RADIOLOGIC HEALTH BRANCH

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HUNTERS POINT SHIPYARD, PARCEL A-2
HEALTH AND SAFETY SURVEY

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Contents

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RADIOLOGIC HEALTH BRANCH

Hunters Point Shipyard, Parcel A-2, Health and Safety Survey

INTRODUCTION

PURPOSE

As a result of data falsification elsewhere at Hunters Point Shipyard and public concern regarding Parcel A, the US Environmental Protection Agency (US EPA), the Navy, the Department of Toxic Substances Control (DTSC), and stakeholders from the City of San Francisco, requested the California Department of Public Health (CDPH) to perform a radiological health and safety survey of Parcel A.

Figure 1 Hunters Point Shipyard, from Navy website

Parcel A consists of two separate land areas, Parcels A-1 and A-2. CDPH staff performed a radiological survey of Parcel A-2 (Parcel A-1 was previously surveyed). Parcel A-2 was surveyed because it is planned for development with housing units and residents, and because some of the soil excavated during the development of Parcel A-1 was placed at Parcel A-2. This CDPH survey was limited to investigating ionizing radiation that could pose a risk to the public's health or safety. CDPH has regulatory authorities and recognized expertise in the area of radiological health. The Environmental Management Branch and the Radiologic Health Branch serve as radiological contamination remediation consultants for the Department of Toxics Substances Control (DTSC).

The detection instruments used were state-of-the-art, highly-sensitive calibrated instruments that were appropriate for performing sensitive gamma ray scans. The instruments were sensitive enough to detect levels of radiation that could be harmful to future residents, even if it was located below the surface. The survey was done in two parts, a mapping survey where a towed array of large volume radiation detectors of Radiation Solutions (RS-700) gamma mapping system was pulled over accessible parts of the parcel and a walkover survey with handheld instruments for areas less accessible to the towed array. This two-part survey ensured that as much of Parcel A-2 was scanned as possible.

LOCATION

Former Naval Shipyard Hunters Point, Parcel A, San Francisco, California, covering approximately 75 acres, subdivided into Parcel A-1 and Parcel A-2. Parcel A was transferred from Navy possession to the City of San Francisco in 2004. Parcel A-2 has not been developed, but plans are in place to develop it for residential use, including townhomes and condominiums. See Figure 1[1] for location of Parcel A.

Figure 2 Aerial View of Parcel A-2

The area labeled Parcel A-2 in Figure 1 is currently open land without buildings, paved roads or sidewalks. The topography of Parcel A-2 includes extremely steep slopes, retaining walls, and natural barriers. Accessibility of these steep slopes is dependent on staff safety considerations. The red line on Figure 2[2] shows the approximate border of Parcel A-2.

SURVEY SCOPE

CDPH performed this gamma radiation survey of all accessible areas within Parcel A-2 where staff could remain safe while completing accurate and detailed surveys. CDPH was able to survey close to 90% of Parcel A-2 (see Map 1 on page 10 below). This gamma radiation survey, with isotopic identification performed at locations where elevated readings were detected, was the most effective and efficient method to determine if any sources of radiation from human activity were present and assessed the radiological health and safety of the public and the environment. The array of instruments used for this survey included the various types of hand held radionuclide identification devices and the towed array RS-700. Given the historical uses of Parcel A,

[1] https://bracpmo.navy.mil/brac_bases/california/former_shipyard_hunters_point/hpns_parcels.html; access date: August 16, 2018
[2] Google Maps; https://www.google.com/maps/place/Bayview,+San+Francisco,+CA/@37.719312,-122.3707184,1122a,35y,39.13t/data=!3m1!1e3!4m5!3m4!1s0x808f7f1bb30d3455:0xccec952a18d54560!8m2!3d37.730416!4d-122.384424?hl=en; access date: August 16, 2018

and based on the results from the Parcel A-1 scanning (where all anomalies were discrete, and all but two anomalies were confirmed to be naturally occurring potassium-40), scanning was determined to be more effective in detecting discrete forms of contamination, such as a deck marker, than soil sampling. This was not a *MARSSIM*[3] survey because *MARSSIM* statistics do not apply to discrete radioactive sources or to radioactive materials in soils at depths greater than six inches. More information on the survey of Parcel A-1 can be found on the CDPH website at https://www.cdph.ca.gov/Programs/CEH/DRSEM/Pages/RHB-Environment/Hunters-Point-Naval-Shipyard-Parcel-A-1-Survey.aspx/#.

SURVEY ACTIONS

From October 22 to November 28, 2018 CDPH conducted a radiation survey at Hunters Point Parcel A-2. The survey consisted of a walkover component and a towed array RS 700 component. The following survey actions were performed:

- Gamma walkover survey of soil, vegetated areas, and areas inaccessible to the Radiation Solutions RS-700 gamma mapping system using 2” by 2” scintillation detectors.
- Using the Radiation Solutions RS-700 Gamma Mapping System, performed gamma scan over all accessible areas where vegetation was absent or less than four inches in height.
- Confirmatory gamma spectroscopic investigation of static measurements greater than the background average plus three sigma using a Canberra Inspector 1000.

When a radiation measurement greater than survey unit variability average plus three sigma was found, the following steps were performed before initiating the Notification Plan.

1. Anomalous Measurement Confirmation – Performed static one-minute counts at contact, 2-inch and 12-inch heights centered on highest count rate point, using 2” by 2” scintillation detector recorded measurements, location, date, and time.

2. Performed 30-minute measurement on contact centered at highest count rate point using the Canberra Inspector 1000 for radionuclide identification; saved data, including radionuclide identity.
3. Performed radionuclide identification to verify if anthropogenic (man-made) radionuclides exist before initiating the Notification Plan.
4. The Notification Plan was not initiated as there were no anthropogenic radionuclides detected.
5. Because there were no man-made sources found, source recovery action was not necessary.

