Before we start…..

- WRRC 2nd Land Reclamation Symposium June 1-8 in Laramie, WY
  - Contact Kristin Herman: kherman@uwyo.edu (phone 307-766-3576).
- Others?

SOIL MANAGEMENT – *LINEAR DISTURBANCES*

PIPELINE RECLAMATION WORKSHOP

Sidney, MT

March 5, 2013

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What is a linear disturbance?

- Pipelines
- Roads
- Railroads
- Transmission Lines
- Others?

Pipeline Reclamation Challenges

- Narrow workspace
- Crosses numerous landowners
- Access to any one point may be difficult
- Weed control may be problematic

Two major challenges to linear disturbances

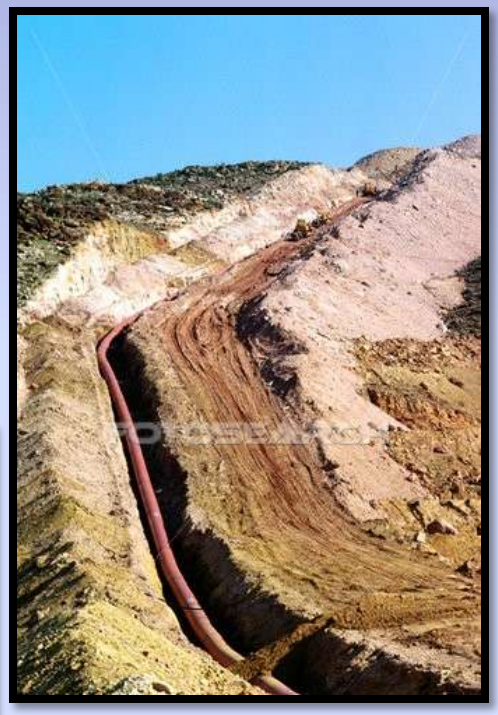
- Scale of disturbance
- Crossing multiple landscapes, soil types, and vegetation types

FIRST MAJOR CHALLENGE

Scale

Pipelines

- ROW width and total length of pipeline can range from small to large?



