East Mission Flats Repository
Enhanced Monitoring Plan

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East Mission Flats

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SECTION 1.0 INTRODUCTION

This Enhanced Monitoring Plan (EMP) for the East Mission Flats (EMF) repository was developed in response to the recommendation in the United States Environmental Protection Agency (USEPA) Office of Inspector General (OIG) Hotline Report titled *Contaminated Soil Waste Repository at East Mission Flats, Idaho* Report No. 09-P-0162 issued June 8, 2009 (USEPA 2009a) in connection with the EMF repository design. The recommendation stated:

> *"finish analyzing the geochemical and physical conditions that might lead to contaminants dissolving near the repository base; then confirm the adequacy of the repository design to prevent dissolved contaminants from being released under these conditions."*

USEPA Region 10 and the Idaho Department of Environmental Quality (IDEQ) identified the development of the EMP as the key element to their OIG corrective action plan, which was developed in response to the OIG's final recommendation. On August 12, 2009, the OIG accepted the agencies action plan to develop the EMP as a means of addressing the OIG's remaining technical concerns.

This EMP will be incorporated as an addendum to Appendix M of the *East Mission Flats Repository 90% Design Report* issued June 5, 2009 (TerraGraphics 2009a). Appendix M is the *Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) for Groundwater and Surface Water Monitoring at the East Mission Flats Repository* (TerraGraphics 2009b), hereinafter referred to as the EMF SAP/QAPP. The EMF SAP/QAPP was made available for public comment as part of the 60% design review period. The scope of this EMP was developed by IDEQ, in coordination with USEPA, including input from the independent USEPA technical reviewer recommended by the OIG.

1.1 Problem Definition/Background

The EMF repository is located in a floodplain that experiences frequent inundation. In addition, shallow groundwater beneath the site has the potential to reach surface elevations should extended hydrogeologic conditions favor upward movement. These conditions generally occur in the late winter and early spring and result in fluctuating groundwater levels that may introduce free water into the repository. Sampling results have indicated the underlying groundwater prior to construction of the EMF repository contained oxygen levels that were less than saturated.

Free water within the repository is a concern due to the geochemical characteristics of metals bound in the waste soil stored in the facility. During this seasonally transient window of geochemical and hydrogeologic conditions, if the underlying oxygen-depleted groundwater reaches the base of the waste soil, free water introduced to the repository from this source may result in a localized reducing environment.

Under these conditions there is a potential for metals dissolution into the free water and subsequent transport to the underlying groundwater. If reducing conditions are persistent, and the volume of water is sufficient for transport mechanisms to allow downward migration, then the shallow water-bearing zone below the repository may be impacted.

The EMF design is based on predictive modeling for downward infiltration of precipitation and water flux through expected repository waste soils to determine anticipated repository performance and impacts on underlying groundwater quality. This modeling indicated that no significant impacts to groundwater will occur due to the repository. During the EMF Repository design, the pathway for upward penetration of groundwater into the base of the repository was not considered viable because of the low hydraulic conductivity of the compacted native material and the relatively short period of upward vertical flow. However, no field data are currently available to confirm this design assumption. This EMP is intended to provide the field data to better assess the potential for groundwater impacts and evaluate the validity of this design assumption.

1.2 Purpose and Objectives

The purpose of the EMP is to address the OIG recommendation for additional analysis of site geochemical and physical conditions. The work described is additional to the EMF SAP/QAPP. This EMP has four objectives as follows:

1) Monitor soil saturation in the EMF repository waste soil mass;
2) Evaluate vertical gradients between the shallow and deep water-bearing zones at the EMF repository site;
3) Evaluate how Coeur d'Alene River water levels influence groundwater levels at the EMF site; and
4) Perform a statistical/trend analysis evaluation of the EMF groundwater quality monitoring data.

To achieve these objectives, the scope of work outlined in Sections 2 through 4 will be performed.

