PHASE II ENVIRONMENTAL SITE CHARACTERIZATION
Block 52
San Francisco, California
(REV. 01)

Prepared For:

Jonathan Rose Company
551 Fifth Avenue, 23rd Floor
New York, New York 10176

Prepared By:

Langan Engineering and Environmental Services, Inc.
135 Main Street, Suite 1500
San Francisco, California 94105

Peter J. Cusack
Associate Principal/VP

Dorinda Shipman, PG, CHG
Principal/VP

10 November 2022
770681001

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

PHASE II ENVIRONMENTAL SITE CHARACTERIATION
Block 52
San Francisco, California

1.0 INTRODUCTION

Langan Engineering and Environmental Services, Inc. (Langan) has prepared this Draft Phase II Environmental Site Characterization (ESC) on behalf of the Jonathan Rose Company, Sponsor and Client, and the San Francisco Housing Development Corporation for Block 52 located at the northwest corner of Friedell Street and Kirkwood Avenue in San Francisco, California (site, Figure 1). The proposed development will be a five-story podium-style building with one level of concrete podium topped with four wood-framed levels of residential units. The concrete level will be partially below grade and will consist of a parking garage, utility rooms, and community spaces, including a courtyard and offices. Proposed excavations range from none on the north side to approximately 15 feet below ground surface (bgs) on the south side of the site.

2.0 SITE DESCRIPTION

The site consists of one assessor parcel (APN) 4591C/215 and is located at the Hilltop Neighborhood within Parcel A of the Hunters Point Shipyard. The site is bound by Jerrold Avenue to the northeast, a recent residential development to the southeast, Kirkwood Avenue to the southwest, and Friedell Street to the northwest, as shown on Figure 2. The site is located in a mixed-use area of San Francisco and is approximately 0.46 acres in size. The site is vacant and currently used for construction staging.

The site is subject to the requirements of Article 31 of the San Francisco Health Code. Article 31 specifically applies to environmental conditions during construction at the former Hunters Point Shipyard Redevelopment project. Article 31 requires that prior to receiving approval of construction permits; a developer/builder must submit Article 31 compliant plans to ensure safe work practices and environmental protection during construction. The Article 31 plans that have already been approved and will continue to be implemented at Block 52 are a Site Evaluation Report, a Dust Control Plan (DCP); an Unexpected Condition Response Plan (UCRP); a Soil Import Plan (SIP); and a serpentine Cover Plan. Additional plans that will be submitted specific to Block 52 are a Transportation and Disposal Plan (TDP) and an Environmental Health and Safety Plan (EHASP). Lastly, when construction is complete and prior to receiving permission to occupy the new Block 52 residences, the developer/builder must submit an Article 31 Closure Report for

San Francisco Department of Public Health (SFDPH) approval verifying that all approved Article 31 plans were properly implemented.

2.1 Project Description

The proposed development will be a five-story podium-style building with one level of concrete podium topped with four wood-framed levels of residential units. The concrete level will be partially below grade and will consist of a parking garage, utility rooms, and community spaces, including a courtyard and offices. Proposed excavations range from none on the north side to approximately 15 feet bgs on the south side of the site.

2.2 Geology and Hydrogeology

The site is part of the California Coastal Range Province, a region characterized by northwest-trending ridges and valleys that generally parallel the major geologic structures, such as the San Andreas and Hayward Fault systems. Bedrock in the area is composed of highly consolidated and tectonically deformed sedimentary, volcanic, and metamorphic rocks of the Franciscan Complex (about 180 million years old). Large intrusions of serpentinite are closely associated with Franciscan rock. The Franciscan rocks commonly consist of pervasively sheared shale and sandstone that include isolated masses of other types of rocks and are referred to as mélange. Previous analytical results of rock samples collected during Engeo's geotechnical investigation detected elevated asbestos at concentrations ranging from 2.75 percent (%) to 4.5%. Groundwater was not encountered during the onsite geotechnical investigation conducted by Engeo (July 2020) or during this environmental characterization effort.

Subsurface soil conditions, based on reports completed by Engeo (2020), indicate that the site is blanketed by one to three feet of fill underlain by bedrock. The near surface material consists primarily of stiff to hard sandy clay with varying amounts of silt, sand, and gravel. Below the fill Engeo encountered residual soil comprising stiff to hard sheared serpentinite mélange. The serpentinite bedrock beneath the site is moderately soft, with low hardness, and deeply to intensely weathered.

3.0 SITE HISTORY

Historically, the site was located within the former Hunters Point Shipyard Parcel A, which was primarily used for Navy administration offices and housing (USEPA, 2020). In the early 1990s, the Navy performed routine cleanup activities at Parcel A, including removal of transformers and an underground storage tank, abrasive blast material that had been used as utility trench backfill

from two areas, and soil impacted by petroleum and other contaminants from two other areas. Soil was disposed of off-site and those areas were backfilled with clean soil (Navy, 2004). These areas are outside of the current Block 52 boundaries and no known release of petroleum or hazardous substances occurred there (Navy, 2004). Former Parcel A was found to not require additional action in 1995 by the United States Environmental Protection Agency (USEPA) and the USEPA removed Parcel A from being part of the Hunters Point Shipyard superfund site in 1999 (USEPA, 2020).

In December 2004, the Navy transferred Parcel A to the San Francisco Redevelopment Agency, which is now known as the Office of Community Investment and Infrastructure (successor agency). Developers removed all Navy-era utilities, including sewer lines and maintenance holes. Additionally, the developer excavated (dug out) former Parcel A surface soil and graded the site to prepare the land for redevelopment, removing approximately 20 feet of soil from Block 52 (ENGEO, 2007). The developer also brought in engineered fill for placement under hardscape to construct new utilities, streets, sidewalks, building foundations and added additional soil for landscaping.

In 2018, California Department of Public Health (CDPH) performed gamma radiological scanning in all accessible, outdoor areas in Parcel A. CDPH's scanning activities included the use of handheld instruments and instruments that were towed on a trailer behind a small vehicle. The areas scanned included the soil stockpiles and the undeveloped portion of Parcel A. CDPH's Division of Radiation Safety and Environmental Management Radiologic Health Branch presented the results of the health and safety survey in the report *Hunters Point Shipyard, Parcel A-1, Health and Safety Survey*, dated 5 February 2019. CDPH concluded there were "No radiological health and safety hazards to the residents of Parcel A-1." Comprehensive scanning by CDPH showed no radiological contamination in the near-surface soil.

Based on a review of aerial photographs by SCA (October 2018), in 1938, the Block 52 site appeared to be occupied by five rectangular-shaped buildings which were likely residential or military barracks. By 1946, the five rectangular buildings had been demolished and replaced with four rectangular-shaped buildings which were likely used by the Navy. These buildings began to be removed from the site in the 1980s. By 2009, the site had been cleared of structures and is currently a vacant lot.

4.0 SUBSURFACE INVESTIGATIONS

4.1 Langan's July 2022 Phase I Environmental Site Assessment

Langan prepared a Phase I Environmental Site Assessment (ESA) dated July 2022. The Phase I ESA identified two recognized environmental conditions (RECs) for the site:

REC 1 – Presence of Contaminated Fill Material
Based on the location of the site within the Maher Ordinance (2013) boundary limits, fill material, potentially contaminated with heavy metals and/or petroleum hydrocarbons, exists beneath the site. The fill material represents a REC for the site.

REC 2 – Presence of Naturally Occurring Asbestos
Based on the results of ENGEO's 2020 geotechnical investigation and subsurface investigations, endemic serpentinite rock containing naturally occurring asbestos (NOA) is present beneath the site. Due to concentrations of NOA detected in rock samples beneath the site, preparation of an Asbestos Dust Mitigation Plan (ADMP) and DCP will be required prior to construction.

4.2 Langan's March 2022 Environmental Sampling

Langan performed a Phase II subsurface investigation in March 2022 for the collection and analyses of soil and rock samples. Prior to any drilling and sampling activities, Langan obtained a drilling permit from SFDPH, notified Underground Services Alert (USA) and retained a private underground utility locating service to check that locations of exploratory borings were clear of existing utilities.

On 30 March 2022, 12 exploratory borings, E-13 through E-24, were advanced to depths of approximately five to 15 feet bgs by direct push drilling methods or hand auger. All environmental drilling was conducted by Gregg Drilling, LLC (Gregg) of Martinez, California. The exploratory boring locations are shown on Figure 2.

Based on the depth of the proposed excavation and in an effort to adequately characterize the material to be off-hauled during construction, soil/rock samples were collected at depths of approximately 0.5, 1.5, 3.0, 5.0, 7.5, and 10.0 feet bgs. Sample ends were covered with Teflon, sealed with plastic end caps, labeled, and stored on ice until delivery to the analytical laboratory. All samples were delivered under chain-of-custody control to McCampbell Analytical, Inc. (McCampbell), a California Department of Public Health certified analytical laboratory in Pittsburg, California.

Additionally, one to three soil samples were collected from each boring location at depths of approximately 0.5, 1.5, and 3.0 feet bgs and were delivered under chain-of-custody control to Eurofins TestAmerica, St. Louis (Eurofins), a certified analytical laboratory in Earth City, Missouri for radionuclides testing described in Section 4.2.2.

Following sample collection, each boring was properly abandoned via grouting per permit requirements. Environmental boring logs from this investigation are presented in Appendix A as Figures A-1 through A-12. The material encountered was classified according to the soil classification system described on Figure A-13.

4.2.1 Phase II Sample Selection and Analytical Testing

The chemical analytical schedule was chosen to assess soil quality in accordance with Article 31 requirements and to satisfy waste profiling scenarios generally accepted by landfills. The soil samples were analyzed for a combination of some or all of the following:

- Total petroleum hydrocarbons (TPH) as gasoline (TPHg), diesel (TPHd), and motor oil (TPHmo) by USEPA Method 8021/8015;
- Volatile organic compounds (VOCs) by USEPA Method 8260;
- Semi-volatile organic compounds (SVOCs) by USEPA Method 8270;
- Organochlorine pesticides (OCPs) by USEPA Method 8081;
- Polychlorinated biphenyls (PCBs) by USEPA Method 8082;
- California Assessment Manual (CAM) 17 metals by USEPA Method 6020;
- Leaking Underground Fuel Tank (LUFT) 5 metals by USEPA Method 6020;
- Asbestos by California Air Resources Board Method 425;
- pH by EPA Method 9045C;
- Sulfides by EPA Method 9030B; and
- Total cyanide by EPA Method 9010C.

Analytical results for metal concentrations in soil were compared to the total threshold limit concentration (TTLC). Samples with concentrations of any metal greater than 10 times the soluble threshold limit concentration (STLC) were also analyzed for soluble metals using the California waste extraction test (WET) method. Select soil samples in which the TTLC

concentration was elevated or where the detected concentrations exceeded the STLC value after analysis with the WET method were submitted for analysis by the Federal toxicity characteristic leaching procedure (TCLP). These analyses were performed to determine soil disposition requirements.

4.2.1.1 Phase II Soil Analytical Results

The non-radiological laboratory analytical results for soil are summarized in Tables 1 and 2 and discussed below. Copies of the certified analytical laboratory reports are presented in Appendix B.

Soil analytical results for parameters other than metals are summarized in Table 1. TPHg was detected in four of the 39 samples analyzed at concentrations ranging from 1.1 milligrams per kilogram (mg/kg) to 1.9 mg/kg. TPHd was detected in six of the 39 samples analyzed at concentrations ranging from 3.1 mg/kg to 47 mg/kg. TPHmo was detected in 13 of the 39 samples analyzed at concentrations ranging from 13 mg/kg to 600 mg/kg. Three VOCs (ethylbenzene, m,p-xylene, and o-xylene) were detected above the laboratory reporting limit in one of the 17 samples analyzed. Ethylbenzene was detected in one of the 17 samples at a concentration of 0.027 mg/kg. M,p-xylene was detected in one of the 17 samples at a concentration of 0.1 mg/kg. O-xylene was detected in one of the 17 samples at a concentration of 0.022 mg/kg. None of the detections of TPHg, TPHd, TPHmo, and VOCs exceeded the 2019 Regional Water Quality Control Board (RWQCB) residential environmental screening levels (ESLs).

Low levels of seven SVOCs (benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenzofuran, fluoranthene, fluorene and pyrene) were detected in at least one of the 17 samples analyzed. None of the SVOC detections exceeded the 2019 Residential ESLs.

Low levels of nine OCPs (Lindane [g-BHC], alpha-chlordane, gamma-chlordane, dieldrin, endosulfan II, 4,4-dichlorodiphenyldichloroethane [DDD], 4,4-dichlorodiphenyldichloroethylene [DDE], 4,4-dichlorodiphenyltrichloroethane [DDT], and toxaphene) were detected in at least one of the 12 samples analyzed. None of the OCP detections exceeded the 2019 Residential ESLs.

No PCBs were detected in any of the soil samples analyzed. Soil pH was measured at 8.31 and 8.54 in the two samples analyzed. Sulfide and cyanide were not detected the two samples analyzed. Elevated asbestos concentrations were detected in 21of the 27 samples analyzed at concentrations ranging from 0.50% to greater than 10%.

The metal analytical results are summarized in Table 2. Total chromium was detected in each of the 38 soil samples analyzed at concentrations ranging from 70 mg/kg to 1,500 mg/kg, below the California non-RCRA concentration threshold (TTLC) of 2,500 mg/kg. The thresholds of 10 times the STLC (50 mg/kg) and 20 times the TCLP (100 mg/kg) were used to identify samples requiring STLC and TCLP analyses. Each of the samples detected above these thresholds was subsequently analyzed for STLC and/or TCLP, as appropriate, to determine soluble chromium levels. STLC chromium was detected above the reporting limit (0.10 milligrams per liter [mg/L]) in each of the 38 soil samples analyzed ranging in concentrations from 0.11 mg/L to 4.3 mg/L. None of the samples analyzed exceeded the California non-RCRA criteria (STLC) of 5 mg/L. A total of 37 soil samples were analyzed for TCLP chromium and one soil sample detected soluble chromium above the reporting limit (0.10 mg/L) at concentrations of 0.11 mg/L, which did not exceed the Federal RCRA criteria of 5 mg/L.

Total nickel was detected in each of the 38 soil samples analyzed at concentrations ranging from 45 mg/kg to 3,000 mg/kg, with one sample (E-24-10.0) exceeding the California non-RCRA concentration threshold of 2,000 mg/kg. The threshold of 10 times the STLC (200 mg/kg) was used to identify samples requiring STLC analysis. Each of the samples detected above this threshold was analyzed for STLC to determine soluble nickel levels. Soluble nickel was detected above the reporting limit (0.10 mg/L) in all 33 soil samples analyzed ranging in concentrations from 0.9 mg/L to 26 mg/L. One soil sample (E-24-10.0) exceeded the California non-RCRA criteria (STLC) of 20 mg/L. Total nickel was detected above the residential ESL of 820 mg/kg in 13 of the samples analyzed. All nickel detections were within background ranges found locally[1], except six soil samples (E-20-10, E-21-5, E-22-3, E-24-3, E-24-7.5, and E-24-10). The nickel data set was further evaluated to determine whether the concentrations exceed background at a statistically significant level (95 percent upper confidence limit [UCL]). The calculated 95UCL of 990 mg/kg was within background.[2]

---

1 95% UCL for soil and rock matrices for Innes Avenue dataset. Metals Concentrations in Franciscan Bedrock Outcrops: Three Sites in the Hunters Point Shear Zone and Marin Headlands Terrane Subunits, Hunters Point Shipyard, San Francisco, California. March 2004.

2 USEPA. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. December 2002.

Arsenic was detected at or above the reporting limit in 21 of the 24 samples analyzed at concentrations ranging from 0.62 mg/kg to 8.6 mg/kg. These detections are within normal background ranges[3] found in the San Francisco Bay Area.

