Attachment 2.05.3(3)-22
Pond 011
Engineering and Hydrologic Design

Pond 011 was initially designed for the 2000 Permit Amendment. The pond was constructed in 2007. The as built report is included in attachment 2.05.3(3)-21. Due to the decision by WFC to eliminate Pond 010, Ponds 011 and 013 will receive a greater drainage area. This revised design of Pond 011 will demonstrate that the as built pond is sufficient to handle the revised drainage area.

Pond 011 is a partially incised pond designed to contain the flow from a 10 year 24 hour storm below the emergency spillway. the valve on the principal spillway pipe is normally held shut. The principal spillway design is an 18-24" diameter CMP or other pipe which will have a valve on the entrance. This pipe will be stopped down in the inlet side to a 6" valve which will be controlled by a wheel on the pond embankment. During normal conditions, the valve will be shut to provide 24 hour detention time for each pond during the large events. When a large event occurs, the operator will wait a minimum of 36 hours after the storm has ceased to check the water still detained by the pond. An Imhoff cone will only be used to determine if the water can be discharged. If an Imhoff cone shows that the water meets the effluent standard of 0.5ml settleable solids per liter, the valve will be opened until the water has dissipated to the valve level. It will then be shut to allow detention time for subsequent storms. Full sampling and laboratory analyses of the discharge will take place for all discharges, according to the NPDES permit.

Pond 011 - Proposed Design

Pond 011 has been re-designed for the Permit Revision of 2009. The drainage basins in both pre mine and post mine situations have changed.

Design Parameters:

- Since the post mine drainage area is larger than the pre mine, but does not involve pit pumping, the post mine condition and the pre mine condition need to be compared to determine the worst case. The pre-mine drainage area is 155.43 acres while the post mine area is 166.1 acres.
- Primary spillway riser will have 2 partially opened 6 inch gate valves two feet from the base (5612' elevation) so surface water will be mixed with pond bottom water to better mix the pit pump water for water quality purposes.
- There will be an 24 inch Riser/Barrel Primary Discharge with the two 6" weep hole openings with gate valves described above plus an open channel, lined and riprapped Emergency

Spillway in the embankment, for a combined two separate discharge pond design.

Pre Mine Drainage Calculations

- 155.43 acre drainage area (See Map 2.05.3(3)-1)
- Curve Number (CN) to use: From SEDCAD 4 for Windows Help menu :
  - I. Curve Numbers for Other Agricultural Land Category
  - II. Cover type: Pasture, grassland, or range -- continuous forage for grazing
  - III. Hydrologic Condition: Good (Good: >75% ground cover)
  - IV. Hydrologic Soil Group = C
  - V. CN=74

Runoff Curve Number and Runoff

Project: Pond 011 By: B Langenfeld Date: 08/17/09

Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Type	Area(Acre)
Pasture Grassland Range (Good)	74	C	1.839
Pasture Grassland Range (Good)	74	C	46.185
Pasture Grassland Range (Good)	74	C	74.138
Pasture Grassland Range (Good)	74	C	29.121
Pasture Grassland Range (Good)	74	C	4.160

CN (weighted): 74.0

Total Area: 155.443 Acre

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.00	in
Runoff, Q:	0.3498	in
Runoff Volume:	4.5316	Acre-Ft

The pond volume below the emergency spillway will be comprised of three design needs:
1) 10 year storm inflow of 4.5 acre feet, as described above
2) 3 year sediment delivery of 0.02 acre feet, as based on the calculations shown below.
Therefore, the total design volume below the emergency spillway is 4.5 + 0.02 ac-ft which is 4.52 acre feet. As is shown in the SEDCAD details, the bottom of the emergency spillway is 5616.0', which has a volume of 12.3 acre-ft at this elevation.

Pond Volume Calculation based on Universal Soil Loss Equation (SurvCAD)

Input Data

Landuse	Area (ft^2)	Rainfall Factor	Erod-ability	Length (ft)	Slope (%)	Ls	Cf	Pf
Pasture	6770530.8	50.0	0.37	2121.0	4.1	1.39	0.04	1.00

Runoff = 1.000 inch.
Sediment Density = 175.000
Time = 1.0 years
Drainage Ratio = 0.37

Total Area = 155.430 acres
Gross Erosion = 159.846 tons/yr.
Total Yield = 59.143 tons/yr.
Runoff Volume = 12.953 acre-ft
Sediment Volume = 0.016 acre-ft (3-year total)
Total Volume = 12.968 acre-ft

* The Cf factor is determined from the chart on the following page, shown *in Design Hydrology*

and Sedimentology for Small Catchments by Haan, Barfield and Hayes. Based on an approximate ground cover of 70% for permanent pasture, a Cf factor of 0.04 was used, which is conservative.

