December 2, 2016

MEMORANDUM

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FROM: Andrew John, Environmental Scientist, Technical Services Division (TS)
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RE: I-160-02 INL Materials and Fuels Complex (MFC) Industrial Waste Ditch (IWD) and Industrial Waste Pond (IWP), Staff Analysis.

Executive Summary

The Materials and Fuels Complex (MFC) Industrial Waste Ditch (IWD) and Industrial Waste Pond (IWP) are owned by the U.S. Department of Energy – Idaho (DOE-ID) and are operated by Battelle Energy Alliance, LLC. The facility discharges noncontact cooling, boiler blowdown, cooling tower overflow, sink and drain, air wash flow, and steam condensate water to an approximately three acre percolation basin. Under the current permit, the facility is only permitted to apply 17 million gallons per year (MGA) to the IWD and IWP (DEQ 2012, Section F, p. 7).

Major changes proposed by the permittee in the draft permit compared to the current permit include the following:

1. Update the contact personnel as shown in the application form.
2. Decrease the number of constituents monitored in both ground water and wastewater based on historic monitoring results.
3. Increase the permit cycle from five years to 10.

The last three facility inspections demonstrated that the MFC reuse site was in substantial compliance with permit WRU-I-0160-01 (DEQ 2013, 2014 and 2015). The most recent annual report review also found the facility to be in substantial compliance with the permit (DEQ 2016).

It is recommended that the DOE-ID MFC facility be re-permitted for a period of ten (10) years incorporating conditions discussed in this Staff Analysis and specified in the attached draft permit.

Introduction

The purpose of this memorandum is to satisfy the requirements of IDAPA 58.01.17.400.04 for issuing Wastewater Reuse Permits. It states the principal facts and significant questions considered in preparing the draft permit conditions and provides a summary of the basis for the draft permit. The analysis references applicable requirements and supporting materials as appropriate.

A wastewater reuse permit renewal application for the INL Materials and Fuels Complex Industrial Waste Ditch and Industrial Waste Pond was submitted to DEQ by the Idaho National Laboratory (INL) in October 2014 to facilitate the renewal of the current wastewater land application permit WRU-I-160-01, which expired April 30, 2015. The facility is allowed to continue operating under the terms and conditions of the existing permit pursuant to IDAPA 58.01.17.400.10.a. A history of the permit renewal process is as follows:

- The current permit, WRU-I-160-01, was issued to INL on June 21, 2012 and is a modification of LA-000160-01, issued on April 14, 2010.
- The WRU-I-160-01 permit modification consisted of minor contact information changes and minor grammatical changes.
- A permit renewal pre-application meeting between INL and DEQ was held on June 4, 2014 to initiate the permit renewal process and to discuss possible changes to INL's operation as well as potential changes to the new permit.
- A permit renewal application package was submitted to DEQ by INL on October 28, 2014 and contained both a technical report and application forms.
- The permit application was determined by DEQ to be substantially complete on January 23, 2015 with a projected schedule to issue the final permit by July 2015.

I. Site Location and Ownership

The Materials and Fuels Complex IWD and IWP (Appendix 3, Figure A3.3) are located on the restricted access Idaho National Laboratory (INL) Site (Appendix 3, Figure A3.1). The INL Site is a federal government-owned, contractor-operated facility managed by the Department of Energy's Idaho Operations Office. The INL Site is 890 (square miles) mi^2 in area and MFC is located in the southeastern corner (Miller 2014, Section 2.1, p. 2). Battelle Energy Alliance, LLC (BEA) is the current INL management and operating contractor responsible for operating the MFC.

II. Process Description

Industrial wastewater, consisting of continuous discharges of non-hazardous, non-radioactive, non-contact cooling water, boiler blowdown, cooling tower overflow, water from sinks and drains, air wash flows, and steam condensate, is discharged to the IWP from several MFC facilities. The facility noted in the technical report that these flows equal approximately 1.4 million gallons (MG) per month to the IWP (Miller 2014, Section 3.1, p. 5). It was also noted that approximately one gallon per minute (gpm) of cooling tower blowdown water is discharged to the IWD (Miller 2014, Section 3.2, p. 5).

III. Site Characteristics

A. Site Management History

The Department of Energy – Idaho (DOE-ID) controls land within the INL and public access is restricted to public highways and DOE-ID sponsored tours. Grazing of cattle and sheep is not allowed within 2 miles of any nuclear facility. In the technical report, it was noted that MFC has administrative control over approximately 900 acres and the actual MFC facility is approximately 60 acres (Appendix A3, Figure A3.2; Miller 2014, Section 4.1, p. 7).

The facility began discharging wastewater to the IWP in 1962 and discharged 8 to 54 million gallons per year (Miller 2014, Section 4.1, p. 7). Historically, flows to the IWP were much higher than at present but substantial legacy degradation to ground water has not been observed in monitoring wells (Table 2). Therefore, it is unlikely that much lower current flows would substantially degrade ground water quality in the aquifer. Sediments from the IWP and north drainage ditch were removed in 2004. A pipe system was then installed to carry industrial wastewater directly to the pond from the ditch (Miller 2014, Section 4.1, p. 7). On average, the facility discharged approximately 8 MGA to the IWP between 2010 and 2015. The highest loading occurred in 2012 at approximately 12 MG.

B. Climatic Characteristics

The climatic characteristics of the MFC IWP and IWD sites are typical of the high-desert characteristics of the surrounding area. Climate data from 2004 to 2013 are summarized in Section 4.2 of the permit application and are as follows:

- Average annual precipitation of 6.35 inches
- Minimum monthly precipitation of 0.00 inches (July 2008)
- Maximum monthly precipitation of 4.51 inches (June 2009)
- Average summer (June – August) temperature of 66.6^{o}F
- Average winter (December – February) temperature of 17.7^{o}F
- Extreme daily low temperature of -26^{o}F (1/27/2009)
- Extreme daily high temperature of 102^{o}F (7/23/2007)
- Winds generally out of the southwest

C. Soils

At present, there is not a Soil Survey for the INL site. The soil survey for Butte County indicates that soils are likely of the Nargon, Coffee or Atom series (NRCS 2009). These soil series are typically silt loams with mixed alluvium over basalts as parent material (NRCS 2009). According to the permit application, the facility excavated soils in the IWP and IWD in 2004 to remove cesium-137, chromium, mercury, selenium, silver, and zinc. This was conducted under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA; Miller 2014, Section 4.3, p. 8).

D. Surface Water

No permanent, natural, surface water features exist near the MFC facility. There are no designated flood plains (25, 50, or 100 year) adjacent to the facility. According to the permit application, there are no springs, wetlands, or surface waters within ¼ mile of the IWP (Miller 2014, Section 4.4, p. 8).

E. Ground Water Hydrogeology and Quality

The primary source of water for the MFC facility is the Eastern Snake River Plain Aquifer (ESRPA; Miller 2014, Section 4.5, p. 10). The ESRPA is primarily used for domestic, industrial, and agricultural uses. Recharge to the ESRPA from the MFC facility is limited to precipitation and seepage from the IWP.

The subsurface lithology at the MFC facility is primarily basaltic lava flows and depth to the aquifer within the basalt was last recorded at 660 feet (Miller 2014, Section 4.5, p. 10). The MFC facility (formerly Argonne National Laboratory – West, or ANL-W) Waste Area Group 9 (WAG 9) is one of ten INL WAGs identified in the Federal Facility Agreement and Consent Order (FFA/CO) signed by the U.S. EPA, Idaho Department of Health and Welfare (preceding DEQ) and the U.S. Department of Energy. A comprehensive Remedial Investigation/Feasibility Study (RI/FS) was performed which assembled investigations previously conducted for WAG 9 and also thoroughly investigated sites not previously evaluated to determine the overall risk posed by the WAG. The resulting comprehensive Final Record of Decision (ROD) identified eight areas for remedial action and an additional 33 release areas for “No Action” based on the risk to human health and the environment. The remedial actions were chosen in accordance with the 1986 CERCLA, as amended by SARA and were designed to satisfy the requirements of the FFA/CO (INEEL, 1998). The Industrial Waste Pond and ditches, and their associated monitoring wells, were part of the RI/FS and are included in the ROD.

As discussed in the final ROD, the facility conducted subsurface boring in 1988 and 1992 to provide a better understanding of the subsurface geology around MFC. The ROD notes that the subsurface geology at MFC is similar to that on the rest of INL with the biggest difference being the lack of continuous sedimentary interbeds beneath MFC. Interbeds at MFC appear to be discontinuous stringers (calcareous silt, sand or cinders) deposited in low areas on basalt surfaces, and do not appear west of the IWP. Rubble layers between basalt flows are composed of sand and gravel to boulder sized material. The facility does not believe that these interbeds cause substantial perching beneath MFC or the IWP. The ROD indicates the thickness and texture of individual basalt flows are quite variable with the upper surfaces of flows often irregular and containing many fractures and joints. Rubble zones at variable depths revealed zones of blocky or loose basalt. The outer portions of a flow (both top and bottom) tend to be highly vesicular while the middle portions of the flows typically have few vesicles and are dominated by vertical fractures formed during cooling (INEEL, 1998).

Currently, the MFC facility has three ground water monitoring wells used to assess ground water quality impacts from wastewater discharge to the IWP. Monitoring well GW-016001 (ANL-W-MON-A-012) is located up-gradient (UG) of the facility, monitoring well GW-016002 (ANL-W-MON-013) is down-gradient (DG), and GW-016003 (ANL-W-MON-A-014) is down-gradient (DEQ 2012, Appendix 1, p. 14). The monitoring wells listed in the reuse permit were evaluated as part of the facility’s RI/FS process and are discussed in the final ROD. The well driller logs for ANL-

MON-A-11 and ANL-MON-A-14 revealed a thick confining layer of massive basalt just above the aquifer but it is believed to only extend hundreds of feet. The USGS does not believe that this layer impacts the response ability of the down-gradient wells to up-gradient contaminants (INEEL 1998, Section 5, p. 5-4). Ground water monitoring wells ANL-MON-A-13 (GW-016002) and ANL-MON-A-14 (GW-016003) are located approximately 880 and 1400 feet, respectively, down-gradient of the IWP, were located and installed specifically to intercept potential contaminants from the IWD and ditch, and are likely at a sufficient distance from the contaminate source area to avoid the effects of the massive basalt layer.

The wastewater discharged to the IWP consists primarily of non-contact cooling water and condensate from HVAC systems (air conditioners), and is considered to be a weak, low-strength effluent with low potential for ground water impacts (Miller 2014, Section 3.1, p. 5). In 2011, the facility sampled production well EBR-II #2 to characterize the quality of potable water found in this well. At that time the quality of wastewater being discharged to the IWP was similar to the water quality found in ground water wells located around the MFC facility. A comparison of the IWD effluent to the up-gradient monitoring well, up-gradient PWS production well, and down-gradient monitoring well is presented in Table 1.

Table 1. Comparison of constituent concentrations between wastewater discharged to the IWP and ground water monitoring wells during September of 2011.

