

**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:

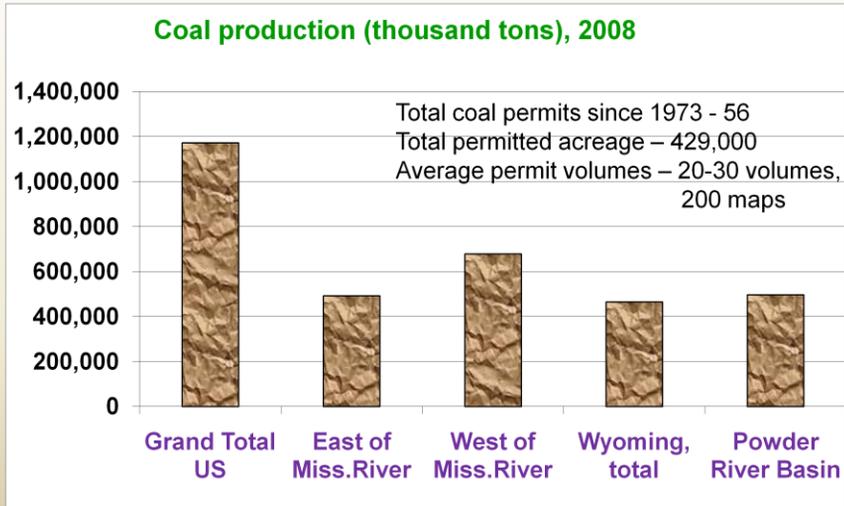
- Provided GIS training for the LQD staff and industry
- Helped develop a Geodatabase design
- Supplied the LQD with GPS units and GIS software licensing

PRC:

- Provided requested data
- Helped develop a system of transferring data of the revised, updated and approved Geodatabase

Verification of environmental compliance in Wyoming

Spatial extent and complexity of mines poses a compliance challenge for the LQD of the WDEQ.



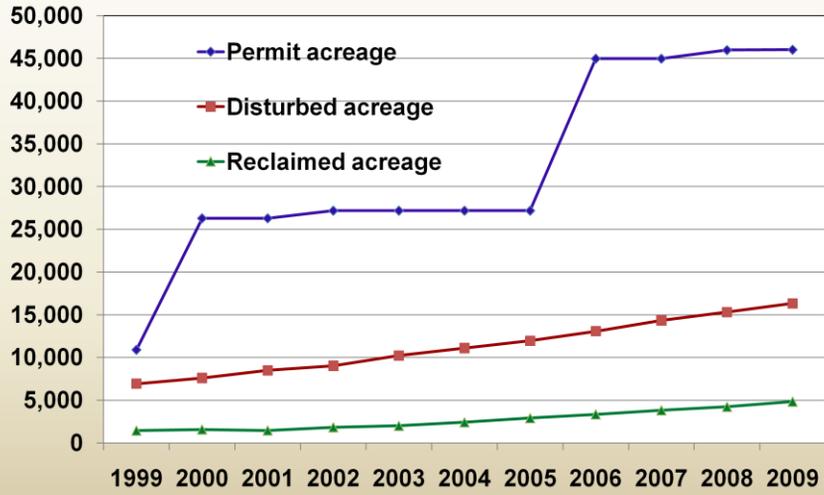
Source: U.S. Department of Labor, Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

North Antelope Rochelle Mine, Wyoming
Permit area: 46,012 acres
Acreage affected: 28,649 acres
Million tons of coal produced in 2009: 98.5
Three major active pits



Reasons for developing Geodatabase for NARM:

■ **Increasing acreage of the permit, disturbed, and reclaimed area**



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.**

The inspected features recorded within NARM's permit area, as of February 2010, included:

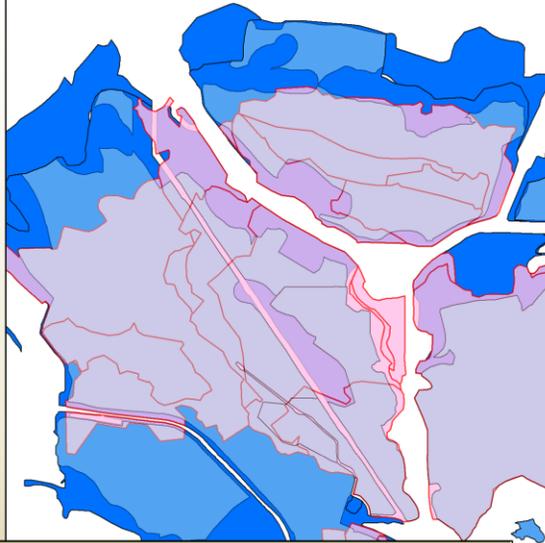
- 89 topsoil stockpiles
- 83 ponds structures (sediment pond, sediment trap, facility, flood control, and backfill ponds and diversion)
- 109 culverts
- 20 alternate sediment control measure (ASCM's)
- 107 groundwater monitoring wells
- 8 surface water monitoring sites

- >400 – total features

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.



Legend

- Phase_1_Partial_Incremental_Approved_February_2010
- LQD_Historical_Rough_Backfill_Verification
- Rough_Backfill_Approved_Catchup_2009

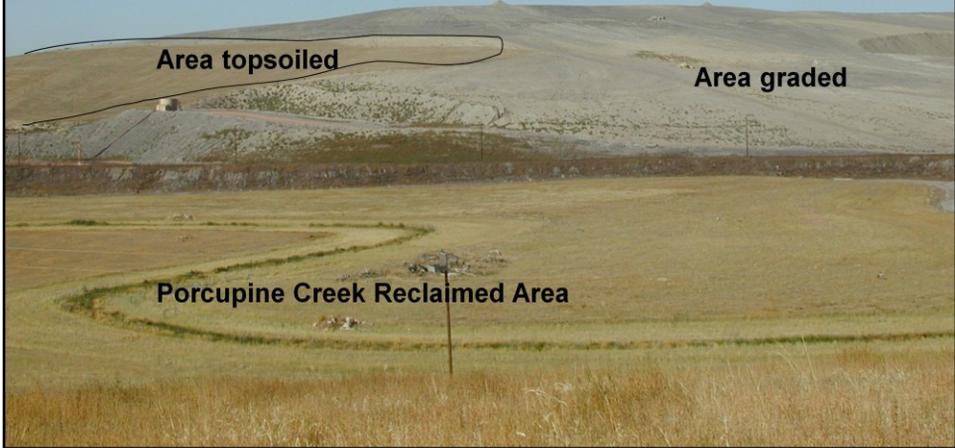
Need to develop a system of tracking reclamation requirements that are verified in the field and later released from the partial incremental bond.

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



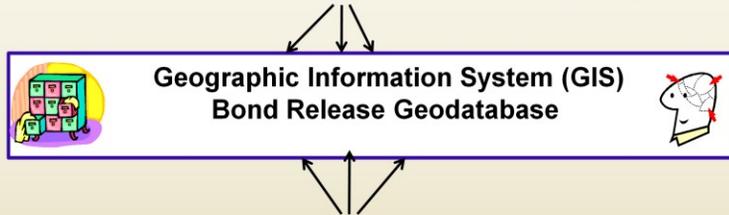
Instruments for bond release verification and approval

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)



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:

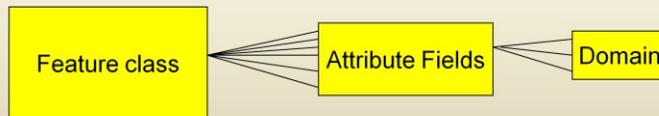
- mine operator,
- inspection reports,
- field collected GPS data

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

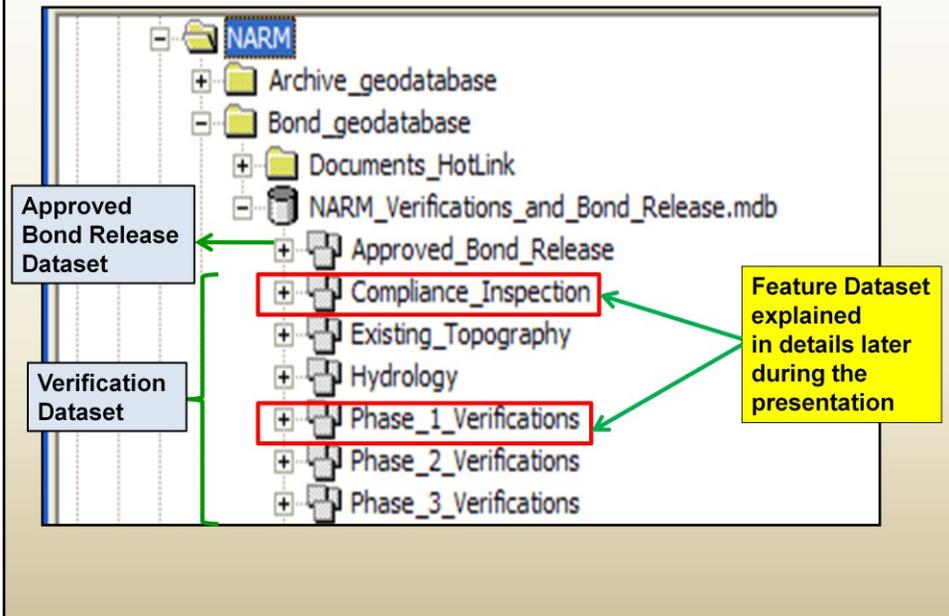
Choosing thematic layers for the Geodatabase

