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CORPORATE REPORT

NO: R237 COUNCIL DATE: November 15, 2010

REGULAR COUNCIL

TO: **Mayor & Council** DATE: **November 15, 2010**

FROM: **General Manager, Planning and Development** FILE: **6520-20 (GH#2/Sunnyside)**

SUBJECT: **Sunnyside Heights (Grandview Heights Neighbourhood #2) - Stage 2 Final Report – Approval of NCP**

RECOMMENDATION

The Planning and Development Department recommends that Council:

1. Approve the Neighbourhood Concept Plan ("NCP") for Sunnyside Heights, which is attached as Appendix I to this report;

2. Approve the design guidelines specified in the NCP for managing the development of and the servicing and financing strategy contained in the NCP for providing services, amenities and facilities for the Sunnyside Heights neighbourhood; and

3. Instruct the City Clerk to introduce the necessary by-law to amend Surrey Zoning By-law, 1993, No. 12000 (the "Zoning By-law"), as documented in Appendix II to this report, which will require the payment of amenity contributions by new development in the Sunnyside Heights NCP area, based on the density bonus concept.

PURPOSE

The purpose of this report is to advise Council about and obtain Council approval for the:

- complete and final NCP for the Sunnyside Heights area;

- adjustments to the Stage 1 Land Use Plan; and

- funding mechanisms for amenities proposed for the Sunnyside Heights NCP area and the associated Zoning By-law amendment.

A separate report from the Engineering Department describes the engineering servicing infrastructure required for and the related funding arrangements associated with the development concept contained in this report.

BACKGROUND

The area covered by Sunnyside Heights NCP is the triangle of land bounded by 24 Avenue to the north, 168 Street to the east and the Highway 99 Corridor Local Area Plan area to the west. It contains 206 individual properties and comprises some 163 hectares (402 acres).

On June 20, 2005, Council approved the Grandview Heights General Land Use Plan (Corporate Report No. C012), which provided the broad land use and servicing concept for the overall Grandview Heights area. That Plan set out a vision for Grandview Heights as a complete community with a mix of residential densities, small commercial nodes, community facilities, schools, parks, pathways and clusters of trees and other protected areas.

The General Land Use Plan defined the boundaries for five separate NCP areas. On April 4, 2005, Council authorized staff to prepare a Terms of Reference for the development of an NCP for the area known as NCP#2 (Corporate Report No. R067), which has since been renamed as the Sunnyside Heights Neighbourhood.

On July 26, 2007, Council approved, the Stage 1 Land Use Plan for the Sunnyside Heights NCP (this Land Use Plan is attached as Appendix III) and authorized staff to proceed with the Stage 2 detailed planning of the NCP (Corporate Report No. R194).

DISCUSSION

Overview of the Land Use Concept Plan

The proposed Stage 2 Land Use Concept Plan (attached as Appendix IV) features a mix of land uses, including a range of residential housing densities, commercial and plaza areas, neighbourhood parks, trail and pathways, a riparian area and an elementary school.

The residential densities shown in the concept plan range from apartments and townhouses to single family dwellings. The highest densities are located on the west side of the plan, adjacent to the Grandview Corners commercial area at 160 Street & 24 Avenue and the planned Business Park Uses in the Highway 99 Corridor Plan area. Cluster Housing designations have been used in key areas of the plan to allow for the retention of valuable trees stands. The majority of proposed single family residential development is located in the central and easterly parts of the plan, with larger sized lots closer to the Agricultural Land Reserve ("ALR") to the south.

Two neighbourhood commercial areas are proposed in the plan area. One small neighbourhood centre is proposed on the southwest corner of 20 Avenue and 164 Street. The second commercial area, located at the south east corner of 168 Street and 24 Avenue, is proposed as a mixed-use development with commercial at ground level and residential above. The commercial area at this second site will include a public plaza, public seating, public art features, and a central open space to accommodate public gatherings or a farmer's market.

Three neighbourhood parks are proposed in key locations to provide residents with recreational areas that offer both active and natural space. An elementary school site is proposed adjacent to the larger, centrally located park.

The Grandview Ridge Trail, a continuous two kilometre recreational trail situated at the top of the slope, will connect the northerly and southerly parts of the neighbourhood. The trail will accommodate a range of users, provide significant viewpoints, and connect two of the three parks. Seating areas, signage and trail markers will be provided at key points along the trail.

A riparian area is located along the 164 Street unopened road right-of-way. A Class B watercourse is located within the riparian area and a segment of the proposed Grandview Ridge Trail runs along this riparian area.

The overall street structure of the plan is based on a modified grid pattern to promote connectivity for pedestrians, cyclists, and automobiles. All streets will include sidewalks and provide on-street parking opportunities. A special standard of street cross-section, a "flexible" street, has been introduced to allow changes in alignment for tree preservation and pedestrian connectivity.

The NCP area features a sustainable, low impact storm water management system. A series of drainage corridors designed to mimic natural infiltration will be constructed in the boulevards and medians of key roads. These corridors will be constructed in the form of bio-swales on local road boulevards and planted median strips on portions of key collector roads.

Public Consultation

An integrated, multi-stakeholder approach to the planning process was used to arrive at the preferred Stage 1 Land Use Concept, which formed the basis for the Stage 2 Land Use Concept Plan. The following provides a brief overview of the consultation that was undertaken in relation to the development of the NCP:

The Sunnyside Heights Citizen Advisory Committee

A Citizen Advisory Committee ("CAC") was established early in the NCP planning process. The objective of the CAC, consisting of 27 individuals, some being owners of property located within the plan area and some being residents of the surrounding neighbourhoods, was to bring local knowledge and community concerns to the planning process and to involve residents in addressing concerns. The CAC met monthly through the Stage 1 planning process to provide input into the development of the Land Use Concept and at key points during Stage 2 as Engineering servicing and financing strategies were being finalized.

Public Meetings

Public meetings/open houses were held at key milestones during the NCP planning process to provide opportunities for interested parties to comment on development concepts and preliminary sustainable development standards for drainage, utilities, and transportation infrastructure.

Modifications to the Stage 1 Land Use Concept Plan

While the proposed Stage 2 Land Use Plan is similar to the approved Stage 1 Land Use Concept Plan, there are a few key changes. A number of issues were to be resolved prior to Stage 2 completion; some of these issues involved modifications to the Stage 1 Land Use Plan. A modified Land Use Plan was presented at an Open House on May 18, 2010 (Appendix V).

The comments received from the public at and after the Open House were taken into consideration by Planning staff in completing the Stage 2 Land Use Plan for the NCP. The major changes between the Stage 1 Land Use Plan (Appendix III) and the proposed final (Stage 2) Land Use Plan (Appendix IV) are described in the following sections. The heading on each of the following sections identifies the respective appendix to this report that illustrates the area to which the section is referring.

Residential and Commercial Land Use Changes (Appendix VI)

<u>Cluster Residential</u>

One of the issues to be resolved in Stage 2 of the NCP process was identification of "Cluster Residential" areas with a view to preserving valuable stands of trees identified in the Environmental Study for the NCP.

To assist in determining the appropriate areas for the Cluster Residential development, a tree study was conducted by Fadum & Associates during the Stage 2 planning process. This study supplemented the Environmental Study prepared by Enkon Environmental Services in during the Stage 1 component. While the Enkon study identified important treed areas for wildlife and habitat, the Fadum report built on these findings and also identified valuable trees with individual specimen value.

The Cluster Residential Designations have been identified on the Stage 2 Land Use Concept and are highlighted in Appendix VI as Areas "A." These sites will provide between 30% and 40% open space. In exchange, the density from the land provided for open space will be transferred to the remaining portion of the site area, thus creating a higher net density on this remaining portion of each such site.

<u>Multiple Residential 10-15 upa</u>

The Stage 1 Plan identified an area along 165A Street to the east of the Grandview Ridge Trail (shown as Area "B" in Appendix VI) as "Medium Density 10-15 Units per acre." Further analysis of the plan during Stage 2 showed that single family development on these properties would be problematic due to the irregular shape and shallow depth of the existing lots. As a result, the designation was changed to "Multiple Residential 10-15 units per acre," to encourage a strata type of development on these sites. The multi-family built form also improves the transition between the apartments that are proposed to the west and the single family detached dwellings that are proposed to the east.

<u>Transition Density Area</u>

After the Public Open House in May 2010, some of the owners of the properties located along 168 Street, north of 20 Avenue, requested that the transition density designation of "up to 8 units per acre" be re-examined. They suggested that higher densities are appropriate along an arterial street (168 Street), and adjacent to the "Mixed Use Commercial 15-25 units per acre" designation that is proposed at 24 Avenue and 168 Street.

The original intent of the transitional density ("up to 8 units per acre") was to provide a reasonable interface between the "Low Density Residential 6-10 units per acre" to the west of 168 Street and the suburban-sized lots on the east side of 168 Street. During Stage 1 of the NCP process, some of the residents from the east side of 168 Street, expressed concern about the interface between the smaller lot sizes proposed in the NCP area along the west side of 168 Street and their larger sized lots on the east side of the plan area. Specifically, they indicated that that situating smaller lot sizes across the west side of 168 Street would impact their property values.

To determine opinion of the owners of the properties on the east side of 168 Street about higher density residential development on the west side of 168 Street, staff undertook a telephone survey of the owners of the properties on the east side of 168 Street to the north of 20 Avenue. The survey results showed that four of the nine households surveyed preferred to see the density increased, two households did not want to see the density increased, and two expressed no preference. One property owner did not respond.

Based on the survey, the density between 24 Avenue and 20 Avenue along 168 Street, (shown as area "C" on Appendix VI) has been increased from "Up to 8 units per acre" to "6-10 units per acre". The densities between 20 Avenue and 16 Avenue along 168 Street have not been adjusted because of their closer proximity to the ALR boundary. The requirement for a 5 metre planted buffer along the frontage of the lots facing 168 Street will remain to help reduce the impact of traffic noise along the arterial.

<u>Neighbourhood Commercial at 20 Avenue and 164 Street</u>

A "Neighbourhood Commercial" land use designation for a triangle portion of a lot located at the southwest corner of 20 Avenue and 164 Street was to be explored during Stage 2 of the NCP planning process (shown as area "D" on Appendix VI). The western portion of this site is encumbered by a BC Hydro right-of–way, leaving the remainder, a small triangular-shaped portion, for development. After examining the site in more detail it was determined that a commercial building could be located on the property and parking could be accommodated on the Hydro right-of-way area. As a result, the designation for this site has been changed to Neighbourhood Commercial.

Parks and Trail Changes (as shown on Appendix VII)

<u>Neighbourhood Park at 162 Street and 23 Avenue</u>

The Stage 1 Land Use Plan showed one of the Neighbourhood Park sites located on the southeast corner of 162 Street and 23 Avenue. The Tree Study revealed that trees on this site were mainly Cottonwood and Alder and would not have a long life span. A stand of Douglas-Fir trees were identified on the adjacent site to the east (shown as area "E" on Appendix VII). This particular tree stand was located in the open and would, therefore, be more likely to be wind firm. The topography of the easterly site is also sufficiently flat to accommodate a playground. As a result, the Neighbourhood Park has been relocated to the easterly site.

For this park site, the alignment and cross section of the proposed road straddling the property line has been shifted slightly to the east to ensure that the tree stand is not disturbed by road construction; however, the final alignment of the proposed road will be determined at the development application stage.

Neighbourhood Park south of 18 Avenue

The Neighbourhood Park located along the south side of 18 Avenue has been reconfigured to an "L" shape to better protect Maple Trees that were identified in the Tree Study (Park shown as area "F" on Appendix VII). The new shape allows for the preservation of the Maples on the west side of the Park, and includes a relatively flat and open area for programmable space on the easterly side of the proposed park.

Grandview Ridge Trail

Modifications to the alignment and cross section of the Grandview Ridge Trail were made during Stage 2 of the NCP process. These areas are shown as areas "G" on Appendix VII. The northerly portion of the trail has been shifted and combined with the road right-of-way along portions of 163 Street, 22 Avenue, and 20 Avenue. Since the road allowance provides five metres for a sidewalk and planted tree boulevard, the Grandview Ridge Trail cross-section has been modified at these locations. In these areas, the additional right-of-way for the Grandview Ridge Trail will be 10 metres.

Area "H" shows the Grandview Ridge Trail adjacent to road and drainage corridor at 22 Avenue, between 163 Street and 164 Street. The road allowance at this location includes a five metre drainage corridor, two metre sidewalk and two metres for boulevard. As a result, the required Trail right-of way will be reduced to five metres at this location. This allowance will allow for additional landscaping and tree planting.

Along the unopened 164 Street riparian area, the Trail alignment has been shifted to the east so that the trail now runs through almost the entire length of the riparian area in the 164 Street unopened road-right-of-way (shown as area "I" on Appendix VII). The right-of-way currently contains a gravel path over a newly installed water main. Since the right-of-way currently exists, additional lands will not be required to accommodate the Trail in this area.

Placemaking Update

Design Guidelines

During Stage 2 of the NCP process, a set of Design and Development Guidelines was established to help guide development in the NCP. Section 3 of the NCP (Appendix I) contains Design Guidelines for the Residential, Neighbourhood Commercial, Mixed Use Commercial, and Grandview Ridge Trail. The purpose of the Design Guidelines is to achieve a pedestrian-friendly, high quality and co-coordinated neighbourhood that is consistent with the principles and objectives of sustainable development. The Design Guidelines describe the dominant characteristics that will be encouraged in these areas. Issues addressed by the Design Guidelines include the relationship of buildings to streets, built form and character, parking, and design considerations for crime prevention.

Character Plan

The Stage 1 Land Use Concept identified several elements that would contribute to the creation of a sense of place within the NCP. These included community landmarks, entrance features, trail markers, seating areas and a public square. As part of the Stage 2 work, these elements have been further refined and detailed in the Design Guidelines and are highlighted in the Character Plan (attached as Appendix VIII).

The following features are included in the Character Plan:

- Gateway features at key entrance points into the community;
- Trail markers at the entrances to the Grandview Ridge Trail and viewpoints with seating areas where the south western exposure grants views toward the ocean and the Semiahmoo Peninsula;
- A public square/gathering place integrated into the mixed use commercial development at 24 Avenue and 168 Street; and
- Public spaces in the mixed use commercial area containing street furniture, special decorative light standards, walkways, and special landscaped areas.

Land Consolidation

Within the plan area there are a number of smaller acreage parcels and irregular shaped lots. Lot consolidation is required to ensure efficient and feasible development of these properties. These land consolidation opportunities will be determined on a case-by-case basis at development application stage. In some cases; however, consolidation requirements are identified in the Land Use Plan to avoid creating remnant pieces that could not develop on their own. These areas have been identified in Appendix IX.

Land Use Statistics

The area of land allocated within the Stage 2 Land Use Plan for each land use type, the estimated number of dwelling units, the population of the area and the potential commercial floor area at build out are summarized in the following sections:

Residential

The Stage 2 Land Use Plan provides for 91 hectares (224 acres) of Residential-designated land. The Land Use Plan anticipates between 2,750 dwelling units and 4,250 dwelling units to be constructed in the area at build out. Based on an average ratio of 2.8 persons per dwelling unit, the build-out population of Sunnyside Heights will be between 7,400 and 11,500 persons.

Commercial

The Land Use Plan allocates a total of 1.4 hectares (3.5 acres) to Commercial designations. At the build-out stage, approximately 930 square metres (10,000 square feet) of commercial space will be developed.

Institutional Uses and Schools

The land designated for a school amounts to 2 hectares (5 acres).

Parks and Open Space

Parks, greenways and riparian areas occupy 12 hectares (30 acres) of land within the plan area.

A table summarizing the land use statistics is attached as Appendix X.

Amenity Requirements

To address the amenity needs of the development in Sunnyside Heights, all development proposals at the time of rezoning or building permit issuance will be required to make a monetary contribution toward the provision of new police, fire protection and library services and toward the development of the parks, open spaces and pathways.

The monetary contribution toward police, fire and library materials will offset the capital costs of providing these services to the new development and are applied on a standardized basis in all of Surrey's NCP areas. The monetary contributions toward parks, open spaces and pathway development are based upon an estimate of the capital costs of these improvements for this particular NCP area. The total cost is divided by the anticipated number of dwelling units and acreages in the case of non-residential development to ensure an equitable contribution arrangement.

Parkland Development

The Sunnyside Heights community will contain one neighbourhood school/park site, two neighbourhood park areas, and a riparian area. The Open Space areas include the Grandview Ridge Trail, a 2 kilometre trail that runs at the top of a ridge line running north –south through the plan area. Portions of this trail run through park areas and portions run through multi-family sites.

The neighbourhood park areas will be designed in view of good place-making and will incorporate water features, public gathering spaces and other amenities that will make lively vibrant areas within the neighbourhood (see Figure 1).

Figure 1 – Example of Place-making Elements in a Park

Two gateway features are to be constructed at 20 Avenue and 168 Street at the eastern entrance to Sunnyside Heights from 168 Street. The remaining entrance features will be constructed through the development of multi- family sites.

The estimated cost of developing park and related amenities in the Sunnyside Heights community is approximately $2,972,427.00. This amount includes the construction of the gateway features along 168 Street. This will require an amenity contribution of $1,082.00 (in 2010 dollars) per dwelling unit.

Library and Library Material

A study of library requirements in Surrey's new neighbourhoods has established that a contribution of $135.54 (in 2010 dollars) per dwelling unit (non-residential development is exempt) is necessary to cover the capital costs for library materials, which are sensitive to population growth. Consequently, a total of approximately $372,463.92 will be collected from new development in Sunnyside Heights towards materials such as books, computers and CDs.

Fire and Police Protection

Future development in this neighbourhood will drive the need to upgrade existing fire and police protection facilities. A study of fire protection requirements in Surrey's new neighbourhoods has established that a contribution of $260.24 per dwelling unit and $1,040.96 per acre of non-residential development (in 2010 dollars) will cover the capital costs for fire protection. A contribution of $60.25 per dwelling unit and $240.92 per acre of non-residential development will cover the capital costs for police protection. This will result in a total capital contribution from Sunnyside Heights of approximately $1,002,444.48 toward fire protection and $232,060.92 toward police protection.

Summary of Funding Arrangements

A summary of the amenity contributions (per dwelling unit or hectare/acre) that will payable on new development and the estimated revenue the City can expect to receive from the Sunnyside Heights NCP area is documented in the following table.

SUNNYSIDE HEIGHTS NEIGHBOURHOOD CONCEPT PLAN AMENITY CONTRIBUTIONS			
	Per Unit Contribution All Residential ***Approx. 2748 dwelling units (@ base densities as per Table 5.1, Section 5 of the NCP)***	**Per Acre Contribution All Non-Residential** ***Approx. 276 acres 112 ha.)***	**Anticipated Revenue**
Police Protection	$60.25 per dwelling	$240.92 per acre	$232,060.92
Fire Protection	$260.24 per dwelling	$1,040.96 per acre	$1,002,444.48
Development of Park/Pathways and Placemaking Features	$1,082.00 per dwelling	n/a	$2,973,336.00
Library Materials	$135.54 per dwelling	n/a	$372,463.92
Total Contribution (per unit or per acre)	**$1,538.03 per dwelling**	**$1,281.88 per acre**	
Total Anticipated Revenue	$4,226,506.44	$353,798.88	$4,580,305.32

The above-noted per unit amenity contributions are derived from estimated base densities in the residential designations and the number of anticipated dwelling units (excluding any coach houses and secondary suites) (Table 5.1 in Section 5 of Appendix I). The estimated costs of the various amenities are distributed evenly to each dwelling unit. Therefore, if the number of dwelling units in a proposed development is lower than that anticipated by the NCP, the applicant will be expected to "top up" the amenity fees based on the number of the dwelling units used to calculate the amenity charge to ensure that there is no shortfall in the funding for the proposed amenities.

Implementation of the NCP

Official Community Plan Amendments

The entire area covered by the Sunnyside Heights NCP is currently designated Suburban in the Official Community Plan ("OCP"). Although the NCP Land Use Plan anticipates changes to the OCP designations in Sunnyside Heights, the determination of the precise boundaries of these changes cannot be established until a detailed survey plan is presented with each development application. It is, therefore, recommended that any necessary changes to the OCP designations in the Sunnyside Heights area proceed concurrently with site specific rezoning applications, as has been the City's convention over time.

Design Guidelines

In the case of single family residential developments, the Design Guidelines will be implemented through the process of reviewing and approving subdivision plans and in developing building schemes. In the case of row houses, town houses and other multiple family residential developments, and commercial developments, the Design Guidelines will be implemented through the process of reviewing and approving the related Development Permits.

Zoning By-law Amendment

To enact the amenity contribution requirements, the Zoning By-law requires an amendment to add Sunnyside Heights to the list of NCPs within which monetary contributions are required from new development. The proposed amendment to Schedule G of the Zoning By-law, to incorporate the amenity fees for Sunnyside Heights, is contained in Appendix II.

CONCLUSION

A City project team, assisted by Urban Systems Ltd. and in consultation with property owners, government agencies, utility companies, representatives of the land development industry and the public, has prepared an NCP, including a land use plan and a related engineering/funding/phasing strategy, for the Sunnyside Heights area.

The proposed NCP is consistent with the policy framework contained within Surrey's OCP. Strategies have been identified for funding various amenities required for the neighbourhood. Subject to Council approval of the recommendations of the report from the Engineering Department related to the engineering servicing and financing strategy, it is recommended that Council:

- Approve the NCP for Sunnyside Heights, which is attached as Appendix I to this report;

- Approve the design guidelines specified in the NCP for managing the development of and the financing strategy contained in the NCP for providing services, amenities and facilities for the Sunnyside Heights neighbourhood; and

- Instruct the City Clerk to introduce the necessary by-law to amend the Zoning By-law, as documented in Appendix II to this report, which will require the payment of amenity contributions by new development in the Sunnyside Heights area, based on the density bonus concept.

Original signed by
Jean Lamontagne
General Manager
Planning and Development

PH:saw
Appendices

Appendix I	Final and Complete Sunnyside Heights Neighbourhood Concept Plan (Stage 2)
Appendix II	Proposed Amendment to Schedule G of the Zoning By-law
Appendix III	Approved Stage 1 Sunnyside Heights Land Use Plan
Appendix IV	Stage 2 Sunnyside Heights Land Use Plan
Appendix V	Revised Stage 1 Land Use Plan presented at May 18, 2010 Open House
Appendix VI	Changes to Residential and Commercial Land Use
Appendix VII	Changes to Parks and Trail
Appendix VIII	Character Plan
Appendix IX	Land Consolidation Areas
Appendix X	Summary of Land Use Statistics

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Sunnyside Heights

Neighbourhood Concept Plan

Stage 2 Plan

November 2010

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Sunnyside Heights Neighbourhood Concept Plan

Acknowledgements

The City of Surrey acknowledges the contributions and participation of the following individuals and organizations through the preparation of this Neighbourhood Concept Plan:

Citizens' Advisory Committee

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Ed Champion	South Grandview Estates' Association
Elena Simerl	South Grandview Residents' Together
Dave Moffat	Country Woods Residents' Association
Gary Scott	West Grandview Heights Residents' Association
Doreen Steckler	Highway 99 Corridor Local Area Plan Area
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Sunnyside Heights NCP

Table of Contents

PART 1: BACKGROUND

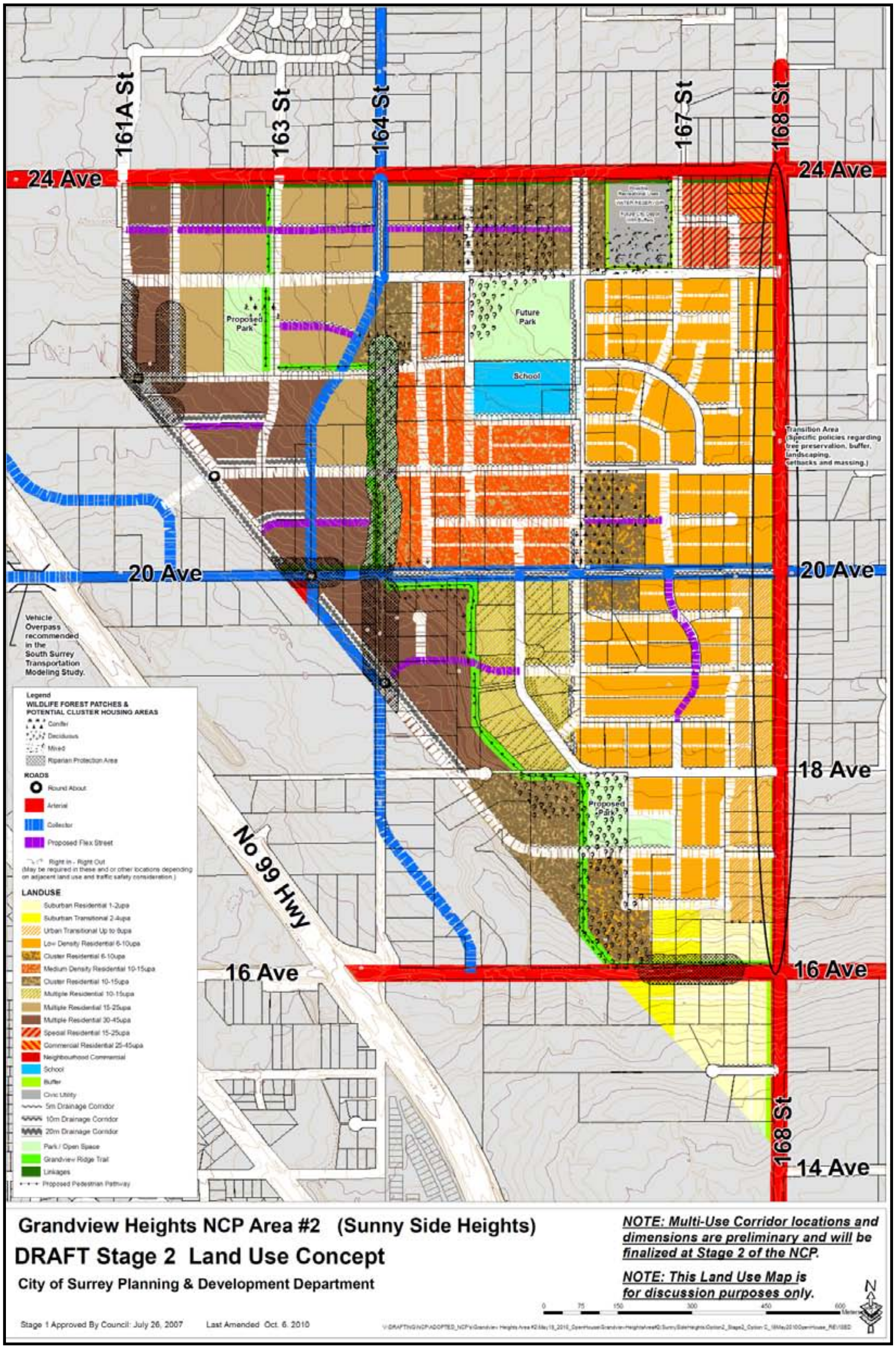
1.1 Introduction

The objective of this document is to outline the desired future land uses in Neighbourhood Area #2 of Grandview Heights in south Surrey called Sunnyside Heights. This document describes the proposed land use designations and accompanying policies, design and development guidelines that include place making and character defining elements as well as servicing strategy and a comprehensive financial plan. Together, these elements are intended to establish the foundation for the creation of a healthy and sustainable neighbourhood.

Planning for Sunnyside Heights began in the fall of 2005 and has been guided by a Citizens' Advisory Committee (CAC). The CAC is a group of approximately 27 residents and community association representatives. The planning process has included consultation with other area stakeholders and has been coordinated by City of Surrey staff.

Figure 1.1, the Land Use Concept Map, has been developed through extensive consultation with the CAC, City staff, project consultants, other stakeholders and the public. The intent of this concept is to guide the development of a compact, environmentally friendly, and sustainable community.

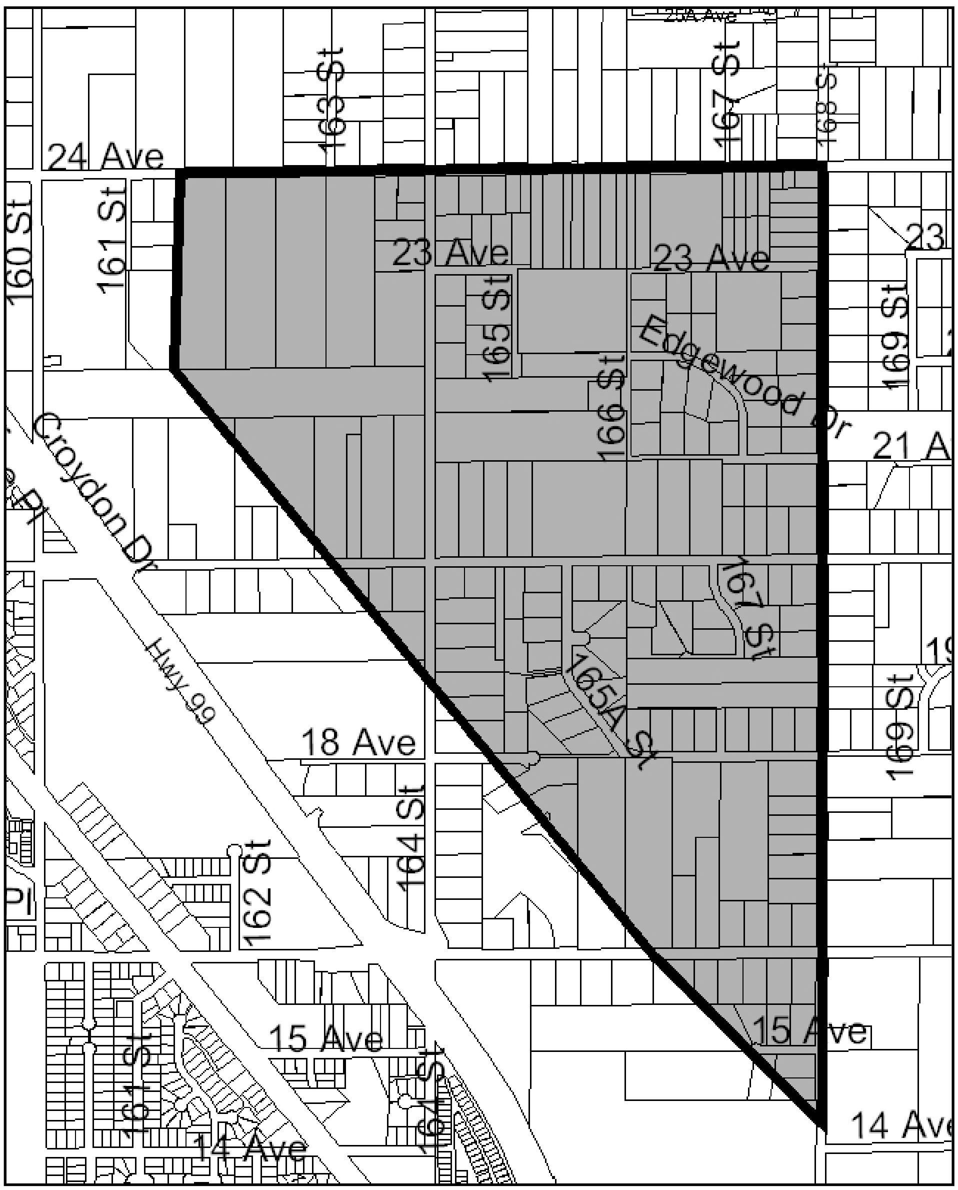
Figure 1.1: Stage 2 Land Use Concept



1.2 Plan Area

The Sunnyside Heights NCP area (**Figure 1.2**) is the triangle of land bounded by 24 Avenue to the north, 168 Street to the east and the Highway 99 Corridor Local Area Plan area to the west. It contains 206 individual properties and comprises some 163 hectares (402 acres).

Figure 1.2: Sunnyside Heights Plan Area



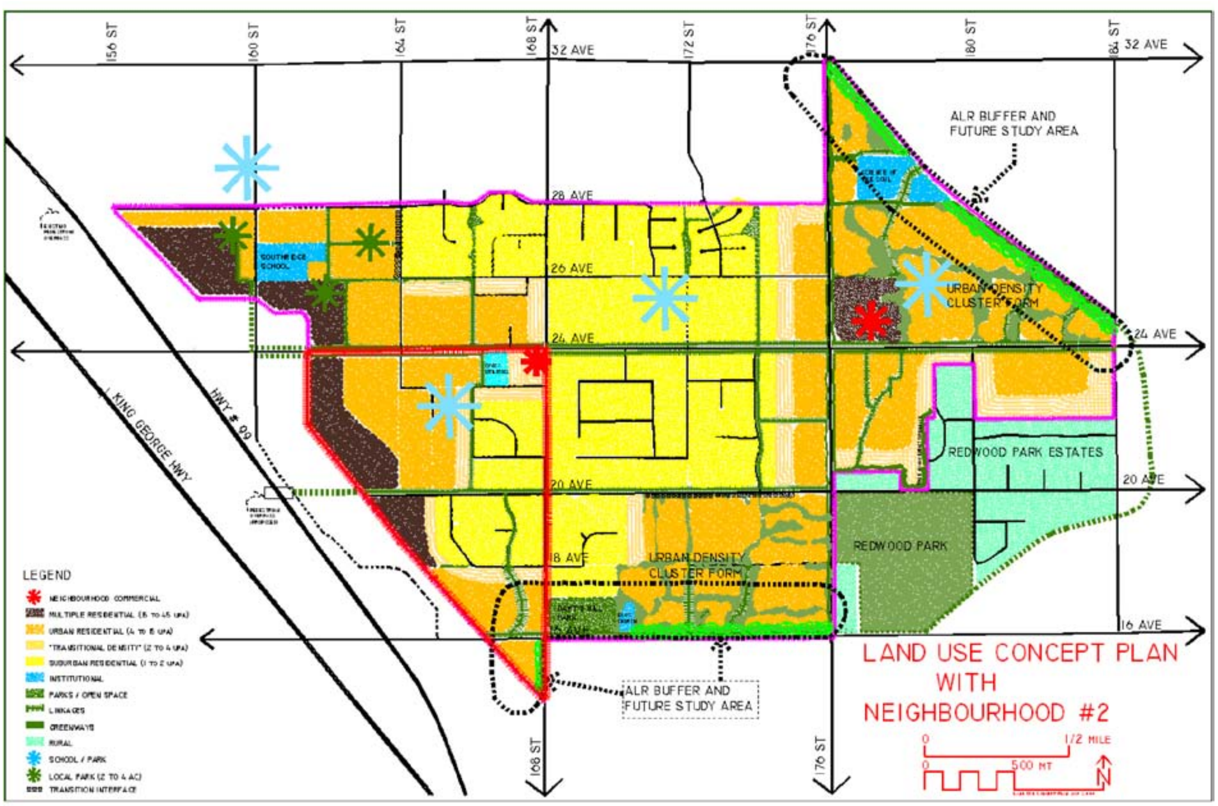
1.3 Planning Context

1.3.1 Grandview Heights General Land Use Plan and NCPs

On June 30, 2005, Surrey City Council approved the Grandview Heights General Land Use Plan, which provides the broad land use and servicing concept for the overall Grandview Heights area. The plan sets out a vision for Grandview Heights as a complete community with a mix of residential densities, small commercial nodes, community facilities, schools, parks, pathways, trees and protected areas.

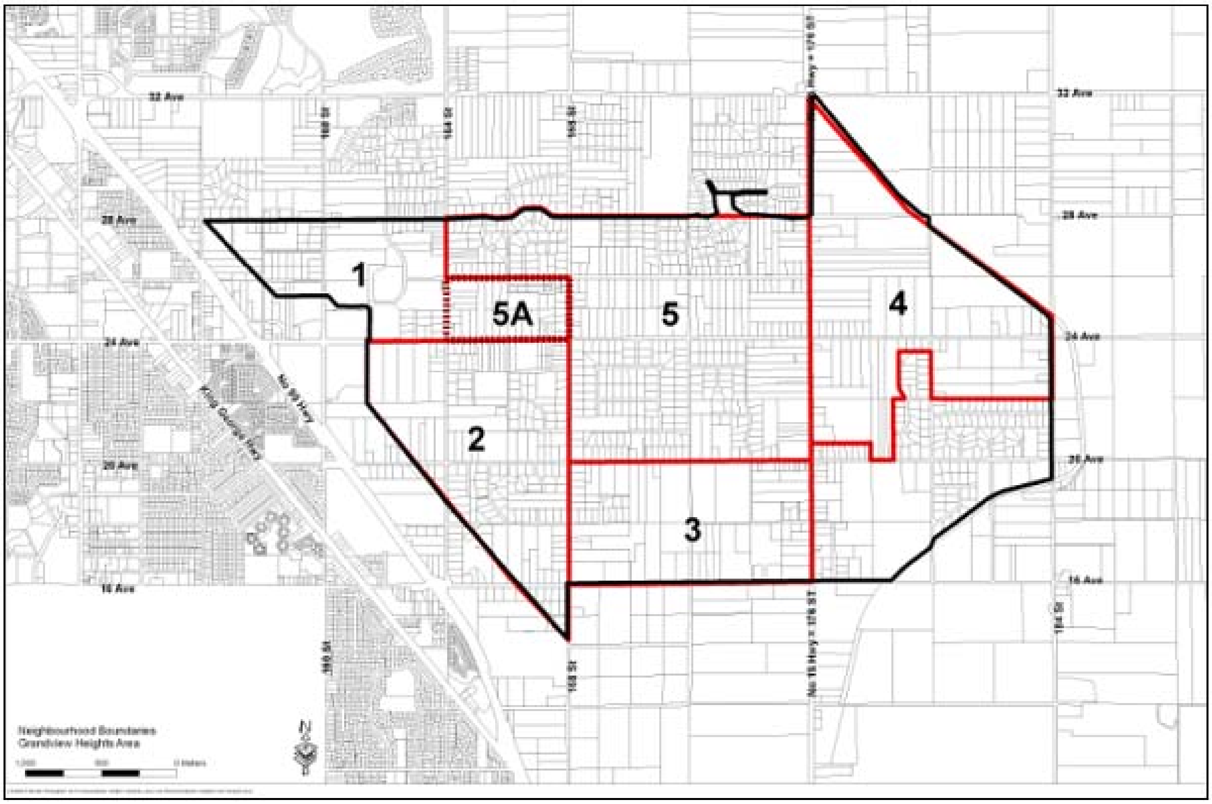
Figure 1.3 shows the Sunnyside Heights (outlined in red) in relation to the larger Grandview Heights General Land Use Plan.

Figure1.3: Grandview Heights General Land Use Plan (GLUP)



The General Land Use Plan defines the boundaries for five separate NCP areas (**Figure 1.4**). Surrey City Council authorized the preparation of a Terms of Reference for Neighbourhood Concept Plan (NCP) #2 in Grandview Heights on April 4, 2005. Council approved the first NCP, Morgan Heights, in September 2006.

Figure 1.4 Grandview Heights GLUP Sub Areas



1.3.2 Official Community Plan

The entire NCP area, Sunnyside Heights, is designated Suburban in the City of Surrey's Official Community Plan. This designation provides for a maximum residential density of one unit per acre. The OCP also states that for Suburban designated lands indicated as having potential for urban, commercial, business or industrial development, the minimum lot area for subdivision is 0.8 hectare (2 acres).

1.3.3 Highway 99 Corridor Local Area Plan

The Highway 99 Corridor Land Use Plan borders Sunnyside Heights to the west and provides for future commercial, Business Park and light industrial uses. The commercial node at160 Street and 24 Avenue, will ultimately contain up to 1.5 million square feet of commercial and services uses at full build-out. The southern part of the plan area contains an important Habitat Preservation Area associated with Fergus Creek - a Class A fish bearing watercourse.

The Highway 99 Plan will provide a substantial buffer along its eastern boundary. The Sunnyside Heights process has explored mechanisms to ensure for appropriate buffering, linkages and transitions related to new residential development, including links to the Pioneer Greenway, as well as access and landscaping at the detention pond south of the future Superstore site.

1.4 Planning Process & Consultation

The planning process for Sunnyside Heights has included meetings with the Citizens' Advisory Committee, Interagency meetings, and Public Open Houses. Key points in the process include:

Sunnyside Heights Stage 1 Process:

- A Suburban and Transitional Property Owners' Meeting on May 2, 2006;
- Inter-agency meetings on September 12, 2005 and October 23, 2006 and electronic circulation of the preferred land use concept on June 26 2007;

- A meeting with the members of the original Grandview Heights General Land Use Plan CAC on November 8, 2006;
- Meetings with all the Agricultural and Environmental Advisory Committees and the Heritage Advisory Commission;
- Three public open houses; and
- Numerous site visits, discussions with area residents, and interested stakeholders.

Sunnyside Heights Stage 2 Process:

- Ongoing consultation with CAC and stakeholder groups
- Open House May 18, 2010

1.5 Sustainability Elements

Sustainability principles and features have been incorporated into the Sunnyside Heights NCP. The NCP framework provides for walkability and inter-connection, places for community gathering and social interaction, diversity of housing form and tenure, protection of biodiversity through riparian area protection, and drainage systems that mimic natural infiltration. These elements are described in more detail below.

1.5.1 Connectivity

The plan provides for an inter-connected, fine-grained street network. This grid structure provides increased options to disperse traffic and avoid congestion. On average, block sizes for single family residential development have been proposed at approximately 100 metres by 200 metres, and 120 metres by 200 metres for townhouses.

The smaller block size also promotes walkability because pedestrians are able to avoid circuitous routes and reach destinations in a more straight-forward manner.

Flex Streets have been introduced into the plan in order to provide connectivity while responding to site- specific challenges. These streets provide flexibility in that there is allowance for a variation in the alignment and/or cross-section so that a public connection through a site is possible.

