CT Consultants
engineers | architects | planners
Since 1922

May 11, 2010

Mr. Robert Sobczak, President
Rome Rock Association
P.O. Box 8, 1875 US Route 6
Rome, Ohio 44085

Re: Report of Findings and Alternatives
Rome Rock Lake Conceptual Study

Dear Mr. Sobczak:

CT Consultants, Inc. (CT) is pleased to submit for your review, our letter report of findings for the conceptual hydrology and hydraulic study for Lake Roaming Rock. The objectives of the study were to analyze the existing lake conditions in order to develop alternatives to stabilize lake levels (reduce excessive fluctuations during storm events), improve lake drawdown capabilities, improve the capability to remove/recirculate low dissolved oxygen water from deep water areas near the dam and provide a means to drain the lake in the case of needed repairs for the earthen dam embankment.

As part of this study, existing drawings, mapping, reports and previous hydrologic and hydraulic modeling available for the lake were obtained to a create a hydrologic and hydraulic model. The low flow storm events for a 1 inch rainfall, as well as 2, 3, 4, 6, 9 month and the more severe 2, 5, 10, 25, 50 and 100-year storm events were analyzed to model a range of storms to evaluate alternates for the study.

A PMF (Probable Maximum Flood) storm event was **not** incorporated into the hydraulic and hydrology model, since the primary focus of the study was to manage the customary flow conditions and rain events that occur at Lake Roaming Rock. The Probable Maximum Precipitation (PMP) is the greatest depth (amount) of precipitation, for a given storm duration, that is theoretically possible for a particular area and geographic location. ODNR used 29.9 inches of rain over a 72 hour period as the PMF in their calculations for Lake Roaming Rock.

The development of alternatives for this conceptual study resulted from the analysis of the (3) unique hydrologic and hydraulic conditions of draining the impounded water within Lake Roaming Rock (Water Level 850 to 820), baseflow conditions through the lake and a 1 inch rainfall event. The impounded water volumes were based on an assumed geometry for the existing lake. The baseflow conditions were based on the monthly flow conditions recorded at the USGS Rock Creek Gage Station from 1942 through 1966. The peak flow and volume of storm water runoff for the 1 inch rainfall event was determined through data defined for the watershed area contributing to Rome Rock Lake and input into the Hydraflow Hydrographs Program.

Predicting the timing and intensity of any rainfall event is very difficult. A 1 inch rainfall event for this area of northeast Ohio is likely to occur approximately one time in any given month.

These (3) volume of water/storm water values were evaluated via the initial approach to this conceptual study focusing on developing either a modified lake spillway system, a siphon system or a combination of these two systems. As the study progressed and additional review meetings were conducted with the Lake Management Committee and Rome Rock Association, the scope of the study was narrowed down to (5) basic goals for Lake Roaming Rock to control the different water/storm water conditions.

1. Lower the Lake Level approximately 5 feet annually for Fall Maintenance of Docks, Vegetation, etc.
2. Lower the Lake Level approximately 10 feet every 5 years for Substantial Maintenance of Dredging, Utilities, Docks, Vegetation, etc.
3. Remove and/or recirculate and aerate low dissolved oxygen water from deep water areas of the lake.
4. Construct a system to drain Lake Rome Rock in the case of needed emergency repairs.
5. Construct a system that will safely maintain the previously defined lowered lake levels with only minor increases in water surface elevations during 1 inch rainfall storm event.

Additionally, the following parameters were utilized for the development of alternatives for this conceptual study.

1. Maximum lake drawdown rate of 4 feet per week. A drawdown from elevation 850 to 820 at this rate would take approximately 7.5 weeks or 53 days.
2. Leave in place and utilize the existing 30 inch outlet drain.
3. Minimize water level increases to 1 foot during a minor storm event for the 5 foot - annual lowered lake condition.
4. Minimize water level increases to 2 feet during a minor storm event for the 10 foot - 5 year lowered lake condition.
5. Utilize existing Village pumping equipment to prime the proposed siphon system.

Summary of Findings and Recommended Alternatives

As a result of redefining the scope during the course of this conceptual study, it has been determined that a siphon system would be the most feasible approach to meeting the (5) goals previously defined for Lake Roaming Rock. In reviewing the various siphon system options, in regards to the time determined to completely drain the lake and the capacity to maintain water surface levels for the (3) different lake drawdown conditions, we recommend either the 24 inch or preferably the 30 inch Siphon System Alternative.

These (2) alternatives were calculated to drain the impounded lake water in 44 days (24 inch siphon) and 28 days (30 inch siphon). The 12, 16, 18 and 20 inch siphon systems were calculated to drain the impounded lake water in 175, 100, 78 and 64 days. The lake drawdown for each of these siphon systems was greater than the goal of 53 days at the drawdown rate of 4 feet per week. The table below shows the additional flows resulting from the baseflow within Rock Creek that would need to be accounted for when draining the lake.

USGS Rock Creek Gage Station Average Monthly Baseflows at Lake Roaming Rock

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average Monthly Baseflow (cfs)	132	149	196	141	85	37	13	17	5	22	42	83

As shown in the Summary of Siphon System Hydraulic Calculations, the capacity of the 24 inch siphon system ranges from 50 to 91 cfs and the 30 inch siphon system ranges from 79 to 142 cfs. The 24 and 30 inch siphon systems should be capable of routing the additional baseflows noted in the above table for given periods of the year; the 24 inch system from approximately June through November and the 30 inch system from approximately May through December.