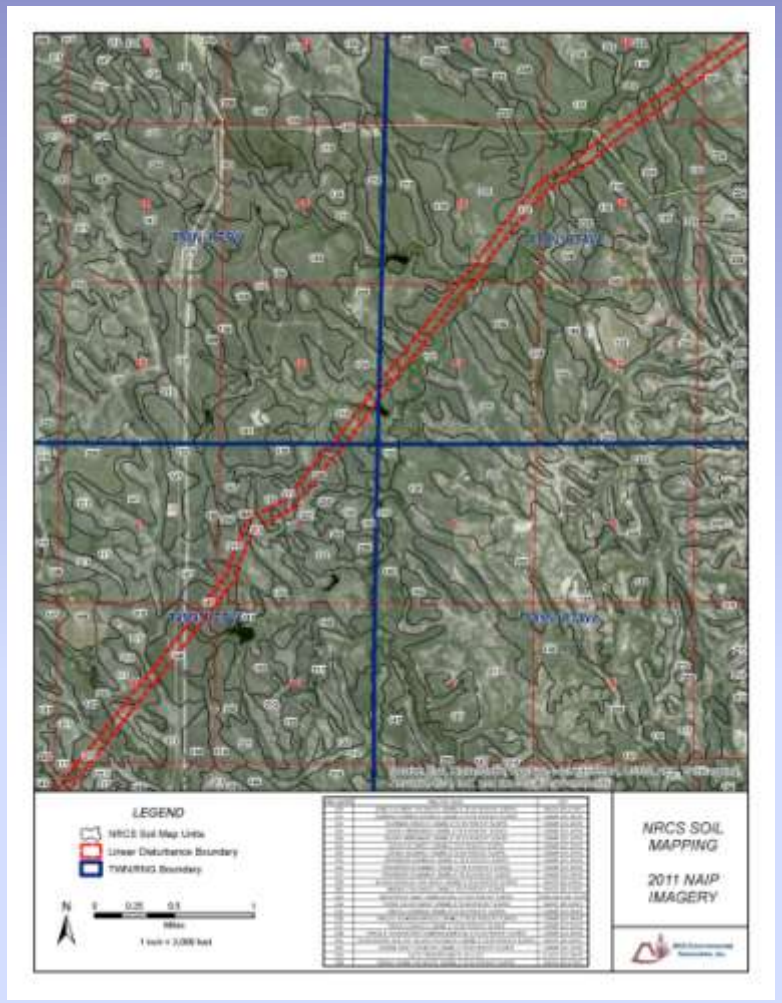
Same with Roads…

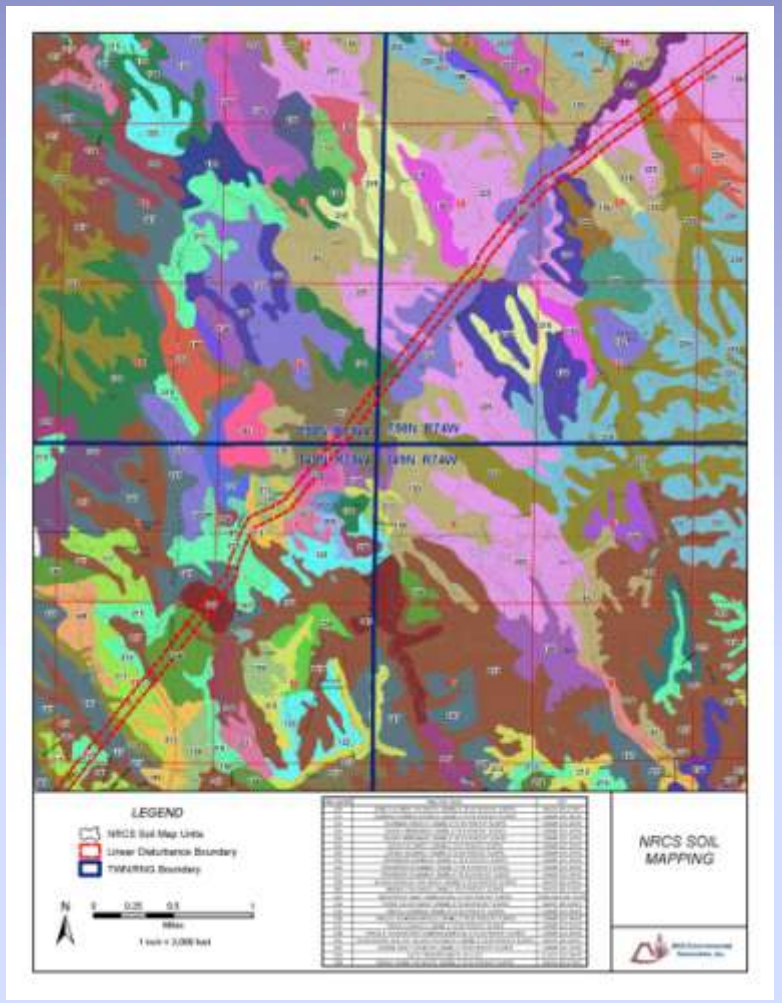
….and Railroads

Examples of multiple ROW's

SECOND MAJOR CHALLENGE

Multiple Landscapes



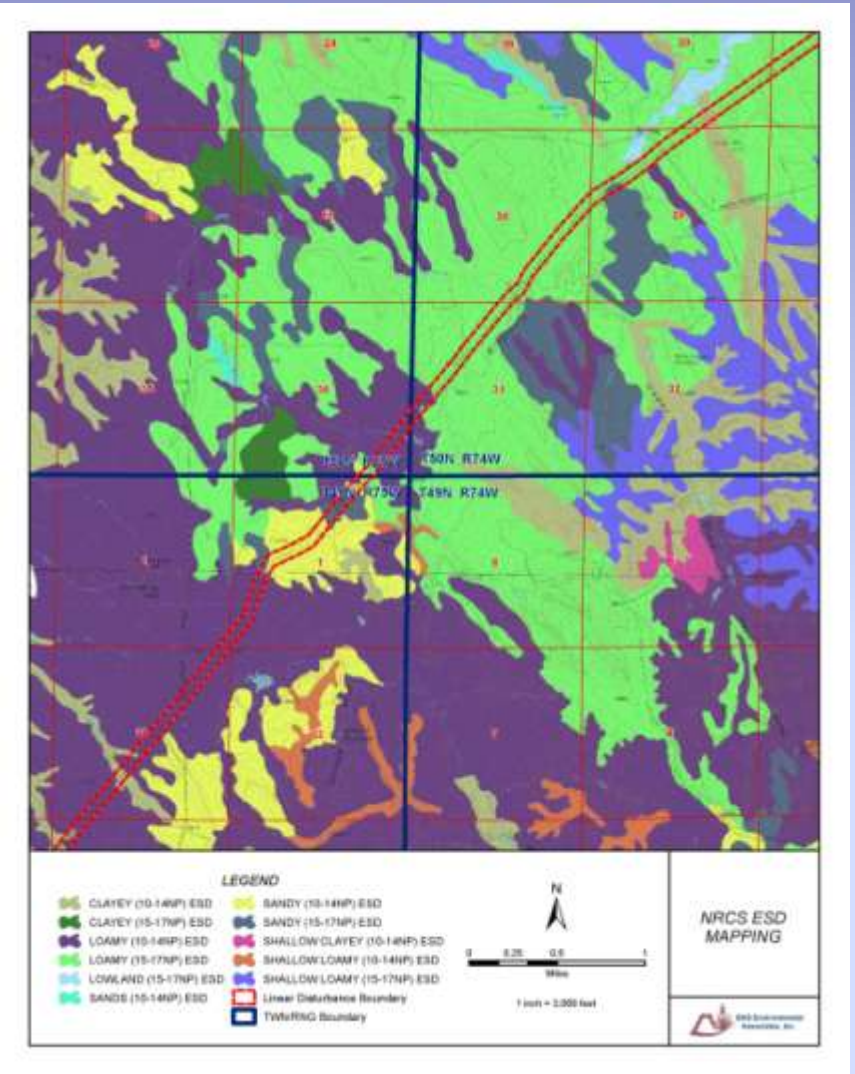


NRCS Order 3 Soil Mapping

NRCS Ecological Site Mapping

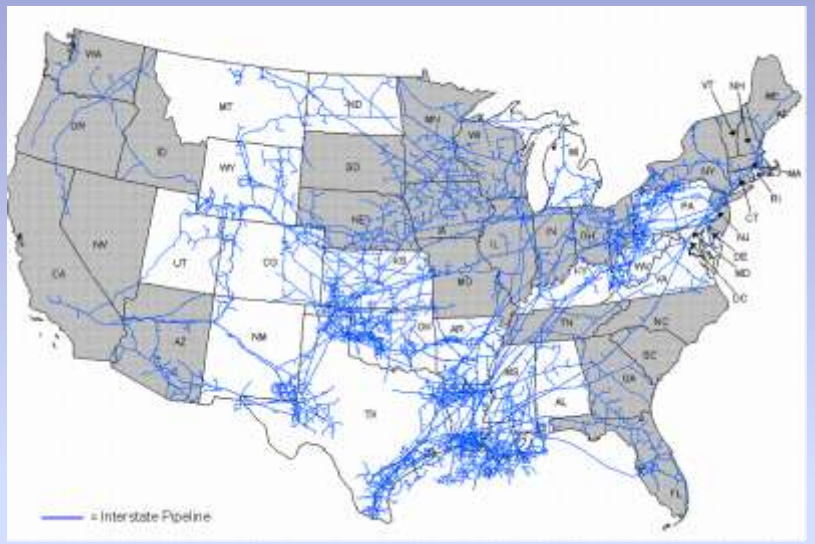
EXAMPLES ON THIS MAP
Loamy vs. Shallow Loamy
Clayey vs. Sandy
Lowland

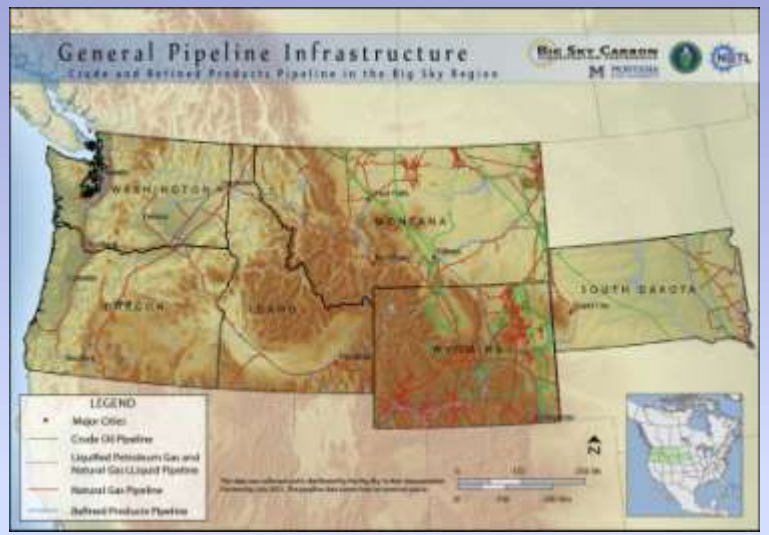
COULD ALSO HAVE:
Rocky soil at or near the surface
Saline phases



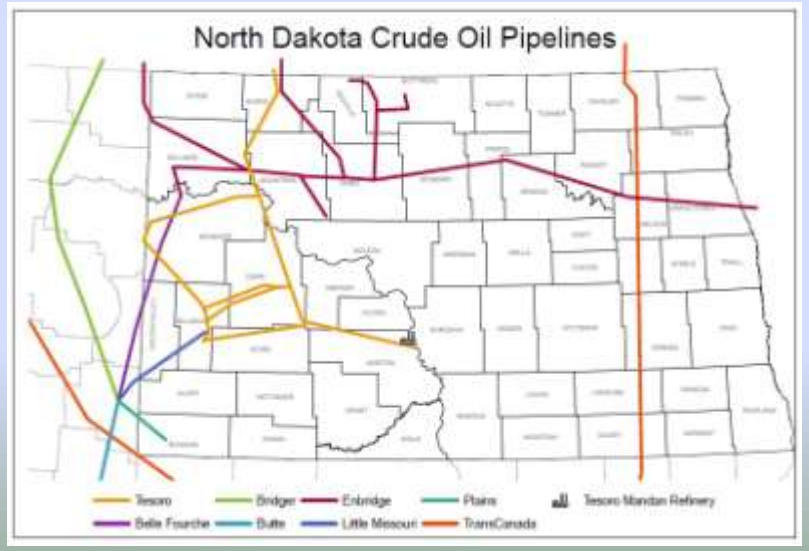
Terrain Challenges

Extent Challenge





Keystone Pipeline

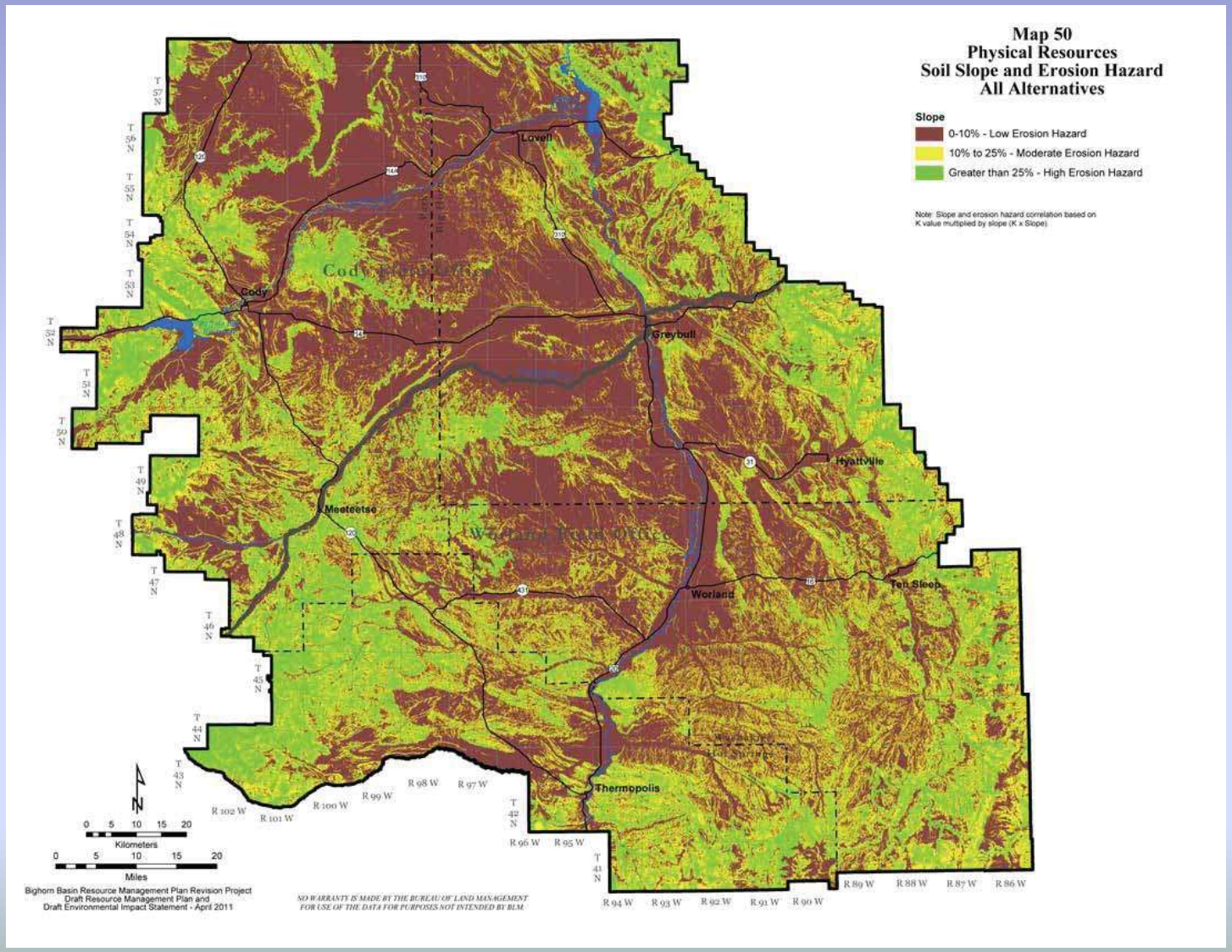


Ruby Pipeline

Interstate as well as intrastate

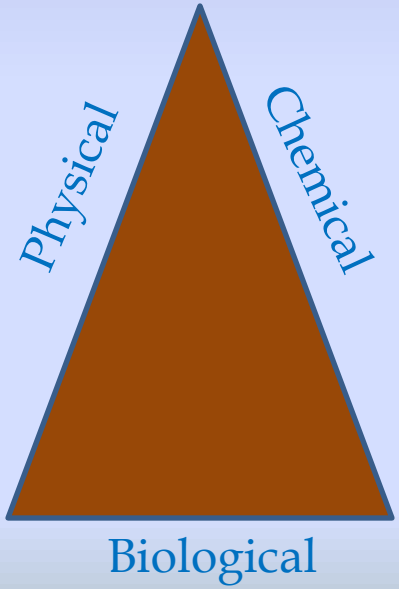
How to deal with those challenges?

