SLOPES: CONSIDERATIONS FOR RECLAMATION
Physical Challenges

- Site Stability
- Thinner Soils
- Erosion
  - Major limiting factor to restoration success
  - Water (sheet and rill/gully)
  - Wind
GEOLOGIC HAZARDS

- Areas prone to sloughing
- Areas prone to landslides/unstable slopes
- Floodplains
- Shallow and/or perched aquifers
Before conducting the onsite inspection, the BLM or surface management agency will determine whether any of the following requirements or features would affect the operational proposal:

- Land management plan
- Lease stipulations
- Level of national environmental policy act (NEPA) analysis required
- Well spacing
- Cultural survey needs
- Wildlife survey needs
- Riparian and wetland areas
- Excessive slopes and erosive soils
- Landowner consultation
SITE SELECTION AND DESIGN

• To the extent permitted by the geologic target, well spacing, and drilling and production technology, well sites, tank batteries, pits, and compressor stations should be planned to minimize long-term disruption of the surface resources and existing uses, and to promote successful reclamation.

• Design and construction techniques, and other practices, should be employed to minimize surface disturbance and associated effects of proposed operations while maintaining reclamation potential.
LEASE NOTICE #1 AND RMP CONSTRAINTS

• Surface occupancy on slopes 25% or greater are generally considered NSO

• May have Controlled Surface Use on slopes less than 25%
  • Additional measures to ensure stability and reclamation
DRAWBACKS

• Building on slopes usually means that grade cannot be balanced resulting in larger cut and fill slopes, and generally more excavated material has to be moved stored.

• These areas generally have minimal interim reclamation and recontouring.
  • Leads to higher longer term maintenance costs
  • May require that production facilities need to be located offsite to minimize long-term disturbance.
HIGH RISK AREAS

• The authorized officer has the option of determining whether professional engineering design and construction oversight is necessary.

• The need for professional engineering design and oversight should be based on factors such as topography, soils, hydrology, safety, and levels/types of use.
PRONE TO GEOTECHNICAL PROBLEMS?

• A geotechnical engineer must investigate the existing site for potential sliding, current failures and potential cut and fill slope stability problems.

• Investigations should include:
  • Soil structure, composition, cohesion and internal friction.
  • Distribution of bedrock and surficial deposits,
  • Outcrops, discontinuities and structural features,
  • Ground-water occurrence and behavior,
  • Observed and potential geologic hazards, reservoir integrity and potential seepage, and existing/potential sources of contamination of usable waters/freshwater.
THE GEOTECHNICAL REPORT

• Should include at a minimum a narrative description of surficial deposits, specifying engineering properties, especially those that can affect design or construction.
  • These descriptions may include, but are not restricted to:
    • The presence of swelling materials, low-density materials, gypsum and other sulfates, caliche, dispersive soils, loose deposits subject to liquefaction or consolidation, and erodible materials.
STORM WATER BEST MANAGEMENT PRACTICES

• ACCOUNT FOR GRAVITY WHEN REPLACING TOPSOIL.

• UTILIZE ALL AVAILABLE EROSION CONTROL METHODS.
  • HYDROMULCH
  • ROUGHEN SURFACES
  • EROSION CONTROL BLANKETS
  • CONTROL STORMWATER RUN-ON AND RUN-OFF
To reduce erosion and soil loss, it may be appropriate to divert storm water away from the well location.

- Ditches, berms, or waterbars may need to be used to trap well location runoff on or near the location.
- Water management plans including retention ponds.
SURFACE ROUGHENING
Smooth vs. Rough
Results of Surface Roughness

Traps Moisture
Respread the Vegetation Skeletons with the Topsoil
GOOD ROUGHNESS
Rough is More Resistant to Erosion

BETTER ROUGHNESS
BEST ROUGHNESS
Avoid Oversized Terraces and Waterbars
Using Rock and Topsoil Together

Interstate-70
Glenwood Canyon, CO
Revegetation
Without Rock

With Rock
SUMMARY

• Scale becomes more important
  • Consider size of watershed input and control
  • Use of geotechnical assessments can be helpful.
    • Minimize cost in the long term
    • Minimize and avoid other potentially negative impacts.
QUESTIONS?

THANK YOU!