MEMO

9/18/2014

Date: September 18, 2014

To: City of Dublin, Barb Cox, PE

From: Taymour El-Hosseiny, Ph.D, PE

Subject: Capacity Analysis for the North Fork Indian Run Sub-trunk

Copies: Craig Bohning

1. Purpose

The purpose of this memo is to provide a discussion on capacity analysis for the North Fork Indian Run (NFIR) trunk sewer operated and maintained by the City of Dublin, OH. This study is an assessment of the whole catchment tributary to the NFIR to consider what effects new developments might have on the performance of the trunk sewer. The study addresses the capacity of the NFIR at build-out conditions. Detailed layout of small diameter sewers for new development is not well defined at this stage. Therefore, capacity of small diameter sewers tributary to the NFIR are beyond the scope of this study and are not included in the analysis.

The capacity analysis uses a dynamic hydraulic modeling to predict the performance of the NFIR at the following development scenarios:

a. Current conditions (2013).

b. Proposed changes in land use from a golf course to a housing development at a site currently operated by Riviera Country Club (approximately 160 acres).

c. Build-out of possible developable open space tributary to the North Fork Indian Run sub-trunk sewer. The available open space for future development is approximately 460 acres including the Riviera site.

2. Background

The Davidson Phillips proposes to change the land use of a site currently operated as a golf course to residential housing units (the golf course is currently operated by the Riviera Country Club). Sanitary wastewater from the new housing units would discharge into the North Fork Indian Run (NFIR) sub-trunk sewer. Due to changes in land use, the City of Dublin, OH has requested Davidson Phillips to provide capacity assurance that the NFIR sub-trunk sewer has adequate capacity to convey collected wastewater at current and build-out conditions without a negative impact on current sewer services and would not impose limitations on future development.

Exhibit 1 illustrates a layout of the NFIR sub-trunk sewer, location of the proposed site development, and open space that can be developed in the future at build-out conditions. This study is a planning

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level analysis, where it is early to decide where the exact tie-in location of the new development into the NFIR. Moreover, since the NFIR sub-trunk sewer is the center of this study, small diameter sewers are not included in the analysis.

Therefore, this study focuses on the capacity assurance of the NFIR sub-trunk sewer only where detailed tributary sewers are considered beyond the scope of this memorandum.

In 2011, the City of Dublin conducted a study to evaluate the capacity of its sub-trunk sewers located within the Bridge Street Corridor[1]. The study used computer modeling of the sewer system (XP SWMM) and the following are important findings related to the NFIR:

a. Field observations shows evidence of surcharge at manhole # 3121located under I-270.
b. Capacity deficiency in the NFIR is predicted at build-out condition if no reduction in current infiltration/inflow (I/I) rates would be implemented based on available flow monitoring data.

3. Study Area:

Exhibit 1 illustrates 3,470 acres tributary area to the NFIR sub-trunk sewer where it shows currently developed and future available open space for development as agreed with the City of Dublin[2]. The western border of the tributary area is bounded by Highland-Croy Road, the southern border is Bridge Street, and the northern border is tributary boundary between the NFIR and the Deer Run sub-trunk sewers. Figure 1 depicts land development status of the 3,740 acres tributary to the NFIR sub-trunk sewer which includes 460 acres (13%) as future development. The total tributary area can be characterized as follows:

- Existing Development (2013): 2,430 acres are currently developed (70% of the total area) as: Single family 67%, multi-family 9%, commercial 14%, and schools 9% (figure 2 illustrates land use of the existing development). It should be noted that the Riviera property is not included either in the Existing Development or Parks categories.

- Future Development: 460 acres (13% of the total tributary area) are available for future development as either mixed residential low density near Brock Road or current large lots that may be subdivided into residential subdivision. The 460 acres includes two major areas for future development: 160 acres for the Riviera property, and 161 acres located near Brock Road at the far north edge of the tributary area.

- Parks: 580 acres (17% of the total area) are designated as parks and open space and will not be developed for either housing or commercial.

[1] City of Dublin, 2011, Bridge Street Corridor, Sanitary Sewer System Modeling, EMH&T
[2] E-mail from Barbara Cox dated 3/26/2013. NFIR Future Tributary area

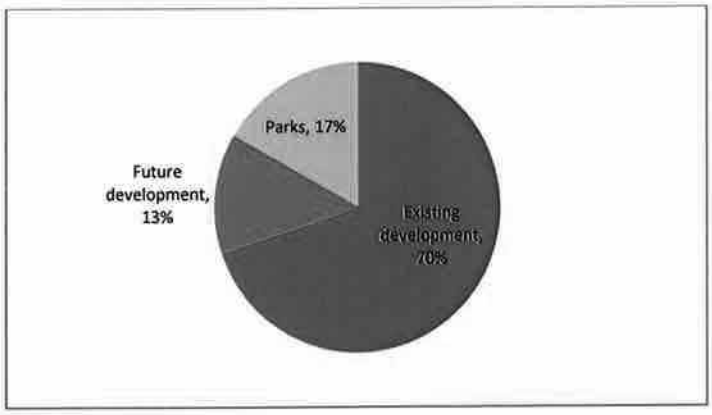

Figure 1: Land Development Status of Tributary Area to the North Fork Indian Run

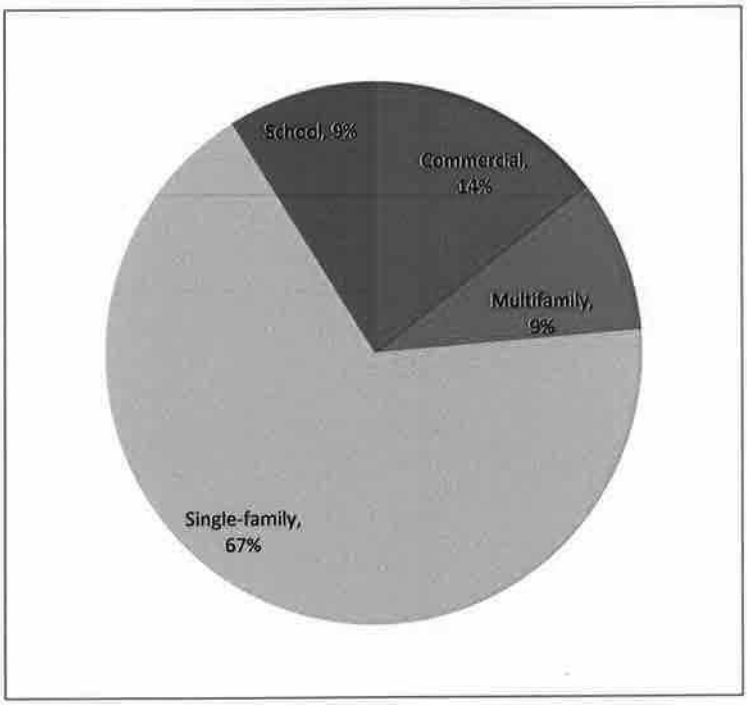

Figure 2: Land Use Classification of Current (2013) Tributary Area to the North Fork Indian Run

4. Flow Monitoring Program

Four (4) flow meters were installed and maintained by EMH&T at key locations to characterize tributary flow. Exhibit 2 illustrates locations of the installed flow meters where data was recorded for approximately 2 month between 3/7/2013 to 4/29/2013. Table A-1 in Appendix A lists the installed flow meter and pictures of the installation. Table 1 is a description of the installed flow meters, measured water depth of average dry weather flow (DWF), and ratio of the average DWF to the sewer diameter.

