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

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#### CASE STUDIES

DISCUSSION

CONCLUSION

SITE PHOTOS

### **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

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### 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



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

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### DISCUSSION

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• 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  |
|--------------|---|
| INTRODUCTION | Site Inventory + Analysis   |
| CASE STUDIES | <ul> <li>Locate facilities and access roads to minimize slope and<br/>stormwater runoff</li> <li>Soil Inventory</li> </ul>  |
| DISCUSSION   | <ul> <li>Vegetation Species Inventory</li> <li>Drainage Basin or Watershed Information</li> <li>Noxious Weed Inventory</li> <li>Analysis of Inventoried information</li> </ul>        |
| CONCLUSION   | <ul> <li>Identify areas for potential topsoil salvage and establish a<br/>replacement plan for interim and final reclamation</li> </ul>   |
| SITE PHOTOS  | • Grade pads and install terraces, berms, benches, etc. to reduce sediment loading during interim and final reclamation<br>• Geomorphic landforming and earthen hydrological controls |
|              | • Apply the proper types and emounts of sail emendments to  |

• 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

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### **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

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### **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



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### **KEY FACOTORS 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





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

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### **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

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## **MONITORING AND MAINTENANCE**

### MAINTENANCE

- Weed Control
  - Mechanical Bush hog, weed eaters, hand pulling
     Typically used in 1<sup>st</sup> 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

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### 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





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### 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.

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### **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

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### **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?





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#### **CASE STUDIES**

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| Table 1 - Estimated Costs of Proper Reclamation Practices on Drill Pads |  |   |   |                                |
|---|--|---|---|--------------------------------|
|   | EnCana - Piceance Basin                            |   | Pioneer - Raton Basin   |                                |
|   | <u>(2.1:1 to 3:1)</u>                              | <u>(1:1 to 2:1)</u>                                     | <u>(2.1:1 to 3:1)</u>   | <u>(1:1 to 2:1)</u>            |
| <b>Treatments</b>   | Cost per Acre                                      | Cost per Acre   | Cost per Acre   | Cost per Acre                  |
| Lifespan Planning   | \$950 to \$1,150                                   | \$950 to \$1,150  | \$1,250 per acre  | \$1,500 per acre               |
| Topsoil Conservation  | \$525 - \$1,142                                    | \$450 - \$1,101   | \$750   | \$1,000                        |
| Topsoil Replacement   | \$1,100 - \$1,060                                  | \$950 - \$1,020   | All Inclusive, Drill<br>Seeding w/<br>Straw<br>Mulch,<br>tackifier,<br>BMPs<br>\$14,000 |                                |
| Pad Regrading   | \$1,224 - \$1,632                                  | \$1,224 - \$1,632                                       |   |                                |
| Landforming   | \$9,500.00   | \$9,900.00  |   | All Inclusive,<br>Hvdroseed w/ |
| Soil Preparation  |  | All Inclusive.  |   | Flexterra                      |
| Soil Amendments   | All Inclusive,<br>Drill Seeding &<br>Crimped Straw | Broadcast<br>Seeding &<br>Flexterra Mulch<br>\$7,015.00 |   | BMPs<br>\$17,000               |
| Seeding   |  |   |   |                                |
| Mulching  | \$2,020.00   |   |   |                                |
| BMP's   | \$900.00   | \$900.00  |   |                                |
| Weed Control  | \$125.00   | \$200.00  | \$125   | \$200                          |
| Total Costs   | \$16,944 to \$18,129                               | \$21,589 to \$22,921                                    | \$16,125  | \$19,700                       |

**CASE STUDIES** 

### **Cost Impact of Sloping Sites**

### Encana

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

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### Pioneer

• Price Increase of %19 for steep slope reclamation (2:1 and over)