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

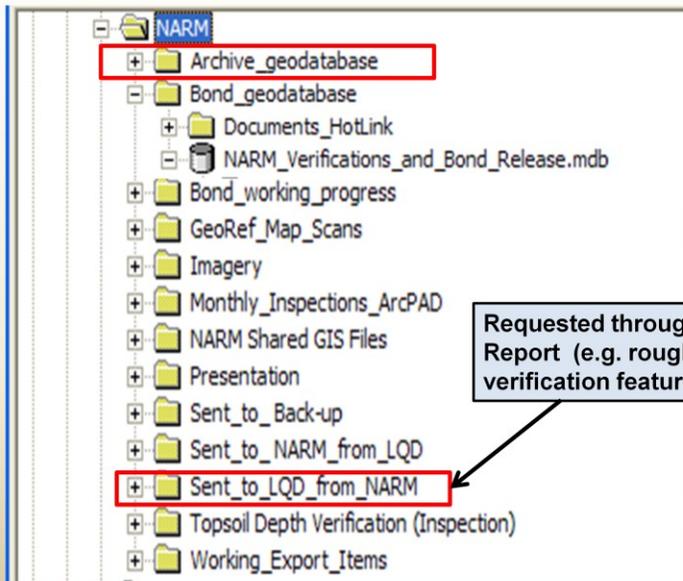
- **Wyoming Environmental Quality Act**
- **Wyoming Department of Environmental Quality Rules and Regulations**
- **Permit Commitments**

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:



Structure of file folders supporting the Geodatabase :



Phase 1 Verifications requirements

Feature classes were chosen for the specific phases on the basis of information included in the LQD Guidelines.

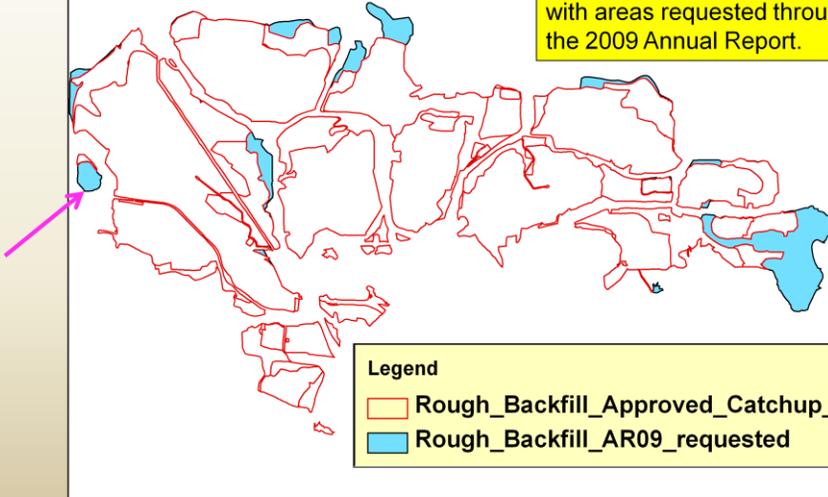
These are ..._Approved feature classes that will be compared with the ..._Requested feature classes.

