

# 2019 Annual Radiological Environmental Operating Report



AMEREN MISSOURI  
CALLAWAY ENERGY CENTER  
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ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

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## PREFACE

This Annual Radiological Environmental Operating Report (AREOR) describes the Ameren Missouri Callaway Energy Center Radiological Environmental Monitoring Program (REMP), and the program results for the calendar year 2019. It is submitted in accordance with section 5.6.2 of the Callaway Energy Center Technical Specifications.

Staff members of the Environmental, Inc., Midwest Laboratory were responsible for the acquisition of data presented in this report. Environmental samples were collected by Ameren Missouri personnel or contractors to Ameren Missouri and shipped to Environmental, Inc. – Midwest Laboratory and Stanford Dosimetry, LLC, for analysis.

The report was prepared by Environmental, Inc., Midwest Laboratory and the Ameren Missouri Callaway Energy Center.

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## 1.0 INTRODUCTION

This report presents an analysis of the results of the Radiological Environmental Monitoring Program (REMP) conducted during 2019 for the Union Electric Company (dba Ameren Missouri) Callaway Energy Center.

The objectives of the REMP are to monitor potential critical pathways of radioactive effluent to man and determine the radiological impact on the environment caused by operation of the Callaway Energy Center. The Radiological Environmental Monitoring Program was initiated in April 1982.

The Callaway Energy Center consists of one 3565 MWt pressurized water reactor, which achieved initial criticality on October 2, 1984. The plant is located on a plateau approximately ten miles southeast of the City of Fulton in Callaway County, Missouri and approximately eighty miles west of the St. Louis metropolitan area. The Missouri River flows by the site in an easterly direction approximately five miles south of the site at its closest point.

Tabulation of the individual analyses for the year 2019 is included in Part II of this report.



## 2.0 SUMMARY

The Radiological Environmental Monitoring Program, as required by the U.S. Nuclear Regulatory Commission (NRC) Technical Specifications for the Callaway Energy Center is described herein. Results for the year 2019 are summarized and discussed.

For the year, the Callaway Energy Center was operated in compliance with Offsite Dose Calculation Manual (ODCM) and Radiological Effluent Controls (REC) requirements. Results from the REMP indicate the Callaway Energy Center has had no significant radiological impact on the health and safety of the public or on the environment.

### 3.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

#### 3.1 Program Design and Data Interpretation

The purpose of the Radiological Environmental Monitoring Program at the Callaway Energy Center is to assess the impact of the plant on its environment. For this purpose, samples are collected from waterborne, airborne, ingestion and terrestrial pathways and analyzed for radioactive content. Direct radiation levels are monitored by thermoluminescent dosimeters (TLDs).

Sources of environmental radiation can include the following:

- (1) Natural background radiation arising from cosmic rays and primordial radionuclides;
- (2) Fallout from atmospheric nuclear detonations;
- (3) Releases from nuclear power plants, planned or accidental; and
- (4) Industrial and medical radioactive waste.

Effects due to operation of the Callaway Energy Center must be distinguished from those due to other sources in interpreting the data.

The indicator-control concept is a major interpretive aid; where feasible the design of the Callaway Energy Center program has both indicator and control stations. Most types of samples are collected at indicator locations (nearby, downwind, or downstream) and at control locations (distant, upwind, or upstream). A station effect would be indicated if the radiation level at an indicator location was significantly larger than that at the control location. The difference would have to be greater than could be accounted for by typical fluctuations in radiation levels arising from other sources.

The monitoring program includes analyses for iodine-131, a fission product, and tritium, which is produced by cosmic rays, atmospheric nuclear detonations, and also by nuclear power plants. Most samples are analyzed for gamma-emitting isotopes, with results for the following groups quantified: zirconium-95, cesium-137, and cerium-144. These three gamma-emitting isotopes are selected as radiological impact indicators because of the different characteristic proportions in which they appear in the fission product mix produced by a nuclear reactor and that produced by a nuclear detonation. Each of the three isotopes is produced in roughly equivalent amounts by a reactor: each constitutes about 10% of the total activity of fission products ten days after reactor shutdown. On the other hand, ten days after a nuclear explosion, the contributions of zirconium-95, cerium-144, and cesium-137 to the activity of the resulting debris are in the approximate ratio 4:1:0.03 (Eisenbud, 1963).

The other group quantified consists of niobium-95, ruthenium-103 and -106, cesium-134, barium-lanthanum-140, and cerium-141. These isotopes are released in small quantities by nuclear power plants, but to date their major source of injection into the general environment has been atmospheric nuclear testing. Nuclides of the next group, manganese-54, cobalt-58 and -60, and zinc-65, are activation products and arise from activation of corrosion products. They are typical components of nuclear power plant effluents, but are not produced in significant quantities by nuclear detonation.

Nuclides of the final group, beryllium-7, which is of cosmogenic origin, and potassium-40, a naturally-occurring isotope, were chosen as analytical monitors and should not be considered radiological impact indicators.

Other means of distinguishing sources of environmental radiation can be employed in interpreting the data. Current radiation levels can be compared with previous levels, including pre-operational data. Results of the monitoring program can be related to those obtained in other parts of the world. Finally, results can be related to events known to cause elevated levels of radiation in the environment, e.g., a nuclear accident.

### 3.2 Program Description

The sampling and analysis schedules for the environmental radiological monitoring program at the Callaway Energy Center are summarized in Tables 5.1 and 5.2 and briefly reviewed below. Table 5.1 identifies sampling locations and specifies as to type (indicator or control) and its distance, and direction relative to the reactor site. The types of samples collected at each location, required analyses and the frequency of collections are presented in Table 5.2.

To monitor the air environment, airborne particulate and airborne iodine samples are collected by continuous pumping, at six locations. The airborne particulates are collected on glass fiber filters and the airborne iodine through activated charcoal cartridges. Both filters and cartridges are exchanged weekly. Airborne particulates are analyzed for gamma-emitting isotopes. Charcoal cartridges are analyzed for iodine-131.

The ingestion pathway is monitored by sampling of milk (if available), fish and green leafy vegetation.

Milk samples are collected semimonthly when animals are on pasture and monthly the rest of the year. There were no milk indicator or control stations identified by the Land Use Census for the subject year. Milk samples are analyzed for iodine-131 and gamma-emitting isotopes when available.

Monthly during the growing season, edible green leafy vegetation is collected from both indicator and control locations. Vegetation samples typically consist of mustard greens, turnip greens, cabbage, lettuce, collards, radish greens, swiss chard, broccoli and poke. Other edible broad leaf vegetation is collected if primary varieties are not available. The samples are analyzed for iodine-131 and other gamma-emitting isotopes.

Feed crops (soybeans, sorghum, and corn) are collected from locations FC-1 through FC-4. FC-1, FC-2 and FC-3 are located on Ameren property traversed by the discharge pipeline. The samples are collected at harvest and analyzed for tritium and gamma emitting isotopes. FC-4 is a control location, beyond the influence of plant operations. Feed crops are grown for animal feed and not for human consumption. The soybean field for sample FC-1 is planted by the Missouri State Department of Conservation (MODOC) to provide feed to wildlife living in the Reform Wildlife Conservation Area. MODOC did not plant the field this year and there was no crop to sample.

The waterborne pathway is monitored by sampling surface water, groundwater and drinking water, and bottom and shoreline sediments. Water samples are analyzed for tritium and gamma-emitting isotopes, and sediments are analyzed for gamma-emitting isotopes.

The waterborne pathway is also monitored by upstream and downstream semiannual collections of fish. The five most abundant recreational or commercial fish species are collected. The edible portions of the samples are analyzed for gamma-emitting isotopes.

Monthly composite samples of surface water from the Missouri River are collected from one indicator location (S02) and from one control location (S01). The surface water samples are composites of daily collections by automatic river samplers.

Onsite surface water from nine ponds is analyzed for tritium and gamma-emitting isotopes. The collection frequencies are semiannually.

To monitor possible sources of ground water contamination due to plant operations, non-potable ground water samples were collected monthly or quarterly from well locations both onsite and along the discharge pipeline. The samples were analyzed for tritium and gamma-emitting isotopes.

### 3.2 Program Description (continued)

Potable well water samples are collected quarterly from the plant drinking water supply and neighboring property owners. The samples were analyzed for tritium and gamma-emitting isotopes.

River bottom sediment is collected semiannually at the plant's intake (A) and discharge (C). The samples are taken from water at least 2 meters deep to prevent influence of bank erosion. Shoreline sediments are collected semiannually in the same area as bottom sediment. These samples are collected within two feet of the edge of the water. The samples are analyzed for gamma-emitting isotopes.

The direct ambient gamma radiation pathway is also considered. This exposure is monitored by thermoluminescent dosimeters (TLDs) at forty-four locations in and around the Callaway site. The TLDs are placed in 16 sectors around the plant as specified in the ODCM-RECS. Five of the TLD stations have neutron monitoring capability and three locations are designated as controls. TLDs are exchanged and analyzed quarterly.

Soil is collected annually from six indicator locations (F2, PR3, F6, PR7, W2, and W5) and two control locations (M9, W1) to monitor the terrestrial environment. The samples are analyzed for gamma-emitting isotopes.

### 3.3 Program Execution

The program was executed as described in the preceding section with the following exceptions.

#### (1) Airborne Particulates and Iodine:

The air sampler station A-1 found not operating 2/28/19, It was determined that the loss of sampling was 4 days 12 hours (CR#201901217).

The air sample station A-1 sampler head was found disconnected and laying on the ground 03/07/19 (CR#201901371).

#### (2) Milk:

Milk sampling has been discontinued at location M-9 since the 4/24/18 sampling event due to the lack of an indicator location. Vegetation sampling is sufficient to comply with the requirements of the ODCM.

#### (3) Food Products-Leafy Green Vegetables:

No vegetable samples were available 04/09/19 at any sampling locations CA-FPL-V9, CA-FPL-V11, CA-FPL-V12 and CA-FPL-V16 (CR#201902277).

The vegetable sample provider for location CA-VPL-V11 indicated 08/28/19 that they can no longer supply samples (CR#201905764).

#### (4) Inedible Crops:

Inedible crops were not available at all three indicator locations CA-FC-1, CA-FC-2, and CA-FC-3 during 2019 as the fields were not planted due to flooding. As the indicator samples were not available, a sample at the control location, CA-FC-4, was not collected (CR#201906235).

### 3.3 Program Execution (continued)

#### (5) Surface Water (Ponds) and Shoreline Sediment from Sludge Ponds:

The surface water sample taken 03/04/19 from location CA-SWA-Sludge Lagoon #4 was not taken from the in-service sludge lagoon as required (CR#201905932). Subsequent reviews determined that two new sludge lagoons existed. In 2016 two new sludge lagoons, designated Sludge Lagoon #5 and Sludge Lagoon #6 were built. These new lagoons were completed and placed into service 05/24/16. Therefore since 05/24/16 sludge lagoon #4 has not been the in-service sludge lagoon meaning that there have been three missed sediment samples and six missed water samples (CR#201906006). Currently sludge lagoon #6 is the in-service sludge lagoon. A ten year review of AREOR's indicates there has never been any radioactivity of plant origin detected in any of the lagoon samples. To prevent recurrence, the sample schedule HTP-ZZ-07101-DTI-REMP-SMPL-SCHED was revised removing the pond designation and the relevant procedure HTP-ZZ-07001-DTI-SOIL-SAMPLING was revised to require the technician to contact either Operations or Chemistry to determine which sludge lagoon is on-line prior to sampling.

#### (6) Ground Water:

A well sample was not collected at location CA-U1MW-010 for the 01/16/19 collection event due to unsafe winter conditions (CR#201900304).

Well samples were not collected at locations CA-U1MW-014, CA-U1MW-016, CA-U1MW-018, CA-U1MW-019 and CA-U1MW-020 for the surveillance period and noted 07/22/19 due to unsafe conditions caused by flooding and the sample designated as "Inside the Old Blowdown Line" was unavailable due to a dry well condition (CR#201904959).

Gamma isotopic analyses were not performed in a timely fashion for a well sample taken at location CA-U1MW-015 10/17/19, resulting in an inability to reach the required LLD for BA-140/La-140. The failure was due to an omission of the required gamma analysis on the sample chain-of-custody and was not discovered until 02/07/20 (CR#202000692).

Well samples were not collected at locations CA-U1MW-014, CA-U1MW-016, CA-U1MW-018, CA-U1MW-019, CA-U1MW-020 and the sample designated as "Inside the Old Blowdown Line" was unavailable for the scheduled period and noted 10/22/19 due to flooding and unsafe conditions (CR#201906819).

#### (7) Fish and Sediments:

Fish and sediment sample collection was not possible in the first half of 2019 due to unsafe river conditions due to extensive Missouri River flooding (CR#201904215).

#### (8) Direct Radiation:

The first quarter TLD at location CA-IDM-44 was found on the ground and treated as a missing sample (CR#201902239).

The second quarter TLD's at locations CA-IDM-09 and CA-IDM-10 were underwater due to excessive Missouri River flooding and treated as missing samples (CR#201904877).

The TLD location CA-IDM-41 was moved 10/09/19 from a location 4.9 miles from the plant to a location 5.2 miles from the plant to eliminate a potential electrical safety hazard (CR#201906570). The new location is a Callaway Electrical Cooperative Utility Pole in the same meteorological sector as the previous location.

### 3.4 Laboratory Procedures

Gamma-spectroscopic analyses were performed with HPGe detectors. Levels of iodine-131 in vegetation and concentrations of airborne iodine-131 in charcoal samples were also determined by gamma spectroscopy.

Tritium was measured by liquid scintillation.

Analytical procedures used by Environmental, Inc. are on file at the laboratory and are available for inspection. Procedures are based on those prescribed by the Health and Safety Laboratory of the U.S. Dep't of Energy, Edition 28, 1997, U.S. Environmental Protection Agency for Measurement of Radioactivity in Drinking Water, 1980, and the U.S. Environmental Protection Agency, EERF, Radiochemical Procedures Manual, 1984.

Environmental, Inc., Midwest Laboratory has a comprehensive quality control/quality assurance program designed to assure the reliability of data obtained. Details of the QA Program are presented elsewhere (Environmental, Inc., Midwest Laboratory, 2018). The QA Program includes participation in Interlaboratory Comparison (crosscheck) Programs. Results obtained through Quality control samples and crosscheck program results are presented in Appendix A.

Environmental TLDs are processed by Environmental Dosimetry Company, affiliated with Stanford Dosimetry, LLC.

### 3.5 Program Modifications

#### Direct Radiation (TLDs):

TLD location #41 was moved from the location 4.9 miles from the plant to a new location 5.2 miles in the same meteorological sector due to an electrical safety hazard near the original location. (CR 201906570)

#### Surface Water (ponds):

Location 'Sludge Lagoon #4' was changed to 'In-service Sludge Lagoon' to assure that the samples are collected from the sludge lagoon in service at the time of sampling. (CR 201905932, CR 201906006)

#### Shoreline sediment from sludge ponds:

Wetlands location W5, 'In-service Sludge Lagoon,' was added and locations W3 and W4 for Sludge Lagoon #4 were removed to assure that samples are taken from the sludge lagoon in service at the time of sampling. (CR 201905932, CR 201906006)

#### Broadleaf Vegetation:

Broadleaf vegetation station V-11 was removed as provider was no longer able to provide samples. This location provided back-up samples. (CR 201905764)

### 3.6 Detection and Reporting Limits

Table 5.3 gives the minimum required detection limits for radiological environmental sample analysis. For each sample type, the table lists the detection level for each isotope. The lower limit of detection (LLD) used in this report is described in NRC Regulatory Guide 4.1 Rev. 1, "Program for Monitoring Radioactivity in the Environs of Nuclear Power Plants" and the NRC Radiological Assessment Branch Technical Position, Rev. 1, November 1979, "An Acceptable Radiological Environmental Monitoring Program".

### 3.7 Land Use Census

The Land Use Census is performed annually during the growing season. In 2019, the field inspection of the sectors was conducted September 18, 2019 within a five mile canvassing radius of the Callaway Energy Center. The area around the plant was divided into 16 meteorological sectors. The locations of the nearest resident, nearest milk animal, and nearest garden of greater than 500 square feet producing broadleaf vegetation were identified.

The results of the census are presented in Table 5.4. The table includes radial direction and distance from the Callaway Energy Center for each location. The bearings listed in Table 5.4 were measured from the Callaway Plant to the sample location.

The following revisions are reflected in the 2019 report. In Sector D, Teresa Canner is the closest resident. In Sector G, Steve Shepard is the closest resident. In Sector H Timothy Barnes is the closest resident and Amy Dillon is the closest resident in this sector with a broadleaf garden. In Sector Q Joyce Hickman will no longer be able to provide broadleaf garden samples.

All residents included in the summary were verified by the Callaway County Assessor's GIS aerial photography.

The US Army Corps of Engineers was contacted, and they confirmed that no new drinking water intakes have been located along the Missouri River within ten (10) river miles downstream from the Callaway Plant. In addition, no irrigation uses of the Missouri River were identified between the discharge point and Portland, MO during the survey.

## 4.0 RESULTS AND DISCUSSION

All collections and analyses were made as scheduled, except for those listed in Table 5.5.

Results are summarized in Table 5.6 as recommended by the Nuclear Regulatory Commission. For each type of analysis and sample medium, the table lists the mean and range of all indicator and control locations, as well as that location with the highest mean and range.

The tabulated results of all measurements are not included in this section, although references to these results will be made in the discussion. A complete tabulation of results for 2019 is contained in Part II of the Annual Report on the Radiological Environmental Monitoring Program for the Callaway Energy Center.

### 4.1 Atmospheric Nuclear Detonations and Nuclear Accidents

The Fukushima Daiichi nuclear accident occurred March 11, 2011. There were no reported accidents involving significant release to the environment at nuclear reactor facilities in 2019. The last reported atmospheric test was conducted on October 16, 1980 by the People's Republic of China. There were no reported atmospheric nuclear tests in 2019.

### 4.2 Program Findings

#### Airborne Particulates and Iodine

No gamma emitting isotopes were identified other than naturally occurring Be-7. There was no I-131 activity detected in any of the charcoal canister samples.

Air sampling for 2019 indicates no radiological effects of plant operation.

#### Direct Radiation (TLDs)

Forty-four gamma sensitive TLDs were placed in 16 sectors around the Callaway site. Measurements from forty-one indicator locations averaged 14.7 mrem/quarter and the three control locations averaged 13.6 mrem/quarter. Readings ranged from 9.7 to 17.0 mrem /quarter, with the highest from the indicator location CA-IDM-10, averaging 16.6 mrem/quarter. The differences are statistically insignificant. The TLD readings were consistent with the results for the years 2000 through 2018 as detailed in table 5.7.

Five neutron sensitive TLDs were placed in locations at the Site Boundary closest to the Independent Spent Fuel Storage Facility Installation (ISFSI) and at a control location approximately 14 miles from the site. There was no significant measureable neutron dose and there was no effect from the ISFSI in 2019.

#### Milk

Sampling has been discontinued since 2018 since there are not enough sampling locations to fulfill the milk sampling requirement. Leafy green (broadleaf) vegetation sampling was performed in lieu of milk sampling.

#### Broadleaf Vegetation

There was no I-131 activity detected in broadleaf vegetation samples. No gamma-emitting isotopes were detected in broadleaf vegetation samples except for naturally occurring beryllium-7 and potassium-40. Vegetation data for 2019 show no radiological effects of plant operation.



## 4.2 Program Findings (continued)

### Non-Food Crops

Soybean samples were not available in 2019. (See Table 5.5 Missed Collections and Analyses).

### Fish

Edible portions of fish were analyzed by gamma spectroscopy. No gamma-emitting isotopes, except for naturally occurring potassium-40, were detected in fish.

### Soil

Cesium-137 activity was detected at eleven of the thirteen sample locations at an average concentration of 331 pCi/kg dry. 377 pCi/kg dry was the average activity for the nine of ten positive indicator locations. Two of the three control samples were positive for Cesium-137 with an average activity of 125 pCi/kg dry. The cesium-137 activity is consistent with levels observed from 1999 through 2018; these levels are attributable to the deposition of fallout from previous decades.

### Surface Water

Low level tritium was detected in three of the twelve samples collected at the downstream location S02 at an average concentration of 239 pCi/L. There was no tritium detected in the remaining nine samples from S02 nor at the upstream location S01. No gamma-emitting isotopes were detected in any of the samples taken in 2019.

### Surface Water, Ponds

Eighteen pond samples were analyzed for 2019. No tritium activity or gamma activity was detected.

### Drinking Water Wells (potable water)

Sixty samples from fifteen different locations were analyzed for tritium and gamma-emitting isotopes in 2019. No tritium or gamma-emitting isotopes were detected.

### Wells and Ponds (non-potable water)

Groundwater samples from deep wells F-05 and F-15 were analyzed for tritium and gamma-emitting isotopes. There were no tritium or gamma emitting isotopes detected.

Wells MW-31, MW-34, MW-36, MW-39, MW-47, MW-58, and MW-59 were installed during the 2014 limited site investigation (LSI) (the 2014 LSI is described in detail in the Callaway Energy Center 2014 Annual Radioactive Effluents Release Report). These wells continue to monitor the natural attenuation of tritium which decreased significantly during 2015 and continued to decrease since 2016. Tritium activity was detected in 20 of 33 samples from these wells. The highest concentration was measured in MW-31 which peaked at 933 pCi/L in October. The average concentration among positive results for these wells was 419 pCi/L. this decline has been steady since December of 2016. The contamination is being remediated by monitored natural attenuation. There are no active leaks.

Wells GWS, 936, 937B, 937D, 939R, 940, 941 and IFSFI Sump are located in the Plant Protected Area, adjacent to the power block. Tritium activity in these wells is believed to be the result of washout from gaseous effluents. The low level tritium activity observed in wells MW-014 is likely due to residual low level contamination from moisture carryover during normal operation of air

## 4.2 Program Findings (continued)

### Wells and Ponds (non-potable water) (continued)

release valves (ARVs) in manholes 5 and 6B on the now-retired discharge pipeline. The pipeline was replaced in 2008 and there has been no new contamination of this area since then. The existing contamination is being remediated by monitored natural attenuation. There are no active leaks and the results are consistent with 2015 through 2018.

### Sediments

Samples of shoreline and bottom sediments were collected in August and October 2019 at both an indicator and a control location and analyzed for gamma-emitting isotopes. Cesium-137 was detected in one of the two bottom sediment samples, The October indicator sample, had a cesium-137 concentration of 64 pCi/kg dry weight. Neither of the two shoreline sediments had a positive result for cesium-137. These results are consistent with results from previous years. There were no other gamma-emitting isotopes detected excepting naturally occurring potassium-40 in any of the sediment samples.

5.0 TABLES

**Table 5.1. Sampling Locations. (TLD's)**

Location Code	Distance / Direction <sup>1</sup>	Description	Sample Types <sup>2</sup>
1a	10.8 mi. 310° NW	City of Fulton on Hwy Z, 0.65 mi. E of Bus. 54, W of Campus Apartments	IDM
3	1.2 mi. 308° NW	0.1 mi. West of Hwy CC on Gravel Rd., 0.8 mi. South Hwy O	IDM
5	1.3 mi. 79° ENE	Meteorological Tower	IDM
6	2.0 mi. 274° W	Cty Rd. 428, 1.2 mi. West of Hwy CC	IDM
7	1.4 mi. 184° S	Cty Rd. 459, 2.6 mi. North of Hwy 94	IDM
9	3.8 mi. 183° S	NW Side of the Cty Rd. 459 and Hwy 94 Junction	IDM
10	3.9 mi. 159° SSE	Hwy 94, 1.8 mi. East of Cty Rd. 459	IDM
11a	4.7 mi. 139° SE	City of Portland	IDM
14	4.9 mi. 122° ESE	SE Side of Intersection D and 94	IDM
17	3.8 mi. 88° E	Cty Rd. 4053, 0.3 mi. E of Hwy 94	IDM
18a	3.7 mi. 67° ENE	East side of Hwy D, 0.5 mi. South of Hwy O	IDM
20	4.7 mi. 46° NE	City of Readsville	IDM
21	3.8 mi. 23° NNE	Cty Rd. 155, 1.9 mi. North of Hwy O	IDM
22a	0.9 mi. 10° NNE	0.9 mi south of HWY O, co-located with air station A8	IDM
23	6.6 mi. 15° NNE	City of Yucatan	IDM
26 <sup>3</sup>	11.7 mi. 82° E	Town of Americus	IDM
27 <sup>3</sup>	9.3 mi. 114° ESE	Town of Bluffton	IDM
30a	4.4 mi. 206° SSW	City of Steedman	IDM
31a	7.8 mi. 224° SW	City of Mokane, Hwy C and Cty Rd. 400, 0.9 mi. N. of Hwy 94	IDM
32	5.4 mi. 250° WSW	Hwy VV, 0.6 mi. west of Cty Rd. 447	IDM
32a	5.0 mi. 243° WSW	Cty Rd. 447	IDM
33	7.4 mi. 272° W	City of Hams Prairie, SE of Hwy C and AD Junction	IDM
34	9.5 mi. 292° WNW	NE Side of Hwy C and Cty Rd. 408 Junction	IDM
35	5.8 mi. 340° NNW	City of Toledo	IDM
36	4.9 mi. 7° N	Cty Rd. 155, 0.8 mi. South of Cty Rd. 132	IDM
37	0.5 mi. 195° SSW	Cty Rd. 459, 0.9 mi. South of Hwy CC	IDM
38	4.6 mi. 334° NNW	Cty Rd. 133, 1.5 mi. South of Hwy UU	IDM
39	5.4 mi. 312° NW	Cty Rd. 111	IDM
39a	5.0 mi. 308° NW	Cty Rd. 111	IDM
40	4.2 mi. 292° WNW	NE Side of Cty Rd. 112 and Hwy O	IDM
41	5.2 mi. 277° W	Hwy AD, 2.5 mi. East of Hwy C	IDM
42	4.4 mi. 231° SW	Cty Rd. 447, 2.6 mi. North of Cty Rd. 463	IDM
43	0.5 mi. 223° SW	Cty Rd. 459, 0.7 mi. South of Hwy CC	IDM
44	1.7 mi. 254° WSW	Hwy CC, 1.0 mi. South of Cty Rd. 459	IDM
45	1.0 mi. 285° WNW	Cty Rd. 428, 0.1 mi. West of Hwy CC	IDM
46	1.5 mi. 328° NNW	NE Side of Hwy CC and Cty Rd. 466 Intersection	IDM
47	1.0 mi. 10° N	Cty Rd. 448, 0.9 mi. South of Hwy O	IDM
48	0.4 mi. NE	Cty Rd. 448, 1.5 mi. South of Hwy O, Plant Security Sign Post	IDM
49	1.6 mi. 94° E	Cty Rd. 448, Reform Wildlife Mgmt. Parking Area	IDM
50	0.9 mi. 168° SSE	Cty Rd. 459, 3.3 mi. North of Hwy 94	IDM
51a	0.3 mi. 150° SE	Owner Control Fence, SE of the Water Treatment Plant	IDM
52	0.4 mi. 111° ESE	Light Pole Near the East Plant Security Fence	IDM
60 <sup>3</sup>	13.5 mi. 224° SW	Just past Tebbetts City sign	IDM

**Table 5.1. Sampling Locations. (TLD's, continued)**

Location Code	Distance / Direction <sup>1</sup>	Description	Sample Types <sup>2</sup>
60N <sup>3</sup>	13.5 mi 224° SW	Co-located with location 60	IDM
61	1.9 mi 334° NNW	Community of Reform, Corner of CC and O	IDM
61N	1.9 mi 334° NNW	Co-located with location 61	IDM
62N	1.2 mi. 308° NW	Co-located with location 3	IDM
63N	0.9 mi. 10° NNE	Co-located with air station A8 and location 22a	IDM
64N	1.0 mi. 285° WNW	Co-located with location 45	IDM

**Table 5.1. Sampling Locations (Airborne Radioiodine and Particulate samples, Surface Ponds, Potable Water)**

A1	1.3 mi. 79° ENE	Meteorological Tower	APT, AIO
A7	9.5 mi. 312° NW	C. Bartley Farm, Fulton, MO	APT, AIO
A8	0.9 mi. 10° NNE	Cty Rd. 448, 0.9 miles South of Hwy 0	APT, AIO
A9	1.9 mi. 334° NNW	Community of Reform	APT, AIO
A10	0.89 mi 276° W	EOF Parking lot	APT, AIO
A11	0.71 mi 166° SSE	Sludge ponds lift pumps area	APT, AIO
3	2.9 mi. 168°	Potable water, County Road 448 Ward Residence	DWA
4	2.6 mi. 158°	Potable water, County Road 448 Miller Residence	DWA
5	2.5 mi. 153°	Potable water, County Road 448 Brucker Brothers Farm	DWA
6	2.2 mi. 141°	Potable water, County Road 448 Lindeman Residence	DWA
7	2.1 mi. 108°	Potable water, County Road 448 Kriete Residence	DWA
8	3.4 mi. 193°	Potable water, County Road 457 Brandt Residence	DWA
9	2.9 mi. 204°	Potable water, County Road 457 Clardy Residence	DWA
10	2.7 mi. 208°	Potable water, County Road 457 S. Dillon Residence	DWA
12	3.6 mi. 165°	Potable water, County Road 464 J. Dillon Residence	DWA
21	2.4 mi. 120°	Potable water, County Road 469 Baumgarth Residence	DWA
22	4.8 mi. 140°	Potable water, State Road 94 Plummer Residence	DWA
23	5.6 mi 142°	Potable water, Curdt Residence	DWA
24	2.9 mi 203°	Potable water, Farley Residence	DWA
V16	1.64 mi. 76° WSW	Wallendorf Farm, Steedman, MO	DWA
PW1	Callaway Cafeteria	Potable water, Unit 1 Construction well #3 open from 400'-1400'	DWA
Pond 01	0.6 mi. 264°	Fishing Pond	SWA
Pond 02	0.7 mi. 232°	Fishing Pond	SWA
Outfall 010	0.6 mi. 42°	Stormwater Run-Off Pond	SWA
Outfall 011	1.0 mi. 60°	Stormwater Run-Off Pond	SWA
Outfall 012	0.5 mi. 178°	Stormwater Run-Off Pond	SWA
Outfall 013	0.5 mi. 189°	Stormwater Run-Off Pond	SWA
Outfall 014	0.6 mi. 343°	Stormwater Run-Off Pond	SWA
Outfall 015	0.7 mi. 4°	Stormwater Run-Off Pond	SWA
Sludge Lagoon	0.8 mi. 153° <sup>5</sup>	In-service Sludge Lagoon	SWA
S01 <sup>3</sup>	4.8 mi. 150° SSE	555 feet Upstream of Discharge North Bank	SWA
S02	4.9 mi. 138° SE	1.1 River Miles Downstream of Discharge North Bank	SWA

**Table 5.1. Sampling Locations, Non-potable Groundwater Wells**

Location Code	Distance / Direction <sup>1</sup>	Description	Sample Types <sup>2</sup>
U1MW-936	Plant Peninsula Area	Diesel Fuel Remediation Well, NW of Fuel Bldg.	WWA
U1MW-937B	Plant Peninsula Area	Monitoring Well, West of the Turbine Bldg.	WWA
U1MW-937D	Plant Peninsula Area	Monitoring Well, North of Discharge Monitor Tanks	WWA
U1MW-939R	Plant Peninsula Area	Monitoring Well, East of the Fuel Bldg.	WWA
U1MW-940	Plant Peninsula Area	Monitoring Well, West of the Radwaste Bldg.	WWA
U1MW-941	Plant Peninsula Area	Monitoring Well, West of the Radwaste Bldg.	WWA
U1MW-GWS	Plant Peninsula Area	Ground Water Sump, West of Reactor Bldg. and Fuel Bldg.	WWA
U1MW-ISFSI	ISFSI sump	ISFSI Sump	WWA
U1MW-001	0.3 mi. 334°	Outside owner controlled area (OCA), Groundwater Monitoring Well	WWA
U1MW-002	0.4 mi. 206°	Outside OCA, Groundwater Monitoring Well	WWA
U1MW-004	3.7 mi. 165°	South of Dillon residence, Groundwater Monitoring Well	WWA
U1MW-005	3.8 mi. 160°	South of Brownlee / Hudson residence, Groundwater Monitoring Well	WWA
U1MW-006	3.0 mi. 171°	South of Ward Residence, Groundwater Monitoring Well	WWA
U1MW-010	3.1 mi. 173°	Old Pipeline Bed, Groundwater Monitoring Well	WWA
U1MW-012	3.0 mi. 172°	South of Ward Residence, Groundwater Monitoring Well	WWA
U1MW-013	0.8 mi. 159°	Pipeline Corridor, south of sludge ponds	WWA
U1MW-014	3.7 mi. 171°	Pipeline Corridor, near manhole 6B	WWA
U1MW-015	3.9 mi. 162°	Pipeline Corridor, North of HWY 94.	WWA
U1MW-016	4.5 mi. 151°	Pipeline Corridor, near heavy haul road at intake structure	WWA
U1MW-018	3.75 mi. 172°	Pipeline Corridor, near manhole 6B	WWA
U1MW-019	3.71 mi. 172°	Pipeline Corridor, near manhole 5	WWA
U1MW-020	3.88 mi. 164°	Pipeline Corridor, near manhole 3B	WWA
U1MW-031		~1m from manhole 86-2 & 1m from HDPE discharge pipeline	WWA
U1MW-034		~130m from manhole 86-2, HDPE discharge line bedding	WWA
U1MW-036		~300m from MH 86-2, HDPE discharge line bedding at cross connection pipe	WWA
U1MW-039		~1100m from manhole 86-2, HDPE discharge line bedding outside OCA	WWA
U1MW-047		Upstream side of HDPE gate valve vault at intake structure inside HDPE pipeline bedding	WWA
U1MW-058		~400m from manhole 86-2, Techite discharge line bedding	WWA
U1MW-059		~1700m from MH86-2, Techite discharge line bedding outside OCA	WWA
Inside Old BDL		Sampled through hole in Techite blowdown line	WWA
U2 MW 2S	1.8 mi. 5°	Located on the periphery of the plateau	WWA
U2 MW 5S	1.1 mi. 261°	Located on the periphery of the plateau	WWA
U2 MW 8	0.4 mi. 12°	Located radially outward from central part of the plateau	WWA
U2 MW 10	0.4 mi. 163°	Located radially outward from central part of the plateau	WWA
U2 MW 16	2.9 mi. 203°	Located along Mud Creek, Farley Property, screened for CJC aquifer	WWA
F05	0.9 mi. 169°	CJC aquifer monitoring well	WWA
F15	0.4 mi. 29°	Outside OCA fence in center portion of plateau, screened for CJC aquifer	WWA

**Table 5.1. Sampling Locations, Soil, Food Products, Milk, Fish, Bottom Sediments and Inedible Crops.**

Location Code	Distance / Direction <sup>1</sup>	Description	Sample Types <sup>2</sup>
F2	1.0 mi. 235° SW	Callaway Plant Forest Ecology Plot F2.	SOL
F6	1.6 mi. 51° NE	Callaway Plant Forest Ecology Plot F6.	SOL
PR3	0.95 mi. 108° ESE	Callaway Plant Forest Ecology Plot PR3.	SOL
PR7	0.46 mi. 320° NNW	Callaway Plant Forest Ecology Plot PR7.	SOL
W1 <sup>3</sup>	0.52 mi. 150° SE	Callaway Plant Wetlands, High Ground.	SOL
W2	0.52 mi. 149° SSE	Callaway Plant Wetlands, Inlet Area.	SOL
W5	(5)	In-service Sludge Lagoon.	SOL
M9 <sup>3</sup>	13 mi. 228° SW	Ferguson Farm, Tebbetts, MO.	SOL
V9	1.9 mi. 294° WNW	Meehan Farm, Steedman, MO	FPL
V11	3.2 mi. 325° NW	Hickman Farm, Steedman, MO	FPL
V12 <sup>3</sup>	18.7 mi. 255° WSW	Kissock Farm, Holts Summit, MO	FPL
V16	1.64 mi. 76° WSW	Wallendorf Farm, Steedman, MO	FPL
A <sup>3,4</sup>		Between 0.6 and 10.0 river miles upstream of the plant intake.	AQF
A <sup>3</sup> .		Upstream of the plant intake.	AQS
C <sup>4</sup>		Downstream, of the plant discharge, between the confluence of the Missouri River and Logan Creek and the Portland boat ramp	AQF
C		Vicinity of Portland – north bank	AQS
FC1		Between discharge pipeline MH-8 and the Katy Trail	FC
FC2		Between discharge pipeline MH-5 and MH-3B.	FC
FC3		Between Hwy 94 and the barge loading dock access road.	FC
FC4 <sup>3</sup>		South Callaway High School, Unlikely to be influenced by plant operations.	FC

<sup>1</sup> Distances are measured from the midpoint of the two reactors as described in Final Safety Analysis Report (FSAR) Sec. 2.1.1.1.

