

## Problem Definition

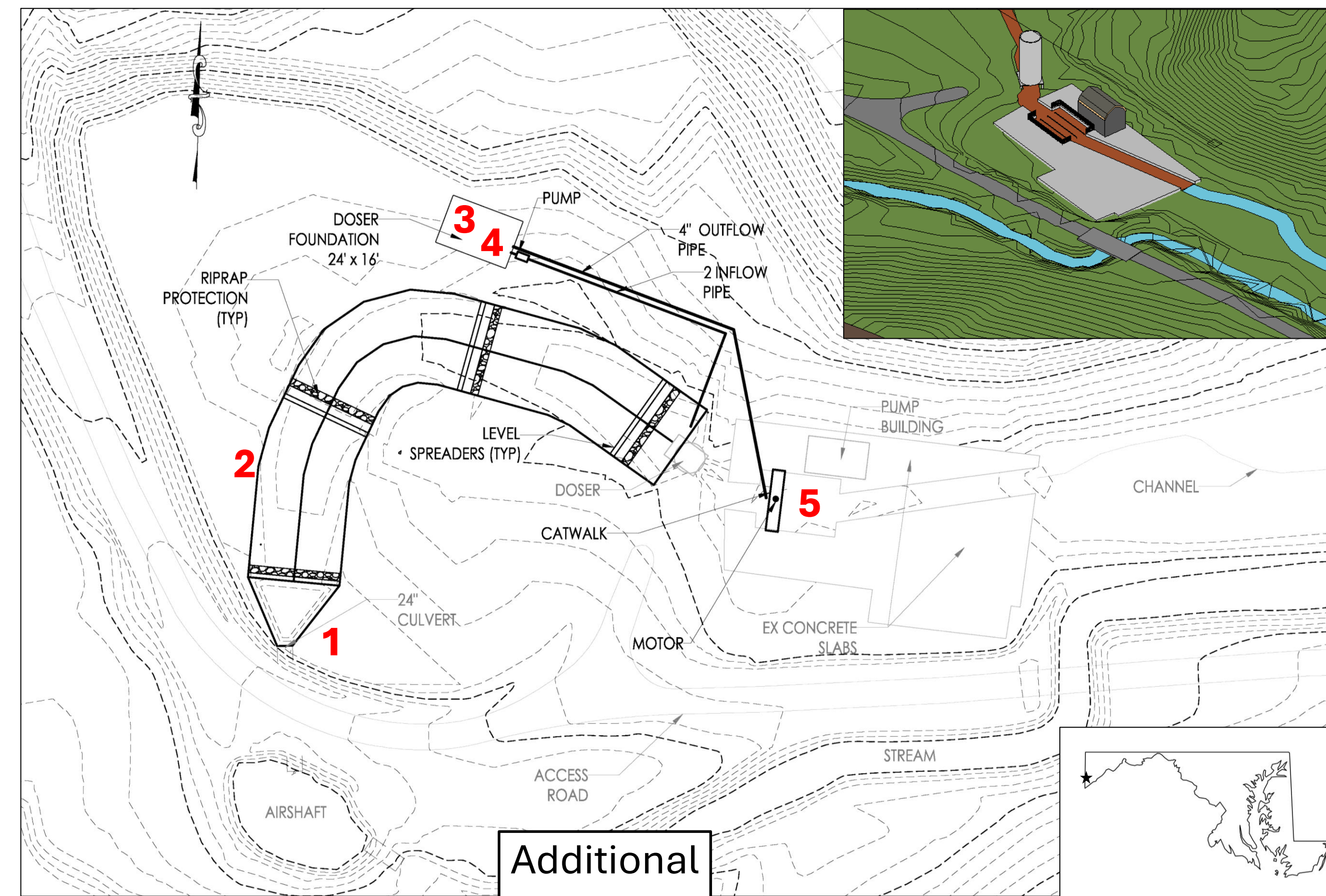
The Kempton Mine Complex was an active coal mine in the early 1900s in western Maryland. Today, it discharges acid mine drainage (AMD) at high flow rates from an air shaft and borehole into a tributary of the North Branch of the Potomac River. The drainage has impaired local ecosystems and contaminated waterways with heavy metals. Current treatment efforts by the Maryland Department of the Environment (MDE) are inefficient. MDE has tasked our team with improving the airshaft treatment design.

