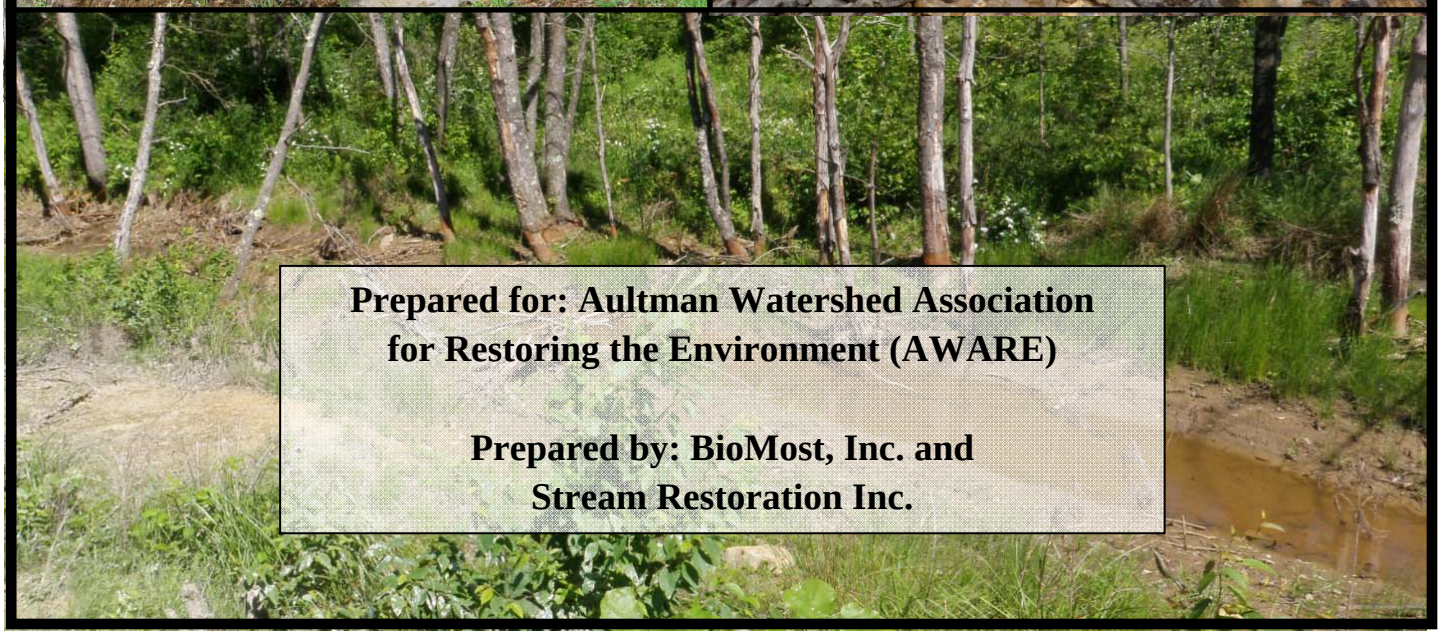
Reeds Run AMD Remediation Construction

Project Summary

2011



Prepared for: Aultman Watershed Association for Restoring the Environment (AWARE)

Prepared by: BioMost, Inc. and Stream Restoration Inc.

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Aultmans Run Watershed, Armstrong Township, Indiana County, PA

EXECUTIVE SUMMARY

The Reeds Run AMD Remediation project targeted a diffuse AMD seep zone within the stream channel of Reeds Run. As noted in a recent assessment report[1], this seep zone has been identified as being the second highest contributor of iron, manganese, and acidity to the 28-square mile Aultmans Run Watershed. The AMD seep zone is in the headwaters of Reeds Run and the immediate downstream impacts are assessed at the monitoring point known as RD0-D1. As monitoring indicated that amelioration of the seepage could decrease the annual pollutant loading to Reeds Run by an estimated 9 tons of acidity and 5 tons of metals, the Aultman Watershed Association for Restoring the Environment **(AWARE)** designated this site to be a high priority for restoration.