<sup>2</sup> AIO = Air Iodine, APT = Air Particulate, AQF = Fish, AQS = Sediment, FPL = Leafy Green Vegetables, FC = Food Crops, IDM = TLD, MLK = Milk, SOL = Soil, SWA = Surface Water, DWA = Drinking Water, WWA = Ground Water.

<sup>3</sup> Control Location.

<sup>4</sup> The expanded collection areas provide sufficient habitat to collect the required number of species.

<sup>5</sup> The coordinates of the in-service sludge lagoon are determined at the time of sampling in accordance with HTP-ZZ-07101-DTI-REMP-SMPL-SCHED.

**Table 5.2. Collection Frequencies and Required Analyses <sup>1</sup> (January 1 through December 31, 2019)**

Sample Type	Media Code	Collection Frequency	Required Analyses
Direct radiation	IDM	Quarterly	Gamma dose for each sample. Neutron dose for the samples monitoring ISFSI direct radiation.
Airborne iodine	AIO	Weekly	<sup>131</sup> I
Air particulate	APT	Weekly	PGE <sup>4</sup> each sample
Surface water (river)	SWA	Monthly composite	PGE and <sup>3</sup> H
Surface water (onsite ponds)	SWA	Semiannually	PGE and <sup>3</sup> H. If contaminated with gamma emitting nuclides of plant origin, analyze for HTD <sup>5</sup> nuclides.
Groundwater (not potable)	WWA	Quarterly <sup>6</sup>	PGE and <sup>3</sup> H. If contaminated with gamma emitting nuclides of plant origin, analyze for HTD nuclides.
Well water-potable	DWA	Quarterly	PGE and <sup>3</sup> H. If contaminated with gamma emitting nuclides of plant origin, analyze for HTD nuclides.
Shoreline sediment	AQS	Semiannually	PGE
Bottom sediment <sup>2</sup>	AQS	Semiannually	PGE
Sludge pond sediment	SOL	Annually	PGE
Soil	SOL	Annually	PGE
Milk animal	MLK	Semimonthly when animals are on pasture, monthly other times	PGE and <sup>131</sup> I
Leafy green vegetables	FPL	Monthly when available <sup>3</sup>	PGE and <sup>131</sup> I
Inedible crops	FC	At time of harvest	PGE and <sup>3</sup> H
Fish	AQF	Semiannually	PGE on edible portion

<sup>1</sup> Samples required by ODCM unless specified otherwise.

<sup>2</sup> Required by NPDES permit.

<sup>3</sup> The growing season is defined as the months April 1- November 1, but will vary according to weather conditions.

<sup>4</sup> Principal Gamma Emitters (PGE) are defined as <sup>54</sup>Mn, <sup>59</sup>Fe, <sup>58</sup>Co, <sup>60</sup>Co, <sup>65</sup>Zn, <sup>95</sup>Zr/Nb, <sup>134</sup>Cs, <sup>137</sup>Cs, <sup>140</sup>Ba/La and other gamma- emitting nuclides that may be identified during the gamma spectroscopy analysis.

<sup>5</sup> Hard to Detect (HTD) nuclides are defined as <sup>89</sup>Sr, <sup>90</sup>Sr, <sup>55</sup>Fe, <sup>63</sup>Ni, <sup>237</sup>Np, <sup>238</sup>Pu, <sup>239/240</sup>Pu, <sup>241</sup>Pu, <sup>241</sup>Am, <sup>242</sup>Cm and <sup>243/244</sup>Cm.

<sup>6</sup> Monthly for locations U1MW-936, U1MW-937B, U1MW-937D, U1MW-939R, U1MW-940, U1MW-941 and U1MW-GWS.



**Table 5.3. Minimum Required Detection Capabilities for REMP Sample Analysis<sup>1</sup>**

Analysis	Water (pCi/L)	Airborne (pCi/m <sup>3</sup> )	Fish (pCi/kg wet)	Milk (pCi/L)	Food Products (pCi/kg wet)	Non-Food Products (pCi/kg wet)	Soil and Sediment (pCi/kg dry)
H-3	3000/2000 <sup>3</sup>					3000	
Mn-54	15		130				
Fe-59	30		260				
Co-58/60	15		130				
Zn-65	30		260				
Zr-Nb-95 <sup>2</sup>	15						
I-131	1000/1 <sup>3</sup>	0.07		1	60		
Cs-134	15	0.05	130	15	60	60	150
Cs-137	18	0.06	150	18	80	80	180
Ba-La-140 <sup>2</sup>	15			15			

<sup>1</sup> This list does not mean only these nuclides will be detected and reported. Other peaks which are measurable and identifiable will be reported.

<sup>2</sup> Total activity, parent plus daughter activity.

<sup>3</sup> LLDs for Surface and Drinking / Ground water are the same, with the exception of H-3 and I-131. The Drinking / Ground water LLDs for H-3 and I-131 are 2000 and 1 pCi/liter respectively.

**Table 5.4 2019 Land Use Census Results**

**Closest Receptor in Miles**

<b>Sector</b>	<b>Residence</b>	<b>Garden <sup>1, 2</sup></b>	<b>Milk <sup>1</sup></b>
N(A)	2.37	NI	NI
NNE(B)	2.16	NI	NI
NE(C)	2.26	NI	NI
ENE(D)	2.86	NI	NI
E(E)	3.51	NI	NI
ESE(F)	2.11	4.47	NI
SE(G)	2.72	NI	NI
SSE(H)	3.11	3.28	NI
S(J)	2.86	NI	NI
SSW(K)	2.38	NI	NI
SW(L)	2.63	2.72	NI
WSW(M)	1.20	1.96	NI
W(N)	1.56	3.55	NI
WNW(P)	1.93	1.93	NI
NW(Q)	2.07	NI	NI
NNW(R)	1.81	NI	NI

<sup>1</sup> NI = None Identified.

<sup>2</sup> Broadleaf Vegetation

**Table 5.5. Missed collections and analyses, Callaway Energy Center**

Sample Type	Analysis	Location(s)	Collection Date or Period	Comments
WWA	H-3, Gamma	U1MW-010	01-16-19	Sample not collected due to weather Related safety issues.
APT	Gamma	CA-A-001	02-28-19	Pump found not running.
AIO	I-131	CA-A-001	02-28-19	Pump found not running.
APT	Gamma	CA-A-001	03-07-19	Sampler head found not connected.
AIO	I-131	CA-A-001	03-07-19	Sampler head found not connected.
SWA	H-3, Gamma	CA-SWA-SLUDGE LAGOON #6	03-04-19	In-service Sludge Lagoon (#6) was not sampled.
IDM	Gamma	CA-IDM-44	1 <sup>st</sup> Qtr 2019	TLD found on ground.
IDM	Gamma	CA-IDM-9	2 <sup>nd</sup> Qtr 2019	TLD found underwater.
IDM	Gamma	CA-IDM-10	2 <sup>nd</sup> Qtr 2019	TLD found underwater.
AQS	Gamma	CA-AQS-A, CA-AQS-C	1 <sup>st</sup> Half 2019	Unable to collect samples due to extreme flooding.
AQF	Gamma	CA-AQF-A, CA-AQF-C	1 <sup>st</sup> Half 2019	Unable to collect samples due to extreme flooding.
WWA	H-3, Gamma	U1MW-014	07-19-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	U1MW-016	07-19-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	U1MW-018	07-19-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	U1MW-019	07-19-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	U1MW-020	07-19-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	Inside Old Blowdown Line	07-19-19	Well was dry.
FPL	Gamma, I-131	CA-FPL-V9	04-09-19	Garden not yet producing.
FPL	Gamma, I-131	CA-FPL-V11	04-09-19	Garden not yet producing.
FPL	Gamma, I-131	CA-FPL-V12	04-09-19	Garden not yet producing.
FPL	Gamma, I-131	CA-FPL-V16	04-09-19	Garden not yet producing.
FPL	Gamma, I-131	CA-FPL-V-11	09-10-19	No sample available.
FC	Gamma	CA-FC-1	2019 Harvest	Crops not planted due to flooding.
FC	Gamma	CA-FC-2	2019 Harvest	Crops not planted due to flooding.

**Table 5.5. Missed collections and analyses, Callaway Energy Center (continued)**

<b>Sample Type</b>	<b>Analysis</b>	<b>Location(s)</b>	<b>Collection Date or Period</b>	<b>Comments</b>
FC	Gamma	CA-FC-3	2019 Harvest	Crops not planted due to flooding.
FC	Gamma	CA-FC-4	2019 Harvest	Control location not collected as no indicator locations were planted.
WWA	H-3, Gamma	U1MW-014	10-17-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	U1MW-016	10-17-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	U1MW-018	10-17-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	U1MW-019	10-17-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	U1MW-020	10-17-19	Well inaccessible due to flooding.
WWA	H-3, Gamma	Inside Old Blowdown Line	10-17-19	Well inaccessible due to flooding.

**Table 5.6 Radiological Environmental Monitoring Program Summary**

Sample Type (Units)	Type and Number of Analyses(a)		Req'd LLD(b)	Indicator Locations Mean, Fraction, Range (c)	Location with Highest Annual Mean		Control Locations Mean, Fraction, Range (c)	Number Non-Routine Results(e)
					Location (d)	Mean, Fraction, Range (c)		
<b>Waterborne Pathway</b>								
Surface Water (pCi/L)	H-3	24	3000	239(3/12) (204-261)	CA-SWA-S02 4.9 mi SE	239 (3/12) (204-261)	ND	0
	GS	24	(b)	ND	-	-	ND	0
Surface Water, Ponds (pCi/L)	H-3	18	3000	ND	-	-	None	0
	GS	18	(b)	ND	-	-	None	0
Potable Wells (pCi/L)	H-3	60	2000	ND	-	-	ND	0
	GS	60	(b)	ND	-	-	ND	0
Wells (non-potable) (pCi/L)	H-3	204	3000	396 (94/204) (151-1985)	CA-U1MW-31	660 (5/6) (275-933)	None	0
	GS	135	(b)	ND	-	-	None	0
Sediments (pCi/kg) dry	Cs-134	8	150	ND	-	-	ND	0
	Cs-137	8	180	64 (1/4)	CA-AQS-C	64 (1/4)	ND	0
<b>Airborne Pathway</b>								
Airborne Particulates (pCi/m <sup>3</sup> )	GS	310	(b)	ND	-	-	None	0
Airborne Iodine (pCi/m <sup>3</sup> )	I-131	310	0.07	ND	-	-	None	0
<b>Soil</b>								
Soil (pCi/kg) dry	Cs-134	13	150	ND	-	-	ND	0
	Cs-137	13	180	377 (9/10) (83-694)	F-002 1.0 mi. SW	666 (2/2) (640-694)	125(2/3) (121-128)	0

**Table 5.6 Radiological Environmental Monitoring Program Summary**

Sample Type (Units)	Type and Number of Analyses(a)		Req'd LLD(b)	Indicator Locations Mean, Fraction, Range (c)	Location with Highest Annual Mean		Control Locations Mean, Fraction, Range (c)	Number Non-Routine Results(e)
					Location (d)	Mean, Fraction, Range (c)		
<b>Ingestion Pathway</b>								
Food Products Leafy Green Vegetables (pCi/kg wet)	GS	64	(b)	ND	-	-	ND	0
Non- food Products Soybeans (pCi/kg) wet	H-3 (f)	0	3000	ND	-	-	ND	0
	GS	0	(b)	ND	-	-	ND	0
Fish Edible Flesh (pCi/kg) wet	GS	20	(b)	ND	-	-	ND	0
Milk (pCi/L)	I-131	0	1	none	-	-	ND	0
	GS	0	(b)	ND	-	-	ND	0
<b>Direct Radiation</b>								
(Quarterly TLDs) (mrem/Qtr)	Gamma	173	-	14.7(161/161) (10.6-17.0)	CA-IDM-10, 3.9 mi. SSE	16.6 (4/4) (16.1-17.0)	13.6 (12/12) (9.7-16.3)	0
	Neutron	20	-	ND	-	-	ND	0

(a) GS = gamma spectroscopy.

(b) LLD = nominal lower limit of detection based on a 4.66 sigma counting error for background sample. LLD's for gamma spectroscopy are in Table 5.3.

(c) Mean and range are based on detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (F). ND= not detected.

(d) Locations are specified by station code (Table 5.2) and distance (miles) and direction relative to reactor site.

(e) Non-routine results are those which exceed ten times the control station value. If no control station value is available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.

(f) Units: pCi/L.

**Table 5.7 Direct Radiation Dose (mrem/90 days) for the Period 2000-2018**

Station Code	Mean	$3\sigma$	Mean + $3\sigma$	Max
CA-IDM-1A	16.0	2.8	18.7	18.0
CA-IDM-3*	16.9	2.9	19.8	20.0
CA-IDM-5	14.3	2.7	17.1	17.1
CA-IDM-6	16.4	3.4	19.8	19.0
CA-IDM-7	16.2	3.1	19.3	19.0
CA-IDM-9	15.0	2.5	17.5	17.0
CA-IDM-10	17.0	2.7	19.7	19.3
CA-IDM-11A	17.2	2.7	19.9	19.3
CA-IDM-14	15.9	2.8	18.7	18.7
CA-IDM-17	16.1	2.9	19.0	18.3
CA-IDM-18A	16.2	4.7	20.9	18.9
CA-IDM-20	16.5	2.9	19.4	19.3
CA-IDM-21	16.4	3.3	19.7	19.0
CA-IDM-22A*	14.6	5.0	19.6	18.0
CA-IDM-23	16.6	2.7	19.3	19.0
CA-IDM-26(C)	11.4	2.2	13.6	13.1
CA-IDM-27(C)	17.2	2.8	20.0	20.0
CA-IDM-30A	15.7	2.7	18.5	18.2
CA-IDM-31A	17.0	2.6	19.6	19.0
CA-IDM-32	16.7	2.8	19.5	19.0
CA-IDM-32A	16.2	3.9	20.0	20.0
CA-IDM-33	16.0	2.7	18.7	18.0
CA-IDM-34	15.4	2.9	18.3	18.0
CA-IDM-35	14.8	2.5	17.4	17.3
CA-IDM-36	15.5	3.3	18.8	18.7
CA-IDM-37	15.8	2.7	18.5	18.0
CA-IDM-38	11.4	2.2	13.6	13.9
CA-IDM-39	15.8	3.0	18.8	19.0
CA-IDM-39A	16.5	3.0	19.4	19.0
CA-IDM-40	17.0	3.0	20.0	19.2
CA-IDM-41	15.8	3.0	18.8	19.0
CA-IDM-42	13.6	2.5	16.1	15.6
CA-IDM-43	16.0	2.8	18.8	18.7
CA-IDM-44	16.3	3.2	19.4	19.0
CA-IDM-45*	14.8	3.2	18.0	20.0
CA-IDM-46	16.4	2.8	19.2	19.9
CA-IDM-47	15.6	2.7	18.3	18.0
CA-IDM-48	16.6	2.7	19.3	19.0
CA-IDM-49	15.5	2.6	18.2	18.0
CA-IDM-50	16.3	2.8	19.1	20.0
CA-IDM-51A	17.0	2.8	19.8	19.8
CA-IDM-52	16.7	2.6	19.3	19.1
CA-IDM-60(C)*	16.1	2.5	18.6	18.0
CA-IDM-61*	14.8	1.7	16.4	15.7

\* ISFSI monitoring  
(C) Control location

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## APPENDIX A

### INTERLABORATORY AND INTRALABORATORY COMPARISON PROGRAM RESULTS

**NOTE:** Appendix A is updated four times a year. The complete appendix is included in March, June, September and December monthly progress reports only.

January, 2019 through December, 2019

## Appendix A

### Interlaboratory/ Intralaboratory Comparison Program Results

Environmental, Inc., Midwest Laboratory has participated in interlaboratory comparison (crosscheck) programs since the formulation of its quality control program in December 1971. These programs are operated by agencies which supply environmental type samples containing concentrations of radionuclides known to the issuing agency but not to participant laboratories. The purpose of such a program is to provide an independent check on a laboratory's analytical procedures and to alert it of any possible problems.

Participant laboratories measure the concentration of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used.

Results in Table A-1 were obtained through participation in the RAD PT Study Proficiency Testing Program administered by Environmental Resource Associates, serving as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

Results in Table A-2 were obtained through participation in the New York Department of Health Environmental Laboratory Approval Program (ELAP) PT

Table A-3 lists results for thermoluminescent dosimeters (TLDs), via irradiation and evaluation by the University of Wisconsin-Madison Radiation Calibration Laboratory at the University of Wisconsin Medical Radiation Research Center.

Table A-4 lists results of the analyses on in-house "spiked" samples for the past twelve months. All samples are prepared using NIST traceable sources. Data for previous years available upon request.

Table A-5 lists results of the analyses on in-house "blank" samples for the past twelve months. Data for previous years available upon request.

Table A-6 lists analytical results from the in-house "duplicate" program for the past twelve months. Acceptance is based on the each result being within 25% of the mean of the two results or the two sigma uncertainties of each result overlap.

The results in Table A-7 were obtained through participation in the Mixed Analyte Performance Evaluation Program.

Results in Table A-8 were obtained through participation in the MRAD PT Study Proficiency Testing Program administered by Environmental Resource Associates, serving as a replacement for studies conducted previously by the Environmental Measurement Laboratory Quality Assessment Program (EML).

Attachment A lists the laboratory acceptance criteria for various analyses.

Out-of-limit results are explained directly below the result.

Attachment A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

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Analysis	Ratio of lab result to known value.
Gamma Emitters	0.8 to 1.2
Strontium-89, Strontium-90	0.8 to 1.2
Potassium-40	0.8 to 1.2
Gross alpha	0.5 to 1.5
Gross beta	0.8 to 1.2
Tritium	0.8 to 1.2
Radium-226, Radium-228	0.7 to 1.3
Plutonium	0.8 to 1.2
Iodine-129, Iodine-131	0.8 to 1.2
Nickel-63, Technetium-99, Uranium-238	0.7 to 1.3
Iron-55	0.8 to 1.2
Other Analyses	0.8 to 1.2

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TABLE A-1. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)<sup>a</sup>.  
RAD study

Lab Code	Date	Analysis	Concentration (pCi/L)			Acceptance
			Laboratory Result	ERA Result	Control Limits	
ERW-71	1/7/2019	Ba-133	97.9 ± 4.5	99.5	84.1 - 109	Pass
ERW-71	1/7/2019	Cs-134	45.4 ± 3.1	49.1	39.5 - 54.0	Pass
ERW-71	1/7/2019	Cs-137	129 ± 6	125	112 - 140	Pass
ERW-71	1/7/2019	Co-60	98.1 ± 4.1	96.4	86.8 - 108	Pass
ERW-71	1/7/2019	Zn-65	80.4 ± 7.8	77.4	69.5 ± 93.2	Pass
ERW-73	1/7/2019	Gr. Alpha	22.2 ± 1.6	21.8	10.9 - 29.5	Pass
ERW-73	1/7/2019	Gr. Beta	46.4 ± 1.4	55.7	38.1 - 62.6	Pass
ERW-75	1/7/2019	Ra-226	7.19 ± 0.30	7.37	5.55 ± 8.72	Pass
ERW-75	1/7/2019	Ra-228	4.02 ± 0.70	4.28	2.48 - 5.89	Pass
ERW-75	1/7/2019	Uranium	50.2 ± 2.9	68.2	55.7 - 75.0	Fail <sup>b</sup>
ERW-77	1/7/2019	H-3	2,129 ± 158	2,110	1,740 - 2,340	Pass
ERW-397	2/11/2019	I-131	27.2 ± 1.0	25.9	25.1 - 30.6	Pass
ERW-1141	4/8/2019	Ra-226	7.58 ± 0.53	7.15	5.39 - 8.48	Pass
ERW-1141	4/8/2019	Ra-228	2.64 ± 0.79	2.94	1.54 - 4.35	Pass
ERW-1141	4/8/2019	Uranium	67.0 ± 0.9	55.9	45.6 - 61.5	Fail <sup>c</sup>
ERW-2471	7/8/2019	Ba-133	66.5 ± 4.0	66.9	55.8 - 73.6	Pass
ERW-2471	7/8/2019	Cs-134	29.6 ± 2.6	32.0	25.1 - 35.2	Pass
ERW-2471	7/8/2019	Cs-137	21.3 ± 3.6	21.4	17.6 - 26.7	Pass
ERW-2471	7/8/2019	Co-60	99.9 ± 4.4	95.1	85.6 - 107.0	Pass
ERW-2471	7/8/2019	Zn-65	43.7 ± 6.2	41.2	35.3 - 51.4	Pass
ERW-2473	7/8/2019	Gr. Alpha	41.7 ± 2.1	70.6	37.1 - 87.1	Pass
ERW-2473	7/8/2019	Gr. Beta	57.0 ± 1.6	63.9	44.2 - 70.5	Pass
ERW-2477	7/8/2019	Ra-226	16.2 ± 0.5	18.5	13.8 - 21.1	Pass
ERW-2477	7/8/2019	Ra-228	6.2 ± 0.8	8.2	5.2 - 10.3	Pass
ERW-2477	7/8/2019	Uranium	63.8 ± 3.6	68.3	55.8 - 75.1	Pass
ERW-2479	7/8/2019	H-3	8,630 ± 200	16,700	14,600 - 18,400	Fail <sup>d</sup>
ERW-2475	7/8/2019	I-131	33.6 ± 1.3	29.6	24.6 - 34.6	Pass

<sup>a</sup> Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing in drinking water conducted by Environmental Resource Associates (ERA).

<sup>b</sup> In order to get to the root cause of the above "Fail" resolution the U-232 tracer was standardized using a known concentration of NIST U-238 solution. A duplicate analysis was performed and the results obtained were well within the acceptance range (Known value for Total Uranium=68.2 pCi/L, acceptance range of (55.7-75 pCi/L). The results obtained were 63.3 pCi/L and 66.0 pCi/L respectively.

<sup>c</sup> The standardized U-232 value utilized on ERA sample ERW-1141 above was found to be estimated high due to interferences in the U-238 solution causing ERW-1141 to fail the study. After performing U-isotopic chemistry on the NIST-Uranium solution to remove interferences a more accurate U-232 tracer concentration was obtained. The Uranium result in the subsequent ERA PT study was acceptable. See ERW-2477 Uranium result above.

<sup>d</sup> EIML's routine H-3 analysis does include a blank sample. The ERA provided blank was paired with a H-3 standard vial and EIML's blank was also paired with a standard vial. Inadvertently the efficiency was overestimated by a factor of 2. This understated the calculated results by half. The result of reanalysis (17,400 pCi/L) is within the control limits for the study.

TABLE A-2. Interlaboratory Comparison Crosscheck program, New York Department of Health (ELAP)<sup>a</sup>.

Lab Code	Date	Concentration (pCi/L)				Acceptance Limits	Acceptance
		Analysis	Laboratory Result	Assigned Value			
Shipment 427R							
NYW-3472	9/17/2019	H-3	5250 ± 229	4991	4280 - 5490	Pass	
NYW-3476	9/17/2019	Gross Alpha	18.0 ± 1.2	20.1	9.99 - 27.5	Pass	
NYW-3476	9/17/2019	Gross Beta	22.7 ± 1.0	27.2	17.1 - 35.1	Pass	
NYW-3478	9/17/2019	I-131	18.7 ± 1.8	15.6	12.8 - 19.3	Pass	
NYW-3480	9/17/2019	Ra-226	5.02 ± 0.37	4.41	3.37 - 5.43	Pass	
NYW-3480	9/17/2019	Ra-228	16.0 ± 1.9	18.3	12.3 - 21.9	Pass	
NYW-3480	9/17/2019	Uranium	13.7 ± 0.9	13.9	11.0 - 15.7	Pass	
NYW-3482	9/17/2019	Co-60	63.9 ± 4.0	63.0	56.7 - 71.8	Pass	
NYW-3482	9/17/2019	Zn-65	108 ± 9	113	97.2 - 129	Pass	
NYW-3482	9/17/2019	Ba-133	53.3 ± 4.3	61.9	51.4 - 68.2	Pass	
NYW-3482	9/17/2019	Cs-134	47.2 ± 3.4	55.8	45.1 - 61.4	Pass	
NYW-3482	9/17/2019	Cs-137	52.0 ± 4.6	53.8	48.4 - 62.0	Pass	

<sup>a</sup> Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing in drinking water conducted by the New York Department of Health Laboratory Approval Program (NY ELAP).

TABLE A-3      Table has been intentionally omitted.

TABLE A-4. In-House "Spiked" Samples

Lab Code <sup>b</sup>	Date	Analysis	Concentration <sup>a</sup>				Acceptance	Ratio Lab/Known
			Laboratory results 2s, n=1 <sup>c</sup>	Known Activity	Control Limits <sup>d</sup>			
SPW-61	1/5/2019	Ra-226	13.4 ± 0.4	12.3	9.8 - 14.8	Pass	1.09	
SPW-118	1/14/2019	H-3	15,463 ± 369	16,507	13,206 - 19,808	Pass	0.94	
SPW-178	1/16/2019	Ra-228	17.7 ± 2.1	15.1	12.10 - 18.14	Pass	1.17	
SPW-199	1/18/2019	Sr-90	17.6 ± 1.2	17.9	14.3 - 21.5	Pass	0.98	
SPW-250	1/24/2019	Ni-63	356.3 ± 44.5	465	326 - 605	Pass	0.77	
SPW-256	1/15/2019	Ra-226	12.0 ± 0.4	12.3	9.8 - 14.8	Pass	0.98	
SPW-271	3/18/2019	H-3	22,035 ± 450	21,700	17,360 - 26,040	Pass	1.02	
SPW-281	1/25/2019	Ra-226	11.6 ± 0.4	12.3	9.8 - 14.8	Pass	0.94	
W-012119	4/29/2016	Cs-134	37.3 ± 10.6	36.2	29.0 - 43.4	Pass	1.03	
W-012119	4/29/2016	Cs-137	82.7 ± 8.0	71.9	57.5 - 86.3	Pass	1.15	
W-012319	4/29/2016	Cs-134	33.4 ± 10.1	36.2	25.3 - 47.1	Pass	0.92	
W-012319	4/29/2016	Cs-137	79.1 ± 9.6	71.9	57.5 - 86.3	Pass	1.10	
W-012519	4/29/2016	Cs-134	35.0 ± 7.7	36.2	29.0 - 43.4	Pass	0.97	
W-012519	4/29/2016	Cs-137	79.2 ± 7.9	71.9	57.5 - 86.3	Pass	1.10	
W-012919	4/29/2016	Cs-134	32.3 ± 8.3	36.2	29.0 - 43.4	Pass	0.89	
W-012919	4/29/2016	Cs-137	82.3 ± 8.3	71.9	57.5 - 86.3	Pass	1.14	
SPW-370	3/19/2019	H-3	21,689 ± 444	21,700	17,360 - 26,040	Pass	1.00	
SPW-400	1/31/2019	Ra-226	11.6 ± 0.4	12.3	8.6 - 16.0	Pass	0.95	
SPW-461	2/12/2019	Ra-226	11.1 ± 0.4	12.3	8.6 - 16.0	Pass	0.90	
W-020619	4/26/2016	Cs-134	35.0 ± 14.9	36.2	29.0 - 43.4	Pass	0.97	
W-020619	4/29/2016	Cs-137	72.8 ± 8.9	71.9	57.5 - 86.3	Pass	1.01	
W-020819	4/26/2016	Cs-134	36.7 ± 8.6	36.2	29.0 - 43.4	Pass	1.01	
W-020819	4/29/2016	Cs-137	76.7 ± 8.7	71.9	57.5 - 86.3	Pass	1.07	
SPW-568	2/21/2019	Ra-226	10.3 ± 0.3	12.3	8.6 - 16.0	Pass	0.84	
W-021319	4/29/2016	Cs-134	37.7 ± 11.5	36.2	29.0 - 43.4	Pass	1.04	
W-021319	4/26/2016	Cs-137	75.8 ± 9.6	71.9	57.5 - 86.3	Pass	1.05	
SPW-469	3/19/2019	H-3	21,696 ± 447	21,700	17,360 - 26,040	Pass	1.00	
SPW-600	3/6/2019	H-3	20,710 ± 425	21,700	17,360 - 26,040	Pass	0.95	
SPW-837	3/21/2019	Ra-228	11.7 ± 1.5	15.1	10.58 - 19.66	Pass	0.78	
SPW-709	3/19/2019	H-3	20,369 ± 421	21,700	17,360 - 26,040	Pass	0.94	
SPW-818	3/19/2019	H-3	20,457 ± 424	21,700	17,360 - 26,040	Pass	0.94	
SPW-845	3/22/2019	U-234	15.1 ± 0.5	13.6	9.5 - 17.7	Pass	1.11	
SPW-845	3/22/2019	U-238	15.3 ± 0.5	13.1	9.2 - 17.0	Pass	1.17	
SPW-934	3/19/2019	H-3	20,487 ± 421	21,700	17,360 - 26,040	Pass	0.94	
SPW-1061	3/1/2019	Ra-226	10.6 ± 0.3	12.3	8.6 - 16.0	Pass	0.86	
SPW-1091	4/10/2019	H-3	20,323 ± 421	21,700	17,360 - 26,040	Pass	0.94	
SPW-1093	4/8/2019	Ra-228	14.9 ± 1.9	15.1	10.6 - 19.6	Pass	0.98	
SPW-1267	4/16/2019	H-3	20,302 ± 421	21,700	17,360 - 26,040	Pass	0.94	
SPW-1339	4/18/2019	H-3	19,924 ± 417	21,700	17,360 - 26,040	Pass	0.92	
SPW-1403 <sup>o</sup>	4/25/2019	Gr. Alpha	56.7 ± 2.6	72.4	36.2 - 108.6	Pass	0.78	
SPW-1403 <sup>o</sup>	4/25/2019	Gr. Beta	43.2 ± 1.4	54.8	43.8 - 65.8	Fail	0.79	
SPW-1427	4/26/2019	H-3	20,119 ± 418	21,700	15,190 - 28,210	Pass	0.93	
SPW-1537	5/6/2019	Sr-90	19.9 ± 1.2	17.9	14.3 - 21.5	Pass	1.11	
W-050719	4/29/2016	Cs-134	38.5 ± 9.0	36.2	29.0 - 43.4	Pass	1.06	
W-050719	4/26/2016	Cs-137	85.2 ± 8.5	71.9	57.5 - 86.3	Pass	1.18	
SPW-1582	5/9/2019	H-3	20,492 ± 423	21,700	15,190 - 28,210	Pass	0.94	