[3] Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575

SURVEY ORGANIZATION

RHB staff performed the following tasks:

- Gamma Walkover Survey

    - Teams of two staff each performed a walking radiological scanning survey on Parcel A-2 using 2"x2" Sodium Iodide (NaI) scintillation detectors. Because these instruments cannot record data or location, the surveyors recorded periodic and judgmental static measurements and their locations. At those same static measurement locations, staff also recorded dose rate measurements.

- RS-700 Gamma Scan Survey with GPS

    - Radiological Assessment Unit (RAU) used the towed array RS-700 gamma scan to map accessible grounds. This gamma mapping occurred concurrently with the walkover survey. The data from the RS-700 towed gamma scan array was analyzed and mapped with Earth Science Research Institute (ESRI) ArcMap software.

    - The following procedures were followed on the usage of RS-700 system:
        - Radiation Solutions RS-700 Gamma Mapping Overview
        - Radiation Solutions RS-700 Procedures
        - Technical Basis Document, RS-701 Radiation Mapping System

- Survey Units

    - Gamma Walkover Survey Units

        - Survey units for Gamma Walkover Survey were drawn and outlined in green color on the map. No RS-700 scanning was possible on these areas due to the topography and natural barriers on the parcel. These areas were only accessible by foot. Accessibility to some areas of these units was limited due to retaining walls and steep slopes. Five of these units were inaccessible to survey.

    - RS-700 Survey Units

        - RS-700 Survey Units were drawn considering the drivability of the RS-700 survey equipment. These units were outlined in blue color on the map. Safety was a consideration for driving on uneven ground conditions.

- Radioactive Isotope Identification

    - The Site Lead or Site Assistant/Tech used the Canberra Inspector 1000 to collect gamma spectroscopic data for radioactive isotope identification at the points of elevated measurements flagged by survey teams.

- Staff positions

    - Survey team for the towed array (RS-700) gamma scan, three staff members

        - Scanner – configured the software and the system, performed quality control checks before and after scanning, and drove the vehicle for towing the RS-700 radiation-monitoring cart.

        - Guides (2 positions) – Helped and guided in delineating the drivable areas for RS-700 towed array system. Marked the scanned areas and ensured the safety of the equipment and personnel.

    - Survey teams for Gamma Walkover Surveys, two staff members per team

        - Scanner – operated the detector and read the instrument measurements.

        - Data Recorder – recorded the survey instrument measurements.

    - Site Assistant directed daily instrumentation Quality Assurance (QA) checks, performed gamma spectroscopy radioactive isotope identification, and assisted in supervising survey teams

    - Site Lead presented the daily safety and survey briefing, supervised survey teams, answered questions from residents, managed survey assignments, provided notifications to headquarters, and first aid to staff as needed.

WALKOVER GAMMA SURVEY

ESSENTIALS TO UNDERSTANDING SURVEY RESULTS

Gamma rays are a good identifier of the elements present in any composition of materials by their energy signature. A homogeneous region is one that is composed of a consistent distribution of elements. The fundamental assumption of gamma surveys is that a homogeneous region will, when sampled sufficiently, produce a dataset that is statistically distributed normally. Randomly collected samples within a homogenous region will fall within certain statistical bounds. For example, given the standard deviation of a region, for every 1000 sample points collected, 997 will fall within the average reading plus or minus three standard deviations. Put another way, an anomaly is likely present in different concentrations than found in the rest of the sample set if a sample is outside of the set's average and standard deviation.

Two regions that consist of different materials will produce datasets that are both distributed normally, but the statistical quantifiers may be different. For example, if samples are taken in a grassy field and compared to samples from an asphalt parking lot, the averages and standard deviations of the regions are unlikely to be similar because the elemental composition is different. Knowledge of material composition thus helps the user of a radiation detector to distinguish between statistically normal readings and statistically anomalous readings.

An area such as Hunters Point contains many different regions of material composition due to variations in natural lithology and due to fill and other added materials. For this reason, this survey did not use a *MARSSIM* approach with predetermined release criteria. Instead, CDPH applied a statistical approach to evaluate each material, such as dirt or rock, against itself to look for statistically excessive measurements.

A relatively simple radiation detector reports measurements as a single number, that being the total quantity of photons of all energies that were detected during a known period. The statistical procedure described above works by collecting a large number of such measurements. A more complex radiation detector separates the counted photons by energy, reporting a series of numbers known as a spectrum. The CDPH-RHB walkover survey collected thousands of the simpler measurements to evaluate Hunters Point and over one hundred spectra to evaluate statistical anomalies.

Every spectrum collected outside of carefully controlled laboratory conditions will contain an observable peak centered around 1461 keV that corresponds to potassium-40 (K-40), highlighted with red in Figure 3.

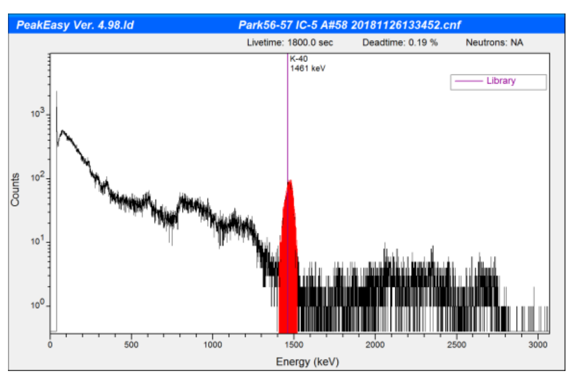


Figure 3: Spectrum with K-40 Highlighted in Red

There are certain nuclides that are deemed to be naturally occurring radioactive material (NORM). Whereas potassium-40 decays into either calcium-40 or argon-40, both of which are stable, much heavier elements such as thorium-

232 and uranium-238 transform into a series of nuclides called decay chains until they reach a stable form of lead. The features common across spectra correspond to various members of these decay chains.

The spectra collected by this project are very similar in appearance to each other. The small differences are caused primarily by differences in concentrations between K-40 and the decay chains of uranium and thorium.

