Wash. WW

Assistance Detail

Assistance ID: 74906

Contact: Rob Baker Date: 11/17/2014

Assistance Type: Consultant Staff: Paul Brandt

Program Type(s): Wastewater

Note(s):

Date: 12/03/2014

Sender: paul.brandt@dnr.iowa.gov

Rob Baker, Fox Engineering called the field office on 11-17-2014 about the Lexington St. lift station project. They plan to replace pumps with larger capacity, new electrical panel, phone dialer system and emergency generator. He has alreacy talked to Terry Kirschenman about construction permits.

Site Detail

Site Name:	Washington City Of Stp	State ID:	310643746
Location Address:	CITY CLERK/CITY HALL	Derived Address:	False
City/State/Zip:	Washington Iowa 52353	Direction:	
County:	Washington	GIS Accuracy:	100
Field Office:	FO 6-Washington	Location Comment:	From original WWTP.shp where Location Method=Locator Map

Township Name: Washington

Sec: 19 Tier: 75 Range: 07 W

Program Name	Program Id
Floodplain - Flood Plan Permit	1987-167
Wastewater - NPDES Wastewater Treatment Operating Permit	9271001

Wash. WW

Brandt, Paul [DNR]

From: Rob Baker <rjb@foxeng.com>
Sent: Wednesday, November 12, 2014 4:46 PM
To: Brandt, Paul [DNR]
Cc: Fred Doggett; Steve Troyer
Subject: Lexington Blvd Lift Station in Washington
Attachments: Wash Lexington PS Report Oct 2014.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Paul,

Per our phone conversation, see letter report that is attached. Due to the unknown nature of the I/I problem, City staff has directed us to specify a replacement pump with the largest capacity compatible with the existing wet well structure (wet well will not change).

Terry K. at the Construction Permits section said that a Facility Plan would not be required for a minor lift station project, unless some other regulatory office is requiring it. A construction permit is required due to the change in capacity and plans to add a permanent generator to the site.

Terry also said to check that the sewer downstream of the lift station has the capacity to accept more flow from the lift station. You will not find that in the letter, but we will be sure to verify.

Please review the letter and reply with any other foreseeable requirements to help the City resolve the overflow problem.

Thank you,
Rob

Robbie Baker, P.E.

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FOX engineering

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October 23, 2014

Fred Doggett
City of Washington
215 E. Washington Street
Washington, IA 52353

RE: LEXINGTON BOULEVARD WASTEWATER PUMP STATION
2045-08A.201

Fred:

This letter is in response to the City's request for FOX Engineering to make a brief evaluation of the wastewater pump station on Lexington Boulevard. This letter will summarize the recent overflow events at the pump station, the existing characteristics and capacity of the pump station, description of the collection system which the pump station serves and anticipated future capacity, a description of infiltration/inflow reduction efforts, and our recommendations.

Event Timeline

FOX Engineering reviewed the monthly operating reports (MOR's) from August 2011 until August 2014 and the lift station bypass reports provided by the City. A brief timeline summary follows:

- 5/03/2012: During a rainfall event of 3.91 inches, the Lexington Boulevard alarm dialer called the on-call operator for a high water alarm. The Creek adjacent to the Lexington Boulevard pump station site was out of its banks and over the pump station wet well, causing by-passing. No electrical or mechanical problems observed. The station was submerged from 9:09 P.M. until 12:05 A.M. There were also bypass reports for the Parkside Estates lift station, Sunset Park lift station, and the headworks of the old WWTP associated with this rainfall event.
- 6/30/2014. During a heavy rain (1.4 inches), the Lexington Boulevard alarm dialer called the on-call operator for a high water alarm. Operator observed that both pumps were running but could not keep up with the influent flow. The station surcharged from 8:08 P.M. until 9:27 P.M. with an estimated flow of 200-300 gallons.
- 7/05/2014. During a heavy rain (1.44 inches), the Lexington Boulevard alarm dialer called the on-call operator for a high water alarm. Operator observed that both pumps were running, but not keeping up with the influent flow. There was no bypass or surcharge at that time (12:50 P.M.) No electrical or mechanical problems observed. Subsequently, the rainfall paused or slowed, but later another heavy rain occurred. Operator returned to the pump station to observe that the pump station was surcharging and reported a bypass. The station was submerged from 5:20 P.M. until 6:45 P.M.
- 8/23/2014. During a heavy rain (1.37 inches), operator reported bypass event at the Lexington Boulevard Lift Station.
- 8/26/2014. After one of the Lexington Boulevard pumps tripped out multiple times, Electric Pump arrived to retrieve the problem pump. Pump was severely damaged and requires a major rebuild or replacement. City investigating sources of I/I.
- 8/28/2014. During a heavy rain (2.33 inches), operator reported a bypass event at the Lexington Boulevard Lift Station.

