

MINE MAP DIGITIZATION & GIS IMPLEMENTATION

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Mining Specialist

IMCC Conference 2/16/2012

**Pennsylvania Department of
Environmental Protection**



MINE MAP DIGITIZATION & GIS IMPLEMENTATION

- Why is this important?
 - Mine Subsidence Insurance Program
 - Archival Quality Digital Map Images
 - Mine Safety
 - Mine Reclamation Projects
 - Oil and Gas Drilling
 - Make Government more Efficient

Mine Map Acquisition

- Active Mining Permit Maps
- In-House DEP CDO Mine Map Collection
- CONSOL Collection at PITT (Pgh Coal Co)
- R&P Collection at IUP
- County Courthouses
- Private Collections

Mine Map Scanning

- Purpose is to create an archive of Digital Map Images that meet image quality standards
- Current Scanning Standards:
 - Uncompressed tagged image file format (.tif)
 - 400 dpi (230 dpi for large format maps)
 - 24-bit color depth

Mine Map Scanning

- Paradigm GXT 56 HD roll scanner
 - Colortrac
 - Maps in good condition & <56 in
- Cruse flat-bed scanner
 - Maps >56 inches or damaged
 - 2 Available: OSM and IUP



Digital Map Image Storage

- Currently have 71,223 digital map images (varying quality from multiple resources)
- Each new archival Digital Map Image is approximately 0.5 GB to 1.5 GB
- Approximately 3,500 more paper maps in the CDO Collection to scan to standards,
- Continuous intake from outside collections

Digital Map Image Storage

- IBM x-Series server and storage array
 - 38.0 configured terabytes
 - 18.6 terabytes used for digital map images
 - Also stores GIS imagery and vector data
 - Expandable storage array for future needs
- IBM TS3200 Library for Tape Back-up
 - Weekly differentials to tape
 - Full back-ups 3 or 4 times a years

Database Entry - PHUMMIS

- The information contained on the mine maps is entered into the Pennsylvania Historic Underground Mine Map Inventory System
 - Mine Name
 - Operator
 - Coal Seam
 - etc.
 - Scale
 - Location
 - Survey Dates

Database Entry - PHUMMIS


PHUMMIS - Sheet Search - Windows Internet Explorer provided by DEP

http://epenwebs01/PHUMMIS/SheetSearch.aspx

PHUMMIS - Sheet Search

PHUMMIS - Sheet Search

• Textbox searches can make use of % for wildcards.



CWOPA\SSTEINGRAB

- PHUMMIS Home
- Search
- Search For Sheets
- New
- New Sheet
- Reports
- Rpt by File
- Rpt by Mine
- Rpt by Operator

Mines & Company Information

Mine Name

Company Name

Permit #

Longwall Method

Source Information

Dep Office

Hard Copy Location

Original Map Source

Location Information

Quadrangle

County

Municipality

Abbottstown

Aberdeen MD

Accident

Addison NY

Afton NY

Airville

Albion

Aldenville

Alexandria

Scanning Information

Scan File Name

GEO-Referenced

General Information

Projection Number

Coordinate System

Horizontal Datum

Vertical Datum

Color

Geology Information

Resource Mined

Local Coal Seam

Formal Coal Seam

Coal Field

Map Information

Local Sheet ID

Folio ID\CDO File Number

OSM ID

Map Type

Scale

Sheet Name

Certified

Final

Search Reset

• Textbox searches can make use of % for wildcards.

Digital Map Image Post-Processing

- Creating an image for faster display refresh and reduced network bandwidth than the archival quality image, for use in a Geographic Information System (GIS)
 - Stitching Multiple Scenes
 - Photoshop CS4's Photo Merge
 - Crop image to neatline
 - Seamless Coalbed/Mine display
 - Convert .tif to Mr.Sid
 - compression at 20:1 size ratio

Digital Map Image Georeferencing

- Fitting mine map image into correct spatial location in virtual space (GIS)
- Goal of at least 4 Control Points
- Source Control Point Selection
 - Coordinate Points on Paper map
 - Road Intersections
 - Structures
 - Property Lines

Digital Map Image Georeferencing

- Georeferencing Target Priorities
 1. Projected Coordinate Points
 2. Aerial Orthoimagery
 - a. PA DCNR PAMAP Program
 - b. Historic Images (if available)
 3. USGS Topographic Maps
 4. County-supplied Property Parcel Shapefiles
 5. Historic USGS Topographic Maps
 6. Adjacent Georeferenced Mine Maps

Digital Map Image Georeferencing

- More of an Art Form than a Science
- Limitations
 - Unknown coordinate systems of mine maps
 - Lack of surface control points
 - Original draftsmanship
 - Movement of surface control points (i.e. roads, streams, property lines) over time
 - Image distortions from paper aging (paper shrinkage) and scanning (folds/creases)

