ET COVER SYSTEM IN ARID ENVIRONMENTS

JUSTIFYING THE USE OF AN EVAPO-TRANSPIRATIVE COVER SYSTEM FOR CAPPING AN INDUSTRIAL WASTE PILE SAVES CLIENT MILLIONS

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PRESENTATION OUTLINE

- History Of Project
- Inert Waste Pile Issues
- Preliminary Investigation Activities
- Closure Documentation And Alternative Cap Justification
- Final Closure
HISTORY OF PROJECT

- Located In Southern CA
- Wallboard Production Plant Operating Since 1930s
- 2.6M CY Of Waste Wallboard (<1% Of Produced Wallboard)
- Preparations For Closure Started In Early 2000s
- 100% Recycle Of Waste Wallboard Started In 2005
  - Inactive Waste Piles Require Closure Under CA Title 27
INERT WASTE PILE ISSUES

- Public Perception (Eye Sore)
- 2.6M CY Of Inert Material
- Spread Across 80 Acres
- IMSA Contents:
  - >99% Inert Waste Wallboard (I.E., Paper And Gypsum)
  - <1% Putrescible Household Waste
- Source Of Dust Pollution
PRELIMINARY INVESTIGATION ACTIVITIES

- Regional Weather
- Groundwater Characterization
- Solid Waste Assessment Testing
- Landfill Gas Investigation
REGIONAL WEATHER

- Located In The Salton Basin Desert
- Average Winter Low Temperature Is 35 Deg. F.
- Average Summer High Temperature Is 110 Deg. F.
- Rains 3 To 4 Inches Per Year
REGIONAL TOPOGRAPHY, GEOLOGY AND GROUNDWATER

- Site Elevations Range From 108’ To 117 Along Western Perimeter And 89’ To 90’ Along Eastern Perimeter
- Waste Pile Up To 136’ AMSL
- Colorado River Basin
- Regional Groundwater At Sea Level
  - ~100 Feet Below Waste Pile
SOLID WASTE ASSESSMENT TEST

- Installed Below Bottom Of Inert Waste Pile:
  - Two Groundwater Wells
  - Three Lysimeters (15’ Below Waste)
  - Three Free-drainage Monitoring Devices (5’ Below Waste)
- Sampled Quarterly
- Analyzed For Total Metals, Volatile And Halogenated Hydrocarbons

Results:
- No Impacts To Groundwater
- Landfill Materials Primarily Waste Gypsum (I.E., Calcium Sulfate)
- Non-toxic And Unlikely To Negatively Affect Groundwater
- Low Annual Precipitation And High Annual Evaporation Significantly Reduces Possibility Of Leachate
LANDFILL GAS INVESTIGATION

- Putrescible Waste Decomposes And Creates Methane And Carbon Dioxide
- Gypsum Wallboard Decomposes (Generally In Wet Climates) Generates Hydrogen Sulfide

Testing:
- 36 Locations (22 Waste, 14 Around Perimeter)
- Gas Probes Driven 1 To 3 Feet Into Waste Or Soil
- Gas Samples Collected And Analyzed In The Field For Methane, Carbon Dioxide, Oxygen, Nitrogen And Hydrogen Sulfide
- 4 Random Samples Collected And Analyzed At A Laboratory
LANDFILL GAS INVESTIGATION

- Findings:
  - No Significant Amount Of Landfill Gas Or Hydrogen Sulfide Were Measured Either Within The Waste Or In The Surrounding
  - Potential For Any Significant Landfill Gas Generation Is HIGHLY Unlikely
  - Exemption From Landfill Gas Monitoring After Closure Approved
REGULATIONS / STAKEHOLDERS

- Final Closure Plan Developed Class III Landfill
- Title 40 CFR, Part 58 – Criteria For Municipal Solid Waste Landfill
- Title 27 CCR – Solid Waste Division
- Stakeholders:
  - California's Department Of Resources Recycling And Recovery (CalRecycle)
  - California Integrated Waste Management Board
  - California Regional Water Quality Control Board
  - Imperial County Air Pollution Control District
  - Imperial County Planning And Development Services
  - Imperial County Public Health Department (Lead Enforcement Agency)
Title 27 CCR – Final Cover Requirements