1.3 Corrective Action Response Thresholds

The EMP will provide two tools DEQ and EPA can use to identify when release of metals from the repository materials may be occurring. The two tools are: (1) the piezometers in the waste soil mass for early detection of saturated conditions; and (2) a statistical analysis of groundwater monitoring data to identify if and when metals release from the repository is causing groundwater contamination. A brief description of the tools, and when information from the tools will trigger a corrective action response is outlined in the subsequent paragraphs.

1.3.1 Piezometer Data

The piezometers will monitor conditions within the waste soil mass that may lead to releases of metals to groundwater. The early detection of reducing conditions within the waste soil mass will initiate the agencies to develop corrective action to minimize the

potential of metals leaching from the repository material. The corrective action will be designed to identify the cause of the reducing conditions, and if necessary mitigate the impacts of metals migration to the underlying groundwater. Depending on the nature and extent of reducing conditions within the waste soil mass, potential measures to mitigate the potential leachate migration may include active or passive dewatering systems, construction of aeration cells within the waste soil mass, or other remedial measures as appropriate.

1.3.2 Groundwater Data Analysis

The EMF site is ringed with a network of six groundwater monitoring wells. The wells are located both up-gradient and down-gradient of the repository footprint. The wells have been sampled on a quarterly basis since December 2007. The sampling conducted since 2007 provides a snapshot of groundwater conditions prior to August 2009 when the first loads of contaminated soil were received at the site.

The important issue when interpreting groundwater monitoring results will be to identify trends of increasing metals concentrations indicative of a release of metals from the repository materials. Of concern will be variation in metals concentrations greater than expected due to natural fluctuation. In order to evaluate the significance of variance of metals concentrations from year to year, the groundwater data from the monitoring wells will be analyzed using appropriate statistical methods. The statistical analysis will be used to identify if and when metals concentration are greater than would be expected due to natural variation.

The statistical analysis will be summarized in the EMF Operations Report issued on an annual basis. If the results of the analysis suggest a significant increase in metals concentrations, a corrective action plan will be developed to identify the cause of the release and, if necessary, outline steps to prevent further release of metals from the repository materials.

1.3.3 Risk Assessments

In cases where corrective action is proposed, the recommended corrective actions will be commensurate with the risk posed by the metals concentrations. This may involve performance of risk analyses to identify completed exposure pathways to sensitive receptors. The results of the risk assessments will be used to develop appropriate remedial actions that address the principal human and/or environmental health risks due to exposure to the metals.

SECTION 2.0 DATA COLLECTION

Data will be collected to support the primary objectives and analyses anticipated in this EMP. Those data collection objectives are i) Waste Soil Moisture Monitoring, ii) Vertical Gradient Evaluation, iii) Surface Water Influence, and iv) Groundwater Sampling and Analysis.

The plan to monitor waste soil moisture conditions adopts a phased approach. The first phase is intended to detect if the soil becomes saturated resulting in the presence of free

water within the waste soil mass. If free water is observed, a multi-parameter probe will be installed in the piezometer(s). If water quality data from the multi-parameter probe indicate that reducing conditions are present, then additional tasks will be developed and implemented to evaluate the geochemical conditions of the water and causal mechanisms for the presence of water within the waste soil mass. These additional objectives and tasks will be developed and included as an addendum to this EMP at that time.

The locations of the existing monitoring wells are illustrated in Figure 1. The additional monitoring well, screened in the deep water-bearing zone, will be installed near the location of existing well MW-C at the EMF repository site as depicted on Figure 2. Well construction and screened interval details for this additional well will be determined following the installation of the water supply well at the EMF Phase 2 decontamination pad, scheduled for construction in early spring 2010 and it is estimated that it will be installed approximately 110 feet below ground surface. During the installation of the water supply well, observations of the borehole cuttings will be made, and noted information will be used to design the deep water-bearing zone monitoring well. This well will be added to the quarterly groundwater monitoring program described in the EMF SAP/QAPP. Data from the quarterly groundwater monitoring program at the EMF repository site will be used to perform trend analyses and evaluate changes in groundwater quality. The deep and shallow wells at MW-C will be fitted with transducers to evaluate vertical hydraulic gradients in the two water-bearing zones.