Table 1: Summary Characteristics of Installed Flow Meters in the North Fork Indian Run Sub-Basin

Flow meter ID	MH#	Location	Description	Sewer Diameter, Slope	Average DWF* Depth	Ratio of DWF to Diameter
				Inch, %	inch	%
FM1	2515	Near Kilgour Place and Indian Run Falls Park	Outfall of the North Fork Indian Run sub-trunk sewer	24, 0.38%	9.64	40%
FM2	3472	Tenbury Dr and Worsley Pl	Northern area to the NFIR: Brandon Sections 1, 2 and 3, Bristol Commons, Ashnaugh Outfall, Muirfield Village	15, 0.2%	5.47	36%
FM3	775	Finnegan Ct and Earlsford Dr	Southern area to the NFIR: Avery Rd Sewer, Dublinshire, Windham Village, Westbury, Park Place, Bishop Crossing	18, 0.3%	3.45	19%
FM4	1508	Avery Rd and Balmoral Dr	North area of NFIR: Shannon Glen, Belvedere, Tartan West, Tartan Ridge	24, 0.23%	4.2	17%

*DWF: Dry Weather Flow

During the monitoring period, four (4) rainfall events were used on model calibration (all of them are less than 1-yr recurrence). Table 2 lists the highest recorded flow during the monitoring period due to a rainfall event occurred on 3/18/2013. The total rainfall for this event was 0.9-inch for a 6-hours duration which can be classified as 2-month, 6-hr storm. Table 2 lists maximum recorded water depth and ratio to the sewer diameter where FM2 recorded 96% full due to that storm (2-month storm). The City of Columbus,

Division of Sewerage and Drainage (DOSD) provided Rainfall data recorded at rain gauge RG1 which is installed at 5800 Post Rd, Dublin OH (Coffman Park).

Table 2: Highest Recorded Wet Weather Flow between 3/7/2013 and 4/29/2013

Flow meter ID	MH#	Sewer Diameter	Max Water Depth (3/18/2013)	Ratio of max water depth to sewer diameter
		in	in	%
FM1	2515	24	14.8	61%
FM2	3472	15	14.4	96%*
FM3	775	18	4.09	22%
FM4	1508	24	5.12	21%

* Sewer reached 96% full due to 2 month storm

5. Modeling Analysis

A dynamic hydraulic model was developed for this study to evaluate the capacity of the NFIR sub-trunk sewer employing PCSWMM 2013 software and SWMM engine 5.0.022. The model used the following assumptions:

1. Detailed physical characteristics of the NFIR acquired from the City of Dublin sewer records and GIS. The information includes sewer invert elevation, top-of-casting elevation, sewer diameter, sewer slopes, and sewer offsets.
2. Flow estimates for dry and wet weather flow are based on land use, acreage, house counts, per capita wastewater allowance 100 gal/day, diurnal hourly variations during the day, and Infiltration/Inflow (I/I) rates using flow monitoring data.
3. Future development for the Riviera property: 160 acre, 6.0 units per acre, 2.8 people per unit, for an estimated population of 2,688 people.
4. Average Dry Weather Flow from the Riviera property is estimated at 0.415 cfs which was varied in the model to consider diurnal hourly variations.

Sewer model scenarios were developed to perform the following tasks:

1. Calibrate the sewer model to observed flow data to improve model accuracy.
2. Evaluate the capacity of the NFIR at Build-out conditions including proposed development at the Riviera Property and identify locations and causes of sewer capacity deficiency.
3. Propose alternatives to eliminate identified deficiency (if any).

Table 3 is a summary of the model scenarios for the NFIR illustrating the purpose of each scenario, rainfall used to generate wet weather flow as a Level-of-Service, and a brief description of the model component. Model calibration scenario represents current condition (2013), which does not include the Riviera development while the Build-out conditions include the Riviera development.

Table 3: Summary of Model Scenarios for the NFIR Sub-trunk Sewer

	Purpose	Scenario	Rainfall	Comments
1	Model Calibration	Current conditions	Historical	Continuous simulation between 03/7/2013 thru 4/29/2013 (53 days duration). Use current tributary area and current I/I
2	Capacity deficiency ID assume Build-out including Riviera with NO improvements	Build-out including Riviera property	Design storm, 25-yr, 6-hr	Event model: Ultimate tributary area with no improvements

	Purpose	Scenario	Rainfall	Comments
3	Alternative Analysis assuming build-out including Riviera property	Alternative 1: Replace and up-size	Design storm, 25-yr, 6-hr	Replace and upsize deficient capacity sewer segments for the NFIR
4		Alternative 2: Express relief sewer	Design storm, 25-yr, 6-hr	Augmentation Express relief sewer at the same grade as NFIR to relief excess flow above the capacity of the trunk sewer
5		Alternative 3: parallel relief sewer	Design storm, 25-yr, 6-hr	Augmentation Parallel relief sewer 1-ft above existing sewer to convey excess flow above the capacity of the trunk sewer
6		Alternative 4: In-line storage	Design storm, 25-yr, 6-hr	In-line Storage to shave peak flow and release stored flow to the NFIR after water drops in the trunk sewer

5.1. Model Calibration:

Figure 3 is a graphical comparison between model results (computed) and recorded flow data at flow meter FM1 (MH# 2515) for dry and wet weather flow. The illustration is for a selected period pulled from the continuous simulation to demonstrate the largest response during the monitoring period (March 18, 2013). Table 4 lists computed and observed peak flow and corresponding difference. For more detailed comparison of the other flow meters, refer to the digital sewer model in the attached CD using PCSWMM.

