Achieving Contemporaneous Geomorphic Reclamation at El Segundo Mine, New Mexico

EMILY HYDRUSKO
ENGINEER I
PEABODY ENERGY

Our Experience in Geomorphic Reclamation

- El Segundo Mine has implemented 3 geomorphic reclamation areas
  - Pit 1
    - Learned importance of careful planning to reduce re-handle
    - Learned strategies for more feasible designs
  - Pit 5
    - Learned strategies to improve drain implementation
    - Learned importance of concurrent sloping
  - Pit 6 West
    - Demonstrated benefits of direct placing of spoil in final location
    - Learned how to most effectively cut in drains

Traditional Method for Designing Reclamation in the Southwest

- Main drainages developed based on ramp locations
- Drains designed based on wide flat bottomed channels mimicking native drains
- Mine cut by mine cut mass balance
- Areas in between ramps filled until a balance is reached

Traditional Coal Mine Reclamation

- Large incised drains usually built from mining ramps
- Long side slopes
- Little relief in topography

Concerns with Traditional Reclamation

- Limited secondary drainage
- Maintenance issues
  - Rills and gullies
  - Prolonged bond release
- Difficulty establishing vegetation
  - Increased susceptibility to wind
  - Few areas for cool season grasses to establish
    - End use of mined lands requires diverse vegetation establishment

Geomorphic Method for Contemporaneous Reclamation

- El Segundo Mine has a unique opportunity to include geomorphic reclamation techniques contemporaneously
- The process being cultivated at the El Segundo Mine includes
  - Volumetric cut/fill for overall material balance
  - Defined drainages on the base contours checked for capacity
  - Using the base contours to define areas appropriate for geomorphic reclamation
    - Usually side slopes to help stabilize potential erosion areas

Geomorphic Method for Contemporaneous Reclamation

- Small boundaries used in Carlson Natural Regrade** or other similar methods
- Finally all contours are combined together to create a final post mining topography
- The final contours can then be used by engineering to design dumps and put in the geomorphic reclamation contemporaneously

- **Note, Peabody does not endorse Carlson Natural Regrade as the only software for geomorphic reclamation

Criteria Each Geomorphic Reclamation Design Must Meet

- Sinuosity
  - A reasonable range of sinuosity values must be met with each design and reflected as such on all maps
- Drainage density
  - El Segundo Mine Permit requires 60 linear ft/acre
  - Determined by our pre-mining conditions
- Overall channel stability
  - Each channel must remain stable with a storm producing a flow of 4ft/sec

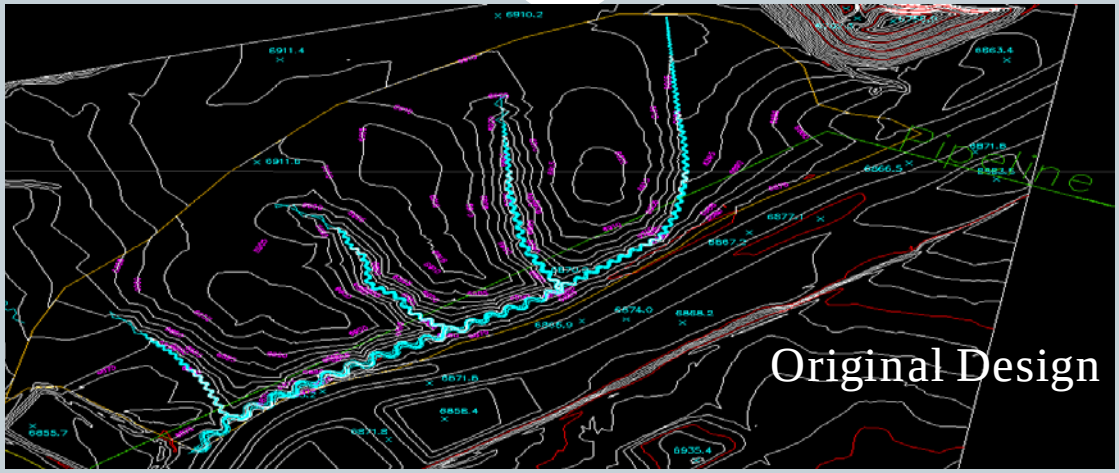
How El Segundo Mine is Achieving Geomorphic Criteria