Soils is more than just an erosion hazard map!



Understand Soils Starting with the Basics

- Complex, dynamic, living system
- Changes to one property category will impact the other two

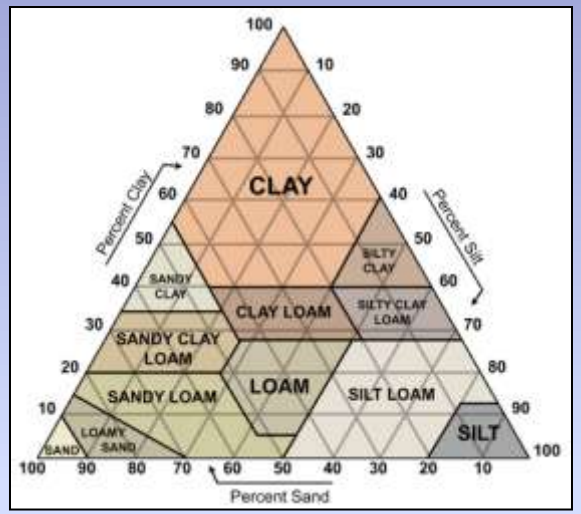


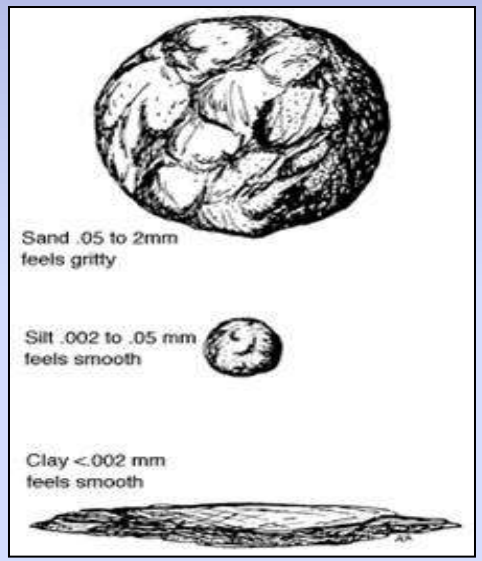
Chemical Properties

- pH
- $CaCO_3$
- Metal toxicity based on climate and geology
  - Selenium for example
- Salinity and/or sodicity
  - Seep areas
- Fertility
- Organic matter (physical property also)

Physical Properties

- Texture
- Bulk density
- Compaction
- Structure
- Organic Matter
- O_2 concentration
  (waterlogged soils)





Organic Matter

Why is it important to salvage and segregate that top layer?

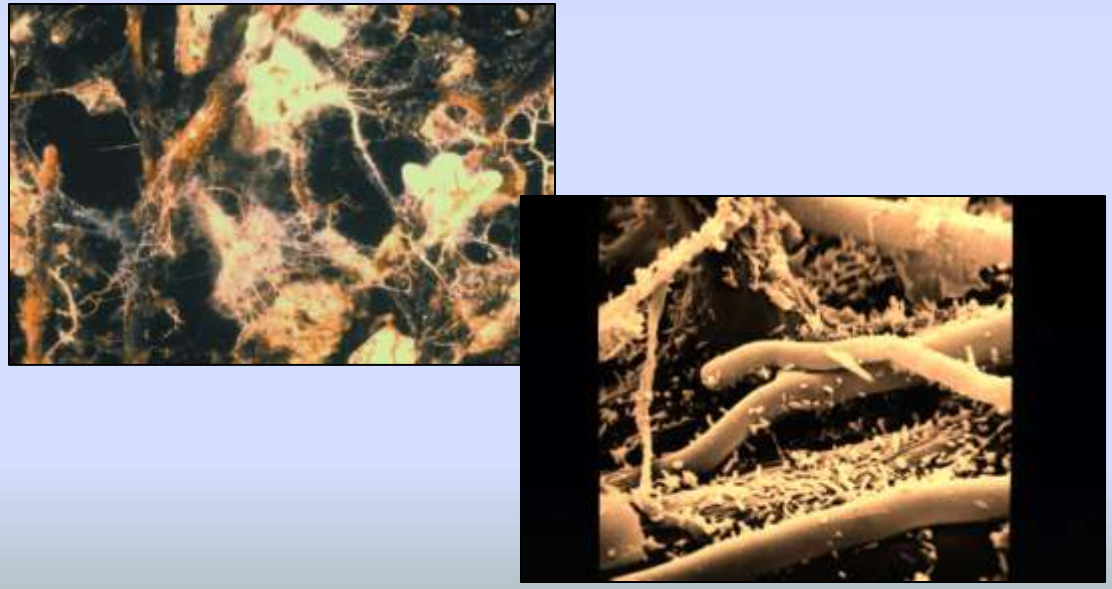
Importance of organic matter

- Provide soil fertility
- Provides energy sources for soil microorganisms
- Helps to kick start biogeochemical cycling
- Top horizon material can be a seed source (both good and bad)

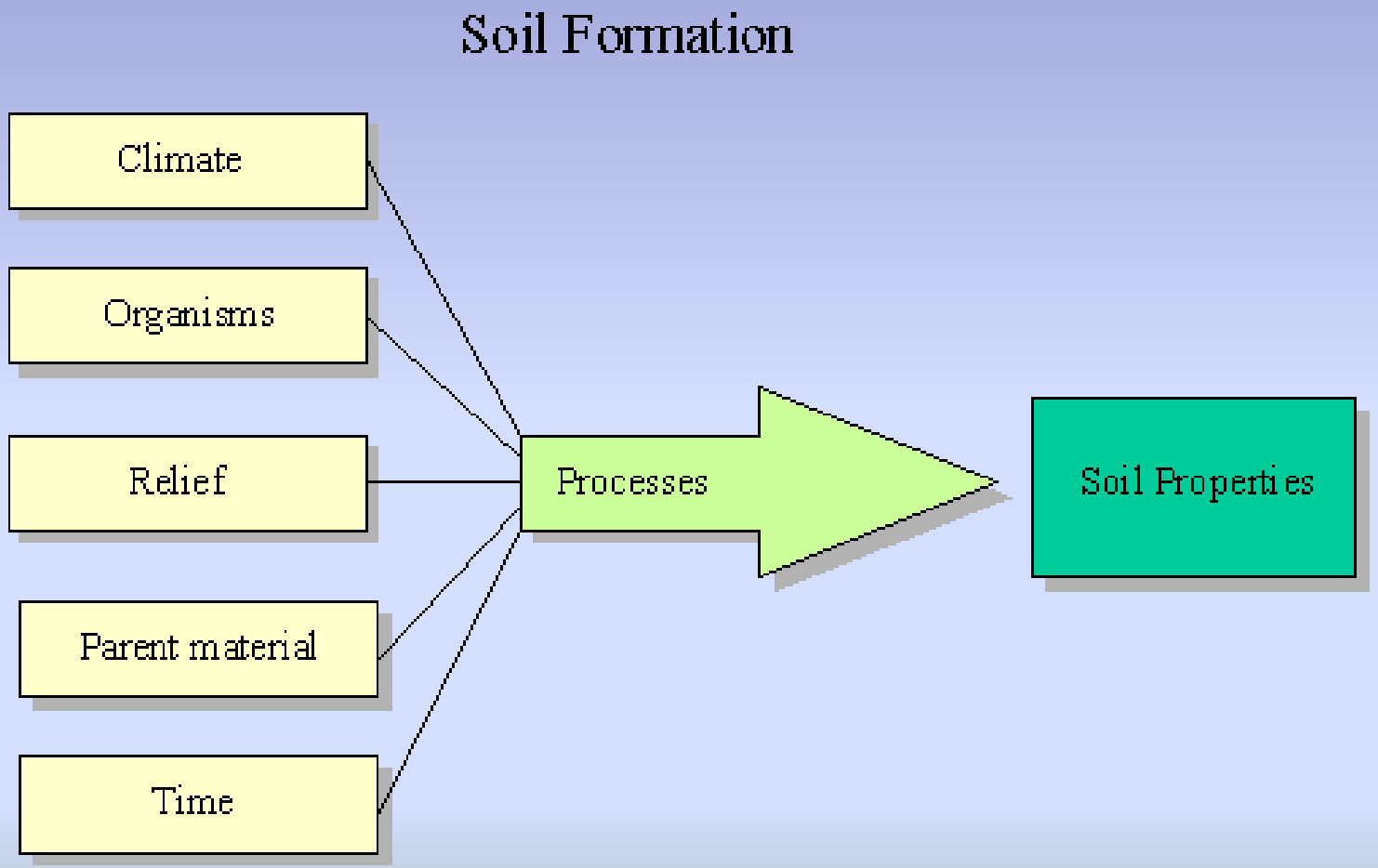
A little bit goes a long way

Biological Properties

- Last but certainly not least
- Generally soil microbial populations or biota
- Biogeochemical cycles (nutrient cycling)