The site assessment began in 2004 after a Growing Greener Grant was awarded to AWARE and Stream Restoration Incorporated **(SRI)**. A technical report[1], completed June 2007, was prepared which dealt with the site history, current site conditions, water quality, chemical and physical hydrogeology, and development of a restoration strategy. The restoration strategy described included draining and utilizing a portion of existing Sediment Pond "A" to install a 3000-ton Horizontal Flow Limestone Bed **(HFLB)** as an alkalinity generator and creating a ½-acre wetland to receive the effluent from the HFLB for settling of metal particulates.

A grant was sought to implement the restoration strategy and partial funding (Doc. #4100039012; Proj. #CD060063CEI) was awarded on 10/8/2006 for $121,000 through the PA DEP Growing Greener County Environmental Incentives Program administered by the Indiana County Conservation District.

Based on additional subsurface investigations and insight by the landowner (Central Blair Electric) and John Foreman, PG, the restoration strategy was revised and expanded to include the removal of the existing coal refuse in order to address the major source of AMD. To remove the coal refuse and to handle the non-fuel grade material **(NFG)** encountered, Robindale Energy Services joined the public-private partnership effort. As the NFG material to remain at the site was potentially acid producing, an additional project partner was needed to supply material for alkaline addition. Initially, circulating fluidized-bed **(CFB)** coal ash was considered as, after delivery of the coal refuse to the newly-opened (2004) Seward Generating Station to produce electricity, the coal ash could be delivered to the site by back-haul. Based on the understanding of project participants, however, sufficient funding and time were not available to complete the necessary permit/approval applications for use of the CFB coal ash. A new partner was asked to join the team, Harsco Minerals, who generously offered to donate the alkaline material (Mineral CSA, a PA DEP-approved co-product). The coal refuse recovered from the site was 72,647 tons and 6,967 tons of Mineral CSA was mixed with the NFG.

In the location of the original stream channel for Reeds Run, which had been buried during the historic coal mining activities, the coal refuse was removed to the approximate original ground. After final grading by Robindale Energy, long-time project partner Quality Aggregates Inc. and Saddle Creek Farms Bedding, Inc. began constructing a 0.75-acre wetland followed by a 0.60-acre open water habitat to help ameliorate any lingering degraded seepage from the NFG material remaining on site. The area for wetland construction was re-configured and compost was mixed with minesoil to create a ~1-foot thick wetland substrate. To establish a more natural wetland, the substrate was not evenly spread or compacted. Good quality water previously entering the existing Sediment Pond "A" was diverted

[1] *Aultman Watershed Assoc. for Restoring the Env. & Stream Restoration Inc., 6/07, Reeds Run AMD Remediation Design Tech. Rept., Aultmans Run Watershed, Armstrong Twp., Indiana Co., PA: funded by PA DEP Growing Greener Doc. #4100028800, Proj. #CD40319.*

during construction and then re-directed to the inlet of the created wetland. Volunteers including local college students participated in a hands-on, education/outreach opportunity by planting the wetland.

Before final restoration efforts were entirely completed, fish were observed in the open water habitat and within the effluent prior to entering Reeds Run. Fish were also observed, probably for the first time in over 50 years, in the section of the Reeds Run headwaters formerly severely impacted by the AMD seep zone. Based on initial findings, over one mile of Reeds Run has been essentially restored and another 2½ miles have been significantly improved.

Water quality at stream sampling point RD0-D1 depicts the dramatic improvement to Reeds Run. As the water quality and flow rate at RD0-D1 appear to be extremely variable seasonally and responsive to precipitation events and beaver activity, in addition to including average values of selected parameters, individual sampling dates in the characteristically low-flow season that conform to the initial post-construction sampling date are included in the following table.