- Approved_Bond_Release
 - Phase_1_Partial_Incremental_Approved_February_2010
 - Phase_2_Partial_Incremental_Approved
 - Phase_3_Partial_Incremental_Approved
- Compliance_Inspection
- Existing_Topography
- Hydrology
- Phase_1_Verifications
- Drainage_System_Functionality_Approved_Catchup_2009
- LQD_Historical_Rough_Backfill_Verification
- Quality_Backfill_Approved_Catchup_2009
- Rough_Backfill_Approved_Catchup_2009
- Stream_Channel_Reconstruction_Approved_Catchup_2009
- Topsoil_Depth_Approved_Catchup_2009

Bond Release Verification of the Rough/Quality Backfill feature class

0 490 980 1,960 2,940 3,920
Feet

Comparing already verified rough/quality backfill areas with areas requested through the 2009 Annual Report.



Legend

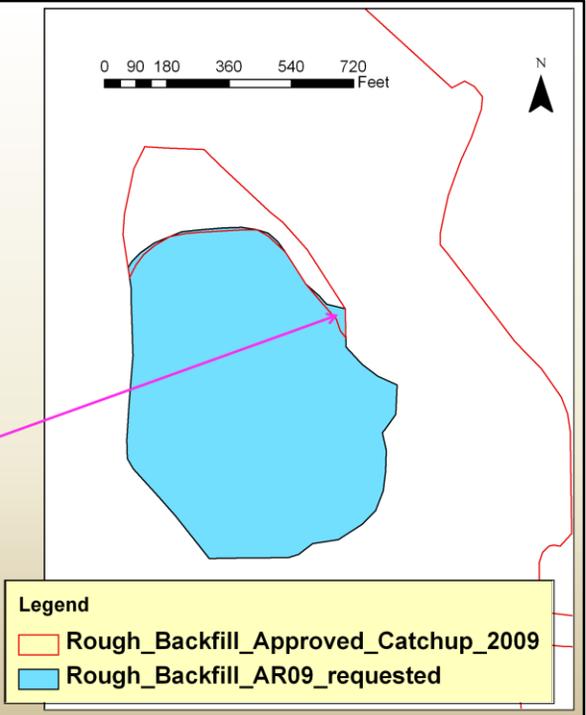
- Rough_Backfill_Approved_Catchup_2009
- Rough_Backfill_AR09_requested

**“Office” verification
of rough/quality
backfill areas**

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.



- Legend**
- Rough_Backfill_Approved_Catchup_2009
 - Rough_Backfill_AR09_requested

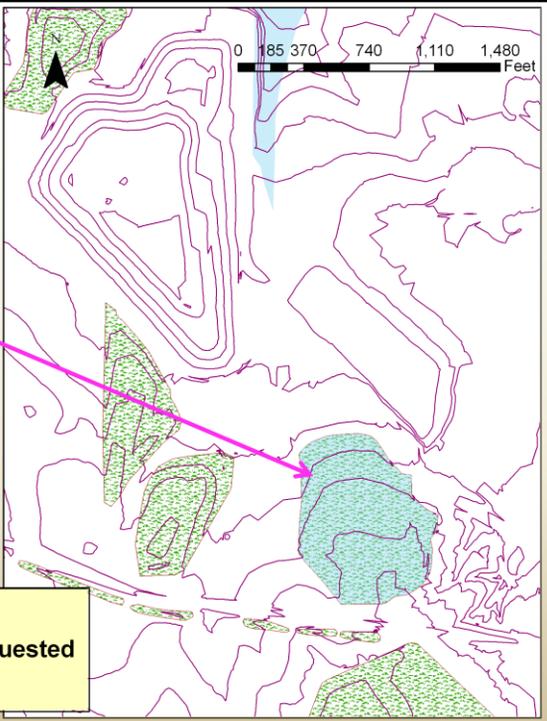
“Field” verification of rough/quality backfill areas

