



USE OF REMOTE SENSING IN DETERMINING APPROXIMATE ORIGINAL CONTOUR

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APPROXIMATE ORIGINAL CONTOUR**

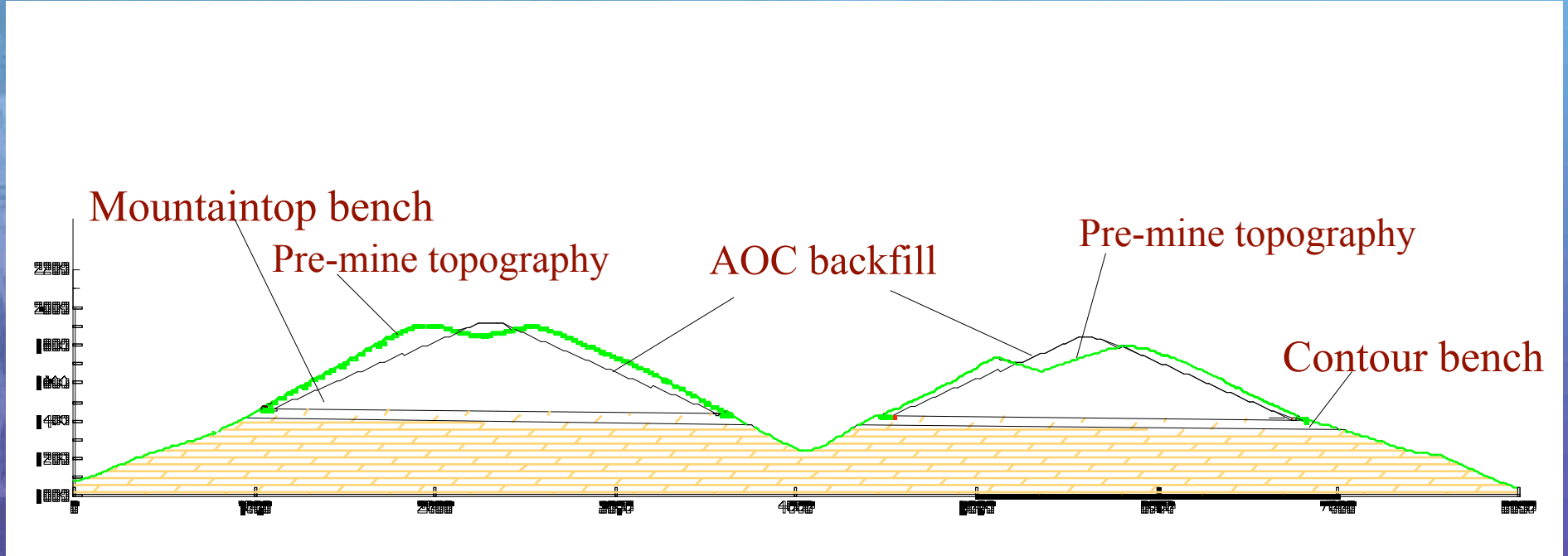
AOC OVERSIGHT IN APPALACHIAN REGION

- **STEEP SLOPE MINING IN WV, VA, TN, KY**
- **INCLUDE PERMITS ISSUED AFTER
CURRENT STATE AOC POLICY
IMPLEMENTED**
- **EVALUATE AOC AND PMLU**
- **LIMITED TO MOUNTAINTOP MINING**



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Mountaintop Mining





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Methodology

- **Attaining Data**
- **Access Accuracies**
- **Generate Cross Sections**
- **Develop Models**
- **Calculate Volumes**



