioxins	5.7		
Total heptadioxins	8.76		
Total tetrafurans	19.6		
Total heptafurans	31.9		
Total hexafurans	60.6		
Total pentafurans	23.7		

SVOC's	Results in mg/Kg		ESL
2-methylnapththalene	**31**		0.25

PCB's
Non detected above their respective detection limit

TPH	Results in mg/Kg		ESL
TPH-dro	**3,500**		110
TPH-oro	**2,200**		500

Table Notes:
pg/g = grams per picogram
WHO-TEF = World Health Organization Toxic Equivalency Factor
ESL – environmental screening limits set forth by the California Regional Water Quality Control Board as of December 2013

TABLE 2. ANALYTICAL RESULTS - GROUNDWATER

3037-3115 Adline Street, Oakland

Sample ID	Date	TPH-gro	TPH-dro	TPH-oro
		(µg/L)		
PES-B1-GW	1-May-13	<0.50	<0.50	<0.50
PES-B2-GW	1-May-13	NA	<0.50	<0.50
ESL		100	100	100

Notes
NA = Not Analyzed
(µg/L) = microgram per liter
TPH-gro = Total petroleum hydrocarbons quantified as gasoline range organics
TPH-dro = Total petroleum hydrocarbons quantified as diesel range organics
TPH-oro = Total petroleum hydrocarbons quantified as oil range organics
ESL = environmental screening limits set forth by the RWQCQ for a Property where groundwater is considered a potential source of drinking water

SOIL GAS ANALYTICAL RESULTS

3037 Adeline Street, Oakland, California

Boring	benzene	toluene	ethylbenzene	m,p-xylenes	o-xylenes	napthalene #	napthalene *	oxygen	methane	carbon dioxide
	μg/m³							%		
SS-1 (sub slab)	<3.9	<4.6	<5.2	<5.2	<5.2	<25	<5.0	13	<0.00024	6.6
VP-1 (soil gas)	90	90	59	<54	73	<260	60	4.0	9.0	13
ESL IAxAF	8	26,000	98	8,800	8,800	7.2	7.2			
ESL com	420	1,300,000	4,900	440,000	440,000	360	360			

