FINAL REPORT

DOUGLAS NCP AMENDMENT
SANITARY SERVICING STRATEGY

Prepared on Behalf of:

Cressey Development Corporation, Equitas Development Corporation & The City of Surrey

APLIN & MARTIN CONSULTANTS LTD

Project No. 25194
March 2007

March 13, 2007

Our File: 25194

City of Surrey
14245 – 56 Avenue
Surrey, BC V3X 3A2

Attention: Mr. Robert Lee, PEng

Dear Mr. Lee:

Re: Douglas Neighbourhood Concept Plan Amendment Sanitary Servicing Strategy

We appreciate this opportunity to provide detailed sanitary servicing solutions for the Douglas NCP Amendment area. We are in agreement that based on the rapid development within Surrey since the 1999 Douglas NCP, the servicing solutions originally established are no longer applicable. We have undertaken a comprehensive analysis of the sanitary infrastructure and devised a detailed servicing strategy to guide the development of the Douglas Amendment area.

In preparing this strategy, we have modified the flows from the Douglas NCP Amendment area to account for an ultimate population of 1.5 times the 1999 NCP estimates. As well, we have made allowance for flows from the industrial / commercial area identified in the OCP east of 176 Street, the Peace Arch Golf Course, the Peace Arch duty-free area and the pumped flow from the Hazelmere Golf Course.

Further, as we are aware the Semiahmoo Pump Station does have capacity constraints, in part due to the allocation of 40 L/s capacity to developments in the Highway 99 Corridor. We have addressed this in our strategy by providing for upgrades to the pump station as development in the Douglas NCP area progresses.

The servicing strategy for the Douglas NCP Amendment area involves construction of $7,062,350 of communal infrastructure. As part of this strategy, the Semiahmoo Pump Station and associated infrastructure will be upgraded. A second pump station complete with emergency underground storage within Douglas will be constructed, and the force main from this new pump station will connect to the existing force main from the existing Douglas Pump Station. This station will also be upgraded. Once the combined flows from these two stations exceed the pre-determined threshold, the remainder of the force main will be twinned.

The proposed strategy, including the Semiahmoo Pump Station upgrades, results in a net deficit of $3,938,350 necessitating a levy of approximately $62,713/hectare on the entire Benefiting Area.

Yours truly,

APLIN & MARTIN CONSULTANTS LTD.

James Kay, PEng
Design Engineer

JBK

Enclosure

cc: Mr. Rob Wilson, City of Surrey
Mr. John Wilson, City of Surrey
Mr. Lorne Robinson, City of Surrey
Mr. Chris Turcotte, Cressey Development Corporation
Mr. Bob Ambardar, Cressey Development Corporation
Mr. James Evans, Equitas Development Corporation

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1.0 DOUGLAS NCP AMENDMENT

On behalf of Cressey Development Corporation, Equitas Development Corporation and the City of Surrey, Aplin & Martin Consultants Ltd. has prepared this report to propose a sanitary servicing strategy for the Douglas Neighbourhood Concept Plan (NCP) Amendment area. The Douglas NCP Amendment area covers a developable area of approximately 61 hectares/150 acres, bound by Highway 99 to the west, Washington State to the south, 4 Avenue to the north, and industrial lands adjacent to 176 Street to the east. Some of the lands are presently serviced by municipal sanitary sewers; however, the NCP prepared in July 1999 identified deficiencies in the existing system that would require upgrading to accommodate increases in population. This proposed NCP Amendment will further densify these lands, and as a result, require additional upgrades to the sanitary sewer servicing infrastructure to accommodate growth. It will also accommodate basements throughout the Amendment area wherever possible.

1.1 DOUGLAS NEIGHBOURHOOD CONCEPT PLAN – JULY 1999

The current Douglas NCP was adopted by Council in July 1999. It estimated the population in Douglas at the time to be approximately 900 people within 270 housing units. It proposed 954 new housing units and an ultimate population of approximately 2900 people. This new development was to be predominantly single-family housing. See Figure 1.

Since 1999 there has been limited development activity within the NCP area. However, recent development interest for single-family, as well as other types of housing in this area, has prompted the review of the original servicing strategies. This NCP Amendment will propose revised servicing strategies, where necessary, to accommodate additional growth, reflect revisions to City servicing standards, and take into consideration the status and capacity of the adjacent infrastructure.

1.2 DOUGLAS NCP AMENDMENT - 2007

At this time there are several development applications under review by the City of Surrey for development within the Douglas NCP area. However, these applications are still working documents, and as such, their actual development form and populations are not finalized. Assumptions have been made to account for the ultimate build-out of the Douglas NCP area.

1.2.1 Proposed Land Uses & Population Densities

The Douglas Amendment anticipates the same land uses as originally proposed in the 1999 NCP; however, the single-family areas will be developed at higher densities. For example, whereas the original NCP anticipated urban single-family development at 6 upa, it is more likely that 10 upa will be achieved. Whereas small lot single-family was anticipated at 10 upa, the plan now anticipates 15 upa. Ultimately it is anticipated that the Douglas NCP area will accommodate 4200 people and approximately 1400 units, resulting in an NCP-wide average of 9.33 units/acre. However, for the purposes of sanitary capacity analysis, based on conservative land use densities instead of unit counts, the analysis assumes 6496 people, or a 55% allowance for growth/suites.

2.0 SANITARY SEWER SYSTEM INFRASTRUCTURE

Extensive discussions between the consulting team and City staff have been held in order to ascertain the implications of more dense development on the City sanitary infrastructure. Due to growth throughout Surrey in the years since the 1999 Douglas NCP, the original servicing strategy is no longer valid. This necessitated an extensive investigation of the infrastructure and a revised sanitary servicing strategy.

2.1 EXISTING INFRASTRUCTURE

Subsequent to the 1999 Douglas NCP there have been few upgrades to the existing sanitary sewer infrastructure within the NCP area. The existing sewer systems service approximately half of the NCP area, mostly in the more developed southwest. The gravity collection system is tributary to the Douglas Pump Station on 171 Street at the projection of 2 Avenue, which has a capacity of 42 L/s. From the Douglas Pump Station, a 250mm diameter forcemain conveys flows north and west to a gravity main at 8 Avenue and 165A Street, west of Highway 99. This gravity main is tributary to the Semiahmoo Pump Station at 8 Avenue east of 160 Street which has a capacity of 190 L/s. Flows from the Semiahmoo Pump Station are conveyed to a GVRD trunk sewer at 152 Street and 16 Avenue. The existing sanitary infrastructure is shown in Figure 2.

2.2 PREVIOUS ANALYSES

As outlined in the Douglas 1999 NCP, all development within the area is to be serviced by municipal sanitary sewers. This will involve the extension of mains in areas not currently serviced at the cost of each developer. However, there are also upgrades required to service the overall area in order to accommodate the anticipated growth. The following upgrades to the existing system were proposed in the 1999 NCP to accommodate ultimate flows:

- Sewer replacement on 171 Street from the Douglas Pump Station to the existing manhole located approximately 45 m south of the pump station.
- Relief sewer on 2 Avenue from 172 Street to 174 Street to supplement capacity of the existing, rather deep sewer.
- Replace the existing Douglas Pump Station (capacity 42 L/s) with a new Douglas Pump Station (capacity 80 L/s) complete with emergency underground storage.

The sewer collection system was proposed to be marginally deeper than the City's standard design criteria of 3.5 m, but limited to a maximum depth of 4.0 m to alleviate concerns about "running sand" encountered during previous construction on the existing system. The existing sewers, some greater than 6.0 m depths, would remain. It was still not possible, due to the topography of the area, to extend the gravity sewer system fully to the extreme northeast limit of the NCP area. It was proposed that the areas beyond the reach of the gravity system be designated as strata development sites, with private pump stations to overcome this constraint. Further, certain sections of the existing sewers are currently located within rights-of-way on existing lots. If these mains are not relocated within the roadways as development of these lots proceeds, the mains will need to be covered with pedestrian walkways to facilitate access for maintenance.

2.3 SANITARY CATCHMENT ANALYSIS

The analysis of the sanitary system extends beyond the Douglas NCP Amendment area and includes the entire sanitary catchment. For example, as illustrated in Figure 3, the catchment includes the Peace Arch Golf Course, the Peace Arch duty-free area, additional commercial/industrial lands east of 176 Street, as well as pumped flows from Hazelmere Golf Course which are outside this NCP.

As noted above, based on a maximum depth of new sanitary sewers being limited to 4.0 metres, the existing sanitary system could not be extended to service the entire NCP area, nor would it adequately service basements within the proposed development. Therefore, instead of replacing the existing Douglas Pump Station in order to accommodate the ultimate flows, it is proposed to dedicate the existing Douglas Pump Station to service the west side of the NCP area, the Peace Arch Golf Course and the Peace Arch duty free area, and construct an additional pump station to service the growth further east. The comparison of these two alternatives is as follows:

- Single Pump Station Option:
  - Total equivalent population = 9,420
  - Catchment area = 126.21 Ha
  - Design Flow = 130.09 L/s
  - Sewers often exceeded 4.0 metre depths
  - Requires private pumped systems in the Northeast.
- Two Pump Station Option:
  - Existing Douglas Pump Station:
    - Equivalent population = 2,719
    - Catchment area = 35.56 Ha
    - Design Flow to the existing pump station = 41.87 L/s
    - Existing deep sewers remain
    - The existing sewer system has sufficient capacity to service the catchment.
  - Additional Pump Station #2:
    - Equivalent population = 6,701
    - Catchment area = 90.65 Ha
    - Design flow to the new pump station = 93.89 L/s
    - The depths of the new sewers were less than for the single pump station option, basements could be accommodated throughout the NCP area, and no low pressure pumped system was required.

These two options have similar costs. Due to the peaking factors involved, it appears that the two pump station option would face higher flows; however, this is not the case. Upgrading the existing Douglas Pump Station was originally budgeted at $1.5 million, but would be closer to $2.0 million with the increased flows. The additional Pump Station and forcemain is anticipated to cost $2.1 million. However, this increased initial cost is more than offset by the savings resulting from shallower sewers ($300,000), minimized private pumping ($500,000), and the increase in value resulting from the ability to accommodate basements throughout the Douglas NCP ($1,000,000). As a result, the two pump station option has been selected.

The sanitary sewer design sheets are included as Appendix I.

2.4 PROPOSED UPGRADES

The two criteria used to determine sewer upgrades are capacity and depth.

- Trunk sewers conveying 40L/s or more need to be upgraded once flows exceed 83.7% of conveyance capacity (70% depth of flow);
- Existing local sewers conveying less than 40L/s need to be upgraded once flows exceed 70% conveyance capacity; and
- Sewers exceeding 4.0m depth require a secondary relief/header sewer to accommodate service connections with inside drop structures into the downstream manholes. These sewers will be constructed as development fronting the main proceeds.

2.4.1 Douglas Sanitary Sewer Collection System – West Catchment

The West Catchment is illustrated in Figure 4 and the sewer analysis is provided in Appendix I. The majority of the existing sewers tributary to the Douglas Pump Station have sufficient capacity to accommodate the anticipated flows for the west catchment of the Douglas NCP area.

The following upgrades to the existing system are required to accommodate ultimate flows:

- Sewer upsizing from MH ES48 at 170 Street south of the Open Space to MH ES1 at the existing Douglas Pump Station. (265m)
- Header sewers in all areas where existing sewers exceed 4.0 metres depth.

These upgrades will be triggered by the first development upstream of one of these sections of sewer, are not eligible for DCC funding, though may be considered for Latecomer funding.

2.4.2 Douglas Sanitary Sewer Collection System – East Catchment

The East Catchment is illustrated in Figures 5 and 6 and the sewer analysis is provided in Appendix I. New sewers will need to be constructed to convey flows to the second pump station servicing the east portion of the NCP area, the industrial/commercial area to the east of 176 Street, and Hazelmere Golf Course. Flows in portions of this new sewer system would exceed 40 L/s making the upsizing of these sections, from the nominal 200 mm diameter, eligible for DCC funding.

Analysis of the existing mains indicate that the following upgrades to the existing system are required to accommodate ultimate flows:

- Header sewers in all areas where existing sewers exceed 4.0 metres depth.

These upgrades will be triggered by the first development fronting these sections of sewer.