Cobalt was detected at or above the reporting limit in each of the 24 samples analyzed at concentrations ranging from 25 mg/kg to 86 mg/kg. Total cobalt was detected above the residential ESL of 23 mg/kg in each of the 24 of the samples analyzed. All cobalt detections were within background ranges found locally.[1]

4.2.2 Radiological Sample Selection and Analytical Testing

In addition to the studies and conclusions discussed in Section 3.0, out of an abundance of caution and at the request of the community and district Supervisor, radiological soil analyses were conducted to provide added confidence that subsurface soil is free from radiological contamination. The radiological sampling and testing conducted at Block 52 was not required by Article 31.

The purpose of this radiological sampling was to screen for significant concentrations of tested radionuclides, i.e., at concentrations that may pose a health risk. With the exception of cobalt-60,[4] the radionuclides tested are naturally occurring in soil and rock (radium-226, thorium-232, uranium-235) or present in the environment due to worldwide fallout from historical nuclear testing (americium-241, cesium-137, plutonium-239, strontium-90). Thus, while the concentrations of these materials may vary, their presence in environmental samples is expected. Minute amounts of these radionuclides are ubiquitously found in the environment and do not pose a health risk.

The radiological sampling included advancing borings to collect soil samples for radionuclide analysis. Radionuclide laboratory analysis involves measuring the activity (emissions) of radionuclides to estimate the quantity of the substance present using a small sample volume over a specific time period.

Twenty five samples were collected and analyzed for radionuclides via gamma spectroscopy by Department of Energy (DOE) Health and Safety Laboratory (HASL) 300 4.5.2.3/GA-01-R

---

3 Background concentration ranges of metals in Bay Area soils, Appendix A, Table A-2 from Environmental Resources Management. Feasibility Study, Hookston Station, Pleasant Hill, California. July 2006.

4 Cobalt-60 is a man-made cobalt isotope that has a relatively short half-life or decay rate of approximately 5 years.

consistent with USEPA 901.1 to determine the concentration of the following radionuclides: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), and radium-226 (Ra-226). Alpha spectroscopy by DOE A-01-R Mod was used to determine the levels of thorium-232 (Th-232), plutonium-239 (Pu-239) and uranium-235 (U-235). Strontium-90 (Sr-90) was analyzed by Eurofins Environmental Testing Laboratory Standard Operating Procedure (SOP) No. ST-RC-0058[5]. Soil analytical results for radionuclides are summarized in Table 3. The analytical laboratory report is provided in Appendix C. As presented in Table 3 and Appendix C, some radionuclides are present in site soil at low concentrations. It should be noted that the typical background concentrations of these radionuclides are very low. The low concentrations present approach the limits of the ability to detect the radionuclides with available analytical laboratory methods. For comparison purposes, background threshold values (BTVs) are also presented in Table 3.[6]

Table 3 includes the calculated average (i.e., mean) concentrations of the detected radionuclides and the calculated 95th percentile concentrations of the detected radionuclides. Average concentrations of a radionuclide represent a reasonable estimate of the concentration likely to be contacted by a site receptor over time. A 95th percentile concentration of a radionuclide is a concentration that is greater than 95 percent of the detected concentrations. Using an overall concentration comparison (i.e., average concentration) versus a point-by-point approach (i.e., single concentration) to evaluate potential risk is generally applicable for scenarios where the potential risk from direct human contact exposure is being evaluated.[7] Comparison to the 95th percentile is also a useful benchmark.

---

5 Eurofins Environmental Testing Laboratory SOP No. ST-RC-0058 for Sr-90 analysis, with sample preparation using extraction chromatography, is based on ASTM Method C1507-07 and Eichrom Method SRW01 with modifications. Eurofins Environmental Testing Laboratory's DoD ELAP certification references this SOP number for extraction chromatography.

6 Precise quantification of background levels was not the goal of the sampling conducted at the site. Block 52 is not a radiological release site and radionuclides, if present, would be expected at background levels. Background concentrations identified in Table 3 are from a recent background study conducted by the Navy, which identifies BTVs from a reference area (referred to as the San Bruno reference area) located outside of the Hunters Point Shipyard superfund site (Navy, 2020a and b). USEPA Region 9 Santa Susana Field Laboratory background threshold values are also provided for additional reference (USEPA, 2011).

7 U.S. Department of Defense, U.S. Nuclear Regulatory Commission, U.S. Department of Energy, Environmental Protection Agency, 2000. The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). Revision 1. August.

The soil radiological analytical data provided in the laboratory report (Appendix C) include a number of measures to aid interpretation of the results. These include the uncertainty[8] associated with each result, the limit of quantitation (LOQ), and the decision level concentration (DLC). The LOQ is the lowest value where quantitation is valid to achieve a given precision and accuracy. The LOQ is a fixed value that represents the capability of a given analytical method. In contrast, the DLC is the level at which the radionuclide can be detected in a given sample, but with no guarantee about the bias or precision of the result. The DLC is measurement-specific (i.e., it will differ for each individual analysis). The confidence in an analytical result increases the more it exceeds the applicable threshold for detection (i.e., the DLC) and as its uncertainty decreases.

4.2.2.1 Radiological Results

The average concentration of each radionuclide and the LOQ, DLC and uncertainty associated with each analysis are provided in Table 3. Using the uncertainties presented in Table 3, statistical uncertainties were calculated as percentages relative to the mean for each radionuclide. High percent uncertainties indicate results were at or below the limits of detection. Limits of detection for all the radionuclides are well below levels that would indicate a health risk.

The mean concentration of Am-241 is 0.0029 picocuries per gram (pCi/g) with an uncertainty of 809%. None of the individual Am-241 sample results exceeded the LOQ. Two of the 25 sample results exceeded their respective DLC. Collectively these results (i.e., high uncertainty percentage and limited number of sample results in exceedance of their respective DLC and LOQ) do not indicate the presence of Am-241.

The mean concentration of Cs-137 is 0.0010 pCi/g with an uncertainty of 1,403%. One of the 25 sample results of Cs-137 exceeded the DLC and none exceeded the LOQ. Collectively these results (i.e., high uncertainty percentage and limited number of sample results in exceedance of their respective DLC and LOQ) do not indicate the presence of Cs-137.

[8] Uncertainty is defined as the interval within which the true value can be considered to lie with a given level of confidence or probability. Radiological analyses involve counting the emission of radiation. Because the emission of radiation from an atom is a random process, a sample counted several times usually yields a slightly different result each time; therefore, a single measurement is not definitive. To account for this variability, the concept of uncertainty is applied to radiological data. Therefore, the reported result (X) is within an expected interval (equal to the reported uncertainty [+/-]) of the true value, with a certain level of confidence. The laboratory reported uncertainty is provided as standard deviations of the mean. Roughly, 95% of all readings will fall within two standard deviations.

Co-60 has a short half-life (or the time for the radionuclide to decay into other isotopes to half of its original amount) of around five years[9]. This half-life is less than other radionuclides, for example, Ra-226 has a half-life of 1,600 years[10]. Given this half-life, the presence of Co-60 is not expected. The mean concentration of Co-60 is 0.0059 pCi/g with an uncertainty of 263%. None of the individual sample results exceeded the LOQ. Six of the individual Co-60 results exceeded their corresponding DLCs, which is not unexpected given the very high uncertainties associated with measurements for an analyte that is not actually present. Collectively these results (i.e., high uncertainty percentage and limited number of sample results in exceedance of their respective DLC and LOQ) do not indicate the presence of Co-60.

The mean concentration of Pu-239 was 0.0055 pCi/g with an uncertainty of 87%. None of the individual sample results exceeded the LOQ. Four of the individual sample results exceeded the DLC. Collectively the results do not indicate the presence of Pu-239.

The mean concentration of Ra-226 is 0.4626 pCi/g with an uncertainty of 8%. Ten of the individual sample results exceeded the LOQ and 24 of the individual sample results exceeded the DLC. Collectively the data indicate the presence of Ra-226 (i.e., a reliable result) at a mean concentration below the BTV (Table 3). The 95th percentile concentration is at the BTV (Table 3). The mean concentration below the BTV and the 95th percentile concentration at the BTV indicate that the Ra-226 data are consistent with naturally occurring background.[11]

The mean concentration of Sr-90 is 0.00393 pCi/g with an uncertainty of 128%. None of the individual sample results exceeded the LOQ. Two of the individual sample results exceeded the

---

9 Stanford, 2020. *Environmental Health and Safety, Radionuclide Safety Data Sheet, Cobalt-60*. March.

10 USEPA, 2021. *Radionuclide Basics: Radium*. July. https://www.epa.gov/radiation/radionuclide-basics-radium.

11 Two of the 25 soil samples collected at Block 52 contained Ra-226 above the BTV (0.861 pCi/g) at 0.867 pCi/g and 0.946 pCi/g. To evaluate consistency with naturally occurring background, an additional evaluation of the Block 52 Ra-226 data was performed. Specifically, Ra-226 data were evaluated by developing quantile-quantile (Q-Q) plots (Appendix E; USEPA, 2022) and comparing Block 52 data to the data set used to develop the BTV (the "San Bruno data set;" Navy, 2020a and b). Q-Q plots are a useful statistical method to graphically evaluate whether data are a mixture of different populations or from the same data set. Q-Q plots for Block 52 and San Bruno indicate both data sets are normally distributed. The Block 52 Q-Q plot indicates the two highest values are part of the same data set as the remainder of the Block 52 data (i.e., all data is part of naturally occurring background). In other words, the two highest data points are not outliers and do not represent non-background concentrations. The occurrence of Ra-226 at Block 52 above the BTV is related to natural differences in dispersion of Ra-226 at Block 52 and at the San Bruno reference site. The mean for the Block 52 Ra-226 data (0.4626 pCi/g) is actually less than the mean for the San Bruno Ra-226 data (0.64 pCi/g). Even though there are two detections above the BTV, these results are not a concern from a public health stand point because they are part of the naturally occurring background.

DLC. Collectively these results (i.e., high uncertainty percentage and limited number of sample results in exceedance of their respective DLC and LOQ) do not indicate the presence of Sr-90.

The mean concentration of Th-232 is 0.2666 pCi/g with an uncertainty of 9%. Nineteen of the individual sample results exceeded the LOQ and 24 exceeded the DLC. Collectively the data show a reliable result for a background concentration of Th-232. The mean concentration of Th-232 is below the BTV (Table 3). The 95th percentile concentration is also below the BTV (Table 3).

The mean concentration of U-235 is 0.0206 pCi/g with an uncertainty of 30%. None of the individual sample results exceeded the LOQ. Seventeen of the individual sample results exceeded the DLC. Collectively the data show a reasonably reliable value. The mean concentration for U-235 is below the BTV (Table 3). The 95th percentile concentration is also below the BTV (Table 3).

Further evaluation, including estimates for dose and risk, of the radionuclide concentrations detected at Block 52 is provided in Appendix D. Evaluation of naturally occurring, background concentrations, such as those at Block 52, is not generally conducted or required by the USEPA, the Argonne National Laboratory (ANL), the United States Department of Energy (DOE), or the United States Nuclear Regulatory Commission (NRC);[12] therefore, the evaluation presented in Appendix D should be considered for informational purposes only.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The site consists of one APN - 4591C/215 and is located in a mixed-use area of San Francisco and is approximately 0.46 acres in size. The site is vacant and used for construction staging and is located at the Hilltop Neighborhood within Parcel A of the Hunters Point Shipyard. The proposed development will be a five-story podium-style building with one level of concrete podium topped with four wood-framed levels of residential units. The concrete level will be partially below grade and will consist of a parking garage, utility rooms, and community spaces, including a courtyard and offices. Proposed excavations range from none on the north side to approximately 15 feet bgs on the south side of the site.

[12] Refer to USEPA's Preliminary Remediation Goal (PRG) Calculator for Radionuclide Contaminants at Superfund Sites and ANL's, DOE's and NRC's Residual Radiation (RESRAD) Tool User's Guides at: https://epa-prgs.ornl.gov/radionuclides/ and https://resrad.evs.anl.gov/.

5.1 Conclusions

Based on the analytical results from our environmental subsurface investigation, some of the subsurface material contains total and soluble nickel concentrations above off-site disposal criteria. The areas of material containing total and soluble nickel concentrations above off-site disposal criteria are near soil boring EB-24 at a depth of 10 feet bgs as shown on Figure 3. This material must be removed and disposed as Class I non-RCRA waste and the remaining material on-site to be excavated and removed must be disposed of as Class II material based on the asbestos concentrations. Remaining non-radiological constituents were not detected at elevated concentrations that would represent a concern to construction workers, the public or future residents.

The radiological testing results do not indicate the presence of radionuclides above background levels or the presence of radionuclides at levels that would indicate a release from a contaminant source at the site. In addition, the calculated maximum annual dose rate and relative risk associated with exposure to the maximum annual dose rate were calculated using RESRAD for each radionuclide considered at the site. The maximum annual dose rates were well below the NRC's dose rate criterion of 25 mrem/yr. The risk values associated with these maximum annual dose rates were below or within the generally acceptable risk range of E-06 to E-04. All of the mean (i.e., average) or maximum concentrations of radionuclides detected in site soil were below or within the accepted risk range or otherwise within expected background.

5.2 Recommendations

An approved ADMP and DCP must be implemented due to the presence of endemic serpentinite rock containing NOA confirmed in the samples collected at the site. Real-time NOA and PM-10 dust monitoring and third party inspections must be conducted during potential dust generating activities such as grading, excavation, trenching, soil stockpiling, backfilling, soil handling and movement, and vehicular traffic on unpaved surfaces.

Per Article 31, a TDP must be submitted for SFDPH approval prior to construction because NOA, and nickel are present on-site above off-site disposal criteria. Nickel is naturally occurring in the endemic serpentinite rock. The TDP must provide guidance and protocols to the contractor for soil/rock handling, transport, and disposal according to the pertinent regulations in an environmentally sound and safe manner. The UCRP contains protocols that should be referenced in the TDP and must be implemented during excavation activities if unanticipated conditions are encountered. The EHASP must outline proper material handling procedures and health and safety

requirements to minimize worker and public exposure to hazardous materials during construction.

The Article 31 Closure Report must include the results of implementation of all the required Article 31 plans, all air monitoring results, copies of the required EHASP trainings (asbestos and lead awareness) and any notifications during construction.

The radiological sampling and testing conducted at Block 52 was not required by Article 31. As stated above, these radionuclides (except Co-60) are naturally occurring in rock or present due to worldwide fallout from nuclear testing. These radionuclides are present at very low concentrations that test the limits of the available and appropriate analytical laboratory methods (as indicated by the relative uncertainties associated with each radionuclide).[13] Given the very low concentrations and lack of radiological dose or risk exceedances, these radiological results do not pose a risk to the public or future residential users.

6.0 LIMITATIONS

Descriptions of specific field activities and historical events are based on our observations and on information provided by others. The opinions and information presented in this report apply to site conditions and the information that was available at the time the work was performed and do not apply to changes of which we are not aware or have not had the opportunity to evaluate. Langan makes no guarantees or warranties with respect to the accuracy or completeness of this information.

[13] Radionuclide laboratory analysis involves measuring the activity of radionuclides to estimate the quantity of the substance present using a small sample volume over a specific time period and thus has inherent uncertainties.

7.0 REFERENCES

California Department of Public Health, *Hunters Point Shipyard, Parcel A-1 Health and Safety Survey*, dated 5 February 2019.

ENGEO Incorporated, *Foundation Recommendation Hunters Point Shipyard OCII Blocks 52 and 54,* dated 28 July 2020.

ENGEO Incorporated, *Testing and Observation Services During Grading and Retaining Wall Construction, Parcel A', Hunters Point Shipyard, San Francisco, California*, letter to Brian Olin at Lennar Urban, dated 10 December 2007.

Environmental Resources Management, *Background concentration ranges of metals in Bay Area soils, Appendix A, Table A-2*, *Feasibility Study, Hookston Station, Pleasant Hill, California*, dated July 2006.

Langan, *Phase I Environmental Site Assessment. Hunters Point Block 54, San Francisco, California*, dated 8 July 2022.

Mithun, Inc and Kerman Morris Architects, LLP, *Hunters Point Shipyard – Block 51 & 54, Block 52, 100% Design Development,* dated 20 September 2019.