Reeds Run Above and Below In-Stream AMD Seep Zone

Sample Point		Date	Flow (gpm)	pH (lab)	Alk. (mg/L)	Acid. (mg/L)	TFe (mg/L)	TMn (mg/L)	TAl (mg/L)	SO_4 (mg/L)
SW-32 *upstream*	Pre-Const.	min/avg/max 1983-2007	2/147/620 (n=26)	4.1/6.6/7.8 (n=67)	2/33/114 (n=70)	0/42/112 (n=66)	0/12/49 (n=71)	0/1/9 (n=71)	1 (n=12)	25/110/219 (n=71)
	Post-Const.	09/23/11	25E	7.6	42	-25	<0.3	0.1	<0.5	27
RD0-D1 *downstream*	Pre-Const.	min/avg/max 2002-2007	26/524/1731 (n=10)	2.9/5.3/7.0 (n=22)	0/7/14 (n=22)	-4/344/5329 (n=22)	3/104/1649 (n=22)	<1/4/5 (n=22)	1/19/294 (n=22)	39/433/5581 (n=21)
		10/04/02	34	3.4	2	183	55.3	2.3	10.1	289
	Post-Const.	09/23/11	25E	7.4	44	-22	1.9	2.1	0.9	159

E-estimated; NM-not measured; SW-32 sample analyses reported for 8/12/99 assumed spurious and excluded from max/min values

Note in the above table that the highest pH and alkalinity and lowest acidity and iron values ever recorded for Reeds Run at RD0-D1 were post-implementation of the AMD remediation project.

TIMELINE (Selected Events)

Abbreviations: Aultman Watershed for Restoring the Environment **(AWARE);** BioMost, Inc. (**BMI**); Stream Restoration Incorporated **(SRI)**; Horizontal Flow Limestone Bed (**HFLB**); Pennsylvania Department of Environmental Protection (**PA DEP**)

DATE	DESCRIPTION
02/23/06	Letter of Commitment received from G and C Analysis Lab., Inc.
02/24/06	Letter of Support received from Center Township Board of Supervisors
02/27/06	Letter of Support received from PA State Representative Dave Reed
02/27/06	Letter of Support received from United States Department of the Interior
02/28/06	Letter of Support received from Indiana County Tourist Bureau
02/28/06	Letter of Support received from Indiana County Office of Planning and Development
03/01/06	Letter of Support/In-Kind received from BMI
03/02/06	Letter of Support received from Indiana University of Pennsylvania
03/02/06	Letter of Support/In-Kind received from Quality Aggregates Inc.
03/03/06	Environmental Stewardship and Watershed Protection Grant Application submitted
03/03/06	Letter of Commitment received from Aultman Watershed Assoc. for Restoring the Environment (AWARE)
03/06/06	Letter of Support received from Armstrong Township Supervisors
05/01/06	Letter of Support received from Indiana County Pennsylvania Senior Environmental Corps
06/02/06	Example Support Letter sent to US Environmental Research Service
06/22/06	Letter of Support received from PA State Representative Jeffrey P. Pyle
06/25/06	Letter of Support received from US Environmental Research Service
06/28/06	Letter of Support received from Central Blair Electric Company
06/29/06	Additional Support Letters for Reeds Run AMD Remediation Construction sent to PA DEP Grants Center
12/07/06	Growing Greener grant (CD060114) not awarded – Reeds Run AMD Remediation Construction
01/26/07	Executed County Env. Grant Agreement, etc. submitted to DEP
03/06/07	County Env. Grant Agreement awarded 3/8/07; $121,000.00 for construction; duration 10/09/06 to 10/08/09
07/26/07	Qtr. Work Progress Rept. sent to Crittenden, DEP
08/15/07	Match Requirement Documentation sent to DEP
10/24/07	Qtr. Work Progress Rept. sent to Crittenden, DEP
01/16/08	Revised narrative and plan sent to Malcolm Crittenden, Project Advisor PA DEP Cambria DMD via e-mail
01/17/08	Qtr. Work Progress Rept. sent to Crittenden, DEP
03/05/08	Growing Greener grant (CD070088) not awarded – Reeds Run AMD Remediation Construction
03/28/08	Water sample taken at site
04/23/08	Qtr. Work Progress Rept. sent to Crittenden, DEP
04/30/08	Field investigation: sediment removed from dewatering pipes; upland plant community characterization
07/18/08	Qtr. Work Progress Rept. sent to Crittenden, DEP

