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MINE TAILINGS DRAINAGE – A BOTTOMS UP APPROACH USING HDD DRILLING AND INSTALLATION METHODS
Tailings Dams

• Impoundments used to retain tailings
  – Effluents, ground rock, dry stacked or pumped as slurry

• Many times constructed from local materials or tailings themselves

• Guidelines exist for design, construction and closure

• Some dams raised over time
  – Conditions may change
  – Supervision may change

• Estimated 3,500 worldwide
Why Do They Fail?

- Poor construction
- Overtopping
- Foundation failure
- Piping – erosion
- Poor maintenance
Callahan Mine - Maine

- Open pit zinc/copper mine
  - Deposit discovered at low tide in 1880
  - Commercial mining started in 1887
  - Mining/milling ended in 1972

- Added to National Priorities List – Superfund in 2002

- State of Maine entered into Administrative Order to Complete RI/FS in 2005

- Tailings impoundment designated as OU3
OU 3 Tailing Impoundment

- 17 acres
- Over 700,000 cubic yards of material
  - Fine sand, silt and clay
  - Saturated material
- Three sided dam
  - 60’ height
  - 1.3H to 1V
  - Constructed of cobble and boulder sized waste rock material
OU 3 Tailing Impoundment

• Impoundment “marginally unstable” under long term static conditions
• May fail under long term design magnitude earthquake
• Tailing material and seepage result in sediment and surface water contamination
  – Pb, Zn, Cd, As, Mg
OU 3 Remediation Goals

- Reduce contaminant load to surface and ground water
  - Dewatering of tailings impoundment
    - Water sent to anaerobic wetland bioreactor
  - Excavation, regrading and capping
    - Reduce surface water recharge infiltration and seepage
**Dewatering Options**

- **Vertical wells**
  - Based on modeling 20 required
    - Would preclude excavation, regrading and capping
    - No power on site

- **Deep trench**
  - Either excavated or installed “one pass”
  - Cost estimate over $1,000,000

- **Directionally drilled horizontal well**
  - No surface access needed during construction or dewatering
  - Bit/well could be steered and placed precisely
  - Gravity flow – no power needed
Continuous Well Installation
Site Constraints - Continuous

- Well screen needed to be at the base of the tailings
- No rig up area to drill from East to West
- Limited rig up area to the North
- No room to work or lay out well materials on the South side of the pond
Blind Well Open Hole
Site Constraints – Open Hole Blind Completion

- Would borehole stay open in tailings consisting of silts, sands and clays?
  - 50’ of saturated thickness above the borehole

- Could PVC be pushed 900’ into an open borehole?

- Would the material flow uncontrollably back to the rig?
Knock Off Blind Well Method
Knock Off Installation

• The method would solve the problems of borehole stability and compressive forces on the PVC screen and casing

• EVERYONE still concerned about uncontrolled flow of tailings back to the rig
Solution

- Drill pad construction prior to equipment mobilization
- Install and cement 40’ of 16” steel casing at the exit point
  - Crude horizontal “blow out” preventer
- Installed using auger boring methods
- Surface casing installation proved challenging
- Screen installed as a slope of 6° above horizontal
Drill Pad Construction
Drilling and Installation

- Entered surface casing with 12 ¼ tricone bit to drill through grout plug and under dam into tailings
- Pulled tricone and re-entered borehole with knock off bit
- Drilled to 995’ MD
- End of well
  - 24’ above entry point
  - 40’ below top of tailings
Drilling and Installation

- Installed 4” dia., sch. 80 PVC screen and casing inside of drill pipe
  - 740’ screen
  - 251’ casing
  - 991’ total length
- Engaged knock off bit and removed drill pipe
- Cement-bentonite grout to 140’ MD
Well Development

- Flush with fresh water
- Flush with enzyme additive to break biopolymer drilling fluid
- Jet screen with fresh water
Finally

- Flow rate after development – 5 gpm
- Monitor drain flow rates
  - Siltation
  - Screen plugging
  - Periodic maintenance
In Summary

- HDD blind well drilling is a viable solution to tailings dewatering
- Worst case scenario must be included in project planning
- Communication between regulators, stakeholders and contractors is paramount
- Review and preplanning required
  - Project scope
  - Site visit
  - Preconstruction meeting
Contact Information

• Office locations
  – Bellefonte, PA
  – Mineral Wells, TX
  – Bremerton, WA
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Timeline

- May 2014 – Discussed HDD as a remedial option with Maine DEP
- June 2015 – Site walk and Bid Submittal and award
- July 2015 – Propose casing to stabilize bore incase of uncontrolled release (not part of original SOW)
- August 5 – Animas River mine failure
- August 13 – Complete setting casing (3 pm), EPA shuts down work on US mine sites pending review
- August 25 – Begin HDD
- September 1 – Demobilize
References

- www.tailings.info
- www.fema.gov
- www.klohn.com
- US EPA
- OU3 Draft Final Remedial Design Report – 5 December 2014 – prepared by AMEC Environmental & Infrastructure