GEOTECHNICAL CHALLENGES AT OWENS LAKE, CALIFORNIA

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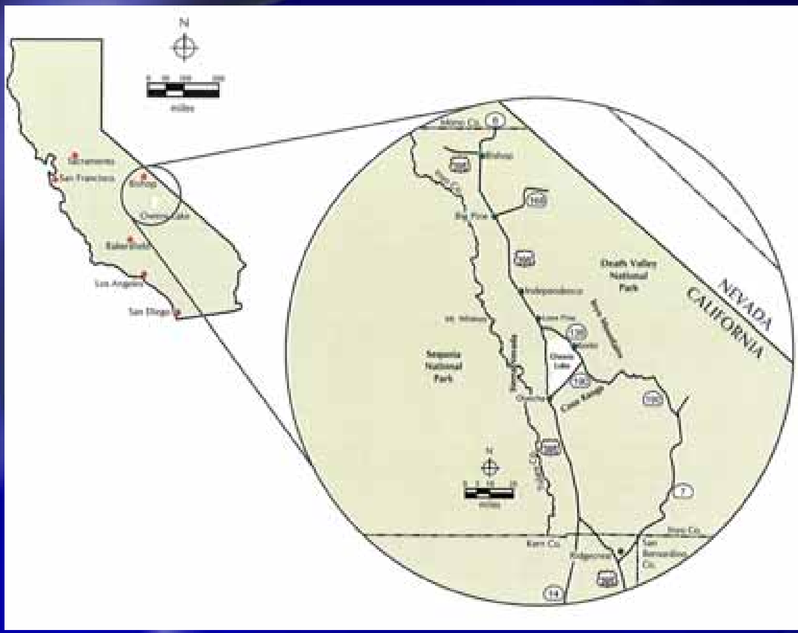
CDM

PRESENTATION OUTLINE

- Project Background
- Geotechnical Evaluation
- Project Challenges

Q & A

SITE LOCATION



Project Background

- Lake area ~ 110 sq. miles
- Dry, salt-laden lakebed sediments are exposed to wind erosion
- Dust blowing from lakebed is a major health hazard
- Purpose of the project is long-term dust mitigation
- This is Phase 7 of work at Owens Lake

What is Particulate Matter ?

- USEPA indicator for particulate matter is PM_{10} (particulate matter ≤ 10 microns)
- 1/7th the thickness of a human hair
- Mixture of materials including dust, smoke, soot, salts, acids, and metals
- Responsible for haze/ smog and is a health hazard
- Windblown dust is a major source of PM_{10} at Owens Lake and is carried beyond the area

EPA Standards v. Owens Lake

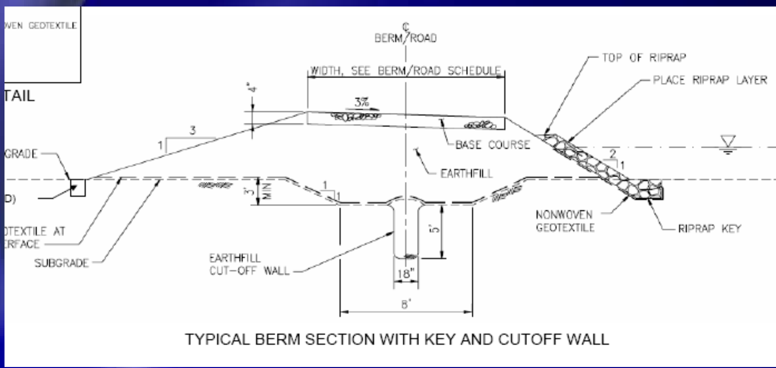
- PM_{10} Standard:
  - 150 µg/m^3 for 24 hr average
  - 50 µg/m^3 for annual average
- At Owens Lake:
  - PM_{10} > 12,000 µg/m^3 measured at Dirty Sock Well (May 2, 2001)
  - Annual PM_{10} average ~ 157 µg/m^3

