

Veterinary Services

Using Geospatial Methods to Locate Suitable Burial Sites for Livestock Mortalities



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Background

Disposal by Burial

- Proper disposal of carcasses is a consideration for livestock production facilities and small producers
- Natural disasters, disease events, and agroterrorism events necessitate knowing where to site burial trenches well in advance of an emergency
- Concerns include public health, environmental impacts, public perception, and logistical issues
- Other methods of disposal may be required for large numbers of livestock mortalities



Flooding in Weld and Morgan Counties



September 13-15, 2013



South Dakota blizzard kills and buries up to 20,000 cattle

Posted on: 9:20 am, October 10, 2013, by [CNN Wire](#)

PIERRE, South Dakota

An early blizzard caught ranchers off guard this week in the state, killing as many as 20,000 head of cattle, a state official says.



“Some people were very well prepared and lost 50% of their herd. Some were not prepared and took no losses. There was no rhyme or reason to it. Some ranchers lost everything.”

The state has issued ranchers a final, grim and expensive chore to take care of on top of their losses. They must dispose of the carcasses quickly, before they rot, and in accordance with regulations.

The ranchers can pay a factory to render them.

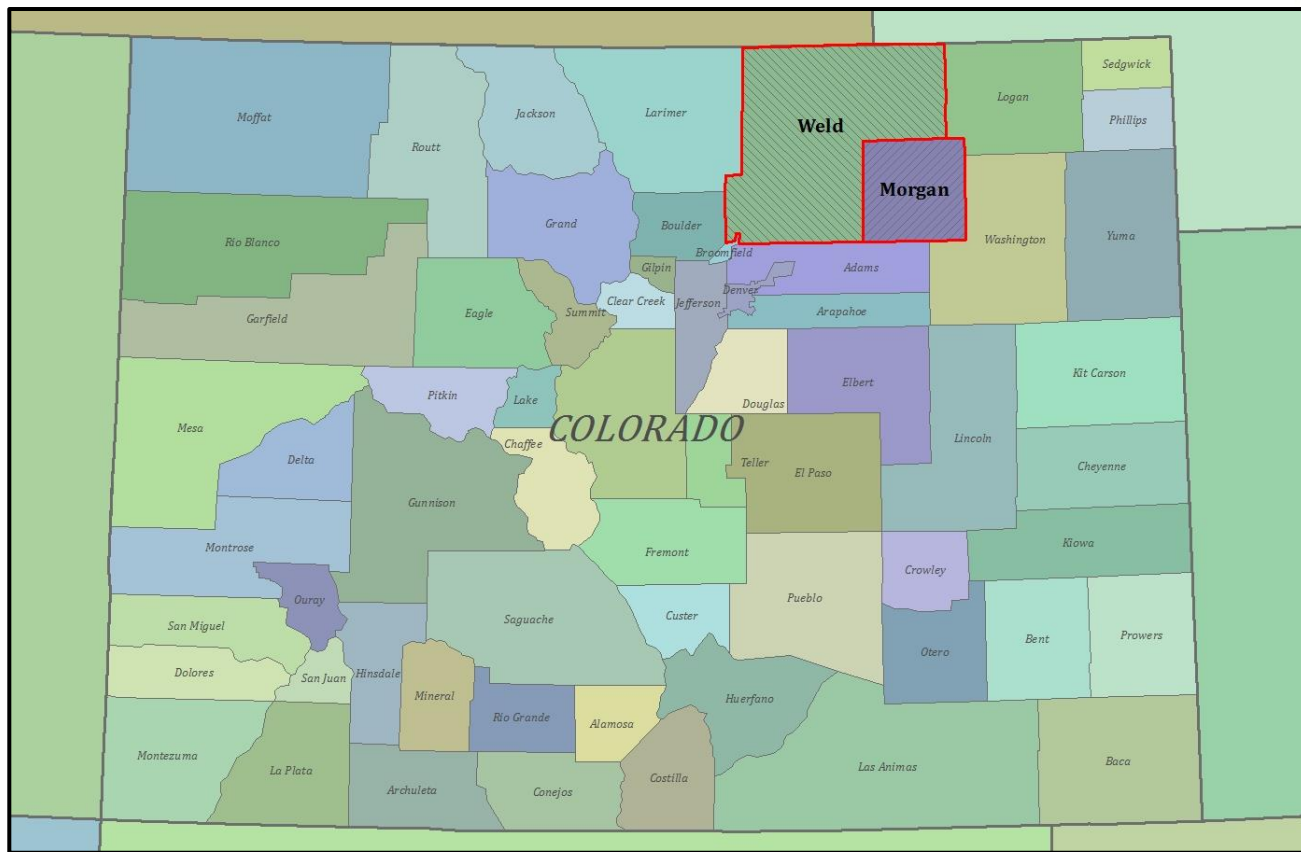
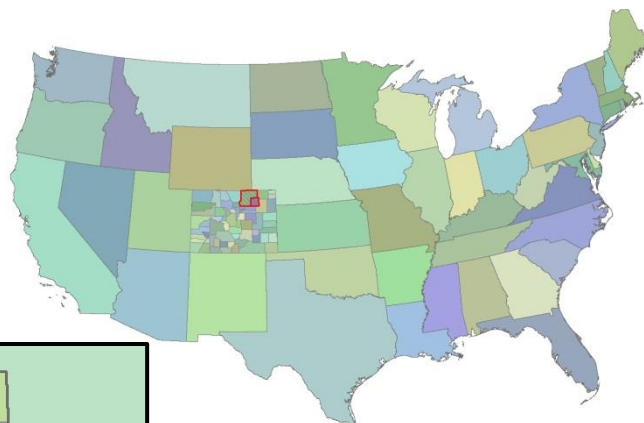
Or they can burn them themselves, or dig large pits at least four feet deep and bury them by the hundreds.