The calculated times for the 24 and 30 inch siphon system to drain Lake Roaming Rock for the combined volume of water from the average baseflow values and the impounded water within the lake is provided in the table for the periods of the year that would result in drawdown of approximately 53 days. The volume of water to be routed through the siphon systems for a 1 inch rainfall event was negligible; the flows only added approximately ½ day to the total drawdown time.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Total Drawdown Time 24 inch Siphon (days)	Beyond Capacity of Siphon System					89	53	56	47	62	107	Beyond Capacity of Siphon System
Total Drawdown Time 30 inch Siphon (days)	Beyond Capacity of Siphon System				97	38	30	31	28	32	40	89

The Opinion of Probable Construction Costs for the 24 inch siphon system is $170,700. The Opinion of Probable Construction Costs for the 30 inch siphon system is $194,700. The preferred alternative would be the 30 inch siphon system, the additional capacity provided beyond the 24 inch system would allow (2) additional months for any necessary drawdowns of the lake. The additional cost of $24,000 for the 30 inch siphon system would be a minor cost for the increased capacity and flexibility of this system. The priming station ($100,000) and recirculation systems ($290,000) are optional components that can be added to either siphon system at a later date.

A summary of the alternative analysis for each of the siphon systems (12 through 30 inch) are presented in the Summary of Siphon System Hydraulic Calculations (Exhibit 1), Summary of Preliminary Opinion of Probable Construction Costs and detailed breakdown of unit costs (Exhibit 3). The summary of the hydraulic calculations illustrate flow rates and drawdown durations in 5 foot increments for the 30 feet to drain the lake (850 to 820) , the number of days to drain the lake and the outflow rates for each of the 5 foot increments. A layout for the conceptual siphon system is provided in Exhibit 2.

Engineering judgment should be exercised in regard to any proposed lake drawdowns, considering anticipated storm events, anticipated baseflows for the watershed, overall timeframe of drawdown period and the drawdown rate permitted by ODNR.

The following (2) options were also investigated as part of this conceptual study but not considered as feasible alternatives.

1. A modified spillway system approach was considered to be impractical since this option would be extremely expensive to excavate to depth of 30 feet below the existing lake level in order to construct an outlet to drain the lake.

2. Boring through the earthen embankment of the dam for the installation of a lake drain was an additional approach that was investigated but eliminated since this option was strongly discouraged by ODNR.

Should you have any questions or require additional information, please do not hesitate to call.

Respectfully submitted,

CT CONSULTANTS, INC.

Scott Wood, P.E.

RSW:mmm

cc: Clyde C. Hadden, P.E., P.S., CFM
Tom Voldrich, P.E. CT Consultants, Inc.

H:\2009\09153\PHASE\52PW-M\Report 05_2010.doc

APPENDIX

The following sections provide a brief summary of the methodology and results determined from our conceptual analysis. As defined by the revised proposal of June 15, 2009, a less-detailed and more conceptual analysis was completed for this study as compared to the original scope defined by our proposal of April 20, 2009.

Data Collection and Review

ODNR Inspection Reports (Previous and 2008/2009 Reports) provided data for the existing conditions at Lake Roaming Rock.

1. Class I Dam construction completed in 1967
2. Contributing watershed drainage area – 73.5 square miles (47,040 acres)
3. Normal Lake Water Surface Area @ Elevation 850 – 460 acres
   Lake Water Surface Area @ Elevation 854 – 595 acres
4. Volume of water impounded by dam @ Elevation 850 – 6,091 acre-feet
5. (3) Outlet/Spillway Structures

- Lake Drain – 36 inch CMP w/30 inch liner @ Elevation 840
- Principal Spillway – 180 foot wide Ogee Shaped Weir @ Elevation 850
- Auxiliary Spillway – 110 foot wide Ogee Shaped Weir @ Elevation 852
- Emergency Spillway – 80 feet wide @ Elevation 854
- Top of Earthen Embankment – 730 feet wide @ Elevation 861

USGS and Ashtabula County Mapping were utilized to develop the hydrology and hydraulic modeling for the dam. This mapping verified that the watershed drainage area and lake water surface areas were similar to the ODNR data.

Existing Engineering Drawings of the Dam were utilized to review and develop the schematic layout of the proposed Alternatives. Existing Utility records were not available for the study. However, it was noted by the Village that a water main and sanitary sewer force main are located through the entire length of the earthen embankment of the dam.

Flow data was obtained from USGS from the Rock Creek Gage Station that was in operation from 1942 through 1966. It was apparently in the vicinity of Lake Roaming Rock and was removed as part of the construction of the dam. The data from the gage station monthly average stream flow data and one day peak stream flow data for each year for Rock Creek. This data was extremely beneficial in estimating a base flow value for the dam at various periods throughout the year. (See attached Exhibit 4 USGS Surface –Water Monthly Statistics for the Nation)

Field Survey

The site was visited on (3) separate occasions to review the hydrologic and hydraulic characteristics required to create the models, as well as to make overall observations for the existing conditions at the lake and dam facilities. The lake was observed during the Fall 2009 drawdown period. This site revealed the shallow depth of the lake in the vicinity of the auxiliary and emergency spillways.