A geotechnical investigation conducted in 2005 by Levelton, and subsequently supplemented by another investigation by Thurber, specifically to address the “running sand” issue concluded “In the absence of water-bearing sand seams within the proposed depth of service trenches, we do not expect that a problem with running sand will be experienced during excavation” provided construction methods used were suitable to the soils encountered.

2.4.3 Douglas Pump Stations and Force Mains

The existing Douglas Pump Station has sufficient capacity to accommodate the anticipated flows for the west catchment of the NCP area. However, the pump station was constructed based on design criteria of the day which have since been updated. Under the current design criteria, a standby generator and emergency storage would be required. Therefore, any development tributary to the existing Douglas Pump Station will be required to provide these upgrades. It is noted that this catchment may be refined at the detailed design stage provided that the flows are always less than 42L/s.

A second pump station is proposed to be constructed to service the east side of the NCP area, the Hazelmere Golf Course and the industrial / commercial area to the east of 176 Street. The station is anticipated to be located on 4 Avenue west of 175A Street; however, this location may vary depending on the availability of a suitable site. The construction of this pump station can be phased: pump installed as necessary with a wet well sized for ultimate flows with provision for partitioning to accommodate smaller pumped flows for the 10 to 15 year horizon.

A force main from the new pump station would extend west along 4 Avenue and tie-in to the existing force main at 171 Street, providing a combined force main up to the Semiahmoo sanitary sewer system. This combined force main could operate until the combined flows from the east and west catchments reaches approximately 88 L/s, at which stage the remaining length of force main would be twinned creating separate force mains for each pump station. As there is 30L/s flow currently from Douglas, this 58L/s of additional capacity represents approximately 50 hectares of development. Remaining capacity will be allocated on a first-come first-served basis.

In addition, there are sections of the gravity sewer between the force main discharge and the Semiahmoo Pump Station on 8 Avenue which, upon build-out, would be under-capacity and need to be replaced. A portion of this sanitary sewer replacement is identified in the 10 year Plan and qualifies for DCC funding.

2.4.4 Semiahmoo Pump Station and Force Main

The existing pumping capacity at the Semiahmoo Pump Station has been tested at 190 L/s. It is important to note that with two pumps operating, the pump station has a capacity of 150L/s. Once development in the catchment reaches 150L/s, the following upgrades are required:

- Install a new Standby Generator to suit future pumps.
- Construct a Surge Tank on the 450 m diameter Semiahmoo force main.
- Divert the existing Force Main at 16025 – 8 Avenue and 832 – 160 Street. Although the diversions of these pipes are not directly attributable to development within the Douglas NCP area, they are targeted for relocation due to levels of risk during seismic events. Further, with the potential for surge hammer from the additional pumps servicing new development within Douglas, this upgrade has been included in this analysis.

Once development in the catchment reaches 190L/s, the following upgrades are required:

- Upgrade the existing pumps to increase the station pumping capacity, but as above, these upgrades may be phased and pumps installed as-needed.

Development within the sanitary catchment is anticipated to be as follows:

Table 1 – Semiahmoo Catchment Capacity Analysis

		Inflow	Capacity
Existing			**190 L/s**
Douglas Catchment		30 L/s	
Semiahmoo Catchment		97 L/s	
		127 L/s	
Highway 99 Corridor		40 L/s	
		167 L/s	(167 L/s)
Existing Capacity for Development			**23 L/s**
		Inflow	**Capacity**
Proposed Development			
Semiahmoo Build-Out		13 L/s	
Douglas Pump Station #1			
Build-Out	42 L/s		
Existing Flows	30 L/s		
Increased Flows	12 L/s	12 L/s	
Douglas Pump Station #2			
Phase One	25 L/s		
Future Development	69 L/s		
Future Flows	94 L/s	94 L/s	
Additional Flows from Development		**119 L/s**	**(119 L/s)**
Additional Capacity Required			**96 L/s**
Required Ultimate Capacity – Semiahmoo			**286 L/s**

As the allocated capacity already exceeds 150L/s, the generator, surge tank, and forcemain diversion will be required to service the first development within Douglas. However, there is 23L/s of available capacity to accommodate further development within the Semiahmoo catchment or from development within the Douglas NCP area.

3.0 DEVELOPMENT PHASING

Generally, development within the Douglas NCP Amendment area will advance on a site-specific basis as applications are received. As a result, there are not rigid boundaries restricting development to future phases. Ultimately, the first development in each of the West and East Catchment will trigger the majority of that catchment's sanitary infrastructure upgrades. Again, these catchment boundaries will remain flexible provided the total catchment to the existing pump station does not generate flows in excess of 42 L/s.

4.0 INFRASTRUCTURE FINANCING AND FUNDING

The City of Surrey's 10 Year Capital Plan includes engineering works which are required for both the existing and future needs of the community. Typically the existing needs are funded from general revenue or utility monies or grants, and infrastructure required for growth is principally (90%) funded by Developers through Development Cost Charges (DCCs). The City will only fund works which are included in the 10 Year Plan.

The City of Surrey has taken the following approach to infrastructure funding in the NCP area.

- The City of Surrey has endorsed the use of DCC Frontender Agreements as a method of reimbursing developers for frontending the cost of major engineering infrastructure that is in the 10-Year Capital Servicing Plan.
- The long term DCC revenues and expenditures for major sanitary improvements, within an NCP area, must balance or show a positive cash flow at build-out. A Development Works Agreement can be considered to cover the cost of major infrastructure items that are not covered by DCCs.
- The City will not fund interim works.

4.1 DCC ELEMENTS

Table 2 – Cost Estimate of DCC-Eligible Infrastructure

INFRASTRUCTURE DESCRIPTION	SIZE	QUANTITY	RATE($/m)	COST	TRIGGER
First Development in Douglas Triggers:					
Semiahmoo Pump Station Upgrade	ID #9843 Revised			$1,800,000	1st Development
Semiahmoo Pump Station Generator	ID #10122			$250,000	1st Development
Semiahmoo Surge Tank @ 160 Street	ID #9844			$530,000	1st Development
Semiahmoo Force Main Diversion	ID #9842			$500,000	1st Development
Sewer Replacement					1st Development
8 Avenue: 164 Street to 164A Street	350 to 450mm	100m	$1,550	$155,000	1st Development
8 Avenue: 164A Street to 165A Street	300 to 375mm	200m	$1,430	$286,000	1st Development
Subtotal Semiahmoo				**$3,521,000**	
First Dev't in East Catchment Triggers:					
Douglas Pump Station #2 w. Storage					
4 Avenue @ Approximately 175 Street	94L/s			$1,600,000	1st East Dev't
Forcemain:					
4 Avenue: Pump Station #2 to 171 Street	300mm	890m	$570	$507,300	1st East Dev't
Trunk Sewer Upsizing:					
4 Avenue: 174 Street to Pump Station #2	450mm	160m	$365	$58,400	1st East Dev't
174 Street: 3A Avenue to 4 Avenue	450mm	100m	$365	$36,500	1st East Dev't
174 Street: 3 Avenue to 3A Avenue	375mm	70m	$255	$17,850	1st East Dev't
174 Street: 2 Avenue to 3 Avenue	375mm	260m	$255	$66,300	1st East Dev't
Subtotal East Catchment				**$2,286,350**	

First Dev't in West Catchment Triggers:					
Douglas Pump Station Emergency Storage	ID #10013			$300,000	1st West Dev't
Douglas Pump Station Standby Generator				$100,000	1st West Dev't
Subtotal West Catchment				**$400,000**	
When Flows are >88L/s:					
Douglas Forcemain Twinning					
4 Avenue @ 171 Street to 8 Avenue	300mm	1,500m	$570	$855,000	58L/s (50 Ha)
TOTAL SANITARY				**$7,062,350**	

The anticipated replacement of the Douglas Sanitary Pump Station (City of Surrey Project ID#6480 - $1,500,000) may be removed from the 10-year Plan.
Upsizing Costs based on difference between $1,185/m for 200mm (Developer Cost) and $1,440 for 375mm, and $1,550 for 450mm Trunk Mains (City Upsizing Contribution).

The Douglas NCP will construct $7,062,350 in DCC-eligible works. These works are illustrated in Figure 7. Of the infrastructure identified above, the Semiahmoo Pump Station Generator, Surge Tank, and Force Main Diversion will be designed, constructed and funded by the City, ($1,280,000), on the condition that the first development in Douglas triggers the Semiahmoo Pump Station upgrade.

It is noted that only those DCC elements in the current 10 Year Plan (DCC elements) will receive DCC reimbursements as per the current City policy. The proposed works in the NCP will be eligible if they are added to the 10 Year Plan (DCC elements).

4.2 DCC REVENUES AND EXPENDITURES

The Douglas area is anticipated to have a build-out of 1400 units which represents a population of 4200 people. However, for cost-recovery purposes, only 1176 units have been conservatively identified as "likely to develop" within the time frame of the available funding mechanisms. Further complicating the financial analysis is the City's recent DCC increase, and the applicability of the one year "grace" period wherein in-stream applications would be eligible to develop under the existing DCC rates. All single-family applications that receive subdivision and all multi-family applications that receive building permit by June 26, 2007 will pay the previous 2005 rates. The most appropriate analysis of the NCP revenues reveals:

Table 3 – Projected DCC Revenues

	Townhouse (RM-30) $1.12/ft.^{2}		Small Lot S.F.(RF-9) $745/$1,799		Urban S.F.(RF/RF-12) $820/$1,979		Suburban (RH) $820/$1,979		Commercial/School $600/1000ft.^{2}		Total Units	Total Revenue
	Units	Revenue(1)	Units	Revenue	Units	Revenue	Units	Revenue	Units	Revenue(2)		
OLD DCC		$0	187	$139,315	222	$182,040	8	$6,560		$0	417	$327,915
NEW EAST		$0	85	$152,915	186	$368,094	15	$29,685		$0	286	$550,694
NEW WEST	344	$481,600	62	$111,538	67	$132,593	0	$0	66,100	$39,660	473	$765,391
									Total at Build Out		1176	$1,644,000

(1) Based on 1,250 Ft.^{2}/Unit
(2) Based on 37,600 Ft.^{2} Commercial, 28,500 Ft.^{2} School

Provided that the items listed in Table 2 are included in the City's 10-year plan, and based on the assumption that a further $200,000 will be contributed by areas outside of Douglas but within the catchment boundary, the sanitary DCC revenues and expenditures result in a net deficit of $3,938,350. Throughout the 62.80-hectare Benefiting Area shown in Figure 9, this represents a shortfall of $62,713/hectare. It is anticipated that every development in the sewer catchment will be required to pay this amount prior to entering into their Servicing Agreement.

As above, the first developer in each sanitary catchment area will be required to construct the necessary infrastructure to service that catchment. The first developer in the Benefiting Area will be responsible for implementing a Development Works Agreement, (DWA), for all of the NCP works in order to establish a levy to recover these shortfalls. The levy would be calculated using actual costs of construction, however, in order to establish a DWA, a petition must be signed by a majority of the landowners representing a majority of the land value in the benefiting area. Further, the DWA must be approved by Council prior to the developer entering into a servicing agreement to construct these works.

It is important to note that DWA's are traditionally only effective for a period of ten years, though this may change to fifteen years, so if the area does not build-out within this time frame, the proponents would not recover their costs.

5.0 IMPLEMENTATION PLAN

The first requirement for the implementation of this plan is the inclusion of the items listed in Table 2 into the City's 10 Year Plan. Also required is approval of $1,280,000 in funding from the City for the Semiahmoo Pump Station generator, surge tank, and forcemain diversion.

Second, the first development in Douglas will be required to implement a Development Works Agreement to establish a levy to fund all of the DCC works. Further, any development within Douglas triggers the Semiahmoo Pump Station upgrade. ($1,800,000) The first development in the west catchment triggers the addition of storage and installation of a generator at the existing Douglas Pump Station. ($400,000) The first development within the east catchment triggers the construction of Douglas Pump Station #2, the forcemain to 171 Street, and a variety of trunk sewer upsizing. ($2,286,350).

