Characteristics and Treatment of Mine Drainage in the Anthracite Region of Pennsylvania

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27th West Virginia Mine Drainage Task Force Symposium

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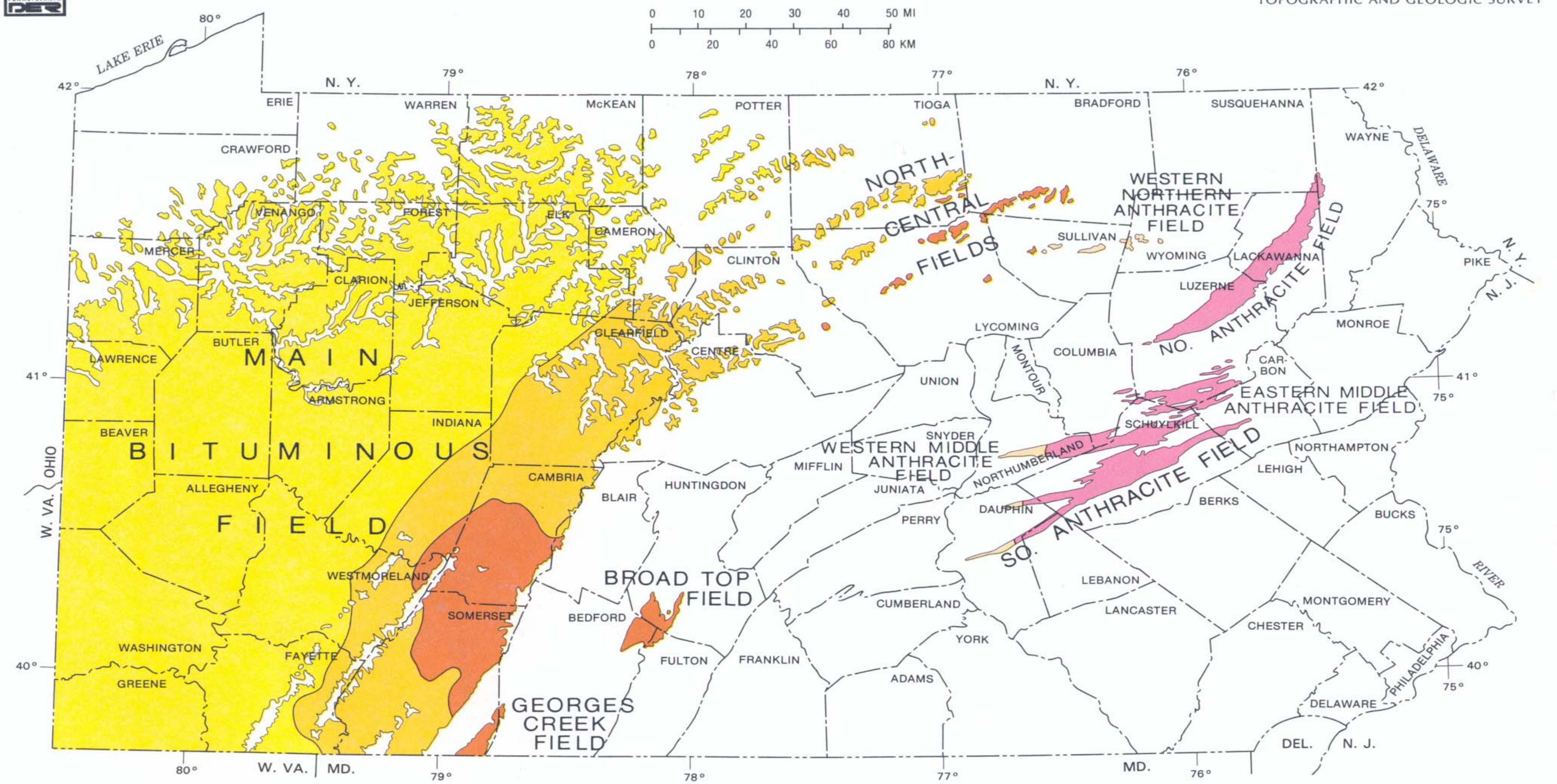
MAP 11

DISTRIBUTION OF PENNSYLVANIA COALS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
OFFICE OF PARKS AND FORESTRY
BUREAU OF
TOPOGRAPHIC AND GEOLOGIC SURVEY



EXPLANATION

BITUMINOUS FIELDS

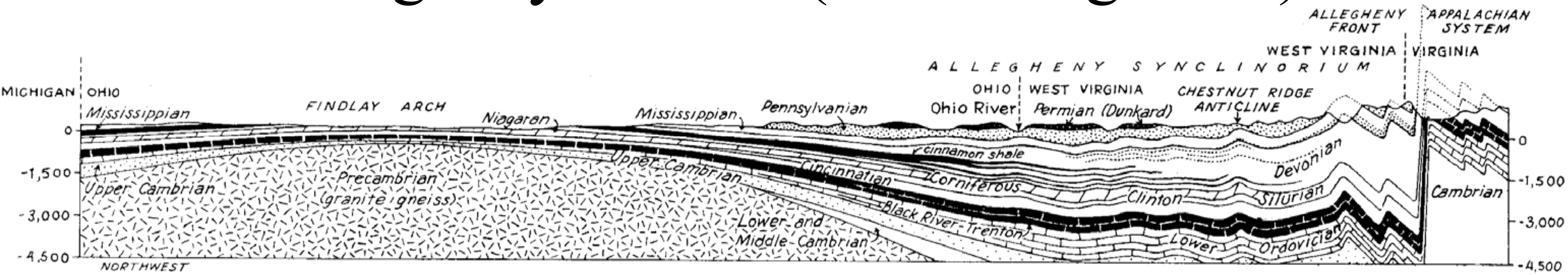
- High-volatile bituminous coal
- Medium-volatile bituminous coal
- Low-volatile bituminous coal

ANTHRACITE FIELDS

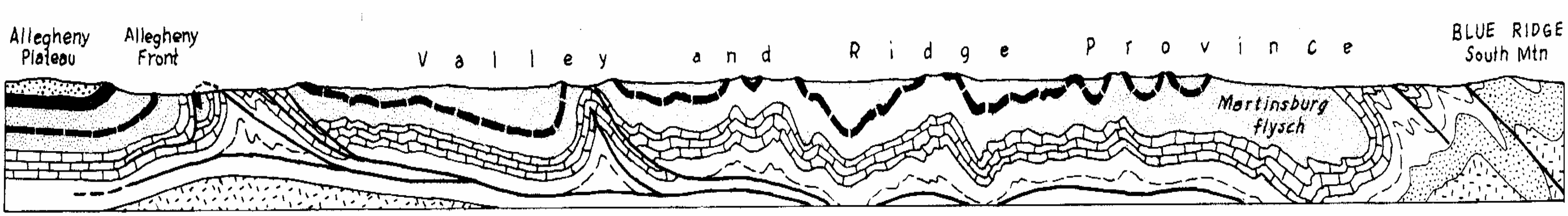
- Anthracite
- Semi-anthracite

DER #855-3/92

Cross-section of the geologic structure of the Allegheny Plateau (from King 1977)



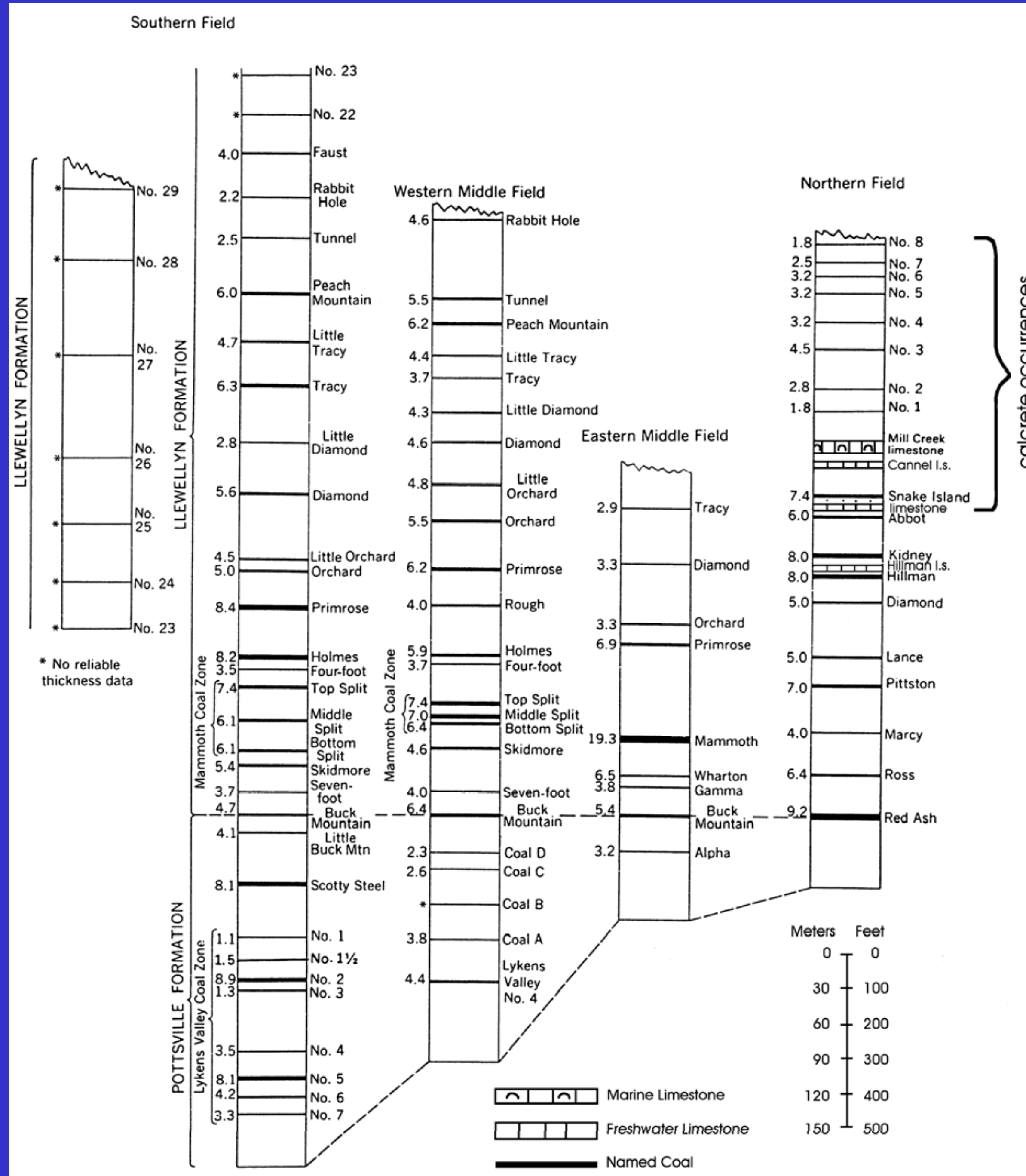
Cross-section of the geologic structure of the Ridge and Valley Province



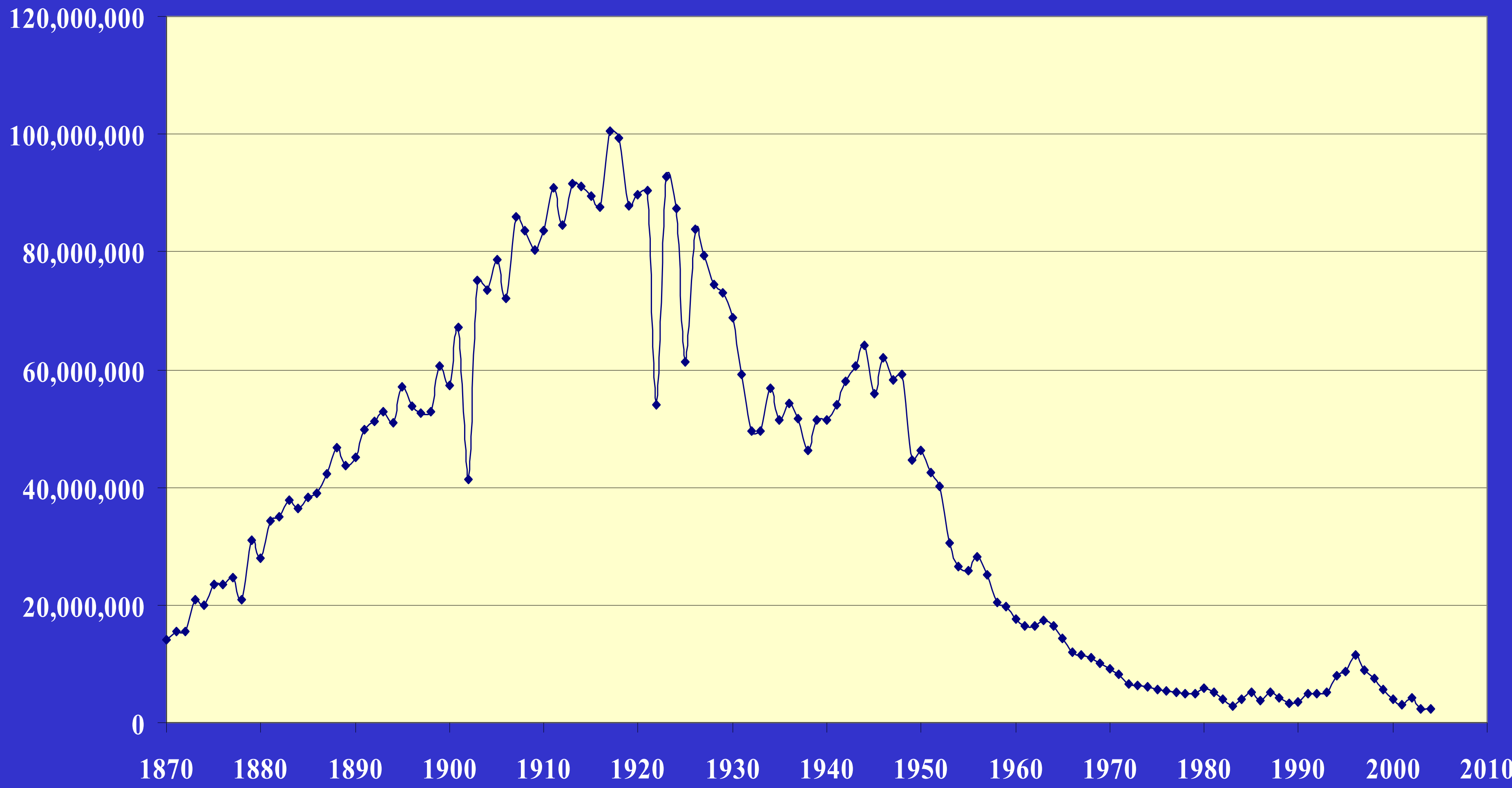
Pottsville Formation Type Section (Rt. 61)

Regional Geology (Whaleback near Shamokin)