Table 4: Computed and Observed Peak Flow at Monitored Locations

Flow meter ID	Peak flow		Difference
	Computed	Observed	
	cfs	cfs	%
FM1	6.55	6.42	2.0 %
FM2	3.43	3.90	12.0 %
FM3	0.71	0.65	7.6 %
FM4	0.85	0.82	4.0 %

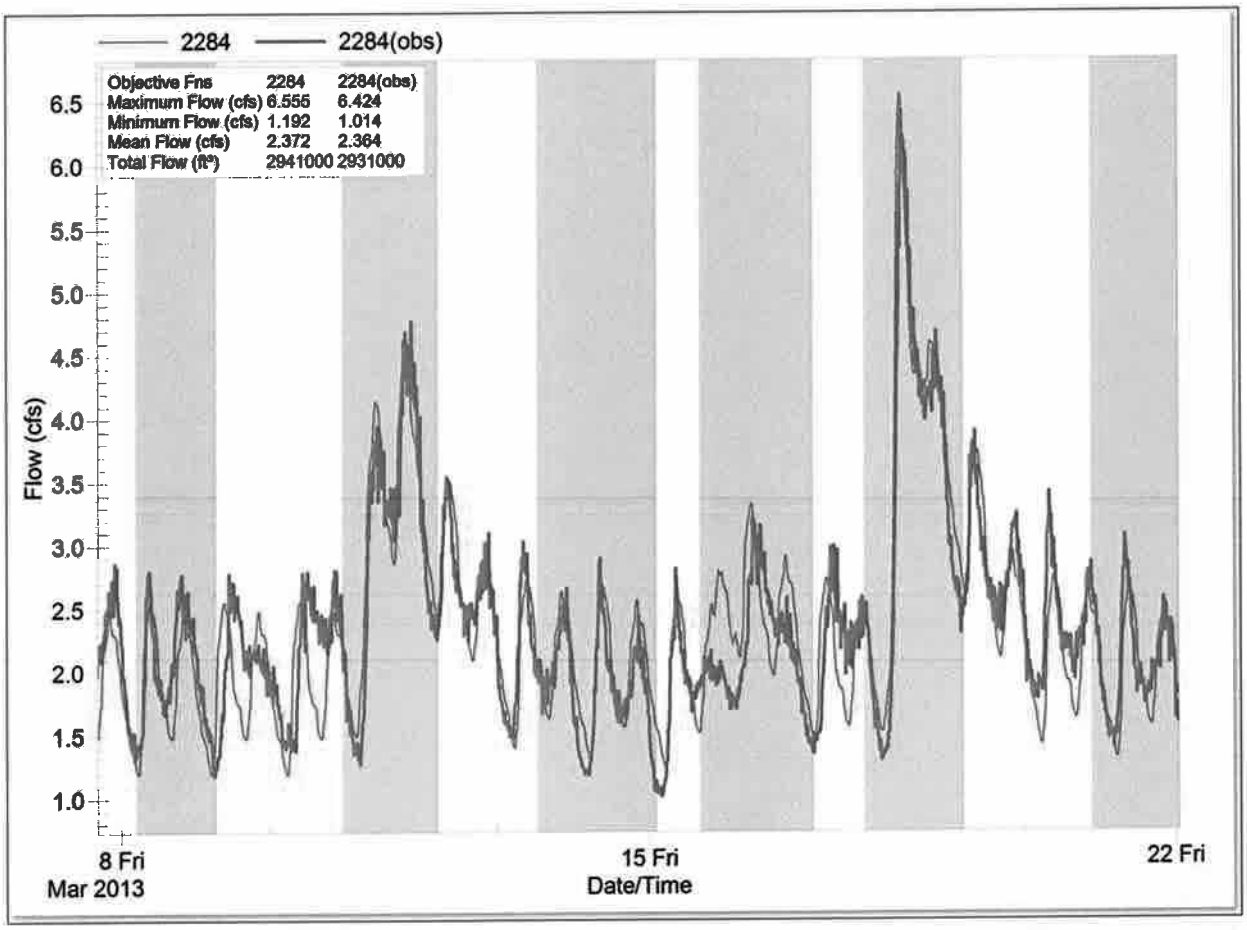

Figure 3: Comparison between Computed and Recorded Flow Data at FM1

5.2. Capacity Analysis:

Capacity analysis for the NFIR was performed with and without future development. For both cases, it is assumed a level-of-service using 25-yr, 6-hr design storm to generate wet weather flow.

5.2.1. Capacity analysis without Future Development:

Exhibit 3 illustrates a summary of findings after running the existing conditions model for the NFIR sub-trunk sewer

1. Segment 1: Adequate capacity is predicted in the sewer segments from the north end of NFIR at Mckitrick Rd (MH# 5562) until the intersection of Earlington/DublinShire (MH# 2121) near Brandon Woode Park.

2. Segment 2: Inadequate capacity in this Segment between MH# 2121 and MH# 2517 due to limited capacity at the 24-inch sewer section at 0.38% slope. The estimated peak flow using 25-yr, 6-hr is 14.8 cfs (9.5 MGD) while the capacity of the trunk sewer is 11 cfs (7 MGD). MH# 2496 is predicted to overflow at 25-yr, 6-hr and surcharge at 1-yr, 6-hr. MH # 2496 is located at the intersection of the NFIR and I-270. See Figure 4.

3. Segment 3: Adequate capacity is available in sewer segments between MH#2517 and the sub-trunk sewer outfall at Dublin Rd. The identified adequate capacity is due to 38-ft drop in elevation from 827.00 to 789.00. The receiving sewer is 36-inch at 0.74% slope.

Figure 5 is a longitudinal hydraulic profile of the NFIR illustrating sewer invert, sewer crown, top-of-casting, and estimated maximum hydraulic grade line using the 25-yr design storm. Potential overflow is predicted at manholes located at low elevations.

5.2.2. Capacity analysis with Future Development (No Improvements):

The following assumptions were used in the analysis

1. Build-out conditions of possible developable land tributary area to the NFIR including possible development of the Riviera.
2. Model parameters for build-out are acquired from the calibrated model at current conditions assuming no change in I/I parameters.
3. Level-of-service at 25-yr, 6-hr design storm to generate wet weather flow

Since overflow is predicted at existing conditions for the 25-yr, 6-hr level-of-service; additional flow due to future development will make it a worse situation and mitigations are needed regardless of the future development.