Upon addition of 58L/s, which correlates to approximately 50 hectares, the original forcemain from 171 Street at 4 Avenue will require upgrading to 8 Avenue. ($855,000)

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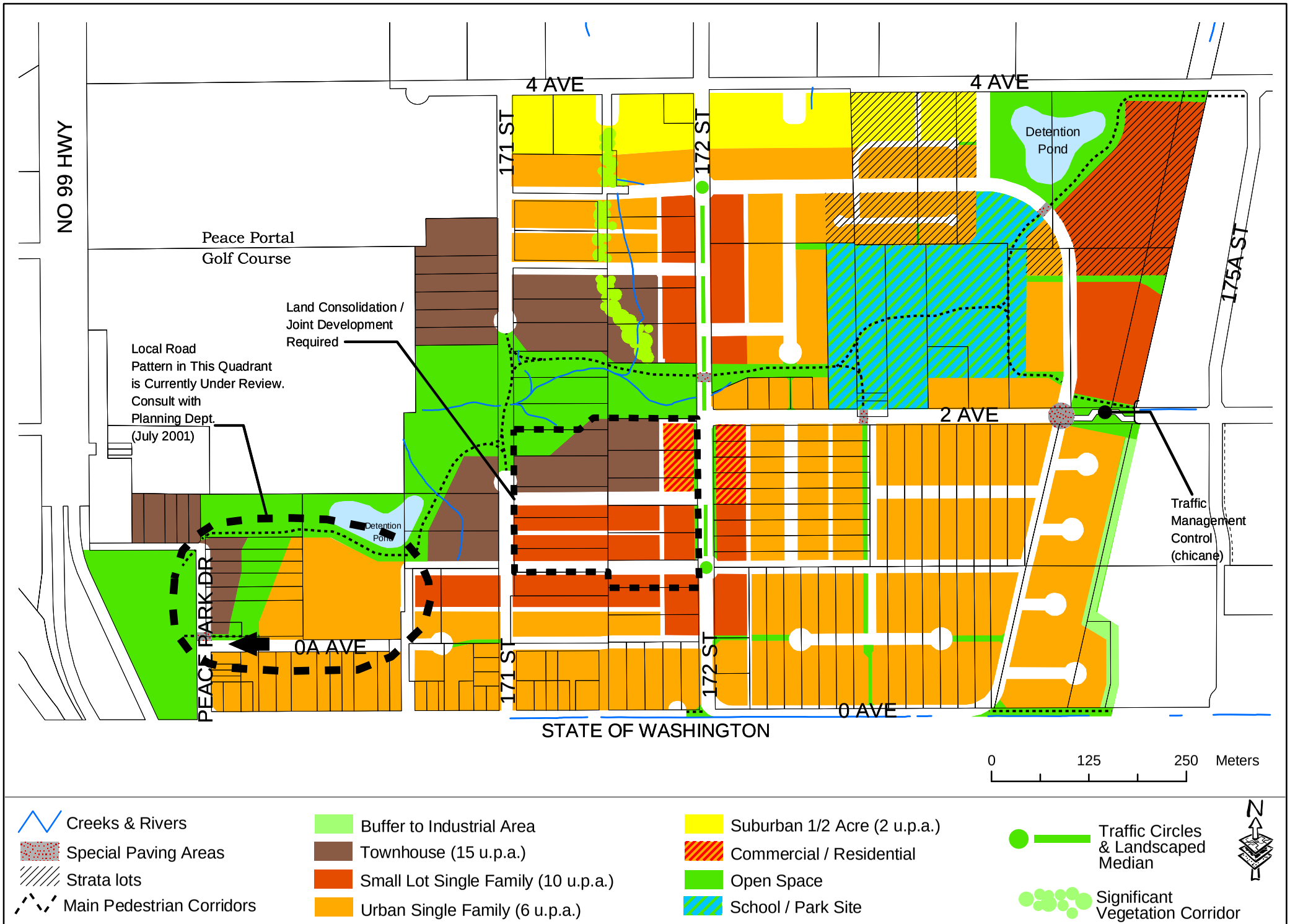
FIGURES

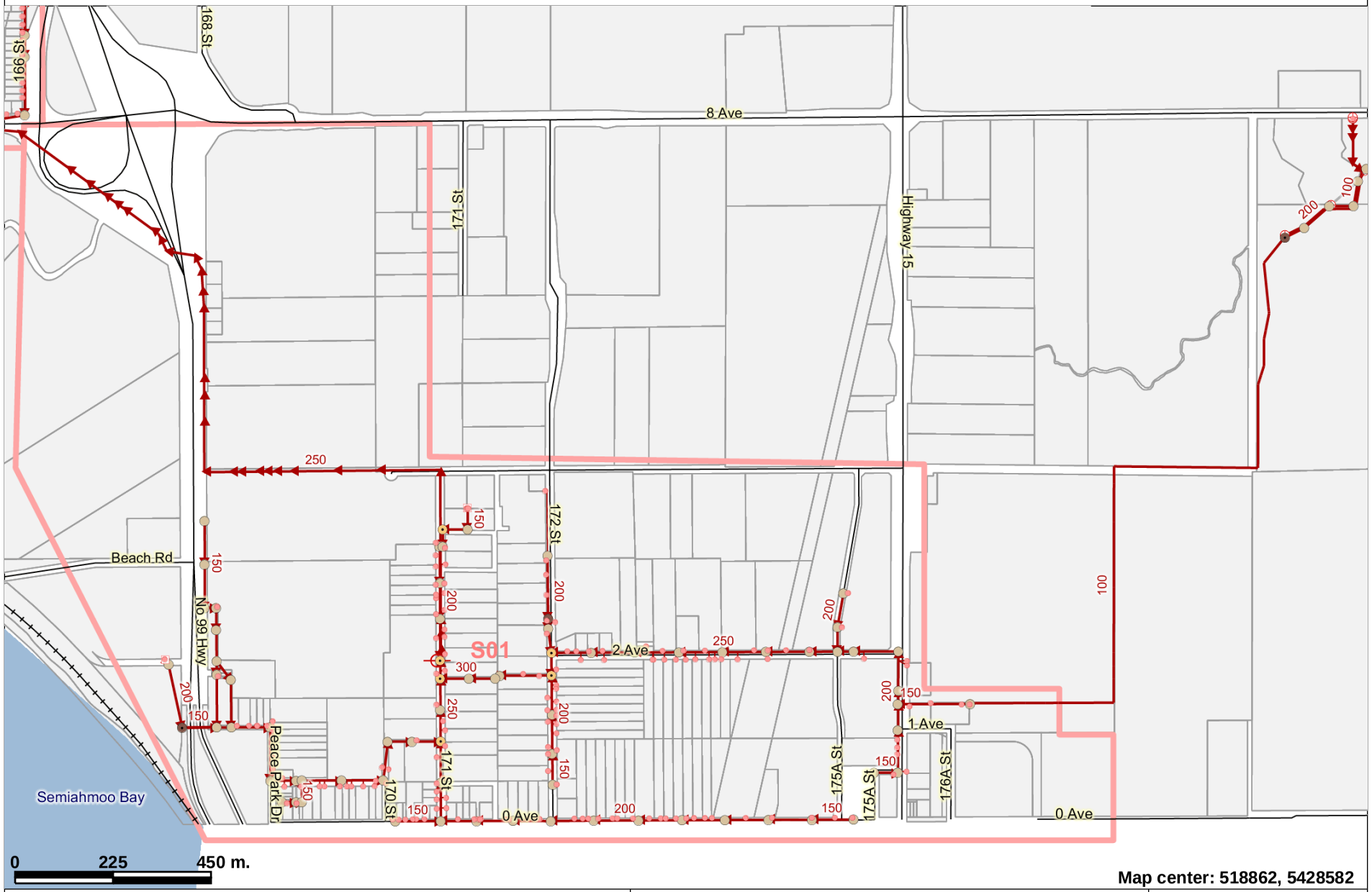


DOUGLAS LAND USE PLAN

Approved by Council: April 15, 1999

This map is provided as general reference only. The City of Surrey makes no warrantees, express or implied, as to the fitness of the information for any purpose, or to the results obtained by individuals using the information and is not responsible for any action taken in reliance on the information contained herein.

Existing Sanitary Infrastructure



Map center: 518862, 5428582

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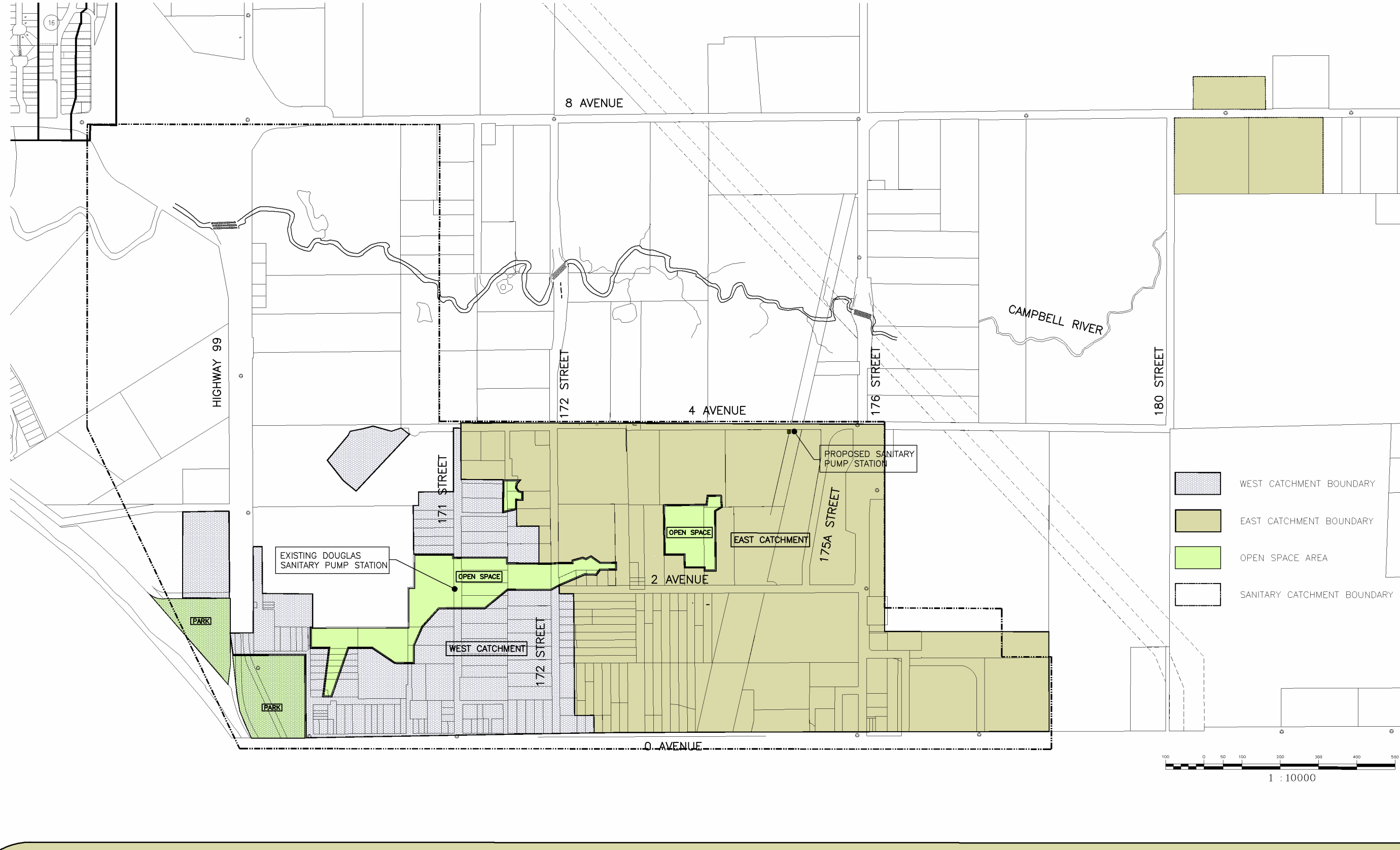