TABLE A-4. In-House "Spiked" Samples

Lab Code <sup>b</sup>	Date	Analysis	Concentration <sup>a</sup>				Acceptance	Ratio Lab/Known
			Laboratory results 2s, n=1 <sup>c</sup>	Known Activity	Control Limits <sup>d</sup>			
W-050919	4/29/2016	Cs-134	37.4 ± 8.9	36.2	29.0 - 43.4	Pass	1.03	
W-050919	4/26/2016	Cs-137	81.5 ± 7.8	71.9	57.5 - 86.3	Pass	1.13	
SPW-1596	5/8/2019	Ra-228	14.1 ± 1.7	15.1	10.6 - 19.6	Pass	0.94	
W-051419	4/29/2016	Cs-134	36.2 ± 11.7	36.2	29.0 - 43.4	Pass	1.00	
W-051419	4/26/2016	Cs-137	75.8 ± 10.0	71.9	57.5 - 86.3	Pass	1.05	
SPW-1676	5/17/2019	H-3	20,233 ± 420	21,700	15,190 - 28,210	Pass	0.93	
SPW-1799	5/20/2019	H-3	20,428 ± 422	21,700	15,190 - 28,210	Pass	0.94	
SPW-1858	5/28/2019	H-3	20,367 ± 522	21,700	15,190 - 28,210	Pass	0.94	
SPW-1890	5/30/2019	H-3	20,206 ± 419	21,700	15,190 - 28,210	Pass	0.93	
SPW-2014	5/31/2019	Ra-226	11.9 ± 0.3	12.3	8.6 - 16.0	Pass	0.97	
SPW-2030	6/12/2019	Ni-63	377 ± 45	464.8	325 - 604	Pass	0.81	
SPW-2093	6/18/2019	H-3	20,158 ± 418	21,700	17,360 - 26,040	Pass	0.93	
W-062419	4/29/2016	Cs-134	33.0 ± 12.4	36.2	29.0 - 43.4	Pass	0.91	
W-062419	4/26/2016	Cs-137	66.0 ± 10.4	71.9	57.5 - 86.3	Pass	0.92	
SPW-2338	6/26/2019	H-3	20,032 ± 417	21,700	17,360 - 26,040	Pass	0.92	
SPW-2552	7/1/2019	Gr. Alpha	20.4 ± 1.5	21.8	10.9 - 32.7	Pass	0.94	
SPW-2552	7/1/2019	Gr. Beta	46.1 ± 1.3	55.7	44.6 - 66.8	Pass	0.83	
W-072619	4/29/2016	Cs-134	36.3 ± 9.2	36.2	29.0 - 43.4	Pass	1.00	
W-072619	4/26/2016	Cs-137	79.7 ± 7.6	71.9	57.5 - 86.3	Pass	1.11	
SPW-3188	7/30/2019	Ra-226	11.9 ± 0.3	12.3	8.6 - 16.0	Pass	0.97	
SPW-2947	8/9/2019	H-3	20,128 ± 425	21,700	17,360 - 26,040	Pass	0.93	
SPW-3003	8/14/2019	H-3	20,588 ± 435	21,700	17,360 - 26,040	Pass	0.95	
W-081519	4/26/2019	Cs-134	36.2 ± 9.2	36.2	29.0 - 43.4	Pass	1.00	
W-081519	4/26/2019	Cs-137	78.1 ± 8.4	71.9	57.5 - 86.3	Pass	1.09	
W-082119	4/26/2019	Cs-134	32.8 ± 9.1	36.2	29.0 - 43.4	Pass	0.91	
W-082119	4/26/2019	Cs-137	79.1 ± 7.9	71.9	57.5 - 86.3	Pass	1.10	
SPW-3151	8/26/2019	H-3	20,329 ± 428	21,700	17,360 - 26,040	Pass	0.94	
W-082619	4/26/2019	Cs-134	33.3 ± 17.8	36.2	29.0 - 43.4	Pass	0.92	
W-082619	4/26/2019	Cs-137	82.6 ± 13.2	71.9	57.5 - 86.3	Pass	1.15	
W-082719	4/26/2019	Cs-134	33.9 ± 7.0	36.2	29.0 - 43.4	Pass	0.94	
W-082719	4/26/2019	Cs-137	81.4 ± 6.0	71.9	57.5 - 86.3	Pass	1.13	
SPW-3359	8/30/2019	Gr. Alpha	54.2 ± 0.3	72.4	36.2 - 108.6	Pass	0.75	
SPW-3359	8/30/2019	Gr. Beta	59.7 ± 0.2	54.8	43.8 - 65.8	Pass	1.09	
SPW-3323	9/6/2019	Ra-228	12.7 ± 1.8	15.1	10.6 - 19.6	Pass	0.84	
W-091019	4/26/2019	Cs-134	31.0 ± 11.3	36.2	29.0 - 43.4	Pass	0.86	
W-091019	4/26/2019	Cs-137	80.5 ± 10.0	71.9	57.5 - 86.3	Pass	1.12	
SPW-3349	9/10/2019	H-3	19,851 ± 422	21,700	17,360 - 26,040	Pass	0.91	
SPW-3410	9/13/2019	H-3	20,267 ± 431	21,700	17,360 - 26,040	Pass	0.93	
W-091719	4/26/2019	Cs-134	39.3 ± 12.6	36.2	29.0 - 43.4	Pass	1.09	
W-091719	4/26/2019	Cs-137	81.1 ± 9.9	71.9	57.5 - 86.3	Pass	1.13	
SPW-3450	9/17/2019	H-3	20,036 ± 427	21,700	17,360 - 26,040	Pass	0.92	
W-091919	9/19/2019	Cs-134	40.0 ± 10.7	36.2	29.0 - 43.4	Pass	1.10	
W-091919	9/19/2019	Cs-137	71.0 ± 8.7	71.9	57.5 - 86.3	Pass	0.99	
SPW-3569	8/28/2019	Ra-226	11.9 ± 0.3	12.3	8.6 - 16.0	Pass	0.97	
SPW-3571	9/27/2019	H-3	21,026 ± 440	21,700	17,360 - 26,040	Pass	0.97	



TABLE A-4. In-House "Spiked" Samples

Lab Code <sup>b</sup>	Date	Analysis	Concentration <sup>a</sup>		Control Limits <sup>d</sup>	Acceptance	Ratio Lab/Known
			Laboratory results 2s, n=1 <sup>c</sup>	Known Activity			
SPW-3615	10/1/2019	Ra-228	18.9 ± 2.5	14.9	10.4 - 19.3	Pass	1.27
SPW-3706	10/8/2019	H-3	20,082 ± 427	21,700	17,360 - 26,040	Pass	0.93
SPW-4093	10/14/2019	Gr. Alpha	20.8 ± 0.1	19.7	9.9 - 29.6	Pass	1.06
SPW-4093	10/14/2019	Gr. Beta	63.2 ± 0.1	61.1	48.9 - 73.3	Pass	1.03
SPW-4095	10/24/2019	H-3	20,684 ± 432	21,700	17,360 - 26,040	Pass	0.95
SPW-4144	9/26/2019	Ra-226	12.8 ± 0.3	12.3	8.6 - 16.0	Pass	1.04
W-091719	3/19/2018	H-3	22,291 ± 470	21,700	17,360 - 26,040	Pass	1.03
SPW-4239	10/30/2019	Ra-228	12.4 ± 1.8	14.9	10.4 - 19.3	Pass	0.84
SPW-4254	11/8/2019	H-3	20,187 ± 427	21,700	17,360 - 26,040	Pass	0.93
SPW-4368	11/14/2019	H-3	20,386 ± 429	21,700	17,360 - 26,040	Pass	0.94
SPW-4370	10/30/2019	Ra-226	12.8 ± 0.4	12.3	8.6 - 16.0	Pass	1.04
SPW-4472	11/21/2019	H-3	20,479 ± 432.0	21,700	17,360 - 26,040	Pass	0.94
SPW-4474	11/22/2019	Sr-90	18.9 ± 1.2	17.9	14.3 - 21.5	Pass	1.06
SPW-4602	12/5/2019	H-3	20,187 ± 429	21,700	17,360 - 26,040	Pass	0.93
W-121119	3/19/2018	H-3	22,734 ± 477	21,700	17,360 - 26,040	Pass	1.05
SPW-4663	12/11/2019	Ra-228	11.2 ± 1.6	14.9	10.4 - 19.3	Pass	0.75
SPW-4688	12/13/2019	H-3	20,506 ± 431	21,700	17,360 - 26,040	Pass	0.94
SPW-4734	11/15/2019	Ra-226	12.6 ± 0.3	12.3	8.6 - 16.0	Pass	1.02
SPW-4743	12/5/2019	Ra-226	10.0 ± 0.3	12.3	8.6 - 16.0	Pass	0.81
SPW-4745	12/19/2019	H-3	20,067 ± 427	21,700	17,360 - 26,040	Pass	0.92
SPW-4889	12/19/2019	Ra-226	9.3 ± 0.3	12.3	8.6 - 16.0	Pass	0.76
SPW-4636	12/27/2019	Tc-99	94.3 ± 8.2	90.3	72.2 - 108.4	Pass	1.04
SPW-4899	1/3/2020	H-3	20,386 ± 432	21,700	17,360 - 26,040	Pass	0.94

<sup>a</sup> Liquid sample results are reported in pCi/Liter, air filters ( pCi/m<sup>3</sup>), charcoal (pCi/charcoal canister), and solid samples (pCi/kg).

<sup>b</sup> Laboratory codes : W & SPW (Water), MI (milk), AP (air filter), SO (soil), VE (vegetation), CH (charcoal canister), F (fish), U (urine).

<sup>c</sup> Results are based on single determinations.

<sup>d</sup> Control limits are listed in Attachment A of this report.

<sup>e</sup> The LCS sample was prepared from an Environmental Resource Associates (ERA) sample of known activity. While the analysis did satisfy the acceptance criteria of the ERA study from which it was sourced, it did not satisfy EIML's internal LCS acceptance criteria. An investigation into the cause for the failure was inconclusive and the original sample had been completely consumed. Subsequent LCS results have been satisfactory.

NOTE: For fish, gelatin is used for the spike matrix. For vegetation, cabbage is used for the spike matrix.

TABLE A-5. In-House "Blank" Samples

Lab Code <sup>b</sup>	Sample Type	Date	Analysis <sup>c</sup>	Concentration <sup>a</sup>		Acceptance Criteria (4.66 $\sigma$ )
				Laboratory results (4.66 $\sigma$ )		
				LLD	Activity <sup>d</sup>	
SPW-5449	Water	1/7/2019	Gr. Alpha	0.76	-0.30 ± 0.52	2
SPW-5449	Water	1/7/2019	Gr. Beta	0.42	0.19 ± 0.31	4
SPW-34	Water	1/7/2019	I-131	0.36	0.13 ± 0.18	1
SPW-60	Water	11/5/2018	Ra-226	0.03	0.15 ± 0.03	2
SPW-119	Water	1/14/2019	H-3	148	42 ± 80	200
SPW-177	Water	1/16/2019	Ra-228	0.93	-0.10 ± 0.42	2
SPW-198	Water	1/18/2019	Sr-89	0.67	0.25 ± 0.50	5
SPW-198	Water	1/18/2019	Sr-90	0.67	-0.16 ± 0.29	1
SPW-249	Water	1/24/2019	Ni-63	67	31 ± 41	200
SPW-255	Water	1/15/2019	Ra-226	0.04	0.16 ± 0.03	2
SPW-280	Water	1/25/2019	Ra-226	0.06	-0.09 ± 0.14	2
SPW-399	Water	1/31/2019	Ra-226	0.03	0.15 ± 0.03	2
SPW-460	Water	2/12/2019	Ra-226	0.03	0.15 ± 0.02	2
SPW-567	Water	2/21/2019	Ra-226	0.03	0.13 ± 0.02	2
SPW-844	Water	3/22/2019	U-234	0.19	0.04 ± 0.14	1
SPW-844	Water	3/22/2019	U-238	0.19	0.00 ± 0.11	1
SPW-836	Water	3/21/2019	Ra-228	0.74	0.53 ± 0.41	2
SPW-1060	Water	3/31/2019	Ra-226	0.04	-0.02 ± 0.03	2
SPW-1090	Water	4/10/2019	H-3	155	-14 ± 72	200
SPW-1092	Water	4/8/2019	Ra-228	0.82	0.75 ± 0.46	2
SPW-1266	Water	4/16/2019	H-3	152	67 ± 74	200
SPW-1338	Water	4/18/2019	H-3	152	66 ± 79	200
SPW-1386	Water	4/8/2019	Ra-226	0.03	0.09 ± 0.03	2
SPW-1426	Water	4/26/2019	H-3	156	34 ± 75	200
SPW-1536	Water	5/6/2019	Sr-89	0.66	-0.07 ± 0.45	5
SPW-1536	Water	5/6/2019	Sr-90	0.59	-0.10 ± 0.26	1
SPW-1581	Water	5/9/2019	H-3	147	73 ± 77	200
SPW-1644	Water	4/22/2019	Ra-226	0.02	0.15 ± 0.02	2
SPW-1675	Water	5/17/2019	H-3	154	-30 ± 71	200
SPW-1798	Water	5/20/2019	H-3	149	24 ± 73	200
SPW-1857	Water	5/28/2019	H-3	150	54 ± 74	200
SPW-1889	Water	5/30/2019	H-3	152	45 ± 73	200
SPW-2013	Water	5/31/2019	Ra-226	0.01	0.13 ± 0.02	2
SPW-2029	Water	6/12/2019	Ni-63	66	10 ± 40	200
SPW-2092	Water	6/18/2019	H-3	154	-42 ± 70	200
SPW-2237	Water	6/26/2019	H-3	150	-9 ± 69	200
SPW-2107	Water	6/18/2019	I-131	0.16	0.04 ± 0.09	1
SPW-2152	Water	6/19/2019	I-131	0.16	0.04 ± 0.09	1

TABLE A-5. In-House "Blank" Samples

Lab Code <sup>b</sup>	Sample Type	Date	Analysis <sup>c</sup>	Concentration <sup>a</sup>		Acceptance Criteria (4.66 $\sigma$ )
				Laboratory results (4.66 $\sigma$ )		
				LLD	Activity <sup>d</sup>	
SPW-3187	Water	7/30/2019	Ra-226	0.02	0.17 $\pm$ 0.02	2
SPW-2924	Water	8/6/2019	Sr-89	0.71	-0.06 $\pm$ 0.57	5
SPW-2924	Water	8/6/2019	Sr-90	0.59	0.08 $\pm$ 0.28	1
SPW-2946	Water	8/9/2019	H-3	152	33 $\pm$ 72	200
SPW-3002	Water	8/14/2019	H-3	152	-22 $\pm$ 74	200
SPW-3150	Water	8/26/2019	H-3	151	115 $\pm$ 77	200
SPW-3358	Water	8/30/2019	Gr. Alpha	0.44	-0.08 $\pm$ 0.30	2
SPW-3358	Water	8/30/2019	Gr. Beta	0.72	-0.31 $\pm$ 0.49	4
SPW-3568	Water	8/28/2019	Ra-226	0.03	0.16 $\pm$ 0.03	2
SPW-3322	Water	9/6/2019	Ra-228	0.82	0.46 $\pm$ 0.43	2
SPW-3348	Water	9/10/2019	H-3	150	107 $\pm$ 76	200
SPW-3409	Water	9/13/2019	H-3	154	133 $\pm$ 79	200
SPW-3449	Water	9/17/2019	H-3	147	102 $\pm$ 79	200
SPW-3570	Water	9/27/2019	H-3	151	70 $\pm$ 77	200
SPW-3614	Water	10/1/2019	Ra-228	1.29	1.03 $\pm$ 0.73	2
SPW-3705	Water	10/8/2019	H-3	147	107 $\pm$ 77	200
SPW-4238	Water	10/30/2019	Ra-228	0.99	0.58 $\pm$ 0.52	2
SPW-4253	Water	11/8/2019	H-3	151	80 $\pm$ 76	200
SPW-4367	Water	11/14/2019	H-3	154	42 $\pm$ 74	200
SPW-4369	Water	10/30/2016	Ra-226	0.03	0.14 $\pm$ 0.03	2
SPW-4471	Water	11/21/2019	H-3	155	81 $\pm$ 77	200
SPW-4474	Water	11/21/2019	C-14	12	0 $\pm$ 7	200
SPW-4476	Water	11/22/2019	Sr-89	0.62	0.23 $\pm$ 0.45	5
SPW-4476	Water	11/22/2019	Sr-90	0.57	-0.16 $\pm$ 0.24	1
SPW-4601	Water	12/5/2019	H-3	155	28 $\pm$ 74	200
SPW-4635	Water	12/9/2019	Tc-99	12	-6 $\pm$ 7	20
SPW-4662	Water	12/17/2019	Ra-228	0.77	0.55 $\pm$ 0.42	2
SPW-4687	Water	12/13/2019	H-3	150	143 $\pm$ 78	200
SPW-4733	Water	11/15/2019	Ra-226	0.03	0.13 $\pm$ 0.03	2
SPW-4742	Water	12/5/2019	Ra-226	0.04	0.10 $\pm$ 0.10	2
SPW-4744	Water	12/19/2019	H-3	151	119 $\pm$ 81	200
SPW-4888	Water	12/19/2019	Ra-226	0.03	0.15 $\pm$ 0.02	2
SPW-4898	Water	1/3/2020	H-3	159	19 $\pm$ 78	200

<sup>a</sup> Liquid sample results are reported in pCi/Liter, air filters ( pCi/m<sup>3</sup>), charcoal (pCi/charcoal canister), and solid samples (pCi/g).

<sup>b</sup> Laboratory codes : W & SPW (Water), MI (milk), AP (air filter), SO (soil), VE (vegetation), CH (charcoal canister), F (fish), U (urine).

<sup>c</sup> I-131(G); iodine-131 as analyzed by gamma spectroscopy.

<sup>d</sup> Activity reported is a net activity result.

TABLE A-6. In-House "Duplicate" Samples

Lab Code <sup>b</sup>	Date	Analysis	Concentration <sup>a</sup>		Averaged Result	Acceptance
			First Result	Second Result		
AP-5499,5500	1/2/2019	Fe-55	941 ± 220	1027 ± 226	984 ± 158	Pass
AP-5499,5500	1/2/2019	Sr-89	20.2 ± 7.3	14.9 ± 5.7	17.5 ± 4.7	Pass
AP-5499,5500	1/2/2019	Ni-63	12.1 ± 8.5	15.6 ± 8.5	13.8 ± 6.0	Pass
CF-20,21	1/2/2019	Gr. Beta	10.0 ± 0.2	10.7 ± 0.2	10.3 ± 0.2	Pass
CF-20,21	1/2/2019	Sr-90	0.005 ± 0.002	0.005 ± 0.002	0.005 ± 0.001	Pass
CF-20,21	1/2/2019	Be-7	0.27 ± 0.09	0.29 ± 0.08	0.28 ± 0.06	Pass
CF-20,21	1/2/2019	K-40	6.69 ± 0.34	6.83 ± 0.34	6.76 ± 0.24	Pass
SG-211,212	1/21/2019	Ra-226	7.94 ± 0.26	8.50 ± 0.29	8.22 ± 0.19	Pass
SG-211,212	1/21/2019	Ac-228	4.46 ± 0.37	4.63 ± 0.43	4.55 ± 0.28	Pass
WW-324,325	2/4/2019	Gr. Alpha	0.68 ± 0.44	0.49 ± 0.46	0.59 ± 0.32	Pass
WW-324,325	2/4/2019	Gr. Beta	1.80 ± 0.55	2.95 ± 0.63	2.37 ± 0.42	Pass
W-345,346	2/4/2019	H-3	245 ± 84	277 ± 85	261 ± 60	Pass
WW-797,798	3/5/2019	H-3	165 ± 80	222 ± 83	193 ± 58	Pass
WW-648,649	3/8/2019	H-3	587 ± 101	630 ± 102	608 ± 72	Pass
SW-713,714	3/14/2019	H-3	326 ± 90	254 ± 86	290 ± 62	Pass
AP-1241,1242	4/2/2019	Be-7	0.097 ± 0.018	0.108 ± 0.020	0.103 ± 0.013	Pass
AP-1285,1286	4/3/2019	Be-7	0.080 ± 0.014	0.078 ± 0.012	0.079 ± 0.009	Pass
AP-1306,1307	4/3/2019	Be-7	0.085 ± 0.009	0.096 ± 0.011	0.090 ± 0.007	Pass
AP-1327,1328	4/3/2019	Be-7	0.078 ± 0.010	0.079 ± 0.011	0.078 ± 0.007	Pass
AP-1327,1328	4/3/2019	K-40	0.012 ± 0.007	0.021 ± 0.010	0.017 ± 0.006	Pass
AP-2119,2120	4/3/2019	Be-7	0.276 ± 0.098	0.265 ± 0.116	0.270 ± 0.076	Pass
AP-2225,2226	4/3/2019	Be-7	0.231 ± 0.128	0.208 ± 0.123	0.220 ± 0.089	Pass
CF-820,821	4/3/2019	K-40	6.39 ± 0.30	6.63 ± 0.37	6.51 ± 0.24	Pass
WW-648,649	4/5/2019	H-3	587 ± 101	630 ± 102	608 ± 72	Pass
WW-1043,1044	4/5/2019	H-3	666 ± 121	662 ± 121	664 ± 86	Pass
SW-1087,1088	4/8/2019	H-3	9,997 ± 300	10,330 ± 305	10,164 ± 214	Pass
WW-1198,1199	4/9/2019	H-3	562 ± 99	640 ± 102	601 ± 71	Pass
LW-1503,1504	4/25/2019	Gr. Beta	1.09 ± 0.55	1.46 ± 0.57	1.27 ± 0.39	Pass
WW-1789,1790	5/7/2019	H-3	366 ± 90	400 ± 92	383 ± 64	Pass
SG-2269,2270	5/7/2019	Pb-214	39.1 ± 0.5	40.3 ± 0.5	39.7 ± 0.4	Pass
SG-2269,2270	5/7/2019	Ac-228	53.2 ± 1.0	57.1 ± 1.0	55.2 ± 0.7	Pass
DW-10049,10050	5/7/2019	Ra-226	1.31 ± 0.13	1.66 ± 0.15	1.49 ± 0.10	Pass
DW-10049,10050	5/7/2019	Ra-228	1.24 ± 0.52	1.33 ± 0.53	1.29 ± 0.37	Pass
WW-1690A,B	5/8/2019	H-3	325 ± 89	303 ± 93	314 ± 64	Pass
S-1812,1813	5/16/2019	K-40	22.0 ± 0.9	23.3 ± 1.0	22.6 ± 0.7	Pass
S-1812,1813	5/16/2019	Cs-137	0.05 ± 0.03	0.07 ± 0.04	0.06 ± 0.02	Pass
DW-10053,10054	5/22/2019	Gr. Alpha	0.93 ± 0.63	1.14 ± 0.72	1.04 ± 0.48	Pass
DW-10053,10054	5/22/2019	Gr. Beta	1.43 ± 0.62	1.13 ± 0.59	1.28 ± 0.43	Pass
W-2053,2054	5/29/2019	H-3	1572 ± 135	1470 ± 131	1521 ± 94	Pass

TABLE A-6. In-House "Duplicate" Samples

Lab Code <sup>b</sup>	Date	Analysis	Concentration <sup>a</sup>		Averaged Result	Acceptance
			First Result	Second Result		
G-1989,1990	6/3/2019	Be-7	0.80 ± 0.18	0.72 ± 0.15	0.76 ± 0.12	Pass
G-1989,1990	6/3/2019	K-40	6.15 ± 0.51	5.98 ± 0.46	6.07 ± 0.34	Pass
G-1989,1990	6/3/2019	Gr. Beta	7.24 ± 0.19	7.00 ± 0.19	7.12 ± 0.13	Pass
WW-2204,2205	6/6/2019	H-3	3861 ± 194	3722 ± 191	3792 ± 136	Pass
S-2031,2032	6/10/2019	Pb-214	5.16 ± 0.19	4.75 ± 0.22	4.96 ± 0.15	Pass
S-2031,2032	6/10/2019	Ac-228	3.81 ± 0.31	3.63 ± 0.33	3.72 ± 0.23	Pass
S-2010,2011	6/10/2019	Pb-214	1.48 ± 0.10	1.05 ± 0.11	1.27 ± 0.07	Pass
F-2140,2141	6/12/2019	K-40	1.01 ± 0.28	1.39 ± 0.32	1.20 ± 0.21	Pass
S-2162,2163	6/12/2019	Pb-214	0.65 ± 0.06	0.54 ± 0.05	0.60 ± 0.04	Pass
S-2162,2163	6/12/2019	Ac-228	0.46 ± 0.10	0.44 ± 0.08	0.45 ± 0.07	Pass
S-2162,2163	6/12/2019	K-40	4.22 ± 0.49	3.81 ± 0.41	4.02 ± 0.32	Pass
S-2162,2163	6/12/2019	Tl-208	0.09 ± 0.02	0.10 ± 0.02	0.09 ± 0.01	Pass
S-2162,2163	6/12/2019	Pb-212	0.34 ± 0.03	0.26 ± 0.03	0.30 ± 0.02	Pass
SWT-2355,2356	6/25/2019	Gr. Beta	1.12 ± 0.57	1.24 ± 0.56	1.18 ± 0.40	Pass
AP-2689,2690	6/28/2019	Be-7	0.089 ± 0.020	0.075 ± 0.018	0.082 ± 0.013	Pass
AP-2710,2711	7/1/2019	Be-7	0.091 ± 0.010	0.097 ± 0.010	0.094 ± 0.007	Pass
AP-2731,2732	7/2/2019	Be-7	0.073 ± 0.013	0.072 ± 0.011	0.072 ± 0.009	Pass
DW-10062,10063	7/5/2019	Ra-226	4.10 ± 0.30	4.03 ± 0.30	4.07 ± 0.21	Pass
DW-10062,10063	7/5/2019	Ra-228	1.95 ± 0.60	2.31 ± 0.62	2.13 ± 0.43	Pass
AP-70818,70819	7/8/2019	Gr. Beta	0.021 ± 0.004	0.023 ± 0.004	0.022 ± 0.003	Pass
XW-2459,2460	7/10/2019	H-3	304 ± 92	234 ± 89	269 ± 64	Pass
VE-2516,2517	7/10/2019	Be-7	0.63 ± 0.16	0.52 ± 0.19	0.58 ± 0.12	Pass
VE-2516,2517	7/10/2019	K-40	6.50 ± 0.47	6.81 ± 0.54	6.66 ± 0.36	Pass
AP-71518A,B	7/15/2019	Gr. Beta	0.022 ± 0.004	0.025 ± 0.004	0.023 ± 0.003	Pass
VE-2668,2669	7/16/2019	K-40	3.84 ± 0.27	3.74 ± 0.26	3.79 ± 0.19	Pass
DW-10076,10077	7/16/2019	Gr. Alpha	3.01 ± 0.92	4.13 ± 0.91	3.57 ± 0.65	Pass
DW-10073,10074	7/16/2019	Ra-226	1.57 ± 0.18	1.51 ± 0.21	1.54 ± 0.14	Pass
DW-10073,10074	7/16/2019	Ra-228	1.29 ± 0.56	1.48 ± 0.57	1.385 ± 0.40	Pass
AP-72218A,B	7/22/2019	Gr. Beta	0.013 ± 0.004	0.016 ± 0.004	0.015 ± 0.003	Pass
G-2752,2753	7/23/2019	K-40	4.53 ± 0.42	4.47 ± 0.46	4.50 ± 0.31	Pass
G-2752,2753	7/23/2019	Be-7	1.98 ± 0.29	1.96 ± 0.29	1.97 ± 0.20	Pass
AP-2800,2801	7/25/2019	Be-7	0.208 ± 0.090	0.321 ± 0.147	0.264 ± 0.086	Pass
AP-72918A,B	7/29/2019	Gr. Beta	0.026 ± 0.005	0.025 ± 0.005	0.025 ± 0.003	Pass
VE-2840,2841	7/31/2019	K-40	3.94 ± 0.38	3.99 ± 0.47	3.96 ± 0.30	Pass
AP-2903,2904	8/1/2019	Be-7	0.198 ± 0.102	0.228 ± 0.102	0.213 ± 0.072	Pass
P-2882,2983	8/1/2019	H-3	265 ± 85	327 ± 88	296 ± 61	Pass
SG-2926,2927	8/5/2019	Pb-214	9.07 ± 0.39	8.82 ± 0.39	8.95 ± 0.28	Pass
SG-2926,2927	8/5/2019	Ac-228	9.00 ± 0.76	8.58 ± 0.72	8.79 ± 0.52	Pass
AV-2993,2994	8/9/2019	Gr. Beta	1.22 ± 0.19	1.28 ± 0.21	1.25 ± 0.14	Pass
AV-2993,2994	8/9/2019	K-40	3.12 ± 0.36	3.14 ± 0.35	3.13 ± 0.25	Pass

TABLE A-6. In-House "Duplicate" Samples

Lab Code <sup>b</sup>	Date	Analysis	Concentration <sup>a</sup>		Averaged Result	Acceptance
			First Result	Second Result		
DW-10088,10089	8/9/2019	Ra-228	0.60 ± 0.50	1.20 ± 0.50	0.90 ± 0.35	Pass
DW-10088,10089	8/9/2019	Ra-226	1.40 ± 0.20	0.94 ± 0.20	1.17 ± 0.14	Pass
VE-3016,3017	8/12/2019	Be-7	0.39 ± 0.12	0.47 0.28	0.43 0.15	Pass
VE-3016,3017	8/12/2019	K-40	6.13 ± 0.41	6.24 0.64	6.18 0.38	Pass
G-3600,3601	8/12/2019	Be-7	4.42 ± 0.33	4.35 0.27	4.39 0.21	Pass
WW-3100,3101	8/14/2019	H-3	480 ± 96	401 ± 92	441 ± 66	Pass
MI-3211,3212	8/27/2019	K-40	1862 ± 131	1923 ± 136	1893 ± 94	Pass
MI-3211,3212	8/27/2019	Sr-90	0.90 ± 0.33	0.56 ± 0.29	0.73 ± 0.22	Pass
LW-3512,3513	8/30/2019	Gr. Beta	0.79 ± 0.50	1.39 ± 0.58	1.09 ± 0.38	Pass
DW-10100,10101	9/5/2019	Ra-226	0.50 ± 0.11	0.57 0.12	0.54 ± 0.08	Pass
DW-10100,10101	9/5/2019	Ra-228	3.38 ± 0.82	2.54 1.03	2.96 ± 0.66	Pass
DW-10111,10112	9/23/2019	Gr. Alpha	1.72 ± 0.73	1.41 0.68	1.57 ± 0.50	Pass
DW-10115,10116	9/25/2019	Ra-228	3.65 ± 0.80	2.76 0.68	3.21 ± 0.52	Pass
DW-10115,10116	9/25/2019	Ra-226	2.99 ± 0.23	2.74 0.25	2.87 ± 0.17	Pass
WW-3793,3794	10/8/2019	Gr. Beta	3.75 ± 1.18	4.34 1.20	4.05 ± 0.84	Pass
BS-3879,3880	10/9/2019	Pb-214	0.60 ± 0.03	0.65 ± 0.05	0.63 ± 0.03	Pass
BS-3879,3880	10/9/2019	Ra-226	1.27 ± 0.14	1.15 ± 0.14	1.21 ± 0.10	Pass
BS-3879,3880	10/9/2019	K-40	11.05 ± 0.29	10.69 ± 0.30	10.87 ± 0.21	Pass
BS-3879,3880	10/9/2019	Pb-212	0.58 ± 0.02	0.55 ± 0.02	0.56 ± 0.01	Pass
BS-3879,3880	10/9/2019	Tl-208	0.21 ± 0.02	0.21 ± 0.01	0.21 ± 0.01	Pass
BS-3879,3880	10/9/2019	Bi-212	0.75 ± 0.17	0.62 ± 0.17	0.68 ± 0.12	Pass
BS-3879,3880	10/9/2019	Bi-214	0.57 ± 0.02	0.52 ± 0.06	0.54 ± 0.03	Pass
BS-4161,4162	10/29/2019	K-40	15.3 ± 0.6	15.3 ± 0.7	15.3 ± 0.5	Pass
BS-4161,4162	10/29/2019	Ra-226	2.16 ± 0.35	2.27 ± 0.78	2.22 ± 0.43	Pass
DW-10126,10127	10/22/2019	Ra-228	0.85 ± 0.58	1.19 ± 0.62	1.02 ± 0.42	Pass
DW-10129,10130	10/22/2019	Gr. Alpha	1.44 ± 0.96	3.06 ± 0.95	2.25 ± 0.68	Pass
SG-4071	10/22/2019	Ac-228	2.10 ± 0.16	2.16 ± 0.20	2.13 ± 0.13	Pass
SPSG-4071,4072	10/22/2019	Pb-214	1.61 ± 0.10	1.29 ± 0.08	1.45 ± 0.06	Pass
SS-3900,3901	10/15/2019	Bi-212	0.29 ± 0.14	0.19 ± 0.12	0.24 ± 0.09	Pass
WW-4291,4292	11/5/2019	H-3	481 ± 97	528 ± 97	505 ± 68	Pass
DW-10139,10140	11/6/2019	Ra-228	2.61 ± 0.62	2.26 ± 0.63	2.44 ± 0.44	Pass
DW-10139,10140	11/6/2019	Ra-226	1.49 ± 0.17	1.32 ± 0.19	1.41 ± 0.13	Pass
WW-4270,4271	11/6/2019	H-3	112 ± 78	165 ± 81	139 ± 56	Pass
S-4312,4313	11/7/2019	K-40	20.2 ± 0.8	23.0 ± 0.9	21.6 ± 0.6	Pass
AP-4379,4380	11/12/2019	Be-7	0.133 ± 0.075	0.134 ± 0.073	0.134 ± 0.052	Pass
S-4422,4223	11/13/2019	Pb-214	1.22 ± 0.09	1.28 ± 0.10	1.25 ± 0.07	Pass
S-4422,4423	11/13/2019	Ac-228	1.14 ± 0.15	1.21 ± 0.17	1.18 ± 0.11	Pass
WW-4556,4557	11/13/2019	H-3	438 ± 96	482 ± 98	460 ± 69	Pass
SO-5024,5025	11/14/2019	K-40	6.60 ± 0.54	6.26 ± 0.58	6.43 ± 0.40	Pass
MI-4443,4444	11/18/2019	K-40	1304 ± 114	1340 ± 109	1322 ± 79	Pass

TABLE A-6. In-House "Duplicate" Samples

Lab Code <sup>b</sup>	Date	Analysis	Concentration <sup>a</sup>		Averaged Result	Acceptance
			First Result	Second Result		
SW-4492,4493	11/19/2019	H-3	188 ± 87	264 ± 97	226 ± 65	Pass
WW-4577,4578	11/21/2019	H-3	212 ± 83	232 ± 84	222 ± 59	Pass
AP-4514,4515	11/21/2019	Be-7	0.130 ± 0.055	0.193 ± 0.112	0.162 ± 0.062	Pass
SWT-4598,4599	11/26/2019	Gr. Beta	1.43 ± 0.57	1.14 ± 0.54	1.28 ± 0.39	Pass
AP-120218A,B	12/2/2019	Gr. Beta	0.009 ± 0.004	0.013 ± 0.004	0.011 ± 0.003	Pass
S-4644,4645	12/4/2019	Pb-214	1.01 ± 0.09	0.91 ± 0.09	0.96 ± 0.06	Pass
S-4644,4645	12/4/2019	Ac-228	0.85 ± 0.15	0.96 ± 0.16	0.91 ± 0.11	Pass
AP-121618A,B	12/16/2019	Gr. Beta	0.028 ± 0.005	0.030 ± 0.005	0.029 ± 0.003	Pass
S-4735,4736	12/16/2019	Pb-214	9.33 ± 0.38	9.45 ± 0.27	9.39 ± 0.23	Pass
S-4735,4736	12/16/2019	Ac-228	13.4 ± 0.7	14.9 ± 0.7	14.1 ± 0.5	Pass
AP-122318A,B	12/23/2019	Gr. Beta	0.034 ± 0.005	0.035 ± 0.005	0.035 ± 0.003	Pass
AP-123018A,B	12/30/2019	Gr. Beta	0.037 ± 0.005	0.037 ± 0.005	0.037 ± 0.004	Pass

Note: Duplicate analyses are performed on every twentieth sample received in-house. Results are not listed for those analyses with activities that measure below the LLD.

