



CITY OF LAKE FOREST PARK CITY COUNCIL WORK SESSION

Thursday, May 11, 2023 at 6:00 PM

Meeting Location: In Person and Virtual / Zoom
17425 Ballinger Way NE Lake Forest Park, WA 98155

INSTRUCTIONS FOR PARTICIPATING IN THIS MEETING VIRTUALLY:

Please note, this link works for both the Work Session (6:00 p.m.) and Regular Meeting (7:00 p.m.).

Join Zoom Webinar: <https://us06web.zoom.us/j/81208922305>
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Public Comment is not taken during the Work Session.

As allowed by law, the Council may add items not listed on the agenda.
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Meetings are shown on the city's website and on Comcast channel 21 for subscribers within the Lake Forest Park city limits.

AGENDA

1. CALL TO ORDER: 6:00 PM

2. ADOPTION OF AGENDA

3. COUNCIL DISCUSSION TOPICS

- A.** 35th Avenue NE drainage remediation options
- B.** Review of Capital Improvement Plan Pavement Resurfacing Plan

4. ADJOURN

FUTURE SCHEDULE

- Thursday, May 18, 2023 City Council Budget and Finance Committee Meeting 6 pm – *hybrid meeting (Zoom and City Hall)*
- Monday, May 22, 2023 City Council Committee of the Whole Meeting 6 pm – *hybrid meeting (Zoom and City Hall)*
- Thursday, May 25, 2023 City Council Regular Meeting 7 pm – *hybrid meeting (Zoom and City Hall)*
- Monday, May 29, 2023 City Offices Closed in Observance of Memorial Day

Any person requiring a disability accommodation should contact city hall at 206-368-5440 by 4:00 p.m. on the day of the meeting for more information.

TECHNICAL MEMORANDUM

TO: ANDREW SILVIA, P.E.
FROM: KERRI SIDEBOTTOM, P.E.
ROGER KUYKENDALL, P.E.
DATE: APRIL 20, 2023
SUBJECT: 35TH AVENUE DRAINAGE
CITY OF LAKE FOREST PARK,
KING COUNTY, WASHINGTON
G&O #22462.00

EXECUTIVE SUMMARY

An existing stormwater outfall (“middle outfall”) located at 16518 35th Avenue NE discharges runoff onto private property into the head of a steep, incised ravine. The conveyance piping is damaged and undersized for the estimated flows. In addition, the outfall manhole is severely undermined and at risk of falling into the ravine. Two alternative outfall locations have been identified to the north and south of the existing outfall, both of which discharge to the same surface waterbody (Sheridan Creek). The north alignment alternative would impact several private properties and is anticipated to have greater construction challenges. The south alignment alternative collects and conveys runoff from additional areas and can be constructed within the existing right-of-way and a small easement area at the outfall, but requires a longer length of new piping and larger pipe sizes. Replacing the existing outfall would be the least expensive, but it too has challenges.

This Memo provides information regarding our analysis of alternatives to correct the drainage deficiencies in the area, and assesses the feasibility and costs of those alternatives. The four following alternatives are to be considered.

1. Replacing the existing drainage system that conveys runoff from 35th Avenue NE to the middle outfall, and extending the middle outfall pipe to the bottom of the steep ravine to reduce erosion.
2. Diverting all of the runoff tributary to the middle outfall to the north outfall. This option includes abandoning the middle outfall.
3. Diverting all of the runoff tributary to the middle outfall to the south outfall. This option includes abandoning the middle outfall.



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4. Diverting a portion of the runoff tributary to the middle outfall to the south outfall and replacing and extending the middle outfall pipe to the bottom of the steep ravine to reduce erosion.

Water quality treatment for stormwater runoff is not currently provided within the basin. Two levels of treatment are reviewed in this Memo; treatment of runoff from the entire tributary basin, and treatment of runoff from road areas along the alternative alignment only. Runoff treatment could be provided as part of the Project but is not required from a regulatory standpoint.

Table 1 summarizes the estimated planning-level construction cost of the alternatives with the addition of either of the two treatment options.

TABLE 1

Summary of Estimated Construction Costs

Alternative	Conveyance Alone	Conveyance and Full Basin Treatment	Conveyance and Road Treatment
1 – Replace Middle Outfall	\$357,000	\$921,000	\$436,000
2 – Diversion to North Outfall	\$910,000	\$1,474,000	\$989,000
3 – Diversion to South Outfall	\$822,000	\$1,417,000	\$910,000
4 – Hybrid/Partial Diversion to South Outfall and Replace Middle Outfall	\$796,000	\$1,391,000	\$884,000

Replacing the existing conveyance system serving the middle outfall is the alternative with the least cost and is recommended; however, this alternative requires both temporary and permanent easements to be acquired and has construction access challenges. Similar challenges exist for the hybrid alternative, albeit at a lesser extent, and is the second choice. Diversion to the south outfall has the highest cost and would cause the greatest temporary disruption to the public and is the third choice. Access challenges, easement requirements for three separate properties, and significant construction impacts associated with the second option (diversion to the north outfall), are the most onerous and make that option the highest risk and is not recommended.

BACKGROUND

The City of Lake Forest Park has contracted with Gray & Osborne to investigate drainage system problems in the Sheridan Heights neighborhood. The study area lies west of



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Bothell Way NE, also known as State Route 522 (SR 522), on a hill overlooking Lake Washington (see Figure 1). This residential area generally drains to the north and west, discharging into a tributary to McAleer Creek, commonly known as Sheridan Creek. Discharge into the creek occurs in three locations; the north, the middle, and the south outfalls.

- The north conveyance system drains a very small drainage basin (1.44 acres) located north of NE 166th Place and conveys runoff east from 35th Avenue NE to the creek via 10-inch and 12-inch pipes that cross three private properties. There are no known problems with the 10-inch outfall pipe.
- The middle conveyance system drains a large basin (36.29 acres) located west of 35th Avenue NE, from NE 166th Street to NE 158th Street. Runoff is conveyed north and south along 35th Avenue NE within ditches and 12-inch pipes to an existing manhole located on the west side of the street. From this manhole, runoff is conveyed east across the street through 12-inch pipes, and through private property (16518 35th Avenue NE). The pipe is routed around the existing house and discharges onto the top of a steep slope, into a ravine near the rear property line. The ravine conveys runoff down to the creek through an adjacent property (16512 35th Avenue NE). The existing outfall manhole (due to erosion and a small landslide that occurred in 2021), is poorly supported by the underlying soils and is at risk of falling into the ravine (see photos at the end of the Memo). In addition, it is suspected that the 12-inch conveyance system through the property is insufficient to convey extreme peak runoff flows.
- The south conveyance system drains a small basin (10.28 acres) located between 35th Avenue NE and 36th Avenue NE, and north of NE 158th Street. The conveyance system consists of ditches and 12-inch pipes that convey runoff to the creek, discharging into the creek immediately south of NE 162nd Street, at the upstream end of a 24-inch culvert that conveys Sheridan Creek beneath the street. There are no known problems with this outfall.

The City seeks to replace the existing pipes serving the middle outfall, or redirect some or all of the stormwater runoff currently routed to the middle outfall, into a more suitable conveyance system to the other two outfalls.



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EXISTING CONDITIONS – MIDDLE OUTFALL

The middle outfall is located on private property at 16518 35th Avenue NE. Conveyance restrictions have caused flooding and ponding within the right-of-way. A closed-circuit television inspection of the pipe system in 2021 reveals that the existing pipe crossing beneath 35th Avenue NE is a 12-inch concrete pipe that is damaged in several locations. Generally, the joints are poorly assembled and large gaps (several inches) are evident in most. The horizontal alignment of the pipe appears straight; however, there are several significant grade changes that have contributed to the joint separations. In addition, there is a broken section in the top of the pipe that has been poorly repaired with rocks and concrete. If this conveyance component is to remain in service, it should be replaced.

The remainder of the pipe system consists of 4 storm drain manholes and 4 segments of 12-inch PVC pipe that is routed around the north side of the home. The last manhole has been undermined due to erosion and slope failure, leaving less than half the foundation support for the structure. The outfall pipe, only 5 feet in length, discharges runoff into the head of the ravine. The ravine runs east-west to the creek and varies in width and depth, up to 40 feet and 15 feet, respectively. The ravine is partially vegetated with shrubs and groundcover and several large trees have fallen in or across the ravine.

Peak Flow

An estimate of the peak flow to the middle outfall was determined using the Santa Barbara Unit Hydrograph (SBUH) method, which is a 24-hour, single-event runoff computation typically used for sizing conveyance systems. The SBUH method requires specific input data such as tributary area, land cover (and the associated curve numbers), time of concentration, and precipitation amounts for each storm event. All conveyance systems within the City are required to be designed to convey the 25-year peak runoff event.

Tributary Area

The basin and subbasins tributary to the middle outfall were delineated using a topographic survey and LiDAR topographic data for King County and the City's stormwater GIS data. Invert elevations, rim elevations, structure sizes, and other details are not included in the GIS data for the stormwater system in the Project vicinity. For any areas not included in the topographic survey, rim elevations were estimated based on the LiDAR surface elevations, and invert elevations for the existing pipes are assumed to be approximately 5 feet below grade. The middle basin was subdivided into 4 subbasins



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(Subbasin 1 through Subbasin 4). The basin and delineated tributary subbasins are indicated on Figure 1.

Land Cover

Table 2 includes the estimated land cover within the basin that is tributary to the middle outfall. The total basin area is approximately 36.29 acres. The designated zoning within the basin is residential R-7200, which results in a density of approximately six homes per acre. The zoning regulations allows a maximum impervious lot coverage of 45 percent, and a maximum roof area per lot of 35 percent. From aerial imagery, the approximate impervious coverage along the right-of-way within the basin is 66 percent, including the roadway, sidewalks, gravel shoulders, and driveway aprons. The *Stormwater Management Manual for Western Washington* (Ecology Manual) notes that a reasonable assumption of impervious land cover for this housing density is 52 percent. The estimated land cover based on the assumptions in Table 2 is 50.5 percent impervious, which is in line with the Ecology guidance, and was used for each of the subbasins to calculate the peak flow rates. Curve numbers for impervious surfaces (98) and pervious areas (86) are taken from the Ecology Manual, based upon the soil type(s) within the basin.