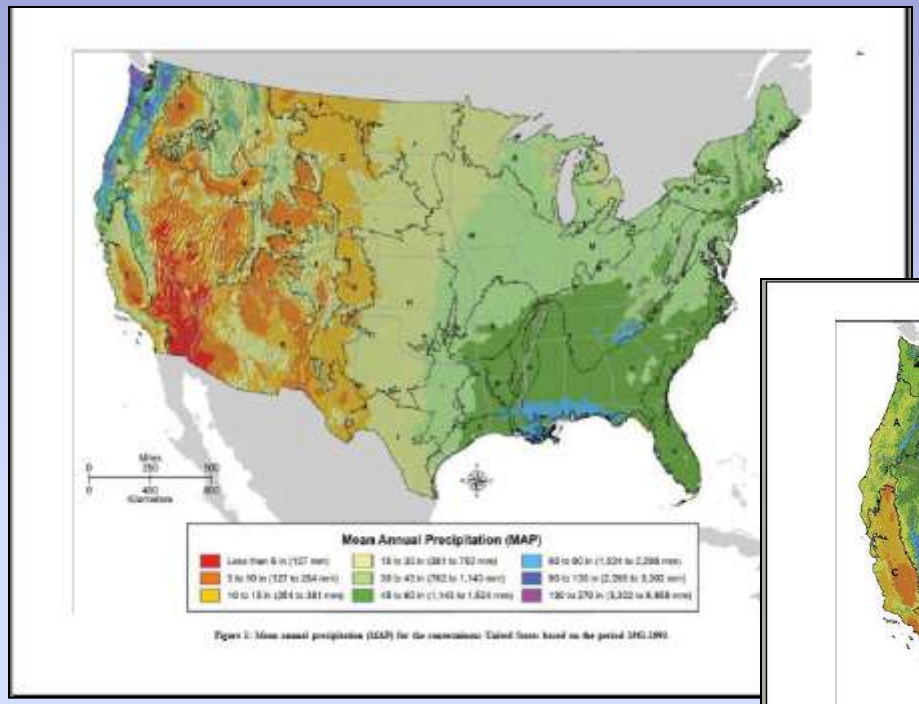


How does soil form?



Climate Maps of the US

Mean Annual Precipitation



Mean Annual Air Temperature

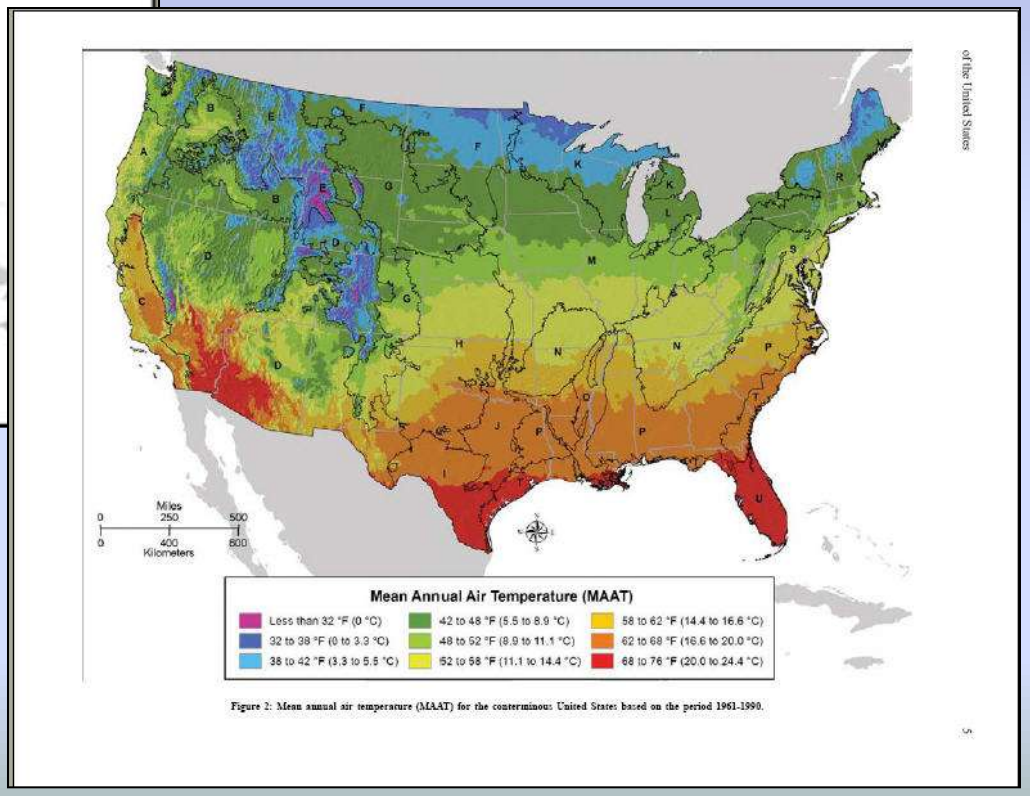
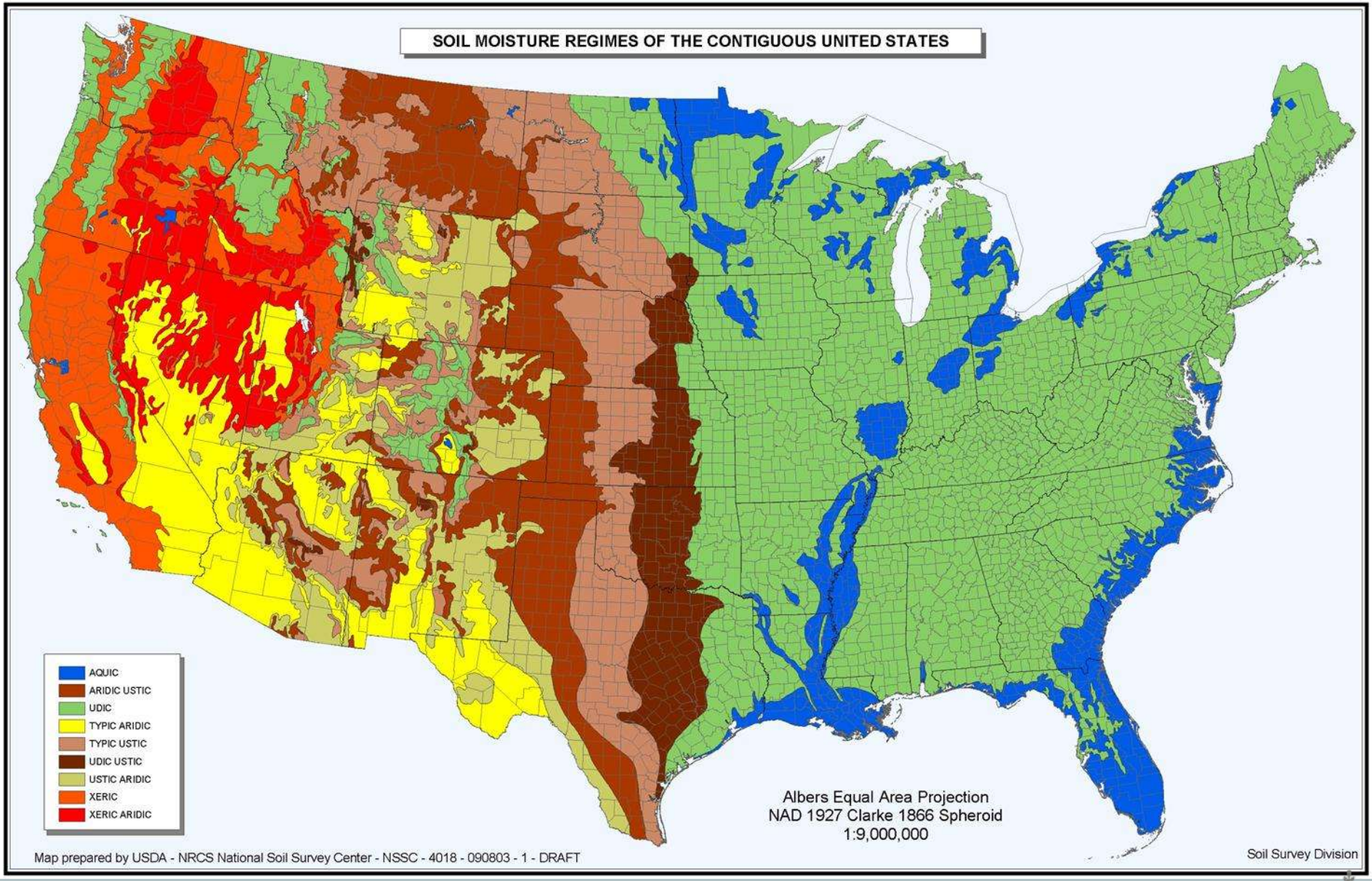


Figure 2: Mean annual air temperature (MAAT) for the conterminous United States based on the period 1961-1990.