1.5.2 Diversity of Housing Form and Tenure

The plan accommodates a wide variety of household types and tenures. The types of housing offered include multiple-unit residential in the form of apartments and townhouses as well as mixed use commercial residential housing. Fee-simple lots include ground oriented row houses, single family homes on small to medium sized lots, as well as larger transition sized lots.

To allow for affordable rental suites, small-lot single family homes will be able to accommodate either a secondary suite or coach house. Smaller unit sizes will be provided through apartments.

1.5.3 Placemaking and Character

Creating places for community interaction was an important consideration when developing the land use plan. Several elements were used to contribute to the social realm and provide civic focal points.

The mixed use commercial area will include a public plaza area with street furniture, special decorative light standards, walkways, special landscaped areas, and an open area for public gatherings. Other elements include gateway features at key entrance points into the community, trail markers at the entrances to the Grandview Ridge Trail and viewpoints with seating areas where the south western exposure grants views toward the ocean and the Semiahmoo Peninsula.

Parks and trail systems have been located centrally within the community to be within walking distance of the various residential areas.

The pedestrian experience along the street will also be enhanced. Lane access along single family designations will create fewer driveway interruptions pedestrians on the sidewalk. Reduced building setbacks are encouraged to promote “eyes on the street” to promote safety.

1.5.4 Employment Opportunities

The Sunnyside Heights NCP area is located adjacent to the Highway 99 Corridor Local Area Plan. This Local Area Plan is primarily planned for Commercial and Business Park uses that will create 6,000 new jobs at full build out. Given Sunnyside Heights close proximity to the Commercial and Business Park area, the NCP proposes a small scale neighbourhood commercial area and another mixed use commercial development. The residential areas in the NCP will support the employment lands in the Highway 99 Corridor.

Opportunities for live/work have been introduced into the plan through the Special Residential" Designation. This land use offers a flexible type of development that permits limited and voluntary retail or service commercial uses on the ground floor of a townhouse unit.

1.5.5 Natural Environment Preservation

The green infrastructure of the plan includes system of Parks, Riparian area, Trail, and Cluster Residential Designations and sustainable drainage features.

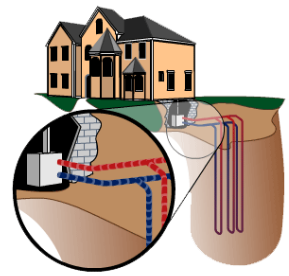
A riparian area is located along the 164th Street unopened road right-of-way. A Class B watercourse is located within the riparian area. This area will be preserved through 30-metre setbacks on the development parcels to each side of the watercourse.

In addition to Park acquisition areas, Cluster Residential Designations have been used in key areas of the plan to allow for the retention of valuable trees stands. The Cluster Designation aims for a 30-40% preservation of open space in exchange for higher densities on the developable portions of the site.

The NCP area features a sustainable, low impact stormwater control system. A series of drainage corridors, designed to mimic natural infiltration, will be constructed in the boulevard and medians of key roads. These corridors will be constructed in the form of bio-swales on local road boulevards and planted medians on portions of key collector roads.

1.5.6 Geoexchange Systems

Prior to the initiation of an NCP for this area, staff evaluated the potential for geoexchange heating systems in this area. Based on that preliminary investigation, it appears that geoexchange heating systems in this area of the City are technically feasible and financially viable. Geoexchange systems rely on a thermal coupling with the earth. The coupling is known as a ground heat exchanger (GHX). Specifically, vertical closed-loop GHX systems are estimated to have a payback between 3 and 23-years depending on the density of the development.



In addition to individual GHX systems, there could be opportunities for a series of private district energy systems for this area. GHX systems are not generally the best thermal energy source for residential district energy systems given the limited load diversity available in predominately residential areas. However, other thermal energy sources such as natural gas based systems may be viable.

1.5.7 LED Street Lighting

The use of LED street lighting has been identified as an opportunity to reduce energy consumption for this area. LED streetlights have different characteristics and higher up front capital cost than standard light fixtures, thus are difficult to economically retrofit into a street light system. However, with a new neighbourhood, the street light system can be designed to suit LED lights which may make it economical over the lifetime of the lights. Staff have been consulting with LED suppliers and lighting experts to determine specifications to incorporate into plan with the development application process.

PART 2: PLANNING

2.1 Planning Objectives

The Neighbourhood Concept Plan outlines the desired future land uses for Neighbourhood #2 of Grandview Heights. This section describes the land use designations and built forms, policies related to specific land uses, and illustrations of character defining elements. Together, these elements are intended to establish the foundation for the creation of a healthy, affordable and special place to live and work.

2.2 Planning Principles and Vision

The framework for the development of the Grandview Heights area was established by the visioning process during the General Land Use Plan. From this vision, the Sunnyside Heights Citizen's Advisory Committee created a set of Guiding Principles to develop the land use plan for the NCP. These principles reflect overall sustainability principles set out in the City's Sustainability Charter.

2.2.1 General Land Use Plan Vision

The Grandview Heights General Land Plan, approved by Council June 30, 2005, envisages Grandview Heights:

> "…*as a complete community with a mix of residential densities, small commercial nodes, community facilities, schools, parks, pathways, trees and protected areas."*

It also contains guiding principles for the development of individual NCPs. The principles that specifically relate to Neighbourhood Concept Plan for Sunnyside Heights are:

- Community Structure and Character - tree retention, respect for the ALR and protection of key view corridors of both mountains and water;

- Residential Land Use - a variety of housing types with highest densities adjacent to the Highway 99 Corridor, transition densities and a review of residential densities in the vicinity of Edgewood Drive;

- Commercial Land Use - a commercial node at the southwest corner of 168 Street and 24 Avenue;

- Schools, Parks, Greenways and Community Amenities - a new elementary school associated with a park; a park area on and/or adjacent to the GVRD water reservoir, a pedestrian and bicycle circulation systems, greenways along 16, 20 and 24 Avenues and stormwater detention ponds as community amenities or as natural park areas;

- Environment and Agriculture -evaluation of significant forest blocks and watercourses, development methods to protect sensitive areas, buffers to ALR uses and mitigation of water runoff in accordance with a GVRD Liquid Waste Management Plan (the Fergus Creek Integrated Stormwater Management Plan);

- Community Heritage - celebration of historic people and events wherever possible and incorporation of community history and heritage features into the design, naming and character of new neighbourhoods;

- Transportation - special road and pathway standards to preserve rural character, a modified grid road system with greenways to encourage walking and cycling and to slow down traffic, appropriate treatment of 24 Avenue to ensure it does not separate the community; and

- Servicing and Infrastructure - drainage plans (Fergus Creek ISMP) to mitigate impacts related to land use change and a new pump station on 168 Street, at approximately 12 Avenue.

2.2.3 Sunnyside Heights CAC- Guiding Principles

The Citizens' Advisory Committee for Sunnyside Heights has considered these principles throughout the process. The CAC also reflected on its vision for the area including:

- Create a healthy, affordable and special place to live;
- Develop a mixed use neighbourhood;
- Create a wonderful place for people to live within walking and bike riding paths and plenty of greenery;
- Create a place that is attractive for people to work;
- Create a sustainable community of which we are all proud;
- Encourage interesting design;
- Develop at densities that support public transit; and
- Maintain the peace and quiet.

2.3 The Land Use Plan and Policies

Sunnyside Heights in Grandview Heights will primarily be a residential community offering a variety of housing forms and densities. The community will have a mixed use commercial/residential node, an elementary school and three parks, and a network of trails and open spaces, as shown on Figure 1.1- of the Land Use Concept. The sections below provide an overview of the proposed designations. The Design Guidelines (Section 3 of the document) outline the specific design criteria for each land use designation.

2.3.1 Residential

Approximately 91 hectares (224 acres) of the Sunnyside Height's land area is proposed for future residential use. The proposed residential land uses will offer a wide variety of densities and housing forms.

"Suburban Residential" and "Suburban Transitional" Designations

- Suburban Residential designation: 1-2 units per acre
- Suburban Transitional designation: 2-4 units per acre

This land use designation is located along the southern edge of the plan area in close proximity to the Agricultural Land Reserve (ALR). These designations will allow for single family homes on larger residential lots. Other forms of housing within the permitted density ranges may be considered (particularly on the north side of 16 Avenue).

These land uses provide a transition to the ALR in accordance with the Official Community Plan (OCP) and Policy No.O-23 ("Residential Buffering Adjacent to the ALR/Agricultural Designation)'. In accordance with Policy O-23, a 15 metre (50 ft.) wide landscaped buffer will be required for lots along 168 St., south of 16 Ave.

“Urban Transitional” Designation

- Up to 8 units per acre

The Urban Transitional Designation was created to ensure an appropriate transition to the suburban lands to the east of the plan area. These transitional densities are located along 168 Street between 20th Avenue and 16th Avenue.

This designation allows for larger lots and urban sized lots (approx 9,000 to 6,000 sq. ft.). Lots fronting 168 Street will be required provide a 10 metre wide landscaped buffer strip in the front yard.

“Low Density Residential” Designation

- 6-10 units per acre

The Low Density Residential Designation is located roughly between 23 and 16A Avenues, and between 165A/166 Street and 167A Street. This designation provides for standard sized residential lots and the retention and mirroring of the existing curved alignment of Edgewood Drive.

This land use designation allows for standard single family residential forms of development with urban lot sizes (approximately 4,000 to 5,000 sq. ft.).

A minimum 5-acre lot consolidation for redevelopment would be required both north and south of Edgewood Drive to minimize impact on residents desiring to stay in the community in the short to medium term. Lot consolidation of a lesser area may be considered on a case-by-case basis.

“Medium Density Residential” Designation

- 10-15 units per acre

The Medium Density Residential Designation is located between 24 and 20 Avenues, between 164 and 166 Streets. This land use designation provides for “small” lots, including 9 metres (30 ft.) or 12 metres (40 ft.) wide, which may include coach houses (suites above lane-access garages). This designation can also accommodate small lot duplexes (RF-SD zone) or row houses. The lot sizes can range from approximately 2,000 to 3,300 sq. ft. for these housing forms.

"Cluster Residential" Designations

- Cluster 10-15 units per acre
- Cluster 6-10 units per acre

The Cluster Designations locations were determined by the high value tree stand locations in the plan area. Through the Cluster Residential Designation, properties will be required to provide between 30 and 40% Open Space. In exchange, the density from the land provided for open space will be transferred to the remaining portion of the development, thus creating a higher net density.

The built form on the net developable areas (excluding the Open Space) will be as follows:

- Cluster 10-15 units per acre designation will allow between 25- 30 units per acre on the developable areas of the site
- Cluster 6-10 units per acre designation will allow between 20-25 units per acre on the developable areas of the site

Lot consolidation may be required for development of some of these areas as shown in **Figure 2.3.**

"Multiple Residential" Designation

- 30-45 units per acre
- 15-25 units per acre
- 10-15 units per acre

The highest densities (30-45 upa), envisioned as low rise apartments are located on the western side of the plan, adjacent to the Commercial and Business Park uses of Grandview Corners and the Highway 99 Corridor Plan. Townhouses (15-25 upa) will generally be located to the east of the apartments and along 24th Avenue.

The Multiple Residential 10-15 units per acre designation is located along 164 Street, south of 20th Avenue. This area may be developed as low density townhouses, duplexes, or detached units. However, due to the irregular shaped lots and shallow lot depths, a strata form of development is envisioned for this designation.

To avoid the isolation of any individual properties as development in the NCP area, consolidation will be required for the properties as shown on **Figure 2.3**.

"Special Residential" Designation

- 15-25 units per acre

The "Special Residential" Designation is located east of the water reservoir, surrounding the commercial-residential node. This designation provides for a flexible development form permitting limited and voluntary retail or service commercial uses on the ground floor of a townhouse or single family dwelling. Lot consolidation will be required as shown on **Figure 2.3**.

2.3.2 Community Commercial

There are two commercially designated areas and the Special Residential area in the NCP comprises a total of 1.4 hectares (3.5 acres) of land area. These commercial areas will be designed to serve the local neighbourhood, while the commercial lands outside the NCP in Grandview Corners is expected to encompass a larger trade area.

“Commercial Residential” Designation

- 25-45 units per acre

The “Commercial Residential” Designation is located at the northwest corner of the NCP area at 168 Street and 24th Avenue. It will encompass approximately five properties where lot consolidation will be required for development.

This designation allows for a mixed use development form, with commercial and office store fronts located at ground level or the second floor with residential units above. A public plaza that can serve as a community meeting place will be required to be incorporated into the development. This area is required to be pedestrian oriented terms of street design as well as massing and orientation. The development is to have a “village-centre” character (see Section 3, Design & Development Guidelines, for design details).

“Neighbourhood Commercial” Designation

The Neighbourhood Commercial Designation is located on a triangle portion of a lot located at south west corner of 20th Avenue and the future 164 Street alignment The western portion of this site is encumbered by a Hydro right-of–way leaving the remainder, a small triangle shaped portion, for development. The plan allows for a commercial building to be located on the triangle portion of the property, and parking to be accommodated on the Hydro right-of-way area.

The smaller-scale commercial will be a street-fronting neighbourhood/community oriented commercial development (see Section 3, Design & Development Guidelines, for design details).

2.3.3 Institutional

Elementary School Sites

A school/park site is shown to the south side of the future park (Sunnyside Saddle Club). If an alternative school location is proposed, the lands shown as preferred school site cannot be developed until another location for the school site is deemed acceptable by the School District and the City.

Civic Utility

This plan provides for a City utility maintenance and materials storage depot on City-owned land on 24 Avenue (south of the existing GVRD reservoir and City pumping station) subject to appropriate access and buffering from adjacent residential uses. In the event that the City explores development of this site for noted utility use, the facility will only have access off of 24 Avenue, or off of the future 167A Street, the alignment of which is located to the east of the site, and will be used during standard operating hours except in emergency situations. It is proposed that the noted driveway access off 24 Avenue will be located as westerly as possible so as to retain trees and a buffer area on the east side of the property.

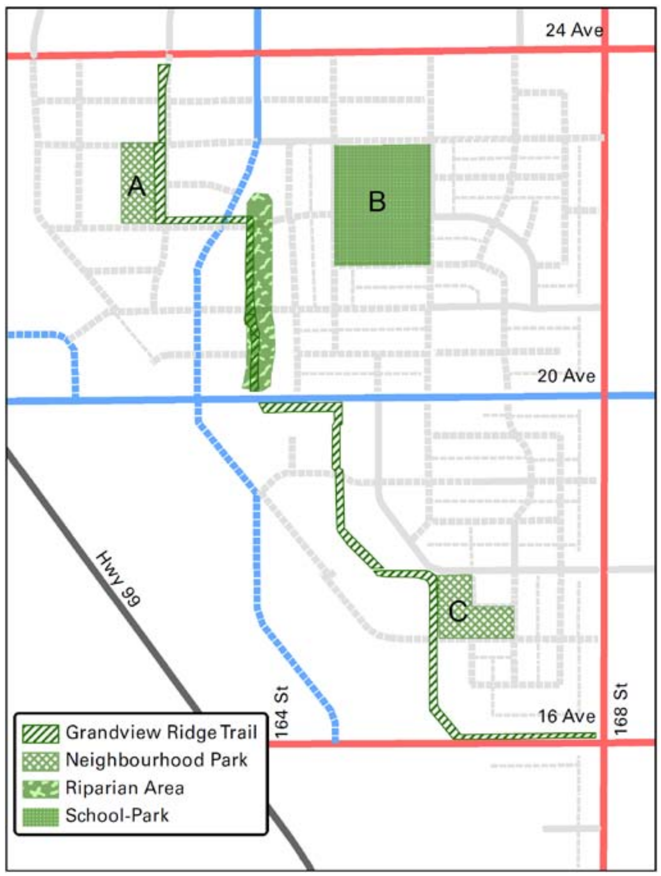
Clustering of structures and uses will be explored, with a view to retaining the important forest patch identified on the southern portion of the City-owned property. A tree integrity study may be required. Development of the site shall be done in a way that recognizes the importance of the area in the structure of the community; or contributes to the character of the area.

Possible hard surface recreational uses such as tennis courts on the top of the reservoir will continue to be explored subject to water safety & security issues being addressed.

2.3.4 Parks, Trails, Riparian Areas and Open Space

A total of 12 hectares (30 acres) of the NCP area is allocated for an integrated system of public and natural areas consisting of: three neighbourhood parks, a riparian area, and trail network. Two of the three neighbourhood parks are proposed that have direct connections to the Grandview Ridge Trail, and riparian area. The Parks, Riparian Trail System is shown on **Figure 2.1.**

Figure 2.1 Parks, Trails and Riparian Areas



Neighbourhood Parks

Three park sites have been identified in the NCP area: Park A (Sunnyside Riding Club); Park B (22nd Avenue); and Park C (18th Avenue). Surrey's Parks, Recreation and Culture Department will manage and oversee the construction and maintenance of all public parks. Detailed design will be completed in consultation with the future community; however potential uses that are viable given the size and nature of each park include the following:

- Park A is approximately 9.6 acres and will be adjacent to a future school site. Under the PRC new park classifications, this park could serve as a large, integrated amenity neighbourhood park.

- The emphasis of Park B is natural area connectivity and local children and youth amenities. Due to projected density of the surrounding areas, there will be a need for a local early and young child play amenities.

- Park C in the southern section of the NCP, is surrounded by lower residential densities, and has high tree preservation values. This neighbourhood amenity park will need to ensure a high level of use and activity, to increase park security and appropriate use.

Riparian Area

A riparian area is located along the 164th Street unopened road right-of-way. A Class B watercourse is located within the riparian area. A segment of the Grandview Ridge Trail runs through the riparian area.

Grandview Ridge Trail

The Grandview Ridge Trail, a continuous 2 kilometre recreational trail situated at the top of the slope, will connect the northern and southern parts of the neighbourhood. The trail will accommodate a range of users, provide significant viewpoints and connect two of the three parks. Seating areas, signage and trail markers will be provided at key points along the trail.

Most of the trail will be located in a 20 metre wide corridor, with statutory right-of-way for public passage. Properties affected by the Trail will be able to have this density transferred to the remaining portion of the lot.

A typical cross section will include a 4-metre permeable meandering path with 8-metres of treed landscaping on either side. Portions of the trail will include seating, lookout viewpoints and signage. Special design guidelines will be developed for residential developments adjacent to the Trail (See section 3, Design & Development Guidelines for detailed design requirements for the trail).

Modifications to cross section of the Grandview Ridge Trail have been made in areas where the alignment runs adjacent to a road. Typically the statutory right of way for the trail has been reduced because the road dedication includes sidewalks and boulevards in the dedication area. These areas include where modifications have been made are described below:

- The property along the northern portion of the trail located along at 163 Street, north of 22 Avenue will be required to provide a 10-metre statutory-right-of–way because the road allowance will include dedication for a sidewalk and tree planted boulevard.

- Properties along the section of the trail along the north side of 22 Avenue will be required to provide a 5-metre statutory-right-way to allow for additional planting on the trail. The dedicated portion of the road allowance includes a 5-metre drainage corridor, a 2-metre sidewalk and a 2-metre boulevard.

Figure 2.2: Sketch of Potential Viewpoint on Grandview Ridge Trail

Greenway/Multi-Use Path

Three greenways are proposed in the plan area: one along the north side of 16 Avenue, the second on the north side of 20th Avenue and the third on the south side of 24th Avenue.

2.4 Population and Dwelling Unit Projections

The following section summarizes the amount of land allocated within the NCP for different land uses, the estimated number of dwelling units, the population of the area and potential commercial floor area at build out of the Land Use Plan.

2.4.1 Residential

The Stage 2 Land Use Plan provides for 91 Ha./224 Ac. of Residential-designated land. The Land Use Plan anticipates between 2,750 dwelling units at the low end of the prescribed density range in the various residential areas to 4,250 dwelling units at the high end of the density range. Based on an average ratio of 2.8 persons per dwelling unit, the build-out population of Sunnyside heights will be between 7,400 and 11,500.

2.4.2 Commercial

The Land Use Plan allocates a total of 1.4 Ha./3.5 Ac. to the Commercial designations. At the built-out stage, the total amount of the commercial floor area is estimated to be approximately 930 sq. m./10,000 sq. ft., based on a floor area ratio varying from 0.3 to 0.6 depending on the specific commercial designation in the Land Use Plan. This number includes the commercial component of the “Special Residential” designation as well.

2.4.3 Institutional Uses and Schools

The land designated for institutional uses, such as schools, amounts to 2 Ha./5 Ac.

2.4.4 Parks and Open Space

Parks, greenways and riparian areas occupy approximately 12 Ha./30 acres of land within the plan area.

Table 2.1: Land Use and Population Low / High Projections

Land Use	Acres	Low Projected Units	High Projected Units	Low Projected Population	High Projected Population
Neighbourhood Commercial	0.2	0	0	0	0
Commercial Residential 25-45upa	1.8	45	82	97	175
Suburban Residential 1-2upa	11.6	12	23	37	75
Suburban Transitional 2-4upa	4.0	8	16	26	52
Urban Transitional Up to 8upa	10.2	82	82	264	264
Low Density Residential 6-10upa	58.9	354	589	1,142	1,903
Cluster Residential 10-15upa	23.0	230	645	710	1,996
Cluster Residential 6-10upa	11.4	68	114	220	366
Medium Density Residential 10-15upa	22.7	227	341	704	1,056
Special Residential 15-25upa	4.8	71	119	221	368
Multiple Residential 10-15upa	9.7	97	146	300	451
Multiple Residential 15-25upa	26.3	394	657	1,220	2,033
Multiple Residential 30-45upa	38.6	1,158	1,737	2,479	3,719
Buffer	3.8	0	0	0	0
Linkages	3.4	0	0	0	0
School	5.2	0	0	0	0
Civic Utility	5.0	0	0	0	0
Park / Open Space	19.9	0	0	0	0
Grandview Ridge Trail	8.4	0	0	0	0
Drainage Corridors	19.5	0	0	0	0
Roads	112.1	0	0	0	0
Total	**400.8**	**2,746**	**4,551**	**7,421**	**12,458**

2.5 Interface with Adjacent Lands

The plan boundaries are adjacent to the Agricultural Land Reserve (ALR) to the southeast, larger suburban lots to the east, Commercial and Business Park uses planned to the west, and multi-family residential densities to the north (Morgan Heights and Orchard Grove NCP areas). As a result of the varying interface conditions, several strategies were considered when developing the land uses for the plan area.

2.5.1 Agricultural Land Reserve

City Policy number O-23, "Residential Buffering Adjacent to the ALR/Agricultural Boundary", identifies a transition area and provides for densities of 1-2 units per acre within the Outer Ring Transition Area of 200 metres from the ALR boundary and densities of approximately 4 units per acre within the Inner Ring Transition Area of at least 400 metres of the ALR boundary.

These parameters were adhered to for the majority of the ALR interface area. However, densities were increased to 6-10 units per acre for an area within the 200-400 metre transition area above a ridge line. Given the specific topographical conditions and configuration of this part of the NCP, and as noted in the General Land Use Plan, a strict application of City Policy No. O-23 was not deemed necessary. This change in elevation between the proposed urban properties and the ALR creates a physical separation between the two areas. As a result the densities were increased somewhat for properties above the ridgeline.

Properties along the west side of 168 Street, south side of 16th Avenue, will be required to provide a 15-metre (50 foot) landscaped buffer in accordance with the OCP Development Permit Area Guidelines for areas adjacent to the agricultural designation.

2.5.2 Larger Suburban Acreage Parcels

The area to the east of 168 Street is comprised of larger suburban sized acreage lots. Some of the owners of these lots had expressed concerns about smaller urban lots t across 168 Street in the plan area. However, some property owners wanted to see increased densities. As a result, the “Urban Transition up to 8 units per acre” designation was proposed for properties along 168 Street, on the south side of 20th Avenue. Properties to the north of 20th Avenue, along 168

Street, were designated at 6-10 units per acre because of their closer proximity to the commercial area at 24^{th} and 168 Street.

A landscape buffer on private property will be required on all lots along 168 Street to help buffer against potential noise along 168 Street.

2.5.2 Commercial and Business Park Uses

The western boundary of the NCP area is situated on a downhill slope adjacent to Commercial and future Business Park uses in the Highway 99 Corridor Local Area Plan. The NCP has proposed apartment densities along this edge. From a planning perspective, higher residential densities are suited along commercial edges. In addition, the apartment housing form typically requires underground parking; the hillside will allow the utilization of the hillside for the underground parking areas.

2.5.3 Morgan Heights and Orchard Grove NCPs

The north side of the NCP is adjacent to Morgan Heights (NCP #1), and Orchard Grove (NCP #5A). A major Arterial (24^{th} Avenue) is located between Sunnyside Heights and the 2 other NCP areas to the north. To help provide connectivity across 24^{th} Avenue, key north/south roads have been aligned to allow connections to the north side (161A Street, 163 Street, 164 Street, 167 Street and 168 Street). Signalized intersections will be at 164 and 168 Streets.

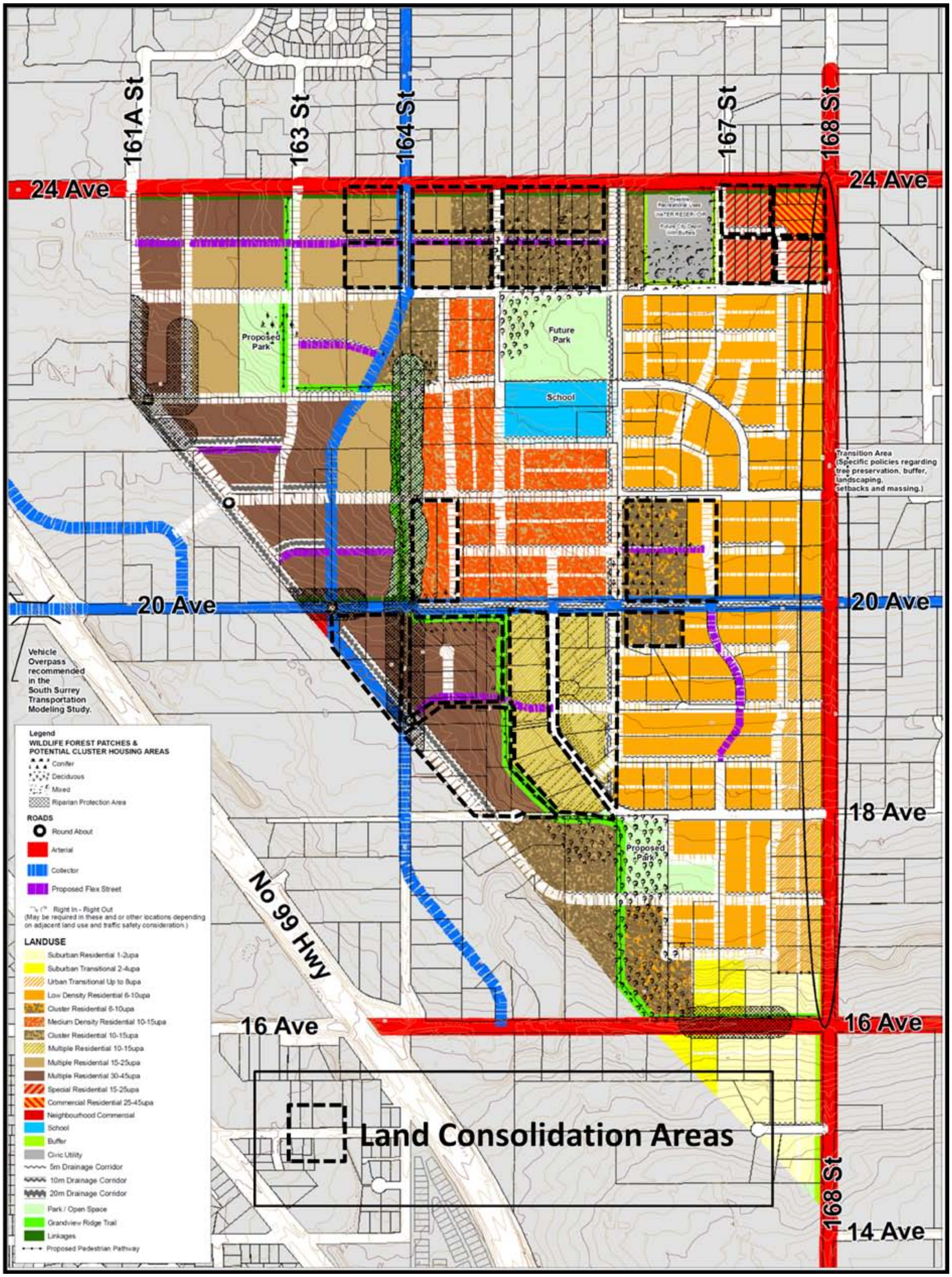
The housing densities along 24^{th} Avenue range from apartments to townhouses. These are similar to existing and planned densities across 24^{th} Avenues.

2.6 Land Consolidation Areas

Within the plan area there are a number of smaller acreage parcels and irregular shaped lots; in several areas lot consolidation is required in order to ensure efficient and feasible development of these properties. These land consolidation opportunities can often be determined on a case-by-case basis at development application stage. In some cases, however, pre-determined consolidation requirements are identified in the Land Use Plan in order to avoid creating remnant pieces that could not develop on their own. These particular properties need to be developed together through consolidation and land assemblies or through coordinated development.

Land consolidation areas have been identified to help advice future developers of the consolidation requirement, to ensure compatibility and feasible development areas, and to achieve an equitable distribution of road dedication and construction costs amongst properties. These areas have been identified in **Figure 2.3.**

Figure 2.3 Land Consolidation Areas



2.7 Placemaking Considerations

Creating places for community interaction was an important consideration when developing the land use plan. Several elements that contribute to the creation of a sense of place within the NCP have been identified on the Character Plan (**Figure 2.4**). These include community landmarks, entrance features, trail markers, seating areas and a public square. These elements are described in detail in Section 3 (Design & Development Guidelines).

Successful places generally have the following qualities:

- The spaces are accessible;
- Places where people are engaged in activities;
- The spaces are comfortable and have a good image; and
- The spaces are designed to promote social interaction.

Design considerations that promote these qualities have been incorporated into the Design & Development Guidelines in Section 3 of the document.

In general, the placemaking elements in the plan include:

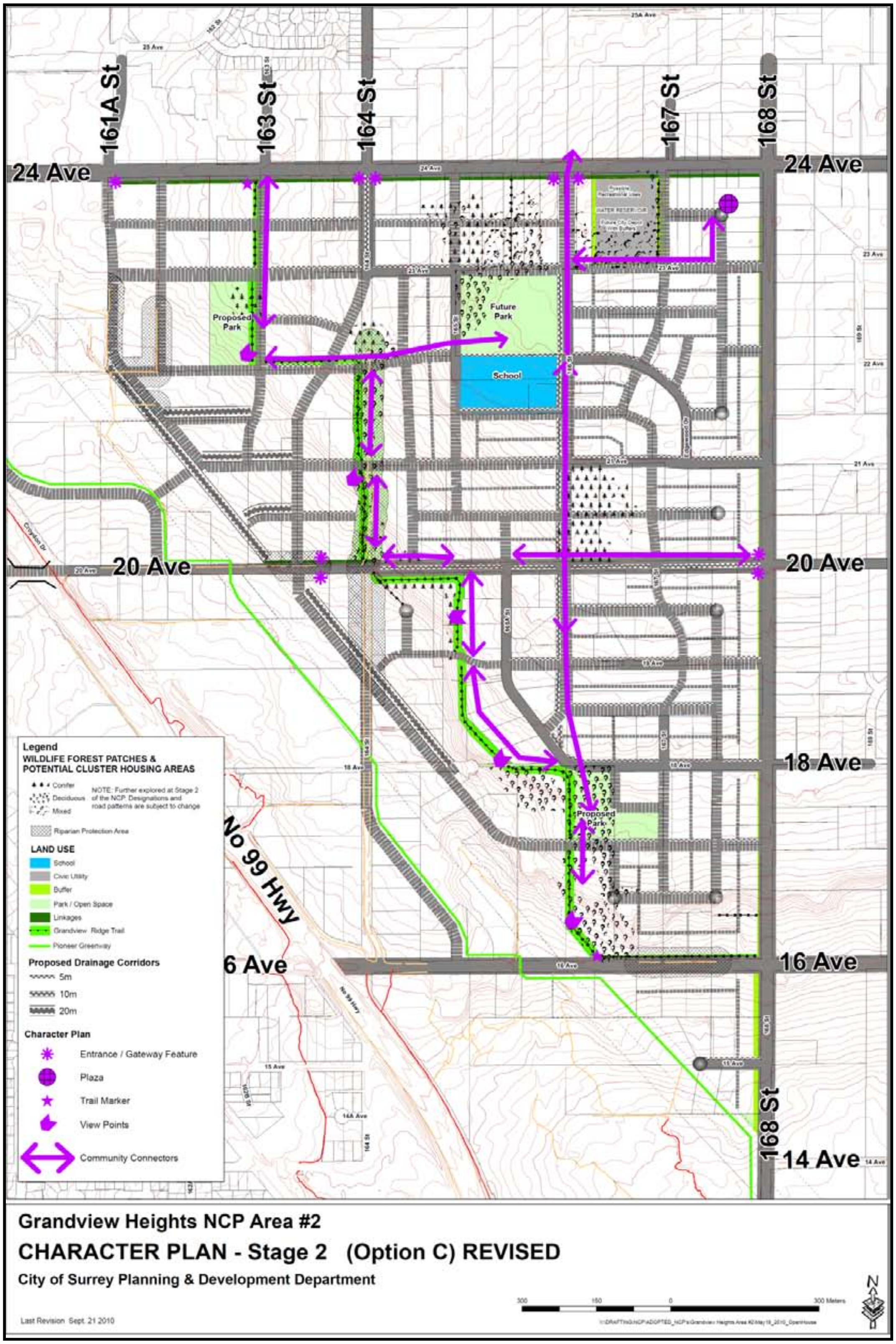
- Gateway features at key entrance points into the community;

- Trail markers at the entrances to the Grandview Ridge Trail and viewpoints with seating areas where the south western exposure grants views toward the ocean and the Semiahmoo Peninsula; and

- A public square/gathering place integrated into the mixed use commercial development at 24 Avenue and 168 Street; and

- The public spaces in the mixed use commercial area will contain street furniture, special decorative light standards, walkways, and special landscaped areas.

Figure 2.4 Character Plan



2.8 Environmental Assessment

ENKON Environmental Limited was retained by the City to inventory fish, wildlife and vegetation resources and identifies any environmentally sensitive areas within the NCP area. The consultant reviewed all relevant environmental reports and also conducted a total of 6 biological surveys during the fall of 2005 and the spring of 2006.

2.8.1 Wildlife Corridors

Connectivity analysis was completed for the overall Fergus Creek Watershed in the Integrated Stormwater Management Plan and important wildlife movement corridors were identified within this analysis related to Plan Area 2.

This corridor is envisaged as a component of the Grandview Ridge Trail. While narrower than a wildlife corridor, it still provides connectivity through the community and between habitat patches including the proposed parks, Dart's Hill Park, and the Fergus Creek Habitat Preservation Area.

2.8.2 Significant Tree Patches

Seven stands of trees ranging in size from 2.0 – 5.4 Hectares were identified and rated on a scale of 0-10 (10 being the highest) related to habitat value protection value.

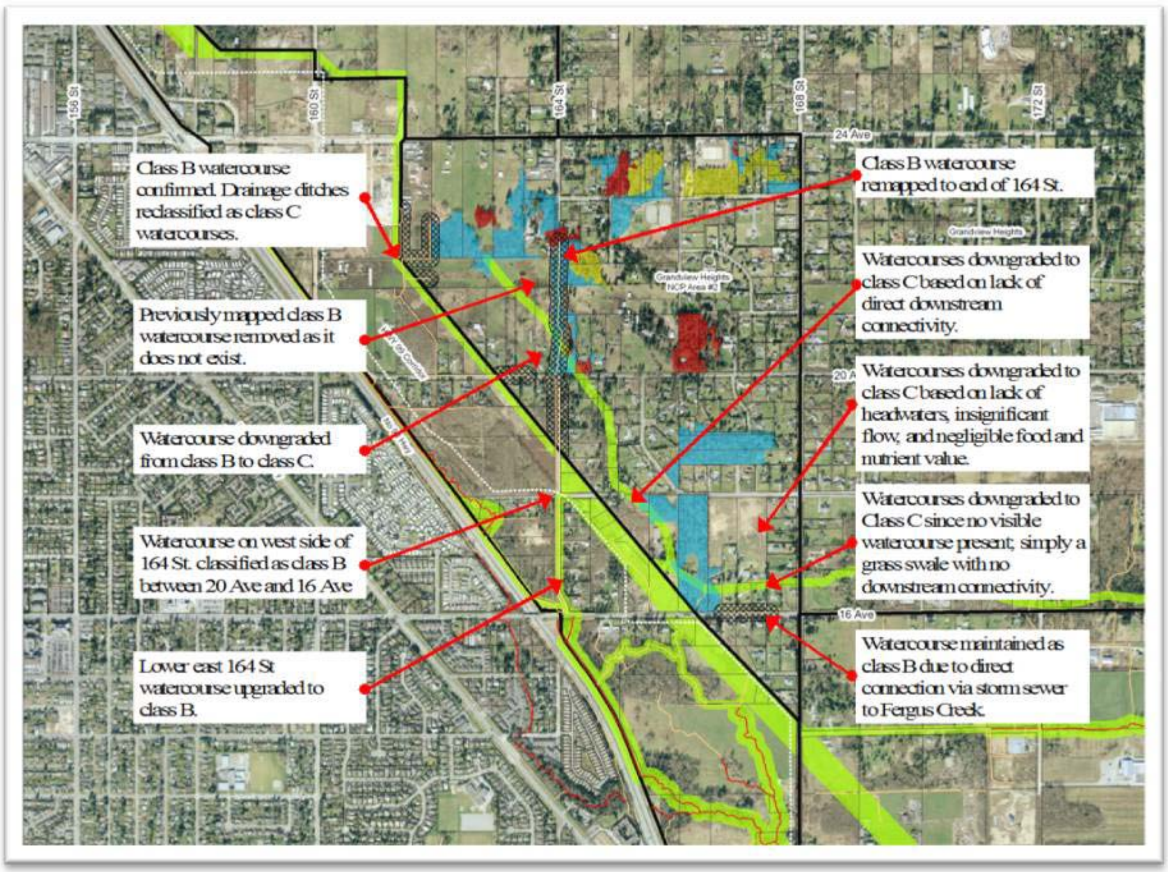
In addition to the Environmental Study, a Tree Study was performed during Stage 2 of the plan process. The goal of this study was to further examine the tree stands identified for habitat value in the Enkon report, as well as other tree stands that had value as specimen trees. The results of this study helped to define the Cluster Designation in the plan.

2.8.3 Streams and Stream Classifications

A complete assessment of watercourses was undertaken and some watercourses were reclassified as shown of **Figure 2.5**. The most significant watercourse runs along the unopened road allowance of 164 Street. This is a Class B (Yellow coded) watercourse – Significant food/nutrient value, with no fish present.

Class A, A(O) and B watercourse are regulated under the federal Fisheries Act and as such require Fisheries and Oceans approval for any modification of in-stream or riparian habitat. Class C watercourses may or may not be regulated under the Fisheries Act.

Figure 2.5: Riparian Areas Map



Setbacks for streams regulated under the Fisheries Act were determined using the Simple Assessment Methodology from the provincial Riparian Areas Regulation.

It is noted that it there is any use of City-owned riparian areas to provide habitat compensation for development in the area, the City of Surrey will be required to be compensated for the full value of the compensation received.

2.9 History and Heritage of Grandview Heights

Commonwealth Historic Resources Management Limited completed a Heritage Study for the Grandview Heights NCPs # 1 and # 2 areas. This study identified heritage resources in the area and outlined opportunities for the 'preservation, commemoration, and integration of any identified heritage features into development in these areas.

Though there was no individual building or site identified that had any heritage amenity, the consultants identified many representative examples of landscapes, subdivisions, houses, and other built and natural features that are specific to the heritage of Grandview Heights. The report states that 'the cultural landscape that is NCP # 2 and NCP # 1 has organically evolved by virtue of the many ways the land has been used.'

Features that were identified as being important from a cultural heritage perspective include:

- The property lines – having followed the boundaries of the original sections and quarter sections marked out by early surveys and subdivided from there over time;
- Unimpeded views along the roadways, with significant views from its highest points;
- Coniferous (and some deciduous) plantings demarking property lines and driveways into the properties. Mature second growth is evidenced throughout the area;
- Fencing and posts, including farm, residential, and equestrian fencing;
- A variety of streetscapes characterized by roadway patterns, roadside plantings, ornamental plantings on the residential properties.

Heritage recommendations included:

- The NCP # 2 community should take a name from the neighbourhood's history, the name "Sunnyside Heights" was chosen;

- Conservation: retaining some rural and semi-rural features such as retaining existing lines of trees or, alternatively, rebuilding or replanting trees in a similar fashion;

- Commemoration: Panels or plaques at specific locations or vistas to explain what was once there;

- Interpretive: Storyboards that tell the story of the area: from logging to farming to suburban to urban. These could be located in the proposed park areas or at gateway locations to the community;

- Retention or restoration of street or place names such as secondary names to numbered streets;

- Naming of the proposed park areas;

- Opportunities for Public Art either by competition of commission. Representative examples include poetry rocks and the commemorative pieces at the new Surrey Museum.

The report suggested these as opportunities to conserve a heritage element in a community that has no specifically identifiable heritage building or structure. Additionally, this type of heritage recognition can be used as part of the character and place making options for this community.

