



Midwest Research Institute

*Solutions through science
and technology*

Remote Spectral Analysis of Erodible Lands in Clark County, Nevada

Funding Organization

Clark County, Nevada

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Background

- Windblown dust in the Las Vegas Valley contributes to exceedances of PM air quality standards
- Increasing land disturbance associated with population growth is intensifying the problem
- A precise tool is needed to track land disturbances and assure that stabilization measures are applied



Purpose

- Use Satellite Imagery to Inventory Erodible Land Areas in Las Vegas Valley
 - Native desert (natural state)
 - Disturbed vacant land (loss of surface protection)
 - Stabilized vacant land (restoration of surface protection)
 - Private unpaved roads (dirt or gravel)

Vacant Land in Las Vegas Valley





Wind Erodibility Groups

- WEG values developed by USDA/NRCS to indicate the susceptibility of surface soil to blowing (Nine WEG values)
- Soil blowing correlated with:
 - Soil texture
 - Organic matter content
 - Effervescence due to carbonate reaction with HCl
 - Rock and pararock fragment content
 - Mineralogy
 - Soil moisture and frozen soil



Potentially Relevant Information

- Antelope Valley Blowsand Areas (Almaraz & Nguyen, as reported by Farber et al., 2003)
- Owens Lake Vegetation (<http://www.hydrobio.org>, 2003)
- Mojave Desert Wind Erosion (USGS, RVDE)
- SSURGO Wind Erodibility Groups



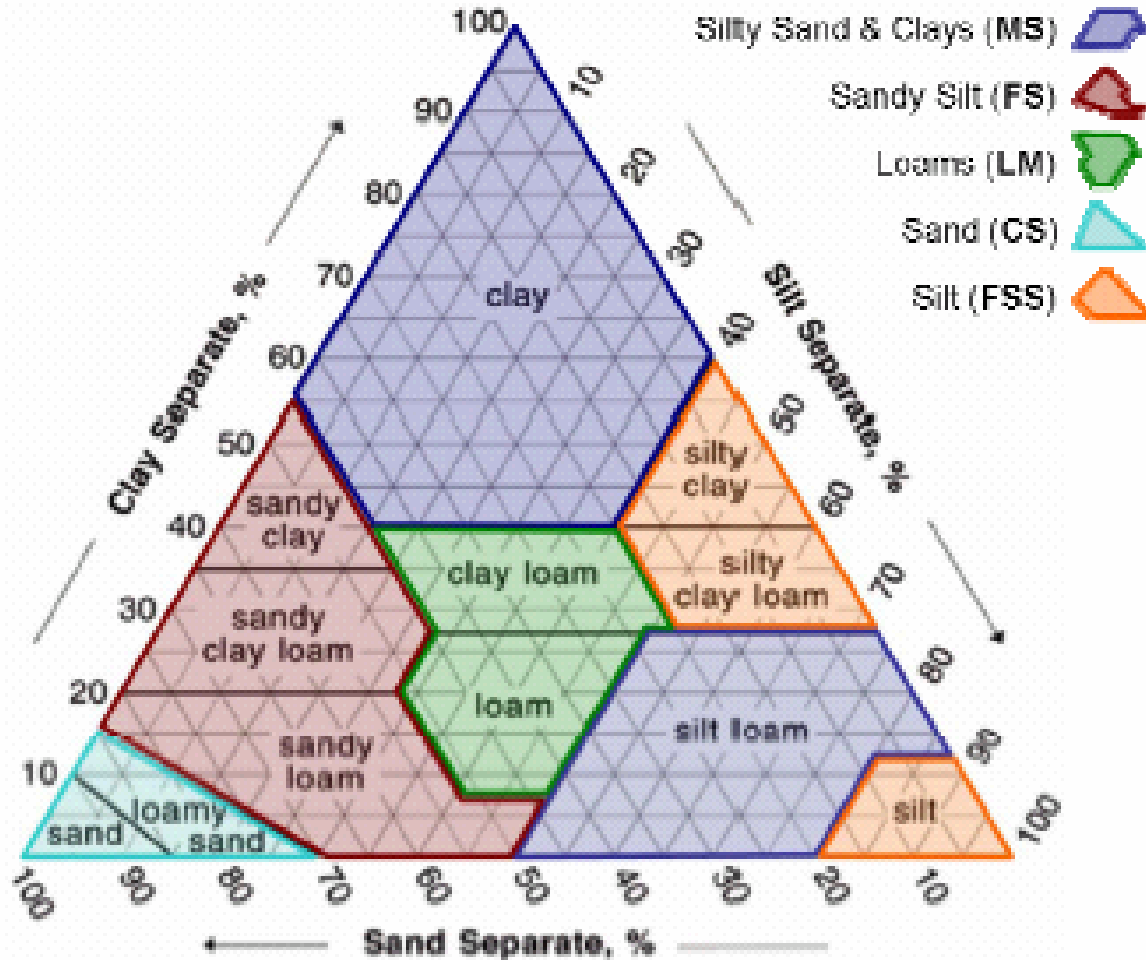
PM-10 Emission Categories vs. Wind Erodibility Groups

- 1 – Silty Sand & Clay (WEG 4 and 5)
- 2 – Sandy Silt (WEG 2 and 3)
- 3 – Loam (WEG 4L)
- 4 – Sand (WEG 1)
- 5 – Silt (WEG 6 and 7)

Note: USDA provides national soil database (SSURGO) with WEG values for GIS analysis.