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Attaining Data

- Premining Contours and Backfill Grading Plan
- Postmining Configuration



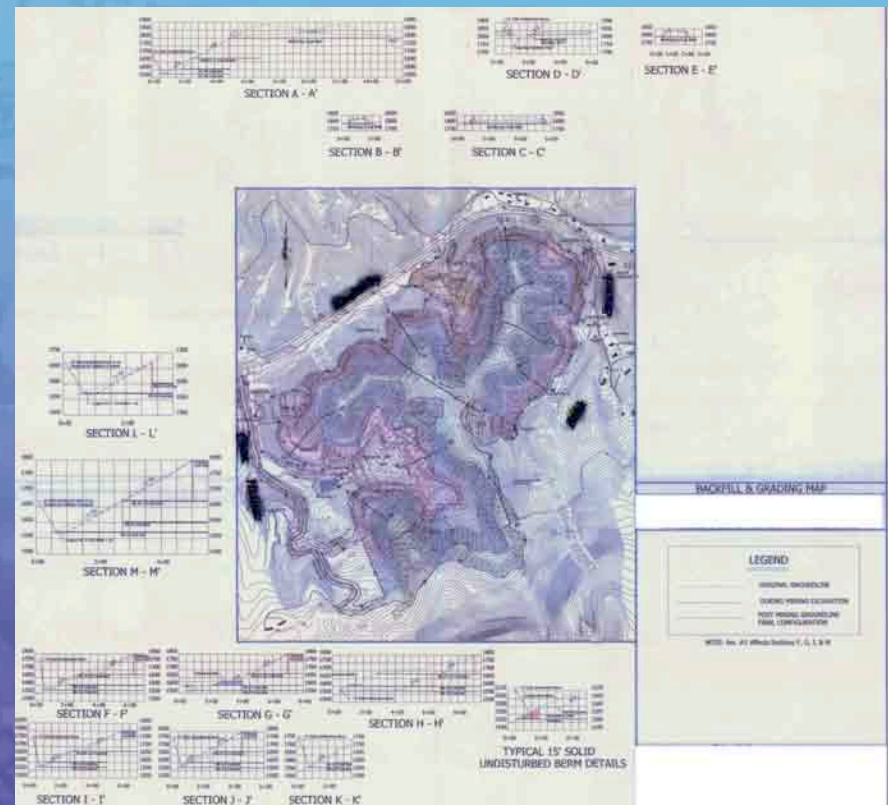


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Attaining Data

Premining Contours and Backfill Grading Plan

- Provided by the Permittees in paper form
- Consisted of plan contour maps and cross sections
- Depicted the original ground and the approved grading/backfill plan





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Attaining Data

Postmining Configuration

Aerial photography was used to extract postmining contours

- **A vendor was contracted**
- **OSMRE selected and surveyed the Ground Control Points (GCP's)**
- **The sites were flown by the vendor and the contours were extracted**



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Postmining Configuration

Establishing GCP's

- In 2006 the four sites used had ground control points (GCP's) established.
- Locations of reference points were determined using a Pro XR GPS with an elevation accuracy of +/-6ft.

Accuracy of the contours is directly tied to the accuracy of the GCP's

- Care has to be taken when establishing GCP's
- In this study it was cost effective to establish GCP's in house



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Postmining Configuration

Flight and Extraction of Contours

- **Vendor Photographed the sites using a JenaLMK 2015 camera at an altitude of 10,800 feet**
- **Resulting imagery had a resolution of 2 feet**
- **A stereo plotter was used to extract the contours**
- **The final product delivered from the vendor was 5 foot contours of all the sites with a map scale of 1 inch=200 feet**



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Accuracies

- Vendor stated the the GCP's surveyed by OSM were "loose"
- GCP's were within 6 feet
- Still would produce accurate contours



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Accuracies

The final product delivered had:

- Vertical accuracy of ± 2.5 feet
- Horizontal accuracy of ± 8 feet





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Generating Cross Sections

Post Mining Cross Sections

- **Postmining contours attained from the vendor were used to generate accurate cross sections of the final configuration of the mine sites**
- **A shapefile was created to show the mining companies cross section locations**
- **The shapefile was brought into ArcMap and with the 3D analyst toolbar and crosssections were generated of the postmining configuration**



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Generating Cross Sections

Final Cross Section: Jpegs of Premining and Plan Configuration were scaled to match the postmining cross sections and superimposed to create the final cross section.

- **Premining**
- **Approved Post Mining Configuration**
- **Final Configuration**



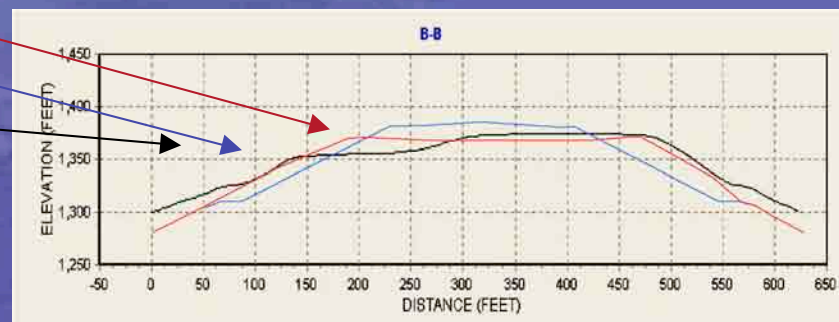
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Generating Cross Sections

- Final Cross Section Examples:



Original Ground (Red)
Planned Configuration (Blue)
Final Configuration (Black)





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3 Dimensional Modeling and Volumetric Calculations

2 software and methods used

- ArcGIS (TIN)



- EarthVision (GRID)



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3 Dimensional Modeling and Volumetric Calculations

**The reasons 2 methods were
used was to:**

- analyze if one method was more accurate**
- evaluate if one method is easier**
- to verify results**



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3 Dimensional Modeling and Volumetric Calculations

ArcGIS

- **A Triangular Irregular Network (TIN) was made from mass points (x,y,z) from the postmining contours**
- **A Coverage was created to represent the coal seam at each of the mine sites.**
- **Using integrated tools from ArcToolbox the spoil volume above the coal seam was calculated**



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3 Dimensional Modeling and Volumetric Calculations

EarthVision

- **A 2D Minimum Tension Grid was made from scattered data that was converted from the contours provided by the vendor.**
- **Using EV's tools, a polygon was digitized to represent the coal seam at each of the mine sites.**
- **Once completed the volumes were calculated using EV's Volumetric Calculator.**



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3 Dimensional Modeling and Volumetric Calculations

- The standard deviations of the spoil volumes between EV and ArcGIS for all mine sites were under 10%.
- This correlation assured that the calculated volumes were accurate and methods used were appropriate for this project.
- The ArcGIS method of using a TIN to represent the surface was not labor intensive and the learning curve for this method would be minimal.
- Overall using EV yielded the most accurate results but this method required more time to convert data and the learning curve for EV is steep.



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