Figure 4: Identified Manhole with Potential Overflow under I-270

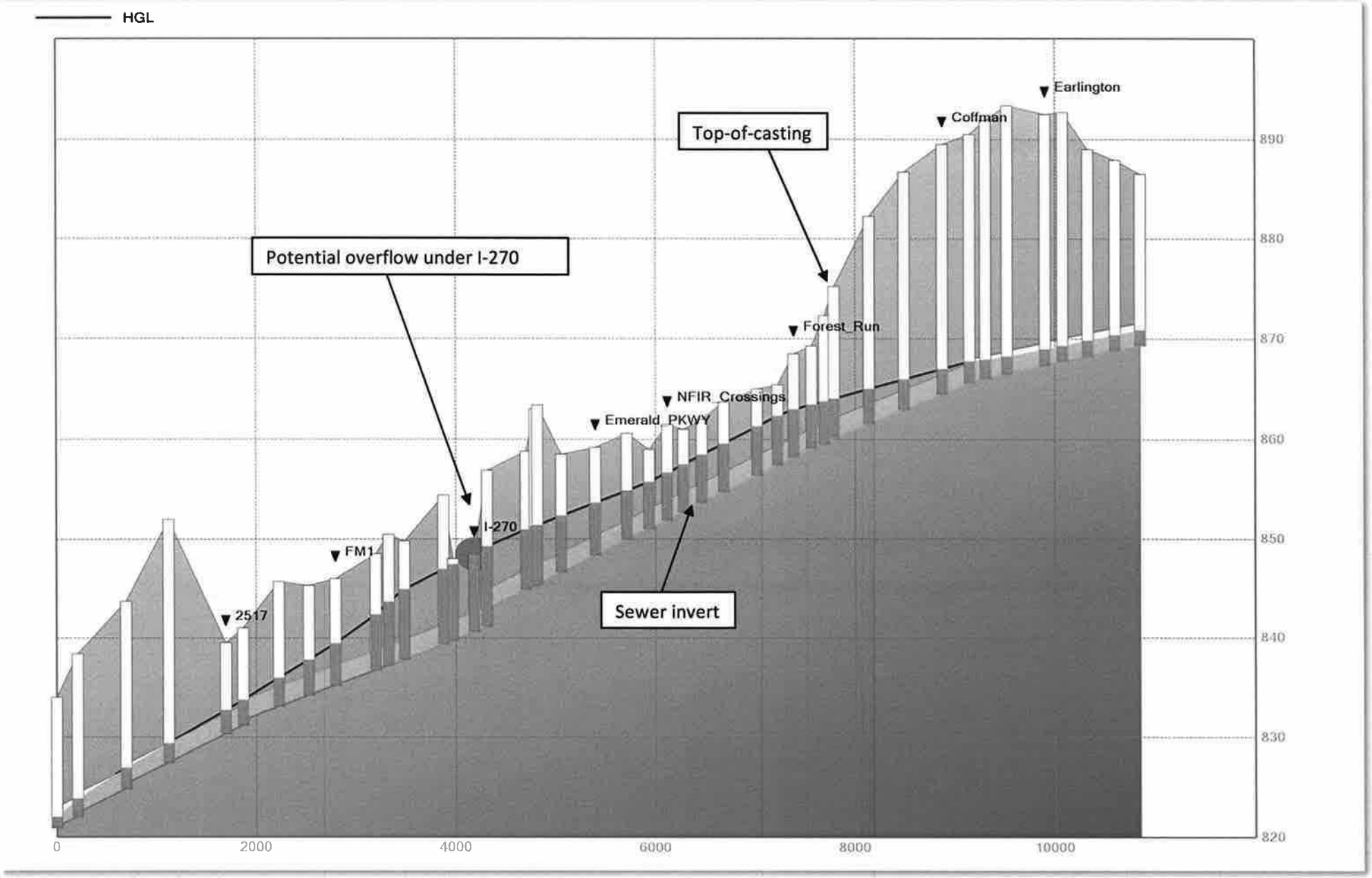

Figure 5: Hydraulic Profile of the NFIR at Existing Conditions using 25-yr, 6-hr storm

5.3. Alternative Analysis

Four technologies are considered viable to alleviate identified capacity deficiency for the NFIR as follows:

1. Replace and Up-size
2. Augmentation Express sewer
3. Augmentation Parallel Relief
4. In-line Storage

Source control (i.e., I/I reduction) was not considered in this analysis due to lack of data for its effectiveness. The City of Dublin is currently implementing a lining program for several sewer segments and assessing its effectiveness in flow reduction. Solid results require a holistic approach to address both public and private sources. At the time of writing this memo, effectiveness of the lining program is under evaluation.

5.3.1. Alternative 1: Replace and Up-size:

This alternative proposes to replace and upsize deficient capacity sewer segments. The proposed improvement would increase the capacity of sewer segments from MH# 2521 to MH# 2512. Table 5 lists proposed improvement and potential increase in capacity. Potential overflows are eliminated due to increase in sewer capacity from 13.9 cfs to 25.00 cfs. Figure 6 illustrates location of the proposed improvements.

5.3.2. Alternatives 2: Augmentation Express Sewer:

This alternative proposes construction of an **Express Sewer** to relief deficient capacity segments. The Express Sewer to be laid at the same grade as the existing sub-trunk sewer. The new sewer will receive excess discharges above the capacity of the existing sewer and release it into the downstream segments of the NFIR where extra capacity is available. Exact alignment is not dot determined at this stage but can be flexible depending on easement availability. The augmentation express sewer would be 18-inch diameter, 1,935-ft long; at slope 0.5-0.3% (Figure 7).

5.3.3. Alternative 3: Augmentation Parallel Relief

This alternative proposes to install a Parallel relief sewer above the existing sewer. The invert of the Parallel Sewer would be offset 1-ft higher than the NFIR sub-trunk sewer crown. The proposed relief sewer would be 18-inch laid at a slope similar to the existing sub-trunk sewer from MH# 2521 to MH# 2512. The estimated length is 2,038-ft. The relief sewer will receive excess flow above the capacity of the NFIR during wet weather flow (Figure 8).

5.3.4. Alternative 4: In-line Storage

This alternative proposes construction of in-line storage by removing 1,000-ft of the existing sewer and installing a large diameter sewer. The in-line sewer will store excess

flow above the capacity of the NFIR during wet weather flow and release it gradually. The proposed in-line sewer would be 60-inch to replace and be laid at the same slope as the existing sub-trunk sewer from MH# 2521 to MH# 2510. The estimated length is 1,000-ft (Figure 9).

Table 6 is a summary of the proposed alternatives

Table 5: Proposed Alternatives to Improve the Performance of the NFIR to Alleviate Capacity Deficiency

Alternative	Length	Manhole		Sewer Size		Sewer Slope		Capacity	
		From	To	From	To	From	To	From	To
	ft	#	#	inch	inch	%	%	cfs	cfs
1: Replace and Up-size	2,038	2521	2512	24	30	0.38 %	0.38 %	13.90	25.00
2: Express Sewer	1,935	2521	2512	N/A	18	N/A	0.5-0.3 %	N/A	8.1
3: Parallel Sewer	2,038	2521	2512	N/A	18	N/A	0.38%	N/A	6.4
4: In-line storage	1,000	2513	2511	24	60	0.30 %	0.30 %	12.3	14.2