San Francisco Bay Regional Water Quality Control Board (RWQCB), *Environmental Screening Levels*, dated January 2019.

SCA Environmental, Inc., *Phase I Environmental Site Assessment, Parcel 52 APN 4951C/215, Hunters Point Shipyard, Parcel A1, San Francisco, CA 94124,* dated October 2018.

Stanford, Environmental Health and Safety, *Radionuclide Safety Data Sheet, Cobalt-60*, dated March 2020.

United States Department of the Navy (Navy), *Final Background Soil Study, Former Hunters Point Naval Shipyard, San Francisco, California*, dated June 2020.

Navy, *Memorandum to File Regarding Radiological Remediation Goals for Removal Site Evaluation Workplan for Parcels B, C, D-1, E, G, UC-1, UC-2, UC-3, Former Hunters Point Naval Shipyard, San Francisco California, dated 8 March 2020.*

Navy, *Finding of Suitability to Transfer for Parcel A (Revision 3), Hunters Point Shipyard, San Francisco, California*, DS.A057.14385, Final, dated 14 October 2004.

Navy, *Metals Concentrations in Franciscan Bedrock Outcrops: Three Sites in the Hunters Point Shear Zone and Marin Headlands Terrane Subunits, Hunters Point Shipyard, San Francisco, California*, dated March 2004.

Navy, *Calculation of Hunters Point Ambient Levels, Draft*, dated 17 August 1995.

United States Environmental Protection Agency (USEPA), *Preliminary Remediation Goals for Radionuclide Contaminants at Superfund Sites" (PRG) Calculator*. https://epa-prgs.ornl.gov/radionuclides/

USEPA, *Statistical Software ProUCL 5.2 for Environmental Applications for Data Sets with and without Nondetect Observations*, Updated June 2022. https://www.epa.gov/land-research/proucl-software

USEPA, *Radionuclide Basics: Radium*, dated July 2021. https://www.epa.gov/radiation/radionuclide-basics-radium

USEPA Region 9, *Bayview Hunters Point's Parcel A is Suitable for Residential Use*, dated November 2020. https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.docdata&id=0902722

USEPA, *Distribution of OSWER Radiation Risk Assessment Q & A's Final Guidance, OSWER 9200.4-40*, dated June 2014.

USEPA, *Final Radiological Background Study Report, Santa Susana Field Laboratory, Ventura County, California*, dated October 2011.

USEPA, *Guidance on Surface Soil Cleanup at Hazardous Waste Sites: Implementing Cleanup Levels, Peer Review Draft*, dated April 2005.

United States Nuclear Regulatory Commission (NRC), *Doses in Our Daily Lives*, dated 13 May 2021. https://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html

NRC, *10 CFR 20 Subpart E, Radiological Criteria for License Termination, commonly referred to as the License Termination Rule (LTR)*.

TABLES

Table 1
Soil Analytical Results - Non-Metals
Hunters Point Block 52
San Francisco, California

Sample ID	Sample Depth	Date Sampled	Petroleum Hydrocarbons			VOCs				All Other VOCs	SVOCs							All Other SVOCs
			TPHg	TPHd	TPHmo	Ethylbenzene	M,P-Xylene	O-Xylene	Total Xylenes		Benzo (a) pyrene	Benzo(b) fluoranthene	Benzo(g,h,i) perylene	Dibenzofuran	Fluoranthene	Fluorene	Pyrene	
			(mg/kg)															
E-13-0.5	0.5	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.012	< 0.032	< 0.012	< 0.0065	< 0.0065	< 0.012	< 0.012	ND
E-13-1.5	1.5	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-13-3.0	3	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	< 0.0013	< 0.0013	< 0.0025	< 0.0025	ND
E-14-0.5	0.5	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-14-1.5	1.5	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	--	< 0.0025	< 0.0063	< 0.0025	< 0.0013	< 0.0013	< 0.0025	< 0.0025	ND
E-14-5.0	5	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	< 0.0013	< 0.0013	< 0.0025	< 0.0025	ND
E-15-0.5	0.5	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-15-1.5	1.5	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	< 0.0013	< 0.0013	< 0.0025	< 0.0025	ND
E-15-3.0	3	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-16-0.5	0.5	3/30/2022	< 1.0	3.4	46	--	--	--	--	--	--	--	--	--	--	--	--	--
E-16-1.5	1.5	3/30/2022	1.9	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.012	< 0.032	< 0.012	0.033	< 0.0065	0.019	< 0.012	ND
E-16-5.0	5	3/30/2022	< 1.0	< 2.0	48	--	--	--	--	--	--	--	--	--	--	--	--	--
E-17-0.5	0.5	3/30/2022	1.1	< 2.0	15	--	--	--	--	--	--	--	--	--	--	--	--	--
E-17-1.5	1.5	3/30/2022	< 1.0	< 2.0	15	--	--	--	--	--	--	--	--	--	--	--	--	--
E-17-3.0	3	3/30/2022	< 1.0	16	120	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.025	< 0.063	< 0.025	< 0.013	< 0.013	< 0.025	< 0.025	ND
E-18-0.5	0.5	3/30/2022	1.7	< 2.0	18	0.027	0.1	0.022	0.12	ND	< 0.0050	< 0.013	< 0.0050	0.0058	0.0034	< 0.0050	< 0.0050	ND
E-18-1.5	1.5	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-18-3.0	3	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-19-0.5	0.5	3/30/2022	< 1.0	< 2.0	25	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.012	< 0.032	< 0.012	< 0.0065	0.0081	< 0.012	< 0.012	ND
E-19-3.0	3	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	< 0.0013	< 0.0013	< 0.0025	< 0.0025	ND
E-19-5.0	5	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-19-7.5	7.5	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-20-0.5	0.5	3/30/2022	< 1.0	< 2.0	42	--	--	--	--	--	--	--	--	--	--	--	--	--
E-20-1.5	1.5	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	0.0022	< 0.0013	< 0.0025	< 0.0025	ND
E-20.5.0	5	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	< 0.0013	< 0.0013	< 0.0025	< 0.0025	ND
E-20-10.0	10	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-21-0.5	0.5	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-21-1.5	1.5	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	0.0059	0.014	0.0086	0.0062	< 0.0026	0.005	0.0061	ND
E-21-3.0	3	3/30/2022	< 1.0	< 2.0	16	--	--	--	--	--	--	--	--	--	--	--	--	--
E-21-5.0	5	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	< 0.0013	< 0.0013	< 0.0025	< 0.0025	ND
E-22-0.5	0.5	3/30/2022	< 1.0	< 2.0	13	--	--	--	--	--	--	--	--	--	--	--	--	--
E-22-3.0	3	3/30/2022	< 1.0	< 2.0	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	< 0.0013	< 0.0013	< 0.0025	< 0.0025	ND
E-23-0.5	0.5	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-23-1.5	1.5	3/30/2022	< 1.0	47	600	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.25	< 0.63	< 0.25	< 0.13	< 0.13	< 0.25	< 0.25	ND
E-23-7.5	7.5	3/30/2022	< 1.0	14	350	--	--	--	--	--	--	--	--	--	--	--	--	--
E-24-0.5	0.5	3/30/2022	1.4	3.1	27	--	--	--	--	--	--	--	--	--	--	--	--	--
E-24-3.0	3	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
E-24-7.5	7.5	3/30/2022	< 1.0	7.6	< 10	< 0.0050	< 0.0050	< 0.0050	< 0.0050	ND	< 0.0025	< 0.0063	< 0.0025	0.002	0.0014	< 0.0025	< 0.0025	ND
E-24-10.0	10	3/30/2022	< 1.0	< 2.0	< 10	--	--	--	--	--	--	--	--	--	--	--	--	--
Environmental Screening Levels[1]																		
Residential			430	260	12,000	5.9	--	--	580	Various	0.11	1.1	--	--	2,400	2,400	1,800	Various

LANGAN

Table 1
Soil Analytical Results - Non-Metals
Hunters Point Block 52
San Francisco, California

Sample ID	Sample Depth	Date Sampled	OCPs									All Other OCPs	PCBs	Sulfide	Cyanide	pH	Asbestos
			g-BHC	alpha-Chlordane	gamma-Chlordane	DDD	DDE	DDT	Dieldrin	Endosulfan II	Toxaphene						
			(mg/kg)														%
E-13-0.5	0.5	3/30/2022	< 0.00050	< 0.00050	< 0.00050	< 0.00050	0.00053	0.00091	< 0.00050	< 0.00050	< 0.025	ND	ND	--	--	--	--
E-13-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.75
E-13-3.0	3	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	< 1.0	< 1.8	8.31	< 0.25
E-14-0.5	0.5	3/30/2022	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.0050	ND	ND	--	--	--	< 0.25
E-14-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
E-14-5.0	5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.25
E-15-0.5	0.5	3/30/2022	< 0.00010	< 0.00010	0.00011	0.00022	0.0017	0.0016	< 0.00010	< 0.00010	< 0.0050	ND	ND	--	--	--	--
E-15-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
E-15-3.0	3	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.25
E-16-0.5	0.5	3/30/2022	< 0.00010	0.00017	0.0002	0.0012	0.002	0.0085	0.00012	< 0.00010	< 0.0050	ND	ND	--	--	--	2.75
E-16-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
E-16-5.0	5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	> 10
E-17-0.5	0.5	3/30/2022	< 0.00010	0.00023	0.00027	0.00059	0.004	0.0053	< 0.00010	< 0.00010	< 0.0050	ND	ND	--	--	--	--
E-17-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.50
E-17-3.0	3	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.25
E-18-0.5	0.5	3/30/2022	< 0.00010	< 0.00010	< 0.00010	0.00018	0.00058	0.00077	< 0.00010	< 0.00010	< 0.0050	ND	ND	--	--	--	--
E-18-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.50
E-18-3.0	3	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.00
E-19-0.5	0.5	3/30/2022	< 0.00010	< 0.00010	< 0.00010	0.00023	0.00058	0.00089	< 0.00010	< 0.00010	< 0.0050	ND	ND	--	--	--	--
E-19-3.0	3	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.75
E-19-5.0	5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5
E-19-7.5	7.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.25
E-20-0.5	0.5	3/30/2022	< 0.00050	0.0014	0.0018	0.0011	0.0015	0.0032	< 0.00050	< 0.00050	< 0.025	ND	ND	--	--	--	--
E-20-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.25
E-20.5.0	5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.25
E-20-10.0	10	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	> 10
E-21-0.5	0.5	3/30/2022	< 0.00010	< 0.00010	< 0.00010	0.00018	0.0007	0.00082	< 0.00010	< 0.00010	0.019	ND	ND	--	--	--	6.5
E-21-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
E-21-3.0	3	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
E-21-5.0	5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	> 10
E-22-0.5	0.5	3/30/2022	< 0.00020	< 0.00020	0.00025	0.00053	0.0028	0.0044	< 0.00020	< 0.00020	< 0.010	ND	ND	--	--	--	2.75
E-22-3.0	3	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	< 1.0	< 2.0	8.54	2
E-23-0.5	0.5	3/30/2022	< 0.00020	0.00075	0.00089	0.003	0.004	0.02	0.00052	0.00023	< 0.010	ND	ND	--	--	--	--
E-23-1.5	1.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.25
E-23-7.5	7.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.75
E-24-0.5	0.5	3/30/2022	0.00028	0.00038	0.00042	0.00043	0.0017	0.0036	0.0005	< 0.00010	< 0.0050	ND	ND	--	--	--	0.75
E-24-3.0	3	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	> 10
E-24-7.5	7.5	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.5
E-24-10.0	10	3/30/2022	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.25
Environmental Screening Levels[1]																	
Residential			0.55	--	--	2.7	1.8	1.9	0.037	--	0.51	Various	0.23	--	--	--	--

LANGAN

Table 1
Soil Analytical Results - Non-Metals
Block 52 54
11 Innes Court
San Francisco, California

Notes:

[1] - Residential Environmental Screening Levels (ESLs), San Francisco Bay Regional Water Quality Control Board (RWQCB),Direct Exposure Human Health Risk Screening Levels, Shallow Soil Exposure (Table S-1) 2019

Asbestos by California Air Resource Board (CARB) 435 Method

DDD - Dichlorodiphenyldichloroethane

DDE - Dichlorodiphenyldichloroethylene

DDT - Dichlorodiphenyltrichloroethane

OCPs - Organochlorine Pesticides, EPA Method 8081A

PCBs - Polychlorinated Biphenyls, EPA Method 8082

SVOCs - Semi-volatile Organic Compounds, EPA Method 8270C

TPHd - Total Petroleum Hydrocarbons as Diesel, EPA Method 8015M

TPHg - Total Petroleum Hydrocarbons as Gasoline, EPA Method 8015M

TPHmo - Total Petroleum Hydrocarbons as Motor Oil, EPA Method 8015M

VOCs - Volatile Organic Compounds, EPA Method 8260B

mg/kg - milligrams per kilograms

ND - Not detected at or above the laboratory reporting limit

– Not Analyzed or criteria not established

< 1.0 - Analyte was not detected at or above the laboratory reporting limit

LANGAN

Table 2
Soil Analytical Results - Metals
Hunters Point Block 52
San Francisco, California