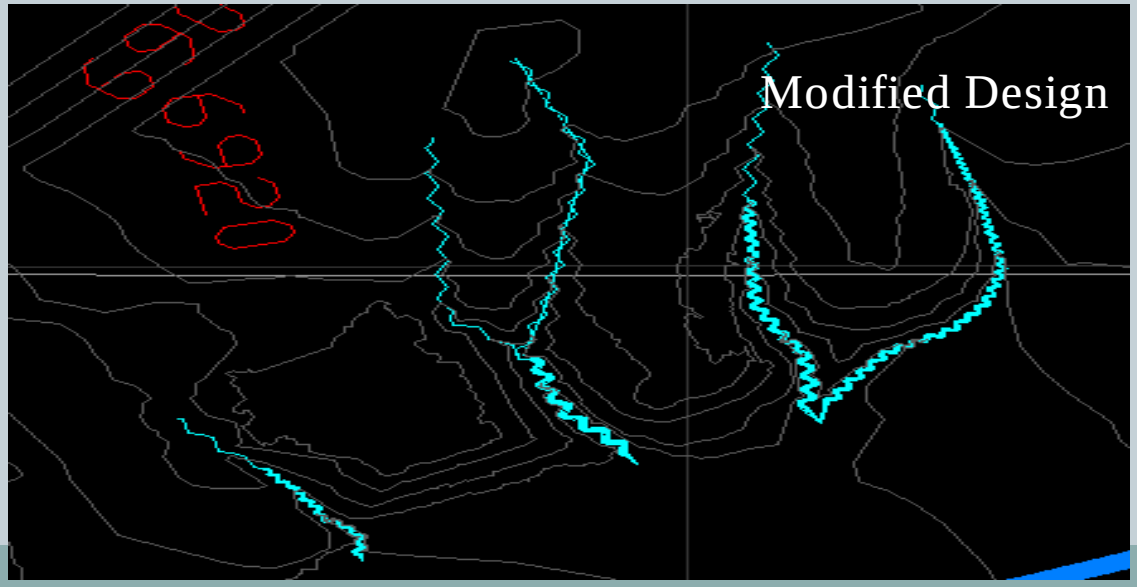
- Sinuosity
  - Trial and error lead us to find a range of sinuosity values that is both stable and reasonable to build
- Drainage density
  - Geomorphic Reclamation incorporates drainage density
- Overall channel stability
  - Generally speaking previous reclamation plans did not include side slope channels
  - Overland flow often causes erosion on such slopes
  - Breaking up the hill slope and adding small drainage ways slows the water down minimizing erosion

Complications (when using geomorphic contemporaneously)

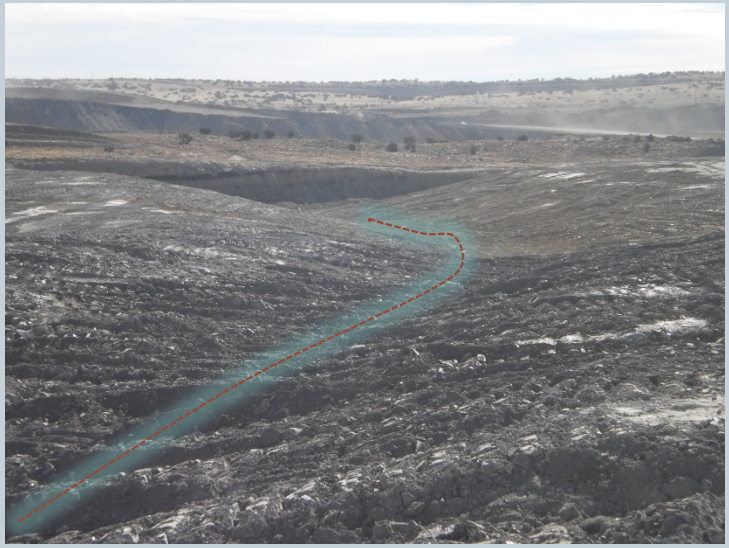
- Time
  - More detailed designs take more time especially in the beginning stages of incorporation
- Added resources (cost)
  - Using available equipment to do detail work adds cost
- Unfamiliar designs
  - Engineers, operators and supervisors alike have never built similar designs in the field