Coal Seams in the Anthracite Region of Pennsylvania

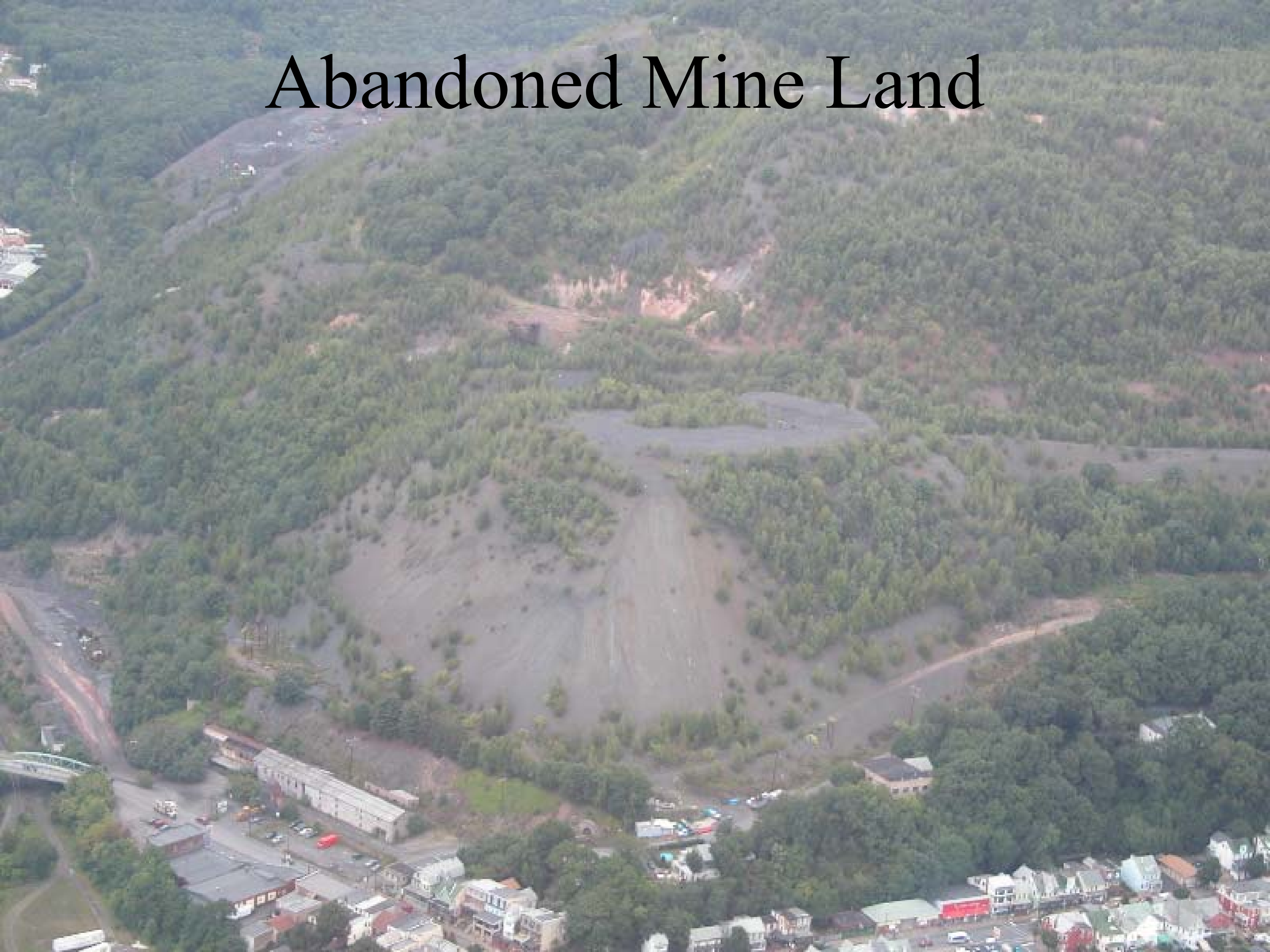


Anthracite Production 1870-2004



Abandoned Mine Land

Abandoned Mine Land

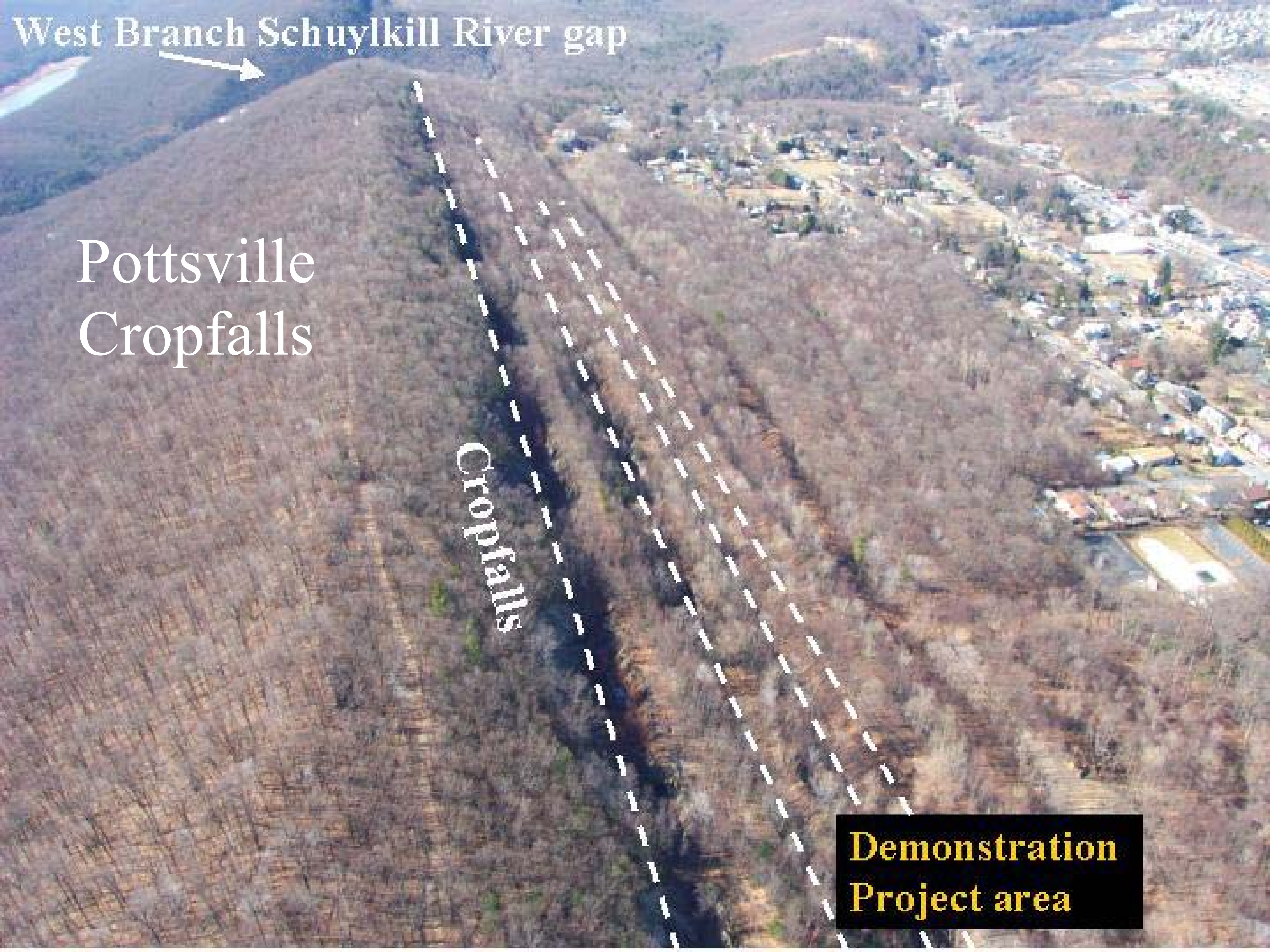


BD-SER with Monitoring Locations

Shen Penn Abandoned Pit

View of extensive cropfalls on multiple veins.

Narrow cropfall


West Branch Schuylkill River gap
Pottsville
Cropfalls
Cropfalls
Demonstration
Project area

Abandoned Surface Mine (Locust Gap)


6/23/1999

Wadesville Anthracite Mine, Schuylkill County, PA

Remining Operation

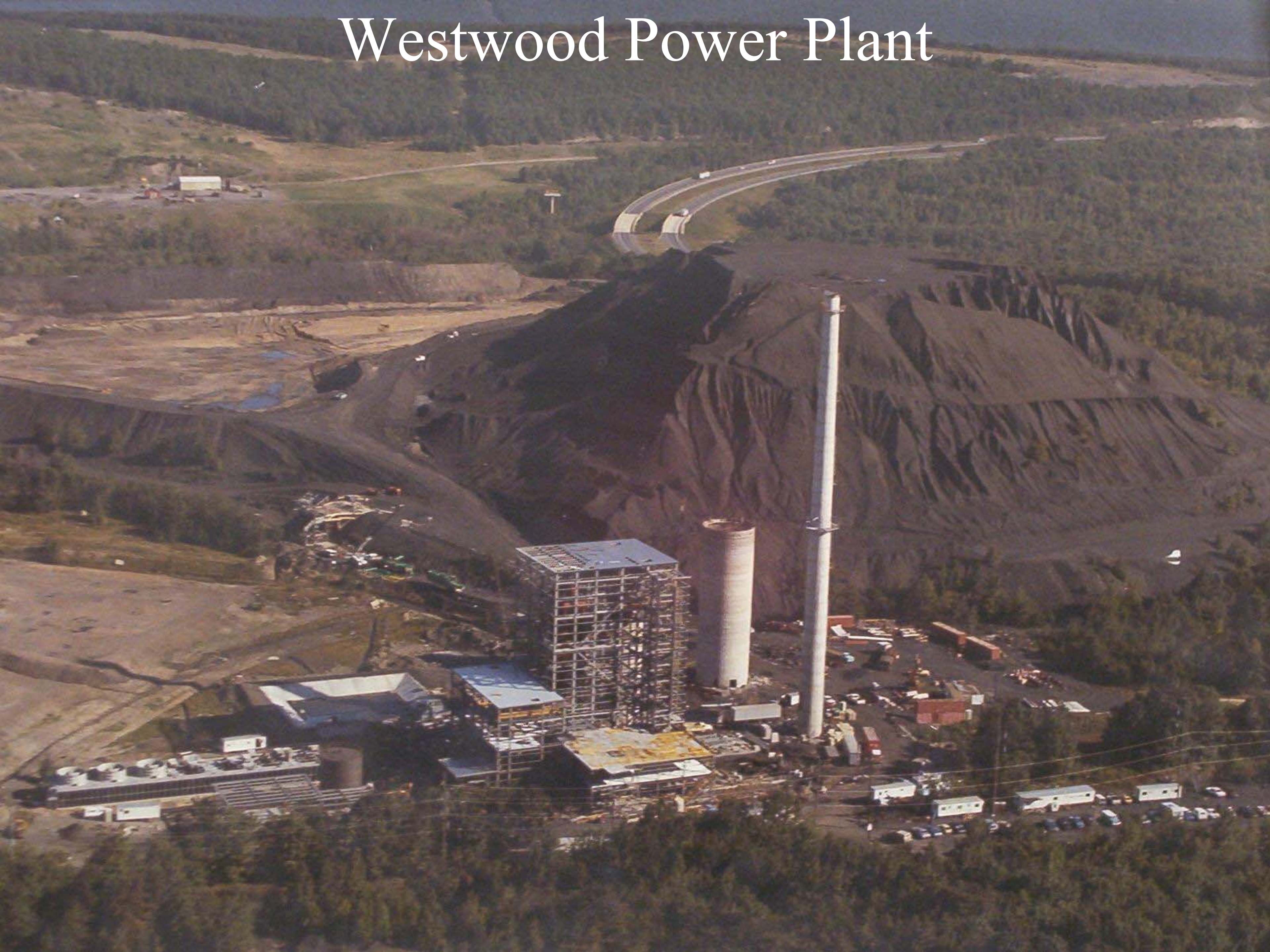
Remining Operation

Remining Operation

Active Slope Deep Mine (Near Tremont)

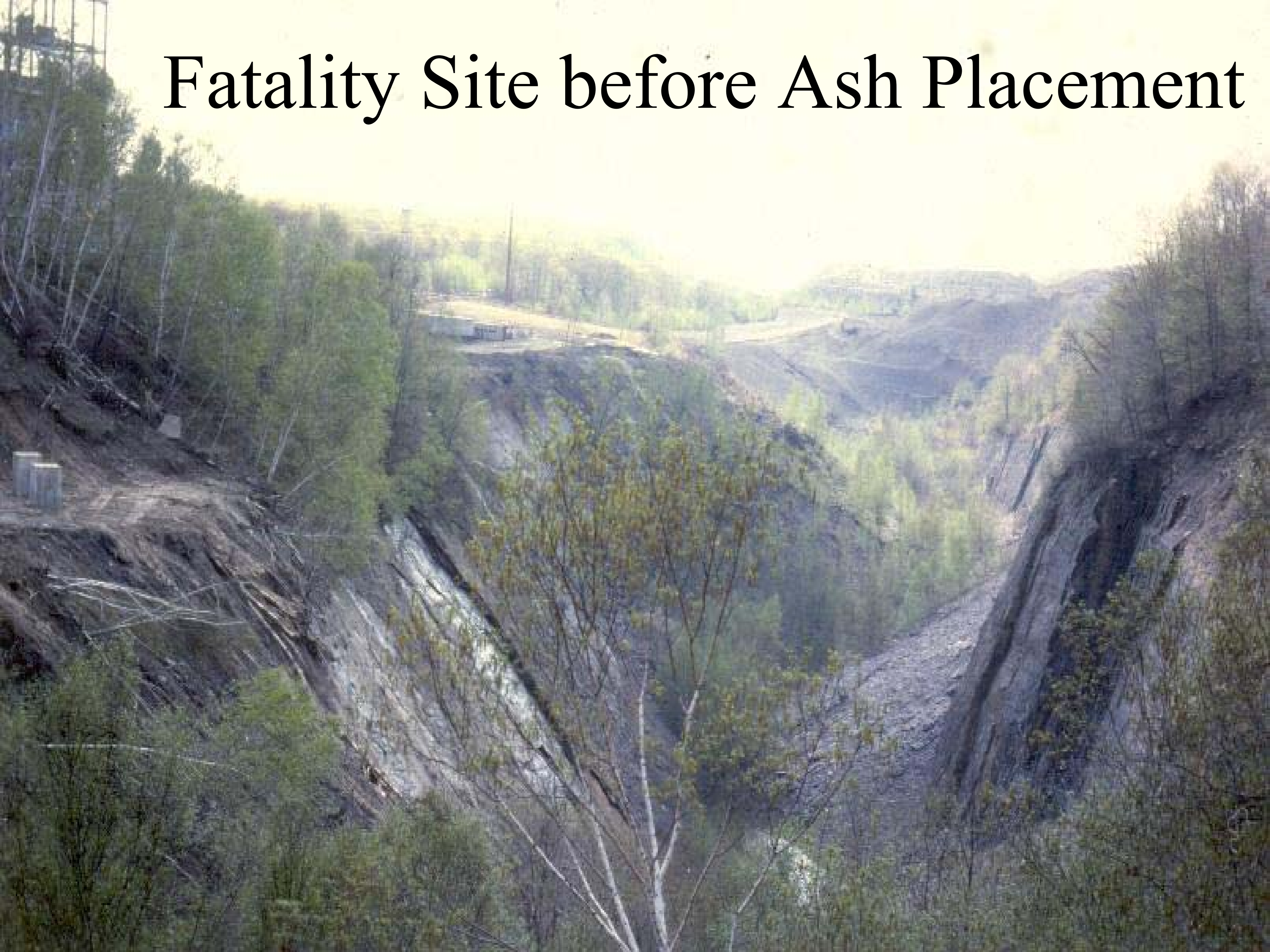
RS&W Coal Co. (drift mine on Gordon Nagle Trail)