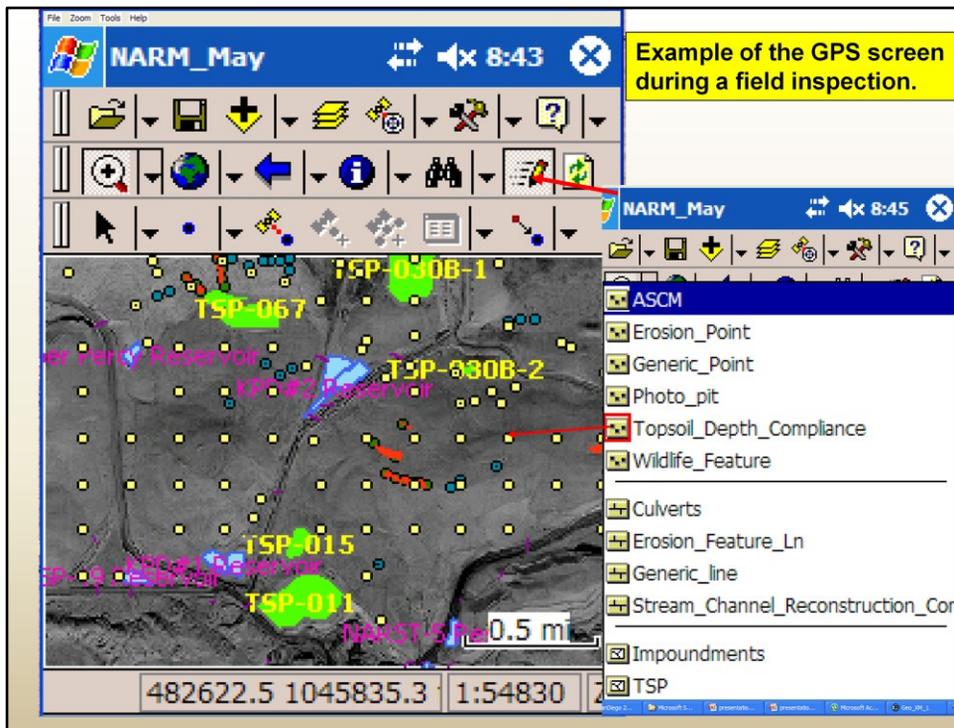
Comparing requested rough/quality backfill area with the “Topsoil Stockpiles” feature class layer.

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.

Legend

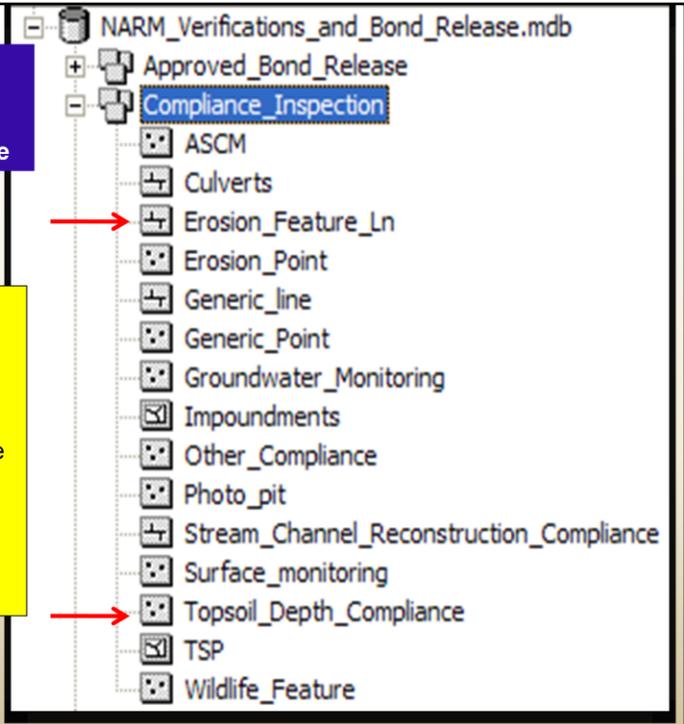
-  Rough_Backfill_AR09_requested
-  Topsoil Stockpile





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.



Bond Release Verification of the topsoil depth feature class

Using Geodatabase to compare:

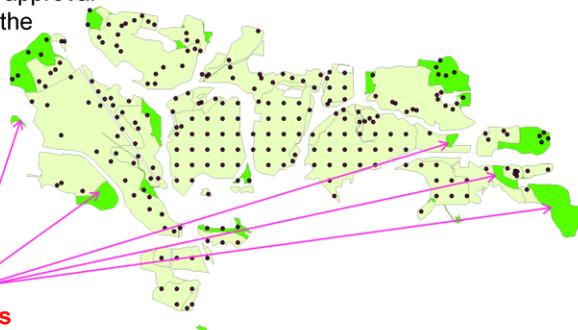
- ◆ Topsoil polygons already approved
- ◆ Topsoil polygons requested for approval
- ◆ Topsoil depth points verified in the field