- <sup>a</sup> Results are reported in units of pCi/L, except for air filters (pCi/Filter or pCi/m<sup>3</sup>), food products, vegetation, soil and sediment (pCi/g).
- <sup>b</sup> CH (Charcoal Canister), DW (Drinking Water), E (Egg), F (Fish), G (Grass), LW (Lake Water), P (Precipitation), PM (Powdered Milk), S, (Solid), SG (Sludge), SO (Soil), SS (Shoreline Sediment), SW (Surface Water), SWT (Surface Water Treated), SWU (Surface Water Untreated), VE (Vegetation), W Water (Water), WW (Well Water).

TABLE A-7. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

Lab Code <sup>b</sup>	Reference		Concentration <sup>a</sup>			
	Date	Analysis	Laboratory result	Known Activity	Control Limits <sup>c</sup>	Acceptance
MAAP-609	2/1/2019	Gross Alpha	0.16 ± 0.03	0.528	0.158 - 0.898	Pass
MAAP-609	2/1/2019	Gross Beta	1.09 ± 0.07	0.948	0.474 - 1.422	Pass
MAW-550	2/1/2019	Gross Alpha	0.73 ± 0.06	0.84	0.25 - 1.43	Pass
MAW-550	2/1/2019	Gross Beta	2.26 ± 0.06	2.33	1.17 - 3.50	Pass
MASO-605	2/1/2019	Am-241	38.89 ± 5.92	49.9	34.9 ± 64.9	Pass
MASO-605	2/1/2019	Cs-134	0.45 ± 2.52	0.0	NA <sup>c</sup>	Pass
MASO-605	2/1/2019	Cs-137	1273.1 ± 13.0	1164	815 - 1513	Pass
MASO-605	2/1/2019	Co-57	0.46 ± 1.1	0.0	NA <sup>c</sup>	Pass
MASO-605	2/1/2019	Co-60	857.96 ± 8.52	855.0	599 - 1112	Pass
MASO-605	2/1/2019	Mn-54	1,138.0 ± 13.5	1027	719 - 1335	Pass
MASO-605	2/1/2019	Zn-65	730.92 ± 16.48	668	468 - 868	Pass
MASO-605	2/1/2019	K-40	676 ± 47	585	410 - 761	Pass
MASO-605	2/1/2019	Sr-90	0.0007 ± 0.0007	0.000	NA <sup>c</sup>	Pass
MASO-605	2/1/2019	Pu-238	78.15 ± 6.11	71.0	49.7 - 92.3	Pass
MASO-605	2/1/2019	Pu-239/240	65.00 ± 5.4	59.8	41.9 - 77.7	Pass
MASO-605	2/1/2019	U-234	65 ± 13	56	39 - 73	Pass
MASO-605	2/1/2019	U-238	237 ± 23	205	144 - 267	Pass
MAW-613	2/1/2019	Am-241	0.46 ± 0.03	0.582	0.407 - 0.757	Pass
MAW-613	2/1/2019	Cs-134	5.49 ± 0.18	5.99	4.19 - 7.79	Pass
MAW-613	2/1/2019	Cs-137	0.089 ± 0.080	0	NA <sup>c</sup>	Pass
MAW-613	2/1/2019	Co-57	10.87 ± 0.24	10.00	7.0 - 13.0	Pass
MAW-613	2/1/2019	Co-60	6.78 ± 0.19	6.7	4.7 - 8.7	Pass
MAW-613	2/1/2019	Mn-54	8.98 ± 0.17	8.4	5.9 - 10.9	Pass
MAW-613	2/1/2019	Zn-65	0.096 ± 0.141	0	NA <sup>c</sup>	Pass
MAW-613	2/1/2019	Fe-55	0.004 ± 4.00	0	NA <sup>c</sup>	Pass
MAW-613	2/1/2019	Ni-63	5.54 ± 1.52	5.8	4.1 - 7.5	Pass
MAW-613	2/1/2019	Sr-90	6.02 ± 0.53	6.35	4.45 - 8.26	Pass
MAW-613	2/1/2019	Pu-238	0.315 ± 0.088	0.451	0.316 - 0.586	Fail <sup>e</sup>
MAW-613	2/1/2019	Pu-239/240	0.07 ± 0.07	0.005	NA <sup>d</sup>	Pass
MAW-613	2/1/2019	U-234	0.96 ± 0.07	0.800	0.56 ± 1.04	Pass
MAW-613	2/1/2019	U-238	0.94 ± 0.07	0.810	0.57 ± 1.05	Pass
MAAP-611	2/1/2019	Cs-134	0.185 ± 0.025	0.216	0.151 - 0.281	Pass
MAAP-611	2/1/2019	Cs-137	0.288 ± 0.045	0.290	0.203 - 0.377	Pass
MAAP-611	2/1/2019	Co-57	0.369 ± 0.033	0.411	0.288 - 0.534	Pass
MAAP-611	2/1/2019	Co-60	0.333 ± 0.045	0.340	0.238 - 0.442	Pass
MAAP-611	2/1/2019	Mn-54	0.546 ± 0.058	0.547	0.383 - 0.711	Pass
MAAP-611	2/1/2019	Zn-65	0.025 ± 0.0348	0	NA <sup>c</sup>	Pass
MAAP-611	2/1/2019	Sr-90	1.34 ± 0.13	0.662	0.463 - 0.861	Fail <sup>f</sup>
MAAP-611	2/1/2019	U-234	4.14 ± 0.97	0.106	0.074 - 0.138	Fail <sup>f</sup>
MAAP-611	2/1/2019	U-238	3.89 ± 0.94	0.110	0.077 - 0.143	Fail <sup>f</sup>
MAW-601	2/1/2019	I-129	0.56 ± 0.08	0.616	0.431 - 0.801	Pass



TABLE A-7. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

Lab Code <sup>b</sup>	Reference Date	Analysis	Laboratory result	Concentration <sup>a</sup>		Acceptance
				Known Activity	Control Limits <sup>c</sup>	
MAVE-607	2/1/2019	Cs-134	2.33 ± 0.10	2.44	1.71 - 3.17	Pass
MAVE-607	2/1/2019	Cs-137	2.62 ± 0.13	2.30	1.61 - 2.99	Pass
MAVE-607	2/1/2019	Co-57	2.39 ± 0.11	2.07	1.45 - 2.69	Pass
MAVE-607	2/1/2019	Co-60	0.046 ± 0.04	0	NA <sup>c</sup>	Pass
MAVE-607	2/1/2019	Mn-54	0.031 ± 0.04	0	NA <sup>c</sup>	Pass
MAVE-607	2/1/2019	Sr-90	0.013 ± 0.022	0	NA <sup>c</sup>	Pass
MAAP-3299	8/1/2019	Gross Alpha	0.13 ± 0.03	0.528	0.158 - 0.898	Fail <sup>d</sup>
MAAP-3299	8/1/2019	Gross Beta	1.06 ± 0.07	0.937	0.469 - 1.406	Pass
MAW-3252	8/1/2019	Gross Alpha	0.93 ± 0.06	1.06	0.32 - 1.80	Pass
MAW-3252	8/1/2019	Gross Beta	3.03 ± 0.07	3.32	1.66 - 4.98	Pass
MASO-3297	8/19/2019	Cs-134	881.98 ± 9.03	1020	714 - 1326	Pass
MASO-3297	8/19/2019	Cs-137	871.50 ± 10.83	789	552 - 1026	Pass
MASO-3297	8/19/2019	Co-57	-1.72 ± 3.01	0	NA <sup>c</sup>	Pass
MASO-3297	8/19/2019	Co-60	783.69 ± 8.21	760	532 - 988	Pass
MASO-3297	8/19/2019	Mn-54	834.48 ± 11.29	745	522 - 969	Pass
MASO-3297	8/19/2019	Zn-65	-3.01 ± 5.27	0	NA <sup>c</sup>	Pass
MASO-3297	8/19/2019	K-40	662.91 ± 42.65	555	389 - 722	Pass
MAW-3240	8/1/2019	Cs-134	-0.08 ± 0.06	0	NA <sup>c</sup>	Pass
MAW-3240	8/1/2019	Cs-137	18.48 ± 0.90	18.4	12.9 - 23.9	Pass
MAW-3240	8/1/2019	Co-57	14.68 ± 0.52	15.6	10.9 - 20.3	Pass
MAW-3240	8/1/2019	Co-60	8.67 ± 0.39	8.8	6.2 - 11.4	Pass
MAW-3240	8/1/2019	Mn-54	20.72 ± 0.93	20.6	14.4 - 26.8	Pass
MAW-3240	8/1/2019	Zn-65	20.52 ± 1.05	20.3	14.200 - 26.400	Pass
MAW-3240	8/1/2019	K-40	5.11 ± 0.68	0	NA <sup>c</sup>	Fail
MAW-3240	8/1/2019	H-3	179.52 ± 3.32	175	123 - 228	Pass
MAW-3240	8/1/2019	U-234	1.11 ± 0.04	1.07	0.75 - 1.39	Pass
MAW-3240	8/1/2019	U-238	1.08 ± 0.04	1.05	0.74 - 1.37	Pass
MAVE-3295	8/1/2019	Cs-134	0.02 ± 0.02	0	NA <sup>c</sup>	Pass
MAVE-3295	8/1/2019	Cs-137	3.38 ± 0.32	3.28	2.30 - 4.26	Pass
MAVE-3295	8/1/2019	Co-57	4.99 ± 0.51	4.57	3.20 - 5.94	Pass
MAVE-3295	8/1/2019	Co-60	5.29 ± 0.39	5.30	3.71 - 6.89	Pass
MAVE-3295	8/1/2019	Mn-54	4.73 ± 0.45	4.49	3.14 - 5.84	Pass
MAVE-3295	8/1/2019	Zn-65	3.10 ± 0.31	2.85	2.00 - 3.71	Pass

<sup>a</sup> Results are reported in units of Bq/kg (soil), Bq/L (water) or Bq/total sample (filters, vegetation).

<sup>b</sup> Laboratory codes as follows: MAW (water), MAAP (air filter), MASO (soil) and MAVE (vegetation).

<sup>c</sup> MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP. A known value of "zero" indicates an analysis was included in the testing series as a "false positive". MAPEP does not provide control limits.

<sup>d</sup> Provided in the series for "sensitivity evaluation". MAPEP does not provide control limits.

<sup>e</sup> Past results have been acceptable so will watch to see if a trend develops.

<sup>f</sup> An erroneous volume conversion caused some incorrect values to be submitted. If the conversion had been performed properly the results in Bq/sample would have been (Sr-90: 0.671 ± 0.066 ) and (U-234: 0.153 ± 0.036) and (U-238: 0.144 ± 0.035). This result had been included in the Uranium investigation. See footnote "C" on Table A-1.

<sup>g</sup> The lab will adopt a MAPEP specific gross alpha/beta filter calibration as discussed in the MAPEP test instructions..

Utilizing a MAPEP specific calibration, the result in Bq/sample yields a result of ( 0.39 ± 0.09 Bq/total).

TABLE A-8. Interlaboratory Comparison Crosscheck Program, Environmental Resource Associates (ERA)<sup>a</sup>.

MRAD-30 Study						
Lab Code <sup>b</sup>	Date	Analysis	Concentration <sup>a</sup>		Control Limits <sup>d</sup>	Acceptance
			Laboratory Result	ERA Value <sup>c</sup>		
ERAP-846	3/18/2019	Am-241	19.1	18.7	13.3 - 24.9	Pass
ERAP-846	3/18/2019	Cs-134	612	721	468 - 884	Pass
ERAP-846	3/18/2019	Cs-137	679	634	521 - 832	Pass
ERAP-846	3/18/2019	Co-60	93.7	93.8	79.7 - 119	Pass
ERAP-846	3/18/2019	Fe-55	612	718	262 - 1150	Pass
ERAP-846	3/18/2019	Mn-54	< 0.5	< 50.0	0.00 - 50.0	Pass
ERAP-846	3/18/2019	Zn-65	1500	1380	1130 - 2110	Pass
ERAP-846	3/18/2019	Pu-238	34.0	33.8	25.5 - 41.5	Pass
ERAP-846	3/18/2019	Pu-239	64.9	67.0	50.1 - 80.8	Pass
ERAP-846	3/18/2019	Sr-90	199	181	114 - 246	Pass
ERAP-846	3/18/2019	U-234 <sup>e</sup>	29.0	18.2	13.5 - 21.3	Fail
ERAP-846	3/18/2019	U-238 <sup>e</sup>	28.6	18.1	13.7 - 21.6	Fail
ERAP-848	3/18/2019	Gross Alpha	48.4	50.3	26.3 - 82.9	Pass
ERAP-848	3/18/2019	Gross Beta	95.5	78.6	47.7 - 119	Pass

<sup>a</sup> Results obtained by Environmental, Inc., Midwest Laboratory (EIML) as a participant in the crosscheck program for proficiency testing administered by Environmental Resource Associates, serving as a replacement for studies conducted previously by the Environmental Measurements Laboratory Quality Assessment Program (EML).

<sup>b</sup> Laboratory code ERAP (air filter). Results are reported in units of (pCi/Filter).

<sup>c</sup> The ERA Assigned values for the air filter standards are equal to 100% of the parameter present in the standard as determined by the gravimetric and/or volumetric measurements made during standard preparation as applicable.

<sup>d</sup> The acceptance limits are established per the guidelines contained in the Department of Energy (DOE) report EML-564, Analysis of Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) Data Determination of Operational Criteria and Control Limits for Performance Evaluation Purposes or ERA's SOP for the generation of Performance Acceptance Limits.

<sup>e</sup> Failure traced to an over-estimated U-232 tracer value. Tracer has been re-standardized. (See footnote "c" on Table A-1).

## APPENDIX B. DATA REPORTING CONVENTIONS

---

### Data Reporting Conventions

1.0. All activities, except gross alpha and gross beta, are decay corrected to collection time or the end of the collection period.

### 2.0. Single Measurements

Each single measurement is reported as follows:  $x \pm s$   
where:  $x$  = value of the measurement;  
 $s = 2\sigma$  counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is less than the lower limit of detection  $L$ , it is reported as:  $< L$ ,  
where  $L$  = the lower limit of detection based on  $4.66\sigma$  uncertainty for a background sample.

### 3.0. Duplicate analyses

If duplicate analyses are reported, the convention is as follows. :

3.1 Individual results: For two analysis results;  $x_1 \pm s_1$  and  $x_2 \pm s_2$

Reported result:  $x \pm s$ ; where  $x = (1/2)(x_1 + x_2)$  and  $s = (1/2)\sqrt{s_1^2 + s_2^2}$

3.2. Individual results:  $< L_1, < L_2$  Reported result:  $< L$ , where  $L$  = lower of  $L_1$  and  $L_2$

3.3. Individual results:  $x \pm s, < L$  Reported result:  $x \pm s$  if  $x \geq L$ ;  $< L$  otherwise.

### 4.0. Computation of Averages and Standard Deviations

4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average  $\bar{x}$  and standard deviation "s" of a set of  $n$  numbers  $x_1, x_2, \dots, x_n$  are defined as follows:

$$\bar{x} = \frac{1}{n} \sum x \qquad s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$$

4.2 Values below the highest lower limit of detection are not included in the average.

4.3 If all values in the averaging group are less than the highest LLD, the highest LLD is reported.

4.4 If all but one of the values are less than the highest LLD, the single value  $x$  and associated two sigma error is reported.

4.5 In rounding off, the following rules are followed:

4.5.1. If the number following those to be retained is less than 5, the number is dropped, and the retained numbers are kept unchanged. As an example, 11.443 is rounded off to 11.44.

4.5.2. If the number following those to be retained is equal to or greater than 5, the number is dropped and the last retained number is raised by 1. As an example, 11.445 is rounded off to 11.45.

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## **Appendix C. NON-RADIOLOGICAL MONITORING PROGRAM**

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### **1.0. Introduction**

Union Electric Company Callaway Plant, d.b.a. Ameren Missouri Callaway Energy Center, in accordance with federal regulations and a desire to maintain the quality of the local environment around Callaway Plant has implemented an Environmental Protection Plan, (EPP) contained in Appendix B of the Callaway Plant Operating License.

The objective of the EPP is to provide for protection of non-radiological environmental values during operation of the Callaway Plant.

This report describes the conduct of the EPP for the Callaway Plant during 2019.

### **2.0. Unusual or Important Events**

No unusual or important events reportable under the EPP Section 4.1 were identified during 2019.

### **3.0. EPP Non-compliances**

During 2019, there were no non-compliances with the EPP.

### **4.0. Nonroutine Reports**

There were no nonroutine reports submitted in accordance with the EPP, Section 5.4.2 in 2018.

### **5.0. Plant Design and Operation Environmental Evaluations.**

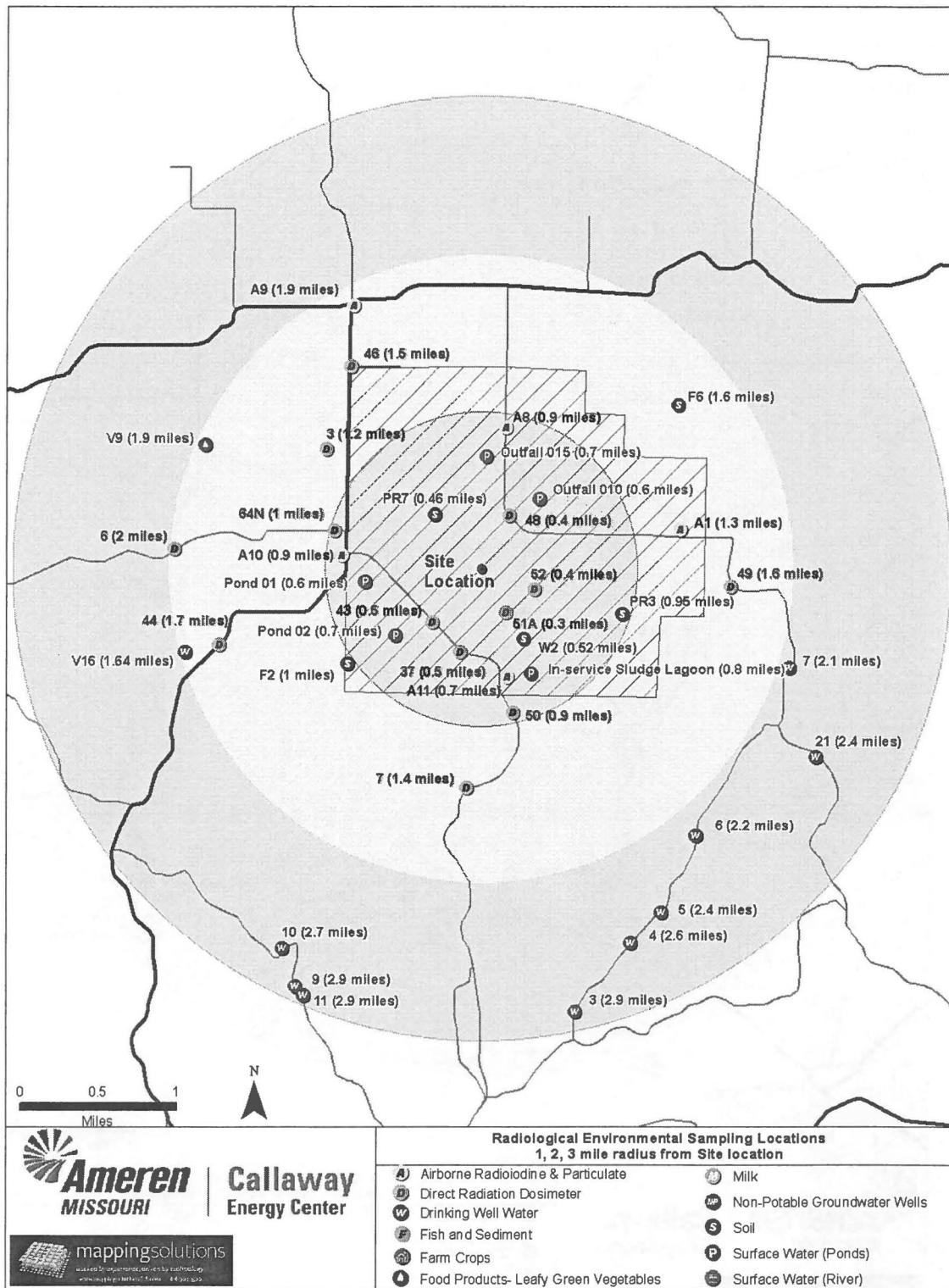
This section lists all changes in the plant design, operation, tests or experiments installed during 2019, which could have involved a potentially significant unreviewed environmental question in accordance with section 3.1 of Appendix B.

During 2019, no major plant changes were completed that could have involved a potentially significant unreviewed environmental question.

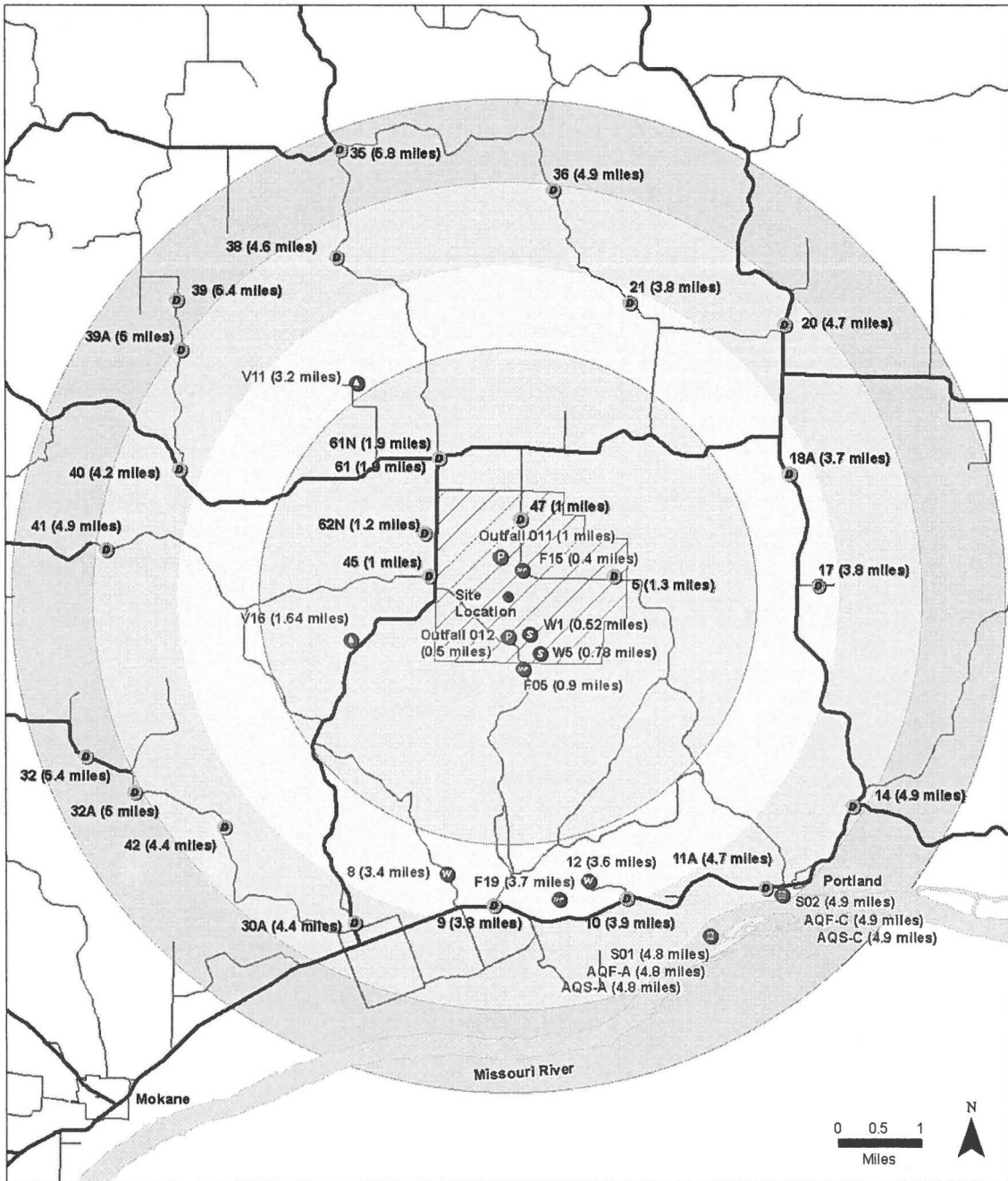
APPENDIX D

Sampling Location Maps

Figure D-1. Radiological Environmental Sampling Locations 1, 2, 3, mile radius from site location.



**Figure D-2. Radiological Environmental Sampling Locations 3, 4, 5, 6 mile radius from site location.**



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**MISSOURI** | **Energy Center**

**mappingsolutions**  
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**Radiological Environmental Sampling Locations  
 3,4,5,6 mile radius from Site location**

<b>A</b> Airborne Radioiodine & Particulate	<b>M</b> Milk
<b>D</b> Direct Radiation Dosimeter	<b>NP</b> Non-Potable Groundwater Wells
<b>W</b> Drinking Well Water	<b>S</b> Soil
<b>F</b> Fish and Sediment	<b>P</b> Surface Water (Ponds)
<b>FC</b> Farm Crops	<b>R</b> Surface Water (River)
<b>LV</b> Food Products- Leafy Green Vegetables	

**Figure D-3. Radiological Environmental Sampling Locations 5, 10, 15 mile radius from site location.**

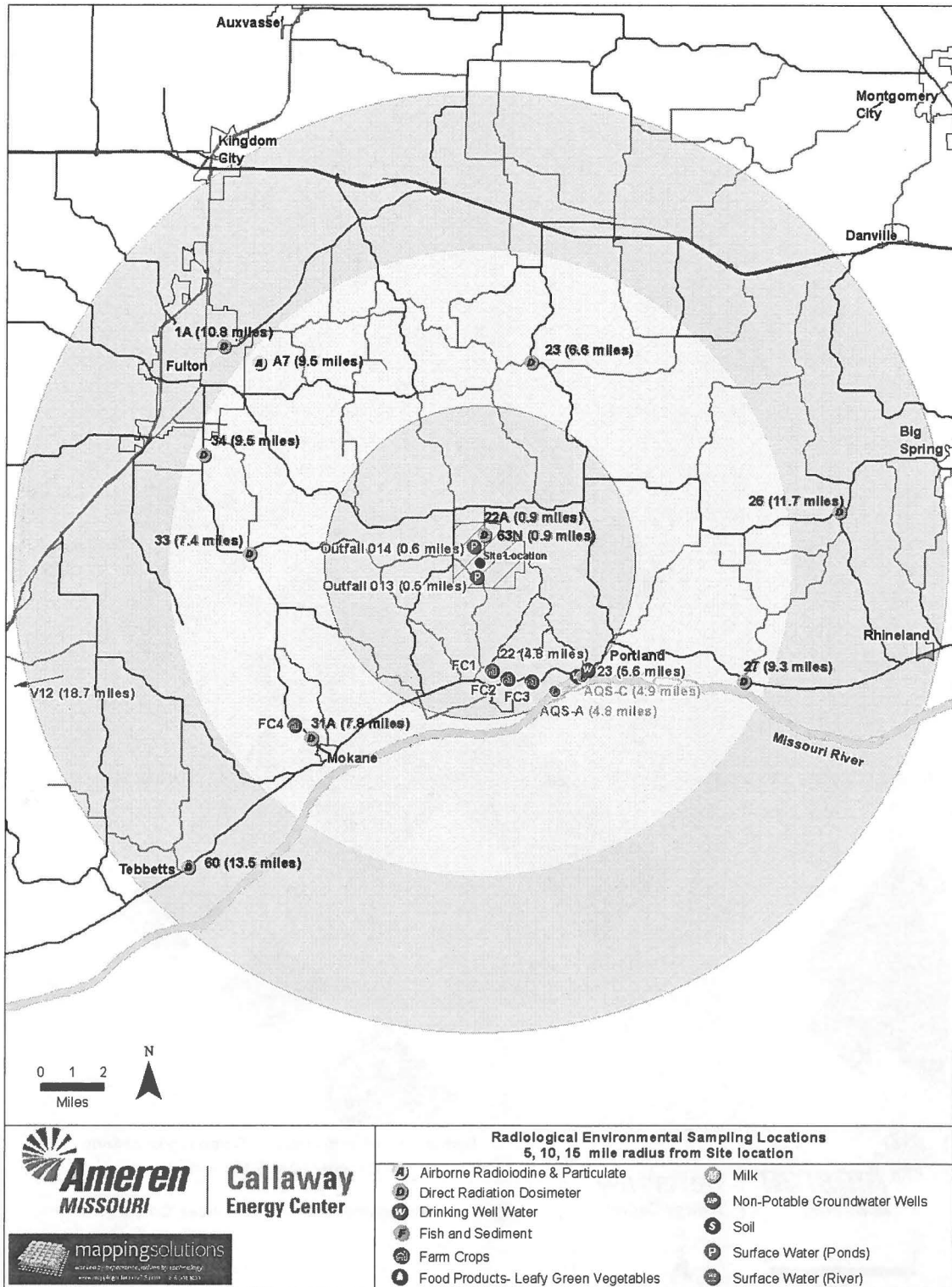




Figure D-4. Non-Potable Groundwater Monitoring Wells, 600 ft radius from Site.

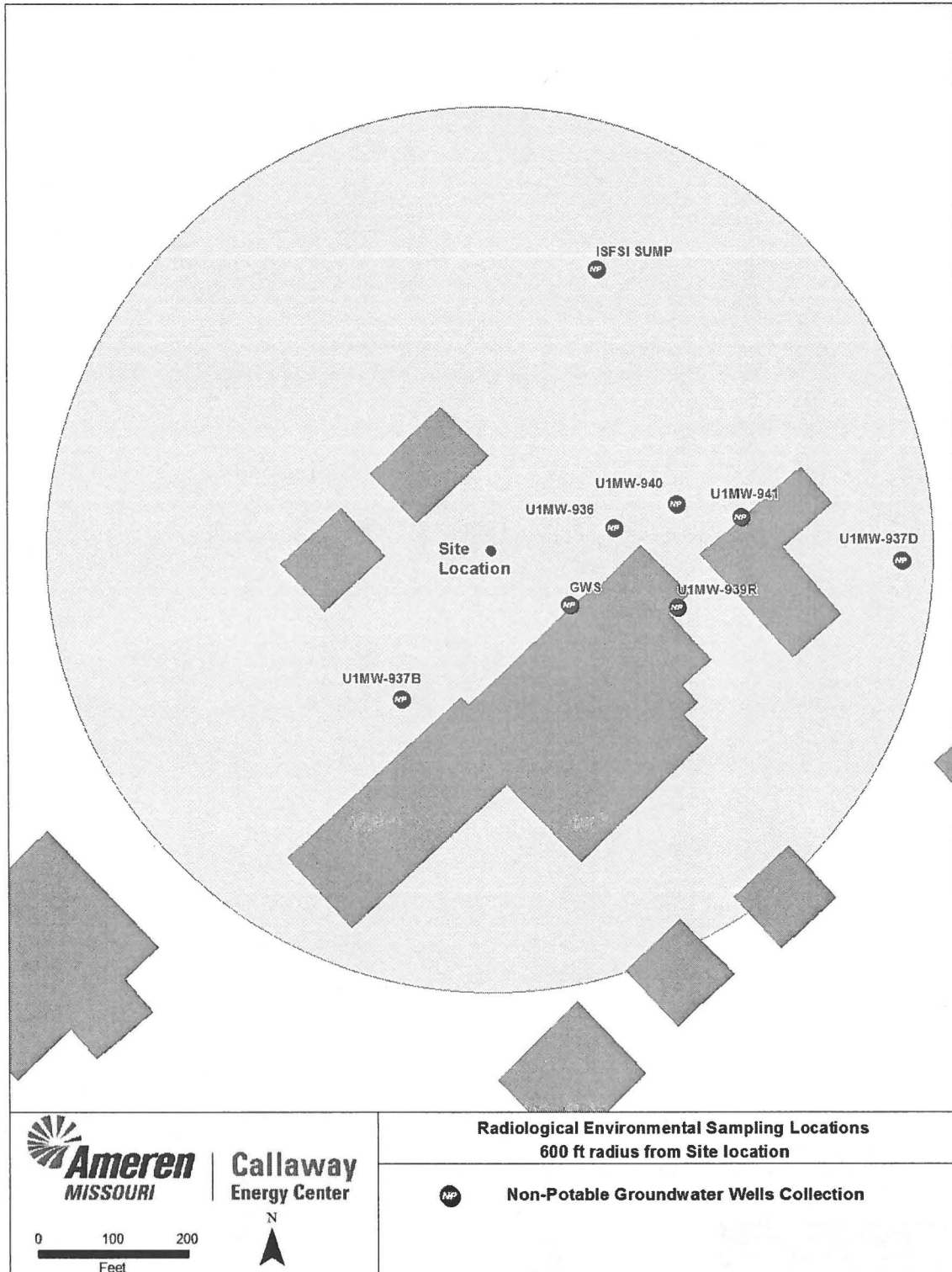
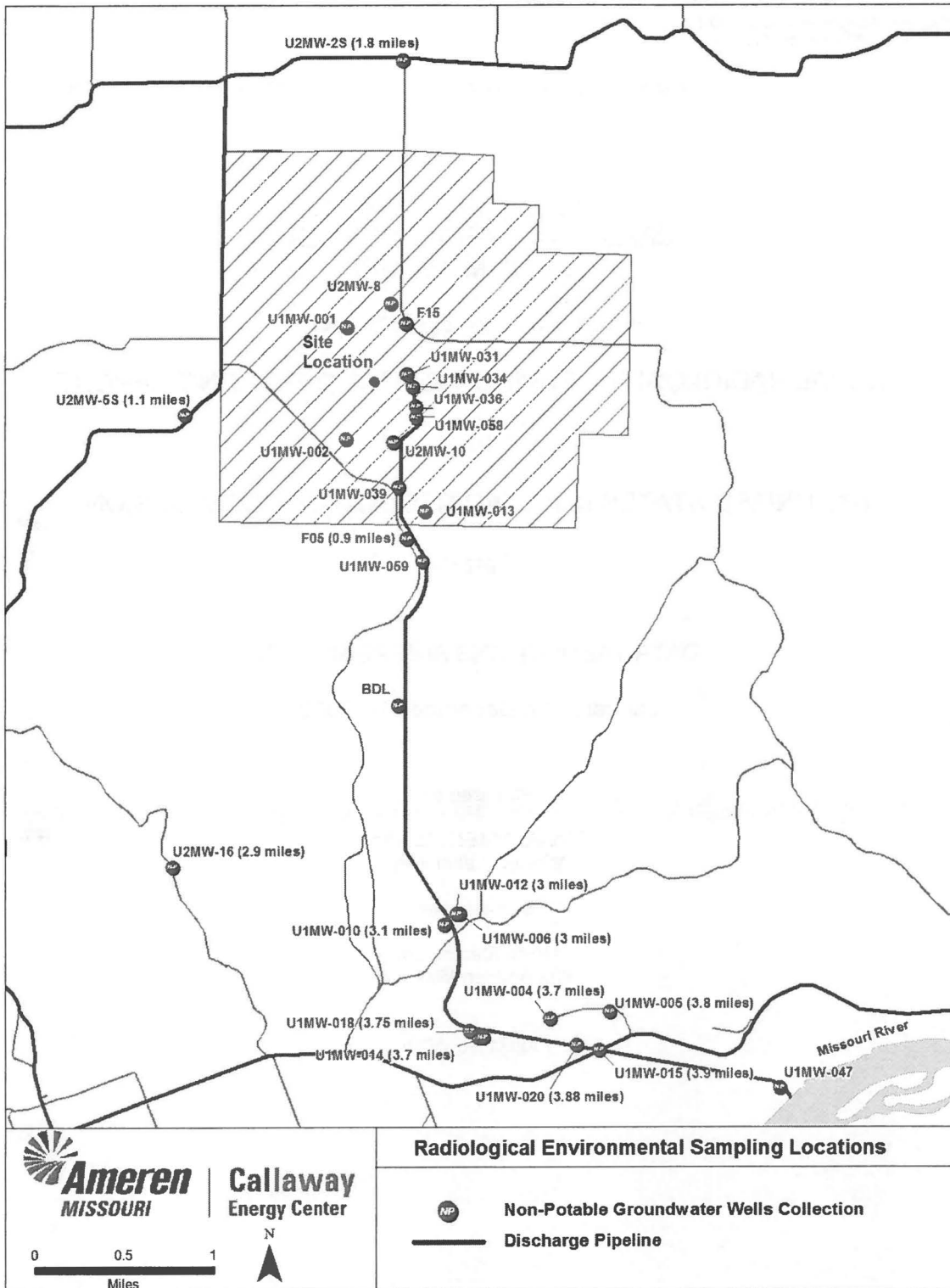


Figure D-5. Non-Potable Groundwater Monitoring Wells Collection.