- 9/1/2014. During a heavy rain (1.01 inches), operator reported a bypass event at the Lexington Boulevard Lift Station.
- 9/4/2014. During a heavy rain (2.15 inches), operator reported a bypass event at the Lexington Boulevard Lift Station.
- 9/9/2014. During a heavy rain (3.43 inches), operator observed bypassing or surcharging of the wet well at the Lexington Boulevard Lift Station starting at 10:25 P.M.
- 9/10/2014. During a heavy rain (3.43 inches), overflows were observed at the WWTP influent channel, septage manhole, and Influent Diversion Structure. Plant headworks overflowed from 4:15 A.M. until 4:42 A.M. West EQ Basin started to overflow at 12:50 P.M at a rate of 9800 gpm. East EQ Basin did not overflow. Lexington Boulevard Lift Station ceased bypassing at 11:50 A.M.
- 9/22/2014. Electric Pump installs a 20-HP rental pump in place of the pump that was removed. New motor starters and breakers were installed. Installing technician noted that the rental pump sits awkwardly on the discharge elbow fitting because of interference with the wet well's formed concrete sump or fillet. The pump's inlet is only about 3 inches above the floor. It was recommended that the pump discharge elbow be adjusted so the rental pump has adequate clearance above the floor.

Description of the Existing Pump Station

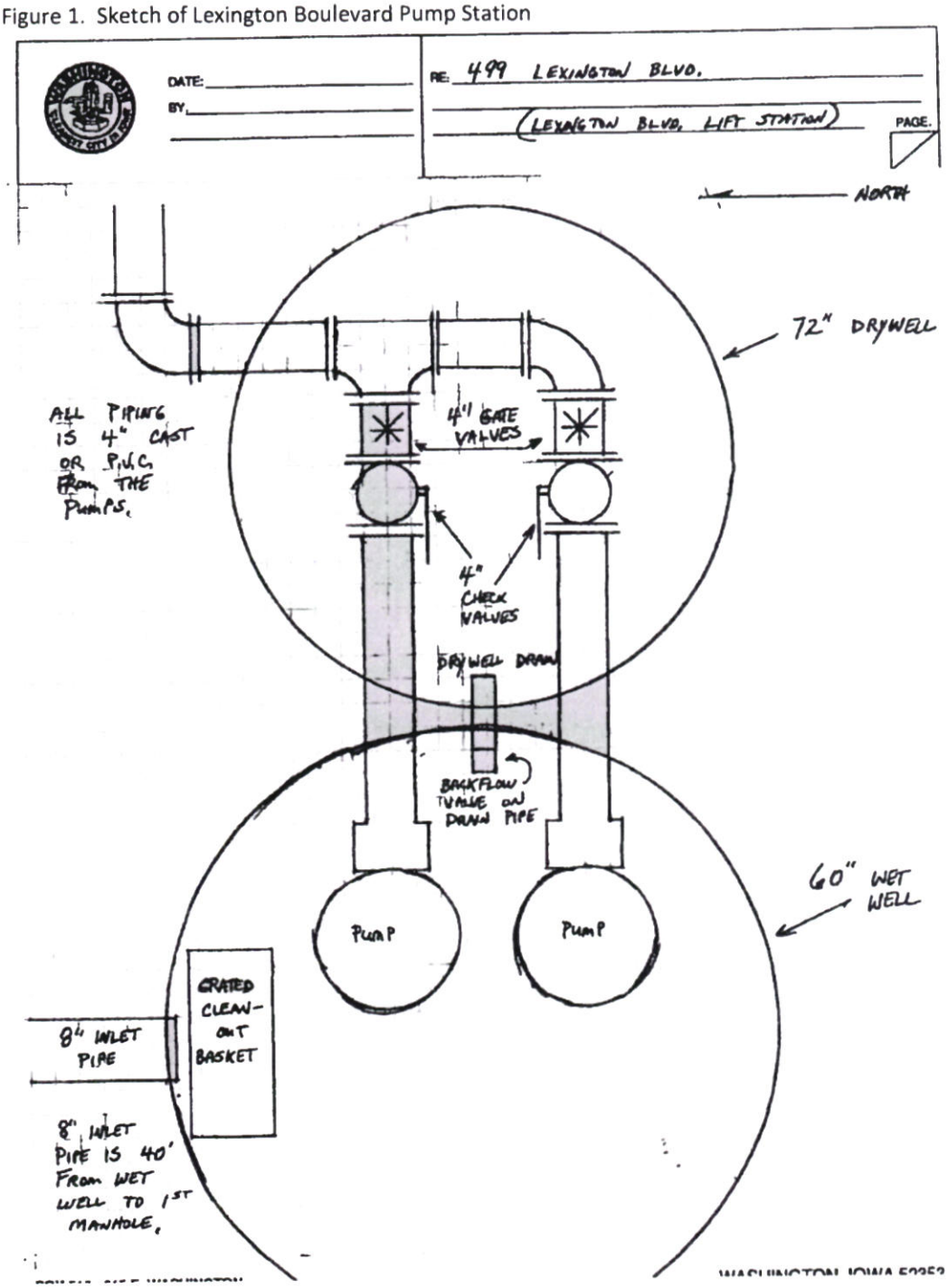
There were no construction drawings available for this lift station, but a sketch was provided by City Staff (Figure 1). A summary of what is known about the Lexington Boulevard lift station is found in Table 1, and most of this information is based on City Staff's observations and what FOX Engineering could conclude and calculate based on these observations.