SURVEY RESULTS

During the walkover scan, staff using a 2”x2” NaI Ludlum 44-10 scintillation detector measured radiation for one-minute periods at 1205 distinct locations distributed across Parcel A-2. For follow-up measurements at locations that exceeded the three-sigma statistical limit, the Canberra Inspector 1000 was used for thirty-minute spectroscopy measurements at 11 locations.

In addition to the above, supplementary measurements with the Canberra Inspector 1000 were taken in every survey unit that did not have any readings in excess of a statistical limit. Twenty-six such readings were taken.

Of the 37 spectra (11 anomalies and 26 supplemental measurements) collected for the walkover survey, the radionuclide identified from these spectra was determined to be potassium-40, which is a naturally occurring radiological material (NORM) present in the biological world.

Data Summary Tables

The following tables summarize the data collected. Maps of areas surveyed along with locations of anomalies are also provided below.

Table 1 summarizes the radiological readings collected during the walkover survey by survey units. For each static reading, if an Inspector 1000 ("Insp1k" in tables) spectrum was collected, then the table line is marked with red for an anomaly or yellow for a supplementary reading.

Table 1: Summary of HPS Parcel A-2 Walkover Gamma Survey

Name of Survey Unit	2"x2" Static Readings	Insp1k Supplement	Insp1k Anomaly
WS1	33	1	0
WS2	29	1	0
WS3	34	1	0
WS4	36	0	1
WS5	18	1	0
WS6	38	1	0
WS7	40	1	0
WS8	53	1	0
WS9	30	0	3
WS10	25	1	0
WS11	42	1	0
WS12	23	1	0
WS13	61	1	0
WS14	47	1	0
WS15	26	1	0
WS16	28	1	0
WS17	56	0	2
WS18	50	1	0
WS19	38	0	2
WS20	55	0	1
WS21	38	1	0
WS22	56	1	0
WS23	36	1	0
WS24	Inaccessible	0	0
WS25	(Partially Inaccessible) 10	1	0
WS26	60	1	0
WS27	Inaccessible	0	0
WS28	50	1	0
WS29	52	1	0
WS30	Inaccessible	0	0

Name of Survey Unit	2"x2" Static Readings	Insp1k Supplement	Insp1k Anomaly
WS31	Inaccessible	0	0
WS32	60	1	0
WS33	23	1	0
WS34	22	0	2
WS35	Inaccessible	0	0
NR1-RS	36	1	0
TOTAL	1205	**26**	**11**

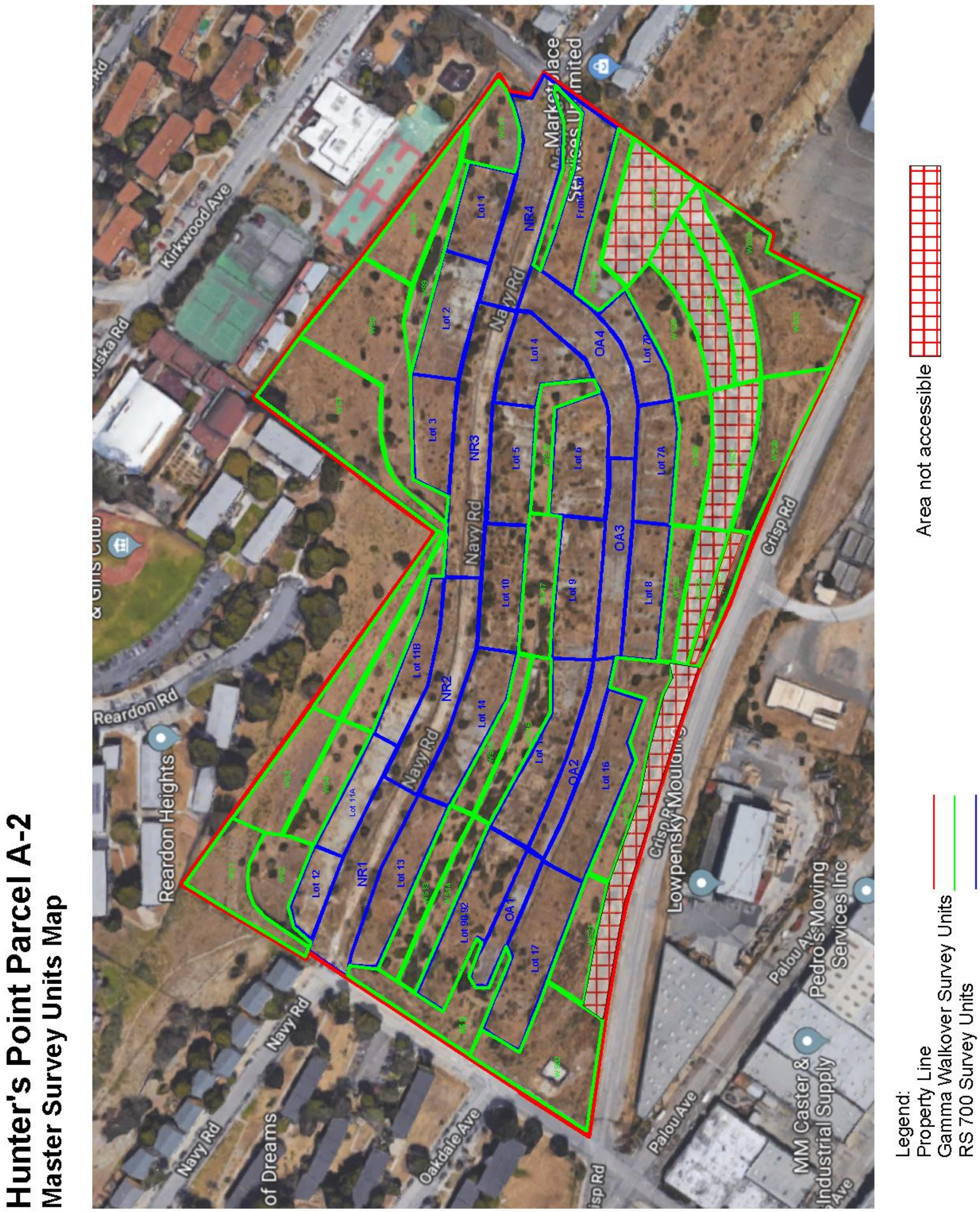
Table 2 lists the all survey units in which anomalies/supplemental readings were analyzed by an Inspector 1000.