Westwood Power Plant

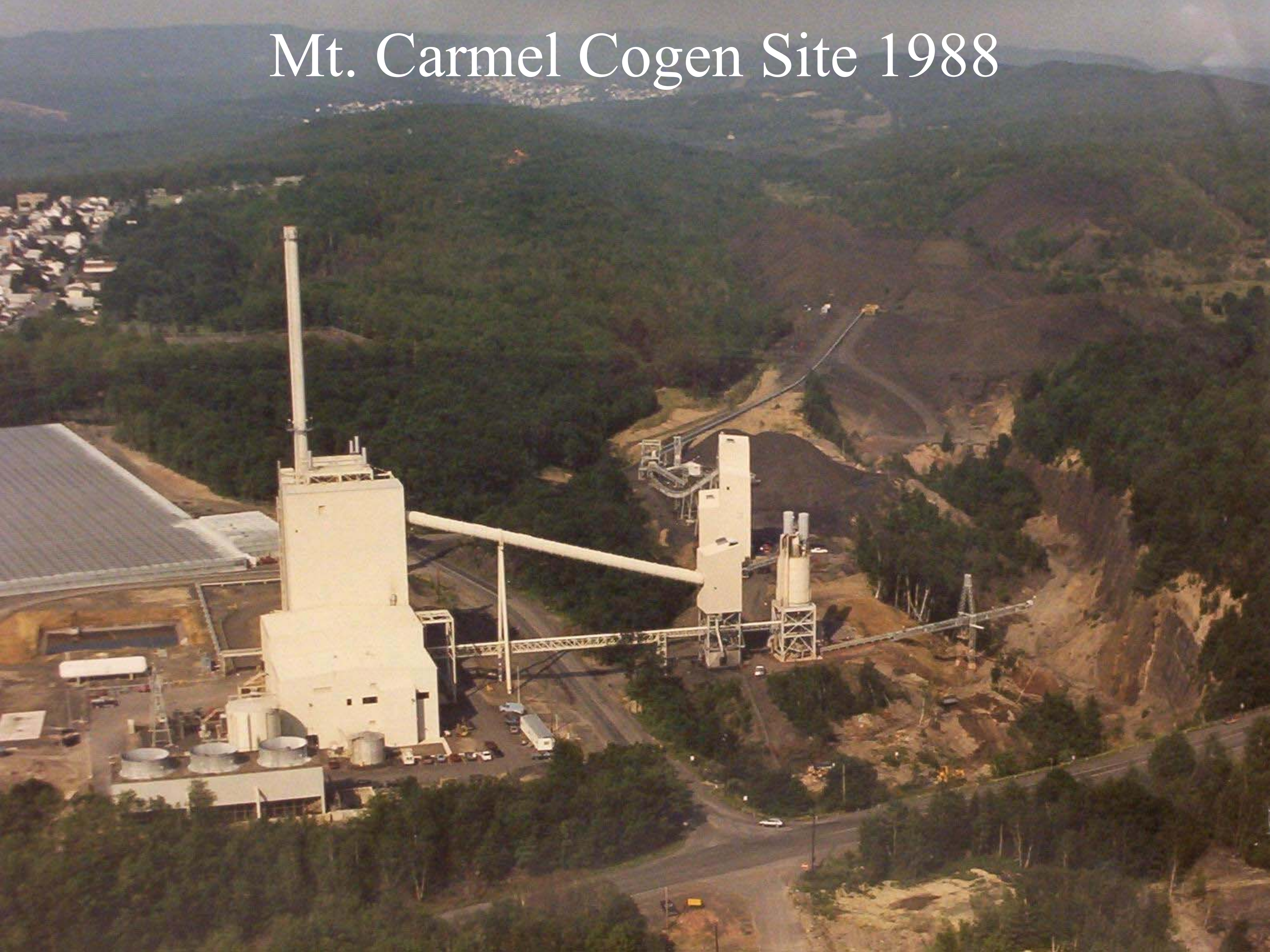


Westwood Pile Removed

Fatality Site before Ash Placement



Mt. Carmel Cogen Site 1988




Mt. Carmel Cogen Site 1998
209 Acres Reclaimed

130Acre Reclamation at Wheelabrator

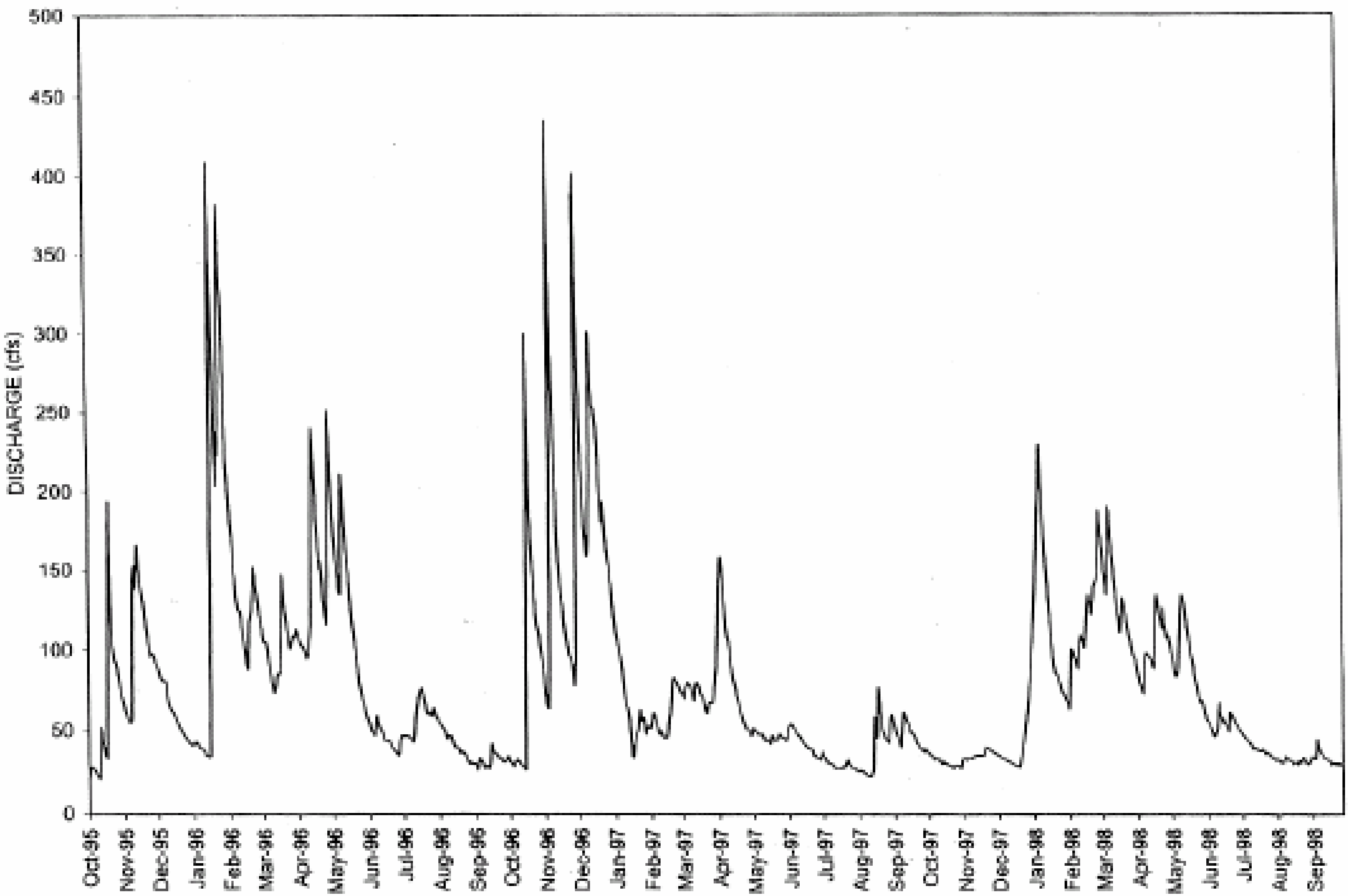
Big Gorilla – Pre Ash Placement

Ash Terraces at NEPCO Big Gorilla Pit


NEPCO Site Water Filled Pit Eliminated


Jeddo Mine Drainage Tunnel

Discharge from the Jeddo Tunnel - water years 1996-98 (from Ballaron 1999).



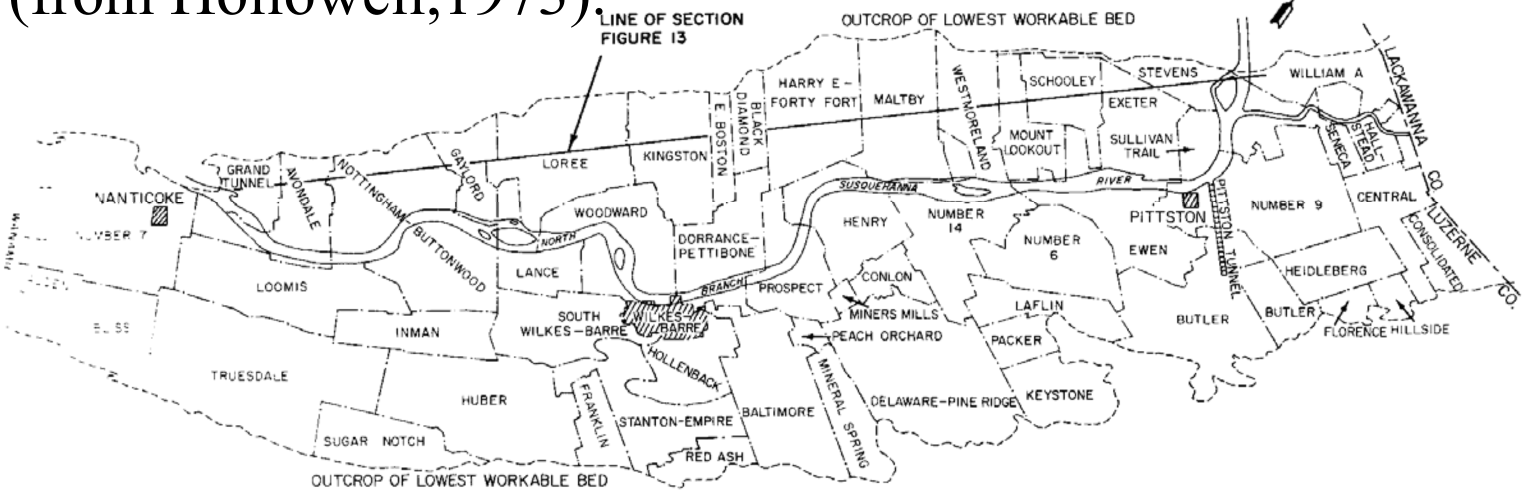
Markson Discharge

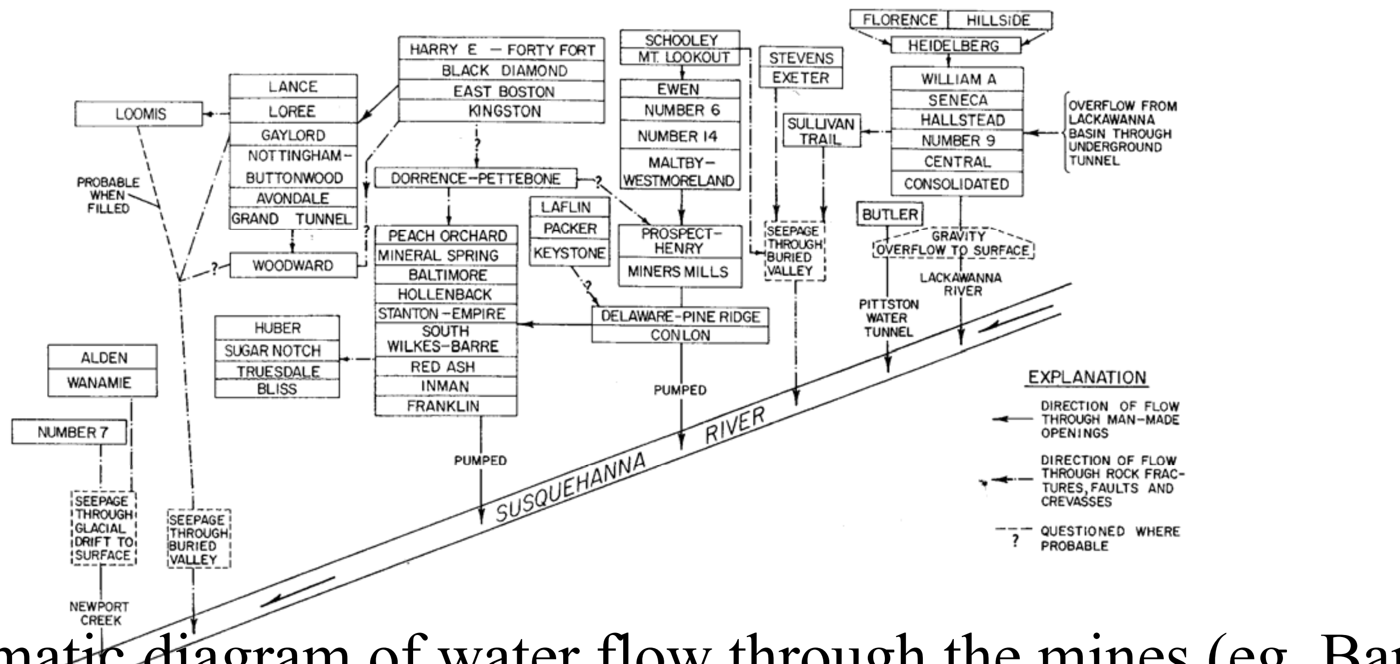
Route 309 discharge

Discharge Point

Discharge enters Schuylkill River

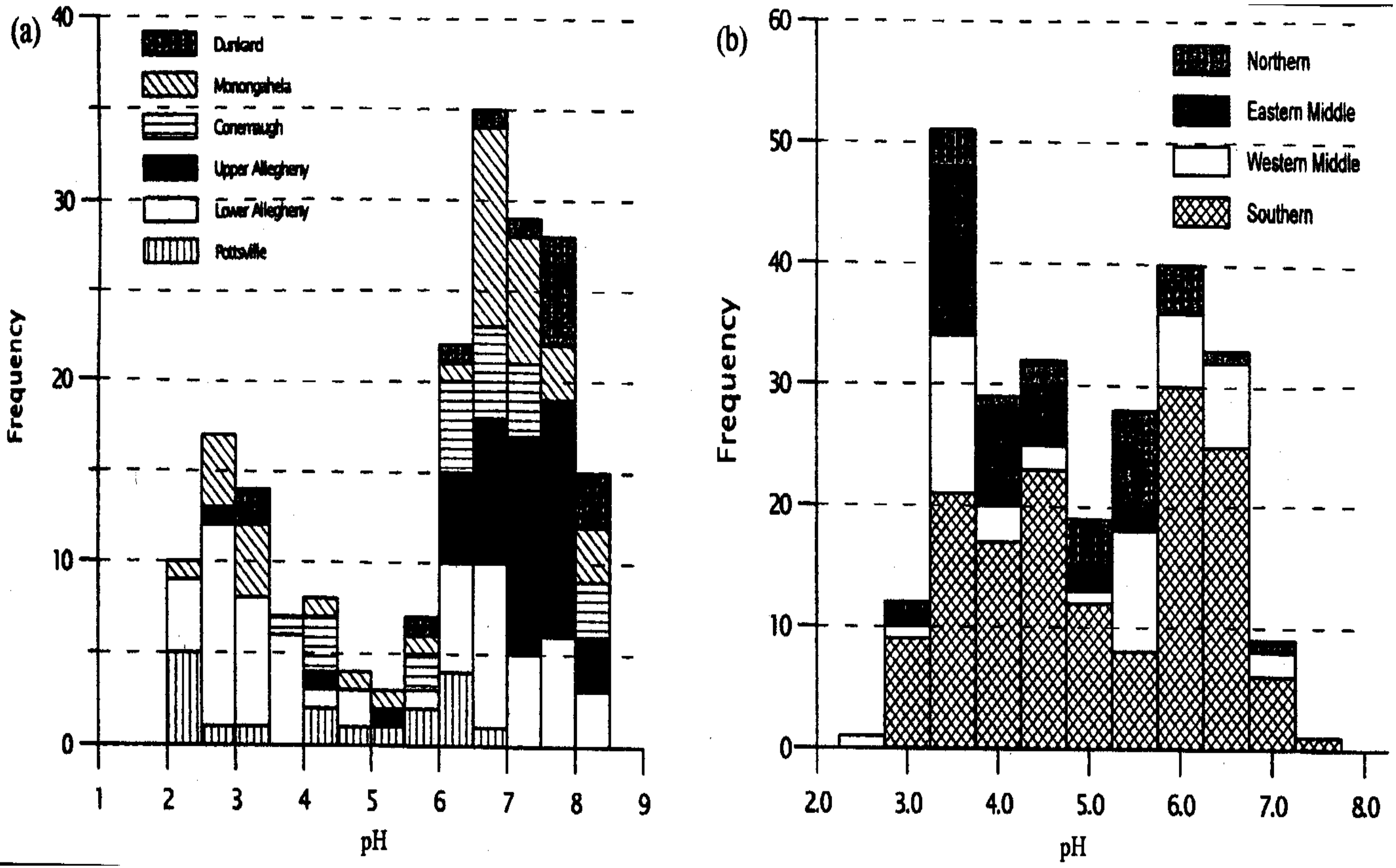
Map of collieries in Wyoming Basin of the Northern Field (from Hollowell,1973).