Digital Map Image Georeferencing



Digital Map Image Georeferencing

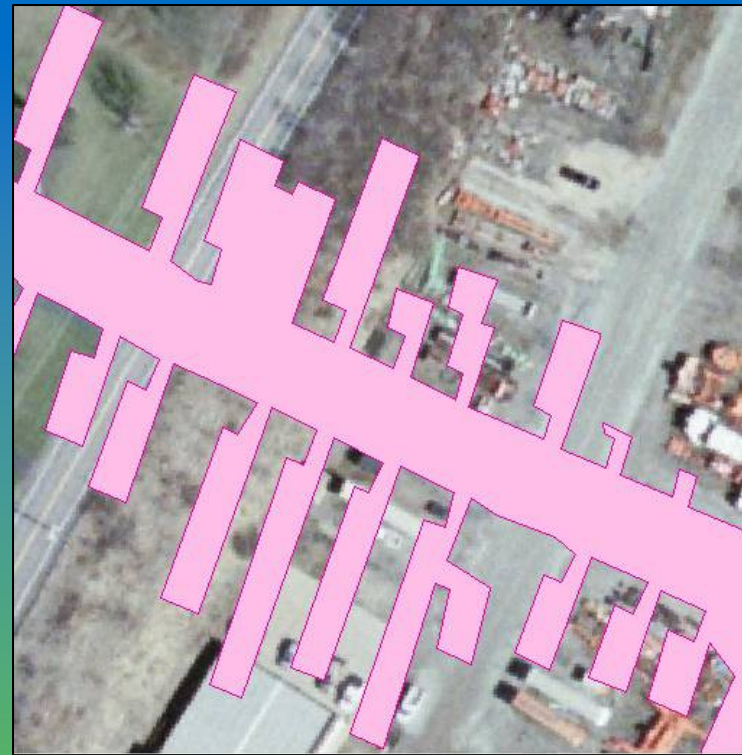
- Accuracy of Georeferencing
 - Non-quantitative
 - Newer maps better than older
 - Unknown accuracy of abandoned mine maps
 - Visual Inspection
 - Compare map image to base maps and adjacent mining
- Over 6,300 Maps georeferenced to date

Map Vectorization

- Creating Vector Data for GIS
- Captured Features
 - Active Underground Permit Boundaries
 - Longwall Panel
 - Mined Out Areas
 - CDO Mine Map Index
 - Coal Seam Elevation

