CCR Site Characterization and Remediation

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Objectives

Provide real-world examples of site characterization and corrective measures assessment work at CCR units

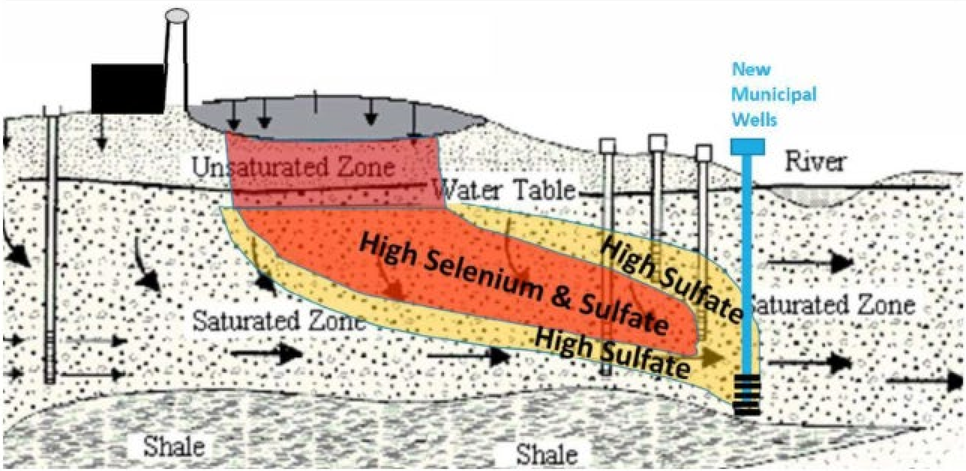
Nothing in this presentation is intended to communicate a determination of compliance, endorsement, or a formal agency position.

Examples Identified

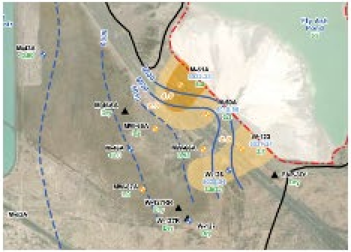
- Characterization of release
  - Vertical depiction
  - Lateral depiction
  - Narrative explanation
- Characterization of site conditions that may affect the remedy ultimately selected
  - Groundwater narrative
  - Soils narrative
- Predicting post-closure flow conditions
- Range of corrective measures assessed

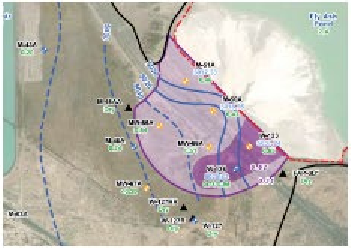
All examples come from Assessment of Corrective Measures (ACM) Reports published prior to January 2020

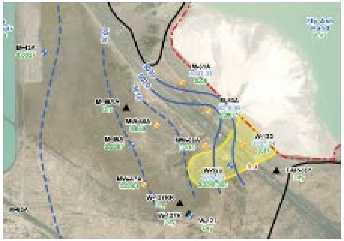
Characterization of release with multiple constituents - vertical