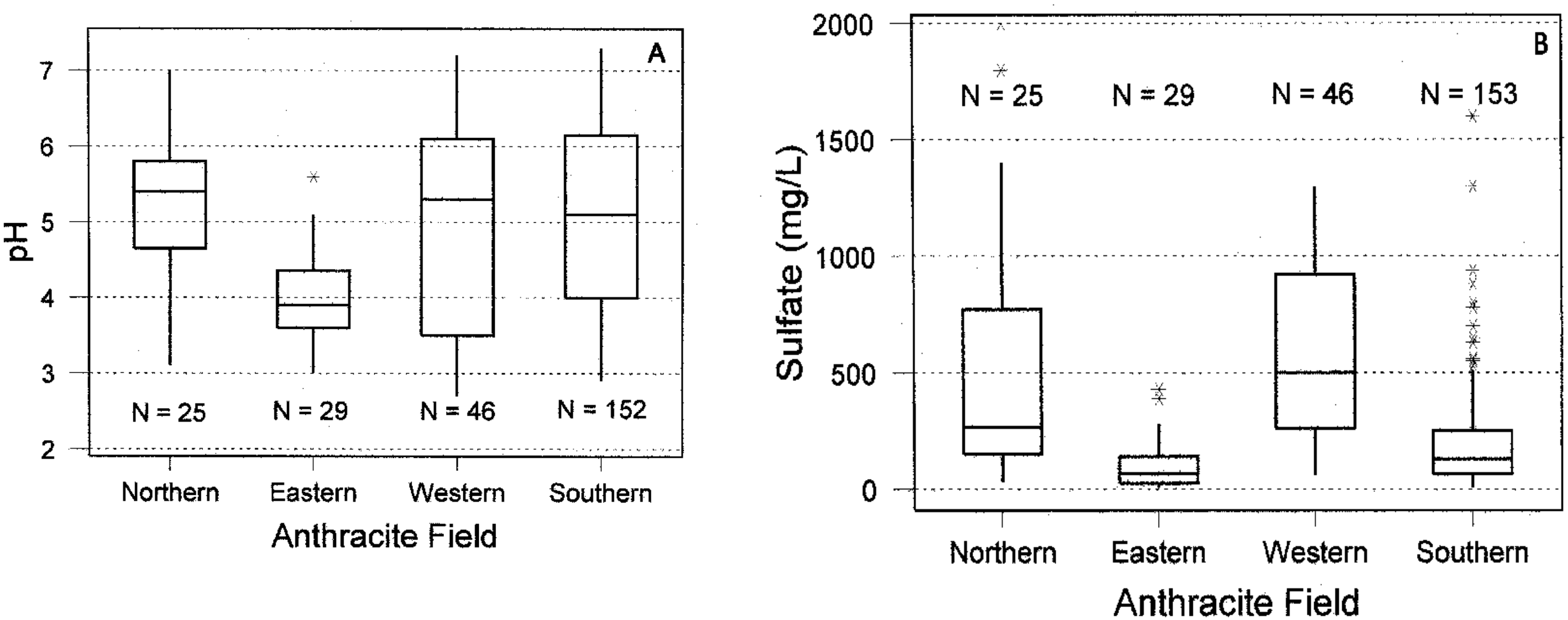


Schematic diagram of water flow through the mines (eg. Barrier pillar breaches) in the Wyoming Basin, (from Hollowell 1973).

Bimodal distribution of pH for (a) bituminous mines and (b) anthracite mine discharges in PA. (from Brady et al. 1998).



Boxplots showing differences in (A) pH and (B) sulfate for discharges from the four anthracite fields in eastern Pennsylvania. Data are from Growitz et al. (1985).



AMD Pollution in Swatara Creek

Rowe Tunnel Discharge

Colket Tunnel Discharge

Restore Streams to the Surface

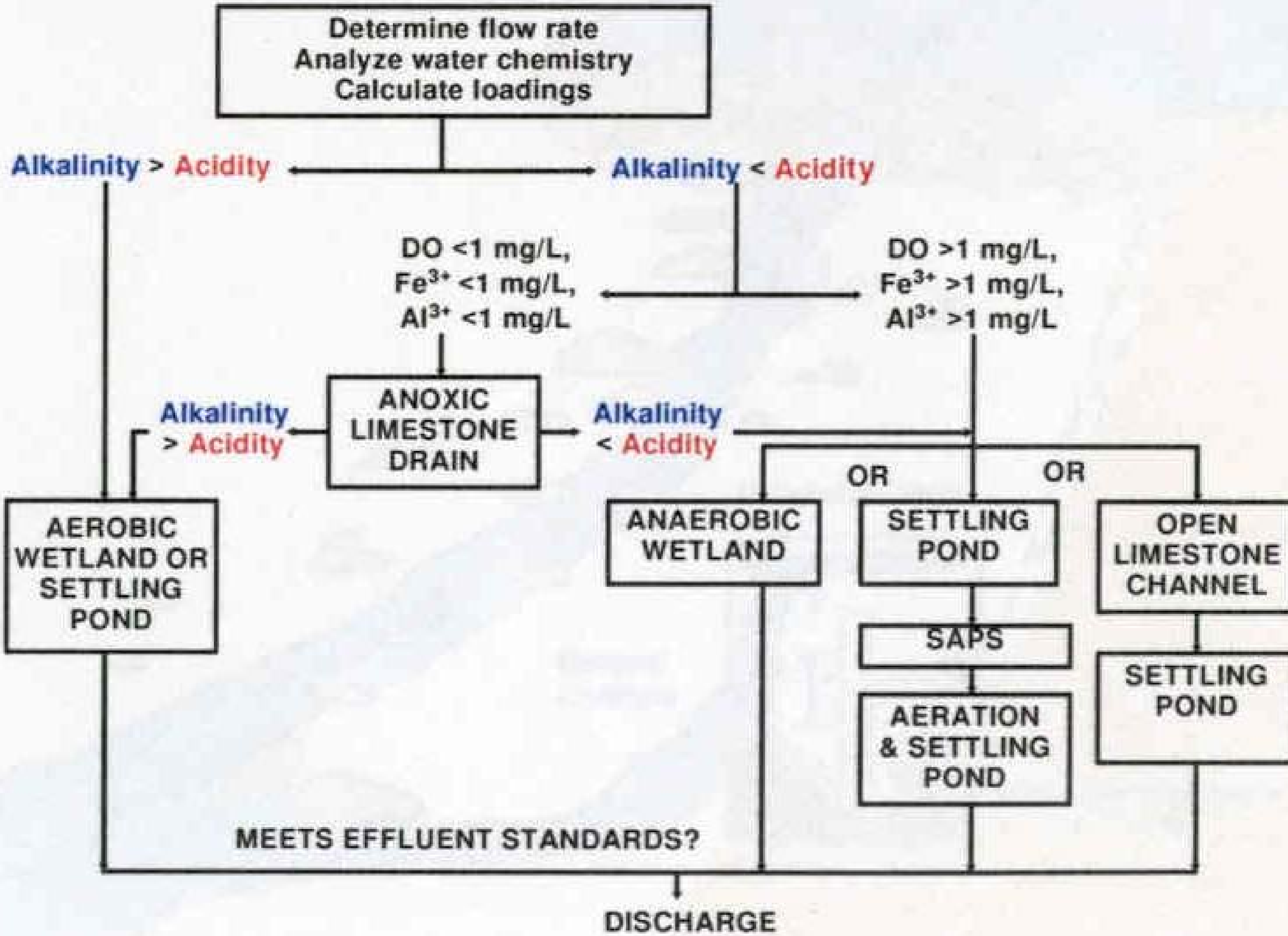

JOHN DEERE

Basic Principles of Mine Drainage Treatment

1) **pH adjustment** – neutralize acidity to promote metals precipitation, prevent dissolution of metals in adjacent materials
2) **Aeration –** promotes formation of various metal hydroxides and allows them to precipitate.
3) **Solids Removal –** filter out solids

ACTIVE TREATMENT

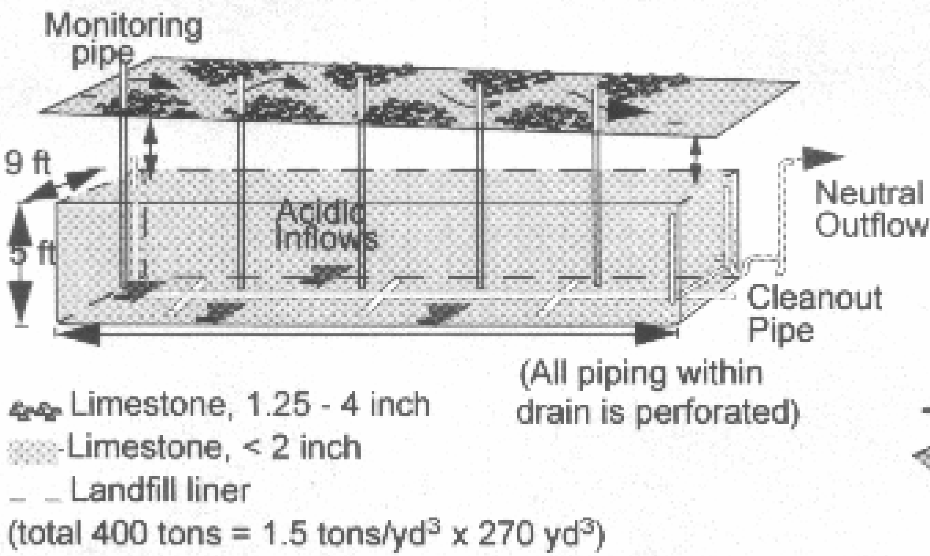
SCHEME FOR PASSIVE TREATMENT OF MINE DRAINAGE