The pond volume below the primary spillway will be comprised of one design needs:
1) 3 year sediment delivery of 0.3 acre-ft, as based on the calculations above.
This is a total volume of 0.3 acre-ft.

As seen in the stage storage relationship, the pond has 5.2 acre-ft of storage at this elevation. Detention time of 24 hours is shown in the SEDCAD outputs, which are at the end of this section.

SCS Table

Table 8.8 Selected USLE *C* Values for Construction, Mining, and Forest Lands.

Condition	*C* factor	References
1. Bare soil conditions		
Undisturbed except scraped	0.66–1.30	[a]
Compacted		
Smooth	1.00–1.40	[a,b]
Root raked	0.90–1.20	[a]
Disk tillage		
Fresh	1.00	[a]
After one rain	0.89	[a]
2. Mulch		
Straw		
0.5 tons/ac	0.30	[a,d]
1.0 tons/ac	0.18	[a,d]
2.0 tons/ac	0.09	[a,d]
4.0 tons/ac	0.02	[a,d]
Wood chips		
0.5 tons/ac	0.90	[a,d]
2.0 tons/ac	0.70	[a,d]
4.0 tons/ac	0.42	[a,d]
6.0 tons/ac	0.22	[a,d]
3. Chemical binders		
Asphalt emulsion, 605 gal/ac	0.14-0.52	[a]
Aquatan, Terra-tack	0.67	[a]
4. Seedings		
No prepared seedbed		
New planting	0.64	[a]
After 60 days	0.54	[a]
Prepared seedbed		
New planting	0.40	[a]
After 60 days	0.05	[a]
5. Undisturbed forest		
100–75% canopy, 100–90% litter	0.0001–0.001	[c]
35–20% canopy, 70–40% litter	0.003–0.009	[c]
6. Permanent pasture and brush cover		
0% canopy, 80% ground cover		
Grass	0.013	[c]
Weeds	0.043	[c]
50% Brush, 80% ground cover		
Grass	0.012	[c]
7. Mechanically prepared woodland sites		
Burned, 10% cover at ground		
Good soil	0.240	[c]
Poor soil	0.360	[c]
Burned, 0% cover at ground		
Good soil	0.260	[c]
Poor soil	0.450	[c]
Disked, 0% cover at ground		
Good soil	0.720	[c]
Poor soil	0.940	

Note. Additional values are given in Appendix 8B.
[a]Transportation Research Board (1980).
[b]Barfield *et al.* (1988).
[c]Wischmeier and Smith (1978).
[d]Meyer *et al.* (1972). C factors for mulch vary depending on slope length and steepness. Slope length limits apply (see Appendix 8B, Table 8B.5).

Post Mine Drainage

- 166.1 acre drainage area
- During mining, the maximum pit pumping rate will be 600 gpm from the active mine pit pump system into Pond 11.
- Pit pump water will need a retention time of approximate 1 day so the PH of the water will stabilize and pass the WET toxicity test.
- Therefore, add: [(600gpm x 60mph x 24hpd x 1 days)/7.5 gal per cu-ft]/43560sq-ft per ac =2.6 ac-ft

Runoff Curve Number and Runoff (SurvCAD)

Project: Pond 011 By: B Langenfeld Date: 09/01/09
Location: New Horizon #2 Checked: Date:
Developed

1. Runoff Curve Number (CN)

Cover description	CN	Soil Type	Area(Acre)
Mined Land, Disturbed (Poor)	87	C	14.700
Herbaceous mixture (Good)	74	C	48.430
Pasture Grassland Range (Good)	80	D	102.944

CN (weighted): 78.9
Total Area: 166.074 Acre

2. Runoff

Return Period: 10-Year
Rainfall, P: 2.00 in
Runoff, Q: 0.5174 in
Runoff Volume: 7.1608 Acre-Ft

The pond volume below the emergency spillway will be comprised of three design needs:
1) 10 year storm inflow of 7.2 acre-ft, as described above
2) 3 year sediment delivery of 0.1 acre-ft, as based on the calculations shown below.
3) 2.6 acre-ft of pit pump water.

Therefore, the total design volume below the emergency spillway is 7.2 + 0.1+2.6 ac-ft which is 9.9 acre-ft. As is shown in the SEDCAD details, the bottom of the emergency spillway is 5616.0', which has a volume of 12.3 acre-ft at this elevation.