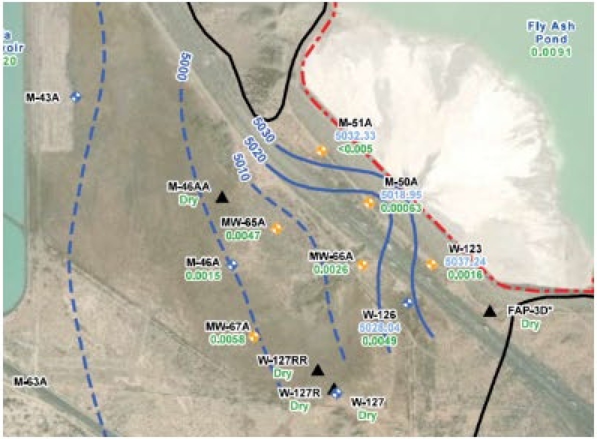


Characterization of release with multiple contaminants - lateral

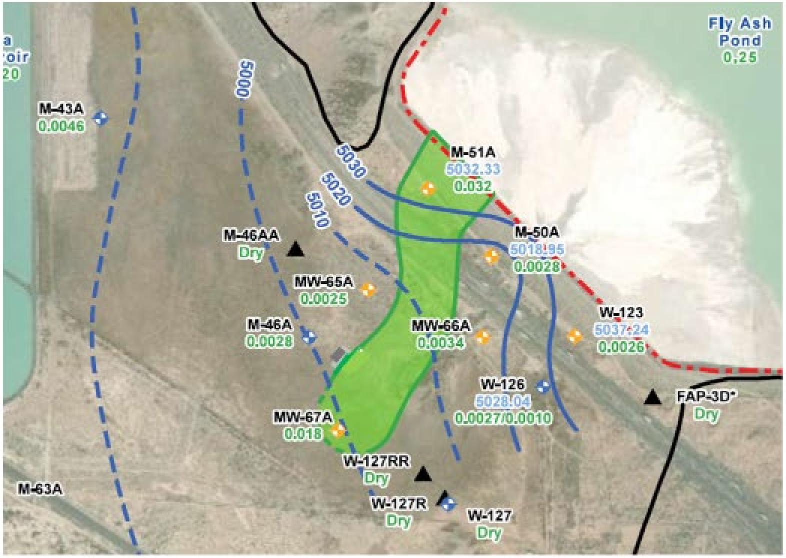




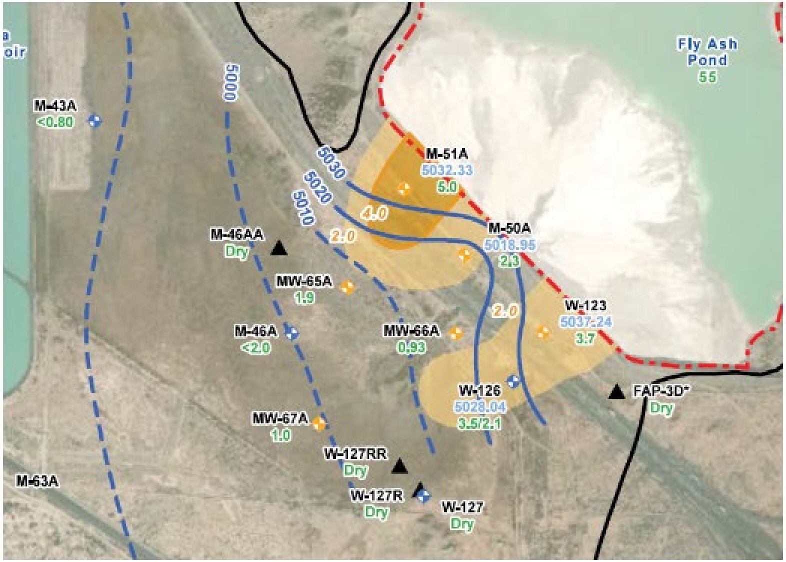




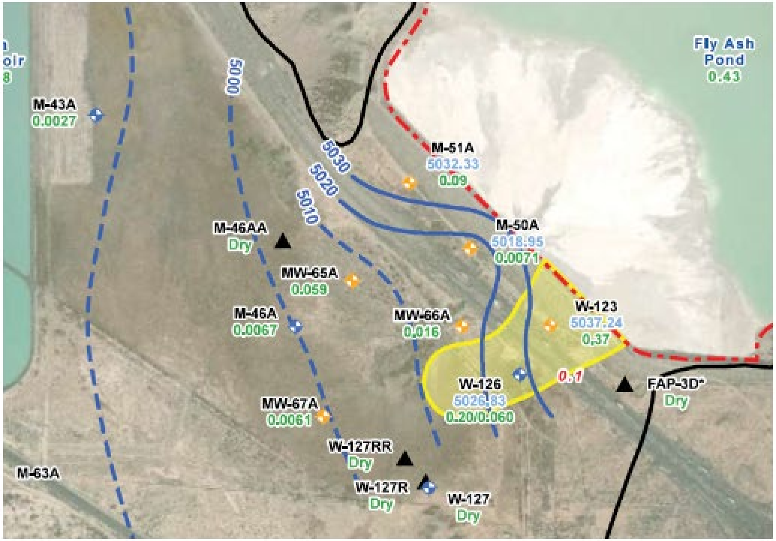
Constituent 1



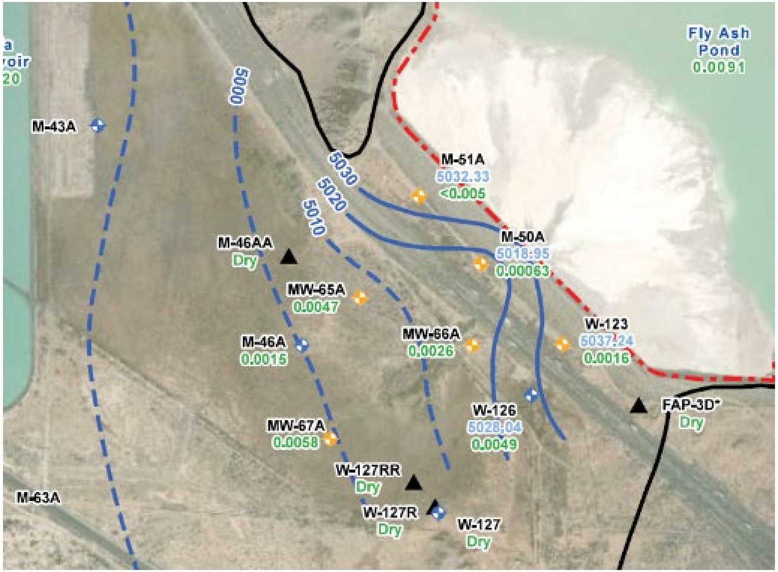
Constituent 2



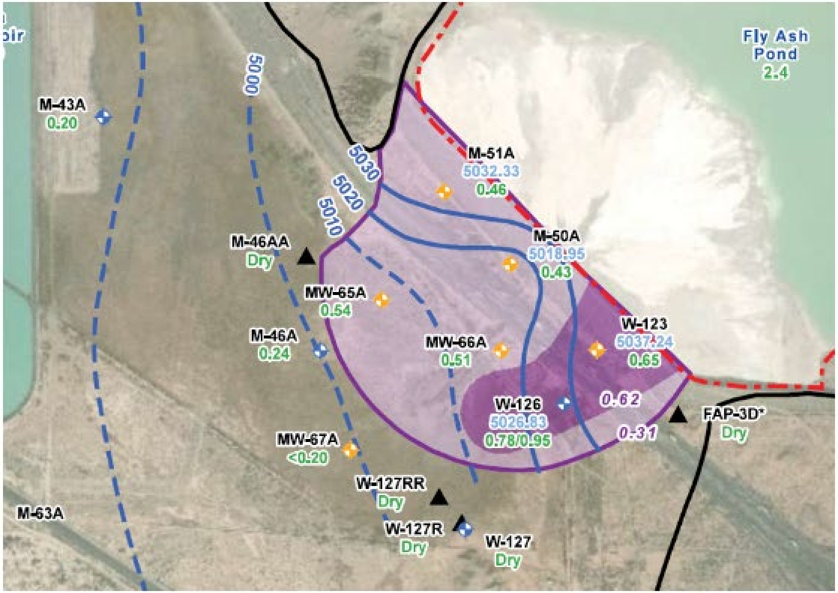
Constituent 3



Constituent 4



Constituent 5



Characterization of release - narrative

In a different 2019 ACM, groundwater data collected to characterize site conditions after a cobalt release included:

- Concentrations of cobalt exceeded the GWPS (0.0564 mg/l) in all CCR monitoring wells except MW-7 on at least one occasion since October 2016 (Figure X). In May 2019, all wells except MW-7 detected cobalt above the GWPS. A sample from the adjacent surface water body in May 2019 did not detect cobalt (<.003 mg/l). Cobalt is likely present as Co^{+2} based on pH and Eh data (Figure Y).