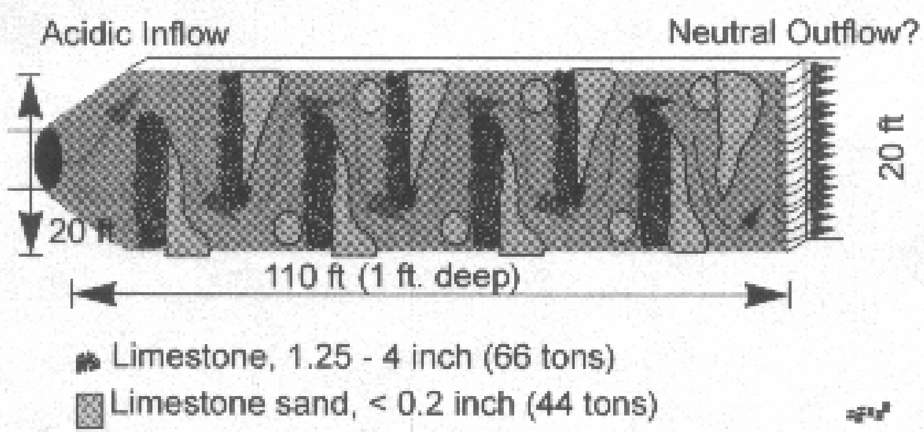
Limestone Channels

Limestone Options

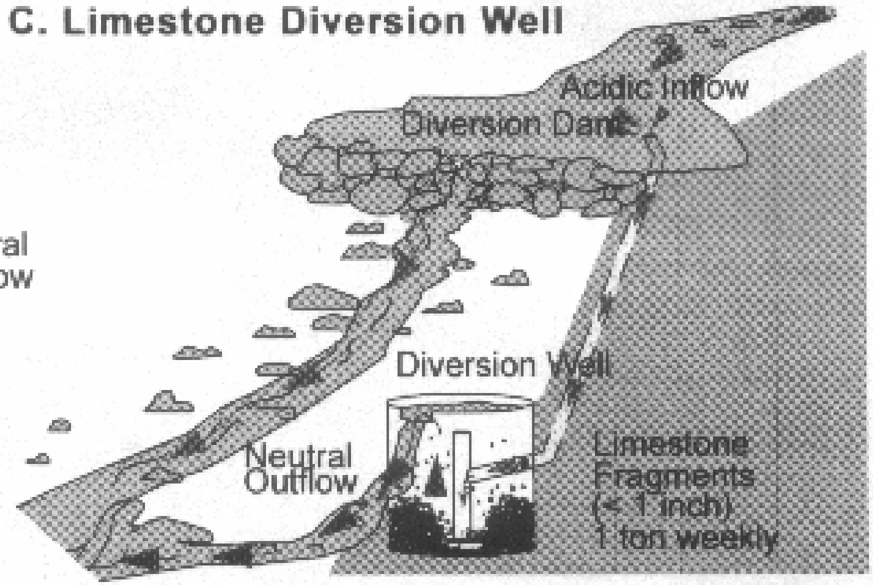
A. Anoxic/Oxic Limestone Drain



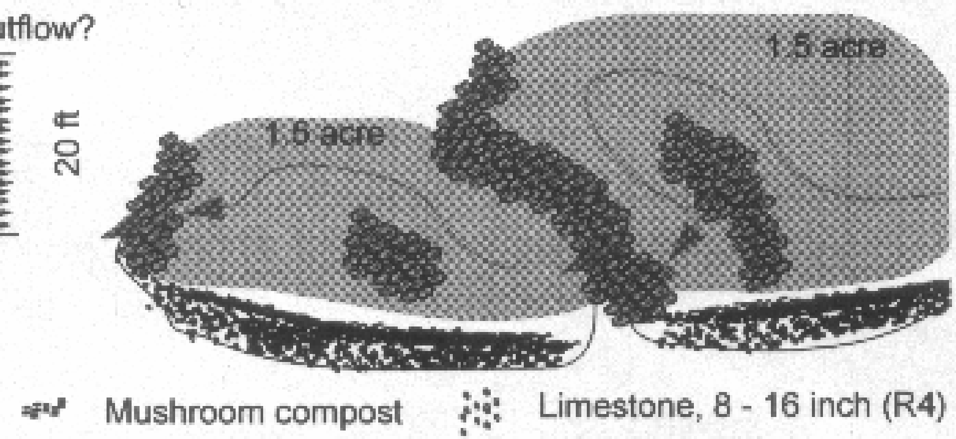
B. Open Limestone Channel



C. Limestone Diversion Well



D. Limestone-Compost Based Wetland



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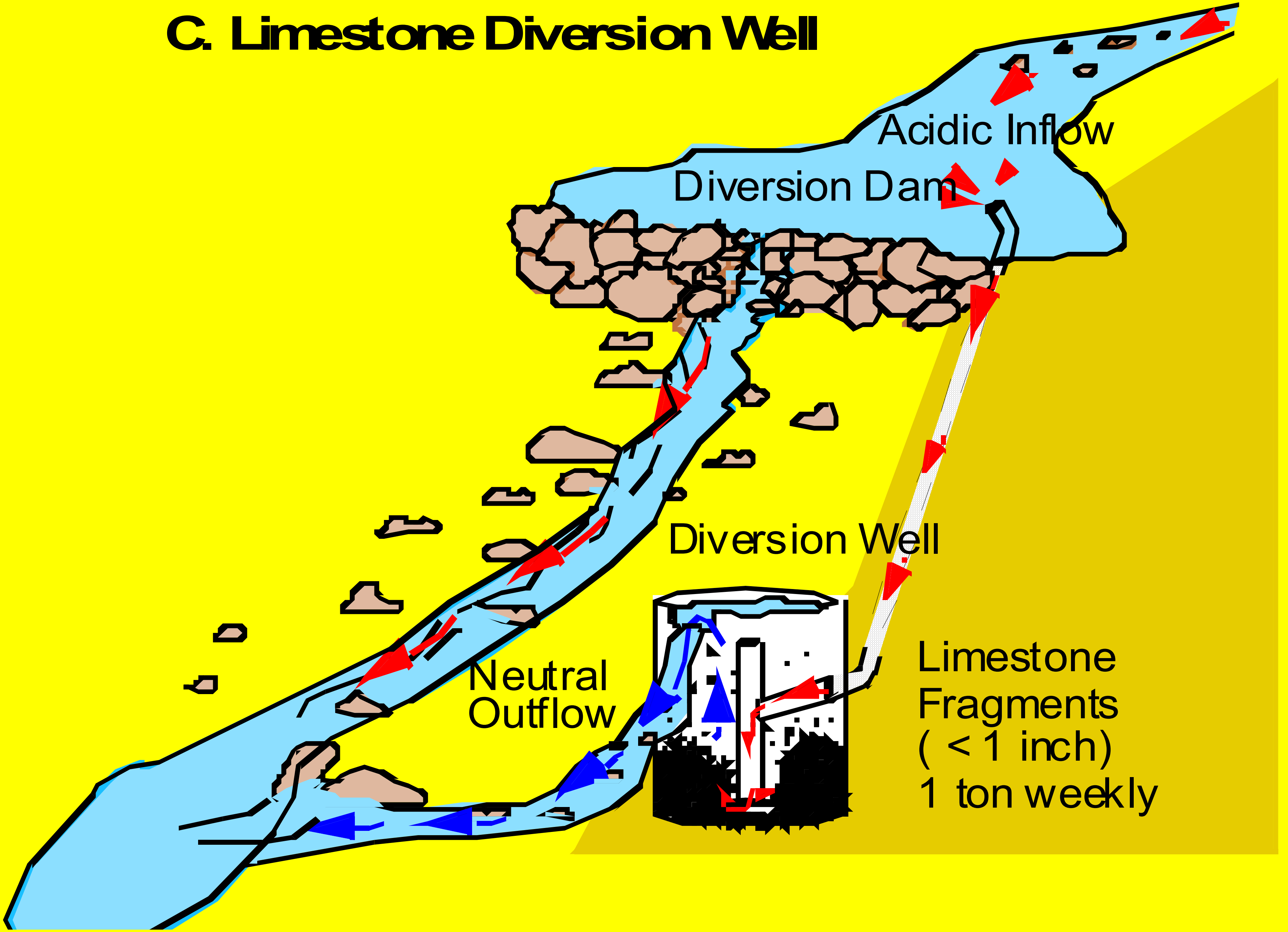
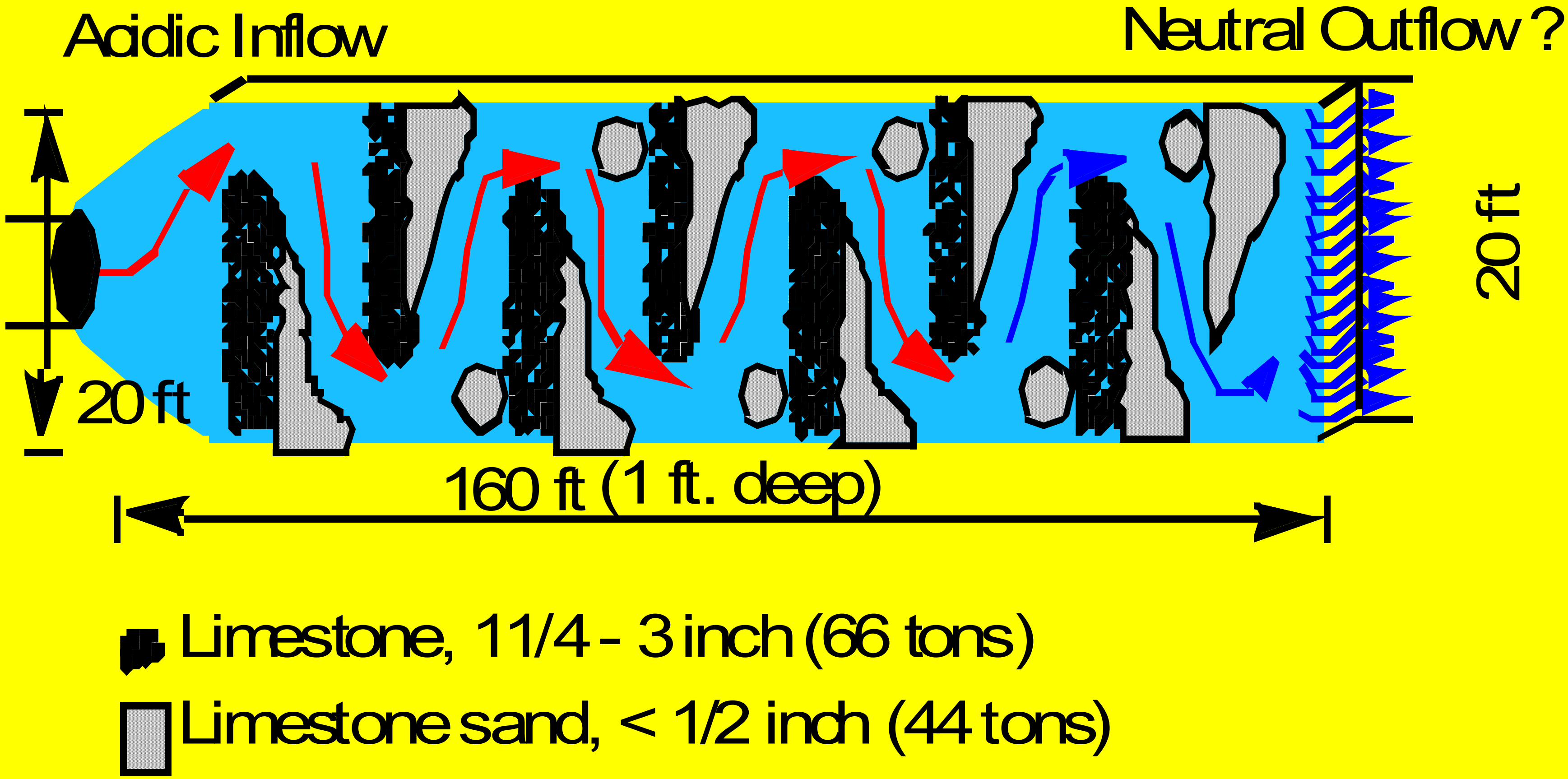


Diversion Wells

Diversion Wells

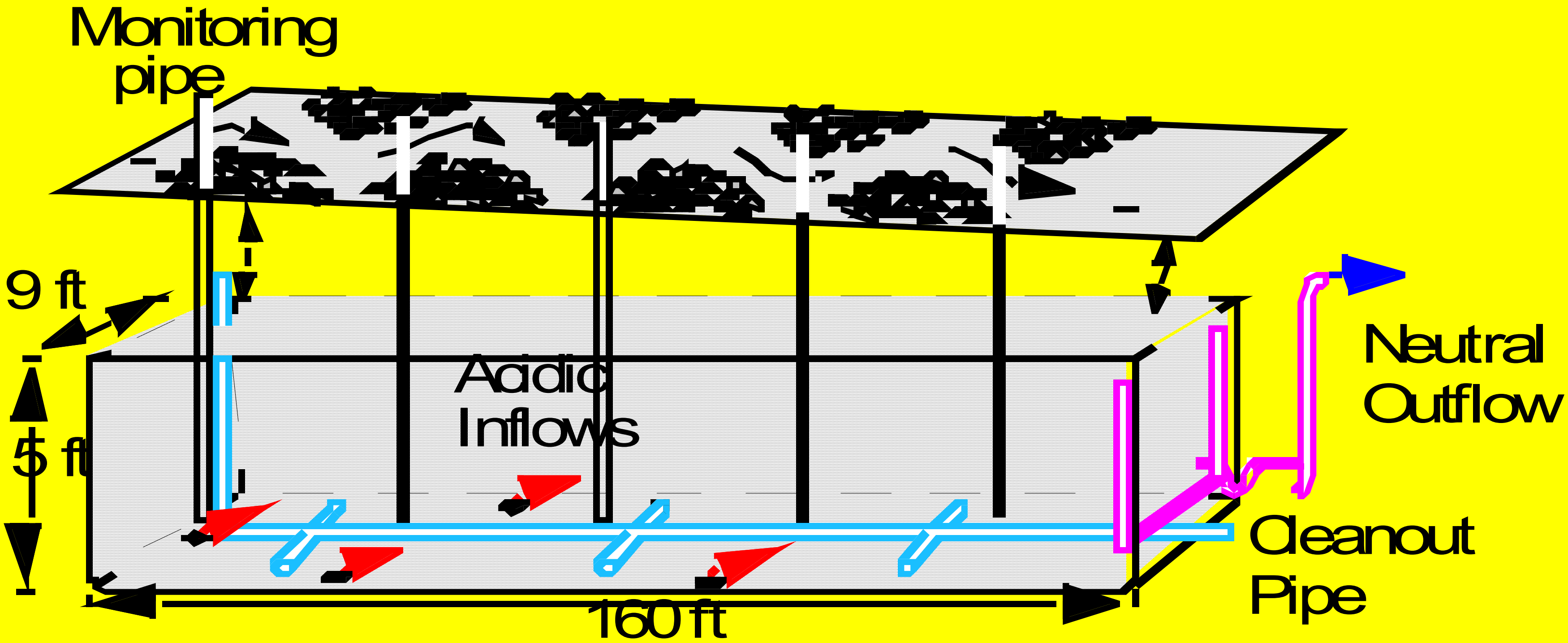
Diversion Wells

B. Open Limestone Channel



Open Limestone Channel/Sand Dosing

A. Anoxic/Oxic Limestone Drain



(All piping within drain is perforated)

Limestone, 1 1/4 - 3 inch

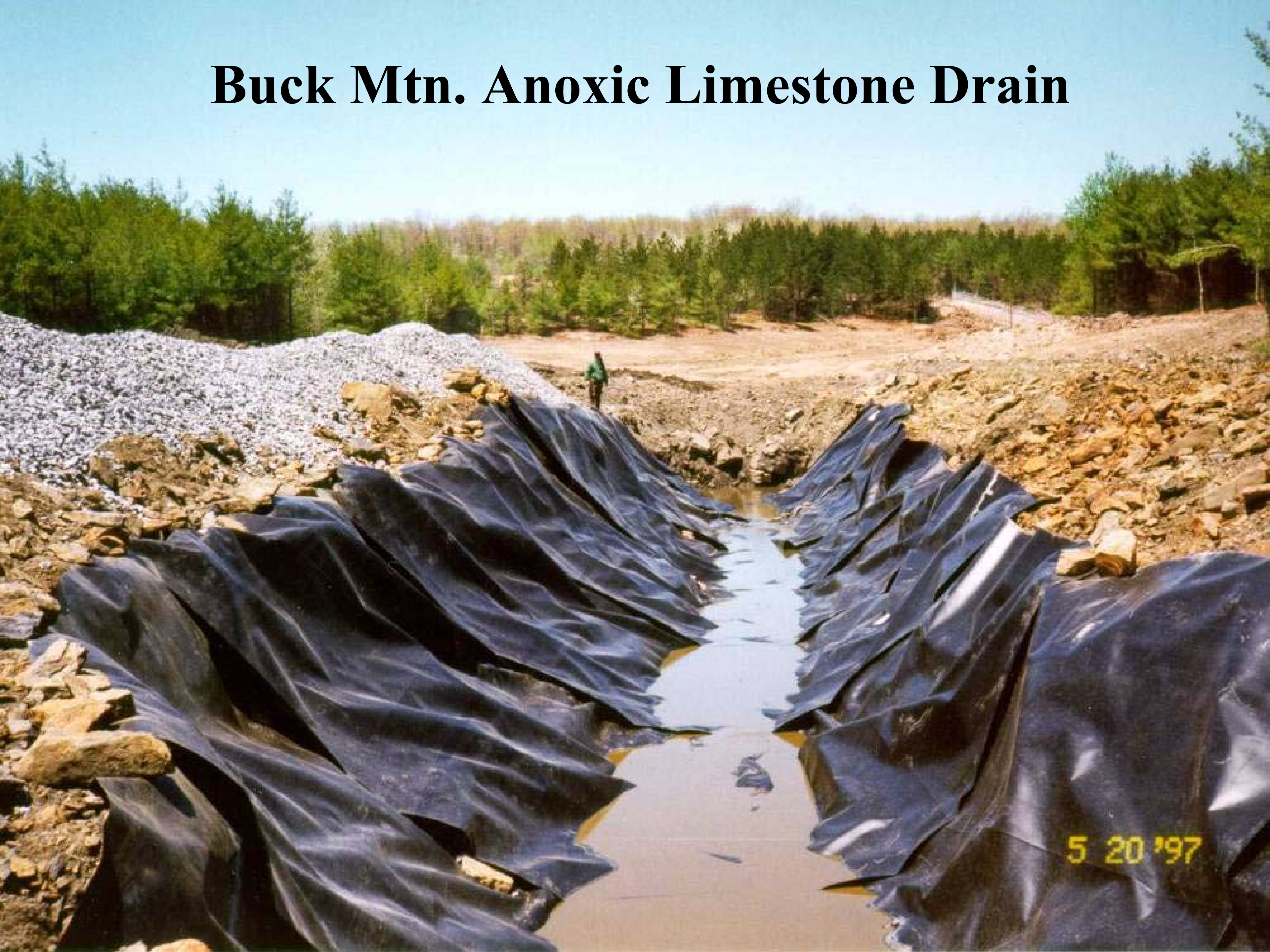
Limestone, < 2 inch

Landfill liner

(total 400 tons = 1.5 tons/yd^3 x 270 yd^3)