TABLE 2

Land Cover Tributary to Middle Outfall

Land Cover Type	Area (acres)	Assumption
Roof	9.39	Maximum 35 percent roof area per lot, as allowed by LFPMC, 18.22.050.
Driveway/Patio	2.68	Maximum 45 percent impervious coverage per lot, as allowed by LFPMC, 18.22.080.
Cleared/Lawn	14.76	55 percent of lot, per LFPMC, 18.22.080.
Impervious ROW	6.24	Assumes 66 percent of ROW is paved, driveway, gravel, or sidewalk.
Cleared ROW	3.22	Assumes 34 percent of ROW is landscaped/lawn.
Total	36.29	



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Time of Concentration

The time of concentration was determined for each of the subbasins, based on the length of the overland flow path (up to 300 feet), channelized surface flow path, and piped conveyance length to the outfall. The Manning Kinematic Equation for overland sheet flow, the Natural Resources Conservation Service (NRCS) method for shallow concentrated flow, and Manning's equation for closed pipe flow were used to calculate the overall time of concentration based on the land slope derived from topographic GIS data. Table 3 indicates the assumptions of the parameters used in the runoff flow calculation.

TABLE 3
Runoff Parameters

Parameter	Value	Notes
Pervious Area Curve Number	86	Applies to good-condition grassed area with underlying Type C soils.
Impervious Area Curve Number	98	Standard value.
2-Year Rainfall	1.6 inches	From Ecology Manual Volume III, Appendix III-A, Isopluvial Maps.
25-Year Rainfall	2.8 inches	From NOAA Atlas 2, Volume IX.
100-Year Rainfall	3.5 inches	From Ecology Manual Volume III, Appendix III-A, Isopluvial Maps.
Overland Flow Manning's Roughness	0.045	Applies to good-condition grassed area.
Piped Conveyance Manning's Roughness	0.013	Conservative value for plastic pipe, typical value for concrete pipe.

Peak runoff rates for each subbasin are estimated to determine conveyance deficiencies and potential replacement strategies. The estimated peak runoff for each subbasin as well as the subbasin areas and times of concentration for each subbasin are included in Table 4.



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TABLE 4
Middle Basin Peak Runoff

Subbasin	Total Area (acres)	Impervious Area (acres)	Pervious Area (acres)	Time of Concentration (minimum)	25-Year Peak Flow (cfs)
B1	8.11	4.10	4.01	12.4	3.92
B2	7.23	3.65	3.58	7.1	3.77
B3	9.10	4.60	4.50	12.9	4.37
B4	11.86	5.99	5.87	12.0	5.79
Total	36.29	19.23	17.06		17.85

The total 25-year peak flow to the middle outfall is estimated at 17.85 cfs.

Existing Conveyance Capacity

The City's GIS information indicates piped conveyance along 35th Avenue NE in the Project vicinity, with some ditches along the roadside. The GIS information indicates that the conveyance pipes in this location are all 12-inch in diameter, and are either CMP, concrete, or PVC. Field observations found that some pipes in this area are also CPEP. The middle outfall receives runoff from the 36.29-acre basin through a network of pipes and ditches along NE 163rd Street, NE 160th Street, NE 158th Street, 33rd Avenue NE, 34th Avenue NE, and 35th Avenue NE.

A topographic survey on 35th Avenue NE and the two parcels containing the middle outfall identified the system's manhole/catch basin rim and pipe invert elevations, and this data was used to calculate the slope and length of the existing pipes, and the capacity of each. Pipe slopes varied from about 6 percent to 36 percent. Manning's equation was used to determine the capacity of the existing pipes. Assuming a roughness coefficient value of 0.013, which is on the conservative side for plastic pipe, the capacity of the existing outfall system is less than the estimated 25-year flow to the outfall, as indicated in Table 5. Therefore, the conveyance from 35th Avenue NE to the middle outfall is undersized for the expected peak flow and that flooding within the right-of-way is possible during high-flow events.



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TABLE 5
Current Middle Outfall Pipe Deficiencies

Pipe Segment ID	Pipe Diameter (inches)	Capacity (cfs)	Deficiency for 25-Year Storm (cfs)
P1	12	8.70	9.15
P2	12	21.20	N/A ⁽¹⁾
P3	12	16.30	1.55
P4	12	18.82	N/A ⁽¹⁾
P5	12	13.17	4.68

(1) Pipe has sufficient capacity.

ALTERNATIVES

Four alternatives, described in the following analyses, were considered to either replace the existing middle outfall, or to divert runoff away from the middle outfall to the north and south outfalls. All alternatives involve challenges with respect to construction including potential utility conflicts, traffic control, space for equipment and materials storage, proximity to existing private improvements, land disturbance, and easement acquisitions. These constraints are discussed in more detail under each alternative.

Alternative 1 – Replace Middle Outfall

This alternative proposes to replace the pipes and structures of the middle outfall from 35th Avenue NE to the ravine, to convey the 25-year storm peak flow. See Figure 2 for the location of each pipe segment and Table 6 for the potential pipe layout.

TABLE 6
Replace Middle Outfall Conveyance Data

Pipe ID	From Structure ⁽¹⁾	To Structure ⁽¹⁾	Length (feet)	Diameter (inches)	Slope (ft/ft)	Pipe Capacity (cfs)	25-Year Flow (cfs)
P1	CB-0852	MMH1	48	18	0.061	25.9	17.85
P2	MMH1	MMH2	24	18	0.367	63.8	17.85
P3	MMH2	MMH3	83	18	0.208	48.0	17.85
P4	MMH3	New Outfall	115	18	0.302	57.9	17.85

(1) All structures noted in the table, if existing, would be replaced with new ones.



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Temporary access for construction equipment to the north side and rear portions of the parcels (address 16518 and address 16512) is limited due to the presence of large trees and a deck along the northern property boundary, and a 10-foot tall, rock wall crossing the southern boundary between the homes (see photos at the end of the Memo). Segment P1 is damaged and requires replacement regardless of its capacity deficiencies. Replacing P3 through P5 requires the removal/replacement of approximately 250 square feet of the existing deck that lies within the building setback. The City would need to acquire both a temporary construction and a permanent drainage easement from the property owner of address 16518. Another option for construction access would be to negotiate for access through the property to the north (address 16522), although this may require a greater restoration effort, with no benefit to that property.

Regardless of the access problems, it is anticipated that in replacing the outfall, the new pipe would be extended towards the stream near the bottom of the ravine. This would require a new permanent easement to be acquired from the property to the south (address 16512), as the new outfall pipe would stretch into their property. This new outfall pipe would be a flexible fuse-welded, high density, polyethylene pipe (HDPE) that would extend from manhole MMH3 initially underground until it daylighted in the ravine and would then lay in the bottom of the ravine.

According to the *Stream Delineation Report*, dated January 26, 2023, prepared by The Watershed Company, Sheridan Creek is classified as a Type-F stream and therefore requires a 115-foot buffer from the ordinary high-water mark (OHWM), according to Lake Forest Park Municipal Code (LFLMC), Chapter 16.16.355. The existing outfall pipe is located approximately 14 feet landward of the buffer boundary. At this location within the ravine, the ravine slope is very steep at over 40 percent, which would be a risky location to terminate the new outfall. Therefore, it is proposed to extend the outfall pipe down the ravine into the buffer approximately 60 feet, where the ravine slope flattens to around 10 percent. LFLMC, Chapter 16.16.350.F allows stormwater discharges so long as the discharge does not increase the rate of flow or decrease the water quality of the stream. For this alternative, the rate of flow would not be increased and water quality would be improved due to the decrease in soil erosion by moving the outfall to a flatter location of 75 feet downstream of the existing outfall. Energy dissipation, in the form of a perforated HDPE tee, would be provided at the proposed outfall to further reduce erosion.

If all current manholes and pipes on the property are replaced, pipe slopes can be adjusted and the new pipes would be able to convey the peak flows with a minimum pipe diameter of 18 inches.



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Alternative 2 – Diversion to North Outfall

The second alternative includes diverting the flow in 35th Avenue NE away from the middle outfall to the north outfall. The existing north outfall pipe crosses three private residential properties; address 16580, 16816, and 16930 35th Avenue NE. It is feasible to divert runoff through a new piped conveyance system; however, construction access onto private property is limited and new easements would be required. The existing middle outfall would be plugged at CB-0852 and abandoned in place. It is believed that the homeowner at 16518 35th Avenue NE has at least one private pipe connected to this system.

Existing Conditions – North Outfall

The existing north conveyance system is indicated on the City's GIS database and consists of ditches and pipes along the west side of 35th Avenue NE, north of NE 166th Place. The conveyance eventually crosses to the east side of the road before entering private property. Topographic survey found that this conveyance consists of ditches and 12-inch CPEP, concrete, and CMP pipe, while the final outfall pipe appears to be 10-inch concrete.

North Outfall Peak Flow

The peak runoff from the area that currently drains to the north outfall was estimated using the SBUH method, with the runoff parameters noted in Table 3.

North Tributary Area

Similar to the middle outfall analysis, the basin tributary to the existing north outfall was delineated using topographic survey and LiDAR topographic data for King County and the City's stormwater GIS data. Invert elevations, rim elevations, structure sizes, and other details are not included in the GIS data. For any areas not included in the topographic survey, rim elevations were estimated based on the LiDAR surface elevations, and invert elevations for the existing pipes are assumed to be approximately 5 feet below grade. The delineated basin is indicated on Figure 1.

North Area Land Cover

Currently, the north conveyance system conveys runoff from a residential area of approximately 1.44 acres. This area includes the cul-de-sac at the north end of 35th Avenue NE, as well as several upslope properties to the west. The designated zoning



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is the same as the middle outfall's tributary area. The estimated impervious land cover, based on the assumptions in Table 2 is 47.3 percent. Coverages are shown in Table 7.

TABLE 7

Land Cover Tributary to North Outfall

Land Cover Type	Area (acres)	Assumption
Roof	0.12	Maximum 35 percent roof area per lot, as allowed by LFPMC, 18.22.050.
Driveway/Patio	0.03	Maximum 45 percent impervious coverage per lot, as allowed by LFPMC, 18.22.080.
Landscaped/Lawn	0.49	55 percent of lot, per LFPMC, 18.22.080.
Impervious ROW	0.53	Assumes 66 percent of ROW is paved, driveway, gravel, or sidewalk.
Landscaped ROW	0.27	Assumes 34 percent of ROW is landscaped/lawn.
Total	1.44	

Time of concentration was calculated in the same manner as for the middle outfall's basin. The estimated peak runoff and the time of concentration for the north basin are included in Table 8.