- Prescriptive Cover
  - Foundation Layer – 2’ Prepared Foundation
    - Geotechnically Stable Material
  - Low-hydraulic Conductivity Layer
    - Not Less Than 1-foot of “Clean” Soil
    - Hydraulic Conductivity Less Than $1 \times 10^{-6}$ Cm/S
  - Erosion-resistant Layer
    - Either Vegetative Layer Or Mechanical
    - 1-foot of Soil (Capable Of Sustaining Native Plant Growth) Or 1-foot of Rock

- Other Requirements
  - No Ponding Areas (All Slopes Greater Than 3%)
  - Precipitation And Drainage Control Plan
  - Steeper Slopes Protected Against Erosion
PRESCRIPTIVE FINAL COVER CONSIDERATIONS

- **Foundation Layer – 2’ Prepared Foundation**
  - 260,000 BCY Soil

- **Low-hydraulic Conductivity Layer – 1’ Soil/Clay**
  - 130,000 BCY Soil/Clay With Less Than 1X10^{-6} Cm/S Permeability

- **Erosion-resistant Layer – 1’ Rock**
  - 130,000 BCY Topsoil Or Rock

- **No Ponding Areas**
  - 80 Acres Of Waste (Upper And Lower Decks)
  - Both Nearly Flat
  - Needs Regraded To <3%
  - ~300,000 BCY Cut/Fill To Regrade To <3%

ET Cover System in Arid Environments
ALTERNATIVE FINAL COVER

- RWQCB can allow any alternative final cover design that it finds will continue to isolate the waste from precipitation and irrigation waters AT LEAST AS WELL as would a final cover built in accordance with the prescriptive final cover.
DESIGN CONSIDERATIONS FOR ALTERNATIVE FINAL COVER

- Infiltration Reduction
- Grading and Drainage To Remove Ponding Areas
- Erosion Resistant Rock Layer
- Settlement
- Stability
- Site Security And Access
INfiltration Reduction

- Minimize Infiltration Into Underlying Waste
- UNSAT-H To Evaluate Prescriptive And Alternative Covers
  - UNSAT-H Computes The Water Balance Of The Cover System Taking Into Account Precipitation, Infiltration, Evaporation, Soil Storage And Drainage From The Bottom Of The Cover System
- Utilized Local Rainfall Data From Wettest 10-year Period On Record (4.2 Inches Per Year From 1989 To 1998)
INfiltration Reduction

- Compared Prescriptive Cover To Alternative
  - Prescriptive:
    - 1-foot Erosion Resistant Rock
    - 1-foot Soil W/Hydraulic Conductivity Of $1 \times 10^{-6}$ Cm/S
    - 2-foot Foundation Soil W/Hydraulic Conductivity Of $2 \times 10^{-5}$ Cm/S
  - Alternative Cover:
    - 2- To 3-inches Erosion Resistant Rock
    - 18-inches Monolithic Native Soil (On-site Soil) W/ Hydraulic Conductivity Of $4.4 \times 10^{-5}$ Cm/S (Actual Data From On-site Soils)
    - 6-inch Gypsum Waste Regraded And Recompacted To 90% Standard Proctor W/ Hydraulic Conductivity Of $2 \times 10^{-7}$ Cm/S
  - Potential Vegetation Negated In Model
INfiltration RedUction

- UNSAT-H Model Results
  - Alternative Final Cover Outperforms Prescriptive Cover
  - Alternative Final Cover Allows ~37% Less Drainage From Bottom Of Cover

<table>
<thead>
<tr>
<th>Cover System</th>
<th>Total Precipitation Over the 10 Wettest Year Period (inches)</th>
<th>Total Drainage From Bottom of Cover Over the 10 Wettest Year Period (inches)</th>
<th>Average Annual Precipitation Over the 10 Wettest Year Period (inches)</th>
<th>Average Annual Drainage From Bottom of Cover Over the 10 Wettest Year Period (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescriptive</td>
<td>42.2</td>
<td>3.8</td>
<td>4.2</td>
<td>0.38</td>
</tr>
<tr>
<td>Alternative</td>
<td>42.2</td>
<td>2.4</td>
<td>4.2</td>
<td>0.24</td>
</tr>
</tbody>
</table>
WASTE GRADING TO REMOVE PONDING AREAS

- **Design:**
  - Re-grade flat decks to 1% minimum grades (Reduce cut by 200K BCY)
  - Re-grade all steep slopes areas to less than 5H:1V
  - Install diversion berms at the top of all 5H:1V to intercept and divert flows to rip-rap lined downdrain structures
  - Perimeter drainage channels conveying stormwater away from waste pile