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**AMEREN MISSOURI,  
CALLAWAY ENERGY CENTER  
FULTON, MISSOURI**

Docket Numbers 50-483 and 72-1045

**ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT**

to

**THE UNITED STATES NUCLEAR REGULATORY COMMISSION**

**Part II**

**DATA TABULATIONS AND ANALYSES**

**January 1 to December 31, 2019**

Prepared by

**ENVIRONMENTAL, Inc.**  
**Midwest Laboratory**

Submitted by

**Union Electric Co.**  
**dba Ameren Missouri**

Project No. 8036

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## 1.0 INTRODUCTION

The following constitutes a supplement to the Annual Report for the Radiological Environmental Monitoring Program conducted at the Ameren Missouri, Callaway Energy Center, Fulton, Missouri in 2019. Results of completed analyses are presented in the attached tables.

For information regarding sampling locations, type and frequency of collection, and sample codes, refer to Part I, Tables 5.1 - 5.2 and the figures in Appendix D.

Analyses results from additional sampling may be found in Appendix A.

## 2.0 DATA TABLES

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.  
 Units: pCi/m<sup>3</sup>

Location		CA-A-001							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
01-10-19	277	0.21 ± 0.08	< 0.007	< 0.006	< 0.012	< 0.009	< 0.009	< 0.012	< 0.029
01-17-19	272	< 0.12	< 0.014	< 0.012	< 0.019	< 0.014	< 0.011	< 0.020	< 0.056
01-24-19	276	< 0.10	< 0.009	< 0.008	< 0.011	< 0.009	< 0.008	< 0.009	< 0.045
01-31-19	270	< 0.12	< 0.007	< 0.007	< 0.017	< 0.012	< 0.009	< 0.015	< 0.033
02-07-19	278	< 0.09	< 0.005	< 0.008	< 0.012	< 0.010	< 0.008	< 0.012	< 0.048
02-14-19	282	< 0.11	< 0.010	< 0.010	< 0.013	< 0.012	< 0.010	< 0.019	< 0.054
02-21-19	279	< 0.09	< 0.008	< 0.009	< 0.010	< 0.010	< 0.004	< 0.006	< 0.044
02-28-19					NS <sup>b</sup>				
03-07-19					NS <sup>c</sup>				
03-14-19	266	0.28 ± 0.13	< 0.008	< 0.009	< 0.013	< 0.009	< 0.008	< 0.007	< 0.051
03-21-19	279	< 0.10	< 0.008	< 0.008	< 0.010	< 0.010	< 0.009	< 0.010	< 0.052
03-28-19	276	0.26 ± 0.12	< 0.009	< 0.009	< 0.018	< 0.011	< 0.007	< 0.009	< 0.053
04-04-19	272	< 0.13	< 0.012	< 0.013	< 0.015	< 0.011	< 0.009	< 0.015	< 0.070
04-11-19	273	0.16 ± 0.09	< 0.010	< 0.005	< 0.020	< 0.009	< 0.009	< 0.022	< 0.042
04-18-19	270	< 0.12	< 0.009	< 0.013	< 0.015	< 0.010	< 0.008	< 0.027	< 0.046
04-25-19	269	< 0.14	< 0.011	< 0.010	< 0.017	< 0.013	< 0.011	< 0.014	< 0.071
05-02-19	268	< 0.12	< 0.008	< 0.010	< 0.018	< 0.010	< 0.012	< 0.017	< 0.046
05-09-19	273	0.18 ± 0.08	< 0.006	< 0.010	< 0.016	< 0.010	< 0.008	< 0.018	< 0.055
05-16-19	270	< 0.12	< 0.007	< 0.016	< 0.013	< 0.013	< 0.012	< 0.012	< 0.062
05-23-19	266	< 0.13	< 0.009	< 0.013	< 0.021	< 0.011	< 0.008	< 0.017	< 0.045
05-30-19	266	< 0.17	< 0.012	< 0.010	< 0.016	< 0.012	< 0.007	< 0.016	< 0.059
06-06-19	268	0.29 ± 0.12	< 0.006	< 0.013	< 0.012	< 0.012	< 0.011	< 0.014	< 0.041
06-13-19	263	0.26 ± 0.12	< 0.008	< 0.010	< 0.015	< 0.011	< 0.009	< 0.013	< 0.055
06-20-19	269	0.29 ± 0.13	< 0.006	< 0.012	< 0.015	< 0.010	< 0.012	< 0.014	< 0.041
06-27-19	266	< 0.14	< 0.015	< 0.014	< 0.024	< 0.017	< 0.010	< 0.018	< 0.060
07-03-19	223	0.23 ± 0.13	< 0.011	< 0.012	< 0.021	< 0.014	< 0.013	< 0.018	< 0.066
07-10-19	265	< 0.13	< 0.010	< 0.007	< 0.024	< 0.012	< 0.007	< 0.048	< 0.057
07-18-19	308	< 0.12	< 0.007	< 0.007	< 0.017	< 0.010	< 0.013	< 0.041	< 0.049
07-25-19	264	< 0.12	< 0.013	< 0.007	< 0.022	< 0.010	< 0.012	< 0.030	< 0.047
08-01-19	267	0.25 ± 0.10	< 0.011	< 0.009	< 0.019	< 0.010	< 0.007	< 0.027	< 0.053
08-08-19	267	0.31 ± 0.12	< 0.010	< 0.007	< 0.011	< 0.011	< 0.006	< 0.007	< 0.048
08-14-19	226	< 0.12	< 0.009	< 0.008	< 0.014	< 0.012	< 0.010	< 0.010	< 0.065
08-22-19	307	< 0.11	< 0.009	< 0.006	< 0.025	< 0.015	< 0.010	< 0.021	< 0.061
08-29-19	257	< 0.11	< 0.011	< 0.006	< 0.016	< 0.011	< 0.007	< 0.030	< 0.052
09-05-19	268	< 0.14	< 0.007	< 0.009	< 0.019	< 0.012	< 0.011	< 0.016	< 0.046
09-12-19	268	0.21 ± 0.10	< 0.010	< 0.005	< 0.021	< 0.011	< 0.012	< 0.019	< 0.060
09-19-19	264	0.30 ± 0.11	< 0.007	< 0.010	< 0.012	< 0.011	< 0.008	< 0.018	< 0.049
09-26-19	267	0.26 ± 0.14	< 0.009	< 0.012	< 0.018	< 0.011	< 0.007	< 0.011	< 0.030
10-03-19	267	< 0.11	< 0.006	< 0.012	< 0.011	< 0.010	< 0.009	< 0.009	< 0.049
10-10-19	270	< 0.12	< 0.009	< 0.010	< 0.018	< 0.011	< 0.006	< 0.022	< 0.048
10-17-19	272	< 0.18	< 0.012	< 0.012	< 0.029	< 0.015	< 0.017	< 0.025	< 0.054

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

<sup>b</sup> "NS" = No sample; see Part I Table 5.5, Listing of Missed Samples.

<sup>c</sup> "NS" = No sample; see Part I Table 5.5, Listing of Missed Samples.



**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.  
 Units: pCi/m<sup>3</sup>

Location		CA-A-001 (cont.)							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
10-24-19	267	< 0.10	< 0.011	< 0.009	< 0.023	< 0.011	< 0.010	< 0.017	< 0.039
10-30-19	233	< 0.14	< 0.009	< 0.011	< 0.028	< 0.010	< 0.009	< 0.024	< 0.058
11-06-19	272	< 0.11	< 0.011	< 0.009	< 0.017	< 0.009	< 0.008	< 0.014	< 0.052
11-12-19	319	0.16 ± 0.09	< 0.006	< 0.008	< 0.010	< 0.008	< 0.008	< 0.013	< 0.045
11-21-19	268	0.24 ± 0.13	< 0.010	< 0.011	< 0.019	< 0.011	< 0.011	< 0.019	< 0.040
11-27-19	230	< 0.11	< 0.009	< 0.010	< 0.015	< 0.012	< 0.011	< 0.017	< 0.071
12-05-19	311	< 0.10	< 0.008	< 0.011	< 0.010	< 0.011	< 0.008	< 0.020	< 0.045
12-12-19	266	< 0.12	< 0.008	< 0.010	< 0.019	< 0.011	< 0.007	< 0.021	< 0.063
12-19-19	264	< 0.14	< 0.008	< 0.011	< 0.019	< 0.010	< 0.008	< 0.036	< 0.036
12-26-19	263	< 0.14	< 0.009	< 0.011	< 0.024	< 0.011	< 0.014	< 0.033	< 0.051
01-02-20	264	< 0.14	< 0.009	< 0.012	< 0.024	< 0.015	< 0.012	< 0.048	< 0.057

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.

Units: pCi/m<sup>3</sup>

Location		CA-A-007							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
01-10-19	253	< 0.20	< 0.015	< 0.010	< 0.028	< 0.018	< 0.014	< 0.031	< 0.061
01-17-19	248	< 0.11	< 0.009	< 0.009	< 0.011	< 0.013	< 0.010	< 0.017	< 0.044
01-24-19	242	< 0.10	< 0.006	< 0.007	< 0.015	< 0.009	< 0.007	< 0.006	< 0.045
01-31-19	231	0.21 ± 0.10	< 0.007	< 0.011	< 0.017	< 0.013	< 0.012	< 0.016	< 0.049
02-07-19	248	< 0.14	< 0.009	< 0.018	< 0.023	< 0.016	< 0.012	< 0.027	< 0.071
02-14-19	287	0.19 ± 0.09	< 0.005	< 0.008	< 0.013	< 0.009	< 0.008	< 0.007	< 0.035
02-21-19	279	< 0.11	< 0.007	< 0.012	< 0.012	< 0.011	< 0.007	< 0.007	< 0.035
02-28-19	285	< 0.10	< 0.005	< 0.009	< 0.019	< 0.009	< 0.009	< 0.006	< 0.050
03-07-19	278	< 0.11	< 0.005	< 0.009	< 0.018	< 0.010	< 0.008	< 0.007	< 0.046
03-14-19	285	0.23 ± 0.11	< 0.006	< 0.012	< 0.016	< 0.008	< 0.007	< 0.008	< 0.058
03-21-19	287	< 0.08	< 0.006	< 0.009	< 0.023	< 0.009	< 0.009	< 0.007	< 0.050
03-28-19	290	< 0.13	< 0.006	< 0.011	< 0.018	< 0.012	< 0.006	< 0.014	< 0.032
04-04-19	281	< 0.13	< 0.010	< 0.007	< 0.020	< 0.012	< 0.007	< 0.017	< 0.055
04-11-19	287	0.21 ± 0.11	< 0.009	< 0.011	< 0.010	< 0.011	< 0.009	< 0.013	< 0.066
04-18-19	277	< 0.13	< 0.007	< 0.006	< 0.011	< 0.010	< 0.010	< 0.010	< 0.051
04-25-19	278	< 0.12	< 0.010	< 0.010	< 0.012	< 0.012	< 0.010	< 0.020	< 0.052
05-02-19	278	< 0.13	< 0.008	< 0.011	< 0.015	< 0.012	< 0.008	< 0.013	< 0.039
05-09-19	275	0.20 ± 0.11	< 0.009	< 0.010	< 0.020	< 0.010	< 0.005	< 0.010	< 0.049
05-16-19	274	< 0.12	< 0.009	< 0.013	< 0.017	< 0.010	< 0.012	< 0.009	< 0.052
05-23-19	275	< 0.11	< 0.008	< 0.009	< 0.012	< 0.010	< 0.013	< 0.013	< 0.053
05-30-19	275	< 0.16	< 0.010	< 0.011	< 0.022	< 0.014	< 0.014	< 0.057	< 0.065
06-06-19	274	0.28 ± 0.11	< 0.006	< 0.009	< 0.010	< 0.010	< 0.008	< 0.021	< 0.060
06-13-19	268	< 0.13	< 0.009	< 0.011	< 0.011	< 0.011	< 0.010	< 0.021	< 0.044
06-20-19	271	0.24 ± 0.11	< 0.010	< 0.009	< 0.011	< 0.011	< 0.009	< 0.009	< 0.035
06-27-19	261	0.20 ± 0.11	< 0.006	< 0.012	< 0.015	< 0.010	< 0.008	< 0.011	< 0.056
07-03-19	234	< 0.16	< 0.018	< 0.010	< 0.015	< 0.010	< 0.009	< 0.039	< 0.045
07-10-19	277	< 0.12	< 0.012	< 0.007	< 0.022	< 0.011	< 0.007	< 0.069	< 0.032
07-18-19	313	< 0.11	< 0.009	< 0.008	< 0.019	< 0.010	< 0.007	< 0.032	< 0.051
07-25-19	271	< 0.11	< 0.011	< 0.007	< 0.012	< 0.012	< 0.010	< 0.013	< 0.065
08-01-19	262	< 0.13	< 0.012	< 0.012	< 0.014	< 0.012	< 0.011	< 0.017	< 0.043
08-08-19	256	< 0.14	< 0.006	< 0.010	< 0.013	< 0.011	< 0.008	< 0.011	< 0.046
08-14-19	213	< 0.13	< 0.010	< 0.006	< 0.024	< 0.016	< 0.009	< 0.025	< 0.066
08-22-19	279	0.22 ± 0.13	< 0.009	< 0.007	< 0.018	< 0.009	< 0.010	< 0.017	< 0.045
08-29-19	239	< 0.11	< 0.010	< 0.012	< 0.016	< 0.010	< 0.006	< 0.023	< 0.058
09-05-19	240	0.19 ± 0.09	< 0.012	< 0.005	< 0.025	< 0.012	< 0.009	< 0.022	< 0.053
09-12-19	239	< 0.13	< 0.005	< 0.013	< 0.025	< 0.011	< 0.007	< 0.019	< 0.041
09-19-19	231	0.25 ± 0.11	< 0.009	< 0.006	< 0.010	< 0.013	< 0.012	< 0.014	< 0.048
09-26-19	227	0.23 ± 0.14	< 0.010	< 0.011	< 0.017	< 0.012	< 0.013	< 0.009	< 0.059
10-03-19	275	< 0.15	< 0.012	< 0.009	< 0.022	< 0.013	< 0.007	< 0.017	< 0.056
10-10-19	280	< 0.15	< 0.011	< 0.014	< 0.031	< 0.013	< 0.013	< 0.043	< 0.061
10-17-19	286	0.19 ± 0.10	< 0.010	< 0.010	< 0.015	< 0.009	< 0.011	< 0.018	< 0.052

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.  
 Units: pCi/m<sup>3</sup>

Location		CA-A-007 (cont.)							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
10-24-19	280	< 0.11	< 0.010	< 0.008	< 0.023	< 0.012	< 0.013	< 0.009	< 0.066
10-30-19	246	< 0.11	< 0.010	< 0.014	< 0.015	< 0.011	< 0.009	< 0.021	< 0.043
11-06-19	286	< 0.11	< 0.006	< 0.010	< 0.010	< 0.010	< 0.009	< 0.009	< 0.047
11-12-19	337	0.15 ± 0.07	< 0.007	< 0.008	< 0.011	< 0.008	< 0.008	< 0.011	< 0.034
11-21-19	283	0.22 ± 0.11	< 0.010	< 0.009	< 0.016	< 0.011	< 0.008	< 0.014	< 0.035
11-27-19	243	< 0.12	< 0.011	< 0.011	< 0.022	< 0.011	< 0.010	< 0.026	< 0.034
12-05-19	328	< 0.12	< 0.010	< 0.015	< 0.020	< 0.013	< 0.009	< 0.035	< 0.064
12-12-19	287	< 0.18	< 0.011	< 0.014	< 0.018	< 0.016	< 0.013	< 0.058	< 0.075
12-19-19	289	< 0.14	< 0.015	< 0.012	< 0.012	< 0.012	< 0.010	< 0.051	< 0.062
12-26-19	282	0.26 ± 0.13	< 0.015	< 0.011	< 0.023	< 0.016	< 0.008	< 0.058	< 0.066
01-02-20	285	< 0.10	< 0.006	< 0.011	< 0.019	< 0.011	< 0.011	< 0.018	< 0.045

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.  
 Units: pCi/m<sup>3</sup>

Location		CA-A-008							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
01-10-19	333	0.16 ± 0.09	< 0.007	< 0.004	< 0.010	< 0.007	< 0.006	< 0.016	< 0.032
01-17-19	322	< 0.09	< 0.004	< 0.006	< 0.014	< 0.008	< 0.005	< 0.009	< 0.039
01-24-19	351	0.10 ± 0.06	< 0.006	< 0.005	< 0.012	< 0.007	< 0.004	< 0.012	< 0.023
01-31-19	356	< 0.09	< 0.007	< 0.009	< 0.009	< 0.009	< 0.005	< 0.014	< 0.046
02-07-19	334	< 0.08	< 0.008	< 0.005	< 0.009	< 0.009	< 0.005	< 0.014	< 0.041
02-14-19	266	< 0.11	< 0.011	< 0.011	< 0.022	< 0.012	< 0.011	< 0.012	< 0.049
02-21-19	292	0.13 ± 0.07	< 0.007	< 0.010	< 0.014	< 0.009	< 0.008	< 0.011	< 0.027
02-28-19	293	0.16 ± 0.07	< 0.006	< 0.012	< 0.017	< 0.010	< 0.005	< 0.006	< 0.043
03-07-19	298	0.17 ± 0.10	< 0.011	< 0.010	< 0.018	< 0.011	< 0.009	< 0.015	< 0.049
03-14-19	287	0.30 ± 0.10	< 0.009	< 0.008	< 0.011	< 0.010	< 0.005	< 0.012	< 0.028
03-21-19	295	< 0.13	< 0.008	< 0.010	< 0.018	< 0.009	< 0.011	< 0.008	< 0.055
03-28-19	292	0.23 ± 0.09	< 0.008	< 0.011	< 0.014	< 0.010	< 0.008	< 0.009	< 0.036
04-04-19	288	0.27 ± 0.11	< 0.007	< 0.010	< 0.018	< 0.009	< 0.007	< 0.008	< 0.047
04-11-19	288	< 0.16	< 0.018	< 0.019	< 0.017	< 0.016	< 0.015	< 0.035	< 0.064
04-18-19	282	< 0.11	< 0.015	< 0.015	< 0.014	< 0.012	< 0.012	< 0.018	< 0.060
04-25-19	282	< 0.14	< 0.012	< 0.007	< 0.022	< 0.011	< 0.011	< 0.011	< 0.038
05-02-19	281	< 0.12	< 0.006	< 0.010	< 0.020	< 0.010	< 0.011	< 0.009	< 0.049
05-09-19	287	0.16 ± 0.09	< 0.007	< 0.003	< 0.016	< 0.010	< 0.008	< 0.019	< 0.037
05-16-19	282	< 0.10	< 0.007	< 0.008	< 0.009	< 0.010	< 0.007	< 0.011	< 0.060
05-23-19	279	< 0.14	< 0.006	< 0.010	< 0.016	< 0.011	< 0.012	< 0.031	< 0.049
05-30-19	277	0.29 ± 0.16	< 0.010	< 0.009	< 0.023	< 0.011	< 0.010	< 0.059	< 0.057
06-06-19	281	0.27 ± 0.16	< 0.012	< 0.011	< 0.012	< 0.011	< 0.008	< 0.023	< 0.048
06-13-19	275	0.29 ± 0.14	< 0.013	< 0.015	< 0.014	< 0.011	< 0.011	< 0.021	< 0.034
06-20-19	280	0.21 ± 0.12	< 0.006	< 0.010	< 0.011	< 0.012	< 0.010	< 0.012	< 0.032
06-27-19	279	0.27 ± 0.12	< 0.011	< 0.009	< 0.008	< 0.011	< 0.008	< 0.012	< 0.043
07-03-19	233	0.26 ± 0.15	< 0.010	< 0.007	< 0.020	< 0.012	< 0.010	< 0.058	< 0.061
07-10-19	276	< 0.14	< 0.012	< 0.005	< 0.018	< 0.011	< 0.010	< 0.051	< 0.055
07-18-19	318	< 0.12	< 0.007	< 0.003	< 0.028	< 0.013	< 0.009	< 0.035	< 0.033
07-25-19	275	0.32 ± 0.15	< 0.009	< 0.007	< 0.027	< 0.011	< 0.008	< 0.041	< 0.056
08-01-19	276	0.25 ± 0.12	< 0.008	< 0.007	< 0.017	< 0.009	< 0.008	< 0.027	< 0.053
08-08-19	276	0.17 ± 0.09	< 0.005	< 0.004	< 0.017	< 0.010	< 0.009	< 0.026	< 0.055
08-14-19	234	< 0.11	< 0.008	< 0.004	< 0.016	< 0.012	< 0.014	< 0.021	< 0.037
08-22-19	314	0.22 ± 0.11	< 0.006	< 0.005	< 0.015	< 0.009	< 0.008	< 0.024	< 0.054
08-29-19	271	< 0.11	< 0.006	< 0.005	< 0.022	< 0.012	< 0.010	< 0.023	< 0.046
09-05-19	275	< 0.12	< 0.006	< 0.008	< 0.015	< 0.012	< 0.009	< 0.011	< 0.046
09-12-19	272	< 0.11	< 0.013	< 0.008	< 0.016	< 0.014	< 0.008	< 0.018	< 0.072
09-19-19	271	0.23 ± 0.12	< 0.009	< 0.010	< 0.015	< 0.010	< 0.008	< 0.014	< 0.057
09-26-19	274	0.19 ± 0.10	< 0.009	< 0.008	< 0.012	< 0.011	< 0.006	< 0.012	< 0.039
10-03-19	272	0.26 ± 0.15	< 0.012	< 0.010	< 0.012	< 0.012	< 0.007	< 0.017	< 0.061
10-10-19	273	< 0.11	< 0.007	< 0.004	< 0.018	< 0.012	< 0.013	< 0.021	< 0.039
10-17-19	271	0.32 ± 0.14	< 0.012	< 0.009	< 0.020	< 0.011	< 0.007	< 0.030	< 0.055

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.  
 Units: pCi/m<sup>3</sup>

Location		CA-A-008 (cont.)							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
10-24-19	265	< 0.12	< 0.010	< 0.012	< 0.015	< 0.010	< 0.010	< 0.020	< 0.031
10-30-19	224	< 0.15	< 0.011	< 0.013	< 0.026	< 0.016	< 0.010	< 0.022	< 0.066
11-06-19	262	< 0.10	< 0.011	< 0.009	< 0.018	< 0.010	< 0.012	< 0.016	< 0.042
11-12-19	290	< 0.09	< 0.010	< 0.009	< 0.017	< 0.010	< 0.006	< 0.012	< 0.057
11-21-19	255	< 0.13	< 0.006	< 0.011	< 0.016	< 0.011	< 0.013	< 0.018	< 0.063
11-27-19	215	< 0.14	< 0.009	< 0.014	< 0.015	< 0.012	< 0.007	< 0.027	< 0.062
12-05-19	287	< 0.09	< 0.009	< 0.010	< 0.015	< 0.010	< 0.007	< 0.032	< 0.030
12-12-19	266	< 0.18	< 0.014	< 0.013	< 0.030	< 0.016	< 0.010	< 0.058	< 0.037
12-19-19	260	< 0.14	< 0.014	< 0.011	< 0.028	< 0.012	< 0.010	< 0.040	< 0.058
12-26-19	252	< 0.12	< 0.007	< 0.014	< 0.020	< 0.009	< 0.009	< 0.036	< 0.061
01-02-20	250	< 0.15	< 0.006	< 0.014	< 0.023	< 0.011	< 0.011	< 0.040	< 0.055

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.

Units: pCi/m<sup>3</sup>

Location		CA-A-009							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
01-10-19	293	0.20 ± 0.11	< 0.011	< 0.005	< 0.014	< 0.009	< 0.007	< 0.010	< 0.052
01-17-19	284	< 0.11	< 0.006	< 0.009	< 0.014	< 0.009	< 0.006	< 0.007	< 0.041
01-24-19	264	< 0.08	< 0.010	< 0.008	< 0.014	< 0.010	< 0.006	< 0.010	< 0.047
01-31-19	271	0.19 ± 0.10	< 0.006	< 0.007	< 0.021	< 0.010	< 0.010	< 0.015	< 0.037
02-07-19	278	< 0.11	< 0.011	< 0.015	< 0.015	< 0.014	< 0.013	< 0.026	< 0.056
02-14-19	277	< 0.10	< 0.006	< 0.003	< 0.012	< 0.008	< 0.005	< 0.005	< 0.040
02-21-19	267	< 0.08	< 0.003	< 0.012	< 0.012	< 0.010	< 0.011	< 0.013	< 0.032
02-28-19	265	0.20 ± 0.11	< 0.006	< 0.009	< 0.015	< 0.010	< 0.009	< 0.011	< 0.029
03-07-19	259	0.20 ± 0.12	< 0.006	< 0.010	< 0.013	< 0.010	< 0.009	< 0.015	< 0.038
03-14-19	247	0.30 ± 0.13	< 0.009	< 0.010	< 0.021	< 0.013	< 0.011	< 0.012	< 0.061
03-21-19	280	< 0.12	< 0.006	< 0.010	< 0.013	< 0.012	< 0.013	< 0.029	< 0.058
03-28-19	280	0.23 ± 0.11	< 0.007	< 0.007	< 0.020	< 0.010	< 0.007	< 0.019	< 0.046
04-04-19	271	< 0.16	< 0.015	< 0.008	< 0.014	< 0.012	< 0.006	< 0.016	< 0.043
04-11-19	278	< 0.20	< 0.009	< 0.017	< 0.014	< 0.018	< 0.015	< 0.072	< 0.061
04-18-19	271	< 0.13	< 0.008	< 0.011	< 0.019	< 0.011	< 0.012	< 0.013	< 0.044
04-25-19	273	0.20 ± 0.11	< 0.009	< 0.008	< 0.014	< 0.011	< 0.004	< 0.016	< 0.043
05-02-19	270	0.17 ± 0.10	< 0.012	< 0.006	< 0.018	< 0.011	< 0.010	< 0.008	< 0.036
05-09-19	278	< 0.15	< 0.013	< 0.011	< 0.016	< 0.013	< 0.007	< 0.017	< 0.034
05-16-19	272	< 0.17	< 0.018	< 0.013	< 0.020	< 0.016	< 0.015	< 0.035	< 0.040
05-23-19	250	< 0.13	< 0.009	< 0.010	< 0.012	< 0.011	< 0.009	< 0.026	< 0.068
05-30-19	268	< 0.14	< 0.011	< 0.007	< 0.020	< 0.013	< 0.013	< 0.041	< 0.057
06-06-19	273	0.26 ± 0.14	< 0.015	< 0.006	< 0.021	< 0.010	< 0.007	< 0.037	< 0.039
06-13-19	265	< 0.15	< 0.011	< 0.010	< 0.019	< 0.011	< 0.013	< 0.045	< 0.060
06-20-19	272	0.19 ± 0.11	< 0.009	< 0.008	< 0.012	< 0.011	< 0.008	< 0.014	< 0.049
06-27-19	260	0.25 ± 0.15	< 0.007	< 0.011	< 0.010	< 0.014	< 0.012	< 0.043	< 0.055
07-03-19	227	0.24 ± 0.11	< 0.005	< 0.006	< 0.016	< 0.009	< 0.009	< 0.046	< 0.034
07-10-19	266	< 0.12	< 0.009	< 0.008	< 0.012	< 0.011	< 0.011	< 0.029	< 0.046
07-18-19	306	< 0.11	< 0.009	< 0.008	< 0.016	< 0.010	< 0.009	< 0.013	< 0.044
07-25-19	255	0.22 ± 0.13	< 0.015	< 0.007	< 0.019	< 0.011	< 0.008	< 0.031	< 0.048
08-01-19	265	0.24 ± 0.10	< 0.006	< 0.011	< 0.017	< 0.012	< 0.009	< 0.020	< 0.051
08-08-19	269	0.27 ± 0.13	< 0.005	< 0.004	< 0.018	< 0.011	< 0.007	< 0.023	< 0.057
08-14-19	228	< 0.13	< 0.012	< 0.007	< 0.030	< 0.012	< 0.006	< 0.028	< 0.057
08-22-19	305	< 0.12	< 0.012	< 0.009	< 0.023	< 0.011	< 0.012	< 0.023	< 0.049
08-29-19	267	0.20 ± 0.11	< 0.006	< 0.006	< 0.016	< 0.010	< 0.012	< 0.024	< 0.065
09-05-19	269	0.21 ± 0.11	< 0.008	< 0.007	< 0.014	< 0.011	< 0.009	< 0.019	< 0.051
09-12-19	265	0.27 ± 0.12	< 0.007	< 0.006	< 0.014	< 0.012	< 0.006	< 0.016	< 0.052
09-19-19	266	0.22 ± 0.09	< 0.009	< 0.007	< 0.012	< 0.011	< 0.013	< 0.009	< 0.046
09-26-19	266	< 0.11	< 0.007	< 0.010	< 0.020	< 0.011	< 0.008	< 0.015	< 0.062
10-03-19	266	< 0.12	< 0.008	< 0.014	< 0.013	< 0.010	< 0.008	< 0.013	< 0.041
10-10-19	266	< 0.12	< 0.007	< 0.009	< 0.017	< 0.011	< 0.006	< 0.033	< 0.033
10-17-19	228 <sup>b</sup>	< 0.13	< 0.009	< 0.009	< 0.014	< 0.012	< 0.009	< 0.014	< 0.059

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

<sup>b</sup> Lower volume due to pump failure.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.  
 Units: pCi/m<sup>3</sup>

Location		CA-A-009 (cont.)							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
10-24-19	263	< 0.11	< 0.012	< 0.015	< 0.013	< 0.011	< 0.007	< 0.016	< 0.039
10-30-19	240	< 0.15	< 0.013	< 0.010	< 0.020	< 0.013	< 0.010	< 0.017	< 0.057
11-06-19	286	< 0.09	< 0.009	< 0.008	< 0.016	< 0.010	< 0.012	< 0.006	< 0.056
11-12-19	331	0.13 ± 0.07	< 0.010	< 0.007	< 0.012	< 0.008	< 0.005	< 0.013	< 0.027
11-21-19	274	0.19 ± 0.11	< 0.012	< 0.010	< 0.018	< 0.012	< 0.006	< 0.038	< 0.060
11-27-19	240	< 0.13	< 0.008	< 0.010	< 0.013	< 0.013	< 0.012	< 0.025	< 0.034
12-05-19	318	< 0.09	< 0.005	< 0.010	< 0.013	< 0.008	< 0.009	< 0.026	< 0.043
12-12-19	279	< 0.12	< 0.011	< 0.011	< 0.025	< 0.009	< 0.008	< 0.051	< 0.050
12-19-19	275	< 0.11	< 0.006	< 0.009	< 0.012	< 0.010	< 0.007	< 0.017	< 0.048
12-26-19	271	< 0.12	< 0.011	< 0.010	< 0.021	< 0.012	< 0.012	< 0.054	< 0.035
01-02-20	272	< 0.14	< 0.010	< 0.011	< 0.013	< 0.012	< 0.008	< 0.020	< 0.050

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.