Hydrologic and Hydraulics Analysis

A hydrologic and hydraulic model was developed for the existing watershed and dam utilizing the Hydroflow Hydrographs Program for a 1 inch rainfall event as well as 2, 3, 4, 6 and 9 month rainfall frequencies and the 1, 2, 5, 10, 25, 50 and 100 year return period storm events. This model reviewed the storage and flow routing characteristics of the existing lake. The table below provides a summary of the peak inflow, outflow and existing lake surcharge elevations for various storm events.

Existing Lake Roaming Rock Conditions
Peak Flows into Lake, Peak Flows Discharged from Lake and Surcharge Water Surface Elevation (Normal Water Surface Elevation – 850)

Storm Event (Month or Year)	Peak Flow into Lake (cfs)	Peak Flow Discharged from Lake (cfs)	Surcharge Water Surface Elevation
1 inch rainfall	45	13	850.06
2 month	95	36	850.14
3 month	213	101	850.28
4 month	315	161	850.39
6 month	556	310	850.60
9 month	873	521	850.85
1 year	1,254	780	851.11
2 year	2,088	1,365	851.61
5 year	3,561	2,467	852.37
10 year	4,950	3,481	853.01
25 year	7,138	5,132	853.90
50 year	9,070	6,687	854.59
100 year	11,246	8,502	855.28

The previously defined hydrologic and hydraulic model was modified to incorporate a 50 foot wide spillway at an elevation 3 feet lower than the existing lake level (elevation 847). This option was developed in order to investigate the rise in water surface elevations for various storm events during a lake drawdown. The table below provides a summary of the peak inflow, outflow and existing lake surcharge elevations for various storm events.

Modified Lake Roaming Rock Conditions Peak Flows into Lake, Peak Flows Discharged from Lake and Surcharge Water Surface Elevation (Lowered Water Surface Elevation – 847)			
Storm Event (Month or Year)	Peak Flow into Lake (cfs)	Peak Flow Discharged from Lake (cfs)	Surcharge Water Surface Elevation
1 inch rainfall	45	4	847.08
2 month	95	13	847.18
3 month	213	41	847.39
4 month	315	70	847.55
6 month	556	144	847.91
9 month	873	252	848.32
1 year	1,254	392	848.77
2 year	2,088	729	849.68
5 year	3,561	1,794	850.86
10 year	4,950	2,957	851.58
25 year	7,138	4,788	852.50
50 year	9,070	6,409	853.21
100 year	11,246	8,241	853.93

This option to modify the existing emergency spillway or provide an additional spillway to allow for the ability to lower the existing lake level did yield a reasonable result in lowering the lake level and demonstrated that lake levels would rise only approximately 1.8 feet for a rainfall of up to a 1 year storm event. However, as a result of a site visit during the Fall 2009 lake drawdown and additional discussions concerning the ultimate goals of the Lake Management Committee, the scope of the study was directed primarily toward developing siphon system alternatives. The shallow depth of the lowered lake and discussion of a potential shallow rock layer in the vicinity of the emergency spillway area during the Fall 2009 site visit revealed that constructing a lowered spillway would be a difficult and expensive option. Additionally, this lowered spillway option would not ultimately satisfy (3) of the study goals; 1) lowering the lake level by a depth of approximately 10 feet every 5 years, 2) the ability to drain the lake in the case of emergency repairs and 3) the ability to remove oxygen-poor water from the bottom of the lake.

The siphon system would be able to provide for annual lake drawdown that can maintain a reasonably consistent water surface level for an extended period of time, recirculate water from the bottom levels of the lake and drain the lake, if necessary. This schematic plan was based on the premise that the siphon system would be placed overtop of the existing earthen embankment. This alignment would reduce the risks associated with excavating through the earthen embankment of the dam to a depth of approximately 15 feet necessary for a gravity system and the impacts to existing utility mains within the dam embankment. A range of pipe sizes (12" through 30") were reviewed for the siphon system to be compared to the various flow conditions anticipated for the volume of impounded water to be removed to lower the lake water surface combined with the base flow conditions during various periods of the year and flows for various rainfall events. Based on the existing construction plans for the dam, it has been assumed that the bottom of the lake is at an elevation of 820, resulting in a drawdown of 30 feet (850 – 820) to drain the lake. The hydraulic calculations cover a range of drawdowns from 1 foot per week as defined by ODNR to several feet per week.

The table below shows the estimated volume of water impounded by Lake Roaming Rock based on a normal water surface elevation of 850 to bottom of lake elevation of 820.

