SLIDES: The Economic Benefits ofCompleting Initial Reclamation Successfully for Oil and Gas

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THE ECONOMIC BENEFITS OF COMPLETING INITIAL RECLAMATION SUCCESSFULLY FOR OIL AND GAS

DAVID C HENOWETH
WESTERN STATES RECLAMATION, INC

CO-AUTHORS
DAVID HOLLAND, GERALD JACOBY, LINDSEY KRUCKENBERG, JOHN RIZZA, BRYAN WHITELEY
INTRODUCTION TO CASE STUDY APPROACH

Storm water management and proper reclamation is viewed as a direct cost of energy production. Until the upper management in energy companies understand what an adequate reclamation budget is, there is great risk that environmental staff will not be granted adequate budgets for successful initial efforts.

All of us as environmental professionals realize that our efforts in reclamation and stormwater management do not add to the bottom line profitability and stock value for energy development. However, we can add to the bottom line when our consulting and contracting efforts are on track and geared towards successfully completing initial reclamation.

Environmental coordinators and contractors have an obligation to maintain accurate annual cost data that tracks the cost for:

- Adequate budget for successful reclamation
- Cost of repair for failed reclamation
CASE STUDIES + COST DATA

- **Assesses** varying successes of reclamation and stormwater management efforts

- **Pioneer Natural Resources**
  - Study Area = Raton Basin, Trinidad, CO

- **Encana Oil and Gas**
  - Study Area = Piceance Basin, Rifle and Rullison, CO

- **Cost analysis** – Based on in-house records from Encana and Pioneer Environmental staff, Actual bids from Western States Reclamation, Inc. and contract amounts for work completed
SITE LOCATIONS

Pioneer Natural Resource Study Area = Raton Basin, Trinidad, CO
(Figure USGS)
SITE LOCATIONS

Encana Oil and Gas Study Area = Piceance Basin, Rifle and Rullison, CO (Figure USGS)
**DISCUSSION**

- **Round Table** – Encana, Pioneer and Western States Reclamation

  - Poor initial reclamation = Increased Lease Operating Expenses

  - Establish list of key factors for successful reclamation projects

  - Commonly associated direct costs

  - Commonly associated indirect costs
KEY FACTORS FOR SUCCESSFUL RECLAMATION

- **Site Inventory + Analysis**
  - Locate facilities and access roads to minimize slope and stormwater runoff
  - Soil Inventory
  - Vegetation Species Inventory
  - Drainage Basin or Watershed Information
  - Noxious Weed Inventory
  - Analysis of Inventoryed information

- Identify areas for potential topsoil salvage and establish a replacement plan for interim and final reclamation

- Grade pads and install terraces, berms, benches, etc. to reduce sediment loading during interim and final reclamation
  - Geomorphic landforming and earthen hydrological controls

- Apply the proper types and amounts of soil amendments to the soil when topsoil is lacking or poor quality
  - Organic fertilizers and humates used on both Pioneer and Encana sites with success. Cost effective and easy to apply by broadcasting or mixing in hydromulcher
KEY FACTORS FOR SUCCESSFUL RECLAMATION

• Perform proper soil tillage to loosen compaction

• Design proper seed mixtures and application rates
  • Adapted and native grasses, forbs and shrubs
  • Post Disturbance land use (ie. wildlife habitat, livestock grazing)
  • Number of total seeds per sq. ft.
  • Balancing seeds per sq. ft.

• Install and maintain BMPs and erosion control devices until the desired vegetation achieves self sustaining cover

• Maintenance and monitoring program that includes complete mechanical and chemical weed control
KEY FACTORS FOR SUCCESSFUL RECLAMATION

• Seeding Method Selection
  • Drilling
  • Broadcast
  • Hydroseed
  • Aerial Seeding
  • Dozer broadcasting and slope tracking

• All broadcast seeding raked or harrowed into soil
KEY FACTORS FOR SUCCESSFUL RECLAMATION

• Mulch and Erosion Control Fabrics Selection
  • Innovation in FGM, BFM, ECM
  • Straw/Hay
  • Hydromulch
  • Combination of Mulch and Structural

