File – AMD 26(2768)101.2

Cucumber Run
Ohiopyle State Park

Wetland and Anoxic Limestone Drain

Stewart Township
Fayette County, PA

Bureau of Abandoned Mine Reclamation

Compiled from: Dietz, J.M. and D.M. Stidinger. 1993. Evaluation of Wetlands Constructed for the Treatment of Acidic Mine Drainage. The EADS Group, Clarion, PA.

Pre-construction site

- discharges appeared to emanate from subsided headings of the Whipkey/Miller deep mine complex, and also receive some AMD seepage from the eastern toe of the strip mine backfill
- water quality and flow

	DER	EADS
Flow (gpm)		117
pH	2.8-3.1	3.9
Alkalinity (mg/l) as $CaCO_3$	0	0
Acidity (mg/l) as $CaCO_3$	141-525	298
Total Iron (mg/l)	22-126	97
Total Aluminum (mg/l)	4.7-25.2	6.4
Total Manganese (mg/l)	1.2-3.8	2

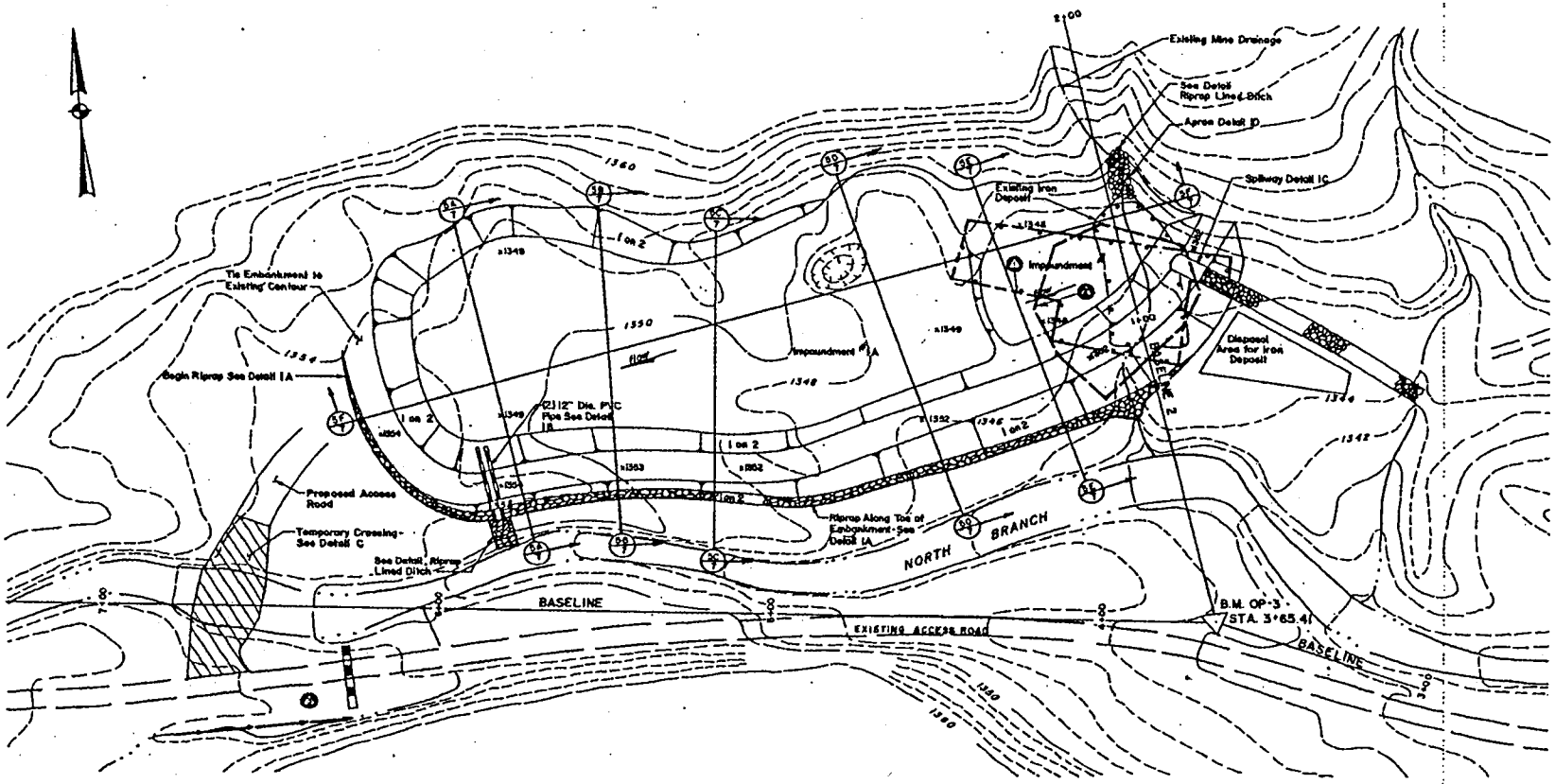
Pre-construction goals

- Average discharge qualities of (less than or equal to):
  - 3 mg/l for iron
  - 5 mg/l for aluminum
  - 7 mg/l manganese

What was built? (final price: $77,558.59)

- Aerobic wetland
  - single-cell, stepped impoundment ~73m (240ft) long and averaged 21m (69ft) wide (single-cell unit used to maximize limited space)
  - first third of the impoundment was deepened substantially to provide settling of suspended solids and precipitation iron. This section provided ~1.5m (5ft) of water depth with no compost or plants
  - second step provided for a total depth of 0.6m (1.5ft) and contained between 0.3m (1ft) and 0.5m (1.5ft) of compost
  - third step provided for a total depth of 0.6m (2ft) with ~0.6m (2ft) of compost
  - the compost was mushroom compost from Blue Mountain Mushroom
  - the second and third steps of the system were planted with aquatic vegetation
