



Broad Top Township vs. AMD: A Success Story in Bedford County, Pennsylvania

Pennsylvania Abandoned Mine Reclamation Conference
State College, PA
August 2 – 4, 2012

Bradley R. Shultz, E.I.T., Skelly and Loy, Inc., 449 Eisenhower Blvd,
Suite 300, Harrisburg, PA 17111, (717)232-0593,
bshultz@skellyloy.com

Ernest Fuller, Broad Top Township, 187 Municipal Rd, P.O. Box 57,
Defiance, PA 16633, (814)928-5253

AMD Pollution in Broad Top Township

- Located in northeastern Bedford County
- Municipality with population less than 2,000
- Over 80 identified AMD discharges
- Three primary 303(d)-listed watersheds (28 square miles):
 - Longs Run
 - Six Mile Run
 - Sandy Run
- Historic underground (approx. 184 mine entries) and surface coal mining legacy of isolated Broad Top coal field since the 1800's
- Abandoned underground mines filled with water and drainage from partially reclaimed surface mines have created AMD throughout the Township
- Broad Top Township/Coaldale Borough Watershed Advisory Committee (a.k.a. Six Mile Run Area Watershed Committee)
- 2001 AMD Assessment & Remediation Plan



Broad Top Township, Bedford County

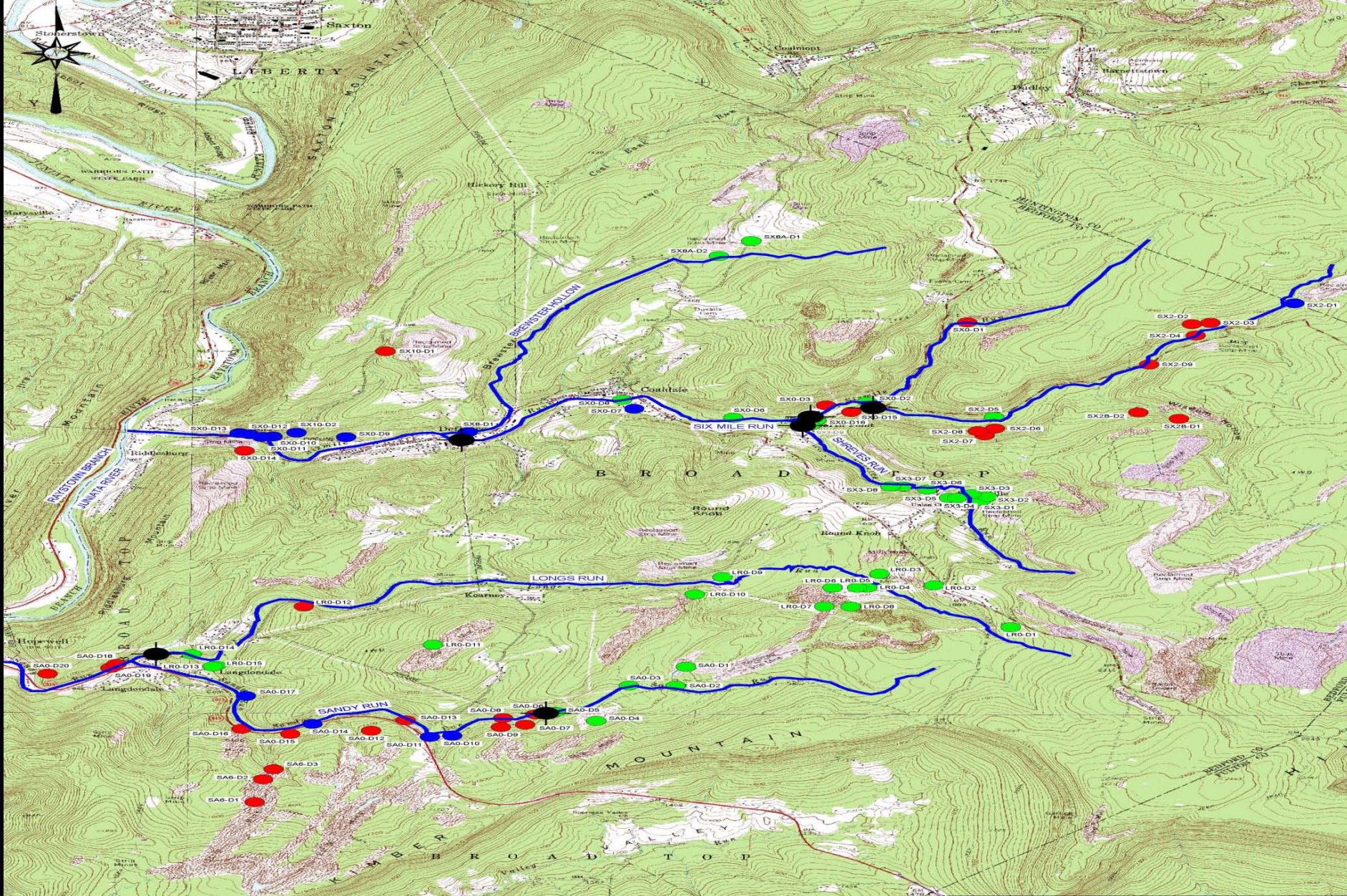


**PROJECT
LOCATION**

AMD Remediation in Broad Top Township

- Annually 63 tons of iron, 42 tons of aluminum, and 542 tons of acidity estimated from 80 identified sources
- 2001 estimates were roughly \$7 million to construct passive treatment at all AMD sites
- PA DEP Growing Greener, Section 319, & OSM Grant Funding
- Design and construction completed for more than 25 priority AMD discharges since 1998
- Flows: Range from <1 gpm to >500 gpm