After a review of pump run times from January 2008 until February 2009, which was a period when the pump station was believed to be in good working order, the average run time for Pump #1 was 1.46 hours per day and for Pump #2 was 2.15 hours per day. On April 2, 2008, City personnel performed a "drawdown" test to determine the pump rates. The wet well level before and after the test was measured and the time it took for the pump to draw down the content in the wet well to the stop level was recorded. Results were 95 gpm for Pump #1 and 64 gpm for Pump #2. Applying these flow rates to the average run times during the period results in an average flow of approximately 8,300 gpd. It was not clear from the pump run time records what the maximum pump run time for one 24-hour period would be. In order to determine maximum day flows (maximum volume pumped in a 24-hour period) using the pump run time data, the motor run time counter needs to be read once per day, at the same time of day. Gaining a better understanding of maximum run times in a 24-hr period helps to determine what the pump station's influent flow is and what the pump capacity needs to be.

Table 1. Characteristics of the Wastewater Pump Station on Lexington Boulevard, September 2014.

Item	Description
Type Pump	centrifugal submersible, wet pit
Number of pumps	Two (2)
Type of pump control	level floats, single speed pumps on/off, Lag pump runs if lead does not keep up.
Pump motor, HP	Pump 1 = 15 HP, Pump 2 = 20 HP
Pump capacity	2008 pump test by City: Pump 1 = 95 gpm, Pump 2 = 64 gpm (current capacity in question)
Pump Hours	2008-2009 Average = 1.5 hr/day for Pump 1, 2.1 hr/day for Pump 2
Flow measurement	Pump hours, 2008-2009 average flow = 8,300 gpd
Wet well	60" sanitary manhole, 15.83' deep, 8-inch dia. inlet from North, inlet flow line approximately 7.65' from bottom, pump discharge flow line at 11.1' from bottom, bottom has formed invert but slope of fillets not known.
Force main	4" diameter, alignment and profile not known, no known high points or air relief valves, discharge is into a sanitary manhole at the intersection of W. 3rd Street and W. 5th Street.
Pump retrieval	Pump rails only on one pump, lifting arm provided for portable hoist.
Trash Basket	Not observed, but wet well has rails for it.
Valve Vault	72" sanitary manhole approx. 6' deep. Two check valves, two isolation valves, remnants of pressure gauge. Direct drain to wet well is missing a gas-tight check valve.
Site Access	Improved driveway for maintenance vehicle, no fence, locks on wet well, valve vault and electrical/control panel. No indication of vandalism.
Flood Elevation	Not known
Alarms	Pump temperature, wet well high level, pump #1 fail, pump #2 fail
Communication	Sensaphone 4 channel alarm dialer
Electric power service	200 amp, 3 phase, 480 VAC
Power Surge Protection?	Yes, fuse on each phase
Backup power	Portable generator or vacuum truck transfer of wastewater