    - cattails were chosen to be the dominant plant because they are common in the area and colonize well in AMD sites, rushes and sedges were also planted, the plants were hand dugged and placed on ~0.6m (2ft) centers allowing for full plant coverage after one growing season

Wetland site plan



Post-construction

- average water quality and flows for 1-Influent to system, 2-Intermediate pond , 3-Discharge from system

	Flow (gpm)	pH**	Acid.*	Alk.*	Hard.*	Sulfate	Total Fe	Ferr. Fe	Total Mn	Total Al
1	17.58	3.18	125.4	0.18	282.7	303.1	33.09	16.14	1.50	3.99
2		3.16	104.4	0.07	274.1	303.8	21.81	5.77	1.52	3.47
3	20.82	3.37	76.1	2.5	280.3	311.6	15.47	4.84	1.5	3.08

(all concentrations are in mg/l)

**pH values in table are -LOG transformation of hydrogen ion statistical results

* Acidity, alkalinity, and hardness are represented as functions of $CaCO_3$

Post-construction comparison with goals

- treatment goals and average effluent concentrations

	Total Fe mg/l	Total Al mg/l	Total Mn mg/l
Goals	3.0	5.0	7.0
Avg. effluent	15.5	3.1	1.5

- other important results
  - 50% decrease in total iron
  - aluminum decreased more than 20%
  - slight increase of 0.2 mg/l in manganese
  - average acidity decreased ~ 40%
  - pH increased from 3.18 to 3.37 in the effluent, which is a 35% decrease in hydrogen ions

- average loading and removal rates in grams per day (GPD) and grams per day per square meter (GDM)

Parameter	Loading GPD	Removal GPD	Unit Area Removal GDM
Iron	2615.0	1278.0	.95
Aluminum	233.8	45.7	0.034
Manganese	94.3	-0.81	-0.001
Acidity	7522.0	2626.0	1.95

Compiled from: Design Report: Acid Mine Drainage Abatement. April 1995. CET Engineering Services, Harrisburg, PA.