- Title 27 section 21090.B.1.B allow portions of the final cover to be built with grades less than 3% if the discharger proposes an effective system for diverting surface drainage from laterally-adjacent areas preventing ponding in the flatter deck areas

- Stakeholders approved the 1% grading and drainage system
EROSION RESISTANT ROCK LAYER

- **Design:**
  - 2- To 3-inches Of Erosion Resistant Rock On Flat Slopes (<10%)
  - 3- To 4-inches Of Erosion Resistant Rock On Steeper Slopes (>10%)
  - Erosion Resistant Rock Has A D50 Of 2.5 Inches

- **Hydrology Analysis To Support Use Of 2- To 3-inch Rock Layer In Lieu Of 1-foot Rock Layer**
  - 100-year Storm Event
  - Rational Method For Maximum Runoff Rate

- **Perimeter Drainage Channels Conveying Stormwater Away From Waste Pile**

- **Stakeholders Approved The Use Of 2- To 3-inch Rock Layer**
ADDITIONAL DESIGN CONSIDERATIONS

- **Stability**
  - Maximum 5H:1V Slopes
  - Static Safety Factor Of 4.4
  - Seismic Safety Factor Of 1.86

- **Settlement**
  - Waste Is Inert And Not Organically Degradable
  - Majority Of Elastic Settlement Already Occurred And Compaction Of Surface Likely To Further Consolidate
  - Minimal Water Infiltration Through Alternative Final Cover
  - Annual Inspections And Maintenance Required If Settlement Occurs

- **Site Security And Access**
  - Access Roads Around Perimeter And Across Top Of Pile For Inspections
  - 6-foot Perimeter Fence Preventing Unauthorized Access
# ALTERNATIVE FINAL COVER COST COMPARISON

<table>
<thead>
<tr>
<th>Cover Component</th>
<th>Quantity</th>
<th>Cost</th>
<th>Cost Difference (Total $14M Savings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescriptive_24” Foundation Layer (screened native soil)</td>
<td>260,000 BCY</td>
<td>$6.98 / BCY</td>
<td>Prescriptive +$850,000</td>
</tr>
<tr>
<td>Alternative_18” Monolithic Native Soil Layer (unscreened native soil)</td>
<td>194,000 BCY</td>
<td>$4.98 / BCY</td>
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</tr>
<tr>
<td>Prescriptive_1’ Low-Perm Soil (Imported)</td>
<td>130,000 BCY</td>
<td>$60 / BCY ($40/Ton)</td>
<td>Prescriptive +$7.6M</td>
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<td>Alternative_0.5” Regraded/Compacted Waste (Onsite)</td>
<td>65,000 BCY</td>
<td>$3.21 / BCY</td>
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<tr>
<td>Prescriptive_1’ Erosion Resistant Rock (Imported)</td>
<td>130,000 BCY</td>
<td>$55.50 / BCY ($37/Ton)</td>
<td>Prescriptive +$4.8M</td>
</tr>
<tr>
<td>Alternative_4” Erosion Resistant Rock (Imported)</td>
<td>43,000 BCY</td>
<td>$55.50 / BCY ($37/Ton)</td>
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<tr>
<td>Prescriptive_3% Minimum Slopes</td>
<td>300,000 BCY</td>
<td>$2.10 / BCY</td>
<td>Prescriptive +$420,000</td>
</tr>
<tr>
<td>Alternative_1% Minimum Slopes + Drainage Berms</td>
<td>100,000 BCY</td>
<td>$2.10 / BCY</td>
<td></td>
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CONCLUSION

- Engineered Alternative Is Appropriate Per 27 CCR 20080 Per The Following:
  - Alternative Out Performs Prescriptive Cover By Allowing 37% Less Drainage From Bottom Of Cover System
  - Prescriptive Cover System Is Unnecessarily Burdensome For This Site Given The Arid Climate And Inert Nature Of Waste
  - Cost Of The Prescriptive Cover Substantially More And Will Not Provide Better Protection Of Public Health, Safety And The Environment
Construction Photos
WASTE REGRADE
WASTE REGRADE
MONOLITHIC NATIVE SOIL COVER
EROSION RESISTANT ROCK

ET Cover System in Arid Environments
DIVERSION Berm AND DOWndrain

ET Cover System in Arid Environments
COMPLETED INSTALL
QUESTIONS?

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