Site Description

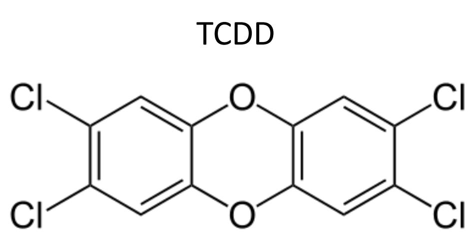
Whereas the US Magnesium site is not currently operational, it’s easiest to refer to the areas of the site in terms of the environmental regulatory frameworks that governed the site during operation: RCRA (Resource Conservation and Recovery Act), and CERCLA (Comprehensive Environmental Compensation and Liability Act).

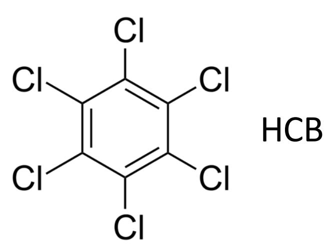
Since RCRA concerns stewardship of newly generated wastes, it governed the areas of the site closest to the operating plant, i.e., west and south of and including the Active Waste Pond (Figure 1). CERCLA, also known as “Superfund” governs previously spilled wastes, and so governed the site outward from the Active Waste Pond, including the Old Waste Pond (Figure 1). Whereas the Active Waste Pond is no longer receiving plant discharge, the name is retained here in order to remain consistent with terms used in previous documents.

Figure 1. US Magnesium site layout showing Star Pond, Active Waste Pond, Gypsum Pile, Smut Pile, and Old Waste Pond.

Contaminant Attributes

Most notable among the contaminants measured at the US Magnesium site are dioxins, of which tetrachlorodibenzo-p-dioxin (TCDD) is an example dioxin, and hexachlorobenze (HCB) (Published Final Phase 1A-B Remedial Investigation Data Report October 2016, Published Final OU1 Baseline Ecological Risk Assessment (BERA) December 2024).





TCDD is a known potent human carcinogen, while HCB is a probable human carcinogen, and both are linked to diabetes and immunotoxicity. Additional measured notable contaminants include polychlorinated biphenyls (PCB) and dissolved metals, the latter of which are highly mobile at the pH of the discharged waste (< 1) but which plate onto surface sediments upon discharge to dry surfaces, giving the Old Waste Pond its characteristic reddish color.

Human and Ecological Risk Assessments

Human and ecosystem risk assessments each demonstrated severe risk due to exposure to contamination. Specifically, human carcinogenic risk was estimates to be 100 times greater than the regulatory goal in the CERCLA portion of the site, and up to 8000 times greater than that goal in the RCRA portion of the site (Published Final Phase 1A-B Remedial Investigation Data Report October 2016; Final OU-1 Baseline Human Health Risk Assessment Technical Memorandum August 2016 Baseline Human Health Risk Assessment for soils, sediments, wastes, and waters of PRIs 1-17 OU1_Baseline_Human_Health_Risk, 2016). Estimated ecosystem risks were also greater than regulatory goals by factors of up to 90 for birds and nearly 2000 for mammals in the RCRA portion of the site, and up to 61,000 for benthic invertebrates in the CERCLA portion of the site (Published Final OU1 Baseline Ecological Risk Assessment December 2024).

These risk assessments demonstrate the hazardous nature of the site, which provided the rationale for emplacement of a barrier wall encompassing the southern, eastern, and northern portions of the site to contain newly generated wastewater. The cessation of site operations may or may not impact the need for a barrier wall, depending on whether contamination is moving outward from the site. Whereas the barrier wall is still required under the court-ordered Superfund cleanup, more pressing is the need for rapid determination of extent to which contaminants are being transported away from the site.

Groundwater Transport

During operation, the site hydrology showed that groundwater was mounded under the site due to loading from waste discharge (Figure 2) (Phase 2B Hydro Remedial Investigation Data Report, May 2020, Groundwater Discharge Permit Application by US Magnesium Corporation, 2018). Groundwater mounding is indicated by the close blue circle under the CERCLA portion of the site southwest of the Gypsum Pile (Figure 2) which denotes a local high in the groundwater hydraulic head, from which groundwater would flow in all directions, but particularly eastward toward Great Salt Lake, as indicated by the larger blue arrows. This predominant flow is perpendicular to the contours (blue lines) that connect equal hydraulic head, as measured in wells. The fact that the hydraulic head contours are spaced closer together east of the Active Waste Pond (Figure 2) shows that a steeper hydraulic gradient exists east of the Active Waste Pond, and this can be expected to drive increased groundwater flow to the east toward Great Salt Lake.