Table 2: Identified Walkover Survey Anomalies

Survey Unit	Static ID	Longitude	Latitude	Insp-1k shot file name
WS4	36	-122.377204	37.728846	WS-4 A #36 20181023153313.cnf
WS9	1	-122.375222	37.728544	WS-9 A #1 20190124114846.cnf
WS9	2	-122.375162	37.728527	WS-9 A #2 20190124115621.cnf
WS9	21	-122.374924	37.728528	WS-9 A #21 20181025150526.cnf
WS17	15	-122.376600	37.728058	WS-17 A #15 20181106165048.cnf
WS17	56	-122.376517	37.728046	WS-17 A #56 20181112142923.cnf
WS19	15	-122.374812	37.728042	WS-19 A #15 20181106152417.cnf
WS19	17	-122.374713	37.728035	WS-19 A #17 20181107103709.cnf
WS20	45	-122.378567	37.727945	WS-20 A #45 20181114160425.cnf
WS34	10	-122.374706	37.727793	WS-34 A #15 20181114120931.cnf
WS34	15	-122.374454	37.727736	WS-34 A #15 20181114120931.cnf

A total of eleven anomalies were found (9 previously reported and 2 anomalies found during data quality check) and were further investigated by an Inspector 1000 to analyze the spectrum and identify the radionuclides. All anomalies were determined to be potassium-40, which is a naturally occurring radiological material (NORM). No radionuclide of concern was identified in these follow-up investigations.

Map 1: Master (All) Survey Units Map



Map 2: Gamma Walkover Survey Units Map

Map 3: Walkover Survey – Inspector 1000 Spectroscopy Locations

TOWED ARRAY GAMMA SURVEY

ESSENTIALS TO UNDERSTANDING SURVEY RESULTS

The physics by which the walkover survey and the towed array survey function are identical. The scintillation detectors used for each are made from the same crystalline material, but the towed array is able to use much larger detectors. The walkover survey detector has a volume of about 6 cubic inches while the towed array detectors total approximately 488 cubic inches.

As described in the technical documentation found in Appendix 5, the RS-700 system generates a spectrum by using a multichannel analyzer (MCA) with 1024 channels. Because the energy of gamma rays is unique to each radioactive element, one technique for analysis involves looking at only a small portion of channels that would contain a signal from a specific radioactive element. This subset of channels is known as a region of interest (ROI).

In contrast to the walkover survey in which measurements from a gamma detector are recorded periodically and require the detector to be motionless for 60 seconds in a single location, the towed array generates a spectrum once per second continuously along its path of travel. This feature is due to the larger volume of the towed array detector. However, this also imposes a physical accessibility limitation on the towed array. Many areas of Hunters Point Parcel A-2 are either too confined or too steep to use this larger system.

Another difference from the walkover survey is the collection of Global Positioning Satellite (GPS) data. With an antenna mounted to the towed array, the surveyors did not need to mark their sampling locations on a map. The spectra and the associated locations measured by the towed array are electronic documents consisting of tens of millions of points of data. The electronic recordings are summarized in this report.

SURVEY RESULTS

The Radiation Solutions RS-700 scintillation detector system measured radiation at 93,231 positions over large open areas distributed across Parcel A-2. Follow-up measurements at survey locations that exceeded the three-sigma statistical limit were conducted with the Canberra Inspector 1000 for thirty-minute spectroscopy measurements. In total, 102 anomalies were detected, all of which were found to be potassium-40, which is not a risk for human health and safety.

Data Summary Tables

The following tables summarize the data collected. Maps of area surveyed along with locations of anomalies are also provided below.

Table 3 lists the number of readings collected by the RS-700 and anomaly spectra collected by the Inspector 1000 (“Insp1k” in tables). No readings by the Falcon 5000 were necessary in support of the towed array survey.

Table 3: Summary of HPS Parcel A-2 Towed Array Gamma Survey

Survey Unit	RS-700 Readings	Insp1k Anomaly
Front Lot	3079	3
Lot 1	2695	3
Lot 2	2399	2
Lot 3	2770	2
Lot 4	4819	4
Lot 5	3193	1
Lot 6	3618	4
Lot 7A	2450	2
Lot 7B	3038	3
Lot 8	3404	3
Lot 9	2751	7
Lot 10	1741	2
Lot 11A	2927	1
Lot 11B	4330	1
Lot 12	1251	3
Lot 13	2814	3
Lot 14	3300	2
Lot 15	3916	3
Lot 16	4180	4
Lot 17	4686	5
Lot 90-92	4925	4
NR Asphalt	1087	10
NR1	2380	3
NR2	2963	7
NR3	3600	5
NR4	1841	2
OA1	2137	3
OA2	4474	3
OA3	3170	3
OA4	4453	4
TOTAL	**94391**	**102**

Table 4 lists the locations at which Gamma spectra were collected with an Inspector 1000 ("Insp1k") and the exposure rate measured on contact.

