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Annual Environmental Monitoring Report
CALENDAR YEAR
2015

REV 3 1/23/1017

US ECOLOGY WASHINGTON
LOW LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY

Radioactive Material License
WN-I019-2
Air Emissions License number
RAEL-009

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1.0 EXECUTIVE SUMMARY

The purpose of the environmental monitoring program is to ensure the limits and constraints of the applicable regulations are met, to ensure the site is being operated in a safe manner and to detect any changes to environmental radiation levels that could be caused by site operations. Figure 2.1 shows the site and the location of the environmental monitoring activities. This report summarizes the results of our program.

US Ecology Washington (USEW) submits this environmental monitoring report each year in accordance with the Washington Administrative Code (WAC 246-250-600 (7)). WAC 246-250-340 also requires environmental monitoring. These regulations require:

> "…measurements and observations be made and recorded to evaluate the potential health and environmental impact during construction and operation of the facility and to enable the evaluation of long-term effects and need for mitigation measures. The monitoring system must be capable of providing early warning of a radiological release before it reaches the site boundary."

The USEW radioactive materials license, state of Washington (WN-I019-2), requires implementation of an environmental monitoring program through USEW Facility Standards Manual (FSM) and Richland Operational Procedures. The environmental monitoring program complies with the requirements in the Washington Administrative Code, and USEW radioactive materials license.

The Washington State Department of Health (DOH) license condition 71 directs that US Ecology must provide an annual report that contains the following information:

> "A comprehensive annual report of all sample analyses, with statistical trend analyses and discussion of all anomalous results and actions taken, specification of the quantity of each of the principle contaminants released to the unrestricted areas in liquid and in airborne effluents during the preceding year, wind rose for the facility, depth to water and depth to bottom, pH, as well as non-radiological contaminants specified in the Facility Standard Manual for all groundwater wells, ventilation exhaust samples taken from the inspection facility, and comparisons of onsite groundwater wells and the U.S. DOE groundwater wells in the vicinity of the facility."

License condition 71 also requires that this report shall be submitted in general accordance with the department's document entitled "Recommended Content and Format for Annual Environmental Reports". The latest version is dated October 21, 2013 (see appendix F).

US Ecology Washington (USEW) is a shallow land burial facility for low level radioactive waste. There is no water above ground, and the ground water is about 300 feet below ground surface. All water used on site is from the Columbia river via the Hanford site water system. Water is used for domestic purposes and for dust control. The disturbed area is approximately 100 acres, which includes the filled and partially filled waste trenches. See site specific drawing attachment 2-1, and in the surrounding community attachment 2.2.

Trends and abnormal sample results are discussed later in this report. In 2015, there were several noteworthy analyses:

- Tritium in ground water is generally decreasing in concentration,

- Uranium in MW-8 and Carbon 14 in MW-5 are being watched,
- Gross beta is being watched in the upgradient wells,
- A slightly elevated tritium concentration was detected in the 2012, 2013, 2014 and 2015 Trench Cap vegetation.

There are numerous results that are above investigation levels or elevated but none are believed to be the result of operations at USEW and none are outside of the levels normally seen.

The annual calculated dose from all sources is 25 mrem, compared to the annual limit of 100 mrem. The annual calculated dose from all effluent sources in negligible (<0.25 mrem/year), compared to our limit of 25 mrem from effluents. The annual dose from air emissions, calculated with the CAP88 code (Environmental Protection Agency, 2016) is 6E-6 mrem per year (Appendix A), compared to our limit of 1 mrem/year. There is no assigned MEI for this facility. Compliance with dose regulations is met by ensuring the fenceline dose is less than the applicable standard.

The radionuclides of concern are those listed in the Environmental Impact Statement (EIS) (Washington State Department of Health, 2004), which include longer lived power plant activated material such as cobalt-60, fuel derived isotopes such as strontium-90 and cesium-137, and naturally occurring and source material such as uranium and radium. This facility is licensed to accept any isotope.

Compliance with the dose limits is ensured if the maximum dose in an uncontrolled area is less than the applicable limit.

2.0 INTRODUCTION

US Ecology Washington (USEW) Low Level Radioactive Waste (LLRW) Disposal Facility is located in north-central Benton County about 20 miles northwest of the city of Richland, Washington. The facility address is ¼ mile west of 200 East, Hanford reservation, Richland Washington. The facility is situated within the US Department of Energy (DOE) Hanford Site on 100 acres of land (see Figure 2.1). DOE leases the site to the state of Washington and the State subleases to USEW. The facility is entirely within the Hanford separations area, which covers approximately 82 square miles in the center of the Hanford Site. The facility is located just southwest of 200-East and about 2.5 miles east of 200-West. The Hanford 200 Areas contain irradiated uranium fuel processing facilities, plutonium separation facilities, and the major radioactive waste storage and disposal facilities (see figure 2.2).

The USEW facility began operating in 1965. Approximately 14 million cubic feet of low-level waste has been received through December 31, 2015. This waste contains solid or solidified materials, contaminated equipment, cleaning wastes, tools, protective clothing, gloves, laboratory wastes, and naturally occurring or accelerator produced radioactive material (NARM). The waste is from any source other than nuclear fuel, and contains limited amounts of Special Nuclear Material. The manifested activity of the buried waste is approximately 4 million curies (Ci). The total radioactivity actually contained on site is considerably less than the manifested activity due to radioactive decay and conservatism of manifested quantities.

All waste is contained in trenches that are excavated into the surficial sediments. When completely filled, each trench is covered with at least eight feet of soil and capped with a layer of gravel. Older trenches were covered with three feet of soil before gravel placement. At present, there are two open trenches and 19 closed trenches, one closed tank farm, and one closed chemical trench that does not contain LLRW. The trenches are located on about 32 acres in the southeast and east-central part of the facilities. Trench size is variable but the larger trenches are up to 150 feet wide, 1,000 feet long and 50 feet deep.

During operation, material is handled in closed containers inside of the restricted area and in open containers in the inspection facility in the lab building. Most waste handling operations are in and around the two open waste disposal trenches, trenches 18 and 19.

The facility officers are:

CEO:	Jeff Feeler
Manager:	Mike Ault
RSO/RPM:	Sean Murphy
Regulatory Compliance:	Parrish Jones

This site has 18 full time employees.

Figure 2.1 Site Layout and Environmental Sampling Locations

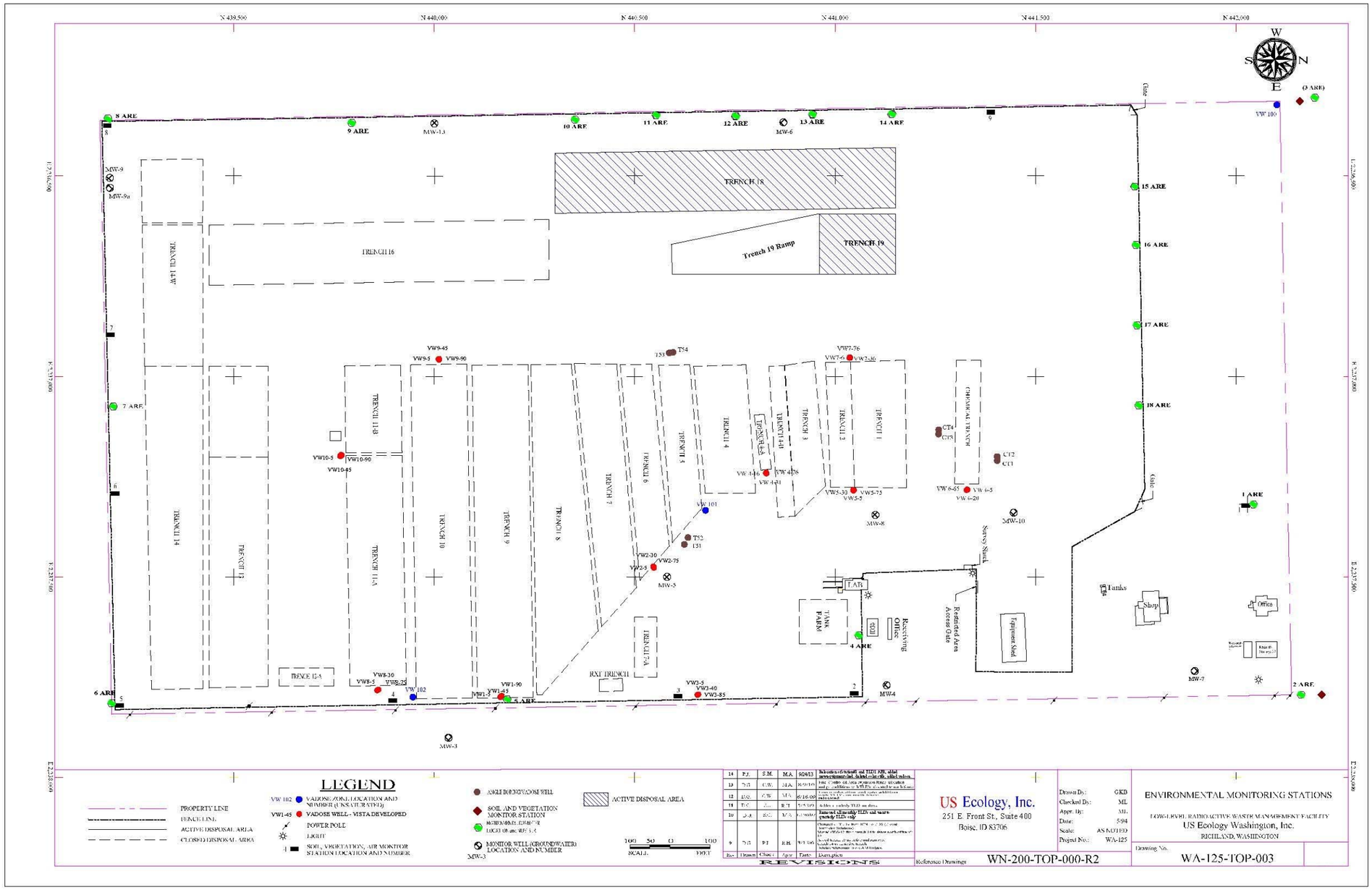
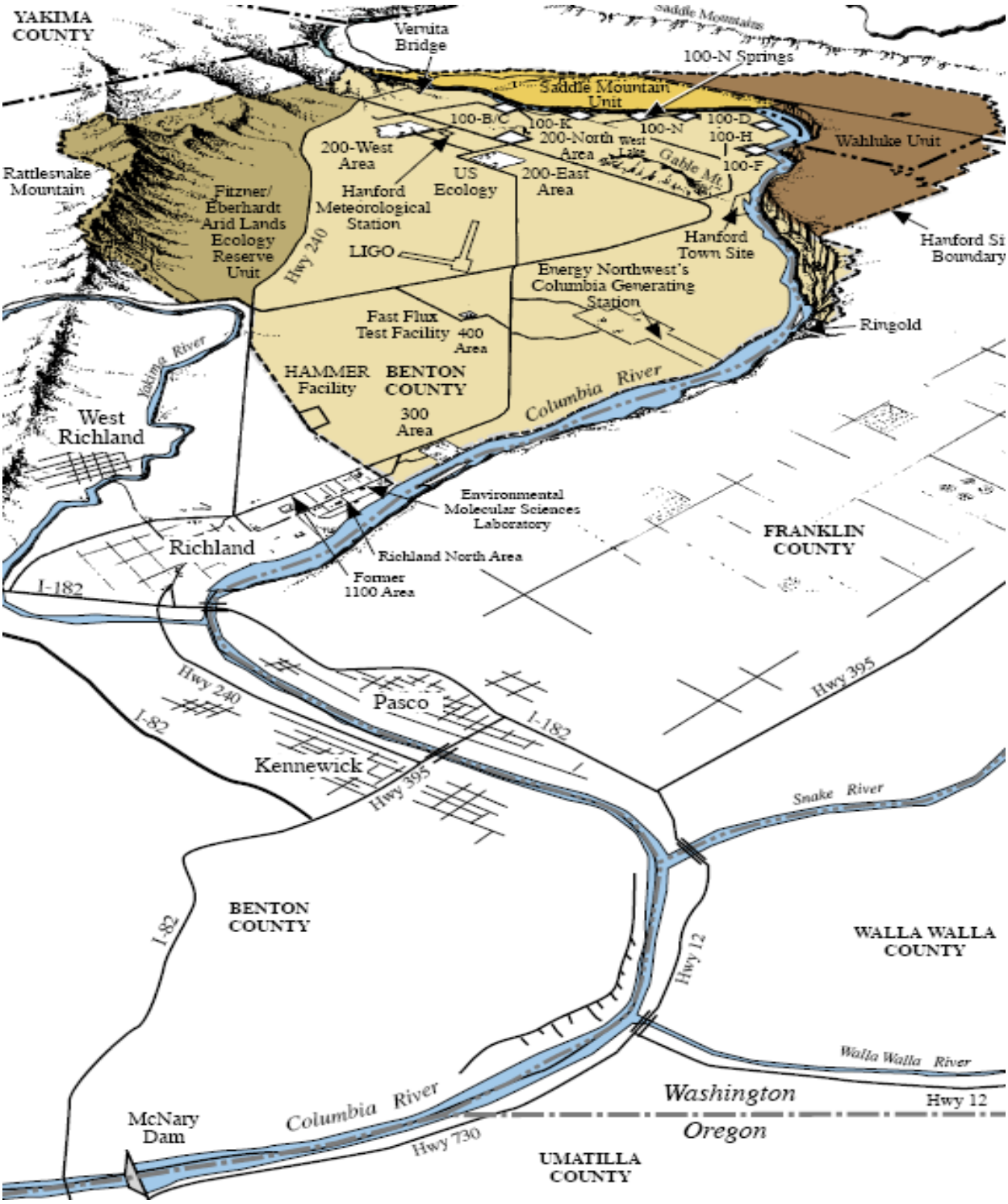


Figure 2.2 DOE's Hanford Site and Surrounding Community



3.0 COMPLIANCE SUMMARY

Each section will contain statistical trend analysis and a discussion of anomalous results. Section 8 of this report will contain a list of any contaminant released in air or water. The wind rose will be included in the appendix B. Section 7 of this report will contain the groundwater protection program information. Ventilation exhaust sample information will be included in the air emissions Appendix A.