Figure 6: Alternative 1 Replace and Upsize

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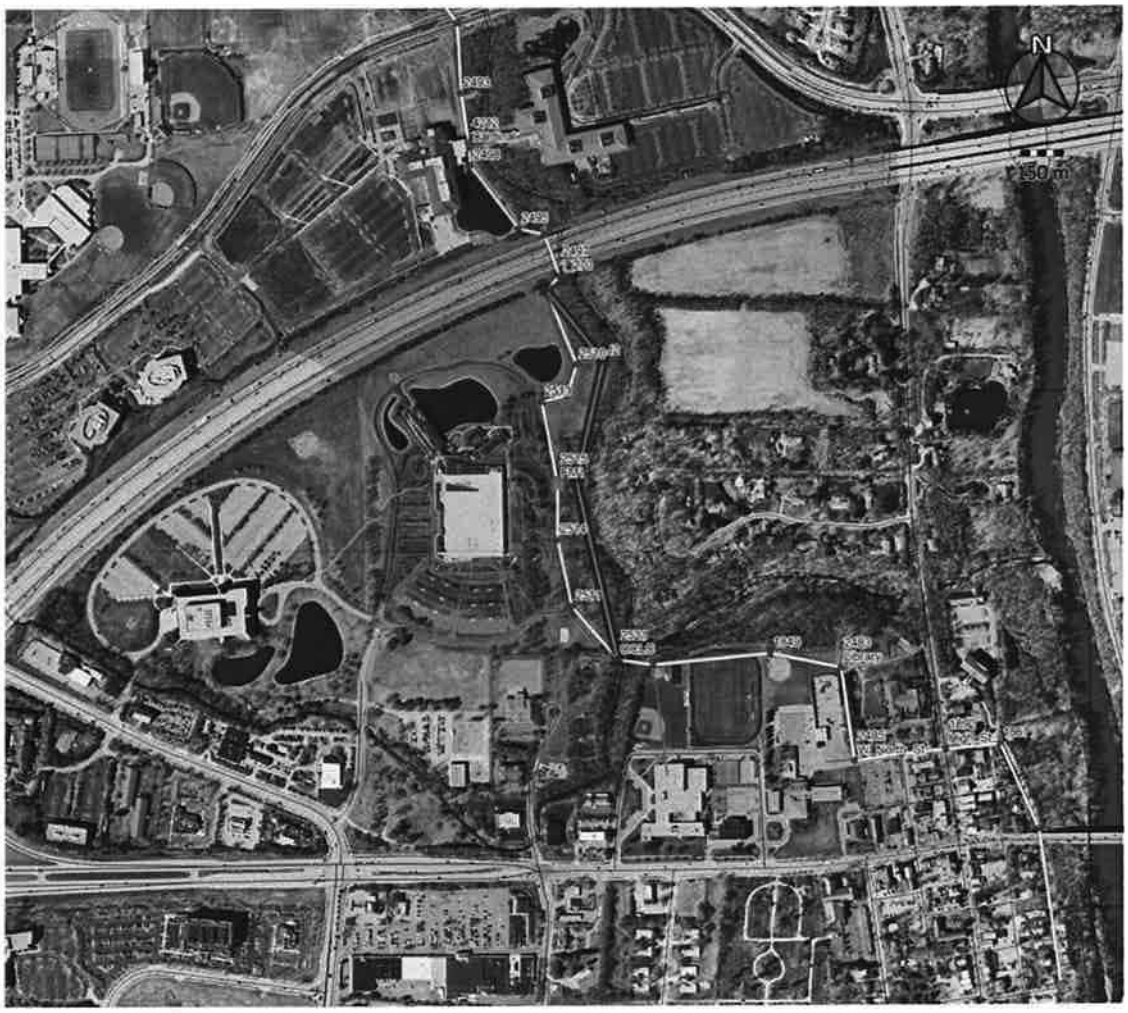

Figure 7: Alternative 2, Augmentation Express Sewer

Figure 8: Alternative 3, Augmentation Parallel Relief Sewer

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Figure 9: Alternative 4, In-Line Storage

5.4. Cost Estimates

Table 6 is a summary of cost estimates for the proposed alternatives to alleviate capacity deficiency for the North Fork Indian Run sub-trunk sewer. Due to the nature of the capacity problem in the trunk sewer, the solution has to be constructed at once and cannot be constructed on phases. Table 7 is a comparison between the proposed alternatives illustrating advantages and disadvantage for each option. Appendix B includes a detailed breakdown of the cost estimates for reference purposes.

Table 6: Proposed Alternatives and Summary of Cost Estimates of Each Alternative

	Alternative	Description	Cost
Alternative 1	Replace and Upsize deficient capacity sewer segments	Replace 2,038-ft from 24-in to 30-in;	$480,400
Alternative 2	Augmentation Express Sewer. Relief sewer with new alignment	Relief sewer 1,935-ft of 18-in;	$530,700
Alternative 3	Augmentation Parallel Relief Sewer, 1-ft above existing sewer	Relief sewer 2,038-ft of 18-in;	$359,000
Alternative 4	Inline Storage, replace existing sewer with a large diameter	In-line storage, 1,000-ft of 60-in;	$542,900

Table 7: Comparison Between Identified Alternatives to Alleviate Capacity Deficiency for the NFIR Trunk Sewer

	Alternative	Advantage	Disadvantage	Cost
1	Replace and Upsize	• Limits disturbance to the existing trench location • No need to purchase easements	• Disrupts existing sanitary sewer service which requires bypass pumping. • Construction process will be slower with replacing and installing new pipe.	$480,400
2	Augmentation Express Sewer	• Existing sanitary sewer remains in service during construction	• Most amount of disturbance • Potential for rock excavation in new trench. • Purchase of new easements	$530,700
3	Augmentation Parallel Relief	• Existing sanitary sewer remains in service during construction • Limits disturbance to the existing trench location	• Potential to damage existing sanitary sewer during construction.	$359,000

	Alternative	Advantage	Disadvantage	Cost
4	In-line Storage	• Least amount of disturbance compared to the other alternatives • Limits disturbance to the existing trench location	• Disrupts existing sanitary sewer service and requires bypass pumping • High material price for 60-inch pipe	$542,900

5.5. Recommendations

The North Fork Indian Run sanitary trunk sewer currently (2013) experiences capacity deficiency during wet weather conditions using a level-of-service at 25-yr, 6-hr storm. This is due high levels of Infiltration/Inflow (I/I) from areas with leaky joints and manholes and limited capacity in the 24-inch sewer at 0.38%. The estimated peak flow using 25-yr, 6-hr is 14.8 cfs (9.5 MGD) while the capacity of the trunk sewer is 11 cfs (7 MGD). MH# 2496 is predicted to overflow at 25-yr, 6-hr and surcharge at 1-yr, 6-hr. MH # 2496 is located at the intersection of the NFIR and I-270.

The City of Dublin is conducting a sewer lining program and assessing results for source control before and after the lining. Solid results require a holistic approach to address both public and private sources. At the time of writing this memo, effectiveness of the lining program is under evaluation.

There is a current need to alleviate the capacity deficiency for the North Fork Indian Run at the southern segment of the trunk sewer especially with proposed development for the Riviera property which will generate additional discharges in the trunk sewer.