Project Scope and Study Area

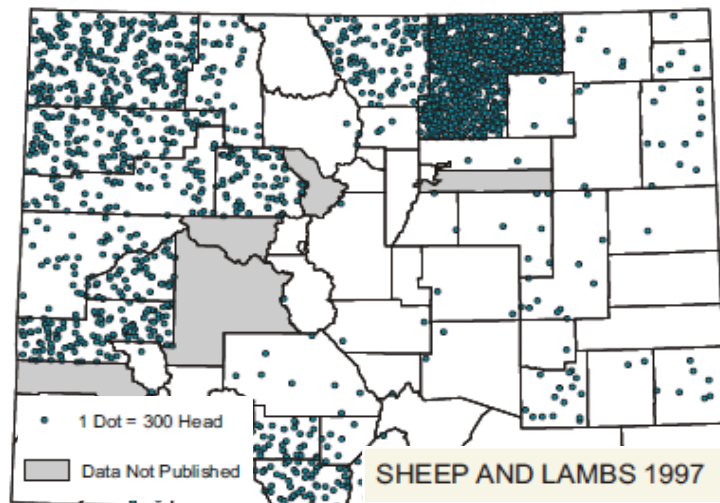
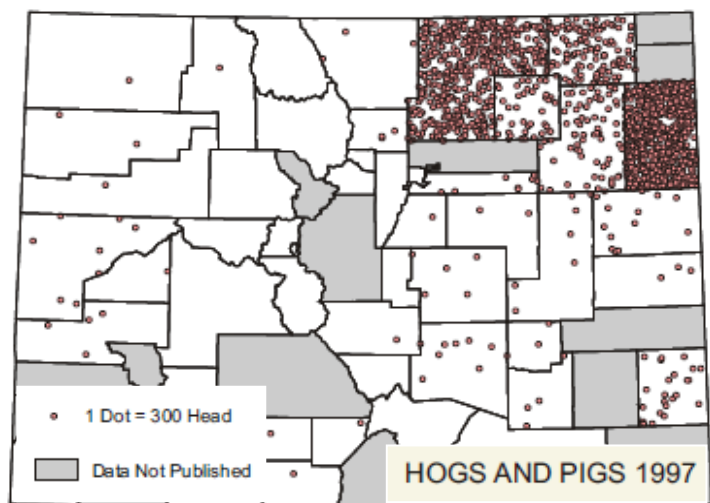
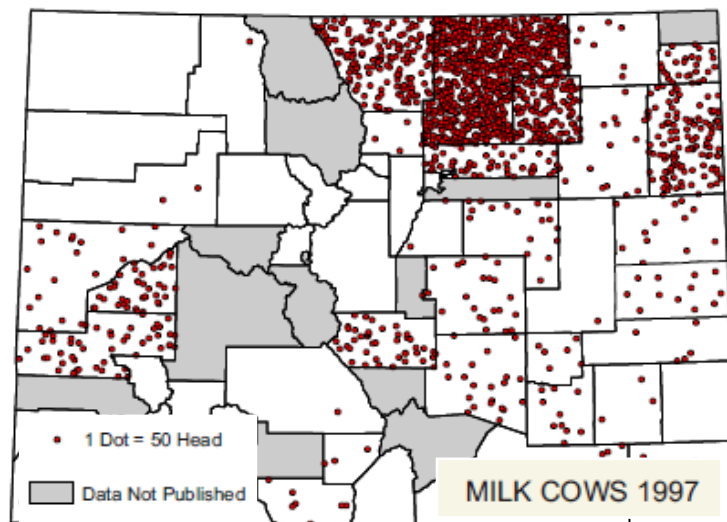
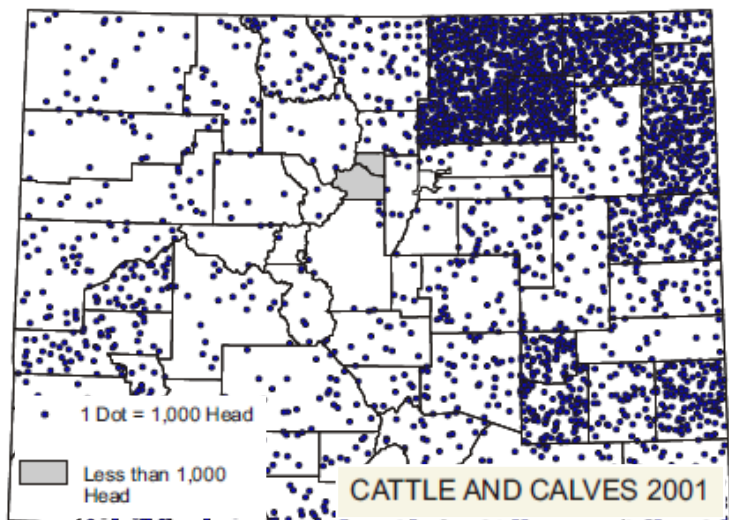
- Provide guidance to state and local governments on developing burial site suitability maps in preparation for animal emergencies
- Morgan County, CO was chosen for the initial pilot study; Weld County to be completed in the second phase
- ArcGIS 10.1 was used for the analysis
- Based on best practices for livestock emergency disposal as determined by Colorado Dept. of Public Health & Environment (CDPHE) and Colorado Dept. of Agriculture (CDA)



Morgan and Weld Counties



Livestock Production



Source: Colorado Department of Agriculture
The Atlas of Colorado: A Teaching Resource – 2003 Edition

Methodology Overview

- Setback buffers created at defined distances from rivers/lakes, roads, urban areas, and wells based on best practices for burial of livestock mortalities
- SSURGO soil data from NRCS' WebSoilSurvey at <http://websoilsurvey.nrcs.usda.gov>



- Topographic slope from DEMs
- Additional data:
 - land ownership
 - concentrated animal feeding operations (CAFO)

Burial Suitability Criteria

*Colorado Department of Public Health and Environment (CDPHE)
and Colorado Department of Agriculture (CDA)*

Criteria for Suitability	Source for Best Practices
> 1 mile from private residences	CDPHE/CDA
> 600 feet from lakes, rivers, all surface waters	CDPHE/CDA
> 150 feet from all types of wells	CDPHE/CDA
> 20 feet above ground water*	CDPHE/CDA
> 200 feet from public roads	CDPHE/CDA
Avoid highly permeable soils, fractured bedrock	CDPHE/CDA
< 6% topographic slope	NRCS and K-State recommendations
Other favorable soil properties	NRCS Catastrophic Mortality, Large Animal Disposal - Trench
Ease of excavation	NRCS Catastrophic Mortality, Large Animal Disposal - Trench

* Depth to ground water data was not used in the analysis

Depth to Ground Water

Depth to ground water data were excluded from the site suitability analysis:

- Colorado DNR DWR data
 - Aquifer data: scale was too coarse
 - Water well data: wells produce water from two different aquifers
- WebSoilSurvey data
 - Data were generalized at depth greater than 200 cm (6.5 ft)

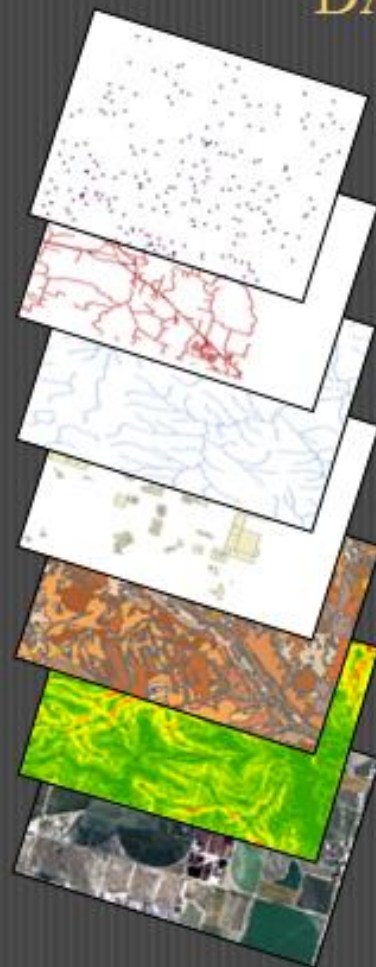
On-site investigations by groundwater engineers, geologists, or soils scientists would be needed

Burial Suitability Criteria

CRITERIA

- > 150' from wells
- > 200' from roads
- > 600' from lakes, rivers
- > 1 mile from residences
- Favorable soils, non-permeable, non-fractured bedrock
- < 6% topographic slope

DATA LAYERS



Wells

Roads

Hydrography

Census Places

Soils (WebSoilSurvey)

Elevation (DEM)

