Bond Release Geodatabase for a surface coal mine in Wyoming

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Project Objectives:

► Develop a Geographic Information System (GIS) Bond Release Geodatabase to track the verification of environmental performance standards and reclaimed areas that have achieved bond release at the North Antelope Rochelle Mine (NARM).

► Develop mobile computing procedures utilizing a Geographic Positioning System (GPS) to verify the reclamation and bond release compliance requirements during inspections.

► Develop a system of spatial data exchange between the Land Quality Division (LQD) of the Wyoming Department of Environmental Quality (WDEQ) and the operator for sending, verifying, and approving features of the Geodatabase.
The project was completed due to the cooperative effort between three parties:

► **Wyoming Department of Environmental Quality/Land Quality Division (WDEQ/LQD)**
► **Office of Surface Mining/Technical Innovation and Professional Services (OSM/TIPS)**
► **Powder River Coal, LLC (PRC)**

**WDEQ/LQD:**
- Developed Geodatabase for Bond release purposes
- Developed Geodatabase for inspection compliance (inspection) purposes
- Updated both Geodatabases with time

**OSM/TIPS:**
- Provided GIS training for the LQD staff and industry
- Helped develop a Geodatabase design
- Supplied the LQD with GPS units and GIS software licensing

**PRC:**
- Provided requested data
- Helped develop a system of transferring data of the revised, updated and approved Geodatabase
## Wyoming Surface Coal Mines Information

<table>
<thead>
<tr>
<th>What</th>
<th>Amount</th>
<th>Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total permits since 1973</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Total active permits</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Total permitted acreage</td>
<td></td>
<td>428,925</td>
</tr>
<tr>
<td>Total affected acreage</td>
<td></td>
<td>234,176</td>
</tr>
<tr>
<td>Range of Permit size</td>
<td></td>
<td>279-46,000</td>
</tr>
<tr>
<td>Average permit volumes</td>
<td>20-30 vol., 200 maps</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Area Bond</th>
<th>8,198</th>
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<tbody>
<tr>
<td>Phase I bond release</td>
<td>17,893</td>
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<tr>
<td>Phase II bond release</td>
<td></td>
</tr>
<tr>
<td>Phase III, full bond</td>
<td>5,905</td>
</tr>
<tr>
<td>release</td>
<td></td>
</tr>
</tbody>
</table>
Verification of environmental compliance in Wyoming

Spatial extent and complexity of mines poses a compliance challenge for the LQD of the Wyoming Department of Environmental Quality.

**Coal production (thousand tons), 2008**

40% of USA total coal production comes from Wyoming

Source: U.S. Department of Labor, Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine Employment and Coal Production Report."
North Antelope Rochelle Mine, Wyoming
Permit area: 46,012 acres
Acreage affected: 28,649 acres
Million tons of coal produced in 2008: 97.5
Three major active pits
Reasons for developing Geodatabase for NARM:

- Increasing acreage of the permit, disturbed, and reclaimed area
The inspected features recorded within NARM’s permit area, as of February 2010, included:

- 89 topsoil stockpiles
- 83 ponds structures (sediment pond, sediment trap, facility, flood control, and backfill ponds and diversion)
- 109 culverts
- 20 alternate sediment control measure (ASCM’s)
- 107 groundwater monitoring wells
- 8 surface water monitoring sites

>400 – total features

**Reasons for developing Geodatabase for NARM:**

- Increasing number of inspection features such stockpiles, sediment control features, diversion, monitoring facilities, active coal pit areas, mined and permanently reclaimed areas, etc.

*Extreme size requires extreme measures*
Reasons for developing Geodatabase for NARM:

- Variable acreage (0.1-482 acres) of rough backfill/quality areas (in a process of verification or bond released) throughout the mine.
Need to develop a system of tracking reclamation requirements that are verified in the field and later released from the partial incremental bond.