TABLE 8

North Basin Peak Runoff

Subbasin	Total Area (acres)	Impervious Area (acres)	Pervious Area (acres)	Time of Concentration (minimum)	25-Year Peak Flow (cfs)
N1/Total	1.44	0.75	0.69	4.7	0.80

The total 25-year peak flow to the north outfall is estimated at 0.80 cfs. If runoff to the middle outfall is diverted to the north outfall, the conveyance piping would need to be sized to convey a peak 25-year flow of 17.85 cfs from the middle outfall basin, plus the existing peak 25-year flow of 0.80 cfs, for a total of 18.65 cfs.

North Basin Existing Conveyance Capacity

Diverting runoff to the north outfall from 35th Avenue NE would require approximately 475 feet of new conveyance piping to connect to the existing north conveyance system, which begins north of NE 166th Street. However, the existing system is not deep enough,



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nor do the existing 12-inch pipes have the capacity to convey the peak runoff. Therefore, an entirely new conveyance system would be required.

Topographic survey and field observations were used to evaluate the feasibility of diverting flow to the north outfall. The topographic survey data was used to establish the rim elevations of existing and proposed structures. A minimum depth to invert of 5 feet was assumed, in order to provide sufficient cover over the storm pipes. Figure 3 indicates the potential stormwater conveyance that would be required to divert runoff to the north outfall. In order to convey the flow, 18-inch pipes would be necessary at a minimum slope of 1.8 percent. The deepest invert elevation is estimated at approximately 12 feet below ground level, at the proposed new manhole labeled “NMH2.” Table 9 includes the pipe diameters, lengths, slopes, and capacities for this potential diversion. The existing structure IDs are provided as noted in the City’s GIS. All existing structures with an ID noted would be replaced with a new structure.

TABLE 9

Diversion to North Outfall Conveyance Data

Pipe ID	From Structure ⁽¹⁾	To Structure ⁽¹⁾	Length (feet)	Diameter (inches)	Slope (ft/ft)	Pipe Capacity (cfs)	25-Year Flow (cfs)
N1	CB-0852	CB-0488	80	18	0.018	14.13	13.93
N2	CB-0488	CB-0489	100	18	0.018	14.13	13.93
N3	CB-0489	New NMH1	37	18	0.030	18.16	17.85
N4	New NMH1	New NMH2	65	18	0.029	18.01	17.85
N5	New NMH2	New NMH3	130	18	0.055	24.79	17.85
N6	New NMH3	CB-0497	63	18	0.162	42.38	18.65
N7	CB-0497	CB-0496	24	18	0.108	34.67	18.65
N8	CB-0496	CB-0495	81	18	0.119	36.26	18.65
N9	CB-0495	CB-0494	80	18	0.109	34.73	18.65
N10	CB-0494	CB-0493	60	18	0.060	25.80	18.65
N11	CB-0493	CB-1449	87	18	0.143	39.76	18.65
N12	CB-1449	Outfall 1159	300	18	0.221	49.55	18.65

(1) All structures noted in the table, if existing, would be replaced with new ones.

This alternative would require 12 new structures (assuming that the existing structures are replaced) and approximately 1,110 feet of 18-inch pipe.



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North Treatment Options (Also for Alternative 1 – Replace Middle Outfall)

The Department of Ecology's Western Washington Hydrology Model (WWHM) was used to determine the potential size of a treatment facility that could be located at the downstream end of the potential north conveyance route, just upstream of the outfall. It is assumed that a proprietary treatment system or vault could be installed in an offline configuration, which requires a slightly lower treatment flow rate than an online configuration. Traditional treatment options such as a biofiltration swale or a wetpond would require a much larger footprint compared with vault-based or manhole-based systems.

The offline water quality flow rate determined in WWHM for the full flow to the north outfall is 1.47 cfs, or 659 gpm. The required facility size was determined for several different proprietary systems, and this is noted in Table 10.

TABLE 10

North Outfall Treatment Sizes – Full Basin

System	Size of Treatment System	Vault Configuration	Total Footprint (square feet) ⁽⁵⁾
Contech Filterra	362 square feet ⁽¹⁾	Three 8 feet by 16 feet	459
Contech StormFilter	59 cartridges ⁽²⁾	10 feet by 26 feet	225
Oldcastle BioPod	412 square feet ⁽³⁾	Three 8 feet by 16 feet, plus 6 feet by 6 feet	508
BioClean Modular Wetlands	659 square feet ⁽⁴⁾	Two 8 feet by 24 feet, plus 4 feet by 8 feet	495

- (1) Based on an filtration rate through the Filterra media of 175 inches per hour.
- (2) Each 18-inch tall cartridge can treat 11.25 gpm.
- (3) Based on an filtration rate through the BioPod media of 1.6 gpm per square foot.
- (4) Based on a supplier-specified treatment flow rate, depending on vault size.
- (5) Assumes 6-inch thickness on all vault walls.

There is a large amount of private open space available just upslope of the north outfall location, which may be suitable for installation of a large vault or series of vaults. The City would need to acquire land in order to use this area, and would need to acquire additional easements for the conveyance and maintenance access. These facilities would also need to be permitted for inclusion within the stream buffer.



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Alternatively, if the City chooses to treat runoff only from the road area that will be disturbed as part of the conveyance improvement, the facility size becomes much smaller. A road section with two 12-foot travel lanes and two 5-foot sidewalks is assumed, with a total length of approximately 820 feet. The offline water quality flow rate determined in WWHM for the disturbed road area is 0.051 cfs, or 23 gpm. The required facility size was determined for several different proprietary systems, and this is noted in Table 11.

TABLE 11

North Outfall Treatment Sizes – 35th Avenue Road Basin Only

System	Size of Treatment System	Vault Configuration	Total Footprint (square feet)⁽⁵⁾
Contech Filterra	13 square feet ⁽¹⁾	4 feet by 4 feet	25
Contech StormFilter	2 cartridges ⁽²⁾	48-inch MH	25
Oldcastle BioPod	14 square feet ⁽³⁾	4 feet by 4 feet	25
BioClean Modular Wetlands	16 square feet ⁽⁴⁾	4 feet by 4 feet	25

- (1) Based on an filtration rate through the Filterra media of 175 inches per hour.
- (2) Each 18-inch tall cartridge can treat 11.25 gpm.
- (3) Based on an filtration rate through the BioPod media of 1.6 gpm per square foot.
- (4) Based on a supplier-specified treatment flow rate, depending on vault size.
- (5) Assumes 6-inch width on all vault walls.

These smaller facility sizes can be easily installed within the 35th Avenue NE right-of-way. A flow splitter manhole would be installed just upstream to divert the required treatment flow rate to the treatment structure.

North Outfall Site Constraints

During a field visit in April 2022, a number of constraints were observed along the route to the north outfall location. The existing conveyance system and easement appears to run alongside several existing houses, and is adjacent to or below an existing rock wall. There is limited space within the existing conveyance alignment to construct a new conveyance pipe, and the cost of shoring and supporting the adjacent structures during excavation could be substantial. Because of the close spacing of the houses at the north end of the 35th Avenue NE cul-de-sac, it is likely to be difficult to install the final run of pipe to a treatment facility and outfall. The construction of the pipe to the outfall will also require additional easements beyond the area of the existing easements.



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Alternative 3 – Diversion to South Outfall

The third alternative includes diverting the flow in 35th Avenue NE away from the middle outfall to the south outfall. The existing south outfall pipe serves the area located south of NE 162nd Street, and east of 35th Avenue NE. The conveyance system resides within the NE 162nd Street right-of-way, discharging into Sheridan Creek just upstream of a culvert crossing beneath NE 162nd Street, in the backyard of 16066 NE 36th Avenue NE. It is unknown if an easement exists for this outfall pipe. It is feasible to divert runoff through a new piped conveyance system, to this location. The existing middle outfall would be plugged at CB-0852 and abandoned in place. It is believed that the homeowner at 16518 35th Avenue NE has at least one private pipe connected to this system.

Existing Conditions – South Outfall

The existing south conveyance system is indicated on the City's GIS database and consists of ditches and pipes along the south side of NE 162nd Street and along 36th Avenue NE, to the outfall. Much of the piped conveyance consists of 12-inch to 18-inch CMP, CPEP, concrete, or PVC pipes.

South Outfall Peak Flow

The peak runoff from the area that currently drains to the south outfall was estimated using the SBUH method, with the runoff parameters noted in Table 3.

South Tributary Area

Similar to the middle and north outfall analyses, the basin tributary to the existing south outfall was delineated using topographic survey and LiDAR topographic data for King County and the City's stormwater GIS data. Invert elevations, rim elevations, structure sizes, and other details are not included in the GIS data. For any areas not included in the topographic survey, rim elevations were estimated based on the LiDAR surface elevations, and invert elevations for the existing pipes are assumed to be approximately 5 feet below grade. The delineated basin is indicated on Figure 1.

South Area Land Cover

Currently, the south conveyance system conveys runoff from an area of approximately 10.28 acres. This area includes 35th Avenue NE and 36th Avenue NE (and the properties in between), from NE 158th Place to NE 162nd Street. The designated zoning is the same



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as the middle and north's outfall tributary area. The estimated impervious land cover (based on assumptions in Table 2) is 51.9 percent. Coverages are shown in Table 12.

TABLE 12

Land Cover Tributary to South Outfall

Land Cover Type	Area (acres)	Assumption
Roof	2.42	Maximum 35 percent roof area per lot, as allowed by LFPMC, 18.22.050.
Driveway/Patio	0.69	Maximum 45 percent impervious coverage per lot, as allowed by LFPMC, 18.22.080.
Landscaped/Lawn	3.80	55 percent of lot, per LFPMC, 18.22.080.
Impervious ROW	2.22	Assumes 66 percent of ROW is paved, driveway, gravel, or sidewalk.
Landscaped ROW	1.14	Assumes 34 percent of ROW is landscaped/lawn.
Total	10.28	

Time of concentration was calculated in the same manner as for the middle and north outfalls. The estimated peak runoff for each subbasin as well as the subbasin areas and times of concentration for each subbasin are included in Table 13.

TABLE 13

South Basin Peak Runoff

Subbasin	Total Area (acres)	Impervious Area (acres)	Pervious Area (acres)	Time of Concentration (minimum)	25-Year Peak Flow (cfs)
S1	2.27	1.25	1.02	6.1	1.22
S2	8.00	4.40	3.60	9.7	4.09
Total	10.27	5.65	4.62		5.31

The total 25-year peak flow to the south outfall is estimated at 5.31 cfs. If runoff to the middle outfall is diverted to the south outfall, the conveyance piping would need to be sized to convey a peak 25-year flow of 17.85 cfs from the middle outfall basin, plus the existing peak 25-year flow of 5.31 cfs, for a total of 23.16 cfs.