The following sections describe the data collection, analysis, and reporting methods required to achieve the objectives of this EMP.

2.1 Waste Soil Saturation Monitoring

Two piezometers will be installed on the EMF repository Phase 2 decontamination pad to monitor free water within the waste soil mass. The installation and data collection methodology for these piezometers follows:

- Advance one soil boring as a pilot hole through the waste soil mass on the Phase 2 decontamination pad (i.e., to the bottom of Phase 2, which is the approximate depth to the underlying native material, with a surface elevation of approximately El. 2,135 feet prior to construction). See drawings provided in Appendix A of the *East Mission Flats Repository 90% Design Report* (TerraGraphics 2009a). This location was selected because it is part of the material initially placed in the waste soil mass.

- Log soils in the pilot hole using continuous coring methods through the waste soil until the underlying native material is encountered.

- Seal the pilot-hole boring using methods described in the Idaho Department of Water Resources Well Construction Standards Rules (IDAPA 37.03.09) for abandonment of wells and boreholes.

- Adjacent to the pilot hole, install two four-inch diameter polyvinyl chloride (PVC) piezometers in accordance with Idaho Department of Water Resources Well Construction Standards Rules (IDAPA 37.03.09). Each piezometer will be completed in a separate boring. Each piezometer will be completed at the surface in traffic-rated, flush mounted vaults.

- The piezometers will be screened over two-foot intervals. One piezometer will be screened as low as possible within the waste soil mass, preferably with the base of the screen within one foot of the waste soil/native soil interface. The base of the second piezometer screen will be located three to four feet above the top of the first piezometer screen.

- The top of the piezometer casings will be surveyed by an Idaho-licensed professional surveyor to the nearest 0.01 foot.

Each new piezometer will be instrumented with a transducer to detect the presence of water and if present, measure the water column height within the piezometer casing. Figure 2 shows the location of the new monitoring well next to MW-C and the two piezometers within the EMF repository.

2.1.1 Piezometer Transducers

Each piezometer will be equipped with a transducer. The transducers installed in the two piezometers will be Solinst Levelogger® Gold Model 3001 level loggers (or equivalent). The transducers will be programmed to record water column height data at a minimum of one reading per 24-hour period. Data will be downloaded from the transducers using either a Solinst Leveloader® Gold unit or a laptop equipped with an optical reader. The water column height data will be downloaded on a quarterly basis in conjunction with the existing EMF repository groundwater sampling program. A water depth measurement will be collected, as described in Section 2.1.2 below, during each data download session to validate the transducer water level reading. In addition, downloaded water column height data will be corrected for barometric pressure prior to use or delivery of data.

2.1.2 Electronic Water Level Indicator

During each quarterly data download session, the piezometers will be sounded with an electronic water level indicator to manually check for the presence of water within the piezometers. The water level will be measured using a QED Environmental Systems (QED) MicroPurge® Drawdown/Water Level Meter Model No. MP30 (or equivalent) by slowly inserting the water level indicator probe into the piezometer casing. As the probe enters the water, a buzzer and indicator light will be activated. The probe will be gently inserted into and retracted from the water surface so that the water surface can be determined accurately. The point at which the water level buzzer and light activate represents the depth to water. The graduation mark on the water level tape adjacent to the north rim of the PVC piezometer casing represents the depth to water. This measurement will be recorded in the field logbook to a precision of 0.01 foot. If free water is present, the water level data will be used to calibrate the water level elevation with the piezometer transducer reading.

2.1.3 Multi-Parameter Water Quality Probe

If water is detected in a piezometer by either the transducer or manual water level readings, then the transducer will be replaced with a dedicated multi-parameter water quality probe to measure water quality parameters. This water quality probe will be an In-Situ Multi-Parameter TROLL ® 9500 (or equivalent). The probe will be placed within the screened interval of the piezometer. The probe will be programmed to record parameters such as water level, pH, dissolved oxygen (DO) and oxidation–reduction potential (ORP) at a minimum of one reading per 24-hour period. Additional parameters may be added as warranted; however, the decision to monitor for additional parameters will be made by IDEQ and USEPA. The multi-parameter probe would replace the transducer for an indefinite period of time and the decision to remove the multi-parameter water quality probe will be made by IDEQ and USEPA. The collected data will be downloaded on a quarterly basis in conjunction with the existing EMF repository groundwater sampling program.