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CRESSEY DEVELOPMENT CORPORATION &
EQUITAS DEVELOPMENT CORPORATION

Douglas NCP Amendment Sanitary Servicing Plan

Overall Catchment Plan

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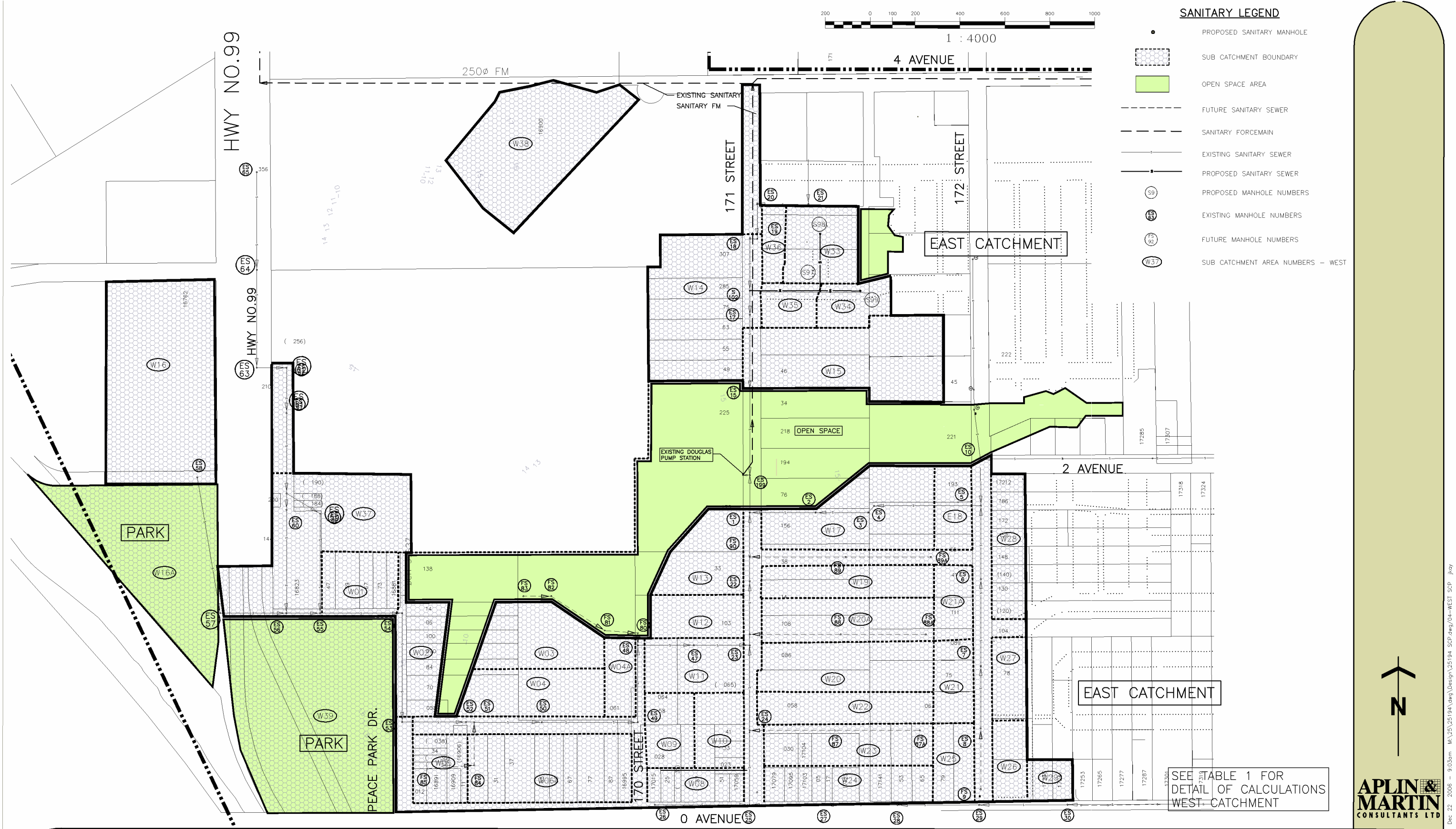
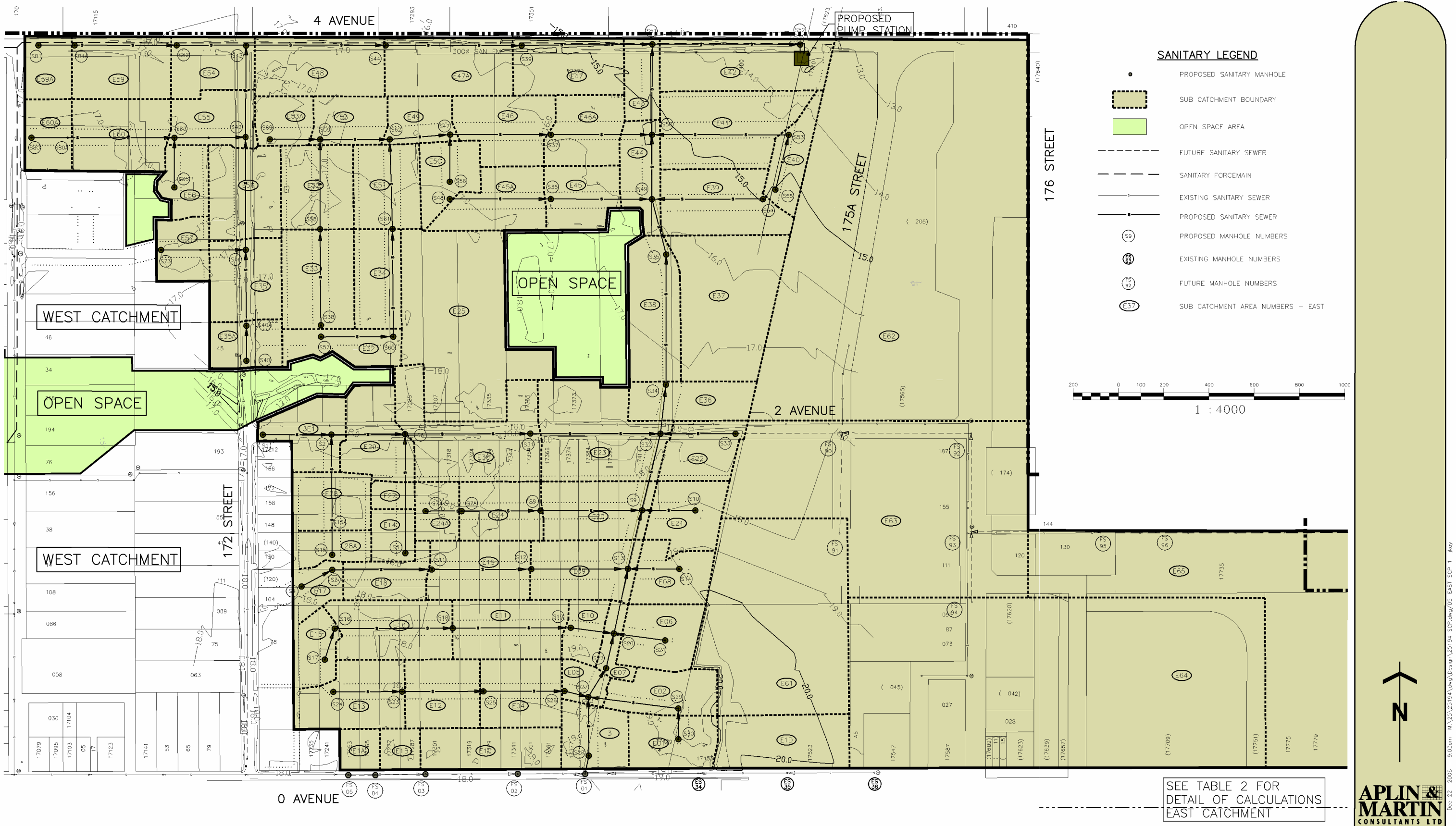


CRESSEY DEVELOPMENT CORPORATION & EQUITAS DEVELOPMENT CORPORATION

Douglas NCP Amendment Sanitary Servicing Plan

West Catchment Plan

04

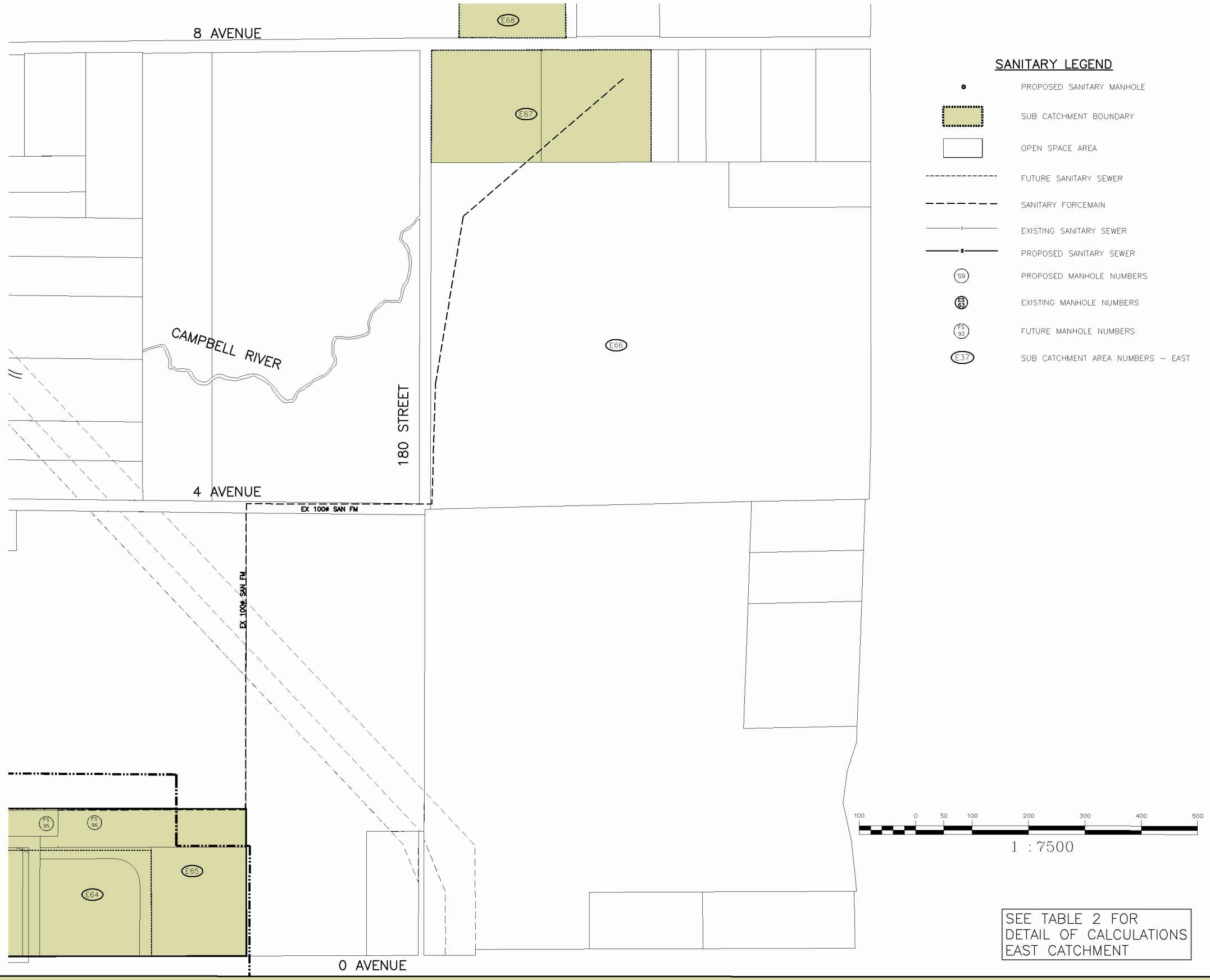


CRESSEY DEVELOPMENT CORPORATION & EQUITAS DEVELOPMENT CORPORATION

Douglas NCP Amendment Sanitary Servicing Plan

East Catchment Plan (1)