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South Basin Existing Conveyance Capacity

Diverting runoff to the south outfall from 35th Avenue NE would require approximately 325 feet of new conveyance piping to connect to the existing south conveyance system, which begins at the intersection of NE 166th Street and 35th Avenue NE. However, the existing system is not deep enough, nor do the existing pipes have the capacity to convey the peak runoff. Therefore, an entirely new conveyance system would be required.

Topographic survey and field observations were used to determine the feasibility of routing flow to the south outfall. The topographic survey data was used to establish the rim elevations of existing and proposed structures. A minimum depth to invert of 5 feet was assumed, to provide sufficient cover over the storm pipes. Figure 4 indicates the potential stormwater conveyance that may be feasible to divert runoff to the south outfall. In order to convey the flow, 18-inch pipes would be necessary at slopes of 0.3 percent or greater. The deepest invert elevation is estimated at 16 feet below ground level, at the proposed manhole labeled “SMH 2.” Table 14 includes the pipe diameters, lengths, slopes, and capacities for this potential diversion. The existing structure IDs are provided, as noted in the City’s GIS. All existing structures with an ID noted would be replaced with a new structure.

TABLE 14
Diversion to South Outfall Conveyance Data

Pipe ID	From Structure ⁽¹⁾	To Structure ⁽¹⁾	Length (feet)	Diameter (inches)	Slope (ft/ft)	Pipe Capacity (cfs)	25-Year Flow (cfs)
S1	CB-0852	CB-0487	51	18	0.0039	6.60	5.81
S2	CB-0487	CB-0486	90	18	0.0034	6.08	5.81
S3	CB-0486	MH1	89	18	0.0056	7.89	7.69
S4	MH1	MH2	44	18	0.030	18.10	17.85
S5	MH2	CB-0510	51	18	0.029	18.06	17.85
S6	CB-0510	MH3	152	18	0.030	18.12	17.85
S7	MH3	MH4	118	18	0.031	18.40	17.85
S8	MH4	MH5	47	18	0.062	26.16	17.85
S9	MH5	CB-0512	131	18	0.074	28.66	19.07
S10	CB-0512	CB-0514	78	18	0.100	33.31	19.07
S11	CB-0514	MH6	35	18	0.049	23.21	23.16
S12	MH6	CB-1894	87	18	0.076	29.08	23.16
S13	CB-1894	Outfall 0879	20	18	0.414	67.73	23.16

(1) All structures noted in the table, if existing, would be replaced as new.



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This alternative would require 13 new structures (assuming that the existing structures are replaced), and approximately 990 feet of 18-inch pipe. Also, this option assumes that runoff would be piped from the south side of NE 162nd Street to the north side of the road, in order to reduce the amount of runoff entering the inlet side of the existing NE 162nd Street culvert.

South Treatment Options

WWHM was used to determine the potential size of a treatment facility that could be located at the downstream end of the proposed conveyance route, just upstream of the outfall. It is assumed that a proprietary treatment system or vault could be installed in an offline configuration, which requires a slightly lower treatment flow rate than an online configuration. Traditional treatment options such as a biofiltration swale or a wetpond would require a much larger footprint when compared with vault-based or manhole-based system, and land is not readily available for these facilities.

The offline water quality flow rate determined in WWHM for the full flow to the outfall is 1.52 cfs, or 683 gpm. The required facility size was determined for several different proprietary systems, and this is noted in Table 15.

TABLE 15

South Outfall Treatment Sizes – Full Basin

System	Size of Treatment System	Vault Configuration	Total Footprint (square feet) ⁽⁵⁾
Contech Filterra	454 square feet ⁽¹⁾	Three 8 feet by 20 feet	567
Contech StormFilter	73 cartridges ⁽²⁾	Two 8 feet by 16 feet	306
Oldcastle BioPod	516 square feet ⁽³⁾	Four 8 feet by 16 feet, plus 4 feet by 4 feet	637
BioClean Modular Wetlands	512 square feet ⁽⁴⁾	Two 8 feet by 24 feet, plus 8 feet by 16 feet	603

- (1) Based on an filtration rate through the Filterra media of 175 inches per hour.
- (2) Each 18-inch tall cartridge can treat 11.25 gpm.
- (3) Based on an filtration rate through the BioPod media of 1.6 gpm per square foot.
- (4) Based on a supplier-specified treatment flow rate, depending on vault size.
- (5) Assumes 6-inch width on all vault walls.

There is very limited area available at the south outfall location to install a large facility, and the parcels adjacent to the right-of-way are all developed. If the vault is installed within the right-of-way, it would occupy approximately half of the right-of-way, below



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the road, and shoulder. It is assumed that the facility would need to be installed partially within the right-of-way and partially within the adjacent private property.

Alternatively, if the City chooses to treat runoff only from the road area that will be disturbed as part of the conveyance improvement, the facility size becomes much smaller. A road section with two 12-foot travel lanes and two 5-foot shoulders is assumed, with a total length of approximately 990 feet. The offline water quality flow rate determined in WWHM for the road area is 0.047 cfs, or 21 gpm. The required facility size was determined for several different proprietary systems, and this is noted in Table 16.

TABLE 16

South Outfall Treatment Sizes – 35th Avenue Road Basin Only

System	Size of Treatment System	Vault Configuration	Total Footprint (square feet)⁽⁵⁾
Contech Filterra	11 square feet ⁽¹⁾	4 feet by 4 feet	25
Contech StormFilter	2 cartridges ⁽²⁾	48-inch MH	25
Oldcastle BioPod	13 square feet ⁽³⁾	4 feet by 4 feet	25
BioClean Modular Wetlands	16 square feet ⁽⁴⁾	4 feet by 4 feet	25

(1) Based on an filtration rate through the Filterra media of 175 inches per hour.

(2) Each 18-inch tall cartridge can treat 11.25 gpm.

(3) Based on an filtration rate through the BioPod media of 1.6 gpm per square foot.

(4) Based on a supplier-specified treatment flow rate, depending on vault size.

(5) Assumes 6-inch width on all vault walls.

These facility sizes can easily be installed along the side of the right-of-way (possibly with some easements), with a flow splitter manhole installed just upstream, in order to divert the required treatment flow rate to the treatment structure.

Alternative 4 – Hybrid/Partial Diversion to South Outfall and Replace Middle Outfall

The fourth alternative is a hybrid solution that combines portions of Alternative 1 and Alternative 3 and includes diverting a portion of the flow in 35th Avenue NE away from the middle outfall to the south outfall, and then replacing the middle outfall pipe. By diverting runoff from Subbasin B3 and Subbasin B4 at the intersection of 35th Avenue NE and NE 162nd Street, the improvements to the south conveyance system would be reduced in scope, avoiding the large pipe sizes and deep excavation that would be required under Alternative 3. At the same time, by reducing the peak flows to the middle outfall, only the outfall pipe (connected to the existing manhole MMH3) would



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require replacement (in addition to Segment P1, which must be replaced due to damage). Replacing the outfall could be accomplished with smaller equipment and removal of the existing deck may not be required.

Estimated Flows with Hybrid

As summarized in previous sections, Subbasins B3 and B4 discharge (for the 25-year storm event) 4.37 and 5.79 cfs, respectively, to the middle outfall. Diverting this runoff to the south outfall would reduce the flows at the middle outfall by 10.16 cfs. In addition, 25 percent of Subbasin B2 would also be diverted, reducing the peak flow at the middle outfall by another 0.94 cfs. Therefore, the total 25-year peak flow to the middle outfall would be reduced to about 6.75 cfs, which is near the existing system's maximum capacity. Therefore, only the two damaged pipes (P1 and P5, the outfall pipe) would need to be replaced at the middle outfall.

The runoff diverted to the south conveyance system would be decreased (from the amounts in Alternative 3) from 23.16 cfs to 16.41 cfs, but would still require replacement of the south system; however, the pipes would be smaller (12 and 18 inches) and would generally not have to be installed nearly as deep (only 4.5 feet deep), thereby saving a significant amount of cost and disturbance regarding the improvements to NE 162nd Street, as compared to Alternative 3.

Diverting a portion of runoff to the south outfall from the intersection would require approximately 720 feet of new conveyance piping to Sheridan Creek, at NE 162nd Street. In order to convey the flow to the south outfall, 18-inch pipes would be necessary at slopes of 3.7 percent or greater. Table 17 includes the pipe diameters, lengths, slopes, and capacities for this potential diversion. The existing structure IDs are provided as noted in the City's GIS. All existing structures with an ID noted would be replaced with a new structure.



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TABLE 17
Hybrid Conveyance Data

Pipe ID	From Structure ⁽¹⁾	To Structure ⁽¹⁾	Length (feet)	Diameter (in)	Slope (ft/ft)	Pipe Capacity (cfs)	25-Year Flow (cfs)
P1	CB-0852	EX SDMH	48	12	0.060	8.80	6.75
P5	EX SDMH	New Outfall	125	12	0.250	17.9	6.75
S4	CB-0509	CB-0510	30	12	0.122	12.48	12.32
S5	CB-0510	CB-0511	20	12	0.245	17.86	12.32
S6	CB-0511	SMH3	152	18	0.055	24.76	12.32
S7	SMH3	SMH4	118	18	0.053	24.34	12.32
S8	SMH4	SMH5	47	18	0.136	38.84	12.32
S9	SMH5	CB-0512	131	18	0.074	28.66	12.32
S10	CB-0512	CB-0514	78	18	0.100	33.31	12.32
S11	CB-0514	SMH6	35	18	0.037	20.30	16.41
S12	SMH6	CB-1894	87	18	0.080	29.88	16.41
S13	CB-1894	Outfall 0879	20	18	0.050	23.55	16.41

(1) All structures noted in the table, if existing, would be replaced as new except for structures at the middle outfall.

This alternative would require no new structures at the middle outfall (but would include an anchor block) and 10 new structures (assuming that the existing structures are replaced), with approximately 50 feet of 12-inch pipe and 670 feet of 18-inch pipe. This is indicated on Figure 5.

Hybrid Treatment Options

Treatment options for this alternative would be similar but slightly smaller than those for Alternative 3, since the disturbed area would be slightly smaller.

COST ESTIMATE

For the purpose of estimating costs, the Contech Filtterra system was assumed as the selected treatment facility. It is likely that the other types of treatment facilities would be similar in cost, as they generally consist of similarly sized vaults.

The estimated planning-level construction costs are provided in Table 18. The cost of only installing the new conveyance is provided and the costs of additionally including a treatment vault for the entire basin or for the equivalent road area are also noted.