Sample ID	Sample Depth	Date Sampled	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	STLC Chromium	TCLP Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	STLC Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
			(mg/kg)						(mg/L)		(mg/kg)						(mg/L)	(mg/kg)				
E-13-0.5	0.5	3/30/2022	< 0.50	2.0	98	0.52	< 0.50	260	0.32	< 0.10	35	38	6.9	0.099	< 0.50	560	5.7	< 0.50	< 0.50	< 0.50	58	63
E-13-1.5	1.5	3/30/2022	< 0.50	5.2	36	< 0.50	< 0.50	310	0.27	< 0.10	35	69	4.4	0.087	< 0.50	540	5.6	< 0.50	< 0.50	< 0.50	57	55
E-13-3.0	3.0	3/30/2022	--	--	--	--	< 0.50	260	0.15	< 0.10	--	--	4	--	--	400	5.1	--	--	--	--	62
E-14-0.5	0.5	3/30/2022	--	--	--	--	< 0.50	190	0.12	< 0.10	--	--	< 2.5	--	--	80	--	--	--	--	--	75
E-14-1.5	1.5	3/30/2022	< 0.50	1.2	120	< 0.50	< 0.50	150	0.15	< 0.10	37	86	< 0.50	< 0.050	1.1	55	--	< 0.50	< 0.50	< 0.50	*220*	78
E-14-5.0	5.0	3/30/2022	2.7	1.2	120	< 0.50	< 0.50	170	0.47	< 0.10	35	86	0.82	< 0.050	1.3	120	--	< 0.50	< 0.50	< 0.50	*200*	71
E-15-0.5	0.5	3/30/2022	2.9	8.6	140	< 0.50	< 0.50	500	0.71	< 0.10	48	36	7.1	0.088	0.77	830	6.1	< 0.50	< 0.50	< 0.50	79	65
E-15-1.5	1.5	3/30/2022	--	--	--	--	< 0.50	120	0.12	< 0.10	--	--	0.64	--	--	59	--	--	--	--	--	76
E-15-3.0	3.0	3/30/2022	< 0.50	< 0.50	94	< 0.50	< 0.50	70	0.11	--	33	87	< 0.50	< 0.050	0.56	45	--	< 0.50	< 0.50	< 0.50	*130*	59
E-16-0.5	0.5	3/30/2022	--	--	--	--	< 0.50	240	0.73	< 0.10	--	--	10	--	--	400	4.8	--	--	--	--	60
E-16-1.5	1.5	3/30/2022	< 0.50	6.2	85	0.56	< 0.50	530	0.76	< 0.10	42	37	6.1	0.099	< 0.50	770	9.1	< 0.50	< 0.50	< 0.50	80	65
E-16-5.0	5.0	3/30/2022	--	--	--	--	< 0.50	300	1.1	< 0.10	--	--	1.3	--	--	1,500	9.5	--	--	--	--	28
E-17-0.5	0.5	3/30/2022	0.7	4.8	110	0.59	< 0.50	230	0.98	< 0.10	26	22	6.4	0.077	0.59	390	5.6	< 0.50	0.57	< 0.50	53	49
E-17-1.5	1.5	3/30/2022	0.6	5	97	< 0.50	< 0.50	400	0.34	< 0.10	44	34	6.6	*0.21*	< 0.50	800	4.1	< 0.50	< 0.50	< 0.50	58	57
E-17-3.0	3.0	3/30/2022	--	--	--	--	< 0.50	230	0.49	< 0.10	--	--	16	--	--	370	4.1	--	--	--	--	69
E-18-0.5	0.5	3/30/2022	0.55	3.7	110	< 0.50	< 0.50	350	0.57	< 0.10	36	23	6.5	0.069	< 0.50	620	4.1	< 0.50	< 0.50	< 0.50	48	44
E-18-1.5	1.5	3/30/2022	< 0.50	< 0.50	270	0.56	< 0.50	470	0.17	< 0.10	39	33	6.8	< 0.050	< 0.50	660	2.6	< 0.50	< 0.50	< 0.50	93	77
E-18-3.0	3.0	3/30/2022	--	--	--	--	< 0.50	560	0.45	< 0.10	--	--	0.79	--	--	1,200	5	--	--	--	--	49
E-19-0.5	0.5	3/30/2022	--	--	--	--	< 0.50	360	0.25	< 0.10	--	--	7.4	--	--	580	2.6	--	--	--	--	61
E-19-3.0	3.0	3/30/2022	< 0.50	1.2	22	< 0.50	< 0.50	*1500*	0.4	< 0.10	74	38	3.2	0.096	< 0.50	1,600	4.8	< 0.50	< 0.50	< 0.50	59	46
E-19-5.0	5.0	3/30/2022	< 0.50	< 0.50	82	< 0.50	< 0.50	510	0.26	< 0.10	37	24	3.5	0.094	< 0.50	700	5.0	< 0.50	< 0.50	< 0.50	49	51
E-19-7.5	7.5	3/30/2022	--	--	--	--	< 0.50	390	0.2	< 0.10	--	--	4.5	--	--	710	5.7	--	--	--	--	54
E-20-0.5	0.5	3/30/2022	< 0.50	3.4	69	< 0.50	< 0.50	170	0.25	< 0.10	25	15	7.1	< 0.050	< 0.50	380	3.3	< 0.50	< 0.50	< 0.50	49	43
E-20-1.5	1.5	3/30/2022	< 0.50	4.3	120	< 0.50	< 0.50	300	0.36	< 0.10	35	31	5.5	0.086	< 0.50	610	6.4	< 0.50	< 0.50	< 0.50	58	56
E-20-10.0	10.0	3/30/2022	< 0.50	0.62	37	< 0.50	< 0.50	*900*	0.48	< 0.10	69	8	< 0.50	< 0.050	< 0.50	*1,700*	6.0	< 0.50	< 0.50	< 0.50	25	25
E-21-0.5	0.5	3/30/2022	--	--	--	--	< 0.50	200	1.4	< 0.10	--	--	5.5	--	--	470	6.2	--	--	--	--	70
E-21-1.5	1.5	3/30/2022	< 0.50	4.2	93	< 0.50	< 0.50	250	1.3	< 0.10	57	27	3.7	0.053	< 0.50	1,000	12.0	< 0.50	< 0.50	< 0.50	52	47
E-21-3.0	3.0	3/30/2022	< 0.50	3.2	54	1.1	< 0.50	120	0.26	< 0.10	26	9.7	6.2	0.055	< 0.50	390	3.6	< 0.50	< 0.50	< 0.50	34	51
E-21-5.0	5.0	3/30/2022	--	--	--	--	< 0.50	*950*	1.8	< 0.10	--	--	< 0.50	--	--	*1,700*	14.0	--	--	--	--	30
E-22-0.5	0.5	3/30/2022	0.6	4	81	< 0.50	< 0.50	*880*	1.9	< 0.10	54	26	5.1	0.056	< 0.50	1,100	9.5	< 0.50	< 0.50	< 0.50	57	53
E-22-3.0	3.0	3/30/2022	< 0.50	0.65	28	< 0.50	< 0.50	*780*	1.6	0.11	86	14	3.3	< 0.050	< 0.50	*1,800*	6.8	< 0.50	< 0.50	< 0.50	34	30
E-23-0.5	0.5	3/30/2022	0.7	6.7	210	0.58	< 0.50	210	0.15	< 0.10	27	34	9.2	*0.12*	0.7	330	0.9	< 0.50	< 0.50	< 0.50	85	77
E-23-1.5	1.5	3/30/2022	--	--	--	--	< 0.50	240	2	< 0.10	--	--	7.1	--	--	500	12.0	--	--	--	--	42
E-23-7.5	7.5	3/30/2022	< 0.50	4	160	< 0.50	< 0.50	230	1.3	< 0.10	38	29	14	0.07	1.7	690	4.6	< 0.50	< 0.50	< 0.50	70	54
E-24-0.5	0.5	3/30/2022	0.56	6.8	140	0.58	< 0.50	220	0.47	< 0.10	27	26	7.8	0.067	0.53	350	3.9	< 0.50	0.67	< 0.50	64	69

LANGAN

Table 2
Soil Analytical Results - Metals
Hunters Point Block 52
San Francisco, California

Sample ID	Sample Depth	Date Sampled	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	STLC Chromium	TCLP Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	STLC Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
			(mg/kg)						(mg/L)		(mg/kg)						(mg/L)	(mg/kg)				
E-24-3.0	3.0	3/30/2022	--	--	--	--	< 0.50	*910*	2.3	< 0.10	--	--	< 0.50	--	--	*1,900*	8.1	--	--	--	--	33
E-24-7.5	7.5	3/30/2022	< 0.50	1.1	17	< 0.50	< 0.50	*880*	4.3	< 0.10	80	13	< 0.50	< 0.050	< 0.50	*1,900*	16	< 0.50	< 0.50	< 0.50	26	27
E-24-10.0	10.0	3/30/2022	--	--	--	--	< 0.50	*720*	2.6	< 0.10	--	--	< 0.50	--	--	***3,000***	**26**	--	--	--	--	56
Hazardous Waste Criteria																						
TTLC			500	500	10,000	75	100	2,500	--	--	8,000	2,500	1,000	20	3,500	2,000	--	100	500	700	2,400	5,000
STLC			15	5	--	0.75	1	--	5	--	80	25	--	0.2	350	--	20	1	5	7.0	24	--
TCLP			--	5	--	--	1	--	--	5	--	--	--	0.2	--	--	--	1	5	--	--	--
Screening Criteria																						
Residential ESLs[1]			11	0.067	15,000	16	78	120,000	--	--	23	3,100	80	13	390	820	--	390	390	0.78	390	23,000
Background Metals in Bay Area[2]			1.5-7.1	1.2-31	41-411	3	0.27-3.3	10-142	--	--	6.5-25.5	5.4-100	4.8-65	0.07-0.6	0.33-11.4	16-144	--	< 0.25-7	0.2-2.2	< 0.25-42.5	22-90	33-282
Background Metals in Hunters Point[3]			5.21-11.34	5.73-8.76	210.17-593.21	0.61-0.75	0.85-2.13	--	--	--	--	35.23-91.54	5.96-34.05	0.15-2.94	0.85-2.81	--	--	0.59-5.20	0.62-1.43	0.56-0.99	87.00-129.26	70.37-371.69
Background Metals in Innes Ave[4]			NA	1.08-2.84	6.59-47.5	--	--	460-662	--	--	84.4-113	27.1-28.6	58.9-85.4	.0812-0.36	--	1,630*	--	--	--	2.71-8.25	12.6-34.6	32.7-99.4

Notes:

[1] Residential Environmental Screening Levels (ESLs), San Francisco Bay Regional Water Quality Control Board (RWQCB),Direct Exposure Human Health Risk Screening Levels, Shallow Soil Exposure (Table S-1) 2019. The lower of the cancer risk or non-cancer hazard ESL listed (where applicable).

[2] Background metals in Bay Area. Environmental Resources Management. Feasibility Study, Hookston Station, Pleasant Hill, California. Appendix A, Table A-2, "Comparison of Background Concentrations of Metals in Bay Area Soils," July 2006.

[3] 95% UCL of the 95 percentile (ambient levels) provided for all soil types, excluding Bay Mud. Navy, Calculation of Hunters Point Ambient Levels. August 1995.

[4] 95% UCL for soil and rock matrices for Innes Avenue dataset. Navy, Metals Concentrations in Franciscan Bedrock Outcrops: Three Sites in the Hunters Point Shear Zone and Marin Headlands Terrane Subunits, Hunters Point Shipyard, San Francisco, California. March 2004.

mg/kg - milligrams per kilograms
mg/L - milligrams per Liter
STLC - California Soluble Threshold Limit Concentration
TCLP - Federal Toxicity Characteristic Leaching Potential Analysis
TTLC - California Total Threshold Limit Concentration
< 0.5 - Analyte was not detected at or above the laboratory reporting limit
-- Not analyzed or not established
240 - Sample exceeds residential ESL and background concentrations
Bold - sample concentration exceeds hazardous waste criteria
Italics - Sample exceeds background metal concentrations

Table 3
Soil Analytical Results - Radionuclides
Block 52
San Francisco, California

Sample ID	Sample Depth (Feet)	Date Sampled	Americium-241			Cesium-137			Cobalt-60			Plutonium-239/240		
			Result	Uncertainty	DLC	Result	Uncertainty	DLC	Result	Uncertainty	DLC	Result	Uncertainty	DLC
			pCi/g			pCi/g			pCi/g			pCi/g		
E-13-0.5	0.5	3/30/2022	-0.0336	0.0858	0.0695	0.0168	0.0719	0.0581	0.0222	0.0366	0.0503	0.0324	0.0366	0.0195
E-13-1.5	1.5	3/30/2022	0.0478	0.107	0.0687	-0.0334	0.0697	0.0545	0.0747	0.0454	0.0132	0.00881	0.0277	0.0195
E-14-0.5	0.5	3/30/2022	0.0111	0.0619	0.0400	0.016	0.0414	0.032	0.0462	0.0344	0.0118	-0.00754	0.0107	0.0141
E-14-1.5	1.5	3/30/2022	0.0243	0.081	0.0656	-0.0148	0.0475	0.0375	0.00546	0.0045	0.0397	0.00461	0.0205	0.0144
E-15-0.5	0.5	3/30/2022	0.0655	0.141	0.114	0.0419	0.0691	0.0535	0.0352	0.0683	0.0308	-0.00931	0.0199	0.0206
E-15-1.5	1.5	3/30/2022	0.0245	0.0562	0.045	-0.014	0.0408	0.0323	-0.0068	0.088	0.0196	0.0221	0.0347	0.0209
E-16-0.5	0.5	3/30/2022	-0.034	0.11	0.0676	0.0469	0.0717	0.0556	-0.006	0.0131	0.0596	-0.0144	0.0144	0.019
E-16-1.5	1.5	3/30/2022	0.0603	0.0551	0.0410	-0.0399	0.0646	0.0503	0.0433	0.0265	0.00918	0.000728	0.0207	0.0167
E-17-0.5	0.5	3/30/2022	0.0103	0.109	0.0897	-0.022	0.0726	0.0585	0.0130	0.0267	0.053	-0.00568	0.0191	0.0186
E-17-1.5	1.5	3/30/2022	0.0513	0.115	0.0927	0.00688	0.0603	0.0492	0.0104	0.0627	0.0305	0.0296	0.0265	0.0098
E-18-0.5	0.5	3/30/2022	-0.0665	0.164	0.133	-0.0417	0.0851	0.0664	0.0364	0.0741	0.0345	0.00310	0.0265	0.0206
E-18-1.5	1.5	3/30/2022	-0.0672	0.168	0.137	0.057	0.100	0.0788	0.0635	0.0388	0.0135	0.00636	0.0127	0.0105
E-18-3.0	3.0	3/30/2022	0.0302	0.0697	0.0564	0.0281	0.0500	0.039	0.0055	0.0564	0.0294	0.0519	0.0473	0.0229
E-19-0.5	0.5	3/30/2022	-0.0276	0.111	0.0909	0.0115	0.0458	0.0366	-0.0239	0.0839	0.0393	0.00218	0.0137	0.00964
E-19-1.5	1.5	3/30/2022	-0.0212	0.0907	0.0687	0.025	0.0478	0.0366	-0.0303	0.104	0.0505	0.00212	0.0134	0.00939
E-20-0.5	0.5	3/30/2022	0.0302	0.0849	0.0569	-0.00781	0.0598	0.0485	0.0158	0.065	0.0318	0.000774	0.022	0.0178
E-20-1.5	1.5	3/30/2022	-0.0066	0.0713	0.0518	0.0105	0.0492	0.0397	-0.0013	0.061	0.0302	0.00674	0.0245	0.0172
E-21-0.5	0.5	3/30/2022	-0.0619	0.176	0.144	-0.004	0.103	0.0847	-0.0436	0.196	0.0928	0.00917	0.0288	0.0203
E-21-1.5	1.5	3/30/2022	-0.00813	0.100	0.0653	0.0487	0.0560	0.0410	-0.0902	0.116	0.0751	-0.00144	0.0154	0.0135
E-21-3.0	3.0	3/30/2022	-0.0592	0.0944	0.0819	-0.0796	0.0633	0.0914	0.0270	0.0588	0.0342	-0.00953	0.0203	0.0211
E-22-0.5	0.5	3/30/2022	0.0604	0.172	0.140	-0.00458	0.0790	0.0647	0.0111	0.0406	0.0544	0.00612	0.0122	0.0101
E-23-3.0	3.0	3/30/2022	0.0387	0.0834	0.0669	0.00940	0.0567	0.0459	-0.00345	0.0665	0.0344	-0.00292	0.0221	0.0194
E-24-0.5	0.5	3/30/2022	-0.0963	0.214	0.174	0.0378	0.0834	0.0656	-0.0284	0.137	0.0794	0.00493	0.0219	0.0154
E-24-1.5	1.5	3/30/2022	0.0918	0.0896	0.0582	0.000	0.0226	0.0532	-0.0402	0.107	0.0514	-0.00961	0.0205	0.0212
E-24-3.0	3.0	3/30/2022	0.00712	0.0861	0.0592	-0.0697	0.123	0.0965	0.0123	0.0367	0.0653	0.00509	0.0226	0.0159
Arithmetic (i.e. Mean) Averages			0.0029	-	-	0.0010	-	-	0.0059	-	-	0.0055	-	-
95th Percentile			0.0645			0.0483			0.0600			0.0318		
Percent Uncertainty of the Average			-	809%	-	-	1,403%	-	-	263%	-	-	87%	-
Limit of Quantitation			0.500	-	-	0.070	-	-	0.100	-	-	0.200	-	-
HPS Background Threshold Values[1]			-	-	-	0.141	-	-	-	-	-	0.515	-	-
SSFL Background Threshold Value[2]			0.0162			0.229			0.00556			0.0134		

LANGAN

Table 3
Soil Analytical Results - Radionuclides
Block 52
San Francisco, California