Parameter*	Industrial Waste Pipe	Production Well (EBR-II) #2	GW-016001 Up-gradient	GW-016003 Down-gradient
Sample Date	9/7/2011	9/29/2011	9/28/2011	9/28/2011
Sodium	18.8	16.6	16.7	16.6
Chloride	21.1	18.9	17.8	18.5
Sulfate	17.8	17.2	16.3	17.2
TDS	247	247	239	232
Arsenic	0.003	0.0016	0.0015	0.0015
Barium	0.0358	0.0352	0.0375	0.0356
Cadmium	<0.001	<0.00025	<0.00025	<0.00025
Chromium	<0.0025	<0.0025	<0.0025	<0.0025
Lead	<0.00025	0.00054	<0.0005	<0.0005
Selenium	0.00062	0.00063	0.00059	0.00053
Silver	<0.005	<0.005	<0.005	<0.005
Zinc	0.0073	0.0106	<0.0025	<0.0025
$NO_3^- + NO_2^-$	1.97	1.89	1.84	1.88
Total Phosphorus	0.103	0.0134	0.0143	0.0185
Total Iron	0.0583	<0.05	<0.05	0.0653
Total Manganese	<0.0025	<0.0025	<0.0025	<0.0025
pH (unitless)	8.41	8.11	8.22	8.09

* Units in mg/L unless specified otherwise

With the exception of median total iron concentrations in GW-016002 (0.33 mg/L), the median constituent concentrations were all below the current ground water quality standards (GWQS) between 2010 and 2015 (Table 2; IDAPA 58.01.11.200.01.a and b). Cadmium, mercury and silver were not detected in any ground water analysis between 2010 and 2015 (Table 3). DEQ staff conducted a Mann-Kendall trend analysis on ground water constituent data between 2010 and 2015. These analyses were performed in R Statistical Software using the *mk.test* function within the *trend* statistical package (R 2016). Any ground water constituents with non-detect values equal to or greater than 50 percent of all samples collected were not run in this analysis (Table 3) because of higher uncertainty when determining trends. Based on this analysis, sulfate, nitrate + nitrite, total iron (unfiltered), and pH were the only ground water constituents that resulted in significant trends (Table 3). It is important to note that the result of a significant trend does not provide the magnitude of the increase but only indicates the confidence with which a trend can be reported.

Table 2. Median ground water constituent concentrations in MFC monitoring wells between 2010 and 2015.

Parameter (mg/L, unless specified)	Standards	GW-016001 (UG)	GW-016002 (DG)	GW-016003 (DG)
Sodium	NS	17.6	18.7	18.0
Chloride	250	17.7	18.9	18.7
Sulfate	250	16.7	19.1	18.2
TDS	500	237	240	235
Arsenic	0.05	0.002	0.002	0.002
Barium	2	0.04	0.04	0.04
Cadmium	0.005	<0.00025	<0.00025	<0.00025
Chromium	0.1	<0.0025	0.004*	0.003*
Lead	0.015	<0.0005	0.0006*	<0.0005
Mercury	0.002	<0.0002	<0.0002	<0.0002
Selenium	0.05	0.0005*	0.0005*	0.0006*
Silver	0.1	<0.005	<0.005	<0.005
Zinc	5	0.0040*	0.0029	<0.0025
$NO_3^- + NO_2^-$	10	1.97	2.04	2.01
Total Phosphorus	NS	0.014*	0.015*	0.014*
Total Iron	0.3	0.09*	0.33*	0.12*
Total Manganese	0.05	<0.0025	0.0077*	<0.0025
pH (unitless)	6.5 to 8.5	8.2	8.1	8.0

NS = No Constituent Standard
* Median calculated using the *cenfit* function in R in the Nondetects and Data Analysis for environmental data (NADA) package. The function "flips" the left-censored data (non-detects) so that a Kaplan-Meier survival analysis can be performed (Helsel 2012, Chapter 6).

The Kaplan-Meier method is a nonparametric technique for calculating the (cumulative) probability distribution and for estimating means, sums, and variances with censored data. It counts the number of data points below each detected concentration, and uses that information to generate an estimate of the probability distribution function. Once the (cumulative) probability distribution is estimated, statistics of interest like the mean or variance can be computed via areas under the distribution curve (ITRC 2013).

From 2010 to 2015, ground water sulfate concentrations in GW-016001 showed an increasing trend (Table 3). This well is up-gradient of the MFC facility and therefore, any trends observed are not due to the MFC reuse activities. Although substantially below the primary GWQS of 10 mg/L, ground water nitrate + nitrite-N concentrations showed an increasing trend in all of the monitoring wells. It also appeared that median concentrations slightly increased between up and down-gradient wells (Appendix 2, Figure A2.1). Total iron (unfiltered) concentrations in the up-gradient well (GW-016001) appear to be increasing but this is likely not in response to the MFC reuse activities. Both total manganese and iron (unfiltered) concentrations show an increasing trend in down-gradient well GW-016002. This well also has the highest median concentrations for these constituents compared to the other wells (Appendix 2, Figures A2.2 and A2.3). Concentrations for these constituents in down-gradient well GW-016003 (furthest from IWP) show similar median levels as the up-gradient well, indicating that concentrations return to background concentrations as ground water moves further down-gradient from the IWP. Lastly, a decreasing trend in pH was observed in each of the three monitoring wells (Table 3). However, pH levels were still well within the Secondary Constituent Standard range (IDAPA 58.01.11.200.01.b).

Table 3. Statistical results from Mann-Kendall Trend Analysis on ground water monitoring constituents (2010-2015).

Parameter	GW-016001			GW-016002			GW-016003		
	% ND	Trend	p-Value	% ND	Trend	p-Value	% ND	Trend	p-Value
Sodium	0	No Trend	0.63	0	No Trend	0.73	0	No Trend	0.22
Chloride	0	No Trend	0.78	0	No Trend	0.27	0	No Trend	0.78
Sulfate	0	Increasing	0.007	0	No Trend	0.41	0	No Trend	0.13
TDS	0	No Trend	0.78	0	No Trend	0.94	0	No Trend	0.15
Barium	0	No Trend	0.58	0	No Trend	0.27	0	No Trend	0.73
Arsenic	0	No Trend	0.17	0	No Trend	0.37	0	No Trend	0.49
Cadmium	100	Analysis not Run		100	Analysis not Run		100	Analysis not Run	
Chromium	58	Analysis not Run		8	No Trend	0.30	33	No Trend	0.48
Lead	83	Analysis not Run		42	No Trend	0.94	83	Analysis not Run	
Mercury	100	Analysis not Run		100	Analysis not Run		100	Analysis not Run	
Selenium	25	No Trend	0.53	17	No Trend	0.89	25	No Trend	0.68
Silver	100	Analysis not Run		100	Analysis not Run		100	Analysis not Run	
Zinc	17	No Trend	0.78	50	Analysis not Run		92	Analysis not Run	
NO_3^- + NO_2^-	0	Increasing	0.0002	0	Increasing	0.023	0	Increasing	0.002
Total Phosphorus	8	No Trend	0.45	0	No Trend	0.94	17	No Trend	0.27
Total Iron	25	Increasing	0.03	0	Increasing	0.005	0	No Trend	0.45
Total Manganese	50	Analysis not Run		17	Increasing	0.046	75	Analysis not Run	
pH (unitless)	0	Decreasing	0.02	0	Decreasing	0.006	0	Decreasing	0.003

IV. Wastewater Loading Rates and Characterization

A. Hydraulic Loading Rate

Wastewater at the MFC IWP and IWD is discharged year-round. Annual average flows are shown in Figure 1. The annual average discharge to the IWP over the current permit cycle (WRU-I-0160-01; 2010-2015) was 8.4 MGA. The highest recorded flow during this time period was 11.8 MGA during 2012. The current permit limits hydraulic loading to the IWP to 17 MGA (DEQ 2012, Section F, p. 7). Based on the hydraulic loading over the past six years, this hydraulic annual loading limit will be appropriate for the I-160-02 permit cycle.

DEQ recommends that a hydraulic loading limit of 17 MGA be included in the I-160-02 permit for the MFC facility.

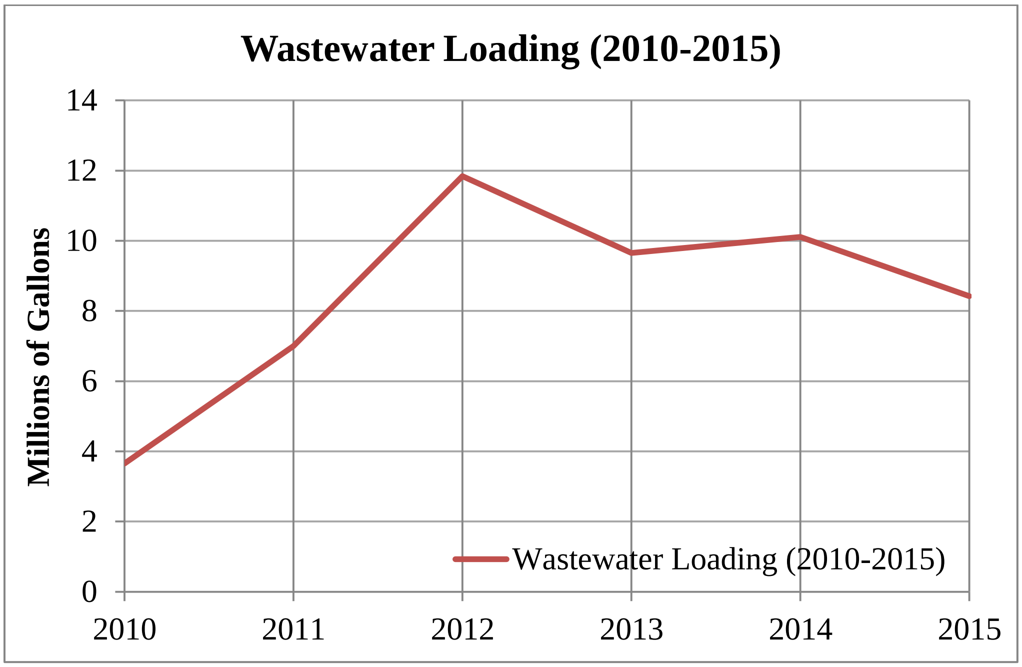

Figure 1. Discharge volumes to the IWP from 2010 to 2015.

B. Wastewater Characterization

Between 2010 and 2015, median arsenic, cadmium, chromium, mercury, silver and total suspended solids concentrations were below detection limits in the IWP pipeline (Table 4). Only in 2011 were total manganese (unfiltered) concentrations above the detection limit (0.0031 mg/L). In the IWD, cadmium, mercury, and silver had yearly median concentrations below the detection limit between 2010 and 2015 (Table 5). Yearly total suspended solids median concentrations were below the detection limit except in 2012 for the IWD (15.8 mg/L).

DEQ Staff conducted a Mann-Kendall trend analysis on wastewater constituent data between 2010 and 2015. These analyses were performed in R Statistical Software using the *mk.test* function within the *trend* statistical package (R 2016). Any wastewater constituents with non-detect values equal to or greater than 50 percent of all samples collected were not run in this analysis (Table 6) because of higher uncertainty when determining trends. This analysis was run separately on data from both the IWP pipeline and IWD.

Table 4. Yearly median wastewater quality data collected from the industrial waste pipeline that flows into the IWP.

Parameter*	2010	2011	2012	2013	2014	2015
Arsenic	<0.0025	<0.0025	<0.0025	<0.005	<0.005	<0.005
Barium	0.036	0.036	0.037	0.035	0.036	0.036
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloride	57.4	57.6	40.5	24.4	29.2	22.6
Chromium	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Fluoride	0.60	0.62	0.62	0.60	0.63	0.61
Total-Fe	0.07	0.08	0.08	0.09	0.11	0.12
Lead	0.0005	0.0003	0.0003	0.0007	0.0003	0.0006
Total-Mn	<0.0025	0.0031	<0.0025	<0.0025	<0.0025	<0.0025
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
TKN	0.46	0.64	0.28	0.26	0.11	0.20
$NO_2^-+NO_3^-$	2.07	2.01	2.04	2.09	2.11	2.13
Total-N	2.51	2.78	2.31	2.31	2.22	2.34
pH	8.50	8.44	8.38	8.25	7.75	8.34
Phosphorus	0.27	0.24	0.12	0.13	0.20	0.11
Selenium	0.0007	0.0006	0.0007	0.0009	0.0005	0.0006
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium	42.4	42.6	31.1	22.9	24.6	21.5
TDS	334	317	292	268	259	258
TSS	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Sulfate	19.1	17.6	17.7	17.6	18.4	18.4
Zinc	0.010	0.011	0.008	0.010	0.013	0.014

* All parameters are in units of mg/L except for pH which is in standard units (S.U.).