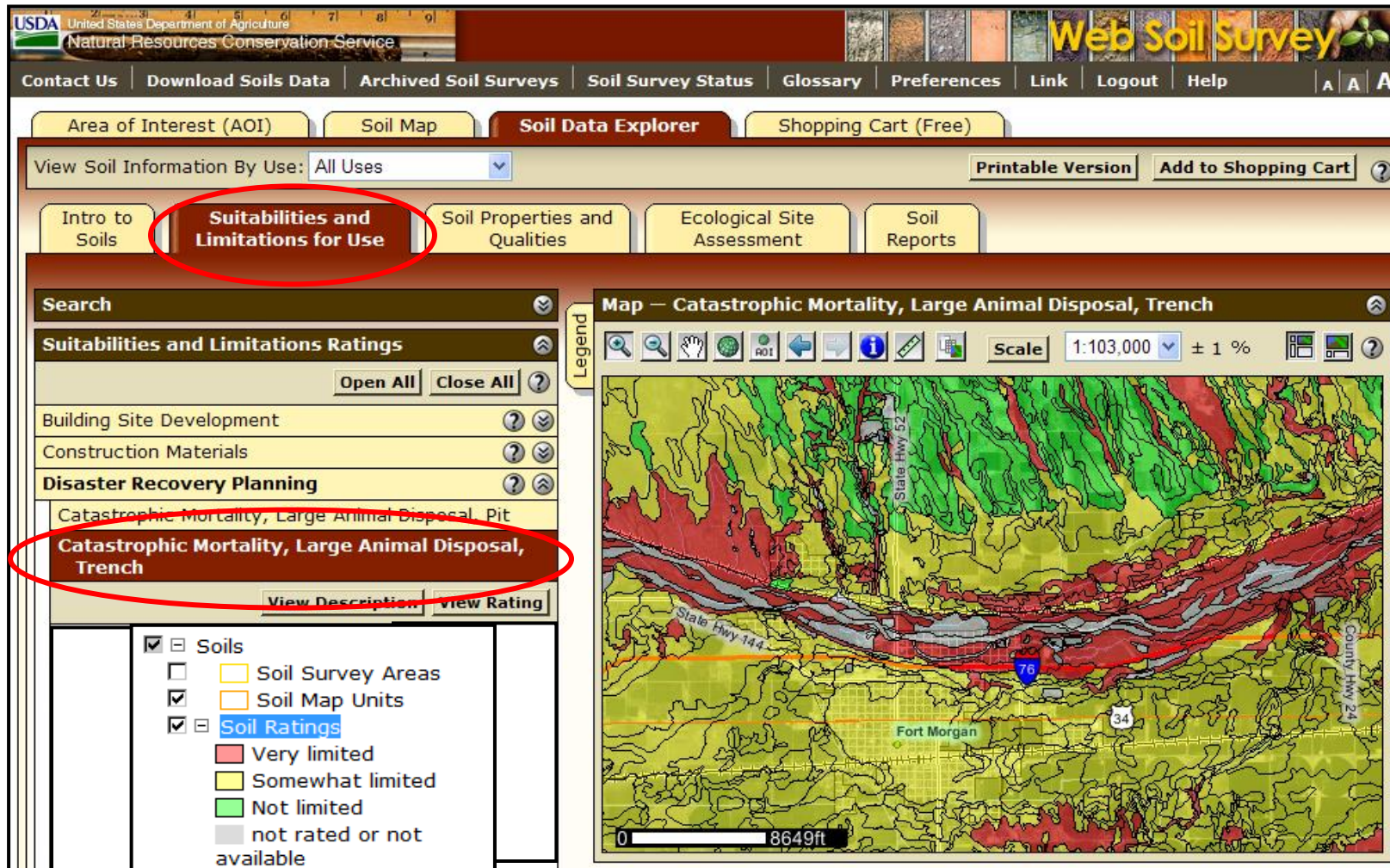
Base Layer (imagery)

Data Sources

Criteria for Suitability	Data Layers Used	Data Source
> 1 mile from private residences	Census Designated Places (CDP)	U.S. Census Bureau Cartographic Boundary Files Places (Incorporated Places and Census Designated Places): http://www.census.gov/geo/www/cob/cbf_place.html
> 600 feet from lakes, rivers, and all surface waters	Hydrography	National Hydrography Dataset 1:24,000 scale <i>Streams, Rivers, Lakes:</i> http://datagateway.nrcs.usda.gov
> 150 feet from groundwater wells	Water wells	Colorado DNR Department of Water Resources <i>Water Well Applications:</i> http://water.state.co.us/DataMaps/GISandMaps/Pages/GISDownloads.aspx
	Oil & gas wells	Colorado Oil and Gas Conservation Commission <i>Well Surface Locations:</i> http://ogcc.state.co.us/Home/gismain.cfm#Downloads
> 20 feet above ground water	Depth to ground water data – NOT INCLUDED	N/A
> 200 feet from public roads	Roads	<u>ColoradoView</u> <i>Highways, Major Roads, Local Roads:</i> http://www.coloradoview.org
Avoid highly permeable soils; bedrock; consider favorable soil properties and ease of excavation	SSURGO soils data (<u>WebSoilSurvey</u>)	NRCS <u>WebSoilSurvey</u> Catastrophic Mortality, Large Animal Disposal (Trench) 1:24,000 scale: http://websoilsurvey.nrcs.usda.gov
< 6% topographic slope	Elevation (10m DEM)	USGS National Elevation Dataset (10 meter): http://nationalmap.gov/viewer.html
N/A	Morgan County administrative boundary	NRCS Geospatial Data Gateway <i>NRCS Counties by State:</i> http://datagateway.nrcs.usda.gov
N/A	Aerial imagery base layer	USGS-FSA National Agricultural Imagery Program (NAIP) 1-meter resolution: http://datagateway.nrcs.usda.gov

USDA NRCS WebSoilSurvey

Catastrophic Mortality - Large Animal Disposal



The screenshot displays the USDA NRCS WebSoilSurvey interface. The top navigation bar includes links for 'Contact Us', 'Download Soils Data', 'Archived Soil Surveys', 'Soil Survey Status', 'Glossary', 'Preferences', 'Link', 'Logout', and 'Help'. Below this, the 'Soil Data Explorer' tab is active, showing a search bar and a 'View Soil Information By Use' dropdown set to 'All Uses'. The 'Suitabilities and Limitations for Use' section is highlighted with a red circle. It contains a list of categories: 'Building Site Development', 'Construction Materials', 'Disaster Recovery Planning', and 'Catastrophic Mortality, Large Animal Disposal, Trench'. The 'Catastrophic Mortality, Large Animal Disposal, Trench' category is also highlighted with a red circle. Below this list, there are checkboxes for 'Soils', 'Soil Survey Areas', 'Soil Map Units', and 'Soil Ratings'. The 'Soil Ratings' section shows a legend with four categories: 'Very limited' (red), 'Somewhat limited' (yellow), 'Not limited' (green), and 'not rated or not available' (grey). To the right of the list is a map titled 'Map - Catastrophic Mortality, Large Animal Disposal, Trench'. The map shows a landscape with various colored regions representing different soil suitability levels. Key features on the map include 'State Hwy 52', 'State Hwy 144', 'Fort Morgan', and 'County Hwy 24'. A scale bar at the bottom left of the map indicates a distance of 8649ft.

USDA NRCS Soil Considerations

WebSoilSurvey Catastrophic Mortality - Large Animal Disposal Morgan County

Soil Characteristics	Concerns
Clay content	High clay content restricts workability
Flooding	Surface water pollution
Large stones	Restricts excavation
Too sandy	Restricts re-vegetation
Seepage	Causes excessive transmission of leachate
Depth to bedrock	Burial limitations and limited percolation
Slope	Machinery and reclamation limitations, erosion potential
Rock outcrop	Excavation and leachate problems
Adsorption	Low adsorption reduces the decay process
Sand content	If high, may cause excessive transmission of leachate
Too steep	Machinery/reclamation limitations, erosion potential
Unstable excavation walls	Collapse or sloughing of excavation walls
Wetness	Restricts excavation, groundwater contamination
Water gathering surface	Concentrates water flow and accelerates erosion