PART 3: DESIGN & DEVELOPMENT GUIDELINES

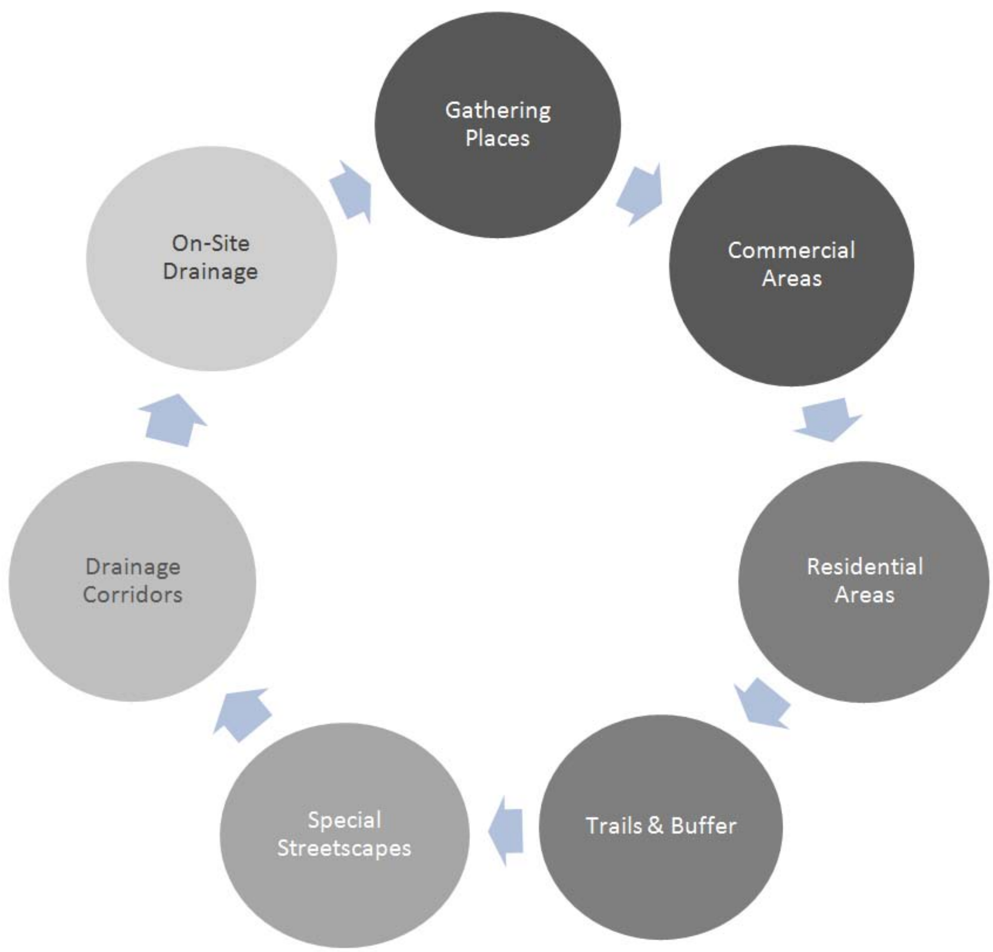
During Stage 2 of the process, a set of Design and Development Guidelines were established to help guide development in the NCP. The purpose of the Design Guidelines is to achieve a pedestrian-friendly, high quality and co-coordinated neighbourhood that is consistent with the principles and objectives of sustainable development. The Design & Development Guidelines describe the dominant characteristics that will be encouraged in these areas. Issues addressed by the Guidelines include the relationship of buildings to streets, built form and character, and design considerations for crime prevention.

3.1 Introduction

These guidelines, along with Surrey's Official Community Plan (OCP), the Grandview Heights General Land Use Plan and Surrey's Zoning By-law will be used to guide development in Grandview Heights NCP #2. The primary intent of these guidelines is to facilitate the development of a unique community that has a sense of place and identity, is pedestrian-oriented, integrates the natural environment, fosters safety, liveability and connection.

Although much of the character of public spaces will evolve over time, specific design criteria will help lay the groundwork for successful evolution of these public gathering spaces in the future.

Ten guiding principles where developed which set the general framework for the more specific design guidelines. The Design & Development guidelines have been organized under the following main themes:



3.2 Design Principles

The following set of principles will set the framework for the NCP #2 Design & Development Guidelines:

Table 1- Design & Development Principles

Sense of Place & Identity	***Principle # 1:***	*Maintain community identity and character through the retention, wherever possible, of trees and vegetation of environmental significance, integration of heritage features into design and identification of places, respect for ALR, and protection of key view corridors of mountains and water at the viewpoints along the Grandview Ridge Trail.*
	Principle # 2:	*Design spaces for gathering that are accessible, provide amenities (public art, benches etc.) and promote social interaction*
Natural Environment	***Principle # 3:***	*Enhance the natural environment through maximum retention of valuable trees and natural areas, clustering of development and promoting natural drainage systems.*
	Principle # 4:	*Promote development of environmentally sensitive design through encouraging implementation of geo-exchange systems, building orientation for solar access, green roofs and green buildings. Support the goals of the City's Sustainability Charter.*
Liveability & Connection	***Principle # 5:***	*Promote a healthy community by development of a highly walkable community with pedestrian networks interconnecting with trails, parks, and corridors.*
	Principle # 6:	*Provide an interconnected street network in a grid or modified grid pattern, combined with greenways, to ensure a variety of itineraries and to disperse traffic congestion, enabling residents to walk or cycle to schools, parks, services and facilities.*
	Principle # 7:	*Provide a range of housing types, densities and forms to allow a range of housing choices for people across the spectrum of income, ability, family type and age.*
Safety	***Principle # 8:***	*Support crime reduction by using CPTED practices in design considerations for all developments.*
	Principle # 9:	*Enhance public safety and promote social interaction in neighbourhoods, by designing dwellings to provide "eyes on the public realm".*
Economic Elements	***Principle # 10:***	*Provide opportunities for local shopping as well as for home-based businesses.*

3.3 Community Gathering Spaces

The intent of the public spaces design guidelines is to encourage the development of public gathering spaces that are connected to the larger community and provide a vibrant and safe place for community interaction.

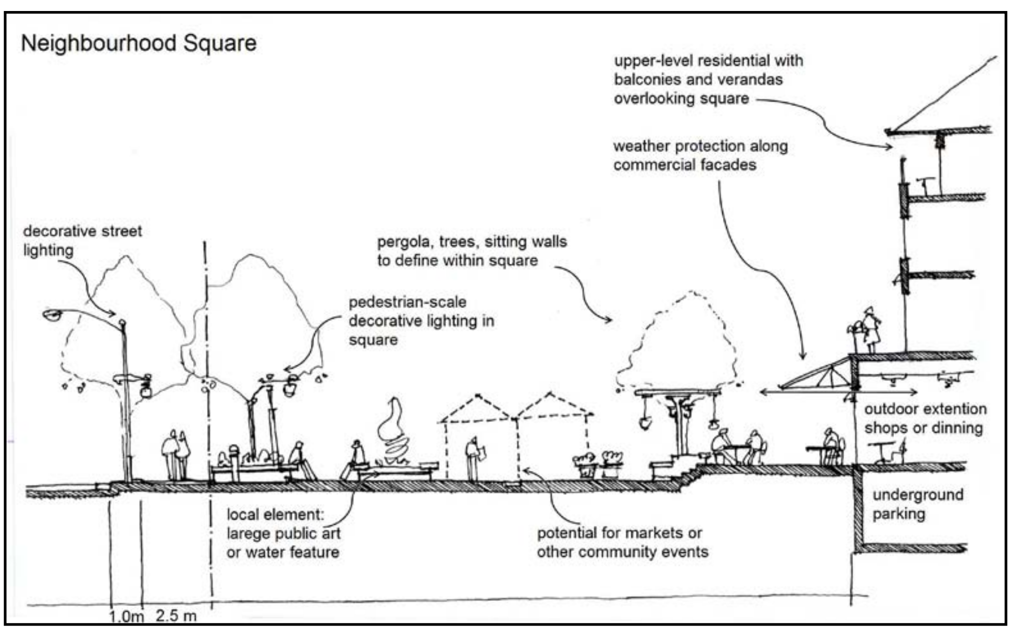
The following section will focus on public space design guidelines for:

- Neighbourhood Square/Plaza
- Parks and Open Space
- Landmarks and Entrance Markers

3.3.1 Neighbourhood Square

A neighbourhood square is planned as part of the mixed use residential and commercial designation at the corner of 168 Street and 24th Avenue. This square will face onto 167A Street and 23A Avenue. The objective of this square is to serve as a neighbourhood heart by providing a combination of activities and spaces that give residents a vibrant, attractive place to come together. Important considerations for this neighbourhood square include elements such as access and connection to surrounding streets, public seating, public art, and a strong image and identity. The following cross-section of the neighbourhood square and mixed use development (**Figure 3.1**) provides a conceptual framework.

Figure 3.1 - Neighborhood Square Interface with Mixed Use Development and Street



Design Components

- The square should include a central open space appropriate for accommodating neighbourhood events and gatherings, along with smaller, more intimate areas defined through the use of canopies, trees, and trellises.

- A strong feature, such as a fountain or a public art installation, should be included as a focal point in the square. This feature will provide the square with a strong image and identity.

- Commercial developments along the edges of the square shall provide public seating. The public seating may be provided in multiple forms such as benches, sit-walls, ledges and steps.
- The surface of the square shall have pavement with contrasting colours and textures for visual interest.

- Adequate bicycle parking racks shall be provided.

- Commercial and directional signage should be oriented to pedestrians and relate to the scale and character of the neighbourhood commercial area.

Access and Circulation

- Streets, sidewalks and public rights-of-way through adjacent developments should lead into the square at multiple points, providing easy and flexible pedestrian access. The square should be accessible by foot, wheelchairs, scooters, cycles and cars.

- Streets adjacent to the square should use traffic-calming measures such as planted curb bulges, traffic bollards, traffic circles, and/or angled parking.

- Large surface parking lots are not permitted in the square. Short-term on-street parking may be supplemented by limited off street parking.

- Crosswalks leading to the square shall be well marked. The use of curb extensions and pavement treatment is encouraged.

- Provision should be made for transit stops within easy walking distance of the square.

Safety

- Residential development across the street from the square shall face the square and have reduced building setbacks to encourage visual surveillance.

- Commercial buildings on the edge of the square shall be designed to provide good visual surveillance both from within the space and along the edges.

- Decorative lamp post and luminaire lights (such as those used in Rosemary Heights) shall be used throughout the neighbourhood plaza/square area

User Attractions

- Public art should be integrated into the development of the square. Consideration should be given to public art that evokes/recalls the history, heritage and character of the Grandview area (e.g. the agricultural and equestrian heritage). The installations should be interactive and “child-friendly”, encouraging sitting, climbing, and/or touching.

- Outdoor extensions of cafes and restaurants into the square are encouraged where the context is appropriate.

- The design of the square shall give consideration to future programming of the space (e.g. have flexibility for open spaces that could be used for performances, outdoor markets, and other activity generators).

3.3.2 Parks & Open Space

Three park sites have been identified in the Sunnyside Heights (NCP #2) area: Park A (Sunnyside Riding Club); Park B (22nd Avenue); and Park C (18th Avenue). Three major corridors connect these parks: the Grandview Ridge Trail, the multi-use drainage corridors, and enhanced sidewalks. Surrey's Parks, Recreation and Culture Department will manage and oversee the construction and maintenance of all public parks. Detailed design will be completed in consultation with the future community; however potential uses that are viable given the size and nature of each park include the following:

Neighbourhood Park A

Park A is approximately 9.6 acres and will be adjacent to a future school site. Under the PRC new park classifications, this park could serve as a large, integrated amenity neighbourhood park. This kind of park could have a informal multi-use sport field shared by the school and the park and a shared parking lot. Other possible amenities for the site might include integrated and compact youth, early child play areas, courts, a possible skate park, a walking track around the park parameter, a possible water spray area for tots, and community gardens. The park amenities will be determined based on community consultation at time of development.

Neighbourhood Park B

The emphasis of Park B is natural area connectivity and local children and youth amenities. Due to projected density of the surrounding areas, there will be a need for a local early and young child play amenities. Amenities in this park should compliment and build upon the nature of the site and existing grades that allow for views corridors. Forest based amenities could include a cross training running track which could also be used for free-ride bike trails.

Neighbourhood Park C

Park C in the southern section of the NCP, is surrounded by lower residential densities, and has high tree preservation values. This neighbourhood amenity park will need to ensure a high level of use and activity, to increase park security and appropriate use. While open informal fields and picnic areas, benefiting from the viewpoints have been identified, there will also be a for a multitude of local amenities in the park, to ensure a wide spectrum of multi-generational uses. Examples could include local sport fields, sensory gardens, frisbee gold, a large young and early child play area, a water park, popular court use, such as tennis and or basket ball, in addition to walking trails, to ensure the park is active and safe.

Common Park Design Features

Common design features for each park include:

- Trails, natural areas, and pedestrian/cycle connections to other neighbourhood amenities and greenways;

- Circuit trails around the park's perimeter, wherever feasible;

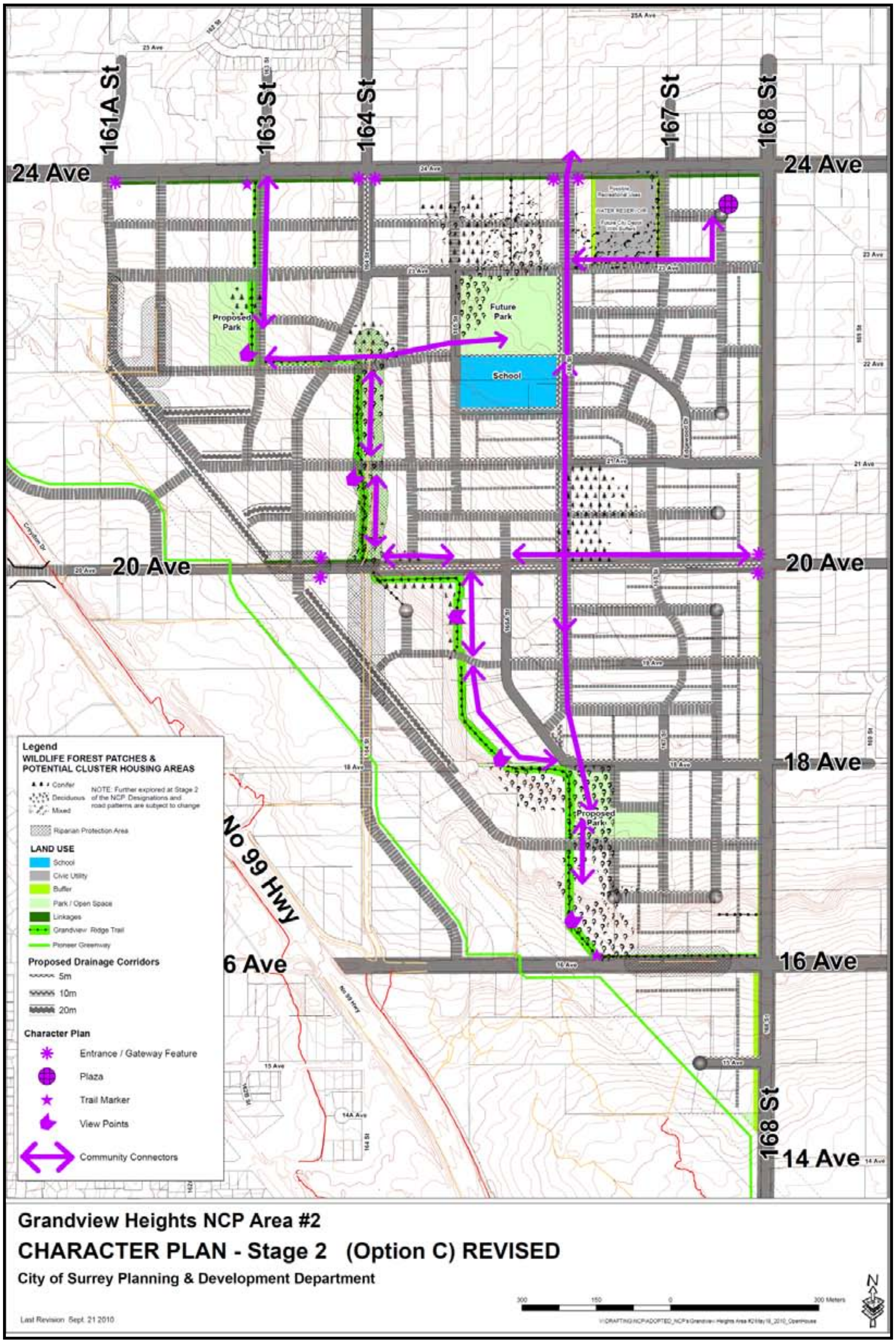
- Activity areas such as playgrounds or sitting areas located in highly visible locations, either near entrances to the park or along the perimeter of the park, visible from surrounding streets;

- Tree plantings that emphasize a strong vegetated edge surrounding an open interior space, while permitting views into the park from surrounding streets and homes.

3.3.3 Landmarks & Entrance Markers

The Character Plan (**Figure 3.2**) outlines opportunities and requirements to clearly identify the community through Gateway Landmarks, Community Landmarks and Entrance Markers.
Public art and landscaping should be incorporated into these features. The Character Plan identifies a number of potential entrance and community landmarks.

Figure 3.2 Character Plan



Gateway/Entrance Landmarks

There is an opportunity to clearly identify the neighbourhood through unique signage and gateways at major entrances into the community along major arterial and collector roads. These locations include, but are not limited to:

- 24 Ave at 161A, 164, 166 and 168 Street; and
- 20 Ave at 163 and 168 Street

Simple stone markers, or similar markers, could be placed in City Owned land / rights-of-way, at minor entrance points to the community, clearly identifying the community for pedestrians and cyclists. These markers will be provided through the rezoning and development permit process.

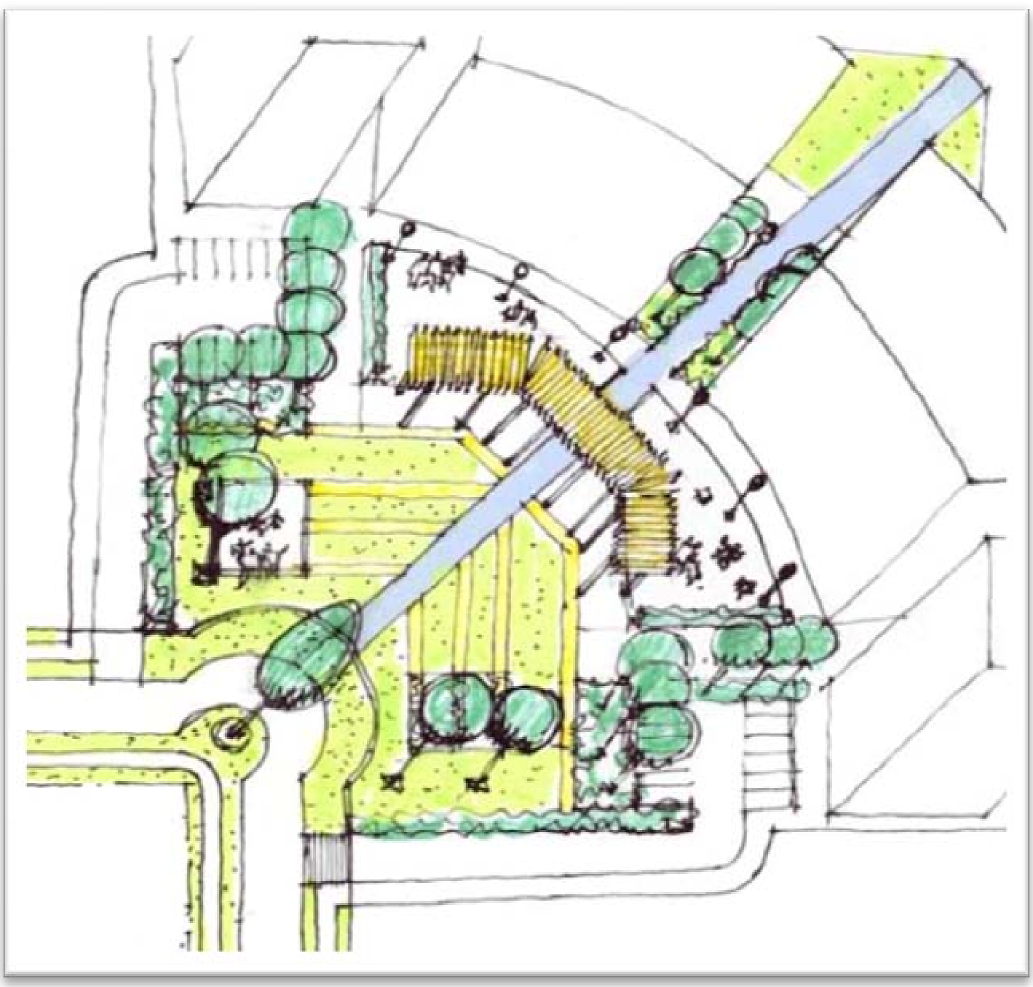
Developers will be required to provide these entrance markers through the rezoning and development permit process. In multifamily sites these markers may be located on private or strata property, while in single-family areas they may be located within the public right-of-way. In all cases, these markers shall be clearly visible from the public road.

Plaza Feature

A Plaza will be included as part of the mixed use commercial development at 168 Street and 24th Avenue. The plaza will include a feature that could a heritage monument, water feature, and/or other forms of community identification, and are intended to mark the heart of this community.

The following sketch (**Figure 3.3**) provides a conceptual framework for the design of the square. Landscaping, seating, textured surfaces, public art, special lighting and open space shall be components of the design. The specific layout and design options of the plaza will be explored at the development stage.

Figure 3.3 - Conceptual Sketch of Neighborhood Square



3.4 Commercial Areas

Two commercial areas have been identified within the neighbourhood: a mixed-use development at 168 Street and 24 Avenue; and a second, small-scale commercial area on 20th Avenue west of 164 Street.

3.4.1 Mixed-Use Development (Commercial Residential 25-45 upa)

This land use designation is intended to provide space for local-serving commercial and retail businesses that are located on the ground floor with residential units above. This development also includes the neighbourhood square to serve as a neighbourhood gathering place. This section addresses the design of the mixed-use building, while the "Community Gathering Places" section outlines the square's design guidelines.

Building Design and Character

- The Plan provides for mixed-use, commercial-residential buildings with a maximum height of four storeys, and providing a near continuous street frontage.
- The face of the building on the second level and above should be set back from the face of the ground floor level on the side of the building overlooking the square.
- The building design should emphasize the public realm through the use of compressed front setbacks along the street frontage, with the primary façade addressing the street.
- Pedestrian weather protection (minimum width of 1.8 metres [6 feet]) shall be provided in the form of awnings or architectural overhangs on all ground-level commercial frontage facing the square and the surrounding public streets.
- Commercial units fronting on the square and the public streets shall be primarily glazed using see-through glass, and shall be directly accessed from the square and/or the public street.

- Wall mounted lighting fixtures are encouraged on all commercial developments. Decorative lamppost and luminaire lighting, designed for the pedestrian scale should be used throughout the commercial area (see neighbourhood square section above).

- Access into the commercial units should be provided directly from the plaza, and also from the public street.

- Terraces or decks are encouraged on the upper levels of the building overlooking the neighbourhood square.

- Several narrow commercial shop fronts are preferred over a single large commercial unit facing the neighbourhood square.

- Residential parking for the mixed-use development shall be provided in underground garages.

- The following illustration shows the character intended for the commercial street frontage.

Examples of Commercial Street Frontage Character

3.4.2 Small Scale Commercial

A node for small scale community commercial will be located on a triangle portion of a lot located at the south west corner of 20th Avenue and 164th Street. The intent of this area is to provide for retail and service development that features small scale commercial enterprises and services such as a neighbourhood grocery or convenience store) that caters to everyday needs of local residents.

Building Design and Character

- The western portion of this site is encumbered by a Hydro right-of–way leaving the remainder, a small triangle shaped portion, for development. It is envisioned that a commercial building be located on the triangle portion of the property, and parking would be accommodated on the Hydro right-of-way area.

- The building form and massing should reflect the surrounding residential character and integrate with the roundabout planned at 20th Avenue and 164 Street.

- The primary façade of the building should address the streets and include architectural detailing that relates to the roundabout.

3.5 Residential Areas

The guidelines for Residential Areas promote the development of a range of housing types, densities, and forms that will provide a variety of housing options while ensuring a strong and unified presence and character for the neighbourhood.

The provision of a variety of housing types and densities from single family to apartments is intended to provide a range of housing choices for people across the spectrum of incomes and family types, and provide options for residents to remain in the neighbourhood as they age.

3.5.1 Special Residential (15-25 upa)

The intent of the Special Residential areas is to provide a flexible option for commercial and residential development. This designation permits and encourages the development of a medium density dual use (residential and business) neighbourhood allowing a wide array of compatible businesses such as artists workshops / studios, craft stores, shops, and similar small-scale retail businesses, personal service uses, and consultants' offices.

At densities between 15 to 25 units per acre these areas will take the form of townhouses or row houses. The following objectives support the development of a functional, and liveable Special Residential area:

- There should be direct pedestrian access from the fronting street to each individual business.
- The business portion of the building shall be located at the ground level.
- Commercial frontages should include weather protection in the form of small canopies or awnings protruding a minimum of 1.5 metres (5 feet) from the building face.

- Signage should be integrated into the design and detailing of the building, and should be scaled and oriented to pedestrians.

- Dwelling units should be designed to ensure a maximum amount of natural light to penetrate the unit.

- Fascia signs, projecting and window signs are encouraged.

- Special Residential development should maintain a residential character in terms of building massing, rooflines, window sizes and locations and architectural articulation such as porches, balconies and bay windows.

- All multiple family developments should investigate opportunities for introducing geo-exchange heating and cooling systems in their developments.

3.5.2 Multiple Residential (30-45 upa)

The multiple residential density of 30-45 units per acre provides for a range of housing types, from townhouses to apartment style buildings of a variety of designs. Dwelling units should face the public street wherever possible, and units located on the ground floor shall have direct access to the street. Parking should be primarily provided underground with access from internal rear lanes or off street driveways.

- All ground-level units should front, and have direct pedestrian access to and from the street wherever possible, to ensure a high degree of walkability.

- To promote "eyes on the public realm" reduced setbacks are encouraged for units that directly abut a street, trail or multi-use drainage corridor. Setbacks of 4 metres for ground-floor levels, and 6 metres for the upper levels are preferred; other variations will be considered.

- Units along a street frontage should have a strong street-oriented character.

- There should be clear delineation between private space and public space, without sacrificing opportunities for casual observation of public spaces.

- Wall mounted lighting is encouraged on units adjacent to trails and corridors.

- Common pedestrian access to adjacent trails, corridors or parks should be provided by clear, identifiable entryways differentiating between public and private lands. Permanently closed gates are not acceptable.

- For sites along the Grandview Ridge Trail, developers will be responsible for erecting fencing on private property fronting the trail. These fences shall be no more than 1.2 metres (4 feet) of a non-solid, wood fence (see Landscaping and Fencing section of the Grandview Ridge Trail above).

- Building facades should be articulated by recessed front entries or porches which clearly distinguish individual units while reinforcing a unified residential character.

- Private rooftop decks and/or private balconies in upper level units are encouraged.

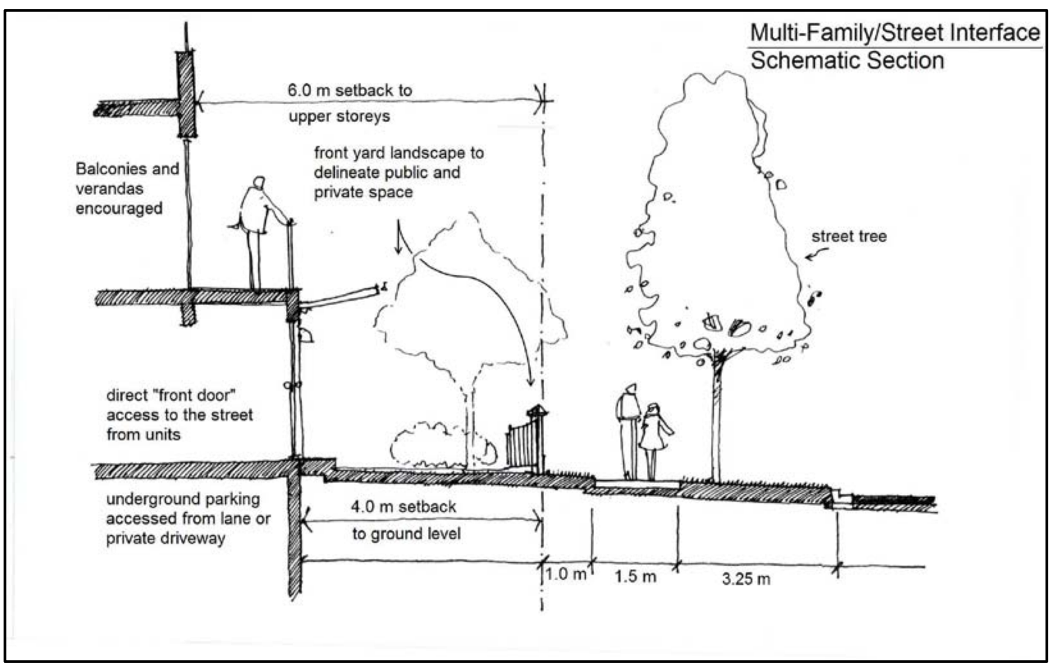
- The massing and proportions of the buildings shall contribute to a humanizing of the street edge through such means as porches, entryways, cornices and overhangs or stepped-back upper levels.

- Dwelling units should be designed to ensure a maximum amount of natural light to penetrate the unit.

- Parking shall be provided underground accessed from rear lanes, or from well landscaped entrances off local streets.

- All multiple family developments should investigate opportunities for introducing geo-exchange heating and cooling systems in their developments.

Figure 3.4 - Cross Section of Multi-Family Site and Street Interface



3.5.3 Multiple Residential (15-25 upa)

The multiple residential density of 15-25 units per acre provides for semi-detached, single family, duplex, four-plex or six-plex units, fee simple row houses, and at the higher density ranges, integrated townhouse and apartment developments. Dwelling units should face the public street wherever possible, and units located on the ground floor shall have direct access to the street.

- There should be clear delineation between private space and public space, without sacrificing the opportunities for casual observation of public spaces.

- To encourage eyes on the public realm, reduced setbacks are encouraged. Setbacks of 2 metres to the verandas or porches, and 4 metres to the front door of units are recommended for units fronting onto a street or trail.

- Units along a street frontage should have a strong street-oriented character, and direct access from sidewalk to units should be provided.

- Corner units exposed to side views should provide sufficient architectural detailing in all street-fronting elevations.

- Fences are not desirable in the front yard area of multiple family residential sites; shrubs and hedges are recommended. If fences are unavoidable, an open-style fence in combination with landscaping and a low stone or brick faced wall as a base is encouraged. Front yard fences should not be higher than 1.2 metres.

- For sites along the Grandview Ridge Trail, the developer will be responsible for installing fencing on private property fronting the trail. These fences shall be no more than 1.2 metres (4 feet) of a non-solid, wood fence (see Landscaping and Fencing section of the Grandview Ridge Trail).

- To encourage visual surveillance of public space, dwelling units should be designed to address a street, trail or park area that they are adjacent to or across from.

- Dwelling units should be designed to ensure a maximum amount of natural light to penetrate the unit.

- Common pedestrian access to adjacent trails, corridors or parks should be provided by clear, identifiable entryways differentiating between public and private lands. Permanently closed gates are not acceptable.

- All multiple residential developments will investigate opportunities for introducing geo-exchange heating and cooling systems in their developments.

3.5.4 Medium Density Residential (10-15 upa)

This land use designation is intended to provide for areas of predominantly single-family residential homes in a more compact neighbourhood, while allowing for some opportunities for alternative housing types including duplexes or row houses. In all cases, access to the garage from the rear lane is mandatory in this area where a rear lane exits. Other features of units in this area include the following:

- Units shall have reduced setbacks of 2.0 metres to front porches and 4 metres to the fronts of units to reinforce the human scale of the street while allowing more backyard space and to encourage surveillance of the street.

- Garages and ancillary dwellings (coach houses etc.) must be accessed by way of the rear lanes.

- Front yards should clearly delineate public and semi-private space through the use of natural low landscaping, and low, open-style fencing.

- Units shall have articulated facades with appropriately proportioned windows and roof projections / peaks.

- Dwelling units should be designed to ensure a maximum amount of natural light to penetrate the unit.

- Use of permeable surfaces for driveways and other paved areas is strongly encouraged.

3.5.5 Low Density Residential (6-10 upa)

The low-density residential designation of 6-10 units per acre permits single-family homes, with the potential for secondary suites and coach house units depending on the size of the lot. These lots would be serviced primarily by rear lanes with on-street parking, and few, if any, driveways or garages facing the street. Opportunities for a reduced or varied front setback would be considered in order to create a friendly and unique street frontage, while allowing for a larger rear yard, yet clearly identifying between public and private realms at the fronts of houses.

- Units may have reduced front yard setbacks to allow for more room with the private back yard space.
- Houses on corner lots will be architecturally unique, and shall face the street on both sides;
- Front porches and verandas with overhangs that define a semi-private area in front of the unit are strongly encouraged.
- Front yards will clearly delineate public and semi-private space through the use of natural low landscaping, and low, open-style fencing.
- Units shall have articulated facades and architectural features such as bay windows, roof projections and gable ends facing the public street.
- Wherever possible, units shall be designed to ensure a maximum amount of natural light to penetrate the unit.
- Use of permeable surfaces for driveways and other paved areas is strongly encouraged.

3.5.6 Urban Transitional Designation (Up to 8 upa)

This designation of up to 8 dwelling units per acre (gross density) is intended to provide a transition between lots on the west side of 168 Street, and larger suburban lots on the east. The lots facing onto 168 Street will provide a landscape buffer on private property to help reduce the impact of the arterial street as well as to provide a smooth transition to the larger suburban lots to the east.

- Lots fronting 168 Street shall have a 15 metre (25 feet) front yard setback in order to accommodate a 10 metre wide landscaped buffer.

- The buffer shall be comprised of a double staggered row of trees and flowering shrubs. Figure K shows a conceptual sketch of the buffer.

- The buffer will be secured through a restrictive covenant for planting and maintenance as well as landscape security held by the City.

- Developments that front 168 Street must provide vehicle access to the unit from rear lanes.

3.5.7 Suburban Transitional (2-4 upa)& Suburban Residential (1-2 upa)

This designation is for an area of ¼ to ½ acre lots that support a larger building footprint in proximity to the Agricultural Land Reserve and Fergus Creek Nature reserve.

- The future subdivision potential and lot layout will need to consider Policy O-23 for transition and buffering to Agricultural Land Reserve to the southeast.

3.5.8 Cluster Areas

Through the Cluster Residential Designation, properties will be required to provide between 30 and 40% Open Space. In exchange, the density from the land provided for open space will be transferred to the remaining portion of the development, thus creating a higher net density. Two cluster designations have developed for this NCP, Cluster (10-15 upa) and Cluster (6-10 upa):

Cluster 10-15 upa

- Cluster 10-15 units per acre designation will allow between 25- 30 units per acre on the developable areas of the site

Cluster 6-10 upa

- Cluster 6-10 units per acre designation will allow between 20-25 units per acre on the developable areas of the site

The purpose of the Cluster Housing designations is to preserve significant natural environmental features and open space by providing flexibility in land use and the siting of buildings.

Residential units within land designated as Cluster Housing shall be grouped in order to preserve 30-40% of the gross site area. This natural open space is to be protected through a Restrictive Covenant or Easement for maintenance purposes and to prevent the removal of trees or the construction of structures.

Cluster Housing Units shall include a mix of unit sizes and types, including single, duplex, triplex, and quad-plex under a strata-type development. The variety of units would reflect the location of trees, site features and environmental watercourses.

It is anticipated that the Cluster Housing areas could be developed under a comprehensive development (CD) zone with special regulations developed to reflect the purpose of the Cluster Housing concept.

The minimum parent parcel size for Cluster Housing is 2 hectares/5 acres, unless the proponent can demonstrate that development located on a smaller site can be designed to properly reflect the site topography, preserve environmental features and trees, provide suitable site access, and achieve the recommended minimum target of 30-40% for natural open space.

The density calculation for cluster housing designation shall be based on gross site area, excluding road dedication.

All Cluster Housing developments will require Development Permits to reinforce design and environmental objectives. A Cluster Housing development application will include a site assessment analysis by a qualified professional(s), which will identify (based on site terrain, environmental landscape and site grading/servicing requirements) potential areas to be preserved on a site.

Figures 3.5, 3.6, and 3.7 show examples of pre-development sites with trees and conventional development versus cluster development.