SOIL MOISTURE REGIMES OF THE CONTIGUOUS UNITED STATES
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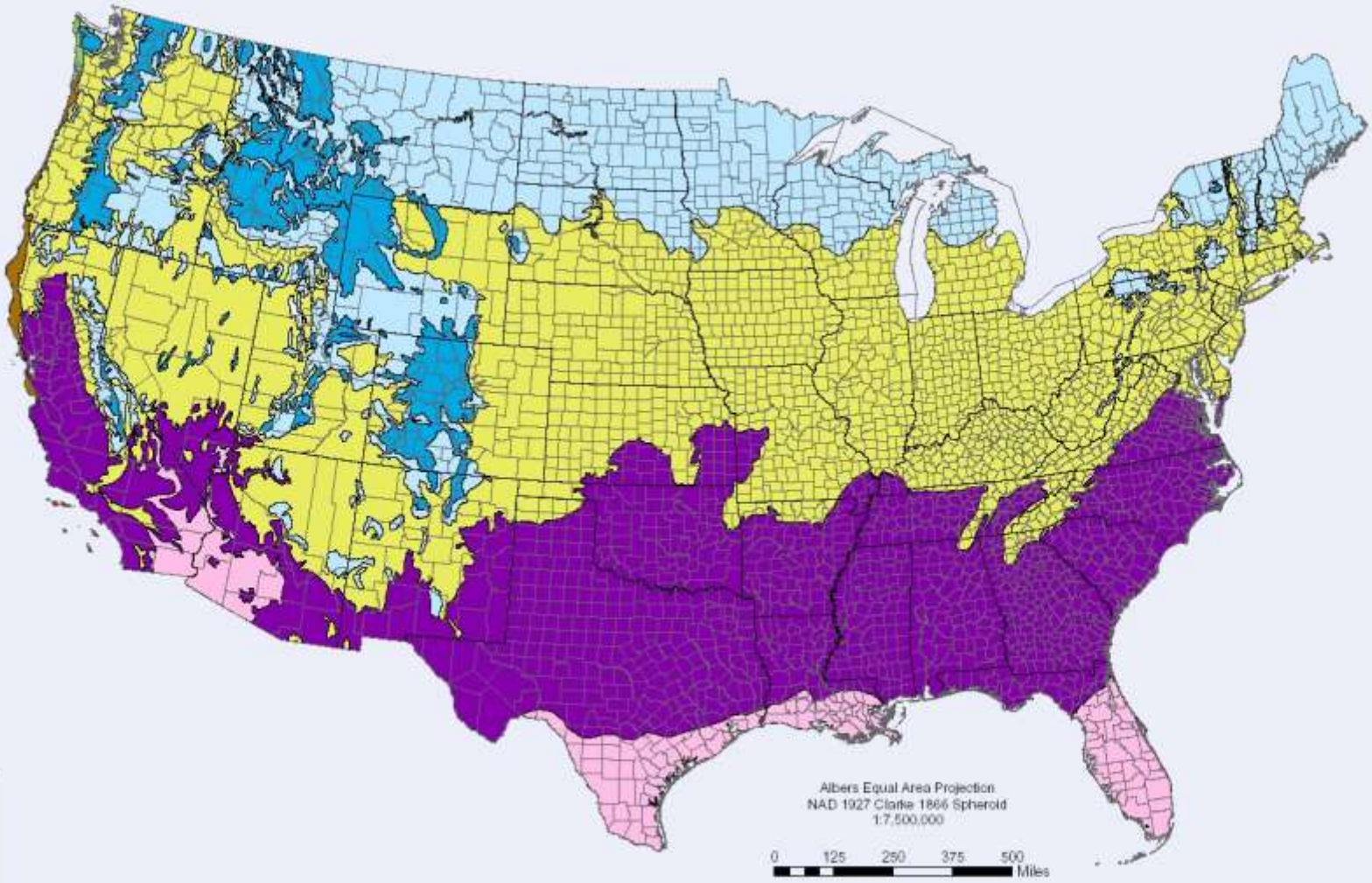
Albers Equal Area Projection
NAD 1927 Clarke 1866 Spheroid
1:9,000,000
Map prepared by USDA - NRCS National Soil Survey Center - NSSC - 4018 - 090803 - 1 - DRAFT
Soil Survey Division

SOIL TEMPERATURE REGIMES OF THE CONTIGUOUS UNITED STATES

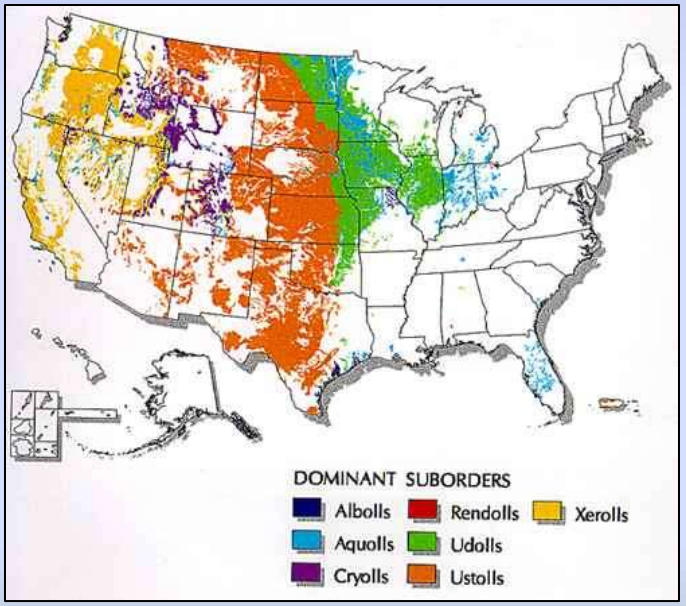


Map prepared by USDA - NRCS National Soil Survey Center - NSSC - 4018 - 102703 - 1 - DRAFT

Soil Survey Division

Humid Continental Climates

- Warm, humid summers
- Cold, wet winters
- Fertile, high organic matter soils
  - Classified as Mollisols
- Dominant soil order in ND

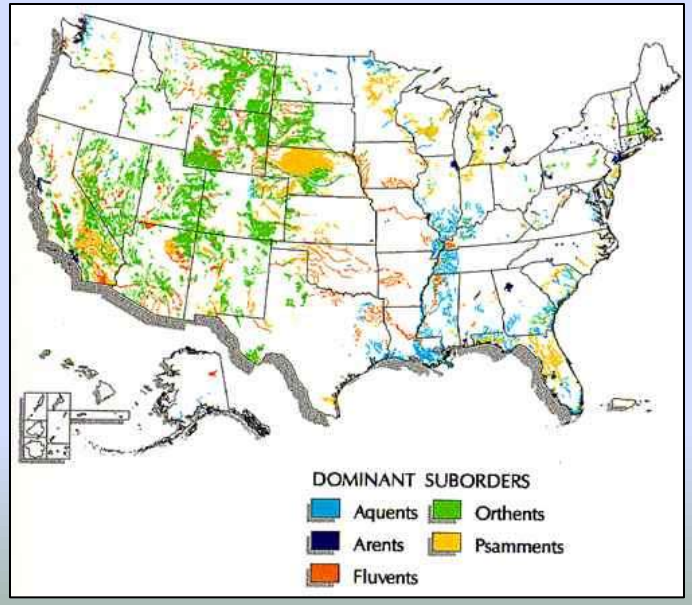


Mollisol Landscapes

Mollisol Profile

Semi-Arid Climates

- Less precipitation than potential evapotranspiration
- Dominated by other soil orders
  - Likely Entisols, Inceptisols, Aridisols