## Design Parameters

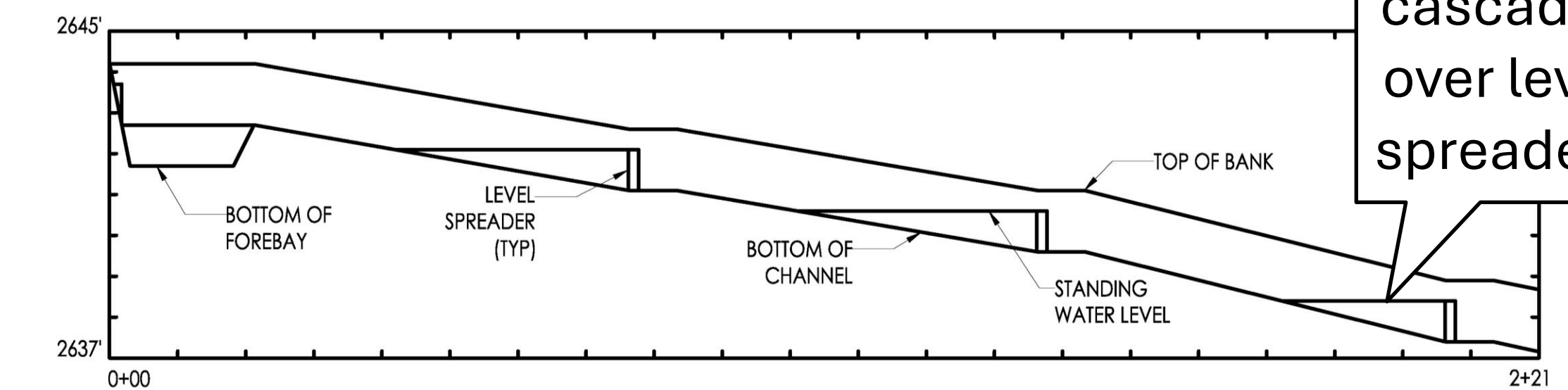
Parameter	95th Percentile	50th Percentile	5th Percentile
Discharge (gpm)	4210	1263	378
Acidity (mg/L)	324	213	139
Dissolved CO <sub>2</sub> (mM)	6.23	1.35	0.29

- Design parameters were estimated by performing lognormal Monte Carlo simulations on existing data.
- Sparse historical site data for discharge and acidity were provided by MDE. Dissolved CO<sub>2</sub> data were gathered from studies of similar sites.
- Geotechnical studies for foundation design were performed by Potesta & Associates, Inc.