In addition to the multi-parameter water quality probe, if free water is observed within the waste soil mass, additional tasks will be developed and implemented to evaluate the causal mechanisms for the presence of water. The additional objectives and tasks will be developed and included as an addendum to this EMP at that time.

2.2 Vertical Gradient Evaluation

In order to evaluate the vertical gradient at the EMF repository site, a new well, screened in the deep water-bearing zone, will be installed near the location of existing monitoring well MW-C. This location was selected because it is down-gradient of the EMF repository and is the closest existing monitoring location to the new piezometers.

Transducers will be installed in this new deep well and in the existing monitoring well MW-C to record water level data in the deep and shallow water-bearing zones, respectively. The transducers will be Solinst Levelogger® Gold Model 3001 level loggers (or equivalent) and will be programmed to record water level data at a minimum of one reading per 24-hour period.

Data will be downloaded from the transducers using either a Solinst Leveloader® Gold unit or a laptop equipped with an optical reader. The water level data will be downloaded on a quarterly basis in conjunction with the existing EMF repository groundwater sampling program. A water depth measurement will be recorded, as described in Section 2.1.2, during each data download session to validate the transducer water level reading. In addition, downloaded water level data will be corrected for barometric pressure prior to use or delivery of data. The water level data will be used to determine the magnitude and direction of the vertical gradient between the shallow and deep water-bearing zones and how it changes over time.

2.3 Surface Water Influence

Further data collection and sampling will be conducted to evaluate the changes in horizontal gradients, and direction of groundwater flow at the repository site.

2.3.1 Groundwater Well Transducer (Monitoring Well MW-A)

Transducers are currently installed in monitoring wells MW-B and MW-D and are planned for installation in monitoring well MW-C and the new deep monitoring well. A transducer will also be installed in the existing monitoring well MW-A to aid in evaluation of the horizontal gradient and direction of groundwater flow at the repository site. The transducer will be a Solinst Levelogger® Gold Model 3001 level logger (or equivalent). Data will be recorded, downloaded, and processed using the same methodology as previously described in Section 2.2.

2.3.2 USGS Cataldo Gauging Station

Real-time data (i.e., gauge height and discharge) from the USGS Cataldo gauging station (USGS Station Number 12413500) will be downloaded on a monthly basis from the USGS National Water Information System website (USGS 2009). These data will be used to evaluate the correlation of the Coeur d'Alene River stage with groundwater levels recorded from the monitoring wells (i.e., monitoring wells MW-A through MW-D and the new deep monitoring well) at the EMF repository site.

2.4 Groundwater Sampling and Analysis (New Deep Monitoring Well)

The new deep well, to be located near monitoring well MW-C, will be added to the existing EMF repository groundwater monitoring well network. Groundwater from this well will be sampled following construction and development of the well and on a quarterly basis thereafter in accordance with the EMF SAP/QAPP. The analytes are listed in Table 1. All sampling, analysis, decontamination, waste disposal, sample handling, and quality control procedures as outlined in the EMF SAP/QAPP will be followed.

Table 1 Analytical Program Summary[1]