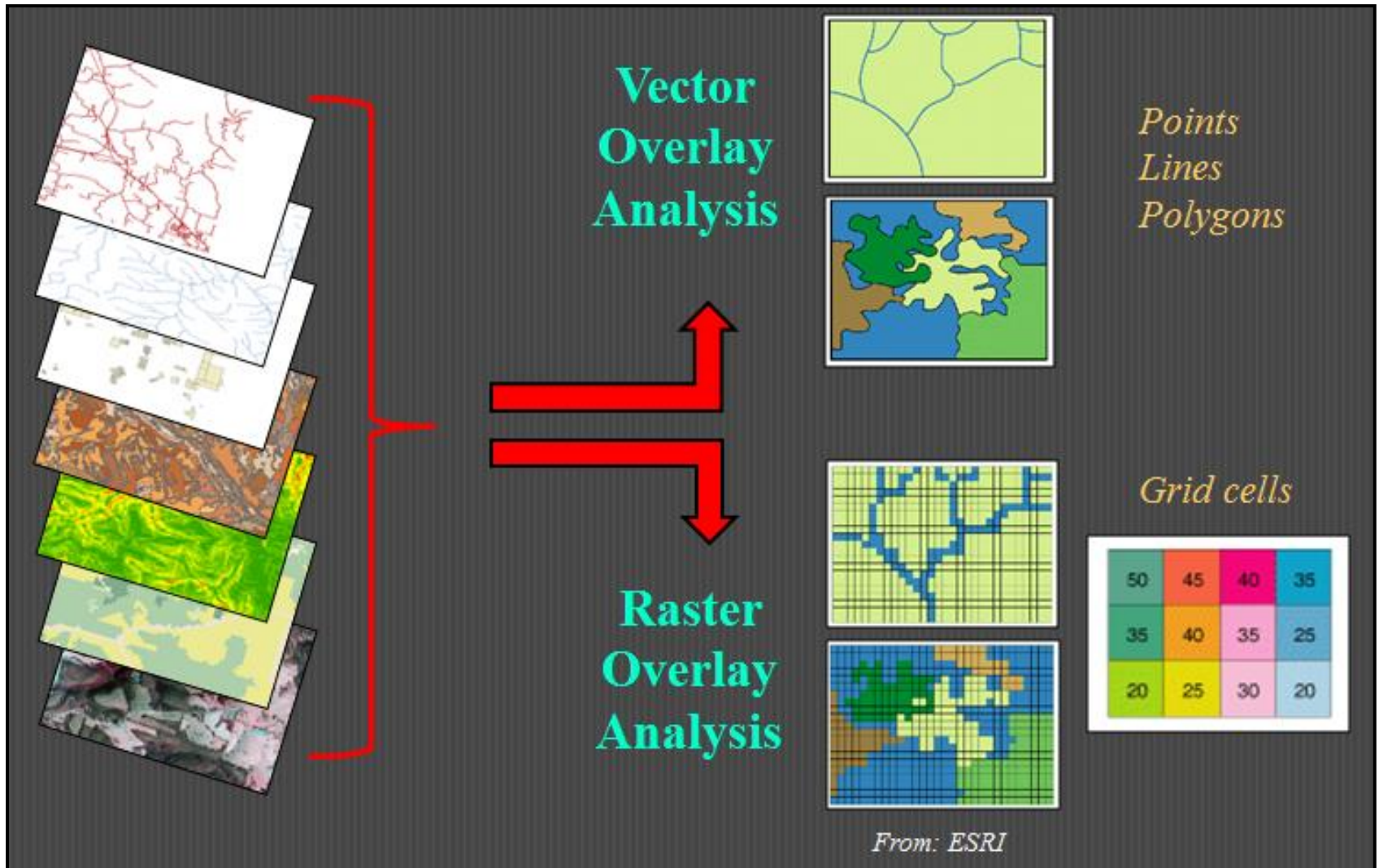
USDA NRCS WebSoilSurvey – Soil Ratings

Tables – Catastrophic Mortality, Large Animal Disposal, Trench – Summary By Map Unit

Summary by Map Unit – Morgan County, Colorado (CO087)

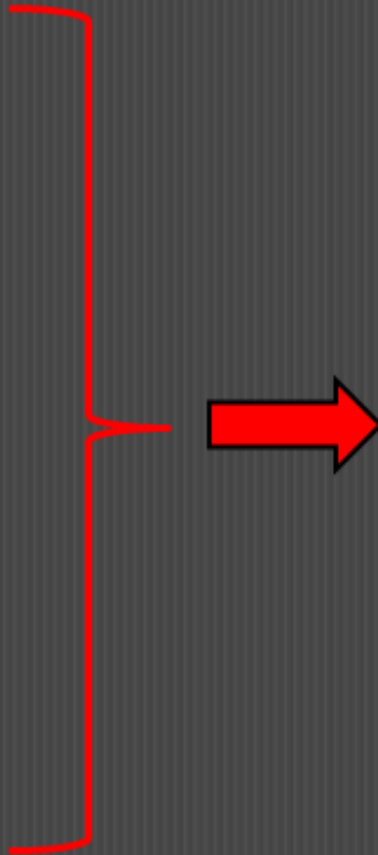
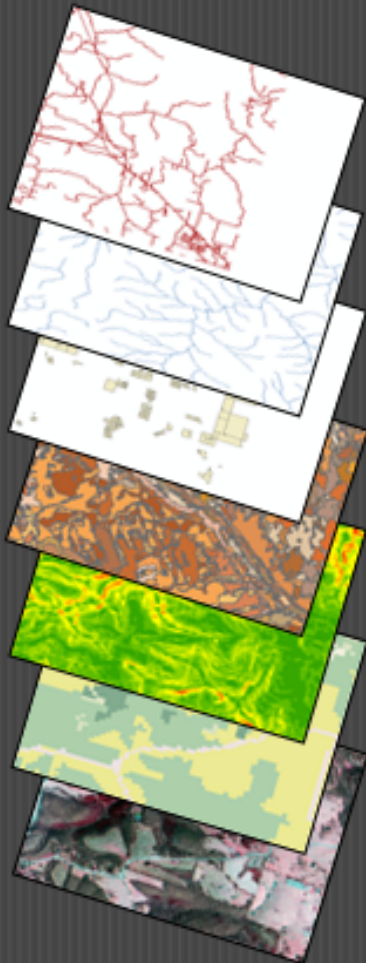
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)
Ap	Apishapa clay	Very limited	Apishapa (85%)	Flooding (1.00) Wetness (1.00) Clay content (0.50) Unstable excavation walls (0.25) Water gathering surface (0.17)
AsB	Ascalon loamy sand, 1 to 3 percent slopes	Somewhat limited	Ascalon (90%)	Water gathering surface (0.20)
AsC	Ascalon loamy sand, 3 to 5 percent slopes	Somewhat limited	Ascalon (85%)	Water gathering surface (0.10)
AtD2	Ascalon sandy clay loam, 3 to 9 percent slopes, eroded	Somewhat limited	Ascalon (85%)	Water gathering surface (0.30)
AuB	Ascalon sandy loam, 1 to 3 percent slopes	Not limited	Ascalon (85%)	
AuC	Ascalon sandy loam, 3 to 5 percent slopes	Not limited	Ascalon (80%)	
AuD	Ascalon sandy loam, 5 to 9 percent slopes	Not limited	Ascalon (80%)	
AvB	Ascalon-Platner sandy loams, 1 to 5 percent slopes	Somewhat limited	Ascalon (70%) Platner (20%)	Water gathering surface (0.10) Water gathering surface (0.10)
Ba	Bankard sandy loam	Very limited	Bankard (80%)	Flooding (1.00) Too sandy (1.00) Unstable excavation walls (0.50) Water gathering surface (0.03)
Bk	Bankard sand, 0 to 3 percent slopes	Very limited	Bankard (70%)	Flooding (1.00) Too sandy (1.00) Unstable excavation walls (0.50) Adsorption (0.25) Water gathering surface (0.03)

Building a Suitability Map



Methodology





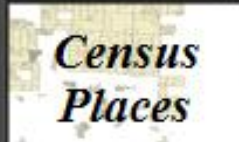

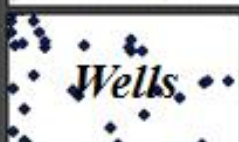

Combining Datasets to Determine Suitability



Determine suitability for each data layer and then combine all layers together to determine the most suitable sites for burial

Vector Overlay Analysis

Buffering Datasets Creating Setback Distances

		200 ft.
		600 ft.
		1 mile
		150 ft.