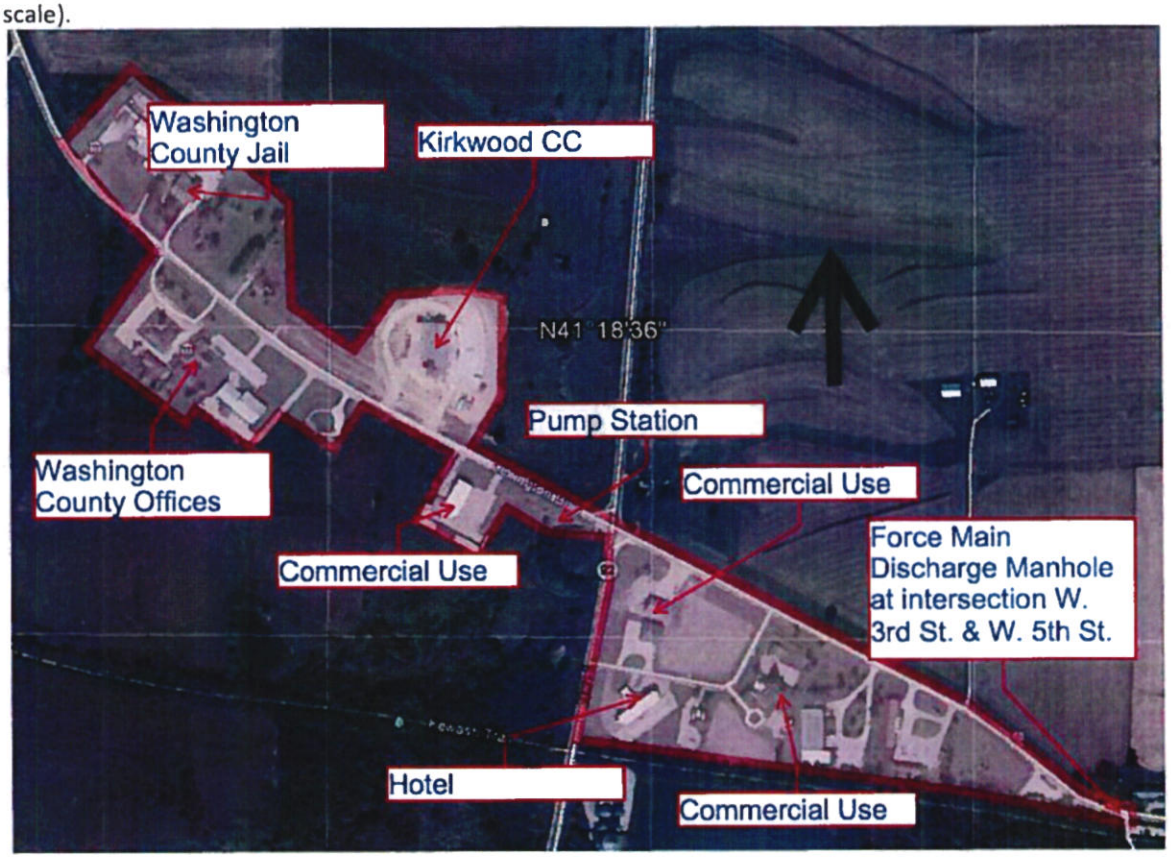
Figure 1. Sketch of Lexington Boulevard Pump Station



Description of Collection System Area Served by the Lexington Boulevard Lift Station

Figure 2 indicates the City staff's best understanding of the collection area for the Lexington Boulevard Lift Station (indicated in the red, shaded polygon). Given the unexpected overflows occurring at the Lexington Lift Station, there may be other properties or drains connected as well. To understand the sanitary flow better, FOX Engineering reviewed the uses of the parcels that we understand are connected to the Lexington Boulevard Lift Station.