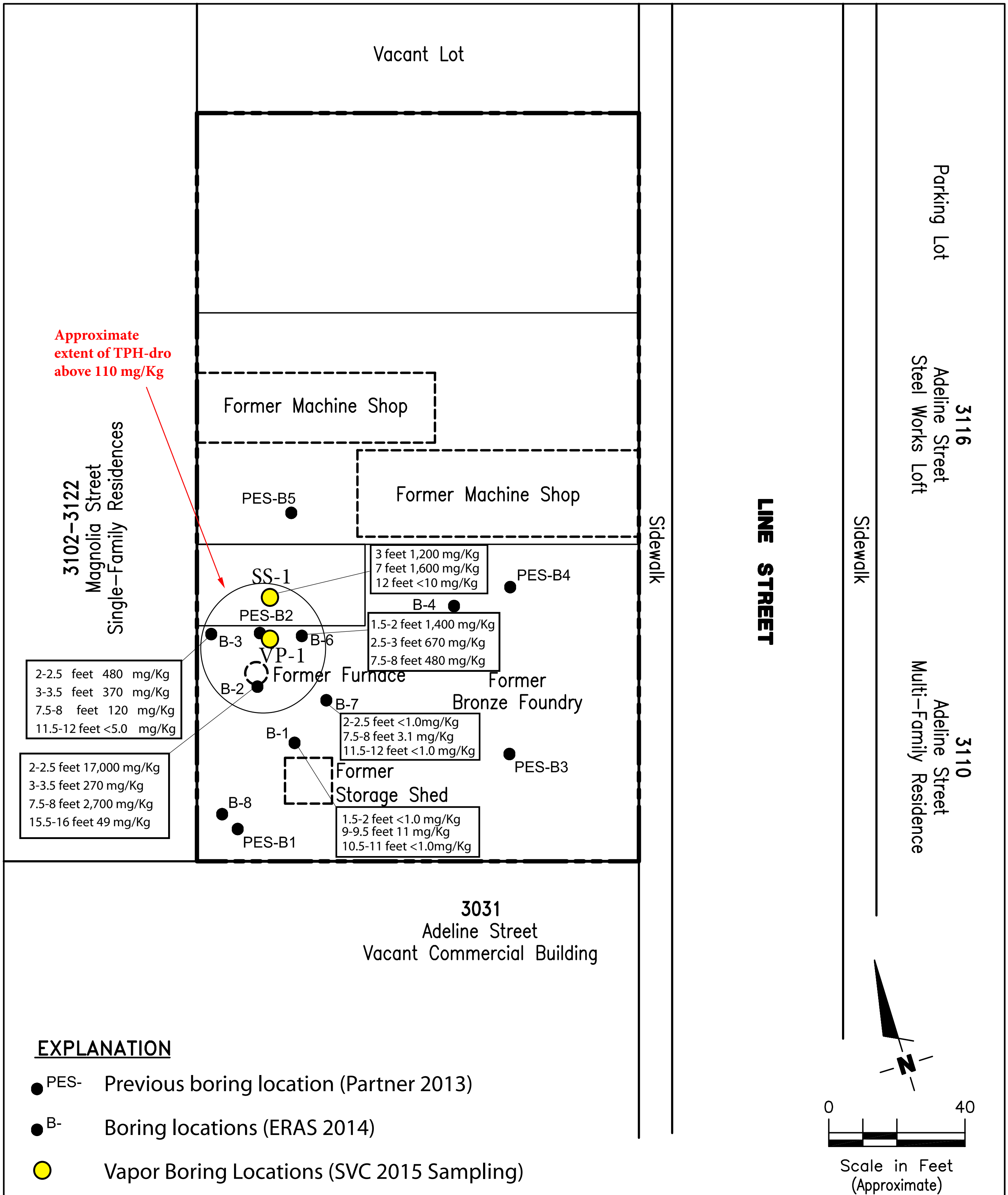
Notes
- napthalene by EPA Method TO-15
* - napthalene by EPA Method TO-17
μg/m³ - micro grams per cubic meter
% - percent
ESL IAxAF - Regional Water Quality Control Board Environmental Screening Levels for Indoor Air at a Commercial Property multiplied by the Department of Toxic Substances Attenuation Factor of 20
ESL com - Regional Water Quality Control Board Environmental Screening Levels for Soil Gas on a Commercial Property

Table A-1
Soil Vapor Analytical Data and Measurements for 2-Propanol

Adeline Foundry
3037 Adeline Street, Oakland
by Modified EPA Method TO-15 using GC/MS in full scan mode

Soil Vapor Sample Designation	Date Sampled	Approximate Depth (feet)	2-Propanol ($\mu g/m^3$)	2-Propanol in Shroud ($\mu g/m^3$)	Average Measured PID 2-Propanol Shroud Concentration during Shroud Sample using CF=6 ($\mu g/m^3$)	Relative Percent Difference between PID measurement & Lab Result (Percent)	Average Measured 2-Propanol Shroud Concentration PID using CF=6 ($\mu g/m^3$)	Drops of Isopropyl Alcohol in Shroud (drops)	Maximum leakage based on detection limit (Percent)
Sub-Slab Soil Vapor				**Shroud Atmosphere**					
			Lab Analytical Results						
SS-1	10/23/15	0.5	300	110,000	104,992	-4.7%	114,896	12	0.26%
VP-1	10/23/15	6.0	330	--	--	--	214,831	14	0.15%

$\mu g/m^3$ = Micrograms per cubic meter
< = Not Detected, less than laboratory reporting limit
CF = Correction Factor for 2-propanol from isobutylene detected by PID (Literature Value = 6)
PID = Photoionization detector (MiniRae 3000)
2-Propanol = 91% Isopropyl alcohol utilized as leak check compound



Sustainable Technologies

ERAS Environmental Inc.