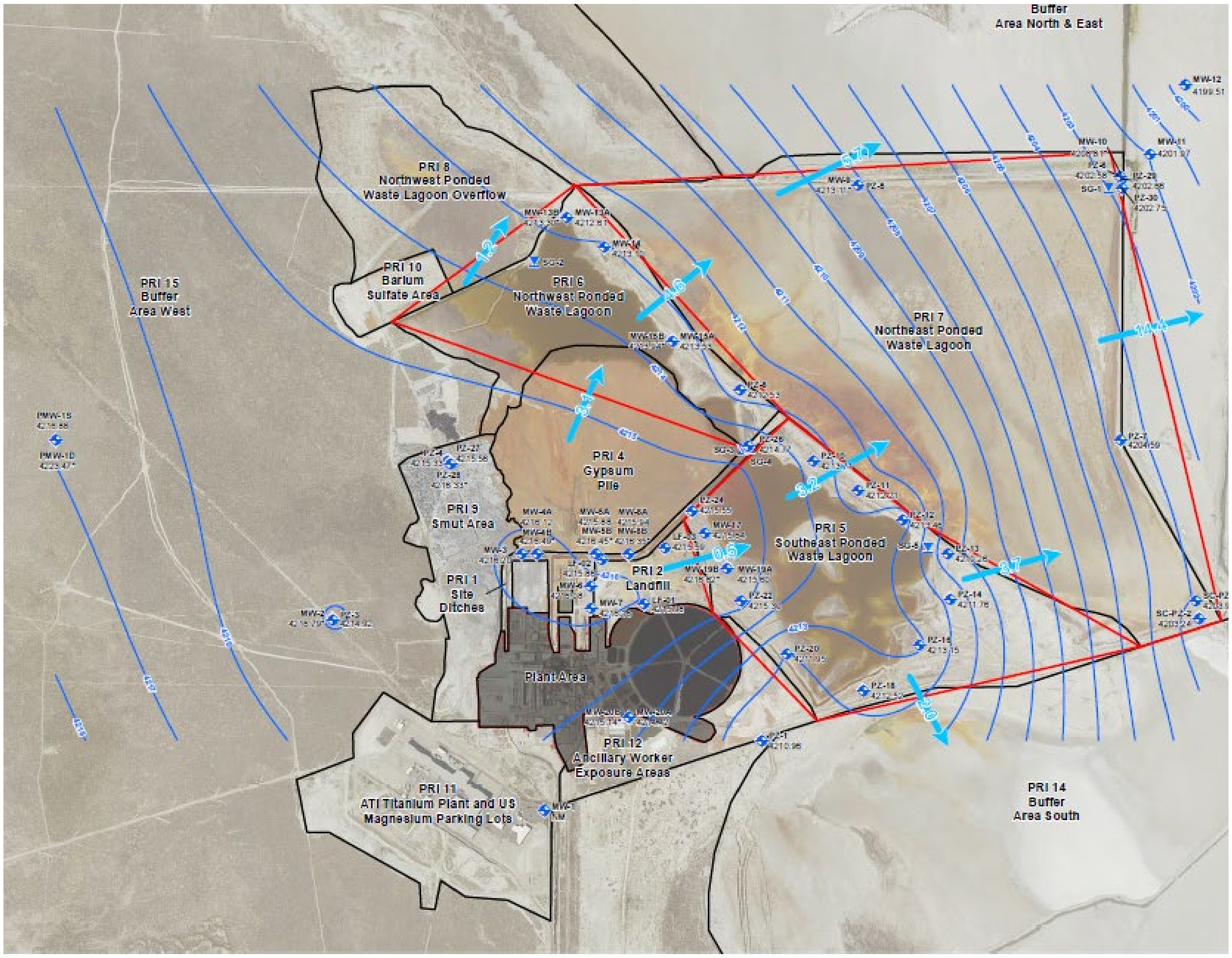


Figure 2. Groundwater hydraulic head contours (blue lines) determined from hydraulic head measurements in wells. Wells are indicated by blue circular symbols. Blue arrows denote general ground water westward toward Great Salt Lake.

Equally concerning to the eastward groundwater flow is the fact that the flow is not expected to be uniform, but rather, higher and faster flow is expected in subsurface layers (strata) that are more permeable, with oolitic sands being a highly permeable layer (Figure 3) (Final Old Waste Pond Conceptual Site Model (OWB_CSM) Hydrologic Report, 2017). In addition to the oolitic sand layer, the fact that the acidic waste also dissolved channels into the underlying sediment (Figure 4) produces additional pathways for potential conveyance of contaminants outward from the site.