Requested - 654 acres

Verified - 403 acres

Additional verification needed - **251 acres**

0 1,6503,300 6,600 9,900 13,200 Feet



Legend

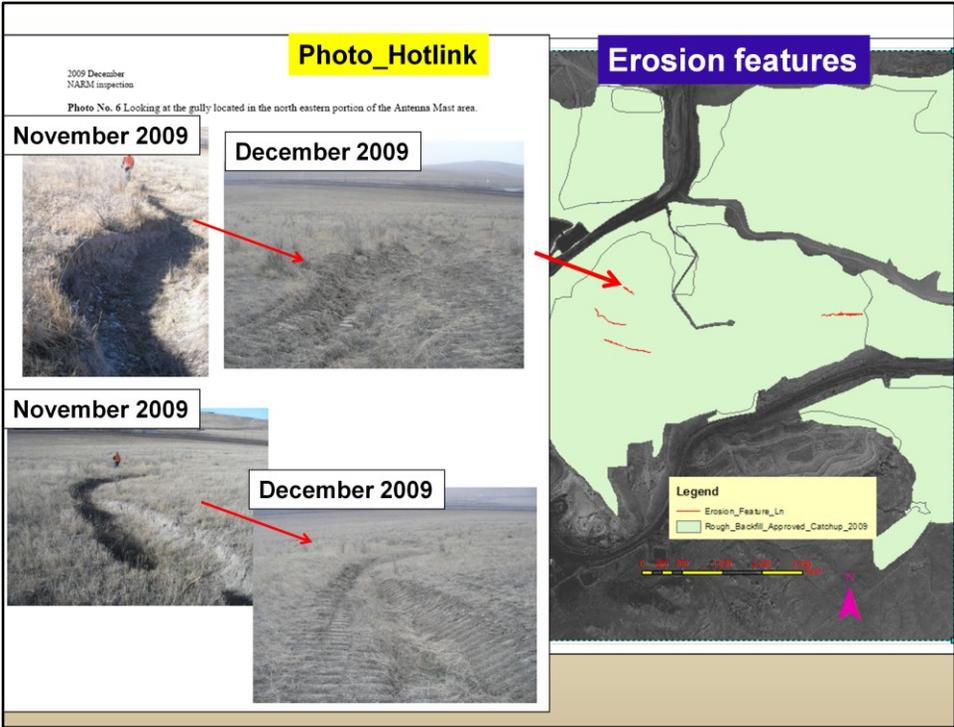
- Topsoil_Depth_Compliance
- Soil_Depth_AR09_requested
- Topsoil_Depth_Approved_Catchup_2009

Field monitoring
of reclaimed areas
(checking for
erosion features)

- NARM_Verifications_and_Bond_Release.mdb
 - Approved_Bond_Release
 - Compliance_Inspection
 - ASCM
 - Culverts
 - Erosion_Feature_Ln
 - Erosion_Point
 - Generic_line
 - Generic_Point
 - Groundwater_Monitoring
 - Impoundments
 - Other_Compliance
 - Photo_pit
 - Stream_Channel_Reconstruction_Compliance
 - Surface_monitoring
 - Topsoil_Depth_Compliance
 - TSP
 - Wildlife_Feature

Erosion Feature Attribute Table, Data Type, and Domain Names

Field name	Data type	Domains	Comments
Feature ID	text		Number
Inspection Date	date	Calendar	Date of the last inspection
Inspector Name	text	Waitkus	Choose the inspector name
Erosion Type	text	Rill active, Rill inactive Gully active, Gully inactive	Depth, width
Erosion Compliance	text	Acceptable, Not acceptable	A significant active or inactive feature is not acceptable
Erosion Compliance Date	date	Calendar	A target date when the erosional feature will be repaired
Cover status	text	Permanent seeded Temporary seeded Mulched	
Vegetation present	text	Yes, No	
Comments	text		
Photo_Link	text		Link to the folder: Documents_Hotlink



Documents Hotlink Folder

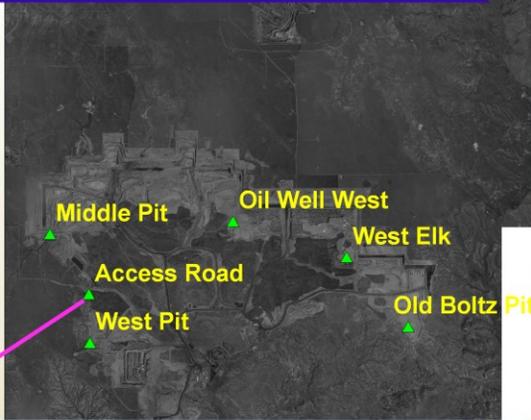
The Document Hotlink Folder structure mirrors the structure of the Geodatabase. All approval documents with dates and signatures as well as photos (related to the mining and reclamation progress and erosion) are stored here.