USEW license allows the possession of 60,000 Curies of dry packaged radioactive waste, 36,000 Kg of Source Material, and Special Nuclear material is quantities no sufficient to form a critical mass. The air emissions license limit is 1 mrem/year.

3.1 Summary of releases of radioactive material that require notification

Date of Release	Type of release	Agency notified
No releases in 2015		

4.0 ENVIRONMENTAL PROGRAM INFORMATION

4.1 Description of the Environmental Program

US Ecology Washington (USEW) is required to perform environmental monitoring to show compliance with the Washington Administrative Code WAC 246-250-170. These regulations require that the annual doses due to effluents do not exceed 25 millirem to the whole body, 75 millirem to the thyroid, and 25 millirem to any other organ of any member of the public. USEW assumes that the methods described in ICRP-26 (Recommendations of the ICRP, ICRP Publication 26, 1977), and adopted by the NRC in 1991, are equal to the above limits. USEW assumes that achieving levels less than 25 mrem CEDE also meet the above limit. In addition, effluents release must be maintained "As Low As is Reasonably Achievable" (ALARA). The constraint on air emissions from WAC 246-221-005(4), 10 millirem per year criterion for airborne emissions, must also be verified.

The environmental monitoring program monitors all pathways which could result in offsite dose. These include environmental air, soil, vegetation, groundwater and direct radiation. Since the facility is located within the Hanford Reservation, the probability of any effluent reaching the general population is very low. Monitoring of food pathways is not possible since there are no farms or ranches near the facility. Wildlife is not monitored as hunting or trapping is prohibited on the Hanford Reservation. Vegetation samples provide some indication of radionuclides that could be found in the diet of wildlife but provide no information for use in a dose assessment to humans. Groundwater is monitored for continuous trending and detection of potential impacts by the site but is not used in human dose assessment. There are no wells that use the underlying aquifer for domestic or agricultural purposes. Soil is monitored as an indication of wind-blown particles that would not be detected in air samples and provides an indication of potential releases from the site. Soil results are not used in a human dose assessment as, other than the respirable portion, there is no pathway into humans.

Table 4.3 describes the USEW environmental monitoring program and action levels required by operating licenses. The actions required when environmental action levels are exceeded are given in Table 4.3. Section 3 of this report presents the results and evaluation of the environmental program. Table 4.1 is a list of the contracts laboratories used for environmental sample analysis.

Ensuring that effluents from the facility are less than regulatory limits is sound business practice.

A drawing showing the location where air, soil, vegetation and water samples are taken, and the location of dosimeters is found on Figure 2.1.

Meteorological information can be found in appendix B.

Table 4.1 Contract Laboratories:

Lab Name	*Type of Analysis*	*Certifications*	*Date of last USEW audit*
Prairie Analytical, Springfield Ill. (PAS)	Chemical	NELAP	10/23/2014
Environmental Inc. Midwest, Northbrook Ill. (EML)	Radiological	Interlab comparison, Environmental Resources Associates	10/2/2012
Mirion Technologies, Irving Ca.	TLD	NVLAP	5/14/2013

The potential exposure pathways for radiation or radioactive materials released from the site are direct exposure, airborne radionuclides, and radionuclide releases into the groundwater. The environmental monitoring program includes nine fixed environmental air stations, routine monitoring of soil and live vegetation, environmental thermoluminescent dosimeters and ten groundwater wells.

Direct radiation exposure rate measurements at all site fence line monitoring locations were within allowed limits and below investigation levels. Since access to the areas near the site is controlled, potential exposure to non-occupational personnel was minimal. Exposures from the direct radiation pathway would be immeasurably low at other Hanford facilities or at the nearest residence which is outside the Hanford Reservation.

In addition, effluent release data from the package inspection facility is used to calculate doses from site airborne releases to the general public. These calculations show that doses from site airborne releases are extremely low and indistinguishable from normal environmental background levels.

The facility completed quality assurance surveillances on the groundwater sampling, soil sampling, vegetation sampling, air sampling and environmental TLD placement.

US Ecology Richland Operation Procedures is included in the appendices.

Table 4.2 Required MDC

Radionuclide	**Water (pCi/l)**	**Airborne Activity (pCi/m3)**	**Soil (pCi/g – dry)**	**Vegetation (pCi/g - dry)**
Ba/La-140	24	0.02	0.05	0.21
Curium-141	10	0.01	0.02	0.09
Ce/Pr-144	92	0.09	0.18	0.30
Cobalt-58	10	0.01	0.02	0.09
Cobalt-60	6	0.01	0.02	0.09
Cesium-134	11	0.01	0.02	0.09
Cesium-137	7	0.01	0.02	0.09
Europium-152	56	0.06	0.11	0.51
Europium-154	27	0.03	0.05	0.24
Europium-155	24	0.02	0.05	0.21
Iron-59	17	0.02	0.03	0.15
Manganese-54	10	0.01	0.02	0.09
Sodium-22	10	0.01	0.02	0.09
Ruthenium-103	10	0.01	0.02	0.09
Ruthenium-106	85	0.09	0.17	0.78
Antimony-124	10	0.01	0.02	0.09
Antimony-125	24	0.02	0.05	0.21
Zinc-65	21	0.02	0.04	0.18
Zr/Nb-95	17	0.02	0.03	0.15
Gross Alpha (Lab)	2	0.002	-	-
Gross Beta (Lab)	3	0.02	0.1	1.0
Gross Alpha (USEW)	-	0.003	-	-
Gross Beta (USEW)	-	0.003	-	-
Iodine-125	-	30	-	-
Plutonium-238	0.01	-	0.01	0.01
Plutonium-239/240	0.01	-	0.01	0.01
Uranium	0.1	-	0.2	0.1

The Minimum Detectable Concentration (MDC) is defined as the concentration at which a 5% risk of false detection and false non-detection exists.

4.2 Environmental Monitoring Program Changes

All aspects of air monitoring, groundwater monitoring, soil monitoring, vegetation monitoring and external exposure monitoring continued in 2015.

Groundwater well MW-8 bladder pump failed during the 3rd quarter sampling evolution. A 3rd quarter sample was not collected. The sample from the 4th quarter for MW-8 was collected from the evacuation pump.

Table 4.3 Environmental Monitoring Requirements

				ACTION LEVELS		
MEDIUM	LOCATION	TYPE, FREQUENCY	ANALYSIS	INVESTIGATION LEVEL	REPORTING LEVEL	ACTION CATEGORY[1]
ENVIRONMENTAL AIR	Environmental Monitoring Stations 1-9	Continuous, changed weekly	Gross Alpha	1 E-14 µCi/cc	1.7 E-14 µCi/cc	3, 4
			Gross Beta	1 E-13 µCi/cc	2.6 E-11 µCi/cc	3, 4
	Environmental Monitoring Stations 1-9	Continuous, Quarterly Composite of Weekly Samples	Cobalt-60	5 E-14 µCi/cc	2.6 E-11 µCi/cc	3, 4
			Cesium-137	5 E-14 µCi/cc	1.9 E-10 µCi/cc	3, 4
			Gamma	5 X MDC	5 X MDC	3, 4
	Environmental Monitoring Stations 1,2,5	Continuous, for at least 30 days/qtr	Tritium	2 E-11 µCi/cc	6.1 E-8 µCi/cc	3, 4
OCCUPATIONAL AIR	One downwind plus one at each location of potential exposure	Continuous during operations, 1 hour minimum NA if no waste handling operations	Gross	NA[4]	3 E-13 µCi/cc[11]	1
			Gross Beta[2]	NA[4]	1 E-12 µCi/cc[11]	1
			I-125 (when required)	NA[4]	5 E-10 µCi/cc[11]	1

MEDIUM	LOCATION	TYPE, FREQUENCY	ANALYSIS	ACTION LEVELS: INVESTIGATION LEVEL	ACTION LEVELS: REPORTING LEVEL	ACTION CATEGORY[1]
SOIL[5]	Env. Monitoring Stations 1-9 and NE, NW Corners	Grab, Once Every Three Quarters	Gross Beta	35 ρCi/g (dry)	35 ρCi/g (dry)	3, 4
			Total Uranium[6]	1 ρCi/g (dry)	1 ρCi/g (dry)	3, 4
			Pu-238	0.03 ρCi/g (dry)	0.03 ρCi/g	3, 4
			Pu-239/240	0.03 ρCi/g (dry)	0.03 ρCi/g	3, 4
			Cobalt-60	0.3 ρCi/g (dry)	0.3 ρCi/g (dry)	3, 4
			Cesium-137	0.25 ρCi/g (dry)	0.25 ρCi/g	3, 4
			Gamma Spec	5 X MDC	5 X MDC	3, 4
VEGETATION[5]	Env. Monitoring Stations 1-9 and NE, NW Corners	Grab, Annually	Gross Beta	100 ρCi/g (dry)	100 ρCi/g	3, 4
			Total Uranium[6]	0.25 ρCi/g (dry)	0.25 ρCi/g	3, 4
			Pu-238	0.02 ρCi/g (dry)	0.02 ρCi/g	3, 4
			Pu-239/240	0.02 ρCi/g (dry)	0.02 ρCi/g	3, 4
			Cobalt-60	0.1 ρCi/g (dry)	0.1 ρCi/g (dry)	3, 4
			Cesium-137	0.2 ρCi/g (dry)	0.2 ρCi/g (dry)	3, 4
			Gamma Spec	5 X MDC	5 X MDC	3, 4
	Filled and capped trenches	Grab Annually	Gross Beta	100 ρCi/g (dry)	100 ρCi/g	3, 4
			Total Uranium[6]	0.25 ρCi/g (dry)	0.25 ρCi/g	3, 4
			Pu-238	0.02 ρCi/g (dry)	0.02 ρCi/g	3, 4
			Pu-239/240	0.02 ρCi/g (dry)	0.02 ρCi/g	3, 4
			Cobalt-60	0.1 ρCi/g (dry)	0.1 ρCi/g (dry)	3, 4
			Cesium-137	0.2 ρCi/g (dry)	0.2 ρCi/g (dry)	3, 4
			Gamma Spec	5 X MDC	5 X MDC	3, 4
			Tritium	NA[4, 8]	NA[4, 8]	