- Chemistry: Net Alkaline (Fe^{2+}), Net Acidic, High Fe/High Al, Low Fe/High Al, High Fe/Low Al, & Low Fe/Low Al, low to moderate Mn, & varying proportions of $\text{Fe}^{3+}/\text{Fe}^{2+}$
- Skelly and Loy as design engineering firm and Broad Top Township as grantee and construction entity since 2000





LEGEND

- MONITORING POINT
- UNTREATED
- SYSTEM IN-PLACE
- FUNDED/IN PROGRESS
- STREAMS

SKELLY and LOY Inc. ENGINEERS—ENVIRONMENTAL CONSULTANTS	8/1/12	FIGURE 1
AMD ASSESSMENT & REMEDIATION PLAN IDENTIFIED DISCHARGE SITES		
AUGUST 2012 SITE STATUS		
BROAD TOP TOWNSHIP BEDFORD COUNTY, PA		
MKT—MUNI	SCALE: 1" = 3000'	

Applying & Evolving Passive Treatment for AMD Remediation

- Even with varying flow rates and chemistries, passive treatment works!
- Nearly all of the 25+ passive treatment systems are functioning as designed
- Most passive technologies have been utilized:
 - Flushable Limestone Beds (FLBs) – Automatic & Manual Flushing
 - Vertical Flow Wetlands (VFWs)
 - Anoxic Limestone Drains (ALDs)
 - Aerobic Wetlands
 - Settling Ponds
 - Oxic Limestone Channels (OLCs)
- Flushing technologies for Limestone Beds
 - First AMD use of Automatic Dosing Siphons and Automatic Inline Structure
 - Inline structures and manual flush valves



Passive Flushing Technologies

Automatic Dosing Siphon



Automatic Inline Structure



Finleyville Passive Treatment System Construction



01/12/2003

Finleyville Passive Treatment System Constructed 2005



Largest passive AMD treatment system in the Township, treating over 250 gpm (avg flow) from 3 discharges with >6,000 tons of limestone in 4 FLBs & 3 settling ponds (Raw pH = 3.0, Raw Al = 15-20 mg/L, Raw Acidity = 160 mg/L)