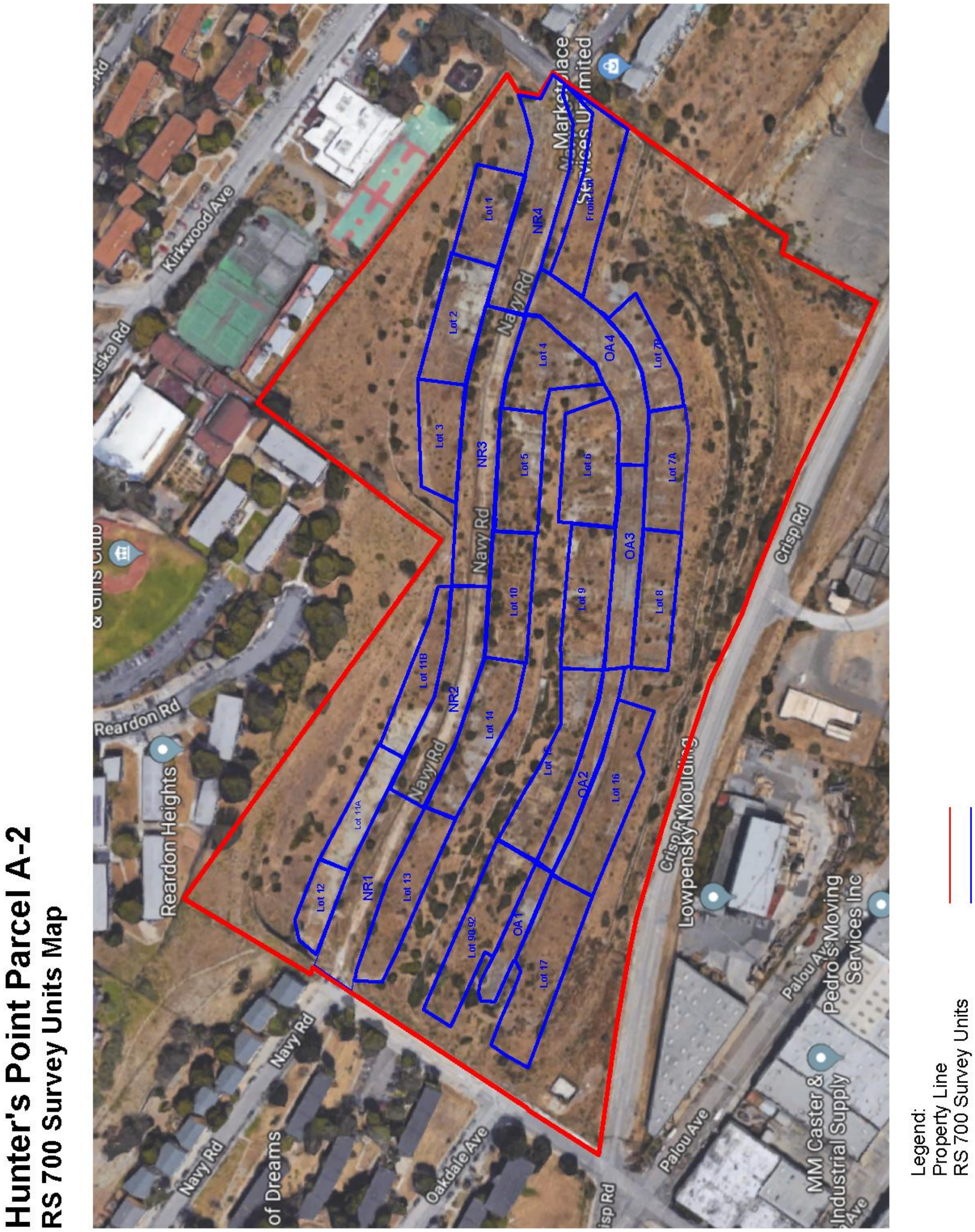
Table 4: Identified Towed Array Survey Anomalies

Survey Unit	Location	Longitude	Latitude	uR/h	Insp-1k shot file name
Front Lot	RS-1	-122.374305	37.727856	18.4	Front Lot RS-1 20181126135202.cnf
Front Lot	RS-2	-122.374394	37.727825	16.5	Front Lot RS-2 20181126143923.cnf
Front Lot	RS-3	-122.374365	37.727800	15.4	Front Lot RS-3 20181126151850.cnf
Lot 1	RS-1	-122.374091	37.728231	10.4	Lot 1 RS-1 20181109085629.cnf
Lot 1	RS-2	-122.374192	37.728232	12.9	Lot 1 RS-2 20181109093454.cnf
Lot 1	RS-3	-122.374281	37.728263	13.0	Lot 1 RS-3 20181109101135.cnf
Lot 2	RS-1	-122.375327	37.728463	12.9	Lot 2 RS-1 20181113104837.cnf
Lot 2	RS-2	-122.375354	37.728404	10.0	Lot 2 RS-2 20181113114819.cnf
Lot 3	RS-1	-122.375417	37.728480	12.2	Lot 3 RS-1 20181113112620.cnf
Lot 3	RS-2	-122.375392	37.728382	13.0	Lot 3 RS-2 20181113122608.cnf
Lot 4-1	RS-1	-122.375374	37.728127	8.1	Lot 4-1 RS-1 20181113142646.cnf
Lot 4-1	RS-2	-122.375374	37.728076	11.6	Lot 4-1 RS-2 20181113152630.cnf
Lot 4-2	RS-1	-122.375394	37.727934	8.1	Lot 4-2 RS-1 20181113143854.cnf
Lot 4-2	RS-2	-122.375024	37.728035	11.6	Lot 4-2 RS-2 20181113154946.cnf
Lot 5	RS-1	-122.376204	37.728202	13.0	Lot 5 RS-1 20181114145228.cnf
Lot 6	RS-1	-122.375585	37.727857	12.0	Lot 6 RS-1 20181114112745.cnf
Lot 6	RS-2	-122.375919	37.727748	12.9	Lot 6 RS-2 20181114153433.cnf
Lot 6	RS-3	-122.375495	37.727734	13.0	Lot 6 RS-3 20181114121410.cnf
Lot 6	RS-4	-122.375474	37.727958	14.0	Lot 6 RS-4 20181114125731.cnf
Lot 7A	RS-1	-122.375985	37.727481	10.5	Lot 7A RS-A 20181114094530.cnf
Lot 7A	RS-2	-122.375507	37.727439	10.4	Lot 7A RS-2 20190124124743..cnf
Lot 7B	RS-1	-122.375177	37.727502	16.5	Lot 7B RS-1 20181126160004.cnf
Lot 7B	RS-2	-122.375284	37.727481	18.1	Lot 7B RS-2 20181126163501.cnf
Lot 7B	RS-3	-122.375392	37.727459	17.8	Lot 7B RS-3 20181126171152.cnf
Lot 8	RS-1	-122.376850	37.727547	14.0	Lot 8 RS-1 20181119142837.cnf
Lot 8	RS-2	-122.376707	37.727554	10.0	Lot 8 RS-2 20181119132747.cnf
Lot 8	RS-3	-122.376057	37.727525	9.0	Lot 8 RS-3 20181119143624.cnf
Lot 9	RS-1	-122.376687	37.727843	12.0	Lot 9 RS-1 20181119151446.cnf
Lot 9	RS-2	-122.376613	37.727951	11.0	Lot 9 RS-2 20181119141533.cnf
Lot 9	RS-3	-122.376282	37.727949	12.0	Lot 9 RS-3 20181119151951.cnf
Lot 9	RS-4	-122.376384	37.727949	16.0	Lot 9 RS-4 20181119160039.cnf
Lot 9	RS-5	-122.376609	37.727802	11.0	Lot 9 RS-5 20181119150038.cnf
Lot 9	RS-6	-122.376270	37.727956	10.5	Lot 9 RS-6 20181114102612.cnf