				ACTION LEVELS		
MEDIUM	LOCATION	TYPE, FREQUENCY	ANALYSIS	INVESTIGATION LEVEL	REPORTING LEVEL	ACTION CATEGORY[1]
GROUNDWATER	Wells	Grab, Once	Gross Alpha	12 ρCi/l	15 ρCi/l	3, 4
	#013[14]	Every	Gross Beta	12 ρCi/l	50 ρCi/l	3, 4
	#010	Quarter	Tritium	3,600 ρCi/l[12]	20,000 ρCi/l	3, 4
	#008		C-14	250 ρCi/l	2,000 ρCi/l	3, 4
	#005		Total Uranium[6]	4.5 ρCi/l	30 ρCi/l	3, 4
	#003		Pu-238	0.03 ρCi/l	See Pu-239/240	3, 4
	#009[14]		Pu-239/240	0.03 ρCi/l	40 ρCi/l (total Pu)	3, 4
	#009A[14]		Cobalt-60	6 ρCi/l	100 ρCi/l	3, 4
	(Tritium		Cesium-137	7 ρCi/l	200 ρCi/l	3, 4
	only)		Gamma Spec	5 X MDC[3]	5 X MDC[3]	NA[4]
	#004		Phenols	NA[4, 8]	NA[4, 8]	NA[4]
	#006[14]		Specific			
	#007		Conductance	NA[4, 8]	NA[4, 8]	NA[4]
			Metals	NA[4, 8]	NA[4, 8]	NA[4]
			TDS	NA[4, 8]	NA[4, 8]	NA[4]
			TOC	NA[4, 8]	NA[4, 8]	NA[4]
			VOC	NA[4, 8]	NA[4, 8]	NA[4]
			Nitrates	NA[4, 8]	NA[4, 8]	NA[4]
			Temperature	NA[4, 8]	NA[4, 8]	NA[4]
FIELD BLANK DEIONIZED WATER		1 blank per set of samples	Note 9	NA[4, 10]	NA[4, 10]	NA[4]
DOH Split Samples	As determined by	As determined by the Department	As determined by the Department	As appropriate for analysis	As appropriate for analysis	3, 4

MEDIUM	LOCATION	TYPE, FREQUENCY	ANALYSIS	ACTION LEVELS: INVESTIGATION LEVEL	ACTION LEVELS: REPORTING LEVEL	ACTION CATEGORY[1]
DIRECT GAMMA DOSE (TLD)	NW, NE, SW, SE Corners and N, S, E, W Fence lines Fence line position(s) nearest each active disposal trench	Continuous, Quarterly	Tissue dose using thermo-luminescent dosimeters	90 mrem/qtr	400 mrem/year	3, 4

NOTES Table 4.3

1) Table 4.4 presents the action required based upon action categories.
2) If Actinium-227 is listed on manifest or known to be present at concentrations required to be manifested, the reporting level is 2.0 E-13 μCi/cc.
3) The required minimum detection concentrations (MDC's) are listed in Table 4.3.
4) NA = Not applicable or none established.
5) Dry to wet ratio will be obtained.
6) Total uranium analysis is defined as the sum of the concentrations of uranium isotopes reported.
7) These are interim reporting levels.
8) Concentrations will be evaluated and reported annually in the environmental report.
9) Field blank analysis is the same as well sample analysis. Used for sample QA.
11) If a respirator is worn, the appropriate protection factor (e.g., PF = 50) can be used in determining whether or not the reporting level was exceeded.
12) Investigation level for MW- 13 tritium is 5000 ρCi/l.
13) Iodine air sampling is only required when offloading or handling packages containing at least 1 mCi of iodine.
14) Background (station 1) or upgradient (MW-9, 9A, 6 and 13).

Table 4.4 Action Categories

Actions Required When Action Level Met or Exceeded

1. Type 1 Event
   Follow Reporting Level requirements
   Potential for bioassay examined by RPM.

2. Type 2 Event
   Immediate notification of on-site inspector
   Take corrective action

3. Investigation Level
   Notify the RPM
   Take corrective actions described in FSM 6.1.5

4. Reporting Level
   Notify the RPM and the Department.
   Take corrective actions described in FSM 6.1.5
   Make reports in accordance with FSM 6.1.4.C

5.0 ENVIRONMENTAL RADIATION PROTECTION PROGRAM AND DOSE ASSESSMENT.

For the 2015 report, the site environmental data was combined into a common database or spreadsheet files. By combining these files, it allows for a comprehensive review of the data collected this year and in previous years.

5.1 Air

This section discusses the US Ecology Washington (USEW) environmental air-monitoring program. Where possible, 2015 results are compared with previously reported data contained in previous USEW Annual Environmental Monitoring Reports and the Hanford Site Environmental Reports for 2013.

Nine low-volume air samplers operating at 1.5 cfm are located around the perimeter of the facility. Particulate air filters were collected weekly such that a minimum of five days and a maximum of nine days collection time have accumulated. USEW uses in-house analysis for gross alpha and gross beta concentration determination. Historically, the amount of radioactive material collected on a filter during a week long period has been too small to accurately analyze for individual radionuclides of concern. Therefore, samples are combined into composite samples to increase the sensitivity and accuracy of the analysis. Particulate filters are composited quarterly and sent to the contract laboratory for gamma spectroscopy.

Three air monitoring stations also collect air moisture in desiccant cartridges operating at 150 cc/min. The desiccant cartridges operate continuously for at least 30 days per quarter and are sent to the contract laboratory for tritium analysis.

Sampling locations are depicted on Figure 4.1.

Station 1, located approximately 1,000 feet north of the receiving area, is the control station for the facility. NUREG 1388 (Environmental Monitoring of Low-Level Radioactive Waste Disposal Facility) states:

> "Air monitoring should include fence line and offsite sampling. The locations of the sampling stations should be based on meteorological data (wind directions) and critical-group locations."

Station 1 is the only non-fence line sample in a wind neutral direction from waste operations, and is representative of air in our vicinity (200 area of the Hanford Nuclear Reservation). The remaining 8 stations are in the predominantly downwind direction.

There are no defined critical groups for environmental dose assessment.

Iodine contained in waste shipments to the site have been infrequent and very low for the last decade, and iodine sampling has not detected iodine above the minimum detectable concentration. As a result, iodine sampling was changed on February 14, 2004 from continuous sampling at the site boundary to close proximity downwind sampling whenever waste packages containing at least 1 mCi of iodine are being handled. Iodine is sampled by collection on charcoal canisters and in-house analysis for iodine using low energy gamma detectors.

Air was sampled continuously during 2015 to determine particulate airborne radionuclide concentrations and to detect trends in concentrations.

All air sample results were at background levels. There is no discernable increasing or decreasing trend in air sample results. See appendix A for details on air emissions.

Cobalt-60 and Cesium-137 are not detected in air sample gamma spec analysis on a consistent basis: no trend analysis is possible. Graphs are not provided.

Air sample station were not operating during the following intervals:

- August 31 to September 8, 23 hours were lost due to a pump failure on station 7.

The dose (CEDE) from facility operations is determined by using the following assumptions:

- The average gross alpha, beta or tritium air sample result, subtracting station 1 results is the average concentration breathed at the fenceline,
- The alpha contamination is from natural uranium, and
- The beta contamination is from strontium-90.

The WAC 246-221-290 Table II column 1 levels are the air concentration that if a person breathed that concentration for an entire year, they would receive a dose of 50 mrem CEDE. To calculate a dose from an air sample, the average for the year is compared to the Table II value, and a dose assigned.

$$\text{Dose (mrem)} = \frac{\text{Average corrected concentration}}{WAC\ 246{-}221{-}290\ table\ II\ col.1} * 50 \text{ mrem}$$

Table 5.1 Air Average Concentrations and Estimated Dose.

	All station, Average Concentration, (µCi/ml)	*Uncertainty* [1]	*Station 1 Average Concentration (µCi/ml)*	*Uncertainty* [1]	*All Station Corrected Average (µCi/ml)*	*Table II column 1*	*Dose in mrem/year*
Alpha	1.68E-15	2.0E-15	1.58E-15	2.1E-15	1.0E-16	9E-14	0.075
Beta	2.45E-14	4.2E-14	2.37E-14	2.9E-14	8.0E-16	6E-12	0.007
Tritium	1.19E-12	2.4E-12	8.75E-13	2.1E-12	3.15E-13	1E-7	0.0002

[1] uncertainty is 2x the calculated standard deviation of all samples collected in 2015.

5.2 Water

There are no water samples collected at this facility, other than ground water.

5.3 Vegetation

Beginning in the first quarter of 2008, vegetation samples are collected annually at site perimeter sampling locations (nine environmental air-monitoring stations and the northeast and northwest site corners) provided there is at least one quarter with sufficient vegetation. Prior to 2008, site perimeter vegetation was sampled quarterly whenever there was sufficient vegetation. Trench

cap vegetation is monitored annually. The vegetation sampling procedure requires at least 300 grams of live deep-rooted vegetation to obtain a minimum sample.

All vegetation samples are analyzed for gross beta, gamma isotopic, uranium, and plutonium. In addition, trench cap vegetation is analyzed for tritium. Tritium monitoring of vegetation is experimental and there is no consensus opinion on interpretation of results. Vegetation samples are not analyzed for non-radiological constituents. All 2015 vegetation samples were below their investigation limits. In 2012, 2013 and 2014, Trenches 5, 11 and 14 vegetation sample tritium concentration were higher than normal.

The following should be noted when reviewing vegetation sample results:

- Vegetation samples from Trench 11 include samples from both the 11A and 11B areas of the trench,
- Vegetation samples from Trench 13 includes samples from both sections of Trench 13 (stable and unstable portions),
- Vegetation samples from Trench 14 include samples from trench 14, trench 14W and the sample portion of trench 14W.

Table 5.2 2015 Sites Not Sampled due to Insufficient Vegetation

Sample location	*Reason for no sample*
Tank Farm	No vegetation present
Trench 4A	No vegetation present

Vegetation Gross Beta Activity

In 2015, all samples from the stations and trench cap were equivalent to previous samples. No vegetation samples exceeded the action level for gross beta activity of 100 pCi/g. Annual trench cap deep-rooted vegetation samples were taken in the second quarter of 2015.

The Department of Energy does not report gross beta concentrations in vegetation at the Hanford Reservation.

According to the National Council on Radiation Protection and Measurements in Environmental Radiation Measurements, gross beta activity is due mainly to potassium-40, lead-210, bismuth-210 and the uranium and thorium series (National Council on Radiation Protection and Measurement, 1976). NCRP 76 suggests background beta in vegetation is between 7.8 and 123 pCi/g.

From a historical standpoint, it is only possible to compare gross beta in vegetation to historical results from USEW because neither the Department of Energy nor the state of Washington performs gross beta measurements of vegetation on or in the vicinity of the Hanford Reservation. Historically (prior to 1990), some vegetation samples have been in excess of 100 pCi/g gross beta, but these results were not considered significant because of the range given by NCRP. Gross beta activity from both trench cap vegetation and environmental monitoring station vegetation samples are consistent with historical results for the facility and expected values throughout the world. None of these results indicate increasing trends.

Vegetation Total Uranium Concentration

Total uranium concentration in vegetation is measured using alpha spectroscopy.

No trend was observed in site perimeter vegetation samples.

Vegetation Plutonium Concentration

Vegetation samples from environmental monitoring stations and trench caps were analyzed for plutonium-238 and plutonium-239/240. All 2015 vegetation samples were less than the minimum detectable concentration of 0.01 pCi/g for plutonium-238 and plutonium-239/240 as in previous years. Therefore, no plutonium in vegetation is attributable to USEW operations.

Because plutonium was not detected in vegetation, no graphs are provided.

Vegetation Spectrometry Analysis of Gamma Emitters

Samples collected in 2015 contained cesium-137 which is usually detected. The samples from the trench caps were generally lower than the samples from the fence line and facility corners. Both trench cap and fence samples were similar to background levels. In 2014, one sample analysis detected 0.03 ± 0.01 pCi/g from station 2, while all other samples did not detect cesium-137. Cesium-137 is frequently detected in Hanford 200 Area vegetation samples. Cobalt-60 was not detected in any vegetation samples.

There is insufficient data to create a graph for cobalt-60 and cesium-137 in vegetation.

Trench Cap Vegetation Tritium

Trench cap vegetation is also analyzed for tritium by extracting the water from the plant mass. The vegetation samples are of species that are not used for human consumption, or for feed of livestock. At this time, tritium monitoring of vegetation is experimental and there is no consensus opinion on interpretation of results. Environmental effects from even the maximum concentrations of tritium in vegetation are negligible.

In 2012 through 2014, the same bush on Trench 14 was resampled and analyzed for tritium, with higher than normal results. It is apparent that the Trench 14 Rabbitbrush (Ericameria Nauseosa) is high in tritium during part of the year. This bush was not individually sampled in 2015.

The Trench 5 concentration result was less than 2013, but still elevated. The sample in 2012 through 2015 were from Bursage (Ambrosia Acanthicarpa). USEW is attempting to establish Rabbitbrush plants in the area we think the high tritium sample was collected. The intent is to establish a plant that is deep rooted and perennial, so it can be resampled to confirm the first result. In the spring of 2014, 9 Rabbitbrush plants that were growing in a gravel pile were harvested with as much of their tap root as possible and transplanted. The plants were placed on the trench cap on Trench 5. No added water, soil amendments, soil conditioning or fertilizers were used in planting. The holes were only big enough for the tap root. Only 2 plants are still alive. The plants are not large or harvestable.