Figure 3.5 Pre-development site for Cluster Housing

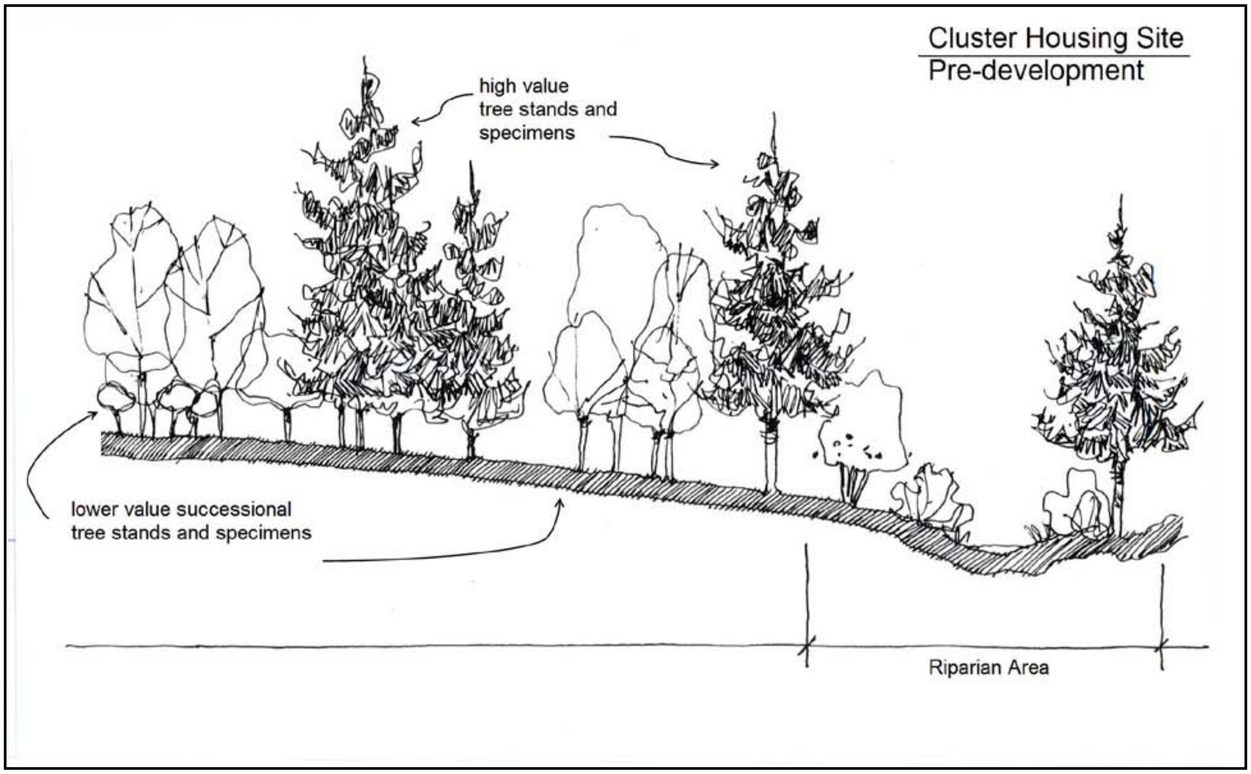


Figure 3.6 Conventional Development

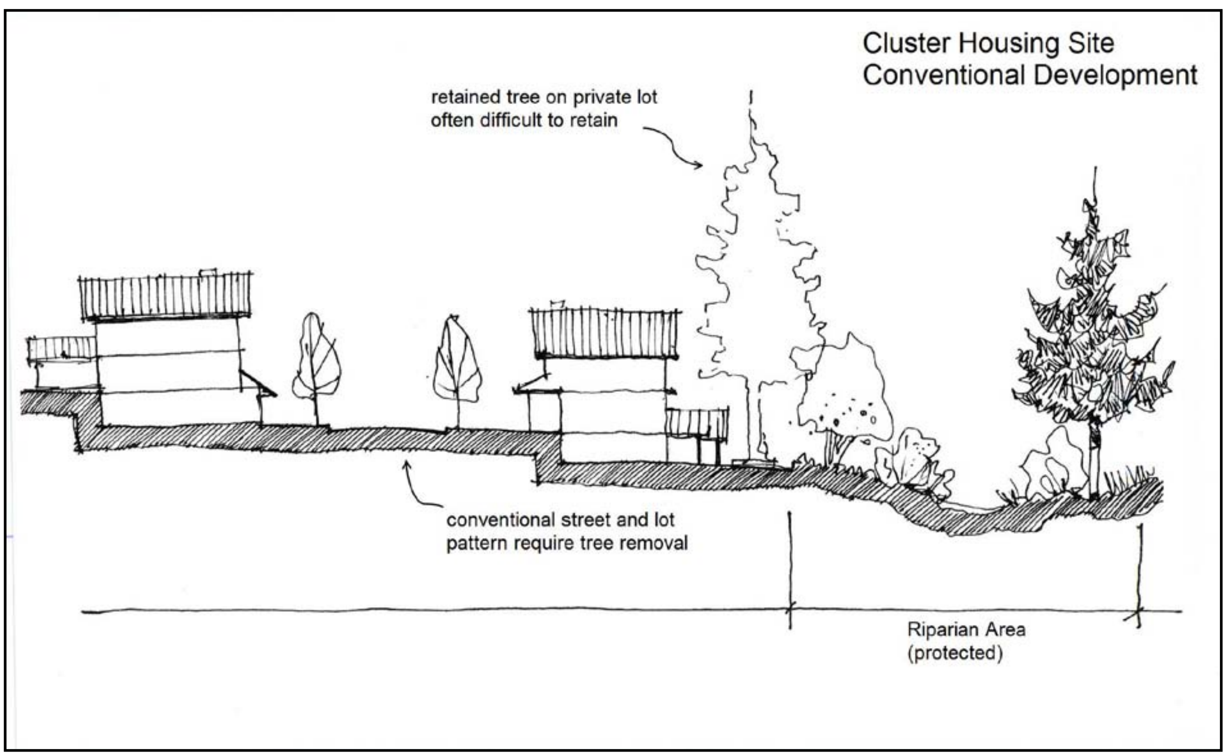
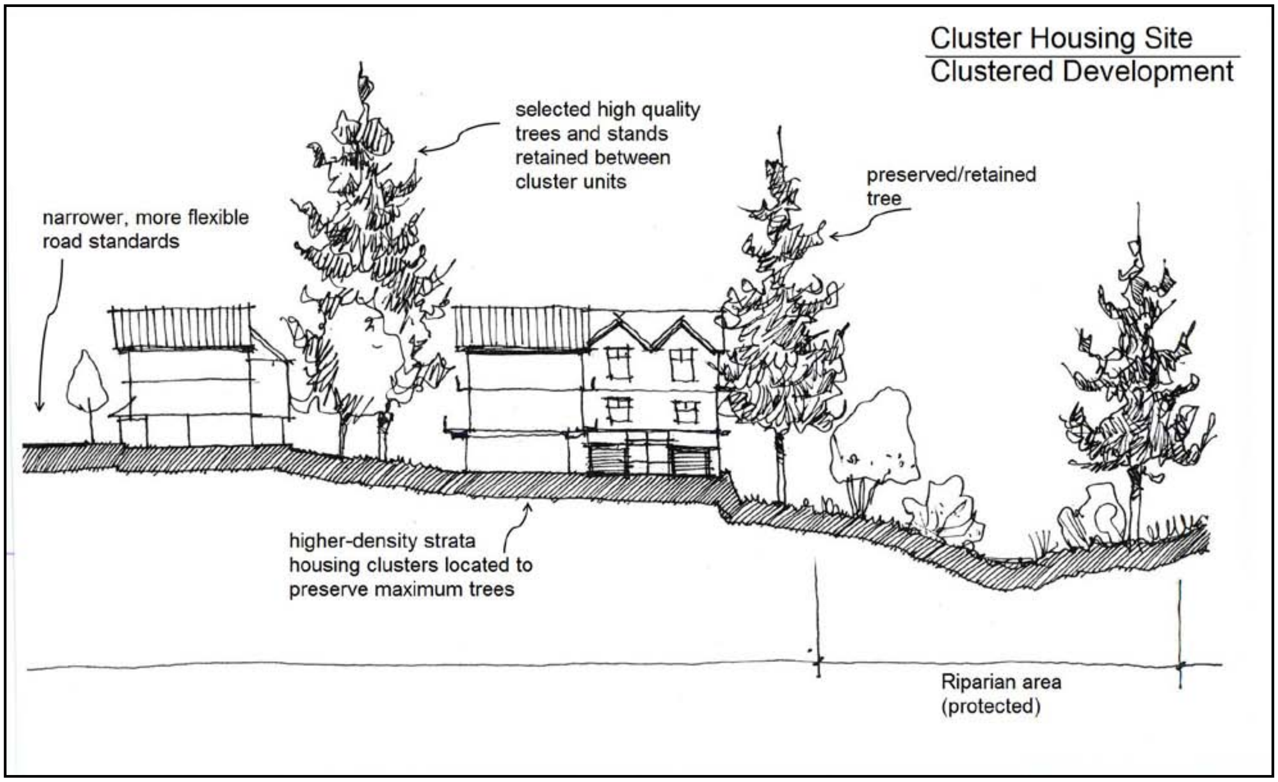


Figure 3.7 Cluster Development



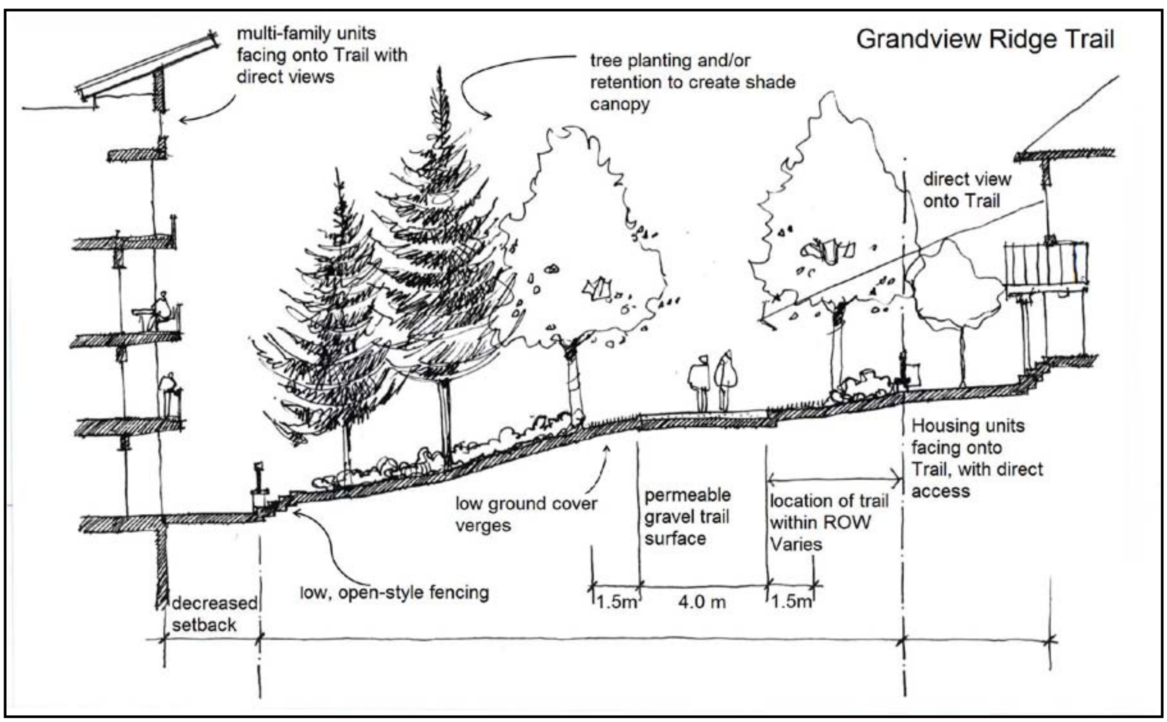
3.5 Trails and Buffers

3.5.1 Grandview Ridge Trail

The Grandview Ridge Trail is a continuous, 2 km, multi-use permeable pathway leading from the Grandview Corners area to Darts Hill Park. The Trail will be within a 20-metre wide corridor generally running north – south on the western side of the NCP Area. Situated at the top of a slope, the Trail will provide significant viewpoints as well as a connection to two of the three parks and the riparian area identified in the NCP. The trail system will be accessible to all residents of the community through multiple easy and safe trail access points and will connect a variety of land uses, including residential areas.

The 20-metre wide right-of-way for the trail will be secured through subdivision and rezoning applications. The trail is mostly located along or through multi-family sites in the NCP area. It will be constructed and maintained by the developer of each multifamily site. The trial may be within a public right-of-way on private or strata-owned property. The design will be regulated through the Development Permit approval process. **Figure 3.8** shows a typical cross-section of the Trail.

Figure 3.8 Typical Cross-Section of Grandview Ridge Trail



The following elements shall be considered in the design and development of the trail:

Design Elements

- The path will be 4 metres wide, located within a 20-metre wide corridor.

- The pathway within the corridor will be situated near the top of the slope wherever feasible, and designed to maintain a stable slope by the use of retaining walls or other means, where necessary.

- The path will be designed to encourage rainwater infiltration by using a permeable surface or by ensuring runoff from the path flows onto a vegetated area. The path surface shall be designed to allow for use by bicycles, wheelchairs and strollers.

- The gradient of the path shall not exceed 8%, and shall be less than 5% wherever possible, to maximize accessibility.

- The edges of the pathway should be well defined to avoid surface erosion and reduce trail maintenance.

Access and Connection

- Direct connections from ground-level multi-family housing units to the trail are recommended. If no direct access from housing units is provided, an access walkway to the trail should be provided, located near the midpoint of development sites.

- Open space and outdoor amenity areas in multi-family developments should be placed adjacent to the trail wherever possible.

Landscaping and Fencing

- Where feasible, and based on the recommendations of a Certified Arborist, existing trees along the ridge area will be retained. Native vegetation and planting should be provided along either side of the pathway.

- The landscaped areas adjacent to the pathway should be covered by tree canopy at maturity. Tree species should include both deciduous and coniferous varieties. Coniferous trees should be located to allow for sunlight penetration onto the Trail, particularly during winter months. Vegetation that contributes to foraging and nesting habitat for songbirds is encouraged.

- Viewpoints along the Trail as identified in the Character Plan shall be protected wherever possible and views must be considered in tree selection and spacing.

- Seating shall be provided at viewpoints (numbered 1 through 4 on the Character Plan) by the multi-family developments and maintained by the respective strata. Seating will be placed in a manner that encourages both the visual surveillance of the trail and surveillance of the seating area from adjacent residences.

- "Equestrian fencing" delineating the trails edge (an example is shown in the photo below) is strongly encouraged; other forms of similar fencing, will be considered.


Examples of open style fencing

Trail Markers

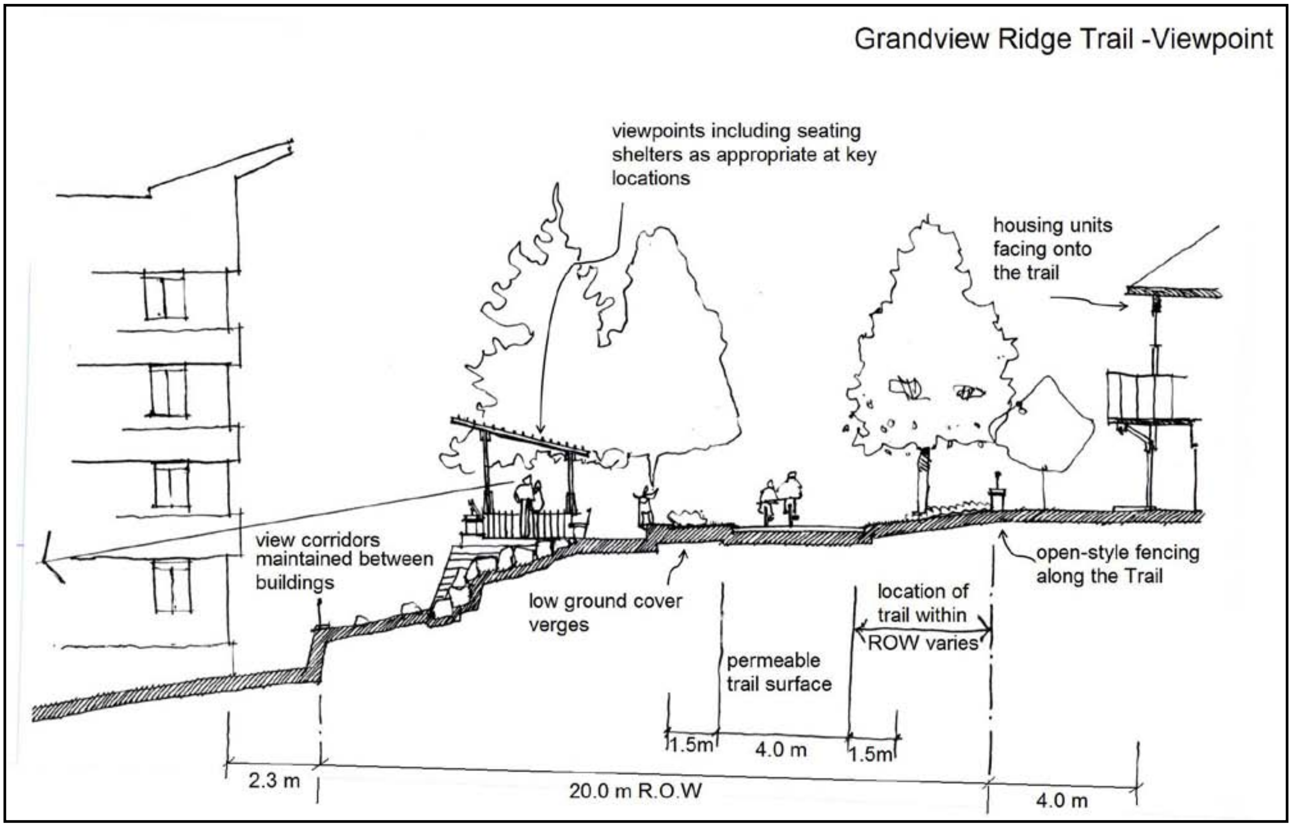
The unique character of this trail will be recognized through trail markers similar to the markers and signs along the Semiahmoo Heritage Trail.

- developments that include entrances to the trail will provide trail markers at the entrances to the trail.

View Points

The trail viewpoints are a key feature of the community, capitalizing on extensive views to the south and the west including Boundary Bay and the San Juan Islands. The areas marked as viewpoints on the Character Plan are subject to further examination, and should include information installations and benches to enjoy the view, wherever feasible. **Figure 3.9** shows a cross section of the Grandview Ridge Trail and Multi-family Residential with a view point area.

Figure 3.9 - Sample Viewpoint along Multi-Family site on the Grandview Ridge Trail



Development Standards for Private Land Abutting the Trail

- Multi-family developments adjacent to the Grandview Ridge Trail will be required to provide a statutory public right of way through the development site. The net density of these sites will not be affected by the presence of the trail.

- Dwelling units located along the corridor should provide second floor windows and balconies facing the corridor to allow casual surveillance of the corridor.

- Pedestrian scale low-level lighting and wall-mounted lighting on units abutting the trail are encouraged, to increase the safety and the perception of safety.

- Housing units along the Trail should face the Trail directly, preferably with direct pedestrian access onto the Trail.

- Multi-family housing developments along the Trail should place active/inhabitable spaces on the ground floor towards the Trail, and should place common outdoor recreation areas and amenity areas next to the Trail wherever possible.

- Developers will be responsible for erecting fencing on private property fronting the Trail. These fences shall be no more than 1.2 metres (4 feet) in height and consist of a non-solid fence constructed of wood or wood with masonry pillars (see Landscaping and Fencing section above).

- Seating shall be provided at viewpoints (numbered 1 through 4 on the attached Character Plan) by the multi-family developments and maintained by the respective strata. Seating should be placed in a manner that encourages both the visual surveillance of the trail as well as surveillance of the seating from the residential.

- Common pedestrian access to the trail from adjacent lands may be provided by clear, identifiable entryways differentiating between public and private lands. Permanently closed gates are not acceptable.

- The landscaping plan for the trail corridor will be established as part of the development permit for multiple family projects fronting the trail.

- Single-family developments along the Trail should front onto the Trail, with automobile access to the houses from a lane at the back of the lot.

Maintaining the Trail

- Where the Trail abuts multiple family developments, the respective strata corporations will maintain the Trail. Maintenance and access will be secured through a restrictive covenant for public right of passage and landscape maintenance. Trail maintenance shall conform to the City's Parks Operations standards.

- In areas where the trail passes through designated parkland, the trail will be treated as part of the Parks network, and maintained and designed in a manner consistent with the intent of the larger Grandview Ridge Trail.

3.5.2 - 168 Street Buffer

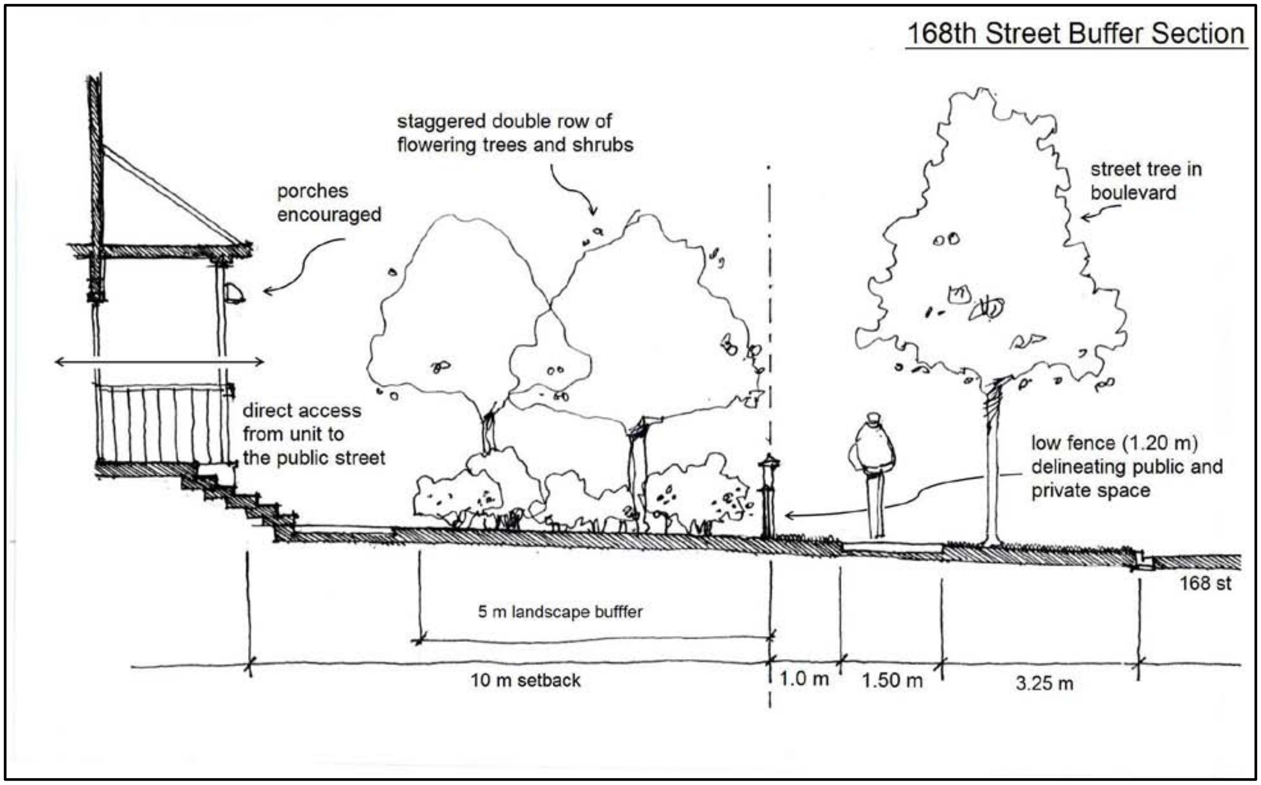
The buffer along 168th Street is important from the perspective of ensuring a matching street frontage to future development along 168th Street, from East to West, and also from the perspective of protecting development from impacts associated with increased traffic along 168 Street. Lots facing onto 168 Street will be a minimum depth of 40 metres and require special setbacks to accommodate a landscaped buffer on private property.

Lots north of 16th Avenue along 168 Street:

- Lots will require a special front yard setback of 10 metres to provide for a 5-metre wide landscaped buffer, on private property, along this arterial road.

- The landscape buffer will be comprised of a staggered double row of flowering trees and shrubs as well as an open style fence that is no higher than 1.2 metres. The landscaping will be secured by way of restrictive covenant and landscaping security.
-

Figure 3.10 - Cross Section of 168 Street Buffer for lots North of 16 Avenue



Lots south of 16th Avenue along 168 Street:

- Lots will require a minimum 37.5 metre (125 ft.) separation between the ALR boundary and the nearest wall of the principle building and be required to provide for a 15-metre wide landscaped buffer on private property.

- A Restrictive Covenant will be required to be registered on these lots to ensure minimum setback requirements, ensure landscape buffer is maintained, and to inform of agricultural practices in the area.

3.6 Streetscapes

NCP #2 will be a highly walkable and interconnected community with streets that have sidewalks, street trees and drainage corridors in key locations. The street network is based on a grid or modified grid pattern, combined with greenways, to allow a variety of itineraries and to disperse traffic; and to enable residents to walk or cycle to schools, parks, services and facilities.

3.6.1 Treatment of Intersections at Trail Crossings

- Decorative pavers, textured paving or other means should be used at all intersections with Grandview Ridge Trail crossings.

- Bollards, curb extensions and trail signage will incorporated into roads at trail crossings.

- See **Figure 4.18** in Transportation section for road cross-section at trail crossings.

3.6.2 Roads Leading into Neighbourhood Square

167A Street and 23A Avenue leading to the Neighbourhood Square are designated for street-oriented higher density residential development, including “Special Residential” townhouses or row houses as well as mixed use apartment buildings. The “Special Residential” designation provides for live/work units.

The following elements will help define the pedestrian character of these streets:

- A landscaped traffic circle will be constructed at the intersection of 163A Street and 23A Avenue.

- Traffic bollards will be used at the intersection of 167A Street and 23A Avenue to delineate between the public plaza and the street.

- Flowering trees and double luminaire street lighting will be used along 167A Street and 23 A Avenue.

- To slow traffic coming into the square and mixed-use commercial area, curb extensions and chokers will be used at the intersections of 167A Street and 23 Avenue and at 23A Avenue and 167 Street. The intersection design will include contrasting colour and/or textured pavement for the pedestrian crossing.

- Street furniture will be used for public seating, along the streets as well as in the plaza.

3.7 Multi-Use Drainage Corridors

Multi-use corridors are intended to serve as stormwater management facilities while also providing a green public amenity. As development in the NCP proceeds, the initial purpose of these corridors is as pervious open space and to provide water quality treatment through surficial infiltration. The stormwater servicing concept for the NCP is designed to control stormwater through on-site source controls combined with the pervious area provided by the drainage corridors. The intent is to mimic a “natural” drainage system by increasing the amount and quality of permeable surfaces. This will reduce the runoff volume and peak flow entering Fergus Creek and mitigate further creek erosion. If required in the future, enhanced infiltration systems can be constructed within these corridors to enable increased stormwater control.

Stormwater control features that can be included within the corridors include:

- Open channel bioretention filter swales (“bioswales”) to promote infiltration and provide runoff treatment;
- Subsurface drain-rock style storage system and perforated underdrains to promote infiltration;
- Periodic water quality ponding areas along the swales;
- Deep amended topsoil
- Trees; and
- In some cases, a trunk storm sewer main if needed for major storm routing.

The bioswales are shallow, wide swales landscaped with grass for the 5-metres corridors or with grass, shrubs, and trees for use in the wider corridors. Bioswales are sized to capture and treat runoff from small rain events (about 30mm in 24 hours). They will typicalls have an overflow structure (lawn basin/field inlet) at the end of each block, connected to the storm sewer to shunt excess flows out of the bioswale. Surface grading is away from houses towards the bioswale and the bioswales are normally on the uphill side of the streets, so that in very severe weather or if the overflow structure is blocked, excess flow may cause some street flooding but should not flood houses.

Future uses of the drainage corridor may include the construction of underground stormwater infiltration or detention storage facilities or the construction of surface infiltration measures such as rain gardens. Landscaping of the corridor must take into consideration of these possible future uses. Extensive tree planting is not permitted in the corridor and no trees are to be planted within the bio-swale. Utilities and other underground services may be permitted in the stormwater corridor if they do not obstruct the construction of future potential underground stormwater facilities in the corridor.

The plan includes three different widths of drainage corridors that are located along the many roadways throughout the plan area. Most of the corridors are 5-metres wide, approximately 80%, while the remainders are 10 and 20-metres wide.

3.7.1 Five Metre Drainage Corridors

The 5m corridors are located on most east-west oriented, Type II and III local roads. A bio-swale is located in the corridor to infiltrate and convey overland flow runoff from the sidewalk and half of the adjacent road surface. The road cross-slope is crowned.

Figure 3.11 Cross Section of 5-Metre Drainage Corridor

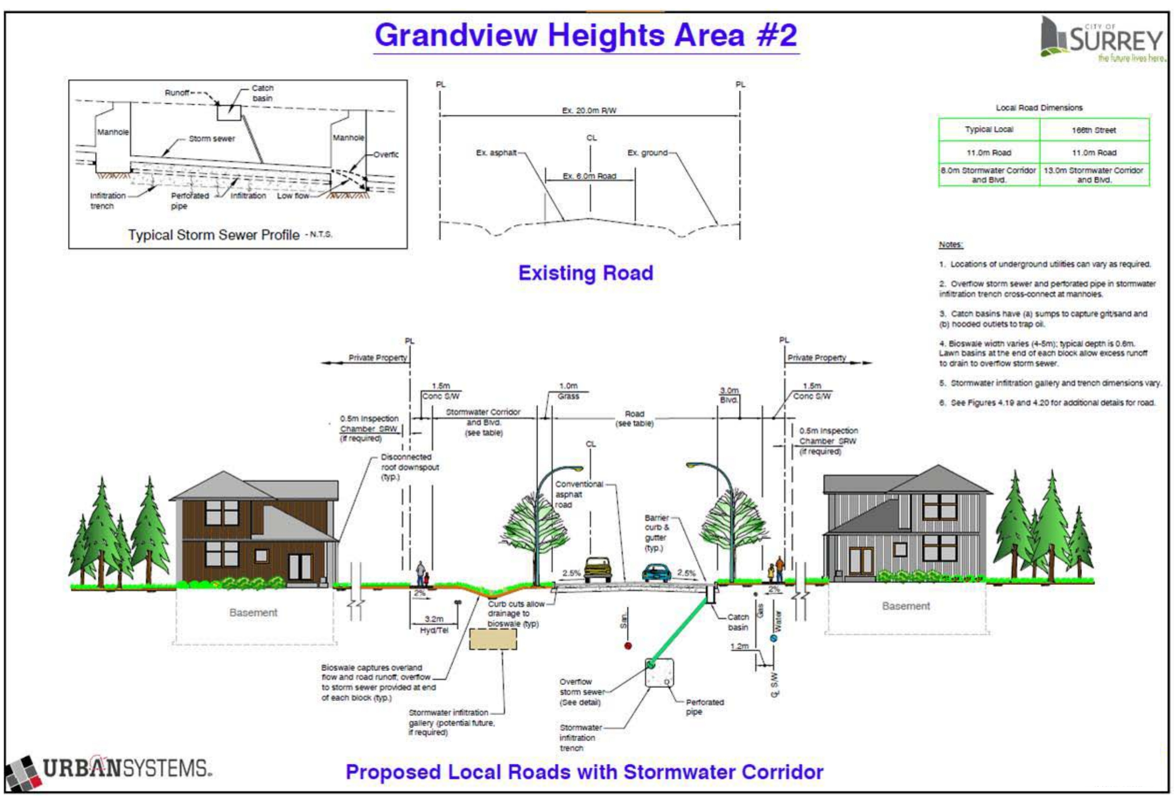
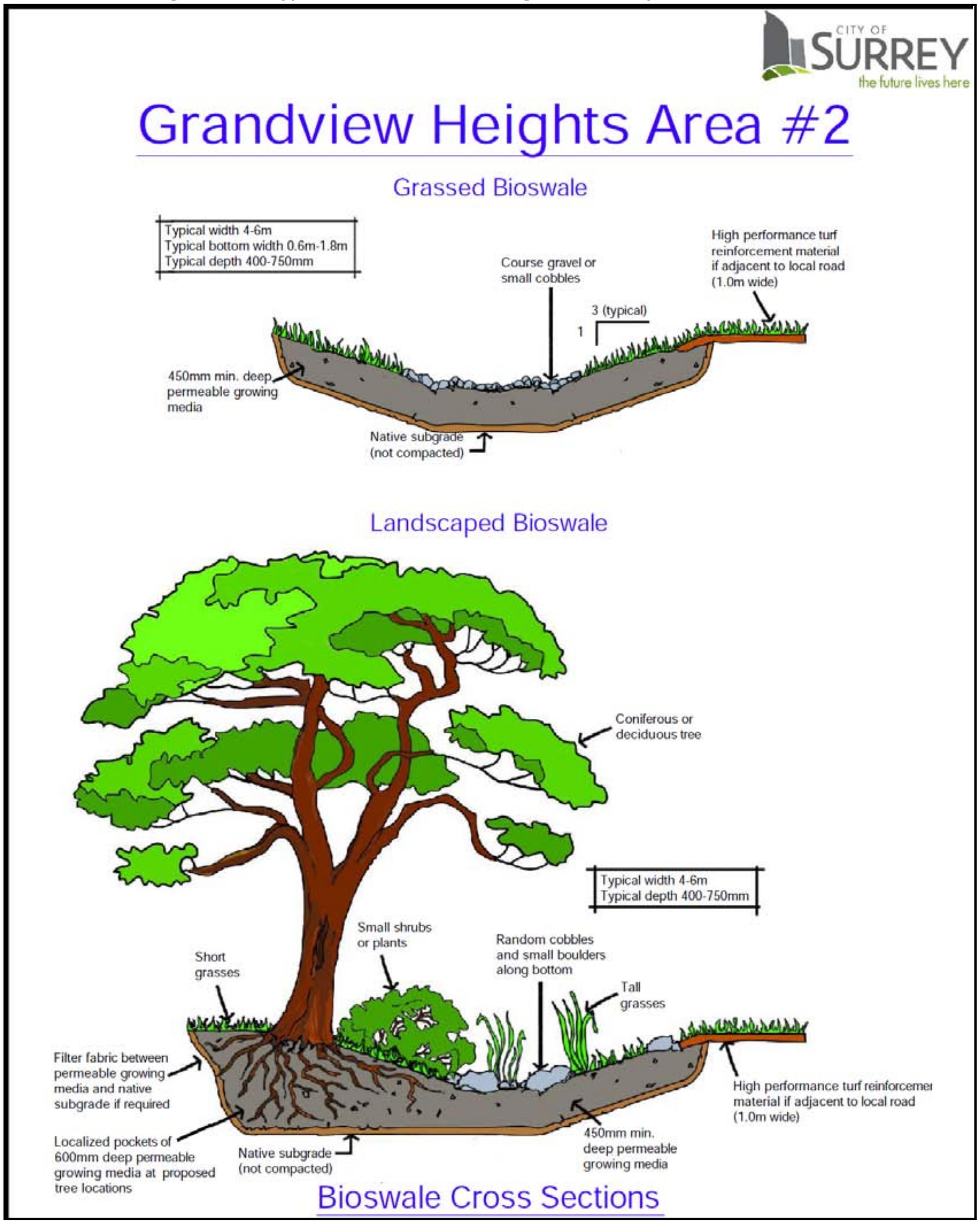


Figure 3.12 Typical Cross sections for grassed and planted bioswales



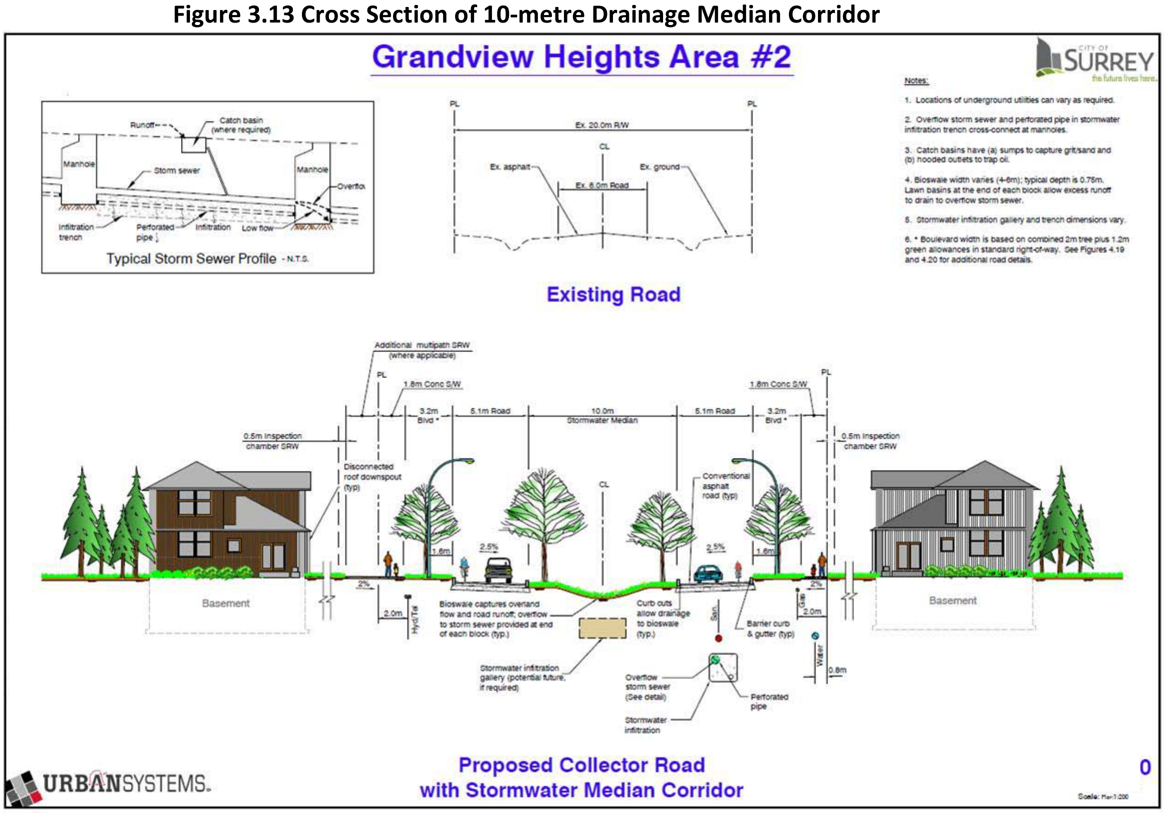
3.7.2 Ten Metre Drainage Corridors on 164th Street

A 10m wide corridor is located on the west side of 164 Street from 23 Avenue south to 18 Avenue.

3.7.3 Ten Metre Drainage Median Corridors

The 10m corridors are located in the centre median of selected Type Ia collector roads, namely 164 Street from 24 Avenue to about 22A Avenue, 166 Street from 23 Avenue to 24 Avenue, and 20 Avenue from 164 Street to 168 Street. A bio-swale is located in the corridor to infiltrate and convey overland flow runoff from the adjacent road surfaces. Overland flow runs off from both sides of the road and enters the drainage corridor through curb cuts. Both directions of road surface are sloped towards the corridor instead of the traditional crowned road.

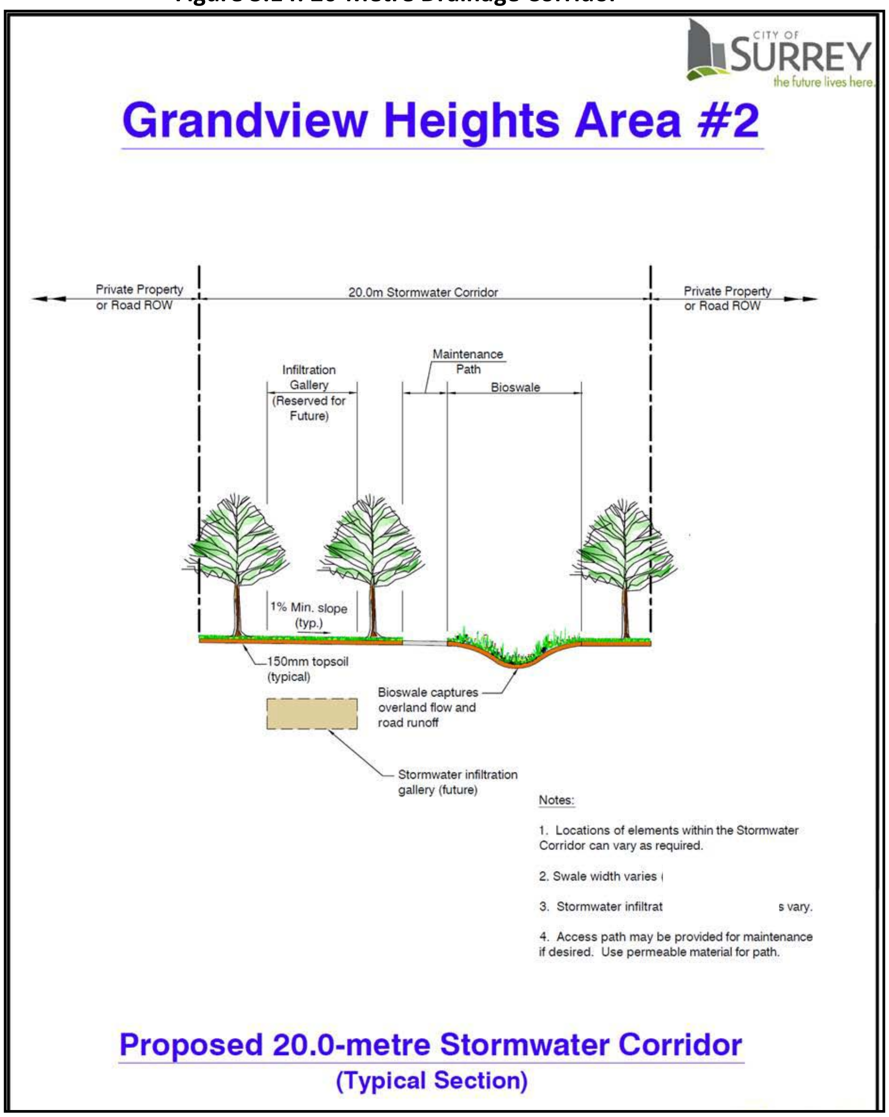
Figure 3.13 Cross Section of 10-metre Drainage Median Corridor



3.7.4 Twenty Metre Drainage Corridors

The few locations with a 20m drainage corridor are adjacent to several roads in the multi-family residential areas along the NCP area's west side. Maintenance access pathways may be integrated into these corridors. These wide corridors are to be incorporated into the landscaping and design of the adjacent multi-family (strata) developments.

Figure 3.14: 20-Metre Drainage Corridor



3.7.3 Interface with Private Lands Abutting the Corridors

- Multi-family dwelling units located along the corridor should provide second floor windows and balconies facing the corridor to allow casual surveillance of the corridor.

- The location of the pathway will be situated close to the dwelling units in order to allow for casual surveillance from the units.

3.8 ON-SITE STORMWATER CONTROLS

On-site stormwater controls are required for all lots in the Grandview Heights NCP #2 area. Relying heavily on sustainable, landscaped-based stormwater source controls, the intent is to maximize infiltration and evapo-transpiration of rainwater. These types of on-site controls are described in Metro Vancouver's April 2005 publication "Stormwater Source Control Design Guidelines 2005."

3.8.1 Single-Family Residential Land Use

For single-family residential lots, a minimum depth of 150mm of amended topsoil is to be applied to all yards and pervious areas. This is to ensure a minimum level of infiltration and rainfall absorption is designed into the lot development. Roof leader drains are to be disconnected from the piped storm sewer system and are discharged onto landscaped areas. Single-family residential lots are also encouraged to incorporate additional forms of on-site controls to minimize the impervious lot coverage associated with paved driveways, patios, and pathways. These on-site controls may include porous pavement, rain gardens, and retaining existing tree cover. Layout, configuration, and construction of these additional controls should be done in accordance with "Stormwater Source Control Guidelines 2005." The Engineer of Record is to verify in writing that the amended topsoil meets the requirements of the Guidelines and has been property installed and that roof leaders discharge to ground not to a storm sewer.

3.8.2 Multi-Family Residential, Commercial, and Industrial Land Uses

Multi-family residential, commercial, and industrial lots are required to meet performance targets for on-site stormwater source controls. The requirements are:

- Install a minimum depth of 150mm of amended topsoil in yard and pervious areas;
- Provide on-site stormwater storage equal to 150 m3/ha of <u>gross site area</u> released at a specified rate according to lot location. The maximum release rate from on-site storage is 0.719 L/s/ha for lots located in the north-west portion approximately bounded by 24 Avenue, 162 Street, the BC Hydro ROW, and 164 Street plus an area between 23 Avenue and 24 Avenue from 164 Street to approximately 167 Street. The maximum release rate for other areas is 0.435 L/s/ha.

- Provide water quality treatment for any specific high risk contaminants associated with the site's land use activities as required by the City; and

- Promote the use of landscape-based stormwater source controls that emphasize infiltration and evapo-transpiration of rainwater from small storms.

The specific mix of source control methods is up to each site owner to allow for integration into the site's overall architectural and landscaping concept. Layout, configuration, and construction should be done in accordance with "Stormwater Source Control Guidelines 2005." The Engineer of Record is to verify in writing that all BMPs have been designed in accordance with the Guidelines and property installed.

PART 4: ENGINEERING

4.1 Sanitary Sewer

The lands within Grandview Heights NCP Area #2 are presently serviced by septic tanks and fields. There is no existing sewer infrastructure. The ultimate sanitary sewer servicing concept for the area will include sanitary sewers to service the entire area.

NCP Area #2 is located south of 24^{th} Avenue and west of 168^{th} Street on the southwest side of a gradual sloping hill with a slope generally in the range of 7 percent toward the south. The highest portion of the area is located to the northeast with an upper contour of about 114 m. The lowest portion of the area is located in the south at an elevation of about 25 m.

A large capacity (600 mm diameter) sewer was recently constructed on 160^{th} Street north of 24^{th} Avenue to capture the anticipated demand from NCP Area #2 and other areas and convey it to the Grandview Heights Interceptor, which runs from east to west and crosses 160^{th} Street north of 28^{th} Ave. All flows from NCP Area #2 will be directed to this sewer either by gravity or pump. The intersection at 24^{th} Avenue and 160^{th} Street is at an elevation of approximately 80 m.

South of 24^{th} Avenue another gravity sewer extends southwards along 160^{th} Street to Croydon Drive and then along Croydon Drive until it reaches Highway 99. At this point the sewer continues south along the north bound shoulder of Highway 99. This sewer is dedicated to servicing the southern portion of the Highway 99 Corridor Plan; there is no capacity in the system to accommodate flow from Grandview Heights NCP Area #2.

There are areas outside of NCP Area #2 that will contribute flows to the sanitary infrastructure within the neighbourhood. The following table outlines the equivalent population expected for sanitary loading and pump station sizing.