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TABLE 18
Summary of Estimated Construction Costs

Alternative	Conveyance Alone	Conveyance and Full Basin Treatment	Conveyance and Road Treatment
Replace Middle Outfall	\$357,000	\$921,000 ⁽¹⁾	\$436,000 ⁽¹⁾
Diversion to North Outfall	\$910,000	\$1,474,000	\$989,000
Diversion to South Outfall	\$822,000	\$1,417,000	\$910,000
Hybrid/Partial Diversion to South Outfall and Replace Middle Outfall	\$796,000	\$1,391,000	\$884,000

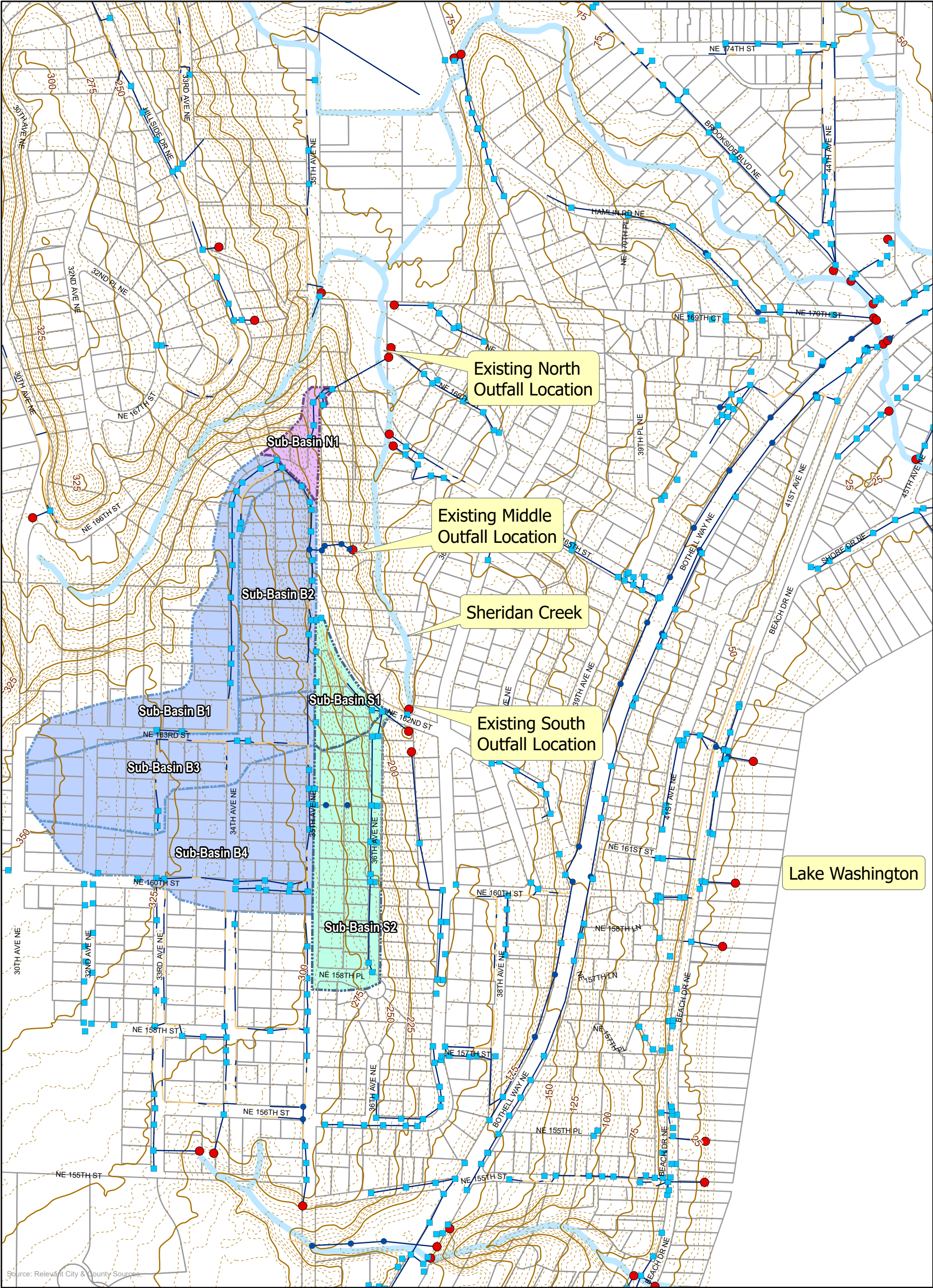
CONCLUSIONS AND RECOMMENDATIONS

In its current configuration, the middle outfall system is not adequate to convey the runoff flowing to it, and there is damage to the pipe crossing 35th Avenue NE, and damage to the outfall manhole. The City should either replace the outfall system, or divert runoff to another location. Selecting the best option from the four considered is difficult due to the many variables. Selection must consider initial capital costs, operation and maintenance costs, construction access and restoration, and the ability to acquire necessary easements, both temporary and permanent. In addition, the City must decide what level of treatment, if any, is desired for the alternative selected.

If temporary construction and permanent easements can be obtained for Alternative 1 – Replace Middle Outfall, the capital costs would be significantly less than the other options and the construction disturbance to the neighborhood would be minimal. Alternative 1 is the preferred choice. Similar easements are needed for Alternative 4 – Hybrid/Partial Diversion to South Outfall and Replace Middle Outfall and would be the second choice.

However, if easements are not straight-forward for Alternative 1 or Alternative 4, Alternative 3 – Diversion to South Outfall would be the third choice, even though it is the most expensive. Alternative 2 – Diversion to North Outfall has significant and difficult construction access and easement requirements and would be the least favorable option.

FIGURES



Source: Relevant City & County Sources

Legend

- | | |
|--------------|---------------|
| CatchBasins | Water Bodies |
| Manholes | Parcels |
| Outfalls | Basins |
| Pipes | Middle Basins |
| Ditches | North Basin |
| 5-ft Contour | South Basins |