 Unsuitable


Vector Overlay Analysis

Calculate Slope Values



> 6% slope



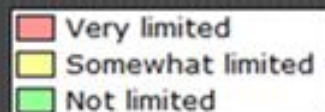
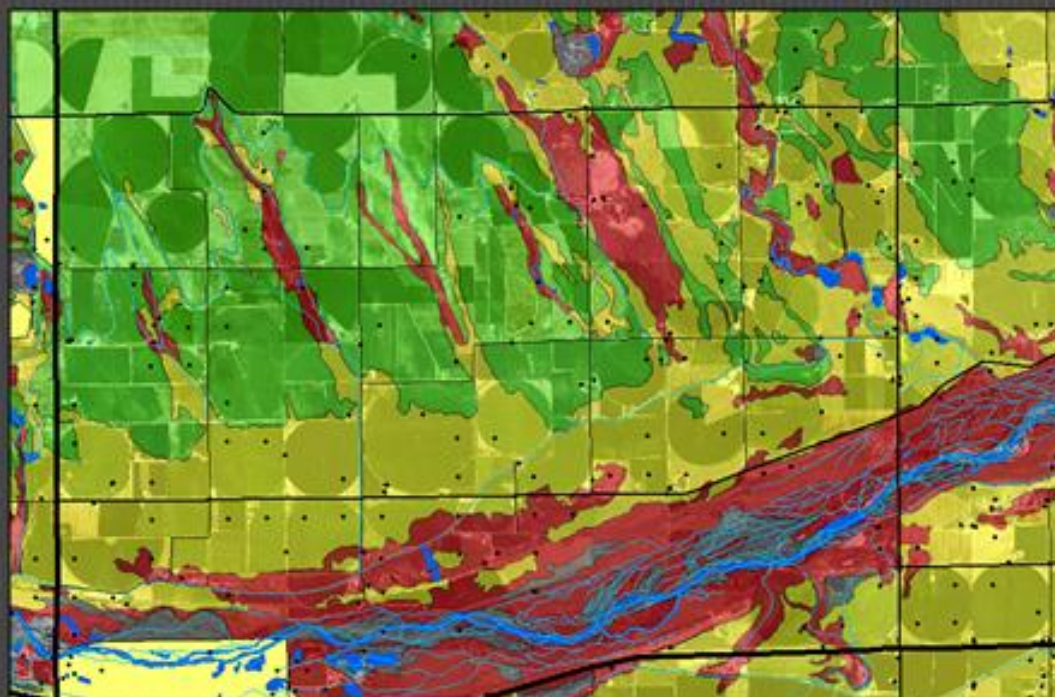
 Unsuitable

Vector Overlay Analysis

Soil Suitability

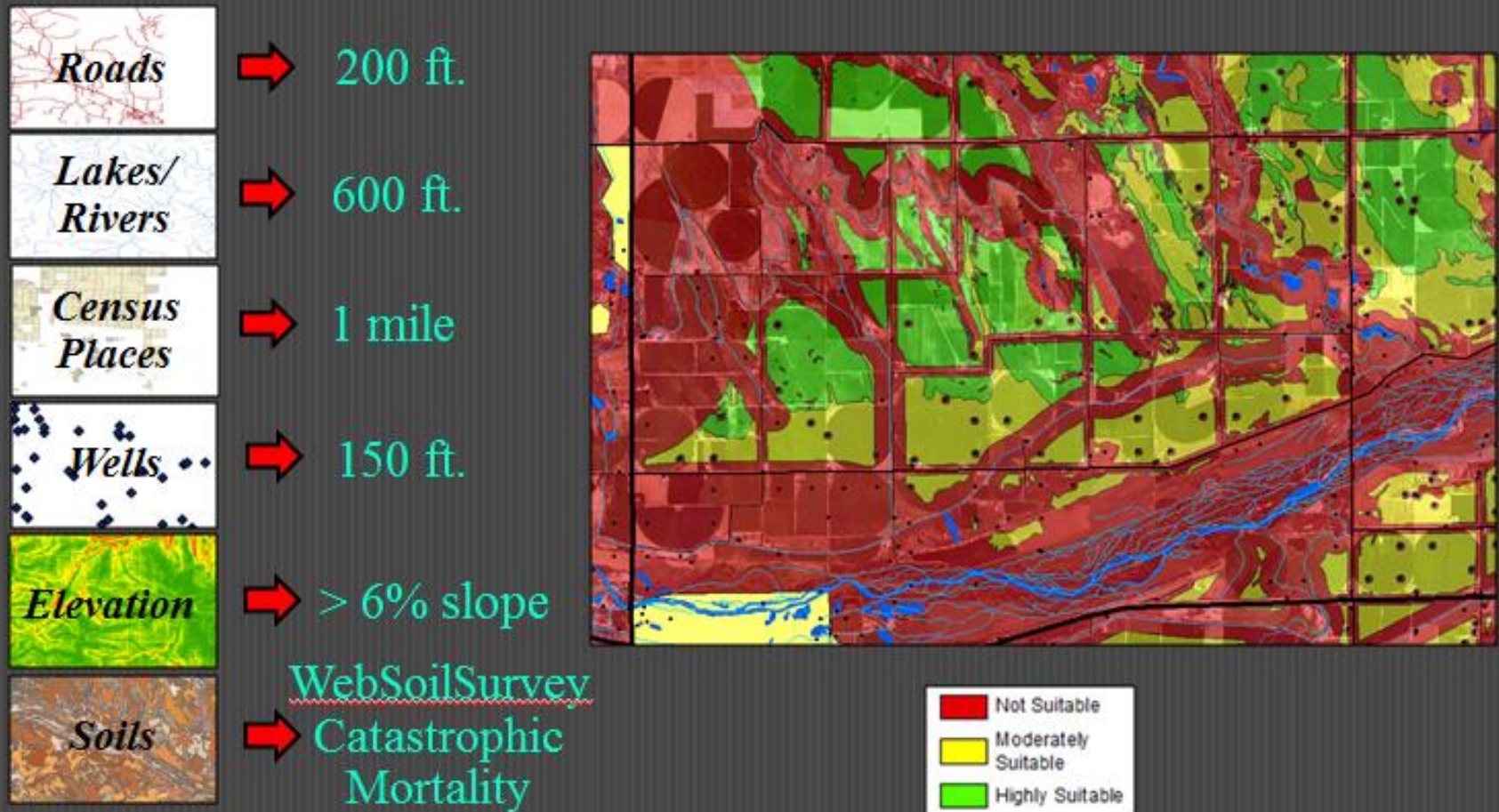


WebSoilSurvey
Catastrophic
Mortality



Vector Overlay Analysis

Burial Suitability Map



Vector Overlay Analysis

Suitability Rating Scale

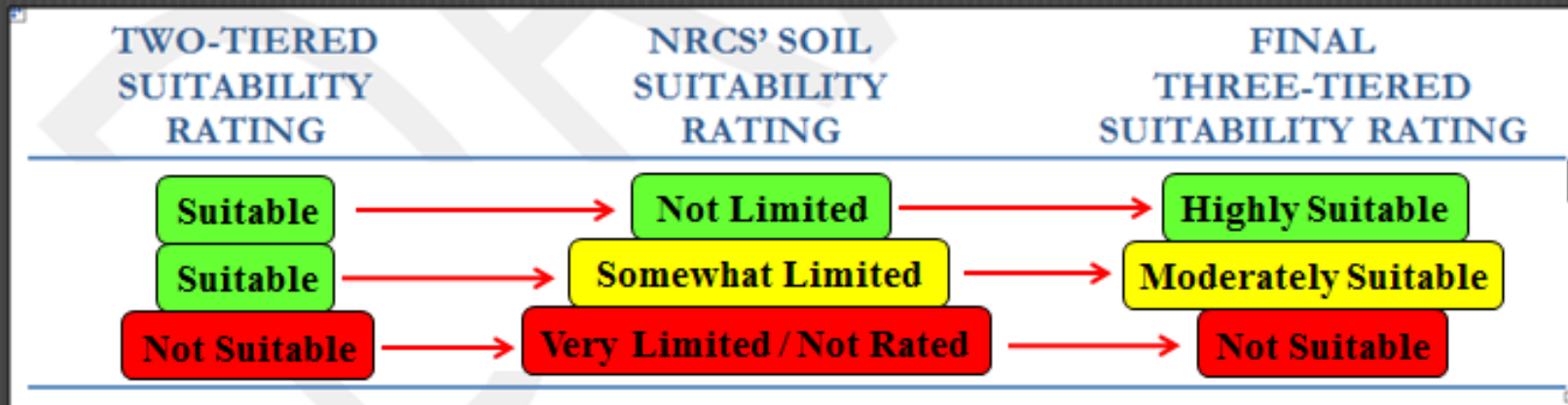
Roads
 Lakes/Rivers
 Wells
 Census Places
 Topographic Slope