Table 5. Yearly median wastewater quality data collected from the industrial waste ditch.

Parameter*	2010	2011	2012	2013	2014	2015
Arsenic	0.0052	0.0042	0.0062	0.0052	<0.0050	0.0074
Barium	0.085	0.080	0.110	0.078	0.084	0.094
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloride	52.8	43.7	44.5	47.6	56.2	46.4
Chromium	0.0099	0.0037	0.0075	0.0039	0.0040	0.0037
Fluoride	1.52	1.38	1.43	1.46	1.63	1.43
Total-Fe	0.15	0.09	1.05	0.04	0.11	0.15
Lead	0.0005	0.0007	0.0019	0.0003	0.0004	0.0003
Total-Mn	0.0042	0.0050	0.0396	<0.0025	<0.0025	0.0035
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
TKN	0.64	0.77	0.70	0.45	0.86	0.81
$NO_2^-+NO_3^-$	4.89	4.33	4.37	4.92	5.98	5.00
Total-N	5.53	5.11	5.07	5.26	6.79	5.76
pH	8.37	8.30	8.02	7.65	8.33	8.32
Phosphorus	0.88	0.96	1.13	0.72	1.18	1.33
Selenium	0.0013	0.0013	0.0013	0.0013	0.0012	0.0011
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium	46.8	44.5	52.0	46.6	58.0	53.0
TDS	600	543	546	557	642	594

TSS	<4.0	<4.0	15.8	<4.0	<4.0	<4.0
Sulfate	44.1	38.6	39.9	41.0	47.4	43.8
Zinc	0.020	0.052	0.034	0.012	0.013	0.013

* All parameters are in units of mg/L except for pH which is in standard units (S.U.).

Based on this analysis, chloride, total Kjeldahl nitrogen, pH, phosphorus, sodium and total dissolved solids concentrations showed decreasing trends in the IWP pipe. Lead, total manganese (unfiltered), sodium, and zinc concentrations showed decreasing trends in the IWD (Table 6). Both total iron (unfiltered) and nitrate + nitrite-nitrogen concentrations in the IWP pipe showed an increasing trend among observation years (Table 6). These two increases do not appear to be very large (Figure 2) but it is recommended that these constituents continue to be monitored. DEQ Staff also analyzed for possible correlations between wastewater flow volumes and concentrations of these two constituents and found weak relationships ($R^2 \leq 0.10$).

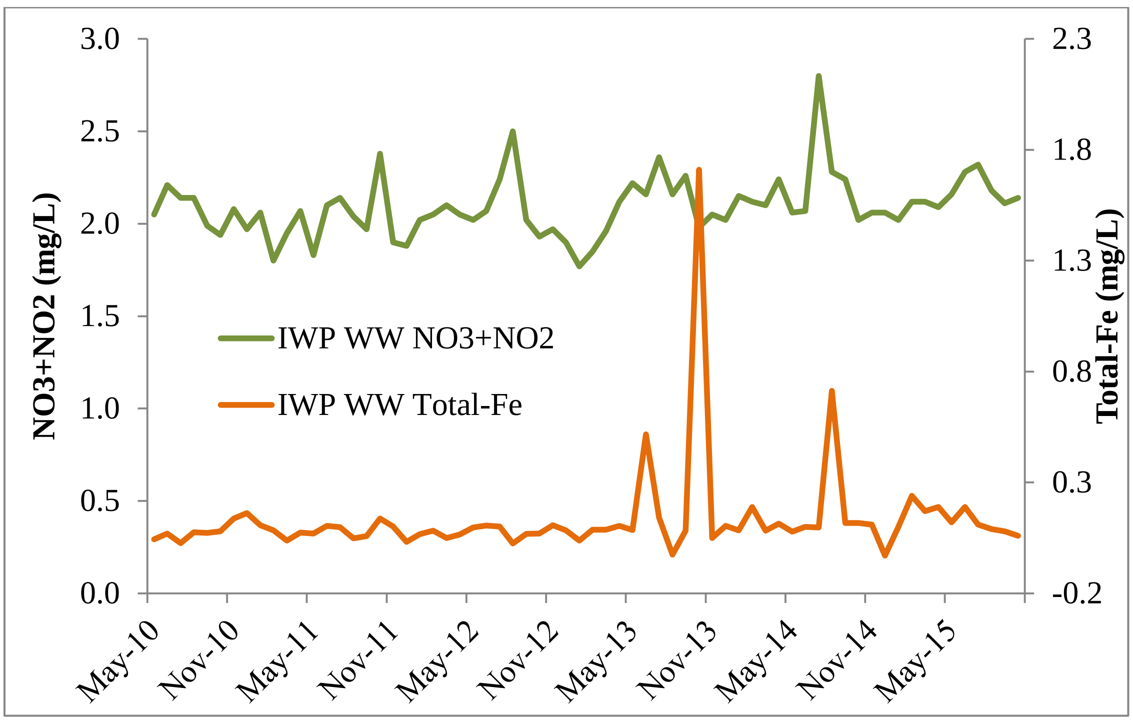

Figure 2. Monthly wastewater constituent data to the IWP.

Table 6. Statistical results from Mann-Kendall Analysis on wastewater monitoring constituents (2010 to 2015).

Parameter	IWP Pipe			IWD (Ditch)		
	% ND	Trend	p-value	% ND	Trend	p-value
Arsenic	89	Analysis not Run		23	No Trend	0.39
Barium	0	No Trend	0.63	0	No Trend	0.63
Cadmium	100	Analysis not Run		100	Analysis not Run	
Chloride	0	Decreasing	0.003	0	No Trend	0.87
Chromium	83	Analysis not Run		0	No Trend	0.11
Fluoride	0	No Trend	0.79	0	No Trend	0.82
Total-Fe	3	Increasing	0.002	14	No Trend	0.87
Lead	27	No Trend	0.59	18	Decreasing	0.023
Total-Mn	70	Analysis not Run		36	Decreasing	0.024
Mercury	100	Analysis not Run		100	Analysis not Run	
TKN	15	Decreasing	2.30E-05	5	No Trend	0.91
$NO_3^-+NO_2^-$	0	Increasing	0.005	0	No Trend	0.28
Total-N	0	No Trend	0.06	0	No Trend	0.40
pH	0	Decreasing	6.30E-06	0	No Trend	0.55
Phosphorus	0	Decreasing	0.003	0	No Trend	0.09
Selenium	11	No Trend	0.32	0	No Trend	0.29
Silver	95	Analysis not Run		100	Analysis not Run	
Sodium	0	Decreasing	0.004	0	Decreasing	0.004
TDS	0	Decreasing	0.002	0	No Trend	0.74
TSS	94	Analysis not Run		82	Analysis not Run	
Sulfate	0	No Trend	0.93	0	No Trend	0.57
Zinc	0	No Trend	0.06	0	Decreasing	0.009

V. Site Management

A. Buffer Zones

The MFC IWP and IWD wastewater reuse site is located on the INL where public access is restricted. Actual buffer distances, fencing, and posting are compared against distances typically recommended in reuse guidance (DEQ 2007, Section 6.5.2.2, p. 19) in Table 7.

Table 7. Buffer Zones for MFC IWP and IWD.

	Buffer Zone Guidance[a]	Actual ATR CWP Buffer
Nearest Inhabited Dwelling	200 ft.	30,000 ft. (Residence SE of MFC) 460 ft. (IWP to nearest occupied MFC Building) 60 ft. (IWD to nearest occupied MFC Building)
Nearest Public Water System	1,000 ft.	~800 ft. (EBR-II, Well #2 to IWP) ~230 ft. (EBR-II, Well #1 to IWD)
Nearest Private Water Supply	500 ft.	30,000 ft. (Residence SE of MFC)
Areas Accessible to the Public	0 ft.	17,500 ft. (Highway 20/26)
Nearest Surface Water	100 ft.	60,000 ft. (Big Lost River channel)
Nearest Irrigation Ditches/Canals	50 ft.	80,000 ft. (Agriculture West of Idaho Falls)
Fencing	Not required	None
Posting	Not required	None

a. Guidance recommendations specified within the DEQ Reuse Guidance Manual, Section 6.5.2.2, p. 19

As shown in Table 6, all generally recommended buffer zones are being met, with the exception of the nearest public water system (Appendix A3, Figure A3.2). Based on the DEQ's Source Water Assessment and Protection program, the IWP is outside of the source water delineation 3-year time-of-travel (TOT) zone for EBR-II, Well #1 (Appendix A3, Figure A3.4). However, the IWD is located within the 3-year TOT zone being at ~230 feet from the well. A Mann-Kendall Trend analysis for nitrate concentration data for the EBR-II, Well #1 revealed an increasing trend since 1995 (p-value <0.05). The data ranged from 1.5 to 2.2 mg/L and the concentrations are below the GWQS of 10 mg/L (Appendix 2, Figure A2.6). The average nitrate concentrations from 2010-2015 in EBR-II, Well #1 and up-gradient well were 2.0 and 1.96 mg/L, respectively. This indicates that the concentrations in the production well are representative of offsite background concentrations. Flows in the IWD are low (1 gpm), moving down-gradient and away from EBR-II, Well #1 and nitrate concentrations in this well are below GWQS. Furthermore, in 1958 the well was pumped for 2,880 minutes at 1,025 gpm and had a 0.25 feet drawdown. When it was pumped again in 1988 for 163 minutes at 1,100 gpm the drawdown was 1.1 feet (Ackerman 1991, p. 7). The pump inlet depth on EBR-II, Well #1 is 705 feet. With a depth to aquifer at 660 feet, it is unlikely that wastewater flows (1 gpm) in the IWD are reaching the aquifer within the well capture zone. It is also improbable that the 1 gpm flow could reach the 705 feet deep pump intake in this highly conductive aquifer that is flowing away from the well. Additionally, a review of monitoring data from the well indicates that the well is not being significantly impacted by reuse operations Therefore DEQ Staff recommends that the existing buffer distances to the EBR-II public water system wells be allowed to continue in the next permit. As a precaution for future construction efforts at INL, it is recommended that the permit also specify that any new PWS wells be constructed in a location that provides a minimum 1,000 feet buffer distance to the reuse system. Occupied buildings at MFC are at a sufficient distance from the IWP. The beginning of the IWD is within 200 feet of an occupied building but flows are approximately one gallon per minute and there is no public access. Surface water and irrigation ditches and canals do not exist at the facility. INL is a secure government facility that does not allow public access without proper security clearances and/or facility escorts. Furthermore, the facility has internal policies and procedures in place to prohibit unauthorized employee access to the IWP. Therefore, DEQ recommends the new permit only specify buffer distances for public water supply and private (domestic water supply wells).

B. Runoff

A runoff management plan was not required under permit WRU-I-0160-01. The MFC facility discharges wastewater directly to the IWP and IWD. Therefore, runoff is not generated on site from reuse activities. No runoff plan is proposed for permit I-160-02.