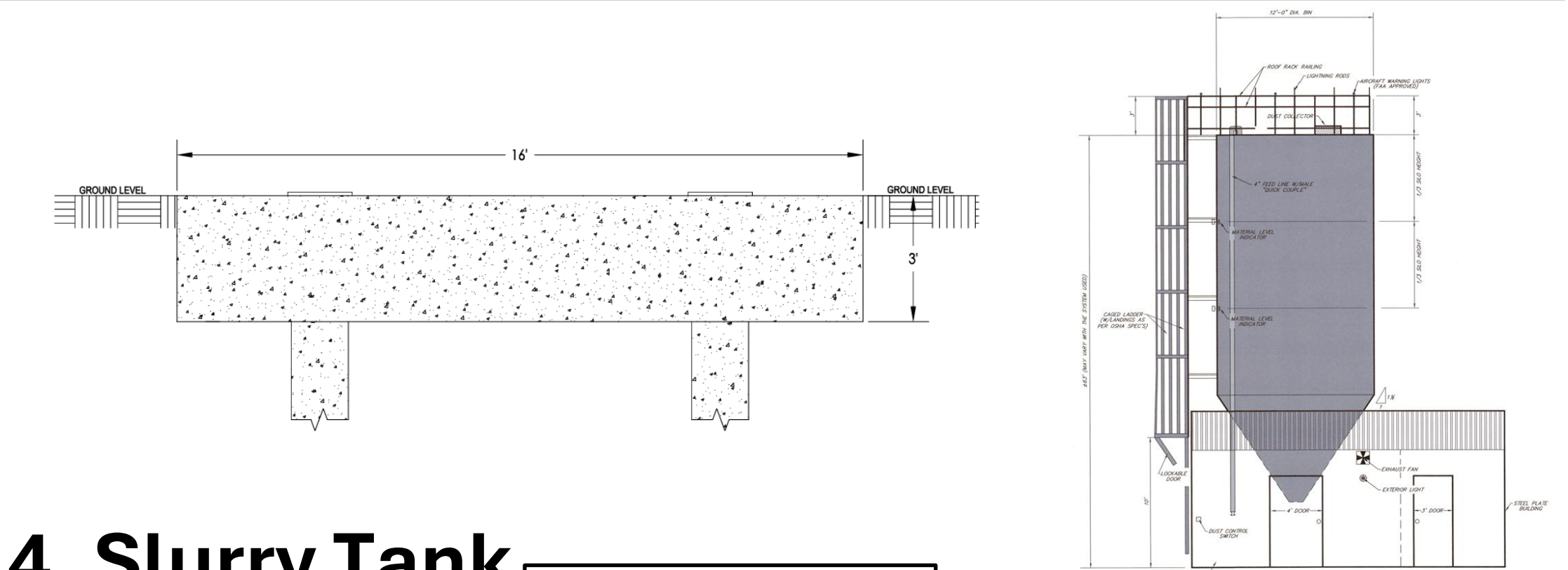
## Recommended Design



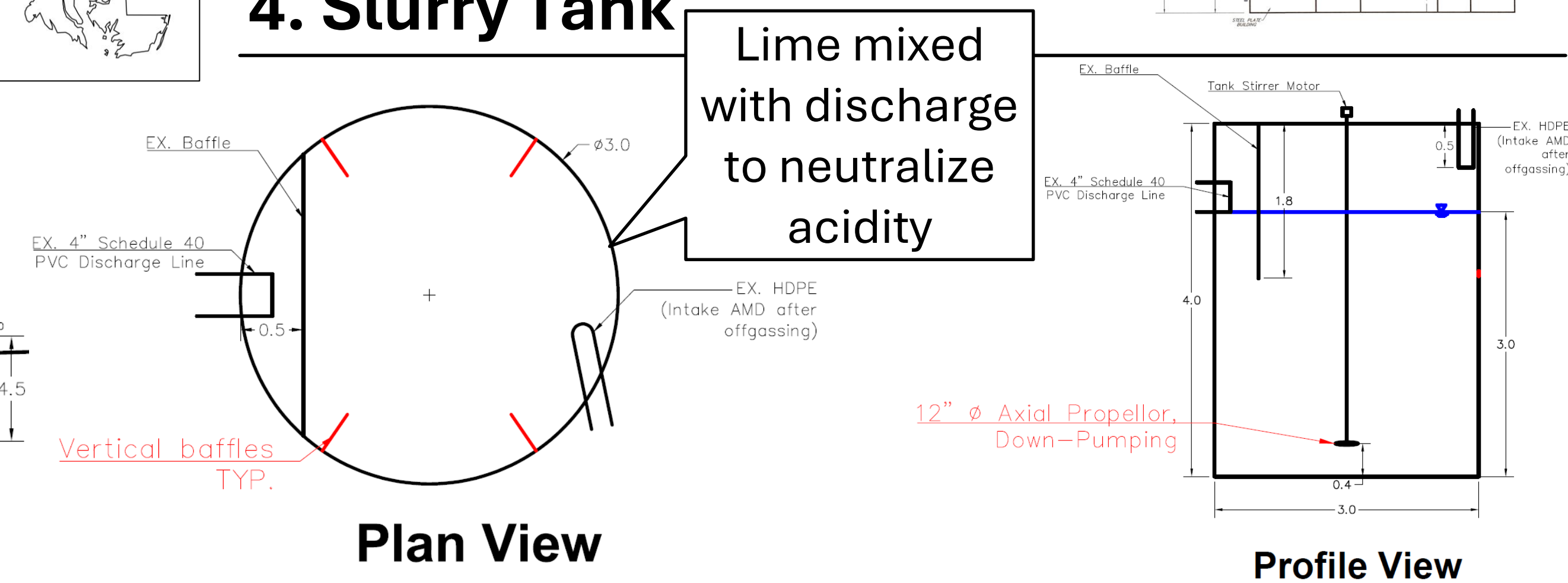