+

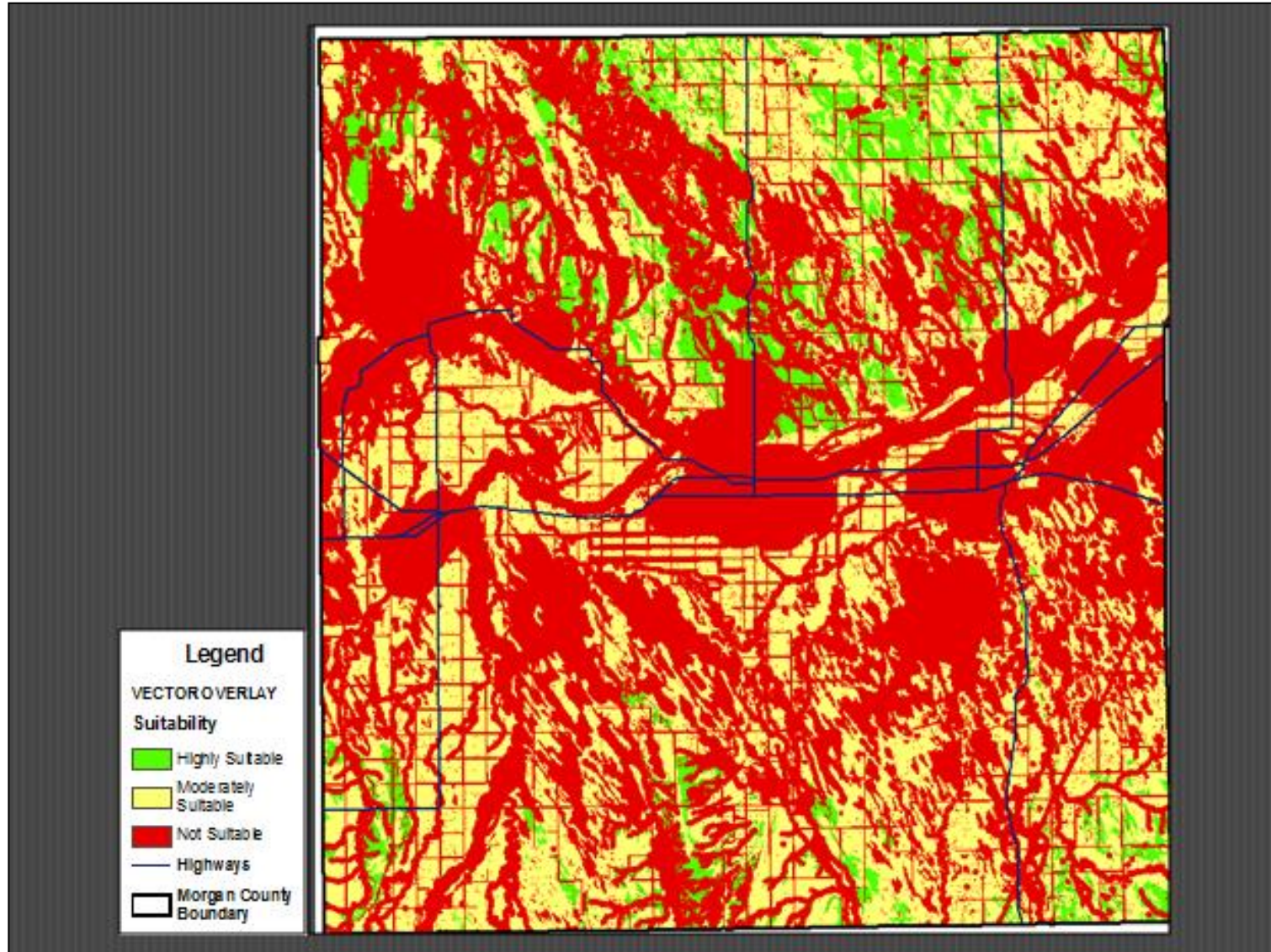
Soils
Suitability

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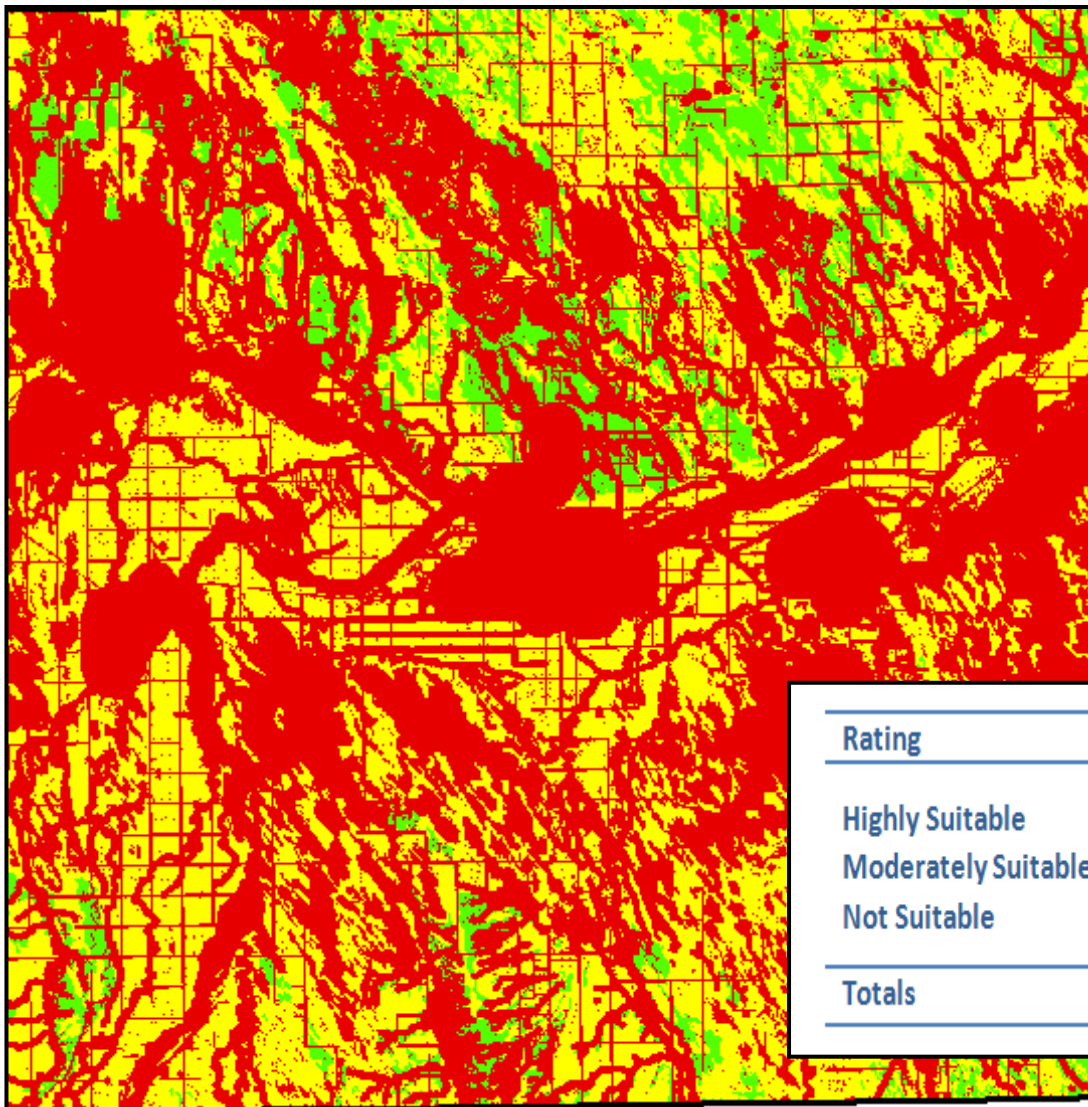
Final Rating Scale