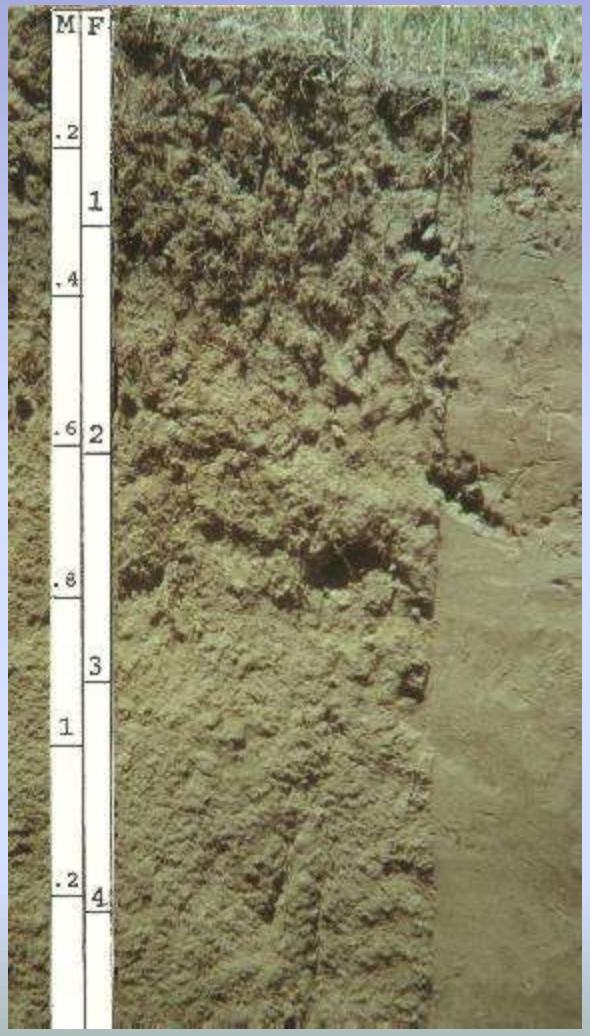


Typical Aridisol Landscape

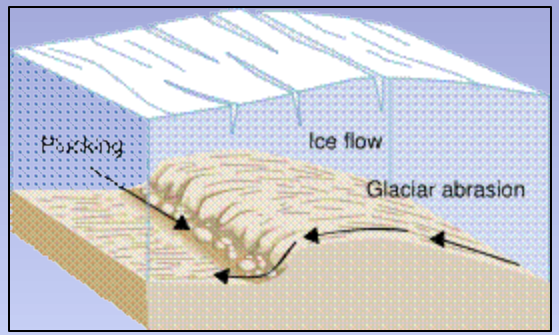
Aridisol Profile

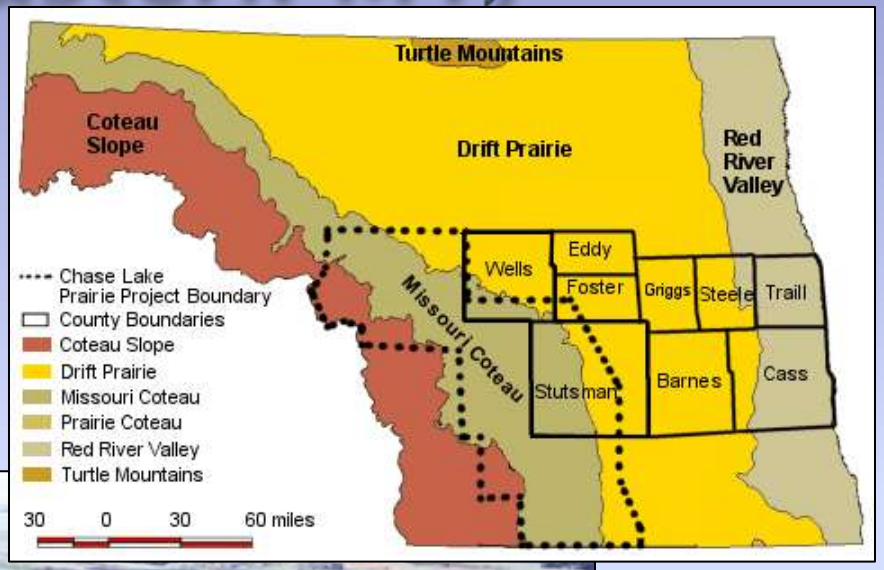
Typical Entisol Landscape

Entisol Profile



Glacial Impacts in ND (and northeastern MT)





Types of Large Scale Man-made Disturbance

- Mining
  - Surface Coal
  - Underground Coal
  - Surface Uranium
  - In-situ Uranium
  - Bentonite
  - Gravel
  - Abandoned mines

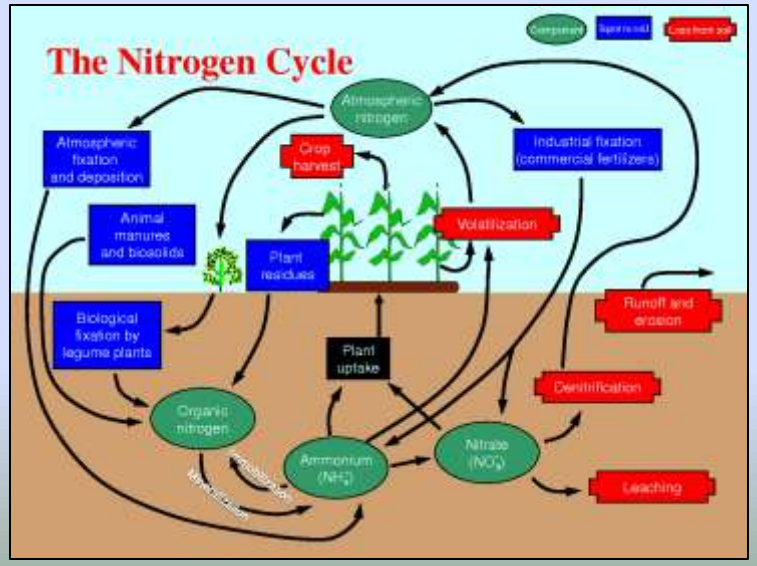
Types of Large Scale Man-made Disturbance (continued…)

- Oil and Gas pads
  - Coalbed methane
  - Tight oil shales
  - Deep gas
- Roads
- Pipelines

Don’t forget gravel or sand quarries needed to support activity

Undisturbed Soils - General

- High biological diversity
- Horizonation
- Organic layer intact
- Defined chemistry
- Greatest resilience to stress
- Always in flux, but generally stable



Major Disturbed Soils - General

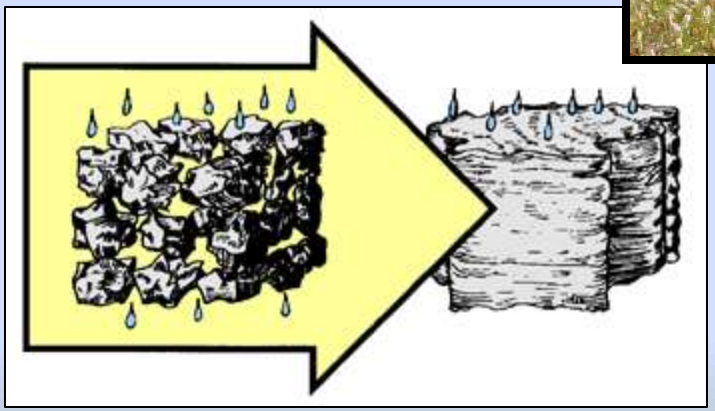
- Low biological diversity
- No horizonation; could be inverted or totally mixed
- Organic layer diluted
- Changes in chemistry
- More open to erosion, both wind and water
- Unstable

Soils under Disturbance

- Increased bulk density
- Decreased soil structure
- Decreased aeration
- Decreased infiltration and moisture holding capacity
- Reduced nutrient cycling
- Reduced microbial activity

Hydraulic Implications

- Decreased infiltration, percolation, water holding capacity
- Increased rates of erosion



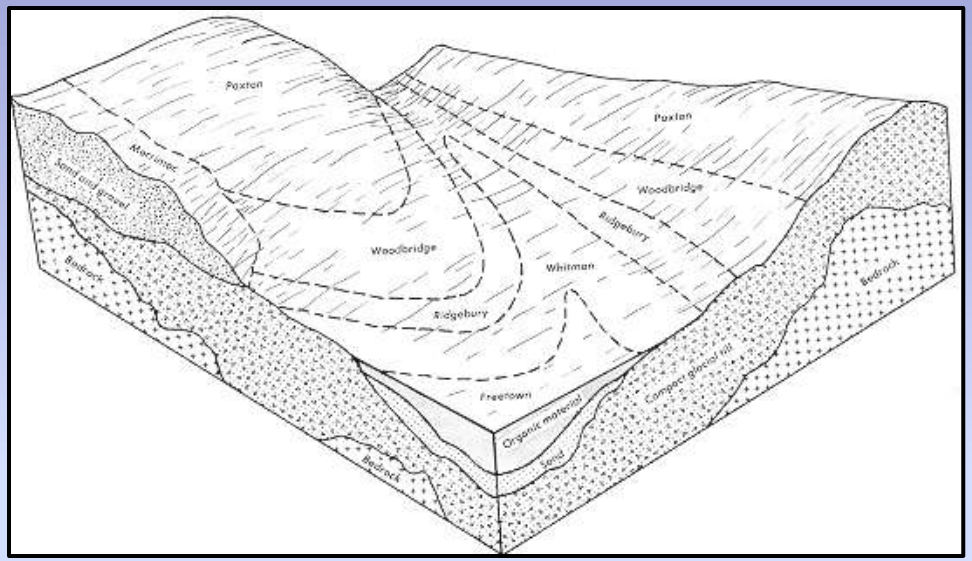
Ways to minimize impact of oil and gas (including pipeline) activity to the soil

General Ways to minimize impacts – 4 phases

- Planning
- Salvage
- Storage
- Replacement

Map your soils for suitable seedbed material, know where you might be able to take more and know your trouble spots

Look in 3-D



Suitability line will likely vary over the landscape.