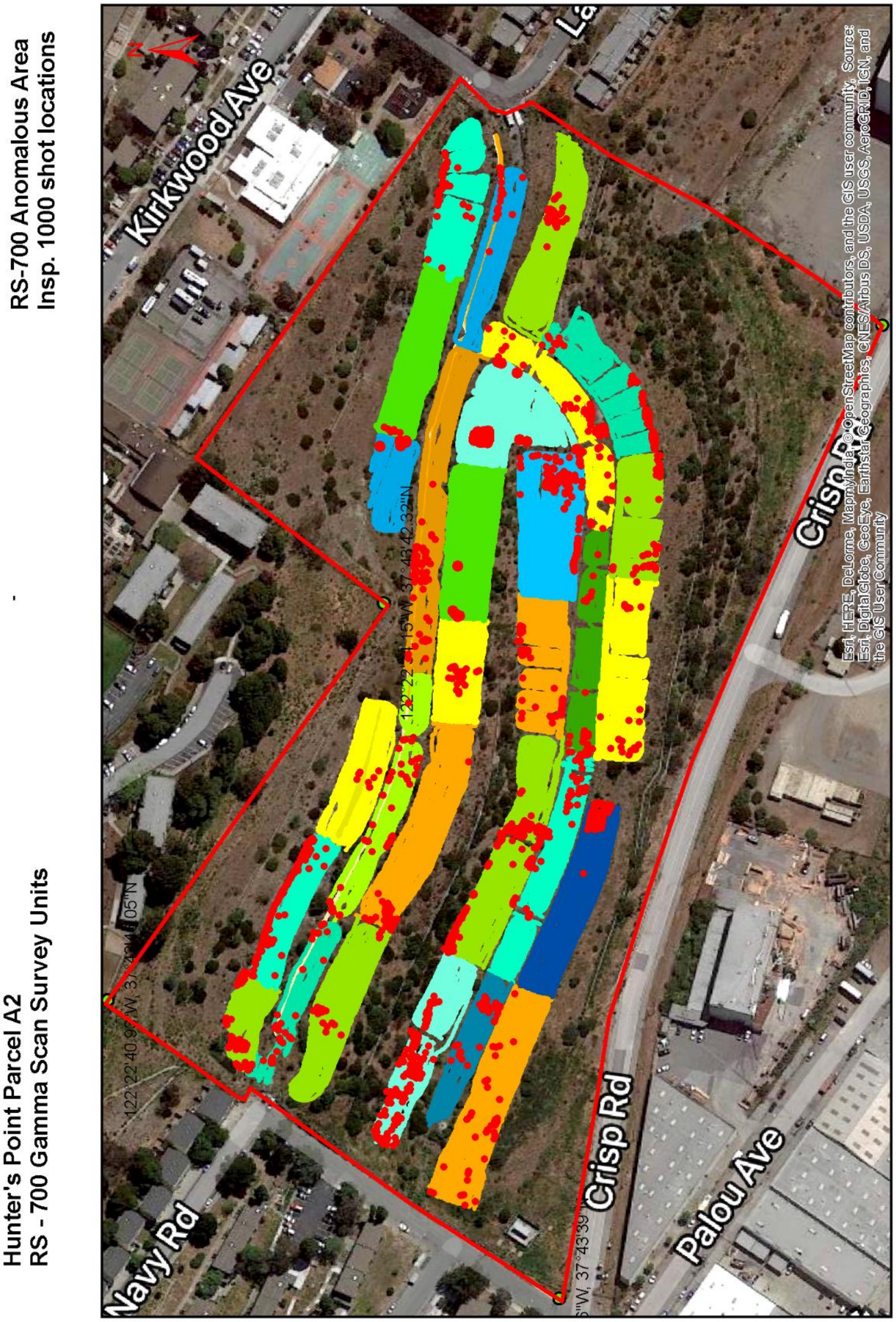
Survey Unit	Location	Longitude	Latitude	uR/h	Insp-1k shot file name
Lot 9	RS-7	-122.376375	37.727935	8.9	Lot 9 RS-7 20181114113817.cnf
Lot 10	RS-1	-122.376496	37.728190	10.0	Lot 10 RS-1 20181115091531.cnf
Lot 10	RS-2	-122.376567	37.728185	9.8	Lot 10 RS-2 20181115095905.cnf
Lot 11A	RS-1	-122.377323	37.728748	9.3	Lot 11A RS-1 20181115094330.cnf
Lot 11B	RS-2	-122.377018	37.728517	14.1	Lot 11B RS-1 20181115101856.cnf
Lot 12	RS-1	-122.377918	37.728987	15.5	Lot 12 RS-1 20181115104405.cnf
Lot 12	RS-2	-122.378218	37.729029	13.9	Lot 12 RS-2 20181115112011.cnf
Lot 12	RS-3	-122.378330	37.729006	12.2	Lot 12 RS-3 20181115115537.cnf
Lot 13	RS-1	-122.377720	37.728479	11.0	Lot 13 RS-1 20181120115553.cnf
Lot 13	RS-2	-122.378070	37.728688	10.0	Lot 13 RS-2 20181120111035.cnf
Lot 13	RS-3	-122.378185	37.728623	13.0	Lot 13 RS-3 20181120123444.cnf
Lot 14	RS-1	-122.377642	37.728429	10.0	Lot 14 RS-1 20181120103547.cnf
Lot 14	RS-2	-122.377596	37.728461	15.0	Lot 14 RS-2 20181120115316.cnf
Lot 15	RS-1	-122.377252	37.727960	13.0	Lot 15 RS-1 20181119160919.cnf
Lot 15	RS-2	-122.377279	37.727886	16.0	Lot 15 RS-2 20181119163758.cnf
Lot 15	RS-3	-122.377684	37.728198	10.0	Lot 15 RS-3 20181119154034.cnf
Lot 16	RS-1	-122.377101	37.727644	11.6	Lot-16 RS-1 20181031133126.cnf
Lot 16	RS-2	-122.377150	37.727696	12.9	Lot 16 RS-2 20181127095347.cnf
Lot 16	RS-3	-122.377110	37.727680	14.0	Lot 16 RS-3 20181127102758.cnf
Lot 16	RS-4	-122.377424	37.727723	8.0	Lot 16 RS-4 20181127113435.cnf
Lot 17	RS-1	-122.378241	37.728050	12.0	Lot 17 RS-1 20181127115044.cnf
Lot 17	RS-2	-122.378564	37.728141	9.0	Lot 17 RS-2 20181127103203.cnf
Lot 17	RS-3	-122.378588	37.728043	13.0	Lot 17 RS-3 20181127123319.cn
Lot 17	RS-4	-122.378983	37.728164	11.0	Lot 17 RS-4 20181127121442.cnf
Lot 17	RS-5	-122.378402	37.728090	10.3	Lot 17 RS-5 20181127111900.cnf
Lot 90-92	RS-1	-122.378060	37.728295	10.0	Lot 90-92 RS-1 20181127095528.cn
Lot 90-92	RS-2	-122.378131	37.728309	8.0	Lot 90-92 RS-2 20181127092052.cnf
Lot 90-92	RS-3	-122.378635	37.728500	8.0	Lot 90-92 RS-3 20181127104854.cnf
Lot 90-92	RS-4	-122.378674	37.728473	11.0	Lot 90-92 RS-4 20181127110741.cnf
NR Asphalt	RS-1	-122.378152	37.728866	10.8	NR Asph RS-1 20181127121437.cnf
NR Asphalt	RS-2	-122.377704	37.728710	10.0	NR Asph RS-2 20181127132503.cnf
NR Asphalt	RS-3	-122.377199	37.728496	9.0	NR Asph RS-3 20181127114634.cnf
NR Asphalt	RS-4	-122.376977	37.728430	10.0	NR Asph RS-4 20181127131056.cnf
NR Asphalt	RS-5	-122.376844	37.728401	8.0	NR Asph RS-5 20181127121830.cnf
NR Asphalt	RS-6	-122.376403	37.728368	11.0	NR Asph RS-6 20181127124555.cnf
NR Asphalt	RS-7	-122.375934	37.728342	10.0	NR Asph RS-7 20181127135839.cnf
NR Asphalt	RS-8	-122.375895	37.728333	9.0	NR Asph RS-8 20181127130433.cnf
NR Asphalt	RS-9	-122.374313	37.728043	13.0	NR Asph RS-9 20181127153713.cnf
NR Asphalt	RS-10	-122.374146	37.728035	8.0	NR Asph RS-10 20181127141859.cnf
NR1	RS-1	-122.378306	37.728881	12.0	NR1 RS-1 20181120103744.cnf