- Bond_geodatabase
 - Documents_HotLink
 - Approved_Bond_Release
 - Phase_1
 - Phase_2
 - Phase_3
 - Phase_1_Verification
 - Drainage_Function
 - Rough_Quality_Backfill
 - Soil_Depth
 - Stream_Channel_Reconstruction
 - Phase_2_Verification
 - Phase_3_Verificaiton
 - Photos
 - Erosion_Feature
 - Photo_Pit
 - Access_Road
 - Middle_Pit
 - Oil_Well_West
 - Old_Boltz_Pit
 - West_Elk
 - West_Pit

- NARM Verifications and Bond Release.mdb

**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.



Attributes of Photo_pit

OBJECTID*	Shape*	Inspection_Date	Att	Comments	Photo_ID	Direction	Photo_Hotlink
1	Point	5/15/2008	Watkus	started 2008	Middle Pit	N	P:\GIS\ARM\Bond_geodatabase\Documents_HotLink\Photos\Photo_Pit\Middle_Pit\Middle_Pit.pdf
2	Point	5/15/2008	Watkus	started 2008, north of West Pit	West Pit	NE	P:\GIS\ARM\Bond_geodatabase\Documents_HotLink\Photos\Photo_Pit\West_Pit\West_Pit.pdf
3	Point	9/29/2009	Buchanan	started 2009, by TSP 91A	West Elk	E	P:\GIS\ARM\Bond_geodatabase\Documents_HotLink\Photos\Photo_Pit\West_Elk\West_Elk.pdf
4	Point	9/24/2009	Buchanan	started 2008, by TSP 52B	Oil Well West	E	P:\GIS\ARM\Bond_geodatabase\Documents_HotLink\Photos\Photo_Pit\Oil_Well_West\Oil_Well_West.pdf
5	Point	10/1/2009	Watkus	started 2005	Access Road	E	P:\GIS\ARM\Bond_geodatabase\Documents_HotLink\Photos\Photo_Pit\Access_Road\Access_Road.pdf
6	Point	10/1/2009	Watkus	started 2009	Old Boltz Pit	N	P:\GIS\ARM\Bond_geodatabase\Documents_HotLink\Photos\Photo_Pit\Old_Boltz_Pit\Old_Boltz_Pit.pdf

Access Road -
Photo_pit

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

May 2005



July 2006

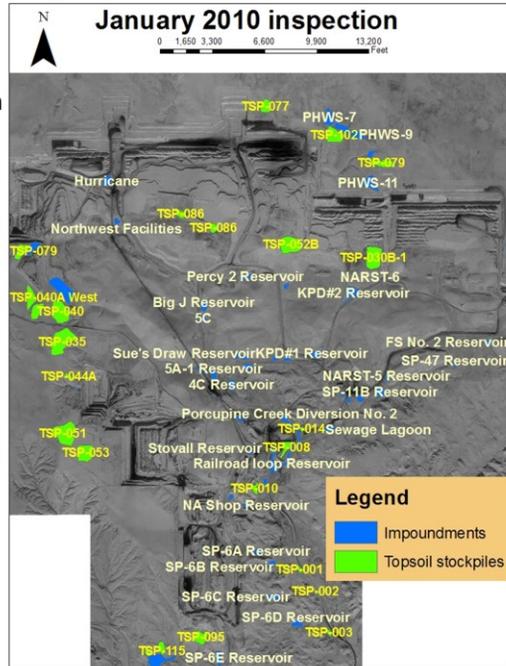


October 2009



Additional benefits of Geodatabase

- Preparing Inspection Reports (Maps as ArcMap and attribute tables in Excel)
- Record storage and maintenance
- Accelerating the process of preparing inspection reports
- Feature inventories and accelerating the process of exchanging information between various agencies
- Compliance assessment (document the location and circumstances of incidents and events for further action or reporting)



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