Table 4.2: Serviced Populations

Neighbourhood	Equivalent Population
NCP #2	
Sanitary catchment 1 (not to PS)	4,980
Sanitary catchment 2 (Pumped)	6,531
Hwy 99 (Pumped)	5,800
NCP #5 (Pumped)	6,630
NCP #3 (Pumped)	2,980
Total	26,921

Notes:

1. Populations from other NCP areas taken from Grandview Heights South Sanitary Sewer Servicing Plan Study by Earth Tech (Canada) Inc. Final Report September 18, 2006 or developed based on the criteria established. Population for Area #2 based on High Range - 2010 Jan 10.

This sanitary sewer servicing plan has been assembled with consideration of the City of Surrey Design Criteria Manual (DCM).

4.1.1 Catchments

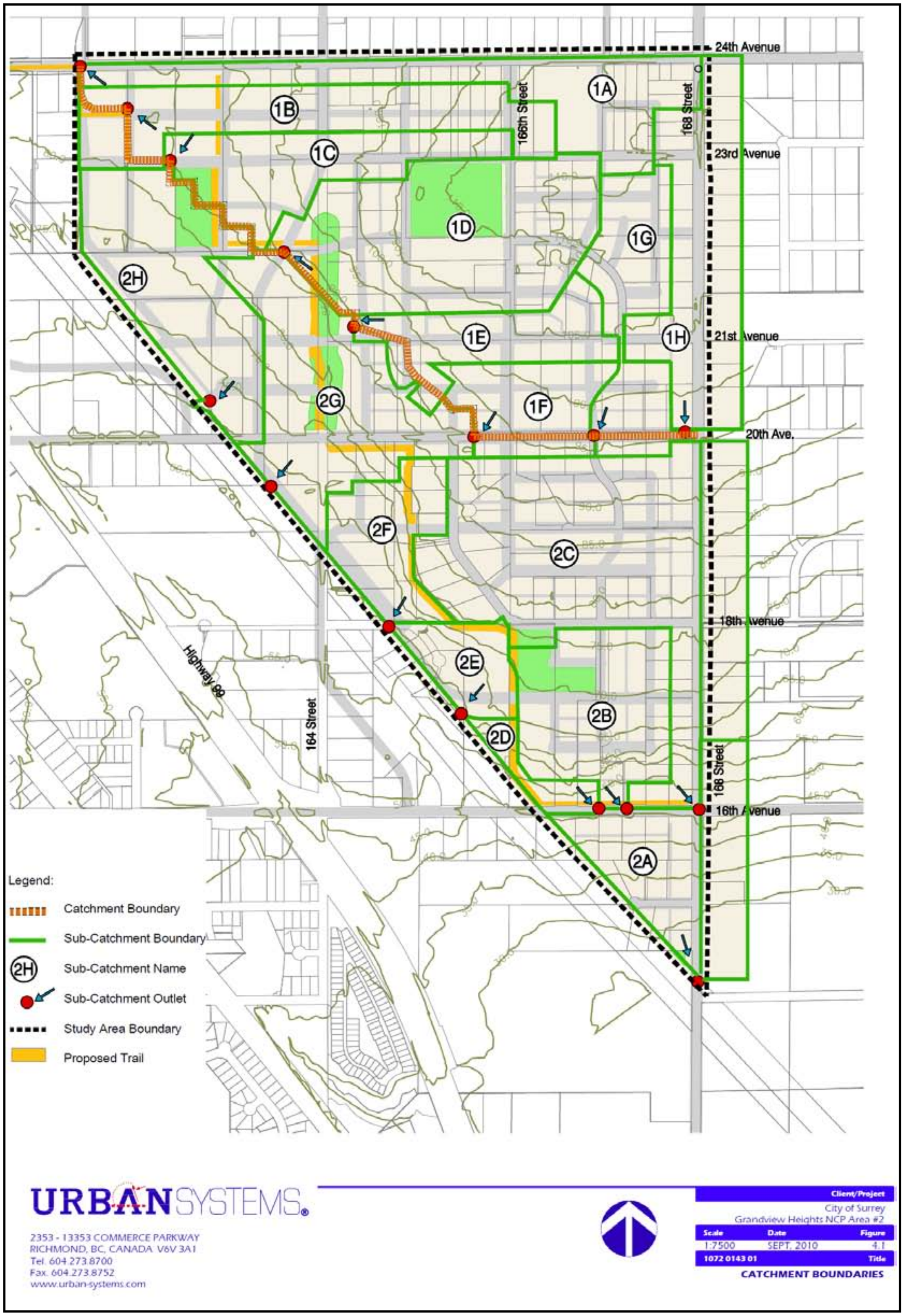
Fundamentally, there are two primary catchments within NCP Area #2: flows that can be conveyed by gravity to the discharge point (intersection of 160th Street and 24th Avenue) and those that need to be pumped. Any flows that are not captured with the trunk sewer and conveyed by gravity will travel downhill to the pump station.

The gravity catchment will be termed Catchment 1, and the pumped catchment will be termed Catchment 2. There are a number of sub catchments that make up each catchment and discharge into the respective trunk sewers. See **Figure 4.1** for catchments and sub catchments.

The population for each catchment and sub catchment is based on population projections provided by the City of Surrey for each land use polygon. Additional population (2.8 additional people for 50 percent of the units) has been included from Area #2 to account for potential secondary suites in the following land use zones:

- Suburban Residential
- Suburban Transitional
- Urban Transitional
- Low Density Residential
- Medium Density Residential

Figure 4.1: Catchment Boundaries



4.1.2 Sewer Design Guidelines and Sizing

The collection system has been designed with consideration for the Surrey Design Criteria Manual (DCM). The following are key design criteria that were followed.

The sizing layout of sewers takes into consideration the following criteria:

- Average daily flows of 350 L/cap/day
- Peaking factor as per Harmon formula
- Manning's "n" of 0.013 for all pipes
- Ground water infiltration of 11,200 L/hectare/day
- Sanitary sewer flow shall not exceed 50 percent of internal diameter
- Trunk and interceptor sewer flow shall not exceed 70 percent of internal diameter
- Maximum depth of trunk and interceptor sewers = 5.0 m (traversing localized areas and short sections only). Preferred maximum depth of trunk and interceptor sewers = 3.5 m
- Maximum depth of local sewers = 4.5 m (only to allow collection of downslope lots); preferred maximum depth of local sewers = 3.5 m.
- Minimum depth of sewers = 2.0 m
- Minimum pipe slope of 0.5 percent on local sewers.
- Minimum slope on terminal sections of local sewers to be 1 percent

The maximum depth of sewers has been limited to 5 m at the invert for short sections with a preferred maximum depth of 3.5 m. Sewers deeper than 3.5 m are located only in areas to allow servicing of downhill properties or to route sewers past localized high spots.

Local permanent or temporary pump stations have not been included as part of the design, and the City's policy is not to allow them. **The City may consider temporary local sewage pump stations on a case by case basis.**

The proposed sanitary network layout (primarily the local sewer system) is conceptual and will be refined to reflect the latest road network with the City's approval.

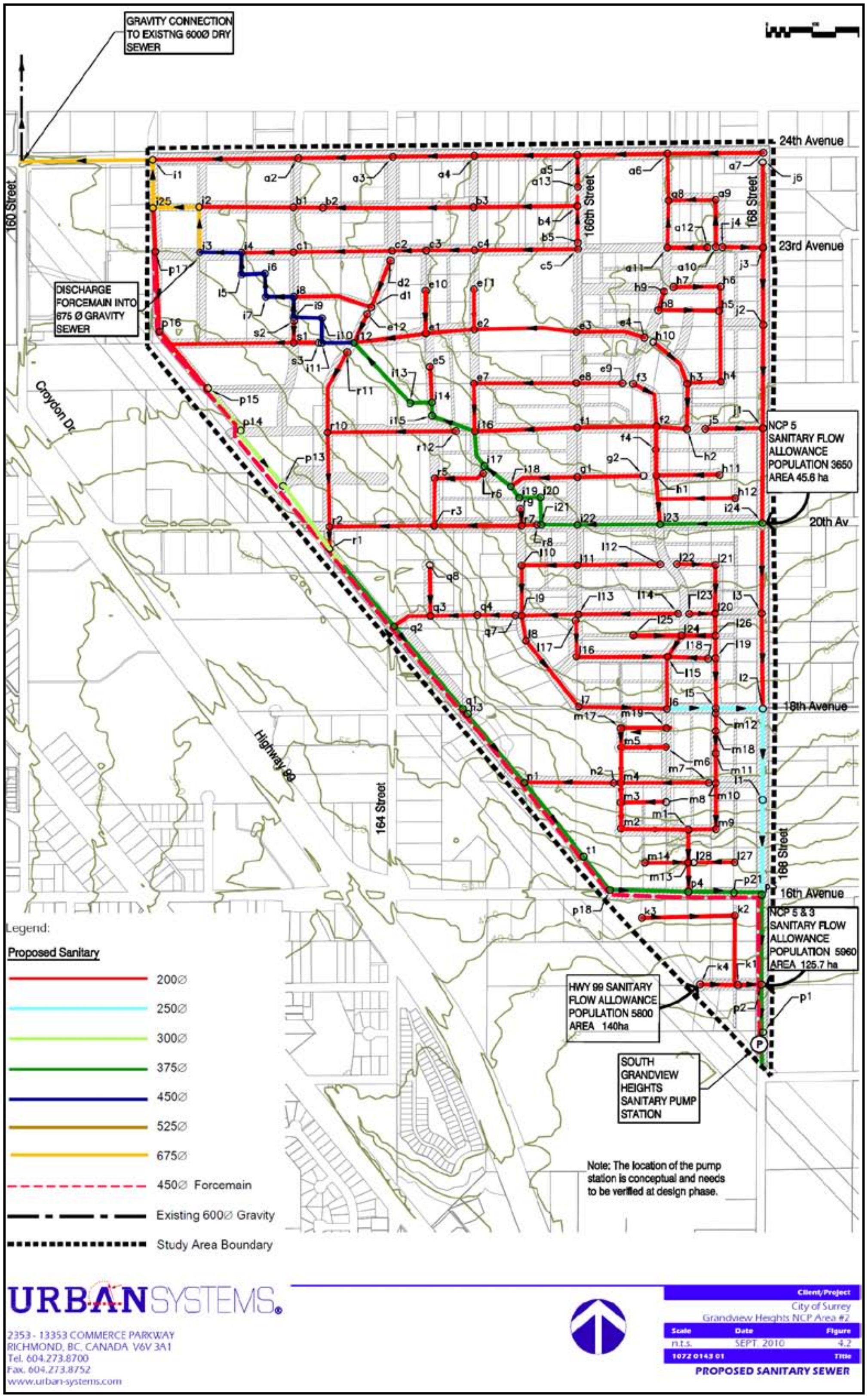
4.1.3 Catchment 1- Sanitary Sewer

The foundation for the collection system within Catchment 1 is the trunk sewer that extends from 20th Avenue and 168th Street to 24th Avenue and 160th Street. The trunk sewer collects all the flows from Catchment 1 and conveys them to the existing gravity sewer on 160th Street.

See **Figure 4.2** for an overview of the collection system. The proposed sanitary network layout is conceptual and should be refined at the detailed design phase with the City's approval.

See **Appendix A.1** for details of the collection system.

Figure 4.2: Proposed Sanitary Sewer



Trunk Sewer

Alignment

Flows from Grandview NCP Area #2 that cannot be captured by gravity will flow downhill to the south and require pumping. The capital and ongoing costs of pumping are a strong incentive to capture as much flow by gravity as possible. The goal when locating this trunk sewer was to maximize the area serviced by gravity flow to the intersection of 24th Avenue and 160th Street.

The alignment of the trunk sewer is based on topography and compatibility with the proposed road and land use plan. The alignment is placed within roads where possible; however, there are some instances where lots were traversed. When it was required to traverse a lot, it was taken at right angles to roads where possible to align with future lot lines and building sites.

The trunk sewer does cross a proposed park site between 21 and 22 Avenues and 162 A and 163 Streets. There are some significant trees situated on this proposed park and the alignment will need to be reviewed at the detailed design stage to minimize impacts to these existing trees.

Ditch Crossing at 164th Street

Within the 164th Street RoW south of 22nd Avenue, there is a constructed ditch that has been identified as a potential location for a future park and is reported to be a yellow listed watercourse. The trunk sewer route crosses this ditch near where 21A Street would be located if it continued through. Due to the environmental significance of this area, an application was made to the Surrey ERC for approval in principal. Approval was given and was recorded on the meeting minutes from May 21st, 2008. See **Appendix A.1** for preliminary crossing design and environmental requirements.

Future Eastward Extension

The trunk sewer begins near the intersection of 168th Street and 20th Avenue. There is potential to continue this sewer to the east to allow capture of some flows from NCP Area # 5 in the future. The sewer downstream has been sized to accommodate flows from this area with an allowance for a population of 3,650 and a land area of 46 Ha.

System Phasing

The sewer system has been designed to allow development to progress from north to south where possible. With the trunk sewer critical to servicing the lands along its route, it is important that downstream land develop prior to land upstream. It is expected that Catchment 1 and particularly areas to the north will develop first. As development proceeds south, the trunk sewer must be constructed first. Once the trunk sewer is operational, development can proceed in conjunction with the collection system.

4.1.4 Catchment 2 - Sanitary Sewer (Pumped)

Alignment and Collection System

There are a number of sewers within this catchment that traverse green space, trails or the BC Hydro RoW. These crossings are key to servicing the upstream lands. Rights-of-way will need to be established for these sewers.

The sewers within this catchment collect and convey flow to the Grandview Heights South Pump Station.

With many of the roads following the contour lines, the parcels downhill from the sewer may have difficulty discharging to the sewer from basements. The primary area where this is a concern is on the south-facing slope south of 20th Avenue.

As part of the collection system design, the service connections have been assumed to be located 7.5 m in from the property line and at a depth of 2.5 m below existing ground. Given a slope of 2 percent from the service connection to the sewer, the maximum lot slope that can be serviced from the front road has been determined. The maximum depth of sewer in the road in these instances is 4.5 m. This means that lots with a slope greater than about 5 percent must be serviced with back lane sewers. Where required, back lane sewers have been shown on the collection system in **Figure 4.2**.

A collection sewer has been located along the south west edge of the NCP Area #2 (next to the BC Hydro corridor) that will require a dedicated utility RoW where it is not coincident with any road. The sewer RoW will be a minimum of 6 m wide and adjacent to the BC Hydro RoW. This sewer will collect flows and convey them to the Grandview Heights South Pump Station. It is expected that the sanitary force main from the pump station will share this sewer RoW.

See **Appendix A.1** for details of the collection system.

Grandview Heights South Pump Station

Location

Previous studies have recommended that the Grandview Heights South Pump Station be located in the vicinity of 12th Avenue and 168th Street. Land fronting 168th Street between 14th Avenue and 12th Avenue on the east side is in the ALR. Only one house currently fronts 168th Street in this portion of the road. Land south of 14th Avenue is unlikely to develop, and existing housing is presently situated on acreage parcels with septic fields. Based on a field reconnaissance completed in February 2007, it is recommended that the pump station be situated in the vicinity of 168th Street and just north of 14th Avenue in the northwest corner of the city-owned land next to the BC Hydro RoW. An overhead high voltage BC Hydro line crosses the intersection of 14th Avenue and 168th Street. The pump station must have its own dedicated location and cannot encroach into the road RoW. The station is expected to require approximately a 40 m by 40 m parcel. The preferred location for the pump station is on the west side of 168th Street north of the BC Hydro RoW. This land is currently vacant and not within the ALR, and an extensive area has recently been acquired by the City for environmental preservation and open space uses. The land is also relatively flat, and site grading would be straightforward. An arrangement would be required with the Parks and Recreation Department for the location of the pump station on this site.

Pump Station Operating Conditions and Design

The ultimate flow to the pump station will be a combination of NCP Area #2 (Catchment 2), Area #5, Hwy 99 Grandview Corner, Hwy 99 South 1 and 2. At the time the pump station is constructed, there will likely be limited development in the catchment. Initially there may only be a small amount of flow to the pump station.

It is planned to divert flows from Hwy 99 Corridor area once the Grandview South Pump Station is operational. In the interim, the Hwy 99 flows will be conveyed to the Semiahmoo sanitary pump station; however, only 40 L/sec has been allocated to the Hwy 99 area. This initial diversion of flow from Hwy 99 will be an important initial contribution to the pump station.

With the minimal initial flows to the pump station, there is concern of odour issues arising from the potentially long residence time of sewage within the force main. To reduce this risk, consideration has been given to twinning the force main as well as odour control systems. See the technical memo in **Appendix A.1** for details.

With the lift station located near 168th Street and 14th Avenue, the static lift required is approximately 60 m. This lift is considered relatively high for a sewage pump station.

The following table summarizes the operating conditions for the pump station.

Table 4.3: Pump Station Operating Conditions

Criteria	350mm diameter	450mm diameter
Q_{min} minimum velocity (cleansing) 1 m/sec	96 L/sec	159 L/sec
Q_{max} (ultimate flow)	N/A	254 L/sec
Initial TDH @ Q_{min}	68 m	66 m
Ultimate TDH @ Q_{max}	N/A	75 m

Note: The duty points indicated in the table above are based on a 2500m long force main.

A cursory review of products from various pump manufacturers has been completed, and several suitable pumps have been found.

It is expected that the pump station would operate in a triplex arrangement. With a triplex arrangement two pumps working together meet the duty point and the third pump is for standby.

With the length of the force main and the minimal initial flows, there is a risk of odour issues when the pump station is first constructed. It is generally accepted that if sewage is allowed to reside for more than four hours there could be increased odour concerns. The station may require staging of certain aspects or components to minimize the hydraulic residence time of the sewage within the system, thus reducing the risk of odour problems.

Given the size and importance of this pump station, protection against power failures and emergency situations is critical. To ensure pumping can continue during a power failure, a standby generator will be required. The Surrey Design Criteria indicates that for stations without standby power a minimum of 1 hour storage at Peak Wet Weather Flow is required. It is our understanding that with this station Surrey is willing to accept 30 minutes of emergency storage given that standby power will be present on site.

Considering the required length of the force main and the flows, there is considerable concern over fluid transient conditions (water hammer). The impact of transients will depend on a number of issues including: pipe materials, flow, and pump characteristics; however, it is expected that transient control measures and protection will be an essential components of the pump station.

Intermediate or Permanent Lift Station at Mid Elevation

Consideration has been given to the potential of constructing a sanitary lift station at an intermediate point within Area #2. This lift station would only serve Area #2, Catchment 2 parcels above wherever the lift station were located.

If the lift station were located at 18th Avenue, it would collect approximately 70 L/sec PWWF (Peak Wet Weather Flow) from Area #2. This intermediate lift station would only serve Area #2.

Technical challenges with an intermediate lift station include the access to 3 phase hydro power and staging of the force main to ensure adequate cleansing velocity.

Challenges with an intermediate lift station include additional overall capital costs as well as ongoing operations and maintenance costs. If an intermediate lift station were constructed, the majority of the high density zoning within Area #2 could be captured by it; however, it would leave the other NCP areas with lower density the financial burden of construction of the main lift station at the bottom of the hill. This burden may cause resistance to development in the lower (southern) portion of Area #2 as well as other NCP Areas.

Based on the increased costs (capital, operational and maintenance) for an additional intermediate lift station, it is recommended that the single lift station be constructed at the bottom of the hill.

Force Main

A force main will be required from the pump station to the discharge point at 162nd Street. In order to service the pump station at build-out, a 450 mm diameter pipe or an equivalent twinned pipe is recommended. The size is a balance between achieving cleansing velocity as soon as the pump station is built and limiting the friction loss in the pipe during the ultimate condition.

Surrey's DCM dictates a minimum cleansing velocity of 1 m/sec within the pipe. This is required to ensure no accumulation of solids within the pipe.

As discussed previously, odour risks may provide incentive to twinning the force main with smaller diameter pipes. The advantage to this would be reduced initial odour risks; however, the overall cost would be higher.

The route of the force main has been assumed to travel up 168th Street to 16th Avenue and then west to the BC Hydro RoW. From 16th Avenue the route will follow along the proposed sewer RoW on the east side of the Hydro RoW. See **Figure 4.2** for force main alignment.

System Phasing

The pump station and force main must be constructed first before any development within Catchment 2. As part of the initial pump station operation, the diversion from Hwy 99 Corridor is required, thus necessitating a gravity sewer from the west. With a gravity sewer in the west, it would make sense for the areas serviced by it to be developed first. Once the pump station is operational, development can proceed in conjunction with the collection system.

4.1.5 Cost Estimates and Financing Approach

To accommodate planned growth, NCP Area #2 must be connected to the City's sanitary sewer system (Currently the area is serviced only by septic fields and septic tanks). The required system will comprise the following three components: upsizing of mains to achieve sizes greater than 200mm, trunk sewers for flows greater than 40 l/s, and a force main and lift station to carry flow from Catchment 2 (see **Figure 4.2**). The force main and pump station will serve not only NCP Area #2 but also future development within the Highway 99 Corridor, a component of future NCP Area #5, and all of future NCP Area #3.

Consistent with current practice, developers will be required to fund frontage works, including costs associated with 200 mm sewer mains. The concept is that the DCC program will fund the upsizing of the base size to achieve the most of the trunk system. Where flows exceed 40 l/s and the trunk element does not front benefiting properties and, therefore, are not achievable using an upsizing approach, the full trunk element costs are included in the DCC eligible works. At this time, it is not possible to exactly identify all the elements that may not benefit fronting development; consequently, a worst case relating to amount of trunk elements has been identified. Where these trunks are achievable through the upsizing approach, this is the approach that will be used. The sewers to be upsized and the identified trunk elements are detailed in **Appendix A.1** and the costs are summarized in **Table 4.4**.

The estimated cost for the force main and pump station (including RoW costs for the force main, land costs for the pump station, and engineering and contingency costs) to service the ultimate catchment area is **$10.4 million**. Although the pump station serves future NCP Areas #3 and #5, these areas currently remain suburban and un-sewered; consequently, until these future NCPs move to a greater level of certainty, no contribution from these areas can be relied on at this time. Excluding the pumping capacity for Areas 3 and 5 reduces the pump station cost to **$10.1 million**. A contribution of nearly **$1.8 million** from Highway 99 Corridor toward the pump station has been included in the City's 10-Year Servicing Plan. Therefore if any development in Area #2 is to proceed ahead of the completion of the NCPs for Areas #3 and #5, Area #2 must be capable of financing the full cost of the pump station less the approximately $1.8 million contribution from Highway 99. If Area #2 does proceed ahead of Areas #3 and #5, then the pumping capacity for Areas #3 and #5 can be deferred, which reduces the cost of the pump station to **$10.1 million**.

As shown in **Table 4.4**, all costs for the required trunk sewers and upsizing of the collection system will be financed through DCCs. The cost recovery approach for the pump station and force main is discussed in Section 4.1.6. As shown in **Table 4.5,** a special cost recovery approach is needed for the pump station and force main because anticipated DCC revenues are less than expected costs for these works.

Table 4.4: Sanitary Sewer Cost Estimates and Financing Approach

Capital Item	Total Cost	Costs Allocated to Area #2	Costs Allocated to Other NCPs	Cost Recovery Approach for Area #2	
				City-Wide DCCs	Other
Sanitary Pump Station and Force Main	$10,100,000	$8,319,000	$1,781,000	$3,230,000	$5,089,000
Trunk Sewer Elements	$1,467,000	$1,467,000	$0	$1,467,000	$0
Upsizing (above base size)	$956,000	$956,000	$0	$956,000	$0
Total	**$12,523,000**	**$10,742,000**	**$1,781,000**	**$5,653,000**	**$5,089,000**

Notes:

1. Costs updated to January 2010 construction costs. Pump station cost excludes pump capacity for NCP Areas #3 and #5.
2. See Table 4.4 for the comparison of anticipated DCC revenues and DCC costs.
3. "Other" cost recovery approaches include Development Works Agreements (see Section 4.7).
4. Pump station estimate does not include pumping capacity for future NCP areas 3 & 5.
5. There have been minor changes to the road network since the detailed trunk sewer cost estimates were prepared, these changes are not considered significant and are considered within the limits of normal estimating accuracy.

Table 4.5: Estimated DCC Revenues and Expenditures – Sanitary Sewer

Estimated DCC Revenues	DCC Eligible Costs	Balance
$5,653,000	$10,742,000	-$5,089,000

Notes:

1. DCCs based on the average development yield for the area.
2. DCC revenues do not include potential DCC revenues from commercial or institutional development within Area #2.
3. DCC eligible costs include those costs in **Table 4.3** identified to be recovered through DCCs generated from within the NCP combined with Development Work Agreements or equivalent financial mechanisms.

4.1.6 Options and Implementation Issues Related to Funding the DCC Shortfall

As identified in Section 4.1.5 there is a shortfall between what is generated by DCCs and the trunk/pump station needs typically funded by DCCs. This shortfall is created by one item, namely the sewer pump station to service Catchment 2 (the southern catchment). This pump station also services other areas, comprising the Highway 99 Corridor, (which provides a $1.8 million contribution) and the future NCPs Grandview Area #3 and a portion of Area #5. However, because Areas #3 and #5 are in the future and have no official status, funding from these areas cannot be built into the financial model at this time nor has the cost for the pumping capacity for these areas been included in the estimate. This leaves a **$5.089** million shortfall for the pump station to be funded by NCP Area #2. This funding situation is further complicated due to the fact that Catchment 1 (the northern catchment) does not physically need the pump station to be able to develop.

The proposed funding approach to overcome this shortfall and fund the pump station for Catchment 2 would be through a Development Works Agreement. Under this approach a developer, or group of developers, could frontend the pump station with cost recovery through a combination of a DCC Frontenders Agreement over the entire NCP (for the component of the DCC not needed for trunks and upsizing - $3.23 million) and a Development Works Agreement ($5.089 million) over Catchment 2.

A Development Works Agreement requires assent of the property owners within the defined benefiting area namely Catchment 2. To recover the $5.089 million shortfall, the Development Works Agreement charge would be about $44,000 an acre. This equates to about $2,500 per unit average charge (higher charge for single family, lower for multi-family units).

An alternative option is for the Catchment 2 area to wait until Grandview NCP Area #3 and #5 are finalized and then jointly fund the pump station with these two other NCP areas.

4.1.7 10 Year Servicing Plan

It is recommended that the City review its 2010-2019 10 Year Servicing Plan to determine whether the works recommended in this report overlap with current projects included in the 10 Year Servicing Plan. **Table 4.6** lists projects currently identified in the 10 Year Servicing Plan that fall within the sanitary sewer study area – these projects should be reviewed.

Table 4.6: 10-Year Servicing Plan Projects to Review – Sanitary Sewer

10-Year Servicing Plan Project ID		
9444	11311	11312
11314	11328	11331

4.2 Water Distribution

This section presents an analysis of the future water system in and around the South Grandview Heights NCP Area #2 study region. The investigation includes a discussion of the existing distribution network as well as the required upgrades. In addition, this section provides specific details of the water distribution system necessary to service the NCP area.

4.2.1 Existing System

Currently the watermains in the study area comprise primarily small diameter pipes (150 and 200 mm diameter) intended to service semi rural areas. There is insufficient capacity to provide adequate service for the proposed land use.

The Grandview Reservoir was constructed in 1999 and is intended to provide water supply to the area. The GVRD transmission main located on 24th Avenue supplies the reservoir. The Grandview Pump Station constructed in 2006 is intended to supply water into the 142 m HGL pressure zone.

To link the Grandview Pump Station with the distribution system to the west a, 600 mm diameter main was constructed in 2007. Currently this 600 mm diameter main extends from the pump station near 24th Avenue and 166th Street to 24th Avenue and 164th Street. The line extends west of 164th Street on 24th Avenue as a 350 mm diameter pipe.

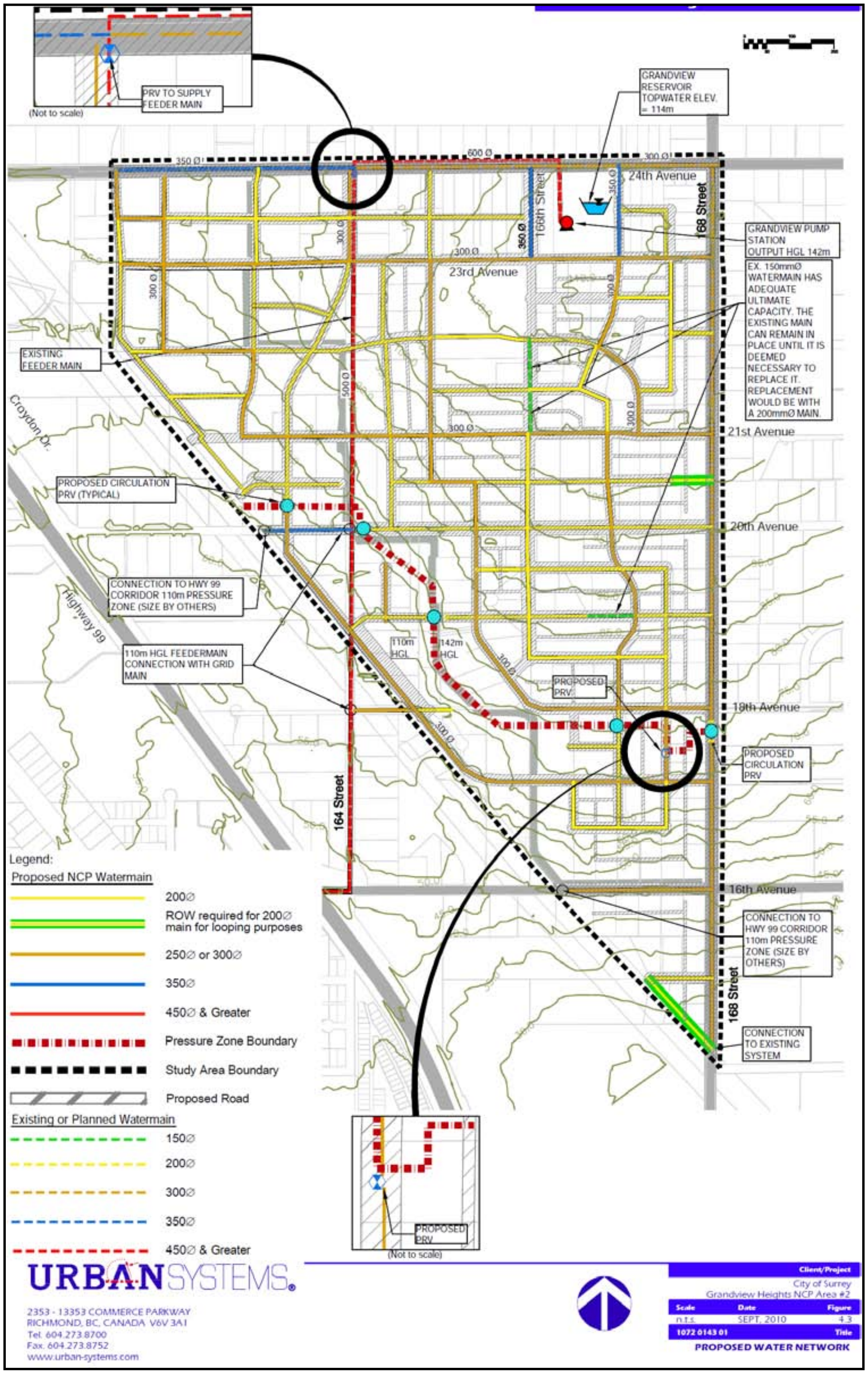
4.2.2 Recent Supply System Improvements

A 500 mm diameter feeder main to supply the 110 m HGL pressure zone was recently constructed. This feeder main is located within the 164th Street right-of-way south of 24th Avenue. The pipe crosses Highway 99 and connects with an existing 450 mm main on King George Highway. Initially this pipe will be connected to the 142 m HGL zone through a Pressure Reducing Valve (PRV) at 24th Avenue and 164th Street. Since reducing pressure from a boosted (pumped) system wastes energy, the pipe will ultimately be fed directly by gravity from the Grandview Reservoir.

4.2.3 Proposed Supply System Improvements

Improvements to provide NCP Area #2 with municipal water are shown in **Figure 4.3**. The proposed improvements will ensure a solid backbone for the area's water supply system. This is based on satisfying peak hour demands as well as providing adequate fire flows as needed. **Figure 4.3** shows the ultimate network required, including pipe sizes. Existing pipes that could form part of the future system have been indicated as a dashed line. The proposed water network is conceptual and should be refined to reflect the latest road network and phasing of development applications with the City's approval.

Figure 4.3: Proposed Water Network



4.2.4 System Analysis

To support the proposed development, a network of new mains will be required. WaterCAD was used to model the system with peak hour demands as well as combinations of maximum day demand with fire flows.

4.2.5 Analysis Criteria and Pressure Zones

Water consumption rates for existing and future development in and around the study area were taken from the City of Surrey Design Criteria Manual (DCM). The following table summarizes the consumption rates:

Table 4.7: Consumption Rates

Demand Type	L/capita/day
Average Day Demand	500
Maximum Day Demand	1000
Peak Hour Demand	2000

Population projections within the NCP study area were provided by the City of Surrey for each land use area.

The minimum pressure required during peak hour demands is 274 kPa (28 m).

The DCM outlines the following criteria for pipes under design flow:

- Hydraulic Grades in water mains greater than 250 mm in diameter not to exceed 0.5 percent; and
- Velocity in pipes not to exceed 2 m/sec

Fire flow capacity of the water system was analyzed for the ultimate system only; fire flows for interim conditions were not considered. Fire flows were based on land use and zoning according to the DCM. For this study area the following flows were used:

Table 4.8: Flows by Land Use

NCP Area #2 Land Use	Fire Flow Required (L/sec)
Suburban Residential 1-2 upa	60
Suburban Transitional 2-4 upa	60
Urban Transitional up to 8 upa	60
Low Density Residential 6-10 upa	60
Medium Density Residential 10-15 upa	120
Multiple Residential 15-25 upa	120
Multiple Residential 30-45 upa	120
Special Residential 15-25 upa	120
Commercial Residential 25-45 upa	120
School	120

The City of Surrey requires that these flows be met with a minimum residual pressure of 140 kPa (14 m), at the point of draw, during maximum day demand. In addition to the minimum residual pressure requirement, negative pressures were not tolerated anywhere in the distribution system during fire flows. During fire flow, system pressures are not allowed to drop below 206 kPa (21 m).

The Grandview Heights NCP Area #2 will be serviced from the Grandview Reservoir and recently constructed pump station. The Grandview Pump Station serves the Grandview 142 m pressure zone[1]. Lower pressure zones will ultimately be fed from a dedicated gravity line from the Grandview Reservoir that has a water elevation of between 106 m and 113.8 m; however, this may not be constructed until the network reaches capacity. In the interim, these lower pressure zones will be fed by the Grandview Pump Station through PRV stations off the 142 m zone.

In order to service the lower elevations within NCP Area #2, a 110 m pressure zone will be created. The boundary between the 142 m and 110 m pressure zones will approximately follow the 70-75 m elevation contour. See **Figure 4.3** for location of the pressure zone boundary.

[1] South Surrey Water Supply Study, interim report February 2007, KWL Consulting Engineers

4.2.6 Hydraulic Analysis

The hydraulic model used for simulations was of the future system only. **Figure 4.3** illustrates the general layout of the water model. Also shown are the existing and future system elements that form the ultimate network.

Demands were allocated as "bulk" point demands to main intersections on the distribution grid.

To simplify the analysis of the study area, only a portion of the overall distribution system was modeled. In constructing the model this way, several assumptions were made about the model boundaries (points where the model ends but the actual system continues). The model boundary conditions are described below:

- The Grandview Pump Station will supply the 142 m HGL zone.
- The 110 m zone was assumed to be fed from a grid main connection to the feeder main at the intersection of 20th Avenue and 164th Street and another connection at 18th Avenue. This feeder main was assumed to be operating at 102 m HGL at the point of connection. In reality the 110 m zone will be connected with the 142 m zone with PRVs in one or several locations. It is assumed that these PRVs will be configured so they will not open under normal operating conditions.
- Areas outside the Grandview Heights NCP Area #2 were not modeled.
- Demands arising from outside the boundaries of the NCP Area were not included in the model. With the 142 m HGL zone, pipes along the boundary (primarily 24th Avenue and 168th Street) were assumed to have pressures equivalent to the max allowed HGL loss (0.5 percent) at the distance from the supply point.

Demands

Demands used in the analysis were based on population projections provided by the City of Surrey for the proposed land use areas. The following is a breakdown of future population and future demand:

Table 4.9: Future Demand

Area	Future Population (# People)	Future Average Day Demand
142 m HGL zone	8,200	47 L/sec
110 m HGL zone	3,100	18 L/sec
Total	**11,300**	**65 L/sec**

System Performance

The distribution system as shown in **Figure 4.3** meets the criteria for pressure, line velocities, and fire flows.

4.2.7 Discussion

The network is configured so each component contributes to the overall integrity and functionality of the system. As development occurs and partial construction of the system takes place, an evaluation of the interim system to meet requirements is necessary.

The recently constructed 600 mm diameter water main on 24th Avenue currently extends west to 164th Street. The City has no plan to upgrade the pipe network north and west of the intersection of 24 Avenue and 164 Street. For the purposes of NCP Area #2, it has been assumed that the existing 350 mm diameter pipe west of 164th Street will remain.

On 24th Avenue, there are two distribution mains providing water to both hydrants and residents. The two pipes are a 150 mm pipe and a newer 300 mm main (350 mm west of 164th Street). The modeling assumed that the 150 mm pipe will be abandoned and any services connections or hydrants would be transferred to the 300 or 350 mm diameter pipe.

There are a number of existing pipes of small diameter that are not included within the future system. These existing pipes located in areas where new pipes are shown should be removed as installation of the new ones proceeds. Hydrants and service connections should be transferred over as the new mains are extended.

For the 110 m pressure zone, there are a number of locations where the Area #2 water system is potentially connected to adjoining areas. Specifically these locations are:

- 20th Avenue and 163rd Street

- 18th Avenue and 164th Street
- 16th Avenue and 166th Street
- 16th Avenue and 168th Street
- 14th Avenue and 168th Street

Pressure Reducing Valves

The proposed Pressure Reducing Valve (PRV) at 17A Avenue and 167A Street will provide a strong redundant linkage to the higher pressure zone to the north. This secondary connection to the high pressure system is an essential component of a secure supply system.

The PRV will be configured to operate only during emergencies or shutdowns of the main supply line. The location of the PRV is important from the standpoint of its connection to the supply network. It was located on 167A Street because that area is a hub for a number of network pipes. The portion of the 110 m pressure zone within NCP Area #2 is only a portion of the total 110 m pressure zone network. The sizing and capacity of this PRV should be considered with respect to an overall servicing strategy to the 110 m pressure zone.

To provide some flow for water across the pressure zone boundary for quality purposes, four circulation PRVs are proposed. This will allow a small amount of water to be circulated across the pressure zone boundary through what would otherwise be dead end pipes thus avoiding problems related to stagnant water. One circulation PRV replaces the existing check valve located near 168th Street and 17A Avenue.

System Phasing

The staging of development within NCP Area #2 is expected to start in the north within the 142 m pressure zone based on constraints imposed with the sanitary sewer system. This is fortunate because the water supply system is fed from the north and the pipes are sized accordingly. The water supply network within the 142 m pressure zone must be constructed from the north to the south. The first step will be to complete the tie-ins to the mains on 24th Avenue and then to provide the grid main linkages extending to the south. As development proceeds, loops and linkages within the network should be constructed to ensure a strong intermediate distribution network.

The recently constructed 164th Street feeder main will provide adequate supply for development to take place in the 110 m pressure zone. The construction of the PRV station at 17A Avenue and 167A Street should occur as soon as there are sufficient distribution mains within the 142 m zone and the 110 m zone to support the connection.

To achieve the required fire flows and system performance, there is a reliance on the integrity of the network. Each pipe on its own would not be able to carry the full flow, but all the pipes working together can. This means that when only part of the system is constructed, it may not be able to convey the required flows. Developments that are proposed to be built with only part of the network in place will need to evaluate the partial system on a case-by-case basis. Over-sizing of pipes to meet temporary requirements may be required.

4.2.8 Cost Estimates and Financing Approach

To satisfy anticipated peak hour demands and provide adequate fire flows, NCP Area #2 will need additional distribution mains and new and/or upgraded trunk mains, as well as a new PRV[2] at 17A Avenue and 167A Street and four smaller re-circulating PRVs. Consistent with current practice, developers will be required to fund frontage works, as well as off site water mains of sufficient size to provide adequate fire and domestic flow for the proposed development, including costs associated with 200 mm distribution mains. The upsizing is based on City of Surrey 2010 ‘all up’ rates for upsizing including engineering, administration, etc. Some sections of the trunk water network already have 200 mm diameter mains, consequently the upsizing approach cannot be use to achieve these sections, and a full cost has been allowed for. The PRV is estimated to cost **$75,000**, and the circulating PRVs are estimated at **$10,000** each (including 15 percent engineering, 5 percent administration, and 30 percent contingency).

As shown in **Table 4.10**, the cost to upsize mains larger than 200 mm, the cost for new trunk elements not achievable through upsizing and the PRV stations are to be recovered through DCCs.

Further details on upsizing locations and cost estimates are included in **Appendix A.2**.

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[2] The system will also require four circulation PRVs, which will be funded by developers as part of their local servicing requirements.

Table 4.10: Water Cost Estimates and Financing Approach

Capital Item	Total Cost	Costs Recovery Approach for Area #2	
		DCCs	Other
Upsizing Costs	$1,528,170	$1,528,170	$0
Trunk Costs	$2,670,740	$2,670,740	$0
Main PRV	$75,000	$75,000	$0
4 Circulation PRVs	$40,000	$40,000	$0
Total	**$4,313,910**	**$4,313,910**	**$0**

Notes:

1. Costs updated to January 2010 construction costs. Upsizing costs provided by the City (February 2010).
2. Minor changes have been made to the road layout since the detailed upsizing cost estimates were made; these changes are not considered significant and are considered within the limits of normal estimating accuracy.