C. Waste Solids

Permit WRU-I-0160-01 Section E, p. 6 included compliance activity CA-160-02 which required the facility to submit a Waste Solids Management Plan for review and approval by DEQ prior to any dredging or removal of solids, mud, or sludge from the

Industrial Waste Pond. The facility noted in the technical report that the plan will be determined at the time of closure and that the only solids entering the pond are from storm-water-runoff events (Miller 2014, Section 6.3, p. 20). DEQ recommends that the same Waste Solids Management Plan required in WRU-I-0160-01 Section E, p. 6 be required in I-160-02.

D. Nuisance Odors

Nuisance odors have not been identified at the MFC facility as recorded in the three most recent site inspections (DEQ 2013, Section 7.3, p. 9; DEQ 2014, Section 7.3, p. 9; DEQ 2015, Section 7.3, p. 10). Furthermore, odors are not expected due to the inorganic industrial nature of MFC effluent. The remote, secure, and limited access nature of the INL facility further supports the recommendation of not requiring an odor management plan at this time.

E. Total Dissolved Inorganic Solids

Between 2010 and 2015, the total dissolved solids loading concentration was relatively low (~300 mg/L) and appears to have little impact on ground water (Appendix 2, Figure A2.5). The ground water TDS concentrations are below the Secondary Constituent Standard (500 mg/L) and no upward trends in data were observed over the past six years (Table 3). Therefore, it is recommended that a total dissolved inorganic solids management plan not be required at this time.

F. Lagoon Seepage

Both the IWP and IWD are designed and constructed as a percolation system. Seepage testing is neither applicable nor required in permit I-160-02.

VI. Monitoring

A. Wastewater Monitoring

In permit WRU-I-0160-01, the MFC facility was required to monitor wastewater quality from the pipeline at a monthly frequency and wastewater quality from the ditch at a quarterly frequency. DEQ recommends this same monitoring schedule be included in permit I-160-02. INL is requesting the removal of total suspended solids (TSS) and total-nitrogen from wastewater monitoring because limits for these constituents are no longer included in IDAPA 58.01.17.600 (Miller 2014, Section 5.1.1, p. 14). Furthermore, these constituents were not being monitored in ground water during the last permit cycle (DEQ 2012, Section G, p. 9).

Total suspended solids concentrations in the pipe wastewater were not detected in 94 percent of the samples during the WRU-I-0160-01 permit cycle (Table 6). The instrument detection limit for this constituent is <4 mg/L and the highest recorded concentration during the WRU-I-0160-01 permit cycle was 13.4 mg/L. During this same time, wastewater samples from the ditch were not detected in 82 % of the samples and the highest recorded value was 182 mg/L (Table 6). During the WRU-I-0160-01 permit cycle, total-N wastewater median concentrations in the pipe were 2 to 3 mg/L and 4 to 6 mg/L in the ditch (Tables 4 and 5). In the statistical analyses, DEQ staff observed no trends in total-N monitoring data in the pipe or ditch (Table 6).

Based on the wastewater data analyses, DEQ Staff recommends the removal of TSS and total-N from the wastewater monitoring in reuse permit I-160-02.

B. Soil Monitoring

The current permit does not require soil monitoring (DEQ 2012, Section G, p. 9). A change is not proposed for permit I-160-02.

C. Ground Water Monitoring

The current permit requires ground water monitoring for water table elevation, water table depth, temperature, conductivity, sodium, chloride, pH, sulfate, total dissolved solids, arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, zinc, nitrate-nitrogen, total phosphorus, total iron, total manganese, dissolved iron, and dissolved manganese on a semi-annual basis (DEQ 2012, Section G, p. 9). It also requires that MFC sample ground water at a semi-annual frequency (September/October and April/May). DEQ Staff recommends this same sampling frequency in permit I-160-02.

In the permit application, INL proposed to remove arsenic, cadmium, chromium, mercury, and silver from the list of ground water monitoring parameters because they have consistently been below the laboratory instruments' minimum detection levels (MDL). The facility also requested that DEQ consider the removal of barium, chloride, selenium, sulfate, and zinc because their concentrations in ground water have also been consistently low (Miller 2014, Section 5.1.1, p. 14). Ground water cadmium, mercury, and silver concentrations have been below the GWQS (IDAPA 58.01.11.200.01.a and b) at each sampling event between 2010 and 2015 (Table 2.) Although, chromium concentrations in ground water monitoring wells have not been consistently below the detection limit, concentrations have been well below the Primary Constituent Standard of 0.1 mg/L (Figure 3). Ground water barium, chloride, selenium, sulfate and zinc concentrations in the three monitoring wells have consistently been well below the GWQS between 2010 and 2015 (Appendix 1; Figures A1.1 to A1.4).

Based on the ground water data analyses, the MFC facility's current contribution of these constituents to ground water is minimal and DEQ recommends the removal of arsenic, cadmium, chromium, mercury, silver, barium, chloride, selenium, sulfate, and zinc from the ground water monitoring plan in reuse permit I-160-02.

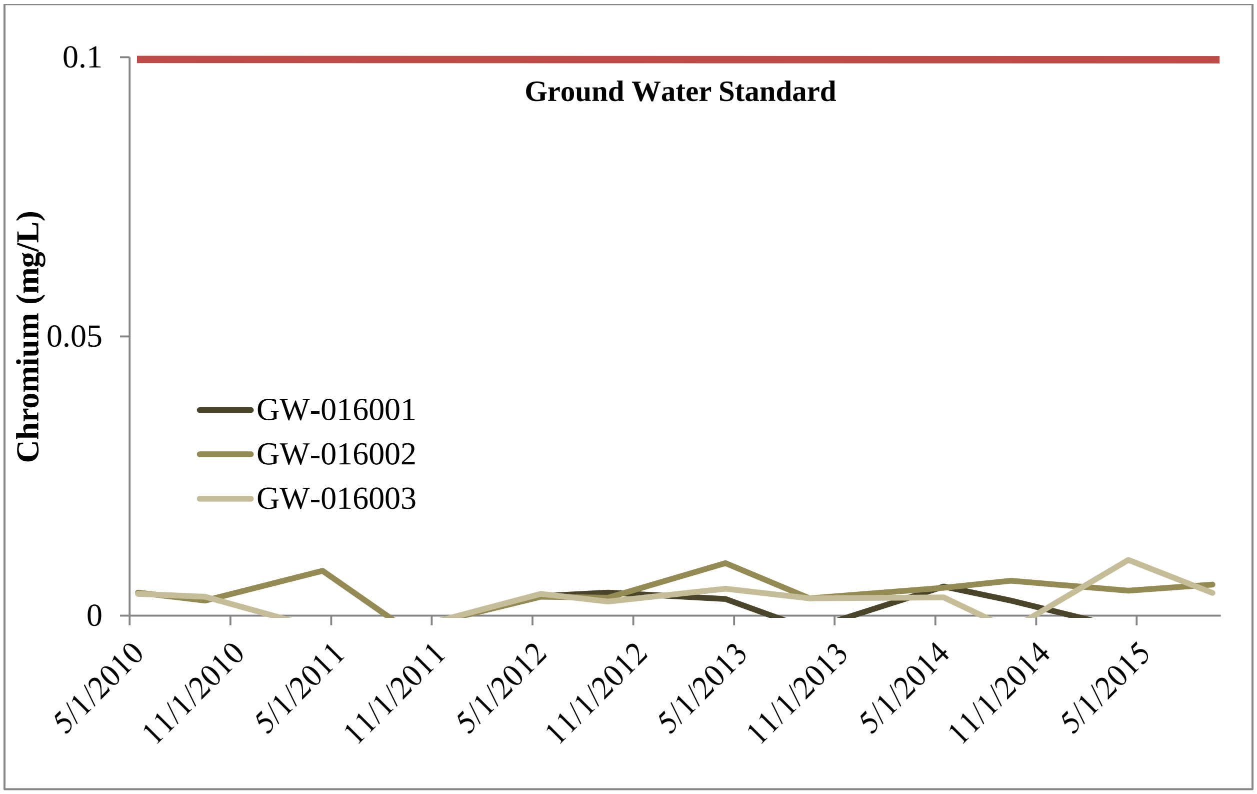

Figure 3. A time series of ground water chromium concentrations in the three MFC monitoring wells compared to the Primary Constituent Standard.

D. Wastewater and Ground Water Monitoring Summary

DEQ recommends monitoring the same parameters in the MFC effluent and ground water so one can effectively evaluate and possibly isolate any ground water impacts from MFC as compared to the historical and other sources of contamination affecting the aquifer at this site. Along with the constituents proposed by the facility to remove from the monitoring program, DEQ has proposed additional removals of monitoring constituents. These decisions were based an analysis of historical monitoring data and statistical Mann-Kendall trend analyses (Table 3 and 6).

Table 8, below, summarizes the wastewater and ground water parameters monitored during the previous permit cycle, DEQ's determination on monitoring based on statistical analyses of historic data, and the justification for keeping or removing constituents in the new permit.

Table 8. Monitoring recommendations and decision justifications for the new permit.

Constituent	GW	WW	Monitor?	Decision Justification
Arsenic	x	x	No	Low GW concentrations (<0.05 mg/L) and no trends observed. Pipe line samples were 89 % non-detect. Ditch concentrations are low (<0.05 mg/L) and no trend observed.
Barium	x	x	No	Low GW concentrations (<2 mg/L) and no trends observed. Low concentrations in WW and no trends observed.
Cadmium	x	x	No	100 % non-detect concentrations in GW (<0.00025 mg/L). 100 % non-detect in WW
Chloride	x	x	No	Low GW concentrations (<250 mg/L) and no trends observed. Low concentrations observed in WW and a decreasing trend observed in pipe WW.
Chromium	x	x	No	Low concentrations in down-gradient wells (<0.1 mg/L) and no trends observed. 83 % non-detect in pipe WW. Low concentration in ditch (<0.1 mg/L) and no trend observed.
Fluoride		x	No	Not currently monitoring in GW. Concentrations are low in WW (< 4mg/L) and no trends observed.
Total-Fe	x	x	Yes	The median total iron concentration in GW-016002 was slightly above the standard (0.33 mg/L) and an increasing trend was observed. An increasing trend was also observed in the pipe WW.
Lead	x	x	No	Above 80 % non-detect in both GW-016001 and GW-016003. 42 % non-detect in GW-016002 and no trend observed. No trend observed in pipe WW and decreasing trend observed in ditch WW.
Total-Mn	x	x	Yes	Increasing trend was observed in down-gradient well GW-016002
Mercury	x	x	No	100% non-detect concentrations in GW (<0.0002 mg/L). 100% non-detect in WW.
TKN		x	No	There is no GW constituent standard for TKN and a decreasing trend was observed in the pipe. No trend was observed in the ditch.
$NO_3^- + NO_2^-$	x	x	Yes	Increasing trends observed in all monitoring wells. Increasing trend observed in pipe WW.
Total-N		x	No	There is no GW constituent standard for total-N and no trends were observed in WW.
pH	x	x	Yes	Decreasing trend was observed in both down-gradient wells and in the pipe WW.
Phosphorus	x	x	No	Low concentrations of phosphorus observed in all monitoring wells (<0.015 mg/L) with no trends observed. Decreasing trend observed in pipe WW. There is no GWQS for P in IDAPA 58.01.11.
Selenium	x	x	No	Low GW concentrations (<0.05 mg/L) and no trends observed. Low concentrations in WW and no trends observed.
Silver	x	x	No	100 % non-detect concentrations in GW (<0.005 mg/L). 95 % non-detect in pipe and 100 % non-detect in ditch.
Sodium	x	x	No	Small difference observed between GW-016001 (17.6 mg/L) and GW-016002 (18.7 mg/L) but not between GW-016001 and GW-016003 (18.0 mg/L). Decreasing trends observed in both pipe and ditch WW.
TDS	x	x	Yes	Although GW concentrations are below the standard and no trends observed, monitoring for TDS will provide indicator data for facility process changes. This is especially true if other salts are removed from monitoring.
TSS		x	No	There is no GW constituent standard for TSS and WW samples were > 80 % non-detect. TSS limits have been removed from IDAPA 58.01.17.600
Sulfate	x	x	No	Low GW concentrations (<250 mg/L) and no trends observed in down-gradient wells. Low concentrations in WW and no trends observed.
Zinc	x	x	No	High number of non-detects in down-gradient GW wells (>50 %; <0.0025 mg/L). Low concentrations in WW. No trend observed in the pipe and a decreasing trend observed in the ditch.