### 1, 2. Forebay & Channel



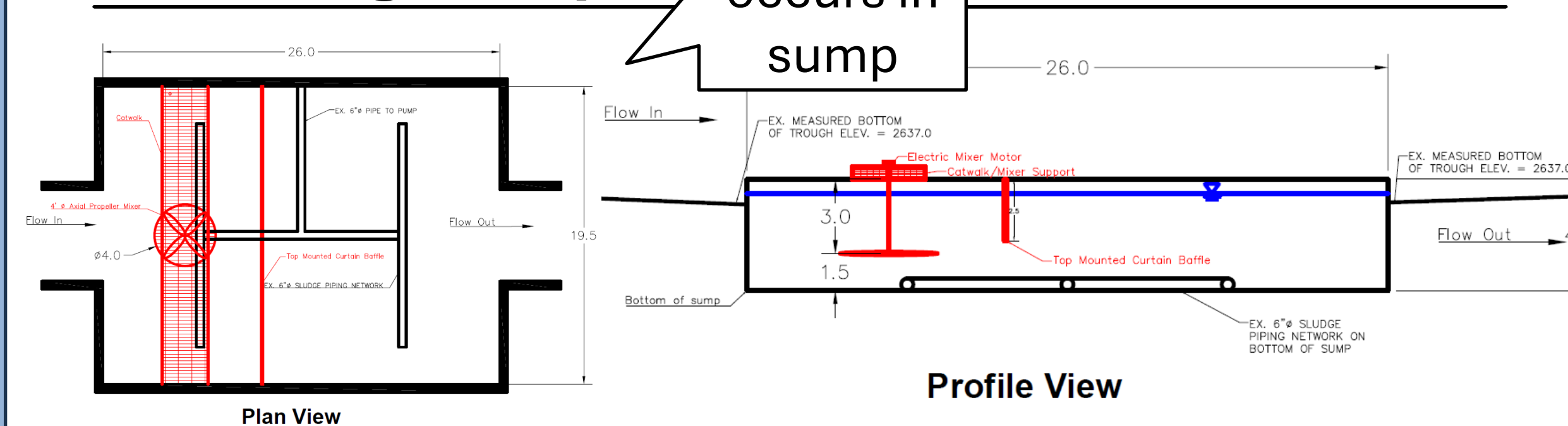
### 3. Doser Structure Foundation