All locations are within their usual range.

Except as noted, the 2015 tritium samples were within their normal range. All of the trench caps will be resampled when regrowth occurs in 2016. Recent Hanford Environmental Reports do not provide tritium in vegetation data.

5.4 Soil

Soil samples are collected in order to detect long term buildup in soil of air borne radionuclides. Starting in the first quarter of 2008, soil samples are collected once every three quarters at the nine environmental air-monitoring stations and at the northeast and northwest site corners. The samples are collected from undisturbed soil from an area of 12 inches by 12 inches by one inch deep. Analyses include gross beta, total uranium, isotopic plutonium, and gamma emitting radionuclides. Prior to 2008, soil samples were collected quarterly.

Gross Beta in Soil

Soil samples were collected in the 3rd quarter in 2015. Soil samples were within the gross beta action level of 35 pCi/g (dry) as defined in Table 6.1 of the Facility Standards Manual. Comparison of 2015 results with data available from previous years shows gross beta concentrations remaining constant, or slightly declining. The variation is probably due to sampling and analysis uncertainties, not changes in the soil concentrations. Gross beta in soil results have not been provided in recent Hanford Near Facility Environmental Reports. USEW gross beta results are similar to undisturbed areas of Hanford. (Pacific Northwest National Labs, 2008)

Uranium in Soil

The concentration of uranium isotopes in soil is measured using alpha spectroscopy and summed for total uranium (uranium-233/234+uranium-235+uranium-238). The results show uranium concentrations are consistent with soils in the Hanford area. The trend is that concentrations are remaining the same.

Plutonium in Soil

The concentration of plutonium isotopes in soil is measured using alpha spectroscopy and summed for total Pu (plutonium-238 + plutonium-239/240). All individual isotopes (plutonium-238 and plutonium-239) values were below the Minimum Detectable Activity (MDA) of 0.01 pCi/g. Trend analysis is conducted by ensuring the levels are routinely below the detection levels. No graphs are provided for plutonium isotopes.

Gamma Emitting Radionuclides in Soil

Cobalt 60, Cesium 137 and Europium 155 have been present in Hanford soils, and USEW 2015 results are consistent with the radionuclides identified in US DOE Hanford's Annual Environmental reports. Probable sources of cesium-137 include past US DOE operations and worldwide cesium-137 fallout. Cobalt 60 has not been detected in USEW or Hanford 200 area soils in statistically significant concentrations for the last several years. The lack of detectable cobalt-60 is probably due to Hanford deposited cobalt-60's soil concentrations decaying to less than detectable quantities. Europium 155 was not detected in site soils from 2010 to 2015. Cesium 137 concentrations were all less than action levels. Considering their very low concentration, gamma emitter in soils concentrations contribute negligible radiation exposure. Because of this, trend analysis is to ensure that levels are consistently below the detection levels. Graphs are provided only for cesium-137, as it is the only isotope that is routinely detected in soil.

Investigation levels are set at five times the theoretical MDC with the exception of cesium-137 and cobalt-60, which are set at 0.25 and 0.3 pCi/g respectively. None of the soil samples exceeded the investigation levels.

In 2013, Hanford 200 East area had a mean cesium-137 value of 2.5±5.6 pCi/g and a maximum value of 8.4±1.1 pCi/g. (U.S. Department of Energy, 2014). DOE Hanford did not report results for gross beta in 2014. Soil samples from areas surrounding the Hanford Reservation (offsite) can be found in PNNL 2008. (Pacific Northwest National Labs, 2008)

5.5 Direct Gamma

Penetrating radiation is measured at numerous site perimeter locations using thermo-luminescent dosimetry (TLD). These locations define the site boundary where an individual not associated with Low Level Radioactive Waste (LLRW) site operation could be exposed to external radiation from the site. The location with the maximum ambient gamma dose was station

Penetrating radiation is measured at the following locations:

- One on each of the east, and south fence lines and two on the north and west fence lines. On September 1, 2010, TLDs 15, 16, 17, and 18 were moved approximately 250 feet to the north to match the new controlled area fence.
- One at each of the northeast, northwest, southeast, and southwest facility corners.
- One on the fence line at the closest point to each active disposal unit.
- One every 200 feet adjacent to Trench 18.
- A background TLD positioned at environmental air monitoring station number one.
- One TLD on the east fence across from the High Radiation Storage area.

TLD locations are shown on Figure 2.1.

The 1st quarter 2015 TLD at station 3 was destroyed at Mirion during analysis. The estimated dose for this station for the 1st quarter is 1.5 mrem/quarter based on the average of the previous 4 quarters data.

The 4th quarter 2015 TLD at station 6 was destroyed. A personnel TLD was placed at station 6 in December, and read zero when processed. No other reading was possible. The estimated dose is 0.5 mrem/quarter, based on the previous 3 quarters of data from this station and neighboring stations.

The maximum TLD station for 2015 is 98 mrem at station 12, or 24.5 mrem when the 25% occupancy factor is used. This is ¼ of the annual limit of 100 mrem/year. Station values can be found in attachment G, H or J. This value was calculated using the following equation:

$$Dose\ (mrem) = \left(\sum quarterly\ dose\ at\ maximum\ station\right) \times 0.25\ occpancy\ factor.$$

Environmental TLDs are supplied by Mirion Technologies, Inc. The Mirion Technologies, Inc. environmental dosimeters comply fully with ANSI N545-1975. The minimum reportable exposure is one mrem.

5.6 Dose Assessment

The 2015 maximum dose to a member of the public is 25 mrem/year. This amount is 25% of the annual limit. This dose was calculated using the following equation:

$$Dose\ \left(\frac{mrem}{year}\right) = Maximum\ direct\ gamma\ dose\ \left(\frac{mrem}{year}\right) + Dose\ from\ air\ station\ result\left(\frac{mrem}{year}\right)$$

Table 5.3 Tabular Reporting of Dose

Pathway	*Dose (mrem)*	*Limit from License (mrem)*	*Limit in Air Emissions (mrem)*
Air (fence)	0.08	25	N/A
Air (Cap88)	1E-6	N/A	1
Direct Gamma	24.5	100	N/A
All pathway	25	100	N/A

5.7 Maximally Exposed Individual (MEI).

The MEI is a hypothetical person whose location and lifestyle is unlikely to exist, but is used as the pathway for radiation dose from possible effluents from the site. This exposure pathway scenario is chosen to represent a hypothetical upper bound of potential dose to an individual, rather than an anticipated or actual dose.

USEW inspects the fence daily during operations. In 2015, there were no people living at or near the fence line of this facility. Any calculated dose is purely hypothetical.

The potential effluents that could cause a dose to the MEI are contaminants in the air.

5.8 Comparison to the 25 mrem per Year Limit.

Washington Administrative Code (WAC) 246-250-160 requires that the site be operated so that reasonable assurance exists that exposures to individuals are within the requirements established in the performance objectives in WAC 246-250-170 through 246-250-200. Among other things, they require specifically that the dose from effluents to any member of the public is less than 25 mrem to the whole body, 75 millirem to the thyroid, and 25 mrem to any other organ. While this dosimetry scheme is not easily defined using ICRP 26/30 (International Commission on Radiological Protection, 1977) methodology that the current regulations are based on, USEW will show that the dose Committed Effective Dose Equivalent (CEDE) form effluents are less than 25 mrem per year from air emissions.

The estimated average annual dose from the air pathway is 0.08 mrem per year for 2015. The dose calculated using the department of Health approved modeling software can be found in Appendix A.

5.9 Outside the Fence Monitoring Activities

USEW does not monitor for radionuclides outside of the immediate area of the waste site.

6.0 GROUNDWATER

US Ecology Washington (USEW) samples groundwater at 10 well locations to detect the presence of possible contamination from facility operations or other activities on the Hanford Reservation. Wells 3, 4, 5, 7, 8 and 10 are down gradient and Wells 6, 9, 9a and 13 are upgradient. The groundwater samples were analyzed for potential radiological and chemical contaminants.

In 2015, the bladder pump for MW-8 stopped working. USEW choose to upgrade the well pump to a style similar to the pumps installed in the wells MW-4, 6 and 7. Due to supply issues, the 3rd quarter sample was not collected, and the 4th quarter sample was collected from the evacuation pump rather than the bladder pump. The measured concentrations in MW-8 appear to be unchanged due to these occurrences.

6.1 Groundwater Gross Alpha and Beta Activity

Gross beta and gross alpha are sensitive and effective methods of detecting radioactivity in groundwater. Gross alpha and gross beta measurements are useful for screening and identifying trends in radionuclide concentrations. However, the variability in naturally occurring radioactivity hinders distinguishing between naturally occurring radioactivity and low level contamination that may have migrated to groundwater. Their analytical process for gross alpha adds variability to results, which make it difficult to quantify a specific level of radioactivity. In addition, the USEW site is located down gradient from the Hanford 200-West area that contains process facilities which have impacted groundwater.

There are no indications of increased gross alpha activity in any groundwater locations. Gross alpha results from upgradient and down gradient wells are similar. In addition, all values are less than investigation levels, are consistently close to the minimum detectable concentrations and within their historic range. Gross alpha showed no observable trends.

The Environmental Protection Agency (EPA) has set a maximum contaminant level (MCL) of 15 pCi/l for gross alpha in drinking water.

There were no indications of increased gross beta activity in any groundwater samples attributed to USEW operations. There were several gross beta results above our investigation level, but all were attributed to DOE activity.

Gross beta in MW-13, which is an upgradient well, has routinely exceeded its gross beta investigation level. Figure 6.1 plots MW-13's gross beta. Technitium-99 is a major contributor to the total beta activity in this well, as its concentration is greater than down gradient wells. The Department of Energy (DOE) year 2012 groundwater report shows that in the period from 1970 to the year 2012, tritium, Technitium-99 and I-129 plumes from 200-West has been slowly approaching the west side of the USEW site. It appears that gross beta in MW-13 is increasing. From 1992 to 2002, the increase was noticeable. Since 2002, the slope has decreased, but the concentration is still increasing from year to year at a slower rate. As the Technitium-99 and other plumes from the 200W area are ameliorated, diluted and decay, the levels should start to

decrease. Other wells, both upgradient and down, show a similar gross beta activity and a Technitium-99 activity.

The DOE groundwater reports provide additional information supporting the impact of 200-West on USEW's MW-13. The southern part of 200-West is part of the 200-UP-1 Operable Unit (OU). Most of the facilities and waste sites within the OU are associated with former operation of the 200 West area. The 200-UP groundwater interest area includes the 200-UP-1 groundwater operable unit in the southern portion of the 200 West Area, and adjacent portions of the surrounding 600 Area. With the exception of the Environmental Restoration Disposal Facility, the facilities and waste sites within 200-UP are associated with early operation of the Reduction-Oxidation Plant (plutonium and uranium separation) and U Plant (uranium recovery). U.S. Department of Energy (DOE) conducts groundwater monitoring in 200-UP under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) for the 200-UP-1 OU and the ERDF; and under the Resource Conservation and Recovery Act of 1976 for Waste Management Area (WMA) S-SX, WMA U, and the 216-S-10 Pond and Ditch. Monitoring of radionuclides is also performed to meet the Atomic Energy Act of 1954 (AEA) requirements.

Groundwater monitoring within the 200-UP-1 OU is performed under a sampling schedule incorporated into the Remedial Design/Remedial Action work plan (DOE/RL-2013-07). Technetium-99, uranium, tritium, iodine-129, nitrate, chromium, and carbon tetrachloride form extensive groundwater plumes in the area. These contaminants originated from operations in this area except for carbon tetrachloride which has migrated into 200-UP from 200-ZP. The contaminants chloroform, 1,4-dioxane, strontium-90, selenium-79, and trichloroethene (TCE) have been found in groundwater to a limited extent and are routinely sampled in selected wells. (CH2MHILL Plateau Remediation Company, 2014). Based on the DOE groundwater findings it is expected that plumes from 200-West will continue to have a slowly increasing effect on USEW's groundwater. The effect will probably continue to be detectable gross beta, technitium-99 and tritium.