GW = Ground Water; WW = Wastewater; x = Current monitoring status of the constituent

In summary, DEQ Staff recommends that the facility continue to monitor water table elevation, water table depth, temperature and conductivity in ground water. DEQ Staff also recommends that the facility continue to monitor total iron (unfiltered), total manganese (unfiltered), pH, total dissolved solids, and nitrate + nitrite in both ground water and wastewater for the I-160-02 permit cycle. In the case of total iron and total manganese, DEQ recommends that dissolved iron and/or manganese analytical results be required if the results for total iron and/or total manganese exceed the standards in IDAPA 58.01.11.200.01.b.h

In order to characterize and track key signatures and potential changes to the regional aquifer over time, staff also recommends limited sampling of the following parameters during the first and last year of the new permit: chloride, sulfate, sodium, potassium, calcium, magnesium, and alkalinity.

VII. Site Operation and Maintenance

Although DEQ rules do not require certified operators at industrial wastewater reuse facilities, MFC has several operators that are currently certified for Class I Treatment and Land Application.

The facility noted in the permit application that small amounts of industrial wastewater from the process holdup tank may also be discharged, pending approval by the facility supervisor and environmental compliance staff (Miller 2014, Section 5.1, p. 14). Per personal communication with Mr. Michael Lewis, the process hold tank is located in building MFC-785 (Hot Fuel Examination Facility) and contains wastewater from janitorial sinks, lab sinks, cooling coil condensate, floor drains, and air conditioning units. Discharge of this wastewater to the IWP occurs approximately twice per year at ~1,000 gallons per discharge. Although hazardous or radioactive constituents are not expected, as a precaution, the tank contents are sampled and analyzed for pH, metals, and radionuclides (Lewis 2016). Other potential discharges discussed were from mop water, concrete cutting water, cooling water, and condensate from HVAC systems. These discharges occur 6 to 12 times per year at 1 to 50 gallons per discharge. MFC analyzes both sources of water to ensure that constituents can be safely discharged to the IWP. For non-radiological parameters, these have been modeled to ensure the concentrations that are discharged to the IWP do not exceed RCRA hazardous waste levels, cause a ground water quality standard to be exceeded, and do not cause a new CERCLA Site to be created. The model used an annual flow volume of 15.3 million gallons/year to the IWP to determine the acceptable release concentrations and annual loading rates. For radionuclides, the sample results are compared to EPA drinking water Maximum Contaminant Levels. If the process holdup tank wastewater or non-routine wastewater sample results are below MCLs for radiological parameters, the wastewater would be allowed to be discharged into the Industrial Waste Pipeline. (Lewis 2016).

Review of the 2010 to 2015 DEQ inspection reports do not reveal any specific operational deficiencies that need to be revised for the next permit cycle.

VIII. Compliance Activities

1. The current Plan of Operation (O&M Manual) for WRU-I-0160-01 was approved by DEQ on June 23, 2011. A compliance activity has been added to the draft permit requiring submission of a revised Plan of Operation that incorporates the requirements of the new permit and incorporates the recent changes to the Plan of Operation requirements specified in Subsection 300.05 of the Recycled Water Rule, IDAPA 58.01.17. DEQ Staff recommends the revised Plan of Operation be submitted within 12 months of permit issuance in accordance with IDAPA 58.01.17.600.05.
2. A new standard requirement of all wastewater reuse permits is the creation and implementation of a Quality Assurance Project Plan (QAPP) to ensure accurate and valid data are collected and submitted to DEQ. A compliance activity has been added to the draft permit requiring submission of a QAPP following available guidance, and implementation of the QAPP within 90-days of permit issuance. A letter and copy of the QAPP must be submitted to notify DEQ that the permittee has fulfilled this compliance condition requirement and has implemented the QAPP. DEQ will not be performing a formal approval function, but will review and comment on the QAPP if necessary to address any deficiencies.
3. A compliance activity has been added to the draft permit requiring submission of a Waste Solids Management Plan. The due date for this compliance activity will be as needed. In the permit application the facility stated that there were currently no plans to remove solids from the IWP (Miller 2014, Section 6.1, p. 20).

IX. Permit Duration

In the permit application, it was noted that no major system changes were anticipated during the next 10 years at the MFC facility (Miller 2014, Section 1, p. 1). It was requested that the new permit duration be 10 years in accordance with the recent rule revisions specified in IDAPA 58.01.17.600.02.

DEQ Staff recommends the permit duration be 10 years and the loading limit be 17 MGA for the MFC facility.

Recommendation

Staff recommend that the draft wastewater reuse permit be issued. The permit specifies hydraulic loading limits and establishes monitoring and reporting requirements to evaluate system performance and determine permit compliance.

References

Ackerman, D.J. 1991. *Transmissivity of the Snake River Plain Aquifer at the Idaho National Engineering Laboratory, Idaho.* U.S. Geological Survey: Water-Resources Investigations Report 91-4058. (Ackerman 1991).

Helsel, D.R. 2012. *Statistics for censored environmental data using Minitab® and R – 2nd ed.: Chapter 6: Computing Summary Statistics and Totals.* John Wiley & Sons, Inc. Hoboken, New Jersey. (Helsel 2012)

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The Idaho Department of Environmental Quality (DEQ) 2013. *2013 Inspection Report for the Materials and Fuel Complex (MFC), Ditch C and Industrial Waste Pond.* Permit LA-000160-01. (DEQ 2013)

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Idaho National Engineering & Environmental Laboratory (INEEL). 1998. *Final Record of Decision, Argonne National Laboratory – West, Section 5: Summary of Site Characteristics.* (INEEL 1998).

Interstate Technology & Regulatory Council (ITRC). 2013. *Groundwater Statistics and Monitoring Compliance, Statistical Tools for the Project Life Cycle.* GSMC–1. Washington, D.C.: Interstate Technology & Regulatory Council, Groundwater Statistics and Monitoring Compliance Team. http://www.itrcweb.org/gsmc-1/ (ITRC 2013)

Lewis, M.G. July 5, 2016. *Personal Communication: Michael Lewis.* (Lewis 2016)

Miller, T.A. 2014. *Recycled Water Reuse Permit Renewal Application for Materials and Fuels Complex Industrial Waste Ditch and Industrial Waste Pond.* (Miller 2014)

The R Foundation (R). 2016. *The R Project for Statistical Computing.* (R 2016)

United States Department of Agriculture – Natural Resources Conservation Service (NRCS). 2009. *Soil Survey of Butte County Area, Idaho, Parts of Butte and Bingham Counties.* (NRCS 2009)

Appendix 1 – INL MFC IWP and IWD Ground Water Quality Data (Requested Removals)

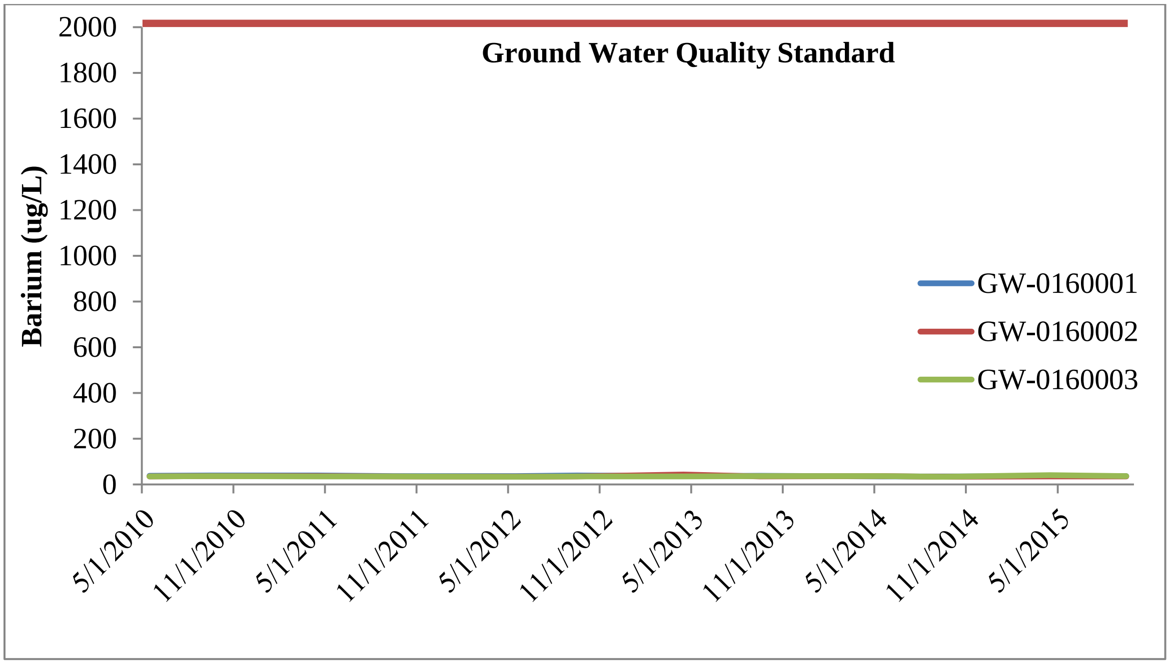

Figure A1.1. A time series of ground water barium concentrations in the three MFC monitoring wells compared to the Primary GWQS.

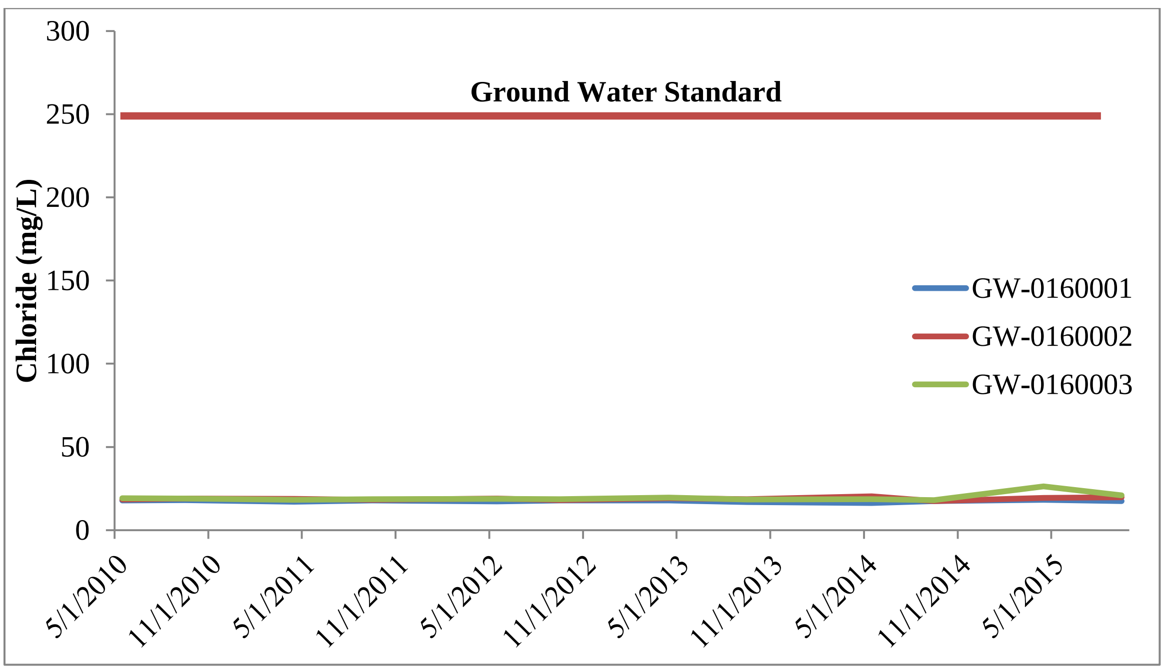

Figure A1.2. A time series of ground water chloride concentrations in the three MFC monitoring wells compared to the Secondary GWQS.