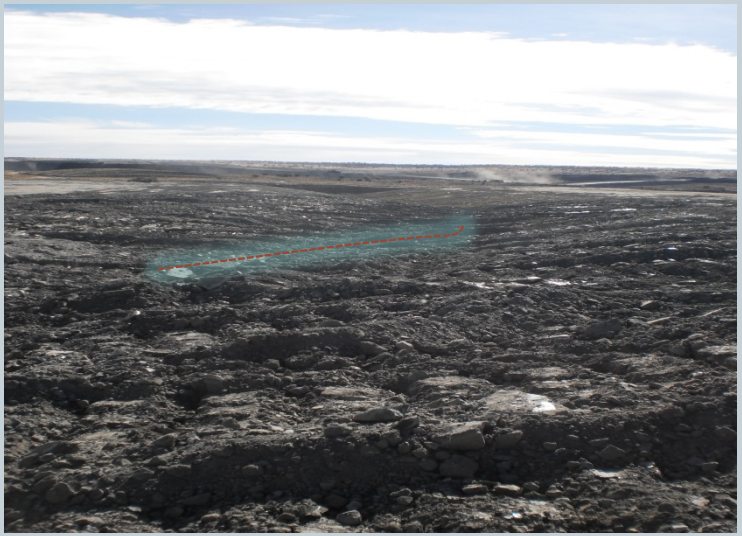
Example: Pit 1 Design



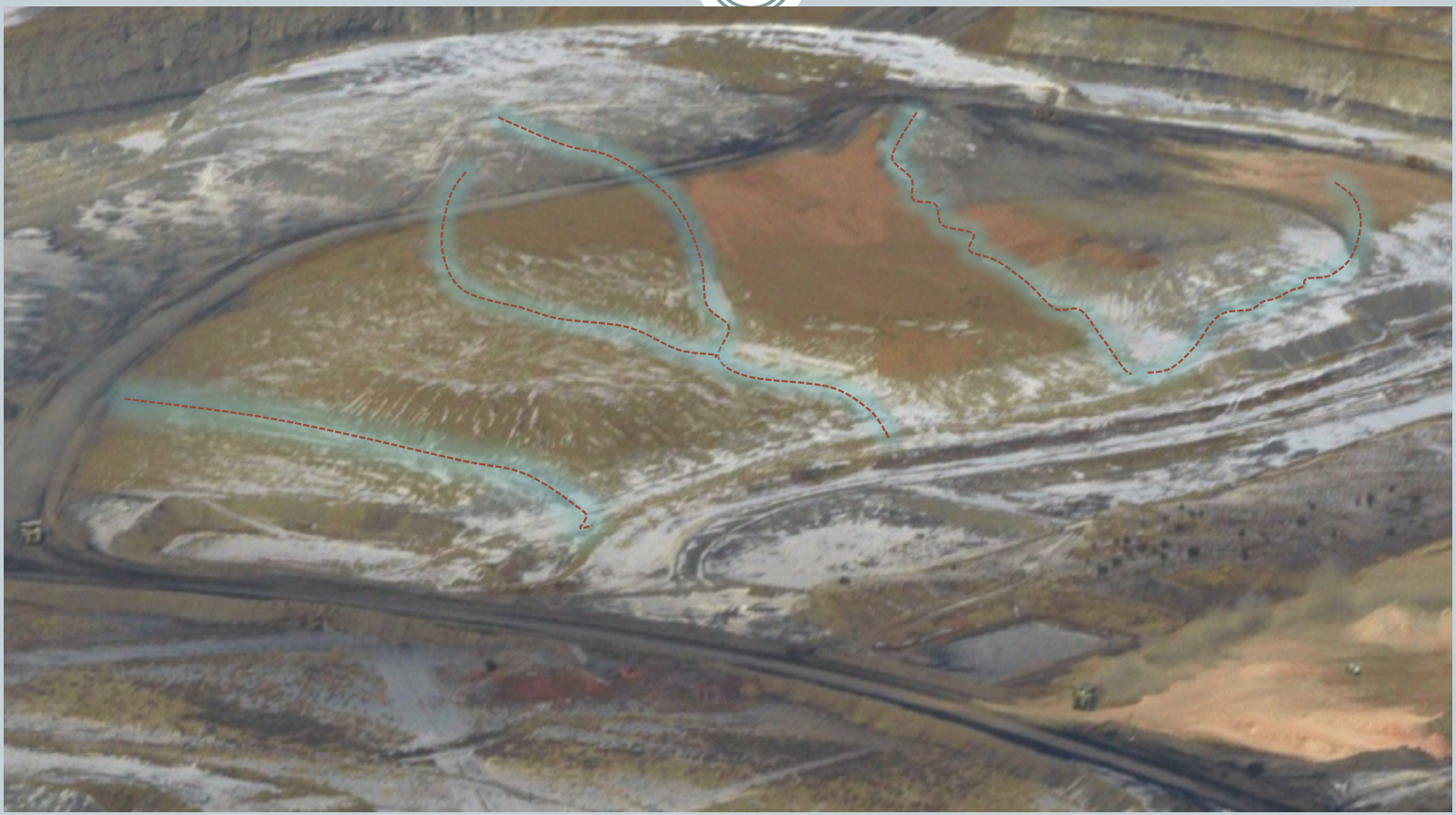


Example: Pit 1 Ongoing





Example: Pit 1 Ongoing



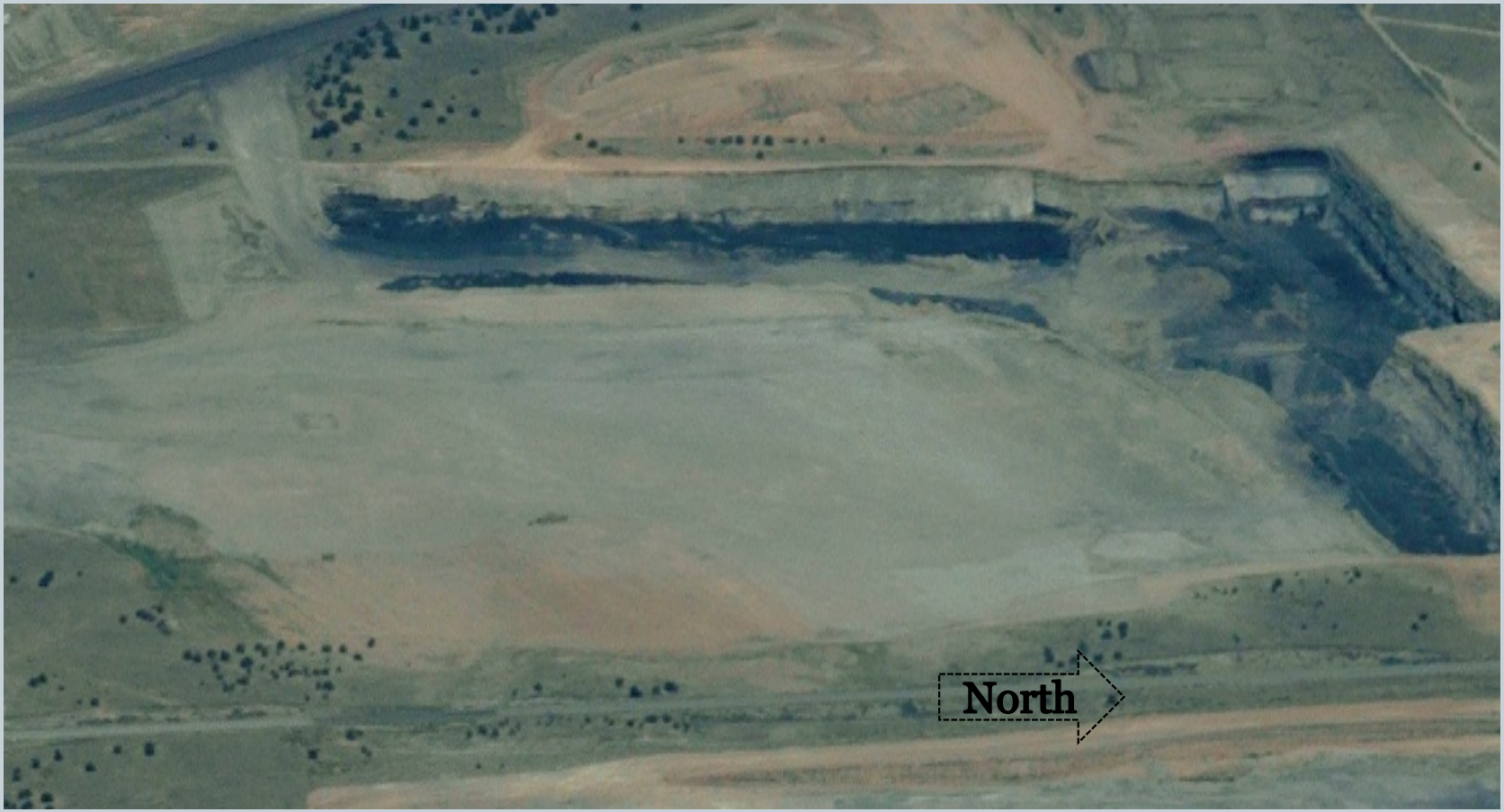