Uniform depth may not apply.

Look for unstable slopes and avoid them

General ways to minimize impact

- Planning
- Salvage
- Storage
- Replacement

Ways to minimize impact

- Know what you are dealing with prior to disturbance…back to planning
- Segregate true topsoil from suitable subsoil to minimize dilution
- Salvage under optimal conditions… not when wet

Look around…POTENTIAL SEDIMENT LOAD IN DRAINAGES

Don’t do this!

Note when the frost goes out of the ground! Important with seismic activity too.

Understand that suitable soil depth varies…uniform soil depth removal is not optimal use of a resource. Suitable soil may be salvaged with heavy equipment…..

…..or a SPOON!

On pipelines, maintain boundary of topsoil/suitable material and geologic material

General ways to minimize impact

- Planning
- Salvage
- Storage
- Replacement

NOTE: Due to temporary nature of pipelines, may or may not apply.

Ways to minimize impact

- Direct haul and replace, if possible, rather than stockpiling
- Minimize storage time
- Salvage during colder, drier months
- Will likely not apply as much to pipelines

Ways to minimize impact

- Stabilize and protect from wind and water erosion
- Temporarily seed stockpiles if greater than 3 months to add organic matter, aid microbial populations, and reduce weeds

Stockpile Height and Size

40 foot stockpile

- Minimize depth of stockpiles, if possible
- Consider space needed and length of time in storage

25 foot stock pile

3 foot stockpile

Large vs. Small Stockpiles

- Large piles – Common in coal industry
  - Less exposed surface area
    - Overall, less susceptible to erosion
  - Overall smaller disturbance footprint
  - Likely longer term if not direct hauled
- Small piles – Preferred by BLM on O&G sites
  - More exposed surface area
    - More susceptible to erosion
  - Overall greater disturbance footprint
  - More of a temporary nature
  - May be able to store onsite as part of interim revegetation

Stockpile seeding

- Seed topsoil stockpile immediately
- Annual cover crop

(different term in agriculture)

- Erosion control methods
  - Earthen berms
  - Limit slope percentage
  - Channels/Ditches

Research findings

- 15-20 year old topsoil piles still biologically healthy
  - Contrary to common thought of "dead" piles
- Microbes in semi-arid and arid climates enter dormancy when stressed
  - Very adaptive to droughts
  - Quickly rejuvenate in proper conditions
  - Reseeding (timing, mix, etc.) and available moisture
- Keep movement and disturbance to stockpiles to a minimum
  - Quality degraded during transportation

General ways to minimize impact

- Planning
- Salvage
- Storage
- Replacement

Ways to minimize impact

- Deep rip compacted areas
- Lightly rip or roughen underlying material
  - Especially on slopes
- Avoid handling wet material
- Stabilize replaced material prior to seeding, e.g., rough

Need to handle large rocks…

Likely Chemistry Changes

Seeded Topsoil

All weeds aren't necessarily bad

Consider mowing Russian thistle instead of spraying.

Gives seedlings some extra cover for increased moisture availability.

Interim Reclamation

Reduces the
disturbance footprint!

Reseeding

- Timing
  - Conditions
    - Seasonal
    - Moisture
    - Drought?
- Seed mix
- Interim stabilization
- Inoculation of soil microbial activity
  - Local source
  - Wind/Dust

Federal Road Considerations

- **On federal ground, construction and maintenance of roads will conform to the BLM Gold Book and BLM 9113 Roads Manual**
- Interim vs. final reclamation on BLM
- Depending on use, could have these types of roads on BLM:
  - Primitive
  - Resource
  - Local
  - Collector

Highways through DOT's

- Objectives may differ from BLM:
- Long term stability
- Little or no maintenance
- Weed suppression
- Do NOT attract large game
- Attraction of bird species acceptable but not high priority
- Attractive landscape
- Ecological correct – "native" species utilized

Pipeline Considerations

REMEMBER…Challenges include crossing multiple soil types, land uses, plant communities, producers, etc.

Planning

- First step in reclamation is planning the linear disturbance
- Items to consider:
  - Soil erosivity
  - Snow catch
  - T&E concerns
  - Drainage
  - Other

Planning
Continued

- Original placement, if possible, should
  - Take reclamation potential into consideration
  - Follow existing disturbances
- Topographic position plays a part in overall reclamation potential
- Can drainage crossings or other problem areas be avoided?

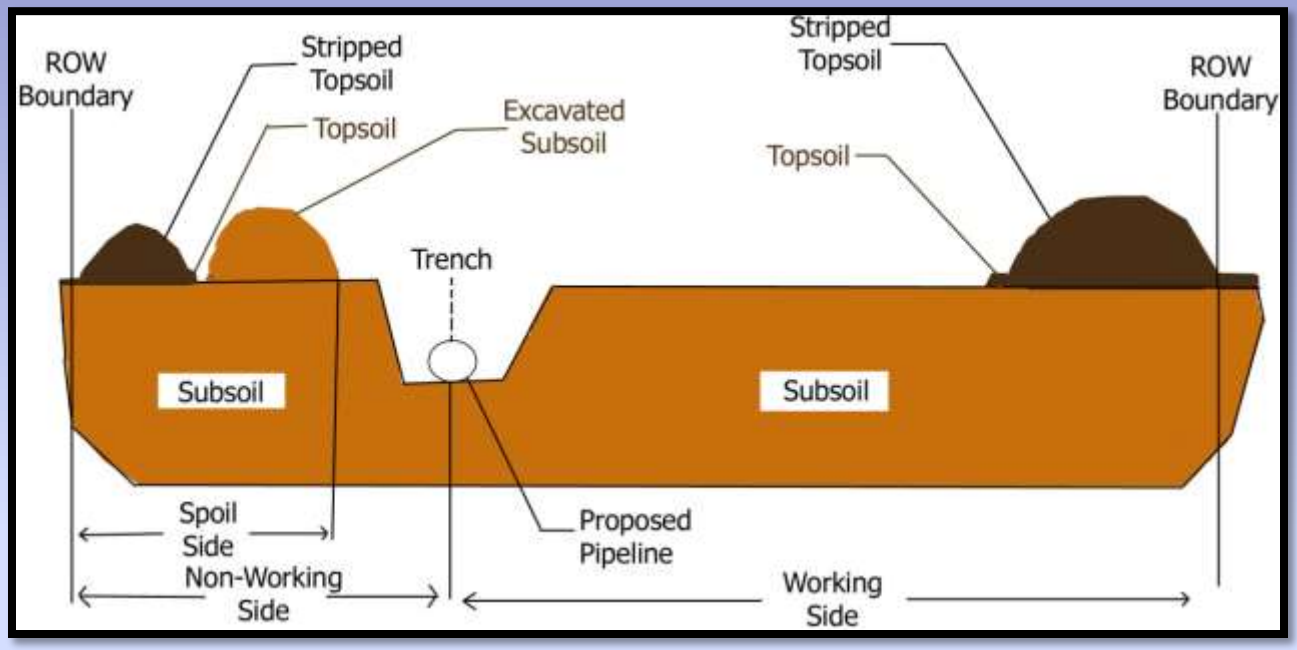
Topsoil Reapplication and Seedbed Preparation

- Determine depth of compacted layer
  - Actual depth may vary
- Rip compacted layer prior to reapplication of topsoil
  - **Don't** turn over top layer
- Rippers should be no more than 24 inches apart
- Leave a rough surface prior to
- topsoil reapplication
- Prepare "suitable" seedbed,
- i.e., firm

Leave a Roughened Seedbed

- Prevent wind erosion, encourage moisture catchment, discourage driving over seeded areas
- Important on steep slope and/or erosive soils
- Additional roughening may be accomplished by:
  - Pitting, gouging, scarification, dozer track-walking
  - Discourage recreational use
- Place erosion protection features on the contour and perpendicular to the prevailing wind and water flow