Existing Lake Roaming Rock – Volume of Impounded Water					
Elevation	Contour Area (sf)	Average Area (sf)	Increment (ft)	Incremental Volume (cf)	Total Volume (cf)
820	0				
		667,920	2	1,335,840	1,335,840
822	1,335,840				
		2,003,760	2	4,007,520	5,343,360
824	2,671,680				
		3,339,600	2	6,679,200	12,022,560
826	4,007,520				
		4,675,440	2	9,350,880	21,373,440
828	5,343,360				
		6,011,280	2	12,022,560	33,396,000
830	6,679,200				
		7,347,120	2	14,694,240	48,090,240
832	8,015,040				
		8,682,960	2	17,365,920	65,456,160
834	9,350,880				
		10,018,800	2	20,037,600	85,493,760
836	10,686,720				
		11,354,640	2	22,709,280	108,203,040
838	12,022,560				
		12,690,480	2	25,380,960	133,584,000
840	13,358,400				
		14,026,320	2	28,052,640	161,636,640
842	14,694,240				
		15,362,160	2	30,724,320	192,360,960
844	16,030,080				
		16,698,000	2	33,396,000	225,756,960
846	17,365,920				
		18,033,840	2	36,067,680	261,824,640
848	18,701,760				
		19,369,680	2	38,739,360	300,564,000
850	20,037,600				

EXHIBIT 1

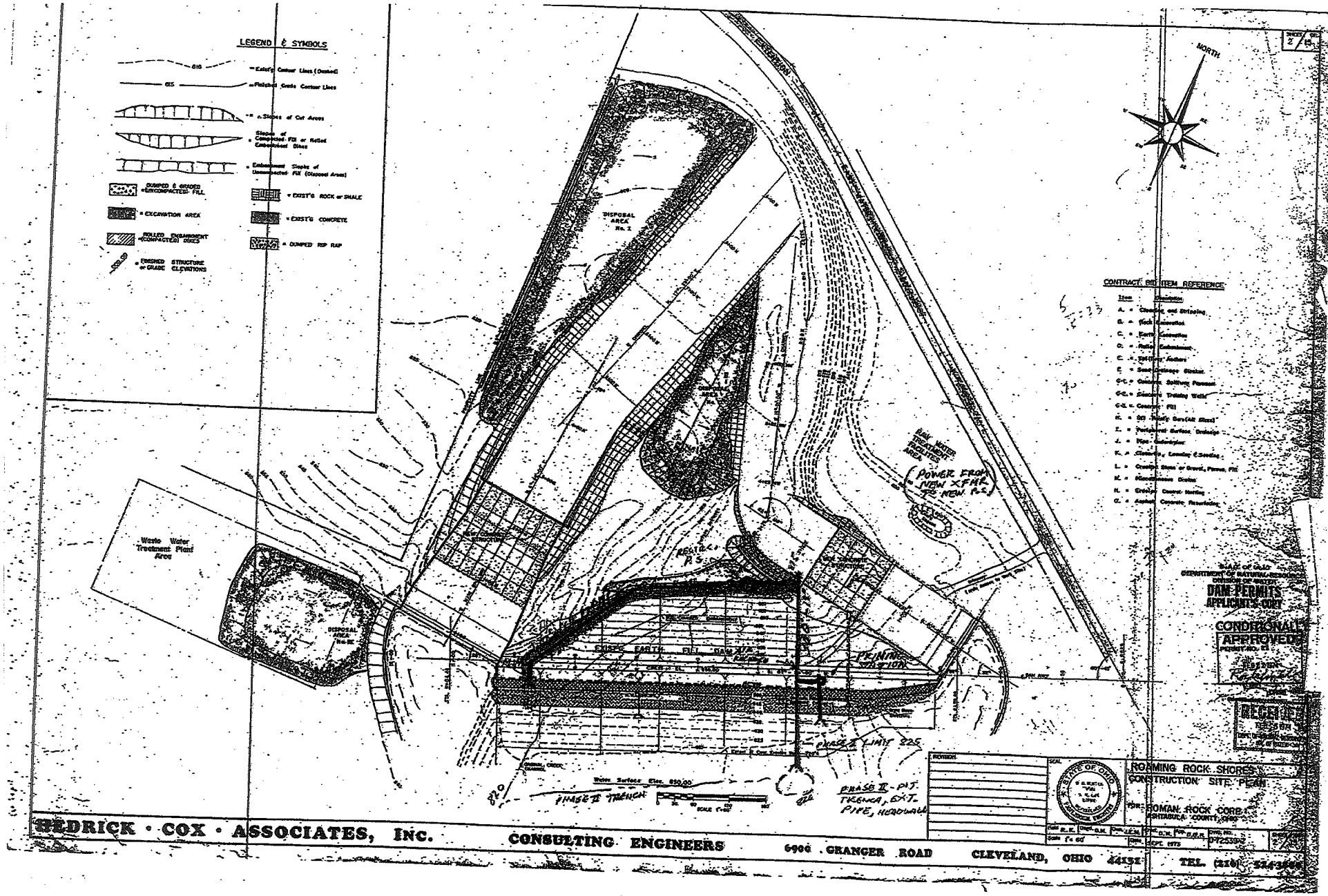
LEGEND & SYMBOLS
= Exist'g Contour Lines (Dashed)
= Finished Grade Contour Lines
= Slopes of Cut Areas
= Slopes of Compacted Fill or Rolled Embankment Dikes
= Embankment Slopes of Uncompacted Fill (Disposal Areas)
= DUMPED & GRADED (UNCOMPACTED) FILL
= EXCAVATION AREA
= ROLLED EMBANKMENT (COMPACTED) DIKES
= FINISHED STRUCTURE or GRADE ELEVATIONS
= EXIST'G ROCK or SHALE
= EXIST'G CONCRETE
= DUMPED RIP RAP
NORTH
CONTRACT BID ITEM REFERENCE
Item
Description
DISPOSAL AREA No. 2
Waste Water Treatment Plant Area
DISPOSAL AREA No. 1
NEW WATER TREATMENT PLANT AREA
POWER FROM NEW XFMR TO NEW P.S.
EXIST'G EARTH FILL DAM
PHASE II TRENCH
PHASE II LIMIT 825
Water Surface Elev. 650.00
PHASE II - PIT, TRENCH, EXT. PIPE, HEADWALL
STATE OF OHIO DEPARTMENT OF NATURAL RESOURCES
DAM PERMITS
APPLICANT'S COPY
CONDITIONALLY APPROVED
RECEIVED
REVISION
SEAL
STATE OF OHIO REGISTERED PROFESSIONAL ENGINEER
ROAMING ROCK SHORES
CONSTRUCTION SITE PLAN
ROMAN ROCK CORP.
PORTAGE COUNTY, OHIO
SEPT. 1975
D-725393
SHEET 2 OF 15
HEDRICK · COX · ASSOCIATES, INC. CONSULTING ENGINEERS 6900 GRANGER ROAD CLEVELAND, OHIO 44131 TEL. (216) 524-3600