The following soil data and analysis were also presented:

- <u>Cobalt:</u> Total cobalt in soil ranged from 1.68 – 6.29 mg/kg. The environmentally-available fraction ranged from 1.4 mg/kg (SB-3) to 4.39 mg/kg (SB-2), representing 58%-83% of total cobalt. Most environmentally-available cobalt was present in the metal hydroxide fractions in SB-1 and SB-2, and the largest proportion of exchangeable cobalt was present in SB-3.

Characterization of site conditions (GW) - narrative

In that same 2019 ACM, groundwater data collected to characterize site conditions included:

- Each GW sample was analyzed for pH, dissolved oxygen, oxidation reduction potential (ORP), conductivity and temperature. These parameters were used to evaluate geochemical conditions in the groundwater and support modeling.
- Oxidized iron (ferric iron, Fe^{+3}) concentrations varied, ranging from non-detect (<0.05 mg/l) to 8.81 mg/l in May 2019 (Appendix X). Reduced iron (Fe^{+2}) concentrations were non-detect (<0.05 mg/l) at all CCR monitoring wells except MW-1 and MW-2. The highest concentration of Fe^{+2} was 49.5 mg/l in MW-1, over 40 times more than any other well. This value corresponded to the highest measurements of beryllium, cobalt and lithium in the Ash Pond area.

Characterization of site conditions (soil) - narrative

In that same 2019 ACM, the following soil data and analysis were presented:

- Iron: While not a COI, iron and its minerals commonly represent one of the most abundant reservoirs for metal/metalloid attenuation in soils (Dzombak and Morel 1990; Smith 1999). Iron was present in all soil samples analyzed, varying from 5,192 (SB-3) to 13,933 (SB-2). In all samples, the non-environmentally available (sulfide and residual) fractions accounted for the largest proportion of total iron (54% to 64%) and, as such, most of the iron is not environmentally available. The remainder of the iron in the samples is present across the exchangeable (except SB-1), carbonate (only in SB-2), amorphous metal, and metal hydroxide phases.
- Aluminum: Aluminum is not a COI at the site, but it has been well studied as a sorbing medium in soils (e.g., Karamalidis and Dzombak 2011). Total aluminum in soils ranged from 14,244 to 33,160 mg/kg, and the environmentally-available fraction ranged from 1,044 at SB-3 to 1,989 mg/kg at SB-2. Aluminum in the soil at the site is, therefore, largely (~84% to 87%) present in the residual, or silicate-bound fraction. This fraction is likely as least partially represented by hydrous aluminum phyllosilicate.

Range of Corrective Measures

Potential Groundwater Corrective Measures

The following presents a summary of potential groundwater corrective measures evaluated as part of this ACM. Based on site-specific information and knowledge of corrective alternatives, the following remedies—or combination of remedies—are being considered using the evaluation criteria specified in 40 CFR 257.96(c) :

- Monitored natural attenuation (MNA)
- Hydraulic containment
  - Pump-and-treat
- Permeable reactive barrier (PRB) walls
- Vertical barrier walls
- Geochemical manipulation (in situ injection)
- Permeation grouting
- In situ solidification/stabilization (ISS)

Predicting future flow conditions after closure

Narrative:

- After the constant heads are removed from the CCR unit and pumping of production wells has ceased, the model predicts a significantly reduced gradient of approximately 0.0001 and flow that is primarily to the south, southwest with travel times on the order of 40 to 50 years from the surface impoundments to the river.

Questions?