A TYPICAL DUST STORM

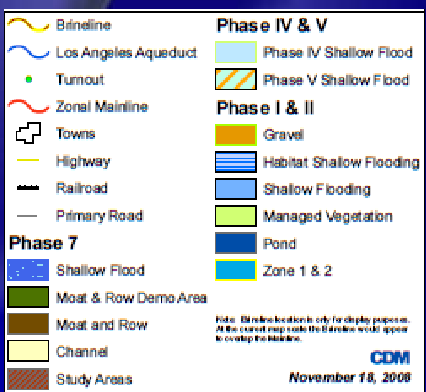

Primary
Mitigation
Methods
Containment berms and ponds
Shallow flooding

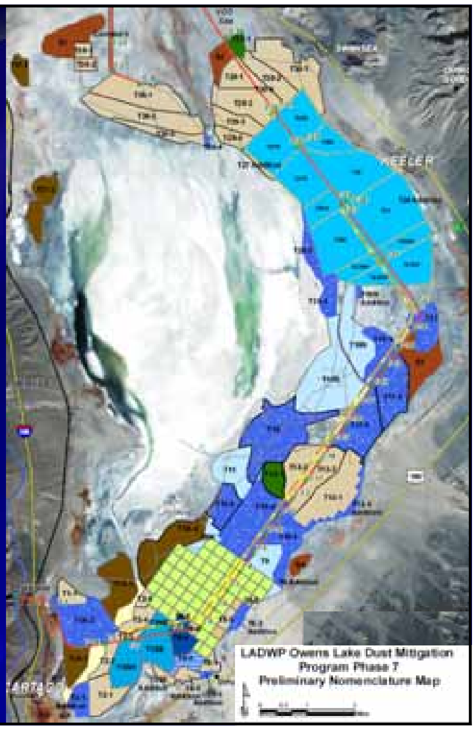

Secondary or
Experimental
Mitigation
Methods
Managed vegetation
(saltgrass)
Moat and row
Tillage