EXHIBIT 2

Summary of Siphon System Hydraulic Calculations - Alternatives 12 inch through 30 inch

			SINGLE BARREL SIPHON OPTIONS (10"-30")																	
Depth	Siphon Head	Siphon head less friction	Q(CFS)/12	V(fps)/12	headloss	Q(CFS)/16	V(fps)/16	headloss	Q(CFS)/18	V(fps)/18	headloss	Q(CFS)/20	V(fps)/20	headloss	Q(CFS)/24	V(fps)/24	headloss	Q(CFS)/30	V(fps)/30	headloss
30	35	13	23	29	21.8	40	29	21.8	51	29	21.8	63	29	21.8	91	29	21.8	142	29	21.8
25	30	11	21	27	18.2	37	26	16.9	47	27	18.2	58	27	18.2	84	27	18.2	131	27	18.2
20	25	10	20	25	15.4	35	25	15.4	45	25	15.4	55	25	15.4	80	25	15.4	125	25	15.4
15	20	8	18	23	12.8	32	23	12.8	40	23	12.8	50	23	12.8	71	23	12.8	111	23	12.8
10	15	6	15	19	8.6	27	19	8.6	35	20	9.6	43	20	9.6	62	20	9.6	96	20	9.6
5	10	4	13	17	6.9	22	16	6.1	28	16	6.1	35	16	6.1	50	16	6.1	79	16	6.1

Volume Distribution	Time (days)	Time (days)	Time (days)	Time (days)	Time (days)	Time (days)
0-5	52.9	30.4	23.9	19.3	13.4	8.6
5-10	33.1	18.8	14.8	12.0	8.3	5.3
10-15	34.8	19.9	15.5	12.7	8.7	5.6
15-20	25.1	14.1	11.3	9.0	6.4	4.1
20-25	18.6	10.3	8.0	6.5	4.5	2.9
25-30	10.7	6.3	5.0	4.0	2.8	1.8
total	**175.2**	**99.9**	**78.4**	**63.5**	**44.0**	**28.2**

			DOUBLE BARREL SIPHON OPTIONS (10"-30")																	
Depth	Siphon Head	Siphon head less friction	Q(CFS)/12	V(fps)/12	headloss	Q(CFS)/16	V(fps)/16	headloss	Q(CFS)/18	V(fps)/18	headloss	Q(CFS)/20	V(fps)/20	headloss	Q(CFS)/24	V(fps)/24	headloss	Q(CFS)/30	V(fps)/30	headloss
30	35	13	46	30	22.5	80	29	21.0	102	29	21.8	126	29	21.8	182	29	21.8	284	29	21.8
25	30	11	42	27	17.5	74	27	17.5	94	27	17.5	116	27	17.5	168	27	17.5	262	27	17.5
20	25	10	40	26	16.0	70	25	15.4	90	26	16.0	110	25	15.4	160	26	16.0	250	26	16.0
15	20	8	36	23	12.8	64	23	12.8	80	23	12.3	100	23	12.8	142	23	12.3	222	23	12.3
10	15	6	30	19	8.6	54	20	9.1	70	20	9.6	86	20	9.1	124	20	9.1	192	20	9.1
5	10	4	26	17	6.5	44	16	6.1	56	16	6.1	70	16	6.1	100	16	6.1	158	16	6.1

Volume Distribution	Time (days)	Time (days)	Time (days)	Time (days)	Time (days)	Time (days)
0-5	26.5	15.2	11.9	9.7	6.7	4.3
5-10	16.6	9.4	7.4	6.0	4.1	2.7
10-15	17.4	9.9	7.7	6.3	4.3	2.8
15-20	12.6	7.1	5.7	4.5	3.2	2.0
20-25	9.3	5.2	4.0	3.2	2.2	1.4
25-30	5.4	3.2	2.5	2.0	1.4	0.9
total	**87.6**	**49.9**	**39.2**	**31.7**	**22.0**	**14.1**