Four (4) alternatives were explored using a dynamic hydraulic model to simulate performance of the trunk sewer with and without future development as follows:

1. Replace and Up-size, 2,038-ft from 24-in to 30-in; $480,400
2. Augmentation Express sewer, 1,935-ft of 18-in; $530,700
3. Augmentation Parallel Relief, 2,038-ft of 18-in; $359,000
4. In-line Storage, 1,000-ft of 60-in, $542,900

All alternatives would alleviate the capacity deficiency for the trunk sewer. Table 6 &7 are summaries and comparison between the identified alternatives.

Alternative 3 (augmentation parallel relief sewer) is recommended to be laid at the same alignment of the existing sewer at1-ft above the sewer crown. The relief sewer will receive excess flow above the capacity of the NFIR during wet weather. This alternative has the most advantages among the other options due to the following:

1. Least construction cost
2. No need to purchase easements
3. Potential rock excavation is eliminated
4. Limits disturbance to existing trench location
5. Existing sanitary sewer remains in service during construction

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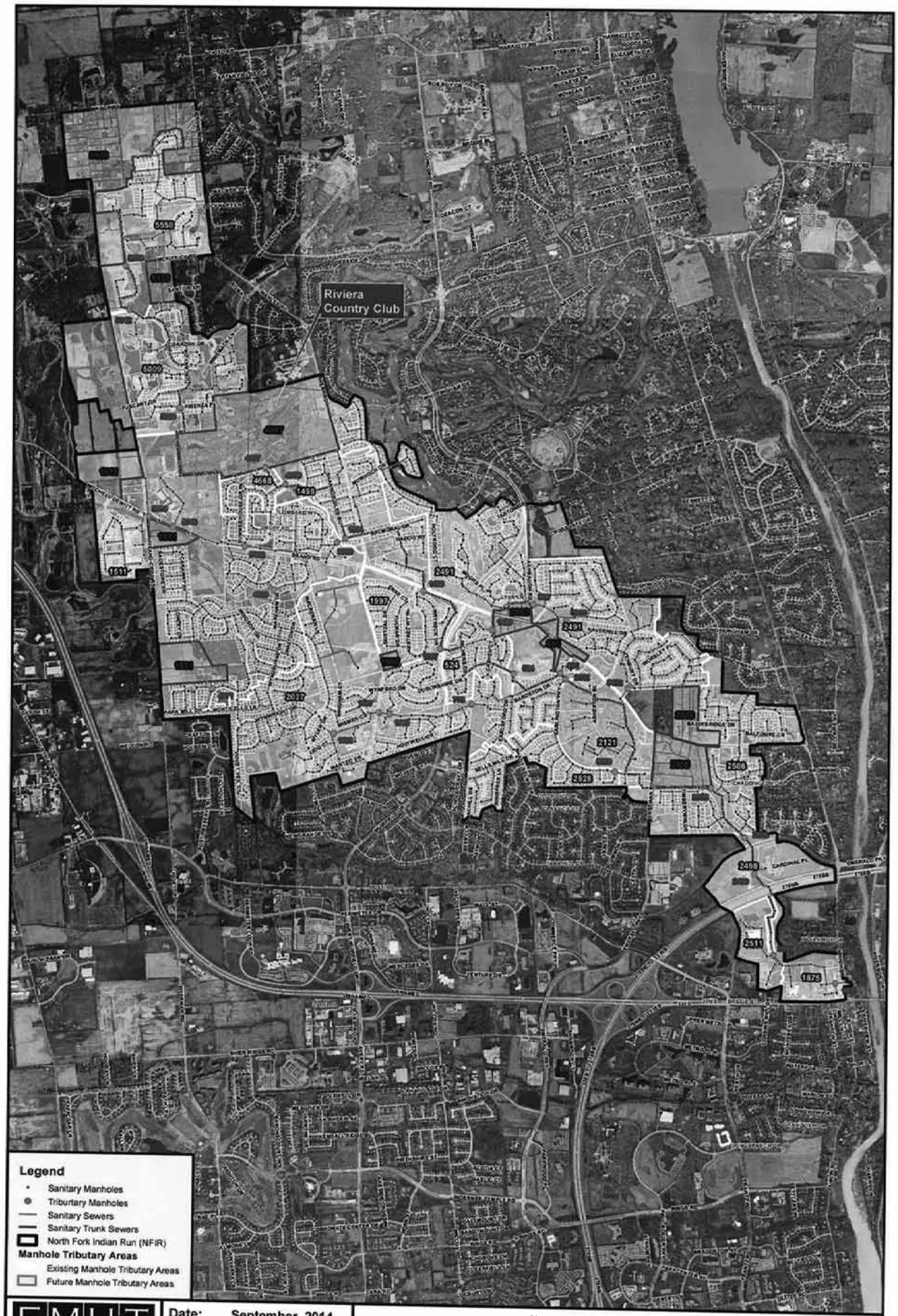

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CITY OF DUBLIN, FRANKLIN COUNTY, OHIO

North Fork Indian Run Sub-Trunk Sewer
Current & Build-Out Tributary Areas
Exhibit 1