Pond Sediment Volume Calculation based on Universal Soil Loss Equation (SurvCAD)

Input Data

Landuse	Area (ft^2)	Rainfall Factor	Erod-ability	Length (ft)	Slope (%)	Ls	Cf	Pf
Reclamat	7235316.0	50.0	0.37	3076.0	4.1	1.61	0.04	1.00

Runoff = 0.517 inch.
Sediment Density = 175.000
Time = 3.0 years
Drainage Ratio = 0.84

Total Area = 166.100 acres
Gross Erosion = 198.206 tons/yr.
Total Yield = 166.493 tons/yr.
Runoff Volume = 7.162 acre-ft
Sediment Volume = 0.131 acre-ft (3 year total)
Total Volume = 7.293 acre-ft

* The Cf factor is determined from the chart on page 6, shown *in Design Hydrology and Sedimentology for Small Catchments* by Haan, Barfield and Hayes. Based on an approximate ground cover of 70% for permanent pasture, a Cf factor of 0.04 was used, which is conservative.

The pond volume below the primary spillway will be comprised of two design needs:
1) 3 year sediment delivery of 0.1 acre-ft, as based on the calculations above.
2) Maximum pit pumping of water into pond 011 of 2.6 acre-ft.

As seen in the stage storage relationship, the pond has 5.2 acre-ft of storage at this elevation. Detention time of 24 hours is shown in the SEDCAD outputs, which are at the end of this

section.

The pre mine water volume required to be stored in Pond 011 is 4.52 acre-ft. The post mine water volume that must be stored in Pond 011 is 9.9 acre-ft. The post mine conditions are the worst case, and therefore are used to determine if Pond 011 is sufficient. As shown by the SEDCAD calculations, Pond 011 has 12.3 acre-ft of capacity at the emergency spillway, and will be able to hold the worst case (pre mine) conditions.

The pond design does not meet MSHA Impoundment criteria, as shown below, since it does not have a storage volume of 20 acre-ft and does not have an elevation of 20 feet.

30CFR77.216 Water, sediment, or slurry impoundment and impounding structures; general.
(a) Plans for the design, construction, and maintenance of structures which impound water, sediment, or slurry shall be required if such an existing or proposed impounding structure can:

1. Impound water, sediment, or slurry to an elevation of five feet or more above the upstream toe of the structure and can have a storage volume of 20 acre-feet or more; or
2. Impound water, sediment, or slurry to an elevation of 20 feet or more above the upstream toe of the structure; or
3. As determined by the District Manager, present a hazard to coal miners.

011 POND
10YR-24HR EVENT
(RN-05) UPDATE
POST MINE DISTURBANCE
CN =74,80 & 87

MINED LAND 14.7AC @ CN87

HERBACEOUS MIXTURE 48.43AC @ CN74

DRY PASTURE 102.944AC @CN80

with 2.7 ac-ft (600gpm pit pump for 24hr) of storage for pit pumping

Ronald Gubler, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	2.000 inches

Particle Size Distribution:

Size (mm)	NEW HORIZON MINE 1 PARTICAL SIZE DISTRIBUTION
2.0000	100.000%
1.0000	70.000%
0.5000	67.000%
0.2500	58.000%
0.1250	52.000%
0.0630	38.000%
0.0160	21.000%
0.0040	11.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#5	0.000	0.000	Mined Land Disturbed (poor)
Channel	#2	==>	#5	0.000	0.000	Herbaceous mixture (good)
Channel	#3	==>	#5	0.000	0.000	Pasture Grassland Range (good)
Pond	#5	==>	End	0.000	0.000	pond
Null	#6	==>	#5	0.000	0.000	pit pump

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#6		17.000	17.000	25.90	2.67	0.0	2	0.00	0.00
#3		102.944	102.944	66.52	4.82	11.0	3,537	2.30	1.09
#2		48.430	48.430	19.67	1.41	2.8	3,418	2.22	0.95
#1		14.700	14.700	14.37	1.11	2.1	2,607	1.69	0.88
#5	In	0.000	183.074	126.46	10.00	15.9	2,690	1.75	0.76
	Out			4.28	6.73	0.8	104	0.00	0.00

Particle Size Distribution(s) at Each Structure

Structure #6 (pit pump):

Size (mm)	In/Out
2.0000	100.000%
1.0000	70.024%
0.5000	67.023%
0.2500	58.020%
0.1250	52.018%
0.0630	38.013%
0.0160	21.007%
0.0040	11.004%

Structure #3 (Pasture Grassland Range (good)):

Size (mm)	In/Out
2.0000	100.000%
1.0000	70.236%
0.5000	67.226%
0.2500	58.196%
0.1250	52.175%
0.0630	38.128%
0.0160	21.071%
0.0040	11.037%

Structure #2 (Herbaceous mixture (good)):