Finleyville Passive Treatment System



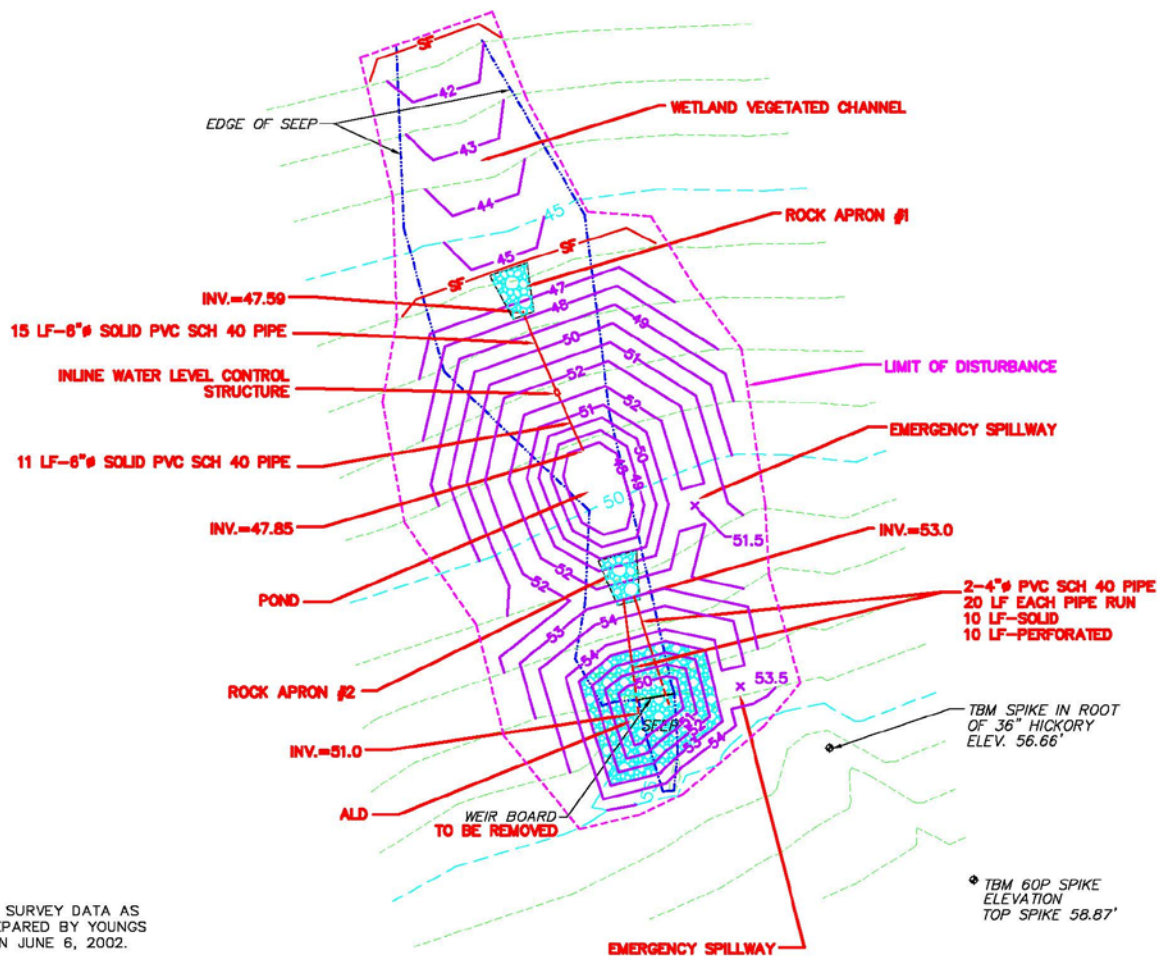
01/12/2003

Finleyville Passive Treatment System Automatic & Manual Flushing



04/17/2003

Longs Run Phase I – First Passive Treatment System Design (LR0-D6)