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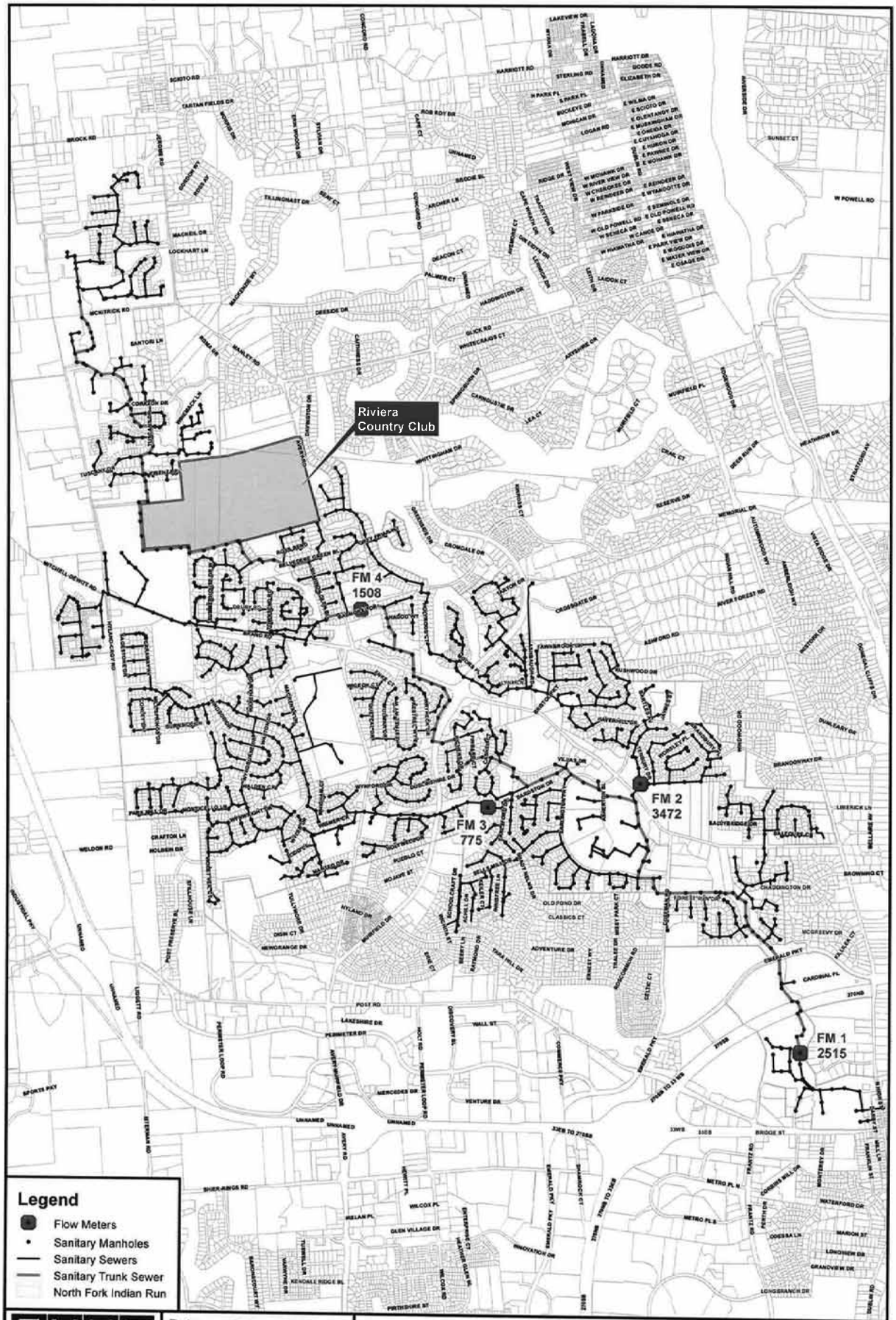

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CITY OF DUBLIN, FRANKLIN COUNTY, OHIO

North Fork Indian Run Sub-Trunk Sewer
Installed Flow Meter Locations
Exhibit 2

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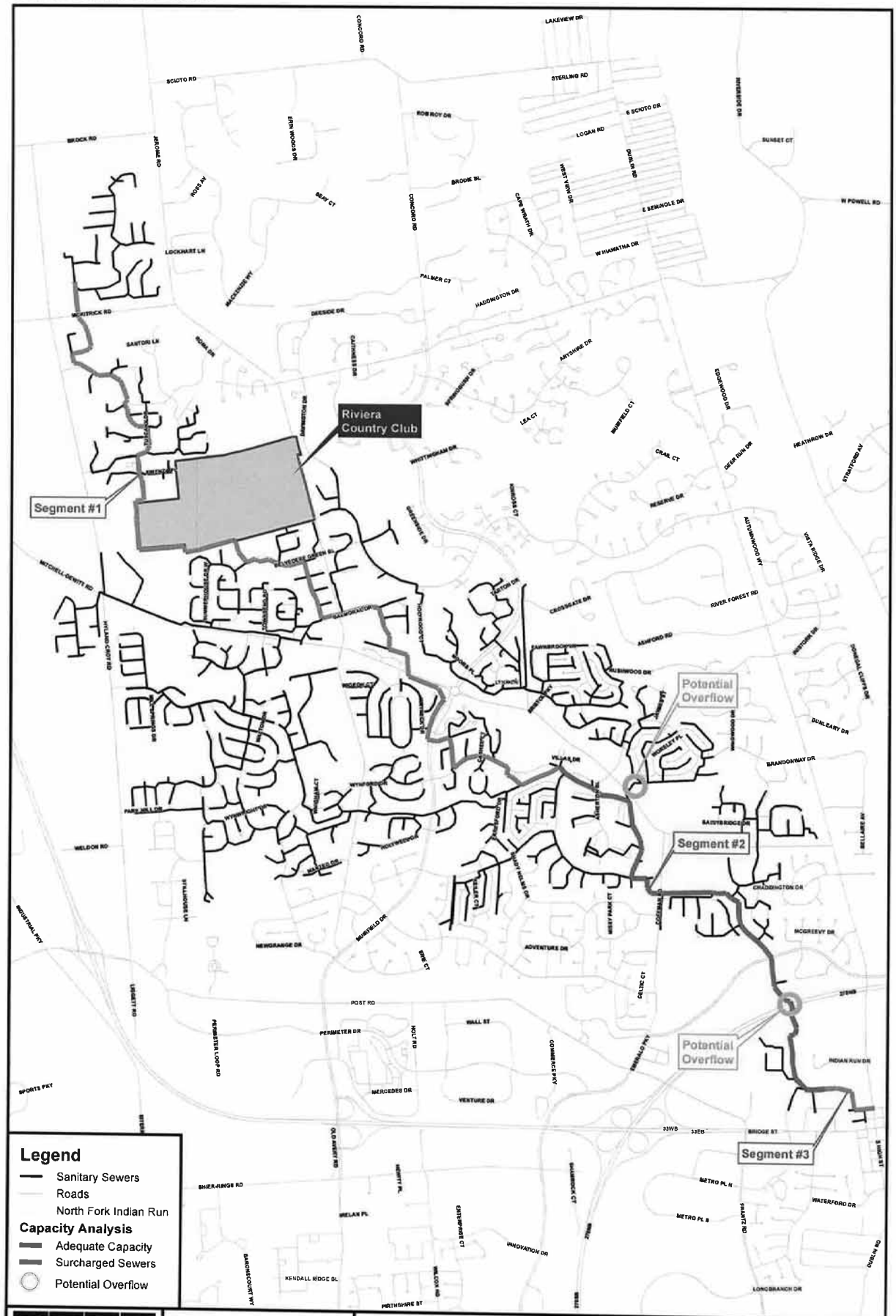

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Job No.: 2013-0326

CITY OF DUBLIN, FRANKLIN COUNTY, OHIO
North Fork Indian Run Sub-Trunk Sewer
Capacity Exhibit
Exhibit 3

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Appendix A

Flow Monitoring Program

Table A-1: Installed Flow Meters in the North Fork Indian Run Sub-Trunk Sewer

Flow meter	MH ID	Sewer size	Installation water depth	From / To	Picture of Installation
FM1	2515	24-inch	9.5-inch	3/7/2013 – 4/29/2013	
FM2	3472	15-inch	5.5-inch	3/7/2013 – 4/29/2013	
FM3	775	18-inch	2.5-inch	3/7/2013- 4/29/2013	
FM4	1508	24-inch	3.5-inch	3/7/2013- 4/29/2013	