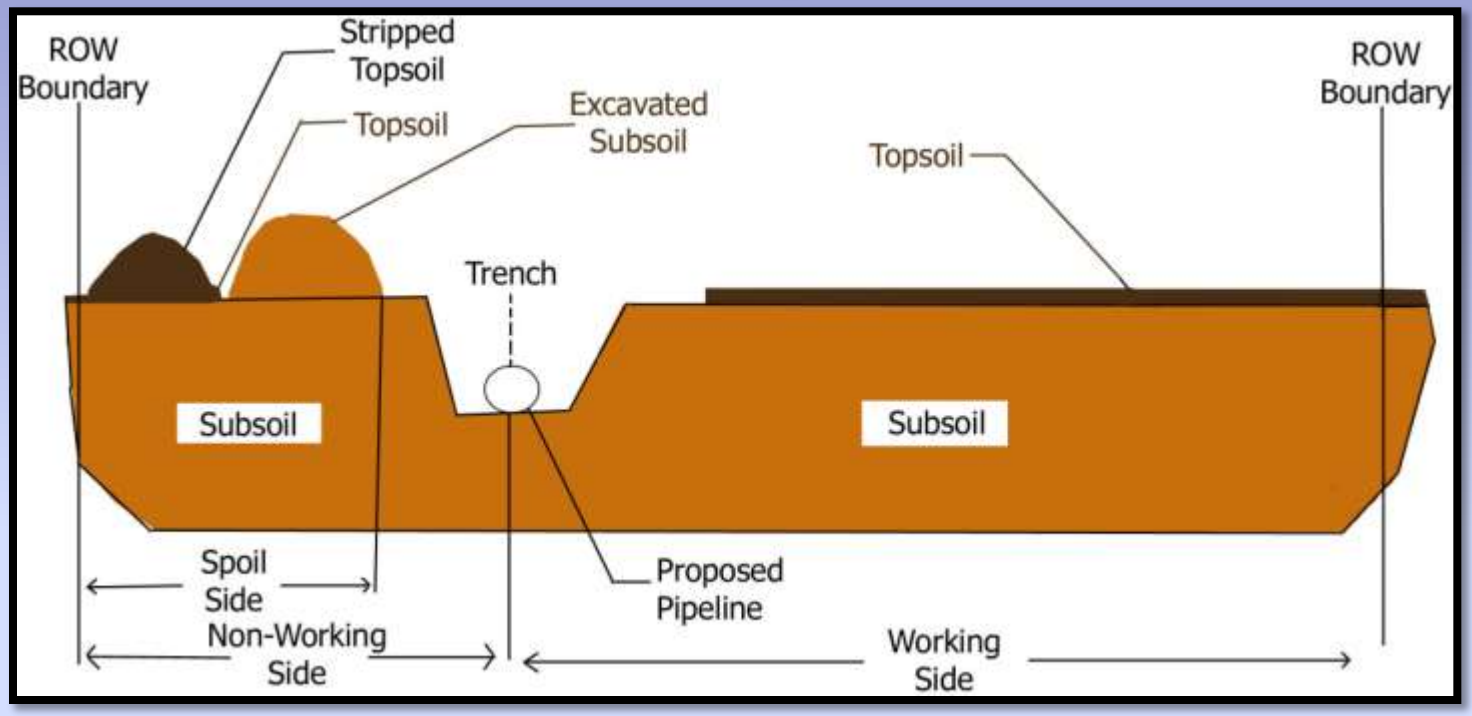
Topsoil Stripping Methods
Full-Width



- **Benefits**
- Minimizes mixing topsoil and subsoil
- Reduces topsoil compaction
- Allows for work in wet conditions

- **Disadvantages**
- Requires increased workspace, time and equipment
- Vegetation root structure is disturbed across entire ROW
- Stabilization and stockpiling of large volumes of topsoil

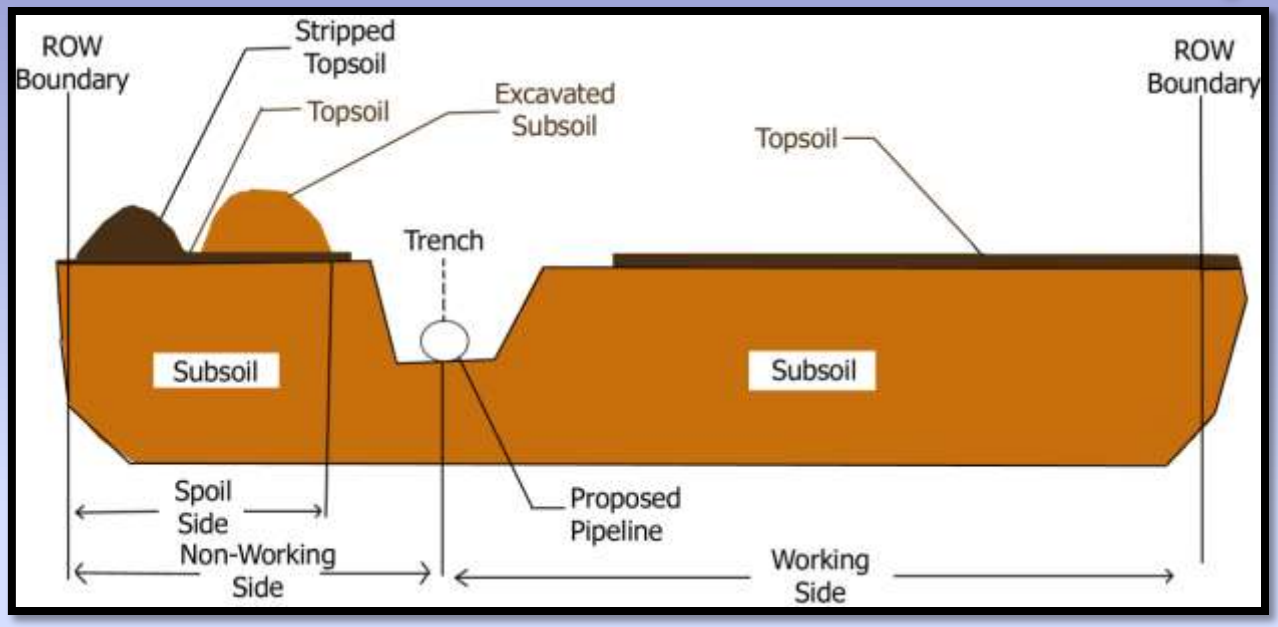
Topsoil Stripping Methods
Trench & Spoil Side



- **Benefits**
- Requires less workspace, time, and equipment than full-width method
- Vegetation root structure is disturbed only in the travel lane

- **Disadvantages**
- Increased mixing of topsoil and subsoil
- Increased compaction of ungraded travel lane
- Limited access during wet conditions
- Spoil storage options reduced

Topsoil Stripping Methods
Trenchline Only



- **Benefits**
- Requires a minimum amount of time, workspace, and equipment
- Vegetation root structure is preserved

- **Disadvantages**
- Impractical on side-slopes or rough terrain
- Increased mixing of topsoil and subsoil
- Increased compaction over ungraded travel lane
- Limited access during wet conditions

Subsidence issues

- Do not backfill frozen soil
- Anticipate settling and account for extra material over the trench itself

Potential soil problems on the backend on all linear disturbance

- Metal toxicity
- Salinity or sodicity or both
- Compaction
- Instability
- pH issues
- Fertility

Pay Now or Pay Later!!!

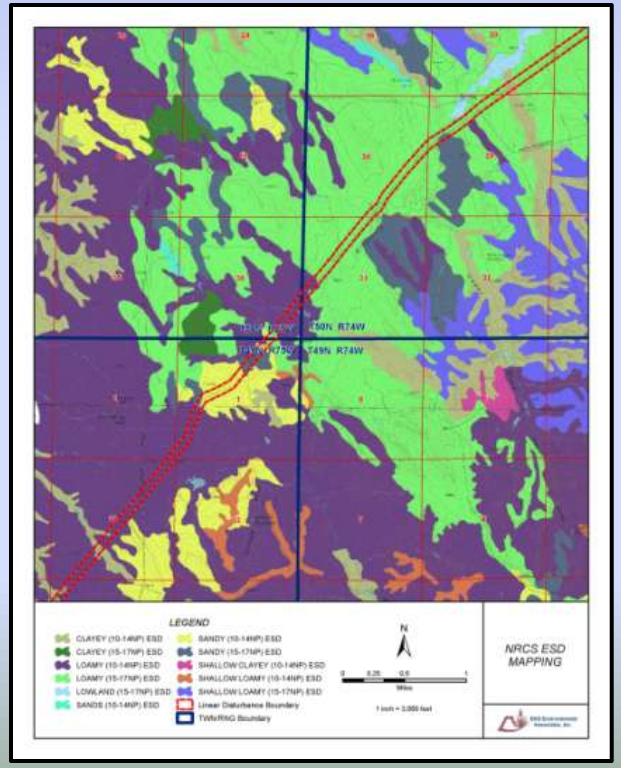
As a private landowner…

- Know your ranch
  - Where are the potential problem areas
  - Where are areas to be avoided
  - Where is the best reclamation potential
  - Ask if ROW width can be minimized in sensitive areas
  - Document what you desire
  - Take photos from same location, if possible
- Be available when activity is on your place
- Get to know your pipeline representative and your construction foreman
  - Don't assume that conversation will be passed to the next person

Progression of pipeline

Minimize landscape and scale challenges

- Get the “big view”…know problem areas
- Design your seedmix around anticipated ecological sites and overall soil conditions



Minimize landscape and scale challenges (cont.)

- Minimize width, if possible, in sensitive areas, e.g., wetlands, sandy areas, etc.
- Assume "one size will not fit all" and break into phases, if possible
- Follow contours if possible, especially on smaller pipelines

It's not all "bad"

- Depending on the size of the linear project, you will likely get edge effect reinvasion of desirable species
- Seeding may actually keep out adjacent undesirables, if present prior to disturbance

Successful Pipeline Reclamation

EARLY INTERIM RECLAMATION

FINAL RECLAMATION

Words to the Wise

- Don't ignore soils…it begins and ends with the soils
- Understand the scale of the information you have or need
- Pay attention early in the planning process
- Avoid areas that will give you problems
- Understand the economics of NOT doing the previous points

QUESTIONS?????

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