05



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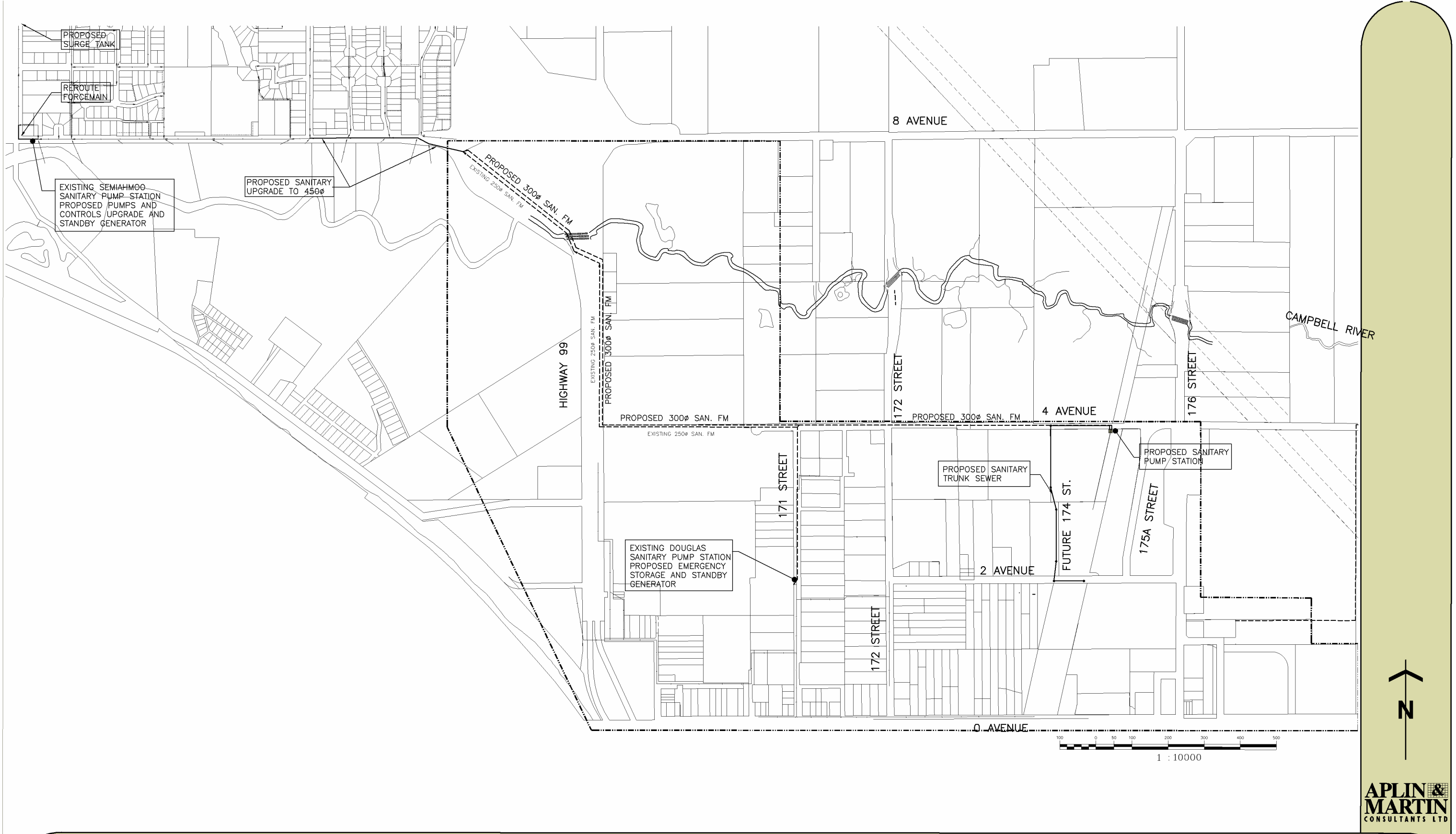
CRESSEY DEVELOPMENT CORPORATION & EQUITAS DEVELOPMENT CORPORATION

Douglas NCP Amendment Sanitary Servicing Plan

East Catchment Plan (2)

06



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CRESSEY DEVELOPMENT CORPORATION & EQUITAS DEVELOPMENT CORPORATION

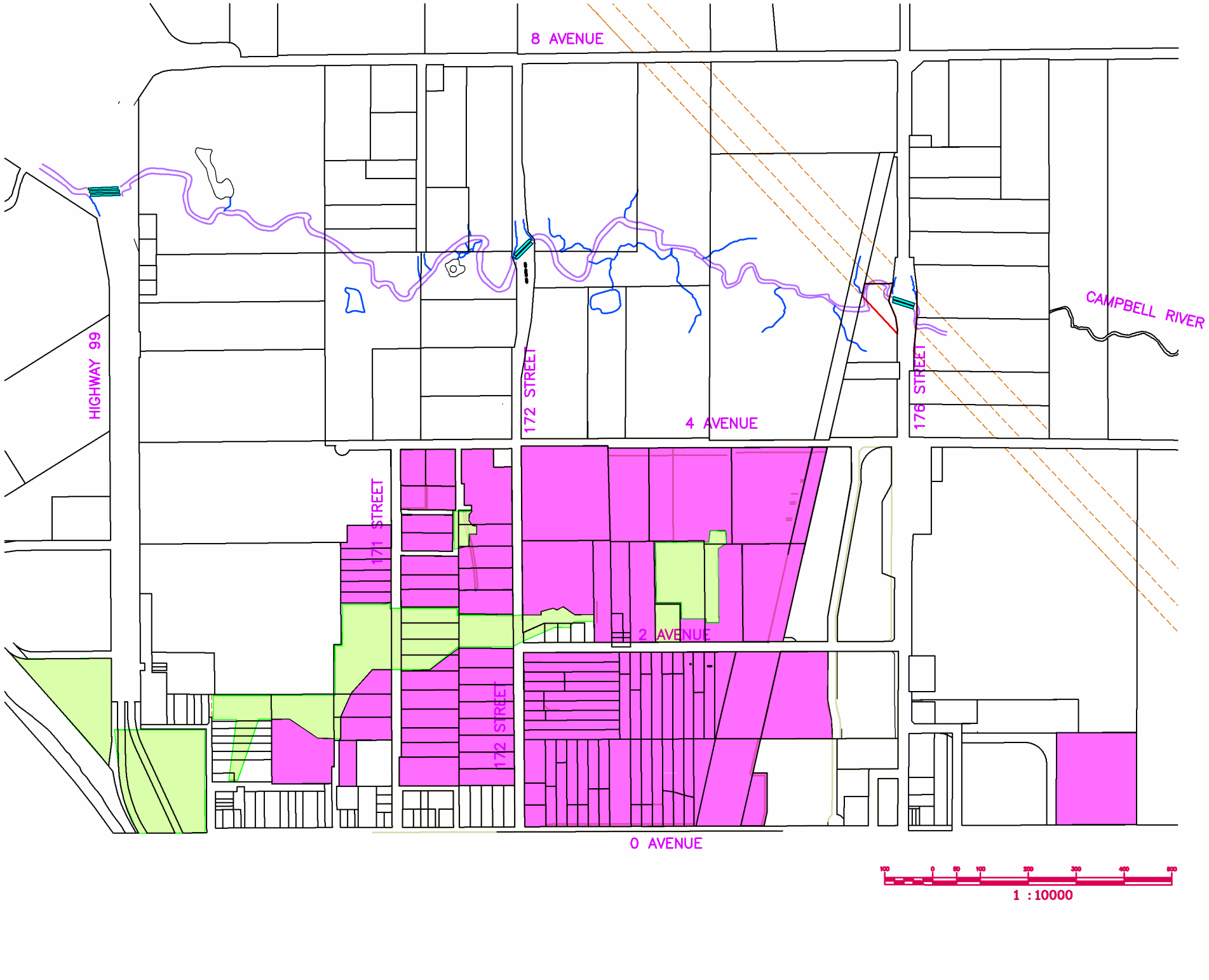
Douglas NCP Amendment Sanitary Servicing Plan

DCC Upgrades

07

BENEFITTING AREA MAP: SANITARY INFRASTRUCTURE

BENEFITTING AREA = 62.80 HA



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CRESSEY DEVELOPMENT CORPORATION & EQUITAS DEVELOPMENT CORPORATION

Douglas NCP Amendment

APPENDICES

TABLE 2: SANITARY SEWER DESIGN - EAST CATCHMENT (SEE DWGs 05 & 06 - EAST CATCHMENT PLANS):

PROJECT: Douglas NCP Amendment
LOCATION: 0 Ave to 4 Ave, 175A St to 171 St.Surrey
A&M PROJECT NO.: 25194
SURREY PROJECT NO.:
CLIENT: Cressy Development Corporation

DATA:
AVERAGE DAILY FLOW = 350 L/S/DAY
INFILTRATION = 0.1296 L/S/HA **MANNING "n"** = 0.013
MAX. DEPTH OF FLOW = 0.50% (New Sewers), 83.7% of Q (Trunk Sewers)
POPULATION DENSITY: As Shown for each land use