Sample ID	Sample Depth (Feet)	Date Sampled	Radium-226			Strontium-89/90			Thorium-232			Uranium-235/236		
			Result	Uncertainty	DLC	Result	Uncertainty	DLC	Result	Uncertainty	DLC	Result	Uncertainty	DLC
			pCi/g			pCi/g			pCi/g			pCi/g		
E-13-0.5	0.5	3/30/2022	0.303	0.150	0.0713	0.00728	0.0282	0.320	0.2530	0.109	0.0221	0.0268	0.0334	0.0132
E-13-1.5	1.5	3/30/2022	0.867	0.216	0.0689	0.0144	0.0274	0.0302	0.438	0.155	0.0254	0.0081	0.0162	0.0134
E-14-0.5	0.5	3/30/2022	0.157	0.106	0.0543	-0.00995	0.0223	0.0272	0.0327	0.0453	0.0201	0.0227	0.0263	0.0125
E-14-1.5	1.5	3/30/2022	0.26	0.131	0.0613	-0.0126	0.0232	0.0285	0.00526	0.042	0.0301	0.0262	0.0326	0.0129
E-15-0.5	0.5	3/30/2022	0.597	0.192	0.0793	0.0177	0.0237	0.0251	0.284	0.143	0.0315	0.0190	0.0294	0.0132
E-15-1.5	1.5	3/30/2022	0.0882	0.063	0.0323	0.0108	0.0287	0.0321	0.0262	0.042	0.0235	0.0162	0.0229	0.0134
E-16-0.5	0.5	3/30/2022	0.383	0.223	0.107	0.0143	0.0251	0.0276	0.326	0.135	0.0264	0.0251	0.0291	0.0139
E-16-1.5	1.5	3/30/2022	0.508	0.118	0.0365	0.00467	0.0193	0.0218	0.25	0.126	0.0399	0.0480	0.0394	0.0133
E-17-0.5	0.5	3/30/2022	0.596	0.172	0.0676	-0.0164	0.0198	0.0257	0.336	0.129	0.0232	0.0270	0.0337	0.0133
E-17-1.5	1.5	3/30/2022	0.484	0.152	0.0641	0.00284	0.0259	0.0298	0.397	0.136	0.0276	0.0085	0.0307	0.0216
E-18-0.5	0.5	3/30/2022	0.281	0.165	0.0743	0.00165	0.0231	0.0268	0.378	0.167	0.0725	0.0308	0.0309	0.0128
E-18-1.5	1.5	3/30/2022	0.396	0.205	0.0975	0.00991	0.0218	0.0241	0.413	0.145	0.0238	0.0239	0.0277	0.0132
E-18-3.0	3.0	3/30/2022	0.131	0.105	0.0556	-0.00484	0.0242	0.0287	0.04	0.0384	0.0159	-0.0059	0.0117	0.0156
E-19-0.5	0.5	3/30/2022	0.399	0.111	0.0361	0.0067	0.0211	0.0236	0.337	0.141	0.0335	0.0178	0.0277	0.0124
E-19-1.5	1.5	3/30/2022	0.580	0.191	0.079	0.0658	0.0318	0.0287	0.19	0.128	0.0631	0.0256	0.0318	0.0126
E-20-0.5	0.5	3/30/2022	0.833	0.198	0.0432	0.00975	0.0253	0.0282	0.323	0.107	0.0246	-0.0099	0.0140	0.0185
E-20-1.5	1.5	3/30/2022	0.53	0.146	0.0527	-0.00627	0.0228	0.0274	0.217	0.126	0.0311	0.0113	0.0255	0.0137
E-21-0.5	0.5	3/30/2022	0.946	0.262	0.0839	0.00343	0.0265	0.0304	0.397	0.167	0.0544	0.0208	0.0426	0.0275
E-21-1.5	1.5	3/30/2022	0.311	0.205	0.111	-0.00311	0.0236	0.0279	0.275	0.100	0.0181	0.0252	0.031	0.0124
E-21-3.0	3.0	3/30/2022	0.736	0.245	0.0848	-0.00346	0.0279	0.0329	0.297	0.117	0.0281	0.0144	0.032	0.0193
E-22-0.5	0.5	3/30/2022	0.0849	0.0894	0.232	-0.0102	0.0208	0.0255	0.322	0.127	0.0289	0.0169	0.0363	0.0229
E-23-3.0	3.0	3/30/2022	0.329	0.130	0.0571	-0.0275	0.0258	0.0333	0.245	0.116	0.0332	0.0207	0.0330	0.0177
E-24-0.5	0.5	3/30/2022	0.850	0.266	0.109	0.0398	0.0315	0.0323	0.408	0.111	0.0156	0.0200	0.0310	0.0139
E-24-1.5	1.5	3/30/2022	0.439	0.170	0.0871	0.0177	0.0251	0.027	0.338	0.109	0.0242	0.0320	0.0411	0.02
E-24-3.0	3.0	3/30/2022	0.477	0.184	0.0844	-0.0347	0.0254	0.0333	0.137	0.0761	0.0196	0.0440	0.0416	0.0136
Arithmetic (i.e. Mean) Averages			0.4626	-	-	0.0039	-	-	0.2666	-	-	0.0206	-	-
95th Percentile			0.8636			0.0354			0.4120			0.0416		
Percent Uncertainty of the Average			-	8%	-	-	128%	-	-	9%	-	-	30%	-
Limit of Quantitation			0.500	-	-	0.15	-	-	0.200	-	-	0.145	-	-
HPS Background Threshold Values[1]			0.861	-	-	0.15	-	-	1.63	-	-	0.145	-	-
SSFL Background Threshold Value[2]			1.88			0.075			2.95			0.130		

LANGAN

Table 3
Soil Analytical Results - Radionuclides
Hunters Point Block 52
San Francisco, California

Notes:

pCi/g - picocuries per gram

DLC - decision level concentration

LOQ - limit of quantitation

MDC - minimum detectable concentration

1. Navy, 2020. Memorandum to File Regarding Radiological Remediation Goals for Removal Site Evaluation Workplan for Parcels B, C, D-1, E, G, UC-1, UC-2, UC-3, Former Hunters Point Naval Shipyard, San Francisco California. 8 March.

2. USEPA Region 9, 2011. Final Radiological Background Study Report Santa Susana Field Laboratory (SSFL) Ventura County, California.

FIGURES

Legend

Approximate Site Boundary

Notes:
1. Topographic basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online Copyright: © 2011 National Geographic Society, i-cubed.

1,000 0 1,000
SCALE IN FEET

LANGAN
Langan Engineering and Environmental Services, Inc.
1 Almaden Boulevard, Suite 590
San Jose, CA 95113-2253
T: 408.551.6700 F: 408.551.0344 www.langan.com

Project	HUNTERS POINT SHIPYARD BLOCK 52 SAN FRANCISCO SAN FRANCISCO COUNTY CALIFORNIA
Figure Title	SITE LOCATION MAP
Project No.	770681000
Date	10/6/2022
Scale	1 " = 1,000 '
Drawn By	JNE
Figure	1

Path: \\langan.com\data\SJO\data0\770681001\Project Data\ArcGIS\MXD\Environmental_Figures\Site Location Map Block 52.mxd

Legend

- Approximate Location of Environmental Soil Boring, Langan 2022
- Site Boundary

Notes:
1. Aerial imagery provided by Langan's subscription to Nearmap.com. Aerial flown 09/16/2022.
2. All features shown are approximate.

50 0 50
SCALE IN FEET

LANGAN

Langan Engineering and Environmental Services, Inc.

1 Almaden Boulevard, Suite 590
San Jose, CA 95113-2253

T: 408.551.6700 F: 408.551.0344 www.langan.com

Project
HUNTERS POINT SHIPYARD BLOCK 52

SAN FRANCISCO

SAN FRANCISCO COUNTY CALIFORNIA

Drawing Title
SITE PLAN WITH SAMPLING LOCATIONS

Project No.	770681000
Date	10/6/2022
Scale	1 " = 50 '
Drawn By	JNE

Figure
2

Path: \\langan.com\data\SJO\data0\770681001\Project Data\ArcGIS\MXD\Environmental_Figures\Site Layout Block 52.mxd

Legend

- Approximate Location of Environmental Soil Boring, Langan 2022
- Site Boundary
- Approximate Location of Class I Non-RCRA State of California Hazardous Waste
- 8.75'-10' Approximate Depth of Class I Non-RCRA State of California Hazardous Waste

Notes:
1. Aerial imagery provided by Langan's subscription to Nearmap.com. Aerial flown 09/16/2022.
2. All features shown are approximate.

50 0 50
SCALE IN FEET

LANGAN
Langan Engineering and Environmental Services, Inc.
1 Almaden Boulevard, Suite 590
San Jose, CA 95113-2253
T: 408.551.6700 F: 408.551.0344 www.langan.com

Project
HUNTERS POINT SHIPYARD BLOCK 52
SAN FRANCISCO
SAN FRANCISCO COUNTY CALIFORNIA

Drawing Title
SITE PLAN WITH ESTIMATED EXTENT OF CLASS I NON-RCRA MATERIAL

Project No.	770681000
Date	10/6/2022
Scale	1 " = 50 '
Drawn By	JNE

Figure 3

Path: \\langan.com\data\SJO\data0\770681001\Project Data\ArcGIS\MXD\Environmental_Figures\Site Layout Block 52 with Haz Waste.mxd

APPENDIX A

EXPLORATORY BORING LOGS

PROJECT:	**HUNTERS POINT BLOCK 52** **San Francisco, California**	**Log of Boring E-13** PAGE 1 OF 1
Boring location: See Site Plan, Figure 2		Logged by: D. Wood Drilled By: Gregg Drilling
Date started: 03/30/22	Date finished: 03/30/22	
Drilling method: Direct Push (DPT)		
Hammer weight/drop: NA	Hammer type: NA	
Sampler: Geoprobe		

DEPTH (feet)	SAMPLES: Sample Number	SAMPLES: Sample	SAMPLES: Blow Count	SAMPLES: Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-13-0.5				0.0	GP	CLAYEY GRAVEL (GP) brown, loose, dry, no odor
1	E-13-1.5				0.0	CL	SANDY CLAY (CL) brown, stiff, dry, slightly plastic, no odor
2				48/ 48"	0.0		
3	E-13-3.0				0.0		
4					0.0		
5	E-13-5.0				0.0		
6				48/ 48"	0.0		
7					0.0	SC	CLAYEY SAND (SC) brown, dense, dry, no odor
8					0.0		
9					0.0		
10				36/ 36"	0.0		
11					0.0	SC	CLAYEY SAND (SC) brown, dense, dry, slightly plastic, no odor
12					0.0		
13				36/ 36"	0.0	GP	GRAVEL SAND MIXTURE (GP) brown and gray, medium dense, dry, no odor
14					0.0		Refusal at 14 feet
15							
16							
17							
18							
19							
20							

End of boring at 14 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.:	Figure:
770681001	A-13

TEST ENVIRONMENTAL INCHES 770681001_HUNTERS POINT_52-ENV.GPJ TEMPLATE_CA-MODIFIED.GDT 10/12/22

PROJECT:	**HUNTERS POINT BLOCK 52** **San Francisco, California**	**Log of Boring E-14** PAGE 1 OF 1
Boring location: See Site Plan, Figure 2		Logged by: D. Wood Drilled By: Gregg Drilling
Date started: 03/30/22	Date finished: 03/30/22	
Drilling method: Direct Push (DPT)		
Hammer weight/drop: NA	Hammer type: NA	
Sampler: Geoprobe		

DEPTH (feet)	SAMPLES: Sample Number	SAMPLES: Sample	SAMPLES: Blow Count	SAMPLES: Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-14-0.5				0.0	GP	SANDY GRAVEL (GP) brown, loose, dry, no odor
1	E-14-1.5				0.0		SILTY SAND (SM) light brown, medium dense, dry, no odor, rock fragments increase over depth
2				48/ 48"	0.0		
3	E-14-3.0				0.0		
4					0.0		
5	E-14-5.0				0.0		
6				48/ 48"	0.0	SM	
7					0.0		
8					0.0		
9					0.0		
10				48/ 48"	0.0		
11							WEATHERED SERPENTINITE ROCK brown, black and green, medium dense, dry, no odor, serpentinite fragments. weathered serpentinite rock pulverized by geoprobe
12							Refusal at 12 feet
13							
14							
15							
16							
17							
18							
19							
20							

End of boring at 12 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.:	Figure:
770681001	A-14

TEST ENVIRONMENTAL INCHES 770681001_HUNTERS POINT_52-ENV.GPJ TEMPLATE_CA-MODIFIED.GDT 10/12/22

PROJECT:	**HUNTERS POINT BLOCK 52** **San Francisco, California**	**Log of Boring E-15** PAGE 1 OF 1
Boring location: See Site Plan, Figure 2		Logged by: D. Wood Drilled By: Gregg Drilling
Date started: 03/30/22	Date finished: 03/30/22	
Drilling method: Direct Push (DPT)		
Hammer weight/drop: NA	Hammer type: NA	
Sampler: Geoprobe		

DEPTH (feet)	SAMPLES: Sample Number	SAMPLES: Sample	SAMPLES: Blow Count	SAMPLES: Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-15-0.5				0.0	GP	SANDY GRAVEL (GP) brown, loose, dry, no odor
1	E-15-1.5			36/ 36"	0.0	SP	GRAVELLY SAND (SP) light brown, loose, dry, no odor
2					0.0		
3	E-15-3.0				0.0		
4	E-15-4.0			12/ 12"	0.0		Refusal at 4 feet
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

End of boring at 4 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.:	Figure:
770681001	A-15

TEST ENVIRONMENTAL INCHES 770681001_HUNTERS POINT_52-ENV.GPJ TEMPLATE_CA-MODIFIED.GDT 10/12/22

PROJECT: **HUNTERS POINT BLOCK 52**
San Francisco, California

Log of Boring E-16

Boring location: See Site Plan, Figure 2

Logged by: D. Wood
Drilled By: Gregg Drilling

Date started: 03/30/22 | Date finished: 03/30/22

Drilling method: Direct Push (DPT)

Hammer weight/drop: NA | Hammer type: NA

Sampler: Geoprobe

DEPTH (feet)	SAMPLES: Sample Number	Sample	Blow Count	Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-16-0.5	●			0.0	GP	SANDY GRAVEL (GP) gray-brown, medium dense, dry, no odor
1	E-16-1.5	●			0.0	CL	SANDY CLAY (CL) brown, stiff, dry, slightly plastic, no odor
2				48/ 48"	0.0		
3	E-16-3.0	●			0.0		WEATHERED SERPENTINITE ROCK green and black, medium dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
4	E-16-4.0	●			0.0		
5				24/ 24"	0.0		
6					0.0		
7				24/ 24"	0.0		
8					0.0		
9					0.0		
10				48/ 48"	0.0		
11					0.0		
12					0.0		
13					0.0		
14				36/ 36"	0.0		
15					0.0		
16							
17							
18							
19							
20							

End of boring at 15 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.: 770681001 | Figure: A-16

PROJECT: **HUNTERS POINT BLOCK 52**
San Francisco, California

Log of Boring E-17

Boring location: See Site Plan, Figure 2

Logged by: D. Wood
Drilled By: Gregg Drilling

Date started: 03/30/22 Date finished: 03/30/22

Drilling method: Direct Push (DPT)

Hammer weight/drop: NA Hammer type: NA

Sampler: Geoprobe

DEPTH (feet)	Sample Number	Sample	Blow Count	Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-17-0.5				0.0	GP	SANDY GRAVEL (GP) gray-brown, medium dense, dry, no odor
1	E-17-1.5				0.0	CL	SANDY CLAY (CL) dark brown, stiff, dry, slightly plastic, no odor, some gravel
2				48/ 48"	0.0		
3	E-17-3.0				0.0		
4					0.0		
5	E-17-5.0				0.0		
6				48/ 48"	0.0	SC	CLAYEY SAND (SC) green and black, medium dense, dry, no odor, some gravel
7					0.0		
8					0.0		
9					0.0		WEATHERED SERPENTINITE ROCK green and gray, dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
10				36/ 36"	0.0		
11					0.0		
12				24/ 24"	0.0		
13					0.0		
14				24/ 24"	0.0		
15					0.0		
16							
17							
18							
19							
20							

End of boring at 15 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.: 770681001 Figure: A-17

PROJECT: **HUNTERS POINT BLOCK 52**
San Francisco, California

Log of Boring E-18

Boring location: See Site Plan, Figure 2

Logged by: D. Wood
Drilled By: Gregg Drilling

Date started: 03/30/22 Date finished: 03/30/22

Drilling method: Direct Push (DPT)