Example: Pit 1

Example: Pit 1

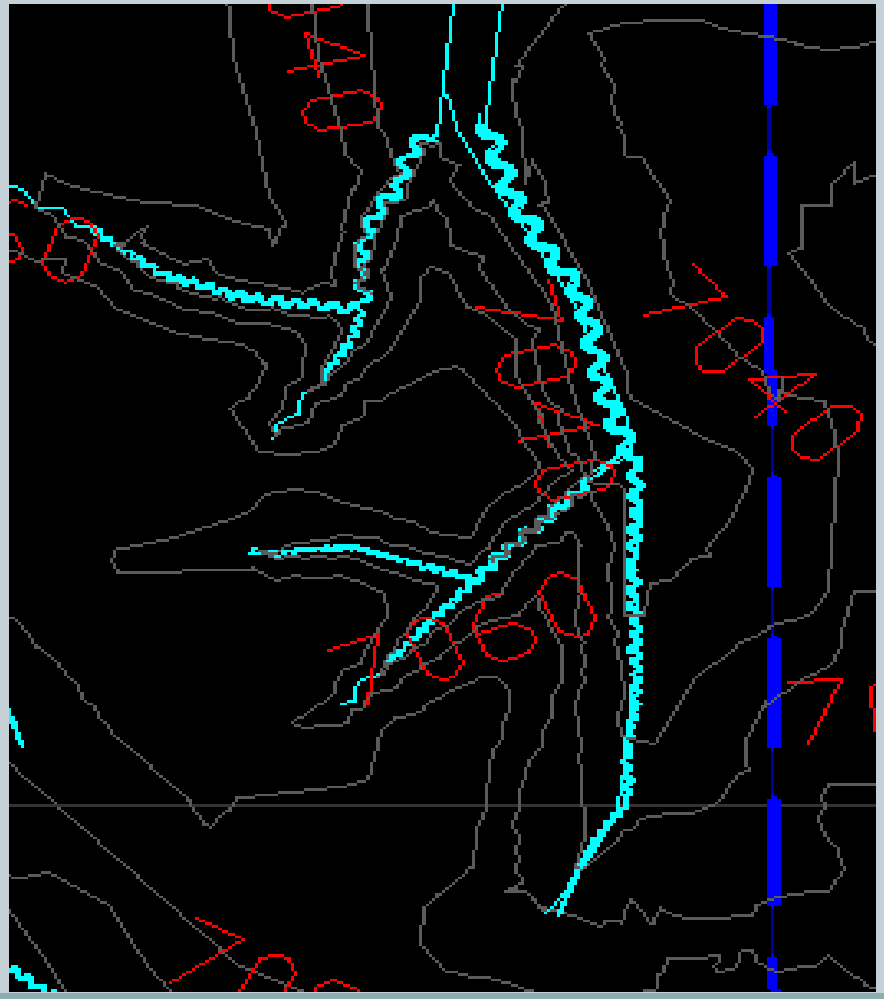
Example: Pit 1 Strategies Learned

- Dumps need to be more carefully designed and monitored
  - To help prevent over-dumping and causing more dozer work for a particular area
- It is not efficient to cut the drains in later
  - This re-handles the dirt
- Consistency of operators on the project is essential