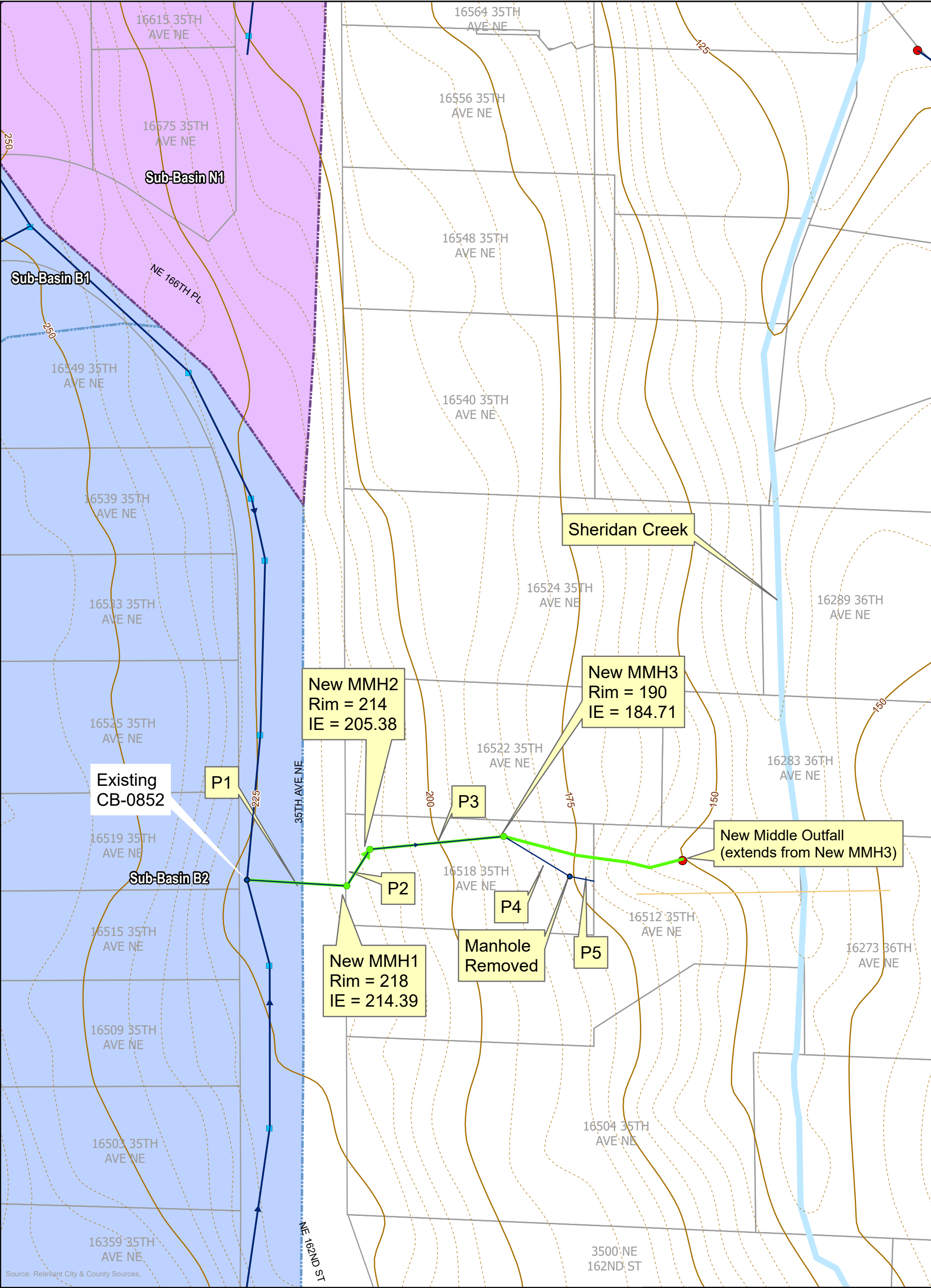


0 100 200 400
Feet

CITY OF LAKE FOREST PARK
35TH AVENUE NE DRAINAGE

FIGURE 1
STUDY AREA



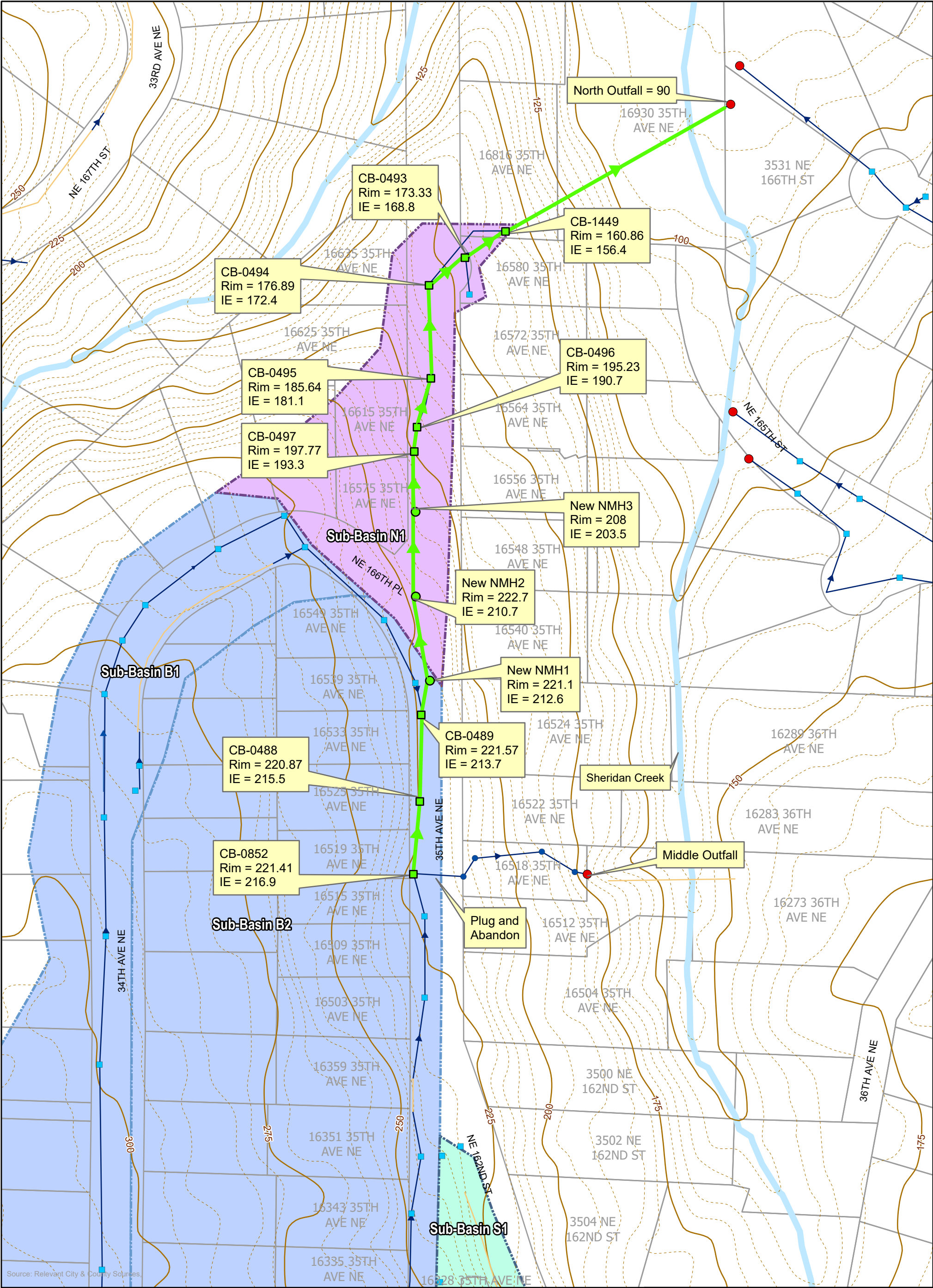


CITY OF LAKE FOREST PARK

35TH AVENUE NE DRAINAGE

**FIGURE 2
MIDDLE OUTFALL REPLACEMENT
ALTERNATIVE 1**





Legend

- CatchBasins
- Manholes
- Outfalls
- Pipes
- Ditches
- 5-ft Contour
- Water Bodies
- Parcels

Basins

- Middle Basins
- North Basin
- South Basins
- New Pipes
- New Manholes
- Catch Basins

N

050100200

Feet


CITY OF LAKE FOREST PARK

35TH AVENUE NE DRAINAGE

FIGURE 3

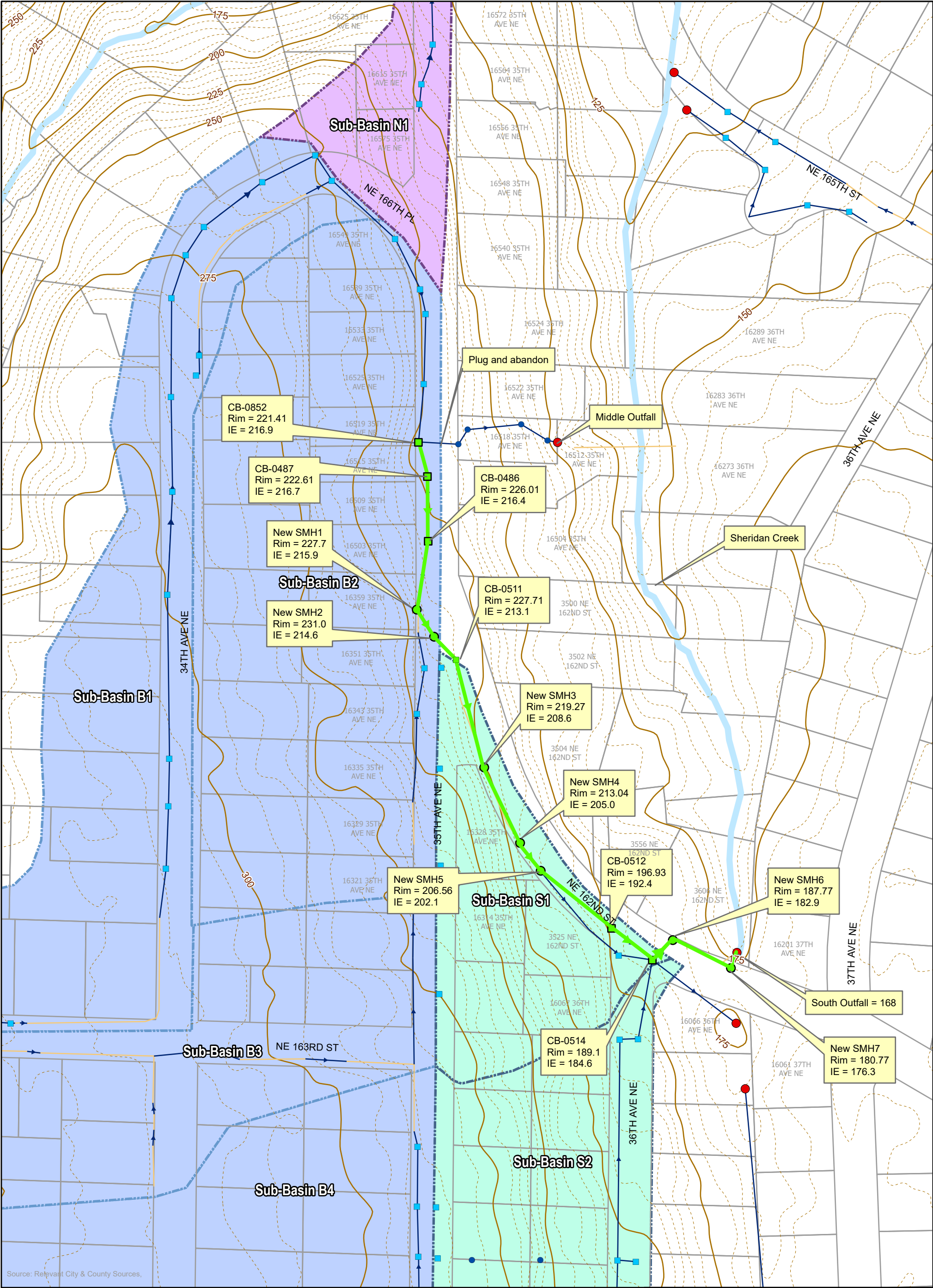
DIVERSION TO NORTH OUTFALL

ALTERNATIVE 2

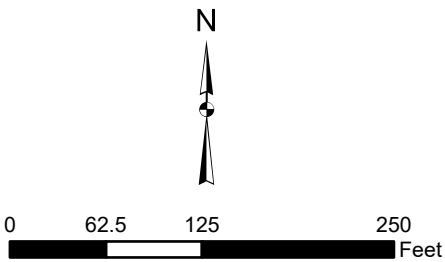


Gray & Osborne, Inc.

CONSULTING ENGINEERS



- Legend**
- CatchBasins
 - Manholes
 - Outfalls
 - Pipes
 - Ditches
 - 5-ft Contour
 - Water Bodies
 - Parcels
 - Basins
 - Middle Basins
 - North Basin
 - South Basins
 - New Pipes
 - New Manholes
 - Catch Basins