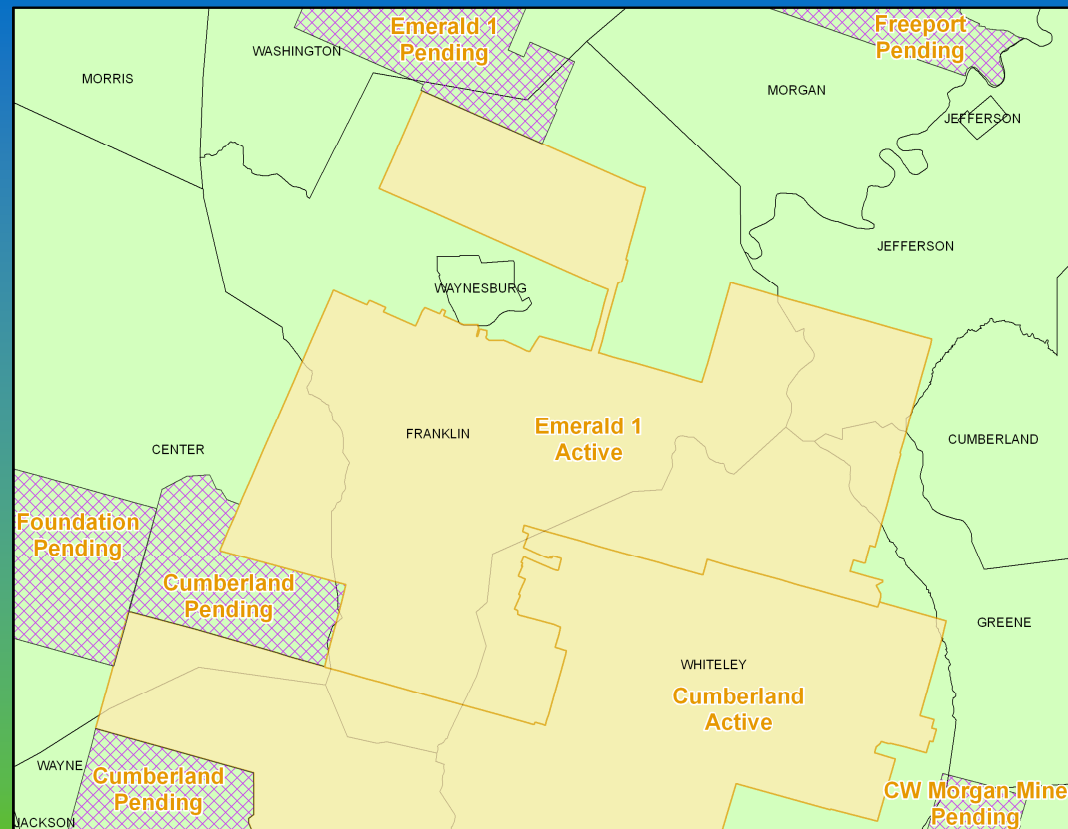
Map Vectorization

- Heads-Up Digitizing



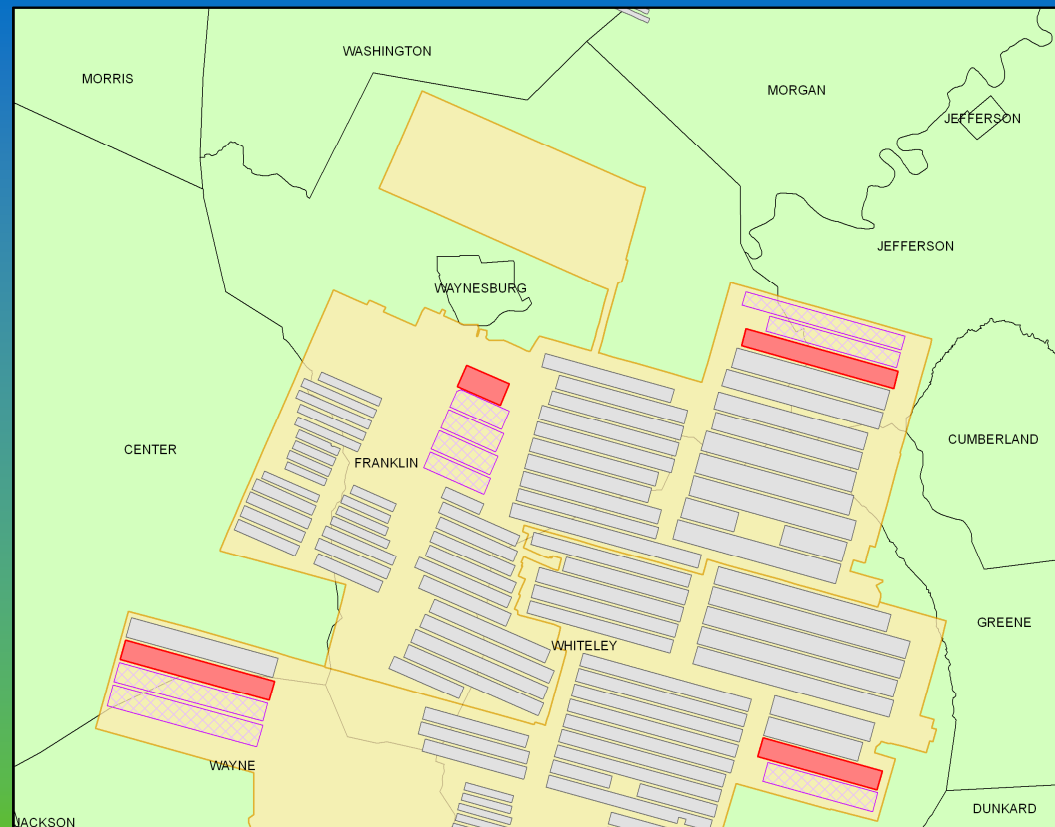
Map Vectorization

- Active Underground Permit Boundaries



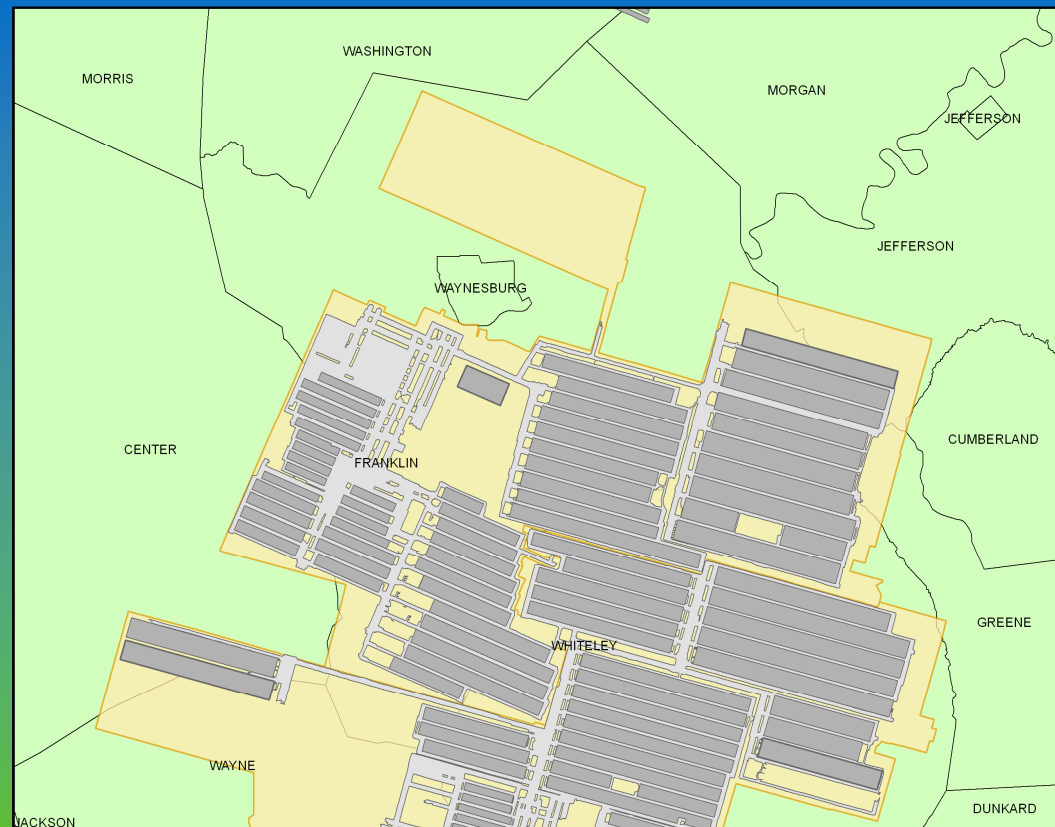
Map Vectorization

- Longwall Panels
 - Panel Footprints



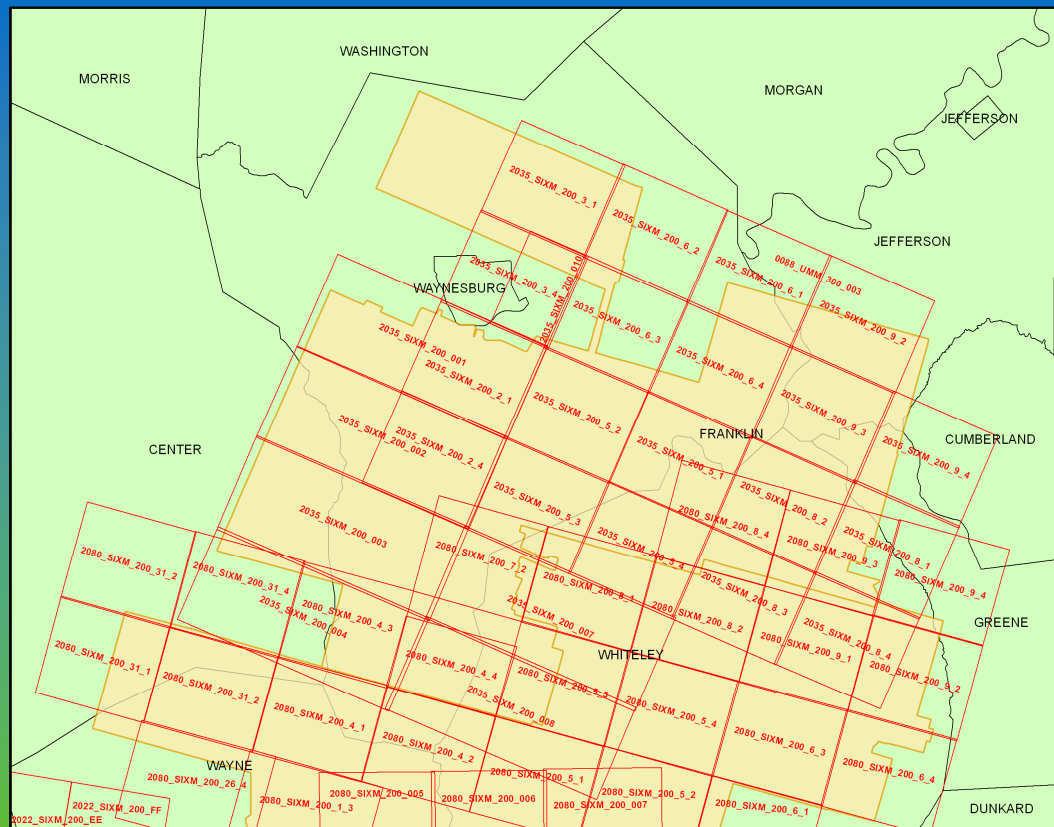
Map Vectorization

- Mined Out Areas
 - Coal Removed, Possible Voids