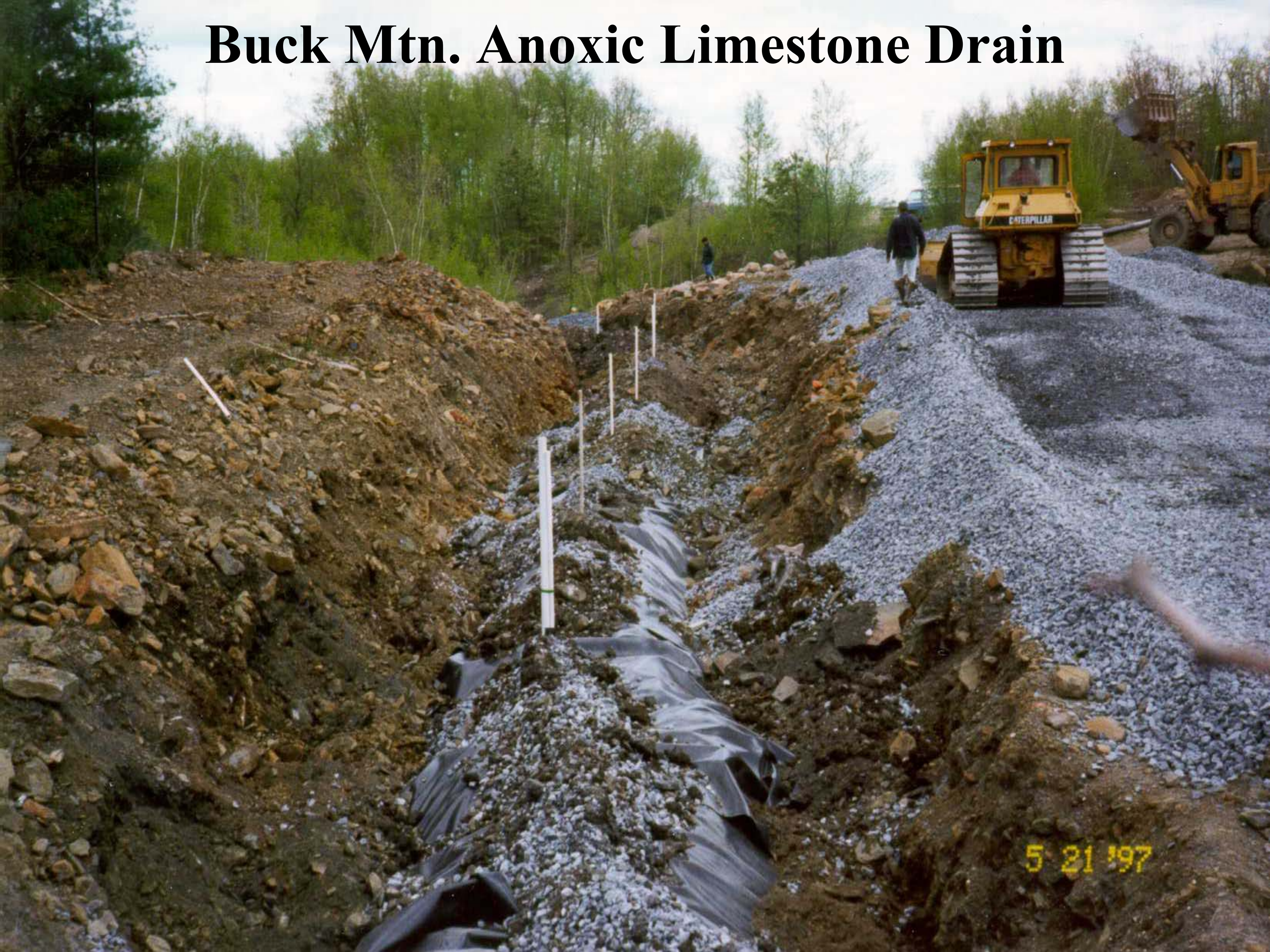
Buck Mtn. Anoxic Drain (before)

Buck Mtn. Anoxic Limestone Drain



Buck Mtn. Anoxic Limestone Drain

Buck Mtn. Anoxic Limestone Drain

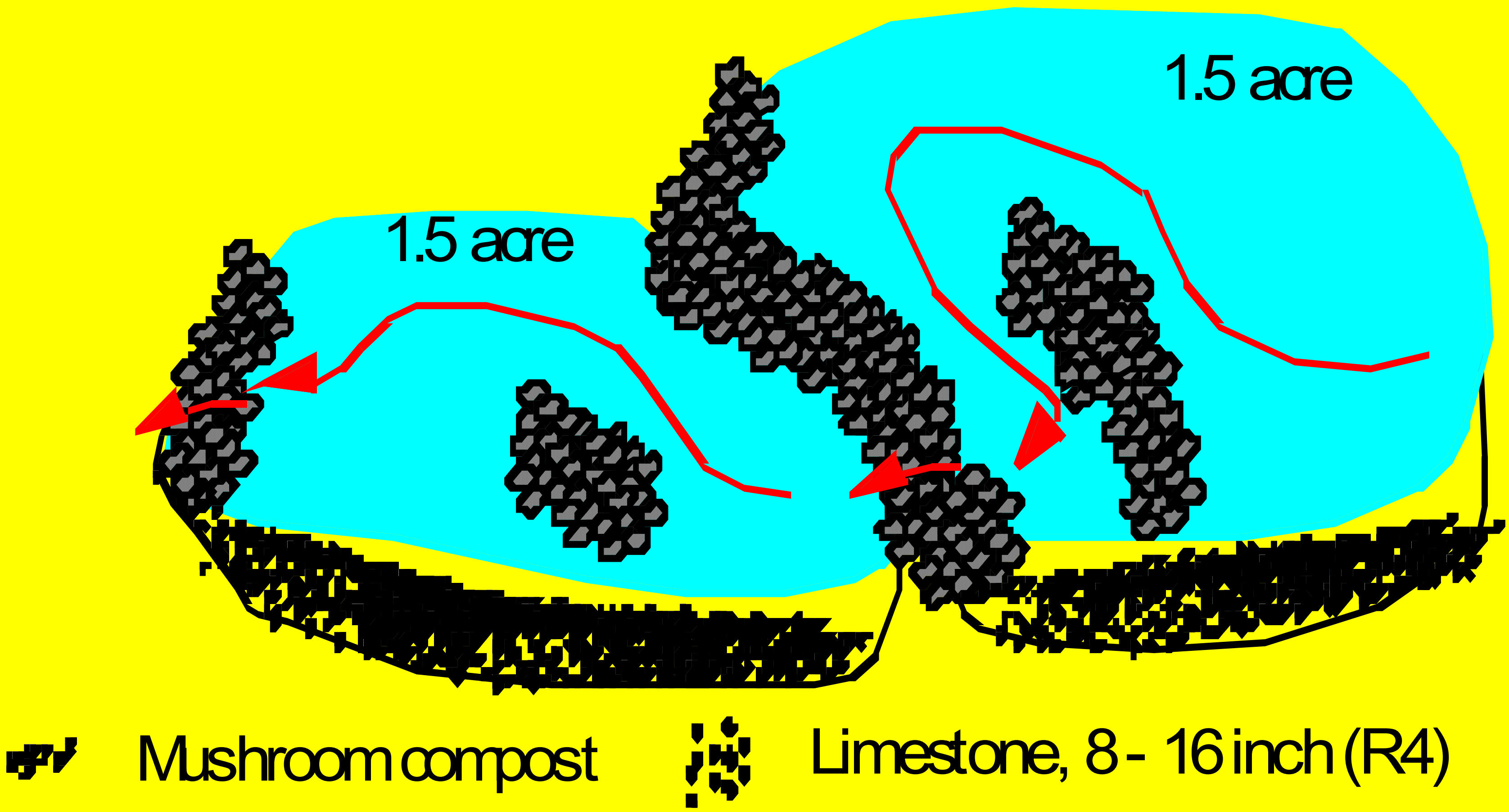


Anoxic Limestone Drain Discharge

Oxic Limestone Drain

Oxic Limestone Drain (before)

D. Limestone-Compost Based Wetland



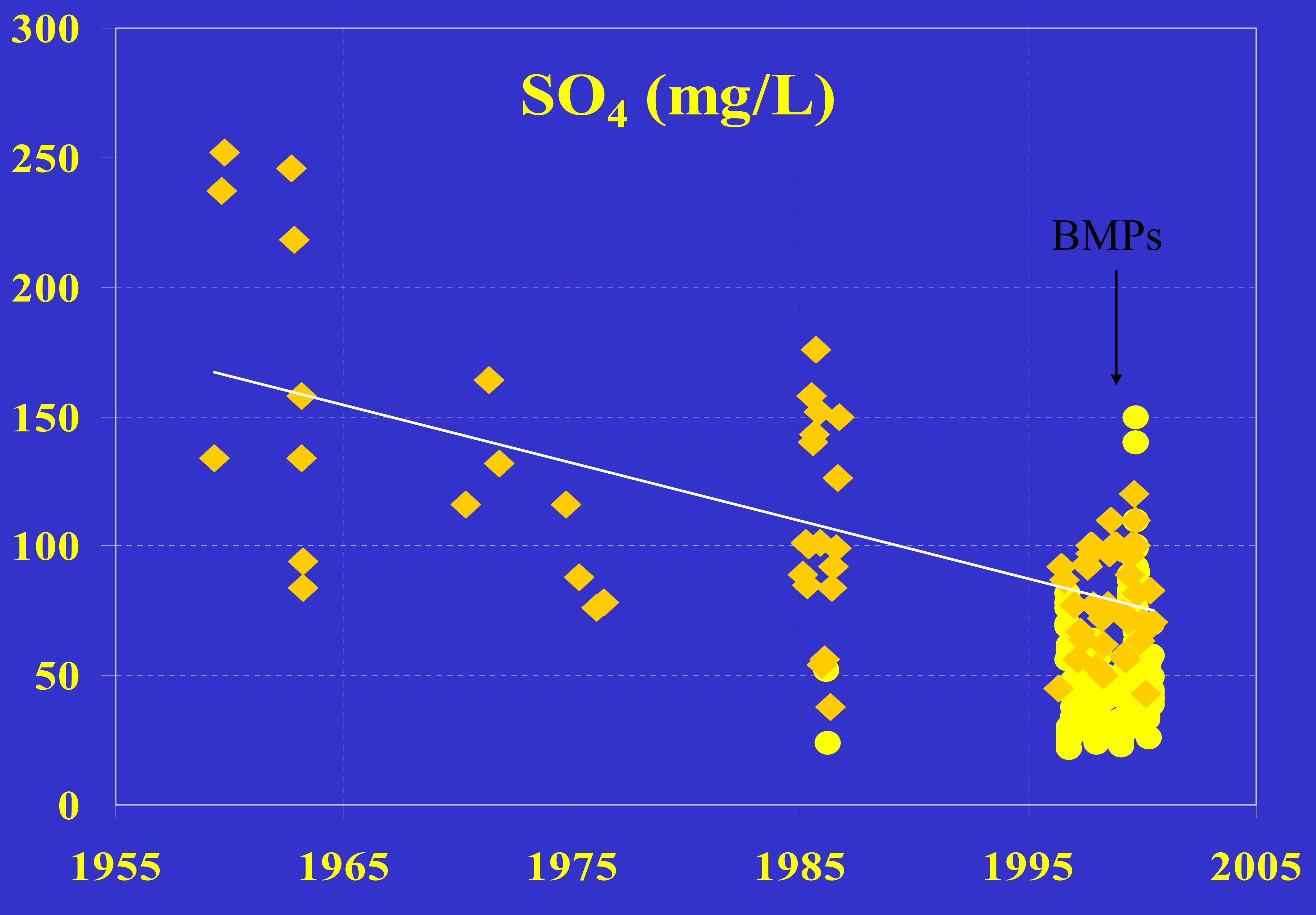
Limestone –Compost Wetland

Limestone – Compost Wetland

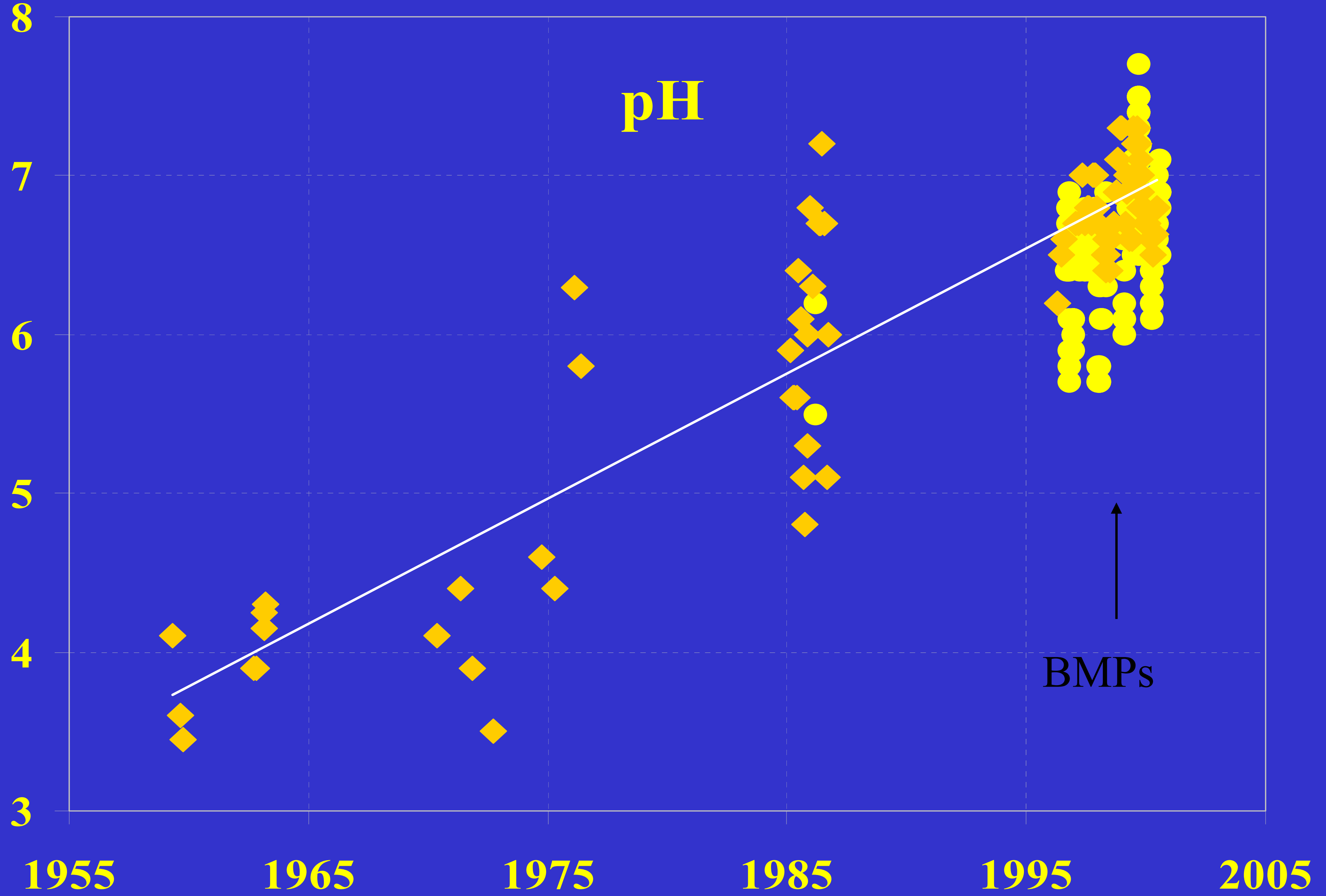

Lorberry Diversion Wells and Wetland
Rowe Tunnel
Diversion well
Aquafix
Wetland
LORBERRY CREEK WETLANDS
APR 23 2002