6.2 Groundwater Tritium, Carbon-14, and Technetium 99

Tritium is present in groundwater at the Hanford site due to both natural processes and previous tritium contaminated liquid waste ground discharges from Hanford Department of Energy facilities (CH2MHILL Plateau Remediation Company, 2014). The USEW LLRW disposal facility is adjacent to the 200-East and 200-West facilities of the Department of Energy Hanford Reservation. As presented in DOE's Hanford Site Environmental Report 2013, tritium concentrations can exceed 200,000 pCi/l in the regions surrounding the 200-East and 200-West areas. As expected, tritium contamination from these plumes is affecting the levels observed in USEW monitoring wells. Since down-gradient wells tend to have lower tritium concentrations than upgradient wells, there appears to be no detectable increase in groundwater tritium due to USEW operations. DOE 2011 groundwater report clearly shows the expansion of the tritium plume from 200-West towards the USEW site from the 1970's until the year 2011. The most current location and levels of the plumes can also be seen at www.phoenix.pnnl.gov.

MW-9 and 9a are upgradient wells that draw their samples from the same location but at different depths. MW-9a, which is completed lower than MW-9 at approximately the center of the unconfined aquifer (345' to 375' below the surface), has lower tritium in earlier years but has

been showing increasing concentrations. However, starting in 2004 tritium concentrations appear to have started to slowly decrease.

The 2013 Hanford Site Groundwater Monitoring Report (U.S. Department of Energy, 2013) shows several plumes following the tritium plume. Some constituents are fully dissolved in the groundwater and migrate with the groundwater flow, as is the case for tritium, while others interact with the aquifer sediment to some degree (i.e., "sorb" by either adsorption or precipitation) and migrate at a slower rate than the groundwater flow, for example strontium-90 which strongly sorbs to aquifer sediments would move slowly in comparison to tritium.

In 2000, Carbon-14's minimum detectable concentration (MDC) was lowered from 200 pCi/l to approximately 15 pCi/l. Although well below investigation levels, Wells MW-3, 4 and 5 appear to have slightly higher Carbon-14 concentrations than the other wells. The concentration of Carbon-14 that would lead to a 4 mrem per year exposure using the assumptions of the EPA drinking water standards is 2000 pCi/l. The investigation level for Carbon-14 is 250 pCi/l.

Analysis for Technitium-99 in groundwater was started in 2000. Technitium-99 appears to follow a similar concentration pattern as tritium and gross beta. Technitium-99 his similar transportation in groundwater properties to tritium, and was disposed in a similar fashion by DOE at Hanford. Technitium-99 is the largest contributor to gross beta in the upgradient wells. Our contract laboratory has investigated the possibility that Technitium-99 is driven off during the drying portion of the gross beta analysis, and concluded that there is no appreciable loss during their procedure. The concentration of Technitium-99 that would result in a 4 mrem per year exposure using the assumptions of the EPA drinking water standards is 900 pCi/l.

6.3 Groundwater Gamma Emitting Radioisotopes in Groundwater

Water samples are analyzed by gamma spectrometry, no results exceeding reported MDAs were reported for man-made gamma emitting radioisotopes in groundwater in 2015. Therefore, site operations had no discernible effect on groundwater gamma emitting isotope concentrations.

There are no graphs, and the trend analysis is simply to confirm that the levels remain less than the detection level of the analysis.

6.4 Groundwater Plutonium

Groundwater samples taken from site monitoring wells were analyzed for Plutonium-238 and Plutonium-239/240. No samples exceeded investigation levels. All samples in 2015 are below the detection level for the lab. Graphs are not provided for plutonium. Trend analysis is to note that the concentration is remaining below detection levels.

Studies of the Hanford site indicate that plutonium should not migrate to groundwater. For example, PNNL-18640 Transuranic Contamination in Sediment and Groundwater at the U.S. DOE Hanford Site (Cantrell, PNNL 18640, 2009) states:

> "The primary reason that disposal of these large quantities of transuranic radionuclides directly to the vadose zone at the Hanford Site has not resulted in widespread groundwater contamination is that under the typical oxidizing and neutral to slightly alkaline pH conditions of the Hanford vadose zone, transuranic radionuclides (plutonium and americium in particular) have a very low solubility and high affinity for surface adsorption to mineral surfaces common within the Hanford vadose zone. Other

> important factors are the fact that the vadose zone is typically very thick (hundreds of feet) and the net infiltration rate is very low due to the desert climate."

The experience of the Hanford site also implies that given the groundwater conditions at Hanford, plutonium should not migrate even if it makes it to groundwater. The plutonium mobility study (Cantrell, PNNL -017839, 2008) states:

> "...both Pu(V) complexes and Pu(IV)O2(am) colloids or nanoclusters are well known for their high adsorption affinity for oxide and hydroxide mineral surfaces. As a result, these species are not likely to remain in solution as pH values approach those of typical Hanford Site groundwater (mildly alkaline, ~ pH 8)."

USEW's waste site has a limited amount of plutonium. There is no expected or measured plutonium impact on groundwater. The EPA has a generic limit for alpha emitters such as plutonium of 15 pCi/l for drinking water standards.

6.5 Groundwater Uranium

Total uranium consists of the sum of uranium-234, 235 and 238 concentrations. All total uranium sample concentrations were less than the investigation level. The EPA has a limit for uranium of 30 μg/l for drinking water (the specific activity of natural uranium is 0.711 pCi/μg).

Uranium in MW-8 is slightly higher than the upgradient well MW-13. The difference is very small, but measureable and consistent. While statistically different, the observation is not specifically an indication that contaminants from the waste site have reached the groundwater. The concentrations of uranium are decreasing slightly. If the waste site were contributing to the contaminants, the downstream concentration would be increasing- we are not seeing this. The difference is probably a function of the overall decrease in the volume of water in the aquifer, the different hydraulic gradients of these two wells, coupled with uranium plumes from Hanford operations and the continued efforts by Hanford to remove contaminants from the 200-UP area. This phenomenon should be reviewed each year.

6.6 Non-radiological Analysis

USEW sampling for non-radiological constituents was temporarily transferred to the Model Toxics Control Act (MTCA) Remedial Investigation/ Feasibility Study (RI/FS) after the first quarter of 2008. These results will be reported separately when the RI/FS is completed. The data has been taken for the RI/FS and the final report is in progress. As of 2011, non-radiological sampling has been resumed for inclusion in this report. Table 6.2 shows the Minimum Detectable Concentrations (Detection Levels - DL) for non-radiological well sampling constituents.

The procedure for gathering non-radiological samples was the same as that for radiological samples with the exception that non-radiological samples are placed in an ice chest and are cooled. Groundwater samples were analyzed for specific conductivity, total organic carbon (TOC), total organic halogens (TOX), nitrates, chlorides, sulfates, dissolved solids, benzene, ethyl-benzene, toluene and xylene.

Chlorides, nitrites, pH, specific conductance, sulfates, and total dissolved solids are similar for all wells. Although there are occasional elevated or depressed values, groundwater quality does not appear to vary by well or have changed over time. In addition, nitrate concentrations are low in comparison to surrounding areas, which range from 20 to over 1,000 ppm in the region surrounding Hanford's 200-East and 200-West.

Groundwater is analyzed for the following 40 CFR 264, Appendix IX constituents: barium, cadmium, chromium, mercury, and silver. Analysis also includes potassium, calcium, magnesium, manganese, iron, and sodium. Comparison of down gradient Wells 3, 4, 5, 8, and 10 to the upgradient Wells 6, 9, and 13 and cross gradient MW-7 show no discernible difference in Appendix IX metals or other metals. Appendix G (electronic database) contains the 2015 analytical data for non-radiological contaminants.

Table 6.1 Typical Chemical Reporting and Detection Levels

ANALYTE	CASNUMBER	DL	RL	UNITS	ANALYTE	CASNUMBER	DL	RL	UNITS
Hexavalent Chromium	18540-29-9	0.0034	0.01	mg/L	n-Propylbenzene	103-65-1	0.0994	5	µg/L
Acetone	67-64-1	1.25	50	µg/L	Styrene	100-42-5	0.0988	5	µg/L
n-Butylbenzene	104-51-8	0.125	5	µg/L	1,1,1,2-Tetrachloroethane	630-20-6	0.168	5	µg/L
sec-Butylbenzene	135-98-8	0.0971	5	µg/L	1,1,2,2-Tetrachloroethane	79-34-5	0.255	5	µg/L
tert-Butylbenzene	98-06-6	0.161	5	µg/L	Tetrachloroethene	127-18-4	0.271	5	µg/L
Carbon disulfide	75-15-0	0.758	10	µg/L	Bromodichloromethane	75-27-4	0.0917	2	µg/L
Carbon tetrachloride	56-23-5	0.106	5	µg/L	Toluene	108-88-3	0.351	5	µg/L
Chlorobenzene	108-90-7	0.221	5	µg/L	1,2,3-Trichlorobenzene	87-61-6	0.23	5	µg/L
Chloroethane	75-00-3	0.356	10	µg/L	1,2,4-Trichlorobenzene	120-82-1	0.28	5	µg/L
Chloroform	67-66-3	0.146	2	µg/L	1,1,1-Trichloroethane	71-55-6	0.122	5	µg/L
Chloromethane	74-87-3	0.66	10	µg/L	1,1,2-Trichloroethane	79-00-5	0.226	5	µg/L
2-Chlorotoluene	95-49-8	0.0998	5	µg/L	Trichloroethene	79-01-6	0.194	5	µg/L
4-Chlorotoluene	106-43-4	0.0921	5	µg/L	Trichlorofluoromethane	75-69-4	0.612	10	µg/L
Dibromochloromethane	124-48-1	0.179	5	µg/L	1,2,3-Trichloropropane	96-18-4	0.138	2	µg/L
Dibromomethane	74-95-3	0.179	5	µg/L	1,2,4-Trimethylbenzene	95-63-6	0.0958	5	µg/L
1,2-Dichlorobenzene	95-50-1	0.237	5	µg/L	1,3,5-Trimethylbenzene	108-67-8	0.107	5	µg/L
1,3-Dichlorobenzene	541-73-1	0.152	5	µg/L	Bromoform	75-25-2	0.209	2	µg/L
1,4-Dichlorobenzene	106-46-7	0.298	5	µg/L	Vinyl acetate	108-05-4	0.289	10	µg/L
Dichlorodifluoromethane	75-71-8	0.727	10	µg/L	Vinyl chloride	75-01-4	0.151	2	µg/L
Benzene	71-43-2	0.122	5	µg/L	Xylenes (total)	1330-20-7	0.525	15	µg/L
1,1-Dichloroethane	75-34-3	0.293	5	µg/L	Bromomethane	74-83-9	0.426	9.8	µg/L
1,2-Dichloroethane	107-06-2	0.236	5	µg/L	2-Butanone	78-93-3	0.16	10	µg/L
1,1-Dichloroethene	75-35-4	0.375	5	µg/L	Total Organic Halides 1		100	100	µg/L
cis-1,2-Dichloroethene	156-59-2	0.171	5	µg/L	Total Organic Carbon	7440-44-0	0.00568	1	mg/L
trans-1,2-Dichloroethene	156-60-5	0.237	5	µg/L	Phenolics		0.00104	0.005	mg/L
1,2-Dichloropropane	78-87-5	0.156	5	µg/L	Barium	7440-39-3	0.000823	0.005	mg/L
1,3-Dichloropropane	142-28-9	0.102	5	µg/L	Cadmium	7440-43-9	0.000226	0.001	mg/L
2,2-Dichloropropane	594-20-7	0.2	5	µg/L	Calcium	7440-70-2	2.33	10	mg/L
1,1-Dichloropropene	563-58-6	0.137	5	µg/L	Chromium	7440-47-3	0.00044	0.005	mg/L
Bromobenzene	108-86-1	0.182	5	µg/L	Iron	7439-89-6	0.0129	0.1	mg/L
cis-1,3-Dichloropropene	10061-01-5	0.111	2	µg/L	Magnesium	7439-95-4	1.59	10	mg/L
trans-1,3-Dichloropropene	10061-02-6	0.092	2	µg/L	Manganese	7439-96-5	0.00039	0.005	mg/L
Ethylbenzene	100-41-4	0.374	5	µg/L	Mercury	7439-97-6	0.0000625	0.0002	mg/L
Hexachlorobutadiene	87-68-3	0.734	7	µg/L	Potassium	7440-09-7	0.0327	0.3	mg/L
2-Hexanone	591-78-6	0.17	5	µg/L	Silver	7440-22-4	0.000327	0.005	mg/L
Isopropylbenzene	98-82-8	0.0903	5	µg/L	Sodium	7440-23-5	4.32	10	mg/L
Bromochloromethane	74-97-5	0.156	5	µg/L	Chloride	16887-00-6	0.1	0.5	mg/L
p-Isopropyltoluene	99-87-6	0.0889	5	µg/L	Nitrate (as N)	7727-37-9	0.05	0.25	mg/L
Methyl tert-butyl ether	1634-04-4	0.398	5	µg/L	Sulfate	14808-79-8	0.3	1.5	mg/L
4-Methyl-2-pentanone	108-10-1	0.0934	5	µg/L	Conductivity		1	10	µmhos/cm
Methylene chloride	75-09-2	0.442	5	µg/L	Total Dissolved Solids		14.1	100	mg/L
Naphthalene	91-20-3	0.545	10	µg/L	pH			0.01	pH Units

As in previous years, groundwater data for 2015 showed no indication of scintillation cocktail constituents of benzene, ethyl benzene, toluene, and xylene. Total organics carbons (TOC) were sporadically detected in MW-7 (quarter 1 and 2) and MW-9 (quarter 3). The constituents that were found in the upgradient wells are attributed to DOE Hanford contaminants. See the 2014 Hanford Environmental Report (U.S. Department of Energy, September 2015). Total organic halogen (TOX) were less than detection level, although they have been detected in the past in wells 3 and 5. In 2011, the procurement specification was changed to match the lower limit of detection reported by the laboratory of 100 µg/l for total organic halogen.