DATE: Dec. 5, 2006
DESIGNED BY: SKS
CHECKED BY: RJW

Line No.	Manhole From	Manhole To	Tributary Area Name/ No.	Land Use	Land Use Density (PPHa)	Pop.	Total Population	Total ADF (C.M/Day)	Peak Factor	Catch. Area (Ha)	Tot. Catch. Area (Ha)	Infiltration (L/s)	Design Flow (L/s)	Pipe Data Dia. (mm)	Length (m)	Slope (%)	Capacity Qfull - (L/s)	Ratio of Qd/Qf	Vel. Full (m/s)	Actual Vel. (m/s)	Inverts at Upstr. MH (m)	DwnStr. MH (m)	Prop. Rim Elev. Of Upstr. MH	Cover of Upstr. MH (m)	Remarks
1	S30	S29	E 01	RF-12	89	52	52	18.2	4.31	0.581	0.581	0.06	0.97	200	33.96	1	32.77	0.03	1.04	0.47	15.49	15.15	19.03	3.34	
2	S29	S27	E 02	RF-12	89	50	102	35.7	4.24	0.566	1.147	0.11	1.87	200	100.27	0.6	25.38	0.07	0.81	0.48	15.12	14.52	19.08	3.76	
3	Ex. 36	Ex.35	E 01D	IL	90	78	78	27.41	4.27	0.87	0.87	0.09	1.44	150	95.4	0.51	10.87	0.13	0.61	0.43	SEE NOTE (4)		19.79	2.00	Existing Sewer
4	Ex.35	Ex.34	–			0	78	27.41	4.27	0	0.87	0.09	1.44	200	99.4	0.43	21.49	0.07	0.68	0.39			19.77	2.49	Existing Sewer
5	Ex. 34	Ex. 33	–			0	78	27.41	4.27	0	0.87	0.09	1.44	200	100.2	0.39	20.46	0.07	0.65	0.38			19.50	2.67	Existing Sewer
6	Ex.33	FS. 01	–			0	78	27.41	4.27	0	0.87	0.09	1.44	200	21	1	32.77	0.04	1.04	0.53	14.82	14.61	19.18	3.90	Future Sewer
7	FS. 05	FS. 04	E 01A	RF-12	89	19	19	6.64	4.38	0.213	0.213	0.02	0.36	200	40	1	32.77	0.01	1.04	0.34	16.45	16.05	18.74	2.09	Future Sewer
8	FS. 04	FS. 03	E 01B	RF-12	89	19	38	13.13	4.34	0.208	0.421	0.04	0.7	200	51.3	0.6	25.38	0.03	0.81	0.35	16.03	15.72	18.74	2.51	Future Sewer
9	FS. 03	FS. 02	E 01C	RF-12	89	63	101	35.34	4.24	0.713	1.134	0.11	1.85	200	99.6	0.6	25.38	0.07	0.81	0.48	15.70	15.10	18.74	2.84	Future Sewer
10	FS. 02	FS. 01	–			0	101	35.34	4.24	0	1.134	0.11	1.85	200	78	0.6	25.38	0.07	0.81	0.48	15.08	14.61	18.86	3.58	Future Sewer
11	FS 01	S28	–			0	179	62.75	4.16	0	2.004	0.2	3.23	200	19.5	0.5	23.17	0.14	0.74	0.52	14.59	14.50	19.05	4.26	Auxiliray (Header) Pipe Required For Service Connections
12	S28	S27	E 03	RF-12	89	47	226	79.2	4.13	0.528	2.532	0.25	4.04	200	64.82	0.5	23.17	0.17	0.74	0.56	14.48	14.15	18.20	3.53	
13	S24	S23	E 13	RF-12	89	72	72	25.2	4.28	0.805	0.805	0.08	1.33	200	76.01	1	32.77	0.04	1.04	0.51	16.19	15.43	18.37	1.98	
14	S23	S25	E 12	RF-12	89	56	128	44.8	4.21	0.632	1.437	0.14	2.33	200	89.77	0.6	25.38	0.09	0.81	0.5	15.41	14.87	17.93	2.32	
15	S25	S26	E 04	RF-12	89	61	189	66.15	4.16	0.689	2.126	0.21	3.4	200	89.77	0.6	25.38	0.13	0.81	0.57	14.85	14.32	18.50	3.45	
16	S26	S27	E 05	RF-12	89	19	208	72.8	4.14	0.215	2.341	0.23	3.72	200	26.94	0.5	23.17	0.16	0.74	0.54	14.29	14.15	18.69	4.20	Auxiliray (Header) Pipe Required For Service Connections
17	S27	S22	–			0	536	187.69	3.96	0	6.02	0.6	9.2	200	37.39	0.4	20.73	0.44	0.66	0.64	14.12	13.97	18.90	4.58	Auxiliray (Header) Pipe Required For Service Connections
18	S22	S20	E 07	RF-12	89	18	554	194	3.95	0.201	6.221	0.62	9.49	200	39.2	0.4	20.73	0.46	0.66	0.65	13.94	13.79	18.67	4.53	Auxiliray (Header) Pipe Required For Service Connections
19	S21	S20	E 06	RF-12	89	54	54	18.9	4.31	0.604	0.604	0.06	1	200	57.19	1	32.77	0.03	1.04	0.47	14.76	14.19	18.67	3.71	
20	S17	S16	E 15	RF-12	89	29	29	10.15	4.36	0.325	0.325	0.03	0.54	200	36.05	1	32.77	0.02	1.04	0.39	16.03	15.67	18.37	2.14	
21	S16	S18	E 16	RF-12	89	77	106	37.1	4.24	0.861	1.186	0.12	1.94	200	130.35	0.6	25.38	0.08	0.81	0.48	15.64	14.86	18.42	2.58	
22	S18	S19	E 11	RF-12	89	73	179	62.65	4.17	0.822	2.008	0.2	3.22	200	130.35	0.6	25.38	0.13	0.81	0.56	14.84	14.06	18.39	3.35	
23	S19	S20	E 10	RF-12	89	27	206	72.1	4.14	0.301	2.309	0.23	3.69	200	48.16	0.5	23.17	0.16	0.74	0.54	14.03	13.79	18.61	4.39	Auxiliray (Header) Pipe Required For Service Connections
24	S20	S13	–			0	814	284.99	3.86	0	9.134	0.91	13.63	250	73.06	0.35	35.15	0.39	0.72	0.67	13.74	13.48	18.62	4.64	Auxiliray (Header) Pipe Required For Service Connections
25	S14	S13	E 8	RF-12	89	48	48	16.8	4.32	0.535	0.535	0.05	0.89	200	56.39	1	32.77	0.03	1.04	0.46	14.46	13.90	18.58	3.92	
26	S4	S3	E 17	RF-12	89	22	22	7.7	4.37	0.245	0.245	0.02	0.41	200	38.59	1	32.77	0.01	1.04	0.36	15.82	15.43	17.62	1.60	
27	S3	S11	E 18	RF-12	89	39	61	21.36	4.3	0.436	0.681	0.07	1.13	200	109.97	0.6	25.38	0.04	0.81	0.41	15.40	14.74	17.67	2.07	
28	S11	S12	E 19	RF-12	89	66	127	44.46	4.21	0.736	1.417	0.14	2.31	200	109.97	0.6	25.38	0.09	0.81	0.5	14.72	14.06	18.09	3.17	
29	S12	S13	E 9	RF-12	89	69	196	68.6	4.15	0.773	2.19	0.22	3.52	200	106.72	0.5	23.17	0.15	0.74	0.53	14.03	13.50	18.25	4.02	Auxiliray (Header) Pipe Required For Service Connections
30	S13	S9	–			0	1058	370.39	3.78	0	11.859	1.19	17.41	300	66.42	0.3	52.93	0.33	0.75	0.67	13.40	13.20	18.57	4.87	Auxiliray (Header) Pipe Required For Service Connections
31	S10	S9	E 21	RF-12	89	53	53	18.55	4.31	0.59	0.59	0.06	0.98	200	59.27	1	32.77	0.03	1.04	0.47	14.26	13.67	18.15	3.69	
32	S7	S7A	E 24A	RF-12	89	28	28	9.8	4.36	0.317	0.317	0.03	0.53	200	40	1	32.77	0.02	1.04	0.39	14.92	14.52	17.88	2.76	
33	S7A	S8	E 24	RF-12	89	53	81	28.36	4.27	0.599	0.916	0.09	1.49	200	87.06	0.6	25.38	0.06	0.81	0.45	14.49	13.97	17.88	3.19	
34	S8	S9	E 20	RF-12	89	69	150	52.51	4.19	0.775	1.691	0.17	2.72	200	111.76	0.6	25.38	0.11	0.81	0.53	13.94	13.27	18.17	4.03	Auxiliray (Header) Pipe Required For Service Connections
35	S9	S32	–			0	1261	441.45	3.73	0	14.14	1.41	20.49	300	80.54	0.37	58.78	0.35	0.83	0.76	13.17	12.87	18.44	4.97	Auxiliray (Header) Pipe Required For Service Connections
36	FS. 96	FS. 95	E 66, E 67	CD	50	50	350	122.5	4.05	9.365	9.365	0.94	6.68	200	76.73	0.5	23.17	0.29	0.74	0.64	15.88	15.50	18.30	2.22	Future Sewer
37	FS. 95	FS. 93	E 65	IL/ C-8	90	65	815	285.12	3.86	6.195	15.56	1.56	14.28	250	136.21	0.3	32.55	0.44	0.66	0.64	15.45	15.04	18.50	2.80	Future Sewer
38	FS. 94	FS. 93	E 64	A1/C-8/RA	25	25	225	78.75	4.13	8.988	8.988	0.9	4.66	200	77.87	1	32.77	0.14	1.04	0.74	15.87	15.09	19.50	3.43	Future Sewer
39	FS. 93	FS. 92	E 63	CD	50	32	1872	655.08	3.61	5.187	29.735	2.97	30.33	300	108.45	0.42	62.62	0.48	0.89	0.88	14.99	14.53	19.10	3.81	Future Sewer
40	FS. 92	FS. 90	E 62	CD	50	50	2422	847.59	3.52	10.995	40.73	4.07	38.6	300	142.47	0.42	62.62	0.62	0.89	0.93	14.53	13.94	18.10	3.27	Future Sewer
41	FS. 91	FS. 90	E 61	RA/ CD	25	82	82	28.7	4.27	3.281	3.281	0.33	1.75	200	111.23	1	32.77	0.05	1.04	0.56	15.11	14.01	18.10	2.78	Future Sewer
42	FS. 90	S33	–			0	2504	876.29	3.51	0	44.011	4.4	39.98	300	117.94	0.5	68.33	0.59	0.97	1	13.91	13.32	18.10	3.89	Future Sewer
43	S33	S32	E 22	RF-12	89	48	2552	893.09	3.5	0.535	44.546	4.45	40.64	300	82.96	0.5	68.33	0.59	0.97	1.01	13.29	12.87	16.94	3.35	
44	S5	S6	E 14, E 27	RF-12	89	42	42	14.7	4.33	0.475	0.475	0.05	0.78	200	131.42	1	32.77	0.02	1.04	0.44	15.48	14.17	17.91	2.23	

TABLE 1: SANITARY SEWER ANALYSIS/ DESIGN - WEST CATCHMENT; (SEE DWG 04 - WEST CATCHMENT PLAN):

PROJECT: Douglas NCP Amendment
LOCATION: 0 Ave to 4 Ave, 175A St to 171 St.Surrey
A&M PROJECT NO.: 25194
SURREY PROJECT NO.:
CLIENT: Cressy Development Corporation

DATA:
AVERAGE DAILY FLOW = 350 L/S/DAY
INFILTRATION = 0.1296 L/S/HA **MANNING "n" =** 0.013
MAX. ALLOWABLE FLOW = 50%(New Sewers), 70% of Q (Existing Sewers)
POPULATION DENSITY: As shown for each land use