CONSTRUCTION SEQUENCE

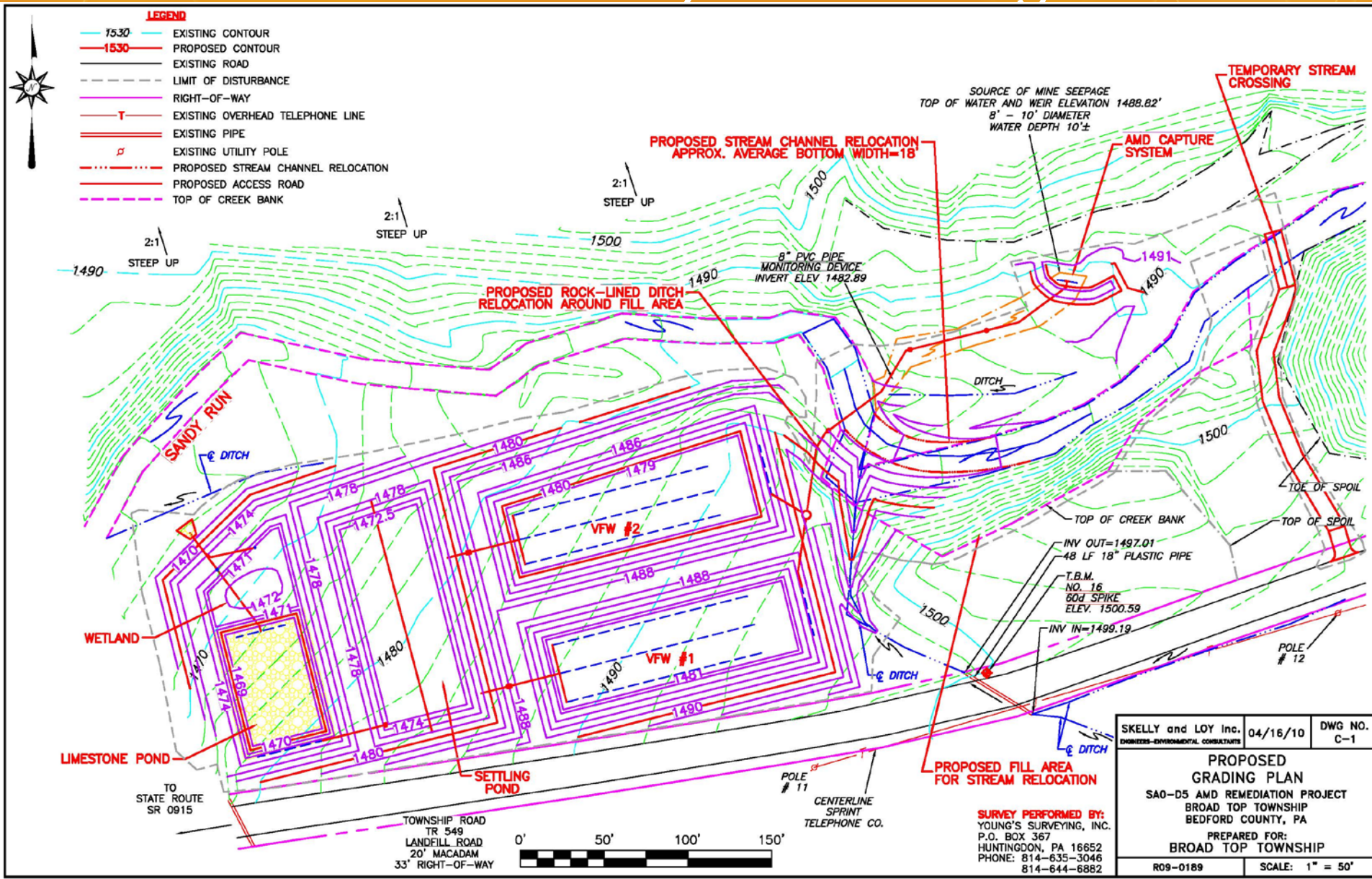
1. WORK AREAS SHALL BE DEWATERED IN ORDER TO PERFORM THE NECESSARY WORK ITEMS. DEWATERING SHALL BE PERFORMED BY USE OF EITHER COFFERDAMS, PUMPS, PIPING, OR OTHER APPROVED SOURCES IN ORDER TO PERFORM THE WORK.
2. INSTALL SILT FENCE IMMEDIATELY NORTH OF ROCK APRON #1 AND SOUTH OF THE START OF THE WETLAND VEGETATED CHANNEL.
3. INSTALL ROCK APRON #1 WITH CLASS 2 OR 4 GEOTEXTILE.
4. BEGIN GRADING ACTIVITIES FOR POND. INSTALL PIPE FROM ROCK APRON TO INLINE WATER LEVEL CONTROL STRUCTURE. CONTINUE GRADING ACTIVITIES FOR POND. INSTALL WATER LEVEL CONTROL STRUCTURE AND PIPE FROM WATER LEVEL CONTROL STRUCTURE TO POND. FINISH GRADING ACTIVITIES IN POND. SEED AND MULCH DISTURBED AREAS OF POND.
5. INSTALL ROCK APRON #2 WITH CLASS 2 OR 4 GEOTEXTILE.
6. BEGIN GRADING ACTIVITIES FOR ALD. INSTALL PIPES FROM ROCK APRON #2 TO ALD. FINISH GRADING OF ALD.
7. PLACE AASHTO NO. 1 STONE IN ALD AREA. INSTALL LINER AND SOIL COVER OVER ALD AREA. SEED AND MULCH DISTURBED AREAS.
8. INSTALL SILT FENCE NORTH OF THE WETLAND VEGETATED CHANNEL.
9. PERFORM GRADING ACTIVITIES FOR WETLAND CHANNEL. PROVIDE WETLAND VEGETATION IN CHANNEL UPON COMPLETION OF GRADING ACTIVITIES.
10. UPON COMPLETION OF CONSTRUCTION ACTIVITIES, SITE SHALL BE LEFT IN A CLEAN AND STABILIZED CONDITION.