Chromium was detected in all wells. Hexavalent chromium is also analyzed in all wells, and shows no statistical difference from Chromium Concentrations. Chromium is one of the

proposed contaminants of concern in the MTCA evaluation. There is a chromium plume under the site that originated in the Hanford 200 West Area from previous DOE operations. The MTCA process is determining if the waste site is adding chromium to the groundwater. The 2014 Hanford Environmental Report (U.S. Department of Energy, September 2015) shows the USEW site on top of the estimated plume location, with the center of the plume (and higher concentrations) coming in the future. A Screen shot from the Phoenix web site is included below, and an update plume map can be found at the Phoenix web site (U.S. Department of Energy, 2015). The DOE estimates that hexavalent chromium exists under our site at concentration up to 480 µg/l. This contamination is attributed to two primary sources: an overfill event of 91,000 l (24,000 gal) from Tank S-104 in the S Tank Farm (Sections 3.7.2 and 4.6 in RPP-RPT-48589, *Hanford 241-S Farm Leak Assessment Report*), and a 190,000 l (51,000gal) leak from Tank SX-115 during 1965 in the SX Tank Farm. (CH2M, 2015)

DOE released an RI/FS report and proposed plan for the 200-UP-1 Operable Unit in 2012. The preferred alternative is a combination of 1) groundwater extraction and treatment for technetium-99, uranium, and chromium, 2) a combination of pump-and-treat and monitored natural attenuation for nitrate and carbon tetrachloride, 3) monitored natural attenuation for tritium, 4) hydraulic containment for iodine-129 while treatment technologies are investigated, and 5) institutional controls. Wells near a 200 E tank farm continued to show the highest technetium-99 concentrations on the Hanford Site in 2012. A new pump-and-treat system began operating during 2012. Between July and December 2012, the system removed 0.25 Curie of technetium-99 from groundwater. The system also remediates nitrate and chromium. (U.S. Department of Energy, September 2013)

Work was done by DOE in 2015 to access and install wells in the area west of USEW.

Other non-radiological contaminants that can be detected in our monitoring wells are Chloroform, cis-1,2-Dicholorethene, 1,1-Dichloroethane, and Trichloroethene. The wells with higher than upgradient concentrations are wells 3, 4 and 5.

Figure 6.1 Average Chromium Concentrations.

This is a screen shot from the Phoenix web site.

6.3 Groundwater Elevations

The elevation above the datum for the depth to water and depth to bottom are shown in the following tables. In January 2014, the wells were surveyed by Rogers Surveying, and the elevation of each sounding tube values were corrected. The values shown in this table represent the readings in depth to water from the sounding tube top, corrected for the new datum (NAVD88, North American Vertical Datum of 1988). Previous elevations were found using the NAVD29 datum which caused a change, and other unknown factors created unexplained differences. USEW is located in an area between a steep hydraulic gradient and a shallow gradient. Water flows from the south west to the north east. MW-13 is an anomalous well, as its elevation is higher than would be expected by the groundwater models.

Table 6.2 Well Depth to Bottom (DTB)

Date	*Location*	*Measurement type*	*Measurement*	*Units*	*Conversion to NAVD88 datum (ft)*	*Depth (Ft, above datum)*
3/11/2015	MW-10	DTB	364.1	Ft	739.72	375.62
3/10/2015	MW-13	DTB	351.6	Ft	728.9	377.30
3/12/2015	MW-3	DTB	353.88	Ft	729.02	375.14
3/12/2015	MW-4	DTB	369.4	Ft	735.11	365.71
3/11/2015	MW-5	DTB	352.6	Ft	727.05	374.45
3/10/2015	MW-6	DTB	369.58	Ft	736.86	367.28
3/12/2015	MW-7	DTB	377.94	Ft	750.28	372.34
3/11/2015	MW-8	DTB	350.34	Ft	730.08	379.74
3/10/2015	MW-9	DTB	352.82	Ft	727.25	374.43
3/10/2015	MW-9a	DTB	378.3	Ft	727.37	349.07

DTB = Depth to Bottom of well case.

Table 6.3 Groundwater Elevations (feet)

Date	*Location*	*Measurement type*	*Measurement*	*Units*	*Conversion to NAVD88 Datum (ft)*	*Depth (Ft, above Datum)*
3/10/2015	MW-13	DTW	323.9	Ft	728.9	405.00
3/10/2015	MW-6	DTW	334.54	Ft	736.86	402.32
3/10/2015	MW-9	DTW	323.4	Ft	727.25	403.85
3/10/2015	MW-9a	DTW	323.72	Ft	727.37	403.65
3/11/2015	MW-10	DTW	339.95	Ft	739.72	399.77
3/11/2015	MW-5	DTW	327.04	Ft	727.05	400.01
3/11/2015	MW-8	DTW	330.34	Ft	730.08	399.74
3/12/2015	MW-3	DTW	329.56	Ft	729.02	399.46
3/12/2015	MW-4	DTW	335.6	Ft	735.11	399.51
3/12/2015	MW-7	DTW	350.8	Ft	750.28	399.48
5/11/2015	MW-13	DTW	323.96	Ft	728.9	404.94
5/11/2015	MW-6	DTW	334.6	Ft	736.86	402.26
5/12/2015	MW-5	DTW	327.08	Ft	727.05	399.97
5/12/2015	MW-9	DTW	323.46	Ft	727.25	403.79
5/12/2015	MW-9a	DTW	323.84	Ft	727.37	403.53
5/13/2015	MW-10	DTW	339.9	Ft	739.72	399.82
5/13/2015	MW-4	DTW	335.35	Ft	735.11	399.76
5/13/2015	MW-8	DTW	330.3	Ft	730.08	399.78
5/14/2015	MW-3	DTW	329.36	Ft	729.02	399.66
5/14/2015	MW-7	DTW	350.58	Ft	750.28	399.70
8/10/2015	MW-13	DTW	324.2	Ft	728.9	404.70
8/10/2015	MW-6	DTW	369.58	Ft	736.86	367.28
8/10/2015	MW-9	DTW	323.68	Ft	727.25	403.57
8/11/2015	MW-5	DTW	327.08	Ft	727.05	399.97
8/11/2015	MW-8	DTW	330.02	Ft	730.08	400.06
8/11/2015	MW-9a	DTW	324	Ft	727.37	403.37

Date	*Location*	*Measurement type*	*Measurement*	*Units*	*Conversion to NAVD88 Datum (ft)*	*Depth (Ft, above Datum)*
8/12/2015	MW-10	DTW	339.85	Ft	739.72	399.87
8/12/2015	MW-4	DTW	335.36	Ft	735.11	399.75
8/12/2015	MW-7	DTW	350.5	Ft	750.28	399.78
8/13/2015	MW-3	DTW	329.26	Ft	729.02	399.76
11/30/2015	MW-13	DTW	324.1	Ft	728.9	404.80
11/30/2015	MW-6	DTW	334.64	Ft	736.86	402.22
11/30/2015	MW-9	DTW	323.68	Ft	727.25	403.57
12/1/2015	MW-10	DTW	339.95	Ft	739.72	399.77
12/1/2015	MW-5	DTW	327.06	Ft	727.05	399.99
12/1/2015	MW-9a	DTW	324.06	Ft	727.37	403.31
12/2/2015	MW-3	DTW	329.16	Ft	729.02	399.86
12/2/2015	MW-4	DTW	335.23	Ft	735.11	399.88
12/2/2015	MW-7	DTW	350.4	Ft	750.28	399.88
12/3/2015	MW-8	DTW	329.83	Ft	730.08	400.25
12/22/2015	MW-8	DTW	330.3	Ft	730.08	399.78

DTW = Depth to Water

Figure 6.2 Groundwater Elevation Trend (average per well)

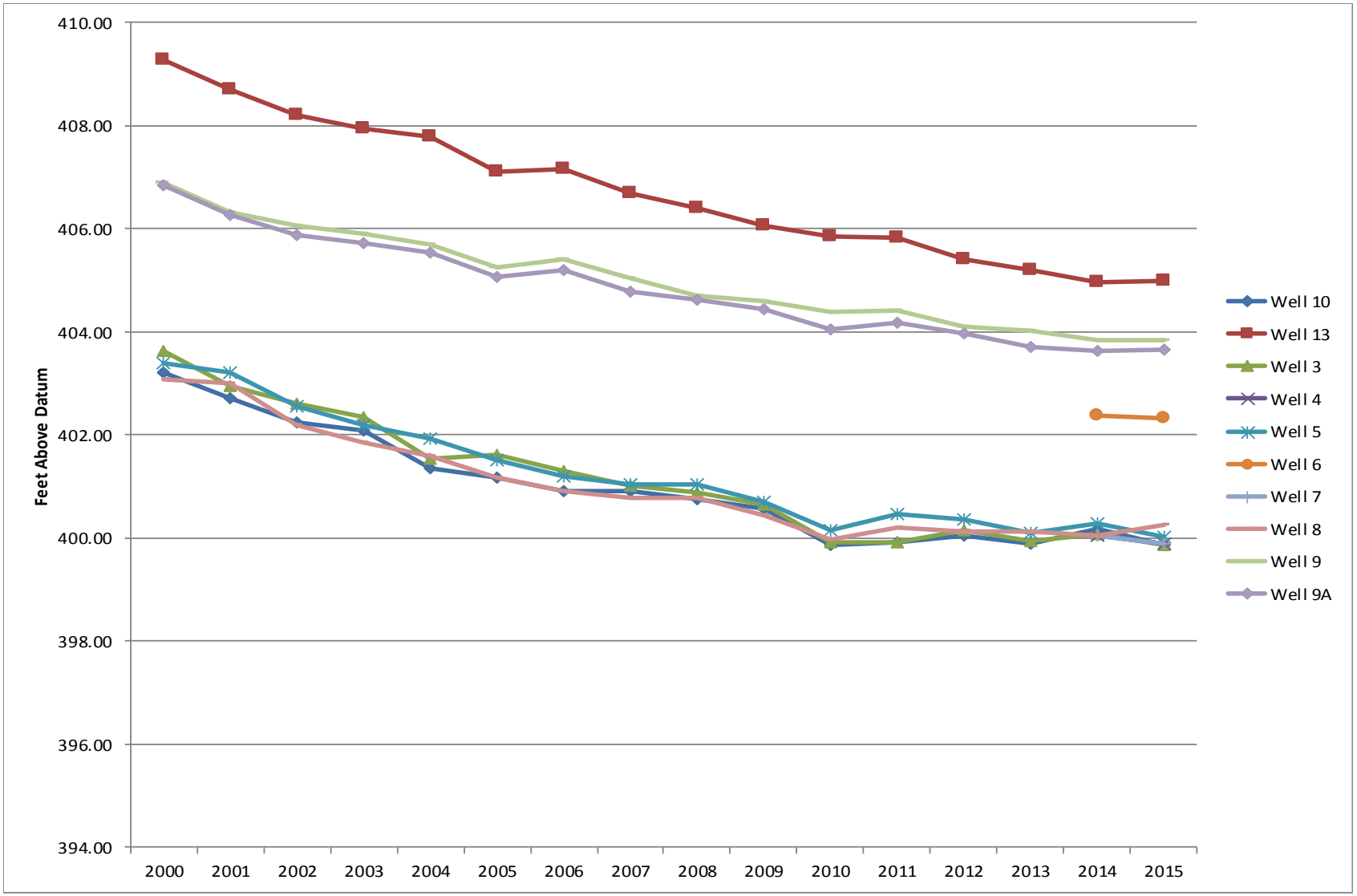
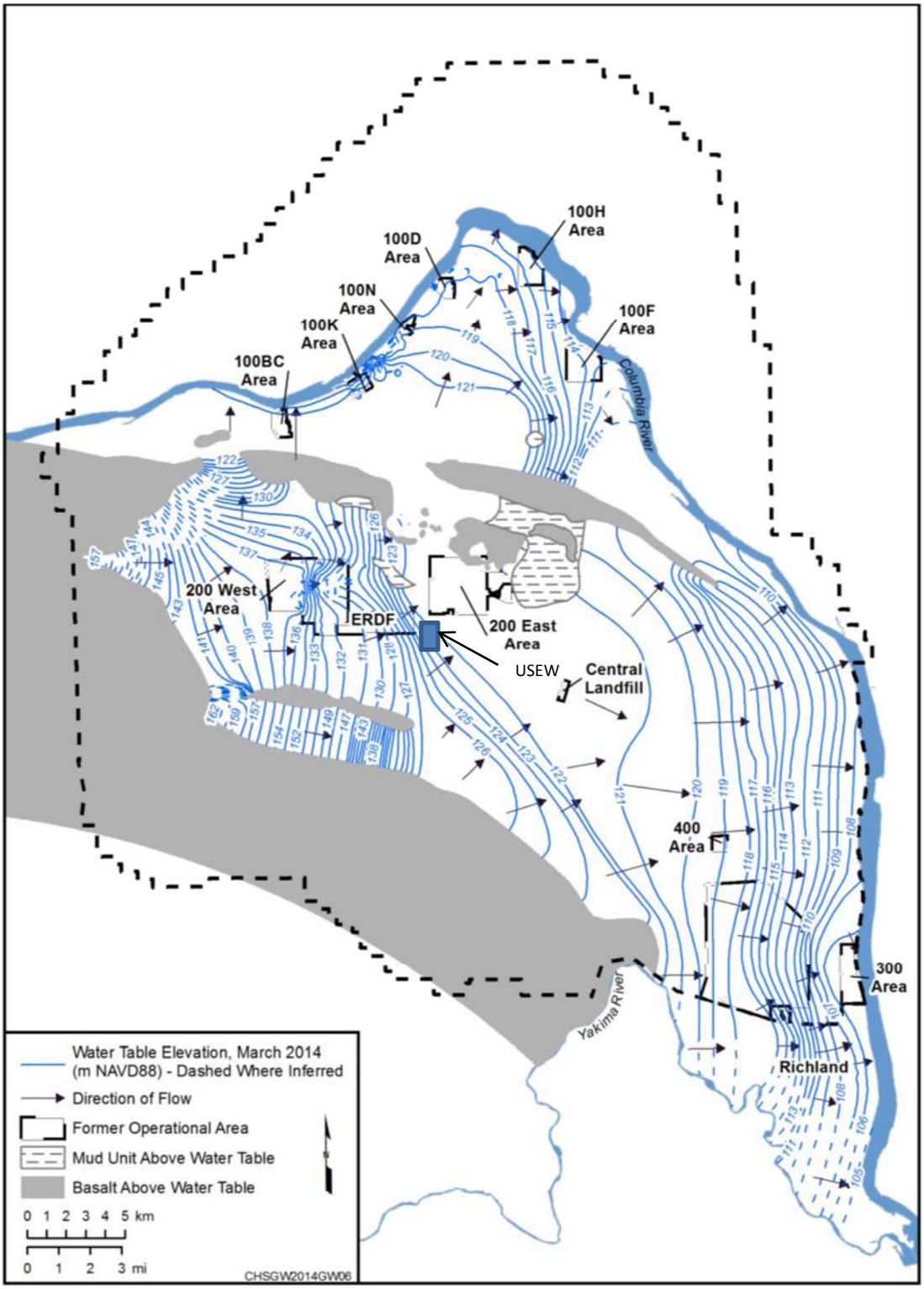