Size (mm)	In/Out
2.0000	100.000%
1.0000	70.473%
0.5000	67.453%
0.2500	58.392%
0.1250	52.351%
0.0630	38.257%
0.0160	21.142%
0.0040	11.074%

Structure #1 (Mined Land Disturbed (poor)):

Size (mm)	In/Out
2.0000	100.000%
1.0000	70.378%
0.5000	67.362%
0.2500	58.313%
0.1250	52.281%
0.0630	38.205%
0.0160	21.113%
0.0040	11.059%

Structure #5:

Size (mm)	In	Out
2.0000	100.000%	100.000%
1.0000	70.296%	100.000%
0.5000	67.283%	100.000%
0.2500	58.245%	100.000%
0.1250	52.220%	100.000%
0.0630	38.161%	100.000%
0.0160	21.089%	100.000%
0.0040	11.047%	100.000%

Structure Detail:

Structure #6 (Null)

pit pump

Structure #3 (Vegetated Channel)

Pasture Grassland Range (good)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
20.00	10.0:1	10.0:1	4.1	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	66.52 cfs		66.52 cfs	
Depth:	0.62 ft	1.62 ft	1.02 ft	2.02 ft
Top Width:	32.48 ft	52.48 ft	40.42 ft	60.42 ft
Velocity:	4.06 fps		2.16 fps	
X-Section Area:	16.37 sq ft		30.84 sq ft	
Hydraulic Radius:	0.503 ft		0.761 ft	
Froude Number:	1.01		0.44	
Roughness Coefficient:	0.0469		0.1165	

Structure #2 (Vegetated Channel)

Herbaceous mixture (good)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
20.00	10.0:1	10.0:1	4.1	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	19.67 cfs		19.67 cfs	
Depth:	0.38 ft	1.38 ft	0.71 ft	1.71 ft
Top Width:	27.52 ft	47.52 ft	34.28 ft	54.28 ft
Velocity:	2.20 fps		1.02 fps	
X-Section Area:	8.93 sq ft		19.38 sq ft	
Hydraulic Radius:	0.324 ft		0.564 ft	
Froude Number:	0.68		0.24	
Roughness Coefficient:	0.0646		0.2027	

Structure #1 (Vegetated Channel)

Mined Land Disturbed (poor)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
20.00	10.0:1	10.0:1	4.1	D, B	1.00	10.00		5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	14.37 cfs		14.37 cfs	
Depth:	0.33 ft	1.33 ft	0.65 ft	1.65 ft
Top Width:	26.60 ft	46.60 ft	33.02 ft	53.02 ft
Velocity:	1.87 fps		0.83 fps	
X-Section Area:	7.69 sq ft		17.26 sq ft	
Hydraulic Radius:	0.289 ft		0.522 ft	
Froude Number:	0.61		0.20	
Roughness Coefficient:	0.0704		0.2345	

Structure #5 (Pond)

pond

Pond Inputs:

Initial Pool Elev:	5,611.90 ft
Initial Pool:	4.99 ac-ft

*Sediment Storage:	0.00 ac-ft
Dead Space:	20.00 %

**No sediment capacity defined*

Perforated Riser

Riser Diameter (in)	Riser Height (ft)	Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Number of Holes per Elev
24.00	10.00	24.00	100.00	1.18	0.0150	5,615.50	1

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	40.00	1.00	0.0150	5,616.00	0.50	0.00

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	40.00	1.00	0.0150	5,616.00	0.50	0.00

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	40.00	1.00	0.0150	5,616.00	0.50	0.00

Pond Results:

Peak Elevation:	5,615.82 ft
H'graph Detention Time:	13.29 hrs
Pond Model:	CSTRS
Dewater Time:	3.03 days
Trap Efficiency:	95.17 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,606.00	0.000	0.000	0.000		Top of Sed. Storage
5,606.01	0.001	0.000	0.000		
5,606.50	0.054	0.010	0.000		
5,607.00	0.163	0.062	0.000		
5,607.50	0.331	0.183	0.000		
5,608.00	0.692	0.433	0.000		
5,608.50	0.811	0.809	0.000		
5,609.00	0.874	1.230	0.000		
5,609.50	0.974	1.692	0.000		
5,610.00	1.171	2.227	0.000		
5,610.50	1.375	2.863	0.000		
5,611.00	1.510	3.584	0.000		
5,611.50	1.572	4.354	0.000		
5,611.90	1.609	4.990	0.000		
5,612.00	1.618	5.152	0.000		Low hole SPW #1
5,612.50	1.659	5.971	0.669	14.83*	
5,612.90	1.697	6.642	0.897	9.05*	
5,613.00	1.706	6.812	0.945	2.18*	
5,613.50	1.746	7.675	1.158	9.02*	
5,614.00	1.789	8.559	1.337	8.00*	
5,614.50	1.833	9.464	1.495	7.75	
5,615.00	1.879	10.392	1.638	7.20	
5,615.50	1.922	11.343	1.769	6.75	Spillway #1
5,615.82	1.949	11.959	4.279	8.00	Peak Stage
5,615.90	1.956	12.118	4.926		
5,616.00	1.965	12.314	6.886		Spillway #2 Spillway #3 Spillway #4
5,616.50	2.014	13.309	18.460		
5,617.00	2.058	14.327	27.951		
5,617.50	2.104	15.368	38.714		
5,618.00	2.154	16.432	49.192		
5,618.50	2.206	17.522	57.616		
5,619.00	2.232	18.632	64.819		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Perf. Riser (cfs)	Straight Pipe (cfs)	Straight Pipe (cfs)	Straight Pipe (cfs)	Combined Total Discharge (cfs)
5,606.00	0.000	0.000	0.000	0.000	0.000
5,606.01	0.000	0.000	0.000	0.000	0.000
5,606.50	0.000	0.000	0.000	0.000	0.000
5,607.00	0.000	0.000	0.000	0.000	0.000
5,607.50	0.000	0.000	0.000	0.000	0.000
5,608.00	0.000	0.000	0.000	0.000	0.000
5,608.50	0.000	0.000	0.000	0.000	0.000
5,609.00	0.000	0.000	0.000	0.000	0.000
5,609.50	0.000	0.000	0.000	0.000	0.000
5,610.00	0.000	0.000	0.000	0.000	0.000
5,610.50	0.000	0.000	0.000	0.000	0.000
5,611.00	0.000	0.000	0.000	0.000	0.000
5,611.50	0.000	0.000	0.000	0.000	0.000
5,611.90	0.000	0.000	0.000	0.000	0.000
5,612.00	6.00>0.000	0.000	0.000	0.000	0.000
5,612.50	0.669	0.000	0.000	0.000	0.669
5,612.90	0.897	0.000	0.000	0.000	0.897
5,613.00	0.945	0.000	0.000	0.000	0.945
5,613.50	1.158	0.000	0.000	0.000	1.158
5,614.00	1.337	0.000	0.000	0.000	1.337
5,614.50	1.495	0.000	0.000	0.000	1.495
5,615.00	1.638	0.000	0.000	0.000	1.638
5,615.50	1.769	0.000	0.000	0.000	1.769
5,615.90	4.926	0.000	0.000	0.000	4.926
5,616.00	6.886	0.000	0.000	0.000	6.886
5,616.50	15.127	(3)>1.111	(3)>1.111	(3)>1.111	18.460
5,617.00	18.526	(3)>3.142	(3)>3.142	(3)>3.142	27.951
5,617.50	21.392	(3)>5.774	(3)>5.774	(3)>5.774	38.714
5,618.00	23.917	(5)>8.425	(5)>8.425	(5)>8.425	49.192
5,618.50	26.200	(5)>10.472	(5)>10.472	(5)>10.472	57.616
5,619.00	28.299	(5)>12.173	(5)>12.173	(5)>12.173	64.819

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#6	1	17.000	0.000	0.001	0.271	99.000	F	25.90	2.667
	Σ	**17.000**						**25.90**	**2.667**
#3	1	102.944	0.010	0.010	0.302	80.000	M	66.52	4.819
	Σ	**102.944**						**66.52**	**4.819**
#2	1	48.430	0.020	0.020	0.224	74.000	M	19.67	1.410
	Σ	**48.430**						**19.67**	**1.410**
#1	1	14.700	0.032	0.032	0.168	87.000	F	14.37	1.108
	Σ	**14.700**						**14.37**	**1.108**
#5	Σ	**183.074**						**126.46**	**10.004**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#6	1	0.000	100.00	0.01	1.0000	1.0000	1	0.0	2	0.00	0.00
	Σ							**0.0**	**2**	**0.00**	**0.00**
#3	1	0.320	100.00	3.00	0.0400	1.0000	1	11.1	3,549	2.31	1.10
	Σ							**11.0**	**3,537**	**2.30**	**1.09**
#2	1	0.320	100.00	3.00	0.0400	1.0000	1	2.8	3,441	2.24	0.95
	Σ							**2.8**	**3,418**	**2.22**	**0.95**
#1	1	0.320	100.00	3.00	0.0400	1.0000	1	2.1	2,621	1.70	0.89
	Σ							**2.1**	**2,607**	**1.69**	**0.88**
#5	Σ							**15.9**	**2,690**	**1.75**	**0.76**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	2. Minimum tillage cultivation	3.00	3.00	100.00	0.860	0.032
#1	**1**	**Time of Concentration:**					**0.032**
#2	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
#2	**1**	**Time of Concentration:**					**0.020**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	6. Grassed waterway	3.00	3.00	100.00	2.590	0.010
#3	**1**	**Time of Concentration:**					**0.010**
#6	1	7. Paved area and small upland gullies	1.00	0.09	10.00	2.010	0.001
#6	**1**	**Time of Concentration:**					**0.000**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	2. Minimum tillage cultivation	3.00	3.00	100.00	0.860	0.032
#1	**1**	**Muskingum K:**					**0.032**
#2	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
#2	**1**	**Muskingum K:**					**0.020**
#3	1	6. Grassed waterway	3.00	3.00	100.00	2.590	0.010
#3	**1**	**Muskingum K:**					**0.010**
#6	1	7. Paved area and small upland gullies	1.00	0.09	10.00	2.010	0.001
#6	**1**	**Muskingum K:**					**0.001**