NOTES:

1. THE EXISTING TOPOGRAPHIC SURVEY DATA AS SHOWN ON THIS PLAN WAS PREPARED BY YOUNGS ENGINEERING AND SURVEYING ON JUNE 6, 2002.

SKELLY and LOY Inc. ENGINEERS-CONSULTANTS	10/11/02	FIGURE 1
SITE PLAN PROJECT SITE D6 BROAD TOP TOWNSHIP BEDFORD COUNTY, PA PREPARED FOR: BROAD TOP TOWNSHIP		
1502111	SCALE: 1" = 20'	

Sandy Run SA0-D5 – Recent Passive Treatment System Design

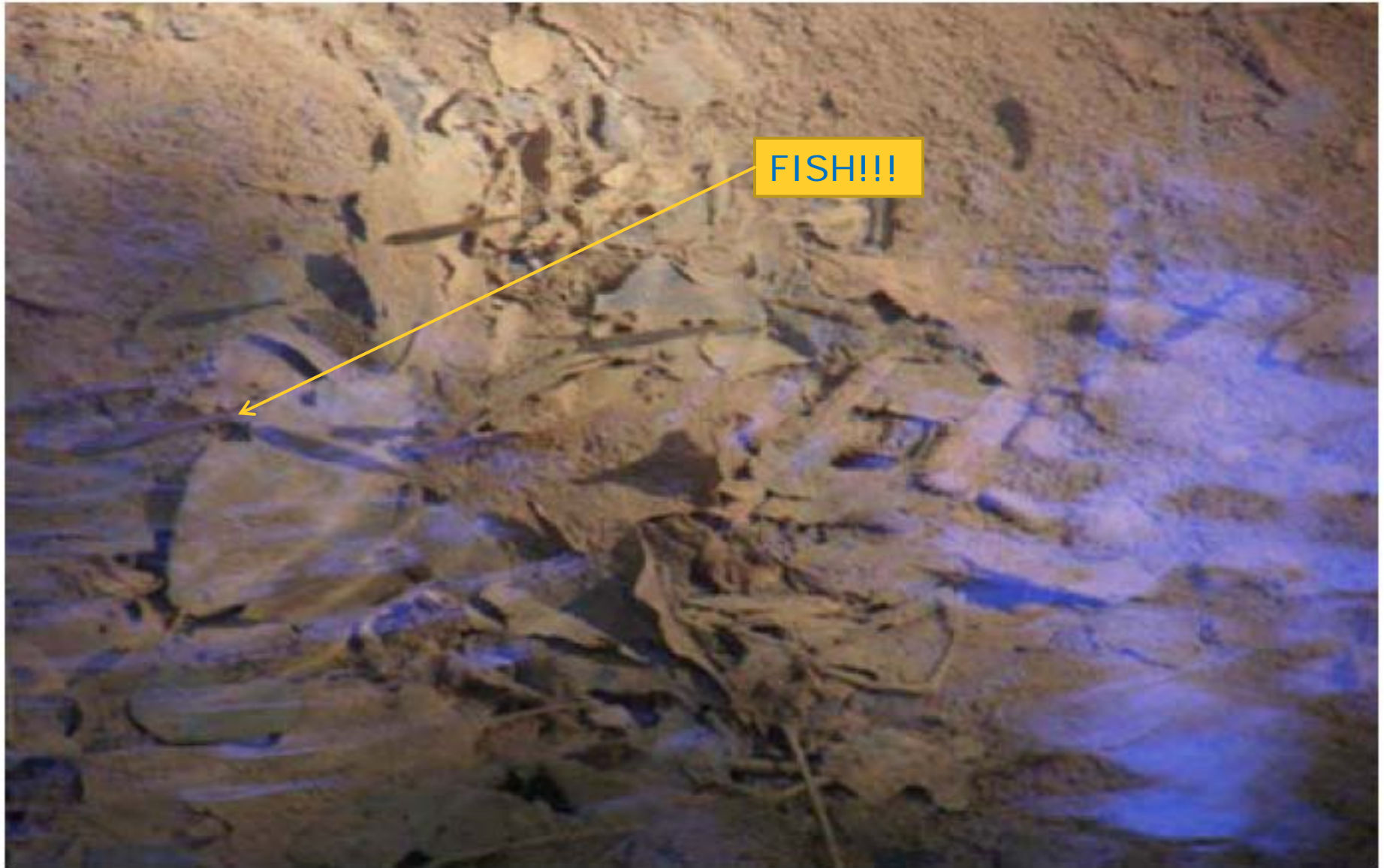


Learning, Adapting, & Working Together to Achieve Success

- Broad Top Township, Skelly and Loy, PA DEP and others have worked together to design and construct the best solution for each AMD discharge and develop most appropriate OM&R plans for each site
- PA DEP (Growing Greener & Section 319) Grant funding
- Permitting – Challenges as regulations evolve over the past 10 years (NPDES, Chapter 105, etc.)
- Broad Top Township – Model for future possibilities
 - Construct treatment systems
 - Personnel readily available to monitor/inspect systems
 - Arsenal of equipment to tackle many maintenance issues
 - Utilize Skelly and Loy (design engineer) for technical guidance on system maintenance and troubleshooting
 - Local citizens with desire to improve their streams for future generations
 - Significant cost savings – Construction and maintenance



Longs Run – Is That a Fish?????