Figure 2. Aerial View of Lexington Boulevard Lift Station Collection Area (image from Google Earth, not to scale).



The maximum number of people that could potentially use the facility was assumed for each land parcel, and then unit values for flow based on land use were applied. These unit values were found in Wastewater Engineering, Treatment and Reuse, Fourth Edition, by Metcalf & Eddy [2003]. The results of this theoretical exercise are summarized in Table 2. The totals from Table 2 give an idea of what the sanitary flows may be without I&I added. For the existing land uses, this was 26,200 gpd or 18.2 gpm. Adding in the future apartment development resulted in a total future flow of 32,000 gpd or 22.2 gpm.

While the variation of flow during a typical day for these uses could not be known without flow metering data, a peaking factor of 2 can be applied to most domestic/commercial sources of wastewater [Metcalf & Eddy, 2003]. The peak flow period tends to be in the morning or around noon. If a peaking factor of 2 is applied to the average flow from table 2, then the peak flow during the day without I/I is 36.4 gpm. The total population served by this pump station is about 700 people at full use, but it should be noted that most of these users are not residents and generally would not produce as much wastewater if the area was

completely residential. If the peaking factor equation required by the Iowa Wastewater Design Standards is used to determine the peak design flow, then the peak flow for this pump station is 124,000 gpd or 86 gpm. This number theoretically accounts for some I/I. Based on this brief review, the theoretical capacity for this pump station should be approximately 86 gpm.

Table 2. Estimated Contribution of Flows to the Lexington Lift Station Using Published Unit Values According to Land Use.

Description	Area, acres	Number of People at Full Capacity	Unit Flow per User, gpd/person	Flow, gpd
County Jail & Sheds	2.65	100	120	12,000
County Office Park	9.2	50	13	650
Kirkwood CC Satellite Campus	7.2	300	15	4,500
Commercial lot west of PS	2.75	15	20	300
Commercial lots north of hotel	3.63	20	20	400
Hotel	3.3	105	70	7350
Church		30	4	120
Kirkwood Office		20	13	260
Eagle One Investments		5	13	65
Ag Commerce		15	10	150
Residence near intersection of 3rd/5th Streets		4	100	400
			Subtotal, Existing	26,195
Future apartments, 24 bedrooms		48	120	5,760
			Subtotal, Future	31,955

Considering the 2008-2009 pump station records and drawdown test and the theoretical capacity of the pump station, it follows that a design capacity of 100 gpm should be adequate. However, the frequency of recent overflow events indicates that the I/I component of the influent flow is much larger than it should be and/or mechanical problems have resulted in reduced pumping capacity.

Infiltration and Inflow (I/I) Investigation

Members of the City staff have investigated for sources of I/I in the Lexington Boulevard pump station's collection system area. One source of I/I was discovered. A former farm house between the County Jail and the Kirkwood Satellite Campus on the North side of Lexington, west of Highway 1, had burned and a floor drain was discovered in its basement. This drain was found to be connected to the sanitary sewer and was plugged. In the first week of October 2014, City staff also conducted smoke testing in the area to look for more storm drains connected to the sanitary sewer. No potential sources were identified.

In general, I/I investigations can take a long time, or can be ongoing, but do not always identify all sources of I/I. Therefore, it is recommended that a reasonable amount of I/I be accounted for in the design for peak pumping capacity after the smoke testing has been accomplished.

Pump Replacement Discussion

The Lexington Pump Station is limited by existing conditions – the size of the wet well and the size and length of the discharge force main. The diameter of an existing wet well can limit the size of a pump that can physically be installed. In this case, the 60-inch diameter wet well limits the pump's laying length to about 38 inches long. The volume in the wet well can also limit the pump's cycle time. This is defined as the time it takes for the wet well to fill, plus the time it takes to pump the wet well back down again, plus the down time the motor needs after the pump shuts off. For this wet well volume, the minimum recommended cycle time is about 15 minutes. Stated another way, this is about four pump starts per hour.