DATE: Dec. 5, 2006
DESIGNED BY: SKS
CHECKED BY: RJW

Line No.	Manhole From	Manhole To	Tributary Area Name/ No.	Land Use	Land Use Density (PPHa)	Sub-Catch. Pop.	Total Pop.	Total ADF (C.M/Day)	Peak Factor	Sub-Catch.A (Ha)	Tot. Catch. Area (Ha)	Infilt-ration (L/s)	Design Flow (L/s)	Pipe Data Dia. (mm)	Length (m)	Slope (%)	Capacity Qfull - (L/s)	Ratio of Qd/Qf	Vel. Full (m/s)	Actual Vel. (m/s)	Inverts at Upstr. MH (m)	Inverts at DwnStr.MH (m)	Ex/Prop Rim El. of Upstr MH	Depth of Upstr. MH (m)	Remarks
1	Ex. 65	Ex.64	W38	CPG	50	100	100	35	4.24	2	2	0.2	1.92	150	100	0.52	10.97	0.17	0.62	0.47	SEE NOTE (5)		16.69	1.78	
2	Ex. 64	Ex. 63	_			0	100	35	4.24	0	2	0.2	1.92	150	100	0.49	10.65	0.18	0.6	0.46			16.84	2.47	
3	Ex. 63	Ex. 62	_			0	100	35	4.24	0	2	0.2	1.92	150	26.22	0.42	9.86	0.19	0.56	0.43			16.57	2.71	
4	Ex. 62	Ex. 61	_			0	100	35	4.24	0	2	0.2	1.92	200	50.7	0.48	22.7	0.08	0.72	0.44			15.81	2.08	
5	Ex. 61	Ex. 60	_			0	100	35	4.24	0	2	0.2	1.92	200	102	0.37	19.93	0.1	0.63	0.41			15.85	2.39	
6	Ex. 60	Ex. 56	_			0	100	35	4.24	0	2	0.2	1.92	200	122	0.42	21.24	0.09	0.68	0.42			16.08	3.02	
7	Ex. 58	Ex. 57	W16	C-5	60	165	165	57.75	4.18	2.747	2.747	0.27	3.07	150	153	0.5	10.76	0.29	0.61	0.53			15.7	1.98	
8	Ex. 57	Ex. 56	W16A, W39	NS	8	51	216	75.6	4.14	6.34	9.087	0.91	4.53	150	80	0.48	10.54	0.43	0.6	0.58			15.57	2.63	
9	Ex. 56	Ex. 55	_			0	316	110.59	4.07	0	11.087	1.11	6.32	200	30.3	0.41	20.98	0.3	0.67	0.59			15.63	3.10	
10	Ex. 59	Ex. 55	W37	CPG	50	104	104	36.4	4.24	2.07	2.07	0.21	1.99	150	111	0.5	10.76	0.19	0.61	0.47			16.1	3.14	
11	Ex. 55	Ex. 54	W1	RM-15	103	55	475	166.25	3.99	0.538	13.695	1.37	9.04	200	92	0.41	20.98	0.43	0.67	0.64			16.5	4.11	Auxiliary (Header) Pipe Required For Service Connections
12	Ex. 54	Ex. 53	W2	RM-15	103	52	527	184.45	3.96	0.503	14.198	1.42	9.88	200	122.9	0.42	21.24	0.47	0.68	0.66			15.39	3.40	
13	Ex. 53	Ex. 52	_			0	527	184.45	3.96	0	14.198	1.42	9.88	200	58.6	0.34	19.11	0.52	0.61	0.62			15.35	3.90	
14	Ex. 52	Ex. 51	_			0	527	184.45	3.96	0	14.198	1.42	9.88	200	10	0.33	18.82	0.52	0.6	0.61			14.13	2.89	
15	FS. 85	FS. 84	W5	RF-12	89	41	41	14.34	4.33	0.465	0.465	0.05	0.77	150	50	1	15.21	0.05	0.86	0.45	11.75	11.25	13	1.10	Future Sewer
16	FS. 84	Ex. 51	_			0	41	14.34	4.33	0	0.465	0.05	0.77	200	49.3	0.35	19.39	0.04	0.62	0.3	11.18	11.00	14.66	3.28	Future Sewer
17	Ex. 51	Ex. 50	W4	RF-12	89	74	642	224.69	3.92	0.827	15.49	1.55	11.73	200	105	0.33	18.82	0.62	0.6	0.63			14.13	2.95	
18	Ex. 50	Ex. 49	W6	RF-12	89	124	766	268.09	3.87	1.395	16.885	1.69	13.7	200	95.45	0.41	20.98	0.65	0.67	0.71			15.82	5.00	Auxiliary (Header) Pipe Required For Service Connections
19	Ex. 49	Ex. 48	W4A, W9	RF-12	89	68	834	291.89	3.85	0.759	17.644	1.76	14.77	200	88.95	0.42	21.24	0.7	0.68	0.73			16.25	5.85	Auxiliary (Header) Pipe Required For Service Connections
20	FS. 83	FS. 82	W3	RF-12	89	78	78	27.3	4.27	0.879	0.879	0.09	1.44	200	31.2	1	32.77	0.04	1.04	0.53	12.19	11.88	14.5	2.11	Future Sewer
21	FS. 82	FS. 81	_			0	78	27.3	4.27	0	0.879	0.09	1.44	200	75	0.5	23.17	0.06	0.74	0.41	11.86	11.49	16	3.94	Future Sewer
22	FS. 81	FS. 80	_			0	78	27.3	4.27	0	0.879	0.09	1.44	200	35	0.5	23.17	0.06	0.74	0.41	11.47	11.29	16	4.33	Auxiliary (Header) Pipe Required For Service Connections
23	FS. 80	Ex. 48	_			0	78	27.3	4.27	0	0.879	0.09	1.44	200	12	0.5	23.17	0.06	0.74	0.41	11.27	11.21	16	4.53	Auxiliary (Header) Pipe Required For Service Connections
24	Ex. 48	Ex. 47	W11	RF-9	128	86	998	349.29	3.8	0.674	19.197	1.92	17.28	200	55.4	0.35	19.39	0.89	0.62	0.7			15.02	5.01	Auxiliary (Header) Pipe Required For Service Connections. Upsize to 250mm
25	Ex. 47	Ex. 23	W12	RM-15	103	51	1049	367.15	3.79	0.499	19.696	1.97	18.06	200	66	0.42	21.24	0.85	0.68	0.76			14.71	4.91	Auxiliary (Header) Pipe Required For Service Connections. Upsize to 250mm
26	Ex. 30	Ex. 29	W29	RF-12	89	19	19	6.7	4.38	0.215	0.215	0.02	0.36	200	98.6	0.37	19.93	0.02	0.63	0.25			18.74	3.67	
27	Ex. 29	Ex. 28	_			0	19	6.7	4.38	0	0.215	0.02	0.36	200	86.74	0.36	19.66	0.02	0.63	0.24			18.53	3.85	
28	Ex. 28	Ex. 27	W24	RF-12	89	67	86	30.15	4.26	0.75	0.965	0.1	1.58	200	84.2	0.33	18.82	0.08	0.6	0.37			18.11	3.76	
29	Ex. 27	Ex. 25	_			0	86	30.15	4.26	0	0.965	0.1	1.58	200	81.7	0.46	22.23	0.07	0.71	0.41			17.6	3.55	
30	Ex. 26	Ex. 25	W8	RF-12	89	36	36	12.6	4.34	0.409	0.409	0.04	0.67	150	104	0.81	13.69	0.05	0.77	0.4			16.94	2.42	
31	Ex. 25	Ex. 24	_			0	122	42.74	4.22	0	1.374	0.14	2.22	200	88.5	0.58	24.96	0.09	0.79	0.5			17.29	3.63	
32	FS. 87A	FS. 87	W22, W23	RF-12	89	141	141	49.35	4.2	1.584	1.584	0.16	2.56	200	98.1	1	32.77	0.08	1.04	0.62	15.21	14.23	18	2.59	Future Sewer
33	FS. 87	Ex. 24				0	141	49.35	4.2	0	1.584	0.16	2.56	200	90.1	0.5	23.17	0.11	0.74	0.49	14.21	13.76	18	3.59	Future Sewer
34	Ex. 24	Ex. 23	W10	RF-12	89	41	304	106.44	4.08	0.461	3.419	0.34	5.36	200	94.5	0.64	26.22	0.2	0.83	0.66			17.51	4.39	Auxiliary (Header) Pipe Required For Service Connections

TABLE 2: CONTINUED.....

Line No.	Manhole From	Manhole To	Tributary Area Name/ No.	Land Use	Land Use Density (PPHa)	Pop.	Total Population	Total ADF (C.M/Day)	Peak Factor	Catch. Area (Ha)	Tot. Catch. Area (Ha)	Infiltration (L/s)	Design Flow (L/s)	Pipe Data Dia. (mm)	Length (m)	Slope (%)	Capacity Qfull - (L/s)	Ratio of Qd/Qf	Vel. Full (m/s)	Actual Vel. (m/s)	Inverts at Upstr. MH (m)	DwnStr. MH (m)	Prop. Rim Elev. Of Upstr. MH	Depth of Upstr. MH (m)	Remarks
45	S15	S15A	E 28A	RF-12	89	26	26	9.1	4.36	0.292	0.292	0.03	0.49	200	30	1	32.77	0.01	1.04	0.38	15.55	15.25	17.56	1.81	
46	S15A	S2	E 28	RF-12	89	46	72	25.2	4.28	0.512	0.804	0.08	1.33	200	102.81	0.6	25.38	0.05	0.81	0.43	15.22	14.60	17.56	2.14	
47	S1	S2	E 31	RF-12	89	51	51	17.85	4.31	0.568	0.568	0.06	0.95	200	75.82	1	32.77	0.03	1.04	0.46	15.36	14.60	17.37	1.81	
48	S2	S6	E 29	RF-12	89	62	185	64.76	4.16	0.694	2.066	0.21	3.32	200	81.37	0.5	23.17	0.14	0.74	0.53	14.57	14.17	17.47	2.70	
49	S6	S31	E 25, E 30	RF-12	89	28	555	194.25	3.95	3.685	6.226	0.62	9.5	200	138.35	0.35	19.39	0.49	0.62	0.61	14.14	13.65	17.77	3.43	
50	S31	S32	E 23	RF-12	89	20	675	236.25	3.9	1.346	7.572	0.76	11.43	250	143.82	0.48	41.17	0.28	0.84	0.72	13.58	12.89	18.13	4.30	Auxiliray (Header) Pipe Required For Service Connections
51	S32	S34	E 36	RF-9	128	76	4564	1597.4	3.28	0.592	66.85	6.68	67.35	375	54.48	0.3	95.97	0.7	0.87	0.94	12.77	12.60	17.66	4.52	Auxiliray (Header) Pipe Required For Service Connections
52	S34	S35	E 37, E 38	RF-9	128	29	4893	1712.55	3.25	2.574	69.424	6.94	71.43	375	143.68	0.3	95.97	0.74	0.87	0.95	12.57	12.14	17.26	4.31	Auxiliray (Header) Pipe Required For Service Connections
53	S35	S49	–			0	4893	1712.55	3.25	0	69.424	6.94	71.43	375	63.18	0.85	161.54	0.44	1.46	1.42	12.11	11.58	16.38	3.89	
54	S54	S49	E 39	RF-9	128	20	120	42	4.22	0.939	0.939	0.09	2.15	200	122.7	1	32.77	0.07	1.04	0.59	12.98	11.75	14.96	1.78	
55	S48	S36	E 45A	RF-12	89	61	61	21.35	4.3	0.685	0.685	0.07	1.13	200	111.74	1	32.77	0.03	1.04	0.49	13.87	12.75	17.06	2.99	
56	S36	49	E 45	RF-12	89	49	110	38.5	4.23	0.549	1.234	0.12	2.01	200	111.74	0.87	30.57	0.07	0.97	0.55	12.72	11.75	16.46	3.54	
57	S49	S50	E 44	RF-12	89	43	5166	1808.1	3.23	0.487	72.084	7.21	74.84	450	71.11	0.25	142.47	0.53	0.9	0.91	11.50	11.32	15.49	3.54	
58	S55	S53	E 40	RF-9	128	52	52	18.2	4.31	0.408	0.408	0.04	0.95	200	62.21	1	32.77	0.03	1.04	0.46	13.10	12.48	15.06	1.76	
59	S53	50	E 41	RF-9	128	57	209	73.15	4.14	1.223	1.631	0.16	3.67	200	150.96	0.6	25.38	0.14	0.81	0.58	12.45	11.54	14.21	1.56	
60	S56	S47	E 50	RF-12	89	42	42	14.7	4.33	0.474	0.474	0.05	0.78	200	51.94	1	32.77	0.02	1.04	0.44	13.16	12.65	16.93	3.57	
61	S57	S60	E 32	RF-12	89	42	42	14.7	4.33	0.476	0.476	0.05	0.78	200	79.81	1	32.77	0.02	1.04	0.44	15.11	14.31	17.49	2.18	
62	S60	S61	E 34	RF-12	89	51	93	32.55	4.25	0.573	1.049	0.1	1.71	200	119.05	0.6	25.38	0.07	0.81	0.46	14.28	13.56	17.85	3.37	
63	S61	S62	E 51	RF-12	89	62	155	54.25	4.19	0.694	1.743	0.17	2.8	200	98.8	0.6	25.38	0.11	0.81	0.53	13.53	12.94	17.21	3.48	
64	S38	S58	E 33	RM-15/RF-9	110	97	97	33.95	4.25	0.881	0.881	0.09	1.76	200	106.39	1	32.77	0.05	1.04	0.56	15.05	13.98	17.53	2.29	
65	S58	S59	E 52	RM-15/RF-9	110	82	179	62.66	4.17	0.743	1.624	0.16	3.18	200	99.17	0.6	25.38	0.13	0.81	0.56	13.95	13.36	17.14	2.99	
66	S69	S59	E 53A	RF-12	89	31	31	10.85	4.35	0.345	0.345	0.03	0.58	200	55.54	1	32.77	0.02	1.04	0.4	13.91	13.36	17.1	2.99	
67	S59	S62	E 53	RF-12	89	39	249	87.16	4.11	0.438	2.407	0.24	4.39	200	77.01	0.5	23.17	0.19	0.74	0.57	13.33	12.94	16.95	3.42	
68	S62	S47	E 49	RF-12	89	34	438	153.31	4	0.384	4.534	0.45	7.56	200	66.48	0.4	20.73	0.36	0.66	0.61	12.91	12.65	16.87	3.76	
69	S47	S37	E 46	RF-12	89	66	546	191.1	3.95	0.747	5.755	0.58	9.32	200	111.74	0.4	20.73	0.45	0.66	0.65	12.62	12.17	16.6	3.79	
70	S37	S50	E 46A	RF-12	89	56	602	210.7	3.93	0.626	6.381	0.64	10.23	250	111.74	0.56	44.47	0.23	0.91	0.74	12.12	11.49	15.91	3.54	
71	S50	S51	E 43	RF-9/12	105	37	6014	2104.91	3.17	0.353	80.449	8.04	85.27	450	96.05	0.18	120.89	0.71	0.76	0.83	11.29	11.12	15.01	3.27	
72	S40	S40A	E 35A	RF-9	128	53	53	18.55	4.31	0.417	0.417	0.04	0.97	200	39.17	1	32.77	0.03	1.04	0.47	15.20	14.80	17.38	1.98	
73	S40A	S41	E 35	RF-9	128	92	145	50.75	4.2	0.721	1.138	0.11	2.58	200	83.33	0.6	25.38	0.1	0.81	0.52	14.77	14.27	17.38	2.41	
74	S73	S41	E 57	RF-12	89	36	36	12.6	4.34	0.405	0.405	0.04	0.67	200	93.8	1	32.77	0.02	1.04	0.42	15.21	14.27	16.9	1.49	
75	S41	S42	E 56	RF-12	89	73	254	88.89	4.11	0.818	2.361	0.24	4.46	200	124.5	0.5	23.17	0.19	0.74	0.57	14.24	13.62	17.5	3.06	
76	S80	S80A	E 60A	RF-12	89	36	36	12.6	4.34	0.403	0.403	0.04	0.67	200	40	1	32.77	0.02	1.04	0.42	15.15	14.75	16.7	1.35	
77	S80A	S83	E 60	RF-12	89	75	111	38.84	4.23	0.848	1.251	0.13	2.03	200	117.8	0.6	25.38	0.08	0.81	0.49	14.75	14.04	16.7	1.75	
78	S85	S83	E 58	RF-12	89	34	34	11.9	4.35	0.386	0.386	0.04	0.64	200	55.4	1	32.77	0.02	1.04	0.42	14.60	14.04	16.8	2.00	
79	S83	S42	E 55	RF-12	89	49	194	67.89	4.15	0.55	2.187	0.22	3.48	200	78.5	0.5	23.17	0.15	0.74	0.53	14.01	13.62	17.5	3.29	
80	S42	S43	–			0	448	156.79	4	0	4.548	0.45	7.71	200	101.1	0.4	20.73	0.37	0.66	0.61	13.59	13.19	17.4	3.61	
81	S81	S81A	E 59A	PH	22	8	8	2.8	4.42	0.355	0.355	0.04	0.18	200	40	1	32.77	0.01	1.04	0.28	14.79	14.39	17.2	2.21	
82	S81A	S82	E 59	PH	22	21	29	10.15	4.36	0.957	1.312	0.13	0.64	200	113.8	0.6	25.38	0.03	0.81	0.35	14.36	13.68	17.2	2.64	
83	S82	S43	E 54	PH	22	13	42	14.7	4.33	0.571	1.883	0.19	0.92	200	76.6	0.6	25.38	0.04	0.81	0.38	13.65	13.19	17.4	3.55	
84	S43	S44	E 48	PH	22	21	511	178.83	3.97	0.948	7.379	0.74	8.95	200	150	0.4	20.73	0.43	0.66	0.64	13.16	12.56	17.48	4.12	
85	S44	S39	E 47A	PH	22	21	532	186.18	3.96	0.942	8.321	0.83	9.37	200	150	0.4	20.73	0.45	0.66	0.65	12.54	11.94	16.64	3.90	
86	S39	S51	E 47	PH	22	18	550	192.48	3.95	0.804	9.125	0.91	9.72	200	144.45	0.4	20.73	0.47	0.66	0.65	11.92	11.34	15.05	2.93	
87	S51	S52	E 42	RF-9	128	37	6701	2345.34	3.12	1.074	90.648	9.06	93.89	450	163.57	0.39	177.94	0.53	1.12	1.14	11.09	10.45	14.05	2.51	
88	S52	P. S.	–			0	6701	2345.34	3.12	0	90.648	9.06	93.89	450	5.5	0.39	177.94	0.53	1.12	1.14	10.42	10.40	12.48	1.61	TIE-IN INVERT = 10.4m