• Structural BMP Selection
  • Erosion Logs
  • Silt Fence
  • Sediment Tubes
  • Erosion Control Blankets
<table>
<thead>
<tr>
<th></th>
<th>PIONEER</th>
<th></th>
<th>ENCANA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil Amendments</strong></td>
<td>Biosol + Humates @ 2,000lb/ac</td>
<td>Biosol + Humates @ 2,000lb/ac</td>
<td>Sustane 3.7.2 (Microrhizae + Humates) @ 2,000-3,500lb/ac</td>
<td>Sustane 3.7.2 (Microrhizae + Humates) @ 1,500-2,500lb/ac</td>
</tr>
<tr>
<td><strong>Erosion Control</strong></td>
<td>N/A</td>
<td>Erosion Control Logs 9” Excelsior. Used to contain and direct runoff/sediment</td>
<td>Erosion Control Logs 9” Excelsior. Used to contain and direct runoff/sediment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td>Sediment Tubes 9”-12” Sediment Tubes. Used to contain and direct runoff/sediment</td>
<td>Sediment Tubes 9”-12” Sediment Tubes. Used to contain and direct runoff/sediment</td>
<td></td>
</tr>
<tr>
<td><strong>Earth Shaping</strong></td>
<td>Planning and siting of sites to more closely fit the natural topography</td>
<td>Planning and siting of sites to more closely fit the natural topography</td>
<td>Maintaining existing drainages with earthshaping. Concentrating flows into created swales armored with erosion control protection. Taking into account natural slope and aesthetics.</td>
<td>Maintaining existing drainages with earthshaping. Concentrating flows into created swales armored with erosion control protection. Taking into account natural slope and aesthetics.</td>
</tr>
<tr>
<td><strong>Mulch</strong></td>
<td>Bonded Fiber Matrix</td>
<td>Certified Weed Free Straw Crimped + Tacked</td>
<td>Flexible Growth Medium - Flexterra @ 3,000lb/ac</td>
<td>Certified Weed Free Straw Crimped + Guar Tackifier. Exposed slopes and areas sometimes tackified with light application of Flexterra.</td>
</tr>
<tr>
<td><strong>Erosion Control Blankets</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>Double Net Straw Biodegradable Blanket + Flexterra Infill</td>
<td>Double Net Straw Biodegradable Blanket</td>
</tr>
</tbody>
</table>
MONITORING AND MAINTENANCE

MAINTENANCE

• WSRI wrote and is implementing an Independent contractor monitoring, recommendation and maintenance program for oil and gas

  • Recognizing soil condition and inadequate amendments

  • Recommendations to aid in vegetative establishment (Watering, Additional Amendments, etc.)

  • Prompt weed control

  • Contractor becomes responsible for oversights
MONITORING AND MAINTENANCE

MAINTENANCE

• Weed Control
  • Mechanical – Bush hog, weed eaters, hand pulling
    • Typically used in 1st growing season and completed 2 times
  • Chemical applications
  • Control when 20% canopy cover is achieved

• Touch-up Seeding
  • After first growing season - 2 Seedlings per sq. ft minimum or touch up seeding must occur
  • Touch up seeding accomplished by broadcast and hand raking in small areas or drill interseeding in large areas.

• BMP Repairs
  • Regrading
  • Addition of more BMP’s when needed
COMMONLY ASSOCIATED DIRECT COSTS OF RECLAMATION FAILURES

• Retrieving sediment from erosion and sediment events, including off-site

• Replacing sediment or other suitable materials in washout areas

• Regrading

• Reseeding

• Replacing and adding BMPs
COMMONLY ASSOCIATED DIRECT COSTS OF RECLAMATION FAILURES

- Extending the duration of weed management activities

- Additional maintenance and inspection costs

- Between Pioneer and Encana the costs are estimated to be between $13,000-$43,000 per acre.
COMMONLY ASSOCIATED INDIRECT COSTS

• Increased staff and consultant time

  • Oil and Gas Environmental Staff or private consultants approximate rates are $100.00 per hour. Thus several thousand dollars could be wasted easily in dealing with poor reclamation and erosion issues
COMMONLY ASSOCIATED INDIRECT COSTS

• Tarnished agency and landowner relationships
  • What kind of price tag do you put on production delays due to challenging relationships?