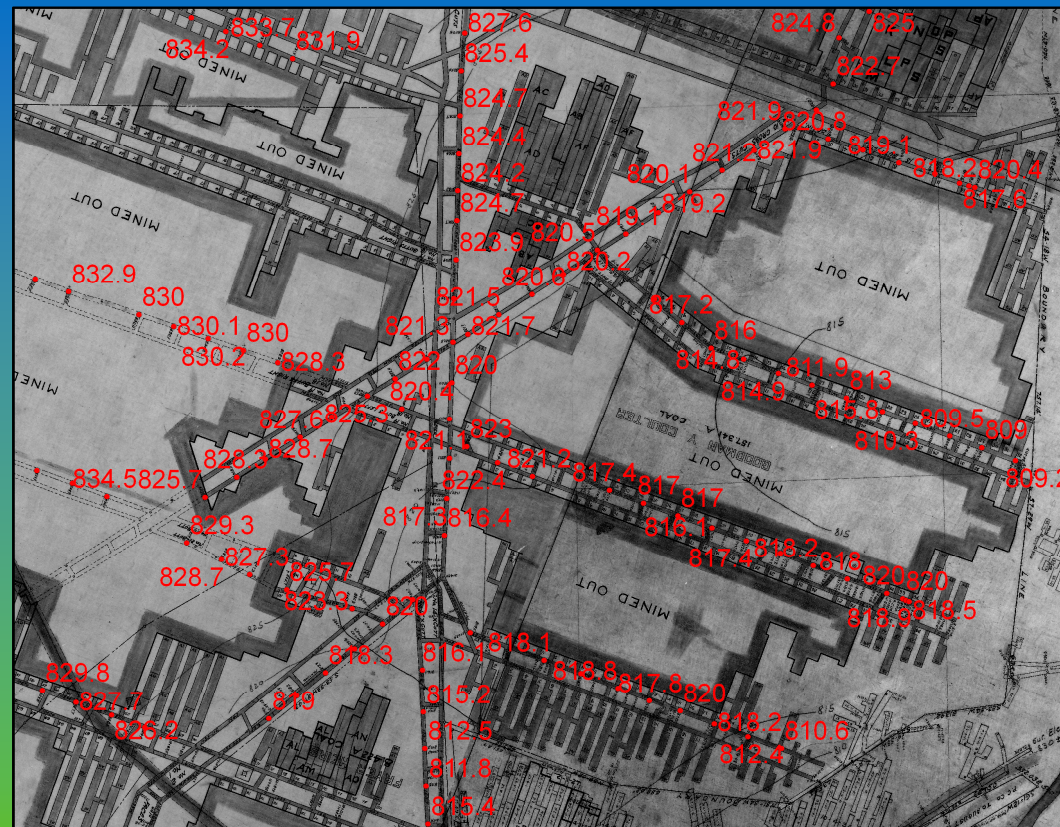
Map Vectorization

- CDO Mine Map Index
 - Extents of Map Sheets, Match PHUMMIS



Map Vectorization

- Coal Seam Elevation
 - Structure Contours, Surveyed Points



GIS Implementation

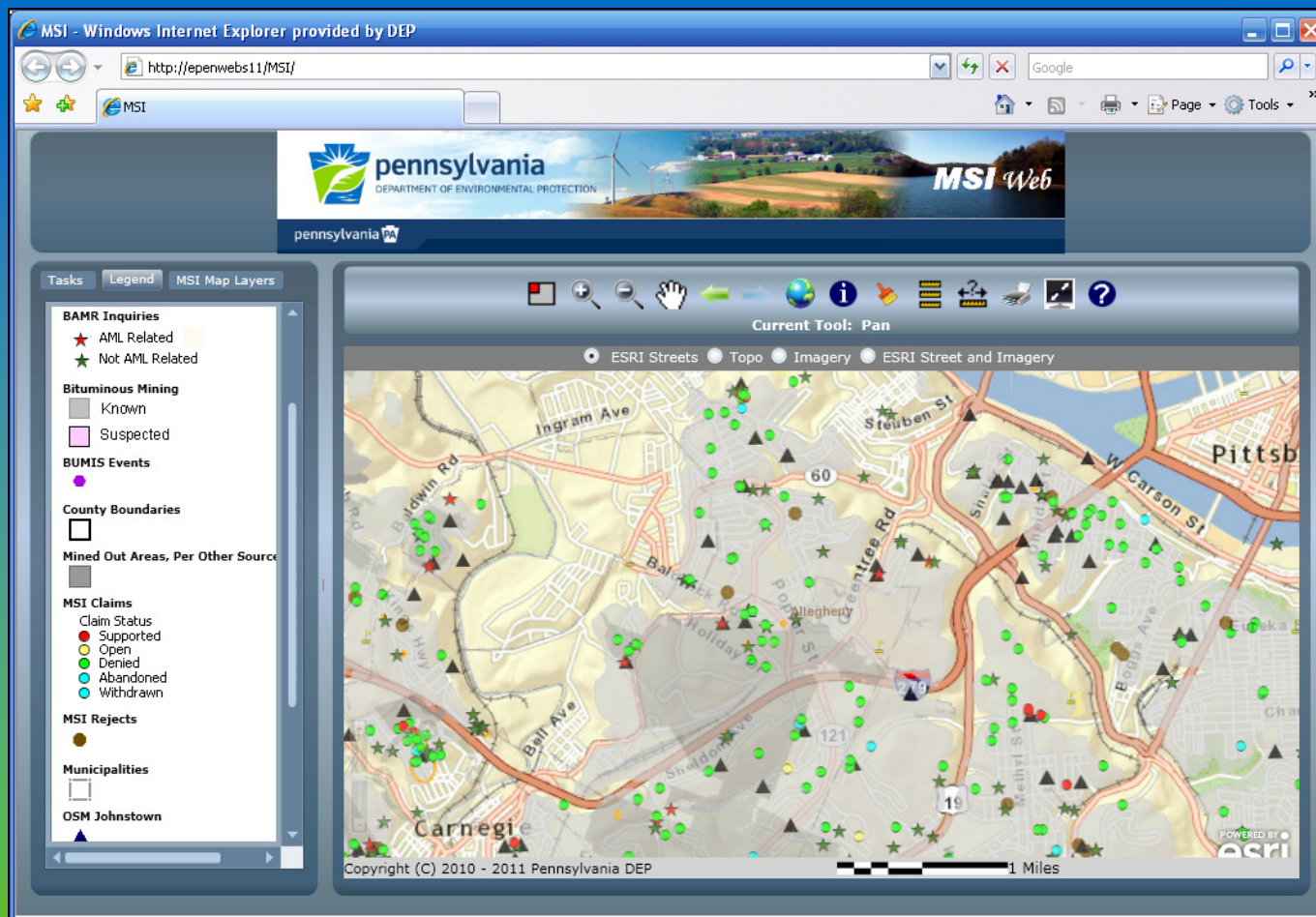
- Web Map using ArcServer: MSIWeb
- Coal Seam Elevation Rasters
- Published Map using ArcReader: SIP Map
- Looking Ahead... Automated Reporting using ArcGIS and Python scripting