	Volume Distribution by 5ft depth increments	Assumed % volume	volume-cf	Upper 10 ft
850-845	0-5	35%	105,197,400	165,310,200
845-840	5-10	20%	60,112,800	
840-835	10-15	20%	60,112,800	
835-830	15-20	13%	39,073,320	
830-825	20-25	8%	24,045,120	
825-820	25-30	4%	12,022,560	
	total	100%	300,564,000	135,253,800

EXHIBIT 3

Summary of Preliminary Opinion of Probable Construction Costs - Siphon System Alternatives

Pool 850-820		Siphon	Priming	Recirculation	Total Project
Siphon Size	Days	Project	Station	System	Cost
12	175	$108,600	$100,000	$290,000	$498,600
16	100	$120,300	$100,000	$290,000	$510,300
18	78	$127,700	$100,000	$290,000	$517,700
20	63	$144,100	$100,000	$290,000	$534,100
24	44	$170,700	$100,000	$290,000	$560,700
30	28	$194,700	$100,000	$290,000	$584,700

12" Siphon				
Description	Units	Qty	Unit Cost	Total Cost
1 Influent Structure	Each	1	$5,000	$5,000
2 12" DIP Siphon Pipe	LF	330	$70	$23,100
3 12" Gate Valve and fence	Each	1	$6,000	$6,000
4 Armor Stone	CY	89	$200	$17,800
5 Headwalls,RipRap	LS	1	$5,000	$5,000
6 100 GPM Priming Station*	LS	1	$75,000	$75,000
7 Siphon Piers and Anchors	Each	18	$600	$10,800
8 Restoration	LS	1	$4,000	$4,000
9 Embankment repair allowance	LS	1	$5,000	$5,000
10 Trenching of Lake Bottom for channel	LF	400	$10	$4,000
11 6,000 GPM Recirculation Station**	LS	1	$150,000	$150,000
12 Inlet Control Valve & Vault	LS	1	$5,000	$5,000
13 16" DIP Recirculation Pipe	LF	450	$90	$40,500
14 Recirculation line Piers	Each	25	$400	$10,000
15 Pipe Fittings	Each	5	$175	$875
16 Power Feeds, breakers, xfmer, meter	LS	1	$50,000	$50,000
Sub Total				$412,100
10%Bond,Mobil,Contingency				$41,200
Total Construction				$453,300
Project Overhead - 10%				$45,300
Total Project				$498,600

* Simplex Pump Stations includes single pump, suction pipe, valves and vault, wetwell, pump station p air release and vault, electrical and instrumentation

* *Simplex Pump Stations includes single pump, 18" suction pipe, discharge valve and vault, wetwell, pump station 16"discharge piping, manhole, electrical and instrumentation

16" Siphon				
Description	Units	Qty	Unit Cost	Total Cost
1 Influent Structure	Each	1	$5,000	$5,000
2 16" DIP Siphon Pipe	LF	330	$90	$29,700
3 16" Gate Valve and fence	Each	1	$8,000	$8,000
4 Armor Stone	CY	89	$200	$17,800
5 Headwalls,RipRap	LS	1	$6,000	$6,000
6 100 GPM Priming Station*	LS	1	$75,000	$75,000
7 Siphon Piers and Anchors	Each	18	$600	$10,800
8 Restoration	LS	1	$4,000	$4,000
9 Embankment repair allowance	LS	1	$5,000	$5,000
10 Trenching of Lake Bottom for channel	LF	400	$10	$4,000
11 6,000 GPM Recirculation Station**	LS	1	$150,000	$150,000
12 Inlet Control Valve & Vault	LS	1	$5,000	$5,000
13 16" DIP Recirculation Pipe	LF	450	$90	$40,500
14 Recirculation line Piers	Each	25	$400	$10,000
15 Pipe Fittings	Each	5	$175	$875
16 Power Feeds, breakers, xfmer, meter	LS	1	$50,000	$50,000
Sub Total				$421,700
10%Bond,Mobil,Contingency				$42,200
Total Construction				$463,900
Project Overhead - 10%				$46,400
Total Project				$510,300

* Simplex Pump Stations includes single pump, suction pipe, valves and vault, wetwell, pump station p air release and vault, electrical and instrumentation

**Simplex Pump Stations includes single pump, 18" suction pipe, discharge valve and vault, wetwell, pump station 16"discharge piping, manhole, electrical and instrumentation