ANALYTE	ANALYTICAL METHOD	METHOD DETECTION LIMIT[a] (mg/l)	METHOD REPORTING LIMIT (mg/l)	NPDWR MCL[b] or TT[c] (mg/l)
Total Metals and Dissolved Metals				
Antimony	USEPA 200.8[d]	0.000072	0.003	0.006
Arsenic	USEPA 200.8[d]	0.00055	0.003	0.010
Cadmium	USEPA 200.8[d]	0.000032	0.0002	0.005
Lead	USEPA 200.8[d]	0.000062	0.003	TT[e]; Action Level = 0.015
Zinc	USEPA 200.8[d]	0.00045	0.0025	NSDWR = 5
Major Water Quality Anions (Dissolved)				
Chloride	USEPA 300.0[f]	0.029	0.2	NSDWR = 250
Nitrate	USEPA 300.0[f]	0.014	0.05	10 (measured as N[g])
Sulfate	USEPA 300.0[f]	0.08	0.3	NSDWR = 250
Major Water Quality Cations (Dissolved)				
Calcium	USEPA 200.7[h]	0.008	0.04	---
Magnesium	USEPA 200.7[h]	0.013	0.06	---
Potassium	USEPA 200.7[h]	0.04	0.5	---
Sodium	USEPA 200.7[h]	0.03	0.5	---
Other				
Alkalinity	SM 2320B[i]	0.4	1.0 (measured as mg $CaCO_3$ per liter)	---
Hardness (Total as $CaCO_3$)	SM 2340B[j]	0.073	0.347	---
Total Phosphorus	SM 4500-P-E[k]	0.0057	0.01	---

[a]The method detection limits (MDLs) provided by SVL change on a quarterly basis. The MDLs listed in this table are current as of December 2007.

[b]Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCL goals as feasible using the best available treatment technology and taking cost into consideration.

[c]Treatment Technique (TT) - A required process intended to reduce the level of a contaminant in drinking water.

[d]*Method 200.8: Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry* (USEPA 1994b)

[e]Lead is regulated by a treatment technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps.

[1] This table was published on June 5, 2009, as Table 2.1 in Appendix M, Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) for Groundwater and Surface Water Monitoring at the East Mission Flats Repository (2009b).

[f]*Method 300.0: Determination of Inorganic Anions by Ion Chromatography* (USEPA 1993)
[g]MDL, MRL, and MCL are for Nitrate measured as Nitrogen (N).
[h]*Method 200.7: Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma – Atomic Emission Spectrometry* (USEPA 1994a)
[i]*Standard Method 2320B Alkalinity: Titration Method* (SM Committee 1997a)
[j]*Standard Method 2340B Hardness (20th Edition): Hardness by Calculation* (SM Committee 1997b)
[k]*Standard Method 4500-P-E Phosphorus: Ascorbic Acid Method* (SM Committee 1999)
Note:
mg/l – milligrams per liter
NPDWR – National Primary Drinking Water Regulations
NSDWR – National Secondary Drinking Water Regulations
SM – Standard Method
USEPA – United States Environmental Protection Agency
--- Not listed in the NPDWR or NSDWR

SECTION 3.0 DATA ANALYSIS

The data will be analyzed and evaluated to address the four main objectives of the EMP: i) Waste Soil Moisture Monitoring, ii) Vertical Gradient Evaluation, iii) Surface Water Influence, and iv) Groundwater Sampling and Analysis.

3.1 Waste Soil Saturation Monitoring

Water column height data from the piezometer transducers will be downloaded quarterly. The data will be calibrated based on the manually-collected water depth measurements and will be corrected for barometric pressure, and converted to water level elevations prior to use or delivery. If free water is present, the resulting water level elevation data for each piezometer will be plotted against time to create hydrographs of water level in the waste soil. Final data will be presented in both tabular and graphical formats. In addition, water level elevations in the piezometers will be compared to other hydrologic data collected for the site such as water level data from the groundwater monitoring wells and surface water level loggers. If saturated conditions occur within the repository in a given year, it will be summarized and reported in the Annual EMF Operations Report.

3.2 Vertical Gradient Evaluation

Water level data from monitoring well MW-C and the new deep monitoring well will be downloaded quarterly. Data collected from the piezometer transducers and the monitoring well transducers will be calibrated based on the manually-collected water depth measurements, corrected for barometric pressure, and converted to water level elevations prior to use or delivery. The resulting water level data for MW-C and the new deep well will be used to determine the magnitude and direction of vertical gradient at the EMF repository site over time. Final data will be presented in both tabular and graphical formats as requested by IDEQ.