08/03/08	Dewatering/kickoff event held
09/29/08	Additional Letter of Support received from Central Blair Electric Company
10/07/08	Updated landowner agreement submitted
10/17/08	Qtr. Work Progress Rept. sent to Crittenden, DEP
01/26/09	Qtr. Work Progress Rept. sent to Crittenden, DEP
04/09/09	Qtr. Work Progress Rept. sent to Crittenden, DEP
07/20/09	Qtr. Work Progress Rept. sent to Crittenden, DEP
08/10/09	1-year grant extension requested to 10/08/10; DEP approved 08/17/09
08/12/09	Site investigation conducted
10/15/09	Qtr. Work Progress Rept. sent to Crittenden, DEP
12/16/09	2 piezometers installed to monitor near subsurface conditions in conjunction with a coal reserve study
01/14/10	Request for Scope of Work to include coal refuse removal submitted to DEP; Qtr. Work Progress Rept. sent
01/19/10	DEP special auth. coal refuse removal (Sec. 4.8, PA SMCRA 52 P.S. 1396.4h) to assist in restoration
04/18/10	Qtr. Work Progress Rept. sent to Crittenden, DEP
04/27/10	Remediation Agreement with Robindale Energy Services, Inc. signed
04/29/10	1-year grant extension requested to 10/8/11; DEP approved 05/13/10
06/02/10	Erosion and Sedimentation Control Plan sent to Robindale Energy Services.
06/14/10	Field “kick off” meeting; coal refuse being removed and trucked to Seward plant for electricity generation
06/28/10	Field meeting; clay found in portions of coal refuse - unsuitable for electricity generation
07/19/10	Qtr. Work Progress Rept. sent to Crittenden, DEP
2010-2011	6,976 tons of Mineral CSA (co-product designation) donated by Harsco to mix with non-fuel grade coal refuse
11/23/10	Field meeting; ditch to be created to divert storm runoff from the western side of non-fuel grade refuse
01/13/11	Qtr. Work Progress Rept. sent to Crittenden, DEP
03/31/11	Mineral CSA mixed with non-fuel grade coal refuse and selectively placed; BMI inspect & sample water
04/08/11	Qtr. Work Progress Rept. sent to Crittenden, DEP
06/02/11	Fish observed at RDO-01; water sampling
06/14/11	Field meeting; discuss wetland construction; wetland construction begins
07/05/11	Construction inspection
07/19/11	Wetland ready to be seeded; construction completed; Qtr. Work Progress Rept. sent to Crittenden, DEP
08/02/11	Fish observed in Reeds Run and in diversion ditch; PA smartweed growing on NFG coal refuse pile
08/25/11	Site investigation, plans made to reseed areas lacking vegetation
10/04/11	Wetland planted and seeded

PROJECT OVERVIEW

INTRODUCTION

The Aultmans Run Watershed encompasses 28 square miles and includes the AMD-impacted Reeds Run Subwatershed. The AMD has caused significantly elevated metals and low pH in the main stem of Reeds Run. The sources of the AMD are drainage from historic coal mining activities including coal refuse. The focus of the recently completed project in the headwaters was a diffuse AMD seep zone within the stream channel of Reeds Run. This AMD seepage was the second largest contributor of acidity and metals in the watershed. Reeds Run upstream of the AMD seep zone, according to studies conducted by Indiana University of Pennsylvania students before project implementation, supported macroinvertebrates sensitive to pollution such as mayflies, stones flies, and caddisflies; however, none were observed in Reeds Run downstream of the AMD seep zone.