Units: pCi/m<sup>3</sup>

Location		CA-A-010							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
01-10-19	250	0.19 ± 0.10	< 0.007	< 0.006	< 0.018	< 0.010	< 0.010	< 0.015	< 0.046
01-17-19	239	< 0.13	< 0.012	< 0.010	< 0.022	< 0.015	< 0.009	< 0.026	< 0.036
01-24-19	227	< 0.14	< 0.010	< 0.014	< 0.018	< 0.014	< 0.013	< 0.014	< 0.046
01-31-19	219	< 0.12	< 0.007	< 0.013	< 0.023	< 0.014	< 0.014	< 0.024	< 0.063
02-07-19	253	0.14 ± 0.08	< 0.009	< 0.010	< 0.015	< 0.010	< 0.005	< 0.020	< 0.060
02-14-19	257	< 0.11	< 0.006	< 0.007	< 0.016	< 0.008	< 0.007	< 0.013	< 0.042
02-21-19	251	< 0.12	< 0.011	< 0.013	< 0.016	< 0.012	< 0.009	< 0.010	< 0.059
02-28-19	255	0.23 ± 0.14	< 0.006	< 0.012	< 0.010	< 0.012	< 0.012	< 0.023	< 0.068
03-07-19	251	0.22 ± 0.13	< 0.007	< 0.011	< 0.013	< 0.013	< 0.008	< 0.014	< 0.037
03-14-19	278	0.30 ± 0.12	< 0.007	< 0.010	< 0.012	< 0.010	< 0.007	< 0.013	< 0.051
03-21-19	287	0.18 ± 0.09	< 0.008	< 0.012	< 0.021	< 0.009	< 0.006	< 0.014	< 0.054
03-28-19	285	0.28 ± 0.14	< 0.006	< 0.012	< 0.011	< 0.009	< 0.007	< 0.009	< 0.051
04-04-19	260	< 0.15	< 0.015	< 0.008	< 0.015	< 0.012	< 0.011	< 0.042	< 0.050
04-11-19	271	< 0.14	< 0.013	< 0.018	< 0.026	< 0.014	< 0.010	< 0.026	< 0.066
04-18-19	265	0.19 ± 0.10	< 0.009	< 0.005	< 0.016	< 0.011	< 0.012	< 0.017	< 0.049
04-25-19	270	0.20 ± 0.11	< 0.008	< 0.011	< 0.009	< 0.012	< 0.012	< 0.019	< 0.054
05-02-19	266	< 0.11	< 0.008	< 0.009	< 0.010	< 0.010	< 0.008	< 0.014	< 0.058
05-09-19	273	0.24 ± 0.11	< 0.005	< 0.014	< 0.018	< 0.010	< 0.007	< 0.010	< 0.043
05-16-19	269	< 0.11	< 0.008	< 0.013	< 0.018	< 0.005	< 0.007	< 0.010	< 0.033
05-23-19	272	0.27 ± 0.13	< 0.010	< 0.008	< 0.020	< 0.009	< 0.010	< 0.017	< 0.045
05-30-19	277	< 0.12	< 0.009	< 0.010	< 0.019	< 0.010	< 0.009	< 0.019	< 0.043
06-06-19	274	0.29 ± 0.13	< 0.008	< 0.009	< 0.026	< 0.011	< 0.007	< 0.021	< 0.033
06-13-19	275	0.25 ± 0.11	< 0.006	< 0.010	< 0.014	< 0.009	< 0.010	< 0.024	< 0.057
06-20-19	276	0.21 ± 0.10	< 0.007	< 0.009	< 0.012	< 0.010	< 0.009	< 0.013	< 0.057
06-27-19	272	< 0.14	< 0.008	< 0.008	< 0.019	< 0.011	< 0.006	< 0.014	< 0.054
07-03-19	256	0.30 ± 0.14	< 0.011	< 0.010	< 0.018	< 0.013	< 0.007	< 0.020	< 0.066
07-10-19	283	< 0.13	< 0.008	< 0.008	< 0.019	< 0.012	< 0.009	< 0.057	< 0.051
07-18-19	324	< 0.10	< 0.010	< 0.006	< 0.016	< 0.009	< 0.004	< 0.035	< 0.042
07-25-19	282	0.20 ± 0.11	< 0.010	< 0.004	< 0.020	< 0.011	< 0.011	< 0.028	< 0.049
08-01-19	288	0.23 ± 0.10	< 0.006	< 0.013	< 0.023	< 0.011	< 0.009	< 0.034	< 0.068
08-08-19	285	0.24 ± 0.12	< 0.008	< 0.005	< 0.016	< 0.009	< 0.009	< 0.021	< 0.047
08-14-19	245	0.20 ± 0.09	< 0.008	< 0.003	< 0.019	< 0.008	< 0.009	< 0.022	< 0.051
08-22-19	329	0.16 ± 0.08	< 0.006	< 0.004	< 0.016	< 0.009	< 0.008	< 0.025	< 0.040
08-29-19	285	0.21 ± 0.09	< 0.009	< 0.004	< 0.013	< 0.009	< 0.009	< 0.022	< 0.053
09-05-19	288	0.29 ± 0.11	< 0.007	< 0.006	< 0.013	< 0.010	< 0.007	< 0.015	< 0.050
09-12-19	290	0.21 ± 0.12	< 0.007	< 0.013	< 0.014	< 0.013	< 0.010	< 0.023	< 0.066
09-19-19	285	0.28 ± 0.16	< 0.007	< 0.015	< 0.015	< 0.013	< 0.010	< 0.013	< 0.039
09-26-19	290	< 0.11	< 0.009	< 0.012	< 0.023	< 0.012	< 0.012	< 0.014	< 0.059
10-03-19	289	< 0.15	< 0.009	< 0.010	< 0.015	< 0.011	< 0.009	< 0.015	< 0.028
10-10-19	291	< 0.10	< 0.007	< 0.009	< 0.011	< 0.009	< 0.006	< 0.015	< 0.051
10-17-19	295	0.27 ± 0.11	< 0.009	< 0.009	< 0.017	< 0.007	< 0.006	< 0.021	< 0.050

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.



**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.  
 Units: pCi/m<sup>3</sup>

Location		CA-A-010 (cont.)							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
10-24-19	288	< 0.13	< 0.013	< 0.010	< 0.019	< 0.014	< 0.007	< 0.038	< 0.052
10-30-19	252	< 0.12	< 0.011	< 0.012	< 0.022	< 0.013	< 0.008	< 0.017	< 0.034
11-06-19	291	< 0.09	< 0.008	< 0.009	< 0.011	< 0.008	< 0.003	< 0.014	< 0.042
11-12-19	349	0.15 ± 0.08	< 0.005	< 0.006	< 0.010	< 0.008	< 0.007	< 0.016	< 0.038
11-21-19	286	0.25 ± 0.12	< 0.006	< 0.008	< 0.016	< 0.009	< 0.007	< 0.023	< 0.039
11-27-19	248	0.23 ± 0.11	< 0.007	< 0.013	< 0.025	< 0.013	< 0.009	< 0.034	< 0.062
12-05-19	330	< 0.09	< 0.008	< 0.007	< 0.014	< 0.009	< 0.010	< 0.008	< 0.040
12-12-19	290	< 0.11	< 0.009	< 0.010	< 0.021	< 0.009	< 0.007	< 0.024	< 0.055
12-19-19	289	< 0.14	< 0.011	< 0.017	< 0.027	< 0.014	< 0.015	< 0.047	< 0.035
12-26-19	286	< 0.15	< 0.012	< 0.012	< 0.027	< 0.017	< 0.011	< 0.051	< 0.063
01-02-20	287	< 0.11	< 0.009	< 0.012	< 0.020	< 0.013	< 0.006	< 0.040	< 0.052

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.

Units: pCi/m<sup>3</sup>

Location		CA-A-011							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
01-10-19	277	< 0.13	< 0.013	< 0.007	< 0.021	< 0.012	< 0.010	< 0.038	< 0.057
01-17-19	257	< 0.11	< 0.008	< 0.006	< 0.017	< 0.009	< 0.007	< 0.012	< 0.045
01-24-19	253	< 0.09	< 0.006	< 0.006	< 0.014	< 0.011	< 0.006	< 0.014	< 0.058
01-31-19	242	< 0.11	< 0.010	< 0.009	< 0.015	< 0.012	< 0.006	< 0.022	< 0.059
02-07-19	267	0.17 ± 0.10	< 0.011	< 0.008	< 0.014	< 0.012	< 0.011	< 0.015	< 0.051
02-14-19	254	0.14 ± 0.08	< 0.008	< 0.013	< 0.016	< 0.010	< 0.010	< 0.015	< 0.044
02-21-19	244	< 0.13	< 0.006	< 0.011	< 0.022	< 0.011	< 0.006	< 0.010	< 0.060
02-28-19	257	< 0.13	< 0.007	< 0.010	< 0.011	< 0.010	< 0.010	< 0.009	< 0.039
03-07-19	241	0.27 ± 0.15	< 0.009	< 0.011	< 0.016	< 0.011	< 0.011	< 0.020	< 0.043
03-14-19	270	0.32 ± 0.18	< 0.013	< 0.010	< 0.018	< 0.013	< 0.008	< 0.015	< 0.055
03-21-19	274	< 0.10	< 0.010	< 0.009	< 0.013	< 0.010	< 0.010	< 0.011	< 0.061
03-28-19	283	0.21 ± 0.13	< 0.005	< 0.009	< 0.006	< 0.012	< 0.011	< 0.019	< 0.041
04-04-19	261	0.21 ± 0.11	< 0.005	< 0.009	< 0.017	< 0.011	< 0.009	< 0.035	< 0.043
04-11-19	292	< 0.19	< 0.011	< 0.013	< 0.024	< 0.013	< 0.011	< 0.024	< 0.049
04-18-19	270	0.17 ± 0.07	< 0.007	< 0.012	< 0.012	< 0.011	< 0.006	< 0.014	< 0.031
04-25-19	278	< 0.11	< 0.008	< 0.010	< 0.016	< 0.010	< 0.010	< 0.020	< 0.049
05-02-19	274	< 0.12	< 0.010	< 0.006	< 0.022	< 0.010	< 0.009	< 0.016	< 0.044
05-09-19	286	< 0.12	< 0.009	< 0.005	< 0.015	< 0.010	< 0.006	< 0.008	< 0.056
05-16-19	279	< 0.13	< 0.011	< 0.009	< 0.014	< 0.009	< 0.005	< 0.017	< 0.053
05-23-19	288	0.33 ± 0.19	< 0.015	< 0.015	< 0.029	< 0.014	< 0.012	< 0.029	< 0.074
05-30-19	298	< 0.15	< 0.009	< 0.007	< 0.020	< 0.010	< 0.009	< 0.026	< 0.038
06-06-19	293	0.26 ± 0.12	< 0.010	< 0.005	< 0.011	< 0.010	< 0.006	< 0.016	< 0.041
06-13-19	290	0.27 ± 0.14	< 0.012	< 0.005	< 0.017	< 0.010	< 0.005	< 0.012	< 0.048
06-20-19	293	< 0.16	< 0.007	< 0.014	< 0.017	< 0.013	< 0.009	< 0.019	< 0.040
06-27-19	292	< 0.13	< 0.007	< 0.004	< 0.024	< 0.010	< 0.007	< 0.029	< 0.054
07-03-19	232	0.29 ± 0.14	< 0.010	< 0.007	< 0.020	< 0.013	< 0.010	< 0.065	< 0.063
07-10-19	300	< 0.12	< 0.010	< 0.004	< 0.020	< 0.008	< 0.005	< 0.054	< 0.053
07-18-19	336	< 0.10	< 0.010	< 0.003	< 0.013	< 0.007	< 0.008	< 0.035	< 0.031
07-25-19	291	0.21 ± 0.10	< 0.006	< 0.005	< 0.020	< 0.009	< 0.007	< 0.040	< 0.059
08-01-19	292	0.26 ± 0.15	< 0.005	< 0.006	< 0.016	< 0.011	< 0.010	< 0.030	< 0.047
08-08-19	289	0.30 ± 0.11	< 0.009	< 0.004	< 0.013	< 0.009	< 0.009	< 0.022	< 0.059
08-14-19	250	< 0.14	< 0.012	< 0.009	< 0.019	< 0.015	< 0.011	< 0.030	< 0.062
08-22-19	337	0.17 ± 0.09	< 0.008	< 0.003	< 0.012	< 0.008	< 0.007	< 0.025	< 0.039
08-29-19	276	< 0.12	< 0.008	< 0.005	< 0.024	< 0.013	< 0.008	< 0.027	< 0.052
09-05-19	283	0.24 ± 0.13	< 0.005	< 0.007	< 0.019	< 0.011	< 0.007	< 0.021	< 0.035
09-12-19	288	< 0.12	< 0.006	< 0.009	< 0.019	< 0.009	< 0.006	< 0.022	< 0.064
09-19-19	284	0.26 ± 0.11	< 0.011	< 0.013	< 0.014	< 0.011	< 0.006	< 0.029	< 0.061
09-26-19	280	0.21 ± 0.12	< 0.010	< 0.009	< 0.017	< 0.011	< 0.010	< 0.016	< 0.035
10-03-19	281	0.30 ± 0.13	< 0.011	< 0.009	< 0.019	< 0.009	< 0.007	< 0.018	< 0.045
10-10-19	264	0.15 ± 0.08	< 0.007	< 0.006	< 0.007	< 0.008	< 0.007	< 0.013	< 0.031
10-17-19	252	0.20 ± 0.12	< 0.017	< 0.022	< 0.020	< 0.018	< 0.016	< 0.036	< 0.064

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 1. Air particulates and charcoal cartridges, analyses for gamma-emitting isotopes and I-131<sup>a</sup>.**

Collection: Continuous, weekly exchange.  
 Units: pCi/m<sup>3</sup>

Location		CA-A-011 (cont.)							
		<sup>7</sup> Be	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> Zr	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa	<sup>144</sup> Ce
Required LLDs		-	-	-	-	0.050	0.060	-	-
Date									
Collected	Vol.								
10-24-19	250	< 0.13	< 0.013	< 0.010	< 0.016	< 0.013	< 0.013	< 0.019	< 0.065
10-30-19	238	< 0.11	< 0.010	< 0.006	< 0.026	< 0.016	< 0.017	< 0.012	< 0.054
11-06-19	276	< 0.13	< 0.009	< 0.009	< 0.013	< 0.010	< 0.005	< 0.020	< 0.053
11-12-19	318	0.18 ± 0.10	< 0.006	< 0.009	< 0.013	< 0.008	< 0.006	< 0.014	< 0.042
11-21-19	283	< 0.13	< 0.007	< 0.005	< 0.021	< 0.010	< 0.008	< 0.008	< 0.037
11-27-19	232	< 0.22	< 0.016	< 0.015	< 0.036	< 0.023	< 0.021	< 0.038	< 0.078
12-05-19	309	< 0.12	< 0.013	< 0.011	< 0.017	< 0.011	< 0.009	< 0.029	< 0.046
12-12-19	265	< 0.15	< 0.009	< 0.010	< 0.026	< 0.010	< 0.009	< 0.061	< 0.054
12-19-19	257	< 0.12	< 0.007	< 0.011	< 0.014	< 0.013	< 0.007	< 0.051	< 0.071
12-26-19	274	< 0.12	< 0.007	< 0.010	< 0.018	< 0.011	< 0.007	< 0.037	< 0.038
01-02-20	267	< 0.17	< 0.018	< 0.012	< 0.020	< 0.013	< 0.007	< 0.021	< 0.063

<sup>a</sup> Iodine-131 concentrations are < 0.07 pCi/m<sup>3</sup> unless noted otherwise.

**Table 2. Milk, analyses for iodine-131 and gamma-emitting isotopes.**

Collection: Semimonthly during grazing season, monthly otherwise.

Units: pCi/L

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Location	CA-MLK-M9						
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Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Zn-65	Cs-134	Cs-137	Ba-La-140
Required LLDs		1	-	-	15	18	15

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Collection discontinued.<sup>a</sup>

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<sup>a</sup> Milk sampling discontinued in 2018.

**Table 3. Vegetation, analyses for iodine-131 and gamma-emitting isotopes.**

Collection: Monthly, during growing season

Units: pCi/kg wet

Lab Code	Collection		Concentration (pCi/kg wet)						
	Date	Sample Type	<sup>40</sup> K	<sup>54</sup> Mn	<sup>58</sup> Co	<sup>60</sup> Co	<sup>131</sup> I	<sup>134</sup> Cs	<sup>137</sup> Cs
<u>Location: CA-FPL-V9</u>									
CAVE- 1692	5/14/2019	Turnip greens	3634 ± 341	< 7.9	< 8.2	< 5.0	< 22.8	< 13.3	< 8.6
CAVE- 1693	5/14/2019	Lettuce	2840 ± 247	< 7.6	< 4.2	< 5.2	< 20.4	< 7.9	< 7.5
CAVE- 1694	5/14/2019	Mustard greens	3787 ± 305	< 8.9	< 9.5	< 6.3	< 16.0	< 9.7	< 6.3
CAVE- 2056	6/11/2019	Collard Greens	4061 ± 328	< 7.9	< 8.2	< 8.1	< 16.7	< 9.4	< 8.8
CAVE- 2057	6/11/2019	Cabbage	2416 ± 211	< 4.6	< 5.5	< 8.1	< 14.7	< 7.4	< 6.8
CAVE- 2058	6/11/2019	Turnip greens	4134 ± 302	< 6.5	< 8.5	< 7.1	< 10.0	< 10.5	< 8.9
CAVE- 2059	6/11/2019	Mustard Greens	4936 ± 341	< 8.3	< 9.3	< 7.8	< 14.8	< 9.2	< 9.2
CAVE- 2060	6/11/2019	Lettuce	5170 ± 389	< 12.2	< 13.3	< 7.8	< 19.6	< 12.8	< 11.0
CAVE- 2061	6/11/2019	Swiss Chard	4914 ± 340	< 10.8	< 9.7	< 11.5	< 17.2	< 10.2	< 11.3
CAVE- 2513	7/10/2019	Turnip greens	4061 ± 381	< 8.2	< 13.8	< 5.0	< 33.4	< 14.3	< 13.2
CAVE- 2514	7/10/2019	Cabbage	2425 ± 213	< 4.1	< 5.0	< 8.5	< 14.1	< 7.0	< 7.6
CAVE- 2515	7/10/2019	Collard Greens	3421 ± 317	< 6.4	< 11.8	< 8.2	< 23.7	< 12.8	< 7.7
CAVE- 2516	7/10/2019	Swiss Chard	6809 ± 538	< 16.1	< 10.1	< 15.8	< 26.3	< 16.4	< 14.2
CAVE- 2518	7/10/2019	Lettuce	5605 ± 470	< 7.6	< 17.9	< 15.0	< 29.0	< 17.6	< 10.3
CAVE- 3010	8/13/2019	Collard Greens	3939 ± 382	< 17.8	< 8.9	< 9.3	< 16.9	< 15.9	< 14.6
CAVE- 3399	9/10/2019	Collard Greens	3512 ± 303	< 7.6	< 8.2	< 7.9	< 15.8	< 8.8	< 9.1
CAVE- 3756	10/8/2019	Turnip greens	3943 ± 292	< 8.4	< 5.7	< 5.6	< 18.7	< 8.7	< 6.9
CAVE- 3757	10/8/2019	Swiss Chard	5005 ± 384	< 12.1	< 7.3	< 9.3	< 20.2	< 12.2	< 10.9
CAVE- 3758	10/8/2019	Collard greens	3549 ± 341	< 11.0	< 9.7	< 6.5	< 17.5	< 12.6	< 11.7
CAVE- 3759	10/8/2019	Lettuce	4323 ± 352	< 9.6	< 9.3	< 8.8	< 14.8	< 10.7	< 11.4
CAVE- 3760	10/8/2019	Mustard greens	4479 ± 310	< 10.0	< 5.3	< 9.6	< 12.8	< 9.7	< 9.0
<u>Location: CA-FPL-V11</u>									
CAVE- 1695	5/13/2019	Lettuce	2820 ± 219	< 5.8	< 6.5	< 6.3	< 16.2	< 7.6	< 6.9
CAVE- 1696	5/13/2019	Spinach	6090 ± 416	< 10.7	< 10.9	< 4.7	< 28.0	< 12.7	< 11.7
CAVE- 1697	5/13/2019	Cabbage	3155 ± 285	< 9.4	< 8.3	< 4.8	< 20.8	< 10.1	< 9.5
CAVE- 2062	6/10/2019	Cabbage	4006 ± 308	< 9.5	< 9.5	< 6.1	< 20.4	< 9.2	< 7.0
CAVE- 2063	6/10/2019	Lettuce	3237 ± 265	< 8.8	< 5.9	< 7.7	< 21.1	< 8.7	< 7.5
CAVE- 2519	7/9/2019	Cabbage	3909 ± 371	< 5.5	< 10.7	< 5.3	< 28.7	< 12.7	< 11.6
CAVE- 2520	7/9/2019	Swiss Chard	4909 ± 456	< 11.7	< 12.6	< 8.5	< 25.8	< 11.9	< 13.9
CAVE- 3011	8/12/2019	Sorghum	4533 ± 409	< 12.9	< 12.4	< 15.1	< 28.2	< 17.2	< 15.4
CAVE- 3012	8/12/2019	Swiss Chard	8884 ± 511	< 13.6	< 12.0	< 14.4	< 21.6	< 15.2	< 12.2
	9/10/2019	NS <sup>a</sup>							
	10/8/2019	NS <sup>a</sup>							

<sup>a</sup>"NS" = No sample; see Part I Table 5.5, Listing of Missed Samples.

**Table 3. Vegetation, analyses for iodine-131 and gamma-emitting isotopes.**

Collection: Monthly, during growing season

Units: pCi/kg wet

Lab Code	Collection Date	Sample Type	Concentration (pCi/kg wet)						
			<sup>40</sup> K	<sup>54</sup> Mn	<sup>58</sup> Co	<sup>60</sup> Co	<sup>131</sup> I	<sup>134</sup> Cs	<sup>137</sup> Cs
<u>Location: CA-FPL-V12</u>									
CAVE- 1698	5/13/2019	Cabbage	2999 ± 283	< 8.3	< 8.6	< 5.8	< 14.6	< 8.7	< 10.3
CAVE- 1699	5/13/2019	Swiss Chard	5520 ± 387	< 12.3	< 7.4	< 11.3	< 19.7	< 11.5	< 12.4
CAVE- 1700	5/13/2019	Lettuce	4663 ± 393	< 12.9	< 15.0	< 7.1	< 14.7	< 14.4	< 11.8
CAVE- 2064	6/10/2019	Cabbage	3402 ± 279	< 6.0	< 9.7	< 6.4	< 20.5	< 11.3	< 10.1
CAVE- 2065	6/10/2019	Swiss Chard	5461 ± 335	< 5.8	< 4.2	< 6.4	< 17.4	< 8.9	< 8.3
CAVE- 2066	6/10/2019	Spinach	4292 ± 385	< 12.8	< 18.0	< 17.1	< 32.6	< 15.4	< 15.1
CAVE- 2067	6/10/2019	Poke Weed	6970 ± 510	< 14.7	< 12.9	< 16.5	< 22.1	< 16.3	< 14.6
CAVE- 2521	7/9/2019	Swiss Chard	9015 ± 481	< 13.6	< 9.2	< 9.4	< 15.4	< 11.6	< 10.3
CAVE- 2522	7/9/2019	Cabbage	4316 ± 381	< 11.5	< 9.7	< 13.0	< 29.2	< 12.1	< 11.9
CAVE- 2523	7/9/2019	Mustard Greens	3628 ± 302	< 10.7	< 11.8	< 10.7	< 20.6	< 10.1	< 9.1
CAVE- 3013	8/12/2019	Swiss Chard	6376 ± 449	< 10.0	< 13.7	< 11.1	< 36.0	< 16.1	< 12.3
CAVE- 3014	8/12/2019	Cabbage	2933 ± 295	< 6.3	< 3.2	< 5.5	< 19.7	< 11.2	< 12.9
CAVE- 3400	9/10/2019	Swiss Chard	5092 ± 414	< 15.4	< 14.5	< 10.1	< 20.9	< 15.0	< 12.5
CAVE- 3402	9/10/2019	Spinach, Mustard	4251 ± 378	< 9.5	< 3.8	< 4.2	< 16.4	< 14.0	< 11.7
CAVE- 3761	10/7/2019	Cabbage	3431 ± 303	< 5.5	< 5.8	< 5.7	< 21.9	< 10.4	< 9.6
CAVE- 3762	10/7/2019	Swiss Chard	4771 ± 331	< 8.5	< 4.9	< 4.5	< 23.0	< 10.6	< 10.7
CAVE- 3763	10/7/2019	Lettuce	3876 ± 347	< 13.2	< 7.6	< 10.7	< 31.4	< 13.0	< 13.9
CAVE- 3764	10/7/2019	Mustard greens	5265 ± 427	< 11.3	< 8.2	< 9.3	< 17.2	< 11.4	< 16.4
<u>Location: CA-FPL-V16</u>									
CAVE- 1701	5/13/2019	Lettuce	4245 ± 364	< 11.1	< 14.7	< 9.7	< 27.9	< 13.2	< 9.6
CAVE- 1702	5/13/2019	Turnip greens	5638 ± 441	< 10.6	< 13.7	< 5.9	< 23.1	< 12.8	< 12.6
CAVE- 1703	5/13/2019	Collard Greens	4859 ± 412	< 15.0	< 5.9	< 5.4	< 24.4	< 13.7	< 6.2
CAVE- 2068	6/11/2019	Collard Greens	6768 ± 558	< 12.3	< 10.5	< 12.2	< 14.0	< 15.2	< 9.2
CAVE- 2069	6/11/2019	Kale	6404 ± 407	< 10.2	< 4.8	< 11.1	< 14.2	< 11.4	< 8.3
CAVE- 2070	6/11/2019	Turnip greens	6454 ± 511	< 8.8	< 7.5	< 5.6	< 21.9	< 14.1	< 8.6
CAVE- 2524	7/9/2019	Collard Greens	10291 ± 654	< 16.8	< 16.4	< 12.2	< 41.7	< 19.4	< 14.1
CAVE- 2525	7/9/2019	Kale	6093 ± 588	< 18.2	< 17.8	< 22.2	< 28.7	< 18.4	< 17.5
CAVE- 2526	7/9/2019	Lettuce	4167 ± 421	< 15.1	< 12.3	< 13.0	< 34.9	< 16.0	< 14.8
CAVE- 3015	8/12/2019	Kale	5891 ± 493	< 14.5	< 13.2	< 8.3	< 25.8	< 14.9	< 12.8
CAVE- 3016	8/12/2019	Basil	6240 ± 636	< 28.1	< 22.9	< 20.2	< 35.1	< 26.5	< 25.1
CAVE- 3403	9/9/2019	Sweet Basil	6573 ± 558	< 17.3	< 15.5	< 8.9	< 26.6	< 17.7	< 16.9
CAVE- 3404	9/9/2019	Kale	4888 ± 486	< 14.3	< 12.7	< 11.1	< 25.9	< 17.0	< 19.5
CAVE- 3765	10/7/2019	Lettuce	8613 ± 1006	< 33.5	< 18.4	< 33.0	< 43.9	< 33.2	< 36.8
CAVE- 3766	10/7/2019	Turnip greens	10302 ± 883	< 17.6	< 15.5	< 28.3	< 44.5	< 31.4	< 30.1
CAVE- 3767	10/7/2019	Basil	8077 ± 916	< 27.4	< 23.0	< 24.1	< 44.2	< 32.0	< 25.3

<sup>b</sup> Small sample quantity.

**Table 4. Non-food Crops, analyses for tritium and gamma-emitting isotopes.**

Collection: Annually, at harvest

Units: pCi/kg wet

Lab Code	Sample Type	Collection Date	Concentration (pCi/kg wet)						
			<sup>3</sup> H	<sup>40</sup> K	<sup>54</sup> Mn	<sup>58</sup> Co	<sup>60</sup> Co	<sup>134</sup> Cs	<sup>137</sup> Cs
			<u>Location: CA-FC-1</u>						
		9/23/2019							NS <sup>a</sup>
		9/23/2019							NS <sup>a</sup>
		9/23/2019							NS <sup>a</sup>
			<u>Location: CA-FC-2</u>						
		9/23/2019							NS <sup>a</sup>
		9/23/2019							NS <sup>a</sup>
		9/23/2019							NS <sup>a</sup>
			<u>Location: CA-FC-3</u>						
		9/23/2019							NS <sup>a</sup>
		9/23/2019							NS <sup>a</sup>
		9/23/2019							NS <sup>a</sup>
			<u>Location: CA-FC-4(C)</u>						
		9/23/2019							NS <sup>a</sup>

<sup>a</sup>"NS" = No sample; see Part I Table 5.5, Listing of Missed Samples.