3.3 Surface Water Influence

Water level data downloaded quarterly from the transducers in monitoring wells MW-A, MW-B, MW-C, MW-D, the new deep monitoring well, and the surface water level loggers LL-1 and LL-2, and data downloaded monthly from the USGS Cataldo gauging station, will be plotted on a full water-year hydrograph. This hydrograph will aid in the evaluation of the hydrologic conditions at the site over time and correlations with the Coeur d'Alene River. This evaluation will include documenting changes in hydraulic gradients and groundwater flow direction over time, both vertically and horizontally.

3.4 Groundwater Quality Trend Analysis

Analytical data for the groundwater samples collected from the new deep monitoring well will be evaluated as part of the existing groundwater quality monitoring program described in the EMF SAP/QAPP. These analytical data along with data from the existing monitoring well network will be included in the groundwater quality trend analysis described below.

The laboratory analytical reports will provide concentrations of the constituents of concern (COCs), as defined in the EMF SAP/QAPP. Since the COCs are naturally-occurring and are already detected on-site from previous monitoring, a method of evaluating the significance of variation in COC concentrations from baseline conditions is necessary to evaluate if a release from the repository is impacting groundwater quality below the site. Trend analysis will focus upon future changes in groundwater quality below the site.

In order to evaluate groundwater quality trends and differences prior to and after waste placement, statistical analyses will be performed using guidance provided in *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities; Unified Guidance* (USEPA 2009a). Statistical tests will be performed on data at each groundwater monitoring well on an annual basis. The results of the analysis will be included in the Annual EMF Operations Report. The statistical test will be selected based on USEPA guidance, characteristics of the data, and will be compatible with both the sample design and management questions being asked. The analysis will aid in identifying if there has been a significant change in groundwater quality post repository installation and operation. In addition, the frequency of MCL exceedences will be summarized. These analyses will be performed on an annual basis.

SECTION 4.0 DATA REPORTING AND PUBLIC AVAILABILITY

4.1 EMF Quarterly Groundwater Monitoring Reports

Transducer water levels, manual water levels, water quality parameters, USGS Cataldo gauging station data, and groundwater analytical data will be summarized and provided in the EMF repository quarterly groundwater monitoring reports. The reports will be posted on the USEPA EMF website when completed (http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/east_mission_flats_repository). The reports will contain tables with cumulative water quality data. The website will post the most current monitoring report; older reports will be archived in electronic format.

4.2 Annual EMF Operations Report

An annual summary of the collected data will be prepared in the first quarter of the subsequent year for inclusion into the Annual EMF Operations Report. The first groundwater quality trend analysis, described in Section 3.4, will be included in the Annual EMF Operations Report due in draft form to USEPA on April 1, 2010. The reports will be posted on the USEPA EMF website when completed (http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/east_mission_flats_repository). The most current Operations Report will be posted on the website. The older reports will be archived in electronic format.

4.3 Water Quality Exchange

Chemical and water level data obtained from the piezometers and MW-A, MW-C, and the MW-C deep well will be posted quarterly to the publicly-accessible Water Quality

Exchange (WQX) [http://www.epa.gov/storet/wqx.html]. This information will be added to the quarterly monitoring data currently being uploaded to the WQX site.

4.4 Citizens Coordinating Council Meetings

Data obtained from the piezometers and MW-A, MW-C, and the MW-C deep well will be presented at the quarterly Citizens Coordinating Council (CCC) meetings as part of the Basin Environmental Improvement Project Commission (BEIPC) process. The CCC meeting minutes are posted for public review on the BEIPC website (http://www.basincommission.com/).

The results of the groundwater quality statistical/trend analysis will be incorporated in the Annual EMF Operations Report. The results will also be presented as part of the repository update in the spring-season CCC meetings and subsequently in the publically available CCC meeting minutes.

SECTION 5.0 REFERENCES

Idaho Administrative Procedures Act (IDAPA) 37.03.09, "Idaho Department of Water Resources Well Construction Standards Rules."

TerraGraphics Environmental Engineering Inc. (TerraGraphics), 2009a, East Mission Flats Repository 90% Design Report prepared for the Idaho Department of Environmental Quality (IDEQ). June 2, 2009.