AWARE was the "driving force" for project implementation. AWARE was founded in February 2000 by concerned citizens in and around the Aultman Run Watershed in order to address the problem of abandoned mine drainage into waterways and groundwaters. Aultmans Run enters the Conemaugh River near the village of Lewisville in Conemaugh Township in Indiana County. The major tributaries in the watershed are Reeds Run, Neal Run, and Coal Run. (Reeds Run→Aultmans Run→Conemaugh River→Kiskiminetas River→Allegheny River→Ohio River)

SITE LOCATION/SETTING

The Reeds Run AMD Remediation site is located on the 7½' USGS McIntyre topographic map at latitude 40° 34' 40" and longitude 79° 16' 36" and lies south of Locust Road (T-425) and west of Reeds Run in Armstrong Township, Indiana County, about 1 mile east of the town of McIntyre. The site is on private property owned by Central Blair Electric Company. A gas line operated by T. W. Phillips Oil and Gas Co. crosses the southern edge of the site. A more detailed history of the site and the surrounding area can be found in the previously referenced Reeds Run AMD Remediation Design Technical Report (June 2007).

SITE PREPARATION

The site preparation effort included cleaning the outlet pipes to existing Sediment Pond "A" to allow draining. In addition, to aid in determining if shallow subsurface flow through the coal refuse was the main contributor of iron, manganese, and acidity to the AMD seep zone within Reeds Run and to aid in determining the coal refuse characteristics, two piezometers were installed on 12/16/09. As part of the partnership effort, John Foreman, PG, representing Central Blair Electric Company, developed the drilling program. The drilling was completed at no additional cost.

RECLAMATION EFFORT

An erosion and sedimentation control plan was prepared by BioMost, Inc. and sent to Robindale Energy Services for implementation prior to coal refuse removal. Beginning in June of 2010, Robindale Energy Services began fuel-grade coal refuse removal operations. This remining operation, made possible through authorization by the PA DEP under Growing Greener Grant #ME-4100039012 to remove refuse from the project site, enabled the implementation of the best-available land reclamation and water quality amelioration effort. A total of 72,647 tons of refuse were removed.

Coal refuse was trucked to the nearby Seward Generating Station, which utilizes circulating-fluidized bed technology. This technology enables the generation of electricity from waste coal that was

previously un-usable by traditional coal burning facilities. Even though relatively new to the United States, this technology has been implemented in Europe for over 30 years. The Seward Generating Station (Indiana County, Seward, PA) is one of the largest in the United States.

Some portions of the coal refuse present on site were not suitable for power generation due to impurities in the material. After removal of fuel-grade refuse, the remaining non-fuel grade (NFG) refuse was mixed with a total of 6,967 tons of alkaline material (Mineral CSA; PADEP approved co-product), which was generously donated by Harsco Minerals (Sarver, PA). The mixture was then placed on a layer of permeable soil material (about 3 feet in thickness), composed of soil encountered during recovery of the coal refuse, in order to convey and limit contact of subsurface flow with the NFG mixture. With final placement of the NFG mixture, the pile was graded to drain, covered with about a foot of soil material, and revegetated.

Diversion ditches were installed around both NFG refuse piles to divert runoff; thereby, further lessening the impact of the remaining NFG refuse by reducing seepage of surface flow into the piles. In addition, most seepage from the NFG refuse piles is expected to be conveyed to, or intercepted by, the constructed wetland and/or open water habitat and ameliorated prior to entering Reeds Run.

WETLAND AND OPEN WATER HABITAT CONSTRUCTION

After refuse removal, construction of the wetlands and open water habitat was completed by Quality Aggregates (Pittsburgh, PA) and Saddle Creek Farms Bedding (Canfield, OH) in June 2011. A 0.75-acre wetland was created along with a 0.60-acre open water habitat, which are bordered by the Primary Non-Fuel Grade Refuse Pile on the west and the stream buffer area on the east. These features were constructed within the vicinity of the original stream channel for Reeds Run which had been buried beneath the coal refuse. Water of good quality which formerly entered the existing Sediment Pond "A" was conveyed by a riprap-lined spillway to the constructed wetland inlet. A By-Pass Ditch with influent pipe (capped when not in use) was installed to divert the good quality water to Reeds Run in order to allow maintenance, if needed, of the created wetland and/or open water habitat. Within the constructed wetland, woody debris was added to provide habitat. The wetlands were created with varying water depths and soil (mixture of compost and onsite soil material) thickness to provide the opportunity for biological diversity. The open water habitat was also constructed to provide a variable depth of water from ~1 to 3^{+} feet. A riprap-lined spillway conveys the open water habitat effluent to a channel (effluent end of permanent diversion ditch) which confluences with Reeds Run.