TYPICAL SECTION



PROJECT LAYOUT

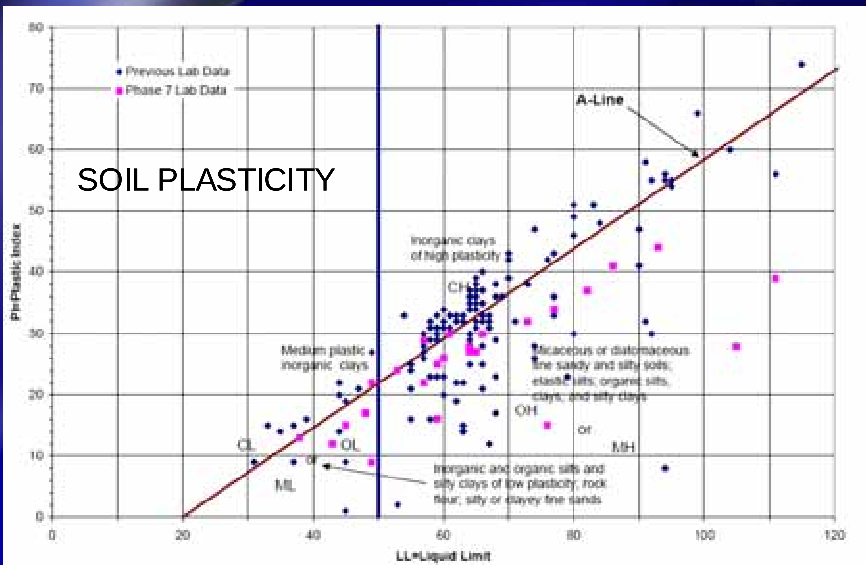




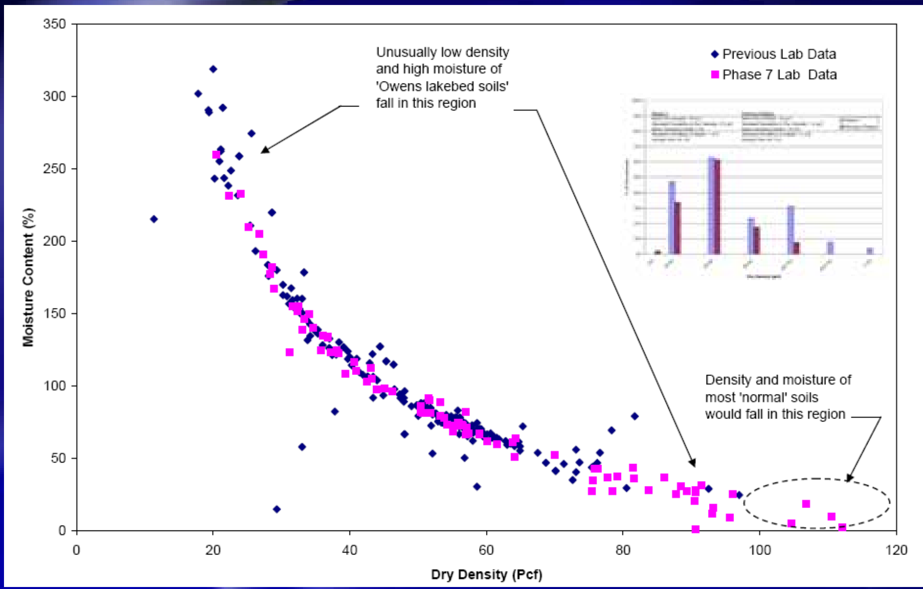
Phase 7 Subsurface Information

- Borings (113 new, 79 old/ nearby)
- Test Pits (53 new, 21 old/ nearby)
- Electrical Resistivity
- Borehole Permeability
- Considerations for biological, historical & archeological resources

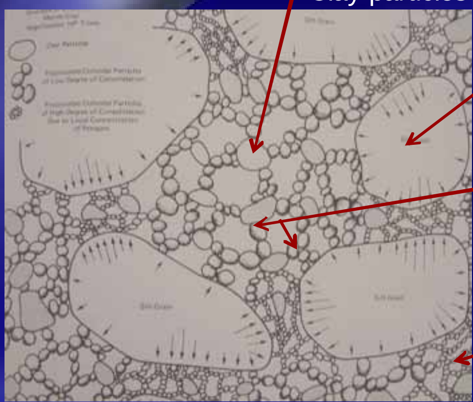
GEOTECHNICAL PROPERTIES OF OWENS LAKEBED SOILS



MOISTURE CONTENT V. DRY DENSITY



THE STRUCTURE OF UNDISTURBED SENSITIVE CLAY



- **Caused by flocculated structure and salt removal**
- **Usually formed in a marine environment, then uplifted to land, then salt leached out by fresh water**

SENSITIVE (QUICK) CLAY

- Changes from a relatively stiff condition to a liquid mass when disturbed
- Sensitive (high undisturbed strength but a low remoulded strength
- Common in Scandinavia and Canada. Not so common in the U.S.

UNDISTURBED

DISTURBED (NO WATER ADDED)

SENSITIVE CLAY AT OWENS LAKE

UNDISTURBED

DISTURBED

SAND ZONES

(generally coincide with fresh water inflow areas)

PROBLEMS IN FRESH WATER INFLOW AREAS

- **These areas are generally located near the lake perimeter**
- **Salt leaching promotes quick clay conditions**
- **Construction equipment access is very difficult (sinking)**
- **Ground fissures, infill zones and berm under-seepage zones are more likely**
- **Fill placement on soft material is much harder, mud waves form easily and berms can fail**
- **Trench excavations are unstable**
- **Personnel safety is a concern (sinking)**

GROUND FISSURES, INFILLS AND UNPREDICTABLE SEEPAGE ZONES

SURFACE

SUBSURFACE

FRESH WATER INFLOW AREAS AT LAKE EDGES

Geotechnical Analysis and Design Considerations

- Analysis
  - 3D patterns in field and lab data
  - Comparison of current and previous data
  - Delineating potential problem areas (sand, ground fissures, salt lenses)
  - Study of previous problems (berm breach, etc.)
- Design
  - Berm stability (slope and erosion control)
  - Settlement control (over-excavation)
  - Seepage control (key, cutoff trench, toe drain)
  - Client-driven adjustments (initial cost v. maintenance)

Considerations for Risk Management

- Low cost/ high risk (let them fail)
- Best guess option by location (based on investigation data)
- Use of add/ deduct unit pricing for bidding
- Use of Observational Method to make adjustments during construction

CONSTRUCTION EQUIPMENT CHALLENGES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WORKING ON MATS


FILL COMPACTION CHALLENGES
MUD WAVE


DUST CHALLENGES

SALT AND CORROSION CHALLENGES

SALT LENSES AND SEEPAGE CHALLENGES


DEWATERING CHALLENGES
Water bubbling
before dewatering
DEWATERING
MOAT


RIPRAP PROTECTION CHALLENGES

FIGHTER JET CHALLENGES

PERSONNEL SAFETY CHALLENGES

NATURE HAS RETURNED


Los Angeles Times

CALIFORNI

Nature has returned, unexpectedly

PROJECT ADMINISTRATION CHALLENGES

- Cost versus liability issues
- Specification enforcement issues
- Maintenance issues
- Multi-disciplinary issues

MIRANDA HARD HAT

QUESTIONS?

CDM

Irvine, California