As shown in **Table 4.11**, anticipated DCC revenues for water from Area #2 are expected to exceed the cost of required water DCC projects in Area #2.

Table 4.11: Estimated DCC Revenues and Expenditures – Water

Estimated DCC Revenues	Estimated Additional DCC Expenditures	Balance
$4,335,000	$4,313,910	$21,090

Notes:

1. DCCs based on the average development yield for the area.
2. DCC revenues do not include potential DCC revenues from commercial or institutional development within Area #2.

4.2.9 Ten Year Servicing Plan

It is recommended that the City review its 2010-2019 10 Year Servicing Plan to determine whether the works recommended in this report overlap with current projects included in the 10 Year Servicing Plan. **Table 4.12** lists projects currently identified in the 10 Year Servicing Plan that fall within the NCP study area – these projects should be reviewed.

Table 4.12: 10 year Servicing Plan Projects to Review – Water

10 Year Servicing Plan Project ID		
4943	5379	9914
9955	9956	9957
10358	10359	10500
10502	10505	11515
11532	11561	11562
11563	11564	11565
11566	11567	11568
11569	11570	11571
11572	11573	11574
11575	11576	11577
11578	11579	11580
11633		

4.3 Stormwater Management

Most of the neighbourhood lies within the Fergus Creek watershed, for which a Master Drainage Plan (MDP) and an integrated stormwater management plan (ISMP) have been previously prepared. The MDP, updated in 2001, provides the basis for conveying major storm event runoff from the area to the creek, including provision for attenuation of peak runoff flows as needed. The ISMP extended the work of the MDP and proposed strategy for managing the many small storm events that occur during the course of a year, with an emphasis on lower impact, source control best management practices. In accordance with direction from the City, the Grandview Heights NCP Area #2 stormwater management plan is to be consistent with this ISMP, with elements from the MDP adapted as required to supplement this framework.

4.3.1 Study Area

Figure 4.4 shows the Grandview Heights Area NCP Area #2, located in the south part of Surrey, just east of the Highway 99 Corridor, as well as the existing drainage infrastructure. The neighbourhood, roughly triangular in shape, covers about 163 hectares and is bounded by 24th Avenue and 168th Street on the north and east sides, respectively. The west side extends along 161A Street; however, about 200 m south of 24th Avenue, the boundary cuts diagonally to the southeast along the BC Hydro corridor, hitting 168th Street just north of 14th Avenue.

Land Use

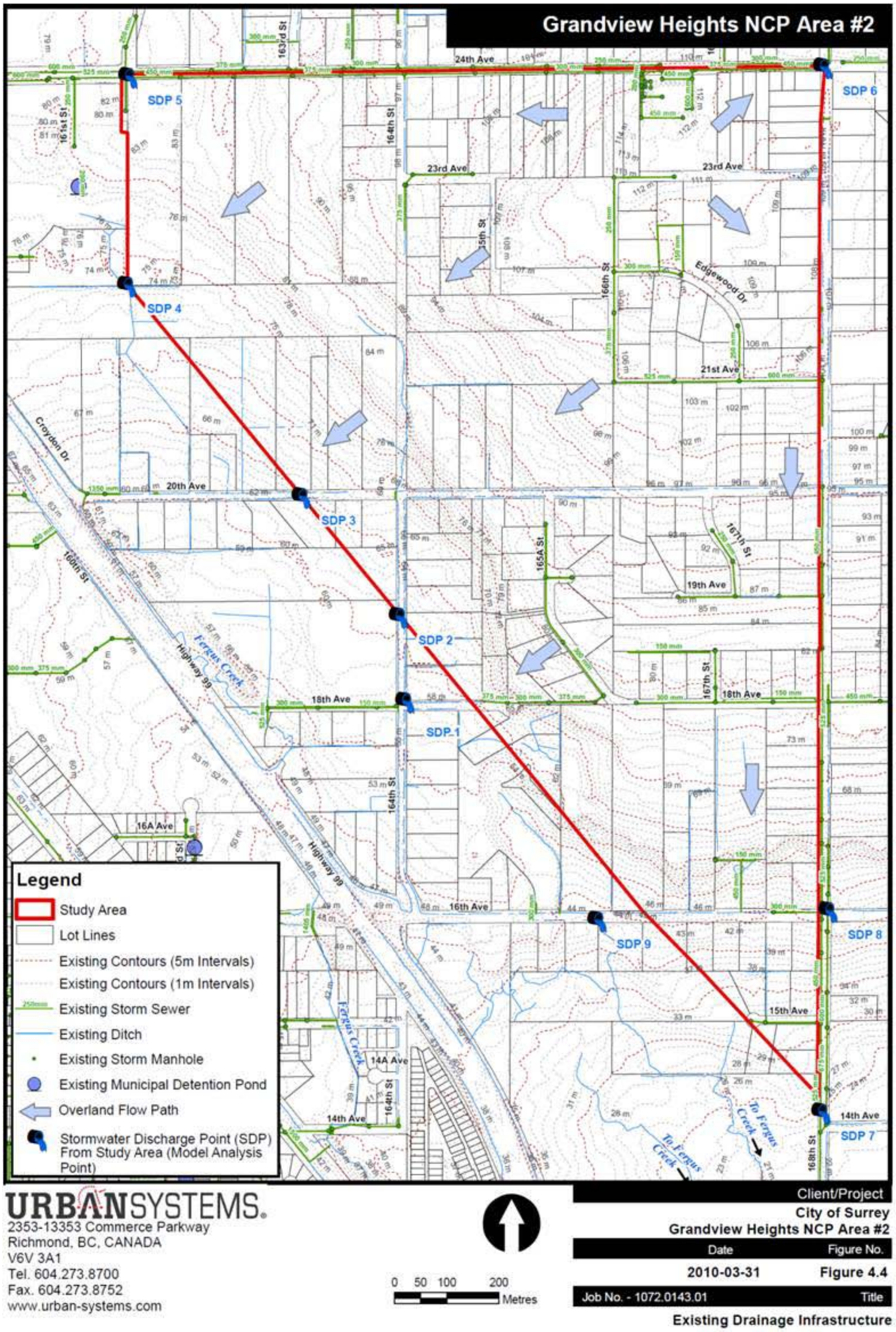
Existing

Except for several parcels on or near the north boundary of the study area (24th Avenue), the neighbourhood is a mixture of rural and low density, single family residential land use conditions. The only significant non-rural, non-residential land uses in the area cluster along 24th Avenue, including a corner grocery at 168th Street and 24th Avenue, a City water reservoir and miscellaneous small machine, auto repair and agriculture uses in the northwest corner of the area.

Proposed

Grandview Heights Area #2 is proposed to remain largely residential, with both suburban and urban-type densities planned. As currently, the corner of 24th Avenue and 168th Street will retain a small commercial node; there are no proposed industrial uses for the area. An elementary school is proposed to be developed on the north end of the study area, which will include large open-space sports field areas. The existing water reservoir will be retained, and its site will also include a City utility maintenance and materials storage depot.

Figure 4.4: Existing Drainage Infrastructure



Topography

The area generally slopes from a high area near 24th Avenue and 168th Street toward the south, southwest and west. The top of the hill, in the neighbourhood's northeast corner, is relatively flat, while a 10+ m high ridge or steep area runs along the area's diagonal southwest boundary, being most prominent from about 20th Avenue and 168th Street down to 16th Avenue and 168th Street.

Overall, the total elevation drop from northeast to south is 87 m with an average slope of 4.8 percent, and from northeast to northwest is 32 m with an average slope of 1.8 percent. Consistent with this, the eastern parts of many east-west streets are characterized by gentle profile grades while north-south streets tend to be steeper.

Watersheds

Nearly the entire neighbourhood lies within the Fergus Creek watershed except for the most northeasterly corner (3 hectares, total) at 24th Avenue and 168th Street. The corner drains toward Burrows Ditch. The Fergus Creek system, covering about 7.8 km^2 in total, drains toward the Campbell River then into Semiahmoo Bay. Burrows Ditch on the other hand drains to the north toward the Nicomekl River, which in turn drains to Mud Bay.

Although storm sewers do serve several of the subdivisions in the neighbourhood now, by and large the area is serviced by open ditch systems. One of these, lying within the 164th Street right-of-way (RoW) from about 23rd Avenue to 20th Avenue and then as a roadway ditch continuing on south to 16th Avenue (just outside the neighbourhood area), is proposed as a riparian protection corridor due to its identification as a Class B watercourse.

Stormwater Management Concepts

Standard of practice for stormwater management in Surrey is undergoing a rapid change, as it is across North America. So-called "traditional" approaches, including simply collecting, conveying and discharging runoff in storm sewers without any control as well as using detention ponds to attenuate peak runoff flows, are losing favour for a variety of reasons including:

- They do not mitigate damage to receiving water ecosystems
- They often exacerbate erosion and flooding if not coordinated within a watershed

- They often do not fit with environmentally sensitive site and community designs now more frequently favoured by homeowners

In lieu of the traditional approaches, more sustainable, lower impact stormwater controls are required for Grandview Heights Area #2 since the area drains to Fergus Creek. Fergus Creek is a fish-bearing watercourse with existing erosion issues. Lower impact controls (sometimes called "low impact development" or LID) emphasize integrating stormwater controls more carefully with environmental values (e.g., fish and wildlife habitat preservation and enhancement) and addressing runoff generation closer to the source, often through the use of landscape-based design practices.

The watershed context for the Grandview Heights Area #2 plan is addressed in two separate but related plans, the Fergus Creek Master Drainage Plan (MDP) Update (2001) and the Fergus Creek Integrated Stormwater Management Plan (ISMP) (2007). The MDP Update provides a framework for conveying runoff from major storm events from the area to Fergus Creek, and includes provision for trunk storm sewers and two offsite detention ponds (see **Figure 4.5**).

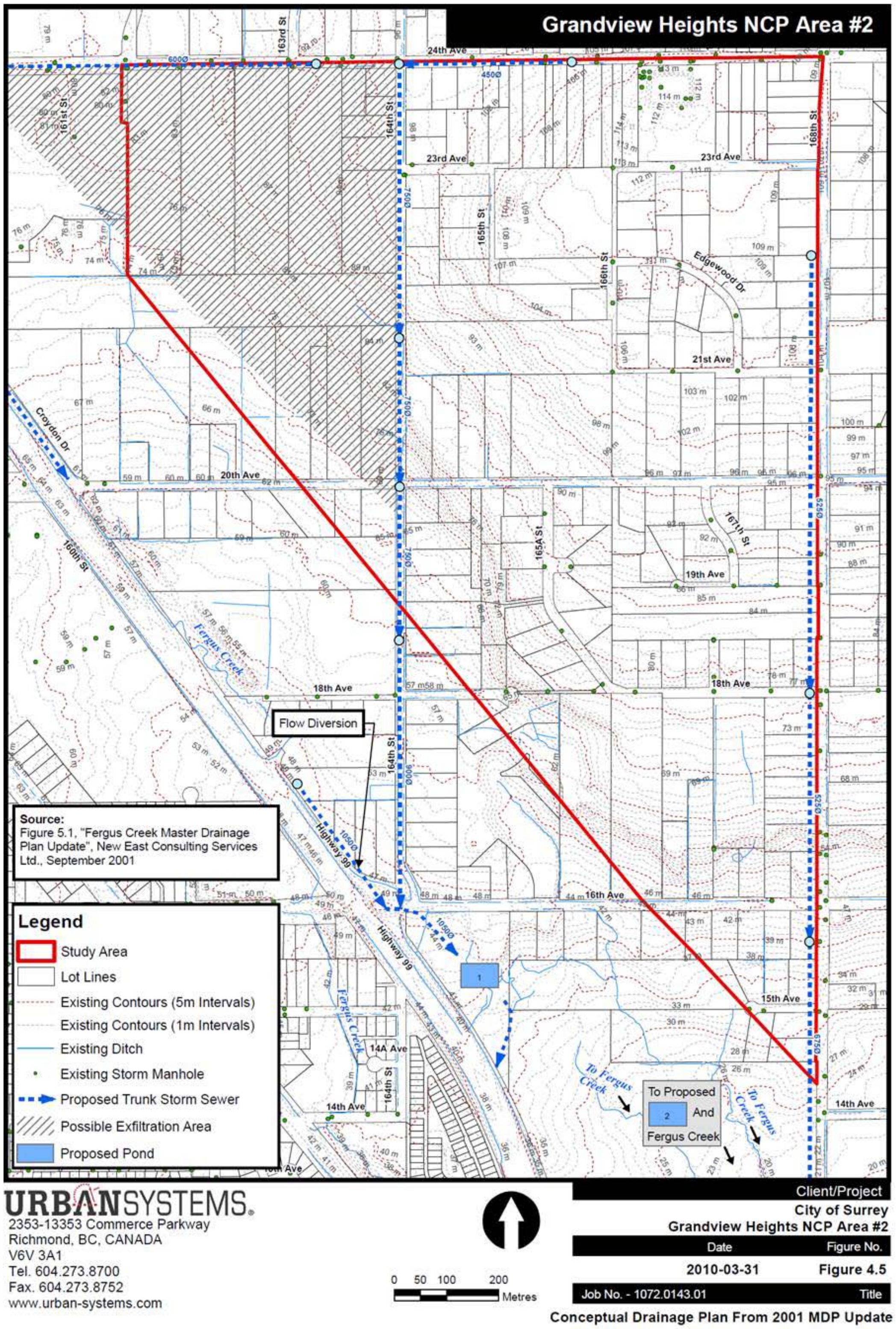
While it assesses the full spectrum of rainfall events, the ISMP particularly focuses on the "typical" or average rain event conditions that represent 90 percent or more of the rainfall that occurs in the course of a year. It further describes flow maintenance and stormwater control targets for the entire watershed as required to maintain and protect the hydrologic conditions in Fergus Creek. The proposed control targets across the watershed are:

- 10 percent (with a minimum of 5%) set aside of open, pervious area available for rainwater infiltration
- 150 m^3 of rainwater detention storage per hectare
- Release rate that varies across the watershed

For Grandview Heights Area #2, the release rates are 0.719 L/s/ha and 0.435 L/s/ha for the western and eastern portions, respectively, of the area. To support these overall targets, the ISMP recommended that three basic types of best management practices (BMPs) be applied throughout the Fergus Creek watershed:

- Roof leader disconnection
- Topsoil preservation and augmentation including:
  - Maintaining tree cover density
  - Increased top soil depth
  - Porous pavement
  - Green roofs
  - Some infiltration-type swales
- Implementation of infiltration infrastructure, including:
  - Rain gardens
  - Infiltration swales with storage
  - Surface or subsurface storage
  - Infiltration ponds
  - Underground galleries

Figure 4.5: Conceptual Drainage Plan from 2001 MDP Update



With respect to these kinds of BMPs, **Table 4.13** provides a general assessment of potential opportunities and challenges for implementing them in Grandview Heights Area #2.

Table 4.13: Opportunities and Challenges for Stormwater Management

Item	Opportunities	Challenges	Resolution
Major drainage routes	• Size reduction as a result of other lower impact stormwater controls • Use of multi-use corridors	• Coordination with sanitary and water services	• Stormwater corridors incorporated into plan • Ultimate coordination at design
Minor drainage routes	• Use of lower impact, decentralized systems	• Obtaining sufficient capacity for all rainwater events • Balancing on-site systems with need for overall drainage of properties	• Decentralized facilities shown to work (see Section 4.3.2) and incorporated into the plan
Lanes	• Minimize impervious or paved surface footprint • Minimize areas requiring lanes • Disconnect from drainage systems	• Tight space with limited opportunity for surface or subsurface control systems • Likely resistance to eliminating lanes if main streets are narrower or otherwise filled with stormwater features	• Not specifically included in plan; developers encouraged to consider stormwater issues within lanes in light of other recommendations
Perforated storm drain/infiltration systems	• Increased infiltration	• Soils conditions may inhibit use • Costs • Existing standards	• Incorporated into plan

Item	Opportunities	Challenges	Resolution
Green streets	• Increased infiltration and evapo-transpiration of rainwater • Aesthetics / neighbourhood enhancement	• Costs • Resistance to "rural feel" of surface stormwater features • Existing standards	• Incorporated into plan, as stormwater corridors along most streets
Performance targets	• Allows developer choice of stormwater controls that integrate with site	• Monitoring for performance • Assurance of proper construction • Enforcement of performance over time	• Proposed for all but single family residential properties, to allow flexibility in design
Prescriptive standards	• Places all sites on same footing with respect to stormwater features to be applied or installed	• "One size fits all" may not be the best approach; doesn't account for site specific conditions	• Proposed for single family residential properties for ease of implementation and long-term success of stormwater management efforts
Site and street grading	• Direct runoff to surface and subsurface features that promote infiltration and evapotranspiration	• Steep areas or areas remote from a multi-use corridor may not be easily directed to such a feature	• Incorporated into plan, to be implemented at time of development
Multi-use corridors	• Increased infiltration and evapotranspiration of rainwater • Water quality treatment • Enhance neighbourhood with landscaping • Corridor widths may be varied to fit local land use character or concept	• Acceptance of concept • Coordination with other uses • Costs • Feasibility on steeper profile slope areas • Maintenance – Who? How often?	• Incorporated into plan as stormwater corridors for flexibility with other land uses and to distribute impact of implementation across the neighbourhood

Item	Opportunities	Challenges	Resolution
Infiltration-based BMPs	• Limit runoff and enhance base flows in streams • Decentralize the systems	• Soils conditions, including depth to hardpan, infiltration capacities (long-term saturated conductivity) and depth to seasonal high water tables	• Incorporated into plan
On-site BMPs ("lower impact stormwater source controls")	• Decentralize the systems • Maximize rainwater infiltration and evapotranspiration	• Guaranteeing sufficient number and size of systems have been installed • Existing standards	• Decentralized systems incorporated into plan
On-site subsurface infiltration trenches	• Increased infiltration	• Soils or site conditions may not allow use • Costs • Long-term maintenance	• Encouraged on single family residential properties and allowed on all other properties to meet performance targets
Amended soils (minimum 150 mm)	• Increased infiltration • Healthier lawns	• "Soggy lawns" • Costs • Existing standards • Enforcement	• Incorporated into plan per Fergus Creek ISMP
Disconnected roof-leaders	• Increased infiltration	• Avoiding "soggy lawns" in areas adjacent to houses • Enforcement, i.e., obtaining full compliance in all areas	• Incorporated into plan, per current City standard for single family residential

The next section describes hydrologic and hydraulic modeling undertaken to assess some of these practices.

4.3.2 Hydrologic / Hydraulic Model Development

The Fergus Creek ISMP hydrologic/hydraulic modeling focused on the creek system only and was not to the level of detail required for use as the basis of the Grandview Heights Area #2 stormwater management plan. Thus a new hydrologic/hydraulic model of the study area was developed using the XPSWMM modeling software program. The following sections describe the input parameters for the development of the XPSWMM model.

Hydrologic Parameters

Catchment Area Properties

Drainage catchment areas were delineated based on a number of factors including topography, existing land uses, existing drainage network configuration, and the anticipated future drainage network configuration. Drainage catchment areas and corresponding stormwater discharge points from the study area are shown on **Figure 4.6**.

Using 2007 aerial photography supplied by the City, the existing impervious coverage within each drainage catchment area was calculated and expressed as a percentage. To compute impervious coverage for the future development scenarios, discussions were held with City staff to reach a consensus on the runoff coefficients and % impervious levels to be used. Based on the land uses specified in the Stage 1 Land Use plan, equivalent zoning designations were selected and agreed upon by the project team and City staff. Corresponding runoff coefficients and % impervious values were then taken from Table 5.3(h) of the City's 2004 Design Criteria Manual (DCM) and applied to the equivalent zoning designations, as summarized in **Table 4.14**.

Figure 4.6: Drainage Catchment Areas

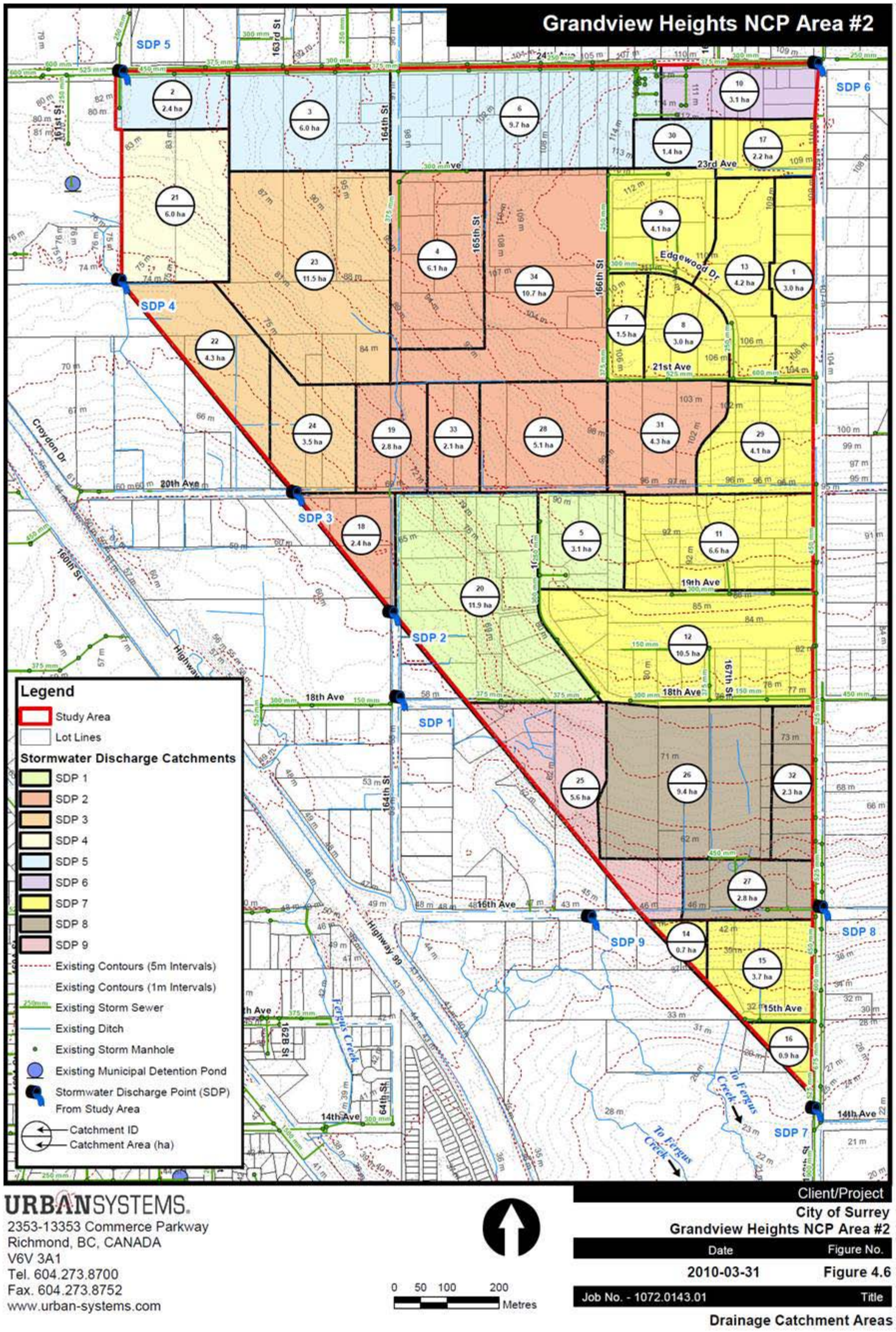


Table 4.14: Equivalent Zoning Designations for Future Land Use Types

Land Use (from Stage 1 Plan)	Equivalent Zoning Designation	Runoff Coefficient	% Impervious
Grandview Ridge Trail	-	0.30	15
Multi-Use Corridor	-	0.25	10
Buffer	-	0.25	20
Linkages	-	0.25	20
Civic Utility	-	0.80	25
Commercial Residential (25-45 upa)	Commercial	0.80	90
Low Density Residential (6-10 upa)	RF / RM 10	0.60	65
Medium Density Residential (10-15 upa)	RF 12 / RF 9 / RM 10	0.70	80
Multiple Residential (15-25 upa)	RM 15 / RM 23	0.60	65
Multiple Residential (30-45 upa)	RM 30 / RM 45	0.60	65
Park / Open Space	-	0.25	20
Road RoW	-	0.70	75
School	-	0.75	80
Special Residential (15-25 upa)	RM 15 / RM 23	0.60	65
Suburban Residential (1-2 upa)	RA, RH / RHG	0.50	55
Suburban Transitional (2-4 upa)	RH/ RHG	0.50	55
Urban Transitional (up to 8 upa)	RF	0.60	65

Table 4.15 summarizes the drainage catchment area properties that were entered into the XPSWMM model. Catchment ID locations are shown on **Figure 4.6**.

Impervious Area Disconnection

To analyze the performance of the municipal drainage network under existing development conditions, it was assumed that all impervious surfaces in the study area were disconnected from the municipal drainage system (i.e., all impervious areas were redirected to pervious, or grassed, surfaces). Given that the study area is currently rural in nature and is predominantly comprised of larger, estate type single family residences, this assumption was felt to be valid.

Under future development conditions, however, it is recognized that the density and form of some of the proposed land uses will result in a larger proportion of area being directly connected to the municipal drainage network. The City currently requires that all land uses, other than single family residential, be directly connected to the municipal drainage system. The Fergus Creek ISMP supports this approach if on-site best management practices are implemented, thus some of the proposed land uses were modeled as directly connected under the future development scenarios summarized in **Table 4.16**.

Table 4.15: Catchment Area Properties

	Stormwater Discharge Point	Area (ha)	Impervious (Existing)	% Impervious (Future)	Width (m)	Slope (m/m)
1	7	3.0	30.0	60.0	400	0.020
2	5	2.4	6.9	55.4	210	0.025
3	5	6.0	16.9	64.9	275	0.040
4	2	6.1	9.0	69.4	360	0.050
5	1	3.1	33.0	59.9	165	0.050
6	5	9.7	14.8	72.3	490	0.050
7	7	1.5	34.9	54.1	200	0.025
8	7	3.0	30.0	64.7	140	0.020
9	7	4.1	23.4	78.8	190	0.020
10	6	3.1	5.0	59.7	290	0.010
11	7	6.6	20.6	61.1	360	0.045
12	7	10.5	17.8	61.8	450	0.051
13	7	4.2	29.9	68.7	110	0.020
14	7	0.7	17.9	55.8	190	0.065
15	7	3.7	12.6	54.7	190	0.020
16	7	0.9	15.6	48.7	70	0.025
17	7	2.2	11.0	65.7	200	0.010
18	2	2.4	9.7	67.4	100	0.050
19	2	2.8	7.9	42.8	140	0.090

	Stormwater Discharge Point	Area (ha)	Impervious (Existing)	% Impervious (Future)	Width (m)	Slope (m/m)
20	1	11.9	15.9	54.2	400	0.090
21	4	6.0	4.4	53.2	200	0.040
22	3	4.3	2.4	49.3	215	0.043
23	3	11.5	2.2	61.5	360	0.084
24	3	3.5	8.7	56.1	165	0.075
25	9	5.6	9.4	55.8	450	0.085
26	8	9.4	5.2	58.3	315	0.055
27	8	2.8	20.2	54.0	250	0.065
28	8	5.1	6.8	72.5	340	0.055
29	2	4.1	14.4	61.1	210	0.040
30	7	1.4	5.0	27.9	150	0.010
31	5	4.3	14.4	60.1	210	0.040
32	7	2.3	5.2	57.0	90	0.055
33	2	2.1	6.8	71.2	340	0.055
34	2	10.7	9.0	53.2	280	0.050
Total		**161**				

Of the 161 hectare total area, 21 hectares (or 13 percent) is covered by impervious surfaces under existing development conditions. For future development conditions, the total impervious area is projected to increase to 97 hectares (or 60 percent) of the overall study area.

Table 4.16: Impervious Area Disconnection Summary (Future Conditions)

Land Use (from Stage 1 Plan)	Impervious Area Redirected to Pervious Surface?
Grandview Ridge Trail	Yes
Multi-Use Corridor	Yes
Buffer	Yes
Linkages	Yes
Civic Utility	No
Commercial Residential (25-45 upa)	No
Low Density Residential (6-10 upa)	Yes
Medium Density Residential (10-15 upa)	Yes
Multiple Residential (15-25 upa)	No
Multiple Residential (30-45 upa)	No
Park / Open Space	Yes
Road	No
School	No
Special Residential (15-25 upa)	No
Suburban Residential (1-2 upa)	Yes
Suburban Transitional (2-4 upa)	Yes
Urban Transitional (up to 8 upa)	Yes

For the future development condition scenarios, approximately 43 hectares (or 44 percent) of the 97 hectare total impervious area noted above were redirected to pervious surfaces.

Infiltration / Depression Storage

Several parameters for infiltration and depression storage were evaluated and utilized in the development of the XPSWMM model. Values for parameters such as depression storage and Mannings 'n' for impervious and pervious surfaces were selected based on the data and past reports reviewed for this study as well as professional expertise based on model calibration for similar studies. The Green-Ampt equation was used to compute infiltration losses based on the hydraulic conductivity of the native underlying soils. According to the hydrogeological investigation undertaken as part of the Fergus Creek ISMP, the native soils in the study area mainly consist of Capilano sediments (marine and glaciomarine till-like deposits, classified as Cd), with Vashon Drift (lodgement till, Va, and glaciofluvial outwash, Vb) in the extreme northeast and southeast corners of the study area. **Table 4.17** summarizes the key infiltration and depression storage parameters used in the XPSWMM model. The initial moisture deficit represents a very wet antecedent, but not fully saturated, moisture condition.

Table 4.17: Infiltration / Depression Storage Parameters

Hydrologic Parameter	Value	Hydrologic Parameter	Value
Impervious Area Depression Storage	0.5 mm	Pervious Area Depression Storage	2.0 mm
Impervious Manning's n	0.011	Pervious Manning's n	0.2
Average Capillary Suction (Cd soils)	200 mm	Initial Moisture Deficit (Cd soils)	0.05
Saturated Hydraulic Conductivity (Cd soils)	1.7 mm/hr		

Rainfall

Although the White Rock STP rain gauge station is located closer in proximity to the study area, rainfall data from the City's Municipal Hall rain gauge was used to be consistent with the Fergus Creek ISMP. Intensity-Duration-Frequency (IDF) data from the station was translated into XPSWMM using traditional "design storm" format with AES and SCS distributions for short duration storms (up to 6 hours) and long duration storms (12 and 24 hours), respectively, per the City's Design Criteria Manual.

Hydraulic Parameters

Background Data Compilation

Much of the information on the existing municipal drainage network was imported into the XPSWMM model from the City's GIS database, including storm sewer sizes, slopes, inverts, lengths and material types. Ground elevations at manhole locations were estimated using available topographic data. According to the City's GIS database, there are no existing municipal detention facilities within the study area; however, there is a municipal detention facility located near 161st Street and 23rd Avenue, which appears to capture flows from Stormwater Discharge Point (SDP) #5 (shown on **Figure 4.6**).

The City's GIS database does not include information on the existing ditch and channel network within the study area, thus field measurements of these features were taken during the site reconnaissance. Ditch and channel slopes were estimated based on the available topographic data as well as the inverts of municipal storm sewers connected to these features.

Stormwater Discharge Points

Based on the configuration of the existing municipal drainage network, nine stormwater discharge points (SDP) were identified for the study area. Discharge point in this context simply means the point at which stormwater runoff that has been collected in pipes or ditches leaves the study area boundaries; some runoff actually leaves the area as overland flow. Eight of the SDPs direct runoff southwards within Fergus Creek watershed; the creek ultimately conveys flows to the Campbell River and Semiahmoo Bay. SDP 6 conveys runoff northeast from the study area to the Burrows Ditch watershed, then to the Nicomekl River and eventually Mud Bay. For the purposes of our analysis, each SDP was considered to be a free outfall, meaning that there is no backwater elevation or constriction downstream that influences the water levels in the municipal drainage network within the study area. SDP locations are summarized in **Table 4.18** and shown on **Figure 4.6**.

Simulated Conditions

Once the XPSWMM model development was complete, the model was run for the 5-year and 100-year return period events to evaluate the performance of the existing municipal drainage network within the study area. These return periods were chosen as they correspond to the minor and major system, respectively, as defined by the City's current drainage design criteria. The 5- and 100-year return period events were run for the following durations: 30-minute, 1-hour, 2-hour, 6-hour, 12-hour and 24-hour. The 30-minute duration generally produced the highest peak flows, thus this duration is considered the critical duration for analysis purposes.

The performance of the existing municipal drainage network was also evaluated with the Mean Annual Rainfall event (MAR), defined statistically as the 2.33-year, 24-hour event; for the study area the MAR is 60 mm. Stormwater BMPs are sometimes sized for the MAR event, as approximately 90 percent of the total annual rainfall volume experienced in the Lower Mainland corresponds to events that are less than MAR intensity.

It should be noted that the XPSWMM model has not been calibrated, as flow data was not available to perform the calibration. However, watershed specific data from past studies and reports were incorporated into the model as much as possible to provide a reasonably accurate picture of the watershed's characteristics. Future work may include a sensitivity analysis on key model parameters to determine which parameters have the most influence on model results.

4.3.3 Model Results

Existing Development Conditions

Municipal Drainage Infrastructure Performance

As noted earlier, the City's current drainage design criteria states that the existing municipal drainage network is intended to convey flows up to the minor event (5-year return period). Thus, the XPSWMM model was initially run for the 5-year return period event to evaluate the performance of the municipal drainage network under existing development conditions. Model results indicate that while most of the existing municipal drainage network meets the City's criteria, there were some reaches of existing storm sewer that were surcharged during the 5-year return period event as shown on **Figure 4.7**. Particular areas of concern include:

- 145 m of 375mmØ storm sewer on 168th Street, just north of 16th Avenue
- 98 m of 375mmØ and 232 m of 450mmØ storm sewer on 18th Avenue, between 167th Street and 168th Street

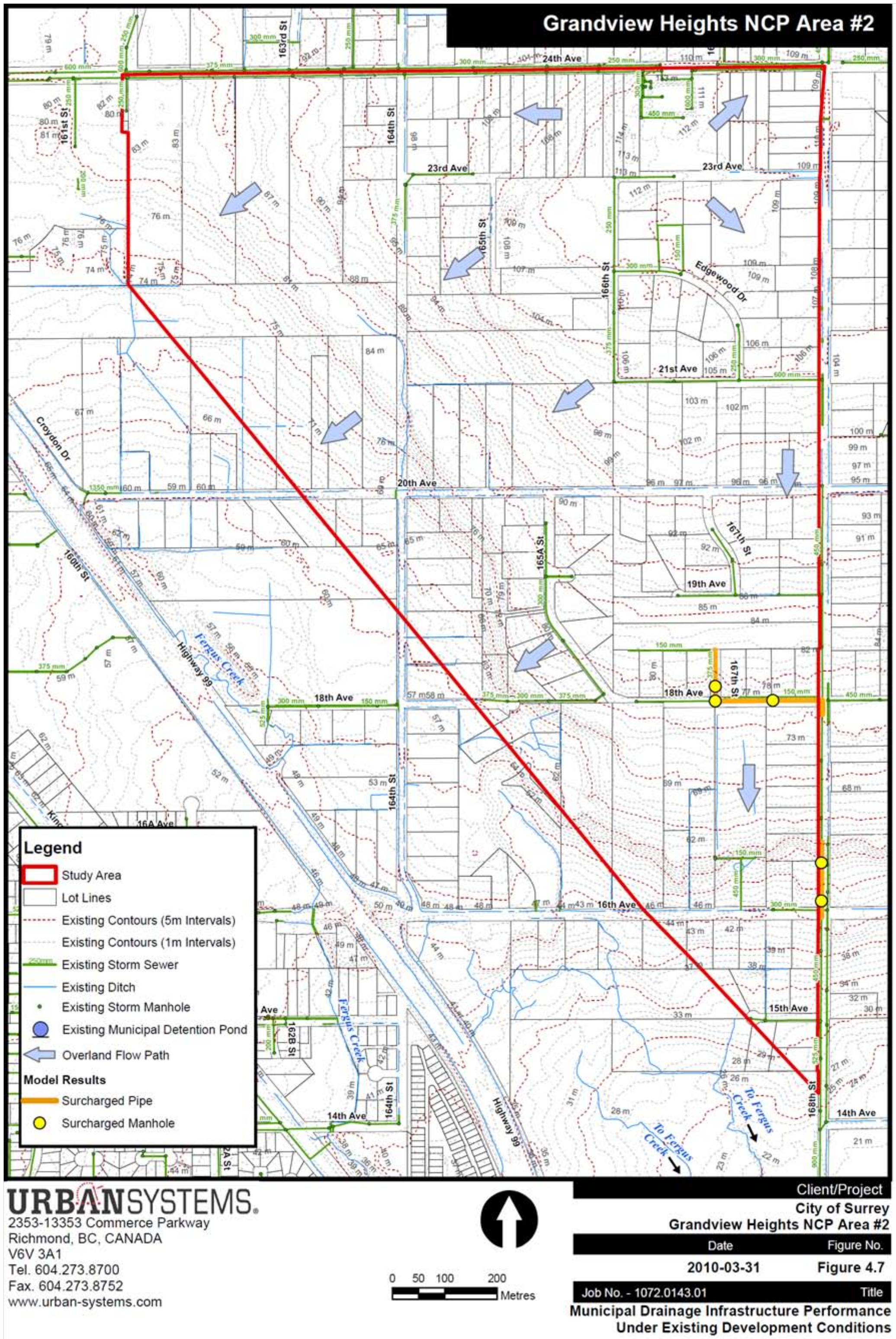
The Fergus Creek ISMP had also identified the 375mmØ storm sewer on 168th Street as having insufficient capacity to convey the minor event. This is a short reach of 375mmØ pipe with 450mmØ pipe immediately upstream and downstream of it. The XPSWMM model was thus revised to upgrade this reach to a 450mmØ storm sewer. The model results also indicated that surcharging on 18th Avenue would be very minor in nature, and given that the downstream system on 168th Street is already a 450mmØ pipe, no upgrades are proposed for 18th Avenue.

For the 100-year return period event, the magnitude of surcharging and flooding increases significantly. The model results indicate that the majority of flooding would occur within the SDP 5 and SDP 7 catchment areas for existing development conditions.

In summary, the model results indicate that the majority of the existing municipal drainage infrastructure within the study area is adequately sized to service existing development as defined by the City's current drainage design criteria with the exception of the few reaches noted above. We understand from discussions with City staff that there have been past drainage/ flooding issues in a few locations, including near 168th Street/18th Avenue and 166th Street/ 23rd Avenue. The City stated that both of these locations appeared to be due to tree roots entering the storm sewer joints rather than resulting from pipe capacity issues.

Peak flows at each stormwater discharge point for the MAR, 5-year and 100-year return period events are shown on **Tables 4.18**, **4.19** and **4.20**, respectively. Total runoff volumes for the same events are tabulated in **Tables 4.21**, **4.22** and **4.23**, respectively.

Figure 4.7: Municipal Drainage Infrastructure Performance Under Existing Development Conditions



Future Development Conditions

The Fergus Creek ISMP recommends three main stormwater best management practices (BMPs) for mitigating future development impacts within the Fergus Creek watershed:

- BMP #1 – Impervious area disconnection for single family residential development
- BMP #2 – Amended topsoil on all pervious areas
- BMP #3 – Onsite detention/infiltration facilities

The XPSWMM model was utilized to assess the benefits of implementing these three stormwater BMPs (using a tiered approach) to mitigate the impacts of future development within the study area. Peak flows and volumes were computed for the MAR, 5-year and 100-year return period events and compared against peak flows and volumes for existing development conditions (with the upgrade on 168th Street in place).

The following sections discuss the results of these future condition scenario runs. Hydrographs for existing and future development condition scenarios at each stormwater discharge point are also included in **Appendix A.3**. (Note that in **Appendix A.3** the "BMP #1" scenario is denoted as "future conditions (unmanaged)".)

BMP #1 – Impervious Area Disconnection

The existing conditions XPSWMM model (with the pipe upgrade on 168th Street in place) was modified to reflect future land uses and impervious levels, as shown on the Stage 1 Land Use Plan and tabulated previously in **Tables 4.13** and **4.14**. Impervious surfaces associated with some future land uses were redirected to pervious areas within the same catchment, as previously discussed. The model was then run assuming that no further upgrades to the municipal drainage network were implemented, to assess the system's performance.

Not surprisingly, the model results indicate that both peak flows and volumes would increase significantly over existing development conditions, as summarized in **Tables 4.18** through **4.23**. The impact is also shown graphically in the hydrographs contained in **Appendix A.3**. As these values are well beyond the existing regime that Fergus Creek currently experiences, implementing BMP #1 alone is insufficient to reduce peak flows and volumes to existing levels.

BMP #2 – Amended Topsoil

For this scenario, the future conditions model was modified to include 150mm of amended topsoil over all pervious areas in the study area. The model was then run to evaluate whether any additional benefit could be achieved by implementing this BMP.

The model results indicate that, if BMPs #1 and 2 are implemented together, a significant benefit could be achieved in the study area over implementing BMP #1 alone. This was particularly evident for longer duration events such as the MAR event, where the model indicated that peak flows were only slightly above existing conditions peak flows at several discharge points. The benefit of additional topsoil was most notable for catchment areas with higher proportions of pervious surfaces (generally single family residential areas).

While runoff volumes were still higher than the volumes generated for existing development conditions, a reduction in volume was also achieved in this scenario over implementing BMP #1 alone. However, the implementation of BMPs #1 and #2 together was still insufficient to match existing condition peak flows and volumes for the 5-year and 100-year return period events. Peak flow and volume summaries are tabulated in **Tables 4.18** through **4.23**, and shown graphically in **Appendix A.3**.