For proper suction hydraulics, the pump's intake must be adequately submerged so that the fluid flows evenly into the pump inlet and the pump works efficiently. Lack of adequate submergence results in irregular flow and/or vortexing at the pump intake. This leads to poor pump performance and possibly excessive maintenance. For 3-inch and 4-inch diameter pump intakes, the Hydraulic Institute Standard for submergence is summarized in Table 3. It was observed by City Staff that water level pumps down to a few inches before the pumps shut off. When the malfunctioning pump was replaced with a rental pump, the minimum submergence was adjusted up to about 6 inches deep. Raising the float that shuts the pumps off reduces the effective wet well volume from 1162 gallons using 3 inches as the low water level, to 1126 gallons using 6 inches as the low water level. The wet well cycle times were calculated based on this adjustment to the low water level.

Table 3. Minimum Pump Intake Submergence per Hydraulic Institute Standards.

Flow, gpm	Submergence for a 4" dia. Intake, ft	Submergence for a 3" dia. Intake, ft
90	0.87	0.72
100	0.93	0.77
120	1.05	0.87
140	1.17	0.97
160	1.29	1.08
180	1.41	1.18
200	1.53	1.28

Based on previous wet well draw down pump tests, the existing pump station capacity is about 95 gpm. This coincides with what it should theoretically be based on a review of land use in the pump station's collection area. Based on the pump station's wet well diameter, depth at the high water level, and the minimum submergence of a 4-inch diameter pump intake per the Hydraulic Institute Standards, and the minimum wet well cycle time, the maximum flow capacity recommended is about 180 gpm. Larger flows would require larger pumps that may not fit in the wet well, may require a deeper submergence, and may require a longer wet well cycle time, because it would also need a larger motor.

Recommended Course of Action

It is recommended that the City continues to investigate and identify sources of I/I. Elimination of just one 4-inch drain, laid at minimum slope but flowing full during a heavy downpour, can reduce the peak flow rate to the pump station by 80 gpm. Further it is recommended that the City should observe the rental pump's run times over a period that includes heavy rains such as the events recorded in this letter. A recent pump station draw down test with the rental pump indicated that it pumps at 91 gpm.

Since the rental pump is not currently installed with enough pump intake clearance, a practical solution to replace the discharge elbow, and discharge piping inside the wet well in order to install the pump discharge elbow at a higher elevation. This effort will respond to the concerns of the rental pump supplier about the

current installation and help the City avoid being charged for damages to the rental pump. This effort would be required anyway once the pumps are replaced. A pump intake clearance of 4" is adequate for most pumps in the range of 95 gpm to 180 gpm.

Along with the replacement of the pumps, it is also recommended that the pump station's electrical panel be replaced. This includes the power distribution and breakers, pump starters, pump controls, and control floats. The City has also budgeted for adding an emergency power generator onsite. An additional transfer switch would be included in the pump station's power distribution infrastructure to utilize a generator. The recommended pump vendors would be capable of pump, piping, and valve installation. They also are capable of supplying the pump electrical and controls panel, or one may be supplied separately by a company such as Jetco. The pump vendor would likely work with a local electrician to have the electrical scope installed, energized, and started up.

The DNR will need to be informed of the planned modifications of the pump station, especially since they are already aware that it has overflow problems. Most of what the DNR needs to review is enclosed in this letter and should be a good basis for informing them of planned actions. It is possible that the DNR may require the City to obtain a construction permit for the pump station modifications, because the capacity of the pump station may become larger. Construction permitting would be brief, but it may also add additional time to the improvements schedule.

We recommend that City obtain a brief set of plans, specifications, and contract documents for the pump vendors to base a formal quotation or bid from. The process of getting formal quotations and contracting may take a couple of months, and an early spring construction period may be a reasonable expectation. If the DNR's review takes less time we will be prepared to provide a set contract documents as sooner. Please let us know if we can do anything further.

Sincerely,
FOX Engineering Associates, Inc.

Robbie J. Baker, P.E.
Engineer