Hammer weight/drop: NA Hammer type: NA

Sampler: Geoprobe

DEPTH (feet)	Sample Number	Sample	Blow Count	Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-18-0.5	●			0.0	CL	SANDY CLAY (CL) gray-brown, stiff, dry, slightly plastic, no odor, rock chunks
1	E-18-1.5	●			0.0	SP	GRAVELLY SAND (SP) dark brown, loose, dry, no odor, some gravel
2				48/ 48"	0.0		
3	E-18-3.0	●			0.0		WEATHERED SERPENTINITE ROCK green and tan, medium dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
4					0.0		
5	E-18-5.0	●			0.0		
6				36/ 36"	0.0		
7					0.0		
8					0.0		
9				36/ 36"	0.0		
10					0.0		
11				24/ 24"	0.0		
12					0.0		Refusal at 12 feet
13							
14							
15							
16							
17							
18							
19							
20							

End of boring at 12 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.: 770681001 Figure: A-18

PROJECT: **HUNTERS POINT BLOCK 52**
San Francisco, California

Log of Boring E-19

Boring location: See Site Plan, Figure 2

Logged by: D. Wood
Drilled By: Gregg Drilling

Date started: 03/30/22 Date finished: 03/30/22

Drilling method: Direct Push (DPT)

Hammer weight/drop: NA Hammer type: NA

Sampler: Geoprobe

DEPTH (feet)	Sample Number	Sample	Blow Count	Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-19-0.5				0.0	GP	SANDY GRAVEL (GP) gray-brown, medium dense, dry, no odor, rock chunks
1	E-19-1.5				0.0	ML	CLAYEY SILT (ML) brown, stiff, dry, non plastic, no odor, rock fragments, serpentinite fragments
2				48/ 48"	0.0		
3	E-19-3.0				0.0		
4					0.0		
5	E-19-5.0				0.0		
6				48/ 48"	0.0		
7	E-19-7.5				0.0	CL	SILTY CLAY (CL) brown, medium stiff, dry, slightly plastic, no odor, rock fragments, serpentinite fragments
8					0.0		WEATHERED SERPENTINITE ROCK green and black, medium dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
9					0.0		
10	E-19-10.0			36/ 36"	0.0		
11					0.0		
12				24/ 24"	0.0		
13					0.0		
14				24/ 24"	0.0		
15	E-19-15.0				0.0		
16							
17							
18							
19							
20							

End of boring at 15 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.: 770681001 Figure: A-19

PROJECT:	**HUNTERS POINT BLOCK 52** **San Francisco, California**	**Log of Boring E-20** PAGE 1 OF 1
Boring location: See Site Plan, Figure 2		Logged by: D. Wood Drilled By: Gregg Drilling
Date started: 03/30/22	Date finished: 03/30/22	
Drilling method: Direct Push (DPT)		
Hammer weight/drop: NA	Hammer type: NA	
Sampler: Geoprobe		

DEPTH (feet)	SAMPLES: Sample Number	SAMPLES: Sample	SAMPLES: Blow Count	SAMPLES: Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-20-0.5	●			0.0	GP	SANDY GRAVEL (GP) gray, loose, dry, no odor
1	E-20-1.5	●			0.0	CL	SANDY CLAY (CL) black, stiff, dry, slightly plastic, no odor, gravel and rock fragments
2				48/ 48"	0.0		
3	E-20-3.0	●			0.0		
4					0.0		
5	E-20-5.0	●			0.0	SC	CLAYEY SAND (SC) brown, medium dense, dry, no odor, rock fragments, serpentinitefragments
6				48/ 48"	0.0		
7	E-20-7.5	●			0.0		
8					0.0		
9					0.0		WEATHERED SERPENTINITE ROCK green and tan, dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
10	E-20-10.0	●		48/ 48"	0.0		
11					0.0		
12					0.0		
13				36/ 36"	0.0		
14					0.0		
15	E-20-15.0	●			0.0		
16							
17							
18							
19							
20							

End of boring at 15 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.:	Figure:
770681001	A-20

TEST ENVIRONMENTAL INCHES 770681001_HUNTERS POINT_52-ENV.GPJ TEMPLATE_CA-MODIFIED.GDT 10/12/22

PROJECT: **HUNTERS POINT BLOCK 52**
San Francisco, California

Log of Boring E-21

Boring location: See Site Plan, Figure 2

Logged by: D. Wood
Drilled By: Gregg Drilling

Date started: 03/30/22 Date finished: 03/30/22

Drilling method: Direct Push (DPT)

Hammer weight/drop: NA Hammer type: NA

Sampler: Geoprobe

DEPTH (feet)	Sample Number	Sample	Blow Count	Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-21-0.5				0.0		GRAVELLY SAND (SP) brown, loose, dry, no odor
1	E-21-1.5				0.0	SP	
2				48/ 48"	0.0		
3	E-21-3.0				0.0		WEATHERED SERPENTINITE ROCK green, gray, and black, dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
4					0.0		
5	E-21-5.0				0.0		
6				48/ 48"	0.0		
7	E-21-7.5				0.0		
8					0.0		
9				24/ 24"	0.0		
10	E-21-10.0				0.0		Refusal at 10 feet
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

End of boring at 10 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.: 770681001 Figure: A-21

PROJECT: **HUNTERS POINT BLOCK 52**
San Francisco, California

Log of Boring E-22

Boring location: See Site Plan, Figure 2

Logged by: D. Wood
Drilled By: Gregg Drilling

Date started: 03/30/22 Date finished: 03/30/22

Drilling method: Direct Push (DPT)

Hammer weight/drop: NA Hammer type: NA

Sampler: Geoprobe

DEPTH (feet)	SAMPLES: Sample Number	Sample	Blow Count	Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-22-0.5				0.0	GP	SANDY GRAVEL (GP) brown, loose, dry, no odor
1	E-22-1.5				0.0	CL	SANDY CLAY (CL) brown, dense, dry, non plastic, no odor, rock and serpentinite fragments
2				48/ 48"	0.0		
3	E-22-3.0				0.0		
4					0.0		WEATHERED SERPENTINITE ROCK green, gray, and black, dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
5	E-22-5.0				0.0		
6				48/ 48"	0.0		
7	E-22-7.5				0.0		
8					0.0		Refusal at 8 feet
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

End of boring at 8 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.: 770681001 Figure: A-22

PROJECT: **HUNTERS POINT BLOCK 52**
San Francisco, California

Log of Boring E-23

Boring location: See Site Plan, Figure 2

Logged by: D. Wood
Drilled By: Gregg Drilling

Date started: 03/30/22 Date finished: 03/30/22

Drilling method: Direct Push (DPT)

Hammer weight/drop: NA Hammer type: NA

Sampler: Geoprobe

DEPTH (feet)	SAMPLES: Sample Number	Sample	Blow Count	Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-23-0.5				0.0	GP	SANDY GRAVEL (GP) brown and green, dense, dry, no odor
1	E-23-1.5				0.0		SANDY CLAY (CL) dark brown, dense, dry, slightly plastic, no odor, rock and serpentinite fragments
2				48/ 48"	0.0	CL	
3	E-23-3.0				0.0		
4					0.0		WEATHERED SERPENTINITE ROCK green and black, dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
5	E-23-5.0				0.0		
6				36/ 36"	0.0		
7	E-23-7.5				0.0		
8				24/ 24"	0.0		
9					0.0		Refusal at 9 feet
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

End of boring at 9 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.: 770681001 Figure: A-23

PROJECT: **HUNTERS POINT BLOCK 52**
San Francisco, California

Log of Boring E-24

Boring location: See Site Plan, Figure 2

Logged by: D. Wood
Drilled By: Gregg Drilling

Date started: 03/30/22 | Date finished: 03/30/22

Drilling method: Direct Push (DPT)

Hammer weight/drop: NA | Hammer type: NA

Sampler: Geoprobe

DEPTH (feet)	SAMPLES: Sample Number	Sample	Blow Count	Recovery (Inches)	OVM (ppm)	LITHOLOGY	MATERIAL DESCRIPTION
0	E-24-0.5	●			0.0	GP	SANDY GRAVEL (GP) gray and brown, dense, dry, no odor
1					0.0		
1	E-24-1.5	●			0.0	CL	SANDY CLAY (CL) brown, dense, dry, slightly plastic, no odor, gravel and rock fragments
2				48/ 48"	0.0		
3	E-24-3.0	●			0.0		WEATHERED SERPENTINITE ROCK green and black, dense, dry, no odor serpentinite fragments, weathered serpentinite rock pulverized by geoprobe
4					0.0		
5	E-24-5.0	●		24/ 24"	0.0		
6					0.0		
7	E-24-7.5	●		24/ 24"	0.0		
8					0.0		
9					0.0		
10	E-24-10.0	●		36/ 36"	0.0		
11					0.0		Refusal at 11 feet
12							
13							
14							
15							
16							
17							
18							
19							
20							

End of boring at 11 feet below ground surface.
Groundwater not encountered during drilling.

LANGAN

Project No.: 770681001 | Figure: A-24

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size)	**Gravels** (More than half of coarse fraction > no. 4 sieve size)	**GW**	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	**SW**	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	**Silts and Clays** LL = < 50	**ML**	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	**MH**	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		**PT**	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size in Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 4.76
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.075
coarse	No. 4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

Unstabilized groundwater level

Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered

Classification sample taken with Standard Penetration Test sampler

Undisturbed sample taken with thin-walled tube

Disturbed sample

Sampling attempted with no recovery

Core sample

Analytical laboratory sample

Sample taken with Direct Push or Drive sampler

Sonic

SAMPLER TYPE

C Core barrel

CA California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter

D&M Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube

O Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube

PT Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube

S&H Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter

SPT Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter

ST Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

LANGAN
Langan Engineering and Environmental Services, Inc.
1 Almaden Boulevard, Suite 590
San Jose, CA 95113
T: 408.283.3600 F: 408.283.3601 www.langan.com

Project: HUNTERS POINT BLOCK 52
SAN FRANCISCO
SAN FRANCISCO COUNTY CALIFORNIA

Figure Title: SOIL CLASSIFICATION CHART

Project No. 770681001
Date 05/06/2022
Drawn By AG
Checked By DW

Figure A-13

Filename: \\langan.com\data\SJO\data0\770681001\Project Data\CAD\01\2D-DesignFiles\Environmental\770681001-B-GI0101_Lab.dwg Date: 5/23/2022 Time: 14:06 User: agekas Style Table: Langan.stb Layout: SOIL CHART

APPENDIX B

NON-RADIOLOGICAL LABORATORY ANALYTICAL REPORTS

(PROVIDED IN ELECTRONIC VERSION ONLY)

APPENDIX C

RADIOLOGICAL LABORATORY ANALYTICAL REPORTS

(PROVIDED IN ELECTRONIC VERSION ONLY)

APPENDIX D

RADIOLOGICAL CALCULATIONS

APPENDIX D
RADIOLOGICAL EVALUATION
Block 52
San Francisco, California

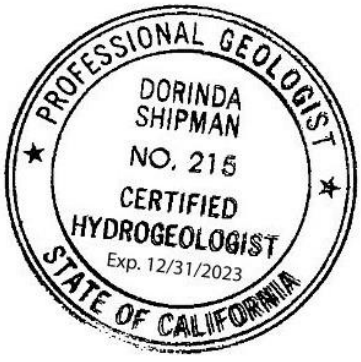
Prepared For:

Jonathan Rose Company
551 Fifth Avenue, 23rd Floor
New York, New York 10176

Prepared By:

Langan Engineering and Environmental Services, Inc.
135 Main Street, Suite 1500
San Francisco, California 94105

Peter J. Cusack
Associate Principal/VP



Dorinda Shipman, PG, CHG
Principal/VP

12 October 2022
770681001

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ATTACHMENTS

APPENDIX D
RADIOLOGICAL EVALUATION
Block 52
11 Innes Court
San Francisco, California

D1.0 INTRODUCTION

Appendix D presents estimated dose and risk associated with exposure to radionuclides detected in site soils. Results confirm that the concentrations of the radionuclides detected in site soils do not pose a risk to the public or to future residents.

Everyone is exposed to radiation every day from both natural sources (such as minerals in the ground) to man-made sources (such as medical x-rays). The average annual radiation dose per person in the United States is 620 millirem (mrem).[1] In general, exposure to this dose has not been shown to impact human health.[2] To provide a perspective on typical radiation dose or the amount of radiation energy absorbed by the body in everyday life, we provide a summary of the relative doses from common radiation sources in Figure D1. As presented in Figure D1, medical x-rays may result in exposure to four mrem of radiation during a single procedure. Living at sea level results in an exposure to cosmic radiation of 24 mrem per year. Radon, emitted from rock and soil, in an average home also may result in 200 mrem of radiation exposure on an annual basis. The U.S. Nuclear Regulatory Commission (NRC) annual dose rate criterion is 25 mrem per year.[3]

The USEPA recommends evaluating potential radiological exposure based on a risk range of E-06 to E-04. The risk range equates to the chance in 1,000,000 to the chance in 10,000 of a person exposed to developing cancer over a lifetime.

---

1 National Council on Radiation Protection and Measurement. Doses are commonly reported in millirems (mrem). A mrem is one thousandth of a rem (roentgen equivalent man), which is a unit used to measure adsorbed radiation dose.

2 https://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html

3 NRC. 10 CFR 20 Subpart E, Radiological Criteria for License Termination, commonly referred to as the License Termination Rule (LTR).

D2.0 RESRAD TOOL

The RESidual RADiation or RESRAD tool was used to evaluate the potential radiation dose of radionuclides detected in site soils. The RESRAD tool was developed by Argonne National Laboratory for the U.S. Department of Energy and is the most extensively verified and used tool to evaluate risk associated with the presence of radionuclides. This tool was used to review and confirm that the Block 52 test results presented in Table 3 of the main report do not pose a health risk to the public or to future residential users. The RESRAD tool is not intended to be used to evaluate background concentrations of radionuclides, such as those detected at Block 52, therefore, this evaluation is conservative and intended for informational purposes only.[4]

The RESRAD tool calculated the dose and the relative risk associated with exposure to average and 95th percentile concentrations in picocuries per gram (pCi/g) for each of the radionuclides. The calculations assumed radionuclide concentrations were uniformly distributed at the applicable concentration to a depth of two meters across the entirety of the site.

The following is a tabulated summary of the dose and risk computed for the radionuclides that showed a positive average concentration. Additional information regarding the RESRAD calculations (including assumptions) is presented in Attachment D1.

Dose and Risk Associated with Exposure to Average Radionuclide Concentrations:

Radionuclide	Site mean concentration (pCi/g)	Maximum annual dose rate (mrem/yr)	Mean concentration carcinogenic risk
Am-241	0.0029	0.0001873	1.623E-09 (0.000000001623)
Cs-137	0.0010	0.0017	2.964E-08 (0.00000002964)
Co-60	0.0059	0.04617	2.959E-07 (0.0000002959)
Pu-239	0.0055	0.0002937	1.297E-09 (0.000000001297)

[4] The RESRAD Tool is intended for estimating radiation doses and cancer risks to an individual located on top of radioactively contaminated soils, within which radionuclides are present in above-background concentrations. All radionuclides detected at Block 52 are considered background. Refer to: https://resrad.evs.anl.gov/

Radionuclide	Site mean concentration (pCi/g)	Maximum annual dose rate (mrem/yr)	Mean concentration carcinogenic risk
Ra-226	0.4626	2.775	6.206E-05 (0.00006206)
Sr-90	0.0039	0.0001005	1.023E-09 (0.000000001023)
Th-232	0.2666	2.109	4.913E-05 (0.00004913)
U-235	0.0206	0.008523	1.905E-07 (0.0000001905)

The following is a tabulated summary of the dose and risk computed for the 95th percentile for all radionuclides (as presented in Table 3 of the main report). Additional information regarding the RESRAD calculations (including assumptions) is presented in Attachment D1.