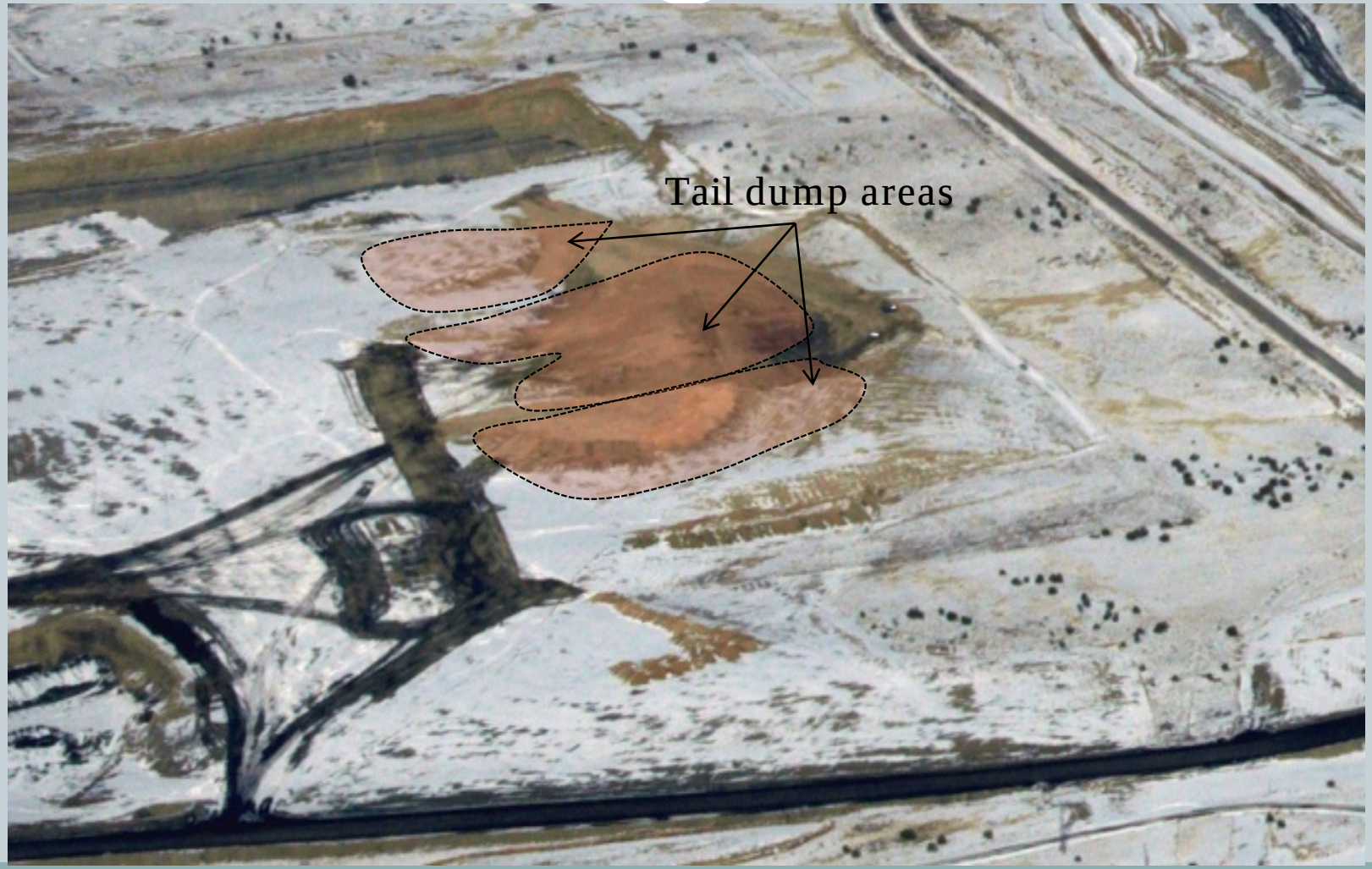
Example: Pit 5



Example: Pit 5 Design



Example: Pit 5



Example: Pit 5 Ongoing

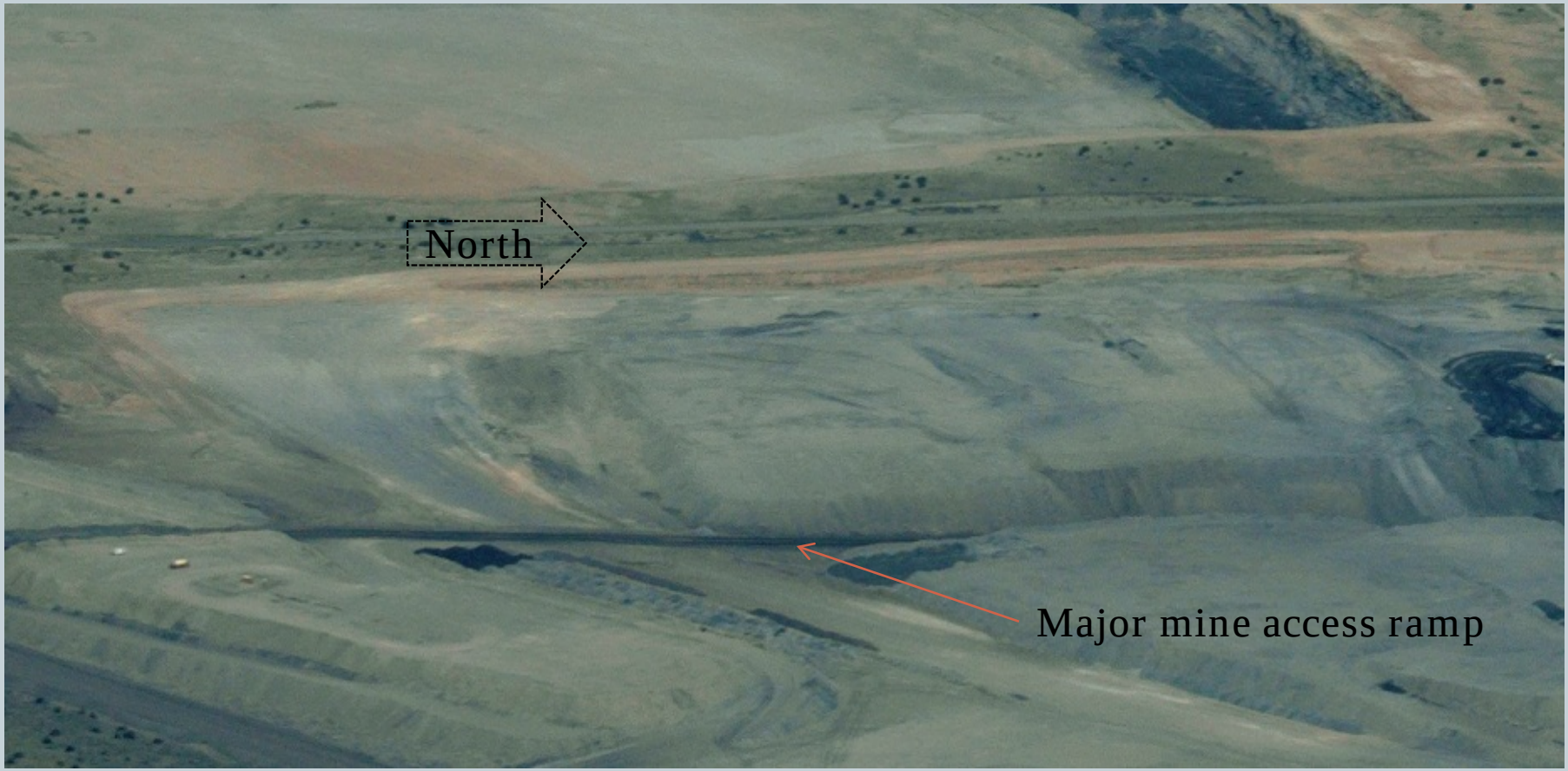
Example: Pit 5 D11 Drain Cut

Example: Pit 5

Example: Pit 5 Strategies Learned