Longs Run – Passive AMD Treatment

- 13 passive treatment systems designed and constructed for 14 AMD discharges (started in 2003, currently building last one LR0-D1)
- Limited space on some sites made full treatment difficult
- Mostly low to moderate flows but some with high dissolved metals and acidity levels
- Incorporating automatic flushing technologies at many of these sites has allowed for effective treatment with minimal maintenance issues
- While the presence of fish has been reported at several locations in Longs Run, the improved water quality also proves the efforts to date have worked:
 - April 2000 @ Mouth: Flow = 2,200 gpm, pH = 5.5, Alkalinity = 2 mg/L, Acidity = 9 mg/L, Al = 0.7 mg/L, Fe = 3.1 mg/L
 - April 2012 @ Mouth: Flow = 600 gpm, pH = 7.0, Alkalinity = 14 mg/L, Acidity = -2 mg/L, Al = 0.04 mg/L, Fe = 1.1 mg/L



LR0-D14: Before System Construction



05/12/2005

LR0-D14: Post Construction



Net alkaline discharge with moderate flow and high Fe^{2+} , but very limited space removes ~ 50% of iron; wetland was slightly enlarged & Aero-Troff added to promote aeration in place of rock-lined channel

Aero-Troff Addition @ LR0-D14



LR0-D10: VFW w/ Automatic Inline Structures

System Constructed in
2006, Performed One
Compost O&M Event
Since 2006 on VFW



LR0-D10 is the most
contaminated AMD discharge in
Longs Run with an acidity =
440 mg/L, flow = 30 gpm, Fe
= 145 mg/L, & Al = 10 mg/L

Six Mile Run – Passive AMD Treatment

- Including Shreves Run and Brewster Hollow, 14 passive treatment systems were designed and constructed for 18 AMD discharges (started on Shreves Run in 2005, still working on mainstem)
- Limited space on some sites made full treatment difficult
- Low to high flows, low to high dissolved metals and acidity levels
- Incorporating automatic flushing technologies at many of these sites has allowed for effective treatment with minimal maintenance issues
- While the presence of fish has been reported at several locations in Six Mile Run, the improved water quality also proves the efforts to date have worked:
 - May 2000 TMDL (2 mi. from Mouth): Flow = 3,700 gpm, pH = 4.3, Alkalinity = <1 mg/L, Acidity = 23 mg/L, Al = 2.0 mg/L, Fe = 0.25 mg/L
 - April 2012 (2 mi. from Mouth): Flow = 3,000 gpm, pH = 7.4, Alkalinity = 15 mg/L, Acidity = 1.6 mg/L, Al = 0.6 mg/L, Fe = 0.3 mg/L



SX0-D8 Before Treatment



SX0-D8 Future Treatment Location (Approx. 1/3 miles from AMD Source)



Future Treatment Ponds

Significant coal
refuse removed
and hauled to Co-
Gen Facility

SX0-D8: FLB Based Passive Treatment System (2011)



Brewster Hollow (SX8A-D2)

Aerobic Wetland



Existing
Wetland/Seeps

Brewster Hollow

Reclaimed Strip
Mine

Rock-Lined
Interceptor Channel

Aerobic Wetland

SX2-D5: Preliminary Construction



Exposed Mine
Entry/Source of AMD

SX2-D5 VFW Passive Treatment System Constructed 2006



Settling Pond

Aerobic Wetland

VFW

Mine Seal &
Reclaimed Mine
Entry

SX0-D6 Prior To Treatment Entering Six Mile Run



SX0-D6: Exposed Buried Mine Entries – Two?



SX0-D16 Exposed Mine Entry



Average Raw AMD:

Flow = 50 gpm

pH = 3.2

Fe = 1.0 mg/L

Al = 6.3 mg/L

Hot Acidity = 107 mg/L

SX0-D16: Mine Seal Installed & Treatment System Constructed (2008)

Reclaimed Mine Entry

Pipes from Wet Seal
in Mine Entry

Flushable Limestone Bed
W/ Dosing Siphon



SX0-D16 Passive AMD Treatment System Using FLBs & Settling Ponds



Final Outfall (Aug 2009):
pH = 7.7
Fe = <0.1 mg/L
Al = 0.2 mg/L
Hot Acidity = -26 mg/L
Alkalinity = 38 mg/L