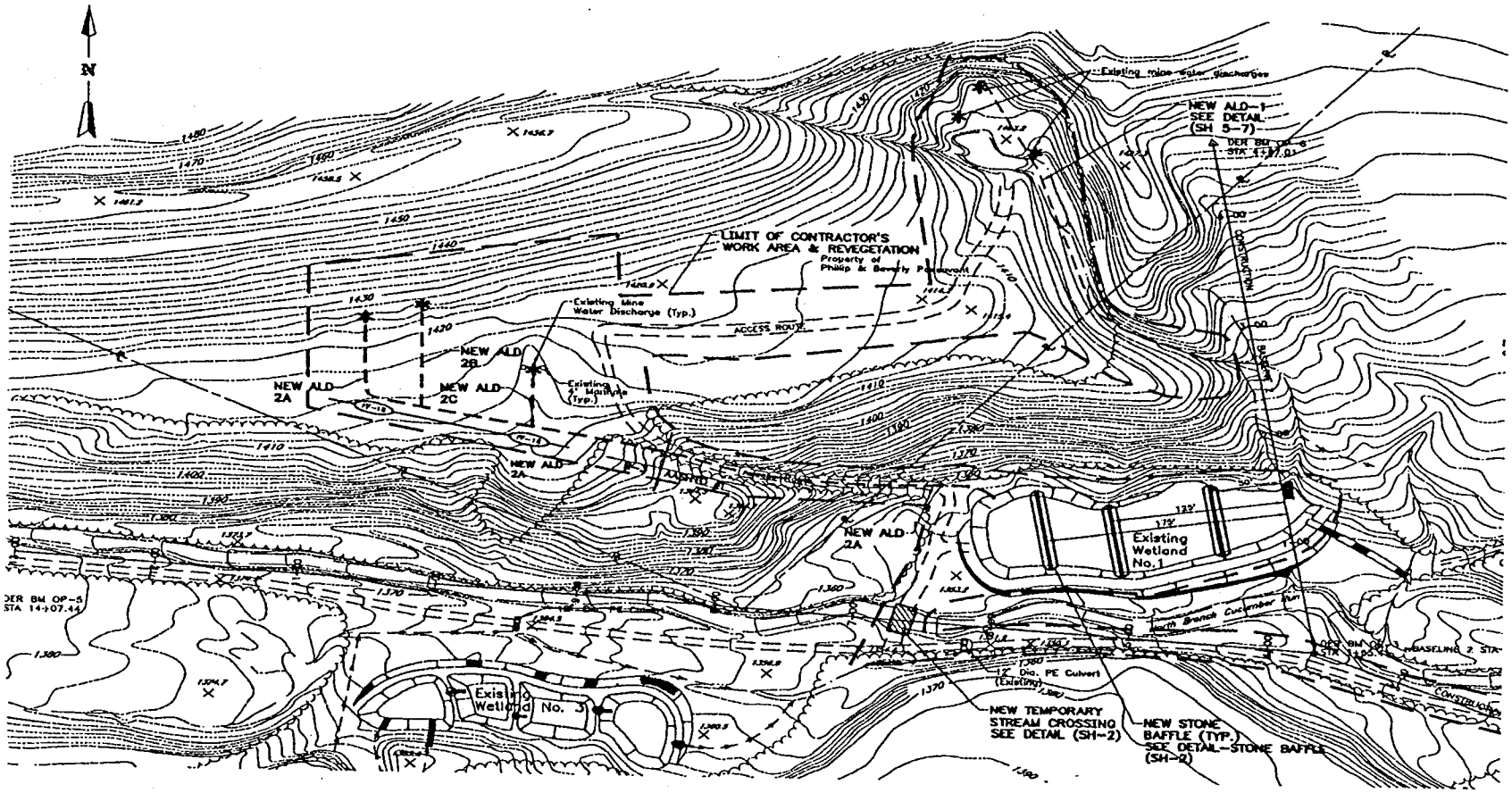
Current action for further desirable reductions in AMD