Dose and Risk Associated with Exposure to 95th Percentile Radionuclide Concentrations:

Radionuclide	95th percentile concentration (pCi/g)	Maximum annual dose rate (mrem/yr)	95th percentile concentration carcinogenic risk
Am-241	0.0645	0.004166	3.611E-08 (0.00000003611)
Cs-137	0.0483	0.08211	1.432E-06 (0.000001432)
Co-60	0.0600	0.4695	3.009E-06 (0.000003009)
Pu-239	0.0318	0.001698	7.498E-09 (0.000000007498)
Ra-226	0.8636	5.18	1.159E-04 (0.0001159)
Sr-90	0.0354	0.0009126	9.284E-09 (0.000000009284)
Th-232	0.4120	3.26	7.592E-05 (0.00007592)
U-235	0.0416	0.01721	3.847E-07 (0.0000003847)

As presented in the tables above, the maximum annual dose rates for the radionuclides range from 0.0001005 to 5.18 mrem/yr, which are well below the NRC's dose rate criteria of 25 mrem/yr. In addition, the risk values associated with these maximum annual dose rates range from 1.023E-09 to 1.159E-04, which are below or within the USEPA's risk range of E-06 to E-04. The risk range equates to the chance in 1,000,000 to the chance in 10,000 of a person exposed to developing cancer over a lifetime.

D3.0 PRG CALCULATOR

The USEPA's *Preliminary Remediation Goals (PRG) for Radionuclide Contaminants at Superfund Sites* calculator (PRG Calculator) is also used to evaluate radionuclides in soil.[5] Although Block 52 is not a remediation site, the PRG Calculator can also be used to analyze radionuclide concentrations at Block 52 as a basis of comparison against USEPA screening levels. The PRG Calculator calculates PRGs based on theoretical cancer risk levels. In consultation with USEPA, USEPA recommended considering a risk range of E-06 to E-04, which equates to the chance in 1,000,000 to the chance in 10,000 of a person exposed to developing cancer over a lifetime. The PRG Calculator is not intended to be used to evaluate background concentrations of radionuclides, such as those detected at Block 52, therefore, this evaluation is conservative and intended for informational purposes only.[6]

The PRG Calculator was used to calculate PRGs for the eight radionuclides. Two PRGs were calculated for each radionuclide to represent the USEPA's target risk range of E-06 to E-04. A summary of the methods and assumptions used to calculate the PRGs is provided in Attachment D1.

A summary of the calculated PRGs for the eight radionuclides of interest is presented in the table below. As presented below, the mean, 95th percentile, and maximum sampling results obtained for each radionuclide were compared to the PRGs for the E-06 to E-04 risk range. The maximum concentrations were considered to provide a conservative assessment of risk; however, an overall concentration comparison (i.e., mean or 95th percentile concentration) is generally

5 https://epa-prgs.ornl.gov/radionuclides/

6 The PRG Calculator User's Guide states that natural background radiation should be considered prior to applying PRGs as cleanup levels. Background and site-related levels of radiation will be addressed as they are for other contaminants at CERCLA sites. The CERCLA program, generally, does not clean up to concentrations below natural or anthropogenic background levels. All radionuclides detected at Block 52 are considered background. Refer to: https://epa-prgs.ornl.gov/radionuclides/users_guide.html

applicable for scenarios where the potential risk from direct human contact exposure is being evaluated.

Radionuclide	Site mean concentration (pCi/g)	Site 95th percentile concentration (pCi/g)	Site maximum concentration (pCi/g)	PRG E-06 to E-04 (pCi/g)
Am-241	0.0029	0.0645	0.0918	2.46 – 246
Cs-137	0.0010	0.0483	0.0569	0.0719 – 7.19
Co-60	0.0059	0.0600	0.0747	0.0388 – 3.88
Pu-239	0.0055	0.0318	0.0519	3.88 – 388
Ra-226	0.4626	0.8636	0.9460	0.0148 – 1.48
Sr-90	0.0039	0.0354	0.0658	4.21 – 421
Th-232	0.2666	0.4120	0.4380	0.0113 – 1.13
U-235	0.0206	0.0416	0.0480	0.277 – 27.7

All of the mean (i.e., average) and 95th percentile concentrations of radionuclides detected in site soil were within or below their respective risk range.

D4.0 CONCLUSIONS

As presented in the main report, the radiological testing results do not indicate the presence of radionuclides above background levels or the presence of radionuclides at levels that would indicate a release from a contaminant source at the site. In addition, the calculated maximum annual dose rate and relative risk associated with exposure to the maximum annual dose rate were calculated using RESRAD for each radionuclide considered. The maximum annual dose rates were well below the NRC's dose rate criteria of 25 mrem/yr. The risk values associated with these maximum annual dose rates were below or within the USEPA's acceptable risk range of E-06 to E-04. PRGs were also calculated using the USEPA's acceptable risk range of E-06 to E-04. All of the mean (i.e., average), 95th percentile, or maximum concentrations of radionuclides detected in site soil were below or within the accepted risk range or otherwise within expected background ranges. Based on the above dose and risk evaluations, the sampling results make it clear that the concentrations of the radionuclides tested do not pose a risk to the public or to future residents.

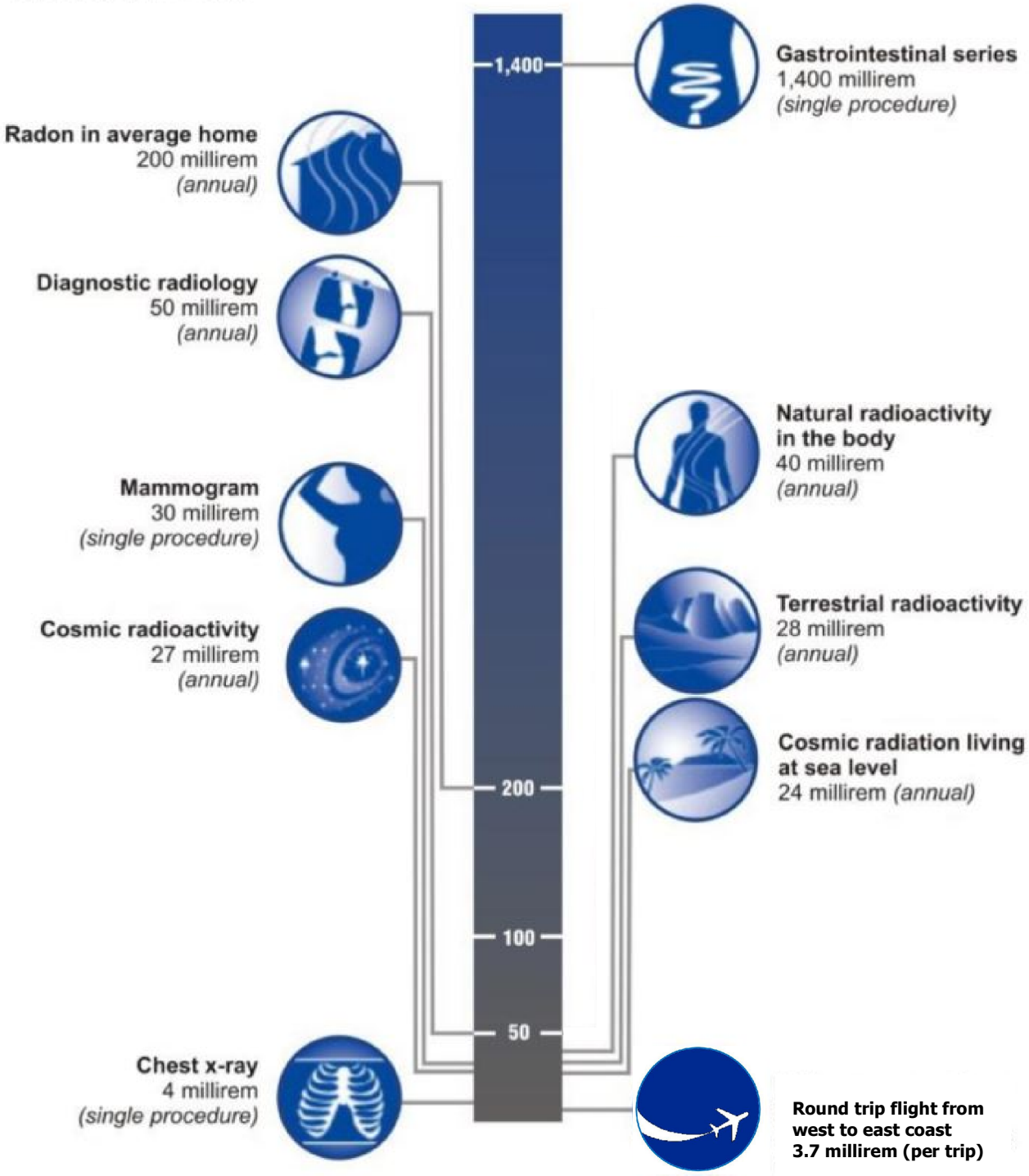
D5.0 REFERENCES

United States Nuclear Regulatory Commission (NRC), Doses in Our Daily Lives, dated 13 May 2021. https://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html

NRC. 10 CFR 20 Subpart E, Radiological Criteria for License Termination, commonly referred to as the License Termination Rule (LTR).

FIGURE

RELATIVE DOSES FROM RADIATION SOURCES
Millirem Doses



Notes:
1. Diagram based on diagram as presented in the United States Department of Energy, Idaho Operations Office's Draft Environmental Assessment for the Resumption of Transient Testing of Nuclear Fuels and Materials dated November 2013.

LANGAN

Langan Engineering and Environmental Services, Inc.

135 Main Street, Suite 1500
San Francisco, CA 94105

T: 415.955.5200 F: 415.955.5201 www.langan.com

Project: BLOCK 52 SAN FRANCISCO SAN FRANCISCO COUNTY CALIFORNIA	Figure Title: EXAMPLES OF RELATIVE DOSES OF RADIATION SOURCES	Project No. 731744801 Date OCTOBER 2022 Scale SEE MAP FOR SCALE Drawn By JNE	Figure D1

Path: \\langan.com\data\SFO\data8\731744802\Project Data\ArcGIS\MXD\Environmental_Figures\Figure 4 - Relative Doses of Radiation Sources.mxd

ATTACHMENT D1

RADIOLOGICAL CALCULATIONS

Attachment D1
Radiological Calculations

D1.1.0 RESRAD CALCULATIONS – MEAN CONCENTRATIONS

RESRAD calculations were performed using an assumption that the mean concentration for each radionuclide was uniformly distributed through the entirety of the site (1,862 square meters = 0.46 acres) to a depth of two meters. The exposure pathways considered external gamma, inhalation, and soil ingestion.

The RESRAD calculation for Americium-241 (Am-241) used a mean concentration of 0.0029 picocuries per gram (pCi/g). The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Am-241	2.900E-03
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.873E-04	1.855E-04	1.819E-04	1.698E-04	1.394E-04	7.000E-05	9.808E-06	4.309E-08
M(t):	7.493E-06	7.420E-06	7.275E-06	6.791E-06	5.577E-06	2.800E-06	3.923E-07	1.724E-09

Maximum TDOSE(t): 1.873E-04 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.623E-09	0.9999
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.814E-13	0.0001
Th-229	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.810E-21	0.0000
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.579E-20	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.623E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Cesium-137 (Cs-137) used a mean concentration of 0.001 picocuries per gram (pCi/g). The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Cs-137	1.000E-03
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.700E-03	1.661E-03	1.587E-03	1.351E-03	8.524E-04	1.702E-04	1.707E-06	1.722E-13
M(t):	6.800E-05	6.645E-05	6.346E-05	5.402E-05	3.409E-05	6.809E-06	6.826E-08	6.887E-15

Maximum TDOSE(t): 1.700E-03 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.964E-08	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.964E-08	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment D1
Radiological Calculations

The RESRAD calculation for Cobalt-60 (Co-60) used a mean concentration of 0.0059 picocuries per gram (pCi/g). The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Co-60	5.900E-03
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.617E-02	4.048E-02	3.111E-02	1.238E-02	8.892E-04	8.839E-08	3.239E-19	0.000E+00
M(t):	1.847E-03	1.619E-03	1.244E-03	4.950E-04	3.557E-05	3.536E-09	1.296E-20	0.000E+00

Maximum TDOSE(t): 4.617E-02 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.959E-07	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.959E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Plutonium-239 (Pu-239) used a mean concentration of 0.0055 picocuries per gram (pCi/g). The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Pu-239	5.500E-03
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.937E-04	2.937E-04	2.936E-04	2.934E-04	2.927E-04	2.904E-04	2.840E-04	2.626E-04
M(t):	1.175E-05	1.175E-05	1.174E-05	1.174E-05	1.171E-05	1.162E-05	1.136E-05	1.050E-05

Maximum TDOSE(t): 2.937E-04 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.731E-20	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.937E-20	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.297E-09	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.625E-16	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.297E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Radium-226 (Ra-226) used a mean concentration of 0.4626 picocuries per gram (pCi/g). The calculation included Lead-210 (Pb-210) at the same concentration, representing an assumption of equilibrium throughout the decay chain. The maximum dose and risk results are shown below.

Attachment D1
Radiological Calculations

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Pb-210	4.626E-01
Thickness:	2.00 meters	Ra-226	4.626E-01
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.775E+00	2.767E+00	2.752E+00	2.699E+00	2.553E+00	2.099E+00	1.198E+00	1.679E-01
M(t):	1.110E-01	1.107E-01	1.101E-01	1.080E-01	1.021E-01	8.397E-02	4.790E-02	6.715E-03

Maximum TDOSE(t): 2.775E+00 mrem/yr at t = 0.000E+00 years

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.325E-06	0.0214
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.074E-05	0.9786
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.206E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Strontium-90 (Sr-90) used a mean concentration of 0.0039 pCi/g. The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Sr-90	3.900E-03
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.005E-04	9.761E-05	9.200E-05	7.479E-05	4.138E-05	5.214E-06	1.402E-08	1.415E-17
M(t):	4.022E-06	3.905E-06	3.680E-06	2.992E-06	1.655E-06	2.086E-07	5.609E-10	5.658E-19

Maximum TDOSE(t): 1.005E-04 mrem/yr at t = 0.000E+00 years

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.023E-09	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.023E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Thorium-232 (Th-232) used a mean concentration of 0.2666 pCi/g. The calculation included Radium-228 (Ra-228) and Thorium-228 (Th-228) at the same concentration, representing an assumption of equilibrium throughout the decay chain. The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Ra-228	2.666E-01
Thickness:	2.00 meters	Th-228	2.666E-01
Cover Depth:	0.00 meters	Th-232	2.666E-01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.109E+00	2.107E+00	2.101E+00	2.084E+00	2.071E+00	2.069E+00	2.068E+00	2.064E+00
M(t):	8.437E-02	8.427E-02	8.404E-02	8.337E-02	8.284E-02	8.277E-02	8.272E-02	8.256E-02

Maximum TDOSE(t): 2.109E+00 mrem/yr at t = 0.000E+00 years

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.747E-05	0.3557
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.161E-05	0.6433
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.950E-08	0.0010
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.913E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Uranium-235 (U-235) used a mean concentration of 0.0206 pCi/g. The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	U-235	2.060E-02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	8.523E-03	8.494E-03	8.438E-03	8.246E-03	7.722E-03	6.146E-03	3.205E-03	3.276E-04
M(t):	3.409E-04	3.398E-04	3.375E-04	3.298E-04	3.089E-04	2.458E-04	1.282E-04	1.310E-05

Maximum TDOSE(t): 8.523E-03 mrem/yr at t = 0.000E+00 years

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.160E-11	0.0002
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.474E-11	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.904E-07	0.9997
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.905E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

D1.2.0 RESRAD CALCULATIONS – 95TH PERCENTILE CONCENTRATIONS

RESRAD calculations were performed using an assumption that the 95th percentile concentration for each radionuclide was uniformly distributed through the entirety of the site (1,862 square meters = 0.46 acres) to a depth of two meters. The exposure pathways considered external gamma, inhalation, and soil ingestion.

The RESRAD calculation for Americium-241 (Am-241) used a 95th percentile concentration of 0.0645 pCi/g. The maximum dose and risk results are shown below.