Survey Unit	Location	Longitude	Latitude	uR/h	Insp-1k shot file name
NR1	RS-2	-122.378194	37.728815	8.0	NR1 RS-2 20181120101104.cnf
NR1	RS-3	-122.377706	37.728714	9.0	NR1 RS-3 20181120092111.cnf
NR2	RS-1	-122.377558	37.728666	10.0	NR2 RS-1 20181120104559.cnf
NR2	RS-2	-122.377277	37.728442	10.0	NR2 RS-2 20181120095748.cnf
NR2	RS-3	-122.376986	37.728380	12.0	NR2 RS-3 0181120111415.cnf
NR2	RS-4	-122.376797	37.728388	9.0	NR2 RS-4 20181120112003.cnf
NR2	RS-5	-122.376504	37.728361	8.6	NR2 RS-5 20190207124001.cnf
NR2	RS-6	-122.376497	37.728323	8.6	NR2 RS-6 20190207135932.cnf
NR2	RS-7	-122.376758	37.728367	7.1	NR2 RS-7 20190207131658.cnf
NR3	RS-1	-122.375961	37.728354	10.0	NR3 RS-1 20181120130044.cnf
NR3	RS-2	-122.376014	37.728320	11.0	NR3 RS-2 20181120120511.cnf
NR3	RS-3	-122.376326	37.728310	10.2	NR3 RS-3 20190207124825.cnf
NR3	RS-4	-122.376398	37.728374	10.0	NR3 RS-4 20190207115608.cnf
NR3	RS-5	-122.376029	37.728309	8.0	NR3 RS-5 20190207132418.cnf
NR4	RS-1	-122.374504	37.728073	10.0	NR4 RS-1 20181120132859.cnf
NR4	RS-2	-122.374160	37.727948	11.0	NR4 RS-2 20181120145639.cnf
OA1	RS-1	-122.378088	37.728044	10.0	OA1 RS-1 20181127084618.cnf
OA1	RS-2	-122.378054	37.728095	8.0	OA1 RS-2 20181127101143.cnf
OA1	RS-3	-122.378273	37.728183	11.0	OA1 RS-3 20181127102911.cnf
OA2	RS-1	-122.376903	37.727731	10.0	OA2 RS-1 20181120140551.cnf
OA2	RS-2	-122.377025	37.727715	14.0	OA2 RS-2 20181120153022.cnf
OA2	RS-2	-122.377621	37.727921	12.0	OA2 RS-3 20181120161053.cnf
OA3	RS-1	-122.376124	37.727703	9.0	OA3 RS-1 20181120132822.cnf
OA3	RS-2	-122.376575	37.727715	12.0	OA3 RS-2 20181120145142.cnf
OA3	RS-3	-122.376870	37.727705	9.0	OA3 RS-3 20181120145507.cnf
OA4	RS-1	-122.374902	37.727989	9.0	OA4 RS-1 20181120133802.cn
OA4	RS-2	-122.375232	37.727697	13.0.	OA4 RS-2 20181120124600.cnf
OA4	RS-3	-122.375357	37.727659	14.0	OA4 RS-3 20181120140613.cnf
OA4	RS-4	-122.375777	37.727697	9.0	OA4 RS-4 20181120141947.cnf