18"Siphon				
Description	Units	Qty	Unit Cost	Total Cost
1 Influent Structure	Each	1	$5,000	$5,000
2 18" DIP Siphon Pipe	LF	330	$100	$33,000
3 18" Gate Valve and fence	Each	1	$10,000	$10,000
4 Armor Stone	CY	89	$200	$17,800
5 Headwalls,RipRap	LS	1	$5,000	$5,000
6 100 GPM Priming Station*	LS	1	$75,000	$75,000
7 Siphon Piers and Anchors	Each	18	$700	$12,600
8 Restoration	LS	1	$4,000	$4,000
9 Embankment repair allowance	LS	1	$5,000	$5,000
10 Trenching of Lake Bottom for channel	LF	400	$10	$4,000
11 6,000 GPM Recirculation Station**	LS	1	$150,000	$150,000
12 Inlet Control Valve & Vault	LS	1	$5,000	$5,000
13 16" DIP Recirculation Pipe	LF	450	$90	$40,500
14 Recirculation line Piers	Each	25	$400	$10,000
15 Pipe Fittings	Each	5	$175	$875
16 Power Feeds, breakers, xfmer, meter	LS	1	$50,000	$50,000
Sub Total				$427,800
10%Bond,Mobil,Contingency				$42,800
Total Construction				$470,600
Project Overhead - 10%				$47,100
Total Project				$517,700

* Simplex Pump Stations includes single pump, suction pipe, valves and vault, wetwell, pump station p air release and vault, electrical and instrumentation

* *Simplex Pump Stations includes single pump, 18" suction pipe, discharge valve and vault, wetwell, pump station 16"discharge piping, manhole, electrical and instrumentation

20"Siphon				
	Description	Units	Qty	Unit Cost	Total Cost
1	Influent Structure	Each	1	$8,000	$8,000
2	20" DIP Siphon Pipe	LF	330	$110	$36,300
3	20" Gate Valve and fence	Each	1	$12,000	$12,000
4	Armor Stone	CY	89	$200	$17,800
5	Headwalls,RipRap	LS	1	$8,000	$8,000
6	100 GPM Priming Station*	LS	1	$75,000	$75,000
7	Siphon Piers and Anchors	Each	18	$800	$14,400
8	Restoration	LS	1	$4,500	$4,500
9	Embankment repair allowance	LS	1	$5,000	$5,000
10	Trenching of Lake Bottom for channel	LF	400	$10	$4,000
11	6,000 GPM Recirculation Station**	LS	1	$150,000	$150,000
12	Inlet Control Valve & Vault	LS	1	$5,000	$5,000
13	16" DIP Recirculation Pipe	LF	450	$90	$40,500
14	Recirculation line Piers	Each	25	$400	$10,000
15	Pipe Fittings	Each	5	$175	$875
16	Power Feeds, breakers, xfmer, meter	LS	1	$50,000	$50,000
	Sub Total				$441,400
	10%Bond,Mobil,Contingency				$44,100
	Total Construction				$485,500
	Project Overhead - 10%				$48,600
	Total Project				$534,100

* Simplex Pump Stations includes single pump, suction pipe, valves and vault, wetwell, pump station p air release and vault, electrical and instrumentation

* *Simplex Pump Stations includes single pump, 18" suction pipe, discharge valve and vault, wetwell, pump station 16"discharge piping, manhole, electrical and instrumentation

24"Siphon					
	Description	Units	Qty	Unit Cost	Total Cost
1	Influent Structure	Each	1	$10,000	$10,000
2	24" DIP Siphon Pipe	LF	330	$140	$46,200
3	24" Gate Valve and fence	Each	1	$15,000	$15,000
4	Armor Stone	CY	89	$200	$17,800
5	Headwalls,RipRap	LS	1	$10,000	$10,000
6	Pipe Fittings	Each	5	$200	$1,000
7	100 GPM Priming Station*	LS	1	$75,000	$75,000
8	Siphon Piers and Anchors	Each	18	$1,000	$18,000
9	Restoration	LS	1	$5,000	$5,000
10	Embankment repair allowance	LS	1	$5,000	$5,000
11	Trenching of Lake Bottom for channel	LF	400	$10	$4,000
12	6,000 GPM Recirculation Station**	LS	1	$150,000	$150,000
13	Inlet Control Valve & Vault	LS	1	$5,000	$5,000
14	16" DIP Recirculation Pipe	LF	450	$90	$40,500
15	Recirculation line Piers	Each	25	$400	$10,000
16	Pipe Fittings	Each	5	$175	$875
	Power Feeds, breakers, xfmer, meter	LS	1	$50,000	$50,000
	Sub Total				$463,400
	10%Bond,Mobil,Contingency				$46,300
	Total Construction				$509,700
	Project Overhead - 10%				$51,000
	Total Project				$560,700

* Simplex Pump Stations includes single pump, 8" suction pipe, valve and vault, wetwell, pump station 4"discharge piping, air release and vault, electrical and instrumentation

* *Simplex Pump Stations includes single pump, 18" suction pipe, discharge valve and vault, wetwell, pump station 16"discharge piping, manhole, electrical and instrumentation