011 POND
25YR-24HR EVENT
(RN-05) UPDATE
POST MINE DISTURBANCE
CN =74,80 & 87

MINED LAND 14.7AC @ CN87

HERBACEOUS MIXTURE 48.43AC @ CN74

DRY PASTURE 102.944AC @CN80

with 2.7 ac-ft (600gpm pit pump for 24hr) of storage for pit pumping

Ross L. Gubka, P.E.

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 24 hr
Rainfall Depth:	2.400 inches

Particle Size Distribution:

Size (mm)	NEW HORIZON MINE 1 PARTICAL SIZE DISTRIBUTION
2.0000	100.000%
1.0000	70.000%
0.5000	67.000%
0.2500	58.000%
0.1250	52.000%
0.0630	38.000%
0.0160	21.000%
0.0040	11.000%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#5	0.000	0.000	Mined Land Disturbed (poor)
Channel	#2	==>	#5	0.000	0.000	Herbaceous mixture (good)
Channel	#3	==>	#5	0.000	0.000	Pasture Grassland Range (good)
Pond	#5	==>	End	0.000	0.000	pond
Null	#6	==>	#5	0.000	0.000	pit pump

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#6		14.000	14.000	25.64	2.66	0.0	2	0.00	0.00
#3		102.944	102.944	95.15	7.03	16.7	3,512	2.28	1.13
#2		48.430	48.430	31.11	2.23	4.7	3,390	2.20	1.00
#1		14.700	14.700	18.99	1.50	2.8	2,616	1.70	0.90
#5	In	0.000	180.074	170.89	13.42	24.2	2,864	1.86	0.86
	Out			8.15	9.60	1.6	168	0.00	0.00

Particle Size Distribution(s) at Each Structure

Structure #6 (pit pump):

Size (mm)	In/Out
2.0000	100.000%
1.0000	70.024%
0.5000	67.023%
0.2500	58.020%
0.1250	52.018%
0.0630	38.013%
0.0160	21.007%
0.0040	11.004%

Structure #3 (Pasture Grassland Range (good)):

Size (mm)	In/Out
2.0000	100.000%
1.0000	70.236%
0.5000	67.226%
0.2500	58.196%
0.1250	52.175%
0.0630	38.128%
0.0160	21.071%
0.0040	11.037%

Structure #2 (Herbaceous mixture (good)):

Size (mm)	In/Out
2.0000	100.000%
1.0000	70.473%
0.5000	67.453%
0.2500	58.392%
0.1250	52.351%
0.0630	38.257%
0.0160	21.142%
0.0040	11.074%

Structure #1 (Mined Land Disturbed (poor)):

Size (mm)	In/Out
2.0000	100.000%
1.0000	70.378%
0.5000	67.362%
0.2500	58.313%
0.1250	52.281%
0.0630	38.205%
0.0160	21.113%
0.0040	11.059%

Structure #5:

Size (mm)	In	Out
2.0000	100.000%	100.000%
1.0000	70.298%	100.000%
0.5000	67.286%	100.000%
0.2500	58.247%	100.000%
0.1250	52.222%	100.000%
0.0630	38.162%	100.000%
0.0160	21.090%	100.000%
0.0040	11.047%	100.000%

Structure Detail:

Structure #6 (Null)

pit pump

Structure #3 (Vegetated Channel)

Pasture Grassland Range (good)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
20.00	10.0:1	10.0:1	4.1	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	95.15 cfs		95.15 cfs	
Depth:	0.72 ft	1.72 ft	1.13 ft	2.13 ft
Top Width:	34.44 ft	54.44 ft	42.66 ft	62.66 ft
Velocity:	4.84 fps		2.68 fps	
X-Section Area:	19.65 sq ft		35.50 sq ft	
Hydraulic Radius:	0.569 ft		0.830 ft	
Froude Number:	1.13		0.52	
Roughness Coefficient:	0.0428		0.0993	