• Potential regulatory and non-compliance
  • What are the potential costs associated with fines?
<table>
<thead>
<tr>
<th>Treatments</th>
<th>EnCana - Piceance Basin</th>
<th>Pioneer - Raton Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifespan Planning</td>
<td>$950 to $1,150</td>
<td>$1,250 per acre</td>
</tr>
<tr>
<td>Topsoil Conservation</td>
<td>$525 - $1,142</td>
<td>$750</td>
</tr>
<tr>
<td>Topsoil Replacement</td>
<td>$1,100 - $1,060</td>
<td></td>
</tr>
<tr>
<td>Pad Regrading</td>
<td>$1,224 - $1,632</td>
<td>All Inclusive, Drill</td>
</tr>
<tr>
<td>Landforming</td>
<td>$9,500.00</td>
<td>Seed w/ straw</td>
</tr>
<tr>
<td>Soil Preparation</td>
<td></td>
<td>mulch, tackifier, BMPs</td>
</tr>
<tr>
<td>Soil Amendments</td>
<td></td>
<td>$14,000</td>
</tr>
<tr>
<td>Seeding</td>
<td></td>
<td>All Inclusive, Hydroseed w/</td>
</tr>
<tr>
<td>Mulching</td>
<td></td>
<td>Flexterra hydromulch, BMPs</td>
</tr>
<tr>
<td>BMP’s</td>
<td>$900.00</td>
<td>$17,000</td>
</tr>
<tr>
<td>Weed Control</td>
<td>$125.00</td>
<td>$200</td>
</tr>
<tr>
<td>Total Costs</td>
<td>$16,944 to $18,129</td>
<td>$21,589 to $22,921</td>
</tr>
</tbody>
</table>

Table 1 - Estimated Costs of Proper Reclamation Practices on Drill Pads

INTRODUCTION

CASE STUDIES

DISCUSSION

CONCLUSION

SITE PHOTOS
Cost Impact of Sloping Sites

Encana

• Price Increase of %21 for steep slope reclamation (2:1 and over)

Pioneer

• Price Increase of %19 for steep slope reclamation (2:1 and over)
## Table 2 - Estimated Costs of Low Budget Reclamation Practices on Drill Pads

<table>
<thead>
<tr>
<th>Treatments</th>
<th>EnCana - Piceance Basin (2.1:1 to 3:1)</th>
<th>EnCana - Piceance Basin (1:1 to 2:1)</th>
<th>Pioneer - Raton Basin (2.1:1 to 3:1)</th>
<th>Pioneer - Raton Basin (1:1 to 2:1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost per Acre</td>
<td>Cost per Acre</td>
<td>Cost per Acre</td>
<td>Cost per Acre</td>
</tr>
<tr>
<td>Initial Planning</td>
<td>$520 to $570</td>
<td>$520 to $570</td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>Topsoil Stockpiling</td>
<td>$775</td>
<td>$625</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Topsoil Replacement</td>
<td>$1,350</td>
<td>$1,250</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Pad Regrading</td>
<td>$1469 to $2122</td>
<td>$1469 to $2122</td>
<td>$1,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>Subsoil Contour Grading</td>
<td>$11,100</td>
<td>$10,750</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Soil Preparation</td>
<td>none</td>
<td>none</td>
<td>minimal</td>
<td>minimal</td>
</tr>
<tr>
<td>Soil Amendments</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Seeding</td>
<td>$500</td>
<td>$500</td>
<td>$500</td>
<td>$500</td>
</tr>
<tr>
<td>Mulching</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>BMP’s</td>
<td>minimal non-structural</td>
<td>minimal non-structural</td>
<td>minimal non-structural</td>
<td>minimal non-structural</td>
</tr>
<tr>
<td>Weed Control</td>
<td>$250</td>
<td>$400</td>
<td>$250</td>
<td>$400</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td><strong>$15,964 to $16,667</strong></td>
<td><strong>$15,514 to $16,217</strong></td>
<td><strong>$2,750</strong></td>
<td><strong>$3,900</strong></td>
</tr>
</tbody>
</table>

Large cost variability between Encana and Pioneer is based upon....