BMP #3 – Onsite Detention / Infiltration Facilities

Using the model from Section 4.2.2 as a base, this third scenario examined the benefits of providing onsite detention storage and encouraging additional infiltration of stormwater, in addition to implementing BMPs #1 and #2. The Fergus Creek ISMP states that each lot within the study area must dedicate 5% of its land area for infiltration purposes, as well as provide $150m^3$/ha of detention storage with the following release rates:

- 0.435 L/s/ha for catchment areas draining to SDPs 1, 2, 6, 7, 8 and 9
- 0.719 L/s/ha for catchments areas draining to SDPs 3, 4 and 5

In modeling terms, each catchment area was routed through a storage node that provided $150m^3$/ha of detention storage spread over an area equal to 5 percent of the catchment area. The scope and nature of this detention storage would be determined during detailed design. An internal rating curve was developed for each storage node that maximized the available storage when the above noted release rates were reached. Flows that exceeded the detention storage capacity were then routed in the model via trunk storm sewers, ditches and overland flow with no further attenuation. Infiltration was also simulated by inputting a constant outflow from the storage node that was equal to the saturated hydraulic conductivity of the underlying soils (1.7 mm/hr).

By implementing BMPs #1, #2 and #3, the peak flow rates for future development conditions were reduced to well below existing condition rates for the MAR, 5-year and 100-year return period events. Runoff volumes were generally lower than existing conditions as well, with the exception of SDPs 3, 4, 5 and 6 where future condition runoff volumes were still slightly higher than existing conditions for the MAR and 5-year return period events.

The Stage 1 Land Use plan identified the inclusion of multi-use stormwater corridors throughout the study area. Based on discussions with City staff and the Fergus Creek ISMP consultant, we understand that, while land for these corridors will be set aside as development proceeds, they would not initially be used for subsurface detention storage and infiltration. Thus, the corridors were modeled only as open space at this time.

Peak flow and runoff volume summaries for all model scenarios are tabulated in **Tables 4.18** through **4.23**, and shown graphically in **Appendix A.3**.

Table 4.18: Stormwater Discharge Points (SDP) from Study Area

Stormwater Discharge Point	Location	Discharge Location	Watershed
SDP 1	164th Street / 18th Avenue	Ditch	Fergus
SDP 2	164th Street / 18th Avenue	Ditch	Fergus
SDP 3	20th Avenue (west of 164th Street)	Ditch	Fergus
SDP 4	161A Street / 22nd Avenue	Ditch	Fergus
SDP 5	161A Street / 24th Avenue	Trunk storm sewer	Fergus
SDP 6	168th Street / 24th Avenue	Trunk storm sewer	Burrows
SDP 7	168th Street / 14th Avenue	Trunk storm sewer, west side of 168th	Fergus
SDP 8	168th Street / 16th Avenue	Trunk storm sewer, east side of 168th	Fergus
SDP 9	166th Street / 16th Avenue	Unnamed Creek	Fergus

Table 4.19: Peak Flow Summary (MAR Event)

Stormwater Discharge Point (SDP)	Peak Flow (m^3/s)			
	Existing Conditions	Future Conditions		
		BMP #1	BMP #1 + #2	BMP #1 + #2 + #3
SDP 1	0.103	0.189	0.106	0.013
SDP 2	0.155	0.438	0.269	0.061
SDP 3	0.080	0.239	0.182	0.048
SDP 4	0.022	0.071	0.049	0.010
SDP 5	0.120	0.263	0.227	0.067
SDP 6	0.014	0.039	0.030	0.011
SDP 7	0.325	0.645	0.294	0.059
SDP 8	0.060	0.160	0.052	0.005
SDP 9	0.039	0.078	0.032	0.002

Table 4.20: Peak Flow Summary (5-Year, 30-Minute Event)

Stormwater Discharge Point (SDP)	Peak Flow (m^3/s)			
	Existing Conditions	Future Conditions		
		BMP #1	BMP #1 + #2	BMP #1 + #2 + #3
SDP 1	0.100	0.535	0.437	0.001
SDP 2	0.106	1.022	0.561	0.001
SDP 3	0.059	0.744	0.695	0.004
SDP 4	0.017	0.231	0.214	0.001
SDP 5	0.123	0.864	0.589	0.002
SDP 6	0.013	0.148	0.135	0.000
SDP 7	0.235	1.426	0.667	0.004
SDP 8	0.056	0.316	0.219	0.001
SDP 9	0.051	0.215	0.053	0.000

Table 4.21: Peak Flow Summary (100-Year, 30-Minute Event)

Stormwater Discharge Point (SDP)	Peak Flow (m^3/s)			
	Existing Conditions	Future Conditions		
		BMP #1	BMP #1 + #2	BMP #1 + #2 + #3
SDP 1	0.488	1.339	0.839	0.002
SDP 2	0.663	2.510	1.092	0.004
SDP 3	0.424	1.226	1.148	0.009
SDP 4	0.112	0.538	0.415	0.002
SDP 5	0.350	1.801	1.106	0.006
SDP 6	0.077	0.330	0.258	0.001
SDP 7	0.781	2.923	1.274	0.006
SDP 8	0.302	0.811	0.410	0.001
SDP 9	0.264	0.551	0.101	0.000

Table 4.22: Volume Summary (MAR Event)

Stormwater Discharge Point (SDP)	Volume (m^3)			
	Existing Conditions	Future Conditions		
		BMP #1	BMP #1 + #2	BMP #1 + #2 + #3
SDP 1	1,932	4,799	3,859	859
SDP 2	2,910	11,363	7,932	2,867
SDP 3	1,428	6,718	5,983	3,115
SDP 4	442	1,921	1,616	673
SDP 5	2,108	7,271	6,217	3,194
SDP 6	245	1,112	993	459
SDP 7	6,316	16,239	11,323	4,028
SDP 8	1,125	3,878	2,321	529
SDP 9	549	1,707	895	187

Table 4.23: Volume Summary (5-Year, 30-Minute Event)

Stormwater Discharge Point (SDP)	Volume (m^3)			
	Existing Conditions	Future Conditions		
		BMP #1	BMP #1 + #2	BMP #1 + #2 + #3
SDP 1	219	893	632	61
SDP 2	248	1,910	860	77
SDP 3	119	1,223	1,065	243
SDP 4	28	333	282	55
SDP 5	216	1,311	754	142
SDP 6	20	199	175	29
SDP 7	678	2,819	1,281	200
SDP 8	116	621	291	18
SDP 9	86	336	81	3

As the analysis shows, application of amended topsoil throughout the NCP, coupled with disconnection of roof leaders in single home residential areas (which is currently required within the City in any case), provides high levels of rainwater control generally sufficient to limit runoff to existing levels and to foster infiltration of rainwater. The addition of detention storage at the level recommended in the Fergus Creek ISMP (150 m^3/ha) throughout the entire area yields peak runoff discharges and total runoff volumes significantly lower than existing conditions. Based on these results, it was decided to limit single family residential requirements to disconnection of roof leaders and application of 150 mm of amended topsoil, leaving the detention storage requirements for larger scale site developments (such as multi-unit facilities). For all scenarios, a 5% (minimum) green space allocation for stormwater corridors was included.

One significant limitation in fully evaluating the benefits of stormwater BMPs using design storm formatted rainfall is that the long term performance of these BMPs cannot be quantified under varying real-time conditions. The Lower Mainland typically sees successive storm events where ponds, depression storage areas and soils do not fully discharge, empty or “dry out” before the next rainfall event commences. As part of a separate work assignment outside the preparation of this stormwater servicing plan for the neighbourhood, continuous simulation was done for a single subcatchment (SDP 2). Using 36 years of hourly rainfall data, hydrologic computations were completed for all four stormwater management scenarios (existing conditions, plus three future conditions). The results confirmed what the design storm-based modeling presented herein suggests, namely, that the objectives of controlling runoff and maximizing infiltration can be met with a combination of disconnected roof leaders, amended soils and targeted detention storage, when also coupled with a set 5% aside of open space for stormwater corridors.

Trunk Storm Sewers

The locations of trunk storm sewers were also determined for the study area. Trunk storm sewers are typically designated by the City for all catchments with a service area equal to or greater than 20 hectares. The trunk storm sewer sizing was based on the future development peak flows generated from the 5-year, 30-minute return period event *with only BMP # 1 in place*.

Based on the above criteria, four trunk storm sewer systems were identified, as summarized below. Trunk storm sewer locations are shown on **Figure 4.8(a)**.

- 675mmØ trunk storm sewer on 164th Street, conveying flows from SDP 2 to an existing drainage ditch along 164th Street (approx. total length = 245 m)
- 600mmØ trunk storm sewer on 163rd Street, conveying flows from SDP 3 to the existing drainage ditch along 20th Avenue (approx. total length = 80 m)
- 675mmØ trunk storm sewer on 24th Avenue, conveying flows from SDP 5 to the existing municipal detention facility near 161st Street and 23rd Avenue (approx. total length = 335 m)
- 525mmØ – 750mmØ trunk storm sewer on 168th Street, conveying flows from SDP 7 to an existing drainage ditch along 168th Street (approx. total length = 1,860 m)

In light of the proposed extensive use of low impact BMPs within the neighbourhood the two municipal detention facilities previously recommended in the Fergus Creek MDP (see **Figure 4.5**) were eliminated. A separate assessment was made of the potential for constructing surface water "features", in lieu of the proposed low impact BMPs, within a section of the neighbourhood; if constructed, these water features could also provide stormwater detention. This feasibility assessment and its results are included at the end of **Appendix A.3**.

Cost estimates for the drainage trunk storm sewer system are provided in Section 4.3.6.

Ditch / Channel Erosion Protection

As part of the XPSWMM modeling effort, peak velocities in the principal ditches within the study area were computed. The principal ditches include:

- 164th Street ditch, south of 22nd Avenue (SDP 2)
- 20th Avenue ditch (SDP 3)
- 161A Street ditch (SDP 4)
- 167th Street RoW ditch, north of 16th Avenue (SDP 8)
- BC Hydro RoW ditch, north of 16th Avenue (SDP 9)

Future condition peak velocities (with BMP #1 only) ranged from 0.7 m/s to 2.0 m/s for flows generated by the 100-year, 30-minute return period event. If the ditches experience peak velocities in the upper range, it is possible that erosion could occur, thus, erosion protection measures should be implemented. At the NCP level of analysis, however, it is difficult to quantify the scope of remedial measures to undertake. For the purposes of costing erosion protection works, it was assumed that erosion protection would consist of riprap and geotextile fabric. We have not accounted for habitat enhancement opportunities and have assumed that only 25 percent of the total ditch length in the NCP would require erosion protection.

4.3.4 Water Quality

Urban development will affect not only runoff peaks and volumes but also the quality of that runoff. Typical pollutants that are conveyed in runoff include suspended sediments, nutrients such as nitrogen and phosphorous, trace metals such as copper, nickel and zinc, bacteria, and hydrocarbons. Many of these are by-products of the means of transportation upon which we rely, i.e., automobiles, buses and trucks, but also of such things as our use of chemicals to maintain green lawns, pet and wildlife activities, and even general littering.

In order to obtain an overview of the runoff quality conditions now and for future developed conditions, a simple runoff pollutant loading model was developed as described below. This method and variations on it have been widely used across North America, particularly the U.S., for preliminary assessment of the impact of non-point source pollutant loads in runoff.

Estimated Runoff Pollutant Loads

In order to assess the pollutant loads associated with stormwater runoff, we used a screening-level tool developed by the Center for Watershed Protection (CWP), a non-profit watershed consulting organization from the U.S. The tool[3], or method, requires minimal input, all of which was readily available for this preliminary assessment:

- Drainage (catchment) area(s) – this information was developed for the XPSWMM model
- Impervious cover – this also was developed for the XPSWMM model
- Annual precipitation – this information was readily available
- Pollutant concentrations – median event mean concentrations (EMCs) are based on data collated by researchers in the U.S.; we focused on just a few pollutants, as representative of the spectrum of potential contaminants in runoff: total suspended solids (TSS); total nitrogen; dissolved phosphorus; total copper; total zinc; and bacteria (specifically, fecal coliforms)

To determine annual pollutant loadings, we assigned one or more of three basic land use categories to each catchment and then used median pollutant concentrations associated with those land use categories. The basic categories are: residential; commercial; and open space[4]. The method was applied to both existing and future “unmanaged” conditions.

Table 4.24 shows the results for both existing and future conditions. As shown loads can be expected to increase nearly four-fold from existing to fully developed conditions if no controls or BMPs are applied.

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[3] Schueller, Tom, *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP’s*, for Metropolitan Council of Governments, Washington, D.C., 1987.

[4] Two additional categories are available (industrial and highway); since these do not apply to the Grandview Heights Area #2, they were not used.

Table 4.24: Volume Summary (100-Year, 30-Minute Event)

Stormwater Discharge Point (SDP)	Volume (m^3)			
	Existing Conditions	Future Conditions		
		BMP #1	BMP #1 + #2	BMP #1 + #2 + #3
SDP 1	1,202	2,042	1,120	197
SDP 2	1,930	4,459	2,012	338
SDP 3	1,068	2,468	1,885	671
SDP 4	288	770	509	162
SDP 5	1,510	2,928	1,727	544
SDP 6	175	431	313	77
SDP 7	3,928	6,616	2,374	554
SDP 8	773	1,569	514	77
SDP 9	469	776	138	14

Impact of Proposed BMPs on Runoff Quality

Reduction in total annual runoff from the neighbourhood due to use of low impact best management practices will also directly reduce discharge of runoff-generated pollutants. In other words, runoff that is infiltrated also effectively removes pollutants from surface discharge to local streams and to Fergus Creek itself. Absorbent landscaping (i.e., deep amended topsoil), disconnected roof drains, rain gardens, subsurface bioswales and similar low impact BMPs will promote infiltration. Even in specific locations within Grandview Heights #2 where perforated underdrains may be required beneath the BMP due to the presence of shallow impermeable soil layer, contact with soil and vegetation will provide substantial removal of key pollutants such as suspended sediments, trace metals and bacteria.

In addition to showing the estimate pollutant loads for existing and future (no controls) conditions, **Table 4.25** also lists the estimated loads with proposed BMPs implemented (as described in Section 4.3.5, below). **Appendix A3** provides expanded tables for the pollutant load estimates.

Table 4.25: Annual Estimated Pollutant Load

Pollutant	Annual Estimated Pollutant Load (Kilograms; except number of colonies for Fecal Coliforms)		
	Existing	Future (No Controls)	Future (with BMPs)
Total Suspended Solids	13,950	44,990	7,560
Dissolved Phosphorous	44	148	25
Total Nitrogen	250	240	140
Fecal Coliforms	22.3 trillion	73.8 trillion	12.3 trillion
Oil & Grease	840	3,270	570
Total Zinc	18	67	12
Total Copper	3	11	2

Limitation of Analysis

This screening assessment makes use of highly simplified approaches to estimate pollutant loads and removal of those loads. The following key limitations to the analysis apply:

- Pollutant concentrations are not specific to the City of Surrey, instead median values for event mean concentrations of pollutants across North America were used;
- While all the concentrations used in the analysis are subject to variability, bacteria (fecal coliform) data are particularly difficult to model and results should be considered to have a very wide band of variability;
- The computations do not account for any dynamic processes affecting pollutant loads and concentrations;
- The computations use an annual average rainfall depth, not a series of discrete storms over time, which would yield a better accounting of actual pollutant wash-off; and
- Complex treatment processes provided by BMPs have not been simulated and simple removal efficiencies were applied.

Two specific classes of pollutants not addressed in the analysis are pesticides and herbicides, both of which can be significant contaminants from lawns (in residential and some commercial areas) and from open space used for sports-type recreation (e.g., golf courses and sports fields). Bacteria counts from residential areas can be quite high as well, particularly in areas with high concentrations of family pets (e.g., dogs). Despite these limitations, the screening level assessment provides a reasonable assessment of the significance of pollutant loading issues and creates a framework for understanding the implications of pollutant washoff in urban areas such as Grandview Heights #2.

4.3.5 Proposed Stormwater Management Concept

The proposed management concept is consistent with the program set forth in the Fergus Creek ISMP and with the level of service expected in developments within the City of Surrey. The focus is on controlling runoff at the source, or as near the source as possible, as well as on maintaining base flows in Fergus Creek, while providing traditional drainage control through use of local and trunk sewers as needed.

Goals and Objectives

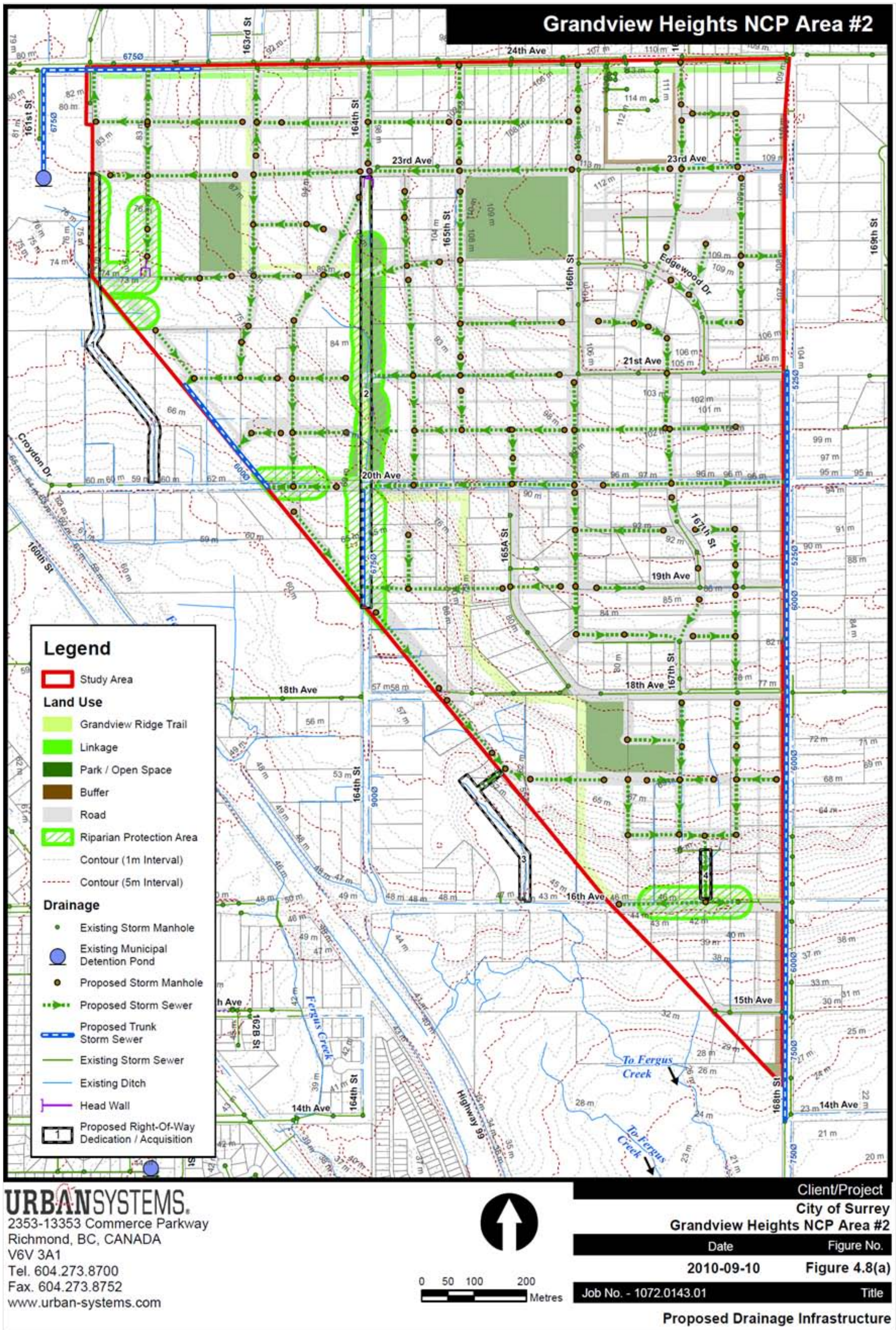
The goal of the stormwater / drainage servicing plan in Grandview Heights Neighbourhood #2 is to provide a stormwater management system that is sustainable, protects property and the public, and is well-suited to the cultural and ecological conditions of the neighbourhood.

To meet this goal, stormwater management objectives for the Grandview Heights Area #2 are:

- Control runoff generated (or potentially generated) by small, minor storms through the use of retention, infiltration, evapo-transpiration and long-term storage at, or very close to, the points of generation;
- Provide publicly-maintained stormwater facilities for control of stormwater runoff generated within rights-of-way and to supplement the onsite controls noted in the first objective;
- Control runoff from major storms by providing adequate safe flow paths and/or temporary detention storage within the roads, stormwater corridors and other areas as may be designated; and
- Minimize adverse impacts of development on runoff quality to the local streams, including Fergus Creek itself.

The stormwater management system will consist of an inter-related set of on-site and public controls, including stormwater corridors, perforated local storm drains in street rights-of-way and landscape-based, low impact source controls on individual lots. **Figures 4.8(a)** and **4.8(b)** show the locations for various elements of the proposed stormwater servicing plan. Sections 4.3.3.2.4 and .5 already discussed trunk sewers and erosion protection requirements of the servicing plan; other elements are discussed in more detail below.

Figure 4.8(a): Proposed Drainage Infrastructure



On-Site Controls

The first line of stormwater management features will be incorporated into each property developed within Grandview Heights #2. Relying heavily on sustainable, landscape-based stormwater source controls, the intent is to maximize infiltration and evapotranspiration of rainwater. These types of controls are described in Metro Vancouver's publication, "Stormwater Source Control Design Guidelines 2005" (April 2005)[5].

Single Family Residential

On single family residential properties, there are two requirements:

- Install at least 150 mm of amended topsoil (per "Stormwater Source Control Design Guidelines 2005") in yards; and
- As per current Surrey standards, discharge roof leaders to ground rather to the storm drain collection system in the streets.

In addition, homeowners will be encouraged to incorporate other stormwater source controls into their properties such as:

- Maintenance (or retention) of high tree cover densities;
- Rain gardens; and
- Permeable pavement for drives, walks and patios.

Layout, configuration and construction of these additional controls should be completed in accordance with "Stormwater Source Control Design Guidelines 2005".

The Engineer of Record should verify in writing that the amended topsoil meets the requirements of the Guidelines and has been properly installed and that roof leaders discharge to ground not to a storm sewer.

Multi-Family, Commercial and Institutional Areas

Multi-family, commercial and institutional sites will be required to meet specific performance targets for stormwater source controls:

- Install at least 150 mm of amended topsoil in lawn areas;

[5] Document is available online at http://www.metrovancouver.org/about/publications/Pages/default.aspx or search for "Stormwater Source Control Guidelines 2005" on MetroVancouver's Website: http://www.metrovancouver.org/Pages/default.aspx.

- Provide runoff storage on-site equal to 150 m^3/ha of gross site area released at a rate dependent on location within the neighbourhood, as shown on **Figure 4.6**:
  - 0.435 L/s/ha for Catchments SDP 1, 2, 6, 7, 8, and 9; and
  - 0.719 L/s/ha for Catchments SDP 3, 4 and 5;
- Provide water quality treatment for any specific high risk contaminants associated with that site's land use activities, e.g., oil capture/removal for gas service stations, if required by the City; and
- Promote the use of landscape-based stormwater source controls that emphasize infiltration and evapotranspiration of rainwater from small storms.

The specific mix of source control methods will be up to each site owner, thus allowing integration into the site's overall architectural and landscaping concept. Layout, configuration and construction should be done in accordance with "Stormwater Source Control Guidelines 2005". Per the recommendation of the Fergus Creek Integrated Stormwater Management Plan, all BMPs except the amended topsoil should be designed with a safety factor of two (2), which should be applied to the <u>volume</u> and <u>surface area</u> of infiltration systems.

The Engineer of Record should verify in writing that all BMPs have been designed in accordance with the Guidelines and properly installed.

Stormwater Corridors

A key component of the overall proposed stormwater management concept is the use of stormwater corridors in lieu of traditional detention ponds to provide primary control of runoff within the area. The stormwater corridor consists of additional right-of-way added to streets within the area. Stormwater control features that can be included within the corridors include:

- Open channel bioretention filter swales ("bioswales") to promote infiltration and provide runoff treatment;
- Subsurface, drain-rock style storage system and perforated underdrains, to promote infiltration;
- Periodic water quality ponding areas along the swales;
- Deep, amended topsoils;
- Trees; and
- In some cases, a trunk storm sewer main, if needed for major storm routing.

Three different widths are proposed for the stormwater corridors:

- *5 m wide corridors* incorporated into most east-west oriented Type II and III local roads throughout the area;
- *10 m wide corridor* along the west side of 164th Street, from the proposed park and school sites between 22 and 23 Avenues south to the proposed park between 17 and 18 Avenues (NOTE: a 2 m wide pathway will be constructed in conjunction with this corridor);
- *10 m wide median corridors* incorporated into several key Type Ia collector roads (164th Street from 24th Avenue south to the proposed riparian area at about 22a Avenue; 166th Street from 24th Avenue south to 23rd Avenue; and 20th Avenue from 168th Street to 164th Street); and
- *20 m wide corridors* adjacent to several roads in the multiple residential areas along the area's west-side; maintenance access pathways may be integrated into these corridors.

Locations for the various corridors are shown on **Figure 4.8(b)**. **Figures 4.9** and **4.10** show cross sections of the corridors proposed for incorporation into local and collector roads, respectively; **Figure 4.11** shows a cross section for a typical 20 m wide corridor in the multiple residential areas.

The proposed bioswales are shallow, wide swales landscaped with grass (for use in the 5-metre corridors) or with grass, shrubs and trees (for use in the wider corridors); they will be sized to capture and treat runoff from small rain events (less than 1/2 MAR, or about 30mm in 24 hours). Bioswales will typically have an overflow structure (lawn basin/field inlet) at the end of each block, connected to the storm sewer to shunt excess flows out of the bioswale and prevent flooding of adjacent property. Surface grading is away from houses towards the bioswales and the bioswales are normally on the uphill side of the streets, so that in very severe weather or if the overflow structure is blocked, excess flow may cause some street flooding but should not flood houses. Current practice is for adjacent homeowners to maintain the boulevard along their property. Similarly, it is anticipated that adjacent homeowners will maintain the grassed bioswales in the 5-m corridors along local roads, with the City maintaining the overflow structure and other downstream underground storm infrastructure. The City would also maintain the bioswales in the wider corridors. **Appendix A.3** includes additional description of the bioswales, including general maintenance guidelines, along with some examples of installations in the Pacific Northwest.

The stormwater corridors are located throughout the area to capture as much of the runoff as possible and thus provide volume reduction, peak attenuation and water quality treatment to minor storm runoff without the use of traditional detention ponds.

As envisioned in the Fergus Creek ISMP, these corridors would constitute at least 5 percent (and up to 10 percent) of the total land use in the neighbourhood. The total stormwater corridor area generated with the current land use plan is 7.83 hectares, or 4.96 percent of the neighbourhood. Including the proposed buffer strip along 168th Street and the additional 3-3.25 m of tree boulevard and grass strip on either side of the stormwater corridors in Type II and III local road RoWs (see **Figure 4.9**), raises this to 10.49 hectares, or 6.65 percent of the neighbourhood. Further, when the significant riparian protection area to be located along the current 164th Street alignment north of 20th Avenue is counted towards the total, another roughly 42,000 m^2 is added, bringing the area's coverage to 9.3 percent.

Residential Streets

Perforated storm drain systems will be installed in local residential streets to maximize the potential for stormwater infiltration (see **Figures 4.9** and **4.10**). The systems consist of a perforated storm drain to promote infiltration during drier months and when the water table is below the sewer subgrade elevation and a parallel standard storm drain to convey runoff during wet winter months when the perforated pipe's capacity is exceeded.

Figure 4.8(b): Drainage Corridor Types and Locations

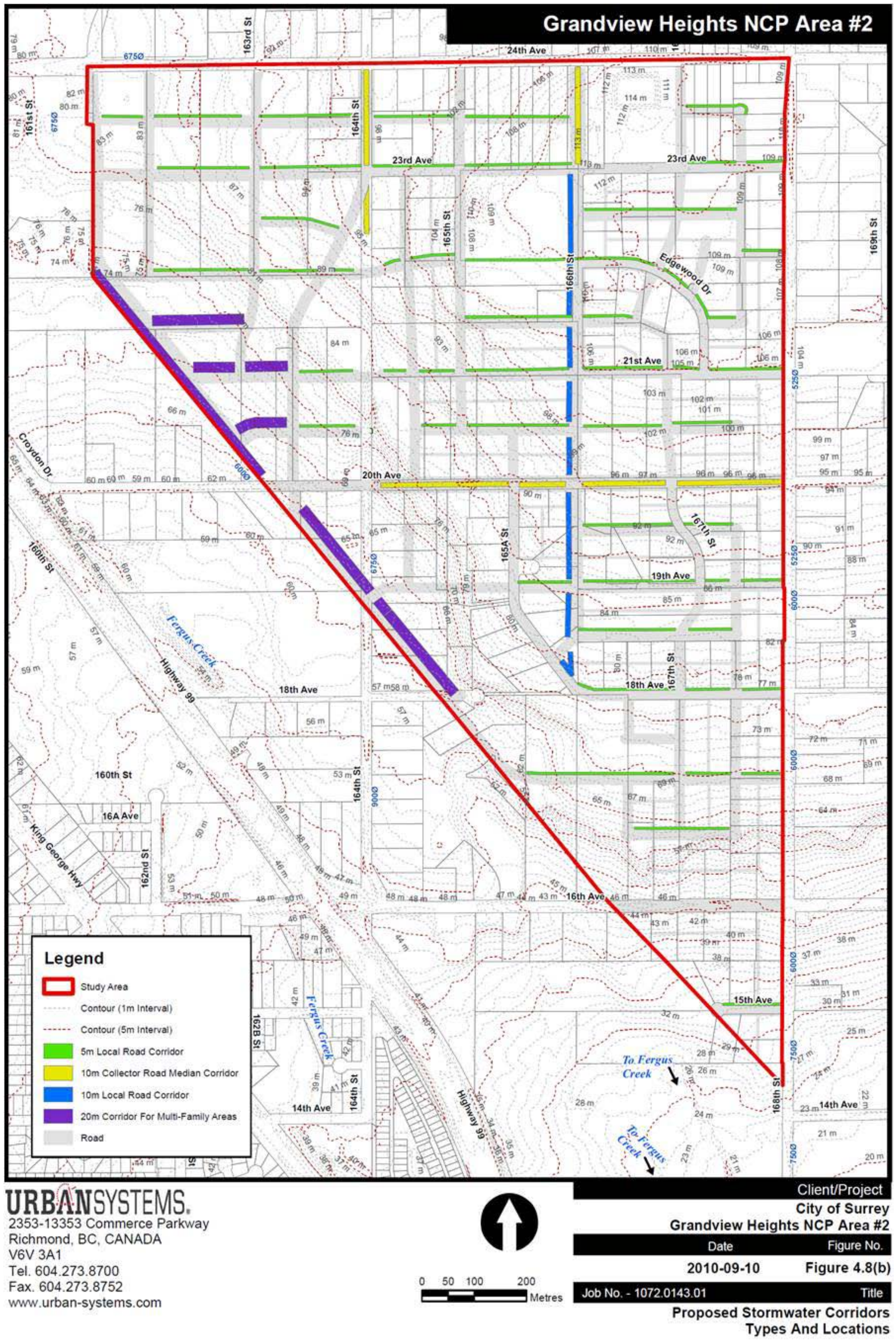


Figure 4.9: Proposed Type II and III Local Roads with Stormwater Corridor

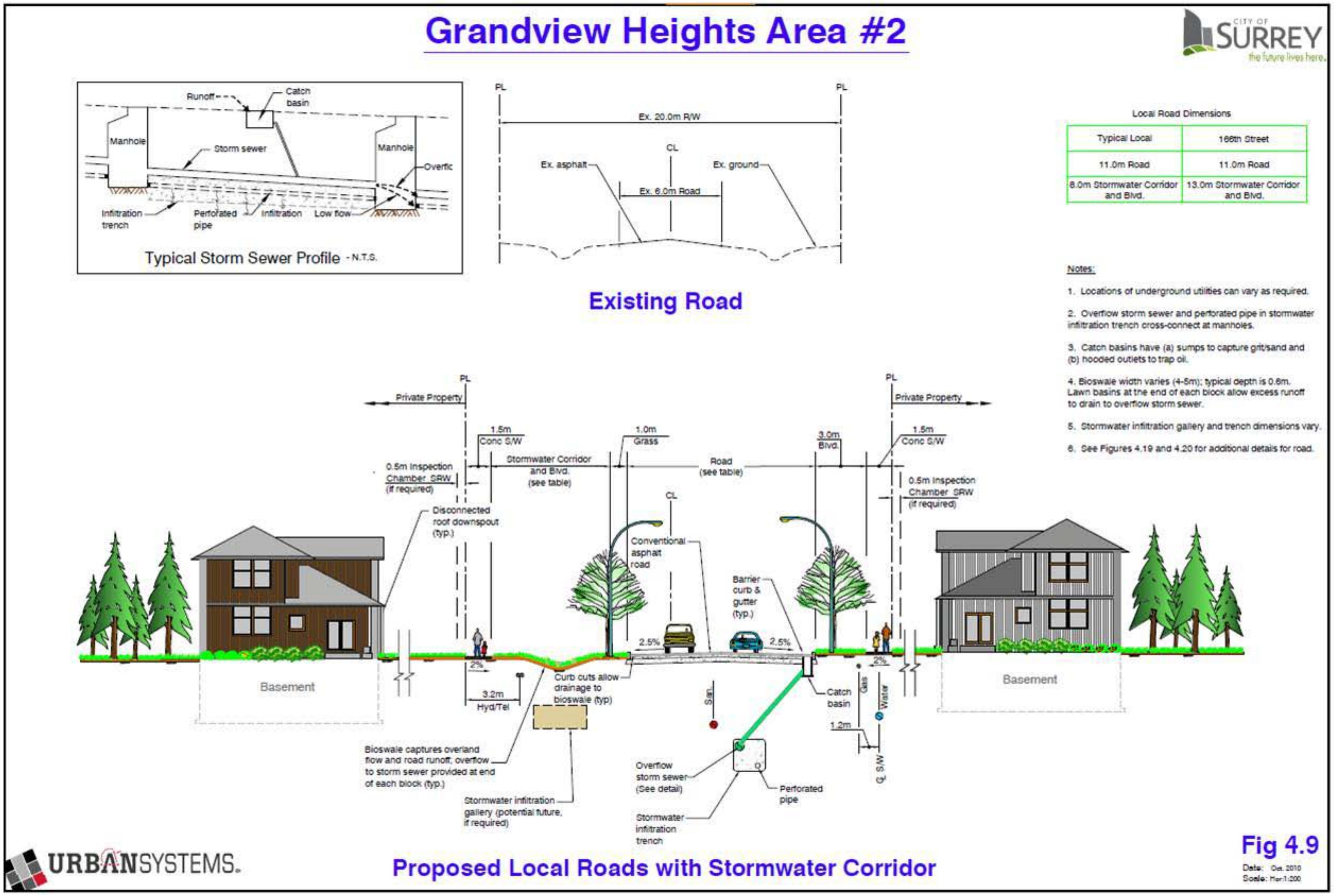


Figure 4.10: Proposed Type 1a Collector Road with Stormwater Median Corridor

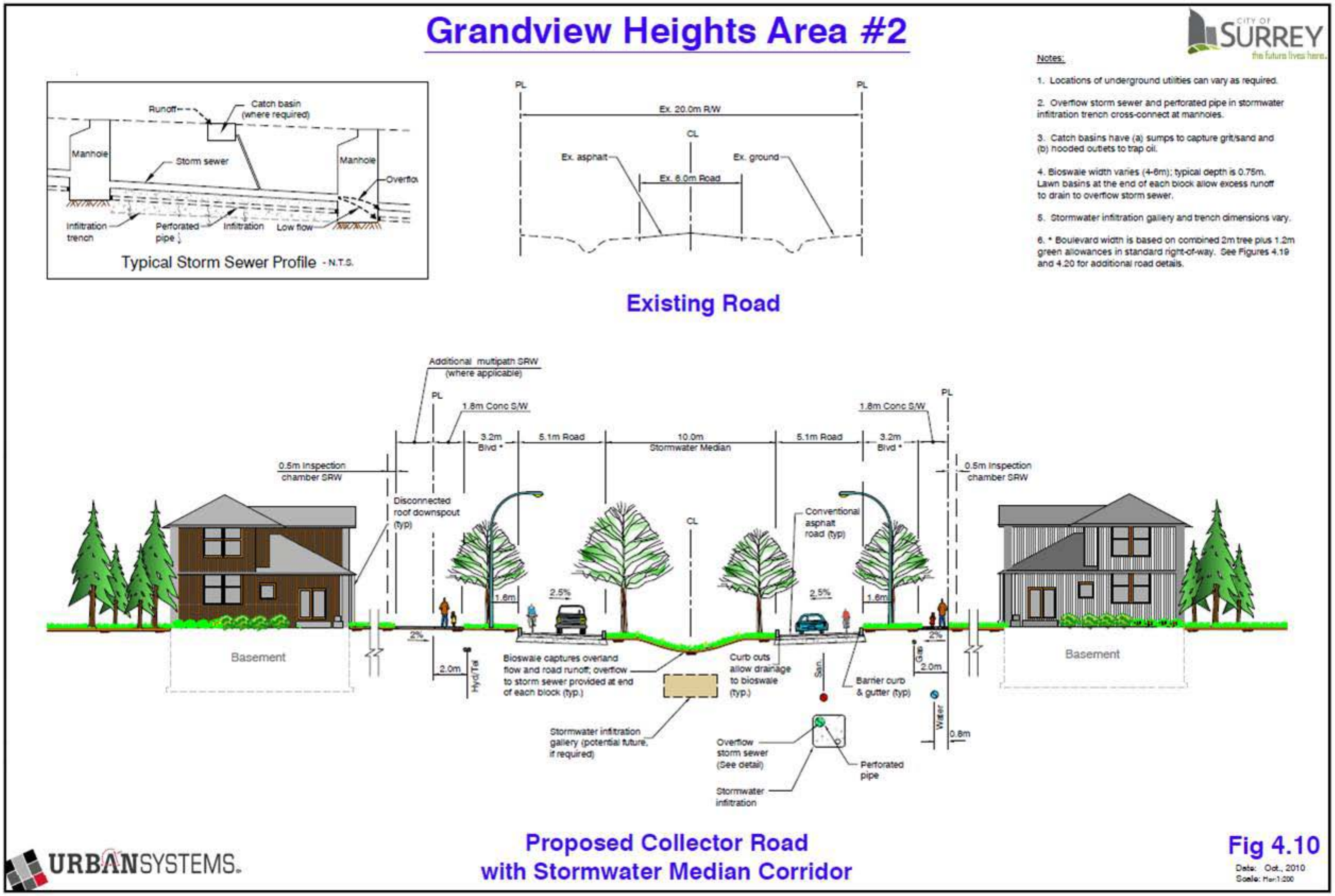
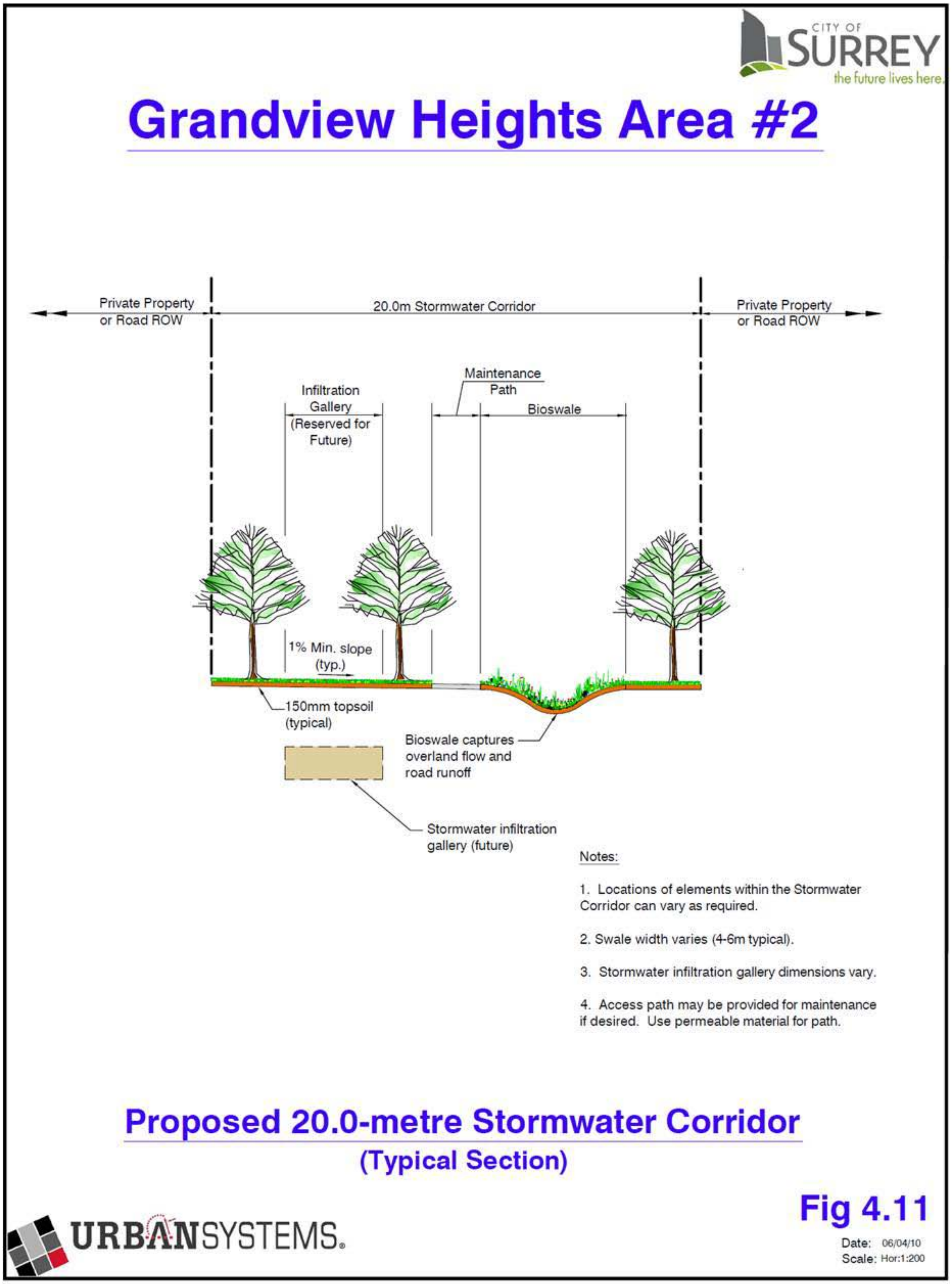


Figure 4.11: Proposed 20.0-metre Stormwater Corridor



Major Storm Conveyance

For those storms which exceed the capacity of the various on-site and public BMPs, conveyance will be provided by trunk storm sewers and open channels.