Appendix B

Opinion of Probable Construction Cost

OPINION OF PROBABLE CONSTRUCTION COST

City of Dublin

20130326 - North Fork Indian Run

Alternative 1

Replace 24" & Upsize 30"

9/16/2014

Ref	Spec	Item No.	Description	Quantity	Units	Unit Cost	Item Cost
		201	Clearing and grubbing	1	L.S.	$1,500.00	$1,500.00
		202	Remove existing 24" sanitary sewer	2038	L.F.	$24.87	$50,685.06
		202	Remove existing sanitary sewer manhole	6	Each	$556.50	$3,339.00
		207	Construction entrance	1	Each	$679.80	$679.80
		207	Filter fabric fence	2100	L.F.	$2.68	$5,628.00
		207	Inlet protection (sanitary manholes)	10	Each	$68.26	$682.60
		207	Temporary seeding	4530	S.Y.	$0.93	$4,212.90
		503	Cofferdams and excavation bracing	1	L.S.	$10,000.00	$10,000.00
		604	Sanitary Manhole, Type C	6	L.F.	$1,995.63	$11,973.78
		614	Maintaining traffic	1	L.S.	$3,000.00	$3,000.00
		624	Mobilization	1	L.S.	$10,000.00	$10,000.00
		659	Seeding and mulcing	4530	S.Y.	$1.39	$6,296.70
		901	30" pipe with Type I bedding	2038	L.F.	$120.00	$244,560.00
		Spec	Core existing manhole	2	Each	$1,000.00	$2,000.00
		Spec	Reinstall flow meter	1	Each	$1,000.00	$1,000.00
		Spec	Sanitary diversion during replacement (pumping)	1	L.S.	$10,000.00	$10,000.00
							$0.00
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*DENOTES CONTINGENCY ITEM

SUBTOTAL =	**$365,600.00**
Engineering	**$60,000.00**
CONTINGENCY (15%) =	$54,800.00
OPINION OF PROBABLE CONSTRUCTION COST =	**$480,400.00**

OPINION OF PROBABLE CONSTRUCTION COST
City of Dublin
20130326 - North Fork Indian Run
Alternative 2
Augmentation Express Sewer
9/16/2014

Ref	Spec	Item No.	Description	Quantity	Units	Unit Cost	Item Cost
		201	Clearing and grubbing	1	L.S.	$5,000.00	$5,000.00
		207	Construction entrance	1	Each	$679.80	$679.80
		207	Filter fabric fence	2100	L.F.	$2.68	$5,628.00
		207	Inlet protection (sanitary manholes)	10	Each	$68.26	$682.60
		207	Temporary seeding	4300	S.Y.	$0.98	$4,214.00
		503	Cofferdams and excavation bracing	1	L.S.	$10,000.00	$10,000.00
		503	Rock excavation (min. trench width, 10' depth)	2400	C.Y.	$65.78	$157,872.00
		604	Sanitary manhole, Type C	6	Each	$2,292.78	$13,756.68
		624	Mobilization	1	L.S.	$10,000.00	$10,000.00
		659	Seeding and mulcing	4300	S.Y.	$1.39	$5,977.00
		901	18" pipe with Type I bedding	1935	L.F.	$100.00	$193,500.00
		Spec	Core existing manhole	2	Each	$1,000.00	$2,000.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00

*DENOTES CONTINGENCY ITEM

SUBTOTAL =	**$409,300.00**
Engineering	**$60,000.00**
CONTINGENCY (15%) =	$61,400.00
OPINION OF PROBABLE CONSTRUCTION COST =	**$530,700.00**

OPINION OF PROBABLE CONSTRUCTION COST

City of Dublin
20130326 - North Fork Indian Run
Alternative 3
Augmentation Parallel Relief
9/16/2014

Ref	Spec	Item No.	Description	Quantity	Units	Unit Cost	Item Cost
		201	Clearing and grubbing	1	L.S.	$1,500.00	$1,500.00
		207	Construction entrance	1	Each	$679.80	$679.80
		207	Filter fabric fence	2100	L.F.	$2.68	$5,628.00
		207	Inlet protection	10	Each	$68.26	$682.60
		207	Temporary seeding	4530	S.Y.	$0.98	$4,439.40
		503	Cofferdams and excavation bracing	1	L.S.	$10,000.00	$10,000.00
		614	Maintaining traffic	1	L.S.	$3,000.00	$3,000.00
		624	Mobilization	1	L.S.	$10,000.00	$10,000.00
		659	Seeding and mulching	4530	S.Y.	$1.39	$6,296.70
		901	18" pipe with Type I bedding	2038	L.F.	$100.00	$203,800.00
		Spec	Core existing manhole	14	Each	$1,000.00	$14,000.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00

*DENOTES CONTINGENCY ITEM

SUBTOTAL =	**$260,000.00**
Engineering	**$60,000.00**
CONTINGENCY (15%) =	$39,000.00
OPINION OF PROBABLE CONSTRUCTION COST =	**$359,000.00**

OPINION OF PROBABLE CONSTRUCTION COST
City of Dublin
20130326 - North Fork Indian Run
Alternative 4
In-Line Storage
9/16/2014

Ref	Spec	Item No.	Description	Quantity	Units	Unit Cost	Item Cost
		201	Clearing and grubbing	1	L.S.	$1,500.00	$1,500.00
		202	Remove existing 24" sanitary sewer	1000	L.F.	$25.00	$25,000.00
		202	Remove existing sanitary manhole	2	Each	$566.50	$1,133.00
		207	Construction entrance	1	S.Y.	$6.00	$6.00
		207	Filter fabric fence	2100	L.F.	$3.00	$6,300.00
		207	Inlet protection (sanitary manholes)	10	Each	$70.00	$700.00
		207	Temporary seeding	2230	S.Y.	$0.98	$2,185.40
		503	Cofferdams and excavation bracing	1	Each	$5,000.00	$5,000.00
		604	Sanitary Manhole, Type C	2	Each	$1,995.63	$3,991.26
		614	Maintaining traffic	1	L.S.	$3,000.00	$3,000.00
		624	Mobilization	1	L.S.	$10,000.00	$10,000.00
		659	Seeding and mulching	2230	S.Y.	$1.39	$3,099.70
		901	60" pipe with Type I bedding	1000	L.F.	$350.00	$350,000.00
		Spec.	Core existing manhole	2	Each	$1,000.00	$2,000.00
		Spec.	Reinstall flow meter	1	Each	$1,000.00	$1,000.00
		Spec.	Sanitary diversion during replacement (pumping)	1	L.S.	$5,000.00	$5,000.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00
							$0.00

*DENOTES CONTINGENCY ITEM

SUBTOTAL =	**$419,900.00**
Engineering	**$60,000.00**
CONTINGENCY (15%) =	$63,000.00
OPINION OF PROBABLE CONSTRUCTION COST =	**$542,900.00**