GIS Implementation

- Mine Subsidence Insurance Web Map (MSIWeb)
 - For Department Internal Use Only
 - MSI Representatives can check for mining conditions and previous subsidence event locations to assist public with their decision to purchase MSI and whether a Pre-Policy Inspection is required.

GIS Implementation

- MSIWeb

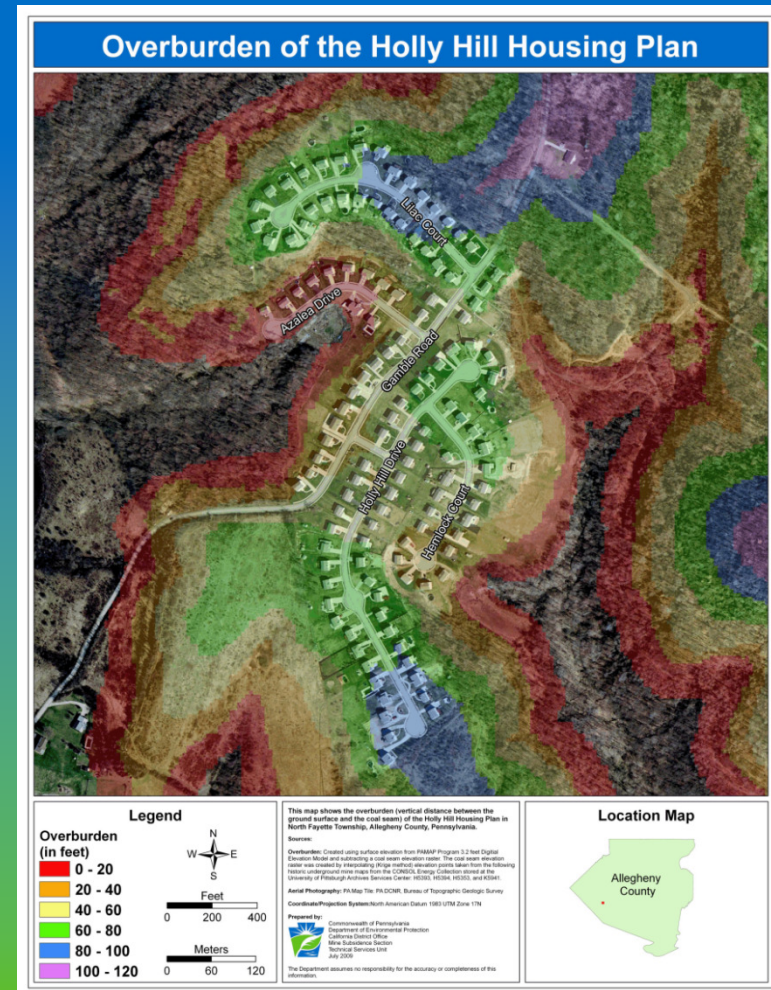
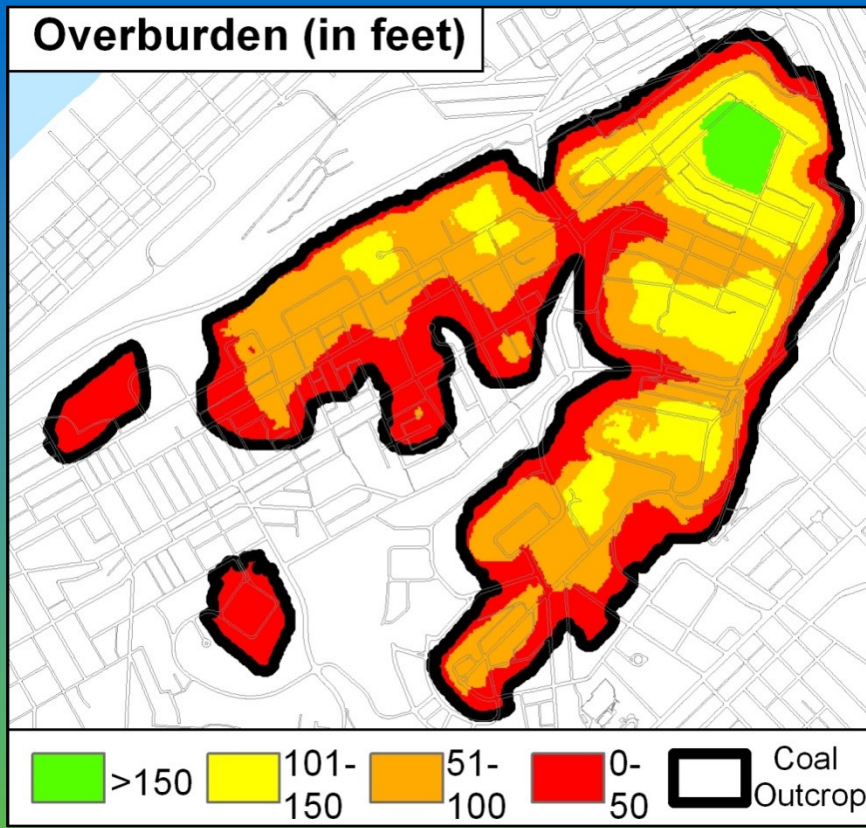