CITY OF LAKE FOREST PARK

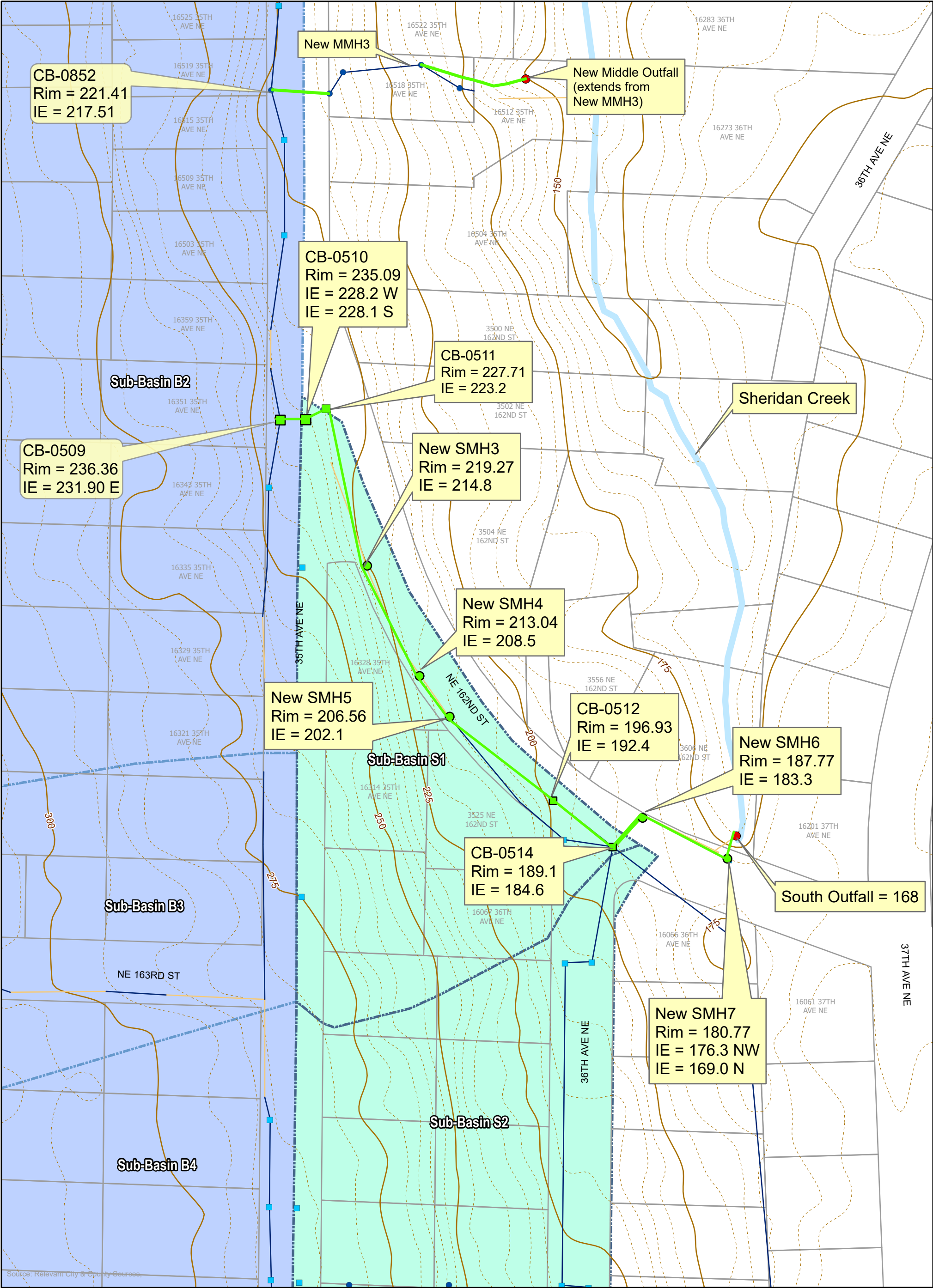
35TH AVENUE NE DRAINAGE

FIGURE 4

DIVERSION TO SOUTH OUTFALL

ALTERNATIVE 3





Source: Relevant City & County Sources

Legend

- | | |
|--------------|-----------------------|
| CatchBasins | Basins |
| Manholes | Middle Basins |
| Outfalls | North Basin |
| Pipes | South Basins |
| Ditches | New Pipes |
| 5-ft Contour | New Manholes |
| Water Bodies | CatchBasins selection |
| Parcels | |



0 50 100 200 Feet

CITY OF LAKE FOREST PARK

35TH AVENUE NE DRAINAGE

**FIGURE 5
SOUTH OUTFALL HYBRID
ALTERNATIVE 4**



PHOTOS



PHOTO 1

Looking Southwest at Middle Outfall Manhole MMH4



PHOTO 2

Looking West Along South Property Line of Address 16518 35th Avenue NE



PHOTO 3

Looking South in Front Yard of Address 16518 35th Avenue NE



PHOTO 4

Looking East Along North Property Line of Address 16518 35th Avenue NE

COST ESTIMATES

City of Lake Forest Park
Planning Level Cost Estimate
35th Avenue Drainage - Replace Middle Outfall (Alt 1)
April 20, 2023

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 23,000	\$	23,000
2 Minor Changes	1	CALC	\$ 10,000	\$	10,000
3 Survey	1	LS	\$ 1,000	\$	1,000
4 Project Temporary Traffic Control	1	LS	\$ 2,500	\$	2,500
5 Clearing and Grubbing	1	LS	\$ 8,000	\$	8,000
6 Removal of Structure and Obstruction	1	LS	\$ 7,000	\$	7,000
7 Locate Existing Utilities	1	LS	\$ 2,000	\$	2,000
8 Bypass Storm Flow	1	LS	\$ 4,000	\$	4,000
9 Commercial HMA for Trench Patch	10	TN	\$ 250	\$	2,500
10 HMA Overlay	0	TN	\$ 110	\$	-
11 CPEP Storm Sewer Pipe, 12 In. Diam. (Incl. Bedding)	0	LF	\$ 100	\$	-
12 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	155	LF	\$ 160	\$	24,800
12 HDPE Storm Sewer Pipe, 18 In. O.D. (Incl. Bedding)	125	LF	\$ 270	\$	33,750
13 Catch Basin, Type 2, 48 In. Diam. (Basic to 8 ft)	3	EA	\$ 5,500	\$	16,500
14 Catch Basin, Type 1	0	EA	\$ 4,000	\$	-
15 Catch Basin Additional Height, 48 In. Diam (Over 8 ft)	0	VF	\$ 300	\$	-
16 Concrete Anchor Block	1	EA	\$ 12,000	\$	12,000
17 Trench Excavation Safety Systems	1	LS	\$ 5,000	\$	5,000
18 Bank Run Gravel for Trench Backfill	340	TN	\$ 35	\$	11,900
19 Erosion Control and Water Pollution Prevention	1	LS	\$ 5,000	\$	5,000
20 Landscaping Restoration	1	LS	\$ 20,000	\$	20,000
21 Tree Replacement	4	EA	\$ 500	\$	2,000
22 Stream Buffer Restoration	1	LS	\$ 20,000	\$	20,000
23 Rolled Curb and Gutter	0	LF	\$ 35	\$	-
24 Cement Concrete Driveway Repair	40	SY	\$ 150	\$	6,000
25 Crushed Surfacing Base Course	40	TN	\$ 45	\$	1,800
26 Crushed Surfacing Top Course	0	TN	\$ 55	\$	-
27 Project Documentation	1	LS	\$ 1,000	\$	1,000
26 Deck Restoration	1	LS	\$ 25,000	\$	25,000
Subtotal				\$	244,750
Contingency (30%)				\$	73,425
Subtotal				\$	318,175
TAX EXEMPT (RULE 171)				\$	-
Easement Acquisition (Temporary and Permanent)	2850 SF		\$ 10	\$	28,500
Fixed Costs for Easements (Negotiations/Agent/Survey/etc.)	2 EA		\$ 5,000	\$	10,000
Total				\$	356,675
Total Construction Cost (Rounded)				\$	357,000

City of Lake Forest Park
Planning Level Cost Estimate
35th Avenue Drainage - Diversion to North Outfall (Alt 2)
April 20, 2023

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 60,000	\$	60,000
2 Minor Changes	1	CALC	\$ 25,000	\$	25,000
3 Survey	1	LS	\$ 5,000	\$	5,000
4 Project Temporary Traffic Control	1	LS	\$ 10,000	\$	10,000
5 Clearing and Grubbing	1	LS	\$ 20,000	\$	20,000
6 Removal of Structure and Obstruction	1	LS	\$ 20,000	\$	20,000
7 Locate Existing Utilities	1	LS	\$ 5,000	\$	5,000
8 Bypass Storm Flow	1	LS	\$ 15,000	\$	15,000
9 Commercial HMA for Trench Patch	140	TN	\$ 250	\$	35,000
10 HMA Overlay	0	TN	\$ 110	\$	-
11 CPEP Storm Sewer Pipe, 12 In. Diam. (Incl. Bedding)	80	LF	\$ 100	\$	8,000
12 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	1,110	LF	\$ 160	\$	177,600
13 Catch Basin, Type 2, 48 In. Diam. (Basic to 8 ft)	12	EA	\$ 5,500	\$	66,000
14 Catch Basin, Type 1	5	EA	\$ 4,000	\$	20,000
15 Catch Basin Additional Height, 48 In. Diam (Over 8 ft)	5	VF	\$ 300	\$	1,350
16 Connection to Existing Structure	3	EA	\$ 1,500	\$	4,500
17 Trench Excavation Safety Systems	1	LS	\$ 10,000	\$	10,000
18 Bank Run Gravel for Trench Backfill	1,930	TN	\$ 35	\$	67,550
19 Erosion Control and Water Pollution Prevention	1	LS	\$ 15,000	\$	15,000
20 Landscaping Restoration	1	LS	\$ 35,000	\$	35,000
21 Tree Replacement	8	EA	\$ 500	\$	4,000
22 Stream Buffer Restoration	1	LS	\$ 35,000	\$	35,000
23 Rolled Curb and Gutter	0	LF	\$ 35	\$	-
24 Cement Concrete Driveway Repair	10	SY	\$ 150	\$	1,500
25 Crushed Surfacing Base Course	180	TN	\$ 45	\$	8,100
26 Crushed Surfacing Top Course	120	TN	\$ 55	\$	6,600
27 Project Documentation	1	LS	\$ 2,000	\$	2,000
Subtotal				\$	657,200
Contingency (30%)				\$	197,160
Subtotal				\$	854,360
TAX EXEMPT (RULE 171)				\$	-
Easement Acquisition (Temporary and Permanent)	4500 SF		\$ 10	\$	45,000
Total				\$	909,360
Total Construction Cost (Rounded)				\$	910,000

North Outfall Additive Option 1
Treatment for Road Only

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 6,000	\$	6,000
1 Treatment Vault (Filterra 4x4)	1	LS	\$ 25,000	\$	25,000
2 Foundation Gravel	5	TN	\$ 30	\$	150
3 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	50	LF	\$ 125	\$	6,250
4 Flow Splitter MH	3	EA	\$ 6,000	\$	18,000
5 Connection to Existing Structure	1	EA	\$ 1,500	\$	1,500
6 Trench Excavation Safety Systems	1	LS	\$ 2,500	\$	2,500
7 Trench Backfill	40	TN	\$ 30	\$	1,200
			Subtotal	\$	60,600
			Contingency (30%)	\$	18,180
			Subtotal	\$	78,780
			TAX EXEMPT (RULE 171)	\$	-
Easement Acquisition (Temporary and Permanent)	0 SF		\$ 10	\$	-
			Total	\$	78,780
			Total Construction Cost (Rounded)	\$	79,000

North Outfall Additive Option 2
Treatment for Entire Basin

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 37,000	\$	37,000
1 Treatment Vault (Filterra 8x16)	3	LS	\$ 110,000	\$	330,000
2 Foundation Gravel	40	TN	\$ 30	\$	1,200
3 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	150	LF	\$ 125	\$	18,750
4 Connection to Existing Structure	1	EA	\$ 1,500	\$	1,500
5 Trench Excavation Safety Systems	1	LS	\$ 5,000	\$	5,000
6 Trench Backfill	300	TN	\$ 30	\$	9,000
			Subtotal	\$	402,450
			Contingency (30%)	\$	120,735
			Subtotal	\$	523,185
			TAX EXEMPT (RULE 171)	\$	-
Easement Acquisition (Temporary and Permanent)	3000 SF		\$ 10	\$	30,000
Fixed Costs for Easements (Negotiations/Agent/Survey/etc.)	2 EA		\$ 5,000	\$	10,000
			Total	\$	563,185
			Total Construction Cost (Rounded)	\$	564,000