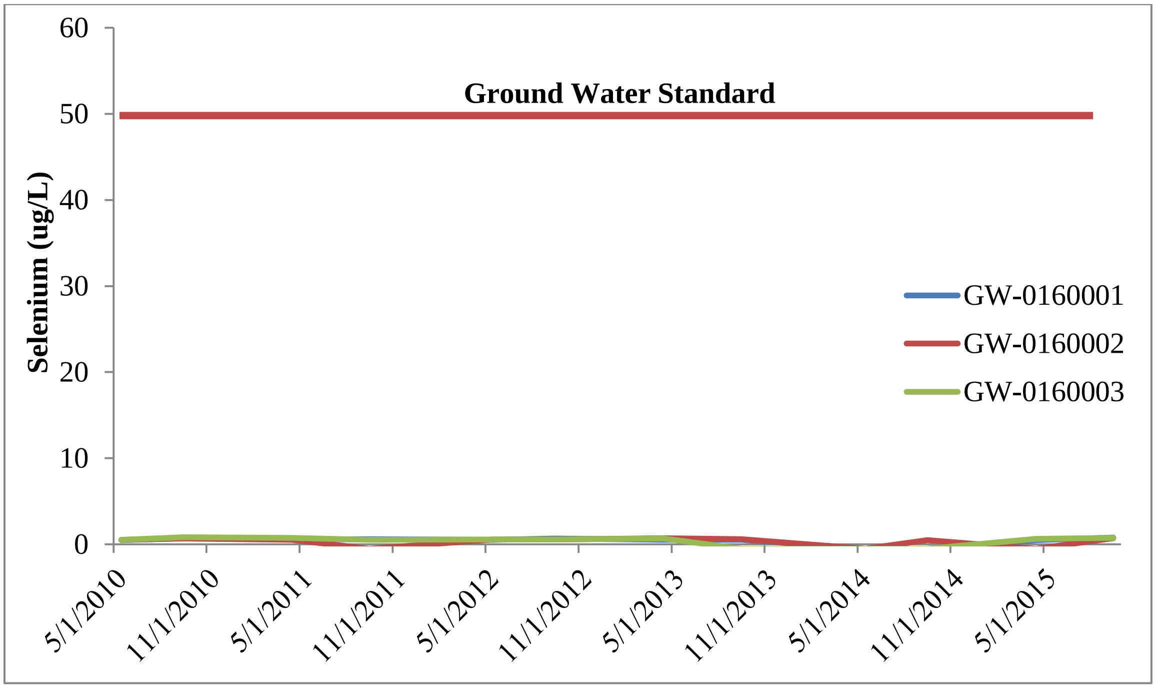

Figure A1.3. A time series of ground water selenium concentrations in the three MFC monitoring wells compared to the Primary GWQS.

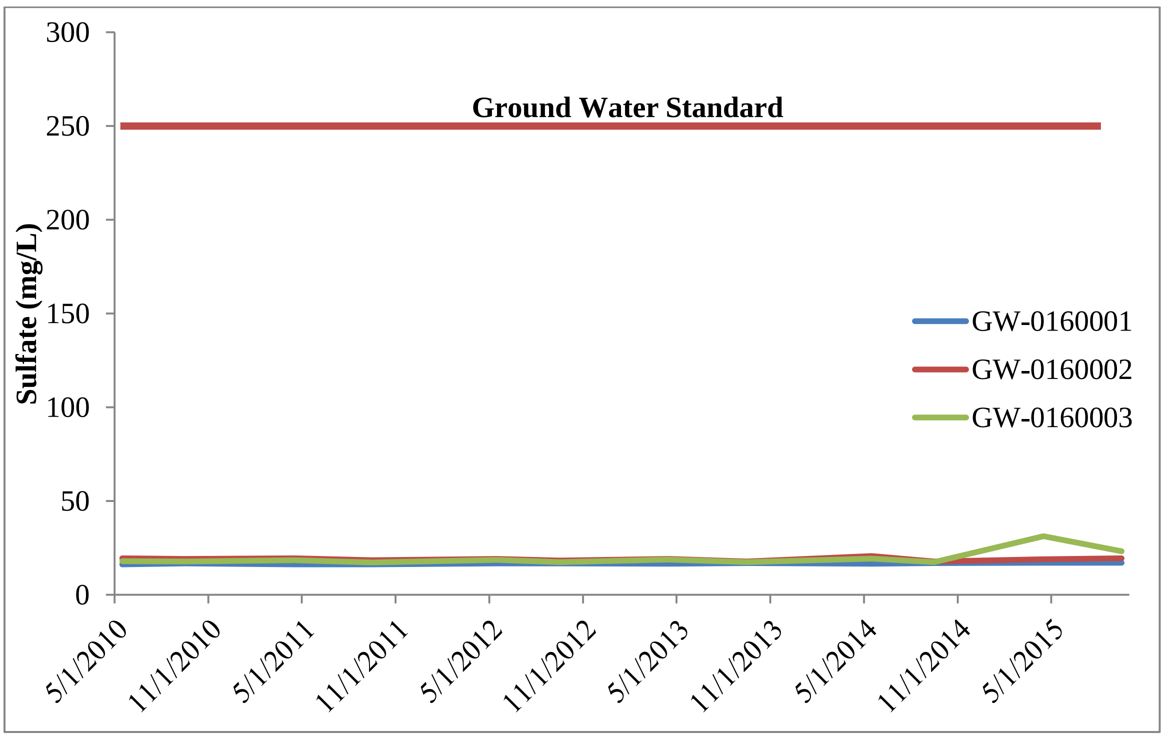

Figure A1.4. A time series of ground water sulfate concentrations in the three MFC monitoring wells compared to the Secondary GWQS.

Appendix 2 – INL MFC IWP and IWD Box Plots for Constituents of Concern

Boxplot Key: Bold black line = median; Box limit = upper and lower quartile; Top and bottom line = maximum and minimum value; Dot = outlier

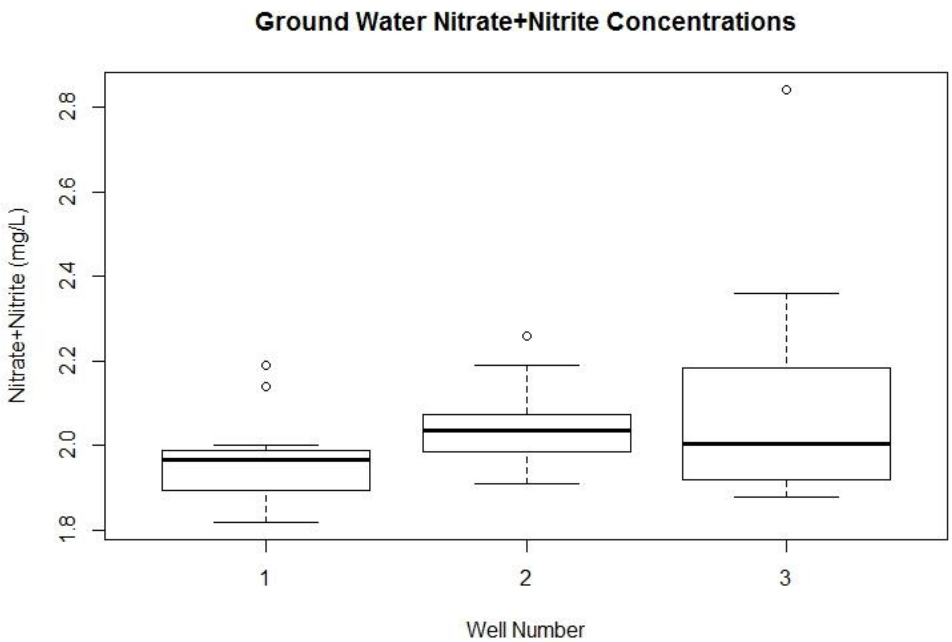

Figure A2.1. Ground water nitrate + nitrite-N concentrations in MFC ground water monitoring wells (1 = GW-016001; 2 = GW-016002; 3= GW-016003).

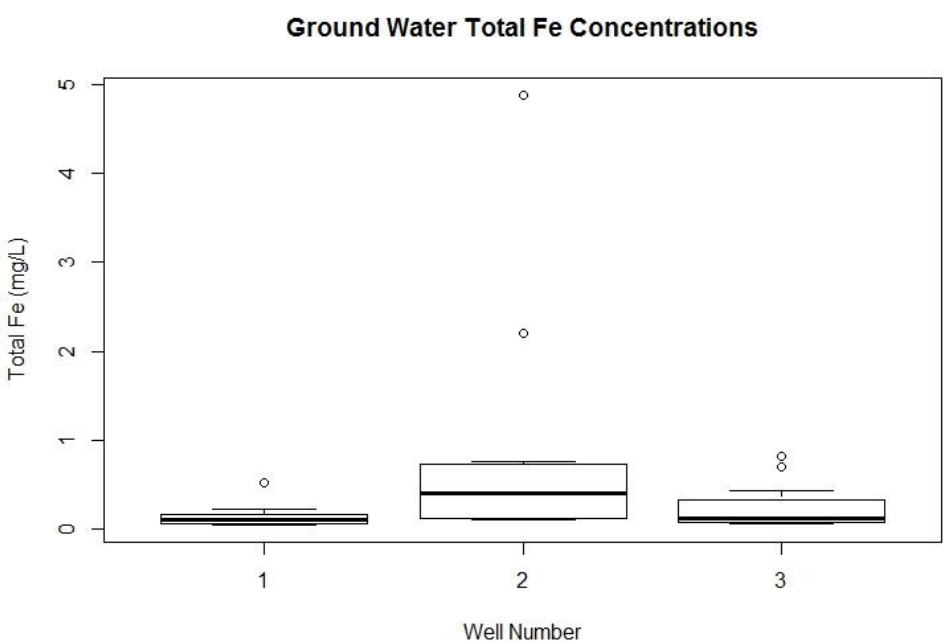

Figure A2.2. Ground water total-Fe (unfiltered) concentrations in MFC ground water monitoring wells (1 = GW-016001; 2 = GW-016002; 3= GW-016003).