### 4. Slurry Tank

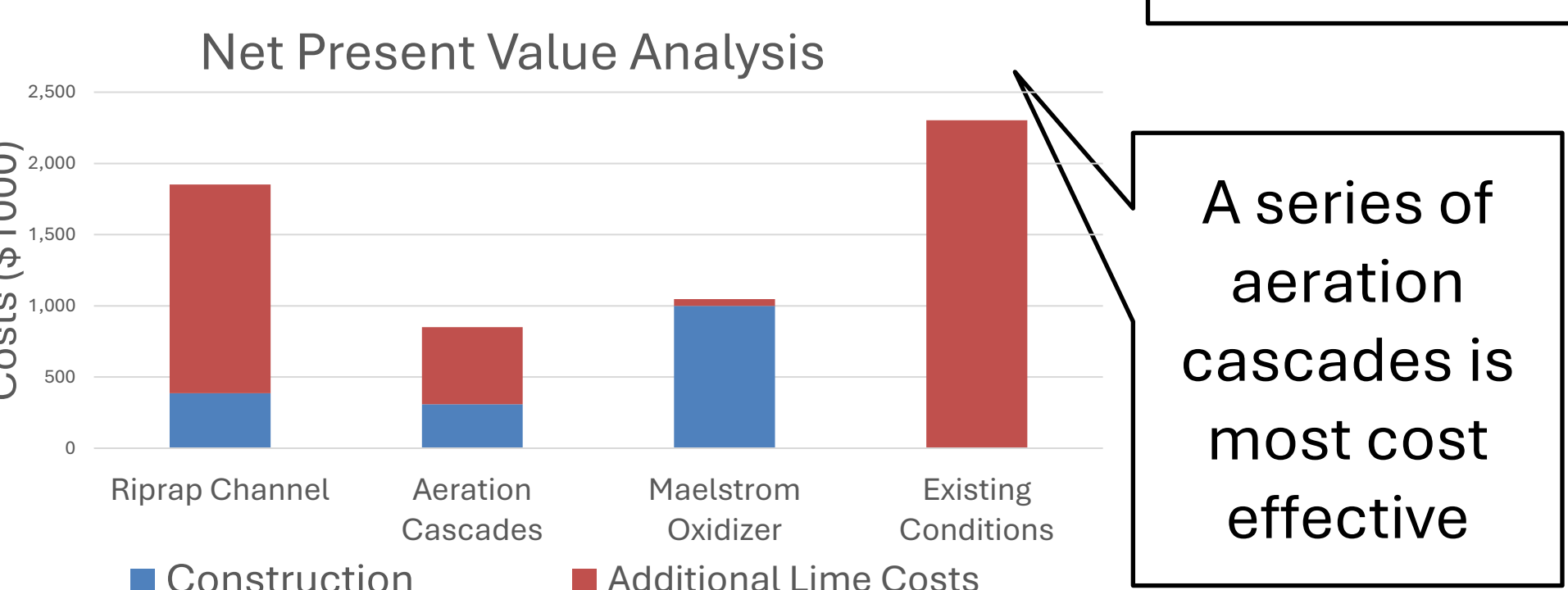
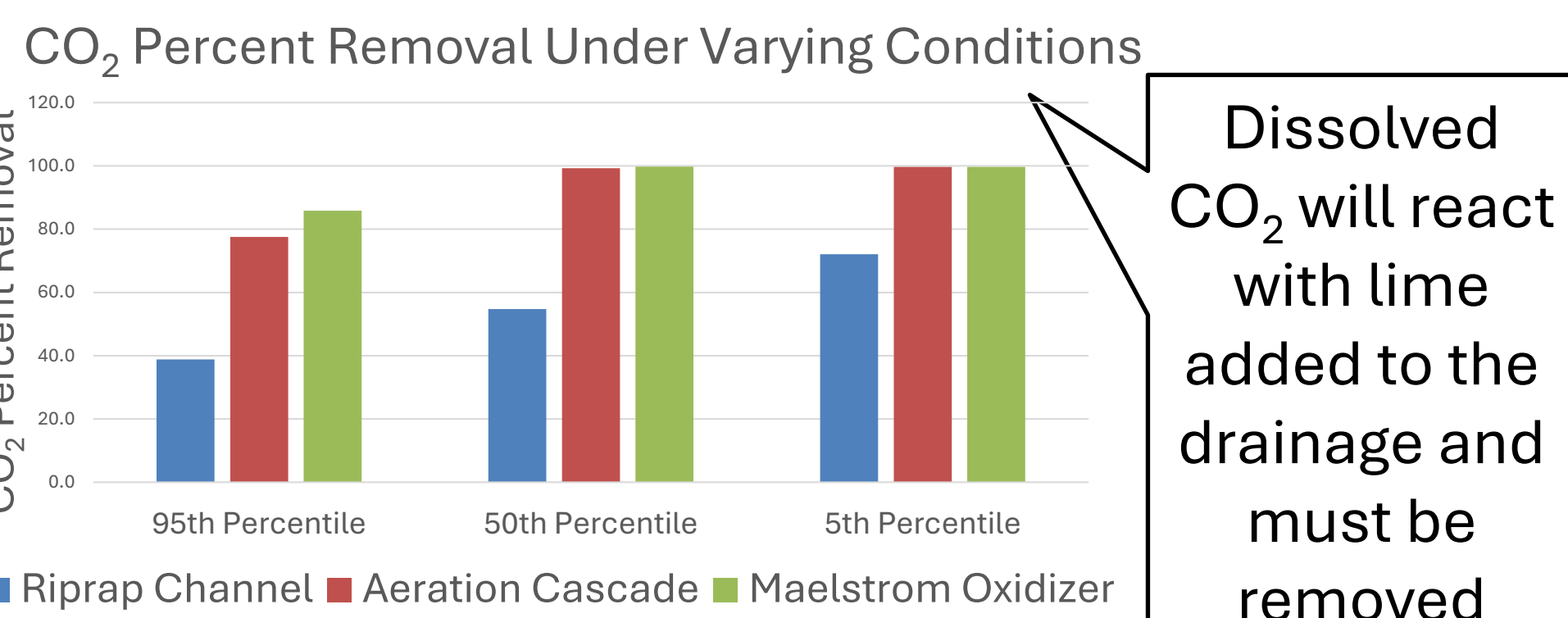