**Encana**
New staff hired specifically to address reclamation procedures and reduce associated fines.

**Pioneer**
Environmental staff still working with low and inadequate budgets.
Costs Associated With Unsuccessful Reclamation Programs

- Redo Costs can be very subjective but an estimate between professionals is $20,000 to $40,000 (depending on severity of site degradation)

- Starting the process over
  - Fines
  - Administrative time
  - Direct costs
<table>
<thead>
<tr>
<th>Redo Treatments</th>
<th>EnCana - Piceance Basin</th>
<th>Pioneer - Raton Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2.1:1 to 3:1)</td>
<td>(1:1 to 2:1)</td>
</tr>
<tr>
<td>Sediment Clean Up</td>
<td>$500 to $1000</td>
<td>$500 to $5,000</td>
</tr>
<tr>
<td>Fill Placement</td>
<td>$500 to $1000</td>
<td>$500 to $5,000</td>
</tr>
<tr>
<td>Regrading</td>
<td>$11,100 to $13,100</td>
<td>$10,750 to $13,750</td>
</tr>
<tr>
<td>Reseeding and Mulching</td>
<td>Drill Seeding &amp; Crimped Straw $2,620</td>
<td>Broadcast Seeding &amp; Flexterra Hydromulch $8,017</td>
</tr>
<tr>
<td>Fix BMP's and Add More</td>
<td>$5,000</td>
<td>$5,000 to $10,000</td>
</tr>
<tr>
<td>1 Year Extended Weed Control</td>
<td>$350</td>
<td>$450</td>
</tr>
<tr>
<td>Total Costs</td>
<td>$20,070 to $23,070</td>
<td>$25,217 to $42,217</td>
</tr>
</tbody>
</table>
Indirect Cost Estimates Resulting From Unsuccessful Reclamation

• Fines can range from $0.10 - $15.00 per acre depending on site conditions and other relevant factors

• Administrative costs can range from $20,000 to $120,000 per year depending on the amount and severity of unsuccessful reclamation

• An estimate of lost opportunity costs to be in the area of $1,000 per acre in standard situations
### Average Cost Per Acre

<table>
<thead>
<tr>
<th></th>
<th>EnCana - Piceance Basin</th>
<th>Pioneer - Raton Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Budget</td>
<td>(1:1 to 2:1)</td>
<td>(1:1 to 2:1)</td>
</tr>
<tr>
<td>Proper Reclamation</td>
<td>(2.1:1 to 3:1)</td>
<td>(2.1:1 to 3:1)</td>
</tr>
<tr>
<td>Reclamation Failure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Comparison of Successful and Failed Reclamation (per acre)

<table>
<thead>
<tr>
<th></th>
<th>EnCana - Piceance Basin</th>
<th>Pioneer - Raton Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper Reclamation</td>
<td>(1:1 to 2:1)</td>
<td>(1:1 to 2:1)</td>
</tr>
<tr>
<td>Total for Reclamation Failure</td>
<td>(2.1:1 to 3:1)</td>
<td>(2.1:1 to 3:1)</td>
</tr>
</tbody>
</table>
CONCLUSIONS

• Significant proof that there are economic benefits to proper initial reclamation

• Minimal input reclamation programs result in significantly higher failure rates

• Reclamation failures can result in a 50% cost increase over initiating proper initial reclamation techniques
CONCLUSIONS

Include the accounting department!

• Environmental staff has an obligation with company to have a system in place that can track costing and that presents the importance of having adequate budgets for initial reclamation.

• Environmental staff should consult with accounting staff to find out availability of job costing software and systems. If a software program or system isn’t established an Excel spreadsheet or QuickBooks program can suffice.

• Set up effective job costing, coding and report system to account for:
  • Administrative time
  • Consultant time
  • Field repairs
O’NEILL RANCH – PIONEER

JUNE 2005

SEPTEMBER 2008
O’NEILL RANCH – PIONEER

JUNE 2005

SEPTEMBER 2008
BMP Blanket Install

FGM Application
Trapped Sediment

Sediment Pond