Structure #2 (Vegetated Channel)

Herbaceous mixture (good)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
20.00	10.0:1	10.0:1	4.1	D, B	1.00			5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	31.11 cfs		31.11 cfs	
Depth:	0.46 ft	1.46 ft	0.82 ft	1.82 ft
Top Width:	29.12 ft	49.12 ft	36.34 ft	56.34 ft
Velocity:	2.78 fps		1.35 fps	
X-Section Area:	11.20 sq ft		23.01 sq ft	
Hydraulic Radius:	0.384 ft		0.632 ft	
Froude Number:	0.79		0.30	
Roughness Coefficient:	0.0572		0.1642	

Structure #1 (Vegetated Channel)

Mined Land Disturbed (poor)

Trapezoidal Vegetated Channel Inputs:

Material: Grass mixture

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
20.00	10.0:1	10.0:1	4.1	D, B	1.00	10.00		5.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	18.99 cfs		18.99 cfs	
Depth:	0.37 ft	1.37 ft	0.71 ft	1.71 ft
Top Width:	27.42 ft	47.42 ft	34.14 ft	54.14 ft
Velocity:	2.16 fps		0.99 fps	
X-Section Area:	8.80 sq ft		19.14 sq ft	
Hydraulic Radius:	0.320 ft		0.559 ft	
Froude Number:	0.67		0.23	
Roughness Coefficient:	0.0653		0.2061	

Structure #5 (Pond)

pond

Pond Inputs:

Initial Pool Elev:	5,611.90 ft
Initial Pool:	4.99 ac-ft
*Sediment Storage:	0.00 ac-ft

Dead Space:	20.00 %

**No sediment capacity defined*

Perforated Riser

Riser Diameter (in)	Riser Height (ft)	Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Number of Holes per Elev
12.00	10.00	12.00	100.00	1.18	0.0150	5,615.50	1

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	40.00	1.00	0.0150	5,616.00	0.50	0.00

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	40.00	1.00	0.0150	5,616.00	0.50	0.00

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev (ft)	Entrance Loss Coefficient	Tailwater Depth (ft)
18.00	40.00	1.00	0.0150	5,616.00	0.50	0.00

Pond Results:

Peak Elevation:	5,616.57 ft
H'graph Detention Time:	10.82 hrs
Pond Model:	CSTRS
Dewater Time:	3.32 days
Trap Efficiency:	93.29 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,606.00	0.000	0.000	0.000		Top of Sed. Storage
5,606.01	0.001	0.000	0.000		
5,606.50	0.054	0.010	0.000		
5,607.00	0.163	0.062	0.000		
5,607.50	0.331	0.183	0.000		
5,608.00	0.692	0.433	0.000		
5,608.50	0.811	0.809	0.000		
5,609.00	0.874	1.230	0.000		
5,609.50	0.974	1.692	0.000		
5,610.00	1.171	2.227	0.000		
5,610.50	1.375	2.863	0.000		
5,611.00	1.510	3.584	0.000		
5,611.50	1.572	4.354	0.000		
5,611.90	1.609	4.990	0.000		
5,612.00	1.618	5.152	0.000		Low hole SPW #1
5,612.50	1.659	5.971	0.669	14.83*	
5,612.90	1.697	6.642	0.897	9.05*	
5,613.00	1.706	6.812	0.945	2.18*	
5,613.50	1.746	7.675	1.158	9.02*	
5,614.00	1.789	8.559	1.337	8.00*	
5,614.50	1.833	9.464	1.495	7.33*	
5,615.00	1.879	10.392	1.638	7.15	
5,615.50	1.922	11.343	1.769	6.75	Spillway #1
5,615.90	1.956	12.118	2.391	4.55	
5,616.00	1.965	12.314	2.674	0.95	Spillway #2 Spillway #3 Spillway #4
5,616.50	2.014	13.309	7.115	8.00	
5,616.57	2.018	13.460	8.146	1.95	Peak Stage
5,617.00	2.058	14.327	14.057		
5,617.50	2.104	15.368	22.670		
5,618.00	2.154	16.432	31.254		
5,618.50	2.206	17.522	37.966		
5,619.00	2.232	18.632	43.594		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	Perf. Riser (cfs)	Straight Pipe (cfs)	Straight Pipe (cfs)	Straight Pipe (cfs)	Combined Total Discharge (cfs)
5,606.00	0.000	0.000	0.000	0.000	0.000
5,606.01	0.000	0.000	0.000	0.000	0.000
5,606.50	0.000	0.000	0.000	0.000	0.000
5,607.00	0.000	0.000	0.000	0.000	0.000
5,607.50	0.000	0.000	0.000	0.000	0.000
5,608.00	0.000	0.000	0.000	0.000	0.000
5,608.50	0.000	0.000	0.000	0.000	0.000
5,609.00	0.000	0.000	0.000	0.000	0.000
5,609.50	0.000	0.000	0.000	0.000	0.000
5,610.00	0.000	0.000	0.000	0.000	0.000
5,610.50	0.000	0.000	0.000	0.000	0.000
5,611.00	0.000	0.000	0.000	0.000	0.000
5,611.50	0.000	0.000	0.000	0.000	0.000
5,611.90	0.000	0.000	0.000	0.000	0.000
5,612.00	6.00>0.000	0.000	0.000	0.000	0.000
5,612.50	0.669	0.000	0.000	0.000	0.669
5,612.90	0.897	0.000	0.000	0.000	0.897
5,613.00	0.945	0.000	0.000	0.000	0.945
5,613.50	1.158	0.000	0.000	0.000	1.158
5,614.00	1.337	0.000	0.000	0.000	1.337
5,614.50	1.495	0.000	0.000	0.000	1.495
5,615.00	1.638	0.000	0.000	0.000	1.638
5,615.50	1.769	0.000	0.000	0.000	1.769
5,615.90	2.391	0.000	0.000	0.000	2.391
5,616.00	2.674	0.000	0.000	0.000	2.674
5,616.50	3.782	(3)>1.111	(3)>1.111	(3)>1.111	7.115
5,617.00	4.632	(3)>3.142	(3)>3.142	(3)>3.142	14.057
5,617.50	5.348	(3)>5.774	(3)>5.774	(3)>5.774	22.670
5,618.00	5.979	(5)>8.425	(5)>8.425	(5)>8.425	31.254
5,618.50	6.550	(5)>10.472	(5)>10.472	(5)>10.472	37.966
5,619.00	7.075	(5)>12.173	(5)>12.173	(5)>12.173	43.594