**Table 5. Soil, analyses for gamma-emitting isotopes.**  
Collection: Annually

Lab Code	Collection Date	Concentration (pCi/kg dry)								
		<sup>40</sup> K	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: SOL-F-002</u>										
CASO- 4647	11/20/2019	11662 ± 847	< 30.6	< 93.6	< 46.9	< 26.1	< 90.0	< 35.4	640 ± 64	< 185.8
CASO- 4648	11/20/2019	11807 ± 828	< 33.9	< 53.8	< 26.8	< 29.8	< 60.7	< 29.3	694 ± 52	< 205.7
<u>Location: SOL-F-006</u>										
CASO- 4649	11/20/2019	11798 ± 768	< 34.6	< 98.9	< 40.4	< 26.7	< 87.5	< 33.1	551 ± 57	< 213.7
CASO- 4650	11/20/2019	10866 ± 834	< 37.0	< 92.6	< 43.3	< 23.5	< 90.9	< 27.7	568 ± 47	< 227.5
<u>Location: SOL-PR-003</u>										
CASO- 4651	11/20/2019	10819 ± 1148	< 20.9	< 59.1	< 22.1	< 27.2	< 62.0	< 23.5	183 ± 36	< 95.2
CASO- 4652	11/20/2019	10681 ± 725	< 31.5	< 86.2	< 20.8	< 24.6	< 84.5	< 32.6	272 ± 34	< 107.1
<u>Location: SOL-PR-007</u>										
CASO- 4653	11/22/2019	11026 ± 776	< 27.9	< 79.4	< 47.6	< 24.1	< 56.4	< 23.3	218 ± 46	< 101.4
CASO- 4654	11/22/2019	9242 ± 684	< 26.4	< 57.3	< 30.9	< 21.3	< 54.9	< 24.1	182 ± 40	< 143.5
<u>Location: SOL-M-009</u>										
CASO- 4658	11/22/2019	14413 ± 744	< 30.5	< 76.3	< 27.4	< 12.2	< 49.7	< 17.3	128 ± 29	< 187.8
CASO- 4659	11/22/2019	15152 ± 735	< 28.9	< 59.2	< 30.7	< 27.7	< 54.4	< 19.8	121 ± 25	< 205.0
<u>Location: SOL-W-001</u>										
CASO- 4655	11/22/2019	13874 ± 650	< 26.3	< 60.5	< 30.8	< 18.8	< 51.6	< 21.8	< 27	< 117.3
<u>Location: SOL-W-002</u>										
CASO- 4656	11/22/2019	14557 ± 760	< 24.1	< 64.2	< 34.6	< 11.1	< 62.8	< 22.8	83 ± 24	< 70.1
<u>Location: SOL-W-005</u>										
CASO- 4657	11/22/2019	8279 ± 555	< 24.8	< 62.3	< 18.7	< 11.3	< 44.3	< 13.0	< 24	< 71.4



**Table 6. Surface water, analyses for tritium and gamma-emitting isotopes.**

Collection: Monthly

Location: CA-SWA-S01

Units: pCi/L

Lab Code	Required	CASW- 307	CASW- 565	CASW- 935	CASW- 1514
Date Collected	LLD	01-28-19	02-26-19	03-25-19	04-30-19
H-3	3000	< 150	< 157	< 155	< 150
Mn-54	15	< 1.4	< 2.7	< 2.1	< 2.1
Fe-59	30	< 4.8	< 4.4	< 3.7	< 7.1
Co-58	15	< 2.3	< 3.6	< 2.3	< 5.0
Co-60	15	< 1.8	< 3.2	< 1.6	< 1.5
Zn-65	30	< 4.8	< 5.9	< 2.8	< 4.1
Zr-Nb-95	15	< 3.6	< 1.6	< 4.2	< 3.2
I-131	1000	< 4.0	< 5.5	< 6.5	< 15.5
Cs-134	15	< 3.4	< 2.6	< 2.5	< 4.5
Cs-137	18	< 3.8	< 3.7	< 3.9	< 3.1
Ba-La-140	15	< 3.0	< 3.2	< 3.8	< 4.9
Lab Code	Required	CASW- 1915	CASW- 2275	CASW- 2854	CASW- 3249
Date Collected	LLD	05-28-19	06-24-19	07-30-19	08-27-19
H-3	3000	< 152	< 149	< 152	< 155
Mn-54	15	< 2.4	< 2.7	< 3.5	< 3.1
Fe-59	30	< 2.9	< 2.7	< 4.7	< 5.3
Co-58	15	< 2.1	< 2.0	< 2.9	< 2.9
Co-60	15	< 1.2	< 1.3	< 2.4	< 2.1
Zn-65	30	< 3.2	< 2.9	< 3.7	< 4.2
Zr-Nb-95	15	< 3.6	< 4.7	< 2.5	< 2.9
I-131	1000	< 24.5	< 7.5	< 7.5	< 6.5
Cs-134	15	< 2.4	< 4.3	< 3.8	< 3.2
Cs-137	18	< 2.7	< 1.8	< 4.0	< 3.7
Ba-La-140	15	< 9.7	< 3.4	< 3.0	< 2.2
Lab Code	Required	CASW- 3573	CASW- 4187	CASW- 4518	CASW- 4908
Date Collected	LLD	09-24-19	10-29-19	11-26-19	12-31-19
H-3	3000	< 151	< 152	< 156	< 158
Mn-54	15	< 2.5	< 3.0	< 3.9	< 1.7
Fe-59	30	< 4.3	< 6.9	< 6.1	< 4.8
Co-58	15	< 1.9	< 2.9	< 2.7	< 2.2
Co-60	15	< 2.4	< 1.9	< 2.9	< 1.9
Zn-65	30	< 1.6	< 4.0	< 6.2	< 3.4
Zr-Nb-95	15	< 3.3	< 2.1	< 5.2	< 2.0
I-131	1000	< 12.7	< 9.1	< 21.0	< 13.3
Cs-134	15	< 2.9	< 3.0	< 5.0	< 2.5
Cs-137	18	< 3.0	< 2.5	< 3.6	< 2.0
Ba-La-140	15	< 5.5	< 3.8	< 12.7	< 4.8

**Table 6. Surface water, analyses for tritium and gamma-emitting isotopes.**

Collection: Monthly  
 Location: CA-SWA-S02  
 Units: pCi/L

Lab Code	Required	CASW- 308	CASW- 566	CASW- 936	CASW- 1515
Date Collected	LLD	01-28-19	02-26-19	03-25-19	04-30-19
H-3	3000	< 150	261 ± 91	252 ± 87	204 ± 83
Mn-54	15	< 2.5	< 3.9	< 2.2	< 2.8
Fe-59	30	< 4.9	< 4.5	< 5.1	< 6.6
Co-58	15	< 2.8	< 2.4	< 2.3	< 3.4
Co-60	15	< 2.3	< 1.7	< 2.8	< 1.3
Zn-65	30	< 5.5	< 2.4	< 4.3	< 5.2
Zr-Nb-95	15	< 3.4	< 3.1	< 3.3	< 3.0
I-131	1000	< 8.2	< 6.5	< 7.9	< 16.8
Cs-134	15	< 4.5	< 2.9	< 3.3	< 3.5
Cs-137	18	< 2.7	< 3.0	< 3.1	< 1.7
Ba-La-140	15	< 3.6	< 3.3	< 4.1	< 4.6

Lab Code	Required	CASW- 1916	CASW- 2276	CASW- 2855	CASW- 3250
Date Collected	LLD	05-28-19	06-24-19	07-30-19	08-27-19
H-3	3000	< 152	< 149	< 152	< 155
Mn-54	15	< 2.6	< 2.7	< 1.9	< 3.1
Fe-59	30	< 7.1	< 3.3	< 5.1	< 6.1
Co-58	15	< 2.6	< 1.3	< 1.6	< 2.9
Co-60	15	< 2.1	< 2.0	< 2.5	< 2.8
Zn-65	30	< 4.5	< 2.9	< 4.8	< 2.4
Zr-Nb-95	15	< 5.1	< 3.8	< 3.5	< 3.2
I-131	1000	< 33.6	< 6.1	< 10.3	< 11.8
Cs-134	15	< 3.3	< 2.9	< 2.7	< 3.8
Cs-137	18	< 3.2	< 2.8	< 3.3	< 3.2
Ba-La-140	15	< 8.9	< 4.4	< 2.5	< 7.4

Lab Code	Required	CASW- 3574	CASW- 4188	CASW- 4519	CASW- 4909
Date Collected	LLD	09-24-19	10-29-19	11-26-19	12-31-19
H-3	3000	< 151	< 152	< 156	< 158
Mn-54	15	< 2.0	< 3.5	< 3.4	< 2.5
Fe-59	30	< 5.5	< 5.1	< 7.8	< 6.9
Co-58	15	< 2.6	< 2.2	< 2.1	< 2.6
Co-60	15	< 1.9	< 3.8	< 1.8	< 2.6
Zn-65	30	< 3.3	< 5.9	< 4.8	< 4.8
Zr-Nb-95	15	< 4.0	< 4.2	< 2.8	< 4.6
I-131	1000	< 9.3	< 9.4	< 24.9	< 21.8
Cs-134	15	< 3.2	< 4.3	< 4.6	< 2.9
Cs-137	18	< 2.9	< 3.3	< 4.2	< 3.2
Ba-La-140	15	< 7.2	< 6.1	< 11.5	< 5.8

**7. Surface Water (Ponds), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-SWA-POND 01</u>											
CASW- 626	03/04/19	< 155	< 3.0	< 4.2	< 2.1	< 2.3	< 1.8	< 3.6	< 3.6	< 3.7	< 2.5
CASW- 3364	09/06/19	< 154	< 2.7	< 5.2	< 2.8	< 2.8	< 4.5	< 3.9	< 4.0	< 4.2	< 5.4
<u>Location: CA-SWA-POND 02</u>											
CASW- 627	03/04/19	< 155	< 1.4	< 3.5	< 2.3	< 1.2	< 5.0	< 3.1	< 3.1	< 4.0	< 1.7
CASW- 3365	09/06/19	< 154	< 3.2	< 7.2	< 1.6	< 2.1	< 4.0	< 3.5	< 4.0	< 3.4	< 4.3
<u>Location: CA-SWA-SLUDGE LAGOON #4 *</u>											
CASW- 635	03/04/19	< 155	< 3.8	< 7.0	< 3.6	< 2.4	< 4.2	< 5.1	< 4.7	< 5.0	< 1.8
* Location discontinued; replaced by Lagoon #6											
<u>Location: CA-SWA-SLUDGE LAGOON #6</u>											
CASW- 3372	09/03/19	< 155	< 2.0	< 8.1	< 3.9	< 2.5	< 3.5	< 4.5	< 3.8	< 3.3	< 3.8

**7. Surface Water (Ponds), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-SWA-OUTFALL 010</u>											
CASW- 629	03/04/19	< 155	< 2.3	< 3.7	< 2.9	< 2.5	< 5.3	< 2.6	< 3.0	< 3.0	< 2.9
CASW- 3366	09/03/19	< 155	< 2.2	< 6.5	< 1.4	< 2.4	< 5.7	< 6.5	< 4.2	< 2.2	< 5.0
<u>Location: CA-SWA-OUTFALL 011</u>											
CASW- 630	03/04/19	< 155	< 2.7	< 3.9	< 1.7	< 1.0	< 4.2	< 3.2	< 3.1	< 4.1	< 4.5
CASW- 3367	09/03/19	< 155	< 2.7	< 8.5	< 1.3	< 1.5	< 3.5	< 2.5	< 3.7	< 3.0	< 4.7
<u>Location: CA-SWA-OUTFALL 012</u>											
CASW- 631	03/04/19	< 155	< 3.8	< 7.6	< 4.0	< 4.5	< 7.8	< 4.2	< 5.1	< 5.4	< 2.9
CASW- 3368	09/06/19	< 154	< 2.5	< 6.0	< 1.1	< 2.4	< 5.5	< 2.9	< 3.1	< 2.4	< 2.3
<u>Location: CA-SWA-OUTFALL 013</u>											
CASW- 632	03/04/19	< 155	< 2.3	< 2.7	< 1.3	< 2.1	< 3.4	< 2.8	< 3.1	< 3.1	< 1.7
CASW- 3369	09/06/19	< 154	< 2.7	< 4.8	< 2.8	< 1.5	< 3.2	< 3.2	< 3.8	< 4.0	< 6.1
<u>Location: CA-SWA-OUTFALL 014</u>											
CASW- 633	03/04/19	< 155	< 2.7	< 4.1	< 2.4	< 2.1	< 5.1	< 2.4	< 3.0	< 3.0	< 2.0
CASW- 3370	09/03/19	< 155	< 2.7	< 9.0	< 1.9	< 3.8	< 3.7	< 3.8	< 4.2	< 3.4	< 7.7
<u>Location: CA-SWA-OUTFALL 015</u>											
CASW- 634	03/04/19	< 155	< 2.3	< 2.1	< 2.6	< 1.0	< 4.8	< 3.0	< 2.6	< 3.0	< 3.3
CASW- 3371	09/03/19	< 155	< 2.3	< 4.6	< 2.0	< 2.2	< 5.6	< 3.7	< 3.7	< 2.1	< 4.7

**Table 8. Drinking Water Wells, analysis for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>CA-DWA-003 (Ward)</u>											
CADW- 352	1/28/2019	< 150	< 2.0	< 5.4	< 1.6	< 2.3	< 3.0	< 3.3	< 3.2	< 2.8	< 2.7
CADW- 1616	5/2/2019	< 154	< 3.5	< 4.4	< 1.2	< 2.4	< 6.2	< 6.2	< 3.2	< 3.3	< 11.0
CADW- 2884	7/31/2019	< 152	< 2.8	< 4.2	< 2.3	< 2.0	< 5.1	< 3.6	< 4.2	< 4.2	< 4.3
CADW- 4217	10/29/2019	< 152	< 2.5	< 7.6	< 3.0	< 2.0	< 5.5	< 3.1	< 3.2	< 3.2	< 5.2
<u>CA-DWA-004 (Miller)</u>											
CADW- 353	1/28/2019	< 150	< 2.6	< 4.2	< 2.0	< 2.5	< 4.7	< 3.3	< 3.7	< 3.8	< 3.6
CADW- 1618	5/3/2019	< 154	< 2.2	< 4.0	< 3.2	< 2.9	< 4.9	< 3.0	< 2.9	< 3.0	< 5.3
CADW- 2885	7/31/2019	< 152	< 3.1	< 4.8	< 2.4	< 1.6	< 2.5	< 2.6	< 3.2	< 2.2	< 4.3
CADW- 4218	10/29/2019	< 152	< 2.7	< 5.4	< 1.7	< 1.4	< 4.5	< 2.9	< 3.0	< 2.9	< 4.3
<u>CA-DWA-005 (Brucker Bros.)</u>											
CADW- 354	2/4/2019	< 150	< 2.6	< 2.5	< 2.9	< 1.9	< 5.9	< 3.2	< 3.4	< 3.2	< 2.1
CADW- 1619	5/4/2019	< 154	< 2.8	< 8.1	< 3.1	< 2.1	< 4.9	< 3.8	< 3.2	< 2.4	< 8.7
CADW- 2931	8/4/2019	< 152	< 2.9	< 7.7	< 3.6	< 3.7	< 5.8	< 3.4	< 4.1	< 3.3	< 6.8
CADW- 4219	10/28/2019	< 152	< 2.5	< 3.6	< 2.6	< 2.1	< 5.9	< 2.1	< 3.8	< 2.7	< 2.9
<u>CA-DWA-006 (Lindeman)</u>											
CADW- 355	1/28/2019	< 150	< 2.8	< 4.4	< 1.4	< 2.3	< 5.7	< 2.1	< 3.1	< 3.6	< 2.7
CADW- 1620	5/2/2019	< 154	< 3.2	< 7.8	< 2.2	< 1.3	< 4.6	< 3.7	< 4.2	< 3.2	< 7.5
CADW- 2887	7/31/2019	< 152	< 3.4	< 7.6	< 2.9	< 1.7	< 2.4	< 3.2	< 3.3	< 3.3	< 3.6
CADW- 4220	10/29/2019	< 152	< 1.8	< 5.7	< 2.0	< 2.3	< 3.7	< 3.0	< 4.3	< 2.2	< 4.3
<u>CA-DWA-007 (Kriete)</u>											
CADW- 356	1/28/2019	< 150	< 2.8	< 6.3	< 3.4	< 2.2	< 2.6	< 5.3	< 4.3	< 2.7	< 4.6
CADW- 1621	5/2/2019	< 154	< 2.8	< 4.8	< 3.0	< 1.9	< 6.3	< 4.7	< 3.1	< 2.5	< 5.6
CADW- 2888	7/31/2019	< 152	< 3.3	< 4.9	< 2.2	< 1.9	< 2.0	< 4.3	< 3.7	< 3.6	< 4.8
CADW- 4221	10/29/2019	< 152	< 2.9	< 6.0	< 3.5	< 1.5	< 3.8	< 4.7	< 4.7	< 2.8	< 4.6

**Table 8. Drinking Water Wells, analysis for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>CA-DWA-008 (Brandt)</u>											
CADW- 357	1/28/2019	< 150	< 3.5	< 2.4	< 3.3	< 3.8	< 4.0	< 3.5	< 3.6	< 2.9	< 3.7
CADW- 1622	5/7/2019	< 154	< 3.2	< 2.8	< 1.6	< 1.8	< 3.2	< 4.4	< 3.2	< 4.0	< 5.0
CADW- 2889	7/31/2019	< 152	< 3.7	< 4.7	< 3.3	< 2.8	< 5.6	< 3.1	< 4.0	< 2.2	< 4.9
CADW- 4222	10/31/2019	< 152	< 2.5	< 5.6	< 3.3	< 2.8	< 4.8	< 4.9	< 4.5	< 5.0	< 7.2
<u>CA-DWA-009 (Clardy)</u>											
CADW- 358	2/1/2019	< 150	< 3.0	< 3.2	< 3.6	< 1.9	< 2.9	< 2.3	< 2.8	< 2.9	< 6.5
CADW- 1623	5/3/2019	< 154	< 2.1	< 4.9	< 4.2	< 3.1	< 3.3	< 5.4	< 3.8	< 2.1	< 5.1
CADW- 2890	7/31/2019	< 152	< 2.4	< 4.5	< 2.7	< 3.4	< 3.7	< 2.6	< 3.3	< 3.0	< 3.0
CADW- 4223	10/31/2019	< 152	< 2.0	< 7.9	< 2.9	< 2.4	< 4.7	< 3.8	< 3.2	< 3.5	< 9.7
<u>CA-DWA-010 (Dillon, Susan)</u>											
CADW- 359	2/1/2019	< 150	< 1.7	< 6.0	< 2.7	< 2.0	< 5.0	< 4.0	< 3.5	< 3.3	< 4.6
CADW- 1624	5/3/2019	< 154	< 2.7	< 8.5	< 2.5	< 1.6	< 5.1	< 4.7	< 3.4	< 3.5	< 10.6
CADW- 2891	7/31/2019	< 152	< 2.0	< 4.1	< 3.2	< 1.6	< 6.0	< 2.0	< 3.3	< 2.5	< 4.8
CADW- 4224	10/31/2019	< 152	< 2.1	< 2.1	< 2.9	< 1.6	< 4.7	< 4.7	< 3.5	< 3.5	< 9.9
<u>CA-DWA-012 (Dillon, Joe)</u>											
CADW- 360	2/1/2019	< 150	< 3.4	< 8.6	< 4.9	< 4.8	< 12.3	< 9.8	< 5.2	< 5.6	< 7.8
CADW- 1625	5/7/2019	< 154	< 2.5	< 6.5	< 2.6	< 2.5	< 2.5	< 3.6	< 2.9	< 3.5	< 5.3
CADW- 2892	7/31/2019	< 152	< 3.1	< 5.7	< 2.6	< 2.7	< 5.0	< 3.7	< 3.5	< 3.9	< 7.5
CADW- 4226	10/31/2019	< 152	< 3.0	< 6.2	< 2.3	< 2.9	< 3.8	< 6.5	< 4.7	< 3.3	< 8.9
<u>CA-DWA-21</u>											
CADW- 362	2/1/2019	< 150	< 2.9	< 5.7	< 2.9	< 1.8	< 2.6	< 3.2	< 4.4	< 4.0	< 4.5
CADW- 1626	5/2/2019	< 154	< 2.6	< 4.7	< 3.8	< 1.3	< 6.7	< 4.7	< 4.0	< 2.7	< 5.3
CADW- 2893	7/31/2019	< 152	< 2.4	< 6.1	< 2.7	< 1.7	< 3.2	< 2.3	< 3.2	< 3.6	< 3.1
CADW- 4227	10/29/2019	< 152	< 1.8	< 4.6	< 2.8	< 1.7	< 3.0	< 3.5	< 2.9	< 2.9	< 6.6

**Table 8. Drinking Water Wells, analysis for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>CA-DWA-022 (Plummer)</u>											
CADW- 363	2/1/2019	< 150	< 2.4	< 5.9	< 2.8	< 2.5	< 5.7	< 3.2	< 3.5	< 3.0	< 2.9
CADW- 1627	5/2/2019	< 154	< 2.8	< 5.7	< 3.2	< 2.2	< 5.6	< 4.4	< 3.0	< 3.0	< 8.7
CADW- 2894	7/31/2019	< 152	< 2.1	< 2.9	< 3.1	< 2.7	< 4.2	< 2.4	< 3.4	< 2.0	< 5.5
CADW- 4228	10/29/2019	< 152	< 3.8	< 4.1	< 2.0	< 2.9	< 5.4	< 3.0	< 3.5	< 3.1	< 5.4
<u>CA-DWA-PW1 (Plant Cafeteria)</u>											
CADW- 366	2/1/2019	< 150	< 1.9	< 4.5	< 2.0	< 2.5	< 2.6	< 4.5	< 3.8	< 3.5	< 5.3
CADW- 1631	5/3/2019	< 154	< 3.2	< 8.2	< 3.5	< 2.4	< 2.6	< 4.9	< 2.8	< 4.4	< 5.4
CADW- 2898	7/31/2019	< 152	< 2.5	< 3.9	< 2.5	< 1.9	< 3.2	< 2.0	< 3.1	< 2.9	< 4.6
CADW- 4232	10/31/2019	< 152	< 3.9	< 6.6	< 4.5	< 1.5	< 4.8	< 4.7	< 3.7	< 1.9	< 8.8
<u>CA-DWA-V16</u>											
CADW- 361	2/1/2019	< 150	< 3.1	< 6.0	< 2.9	< 2.6	< 7.9	< 3.7	< 4.6	< 3.4	< 6.1
CADW- 1630	5/3/2019	< 154	< 3.1	< 6.5	< 2.5	< 2.1	< 5.5	< 4.5	< 3.8	< 3.4	< 6.1
CADW- 2897	7/31/2019	< 152	< 2.7	< 4.7	< 1.5	< 3.1	< 5.7	< 4.2	< 3.4	< 1.5	< 7.2
CADW- 4231	10/29/2019	< 152	< 2.2	< 6.5	< 4.5	< 2.6	< 7.4	< 4.7	< 4.4	< 4.1	< 11.2
<u>CA-DWA-D23</u>											
CADW- 364	2/1/2019	< 150	< 1.6	< 7.2	< 3.0	< 2.5	< 4.6	< 2.5	< 3.1	< 3.1	< 3.2
CADW- 1628	5/2/2019	< 154	< 3.2	< 4.7	< 1.7	< 3.3	< 1.9	< 6.2	< 4.3	< 4.5	< 11.0
CADW- 2895	7/31/2019	< 152	< 3.4	< 5.4	< 2.0	< 1.4	< 4.2	< 2.7	< 3.3	< 3.0	< 5.7
CADW- 4229	10/29/2019	< 152	< 2.3	< 4.1	< 1.9	< 1.4	< 4.1	< 2.8	< 3.7	< 3.7	< 7.7
<u>CA-DWA-024</u>											
CADW- 365	2/1/2019	< 150	< 4.5	< 9.3	< 6.1	< 3.8	< 9.1	< 7.2	< 5.4	< 5.6	< 4.3
CADW- 1629	5/3/2019	< 154	< 2.7	< 3.9	< 2.4	< 1.1	< 4.3	< 4.5	< 3.7	< 2.7	< 7.1
CADW- 2896	7/31/2019	< 152	< 3.3	< 5.7	< 2.1	< 2.2	< 3.1	< 3.3	< 3.9	< 4.1	< 7.9
CADW- 4230	10/31/2019	< 152	< 2.5	< 8.4	< 2.6	< 3.0	< 5.5	< 4.6	< 3.5	< 3.8	< 10.8

**Table 9. Wells and Ponds (non-potable), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-WWA-936</u>											
CAWW- 129	1/9/2019	270 ± 93	< 2.6	< 6.3	< 2.1	< 2.2	< 3.2	< 2.8	< 2.4	< 3.1	< 3.5
CAWW- 402	2/12/2019	462 ± 99	< 3.5	< 5.0	< 2.8	< 3.4	< 6.9	< 2.7	< 3.8	< 2.8	< 2.1
CAWW- 643	3/8/2019	356 ± 90	< 6.3	< 5.0	< 3.4	< 5.7	< 15.2	< 3.8	< 6.1	< 6.0	< 1.9
CAWW- 1042	4/5/2019	242 ± 106	NR <sup>a</sup>								
CAWW- 1251	4/9/2019	387 ± 95	< 2.5	< 5.9	< 2.2	< 2.0	< 6.2	< 3.0	< 3.1	< 3.3	< 4.1
CAWW- 1610	5/9/2019	273 ± 87	< 2.6	< 5.0	< 4.9	< 1.3	< 4.8	< 5.8	< 4.5	< 4.8	< 6.7
CAWW- 2128	6/5/2019	253 ± 84	< 2.3	< 7.9	< 4.4	< 2.2	< 3.9	< 4.4	< 4.8	< 3.6	< 7.7
CAWW- 2599	7/11/2019	< 159	< 2.6	< 4.5	< 3.5	< 2.7	< 6.7	< 5.8	< 3.4	< 2.5	< 11.7
CAWW- 2981	8/8/2019	197 ± 86	< 3.1	< 5.1	< 2.3	< 3.4	< 4.7	< 3.5	< 4.1	< 2.0	< 5.8
CAWW- 3435	9/11/2019	251 ± 87	< 3.1	< 6.4	< 3.0	< 3.9	< 6.4	< 4.2	< 5.5	< 5.1	< 9.2
CAWW- 3826	10/9/2019	310 ± 87	< 4.8	< 9.2	< 5.5	< 3.3	< 11.2	< 6.2	< 6.2	< 4.5	< 5.9
CAWW- 4266	11/6/2019	< 154	< 2.2	< 5.0	< 4.5	< 1.9	< 5.2	< 4.8	< 3.5	< 3.5	< 6.8
CAWW- 4727	12/12/2019	280 ± 90	< 6.0	< 5.9	< 4.5	< 3.7	< 9.6	< 7.3	< 6.2	< 6.4	< 13.0
<u>Location: CA-WWA-937B</u>											
CAWW- 130	1/9/2019	< 177	< 2.9	< 8.9	< 2.6	< 2.5	< 2.6	< 2.2	< 3.6	< 3.8	< 3.4
CAWW- 403	2/12/2019	183 ± 86	< 2.8	< 5.1	< 2.3	< 4.1	< 9.8	< 2.9	< 3.6	< 3.4	< 2.8
CAWW- 644	3/8/2019	269 ± 86	< 3.1	< 3.3	< 3.0	< 1.5	< 7.0	< 4.2	< 4.6	< 4.8	< 2.4
CAWW- 1252	4/10/2019	321 ± 92	< 4.2	< 4.4	< 3.1	< 3.2	< 3.5	< 3.9	< 3.7	< 4.7	< 3.4
CAWW- 1611	5/9/2019	< 154	< 2.6	< 3.9	< 4.4	< 2.2	< 7.8	< 6.8	< 4.9	< 2.4	< 5.6
CAWW- 2129	6/5/2019	177 ± 80	< 3.6	< 6.1	< 4.6	< 1.3	< 4.6	< 2.9	< 4.7	< 3.0	< 7.2
CAWW- 2600	7/11/2019	< 159	< 4.4	< 7.6	< 2.1	< 2.2	< 5.4	< 3.1	< 4.2	< 4.2	< 13.8
CAWW- 2982	8/8/2019	195 ± 86	< 3.7	< 8.3	< 3.6	< 2.2	< 3.7	< 8.1	< 5.1	< 6.4	< 7.8
CAWW- 3436	9/13/2019	255 ± 87	< 3.2	< 7.5	< 2.7	< 1.9	< 5.7	< 3.4	< 3.6	< 3.5	< 10.6
CAWW- 3827	10/9/2019	163 ± 80	< 2.8	< 5.0	< 2.8	< 1.8	< 7.1	< 4.5	< 4.1	< 3.0	< 5.7
CAWW- 4267	11/6/2019	169 ± 81	< 2.5	< 6.1	< 3.2	< 1.6	< 6.1	< 5.4	< 4.7	< 2.3	< 7.3
CAWW- 4728	12/12/2019	190 ± 85	< 3.3	< 7.6	< 2.3	< 2.8	< 9.7	< 5.1	< 4.0	< 3.0	< 9.6
<u>Location: CA-WWA-937D</u>											
CAWW- 131	1/9/2019	< 177	< 2.9	< 3.2	< 2.1	< 2.2	< 4.4	< 4.4	< 3.1	< 3.2	< 2.2
CAWW- 404	2/12/2019	< 155	< 3.2	< 6.8	< 3.1	< 4.2	< 10.2	< 6.2	< 5.7	< 4.0	< 4.5
CAWW- 645	3/8/2019	< 154	< 3.7	< 4.9	< 2.2	< 1.2	< 7.3	< 2.9	< 3.8	< 4.7	< 3.6
CAWW- 1253	4/10/2019	< 152	< 3.8	< 3.0	< 3.4	< 3.1	< 5.7	< 2.7	< 4.0	< 3.1	< 2.4
CAWW- 1612	5/9/2019	< 154	< 4.1	< 3.4	< 2.6	< 3.8	< 9.3	< 4.3	< 4.1	< 2.3	< 7.0
CAWW- 2130	6/5/2019	< 150	< 2.4	< 5.4	< 2.4	< 1.7	< 4.1	< 5.1	< 2.8	< 2.2	< 9.4
CAWW- 2601	7/11/2019	< 159	< 2.0	< 7.4	< 3.4	< 1.7	< 6.3	< 4.3	< 3.9	< 3.5	< 12.0
CAWW- 2983	8/8/2019	175 ± 85	< 2.4	< 7.7	< 3.4	< 3.5	< 6.2	< 4.9	< 4.8	< 4.6	< 7.1
CAWW- 3437	9/13/2019	151 ± 82	< 2.8	< 5.5	< 1.8	< 2.1	< 5.8	< 6.1	< 4.4	< 3.0	< 8.4
CAWW- 3828	10/9/2019	193 ± 81	< 2.1	< 5.4	< 3.3	< 1.8	< 2.1	< 5.1	< 3.6	< 3.5	< 7.6
CAWW- 4268	11/6/2019	159 ± 81	< 2.5	< 8.3	< 2.8	< 3.6	< 4.0	< 4.4	< 3.5	< 3.7	< 9.1
CAWW- 4729	12/12/2019	218 ± 87	< 3.4	< 2.8	< 2.4	< 3.0	< 4.9	< 5.0	< 4.1	< 4.2	< 6.6

<sup>a</sup> "NR" = Not required. Monthly analyses for gamma-emitting isotopes satisfies ODCM requirements.



**Table 9. Wells and Ponds (non-potable), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-WWA-939R</u>											
CAWW- 132	1/9/2019	356 ± 96	< 2.3	< 4.1	< 2.9	< 2.8	< 6.7	< 6.6	< 3.4	< 2.9	< 6.2
CAWW- 405	2/12/2019	680 ± 108	< 4.3	< 9.2	< 3.1	< 3.1	< 8.5	< 2.8	< 4.5	< 4.3	< 4.0
CAWW- 646	3/8/2019	483 ± 96	< 3.0	< 4.3	< 1.9	< 2.2	< 5.6	< 3.0	< 4.3	< 4.4	< 2.2
CAWW- 1043	4/5/2019	662 ± 121	NR <sup>a</sup>								
CAWW- 1254	4/10/2019	572 ± 103	< 2.0	< 7.2	< 3.3	< 0.9	< 4.3	< 3.7	< 3.4	< 3.1	< 4.3
CAWW- 1613	5/9/2019	582 ± 101	< 2.8	< 5.0	< 4.1	< 2.4	< 5.3	< 3.7	< 4.1	< 3.4	< 6.5
CAWW- 2131	6/5/2019	711 ± 104	< 3.4	< 5.6	< 2.8	< 1.1	< 3.5	< 5.1	< 3.3	< 3.4	< 5.1
CAWW- 2602	7/11/2019	565 ± 100	< 3.2	< 4.2	< 2.8	< 2.9	< 5.8	< 3.6	< 3.3	< 2.7	< 4.2
CAWW- 2984	8/8/2019	428 ± 98	< 3.7	< 8.0	< 3.4	< 3.8	< 5.3	< 4.3	< 3.7	< 3.4	< 2.8
CAWW- 3438	9/13/2019	549 ± 101	< 2.1	< 4.3	< 1.6	< 3.1	< 3.6	< 4.0	< 2.9	< 3.0	< 5.6
CAWW- 3829	10/9/2019	294 ± 87	< 2.4	< 11.0	< 5.3	< 3.1	< 3.3	< 6.0	< 4.6	< 3.3	< 8.9
CAWW- 4269	11/6/2019	462 ± 96	< 3.5	< 9.6	< 3.6	< 2.8	< 6.7	< 5.6	< 3.8	< 4.1	< 6.7
CAWW- 4730	12/12/2019	410 ± 96	< 3.8	< 7.1	< 3.2	< 2.7	< 4.4	< 5.7	< 4.3	< 3.5	< 6.0
<u>Location: CA-WWA-940</u>											
CAWW- 133	1/9/2019	254 ± 92	< 2.0	< 7.6	< 2.7	< 2.4	< 3.9	< 3.0	< 3.6	< 4.1	< 3.2
CAWW- 406	2/12/2019	1158 ± 125 <sup>b</sup>	< 3.0	< 4.7	< 1.1	< 1.8	< 3.8	< 4.5	< 3.8	< 3.7	< 3.5
CAWW- 1047 <sup>c</sup>	2/12/2019	784 ± 126	NR <sup>a</sup>								
CAWW- 647	3/8/2019	333 ± 89	< 2.9	< 4.0	< 2.1	< 1.7	< 5.0	< 3.3	< 4.1	< 2.7	< 4.0
CAWW- 999 <sup>d</sup>	3/8/2019	404 ± 97	NR <sup>a</sup>								
CAWW- 1045	4/5/2019	271 ± 107	NR <sup>a</sup>								
CAWW- 1255	4/10/2019	323 ± 92	< 4.9	< 3.9	< 3.9	< 5.4	< 8.0	< 6.3	< 6.5	< 3.8	< 6.7
CAWW- 1614	5/9/2019	311 ± 89	< 3.2	< 6.9	< 2.8	< 2.4	< 6.4	< 5.4	< 3.9	< 2.8	< 6.3
CAWW- 2132	6/5/2019	215 ± 82	< 2.2	< 6.6	< 3.4	< 2.9	< 4.8	< 3.1	< 4.7	< 4.8	< 4.9
CAWW- 2603	7/11/2019	< 159	< 2.3	< 11.6	< 3.6	< 1.4	< 6.1	< 6.3	< 3.4	< 3.9	< 10.8
CAWW- 2985	8/8/2019	211 ± 87	< 3.6	< 4.8	< 2.0	< 3.7	< 9.3	< 7.5	< 3.4	< 3.3	< 6.2
CAWW- 3439	9/13/2019	202 ± 84	< 3.2	< 9.4	< 4.1	< 1.4	< 8.9	< 4.7	< 4.2	< 2.6	< 10.9
CAWW- 3830	10/9/2019	222 ± 83	< 3.1	< 9.4	< 2.6	< 1.9	< 4.0	< 3.3	< 4.5	< 2.4	< 5.0
CAWW- 4270	11/6/2019	165 ± 81	< 2.3	< 7.5	< 2.9	< 2.6	< 5.0	< 4.1	< 3.2	< 2.8	< 8.2
CAWW- 4731	12/12/2019	163 ± 84	< 3.5	< 3.9	< 3.9	< 3.9	< 3.9	< 3.3	< 3.5	< 4.1	< 3.5
<u>Location: CA-WWA-941</u>											
CAWW- 134	1/9/2019	205 ± 91	< 1.9	< 6.0	< 1.7	< 2.2	< 3.8	< 2.3	< 3.2	< 2.2	< 3.8
CAWW- 407	2/12/2019	1697 ± 142 <sup>e</sup>	< 2.6	< 4.8	< 1.7	< 3.5	< 4.2	< 3.1	< 3.6	< 3.1	< 4.0
CAWW- 1048 <sup>f</sup>	2/12/2019	1985 ± 161	NR <sup>a</sup>								
CAWW- 648	3/8/2019	630 ± 102	< 1.9	< 5.8	< 2.8	< 1.4	< 9.1	< 3.8	< 4.3	< 2.5	< 2.4
CAWW- 1000 <sup>g</sup>	3/8/2019	574 ± 105	NR <sup>a</sup>								
CAWW- 1046	4/5/2019	282 ± 107	NR <sup>a</sup>								
CAWW- 1256	4/10/2019	241 ± 88	< 3.6	< 7.2	< 2.6	< 2.8	< 4.2	< 3.9	< 4.8	< 3.5	< 2.3
CAWW- 1615	5/9/2019	262 ± 86	< 3.0	< 7.7	< 4.4	< 3.7	< 4.5	< 3.6	< 3.4	< 3.4	< 7.2
CAWW- 2133	6/5/2019	< 150	< 2.9	< 4.0	< 2.4	< 2.0	< 4.0	< 5.2	< 5.1	< 3.5	< 6.5
CAWW- 2604	7/11/2019	< 159	< 1.3	< 4.7	< 1.8	< 0.9	< 2.2	< 2.3	< 1.5	< 1.7	< 6.4
CAWW- 2986	8/8/2019	< 153	< 4.4	< 4.8	< 3.6	< 2.8	< 5.5	< 3.4	< 4.9	< 2.9	< 8.1
CAWW- 3440	9/13/2019	167 ± 82	< 2.7	< 3.2	< 1.7	< 3.0	< 5.7	< 4.3	< 2.9	< 3.7	< 8.1
CAWW- 3831	10/9/2019	165 ± 80	< 2.0	< 4.1	< 3.0	< 2.7	< 6.4	< 4.9	< 2.9	< 3.8	< 6.2
CAWW- 4272	11/6/2019	< 154	< 2.6	< 3.8	< 4.2	< 1.3	< 3.1	< 3.5	< 3.3	< 3.7	< 7.1
CAWW- 4732	12/12/2019	225 ± 87	< 3.3	< 5.1	< 3.0	< 2.3	< 5.7	< 3.0	< 4.1	< 3.1	< 11.2

<sup>a</sup> "NR" = Not required. Monthly analyses for gamma-emitting isotopes satisfies ODCM requirements.