Map 4: Towed Array Survey Units Map



Map 5: Towed Array Survey Anomalous Areas



CONCLUSION

In total, the radiation survey detected 113 anomalies, 11 from the walkover survey and 102 from the towed array system. All anomalies were determined to be naturally occurring radiological material (NORM), namely potassium-40.

Potassium-40 is a naturally occurring radioisotope of potassium. It is present as a very small fraction (0.012%) of naturally occurring potassium, a substance found throughout nature, including in plants, animals, various foods and our bodies.

Potassium-40 behaves the same as ordinary potassium, both in the environment and within the human body – potassium is an essential element for both. Detection of potassium-40 is not unusual for a radiation scan of this type and is not a health or safety concern for people or the environment.

No radiological hazards were observed presently on the site.

APPENDICES

EXPLANATION OF APPENDICES

Unit Summary: Appendix 1

To streamline personnel organization among the 18 CDPH health physicists that participated during the 7 weeks of the project, HPS Parcel A-2 was broken into 66 survey units (SU) that spanned over open land with vegetation and gravel on the hillside. Walkover Gamma Survey Plan has 36 survey units. Surveys were completed over 30 SU, 1 SU (Lot 25 was partially inaccessible) and 5 SU (Lot 24, Lot 27, Lot 30, Lot 31 and Lot 35) were inaccessible due to steep hillside terrain and overgrowth of vegetation.   RS 700 Towed Array Survey has 30 survey units and all the units were scanned completely.

Static Measurement Table: Appendix 2

The gamma count rate measured by a Ludlum 44-10 2”x2” NaI detector paired to either a Ludlum 2220 or 2221 meter and the exposure rate measured by a Ludlum Model 19 meter, as summarized in table form in Appendix 2, are organized in table form as follows:

Survey Unit
This header is the designated unit of work as presented to the CDPH health physicists.

Static ID
This header designates the order in which static measurements were collected.

Bkg ID
This is the ID for the background material type.

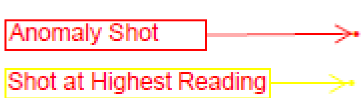
CPM
This is the value of the count rate reading at each Static ID in counts per minute (CPM) as read by a Ludlum 44-10.

uR/h
This is the value of the exposure rate reading at each Static ID in micro-Roentgen per Hour as read by a Ludlum Model 19.

Inspector 1000 shot file name
File name of Inspector 1000 shot.

Walkover Survey Unit Maps with Inspector Shot Locations: Appendix 3

Inspector shot locations with the following legend on the survey unit map



Canberra Inspector 1000 Spectra: Appendices 4 and 7

The gamma spectra collected by the Canberra Inspector 1000, presented as images in Appendices 4 and 7, are organized as follows:

Title
The heading following "PeakEasy Ver. 4.98.ld" lists the survey unit, A for Anomaly or S for Supplement, static ID, year, month, date, and time that the spectrum collection completed in the following manner:

[Survey Unit] [A/S]#[StaticID] [Year][Month][Day][Hour][Minute][Second]

Livetime
This is the period of time during which signals from the detector were measured.

Energy (keV)
This is the channel in which a signal was measured. The calibration procedure assigns an energy, in kiloelectron-Volts (keV), to each channel.

Counts
This is the number of times a signal was received per channel during the counting period, presented on a logarithmic scale.

Towed Array Survey – RS-700 Technical Documentation: Appendix 5

Technical documentation for Towed Array RS-700 system.

Towed Array Data Plots and Tables: Appendix 6

The towed array data summary, presented in Appendix 6, consists of three tables and maps for each of the 17 survey units. In Appendix 6, both Table A and Table C have six data columns corresponding to six regions of interest (ROI) and each ROI has been statistically analyzed for identifying data points over threshold (average + 3 sigma) counts to be mapped with Environmental Systems Research Institute (ESRI) ArcMap. The regions of interest are Range (45-1980), potassium, Ra-226 (1764), thorium, Ra-226 (609), and Cs-137. Table B lists only three of the regions of interest due to overlap of some channels.

APPENDIX 1: SURVEY UNITS SUMMARY
(2 Pages)

APPENDIX 2: WALKOVER SURVEY – STATIC MEASUREMENT TABLE

(34 Pages)

APPENDIX 3: WALKOVER SURVEY UNIT MAPS WITH INSPECTOR SHOT LOCATIONS

(31 Pages)

APPENDIX 4: WALKOVER SURVEY – INSPECTOR 1000 SPECTRA

(19 Pages)

APPENDIX 5: TOWED ARRAY SURVEY – RS-700 TECHNICAL DOCUMENTATION

(40 Pages)

APPENDIX 6: TOWED ARRAY SURVEY – DATA PLOTS AND TABLES

(64 Pages)

APPENDIX 7: TOWED ARRAY SURVEY – INSPECTOR 1000 SPECTRA

(51 Pages)