Location Map & TPH-dro Extent

Adeline Foundry

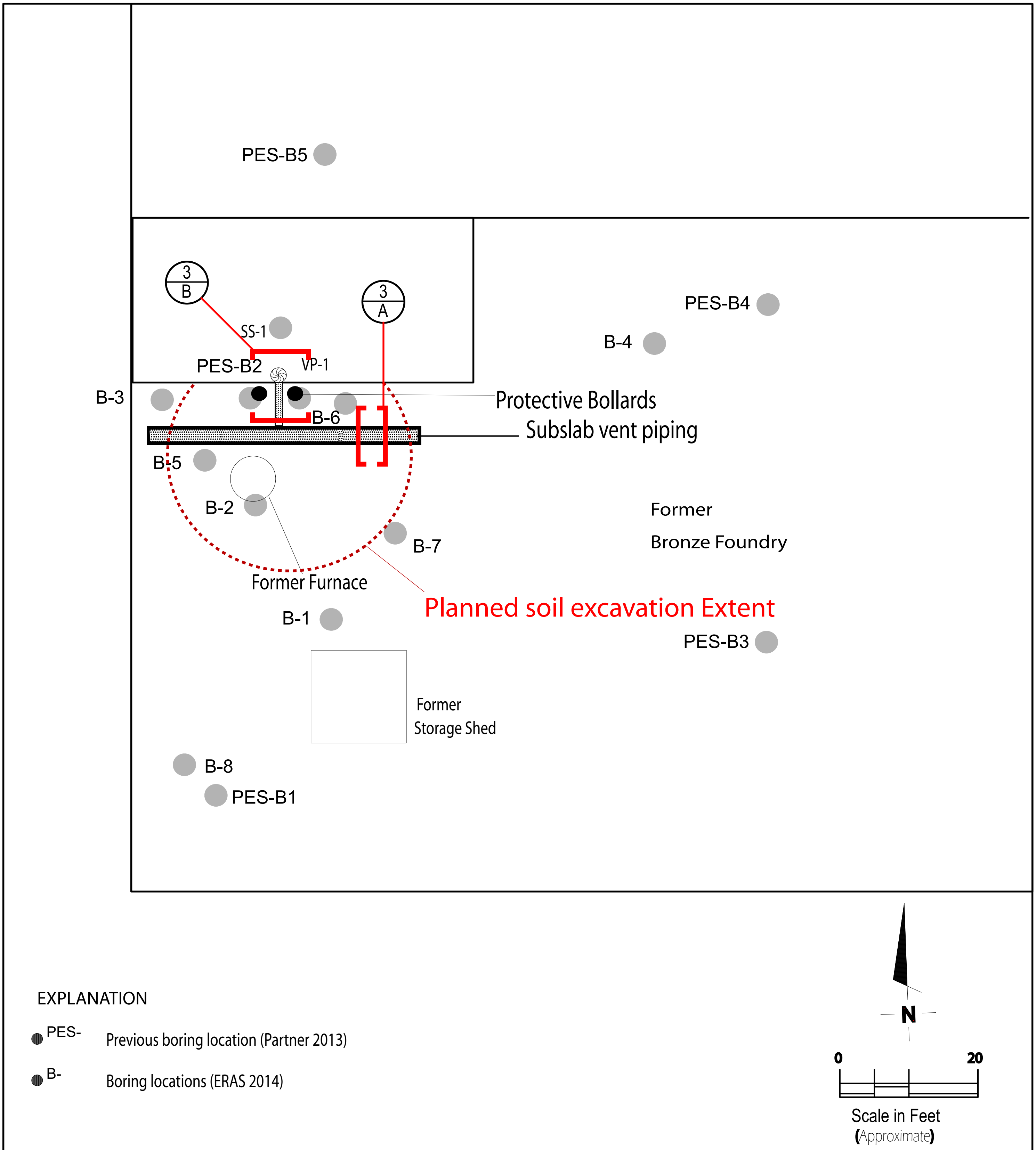
3037, 3101 & 3115 Adeline Street

Oakland, California

DATE 2/08/16

JOB NUMBER R00003142

FIGURE 1



Sustainable Technologies

ERAS Environmental Inc.