Final Burial Suitability Map



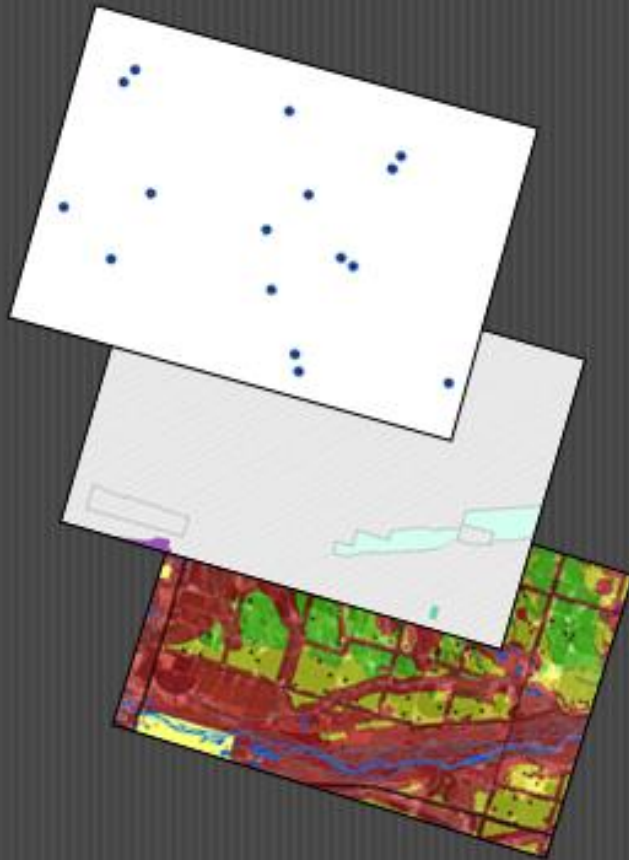
Acreage Calculations by Suitability



Rating	Total Acres	Percentage
Highly Suitable	59,525	7
Moderately Suitable	276,093	33
Not Suitable	492,413	60
Totals	828,031	100

Supplemental Data Layers

Additional Data Layers for Decision-Making



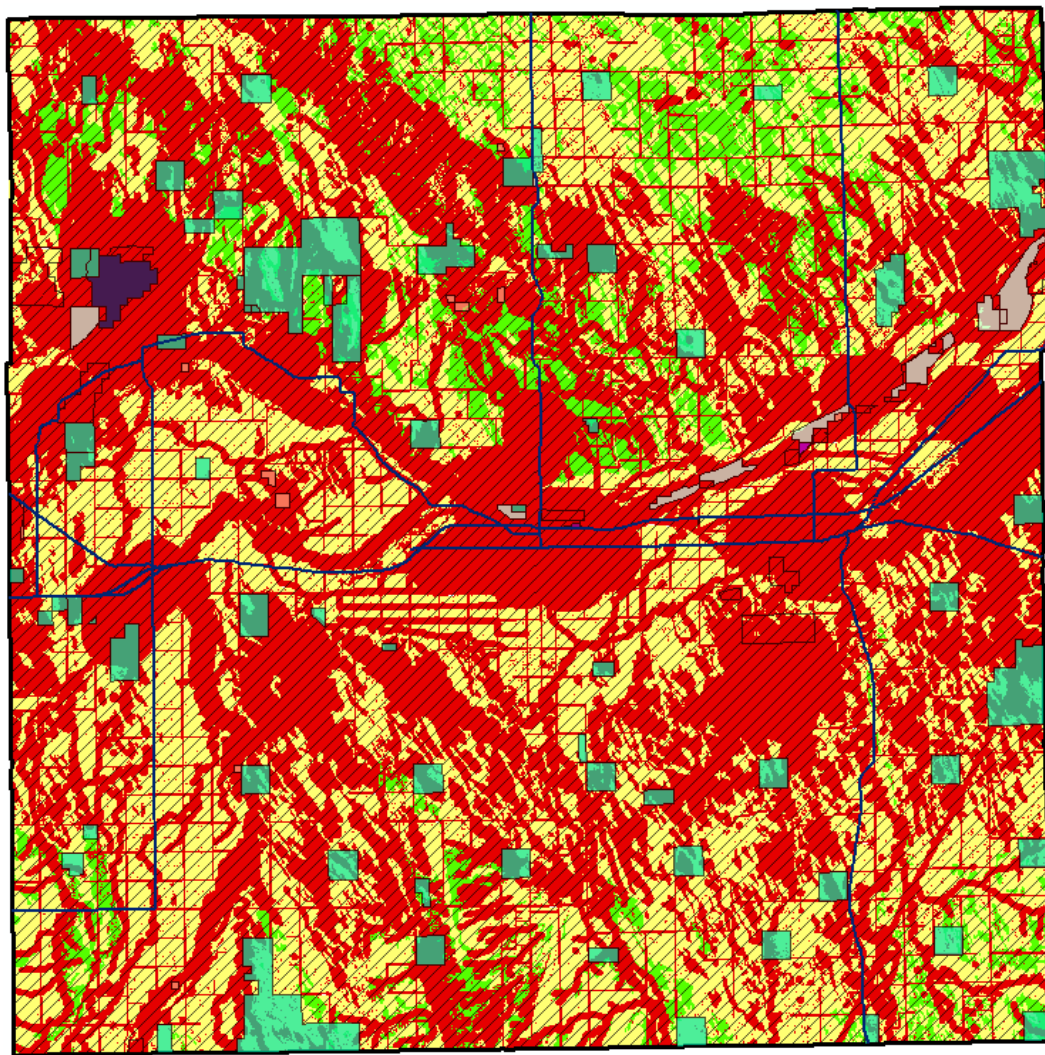
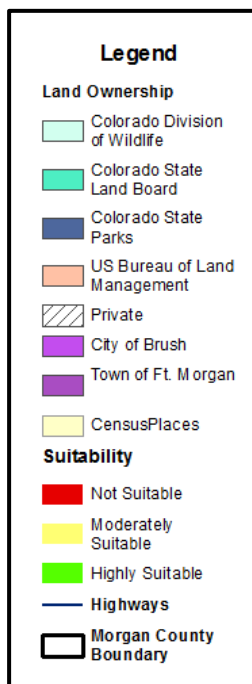
Concentrated Animal Feeding
Operations (CAFO) Locations