Figure 6.3 Hanford Site Water Table and Direction of Groundwater Flow.



(U.S. Department of Energy, September 2015) Elevation in meters.

6.8 Special Water Sampling

Special groundwater sampling for chemical constituents started in 2008 as part of a Model Toxics Control Act (MTCA) Remedial Investigation (RI)/Feasibility Study (FS). These samples were taken at the existing USEW wells for eight consecutive quarters. Detailed sample results are contained in VET-1405-RPT-001, USEW Low-Level Radioactive Waste Disposal Site Remedial Investigation Report. There were numerous analyses performed on the groundwater samples with the majority of results being non-detects. A few analytes in groundwater were found at concentrations above MTCA Method B (unrestricted use) cleanup level. These were hexavalent chromium, trichloroethene, arsenic, and uranium. Chloroform was identified and also added as a contaminant of potential concern due to being in the same location with trichloroethene.

6.9 Comparison of USEW Data with Surrounding Department of Energy Wells

The USEW LLRW Site is located inside the Department of Energy's Hanford Reservation on the 200 Area plateau. The Hanford 200 area includes fuel processing and high-level liquid waste storage facilities which have significantly affected localized groundwater concentrations. The Hanford site is divided into several superfund cleanup sites (OU, operable units). In 2009, the Department of Energy started reporting groundwater results with respect to location by OU rather than the traditional site area. Based on DOE maps, USEW is located within one of the DOE Hanford operable units 200-UP-1 and partially within 200-PO-1 and near to operable unit 200-ZP-1. Although no DOE wells are in close proximity to USEW groundwater wells, there are several groundwater wells in the 200-UP-1 and DOE 200-ZP-1 operable units. DOE well data can be found at phoenix.pnnl.gov (Pacific Northwest National Laboratory, n.d.). (U.S. Department of Energy, 2014).

Below are wells that are generally in an upgradient direction that contain tritium, uranium and technetium 99. These are contaminants that are routinely found in USEW well water. In addition, these contaminants are being removed from by groundwater by water treatment plants in the 200-UP operating unit.

Table 6.4 Upgradient DOE Wells

DOE Well Number	*Analyte*	*Date Sampled*	*Result pCi/l*
699-35-66A	Tritium	3/18/2015	76900 pCi/l
699-32-62	Tritium	4/9/2015	5310 pCi/l
699-36-61A	Tritium	6/23/2014	36,000 pCi/l
699-34-61	Tritium	3/13/2015	8150 pCi/l
699-35-66A	Technitium-99	9/29/2015	139 pCi/l
699-32-62	Technitium-99	11/7/2012	34 pCi/l

DOE Well Number	*Analyte*	*Date Sampled*	*Result pCi/l*
699-36-61A	Technitium-99	5/20/2013	11 pCi/l
699-34-61	Technitium-99	10/1/2013	35 pCi/l
699-30-66	Technitium-99	9/29/2015	139 pCi/l
699-35-66A	Uranium	9/29/2015	1.86 µg/l
699-32-62	Uranium	11/7/2012	2.87 µg/l
699-36-61A	Uranium	5/20/2013	2.1 µg/l
699-34-61	Uranium	10/1/2013	2.07 µg/l

(Pacific Northwest National Laboratory, n.d.)

7.0 QUALITY ASSURANCE

7.1 Corporate Policy Concerning Quality Assurance

"The policy of US Ecology Washington Inc. (USEW), a wholly owned subsidiary of US Ecology, Inc. is to consistently and professionally provide our clients a service that achieves a level of quality, meeting or exceeding defined industry and regulatory requirements, as well as ethical standards. USEW's objective is to maintain a Quality Assurance (QA) Program representative of appropriate industry standards. The requirements contained in this QA Manual apply to all USEW quality-related activities.

This manual describes the QA Program developed by USEW and reflects the quality assurance requirements of NUREG 1293, titled "Quality Assurance Guidance for a Low-Level Radioactive Waste Disposal Facility". In instances where additional project specific requirements are imposed, a project Quality Assurance Program Plan (QAPP) will identify the associated requirements.

The President of US Ecology, Inc. has ultimate responsibility for all activities performed in accordance with this Quality Assurance Manual. The Quality Assurance and Regulatory Compliance Coordinator (QA&RCC) is assigned the responsibility and authority to organize and maintain the QA program and assures its implementation. The QA&RCC has the organizational freedom to identify quality problems, initiate, recommend and provide solutions to quality problems." (US Ecology Washington, 2012)

7.2 Quality Assurance Plan Summary

The USEW Quality Assurance Plan is described in (US Ecology Washington, 2012). USEW procedures are contained in (US Ecology Washington, 2014). The basis for development of the site QA plan is NUREG 1293, Rev 1, April, 1991. The procedures for conducting sampling and the statistical methods used to analyze and validate the sample data are contained in the Richland Operating Procedures (Appendix E).

Internal surveillances are conducted per the schedules of (US Ecology Washington, 2012). In 2015 there were 5 surveillances conducted of environmental monitoring operations.

Qualified Radiation Control and Safety Technicians (RC&STs) collect environmental samples in accordance with operational procedures contained in the US Ecology Washington (USEW) Richland Operating Procedures Manual. RC&ST qualification covers all aspects of the environmental monitoring program and includes training, demonstration of practical factors, and written and oral examinations.

Environmental Inc. Midwest Laboratory of Northbrook Ill. (EML) performs the routine radiochemical analyses of environmental monitoring samples. EML maintains an internal quality assurance program that involves routine calibration of counting instruments, daily source and background checks, yield determinations of radiochemical procedures, replicate analysis to check precision, and analyses of reagents to ensure purity of chemicals. Calibration standards traceable to the National Institute of Standards and Technology (NIST) are used for radiochemical calibrations when available.

In addition, EML participates in the Laboratory Intercomparison Studies Program administered by Environmental Resource Associates (ERA). This program serves as a replacement for the studies previously conducted by the US Environmental Protection Agency's Environmental

Monitoring Systems Laboratory. These programs provide a regular means of evaluating laboratory analytical performance by cross comparison of various environmental media samples (water, milk, air filters, soil, foodstuffs, and tissue ash) containing one or more radionuclides in known amounts. After the samples are analyzed, results are forwarded to ERA for comparison with known values and with results from other laboratories. ERA has established criteria for evaluating the accuracy of results.

Environmental gamma radiation levels are measured using thermoluminescent dosimeters (TLDs) placed along the site boundary. TLDs are exchanged quarterly. Real time confirmatory measurements are made using microR radiation survey instruments and integrating self-reading dosimeters. Washington Department of Health and Hanford Contractor TLDs are in the same location as several of the environmental TLD locations.

Environmental TLDs were supplied by Mirion Technologies, Inc. Mirion Technologies, Inc. is accredited by the National Voluntary Laboratory Accreditation Program for dosimetry processors. This program is administered by NIST for ensuring accuracy and precision of TLD results.

Prairie Analytical (PAS) located in Springfield Illinois provides the non-radiological chemical analysis. PAS is a subcontractor of EML. PAS maintains an internal quality assurance program that involves routine calibration of instruments, chemical procedures, replicate analysis to check precision, and analyses of reagents to ensure purity. Traceable calibration standards and tracer chemicals are used for all vadose analysis. PAS provides calibration and yield data with sample analysis reports.

Radiation counting instruments used to count air samples and iodine cartridges are checked daily and evaluated using statistical quality control. Gas proportional counters used for counting air samples are checked monthly for operating characteristics and χ^2. Radiation detection instruments used to measure fence-line dose rates in support of TLD monitoring are calibrated by an independent calibration facility. The companies contracted to perform calibration services are Ludlum Measurements Inc., Hi-Q, Energy Northwest, and Pacific Northwest National Laboratory (PNNL).

7.3 Vendor Audits

An integral part of supplier selection and qualification are quality assurance evaluations and onsite audits of the vendor. Each supplier of environmental, laboratory or calibration services is required to maintain an internal quality assurance program and to conduct operations in accordance with approved procedures. Vendor's quality assurance programs and operational procedures are reviewed annually. Onsite audits are conducted at least once every five years.

- Mirion Technologies, Inc. was audited in May, 2013.
- Hi-Q was audited November 2011.
- Energy Northwest was audited October, 2015
- Environmental Inc. Midwest Laboratories was audited in October, 2012.
- Ludlum Instruments, Inc. was audited in February, 2015, and
- Pacific Northwest National Laboratory was audited in December, 2011.

These audits focus on implementation of quality assurance programs, calibration and processing procedures, and analysis of samples including air, soil, water, vegetation and TLD materials as appropriate. These audits indicated that these vendors are maintaining acceptable quality assurance programs.