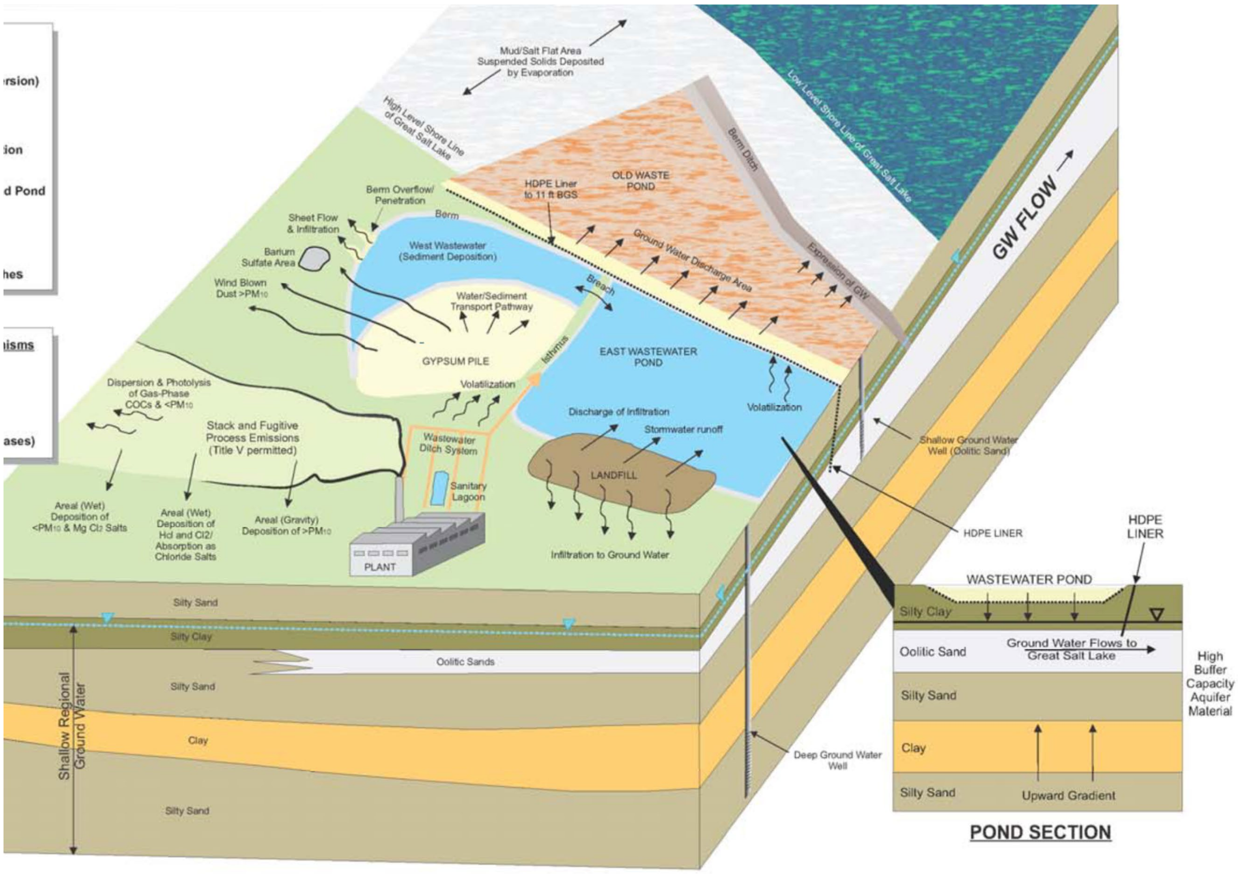


Figure 3. Box diagram of sedimentary layers (strata) beneath the US Magnesium site.

Figure 4. Image of dissolution channels observed as surface sinkholes in the bed of the active waste pond. US Magnesium plant is seen in the middle distance (looking south).

Next Steps

Since both a hazardous source (the US Magnesium site) and a likely pathway to Great Salt Lake exist, the need to determine the flux of contaminants outward (predominantly eastward) from the RCRA and CERCLA sites is urgent. This need is made more urgent by the fact that the planned barrier wall was designed to increase the waste pond footprint by a factor of three, which demonstrates that the waste balance performed by US Magnesium's consultants determined that two thirds of the discharged waste was leaving the site via unknown subsurface routes (Final Old Waste Pond Conceptual Site Model (OWB_CSM) Hydrologic Report, 2017; Groundwater Discharge Permit Application by US Magnesium Corporation, 2018; Retrofitted Waste Pond Phase 1 Basis of Design Report - US Magnesium Facility, Revision B, 2019). Finally, the fact that the barrier wall was implemented as a surface berm, never having been completed with a clay core notched into the underlying clay (Figure 3) as originally planned, and the fact that several years have passed since the design of the waste pond, suggests that waste (and possibly contaminants) have continued to move outward from the site.

Clearly the need is acute to determine the extent to which contaminants have moved, are moving, and could continue to move, outward from the site. This can be done in four steps:

a) Review of existing documents to assess contamination in CERCLA portion as existed during operation.
b) Resampling of well hydraulic heads and retrieval of samples for analysis of selected contaminants in wells to understand changes in groundwater flow and current contaminant concentrations.
c) Installation of additional piezometers for sampling of hydraulic head and contaminants at five to ten sparsely monitored zones on perimeter of older Waste Pond and beyond. Initial locations can be established at four to five unmonitored locations bisecting the unmonitored sections of the Old Waste Pond boundaries (Figure 2), plus an additional five locations lakeward beyond the Old Waste Pond to be determined based on (a) and the initial execution of (c).
d) 3D modeling of contaminant transport conditioned to current hydraulic head and contaminant concentrations to simulate likely transport scenarios for contaminants outward from the site.