**Major reclamation requirements:**

- Postmine topography (overburden backfilled, graded and verified for the quality)
- Stream channel reconstruction and drainage system functionality
- Topsoil depth
- Stability of permanent impoundments
- Erosion stability
- Release from sediment control
- Vegetation establishment, species composition and diversity
- Shrub density establishment
- Wildlife habitat features restoration
North Antelope/Rochelle Mine

Examples of major reclamation phases

Area topsoiled

Porcupine Creek Reclaimed Area

Area graded
**Instruments for bond release verification and approval**

**Tracking of Verification Approval** *(no money release, bond rollover)*

**Annual Report**, verification of:
- Rough Backfill and Quality of Backfill
- Stream Channel Reconstruction and Drainage System Functionality
- Soil Depth

**Stand Alone Bond Release Verification Permit Volume** *(e.g. Regraded Spoil Program)*

**Geographic Information System (GIS)**
Bond Release Geodatabase

**Tracking of Incremental Bond Release Approval** *(money release, $$$$)*

(DEQ/LQD Coal Rules and Regulations, Chapter 15 Process):
- Area Bond (rough backfill graded)
- Phase I (topsoil applied)
- Phase II (initial vegetation established)
- Phase III (full release)
**Methods**

- GIS geodatabase using an ESRI Personal Geodatabase, ArcInfo 9.2 (ArcMap, ArcCatalog, and ArcTools)

- Mobile GIS function - Trimble GeoExplorer Series GeoXM handheld GPS unit using ESRI ArcPad 7.1

**Data sources:**
Mine map layers submitted from the:
- mine operator,
- inspection reports,
- field collected GPS data
Results

Developing Bond Release Geodatabase for bond release and inspection purposes. A spatial database is structured using tables. Each row represents a record contained within the thematic layer (feature class) and columns (attribute fields) contain all required types of information associated with the record including the location.

1. Choosing thematic layers to organize information - Feature Classes

2. Creating Attribute Table (Attribute Fields) for each of the feature class

3. Choosing Data Types and Domains

4. Using mobile GIS applications to collect and update bond release verification features
Choosing thematic layers for the Geodatabase

**Feature Classes and Attribute Tables** are created on the basis of requirements of the:

- Wyoming Environmental Quality Act
- Wyoming Department of Environmental Quality Rules and Regulations
- Permit Commitments

Feature classes that are related by the type of compliance function they support are organized using a feature dataset.
Bond Release Geodatabase structure stored on computer and a structure of file folders supporting the Geodatabase:

File folders supporting Geodatabase:

Feature Dataset explained in details later during the presentation.
Phase 1, 2, and 3 Verifications requirements, Bond Release Geodatabase structure

Feature classes chosen for the specific phases on the basis of information included in the LQD Guideline Nos. 20, 21, and 22.

These are …_Approved feature classes that will be compared with the …_Requested feature classes.
Tracking of Bond Release Verification approval through Annual Report

Rough/quality backfill verification feature class

Comparing rough/quality backfill verification from the Annual Report submitted in Dec. 2009 with the current rough/quality backfill areas already approved.
<table>
<thead>
<tr>
<th>Attribute Field name</th>
<th>Data type</th>
<th>Domain</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polygon ID</td>
<td>text</td>
<td></td>
<td>Unique identifier used to reference the feature</td>
</tr>
<tr>
<td>Acreage</td>
<td>double</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection date</td>
<td>Date</td>
<td>Calendar</td>
<td>Records date of most recent inspection</td>
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<tr>
<td>Inspector name</td>
<td>text</td>
<td>Waitkus Buchanan</td>
<td>Choose the inspector name</td>
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<tr>
<td>Backfill grading</td>
<td>text</td>
<td>Acceptable Not acceptable</td>
<td>Describes if grading is acceptable to the post mine topography and if erosion is present</td>
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<td>Compliance date</td>
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<td>Scheduled date of correction</td>
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<td>Calendar</td>
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<td>Comments</td>
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<td>Document_Hotlink</td>
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<td></td>
<td>Approval document located in the Document Hotlinks database</td>
</tr>
</tbody>
</table>
Comparing already verified rough/quality backfill areas with areas requested through the 2009 Annual Report.
Rough/quality backfill areas discrepancy was found between areas already verified and areas requested through the 2009 Annual Report.