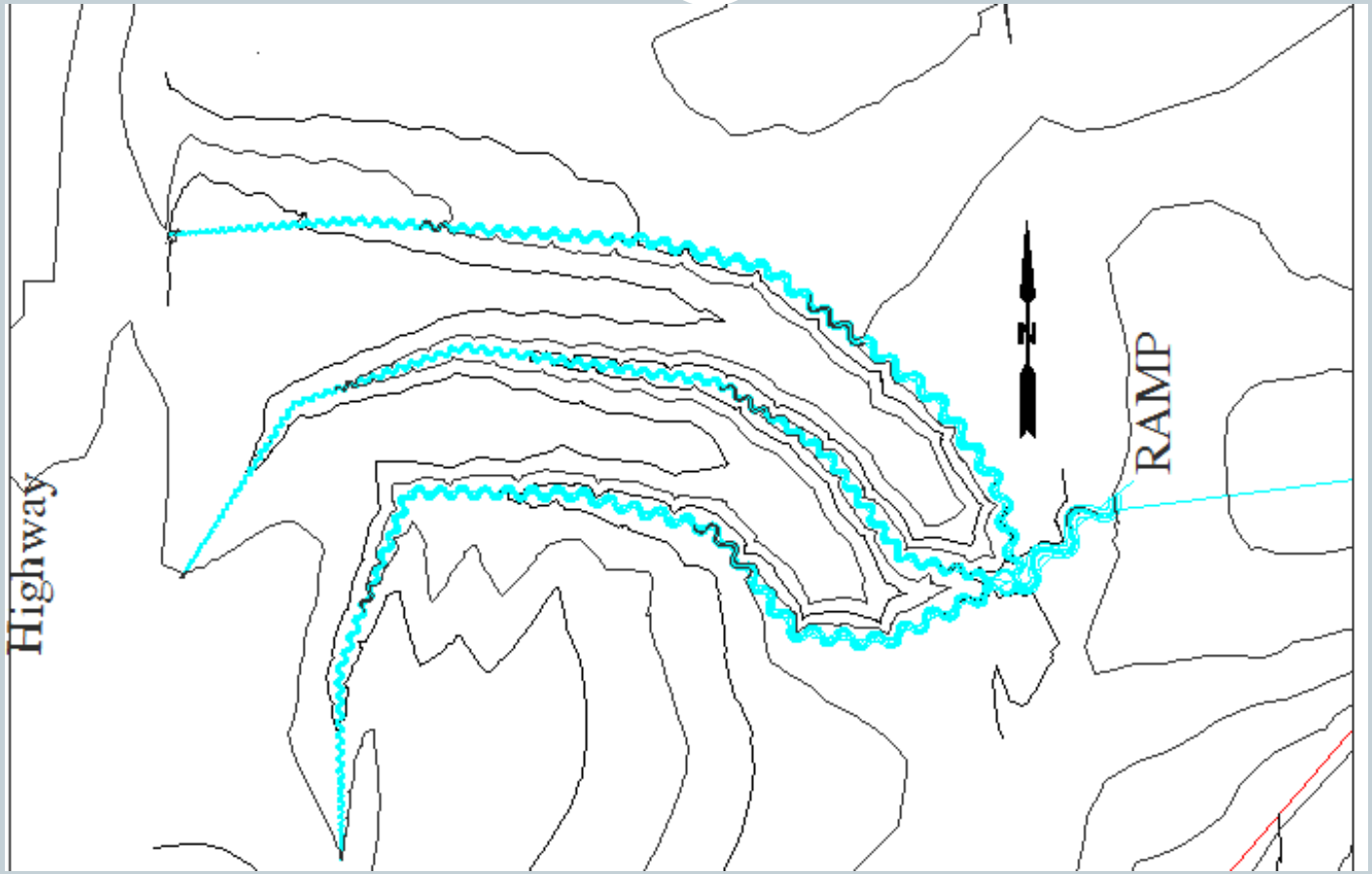
- Dumping lifts in between drain areas is more efficient
- Tail dumping provides a clear view of where ridges and drainages are early in the process
- Hard to gauge how much dirt is still needed when shaping of ridges has not been started