| Table 2 - Estimate         | ed Costs of Low Bud        | get Reclamation Prac       | tices on Drill Pads        |                           |
|----------------------------|----------------------------|----------------------------|----------------------------|---------------------------|
|                            | EnCana - Pie               | ceance Basin               | Pioneer - Raton Basin      |                           |
|                            | <u>(2.1:1 to 3:1)</u>      | <u>(1:1 to 2:1)</u>        | <u>(2.1:1 to 3:1)</u>      | <u>(1:1 to 2:1</u> )      |
| <b>Treatments</b>          | Cost per Acre              | Cost per Acre              | Cost per Acre              | Cost per Acr              |
| Initial Planning           | \$520 to \$570             | \$520 to \$570             | \$1,000                    | \$1,000                   |
| Topsoil<br>Stockpiling     | \$775                      | \$625                      | none                       | none                      |
| Topsoil<br>Replacement     | \$1,350                    | \$1,250                    | none                       | none                      |
| Pad Regrading              | \$1469 to \$2122           | \$1469 to \$2122           | \$1,000                    | \$2,000                   |
| Subsoil Contour<br>Grading | \$11,100                   | \$10,750                   | none                       | none                      |
| Soil Preparation           | none                       | none                       | minimal                    | minimal                   |
| Soil<br>Amendments         | none                       | none                       | none                       | none                      |
| Seeding                    | \$500                      | \$500                      | \$500                      | \$500                     |
| Mulching                   | none                       | none                       | none                       | none                      |
| BMP's                      | minimal non-<br>structural | minimal non-<br>structural | minimal non-<br>structural | minimal nor<br>structural |
| Weed Control               | \$250                      | \$400                      | \$250                      | \$400                     |
| Total Costs                | \$15,964 to<br>\$16,667    | \$15,514 to<br>\$16,217    | \$2,750                    | \$3,900                   |

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

#### Encana

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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

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• 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

#### **CASE STUDIES**

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| Table 3 - Costs Associated with Reclamation Failures |   |  |   |   |
|--|---|--|---|---|
|  | EnCana - Piceance Basin                     |  | Pioneer - Raton Basin                             |   |
|  | <u>(2.1:1 to 3:1)</u>                       | <u>(1:1 to 2:1)</u>                                    | (2.1:1 to 3:1) (1:1 to 2:1)                       |   |
| Redo Treatments                                      | Cost per Acre                               | Cost per Acre  | Cost per Acre                                     | Cost per Acre                                 |
| Sediment Clean Up                                    | \$500 to \$1000                             | \$500 to \$5,000                                       | \$500 to \$1,000                                  | \$1,000 to \$5,000                            |
| Fill Placement                                       | \$500 to \$1000                             | \$500 to \$5,000                                       | \$500 to \$1,000                                  | \$1,000 to \$5,000                            |
| Regrading  | \$11,100 to<br>\$13,100                     | \$10,750 to<br>\$13,750                                | \$5,000 to \$10,000                               | \$8,000 to<br>\$15,000                        |
| Reseeding and<br>Mulching                            | Drill Seeding &<br>Crimped Straw<br>\$2,620 | Broadcast Seeding &<br>Flexterra Hydromulch<br>\$8,017 | Drill Seed, Straw<br>Mulch w/Tackifier<br>\$2,000 | Hydroseed,<br>Flexterra<br>Hydromulch \$8,000 |
| Fix BMP's and Add<br>More                            | \$5,000                                     | \$5,000 to \$10,000                                    | \$5,000   | \$10,000                                      |
| 1 Year Extended Weed<br>Control                      | \$350                                       | \$450  | \$250   | \$400   |
| Total Costs  | \$20,070 to<br>\$23,070                     | \$25,217 to<br>\$42,217                                | \$13,250 to<br>\$19,250                           | \$28,400 to \$43,400                          |

| INTRODUCTION | Indirect Cost Estimates Resulting From Unsuccessful Reclamation   |
|--------------|---|
| CASE STUDIES | <ul> <li>Fines can range from \$0.10 - \$15.00 per acre depending on<br/>site conditions and other relevant factors</li> </ul>                                  |
| DISCUSSION   | <ul> <li>Administrative costs can range from \$20,000 to \$120,000 per<br/>year depending on the amount and severity of unsuccessful<br/>reclamation</li> </ul> |
| SITE PHOTOS  | <ul> <li>An estimate of lost opportunity costs to be in the area of<br/>\$1,000 per acre in standard situations</li> </ul>                                      |





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### CONCLUSIONS

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• 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

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### 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

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JUNE 2005



SEPTEMBER 2008

**CASE STUDIES** 

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SEPTEMBER 2008

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SEPTEMBER 2008

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**BMP Blanket Install** 



### ENCANA OIL & GAS

FGM Application

WESTERN STATES

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ROW – Shrubs + Seed + Slash

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Sediment Pond

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After

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### **CONTACT INFORMATION**

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