This portion of the area has been already verified.

One of the area requested for the rough/backfill verification needs to be revised.
“Field” verification of rough/quality backfill areas

Comparing requested rough/quality backfill area with the “Topsoil Stockpiles” feature class layer.

One of the requested area was the same as the topsoil stockpile located on native area. The 40 acres area needs to be removed from the request.
A list of compliance features verified during monthly inspection at the mine

Some of the features such as topsoil depth, stream channel reconstruction or wildlife features are the bond verification feature requirements. Others, are important compliance features inspected monthly.
Example of the GPS screen during a field inspection.
Bond Release Verification of the topsoil depth feature class

Using Geodatabase to compare:

♦ Topsoil polygons already approved
♦ Topsoil polygons requested for approval
♦ Topsoil depth points verified in the field

Requested - 654 acres
Verified - 403 acres

Additional verification needed - 251 acres
Bond Release Verification of the creek channel restoration feature class

The center line of the restored Reach 1 and 2 of Porcupine Creek was verified in the field and no problem was found compared to the approved permit topography.
### Field monitoring of reclaimed areas (checking for erosion features)

<table>
<thead>
<tr>
<th>Field name</th>
<th>Data type</th>
<th>Domains</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Feature ID</td>
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<td></td>
<td>Number</td>
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<tr>
<td>Inspection Date</td>
<td>date</td>
<td>Calendar</td>
<td>Date of the last inspection</td>
</tr>
<tr>
<td>Inspector Name</td>
<td>text</td>
<td>Waitkus Buchanan</td>
<td>Choose the inspector name</td>
</tr>
<tr>
<td>Erosion Type</td>
<td>text</td>
<td>Rill active, Rill inactive, Gully active, Gully inactive</td>
<td>Depth, width</td>
</tr>
<tr>
<td>Erosion Compliance</td>
<td>text</td>
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<td>A significant active or inactive feature is not acceptable</td>
</tr>
<tr>
<td>Erosion Compliance Date</td>
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<td>Calendar</td>
<td>A target date when the erosional feature will be repaired</td>
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<tr>
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<tr>
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<tr>
<td>Comments</td>
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<tr>
<td>Photo_Link</td>
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<td>Link to the folder: Documents_Hotlink</td>
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</tbody>
</table>
Photo_Hotlink

November 2009

December 2009

November 2009

December 2009

Erosion features

Legend
- Erosion_Feature_In
- Rough_Bexhill_Applied_Catchup_2005
The Document Hotlink Folder structure mirrors the structure of the Geodatabase. All approval documents with dates and signatures as well as photos (related to the mining and reclamation progress and erosion) are stored here.
Review of mining and reclamation progress (Photo_pit)
GPS location of where photographs were taken

Photographs were taken from the same six GPS location sites throughout the years. The progress of mining and reclamation activities was compared with the existing permit. An example of the documented progress is shown for the “Access Road” GPS site, on the next slide.
Access Road - Photo_ pit

View of the reclamation progress over several years in the northern portion of the Western Pit.

May 2005

July 2006

September 2007

October 2009
A system of exchange between the LQD and the operator for sending, verifying and approving feature classes of the Geodatabase has been developed.

Bond Verification/Bond Release Geodatabase procedures were developed and a manual was prepared by the operator. This improved the efficiency of reviews and shortened the time of the bond release approval.
Conclusions

► Due to the size of this coal mining operation and variable size of reclamation units, a Geodatabase is a highly effective method to keep track of the bond release progress.

► The use of GPS technique supports the verification and tracking of compliance features required for bond release.

► Verification of compliance features using the Bond Release Geodatabase included:
  ♦ approximately 5700 acres for rough and quality of backfill areas
  ♦ approximately 4500 acres for topsoil depth applications

► Additional function of the Bond Release Geodatabase includes:
  ♦ improving the inspector’s ability to assess reclamation adequacy
  ♦ review of mining and reclamation progress