	30"Siphon				
	Description	Units	Qty	Unit Cost	Total Cost
1	Influent Structure	Each	1	$10,000	$10,000
2	30" DIP Siphon Pipe	LF	330	$200	$66,000
3	30" Gate Valve and fence	Each	1	$15,000	$15,000
4	Armor Stone	CY	89	$200	$17,800
5	Headwalls,RipRap	LS	1	$10,000	$10,000
6	Pipe Fittings	Each	5	$200	$1,000
7	100 GPM Priming Station*	LS	1	$75,000	$75,000
8	Siphon Piers and Anchors	Each	18	$1,000	$18,000
9	Restoration	LS	1	$5,000	$5,000
10	Embankment repair allowance	LS	1	$5,000	$5,000
11	Trenching of Lake Bottom for channel	LF	400	$10	$4,000
12	6,000 GPM Recirculation Station**	LS	1	$150,000	$150,000
13	Inlet Control Valve & Vault	LS	1	$5,000	$5,000
14	16" DIP Recirculation Pipe	LF	450	$90	$40,500
15	Recirculation line Piers	Each	25	$400	$10,000
16	Pipe Fittings	Each	5	$175	$875
	Power Feeds, breakers, xfmer, meter	LS	1	$50,000	$50,000
	Sub Total				$483,200
	10%Bond,Mobil,Contingency				$48,300
	Total Construction				$531,500
	Project Overhead - 10%				$53,200
	Total Project				$584,700

* Simplex Pump Stations includes single pump, 8" suction pipe, valve and vault, wetwell, pump station 4"discharge piping, air release and vault, electrical and instrumentation

* *Simplex Pump Stations includes single pump, 18" suction pipe, discharge valve and vault, wetwell, pump station 16"discharge piping, manhole, electrical and instrumentation

EXHIBIT 4

USGS Surface-Water Monthly Statistics for the Nation

The statistics generated from this site are based on approved daily-mean data and may not match those published by the USGS in official publications. The user is responsible for assessment and use of statistics from this site. For more details on why the statistics may not match, click here.

USGS 04211000 Rock Creek near Rock Creek OH

Available data for this site | Time-series: Monthly statistics | GO

Ashtabula County, Ohio
Hydrologic Unit Code 04110004
Latitude 41°39'05", Longitude 80°50'10" NAD27
Drainage area 69.2 square miles
Gage datum 813.03 feet above sea level NGVD29

Output formats
Tab-separated data
Reselect output format

00060, Discharge, cubic feet per second,

Monthly mean in cfs (Calculation Period: 1942-04-01 -> 1966-09-30)

Period-of-record for statistical calculation restricted by user

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1942				133.2	163.3	64.2	42.0	129.7	2.22	29.6	116.5	221.1
1943	172.3	181.8	156.1	90.4	132.4	61.4	49.0	0.439	0.283	1.40	5.20	8.38
1944	22.6	136.8	183.7	236.2	66.6	3.81	0.010	0.000	0.000	0.000	1.10	8.36
1945	22.4	264.4	205.5	69.0	100.6	30.8	17.8	4.11	43.5	190.0	89.0	102.0
1946	102.6	111.0	174.9	8.30	197.7	51.7	1.41	0.068	0.000	1.72	9.74	61.5
1947	227.3	31.1	150.9	269.0	221.3	242.8	10.4	6.54	13.4	0.145	1.49	30.7
1948	40.1	158.1	299.1	128.7	107.2	5.70	10.0	10.8	1.38	12.7	54.5	96.1
1949	177.7	124.4	118.5	72.8	115.2	7.73	14.3	1.94	1.72	0.268	7.88	74.6
1950	381.7	239.5	364.0	188.6	74.9	32.7	1.70	2.45	15.4	1.91	88.7	225.8
1951	214.4	250.7	305.5	117.1	37.4	30.9	23.3	0.729	0.513	0.277	96.6	225.1
1952	410.8	127.3	125.4	98.6	65.4	1.81	0.168	1.02	0.413	0.200	13.8	39.1
1953	146.8	60.4	71.1	69.8	160.4	30.9	0.258	1.05	0.000	0.000	0.223	12.1
1954	82.3	81.7	279.6	270.2	44.8	63.4	0.090	0.000	0.000	132.9	85.9	187.5

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1955	86.7	203.9	208.3	94.1	6.00	7.81	0.500	1.50	0.000	12.8	67.3	105.6
1956	9.37	300.9	265.6	183.9	161.4	119.0	43.1	176.7	17.0	4.36	8.14	68.4
1957	136.0	136.7	75.2	310.6	29.7	47.8	6.32	0.000	0.000	0.445	3.25	127.4
1958	73.3	122.4	100.1	56.8	49.1	5.56	95.3	70.2	27.0	14.0	98.7	54.2
1959	253.6	250.6	170.5	138.1	30.2	17.1	5.39	2.05	0.853	99.6	139.1	186.7
1960	160.7	108.3	192.9	94.4	154.7	14.7	2.45	1.35	0.400	0.132	1.74	1.43
1961	6.47	169.9	172.5	322.0	44.8	17.5	1.75	0.310	0.910	2.86	43.8	41.9
1962	67.2	89.4	149.8	83.1	11.3	1.71	0.000	0.000	0.007	1.43	29.8	17.4
1963	19.4	8.21	215.1	61.1	7.36	5.43	3.58	1.13	0.000	0.000	2.42	10.9
1964	69.9	21.5	368.5	220.8	42.3	2.01	0.584	1.68	0.117	0.071	0.407	33.8
1965	224.2	190.9	231.3	61.9	33.2	50.8	0.603	0.019	0.080	14.7	41.5	56.6
1966	71.5	198.3	109.2	135.6	57.1	1.10	0.461	21.7	0.750			
Mean of monthly Discharge	132	149	196	141	85	37	13	17	5.0	22	42	83