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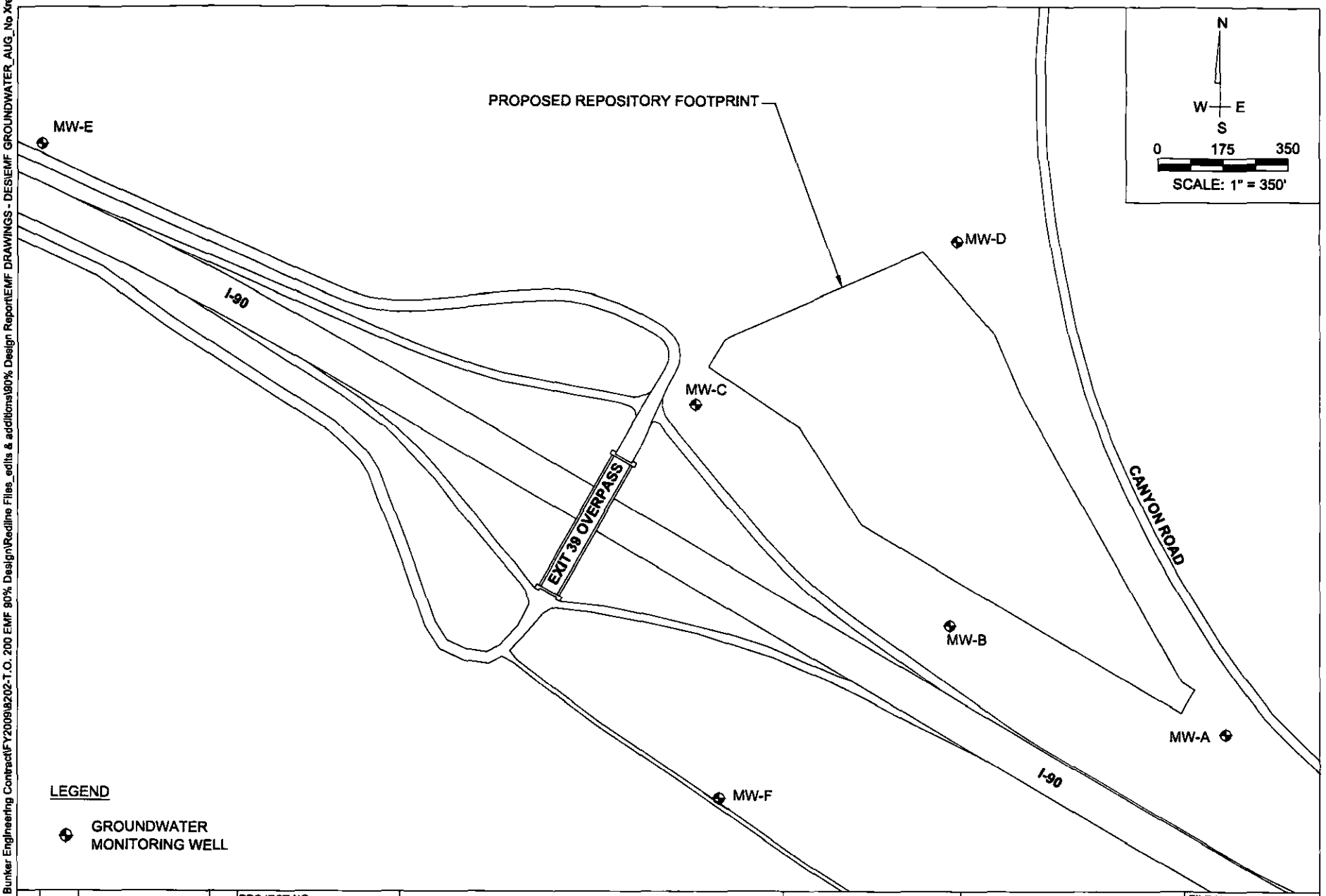
United States Geological Survey (USGS), "USGS Real-Time Water Data for Idaho," <http://waterdata.usgs.gov/id/nwis/uv/?site_no=12413500&PARAmeter_cd=00065,00060>, accessed on September 23, 2009.