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#6	1	14.000	0.000	0.001	0.271	99.000	F	25.64	2.662
	Σ	**14.000**						**25.64**	**2.662**
#3	1	102.944	0.010	0.010	0.302	80.000	M	95.15	7.030
	Σ	**102.944**						**95.15**	**7.030**
#2	1	48.430	0.020	0.020	0.224	74.000	M	31.11	2.228
	Σ	**48.430**						**31.11**	**2.228**
#1	1	14.700	0.032	0.032	0.168	87.000	F	18.99	1.503
	Σ	**14.700**						**18.99**	**1.503**
#5	Σ	**180.074**						**170.89**	**13.422**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#6	1	0.000	100.00	0.01	1.0000	1.0000	1	0.0	2	0.00	0.00
	Σ							**0.0**	**2**	**0.00**	**0.00**
#3	1	0.320	100.00	3.00	0.0400	1.0000	1	16.7	3,524	2.29	1.14
	Σ							**16.7**	**3,512**	**2.28**	**1.13**
#2	1	0.320	100.00	3.00	0.0400	1.0000	1	4.7	3,413	2.22	1.01
	Σ							**4.7**	**3,390**	**2.20**	**1.00**
#1	1	0.320	100.00	3.00	0.0400	1.0000	1	2.9	2,630	1.71	0.91
	Σ							**2.8**	**2,616**	**1.70**	**0.90**
#5	Σ							**24.2**	**2,864**	**1.86**	**0.86**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	2. Minimum tillage cultivation	3.00	3.00	100.00	0.860	0.032
#1	**1**	**Time of Concentration:**					**0.032**
#2	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**1**	**Time of Concentration:**					**0.020**
#3	1	6. Grassed waterway	3.00	3.00	100.00	2.590	0.010
#3	**1**	**Time of Concentration:**					**0.010**
#6	1	7. Paved area and small upland gullies	1.00	0.09	10.00	2.010	0.001
#6	**1**	**Time of Concentration:**					**0.000**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	2. Minimum tillage cultivation	3.00	3.00	100.00	0.860	0.032
#1	**1**	**Muskingum K:**					**0.032**
#2	1	3. Short grass pasture	3.00	3.00	100.00	1.380	0.020
#2	**1**	**Muskingum K:**					**0.020**
#3	1	6. Grassed waterway	3.00	3.00	100.00	2.590	0.010
#3	**1**	**Muskingum K:**					**0.010**
#6	1	7. Paved area and small upland gullies	1.00	0.09	10.00	2.010	0.001
#6	**1**	**Muskingum K:**					**0.001**