Indian Head Wetland

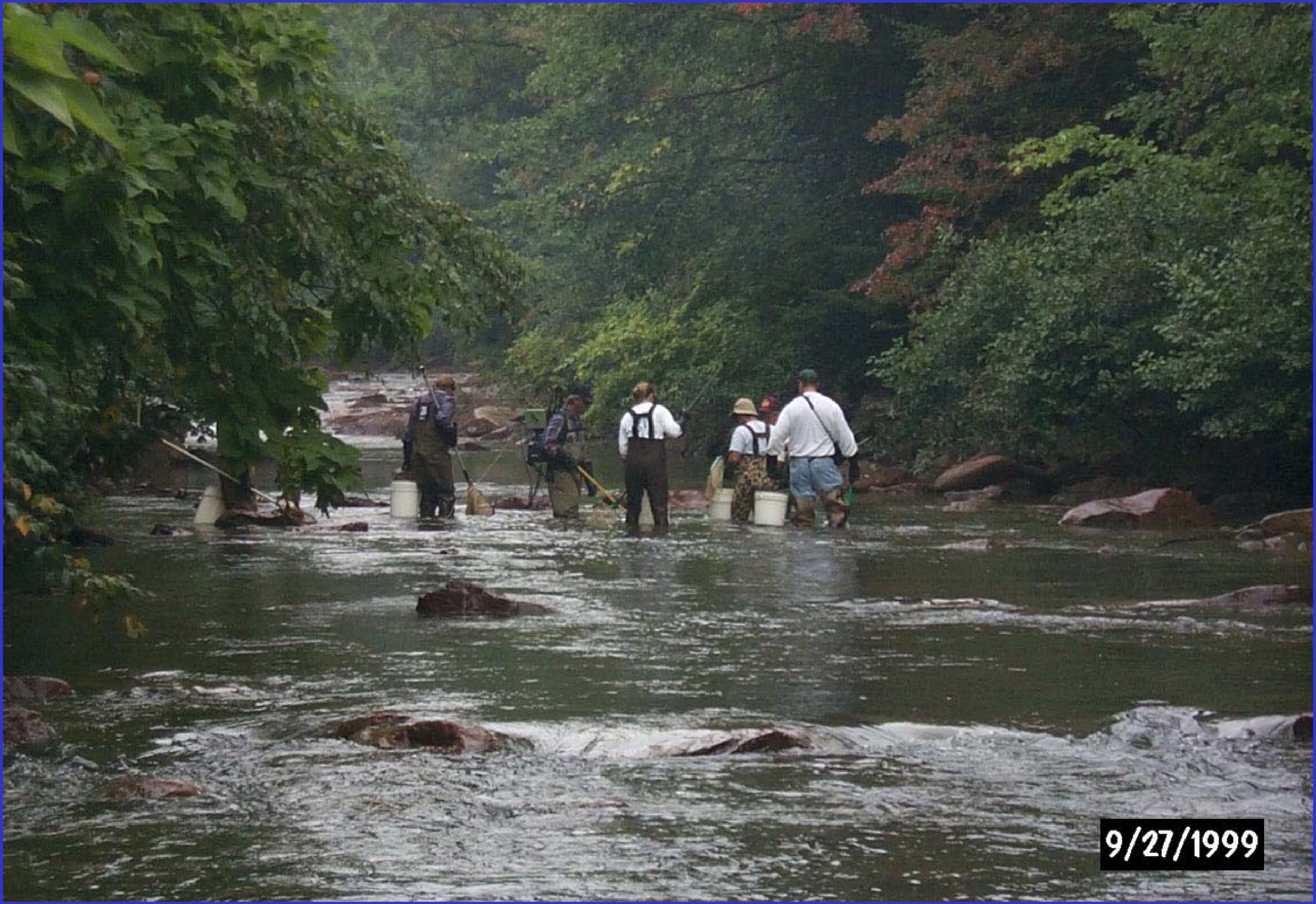
SWATARA CREEK AT RAVINE, PA



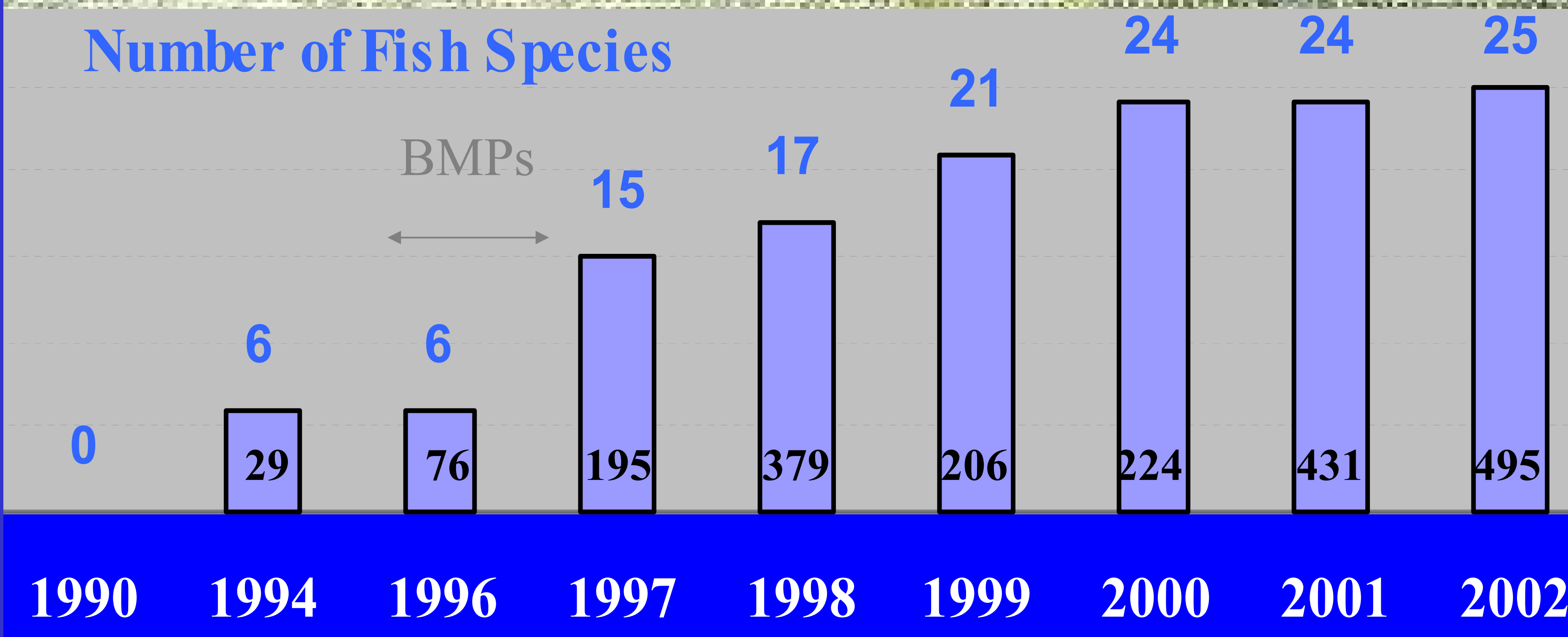
SWATARA CREEK AT RAVINE, PA



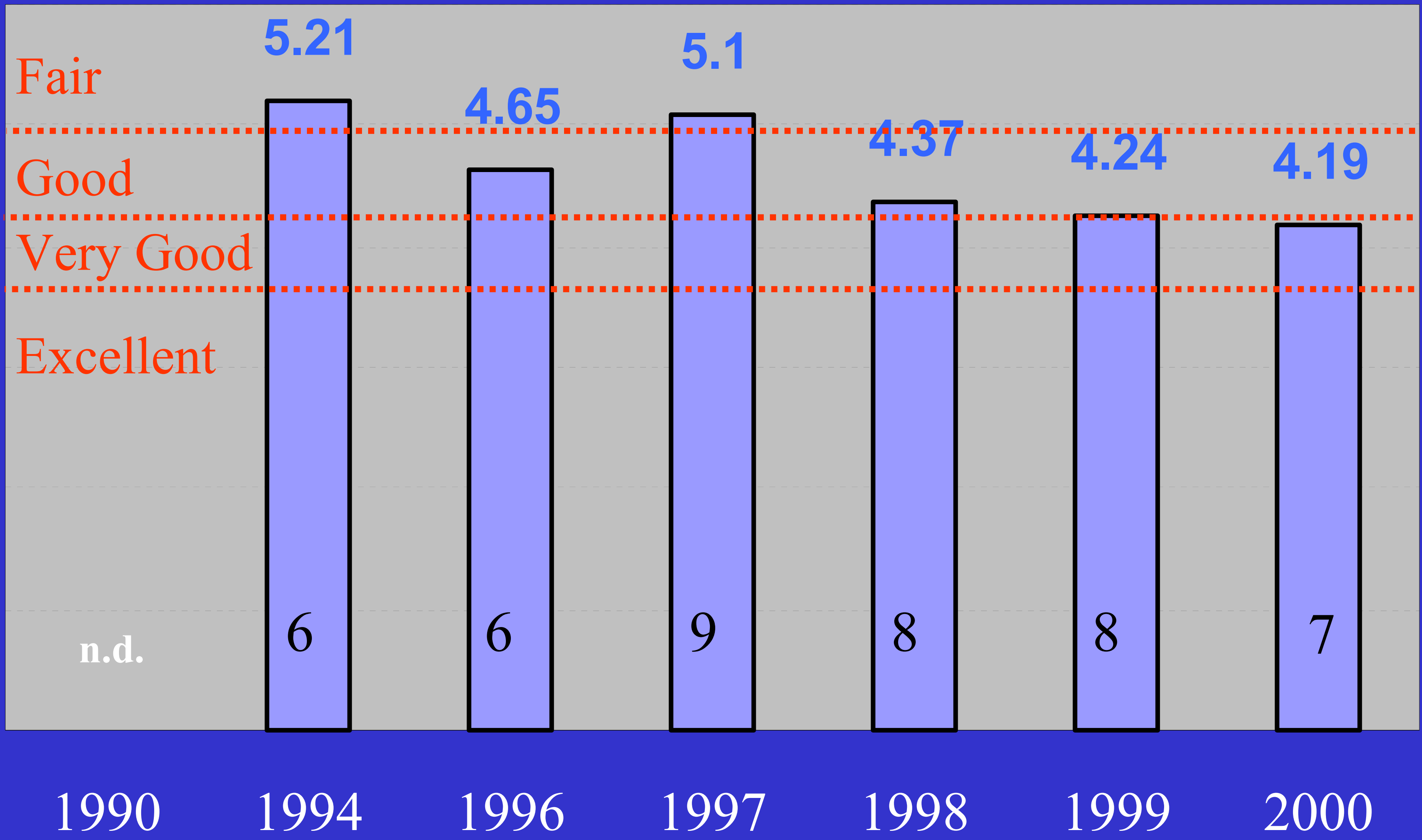
Aquatic Survey



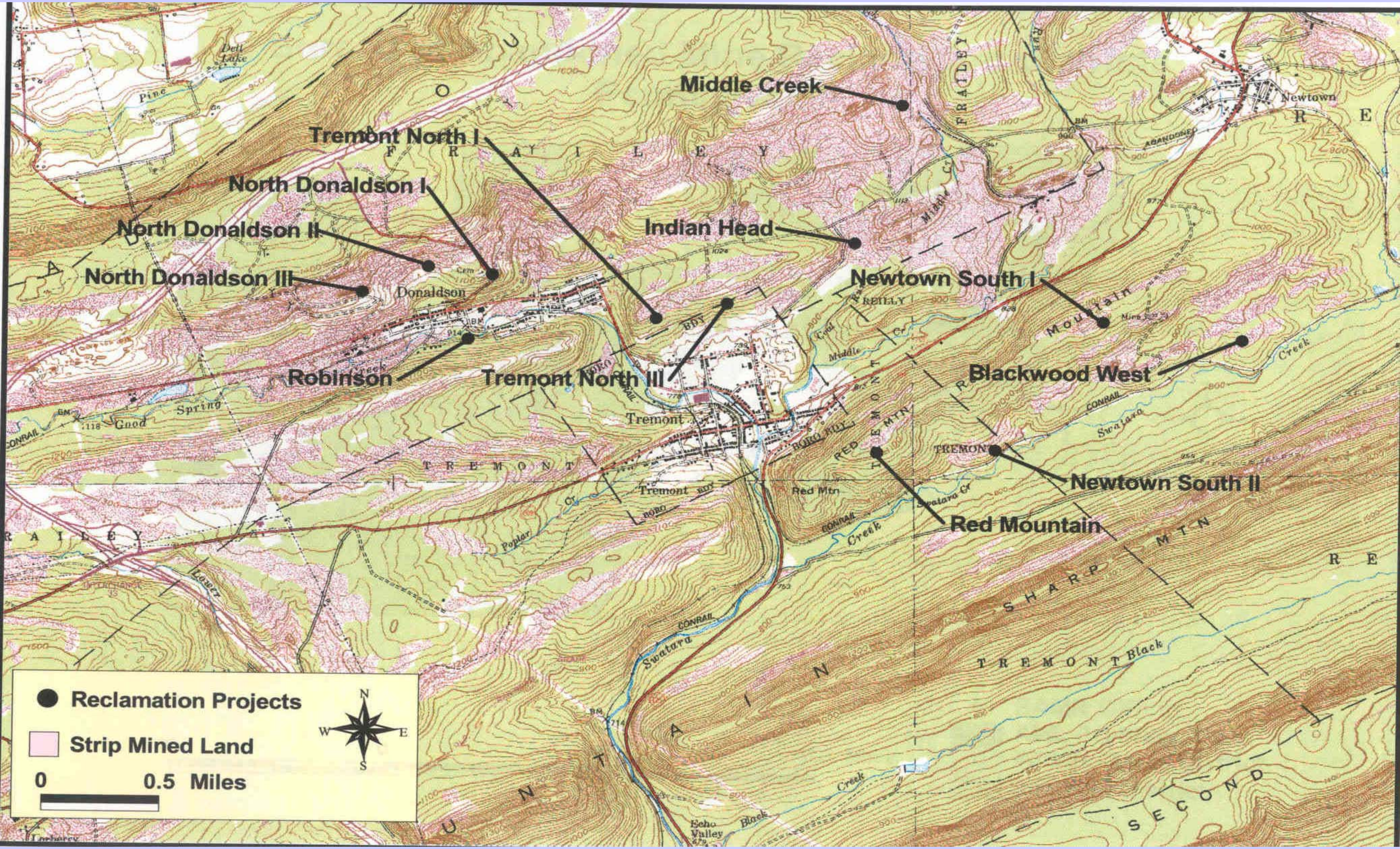
SWATARA CREEK AT RAVINE, PA



Hilsenhoff's Family Level Biotic Index (Macroinvertebrate Diversity at Ravine)