SX8-D1 AMD Discharge

- Discharges directly into Brewster Hollow just upstream of confluence with Six Mile Run
- Design completed in 2012 and waiting for permits to construct FLB based passive treatment system
- Requires intercepting the AMD back from the stream in the underground mine tunnel
- Avg flow = 120 gpm, pH = 3.5, Al = 2 mg/L, Fe = 30 mg/L, Acidity = 125 mg/L




Sandy Run – Passive AMD Treatment

- 5 passive treatment systems were designed and constructed for 5 AMD discharges (BAMR – SAPS in 2000, BTT – 2008 & 2010)
- Limited space on some sites & proximity of discharges to stream will make full treatment difficult
- Low to high flows, moderate to high dissolved metals and acidity levels
- Last of three watersheds to focus remediation efforts, conceptual design report recently completed for remaining discharges
- While remediation efforts have been in upstream segment, instream water quality below SA0-D5 proves the efforts to date have worked:
 - April 2012 (3 mi. below headwaters): Flow = 900 gpm, pH = 7.1, Alkalinity = 23 mg/L, Acidity = 2.6 mg/L, Al = 0.5 mg/L, Fe = 0.8 mg/L
- SA0-D4 project involved the removal of significant quantity of mine spoil for use at Co-Gen facility



SA0-D4 VFW-Based Passive Treatment



Average Raw AMD:
Flow = 25 gpm
pH = 3.0
Fe = 99 mg/L
Al = 38 mg/L
Hot Acidity = 476 mg/L

SA0-D4 Final Settling Pond

Final pH = 7.1



SA0-D5: Passive AMD Treatment System & Stream Channel Realignment / Stabilization

SA0-D5 AMD



Sandy Run Channel





SA0-D5: Exposed Vertical Shaft

Average Raw AMD:
Flow = 70 gpm
pH = 3.1
Fe = 15 mg/L
Al = 16 mg/L
Hot Acidity = 195 mg/L

SA0-D5 AMD Capture System & Sandy Run Channel Realignment / Stabilization (2011)



AMD Capture System →

Stream Bank
Stabilization

Sandy Run

SA0-D5 VFW-Based Treatment System Constructed 2010-2011



SA0-D5 Passive Treatment System

FLB/Wetland Final Pond

Settling Pond w/ Baffle



AMD Remediation Efforts In-Progress

- Last system in Longs Run under construction (LR0-D1)
- SX8-D1 to be constructed in 2012, which will restore Six Mile Run down to the last mile of stream
- Conceptual design projects underway in Six Mile Run (7 AMD discharges) and Sandy Run (4 AMD discharges) – USACE Baltimore District Funded Design Projects
- The Township personnel continue monitoring the system outfall water quality and operations and perform the necessary maintenance activities to keep systems functioning properly
- Skelly and Loy continues to work with the Township to develop solutions to issues that arise and recommend the system improvements needed in order to keep restoration efforts moving forward
- OM&R plans developed for each passive treatment system
- The Township has grant funding to conduct major O&M repairs for approximately half of the existing systems (Longs Run & Finleyville in Six Mile Run)
- Recent water quality monitoring efforts in all three watersheds at the TMDL sampling locations show significant improvements toward removal from the 303(d) list
- The recent use of geochemical modeling will help to determine the best approach to the remaining remediation efforts in Six Mile and Sandy Run as well as treatment options



Final Thoughts & Township Perspective

- While this presentation highlighted some of the major accomplishments for AMD remediation in the Township, it is difficult to provide all of the details of the significant efforts by a municipality to improve the natural resources for the community and for generations to come!
- With approximately 10 VFWs, 3 ALDs, 22 variations of FLBs, 13 OLCs, 33 Settling Ponds, and 13 Aerobic Wetlands a lot of work has been accomplished and passive treatment has helped to improve three AMD impacted watersheds! Remember O&M is needed!
- In addition to the hard workers and dedication from the Township, this work would not have been possible without the necessary funding from PA DEP Growing Greener, Section 319, and OSM grants
- And now a word from Broad Top Township...