Attachment D1
Radiological Calculations

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Am-241	6.450E-02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.166E-03	4.126E-03	4.045E-03	3.776E-03	3.101E-03	1.557E-03	2.181E-04	9.584E-07
M(t):	1.667E-04	1.650E-04	1.618E-04	1.510E-04	1.240E-04	6.228E-05	8.726E-06	3.834E-08

Maximum TDOSE(t): 4.166E-03 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.610E-08	0.9999
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.034E-12	0.0001
Th-229	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.737E-19	0.0000
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.686E-18	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.611E-08	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Cesium-137 (Cs-137) used a 95th percentile concentration of 0.0483 pCi/g. The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Cs-137	4.830E-02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	8.211E-02	8.024E-02	7.663E-02	6.523E-02	4.117E-02	8.222E-03	8.242E-05	8.316E-12
M(t):	3.284E-03	3.210E-03	3.065E-03	2.609E-03	1.647E-03	3.289E-04	3.297E-06	3.326E-13

Maximum TDOSE(t): 8.211E-02 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.432E-06	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.432E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Cobalt-60 (Co-60) used a 95th percentile concentration of 0.06 pCi/g. The maximum dose and risk results are shown below.

Attachment D1
Radiological Calculations

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Co-60	6.000E-02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.695E-01	4.116E-01	3.163E-01	1.259E-01	9.042E-03	8.989E-07	3.294E-18	0.000E+00
M(t):	1.878E-02	1.646E-02	1.265E-02	5.034E-03	3.617E-04	3.596E-08	1.318E-19	0.000E+00

Maximum TDOSE(t): 4.695E-01 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.009E-06	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.009E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Plutonium-239 (Pu-239) used a 95th percentile concentration of 0.0318 pCi/g. The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Pu-239	3.180E-02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.698E-03	1.698E-03	1.698E-03	1.696E-03	1.693E-03	1.679E-03	1.642E-03	1.518E-03
M(t):	6.793E-05	6.792E-05	6.791E-05	6.785E-05	6.770E-05	6.717E-05	6.568E-05	6.073E-05

Maximum TDOSE(t): 1.698E-03 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.048E-19	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.276E-19	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.498E-09	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.409E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.498E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Ra-226 used a 95th percentile concentration of 0.8636 pCi/g. The calculation included Pb-210 at the same concentration, representing an assumption of equilibrium throughout the decay chain. The maximum dose and risk results are shown below.

Attachment D1
Radiological Calculations

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Pb-210	8.636E-01
Thickness:	2.00 meters	Ra-226	8.636E-01
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	5.180E+00	5.166E+00	5.137E+00	5.039E+00	4.767E+00	3.919E+00	2.236E+00	3.134E-01
M(t):	2.072E-01	2.066E-01	2.055E-01	2.016E-01	1.907E-01	1.568E-01	8.942E-02	1.253E-02

Maximum TDOSE(t): 5.180E+00 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.474E-06	0.0214
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.134E-04	0.9786
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.159E-04	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Sr-90 used a 95th percentile concentration of 0.0354 pCi/g. The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Sr-90	3.540E-02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	9.126E-04	8.860E-04	8.351E-04	6.789E-04	3.756E-04	4.733E-05	1.273E-07	1.284E-16
M(t):	3.651E-05	3.544E-05	3.340E-05	2.715E-05	1.502E-05	1.893E-06	5.091E-09	5.136E-18

Maximum TDOSE(t): 9.126E-04 mrem/yr at t = 0.000E+00 years

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.284E-09	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.284E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for Th-232 used a 95th percentile concentration of 0.4120 pCi/g. The calculation included Ra-228 and Th-228 at the same concentration, representing an assumption of equilibrium throughout the decay chain. The maximum dose and risk results are shown below.

Attachment D1
Radiological Calculations

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	Ra-228	4.120E-01
Thickness:	2.00 meters	Th-228	4.120E-01
Cover Depth:	0.00 meters	Th-232	4.120E-01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.260E+00	3.256E+00	3.247E+00	3.221E+00	3.200E+00	3.198E+00	3.196E+00	3.190E+00
M(t):	1.304E-01	1.302E-01	1.299E-01	1.288E-01	1.280E-01	1.279E-01	1.278E-01	1.276E-01

Maximum TDOSE(t): 3.260E+00 mrem/yr at t = 0.000E+00 years

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.700E-05	0.3557
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.884E-05	0.6433
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.650E-08	0.0010
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.592E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

The RESRAD calculation for U-235 used a 95th percentile concentration of 0.0416 pCi/g. The maximum dose and risk results are shown below.

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1862.00 square meters	U-235	4.160E-02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.721E-02	1.715E-02	1.704E-02	1.665E-02	1.559E-02	1.241E-02	6.472E-03	6.616E-04
M(t):	6.884E-04	6.862E-04	6.816E-04	6.661E-04	6.238E-04	4.965E-04	2.589E-04	2.646E-05

Maximum TDOSE(t): 1.721E-02 mrem/yr at t = 0.000E+00 years

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.401E-11	0.0002
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.977E-11	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.846E-07	0.9997
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.847E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment D1
Radiological Calculations

D1.3.0 PRG CALCULATIONS

The USEPA's Preliminary Remediation Goals (PRG) for Radionuclide Contaminants at Superfund Sites calculator (PRG Calculator) was accessed on 11 and 12 November 2021 to calculate PRGs for the following eight radionuclides of interest: Am-241, Cs-137, Co-60, Pu-239/240, Ra-226, Sr-90, Th-232, and U-235. The PRG Calculator can be accessed via the following website: https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

D1.3.1 Calculator Inputs and Assumptions

The following is a list of common input parameters used to calculate the PRGs.

- Target Risk = 1E-06 and 1E-04
    - The results scale linearly with risk, so a PRG for a 1E-04 risk would be 100 times that for 1E-06.
- Resident scenario, soil media.
- Soil area = 2,000 square meters.
- Climate zone for particulate emission factor = San Francisco, California.
- No exposure from produce.

The following is the list of source and decay options selected for each radionuclide:

- Am-241, Co-60, Sr-90, Cs-137, and Pu-239 were run on a peak risk basis, with decay and ingrowth accounted for.
- Ra-226 and Th-232 were run assuming an equilibrated decay chain without decay.
- U-235 was run without progeny since the decay products would not be present for separated material. The only decay product that would be present with separated U-235 would be Protactinium-231 (Pa-231), which is a negligible contributor to the PRG.

D1.3.2 Calculator Outputs (Target Risk 1E-06)

The following is a summary of the PRG Calculator for the eight radionuclides of interest for a target risk of 1E-06. Similar calculations were performed for a target risk of 1E-04. PRGs for both target risks are presented in the table presented in Section 4.3.2.

D1.3.2.1 Results for Am-241

Results for 1E-06 total risk from Am-241 are shown below.

Peak PRG Results	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)
Peak PRG for Am-241 @ PRG units	*4.95E+00*	*1.87E+03*	*4.90E+00*	*-*	*2.46E+00*
Peak start time for maximum risk (yrs)	*1.00E-08*	*1.00E-08*	*1.00E-08*	*-*	*1.00E-08*
Maximum risk during peak interval (unitless)	*2.02E-07*	*5.34E-10*	*2.04E-07*	*-*	*4.07E-07*
Maximum risk-rate during peak interval (risk/yr)	*7.94E-09*	*2.10E-11*	*8.02E-09*	*-*	*1.60E-08*

D1.3.2.2 Results for Cs-137

Results for 1E-06 total risk from Cs-137 are shown below.

Peak PRG Results	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)
Peak PRG for Cs-137 @ PRG units	*2.79E+01*	*8.17E+05*	*7.21E-02*	-	*7.19E-02*
Peak start time for maximum risk (yrs)	*1.00E-08*	*1.00E-08*	*1.00E-08*	-	*1.00E-08*
Maximum risk during peak interval (unitless)	*3.59E-08*	*1.22E-12*	*1.39E-05*	-	*1.39E-05*
Maximum risk-rate during peak interval (risk/yr)	*1.83E-09*	*6.25E-14*	*7.09E-07*	-	*7.09E-07*

D1.3.2.3 Results for Co-60

Results for 1E-06 total risk from Co-60 are shown below.

Peak PRG Results	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)
Peak PRG for Co-60 @ PRG units	*8.28E+01*	*2.43E+06*	*3.88E-02*	-	*3.88E-02*
Peak start time for maximum risk (yrs)	*1.00E-08*	*1.00E-08*	*1.00E-08*	-	*1.00E-08*
Maximum risk during peak interval (unitless)	*1.21E-08*	*4.11E-13*	*2.58E-05*	-	*2.58E-05*
Maximum risk-rate during peak interval (risk/yr)	*1.64E-09*	*5.59E-14*	*3.51E-06*	-	*3.51E-06*

D1.3.2.4 Results for Pu-239

Results for 1E-06 total risk from Pu-239 are shown below.

Peak PRG Results	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)
Peak PRG for Pu-239 @ PRG units	*3.92E+00*	*1.25E+03*	*5.54E+02*	-	*3.88E+00*
Peak start time for maximum risk (yrs)	*1.00E-08*	*1.00E-08*	*1.00E-08*	-	*1.00E-08*
Maximum risk during peak interval (unitless)	*2.55E-07*	*8.01E-10*	*1.81E-09*	-	*2.58E-07*
Maximum risk-rate during peak interval (risk/yr)	*9.82E-09*	*3.08E-11*	*6.95E-11*	-	*9.92E-09*

D1.3.2.5 Results for Ra-226

Results for 1E-06 total risk from Ra-226 are shown below.

Isotope	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)
Secular Equilibrium PRG for Ra-226	*1.57E-01*	*1.17E+03*	*1.63E-02*	-	*1.48E-02*

D1.3.2.6 Results for Sr-90

Results for 1E-06 total risk from Sr-90 are shown below.

Peak PRG Results	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)
Peak PRG for Sr-90 @ PRG units	***8.87E+00***	***2.15E+05***	***8.00E+00***	**-**	***4.21E+00***
Peak start time for maximum risk (yrs)	***1.00E-08***	***1.00E-08***	***1.00E-08***	**-**	***1.00E-08***
Maximum risk during peak interval (unitless)	***1.13E-07***	***4.66E-12***	***1.25E-07***	**-**	***2.38E-07***
Maximum risk-rate during peak interval (risk/yr)	***3.71E-09***	***2.36E-13***	***6.31E-09***	**-**	***8.43E-09***

D1.3.2.7 Results for Th-232

Results for 1E-06 total risk from Th-232 are shown below.

Isotope	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)
Secular Equilibrium PRG for Th-232	***3.08E-01***	***2.99E+02***	***1.17E-02***	**-**	***1.13E-02***

D1.32.8 Results for U-235

Results for 1E-06 total risk from U-235 are shown below.

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Halflife (yr)	2000 m^2 Soil Volume Area Correction Factor	Particulate Emission Factor (m^3/kg)	Ingestion PRG TR=1.0E-06 (pCi/g)
U-235	S	2.50E-08	5.51E-07	9.44E-11	1.48E-10	9.84E-10	7.04E+08	7.23E-01	1.11E+10	6.05E+00

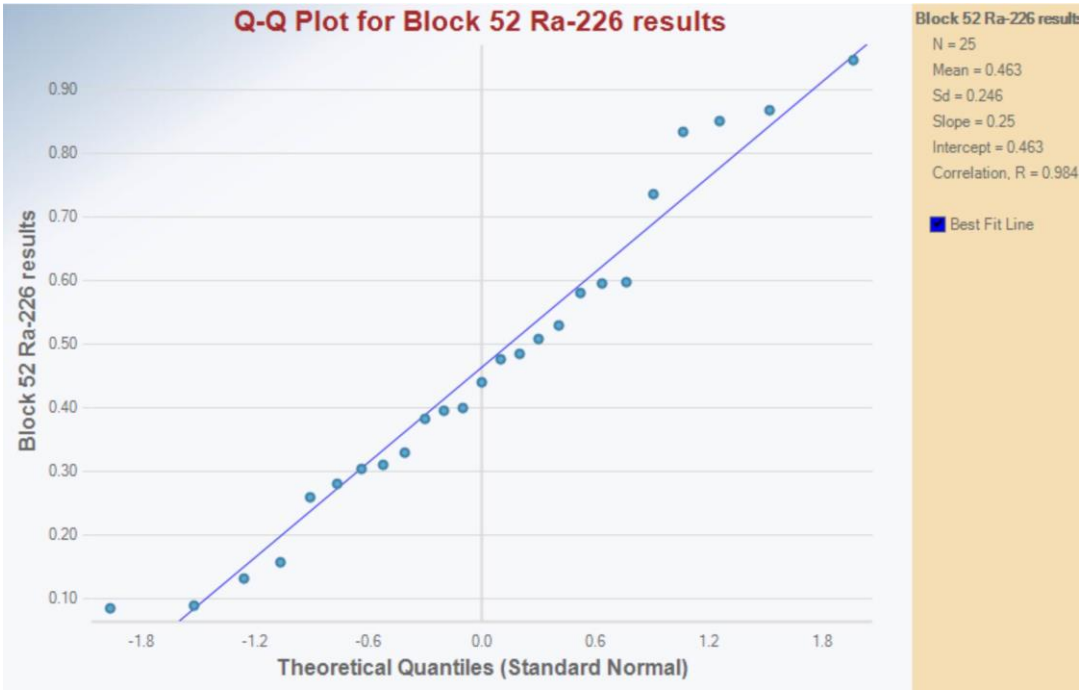
Isotope	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (mg/kg)
U-235	2.77E+03	2.90E-01	-	**2.77E-01**	1.28E-01

APPENDIX E

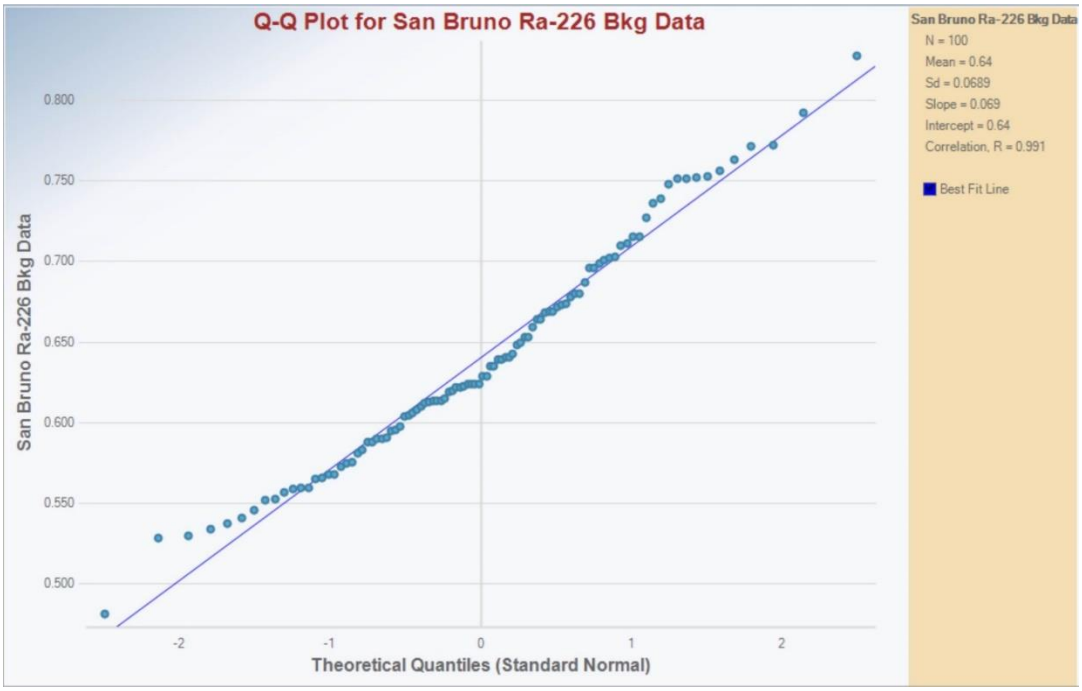
RA-226 QUANTILE-QUANTILE PLOTS

Appendix E
Radium-226 Quantile-Quantile Plots

E1.0 RA-226 Q-Q PLOT FOR BLOCK 52 DATA SET



E2.0 RA-226 Q-Q PLOT FOR SAN BRUNO DATA SET



E3.0 REFERENCE

USEPA, *Statistical Software ProUCL 5.2 for Environmental Applications for Data Sets with and without Nondetect Observations*, Updated June 2022. https://www.epa.gov/land-research/proucl-software