### 5. Mixing Sump

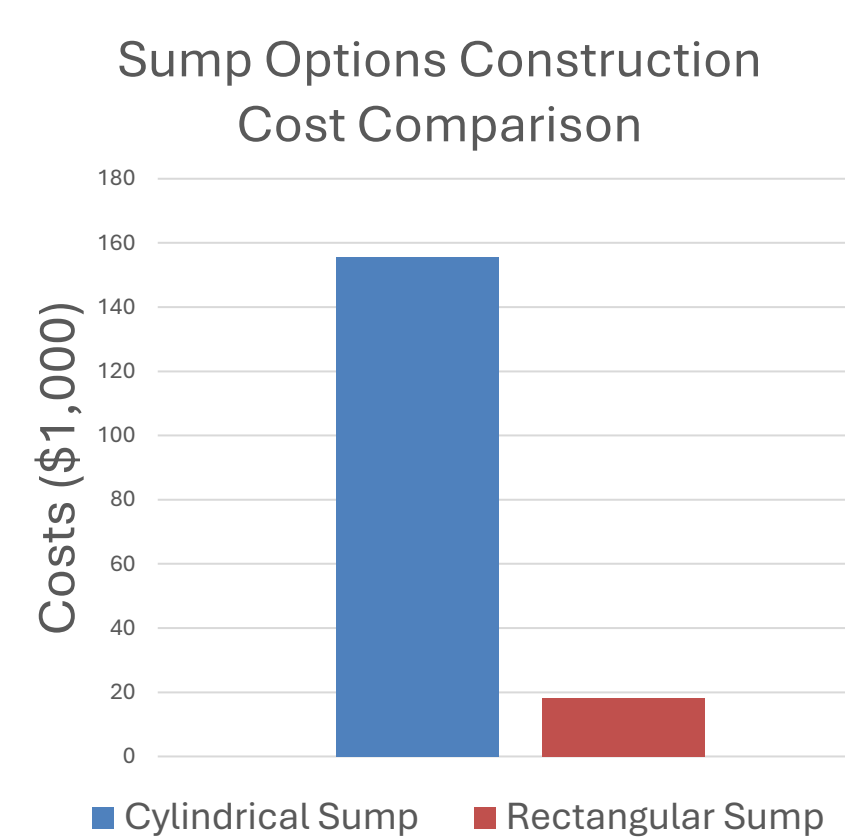


## Design Analysis

### CO<sub>2</sub> Off-Gassing System

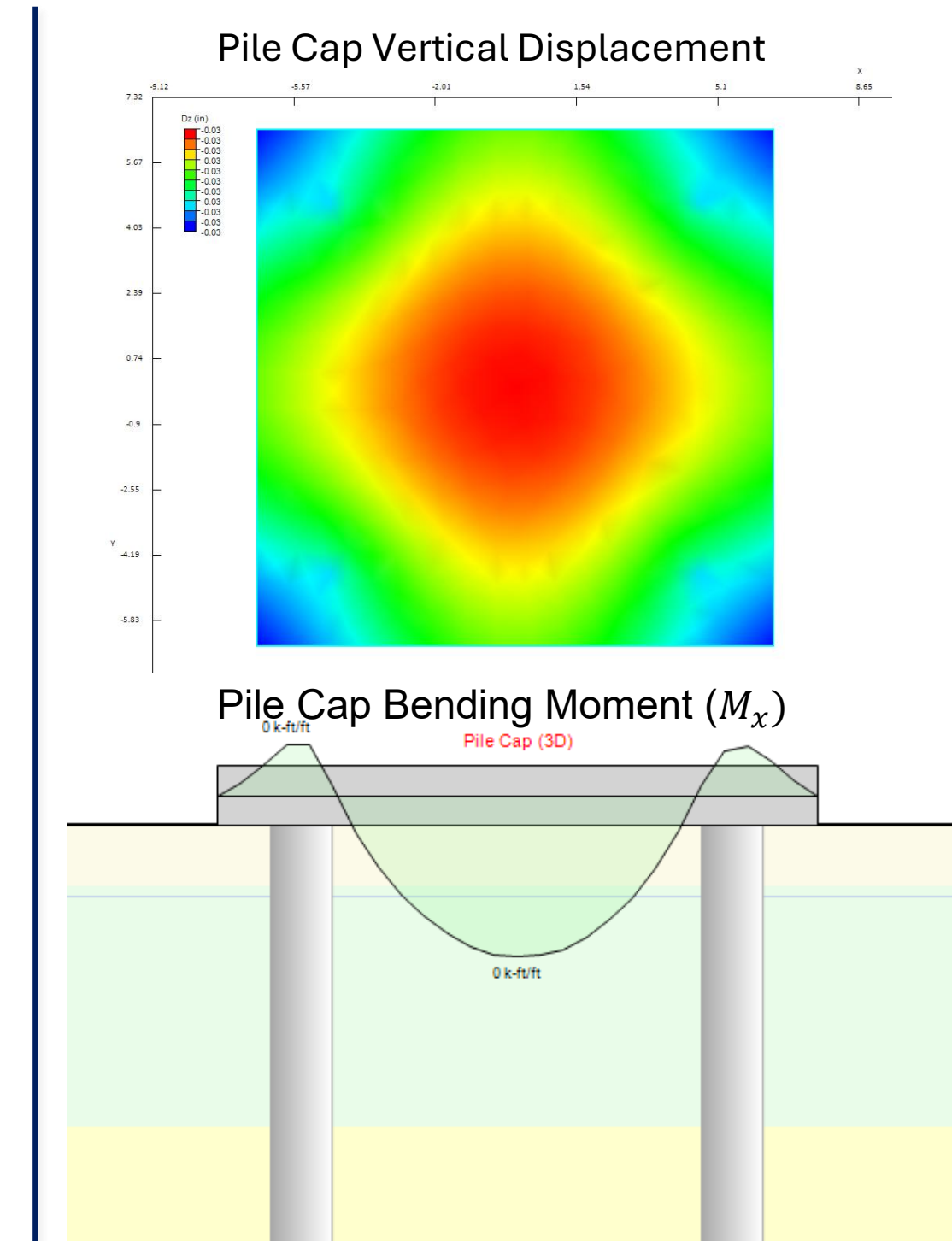


### Sump Analysis



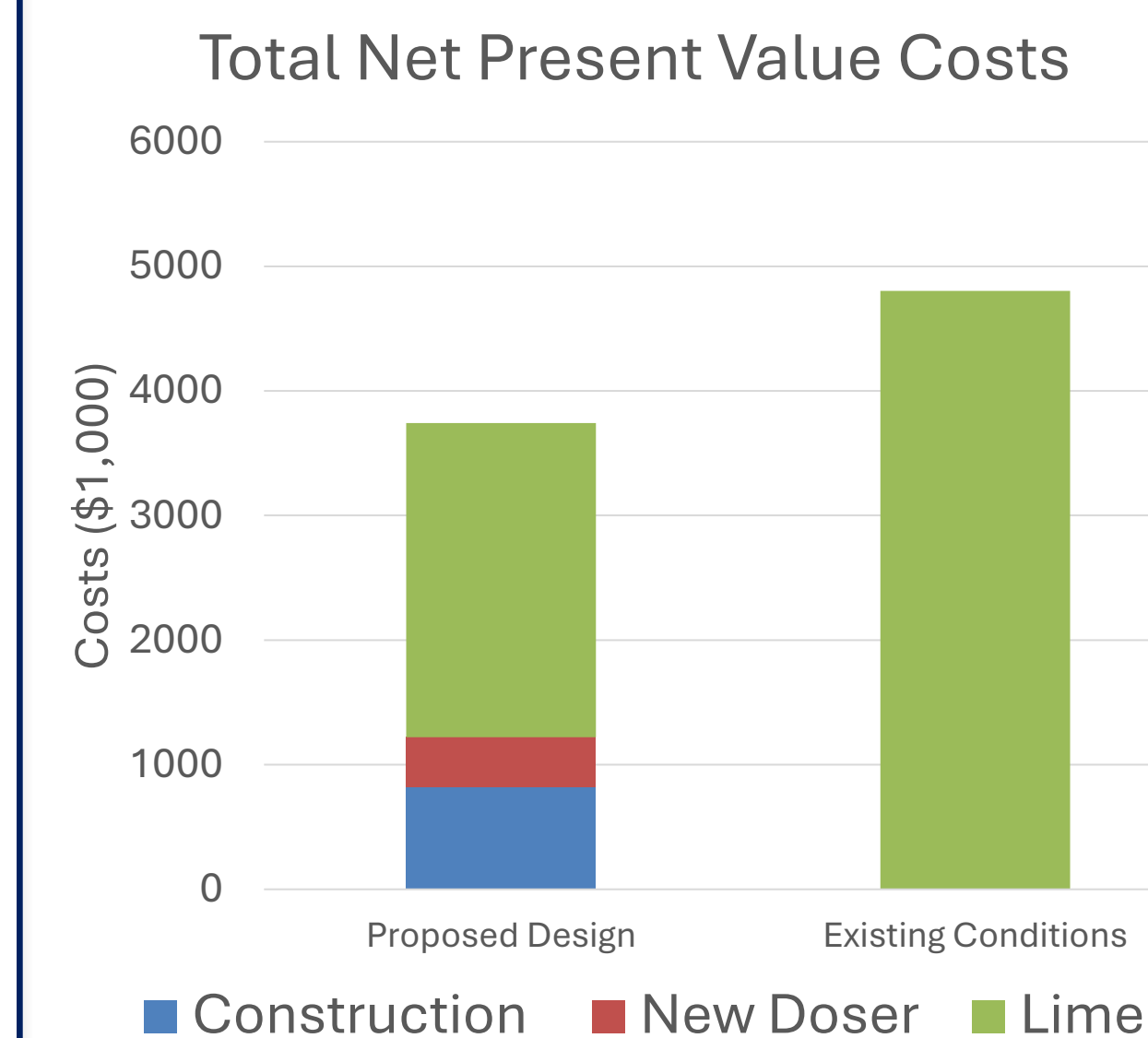
Cylindrical sump is ideal for mixing efficiency but cost prohibitive

### Doser Foundation



A soil exploration of the site revealed challenging conditions for the doser foundation. Due to the high risk of soil settlement, we decided to design a deep foundation. This would remove uncertainty from existing conditions and produce a more reliable product.

### Cost Benefit Analysis and Conclusion



Our design enables MDE to efficiently treat the discharge by off-gassing CO<sub>2</sub>, upgrading lime dosing, and increasing mixing capacity. Our design will treat the drainage to a minimum pH of 6.5 as required by the EPA.