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ENGINEER: S. BARKER

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EAST MISSION FLATS
CATALDO, ID

FIGURE 1
EXISTING MONITORING WELL LOCATIONS

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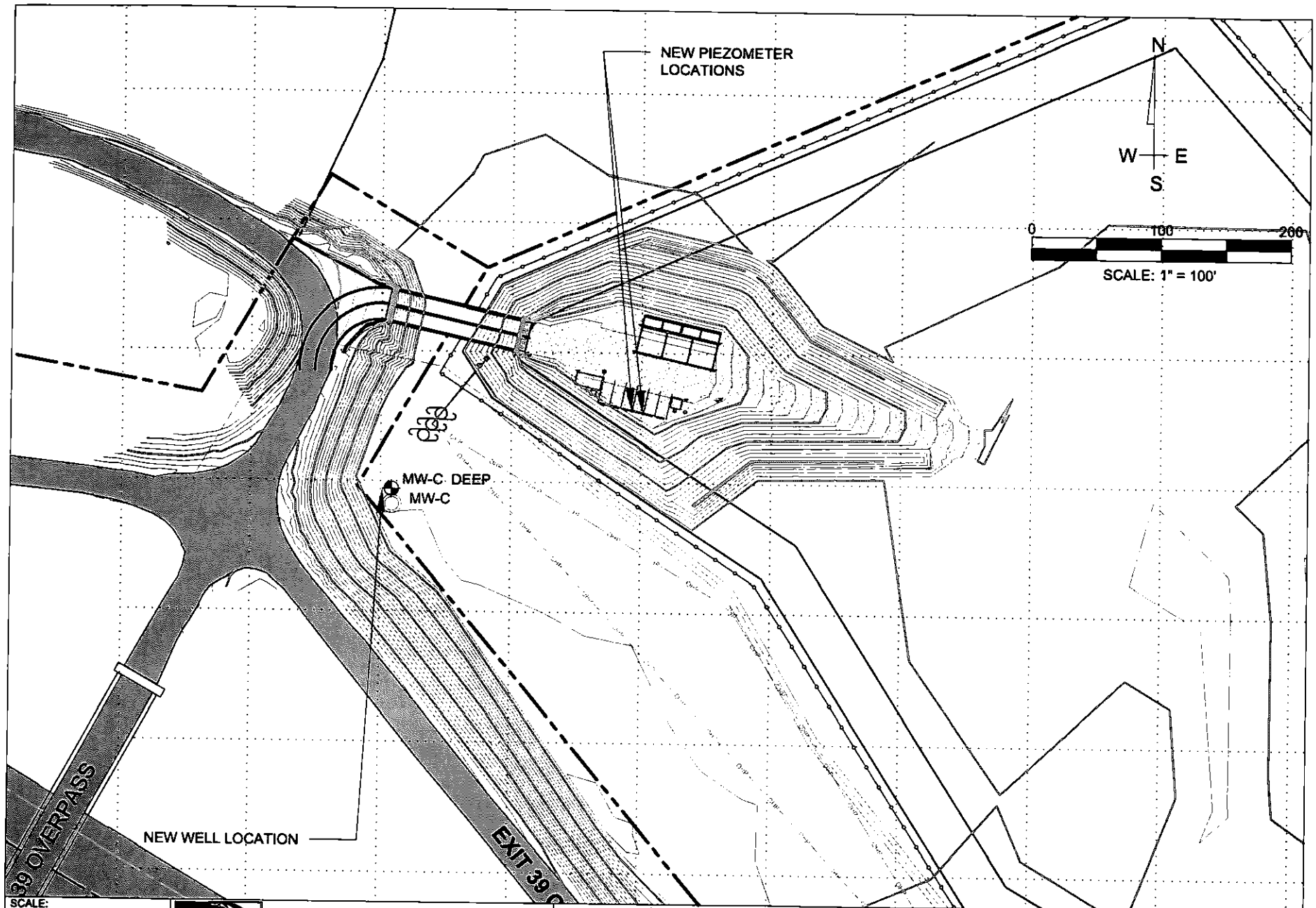

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