Example: Pit 6 West



Example: Pit 6 West Before

Example: Pit 6 West Design



Example: Pit 6 West Drains

Example: Pit 6 West Drain Cuts

Example: Pit 6 West Ongoing

Example: Pit 6 West

Example: Pit 6 West Strategies Learned

- Staking drains before any work begins keeps dumps aligned
- Creating a dozer onboard GPS guidance file just for the drains allows for greater detail within the drains
- Cutting out the drains to grade before dumping in any material gives a clear boundary for dumping in dirt
- Sloping the dump to grade while trucks are dumping keeps rework to a minimum

Engineering Strategies

- Coordinate geomorphic reclamation with mining activities
- Work closely with production supervisors on go to areas
  - Reduce unproductive time
  - Emphasize importance of concurrent reclamation with mining
- Incorporating geomorphic designs into both short term and long term planning

Keeping Grading Contemporaneous: Challenges

- Falling behind
  - Early phases of incorporating geomorphic proved to be time consuming leaving potential to fall behind
  - Dedicated reclamation designer should be observing the pace and offering suggestions
- Bogged down by detail
  - Early designs were more complicated due to lack of knowledge on difficulty
  - Using a dedicated crew for reclamation promotes ownership and pride in results

Keeping Grading Contemporaneous: Challenges

- Conveying desired results
  - Enabling the operators and supervisors to see the big picture
  - Continuous feedback with the operators to ensure that they understand what the outcome should be
  - Geomorphic reclamation is an ongoing process shifting to the more challenging geomorphic reclamation
    - More creativity in the designs leaving diverse landscape
    - Makes reclamation more of an art than a science

The Learning Curve

- Extraneous detail holds up progress
  - Pit 1 showed how unnecessary detail can hold up progress
- Breaking the habit of traditional slopes
- More dirt does not always equal better results
  - Over-dumping in pit 1 hindered results and timing

The Learning Curve

- Sloping needs to be concurrent
  - Tail dumped pit 5 first, started sloping later
  - Difficult to estimate where we needed more dirt
  - Creates extra dozer work not associate with mining
- Drainage areas need attention first
  - Left drains in Pit 5 for last then struggled to get put in
- Must to be able to modify designs due to the unforeseen

The Learning Curve

- Definite progression in designs implemented
  - Pit 6 west was more efficient than pit 5 and pit 5 was more efficient than pit 1
  - The more a design is explained the better the results
    - Different maps depicting the big picture as well as detail work maps aid in getting everyone on the same page
- Each design will have its issues and needs to be dynamic to account for issues that arise from contemporaneous geomorphic reclamation

Findings

- El Segundo Mine has found that using geomorphic reclamation on side slopes is beneficial
  - Overall appearance of the reclamation is more natural
  - Long term maintenance should be reduced
  - As processes to incorporate geomorphic reclamation improve, onsite efficiency in building such designs should improve

Findings

- Using geomorphic reclamation contemporaneously is a dynamic process requiring some flexibility
- Better collaboration between engineering and production is leading to overall better results
- Greater pride in the reclamation process

Summary

- Traditional coal mine reclamation tends to create maintenance issues such as erosion
- Geomorphic reclamation requires strategic planning
- Monitoring of design implementations is critical
- Flexibility to slightly alter designs to fit mining
- Contemporaneous geomorphic reclamation is feasible at the El Segundo Mine

Questions?