As part of an education and outreach effort, seeding and planting were performed on 10/04/11 by volunteers and Indiana University of Pennsylvania students. Live stakes were harvested on site and planted within the created wetland. Plants from existing onsite wetlands such as Eastern burr-reed and soft rush were also transplanted into the created wetland. To supplement the live stakes and plants, a seed mix of native wetland species was also spread.

Species Planted in the Constructed Wetland

Common Name	Scientific Name	Percent by Mass
Fox Sedge	*Carex vulpinoidea*	30
Deertongue	*Panicum clandestinum*	20
Fowl Bluegrass	*Poa palustris*	15
Silky Dogwood	*Cornus amomum*	5
Arrowwood	*Viburnum Dentatum*	5
Blue Vervain	*Verbena hastata*	5
Showy Tickseed Sunflower	*Bidens aristosa*	5
Barnyard Grass	*Echinochloa muricata*	5
Buttonbush	*Cephalanthus occidentalis*	5
Arrowleaf Tearthumb	*Polygonum sagittatum*	3
Creeping Spikerush	*Eleocharis palustris*	2

ENVIRONMENTAL RESULTS AND FUTURE WORK

Removing a major cause of degradation from the base flow (AMD seep zone) to Reeds Run has resulted in a substantial improvement of the downstream water quality.

Pre- and Post-Const. "Snapshot" of Reeds Run Below the In-Stream AMD Seep Zone

Sample Point		Date	Flow (gpm)	pH (lab)	Alk. (mg/L)	Acid. (mg/L)	TFe (mg/L)	TMn (mg/L)	TAl (mg/L)	SO_4 (mg/L)
RD0-D1 *downstream*	Pre-Const.	10/04/02	34	3.4	2	183	55.3	2.3	10.1	289
	Post-Const.	08/02/11	NM	6.6	33	-25	1.4	0.2	0.2	42
		09/23/11	25E	7.4	44	-22	1.9	2.1	0.9	159

E-estimated; NM-not measured; Selected sample dates. See table in Executive Summary for additional sampling data. For long-term monitoring data, also see AWARE & SRI, June 2007, Reeds Run AMD Remediation Design Technical Report: funded by PA DEP Growing Greener Grant Doc. #4100028800, Proj. #CD40319.

Even though future monitoring is required to determine improvements in the quality of Reeds Run long-term, comparing selected sample dates pre-construction with the sampling conducted post-construction dramatically illustrates the immediate improvement in Reeds Run below the AMD seep zone. Compare the acidity readings pre-construction with the negative acidity readings post-construction. In other words, Reeds Run is no longer net acidic but net alkaline. Also note the decrease in total iron content by about 80 to 90%.

Note also the similarity on 09/23/11 of the upstream quality at SW-32 (7.6 lab pH, 42 mg/L alkalinity, -25 mg/L acidity, <0.3 mg/L total iron, 0.1 mg/L total aluminum and 27 mg/L sulfates) with that of the downstream quality shown in the above table, as further indication that the project goals were successfully achieved. This dramatically improved water quality is also supported by observations of fish in this section of Reeds Run, probably for the first time in over 50 years.

Onsite Seepage Before and After Construction of the Created Wetland and Open Water Habitat

Sample Point	Date	Flow (gpm)	pH (lab)	Alk. (mg/L)	Acid. (mg/L)	TFe (mg/L)	TMn (mg/L)	TAl (mg/L)	SO_4 (mg/L)
Pre-Construction (seepage)	03/31/11	2E	4.8	0	523	155.0	25.5	35.3	1897
	06/02/11	NM	3.1	0	218	22.2	19.8	24.4	878
Post-Construction Influent/Effluent	08/02/11	1E/2E	7.0/4.4	163/0	-161/29	0.5/0.4	0.3/15.2	0.2/3.0	98/1280
	09/23/11	--/15	---/7.6	---/39	---/-20	---/0.4	---/0.2	---/<0.5	---/37

E-estimated; NM-not measured; Pre-construction represents water quality prior to creation of the wetland and open water habitat.