GIS Implementation

- Coal Seam Elevation Raster
 - Interpolated from digitized points/contour lines
 - When subtracted from surface DEMS, overburden raster can be created
 - Great for display at public information meetings

GIS Implementation

- Overburden Public Presentation Maps



GIS Implementation

- Subsidence Investigators' Published Map (SIPMap)
 - ArcReader and MS Access (for labels)
 - Includes everything from MSIWeb
 - Back-up if internet goes down
 - Allows Investigator's to create layouts for reports

GIS Implementation

- SIPMap

Micro...

File Home Create External Data Database Tools

Enter_Claim_Info_Here:

SIP Map Label Maker

Title: John Smith
[E.g. Site Location Map, Underground Mine Map, etc.]

Claimant Name: Detailed Mine Map

Claim Number: Claim No B1234

Additional Line 1: Montour No 4 Mine

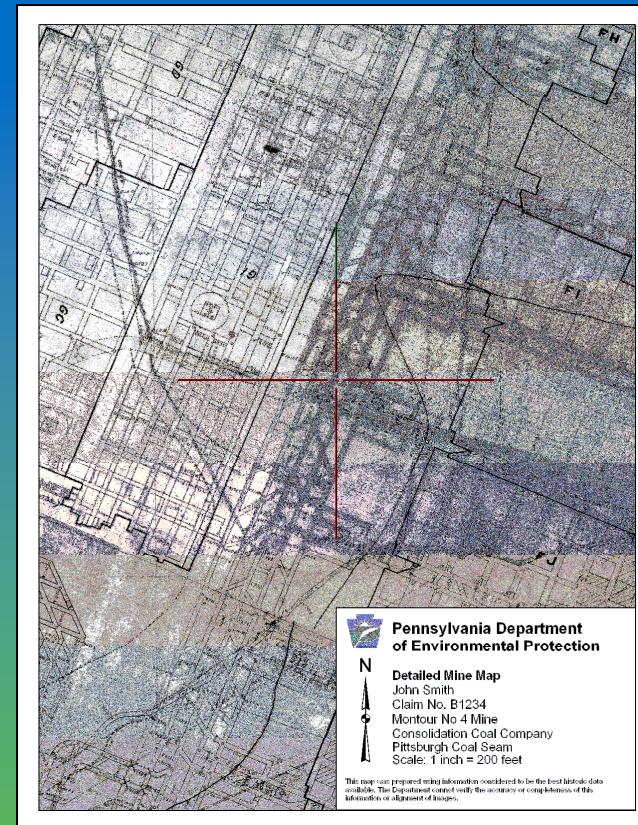
Additional Line 2: Consolidation Coal Company

Additional Line 3: Pittsburgh Coal Seam

Additional Line 4:

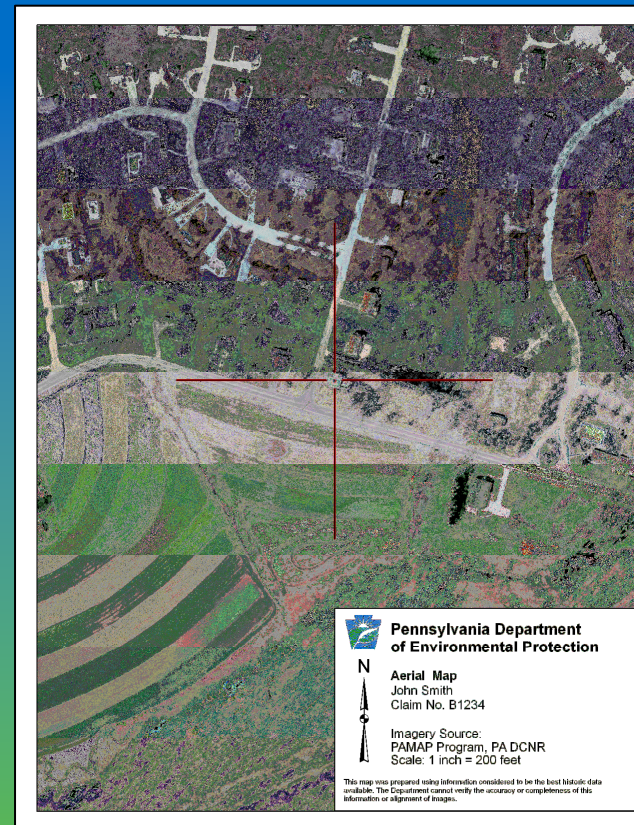
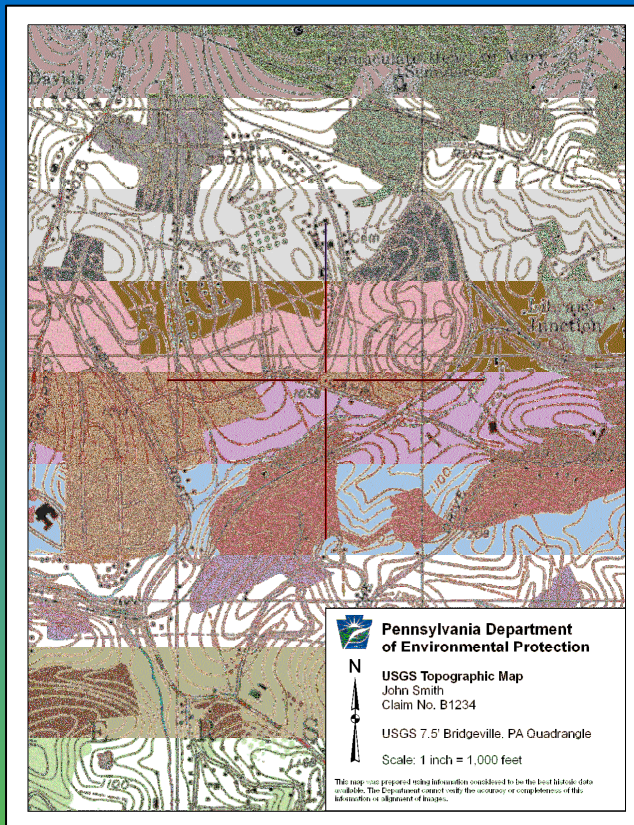
Update Map Label

Form View Num Lock



GIS Implementation

- SIPMap



Looking Ahead...

- Customized Tool using Python Scripting
 - Creates Coal Status Report
 - Report filled in from Feature Attributes
 - Elevations from interpolated Rasters
 - Creates Map layouts
 - Raster catalogs of georeference mine maps

Customized Python Scripting Tool

AutoCSR

- Longitude (in Decimal Degrees)
- Latitude (in Decimal Degrees)
- Requestor / Claimant Name
- Mailing Address Line 1
- Mailing Address Line 2
- Mailing Address City
- Mailing Address State Abbreviate
- Mailing Address Zip Code
- Is Mailing Address the Same as Site Location?
- Purpose of Report:
- Verifying Mining Specialist
- Claim Number

OK Cancel Environments... Show Help >>

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DISTRICT MINING OPERATIONS
25 Technology Drive
California Technology Park
Coal Center, PA 15423
(724) 769-1100

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COAL STATUS REPORT

Name: John Smith
Address: 123 Main St
Apt 4
Pittsburgh PA 12345
Address Same as Site Location: No

Site Location:
Longitude: -80.054221 Latitude: 40.31171
Municipality: BETHEL PARK
County: Allegheny
USGS Quadrangle: BRIDGEVILLE

Purpose of Report: Mine Subsidence Insurance

Coal Seam Researched: Pittsburgh	Surface Elevation: 1242 feet +/-
Mine Name: Terminal 8 Mine	Coal Seam Elevation: 826 feet +/-
Operator: Pittsburgh Terminal Coal Corporation	Cover* (Overburden): 418 feet +/-
Last Mining Date on Source Map: 10/28/1950	
Mining Under or Near Site:	

Remarks:
The site is located over an abandoned mine on the Pittsburgh coal seam and mining is complete.

Available mapping:
0196_INDEX_100_001, 0196_INDEX_100_002, 0348_LOCAT_1000_001,
0346_UMM_400_001, 0346_UMM_400_002, 0346_UMM_750_001, K5460.