AML Projects in the Swatara Creek Watershed



Reclamation Accomplishments Since October 1999

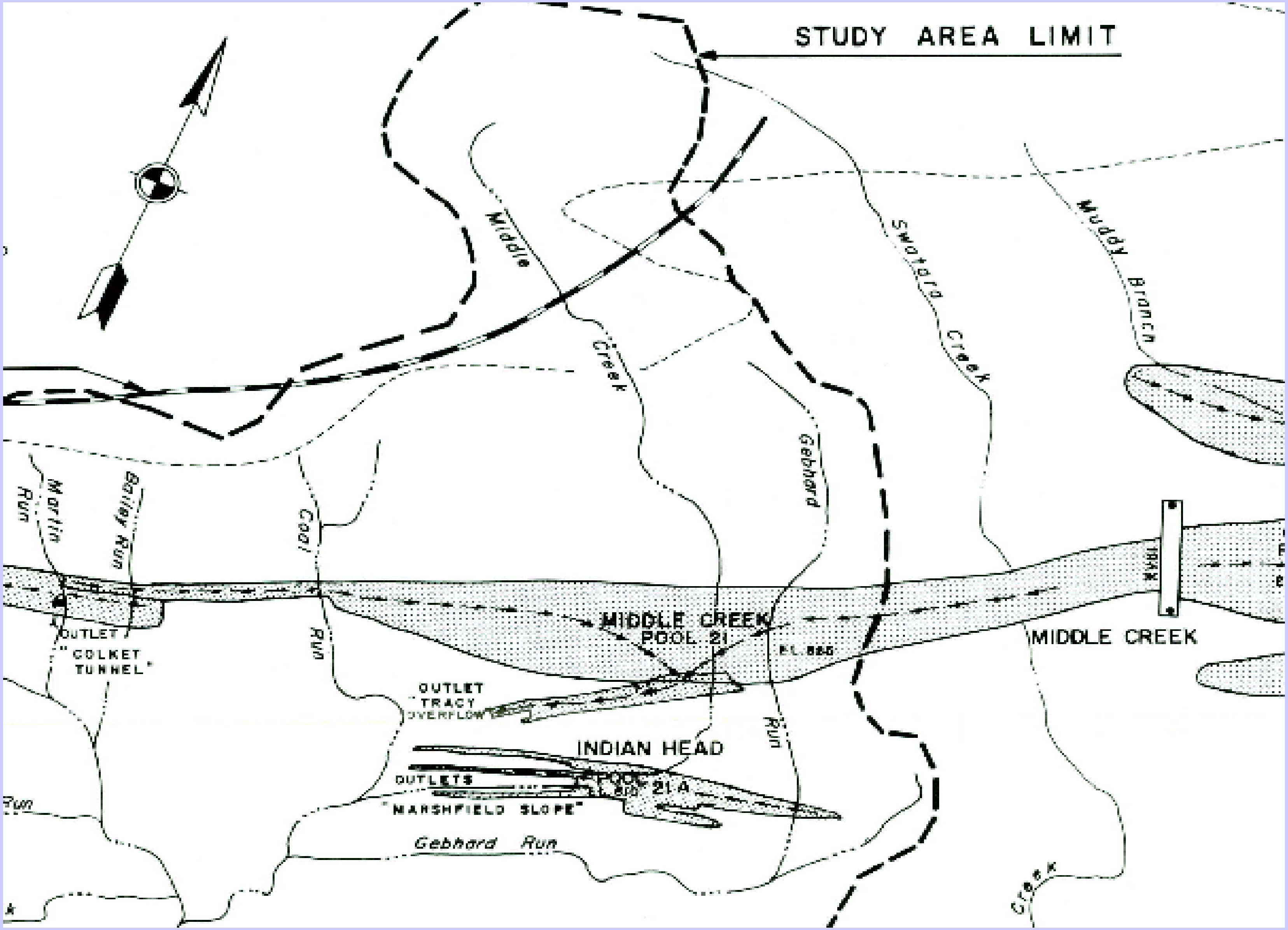
- 460 Acres of Abandoned Mine Land Reclaimed
- 40,200 Linear feet of Dangerous Highwall was eliminated
- 15 Mine Openings were abated
- Over 2 miles of stream bed were re-established
- 11 Acres of wetlands were created
- Total Reclamation Cost: $5.6 million

Middle Creek South AML Project

Pre-Construction Conditions

- From the mid 1800’s until the 1950’s the area was deep mined and strip mined
- Minimal laws existed requiring the area to be reclaimed
- Past strip mining left dangerous highwalls that extended for 4,000 ft. and up to 160 ft. in depth
- Past deep mining created large underground mine pools that produce abandoned mine drainage (AMD)
- In 1972 during heavy rainfall from Hurricane Agnes Middle Creek breached it’s banks and created a channel flowing into an adjacent strip pit
- Middle Creek continued to flow into the underground mine pool and exited out as AMD

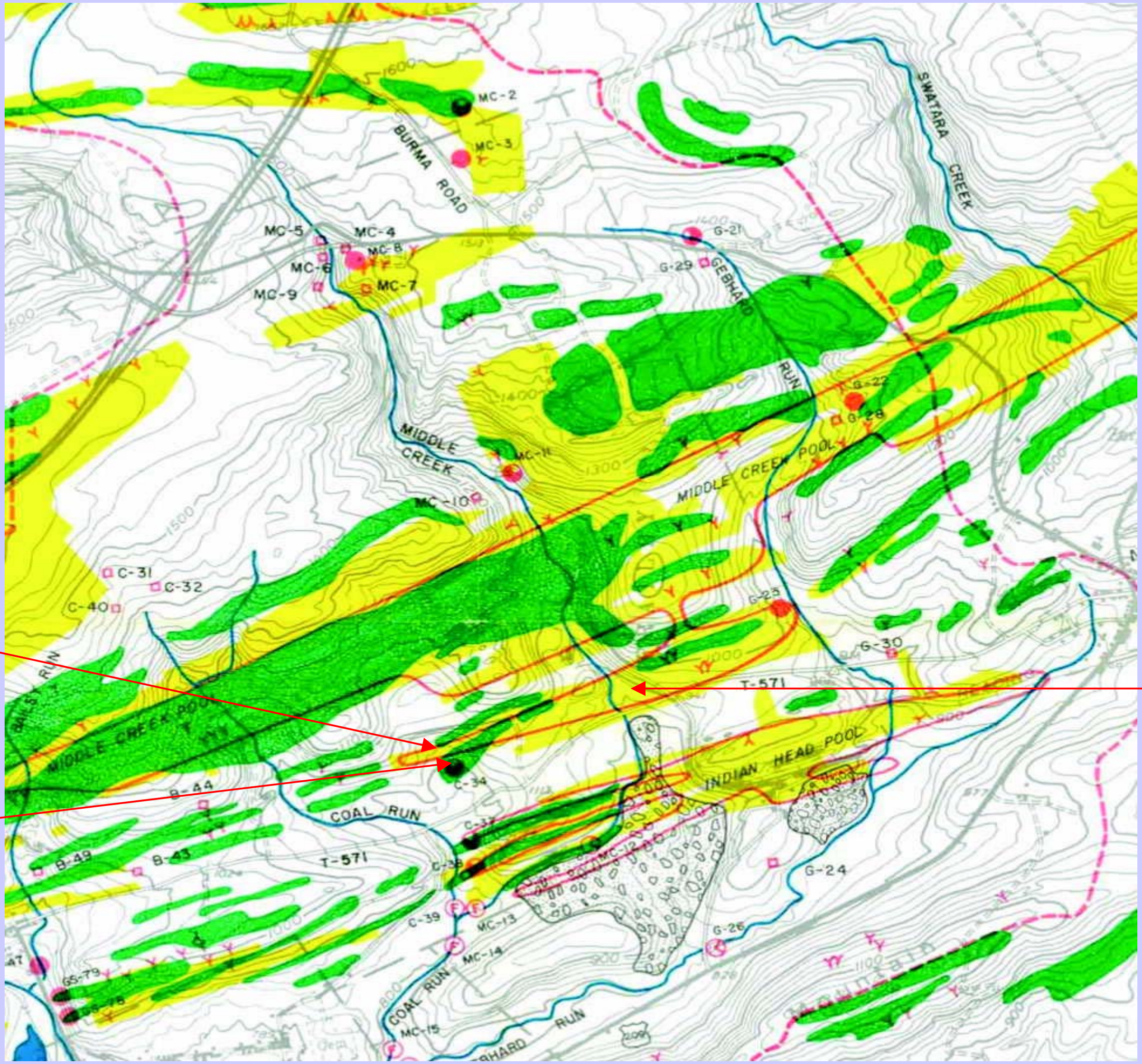
Middle Creek Mine Pool



Middle Creek After Agnes

- No flow was found in the stream bed below the strip pit
- Crop Falls occurred over the mine pool
- Two new mine discharges (Clinton #1 and #2) appeared

Middle Creek Mine Pool Discharges



Clinton #2

Tracy Overflow

Clinton #1

Middle Creek Mine Pool Discharges

- Prior to Hurricane Agnes (1972), the Tracy Overflow was the only discharge from the mine pool: pH – 3.5, Flow – 2,500 gpm, Iron – 29 mg/l
- Shortly after Agnes it was assumed that the Tracy Overflow became restricted and the Clinton #1 and Clinton #2 discharges appeared due to the elevated mine pool.

Middle Creek Mine Pool Discharges

- Data colleted from 1998 to 2003 show a significant change in the Tracy Overflow pH – 5.9, Flow – 650 gpm, Iron – 3.12 mg/l
- Data colleted on the Clinton #1 and #2 in the same time frame show that these discharges are the main outlets for the Middle Creek Mine Pool pH – 5.0, Flow – 2,400 gpm, Iron – 3.3 mg/l

Middle Creek Project Prior to Construction

Middle Creek Project Prior to Construction

Middle Creek Project Details

- 4,000 ft. of Dangerous Highwall as high as 160 ft. were backfilled
- 1,300 ft. of Middle Creek was established on the surface. Fluvial Geomorphology was incorporated into the design to give the stream a more natural look.
- Restoring Middle Creek allowed 3,600 ft. of stream channel to transport water once again.
- A new reinforced concrete box culvert was constructed on the Township Road that allowed Middle Creek to flow to its confluence with Coal Run.

Middle Creek Project Details

- The Project Area was 55 Acres
- Approximately 800,000 c.y. of material was re-graded
- The project began in March 2000 and was completed in September 2003 at a cost of $1.4 million.

Middle Creek during Construction

Middle Creek during Construction

Middle Creek during Construction

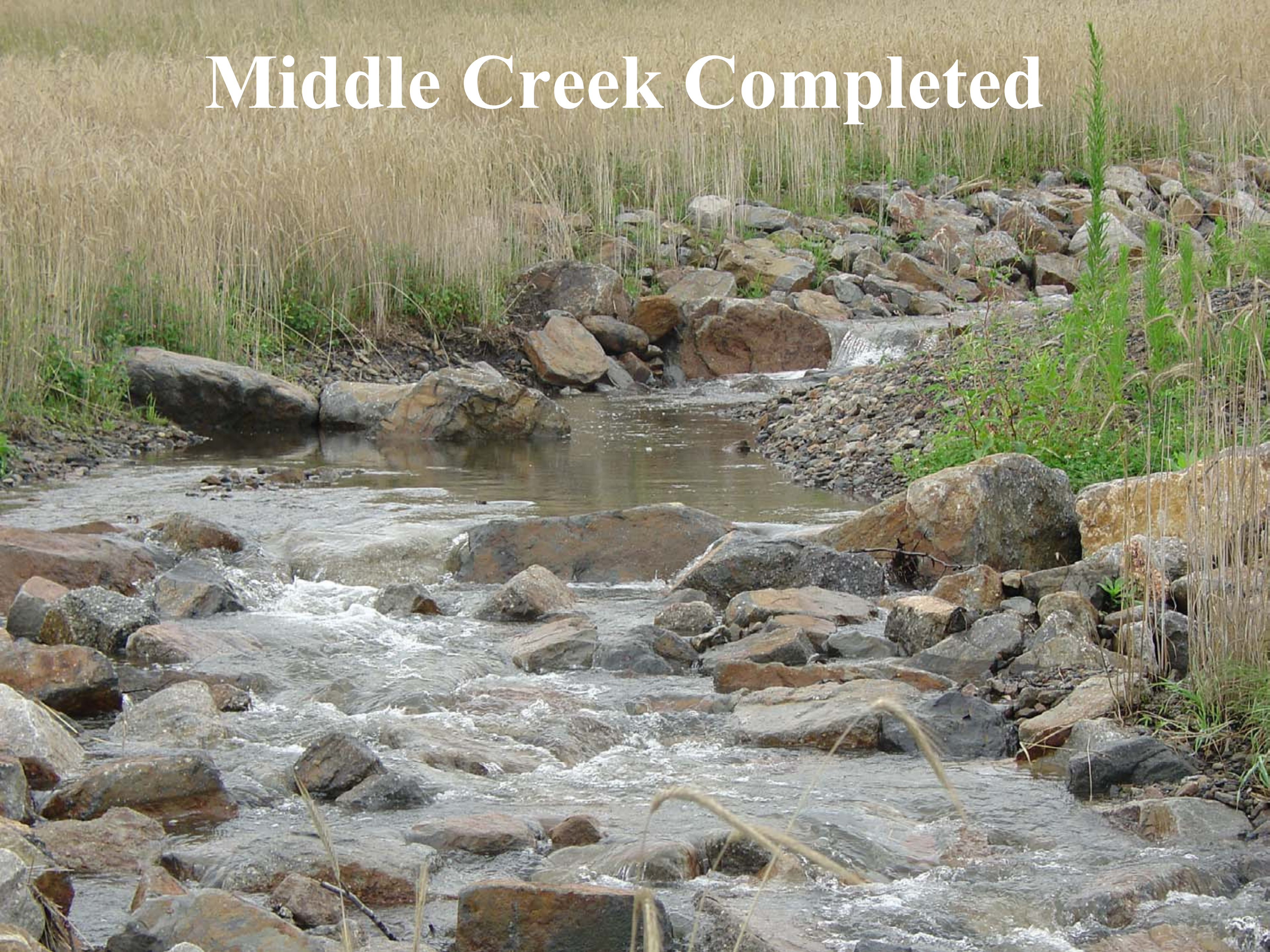

Construction of Middle Creek

Construction of Middle Creek

Middle Creek Project Results

- The project eliminated documented human health and safety problems namely the dangerous highwalls.
- Re-established Middle Creek to the surface, preventing an average of 1,100 gpm from becoming AMD. Crawfish, frogs, and other species have re-established themselves to this once dead area.
- Reduced the flow from the three discharges associated with the mine pool by 25%
- Two wetland areas were created totaling two acres. Rocks and stumps were placed in the wetlands to provide wildlife habitats.

Middle Creek Completed


Middle Creek Completed