7.4 Split Samples

In addition to the formal QA program described above, The Washington Department of Health obtains various environmental samples at the US Ecology Washington sampling locations. In 2015, WDOH and USEW obtained comparative samples for vegetation, soils, and groundwater samples. Environmental Monitoring soil, vegetation, and groundwater sample results are provided in the following tables. Uranium, gross alpha, and gross beta had reasonable comparison. All results for plutonium, gross alpha, cobalt-60 and cesium-137 were less than the minimum detectable activity for USEW, and only a limited comparison can be made.

Quarterly TLDs are in the same location at several site perimeter locations to measure penetrating gamma radiation.

As of this writing, the WDOH results were not available.

Table 7.2 WDOH and US Ecology Washington Soil Samples CY 2015

Location	*Contaminant*	*Date*	*Result*	*Error*	*Units*	*DOH Result*	*WDOH Uncertainty*
NW Corner	Co-60	7/30/2015	0.00E+00	0.00E+00	pCi/g		
NW Corner	Cs-137	7/30/2015	1.00E-02	4.00E-03	pCi/g		
NW Corner	Gross Beta	7/30/2015	2.38E+01	2.80E+00	pCi/g		
NW Corner	Pu-238	7/30/2015	2.00E-03	4.00E-03	pCi/g		
NW Corner	Pu-239/240	7/30/2015	0.00E+00	6.00E-03	pCi/g		
NW Corner	U-233/234	7/30/2015	1.80E-01	3.00E-02	pCi/g		
NW Corner	U-235	7/30/2015	1.00E-02	1.00E-02	pCi/g		
NW Corner	U-238	7/30/2015	1.50E-01	3.00E-02	pCi/g		
Station 9	Co-60	7/30/2015	0.00E+00	0.00E+00	pCi/g		
Station 9	Cs-137	7/30/2015	0.00E+00	0.00E+00	pCi/g		
Station 9	Gross Beta	7/30/2015	2.55E+01	2.90E+00	pCi/g		
Station 9	Pu-238	7/30/2015	2.00E-03	7.00E-03	pCi/g		
Station 9	Pu-239/240	7/30/2015	2.00E-03	6.00E-03	pCi/g		
Station 9	U-233/234	7/30/2015	1.20E-01	2.00E-02	pCi/g		
Station 9	U-235	7/30/2015	0.00E+00	0.00E+00	pCi/g		
Station 9	U-238	7/30/2015	1.30E-01	2.00E-02	pCi/g		

Table 7.3 WDOH and US Ecology Washington Vegetation Samples CY 2015

Location	*Contaminant*	*Date*	*Result*	*Error*	*Units*	*WDOH Result*	*WDOH Uncertainty*
NW Corner	Co-60	6/24/2015	0.00E+00	0.00E+00	pCi/g		
NW Corner	Cs-137	6/24/2015	0.00E+00	0.00E+00	pCi/g		
NW Corner	Gross Beta	6/24/2015	3.28E+01	1.00E+00	pCi/g		
NW Corner	Pu-238	6/24/2015	0.00E+00	8.00E-04	pCi/g		
NW Corner	Pu-239/240	6/24/2015	3.00E-04	6.00E-04	pCi/g		
NW Corner	Total U	6/24/2015	9.00E-03	5.10E-03	pCi/g		
NW Corner	U-233/234	6/24/2015	5.00E-03	4.00E-03	pCi/g		
NW Corner	U-235	6/24/2015	0.00E+00	1.00E-03	pCi/g		
NW Corner	U-238	6/24/2015	4.00E-03	3.00E-03	pCi/g		

Table 7.4 WDOH and US Ecology Groundwater Sample Results CY 2015

Location	*Contaminant*	*Date*	*Result*	*Uncertainty*	*Units*	*DOH Results*	*WDOH Uncertainty*
MW-10	C-14	8/12/2015	-2.00E-01	4.70E+00	pCi/l		
MW-10	Co-60	8/12/2015	0.00E+00	0.00E+00	pCi/l		
MW-10	Cs-137	8/12/2015	0.00E+00	0.00E+00	pCi/l		
MW-10	Gross Beta	8/12/2015	1.47E+01	9.00E-01	pCi/l		
MW-10	H-3	8/12/2015	3.02E+03	1.74E+02	pCi/l		
MW-10	Pu-238	8/12/2015	-1.00E-03	1.00E-02	pCi/l		
MW-10	Pu-239/240	8/12/2015	4.00E-03	1.10E-02	pCi/l		
MW-10	Tc-99	8/12/2015	1.38E+01	3.80E+00	pCi/l		
MW-10	Total U	8/12/2015	2.26E+00	4.44E-01	pCi/l		
MW-9	Total U	5/12/2015	2.33E+00	4.71E-01	pCi/l		
MW-9	C-14	8/10/2015	1.20E+00	4.20E+00	pCi/l		
MW-9	Co-60	8/10/2015	0.00E+00	0.00E+00	pCi/l		
MW-9	Cs-137	8/10/2015	0.00E+00	0.00E+00	pCi/l		
MW-9	Gross Beta	8/10/2015	1.06E+01	8.00E-01	pCi/l		
MW-9	H-3	8/10/2015	3.16E+03	1.77E+02	pCi/l		
MW-9	Pu-238	8/10/2015	-1.00E-03	1.30E-02	pCi/l		
MW-9	Pu-239/240	8/10/2015	0.00E+00	1.30E-02	pCi/l		
MW-9	Tc-99	8/10/2015	1.64E+01	3.80E+00	pCi/l		
MW-13	C-14	11/30/2015	1.40E+00	3.90E+00	pCi/l		
MW-13	Co-60	11/30/2015	0.00E+00	0.00E+00	pCi/l		
MW-13	Cs-137	11/30/2015	0.00E+00	0.00E+00	pCi/l		
MW-13	Gross Beta	11/30/2015	1.21E+01	9.00E-01	pCi/l		
MW-13	H-3	11/30/2015	4.20E+03	2.00E+02	pCi/l		
MW-13	Pu-238	11/30/2015	-3.00E-03	4.00E-03	pCi/l		
MW-13	Pu-239/240	11/30/2015	0.00E+00	4.00E-03	pCi/l		

Location	*Contaminant*	*Date*	*Result*	*Uncertainty*	*Units*	*DOH Results*	*WDOH Uncertainty*
MW-13	Total U	11/30/2015	2.02E+00	2.16E-01	pCi/l		
MW-3	C-14	12/2/2015	2.65E+01	4.40E+00	pCi/l		
MW-3	Co-60	12/2/2015	0.00E+00	0.00E+00	pCi/l		
MW-3	Cs-137	12/2/2015	0.00E+00	0.00E+00	pCi/l		
MW-3	Gross Beta	12/2/2015	6.80E+00	7.00E-01	pCi/l		
MW-3	H-3	12/2/2015	1.79E+03	1.43E+02	pCi/l		
MW-3	Pu-238	12/2/2015	4.00E-03	5.00E-03	pCi/l		
MW-3	Pu-239/240	12/2/2015	1.00E-03	3.00E-03	pCi/l		
MW-3	Total U	12/2/2015	2.15E+00	2.21E-01	pCi/l		
MW-6	C-14	11/30/2015	2.30E+00	3.90E+00	pCi/l		
MW-6	Co-60	11/30/2015	0.00E+00	0.00E+00	pCi/l		
MW-6	Cs-137	11/30/2015	0.00E+00	0.00E+00	pCi/l		
MW-6	Gross Beta	11/30/2015	1.30E+01	9.00E-01	pCi/l		
MW-6	H-3	11/30/2015	4.80E+03	2.12E+02	pCi/l		
MW-6	Pu-238	11/30/2015	1.00E-03	6.00E-03	pCi/l		
MW-6	Pu-239/240	11/30/2015	-2.00E-03	9.00E-03	pCi/l		
MW-6	Total U	11/30/2015	1.95E+00	1.87E-01	pCi/l		
MW-9	C-14	11/30/2015	5.90E+00	4.10E+00	pCi/l		
MW-9	Co-60	11/30/2015	0.00E+00	0.00E+00	pCi/l		
MW-9	Cs-137	11/30/2015	0.00E+00	0.00E+00	pCi/l		
MW-9	Gross Beta	11/30/2015	1.00E+01	8.00E-01	pCi/l		
MW-9	H-3	11/30/2015	2.97E+03	1.73E+02	pCi/l		
MW-9	Pu-238	11/30/2015	-2.00E-03	4.00E-03	pCi/l		
MW-9	Pu-239/240	11/30/2015	-1.00E-03	6.00E-03	pCi/l		
MW-9	Tc-99	11/30/2015	1.21E+01	3.80E+00	pCi/l		
MW-9	Total U	11/30/2015	2.09E+00	1.94E-01	pCi/l		

Table 7.5 WDOH Versus USEW 2015 Environmental TLD Results

QTR.	WDOH ID	WDOH mR/day	USEW ID #	USEW mrem/qtr (Bkg Corrected)	USEW mrem/day (No Correction)	USEW mrem/day (Bkg Corrected)
1	NE CORNER		TLD 2	0	0.233	0.000
2	NE CORNER		TLD 2	0	0.220	0.000
3	NE CORNER		TLD 2	0	0.239	0.000
4	NE CORNER		TLD 2	3	0.305	0.032
1	NW CORNER		TLD 3	lost	lost	lost
2	NW CORNER		TLD 3	1	0.231	0.011
3	NW CORNER		TLD 3	1	0.250	0.011
4	NW CORNER		TLD 3	3	0.305	0.032
1	SE CORNER		TLD 6	2	0.256	0.022
2	SE CORNER		TLD 6	0	0.220	0.000
3	SE CORNER		TLD 6	0	0.239	0.000
4	SE CORNER		TLD 6	lost	lost	lost
1	SW CORNER		TLD 8	2	0.256	0.022
2	SW CORNER		TLD 8	1	0.231	0.011
3	SW CORNER		TLD 8	1	0.250	0.011
4	SW CORNER		TLD 8	4	0.316	0.042

8.0 LIST OF SAMPLES THAT EXCEEDED INVESTIGATION OR ACTION LEVELS

Table 8.1 is a summary of the 2015 exceedences in the environmental monitoring program.

All groundwater exceedances are the result of U.S. Department of Energy operations upgradient from our site. Tritium and gross beta in several groundwater wells have consistently been above investigation levels.

MW-10 3rd quarter sample result was above investigation levels for gross beta. The Technitium-99 level was also elevated. This is not normal, but is expected. The levels in this well are customarily just below the investigation level (5 year average =7.8, 2s = 7.7 pCi/l). Technitium-

99 concentrations were 13.8 pCi/l. This was attributed to contaminants moving from upgradient groundwater sources.

No DOH notification is required for exceeding investigation levels.

Table 8.1 Results Above Investigation or Action Levels

Location	*Contaminant*	*Media*	*Date*	*Remarks*	*Result*	*Uncertainty*	*Units*	*Investigation Level*	*Frequency*
MW-10	Gross Beta	Groundwater	8/12/2015	Tc-99 = 13.8	1.47E+01	9.00E-01	pCi/l	12	1
MW-13	Gross Beta	Groundwater	3/10/2015		1.30E+01	9.00E-01	pCi/l	12	11
MW-13	Gross Beta	Groundwater	11/30/2015		1.21E+01	9.00E-01	pCi/l	12	12
MW-6	H-3	Groundwater	3/10/2015		5.13E+03	2.22E+02	pCi/l	3600	4
MW-6	H-3	Groundwater	5/11/2015		4.71E+03	2.08E+02	pCi/l	3600	5
MW-6	Gross Beta	Groundwater	8/10/2015		1.41E+01	9.00E-01	pCi/l	12	2
MW-6	H-3	Groundwater	8/10/2015		5.17E+03	2.19E+02	pCi/l	3600	6
MW-6	Gross Beta	Groundwater	11/30/2015		1.30E+01	9.00E-01	pCi/l	12	3
MW-6	H-3	Groundwater	11/30/2015		4.80E+03	2.12E+02	pCi/l	3600	7
MW-7	H-3	Groundwater	3/12/2015		5.13E+03	2.22E+02	pCi/l	3600	4
MW-7	H-3	Groundwater	5/14/2015		4.94E+03	2.12E+02	pCi/l	3600	5
MW-7	H-3	Groundwater	8/12/2015		5.03E+03	2.16E+02	pCi/l	3600	6
MW-7	H-3	Groundwater	12/2/2015		4.82E+03	2.12E+02	pCi/l	3600	7

Frequency is over the last 20 calendar quarters.

9.0 APPENDICES

A. Air Emissions Assessment

B. Meteorological Data

C. Radioactive Materials License WN-I019-2

D. Air Emissions License RAEL-009

E. Richland Operating Procedures

F. Correspondence

G. Electronic Database

H. Printed Database

I. List of Acronyms

J. Graphs

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