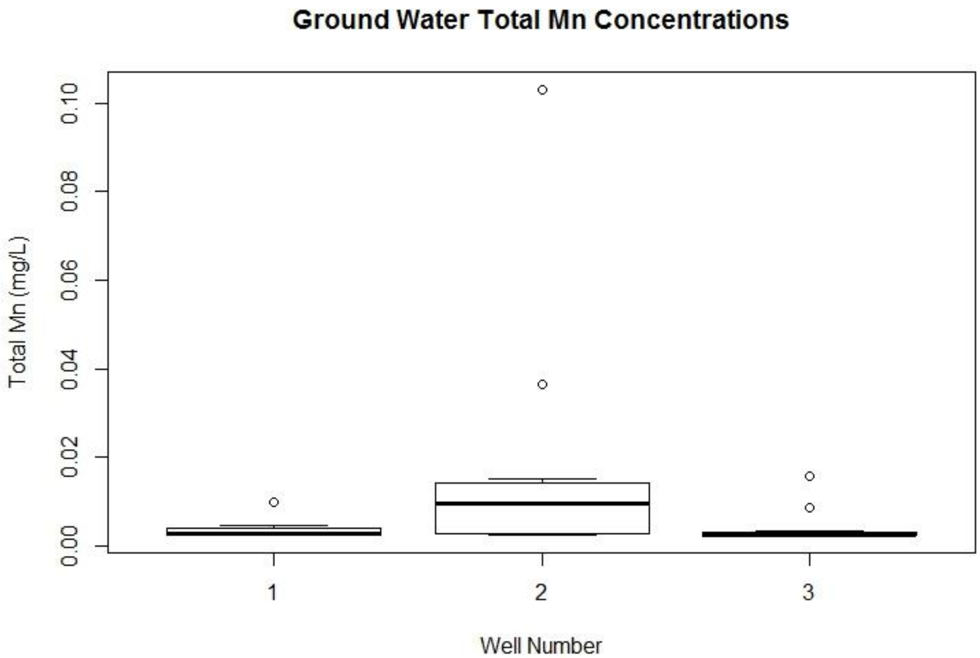

Figure A2.3. Ground water total-Mn (unfiltered) concentrations in MFC ground water monitoring wells (1 = GW-016001; 2 = GW-016002; 3= GW-016003).

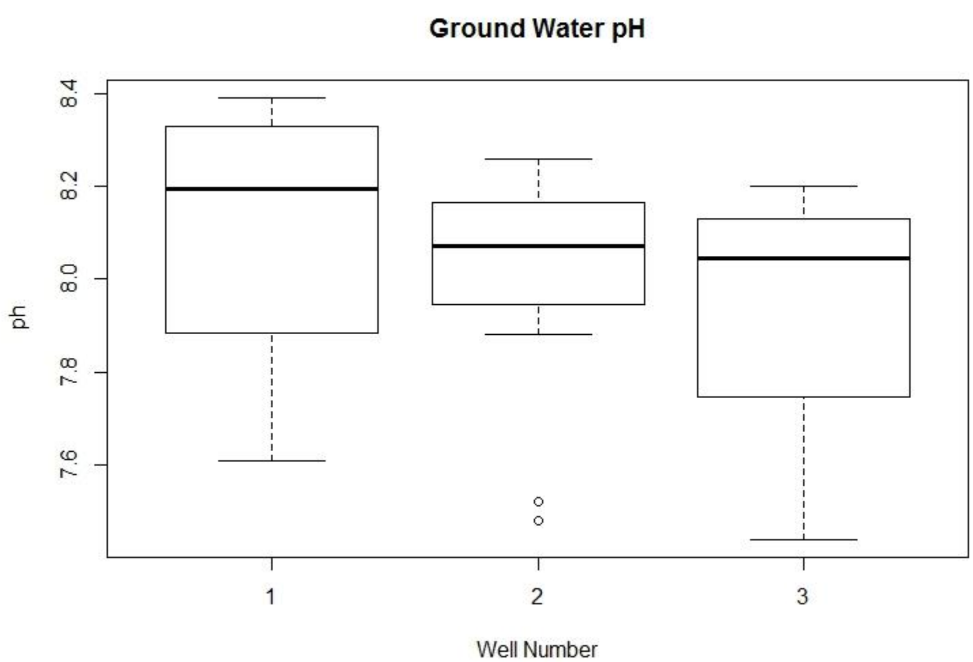

Figure A2.4. Ground water pH in MFC ground water monitoring wells (1 = GW-016001; 2 = GW-016002; 3= GW-016003).

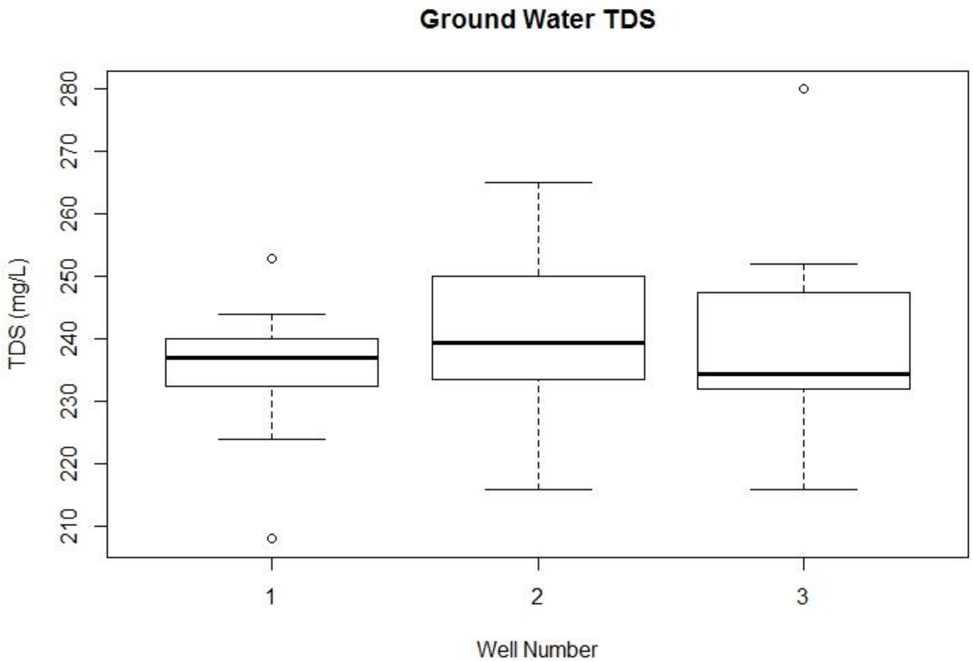

Figure A2.5. Ground water TDS in MFC ground water monitoring wells (1 = GW-016001; 2 = GW-016002; 3= GW-016003).

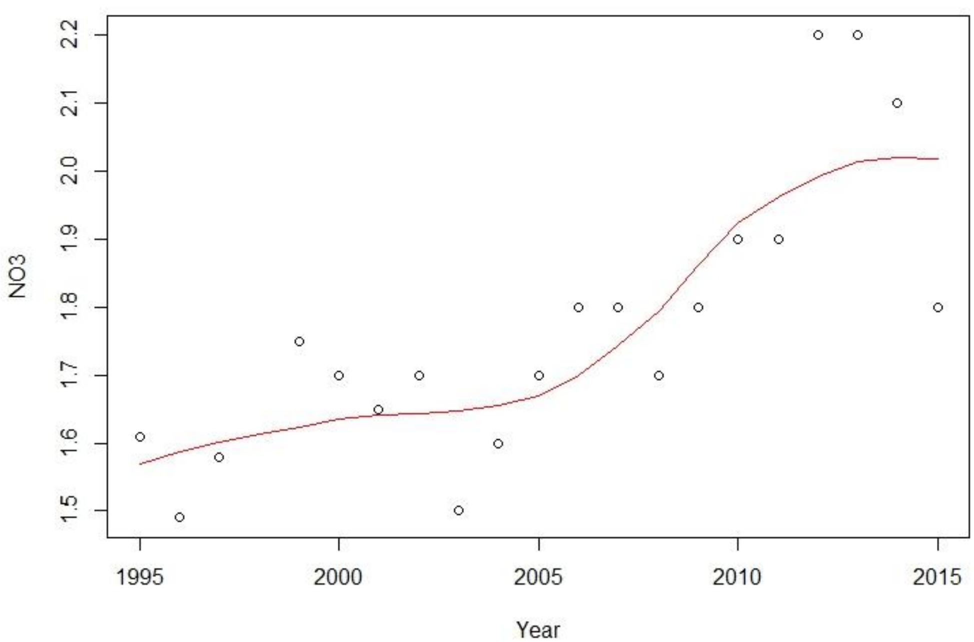

Figure A2.6. Loess smoothing curve for EBR-II, Well #1 nitrate concentration data from 1995 to 2015. Note that nitrate concentrations are in mg/L and the range is 0.7 mg/L.

Appendix 3 – Regional and Facility Maps

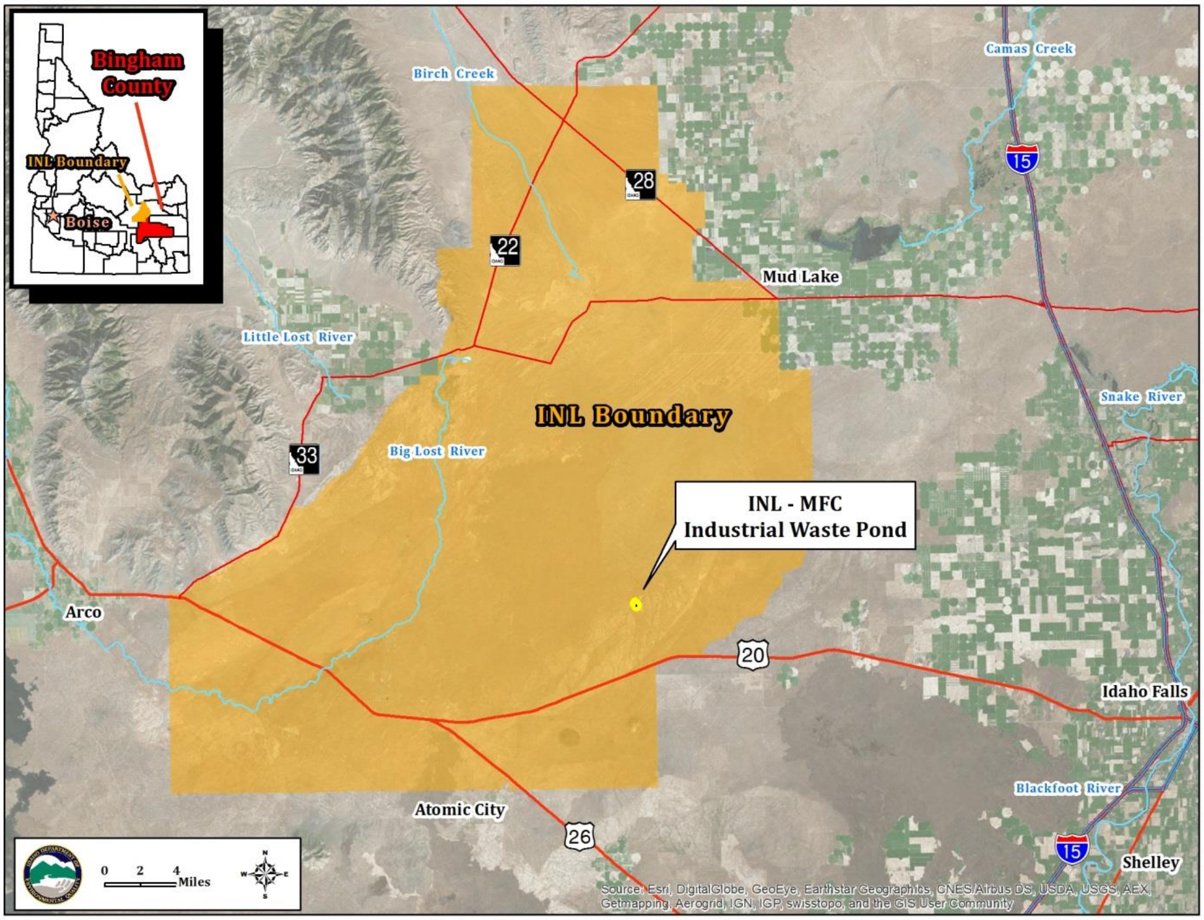

Figure A3.1. Regional map showing the boundary of the Idaho National Laboratory and the location of the MFC Facility reuse site.