Subslab Venting System

Adeline Foundry

3037, 3101 & 3115 Adeline Street

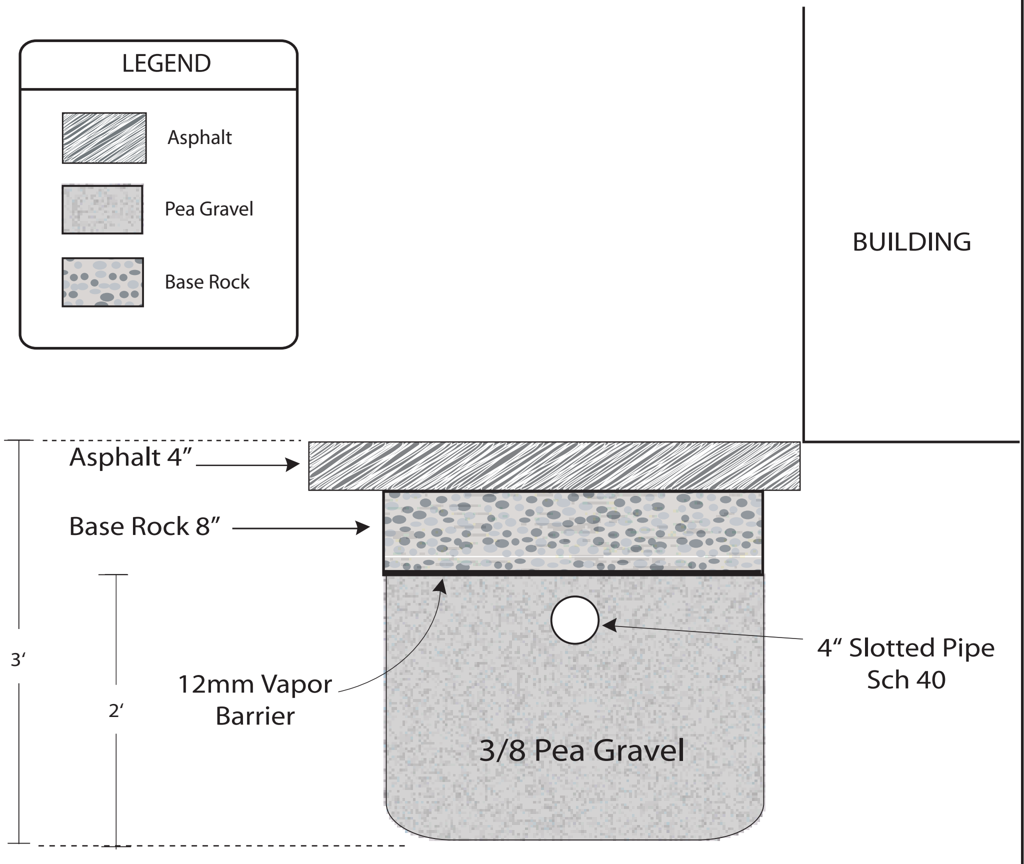
Oakland, California

DATE 2/08/16

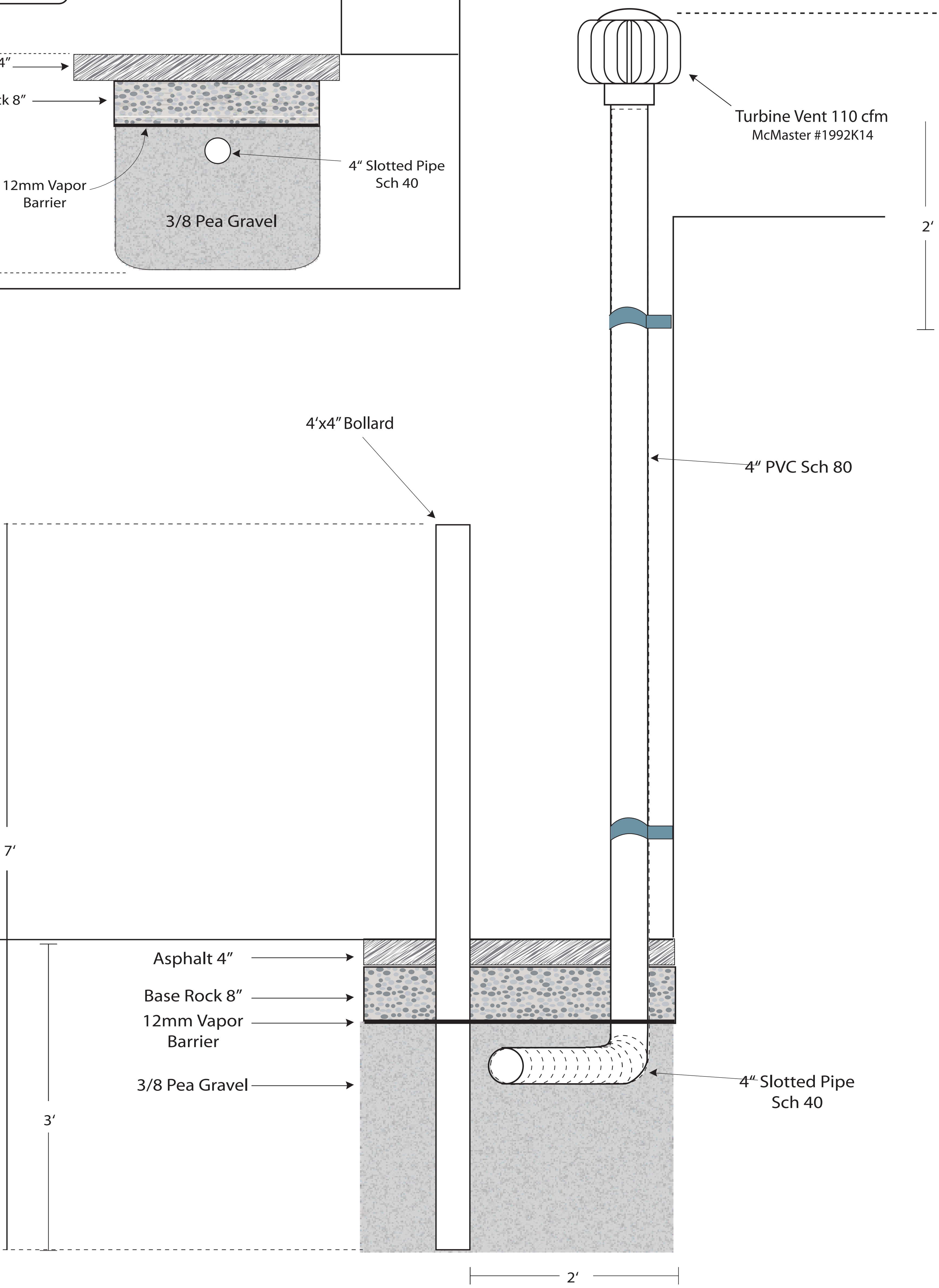
JOB NUMBER RO0003142

FIGURE 2

3/A Detail A
Cross Section of Subslab Venting System



3/B Detail B
Side View and Cross Section of Vent Riser Pipe



Sustainable Technologies

ERAS Environmental Inc.

Subslab Venting System Detail

Adeline Foundry

3037, 3101 & 3115 Adeline Street

Oakland, California

DATE 2/08/16

JOB NUMBER RO0003142

FIGURE 3