<sup>b</sup> Result of reanalysis: 1291 ± 131 pCi/L. Result of triple distillation: 1210 ± 128.

<sup>c</sup> Backup sample to CAWW-406.

<sup>d</sup> Backup sample to CAWW-647.

<sup>e</sup> Result of reanalysis: 1747 ± 145 pCi/L. Result of triple distillation: 1954 ± 152.

<sup>f</sup> Backup sample to CAWW-407.

<sup>g</sup> Backup sample to CAWW-648.

**Table 9. Wells and Ponds (non-potable), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-WWA-GWS</u>											
CAWW- 128	1/9/2019	< 177	< 3.1	< 2.7	< 3.0	< 2.8	< 5.7	< 4.1	< 3.7	< 4.2	< 2.7
CAWW- 401	2/12/2019	< 155	< 4.5	< 7.4	< 4.0	< 1.8	< 6.9	< 3.4	< 5.5	< 2.9	< 3.5
CAWW- 642	3/8/2019	193 ± 82	< 2.4	< 5.9	< 3.0	< 3.3	< 6.2	< 3.8	< 3.9	< 3.7	< 2.3
CAWW- 1257	4/9/2019	279 ± 90	< 3.3	< 4.7	< 2.8	< 1.8	< 3.8	< 5.5	< 3.4	< 3.3	< 4.9
CAWW- 1609	5/9/2019	205 ± 84	< 2.3	< 4.8	< 2.3	< 2.9	< 2.1	< 3.7	< 3.6	< 4.2	< 6.8
CAWW- 2127	6/5/2019	768 ± 106	< 2.5	< 5.9	< 2.2	< 1.9	< 5.1	< 4.4	< 3.6	< 3.8	< 3.5
CAWW- 2598	7/11/2019	470 ± 98	< 2.1	< 5.3	< 4.1	< 2.3	< 2.7	< 3.5	< 3.7	< 2.7	< 13.3
CAWW- 2980	8/8/2019	233 ± 88	< 3.1	< 6.2	< 2.0	< 1.8	< 3.6	< 5.0	< 3.8	< 3.3	< 5.3
CAWW- 3434	9/11/2019	1054 ± 121	< 3.9	< 5.1	< 4.6	< 3.0	< 3.3	< 5.8	< 5.1	< 2.8	< 7.1
CAWW- 3825	10/9/2019	588 ± 100	< 1.5	< 5.8	< 3.3	< 3.4	< 5.3	< 3.9	< 3.2	< 3.3	< 5.5
CAWW- 4265	11/6/2019	293 ± 88	< 3.5	< 2.9	< 3.5	< 2.1	< 4.4	< 5.0	< 4.4	< 2.9	< 9.8
CAWW- 4726	12/12/2019	212 ± 86	< 2.6	< 5.7	< 2.9	< 2.1	< 6.5	< 4.0	< 4.5	< 3.4	< 6.0
<u>ISFSI Sump</u>											
CAWW- 196	1/16/2019	< 177				NR <sup>a</sup>					
CAWW- 1258	4/10/2019	< 152				NR <sup>a</sup>					
CAWW- 2605	7/11/2019	< 159				NR <sup>a</sup>					
CAWW- 4020	10/17/2019	< 150				NR <sup>a</sup>					
<u>Location: CA-WWA-U1MW-001</u>											
CAWW- 197	1/16/2019	< 177	< 2.7	< 6.3	< 1.8	< 3.5	< 8.2	< 3.2	< 4.2	< 4.1	< 3.1
CAWW- 1075	4/6/2019	< 152	< 3.3	< 7.6	< 6.6	< 3.3	< 13.3	< 9.3	< 7.0	< 5.6	< 3.6
CAWW- 2614	7/16/2019	< 159	< 3.9	< 5.0	< 2.9	< 2.9	< 4.6	< 7.1	< 3.4	< 2.9	< 7.6
CAWW- 3747	10/8/2019	< 151	< 3.4	< 7.6	< 2.7	< 2.1	< 3.4	< 4.2	< 4.2	< 2.4	< 4.5
<u>Location: CA-WWA-U1MW-002</u>											
CAWW- 121	1/10/2019	< 177	< 2.8	< 5.1	< 4.7	< 2.8	< 3.9	< 4.1	< 4.1	< 5.7	< 2.6
CAWW- 1349	4/16/2019	< 156	< 2.2	< 2.9	< 3.1	< 2.7	< 4.6	< 3.1	< 2.9	< 3.1	< 4.1
CAWW- 2613	7/12/2019	< 159	< 3.3	< 7.3	< 2.6	< 2.7	< 5.5	< 4.4	< 2.5	< 2.4	< 10.2
CAWW- 3749	10/8/2019	< 151	< 2.4	< 5.8	< 3.0	< 2.2	< 8.3	< 2.8	< 3.4	< 3.9	< 2.6
<u>Location: CA-WWA-U1MW-004</u>											
CAWW- 50	1/3/2019	< 147	< 2.3	< 5.1	< 2.6	< 2.9	< 2.3	< 5.0	< 4.1	< 3.0	< 4.3
CAWW- 1264	4/12/2019	< 152	< 3.4	< 8.3	< 3.0	< 2.5	< 4.6	< 4.8	< 3.1	< 4.4	< 4.7
CAWW- 2619	7/16/2019	< 159	< 2.5	< 7.1	< 3.6	< 1.5	< 4.3	< 5.7	< 4.6	< 2.8	< 8.0
CAWW- 4018	10/15/2019	< 151	< 4.5	< 7.5	< 5.0	< 3.5	< 11.2	< 8.3	< 5.5	< 3.6	< 5.8

<sup>a</sup> "NR" = Not required. Analyses for gamma-emitting isotopes not required by the ODCM

**Table 9. Wells and Ponds (non-potable), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-WWA-U1MW-005</u>											
CAWW- 51	1/3/2019	< 147	< 2.5	< 7.2	< 4.2	< 2.2	< 2.1	< 6.4	< 4.5	< 3.1	< 5.5
CAWW- 1265	4/12/2019	< 152	< 2.3	< 3.2	< 3.8	< 3.1	< 4.0	< 4.9	< 4.2	< 3.8	< 10.4
CAWW- 2646	7/19/2019	< 159	< 2.2	< 6.0	< 3.3	< 1.5	< 2.4	< 3.2	< 3.5	< 4.8	< 8.1
CAWW- 4019	10/15/2019	< 151	< 1.9	< 6.5	< 1.9	< 1.9	< 5.2	< 4.1	< 3.2	< 3.5	< 12.6
<u>Location: CA-WWA-U1MW-006</u>											
CAWW- 188	1/14/2019	< 177	< 4.4	< 5.9	< 2.2	< 3.7	< 8.4	< 3.0	< 4.1	< 3.6	< 3.6
CAWW- 1260	4/12/2019	< 152	< 3.5	< 5.7	< 3.7	< 3.2	< 7.0	< 4.8	< 4.3	< 3.4	< 3.1
CAWW- 2617	7/16/2019	< 159	< 3.7	< 7.2	< 4.4	< 2.7	< 6.1	< 3.9	< 4.3	< 4.4	< 11.8
CAWW- 4015	10/15/2019	< 151	< 2.9	< 3.3	< 2.2	< 2.2	< 2.8	< 4.8	< 3.4	< 3.5	< 5.4
<u>Location: CA-WWA-U1MW-010</u>											
	1/16/2019					NS <sup>a</sup>					
CAWW- 1343	4/15/2019	< 156	< 4.2	< 6.5	< 3.9	< 2.5	< 5.7	< 4.2	< 3.2	< 3.6	< 4.2
CAWW- 2618	7/16/2019	< 159	< 3.6	< 6.7	< 3.8	< 2.3	< 2.4	< 4.9	< 3.1	< 4.1	< 13.0
CAWW- 4016	10/15/2019	< 151	< 4.0	< 5.0	< 3.7	< 1.4	< 5.9	< 4.9	< 4.2	< 2.7	< 7.2
<u>Location: CA-WWA-U1MW-012</u>											
CAWW- 190	1/14/2019	< 177	< 3.3	< 6.7	< 2.1	< 2.4	< 4.1	< 3.3	< 3.0	< 3.9	< 3.3
CAWW- 1259	4/12/2019	< 152	< 3.6	< 6.3	< 4.6	< 2.2	< 6.8	< 5.0	< 4.0	< 2.7	< 6.1
CAWW- 2616	7/16/2019	< 159	< 2.3	< 4.9	< 3.1	< 1.9	< 4.5	< 4.5	< 3.4	< 3.5	< 11.1
CAWW- 4014	10/15/2019	< 151	< 2.2	< 4.0	< 3.1	< 2.0	< 4.2	< 2.8	< 3.9	< 4.4	< 5.7
<u>Location: CA-WWA-U1MW-013</u>											
CAWW- 191	1/15/2019	< 177	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0	< 0.0
CAWW- 1342	4/15/2019	< 156	< 2.3	< 4.7	< 1.8	< 2.0	< 4.7	< 2.2	< 2.2	< 2.1	< 3.1
CAWW- 2615	7/16/2019	< 159	< 2.6	< 3.8	< 2.7	< 2.1	< 5.1	< 4.5	< 2.6	< 2.0	< 10.4
CAWW- 3748	10/8/2019	< 151	< 2.7	< 5.2	< 3.0	< 3.5	< 2.4	< 4.1	< 3.3	< 3.0	< 5.0
<u>Location: CA-WWA-U1MW-014</u>											
CAWW- 124	1/10/2019	280 ± 93	< 1.3	< 6.6	< 1.7	< 2.2	< 2.6	< 2.4	< 3.3	< 3.6	< 2.6
CAWW- 1348	4/16/2019	< 156	< 2.2	< 4.4	< 2.6	< 1.7	< 6.8	< 3.5	< 3.1	< 3.0	< 2.4
	7/19/2019					NS <sup>a</sup>					
	10/17/2019					NS <sup>a</sup>					
<u>Location: CA-WWA-U1MW-015</u>											
CAWW- 55	1/8/2019	< 147	< 2.8	< 10.2	< 3.7	< 3.1	< 4.1	< 3.2	< 3.9	< 2.8	< 4.2
CAWW- 1340	4/15/2019	< 156	< 2.2	< 4.4	< 2.4	< 2.4	< 8.3	< 5.0	< 4.7	< 3.3	< 5.1
CAWW- 2620	7/16/2019	< 159	< 3.7	< 9.4	< 1.4	< 1.6	< 5.7	< 5.3	< 4.1	< 2.6	< 5.0
CAWW- 4022	10/17/2019	< 150	< 1.4	< 3.1	< 1.2	< 0.8	< 2.3	< 3.6	< 1.3	< 1.0	< 22.4 <sup>b</sup>

<sup>a</sup> "NS" = No sample; see Part I Table 5.5, Listing of Missed Samples.

<sup>b</sup> Required LLD not met due to a delay in analysis resulting from an erroneous chain of custody.

**Table 9. Wells and Ponds (non-potable), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-WWA-U1MW-016</u>											
CAWW- 52	1/4/2019	< 147	< 3.1	< 4.9	< 2.8	< 2.4	< 2.7	< 4.9	< 3.4	< 2.7	< 5.0
CAWW- 1262	4/12/2019	< 152	< 3.3	< 4.7	< 2.3	< 3.9	< 7.1	< 4.3	< 3.9	< 3.5	< 5.6
	7/19/2019					NS <sup>a</sup>					
	10/17/2019					NS <sup>a</sup>					
<u>Location: CA-WWA-U1MW-18</u>											
CAWW- 125	1/10/2019	< 177				NR <sup>b</sup>					
CAWW- 1350	4/16/2019	< 156				NR <sup>b</sup>					
	7/19/2019	NS <sup>a</sup>				NR <sup>b</sup>					
	10/17/2019	NS <sup>a</sup>				NR <sup>b</sup>					
<u>Location: CA-WWA-U1MW-19</u>											
CAWW- 123	1/10/2019	< 177				NR <sup>b</sup>					
CAWW- 1346	4/16/2019	< 156				NR <sup>b</sup>					
	7/19/2019	NS <sup>a</sup>				NR <sup>b</sup>					
	10/17/2019	NS <sup>a</sup>				NR <sup>b</sup>					
<u>Location: CA-WWA-U1MW-20</u>											
CAWW- 126	1/10/2019	< 177				NR <sup>b</sup>					
CAWW- 1352	4/16/2019	< 156				NR <sup>b</sup>					
	7/19/2019	NS <sup>a</sup>				NR <sup>b</sup>					
	10/17/2019	NS <sup>a</sup>				NR <sup>b</sup>					
<u>Location: CA-WWA-U1MW-31</u>											
CAWW- 194	1/15/2019	275 ± 93				NR <sup>b</sup>					
CAWW- 1076	4/6/2019	< 152				NR <sup>b</sup>					
CAWW- 2610	7/12/2019	534 ± 101 <sup>c</sup>				NR <sup>b</sup>					
CAWW- 3441	9/11/2019	660 ± 106				NR <sup>b</sup>					
CAWW- 3743	10/8/2019	899 ± 113				NR <sup>b</sup>					
CAWW- 4062	10/8/2019	933 ± 114 <sup>d</sup>				NR <sup>b</sup>					

<sup>a</sup> "NS" = No sample; see Part I Table 5.5, Listing of Missed Samples.

<sup>b</sup> "NR" = Not required. Analyses for gamma-emitting isotopes not required by the ODCM.

<sup>c</sup> Result of reanalysis: 485 ± 96 pCi/L.

<sup>d</sup> Backup sample to CAWW-3743.

**Table 9. Wells and Ponds (non-potable), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)								
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs
<u>Location: CA-WWA-U1MW-34</u>										
CAWW- 193	1/15/2019	219 ± 91				NR <sup>a</sup>				
CAWW- 1077	4/6/2019	167 ± 80				NR <sup>a</sup>				
CAWW- 2607	7/12/2019	197 ± 85				NR <sup>a</sup>				
CAWW- 3744	10/8/2019	546 ± 99				NR <sup>a</sup>				
CAWW- 4063	10/8/2019	537 ± 98				NR <sup>a</sup>				
<u>Location: CA-WWA-U1MW-36</u>										
CAWW- 192	1/15/2019	293 ± 94				NR <sup>a</sup>				
CAWW- 1078	4/6/2019	177 ± 81				NR <sup>a</sup>				
CAWW- 2608	7/12/2019	268 ± 88				NR <sup>a</sup>				
CAWW- 3745	10/8/2019	544 ± 98				NR <sup>a</sup>				
CAWW- 4064	10/8/2019	464 ± 95				NR <sup>a</sup>				
<u>Location: CA-WWA-U1MW-39</u>										
CAWW- 54	1/8/2019	< 147				NR <sup>a</sup>				
CAWW- 1345	4/15/2019	< 156				NR <sup>a</sup>				
CAWW- 2611	7/12/2019	< 159				NR <sup>a</sup>				
CAWW- 3739	10/7/2019	< 151				NR <sup>a</sup>				

<sup>a</sup> "NR" = Not required. Analyses for gamma-emitting isotopes not required by the ODCM.

<sup>b</sup> Backup sample to CAWW-3744.

<sup>c</sup> Backup sample to CAWW-3745.

**Table 9. Wells and Ponds (non-potable), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection		Concentration (pCi/L)									
	Date		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-WWA-U1MW-47</u>												
CAWW- 49	1/3/2019		248 ± 82									NR <sup>a</sup>
CAWW- 1261	4/12/2019		< 152									NR <sup>a</sup>
CAWW- 2647	7/19/2019		< 159									NR <sup>a</sup>
CAWW- 4021	10/17/2019		< 150									NR <sup>a</sup>
<u>Location: CA-WWA-U1MW-58</u>												
CAWW- 195	1/15/2019		405 ± 98									NR <sup>a</sup>
CAWW- 1079	4/6/2019		409 ± 92									NR <sup>a</sup>
CAWW- 2609	7/12/2019		< 159 <sup>b</sup>									NR <sup>a</sup>
CAWW- 3442	9/11/2019		353 ± 92									NR <sup>a</sup>
CAWW- 3746	10/8/2019		253 ± 84									NR <sup>a</sup>
<u>Location: CA-WWA-U1MW-59</u>												
CAWW- 127	1/10/2019		< 177									NR <sup>a</sup>
CAWW- 1347	4/16/2019		< 156									NR <sup>a</sup>
CAWW- 2612	7/12/2019		< 159									NR <sup>a</sup>
CAWW- 4017	10/15/2019		< 151									NR <sup>a</sup>
<u>Inside Old Blowdown Pipeline</u>												
CAWW- 48	1/3/2019		< 147									NR <sup>a</sup>
CAWW- 1353	4/16/2019		< 156									NR <sup>a</sup>
	7/19/2019		NS <sup>c</sup>									NR <sup>a</sup>
	10/17/2019		NS <sup>c</sup>									NR <sup>a</sup>

<sup>a</sup> "NR" = Not required. Analyses for gamma-emitting isotopes not required by the ODCM.

<sup>b</sup> Result of reanalysis: 286 ± 87 pCi/L.

<sup>c</sup> "NS" = No sample; see Part I Table 5.5, Listing of Missed Samples.

**Table 9. Wells and Ponds (non-potable), analyses for tritium and gamma-emitting isotopes.**

Lab Code	Collection Date	Concentration (pCi/L)									
		<sup>3</sup> H	<sup>54</sup> Mn	<sup>59</sup> Fe	<sup>58</sup> Co	<sup>60</sup> Co	<sup>65</sup> Zn	<sup>95</sup> ZrNb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>140</sup> BaLa
<u>Location: CA-WWA-U2MW-2S</u>											
CAWW- 53	1/8/2019	< 147				NR <sup>a</sup>					
CAWW- 1080	4/4/2019	< 152				NR <sup>a</sup>					
CAWW- 2621	7/12/2019	< 159				NR <sup>a</sup>					
CAWW- 3742	10/8/2019	< 151				NR <sup>a</sup>					
<u>Location: CA-WWA-U2MW-5S</u>											
CAWW- 56	1/4/2019	< 147				NR <sup>a</sup>					
CAWW- 1081	4/4/2019	< 152				NR <sup>a</sup>					
CAWW- 2309	7/2/2019	< 149				NR <sup>a</sup>					
CAWW- 3737	10/7/2019	< 151				NR <sup>a</sup>					
<u>Location: CA-WWA-U2MW-8</u>											
CAWW- 58	1/4/2019	< 147				NR <sup>a</sup>					
CAWW- 1082	4/6/2019	< 152				NR <sup>a</sup>					
CAWW- 2310	7/2/2019	< 149				NR <sup>a</sup>					
CAWW- 3741	10/7/2019	< 151				NR <sup>a</sup>					
<u>Location: CA-WWA-U2MW-10</u>											
CAWW- 59	1/8/2019	< 147	< 2.5	< 8.2	< 2.4	< 3.3	< 7.2	< 3.2	< 4.4	< 4.7	< 4.9
CAWW- 1341	4/15/2019	< 156	< 3.9	< 6.8	< 3.1	< 3.4	< 5.6	< 3.0	< 3.7	< 4.2	< 4.8
CAWW- 2622	7/12/2019	< 159	< 3.1	< 8.0	< 3.9	< 2.0	< 3.5	< 4.4	< 2.8	< 3.1	< 9.9
CAWW- 3740	10/7/2019	< 151	< 3.0	< 3.3	< 2.8	< 2.2	< 3.5	< 2.2	< 3.1	< 3.0	< 6.2
<u>Location: CA-WWA-U2MW-16</u>											
CAWW- 57	1/4/2019	< 147				NR <sup>a</sup>					
CAWW- 1344	4/15/2019	< 156				NR <sup>a</sup>					
CAWW- 2308	7/2/2019	< 149				NR <sup>a</sup>					
CAWW- 3738	10/7/2019	< 151				NR <sup>a</sup>					
<u>Location: CA-WWA-F-005</u>											
CAWW- 175	1/11/2019	< 177	< 3.0	< 7.3	< 3.0	< 2.3	< 2.6	< 2.1	< 3.2	< 3.7	< 3.9
CAWW- 1288	4/12/2019	< 152	< 2.9	< 4.3	< 2.5	< 2.6	< 2.4	< 6.2	< 3.8	< 3.3	< 5.1
CAWW- 2677	7/16/2019	< 159	< 2.9	< 3.4	< 2.8	< 2.6	< 4.9	< 4.0	< 2.6	< 2.4	< 9.4
CAWW- 3888	10/9/2019	< 151	< 3.2	< 4.7	< 3.5	< 1.5	< 5.3	< 4.0	< 3.1	< 3.0	< 6.4
<u>Location: CA-WWA-F-015</u>											
CAWW- 176	1/11/2019	< 177	< 2.7	< 5.0	< 2.3	< 3.2	< 4.4	< 2.2	< 3.2	< 3.2	< 3.4
CAWW- 1289	4/12/2019	< 152	< 2.8	< 7.2	< 2.5	< 1.1	< 2.0	< 3.0	< 3.3	< 1.3	< 4.6
CAWW- 2678	7/16/2019	< 159	< 3.0	< 7.1	< 3.0	< 3.4	< 4.3	< 4.6	< 3.8	< 4.2	< 9.3
CAWW- 3887	10/9/2019	< 151	< 3.0	< 5.1	< 3.6	< 2.4	< 3.7	< 3.6	< 3.2	< 3.2	< 5.6

<sup>a</sup> "NR" = Not required. Analyses for gamma-emitting isotopes not required by the ODCM.

**Table 10a. Bottom sediments, analyses for gamma-emitting isotopes.**

Collection: Semiannually

Units: pCi/kg dry

Location			CA-AQS-A	
Lab Code	Req. LLD	NS <sup>a</sup>	CABS- 3030	CABS- 4160
Date Collected	-	1st Half 2019	08-08-19	10-29-19
K-40	-	-	13345 ± 621	14811 ± 665
Mn-54	-	-	< 22.7	< 27.3
Fe-59	-	-	< 67.6	< 72.0
Co-58	-	-	< 20.8	< 31.5
Co-60	-	-	< 16.1	< 24.1
Zr-Nb-95	-	-	< 52.6	< 59.5
Cs-134	150	-	< 13.9	< 18.9
Cs-137	180	-	< 19.5	< 30.9
Ba-La-140	-	-	< 154.0	< 172.5

Location			CA-AQS-C	
Lab Code	Req. LLD	NS <sup>a</sup>	CABS- 3031	CABS- 4161
Date Collected	-	1st Half 2019	08-08-19	10-29-19
K-40	-	-	13511 ± 587	14205 ± 774
Mn-54	-	-	< 22.2	< 21.3
Fe-59	-	-	< 60.6	< 65.5
Co-58	-	-	< 32.3	< 33.9
Co-60	-	-	< 15.9	< 17.2
Zr-Nb-95	-	-	< 64.0	< 46.0
Cs-134	150	-	< 19.1	< 22.4
Cs-137	180	-	< 22.9	64.0 ± 23.8
Ba-La-140	-	-	< 156.6	< 198.0

<sup>a</sup> "NS" = No samples collected; see Part I Table 5.5, Listing of Missed Samples.



**Table 10b. Shoreline sediments, analyses for gamma-emitting isotopes.**

Collection: Semiannually

Units: pCi/kg dry

Location		CA-AQS-A		
Lab Code	Req. LLD	NS <sup>a</sup>	CASS- 3028	CASS- 4158
Date Collected	-	1st Half 2019	08-08-19	10-29-19
K-40	-	-	13899 ± 583	13422 ± 601
Mn-54	-	-	< 22.3	< 25.7
Fe-59	-	-	< 49.7	< 47.6
Co-58	-	-	< 29.3	< 26.2
Co-60	-	-	< 14.0	< 13.8
Zr-Nb-95	-	-	< 60.8	< 28.5
Cs-134	150	-	< 18.4	< 19.1
Cs-137	180	-	< 22.6	< 12.4
Ba-La-140	-	-	< 322.1	< 120.0

Location		CA-AQS-C		
Lab Code	Req. LLD	NS <sup>a</sup>	CASS- 3029	CASS- 4159
Date Collected	-	1st Half 2019	08-08-19	10-29-19
K-40	-	-	13659 ± 637	13587 ± 633
Mn-54	-	-	< 23.7	< 29.0
Fe-59	-	-	< 67.8	< 64.1
Co-58	-	-	< 22.5	< 27.3
Co-60	-	-	< 15.3	< 19.8
Zr-Nb-95	-	-	< 45.8	< 48.1
Cs-134	150	-	< 12.0	< 16.6
Cs-137	180	-	< 19.5	< 23.1
Ba-La-140	-	-	< 68.5	< 101.2

<sup>a</sup>"NS" = No samples collected; see Part I Table 5.5, Listing of Missed Samples.

**Table 11. Fish, analyses for gamma-emitting isotopes.**

Collection: Semiannually

Units: pCi/kg wet

Location		CA-AQF-A	
Lab Code	Req. LLD	NS <sup>a</sup>	
Date Collected		1st Half 2019	
Sample Type			
K-40	-		
Mn-54	130		
Fe-59	260		
Co-58	130		
Co-60	130		
Zn-65	260		
Cs-134	130		
Cs-137	150		

Location		CA-AQF-A				
Lab Code	Req. LLD	CAF- 3018	CAF- 3019	CAF- 3020	CAF- 3021	CAF- 3022
Date Collected		08-08-19	08-08-19	08-08-19	08-08-19	08-08-19
Sample Type		Common Carp (CC)	River Carpsucker (RC)	Freshwater Drum (FD)	Silver Carp (SC)	Bigmouth Buffalo (BM)
K-40	-	3187 ± 431	3329 ± 481	3308 ± 454	3352 ± 426	2830 ± 427
Mn-54	130	< 14.1	< 22.4	< 11.4	< 21.5	< 13.6
Fe-59	260	< 30.4	< 37.8	< 43.6	< 29.4	< 34.3
Co-58	130	< 9.8	< 17.4	< 17.8	< 14.7	< 9.4
Co-60	130	< 7.8	< 12.6	< 13.6	< 16.3	< 14.3
Zn-65	260	< 34.7	< 31.7	< 38.0	< 34.8	< 14.6
Cs-134	130	< 16.2	< 19.7	< 16.3	< 20.7	< 14.9
Cs-137	150	< 12.8	< 17.7	< 18.7	< 16.3	< 17.4

Location		CA-AQF-A				
Lab Code	Req. LLD	CAF- 4148	CAF- 4149	CAF- 4150	CAF- 4151	CAF- 4152
Date Collected		10-29-19	10-29-19	10-29-19	10-29-19	10-29-19
Sample Type		Common Carp (CC)	Freshwater Drum (FD)	Smallmouth Buffalo (SM)	Silver Carp (SC)	River Carpsucker (RC)
K-40	-	2967 ± 481	3167 ± 498	3358 ± 479	3581 ± 469	3357 ± 484
Mn-54	130	< 21.7	< 15.8	< 15.0	< 14.2	< 14.6
Fe-59	260	< 57.2	< 48.4	< 73.2	< 82.4	< 45.1
Co-58	130	< 25.6	< 21.1	< 20.9	< 14.0	< 10.8
Co-60	130	< 17.0	< 17.7	< 13.8	< 15.5	< 14.8
Zn-65	260	< 54.2	< 29.1	< 35.7	< 42.5	< 19.1
Cs-134	130	< 28.4	< 25.7	< 22.4	< 20.7	< 24.6
Cs-137	150	< 21.2	< 15.4	< 13.9	< 17.9	< 12.4

<sup>a</sup>"NS" = No samples collected; see Part I Table 5.5, Listing of Missed Samples.

**Table 11. Fish, analyses for gamma-emitting isotopes.**

Collection: Semiannually

Units: pCi/kg wet

Location		CA-AQF-C	
Lab Code	Req. LLD	NS <sup>a</sup>	
Date Collected		1st Half 2019	
Sample Type			
K-40	-		
Mn-54	130		
Fe-59	260		
Co-58	130		
Co-60	130		
Zn-65	260		
Cs-134	130		
Cs-137	150		

Location		CA-AQF-C				
Lab Code	Req. LLD	CAF- 3023	CAF- 3024	CAF- 3025	CAF- 3026	CAF- 3027
Date Collected		08-08-19	08-08-19	08-08-19	08-08-19	08-08-19
Sample Type		Common Carp (CC)	River Carpsucker (RC)	Freshwater Drum (FD)	Silver Carp (SC)	Bigmouth Buffalo (BM)
K-40	-	2887 ± 405	3450 ± 414	3150 ± 423	2969 ± 425	3407 ± 406
Mn-54	130	< 8.9	< 17.1	< 9.5	< 11.8	< 11.1
Fe-59	260	< 29.1	< 36.7	< 30.1	< 24.5	< 42.1
Co-58	130	< 11.2	< 19.9	< 14.1	< 16.3	< 16.7
Co-60	130	< 9.3	< 16.7	< 10.0	< 12.0	< 15.4
Zn-65	260	< 25.5	< 33.1	< 24.4	< 33.0	< 31.4
Cs-134	130	< 15.5	< 17.6	< 16.4	< 17.5	< 17.6
Cs-137	150	< 16.6	< 18.0	< 15.9	< 21.9	< 10.2

Location		CA-AQF-C				
Lab Code	Req. LLD	CAF- 4153	CAF- 4154	CAF- 4155	CAF- 4156	CAF- 4157
Date Collected		10-29-19	10-29-19	10-29-19	10-29-19	10-29-19
Sample Type		Common Carp (CC)	Freshwater Drum (FD)	Smallmouth Buffalo (SM)	Silver Carp (SC)	River Carpsucker (RC)
K-40	-	2871 ± 503	2459 ± 350	2697 ± 389	2918 ± 400	2974 ± 407
Mn-54	130	< 18.9	< 10.0	< 12.7	< 15.4	< 12.6
Fe-59	260	< 47.9	< 26.4	< 55.3	< 60.2	< 39.2
Co-58	130	< 20.4	< 14.9	< 22.1	< 24.2	< 18.1
Co-60	130	< 17.7	< 15.0	< 8.4	< 17.3	< 12.4
Zn-65	260	< 35.3	< 21.7	< 16.6	< 36.7	< 29.5
Cs-134	130	< 25.0	< 14.5	< 15.3	< 17.4	< 17.6
Cs-137	150	< 14.1	< 7.9	< 16.4	< 17.3	< 15.2

<sup>a</sup> "NS" = No samples collected; see Part I Table 5.5, Listing of Missed Samples.

Table 12a. Direct Radiation (quarterly exposure)

Location	Gamma Dose (mrem/90 days)			
	QTR 1	QTR 2	QTR 3	QTR 4
CA-IDM-1A	14.32	15.54	14.43	15.09
CA-IDM-3	16.00	15.73	16.58	16.04
CA-IDM-5	13.96	12.93	13.93	13.58
CA-IDM-6	15.24	14.22	16.06	15.27
CA-IDM-7	15.56	14.86	15.35	15.02
CA-IDM-9	14.26	NS <sup>a</sup>	13.84	14.36
CA-IDM-10	16.59	NS <sup>a</sup>	16.97	16.13
CA-IDM-11A	15.94	14.77	15.78	15.57
CA-IDM-14	15.28	14.83	15.50	15.29
CA-IDM-17	14.63	14.77	15.23	14.81
CA-IDM-18A	15.38	14.86	16.08	15.38
CA-IDM-20	15.54	15.12	16.33	15.33
CA-IDM-21	16.19	14.64	16.64	15.14
CA-IDM-22A	12.12	12.13	11.89	11.86
CA-IDM-23	15.30	15.17	16.34	16.19
CA-IDM-26 (C)	10.92	10.58	9.73	10.52
CA-IDM-27 (C)	16.31	15.58	15.16	16.08
CA-IDM-30A	14.67	14.22	14.67	14.94
CA-IDM-31A	15.94	15.84	16.41	16.05
CA-IDM-32	13.93	15.87	16.33	16.01
CA-IDM-32A	15.38	13.91	15.06	14.86
CA-IDM-33	15.05	14.80	14.78	15.46
CA-IDM-34	14.82	14.55	15.23	14.80
CA-IDM-35	13.87	13.44	13.67	14.40
CA-IDM-36	13.25	13.06	13.67	14.22
CA-IDM-37	15.50	14.19	14.70	15.16
CA-IDM-38	10.65	10.58	10.55	11.01
CA-IDM-39	14.37	15.33	13.77	14.49
CA-IDM-39A	14.22	15.24	14.39	15.26
CA-IDM-40	14.81	15.29	14.06	16.21
CA-IDM-41	14.81	14.86	14.59	14.85
CA-IDM-42	12.41	13.22	12.72	13.14
CA-IDM-43	14.26	14.28	14.80	14.99
CA-IDM-44	NS <sup>a</sup>	14.78	14.23	14.79
CA-IDM-45	13.46	12.80	13.97	13.81
CA-IDM-46	15.64	14.66	15.16	15.80
CA-IDM-47	15.80	13.98	13.36	15.83
CA-IDM-48	15.28	15.04	15.83	15.42
CA-IDM-49	13.49	15.26	13.22	12.98
CA-IDM-50	14.58	15.16	15.16	15.33
CA-IDM-51A	16.16	15.88	15.99	16.10
CA-IDM-52	15.49	14.77	16.28	15.75
CA-IDM-60 (C)	14.48	14.72	13.93	14.86
CA-IDM-61	14.48	13.44	13.87	13.73

<sup>a</sup> "NS" = No sample; see Part I Table 5.5, Listing of Missed Samples.

(C) Control

**Table 12b. Direct Radiation Neutron (quarterly exposure)**

Location	Neutron Dose (mrem/91 days)			
	QTR 1	QTR 2	QTR 3	QTR 4
CA-IDM-60N (C)	0.0 ± 1.2	0.0 ± 0.8	0.0 ± 1.0	0.0 ± 1.1
CA-IDM-61N	0.0 ± 1.0	0.0 ± 0.7	0.0 ± 1.6	0.0 ± 0.9
CA-IDM-62N	0.0 ± 1.3	0.0 ± 1.5	0.0 ± 1.1	0.0 ± 1.3
CA-IDM-63N	0.0 ± 0.9	0.0 ± 0.6	0.0 ± 0.6	0.0 ± 1.3
CA-IDM-64N	0.0 ± 0.9	0.0 ± 1.1	0.0 ± 1.0	0.0 ± 0.6

(C) Control