- installation of an anoxic limestone drain (ALD)
  - larger wetland would be preferred but an ALD maximizes the passive treatment potential for the limited space available
  - ALD increases the pH (max. possibility with limestone is ~ pH 7.5) which should improve the processes of the wetland treatment system in decreasing the iron concentration (would like it around < 1 mg/l)
- plugging of the ALD is a possible problem
  - the dissolved oxygen in the flow must be minimal to ensure that iron does not oxidize within the drain
  - high aluminum concentrations in the flow could also form deposits starting around a pH > 4

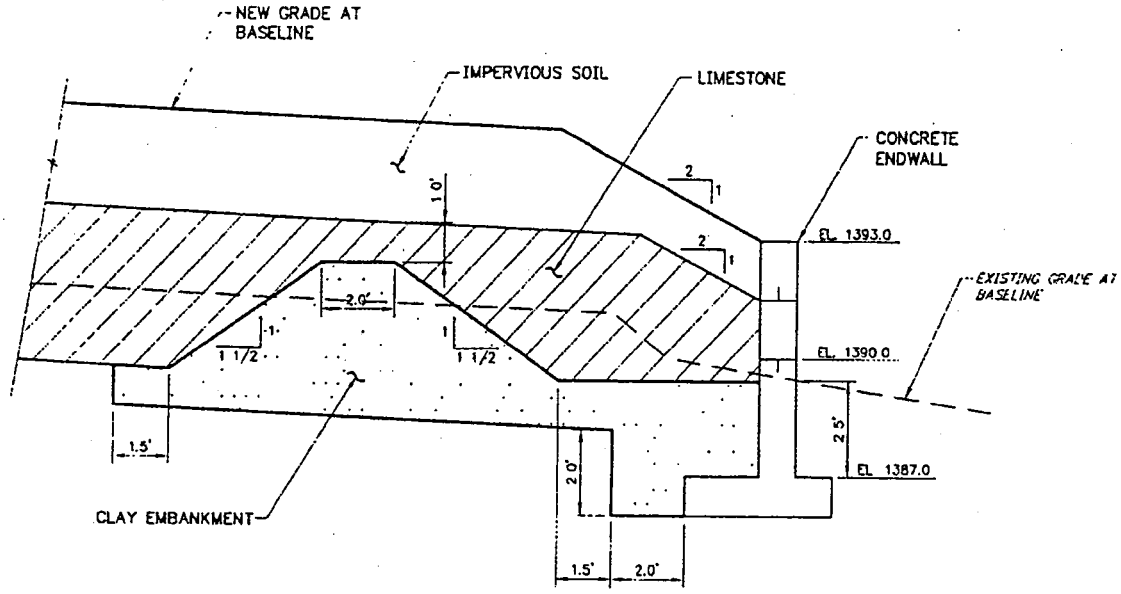
What is to be built? (bid price: 144,047.50)

- three R-3 rock baffles are to be installed in the wetland to slow down the flow of water and decrease channeling
- System of ALDs
  - ALD #1 will be covered with two sheets of 6 mil polyethylene and a minimum of 2.5 ft of impervious soil, R-3 limestone will be first followed by AASHTO #1, ~ 31,600 cu. ft. of limestone is to be used, two clay embankments are also located within the drain to maintain limestone saturation, flow discharges through a concrete endwall with a 12 in drain pipe where it flows freely into the first section of the wetland, drainage ditches will be placed on either side to manage runoff infiltration
  - ALDs #2A, #2B, and #2C covered same as above, limestone still R-3 then AASHTO #1, ~ 10,400 cu. ft. total, cross-sectional area of 4 ft by 4 ft, discharge directly into the third section of the wetland, tried to discharge into first section but was not feasible, low flows should minimize problems associated with this location for the discharge
  - the larger R-3 rocks, extra limestone, and impervious material are being used to help control plugging of the ALDs

ALD site plan



ALD #1 Termination



ALD #1 Cross section