As shown in the preceding table, the seepage in the wetland construction area was highly degraded and may have been caused by coal fines remaining after refuse removal. Note, however, after construction of the created wetland and open water habitat, placement and vegetation of the NFG mixed with alkaline material, and conveyance of the former Sediment Pond "A" influent to the headwaters of the created wetland, the effluent from the open water habitat is remarkably improved.

On 8/2/11, degraded drainage is known to continue to enter the wetland as the sulfates are increased from 98 mg/L (influent) to 1280 mg/L (effluent) and the manganese is increased from <1 mg/L (influent) to 15 mg/L (effluent). Even though direct sampling of the seepage is difficult, substantial iron (visually present) and aluminum are, nonetheless, being removed in the created wetland/open water habitat. Fish were also observed on that date within the effluent of the open water habitat prior to entering Reeds Run. (See following photographs.)

The effluent sample collected on 9/23/11 appears to indicate a response to significant rainfall (reported for the area), where the good water quality influent has a flow rate sufficient to produce a good quality effluent. Note the low sulfate and manganese values.

SUMMARY

Due to the generosity and unwavering commitment by numerous partners, the restoration effort substantially exceeded the project originally proposed, without requesting additional grant funds. The created wetland was vegetated with native plants and fish have been observed in Reeds Run in the formerly "dead" section of the stream. In summary, the project was a success not only due to the stream improvement but also due to the beneficial use of recovered and processed materials that were historically viewed as waste products to generate electricity (coal refuse) and to provide alkaline addition (Mineral CSA) for neutralization of the potentially acidic non-fuel grade material.

PHOTOS

Reeds Run Before

Iron precipitates coat the substrate of the stream channel forming “iron-crete”

Beaver dam caused flooding in portion of project area; iron-laden sediment & lack of vegetation

Reeds Run After

8/12/11 no iron precipitates in stream channel; water quality good (See analyses for 8/2/11.)

Hard to see, but there are fish in the stream!!! 7/12/11

Site Preparation & Evaluation Activities

Cleaning pipes to drain existing Sediment Pond "A"

Existing Sediment Pond "A"

Piezometers installed 12/16/09 - Forsyth Drilling (DuBois, PA); John Foreman, PG; Margaret Dunn, PG

12/16/09 tree being harvested by beaver for dam construction on Reeds Run

6/14/10 stripping and stockpiling soil for later use as (1) substrate (soil mixed with compost) for the created wetland, (2) a pad for the placement of NFG refuse mixed with Mineral CSA, and (3) soil cover for land reclamation

Coal Refuse Recovery and Removal Operations

(Summer/Fall 2010)

Alkaline Addition (Mineral CSA co-product) Mixed with Non-Fuel Grade Refuse
(Summer/Fall 2010)