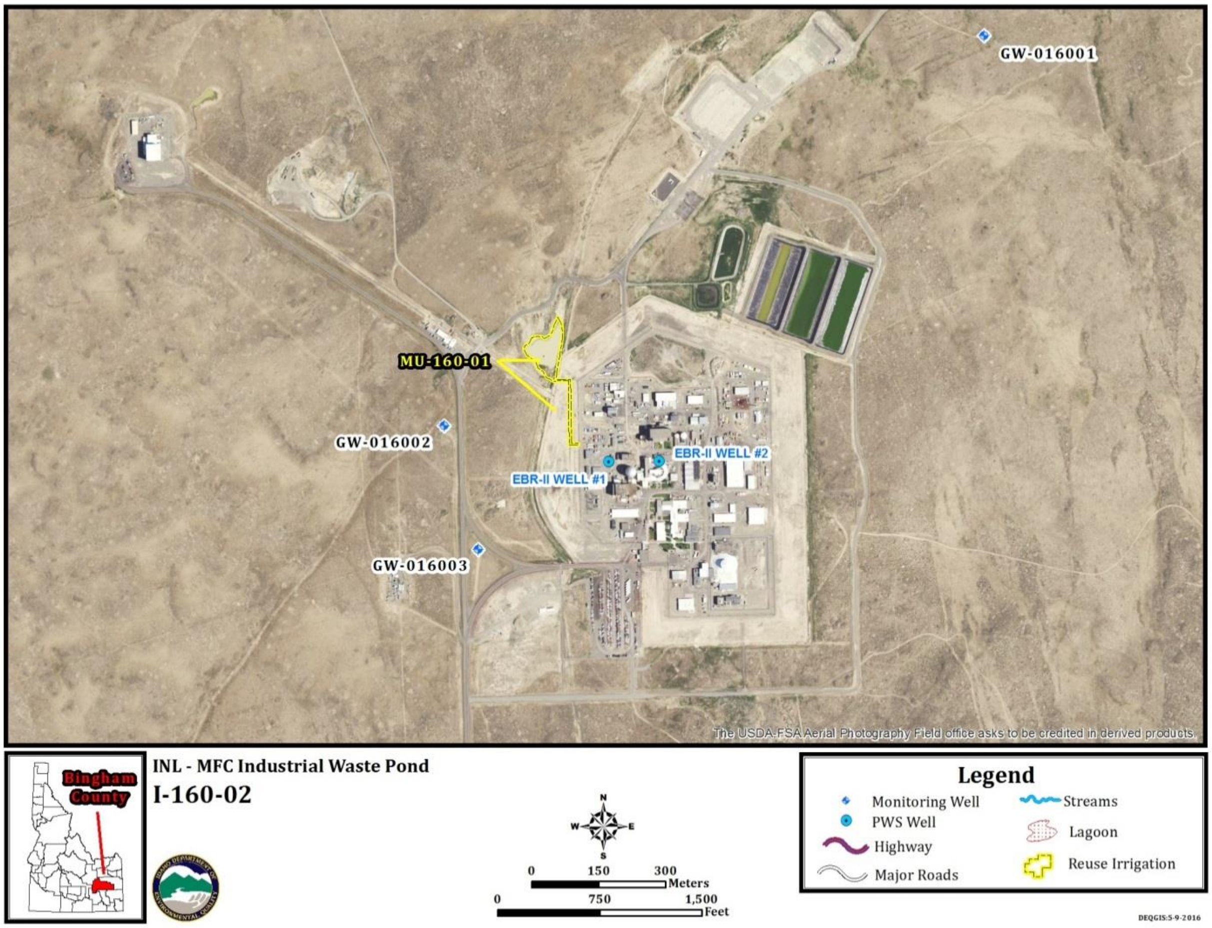

Figure A3.2. MFC facility map showing groundwater monitoring wells, public water supply wells, and the management units.

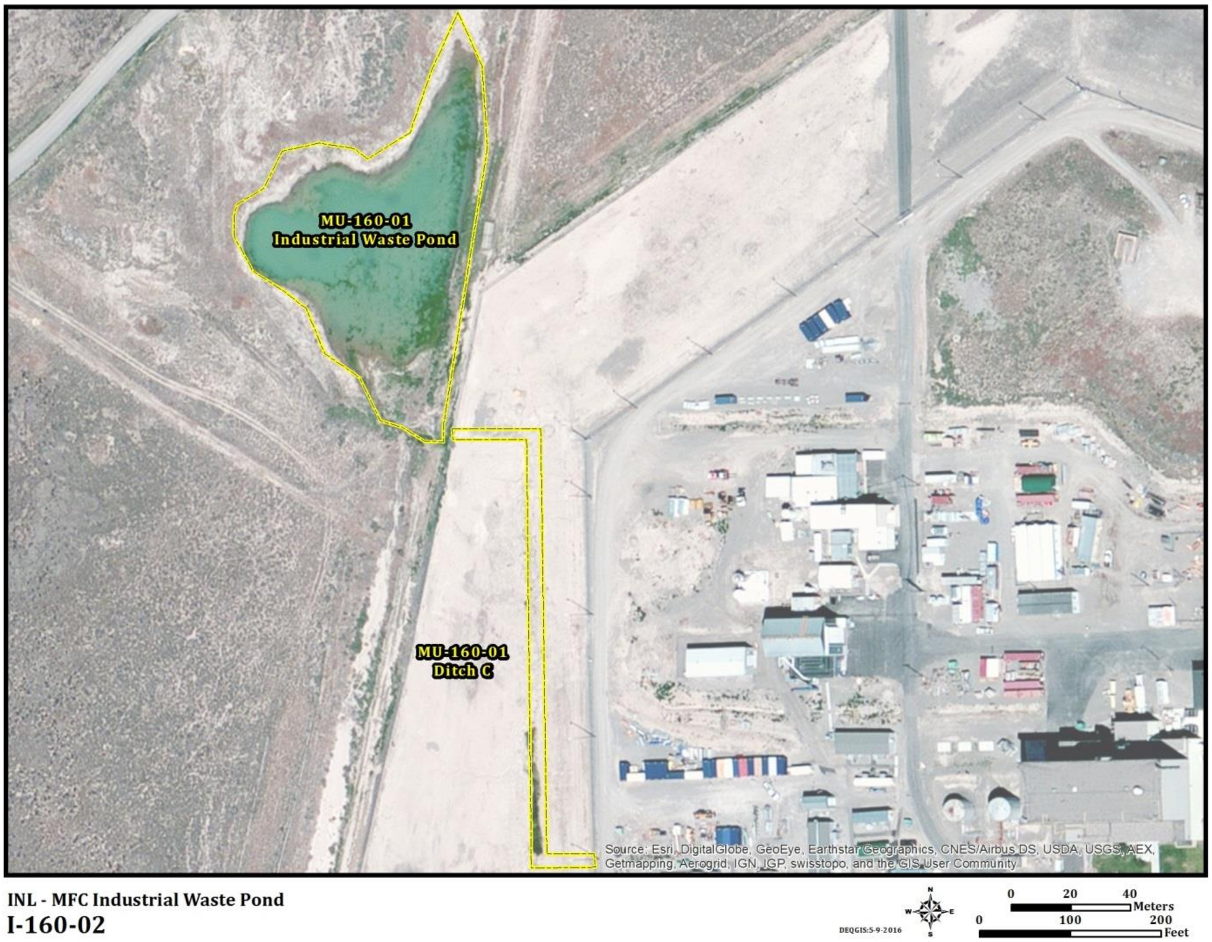

Figure A3.3. Close-up map of the Industrial Waste Pond (MU-160-01) and Ditch (MU-160-01).

Figure A3.4. DEQ Source Water Assessment and Project, drinking water capture zone.

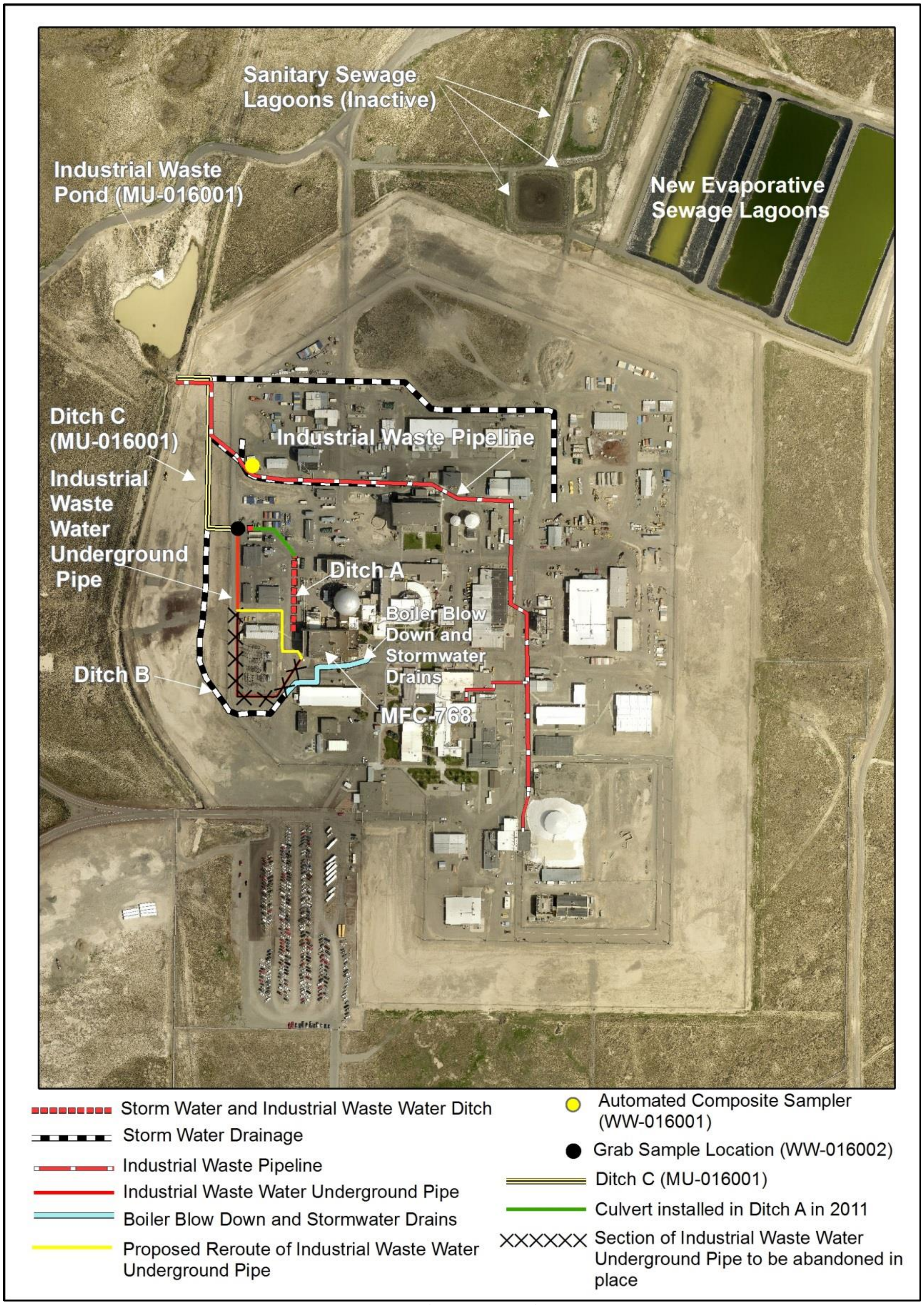

Figure A3.5. Proposed rerouting (yellow line) of a section of the industrial wastewater underground pipe. The line of Xs shows the section of current pipe that will be abandoned.