Report Information Obtained From: CDO File 0346

Verified By: P Jaquay Date: 10/27/2011

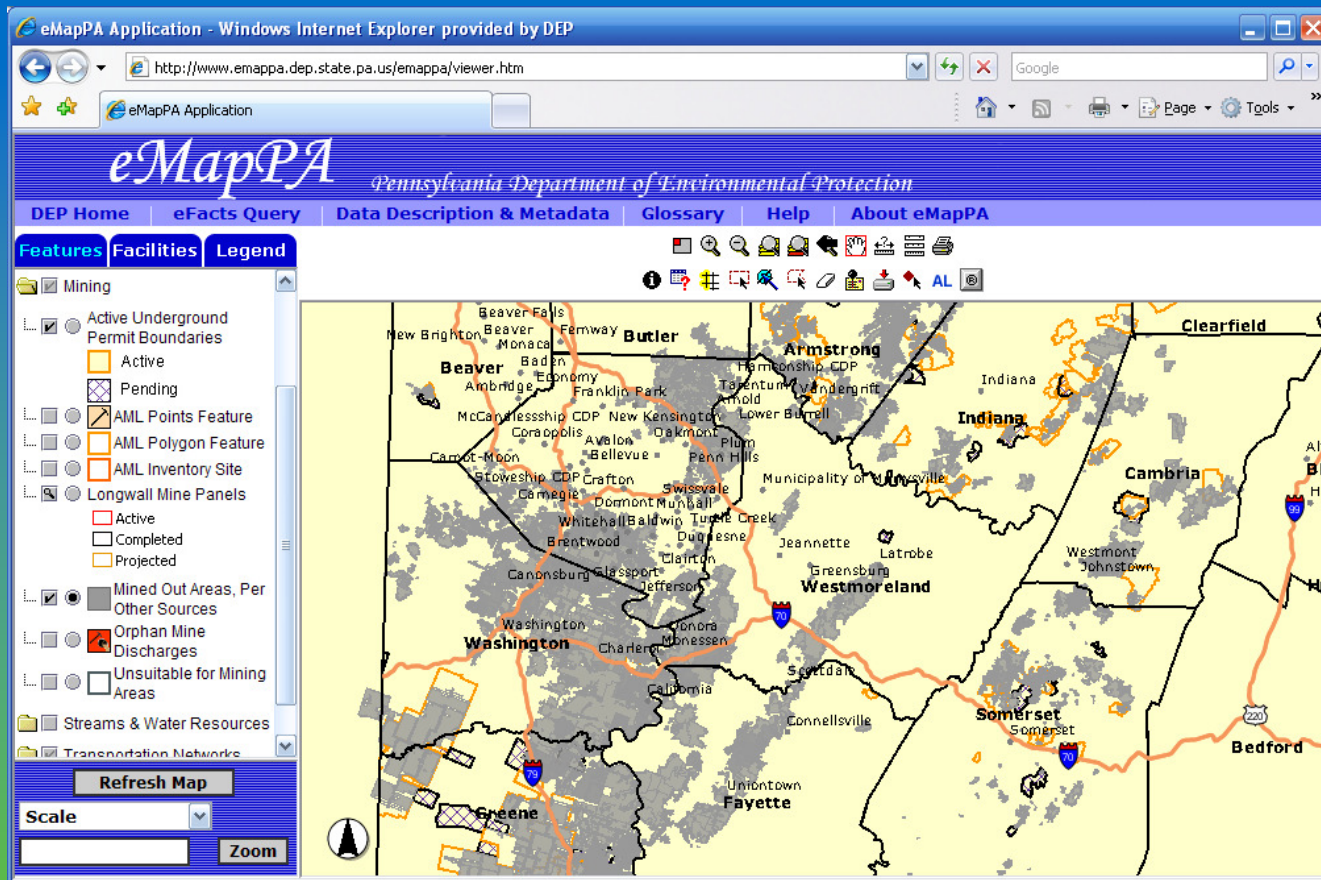
*COVER = Vertical distance between the ground surface and the coal seam.
The above information may be based on maps and plans obtained from various sources.
The Department assumes no responsibility for the accuracy or completeness of this information.

Data Sharing

- eMapPA
 - PA DEP's public access GIS Web Map
 - Contains all of PA DEP's publicly available data
 - <http://www.emappa.dep.state.pa.us/emappa/viewer.htm>

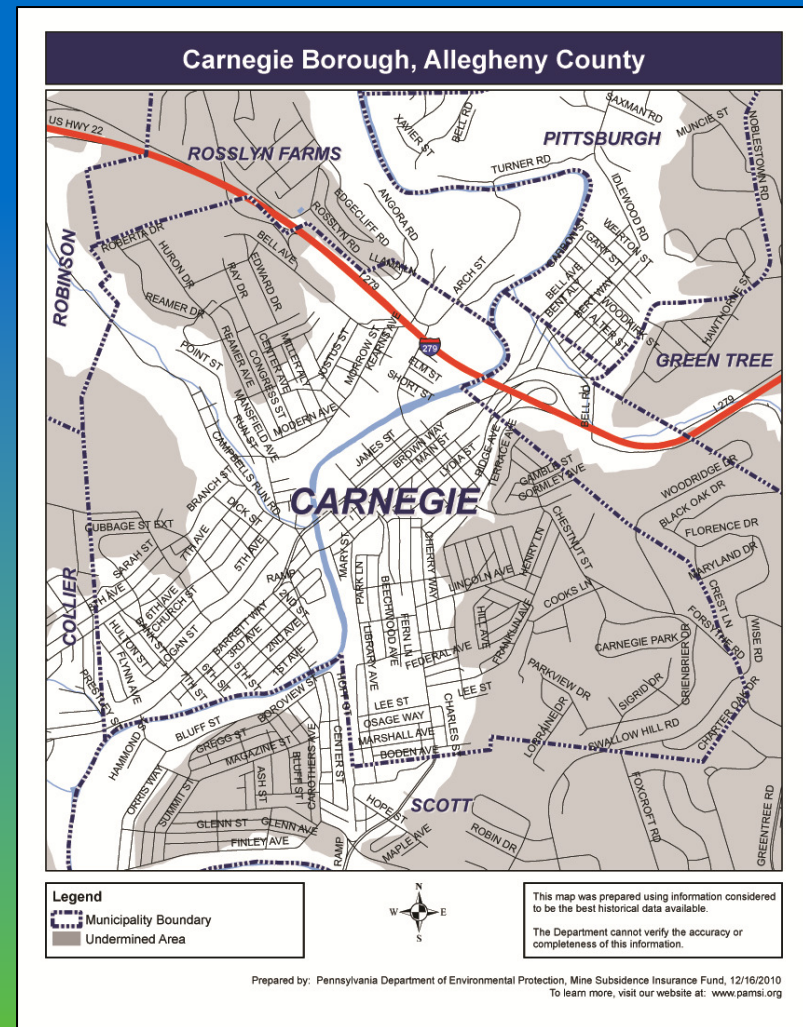
Data Sharing

- eMapPA



Data Sharing

- Mined Out Areas PDF Municipality Maps
 - <http://www.dep.state.pa.us/MSIHomeowners/municipalitymappinglist.html>



Data Sharing

- Pennsylvania Spatial Data Access (PASDA)
 - <http://www.pasda.psu.edu>
 - Administered by Penn State University
 - Public Access ftp site
 - Vector data now available
 - Currently working to share archival Digital Map Images and georeferenced .sid images
 - Will use a web map and CDO Mine Map Index GIS layer to spatial search for mine maps

Thank You!