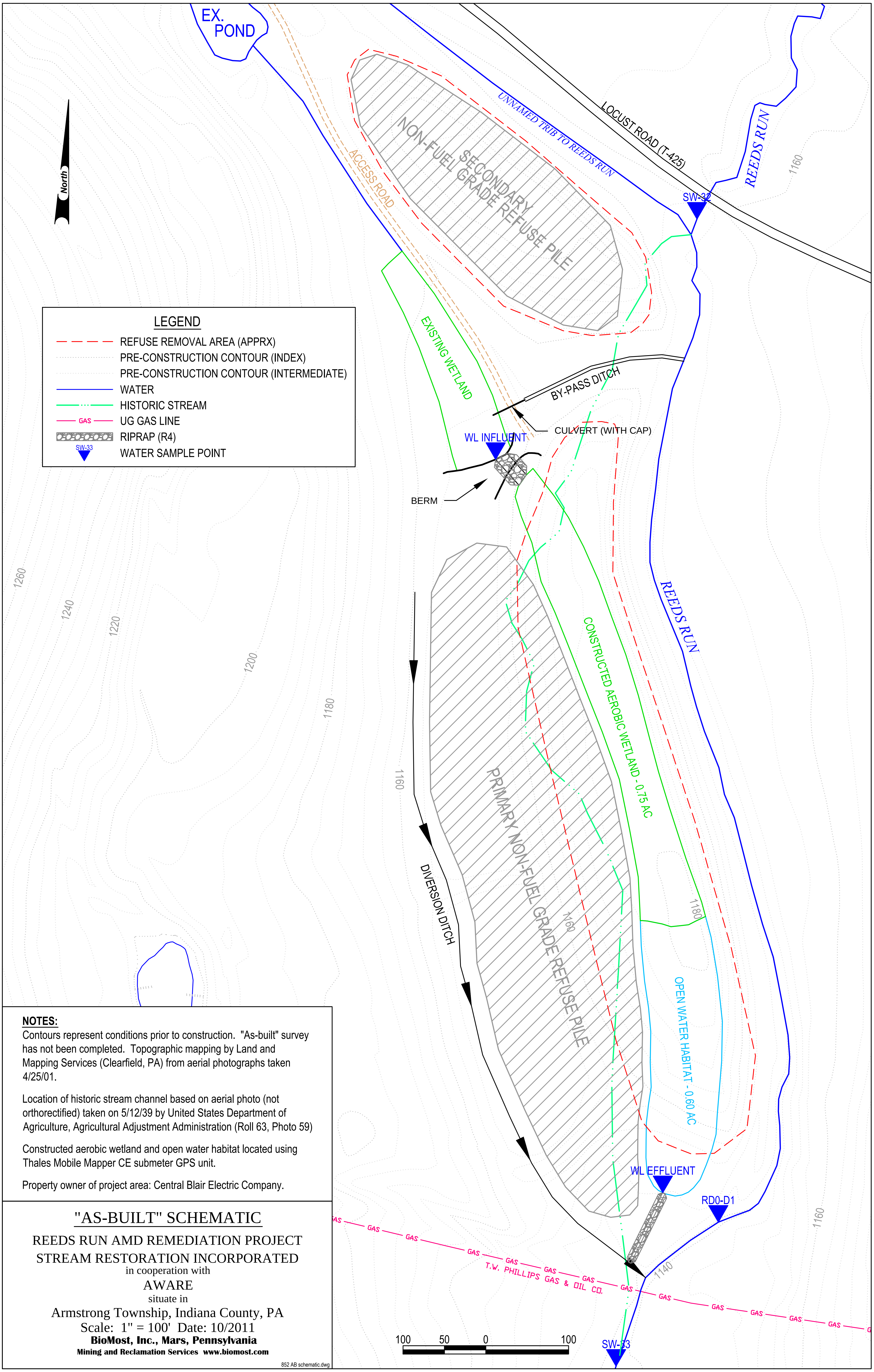
Creating Wetlands and Open Water Habitat

8/25/11 created wetland (center) looking downstream from inlet; vegetated Primary NFG Refuse pile (right)

8/25/11 open water habitat looking upstream from outlet; vegetated Primary NFG Refuse pile (left)

Wetland Planting: AWARE, IUP students, SRI
(10/4/11)

8/2/11 fish observed in Reeds Run at RD0-D1 (circled).



NOTES:

Contours represent conditions prior to construction. "As-built" survey has not been completed. Topographic mapping by Land and Mapping Services (Clearfield, PA) from aerial photographs taken 4/25/01.

Location of historic stream channel based on aerial photo (not orthorectified) taken on 5/12/39 by United States Department of Agriculture, Agricultural Adjustment Administration (Roll 63, Photo 59)

Constructed aerobic wetland and open water habitat located using Thales Mobile Mapper CE submeter GPS unit.

Property owner of project area: Central Blair Electric Company.

"AS-BUILT" SCHEMATIC

REEDS RUN AMD REMEDIATION PROJECT
STREAM RESTORATION INCORPORATED
in cooperation with
AWARE
situate in
Armstrong Township, Indiana County, PA
Scale: 1" = 100' Date: 10/2011

BioMost, Inc., Mars, Pennsylvania
Mining and Reclamation Services www.biomost.com

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