NOTES:

(1)- APPROXIMATE DEPTH OF UPSTREAM MANHOLE IS BASED ON PROPOSED SLOPE AND APPROXIMATE EXISITNG GROUND ELEVATIONS

(2)- SEWER DEPTHS/ PROFILES ARE SUBJECT TO FURTHER IMPROVEMENT DURING THE FINAL DESIGN OF ROAD PROFILES AND GRADING OF LOTS

(3)- AN AUXILIRAY HEADER PIPE AT SHALLOWER DEPTH SHALL BE INSTALLED PARALELL TO ALL SEWER MAINS DEEPER THAN 4m. SERVICE CONNECTIONS TO BE TIED-IN TO AUXILIRALY HEADER PIPES.

(4)- SEE AS-BUILT DRAWINGS FOR INVERT ELEVATIONS OF EXISTING SEWERS.

(5)- Ex..... DENOTES EXISTING MANHOLE, FS..... DENOTES FUTURE MANHOLE. S.... DENOTES PROPOSED MANHOLE FOR CURRENT DEVELOPMENT APPLICATIONS IN DOUGLAS AREA.

(6)- E..... DENOTES SUBCATCHMENT AREA NUMBER IN EAST CATCHMENT

TABLE 1: CONTINUED.....

Line No.	Manhole From	Manhole To	Tributary Area Name/ No.	Land Use	Land Use Density (PPHa)	POP.	Total Population	Total ADF (C.M/Day)	Peak Factor	Catch. Area (Ha)	Tot. Catch. Area (Ha)	Infiltration (L/s)	Design Flow (L/s)	Pipe Data Dia. (mm)	Length (m)	Slope (%)	Capacity Qfull - (L/s)	Ratio of Qd/Qf	Vel. Full (m/s)	Actual Vel. (m/s)	Inverts at Upstr. MH (m)	DwnStr.MH (m)	Ex/Prop Rim El. of Upstr MH	Depth of Upstr. MH (m)	Remarks
35	FS. 88A	FS. 88	W20, W20A	RF-9	128	259	259	90.65	4.1	2.025	2.025	0.2	4.51	200	98.1	1	32.77	0.14	1.04	0.73	14.79	13.81	17.5	2.51	Future Sewer
36	FS. 88	Ex. 23				0	259	90.65	4.1	0	2.025	0.2	4.51	200	90.1	0.5	23.17	0.19	0.74	0.57	13.78	13.33	17.5	3.52	Future Sewer
37	Ex. 23	Ex. 22	–			0	1612	564.24	3.66	0	25.14	2.51	26.39	250	71.9	0.47	40.74	0.65	0.83	0.89			16.4	6.90	Auxiliary (Header) Pipe Required For Service Connections
38	Ex. 22	Ex. 90	–			0	1612	564.24	3.66	0	25.14	2.51	26.39	250	26	0.61	46.41	0.57	0.95	0.98			16.57	7.43	
39	FS. 89A	FS. 89	W19	RF-9	128	84	84	29.4	4.26	0.659	0.659	0.07	1.52	200	95.1	1	32.77	0.05	1.04	0.54	13.72	12.77	16.5	2.58	Future Sewer
40	FS. 89	Ex. 90				0	84	29.4	4.26	0	0.659	0.07	1.52	200	95.1	0.5	23.17	0.07	0.74	0.42	12.74	12.26	16.5	3.56	Future Sewer
41	Ex. 90	Ex. 1	W13	RM-15	103	76	1772	620.25	3.63	0.734	26.533	2.65	28.68	250	46.1	0.61	46.41	0.62	0.95	1			16.67	7.71	Auxiliary (Header) Pipe Required For Service Connections
42	FS. 9	EX. 8	W25, W26	RF-12	89	65	65	22.75	4.29	0.735	0.735	0.07	1.2	200	67	1	32.77	0.04	1.04	0.5			18.55	1.74	Future Sewer
43	Ex. 8	Ex. 7	W27	RF-9	128	42	107	37.44	4.24	0.332	1.067	0.11	1.94	200	70	0.5	23.17	0.08	0.74	0.45			18.72	2.60	Upsize to 200mm
44	Ex. 7	Ex. 6	W21	RF-9	128	54	161	56.34	4.18	0.419	1.486	0.15	2.88	200	90.3	0.85	30.21	0.1	0.96	0.61			18.47	2.72	
45	Ex. 6	Ex. 5	W21A, W28	RF-9	128	115	276	96.6	4.09	0.901	2.387	0.24	4.82	200	90	0.54	24.08	0.2	0.77	0.6			18.14	3.18	
46	Ex. 5	Ex. 4	W18	RF-9	128	50	326	114.1	4.06	0.39	2.777	0.28	5.64	300	119.3	0.43	63.36	0.09	0.9	0.56			17.78	6.88	Auxiliary (Header) Pipe Required For Service Connections
47	Ex. 4	Ex. 3	W17	RM-15	103	141	467	163.45	3.99	1.37	4.147	0.41	7.96	300	12	0.48	66.95	0.12	0.95	0.64			16	5.64	Auxiliary (Header) Pipe Required For Service Connections
48	Ex. 3	Ex. 2	–			0	467	163.45	3.99	0	4.147	0.41	7.96	300	60	0.43	63.36	0.13	0.9	0.62			16	5.71	Auxiliary (Header) Pipe Required For Service Connections
49	Ex. 2	Ex. 1	–			0	467	163.45	3.99	0	4.147	0.41	7.96	300	66.2	0.43	63.36	0.13	0.9	0.62			15.96	5.95	Auxiliary (Header) Pipe Required For Service Connections
50	Ex. 1	Ex.199	–			0	2239	783.69	3.55	0	30.68	3.07	35.24	375	42	0.34	102.17	0.34	0.92	0.84			15.77	7.11	Auxiliary (Header) Pipe Required For Service Connections
51	Ex. 20	Ex. 19	W36	RF-12	89	19	19	6.65	4.38	0.214	0.214	0.02	0.36	200	39.26	0.8	29.31	0.01	0.93	0.32			16.71	2.63	
52	Ex. 19	Ex. 18	–			0	19	6.65	4.38	0	0.214	0.02	0.36	200	7.06	0.5	23.17	0.02	0.74	0.27			16.65	2.91	
53	Ex. 18	S102	W14	RM-15	103	171	190	66.5	4.16	1.664	1.878	0.19	3.39	200	57.9	0.8	29.31	0.12	0.93	0.62			16.74	3.05	
54	S99	S97	W34	RF-12	89	34	34	11.9	4.35	0.386	0.386	0.04	0.64	200	44.8	1	32.77	0.02	1.04	0.42	13.00	12.55	16.4	3.20	Proposed Sewer
55	S98	S97	W33	RF-12	89	63	63	22.05	4.29	0.704	0.704	0.07	1.17	200	63.4	1	32.77	0.04	1.04	0.5	13.19	12.55	16.6	3.22	Proposed Sewer
56	S97	S102	W35	RF-12	89	28	125	43.76	4.22	0.314	1.404	0.14	2.28	200	59.3	0.5	23.17	0.1	0.74	0.47	12.52	12.22	16.5	3.78	Proposed Sewer
57	S102	Ex. 17				0	315	110.26	4.07	0	3.282	0.33	5.52	200	26.6	0.8	29.31	0.19	0.93	0.72	12.19	11.98	16.6	4.21	Auxiliary (Header) Pipe Required For Service Connections
58	Ex. 17	Ex. 15	W15	RM-15	103	165	480	168.01	3.98	1.603	4.885	0.49	8.23	200	82.4	0.87	30.57	0.27	0.97	0.83			16.5	4.34	Auxiliary (Header) Pipe Required For Service Connections
59	Ex. 15	Ex. 199	–			0	480	168.01	3.98	0	4.885	0.49	8.23	200	95.9	1.11	34.53	0.24	1.1	0.9			16.12	4.70	Auxiliary (Header) Pipe Required For Service Connections
60	Ex. 199	P. S.	–			0	2719	951.7	3.48	0	35.565	3.56	41.87	300	4.9	1.43	115.55	0.36	1.63	1.51		8.13	14.3	5.80	Tie-in Invert = 8.13m

NOTES:

(1)- APPROXIMATE DEPTH OF UPSTREAM MANHOLES ARE BASED ON AS-BUILT DRAWINGS AND SURVEY INFORMATION

(2)- LAYOUT OF FUTURE SEWERS ARE SHOWN AS PER ORIGIONAL DOUGLAS NCP SANITATY LAYOUT

(3)- SEWER DEPTHS/ PROFILES ARE SUBJECT TO FURTHER IMPROVEMENT DURING THE FINAL DESIGN OF ROAD PROFILES AND GRADING OF LOTS

(4)- AN AUXILIARY HEADER PIPE AT SHALLOWER DEPTH SHALL BE INSTALLED PARALLEL TO ALL SEWER MAINS DEEPER THAN 4m.
SERVICE CONNECTIONS TO BE TIED-IN TO AUXILIRALY HEADER PIPES.

(5)- SEE AS-BUILT DRAWINGS FOR INVERT ELEVATIONS OF EXISTING SEWERS.

(6)- Ex..... DENOTES EXISTING MANHOLE, FS..... DENOTES FUTURE MANHOLE.
S.... DENOTES PROPOSED MANHOLE FOR CURRENT DEVELOPMENT APPLICATIONS IN DOUGLAS AREA.

(7)- E..... DENOTES SUBCATCHMENT AREA NUMBER IN EAST CATCHMENT