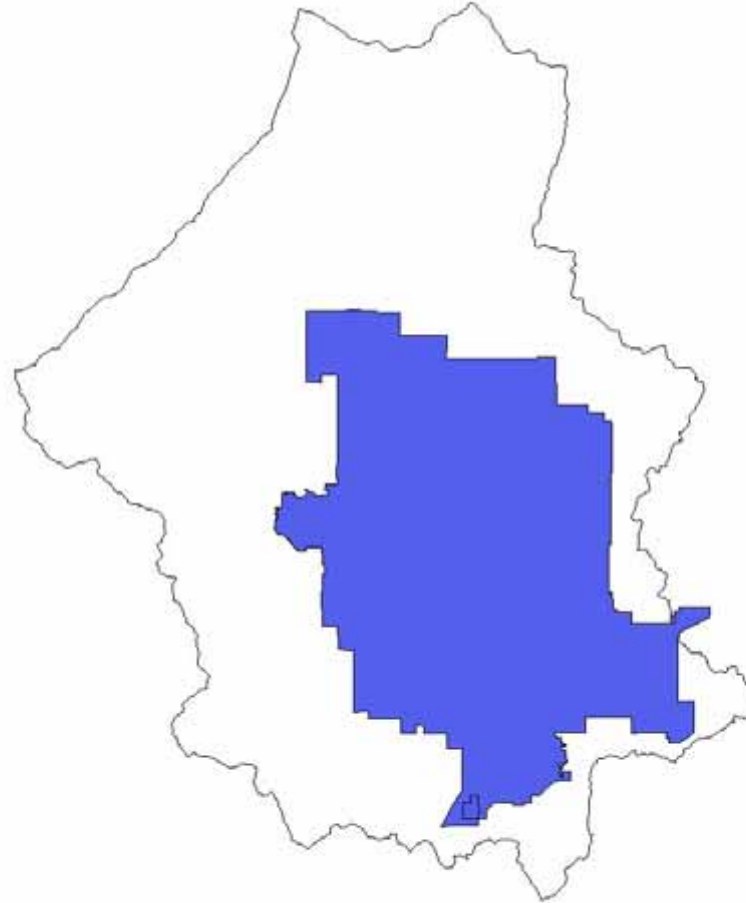
Soil Texture Triangle





Study Area Boundaries

Hydrographic Area 212 - BLM Disposal

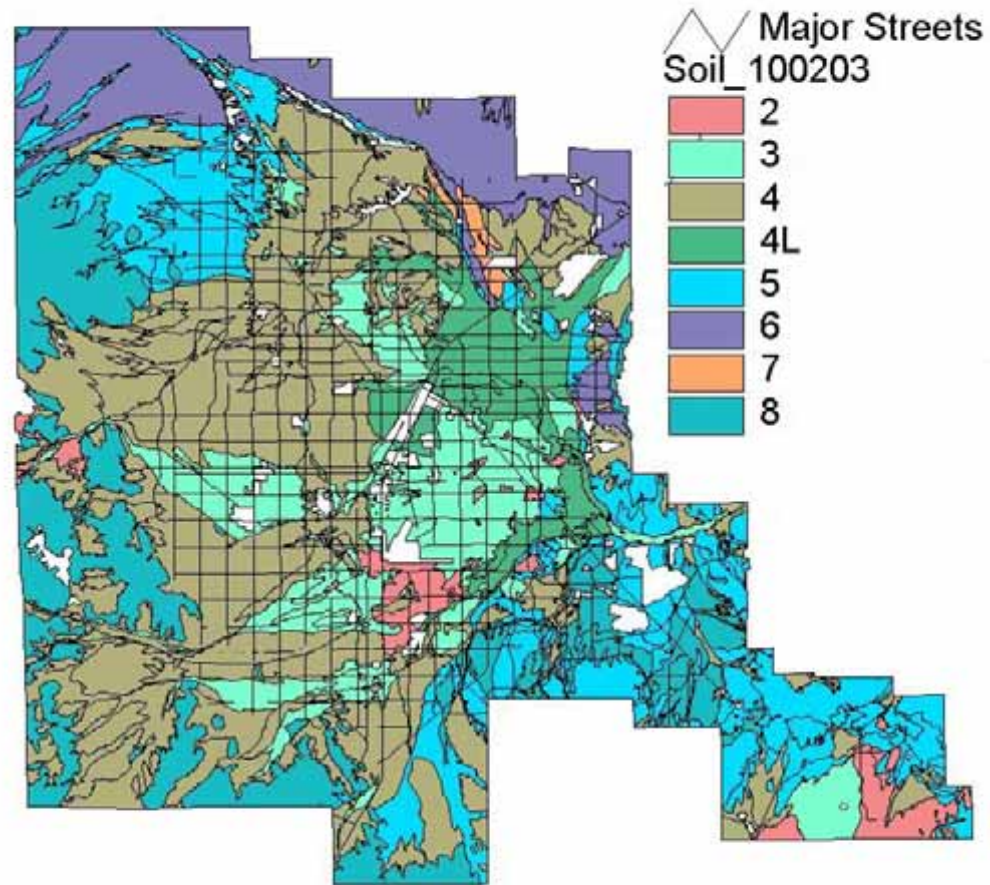


30 0 30 Kilometers



BLM Disposal Area

WEG and Major Streets



10 0 10 20 Kilometers



Project Phases

- Pilot Study (two 64 km² areas)
 - Utilize limited study area to develop and test predictive algorithms
 - Training sites: development of characteristics of land categories
 - Verification sites: assessing accuracy of supervised classification
- Main Study (Rest of BLM zone)
 - Completion of spectral analysis for full study area
 - Check sites: testing of predicted land categories



Pilot Study Sites

- 30 Locations for Training and Verification
- Distributed within BLM Disposal Area
- Distributed among Land Categories (weighted by WEG)
- Ground Truthing within 48 hours of Imagery Acquisition



Pilot Study Sites

- Native desert,
 - moderate to heavy vegetation
 - little or no vegetation
- Disturbed land
 - not stabilized
 - non-vegetated but crusted (stabilized)
- Unvegetated rocky surface
- Sand dunes
- Private unpaved roads (dirt and gravel)





Selection of Pilot Study Sites

- Southern Nevada GIS Metadata
 - Las Vegas Valley Nonattainment Area (CP 3.16)
 - BLM disposal area (CP 3.17)
 - Public-owned land (CP 3.18)
 - Existing land use (CP 3.8)
 - Unpaved roads (CP 3.19)
- SSURGO Database with WEG values
- USGS Topographical Data
- Windshield Observations



Ground Truthing of Pilot Study Sites

- **GPS Coordinates** of NW corner locations
- Inspection of **vegetation** types and coverage
- Characterization of loose **surface material**
- Drop ball test for surface **crust strength**
- Rock cover test for **non-erodible elements**
- Sieving test for **threshold friction velocity**



Satellite Imagery