Land Ownership

Suitability Map

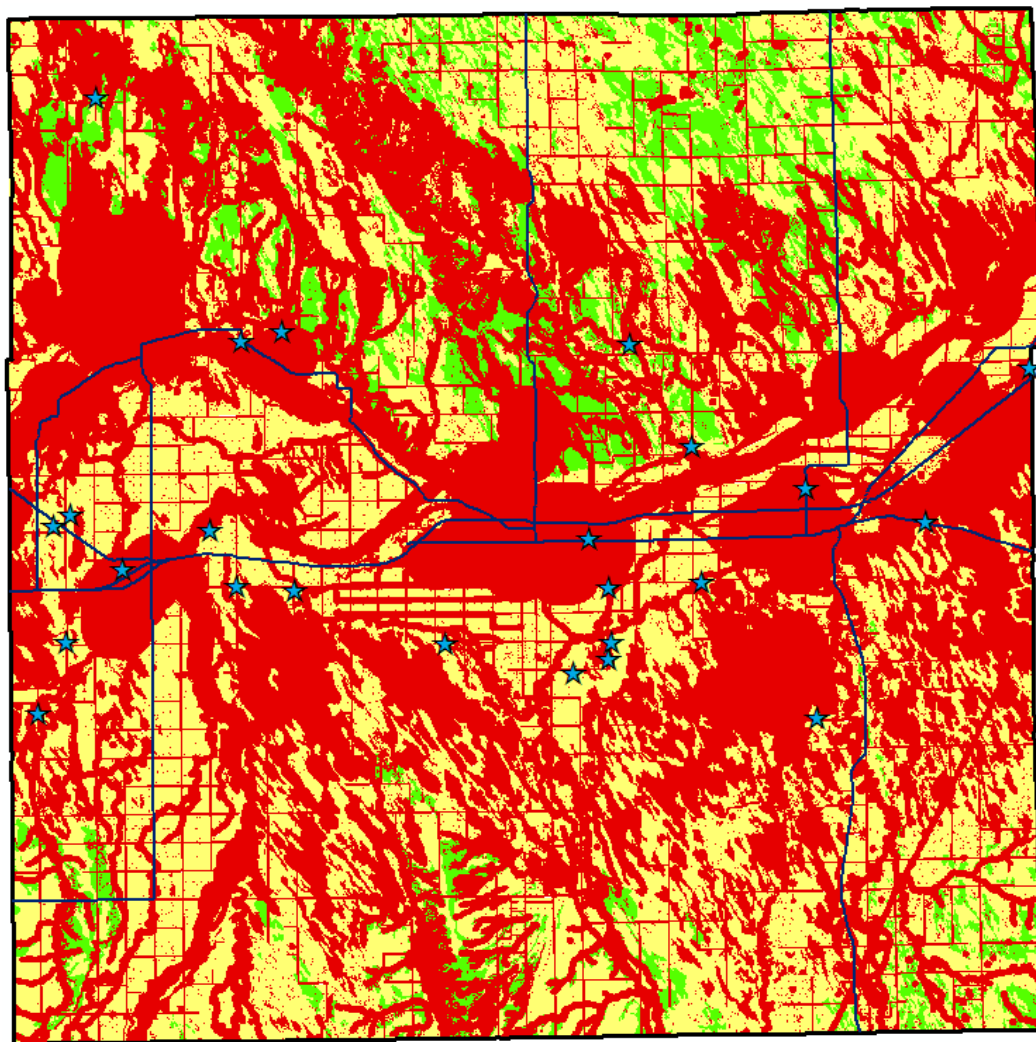
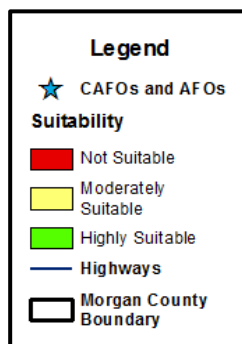
Supplemental Data Layers

Land Ownership



Supplemental Data Layers

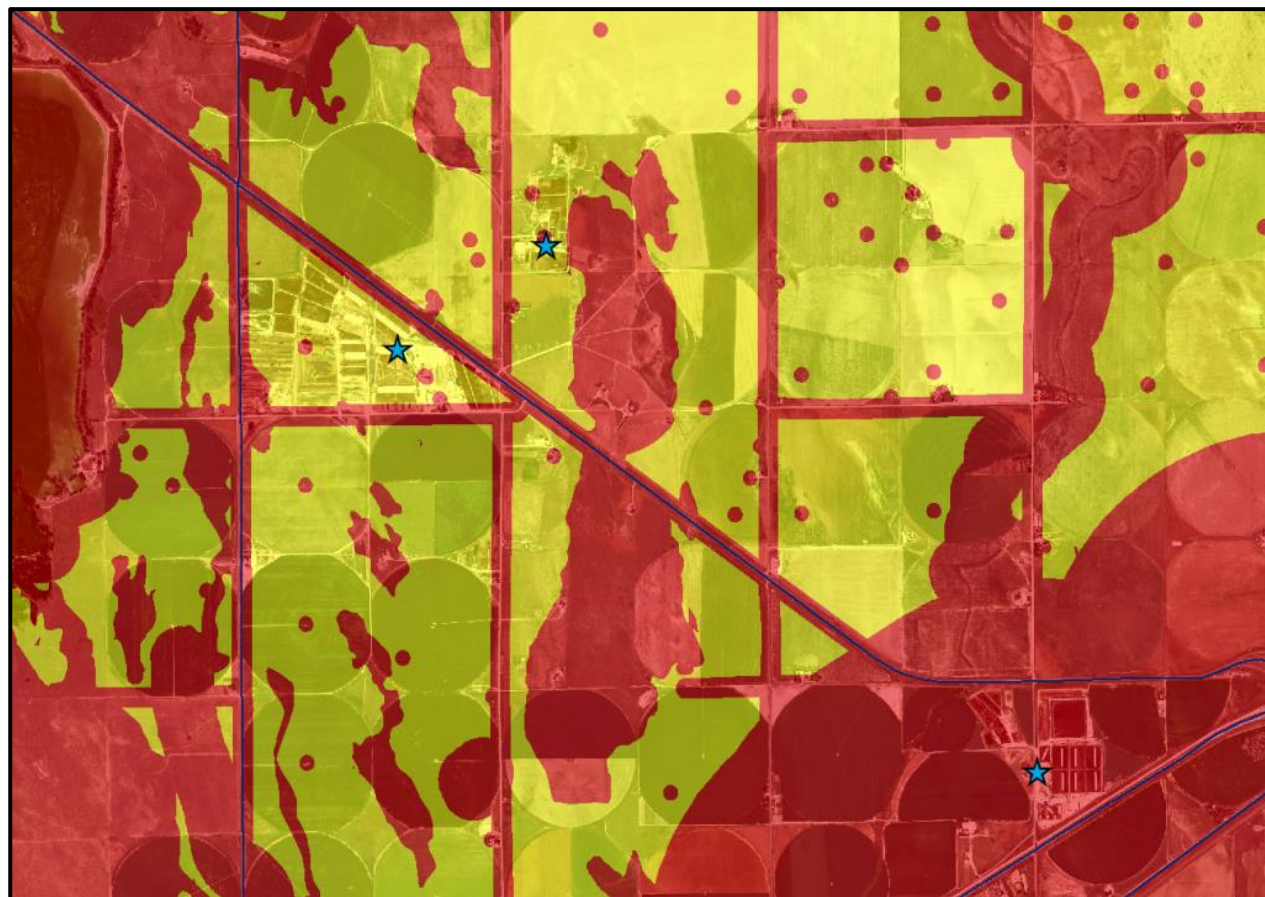
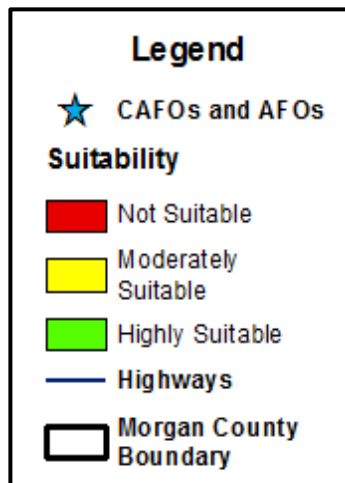
Concentrated Animal Feeding Operations



Maximum Data Resolution

Concentrated Animal Feeding Operations

1:24,000 Map Scale



On-Site Considerations - Groundtruthing

- Geological and soil characteristics
- Depth to ground water or saturated zone
- Visibility from roads/public areas/nearby houses
- Accessibility for large machinery
- Infrastructure - underground and overhead utilities



Next Steps

- Perform on-site assessments in Morgan County to test the accuracy of the burial site suitability map
- Develop a similar site suitability map for Weld County using lessons learned from the on-site evaluation in Morgan County



Questions?



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