City of Lake Forest Park
Planning Level Cost Estimate
35th Avenue Drainage - Diversion to South Outfall (Alt 3)
April 20, 2023

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 57,000	\$	57,000
2 Minor Changes	1	CALC	\$ 15,000	\$	15,000
3 Survey	1	LS	\$ 5,000	\$	5,000
4 Project Temporary Traffic Control	1	LS	\$ 25,000	\$	25,000
5 Clearing and Grubbing	1	LS	\$ 10,000	\$	10,000
6 Removal of Structure and Obstruction	1	LS	\$ 20,000	\$	20,000
7 Locate Existing Utilities	1	LS	\$ 5,000	\$	5,000
8 Bypass Storm Flow	1	LS	\$ 15,000	\$	15,000
9 Commercial HMA for Trench Patch	130	TN	\$ 250	\$	32,500
10 HMA Overlay	0	TN	\$ 110	\$	-
11 CPEP Storm Sewer Pipe, 12 In. Diam. (Incl. Bedding)	80	LF	\$ 100	\$	8,000
12 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	995	LF	\$ 160	\$	159,200
13 CPEP Storm Sewer Pipe, 24 In. Diam. (Incl. Bedding)	0	LF	\$ 210	\$	-
14 Catch Basin, Type 2, 48 In. Diam. (Basic to 8 ft)	13	EA	\$ 5,500	\$	71,500
15 Catch Basin, Type 1	5	EA	\$ 4,000	\$	20,000
16 Catch Basin Additional Height, 48 In. Diam (Over 8 ft)	24	VF	\$ 300	\$	7,200
17 Connection to Existing Structure	2	EA	\$ 1,500	\$	3,000
18 Trench Excavation Safety Systems	1	LS	\$ 15,000	\$	15,000
19 Bank Run Gravel for Trench Backfill	2,630	TN	\$ 35	\$	92,050
20 Erosion Control and Water Pollution Prevention	1	LS	\$ 5,000	\$	5,000
21 Landscaping Restoration	1	LS	\$ 10,000	\$	10,000
22 Tree Replacement	10	EA	\$ 500	\$	5,000
23 Stream Buffer Restoration	1	LS	\$ 5,000	\$	5,000
24 Rolled Curb and Gutter	500	LF	\$ 35	\$	17,500
25 Cement Concrete Driveway Repair	20	SY	\$ 150	\$	3,000
26 Crushed Surfacing Base Course	170	TN	\$ 45	\$	7,650
27 Crushed Surfacing Top Course	110	TN	\$ 55	\$	6,050
28 Project Documentation	1	LS	\$ 2,000	\$	2,000
Subtotal				\$	621,650
Contingency (30%)				\$	186,495
Subtotal				\$	808,145
TAX EXEMPT (RULE 171)				\$	-
Easement Acquisition (Temporary and Permanent)	300 SF		\$ 10	\$	3,000
Fixed Costs for Easements (Negotiations/Agent/Survey/etc.)	2 EA		\$ 5,000	\$	10,000
Total Construction Cost (Rounded)				\$	822,000

South Outfall Additive Option 1
Treatment for Road Only

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 6,000	\$	6,000
2 Treatment Vault (Filterra 4x4)	1	LS	\$ 25,000	\$	25,000
3 Foundation Gravel	5	TN	\$ 30	\$	150
4 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	50	LF	\$ 125	\$	6,250
5 Flow Splitter MH	3	EA	\$ 6,000	\$	18,000
6 Connection to Existing Structure	1	EA	\$ 1,500	\$	1,500
7 Trench Excavation Safety Systems	1	LS	\$ 2,000	\$	2,000
8 Trench Backfill	40	TN	\$ 30	\$	1,200
Subtotal				\$	60,100
Contingency (30%)				\$	18,030
Subtotal				\$	78,130
TAX EXEMPT (RULE 171)				\$	-
Easement Acquisition (Temporary and Permanent)	400	SF	\$ 10	\$	4,000
Fixed Costs for Easements (Negotiations/Agent/Survey/etc.)	1	EA	\$ 5,000	\$	5,000
Total Construction Cost (Rounded)				\$	88,000

South Outfall Additive Option 2
Treatment for Entire Basin

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 40,000	\$	40,000
2 Treatment Vault (Filterra 8x20)	3	LS	\$ 120,000	\$	360,000
3 Foundation Gravel	45	TN	\$ 30	\$	1,350
4 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	140	LF	\$ 125	\$	17,500
5 Connection to Existing Structure	1	EA	\$ 1,500	\$	1,500
6 Trench Excavation Safety Systems	1	LS	\$ 2,000	\$	2,000
7 Trench Backfill	300	TN	\$ 30	\$	9,000
Subtotal				\$	431,350
Contingency (30%)				\$	129,405
Subtotal				\$	560,755
TAX EXEMPT (RULE 171)				\$	-
Easement Acquisition (Temporary and Permanent)	2400	SF	\$ 10	\$	24,000
Fixed Costs for Easements (Negotiations/Agent/Survey/etc.)	2	EA	\$ 5,000	\$	10,000
Total				\$	594,755
Total Construction Cost (Rounded)				\$	595,000

City of Lake Forest Park
Planning Level Cost Estimate
35th Avenue Drainage - Partial South Diversion & Replace Middle Outfall (Alt 4)
April 20, 2023

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 53,000	\$	53,000
2 Minor Changes	1	CALC	\$ 10,000	\$	10,000
3 Survey	1	LS	\$ 5,000	\$	5,000
4 Project Temporary Traffic Control	1	LS	\$ 20,000	\$	20,000
5 Clearing and Grubbing	1	LS	\$ 12,500	\$	12,500
6 Removal of Structure and Obstruction	1	LS	\$ 18,000	\$	18,000
7 Locate Existing Utilities	1	LS	\$ 5,000	\$	5,000
8 Bypass Storm Flow	1	LS	\$ 10,000	\$	10,000
9 Commercial HMA for Trench Patch	100	TN	\$ 250	\$	25,000
10 HMA Overlay	0	TN	\$ 110	\$	-
11 CPEP Storm Sewer Pipe, 12 In. Diam. (Incl. Bedding)	140	LF	\$ 100	\$	14,000
12 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	770	LF	\$ 160	\$	123,200
13 HDPE Storm Sewer Pipe, 16 In. O.D. (Incl. Bedding)	125	LF	\$ 250	\$	31,250
14 Catch Basin, Type 2, 48 In. Diam. (Basic to 8 ft)	10	EA	\$ 5,500	\$	55,000
15 Catch Basin, Type 1	4	EA	\$ 4,000	\$	16,000
16 Catch Basin Additional Height, 48 In. Diam (Over 8 ft)	0	VF	\$ 300	\$	-
17 Connection to Existing Structure	2	EA	\$ 1,500	\$	3,000
18 Concrete Anchor Block	1	EA	\$ 10,000	\$	10,000
19 Trench Excavation Safety Systems	1	LS	\$ 15,000	\$	15,000
20 Bank Run Gravel for Trench Backfill	1,760	TN	\$ 35	\$	61,600
21 Erosion Control and Water Pollution Prevention	1	LS	\$ 8,000	\$	8,000
22 Landscaping Restoration	1	LS	\$ 20,000	\$	20,000
23 Tree Replacement	2	EA	\$ 500	\$	1,000
24 Stream Buffer Restoration	1	LS	\$ 20,000	\$	20,000
25 Rolled Curb and Gutter	500	LF	\$ 35	\$	17,500
26 Cement Concrete Driveway Repair	80	SY	\$ 150	\$	12,000
27 Crushed Surfacing Base Course	150	TN	\$ 45	\$	6,750
28 Crushed Surfacing Top Course	90	TN	\$ 55	\$	4,950
29 Project Documentation	1	LS	\$ 2,000	\$	2,000
Subtotal				\$	579,750
Contingency (30%)				\$	173,925
Subtotal				\$	753,675
TAX EXEMPT (RULE 171)					
Easement Acquisition (Temporary and Permanent)	3150 SF		\$ 10	\$	31,500
Fixed Costs for Easements (Negotiations/Agent/Survey/etc.)	2 EA		\$ 5,000	\$	10,000
Total Construction Cost (Rounded)				\$	796,000

South Outfall Additive Option 1
Treatment for Road Only

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 6,000	\$	6,000
2 Treatment Vault (Filterra 4x4)	1	LS	\$ 25,000	\$	25,000
3 Foundation Gravel	5	TN	\$ 30	\$	150
4 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	50	LF	\$ 125	\$	6,250
5 Flow Splitter MH	3	EA	\$ 6,000	\$	18,000
6 Connection to Existing Structure	1	EA	\$ 1,500	\$	1,500
7 Trench Excavation Safety Systems	1	LS	\$ 2,000	\$	2,000
8 Trench Backfill	40	TN	\$ 30	\$	1,200
Subtotal					\$ 60,100
Contingency (30%)					\$ 18,030
Subtotal					\$ 78,130
TAX EXEMPT (RULE 171)					\$ -
Easement Acquisition (Temporary and Permanent)	400	SF	\$ 10	\$	4,000
Fixed Costs for Easements (Negotiations/Agent/Survey/etc.)	1	EA	\$ 5,000	\$	5,000
Total					\$ 87,130
Total Construction Cost (Rounded)					\$ 88,000

South Outfall Additive Option 2
Treatment for Entire Basin

<u>Item</u>	<u>Quantity</u>		<u>Unit Cost</u>		<u>Total</u>
1 Mobilization, Cleanup, and Demobilization	1	LS	\$ 40,000	\$	40,000
2 Treatment Vault (Filterra 8x20)	3	LS	\$ 120,000	\$	360,000
3 Foundation Gravel	45	TN	\$ 30	\$	1,350
4 CPEP Storm Sewer Pipe, 18 In. Diam. (Incl. Bedding)	140	LF	\$ 125	\$	17,500
5 Connection to Existing Structure	1	EA	\$ 1,500	\$	1,500
6 Trench Excavation Safety Systems	1	LS	\$ 2,000	\$	2,000
7 Trench Backfill	300	TN	\$ 30	\$	9,000
Subtotal					\$ 431,350
Contingency (30%)					\$ 129,405
Subtotal					\$ 560,755
TAX EXEMPT (RULE 171)					\$ -
Easement Acquisition (Temporary and Permanent)	2400	SF	\$ 10	\$	24,000
Fixed Costs for Easements (Negotiations/Agent/Survey/etc.)	2	EA	\$ 5,000	\$	10,000
Total					\$ 594,755
Total Construction Cost (Rounded)					\$ 595,000