- IKONOS (Space Imaging)
 - 3 visible bands (blue, green, red), 1 near IR band
 - Resolution: 4 m multispectral sharpened to 1 m
- QuickBird (Digital Globe)
 - 3 visible bands (blue, green, red), 1 near IR band
 - Resolution: 2.4 m multispectral sharpened to 0.6 m
- LandSat 7 (NASA/NOAA/USGS)
 - 7 bands (same as above plus 3 others)
 - Resolution: 30 m multispectral sharpened to 15 m



Other Satellite Imagery Studies

- Owens Lake Vegetation
 - Test for compliance with 50% coverage requirement
 - Use TM7 and Quickbird data to characterize South Farm area (16 training sites)
- Antelope Valley Blowsand Areas
 - Blowsand areas drive wind erosion of farmland
 - Use Landsat data to map blowsand areas (8 training sites)



Comparison of Satellite Data

- IKONOS/QuickBird
 - High spatial resolution, but expensive
 - Lacks longer wavelenghts for treatment of senesced vegetation
- Landsat 7
 - Inexpensive, but lower spatial resolution
 - Contains spectral data useful for identification of senesced vegetation



Procedure for Spectral Analysis

- Establish training sites that are representative of erodibility categories
- Perform supervised classification of pan-sharpened, high spatial resolution satellite imagery
- Determine classification mapping accuracy by constructing an error matrix



Schedule for Clark County Study

Item No.	Activity/Milestone	Completion Date	
		Planned	Actual
1	Ground Truthing Site Plan	6/25/04	6/25/04
2	Pilot Study	9/30/04	
3	Main Study	11/30/04	
4	Traffic Estimates	11/30/04	
5	Final Report	12/31/04	





Summary

- Use satellite imagery to inventory erodible lands in the Las Vegas Valley
- Begin with pilot study to develop and verify predictive algorithms
- Balance imagery resolution against emission intensity variation to maximize cost-effectiveness