Right-of-Way Acquisitions/Dedications

The stormwater management concept for Grandview Heights, Area #2 calls for the use of drainage corridors running along almost all of the east-west roads and some of the north-south roads, for all road classifications. These drainage corridors are mostly 5 m wide (80 percent of length); however, some are 10 m wide (20 percent of length). Runoff from the roadways and private property flows to bioswales constructed within the corridor. The use of these corridors and bioswales is an innovative approach that eliminates the need for downstream detention ponds and keeps drainage flows closer to pre-development levels compared to a detention pond system.

This drainage corridor approach for the most part does require roads to be 5 m wider than the standard 20 m local road dedication, with a smaller number being 10 m wider. Corridors are located on the uphill side of the road to capture overland flow from adjacent upslope lands. For the east-west roads this means the corridors are located on the north side. For north-south roads the corridors are on either the east side or west sides. Locations are shown on the Land use Concept Plan.

Proposed Approach for Acquiring and Constructing Drainage Corridors

Typically subdivision results in up to 20 m being dedicated for local roads and 22 m for collectors. It is proposed that dedication of an additional 2.5 m per side (in addition to the local 10 or 11 m collector road dedication) would be required where drainage corridors are needed. Where 10 m median stormwater corridors are identified, an additional dedication of 5 metres per side would be required. The financial arrangements proposed for these various acquisitions are discussed in Section 4.7 Infrastructure Financing and Funding.

These requirements will need to be included in the design criteria manual, which will require revision to the Subdivision and Development Bylaw to allow for these unique requirements for this NCP area.

The construction of the bioswale is also required within the drainage corridor. The financial arrangements proposed for this construction are discussed in Section 4.7 Infrastructure Financing and Funding.

Phasing and Implementation Issues

Acquisition of the corridors will primarily occur as development takes place. This will likely result in discontinuities of bioswale operation. This will be a particular problem for the 10 m central median corridors where whole blocks would need to be acquired before construction could take place.

Similar to acquisition, construction will most likely take place on a development-by-development basis, which will mean that transitions in pavement widths will be needed as will interim means of draining the discontinuous sections of bioswale (i.e. temporary lawn basins and leads). These interim items will have to be removed and/or plugged as adjacent sections of bioswale are constructed. Where feasible the city could, through the DCC program, acquire critical missing links in the drainage corridors.

Road allowance widths of 12.5 m for each side and the requirement for a 5 m bioswale results in the road pavement, curbs and sidewalk etc. being shifted to the side of the road without the bioswale (see **Figure 4.9**). This leads to three potential development phasing scenarios, which are discussed below based on assuming a 10.5 m road pavement.

Scenario 1

Development takes place on both sides of the road at the same time. This is the simplest scenario, allows the full road and bioswale cross section to be built in one application, and generates no future phasing or cost sharing issues.

Scenario 2

Development takes place first on the non bioswale side of the road. Under this condition the initial developers would build an 8 m road structure with curbs, sidewalks, and street lights on their side of the road but leave the construction of the bioswale, the extra parking lane, and centre sidewalk for when the other side of the road develops. This may require the use of a latecomer agreement to share the cost of the road infrastructure. It would be advantageous if a right-of-way could be acquired for the adjoining property so the road could be completed.

Scenario 3

Development takes place first on the side of the road identified for the drainage swale. As the bioswale and centre sidewalk take up virtually all the space to the centre line of the road, the developer will have to construct some road beyond the centre line for access and connectivity. At a minimum a 6 m half road should be constructed; however, there is sufficient room to construct an 8 m road complete with curbs and streetlights. The far side sidewalk and parking lane would be left until the far side develops. This scenario would have the option for a latecomer agreement to recover some costs.

4.3.6 Cost Estimates and Financing Approach

The cost estimates for the DCC eligible infrastructure are based on the principle that development is responsible for funding the services that front, and/or are adjacent to, the development lands. DCC eligible items include trunks and other items that serve the overall catchment. These DCC items are itemized in **Table 4.26**. This cost estimate in **Table 4.25** is based on the extensive use of BMPs within the neighbourhood for stormwater management and does not include the use of surface water features as discussed in Section 4.3.3.2.4 and the feasibility assessment in **Appendix 3**.

Table 4.26: Stormwater Management Cost Estimates and Financing Approach

Capital Item	Total Cost	Costs Recovery Approach for Area 2		
		City-Wide DCCs	Area Specific DCC	Utility
Trunks[1]	$3,546,000	$3,546,000	$0	$0
Ditch Erosion Protection[2]	$63,900	$63,900	$0	$0
Bioswale construction in 10 m medians	$917,600	$917,600	$0	$0
Land for 10 m corridors	$4,108,600	$2,054,300	$2,054,300	$0
Land for 5 m corridors	$7,942,500	$0	$7,942,500	$0
Construction in 5 m median corridors	$7,181,400	$0	$7,181,400	$0
Construction in 10 m side swales	$723,000	$0	$723,000	$0
Total	**$24,483,000**	**$6,581,800**	**$17,901,200**	**$0**

Notes:

1. Costs updated to January 2010 construction costs; trunk unit rate costs provided by the City (February 2010).
2. Assumes 25% of ditches in NCP area require protection.

As shown in **Table 4.27**, anticipated DCC revenues are far less than eligible anticipated costs. To pay for the additional costs an area specific DCC is recommended. Details of the area specific DCC are included in Section 4.7.5.

Table 4.27: Estimated DCC Revenues and Expenditures – Stormwater

Estimated DCC Revenues	DCC Eligible Costs	Balance
$6,715,000	$24,483,000	-$17,768,000

Notes:

1. DCCs based on the average development yield for the area.

2. DCC revenues do not include potential DCC revenues from commercial or institutional development within Area #2.

4.3.7 Ten Year Servicing Plan

It is recommended that the City review its 2010-2019 10 Year Servicing Plan to determine whether the works recommended in this report overlap with current projects included in the 10 Year Servicing Plan. The current 10 Year Servicing Plan identifies no works within the NCP area. It does identify item 11650, a storm sewer upgrade on 24 Avenue east of 168 Street just outside the NCP boundary. This item is not impacted by the NCP.

4.4 TRANSPORTATION

4.4.1 Introduction

This section of the report provides an assessment of traffic impacts and recommended transportation improvements as part of the planned land use development for the Grandview Heights Area #2 located in South Surrey. Updates to the bicycle and pedestrian networks, transit services and facilities, and roadway network will be required to accommodate increased travel activity to, from, and within this area based on anticipated growth and development. These improvements will provide travel choices for residents of Grandview Heights to walk, cycle or take transit which are not safe or convenient options today.

The recommendations made in this report are in line with Surrey's vision of developing Grandview Heights "as a complete community with a mix of residential densities, small commercial nodes, community facilities, schools, parks, pathways, trees and protected areas." The guiding principles for transportation provide for "special road and pathway standards to preserve rural character, a modified grid road system with greenways to encourage walking and cycling."

4.4.2 Study Area

The triangular study area is located in South Surrey just east of Highway 99 bounded by 24th Avenue, 168th Street and 16th Avenue. Land use is rural with generally low density, single use residential properties throughout the study area. The only significant non-rural, non-residential land uses in the area are located sporadically along 24th Avenue, including a corner grocery store at 168th Street and 24th Avenue.

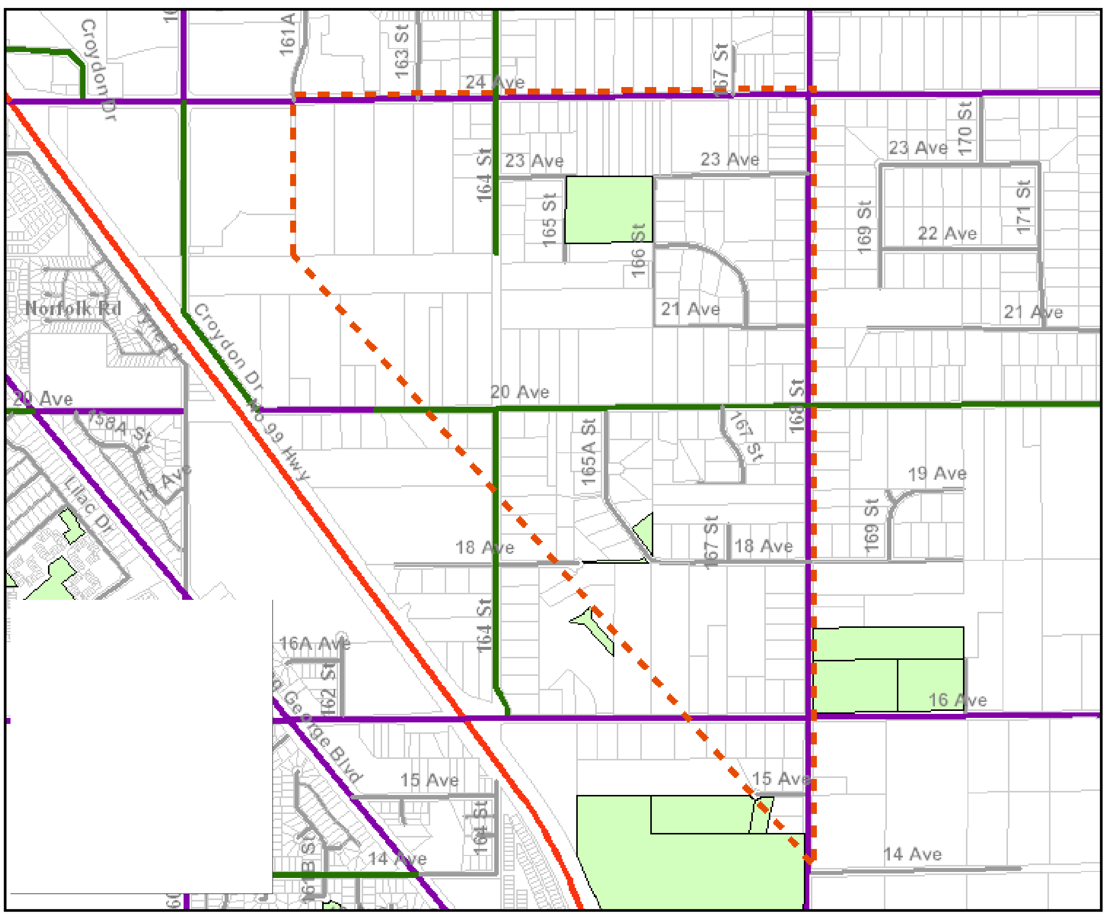
The study area is surrounded by other neighbourhoods as part of the overall Grandview Heights area including Grandview Corners, Morgan Crossing, Morgan Heights and North Grandview. Travel to and from Grandview Heights NCP Area #2 is expected to be influenced by development in these neighbouring communities. While NCP Area #2 is not expected to attract a significant number of trips (other than those generated by the small commercial node at 24th Avenue and 168th Street), residents of NCP Area #2 are expected to travel to and from local recreational and shopping destinations. Large scale retail in Grandview Corners and the commercial/residential development at Morgan Crossing, in particular, are likely to generate trips to and from NCP Area #2. Morgan Heights (nearly built out), North Grandview Heights (not yet built out) and other areas of the Grandview Heights General Land Use Plan are highly connected to NCP Area #2. As this broader area develops, travel to and from NCP Area #2 is expected to be affected.

Current Roadway Network

The current roadway network consists generally of a one mile grid of arterial roadways with collector roadways providing access to neighbourhoods. A series of local roadways provides access to individual properties but not a continuous grid network. Arterial and collector roadways currently provide access to adjacent properties.

The following map provides a summary of the existing roadway network for the study area followed by a brief discussion of roadways and intersections.

Figure 4.12: Existing Roadway Network in Grandview Heights Area #2



Roadways

The City of Surrey defines roadways based on a classification system as follows:

- **Provincial Highways –** are generally controlled access facilities that provide high speed connections to other parts of the region. The nearest facility to the study area is Highway 99 with on and off ramps located at 8^{th} Ave and 32^{nd} Ave.
- **Arterial Roads –** generally function to carry through traffic from one area to another with as little interference as possible from adjacent land uses. In some cases, arterial roads may provide direct access to adjacent properties as a secondary function, although this is generally not desirable.
- **Collector Roads –** primary function is to distribute traffic between arterial roads, other collector roads and local roads within an area. Collector roads may also provide access to adjacent properties as required.
- **Local Roads –** are generally low volume neighbourhood streets that provide access to individual properties. In low density, rural areas such as Grandview Heights Area #2, local roads are discontinuous and provide limited functionality.

Major roadway facilities in the Grandview Heights area include the following:

- **Highway 99 –** is a controlled access freeway with a posted speed of 100 kph that connects the US Border at Peace Arch to Oak Street in the City of Vancouver. This largely four lane freeway provides the primary connection to Vancouver, Richmond (including the airport), South Delta (including the ferry terminals) and the United States.
- **24^{th} Avenue –** is an arterial roadway that provides a significant east/west connection in South Surrey including a connection to Highway 15.
- **16^{th} Avenue –** as a major arterial roadway that is also a designated link in TransLink's Major Road Network. This major east/west facility provides a connection between Semiahmoo Town Centre, Langley Township and Abbotsford as well as a connection to Highway 15.

- **168th Street –** is an arterial roadway that runs north/south from 8th Ave to 96th Ave in North Surrey and also provides a connection to Highway 10.
- **20th Avenue –** is a collector roadway that runs east/west and connects Croydon Drive with 184th St as well as Highway 15.
- **164th St –** is a collector roadway that is currently discontinuous through the study area.

All collector and arterial roadways are currently two lane facilities within the study area. Posted speeds are 50 and 60 kph for collector and arterial roadways respectively. Access to King George Highway with overpasses across Highway 99 includes 16th and 24th Avenue.

Intersections

There are signalized intersections currently at 16th and 24th Avenue both along 168th Street. All approaches to these two intersections include an exclusive left turn bay and shared through and right turn lane. All left turns at these two signalized intersection are permissive with the eastbound left turn at 16th Ave and 168th St provided with a protected/permissive phase.

There is currently four-way stop control at 20th Avenue and 168th Street and two-way stop control at 24th Ave and 164th St with priority along 24th Ave. Access from local streets to arterial and collectors is usually with stop sign control.

Current Transit Services and Facilities

There are no transit services currently available for travel to and from Grandview Heights Area #2. For regional transit services, the South Surrey Park and Ride facility located at King George Highway and Highway 99 provides connections to North Surrey, Richmond and Vancouver. The following map highlights the existing service coverage in South Surrey relative to the study area.

Figure 4.13: Current Transit Service Coverage in South Surrey

Source: South Surrey/White Rock Transit System Map on TransLink Website [http://www.translink.ca/en/Schedules-and-Maps/Transit-Maps/System-Maps.aspx]

TransLink's service design guidelines currently state that "At least 90% of all residents and employees in urbanized development areas should have less than 450 metres walking distance to a bus stop" with urbanized development areas being defined as areas having more than 15 residents or 20 jobs per hectare. With fewer than 15 residents per hectare currently in Grandview Heights Area #2 and limited employment, it does not meet the minimum guidelines for the provision of transit services. Furthermore, the service design guidelines tend to provide transit services directed towards town centres such as Semiahmoo. As such, there are no transit services within a convenient (or safe) walking distance from any of the properties within the study area.

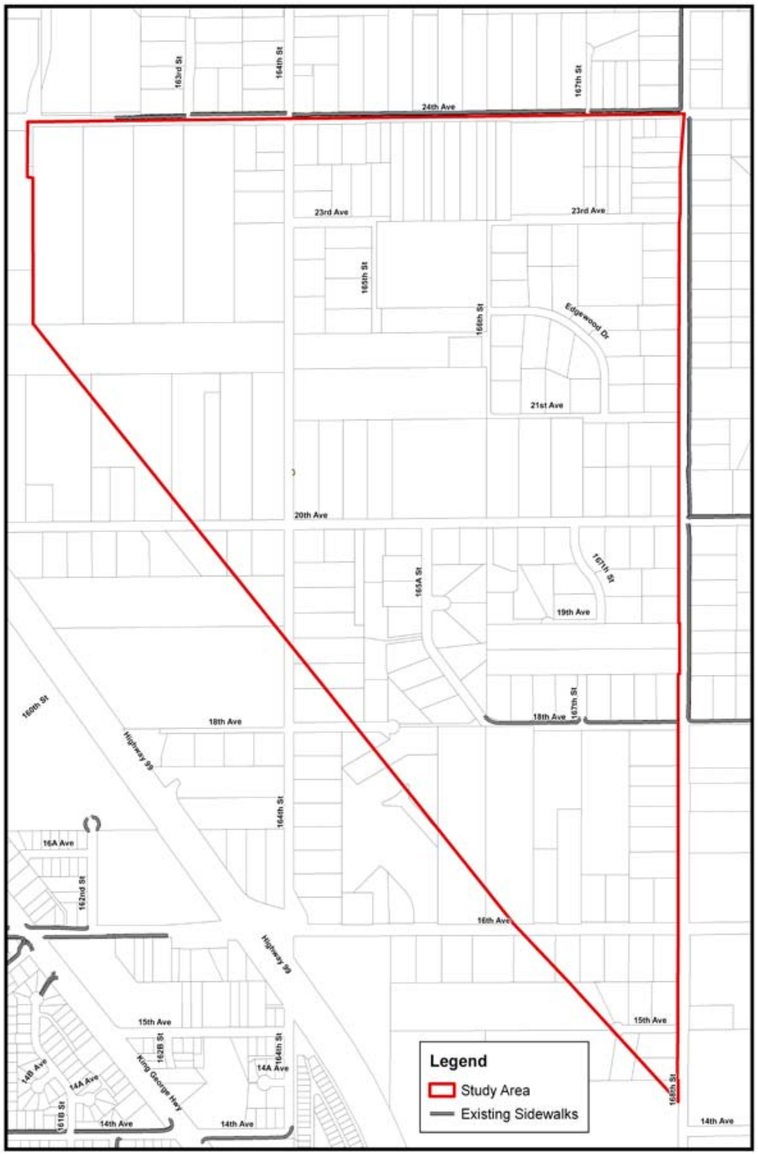
Future growth in this area will push the population density above the minimum threshold for the provision of transit services as defined in TransLink's Service Design Guidelines. As these are just guidelines, there are a number of other factors that influence the transit planning process in Metro Vancouver. TransLink, through the development of the South of Fraser Area Transit Plan, has identified a number of service improvements in South Surrey including the study area that are discussed further in Section 4.4.4.2.

Current Walking and Cycling Facilities

Currently there are limited walking and cycling facilities in the study area. The following map shows the current sidewalk coverage in the Grandview Heights Area #2.

The only roadway with any sidewalk coverage within the study area is the north side of 18th Ave between 165A and 168th St. Furthermore, there are no designated cycling routes or facilities within the study area. As such, walking and cycling are not safe or convenient modes of travel given the lack of sidewalk, pedestrian and cycling facilities. There are plans to provide a complete network of sidewalks, multi-use corridors and cycling facilities as part of the planned improvements discussed further in Section 4.4.5.1. These improvements will allow residents and travelers to walk and cycle on safe and convenient facilities that are designated for these modes of travel.

Figure 4.14: Current Sidewalk Coverage in Grandview Heights Area #2



4.4.3 Current Traffic Conditions

The analysis of current traffic conditions was based on the Synchro traffic operations model using updated traffic count and signal timing information from the City of Surrey. This analysis was used to assess the level of service (LOS) at signalized and stop control intersections along arterial roadways in the study area.

Levels of service range from A to F, where A represents uncongested conditions and F represents significant congestion. The following table provides a summary of the levels of service used to assess traffic conditions at both signalized and unsignalized intersections.

Table 4.28: Levels of Service at Signalized and Unsignalized Intersections

	Signalized Intersections		Unsignalized Intersections	
LOS	**Traffic Conditions**	**Avg Vehicle Delay**	**Traffic Conditions**	**Avg Vehicle Delay**
A	Very few vehicles stopping	<10 sec	Little or no delays	<10 sec
B	Some vehicles must stop	10-20 sec	Short traffic delays	10-20 sec
C	Significant proportion of vehicles must stop	20-35 sec	Average traffic delays	20-30 sec
D	Many vehicles stopped	35-55 sec	Long traffic delays	30-40 sec
E	Frequent individual cycle failures	55-80 sec	Very long traffic delays	40-60 sec
F	Oversaturation of intersection	>80 sec	Unacceptable delays	>60 sec

Traffic operations at signalized intersections are generally considered acceptable when automobile users would experience the following levels of service:

- Overall intersection LOS D or better;
- Through movement LOS D or better; and
- Left turn LOS E or better.

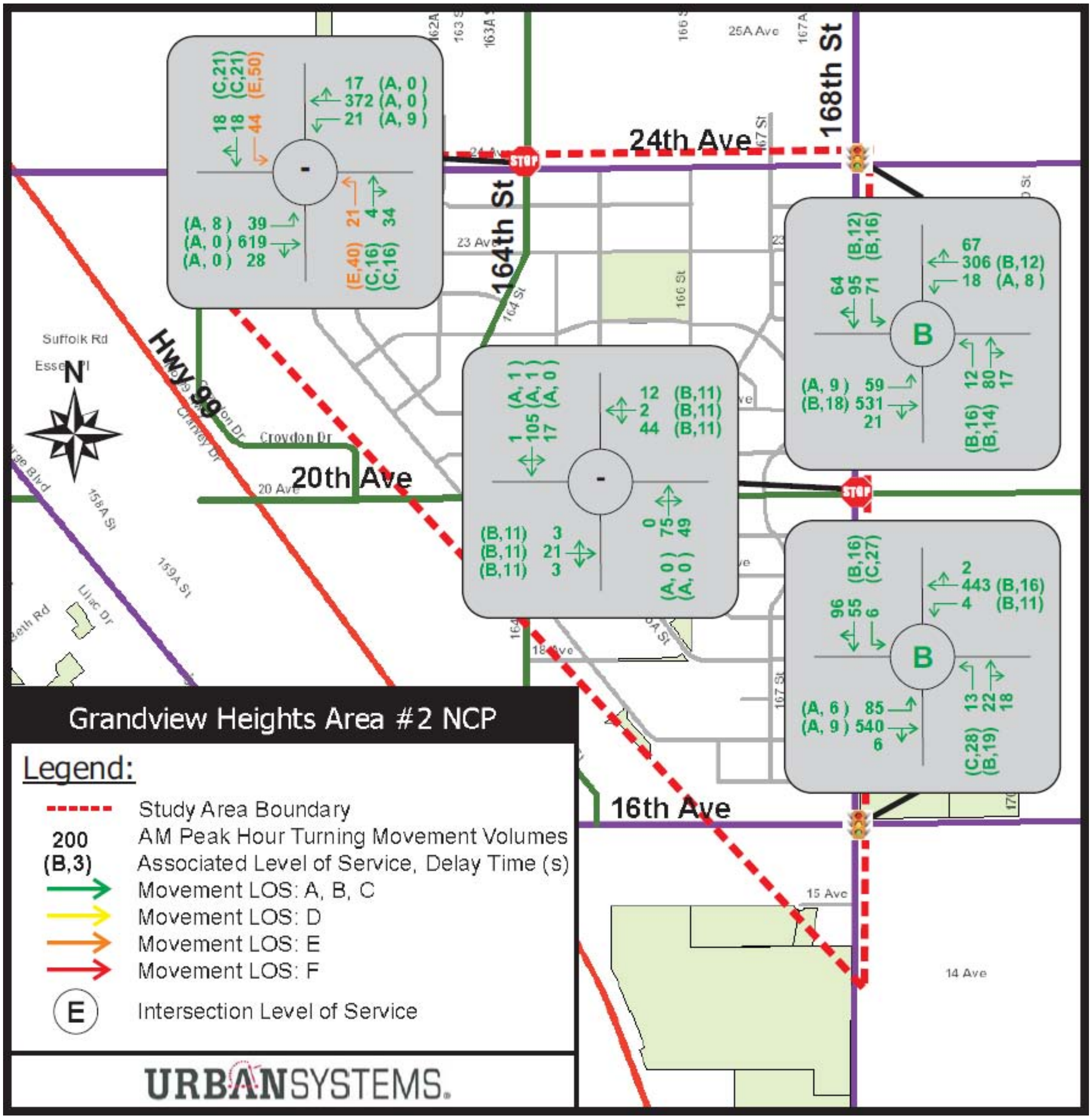
For unsignalized intersections, traffic operations are considered acceptable when motorists making left turns or through movements from the minor street would experience LOS E or better.

Most traffic on the arterial network consists of through travel with limited local trips given the nature and low density of the land uses in the study area. Recent traffic count information and traffic operations analysis show that the current roadway network and signal controllers are adequate for the level of demand. **Figure 4.15** provides a summary of the current traffic volumes and levels of service at key intersections in the study area during the afternoon peak hour which is the busiest time period of the day.

Both signalized intersections along 168th St operate at a LOS B with all individual turning movements operating at LOS C or better. The north and southbound left turns at 24th Ave and 164th St are currently operating at LOS E both based on stop control. As identified above, all study intersections are currently operating at acceptable levels of service.

Given that most peak hour traffic movements operate at a level of service C or better today, there are no immediate short term needs to upgrade signals or intersection configurations. However, the future level of development in the study area and the South Surrey area generally will require improvements such as road widening and signal upgrades as discussed further in Section 4.4.5.

Figure 4.15: Current PM Peak Hour Vehicle Volumes and LOS on Semiahmoo Roadway Links



Travel Patterns

Travel to and from Grandview Heights Area #2 consists largely of people using their private automobiles. Land use in the study area is generally single use, low density residential, which leaves the automobile as the only viable mode of transportation for most people to get to and from places of work, education, shopping and recreation. Furthermore, the lack of transit services and inadequate walking and cycling facilities do not provide convenient or safe choices for people to travel without using their automobiles. The future land use and transportation plan for this area, however, will provide more choices for people to use alternate modes of transport as described later in this report. Furthermore, with a more complete community with nearby shops and amenities, people will have more opportunities to access places of shopping, recreation and socializing using alternate modes of transport including walking, cycling and taking transit.

4.4.4 Proposed Development

The Grandview Heights Area #2 is planned to be developed from a primarily rural and low density residential area to a more densely populated urban/suburban neighbourhood. Approximately 2,200 people currently reside in the study area with plans to significantly increase the density and variety of housing types. Population forecasts developed for the study area indicate that up to 11,300 people will make the Grandview Heights Area #2 their home. This represents the full build out scenario anticipated to occur over the next 20 years. The following table provides an inventory of the land use types used to assess the transportation impacts for this area.

Table 4.29: Inventory of Land Use Type for Future Scenario

Land Use Type	Acres	Low Units	Low Population	High Units	High Population
Roads	39	0	0	0	0
On-Street Parking	16	0	0	0	0
Bike Lanes	2	0	0	0	0
Sidewalks	14	0	0	0	0
Boulevards	30	0	0	0	0
Buffer	4	0	0	0	0
Linkages	4	0	0	0	0
Park / Open Space	22	0	0	0	0
School	8	0	0	0	0
Civic Utility	5	0	0	0	0
Grandview Ridge Trail	10	0	0	0	0
Commercial Residential 25-45upa	2	52	111	94	200
Suburban Residential 1-2upa	11	11	35	22	70
Suburban Transitional 2-4upa	3	6	21	13	42
Low Density Residential 6-10upa	48	287	926	479	1,543
Urban Transitional Up to 8upa	19	152	489	152	489
Cluster Residential 6-10upa	11	67	216	112	360
Cluster Residential 10-15upa	24	235	726	352	1,089
Medium Density Residential 10-15upa	27	269	833	404	1,250
Multiple Residential 10-15upa	8	78	241	117	362
Multiple Residential 15-25upa	21	308	954	514	1,590
Special Residential 15-25upa	5	72	222	119	370
Multiple Residential 30-45upa	41	1,231	2,637	1,847	3,955
Total	**372**	**2,768**	**7,409**	**4,223**	**11,317**

Grandview Heights Area #2 is proposed to remain largely residential, with both suburban and urban-type densities planned. The corner of 24^{th} Avenue and 168^{th} Street will retain a small commercial node with no proposed industrial uses for the area. An elementary school is proposed on the north end of the study area, which will include large open-space sports field areas.

Open space will remain a significant feature of the neighbourhood, with three parks, riparian corridors, connecting pathways, wildlife forest patches, and multi-use corridors providing a variety of natural or nature-like areas. A proposed significant feature, the Grandview Ridge Trail, sits along the crest of the steep slope area running diagonally across the neighbourhood and will be a naturally vegetated corridor with a pathway.

Planned Improvements

As the Grandview Heights area densifies and more people live, work, and play in this area, more travel activity will result. Added transportation infrastructure will be required to accommodate the increased demands for travelling to, from and within the study area. As such, transportation infrastructure (described in detail in Section 4.4.5) will be required to provide more capacity for the following modes of travel:

Walking – a more complete network of sidewalks, trails, and walkways for people to travel by foot around the Grandview Heights area. Better pedestrian facilities would also encourage transit use as riders would have better and safer access to bus stops and transit services.

Cycling – more on-road and off-road routes to promote cycling in and around the Grandview Heights area including connections to other parts of South Surrey. More facilities will help support the convenience, safety and reliability of cycling within Grandview Heights and the surrounding neighbourhoods.

Transit – more transit service as outlined in the South of Fraser Area Transit Plan to provide a competitive alternative to driving for longer trips. Improved transit facilities such as sheltered bus stops and safe walkways and waiting areas to enhance the customer experience while waiting for a bus or transferring between routes.

Auto – increased turning and through capacity along key corridors such that reasonable levels of service are maintained on the roadway network and at intersections. Improvements would include added turn lanes and through lanes as well as signal and signal timing upgrades to manage traffic flows efficiently.

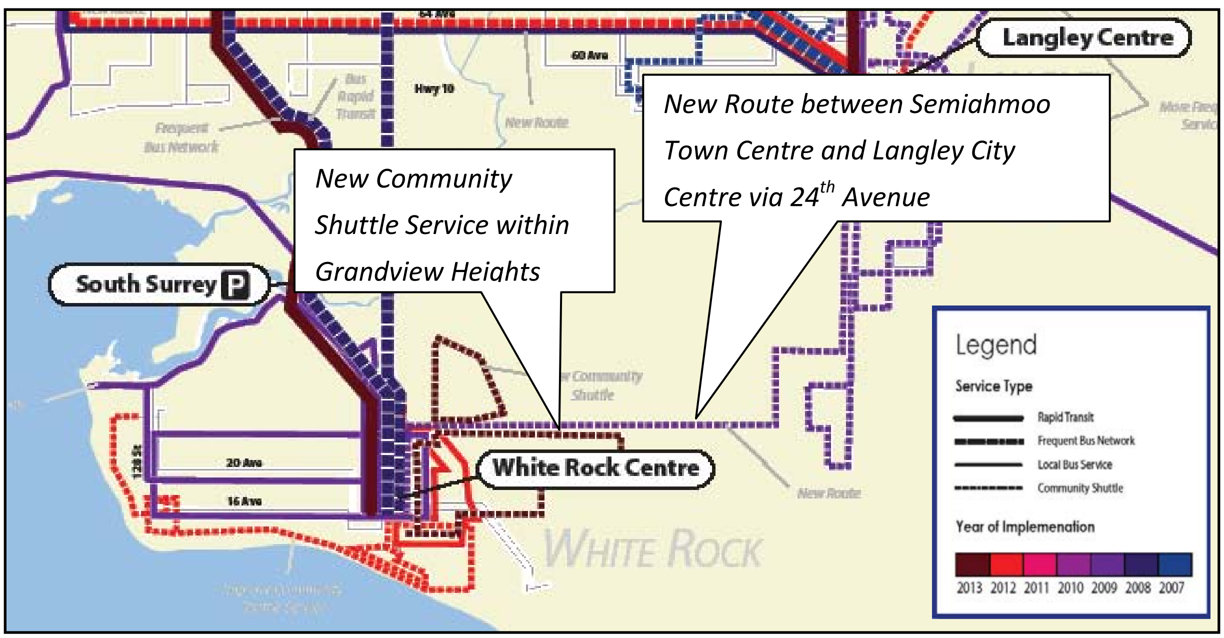
South of Fraser Area Transit Plan

The South of Fraser Area (SoFA) Transit Plan sets out a long-range transit plan and vision for improved transit services in the South of Fraser Area including Grandview Heights. The SoFA plan sets out a short-term implementation plan as well as a longer term strategy. An extensive public and stakeholder consultation process was carried out over two years to build support for this plan, which was approved by the TransLink Board in the spring of 2008.

Several improvements will be implemented in the South Surrey area that will connect the Grandview Heights area to other parts of Surrey and beyond. Existing transit services are largely configured to move people from South of Fraser communities to Vancouver and the central core of Metro Vancouver. The changes in transit services as part of the SoFA plan provide more connections between South of Fraser communities to support local travel.

Relevant service improvements include a conventional transit route between Semiahmoo Town Centre and Langley City Centre via 24th Ave. This new route will provide a connection through the Grandview Heights area that does not exist today and will provide access to the Campbell Heights industrial area. Other relevant service improvements include a new community shuttle service throughout the Grandview Heights area that will connect people to regional rapid bus services at a new exchange facility in the Semiahmoo Town Centre. The map on the following page (**Figure 4.16**) highlights the relevant service improvements to the year 2013.

Figure 4.16: Proposed South of Fraser Transit Improvements to 2013



Source: South of Fraser Transit Plan, Phase 3 Report, 2013 Implementation Plan, Nov 2007.

South Surrey Long-Term Road Network Plan

The City of Surrey has, as part of their strategic planning process, identified road network improvements to accommodate growth in vehicle volumes. The 10 Year Servicing Plan (2010-2019) identifies transportation needs for arterials, major collectors and local roads. This plan also identifies projects that are cost shared with the Province as well as projects related to pedestrians, cyclists, and transit.

The following list of transportation projects has been identified as part of the 10 Year Servicing Plan and will have an impact on travel to and from Grandview Heights Area #2.

Table 4.30: List of Road Projects Identified in the 10 Year Servicing Plan

Project ID	Project Name	Project Location
10056	New Arterial Construction (On-Ramps)	Highway 99 and 24th Avenue
7438	Ultimate Arterial Widening	King George Hwy: 24th Avenue to 152nd St.
10084	Interchange	Highway 99 at 152nd Street
10627	Ultimate Arterial Widening (4 lane)	16th Avenue: Highway 99 – 168th Street

Note: Please refer to **Table 4.35** for a list of the 10 Year Servicing Plan projects that fall within the study area.

Further to the list of projects mentioned above, Surrey has identified roadway network improvements over a longer time horizon. Over the next 30-year period, the following list of projects will likely be required to accommodate the increase in vehicle volumes as the South Surrey area continues to grow.

Table 4.31: List of Road Projects Identified as Long Term Needs

Project #	Project Name	Project Location
1	20th Avenue Connector	20th Avenue: King George Hwy to Croydon
2	24th Avenue Widening to 4 Lanes GP	24th Avenue: 176th St to King George Hwy
3	16th Avenue Widening to 4 Lanes GP*	16th Avenue: 176th St to King George Hwy
4	16th Avenue Interchange	Highway 99 at 16th Avenue

*potential ultimate 6 lane facility

projects will have an impact on travel to and from the Grandview Heights area and have been included as part of the transportation modelling. In this regard, the travel impact including the distribution of trips on the roadway network based on these improvements has been captured as part of this analysis.

The following provides a description of each of these projects and its significance to the study area:

- **20th Ave Connector –** this project has been identified as a key link to connect communities on either side of Highway 99. It has also been recognized to provide a more complete roadway network in the South Surrey area to support efficient traffic circulation. A multi-use pathway along 20th Ave from Grandview Heights to Semiahmoo will provide a significant east/west facility for cycling across Highway 99.
- **24th and 16th Ave Widening –** both of these roadways will require widening from two to four lanes as part of growing travel needs in the South Surrey area. The majority of traffic on these facilities is regional through travel.
- **16th Ave Interchange –** this project is required to provide an alternate access point to Highway 99 for commuters based on the growth trends in South Surrey.

Site-Generated Traffic

Congestion levels will increase as the study area becomes denser and the surrounding neighbourhoods in the South Surrey area continue to develop. The recently updated South Surrey Sub-Area model was used to forecast traffic conditions on the roadway network. Full build out land use numbers were used for the 2031 horizon including development within Grandview Heights and the rest of the region.

This traffic demand forecasting model is based on the regional EMME model that was further calibrated for conditions in the South Surrey area. The EMME model is a multi-modal equilibrium model that is used to forecast travel and traffic conditions for future horizons. There are three main components to this model described as follows:

- **Traffic Zone System –** a system of zones used to store demographic and travel information throughout the Metro Vancouver region.
- **Road and Transit Networks –** digital representation of the roadway and transit networks.

- **Four-Step Modelling Procedure –** a set of mathematical equations used to predict travel behaviour. The four steps comprise of the following:

    1. ***Trip Generation –*** trip generation and attraction rates are used to calculate the total number of trips by purpose to and from each traffic zone. The independent variables used are population by age group and employment by industrial classification. Trip purposes include work, post secondary, grade school and other.

    2. ***Trip Distribution –*** a gravity model is used to distribute trips by purpose between origin and destination traffic zone pairs. Attractiveness of trip making between zones is based on the level of trip activity and the generalized cost of travel between traffic zones. Generalized costs of travel include the distance and out-of-pocket costs associated with trip making using the value of travel time.

    3. ***Mode Split –*** a logit model is used to determine the proportion of trips by mode of travel including automobile, transit and walk/bike. Separate matrices for trips by purpose and mode are calculated.

    4. **Traffic Assignment –** once the number of auto and transit trips has been calculated, they are then assigned to the road and transit networks respectively.

The advantage of using the EMME-based model is that it captures the socio-economic impacts of travel including, but not limited to, the following:

- Supply of transit services
- Growing and aging population trends, with lower peak hour trip rates for people in the older age groups (65+)
- Cost of travel including fuel prices, parking costs and transit fares
- Road network improvements including widening of 16th and 24th Ave and addition of the 20th Ave connector
- Densification and mixture of land uses
- Employment trends
- Background growth in other parts of South Surrey and the Lower Mainland

Based on the EMME model results, the following table illustrates the number of trips to and from the study area for 2006 and 2031 peak hour conditions.

Table 4.32: Growth in Travel between 2006 and 2031

	Inbound		Outbound		Total	
Year	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
2006	340	400	540	530	880	930
2031	1,160	1640	2,340	2290	3,500	3,930
Difference	830	1,110	1,800	1,890	2,620	3,000
Percent	240%	280%	330%	360%	300%	320%

The following table illustrates the change in mode share for trips to and from the study area for 2006 and 2031 during peak hour conditions.

Table 4.33: Change in Travel Mode between 2006 and 2031

	2006		2031		Change	
Mode	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Auto	86%	71%	75%	60%	-11%	-11%
Transit	2%	5%	9%	12%	+7%	+7%
Walk/Bike	13%	23%	16%	27%	+3%	+3%

Using the results from the South Surrey Sub-Area Model, the following methodology was used to develop the automobile turning movement forecasts for the full build out conditions as input to the Synchro traffic operations model:

1. Recently completed traffic counts at key intersections were used as a starting point to assess intersection approach volumes and percentages of turning movements.
2. Intersection automobile volume approach growth factors were developed using the base case and future scenarios from the South Surrey Sub-Area model.
3. Automobile volume approach growth factors were applied to the existing traffic counts in order to develop future forecasts of turn volumes at key intersections.
4. Automobile volumes were balanced to ensure network consistency and reasonableness.

There are a number of points to keep in mind with the development of the turning movement forecasts, network improvements and traffic operational analysis:

- The turning movement forecasts are a simplification of reality and therefore should be interpreted with caution. Traffic flows are very dynamic and can change significantly from day to day and season to season. What is being shown in this analysis is the most likely average weekday peak conditions for the future.

- As congestion levels increase slowly over time, people's tolerance of congestion will also increase as they become more accustomed to driving in a denser and more urbanized environment that is designed to give more priority for pedestrians, cyclists and transit users.

Without any improvements, future traffic conditions on the roadway network within the Grandview Heights area will deteriorate significantly. Roadway network improvements were then developed for critical turn movements that were unacceptable in terms of the level of service criteria. The following section describes the required transportation improvements in order to support the future needs of automobile users in the Grandview Heights area.

4.4.5 Future Transportation Network

The following improvements for each mode of travel will be required in order to accommodate future travel demands anticipated as part of the development of the Grandview Heights Area #2 and surrounding South Surrey area. Furthermore, these enhancements will provide choices for people to travel using alternate mode of transport such as walking, cycling and transit.

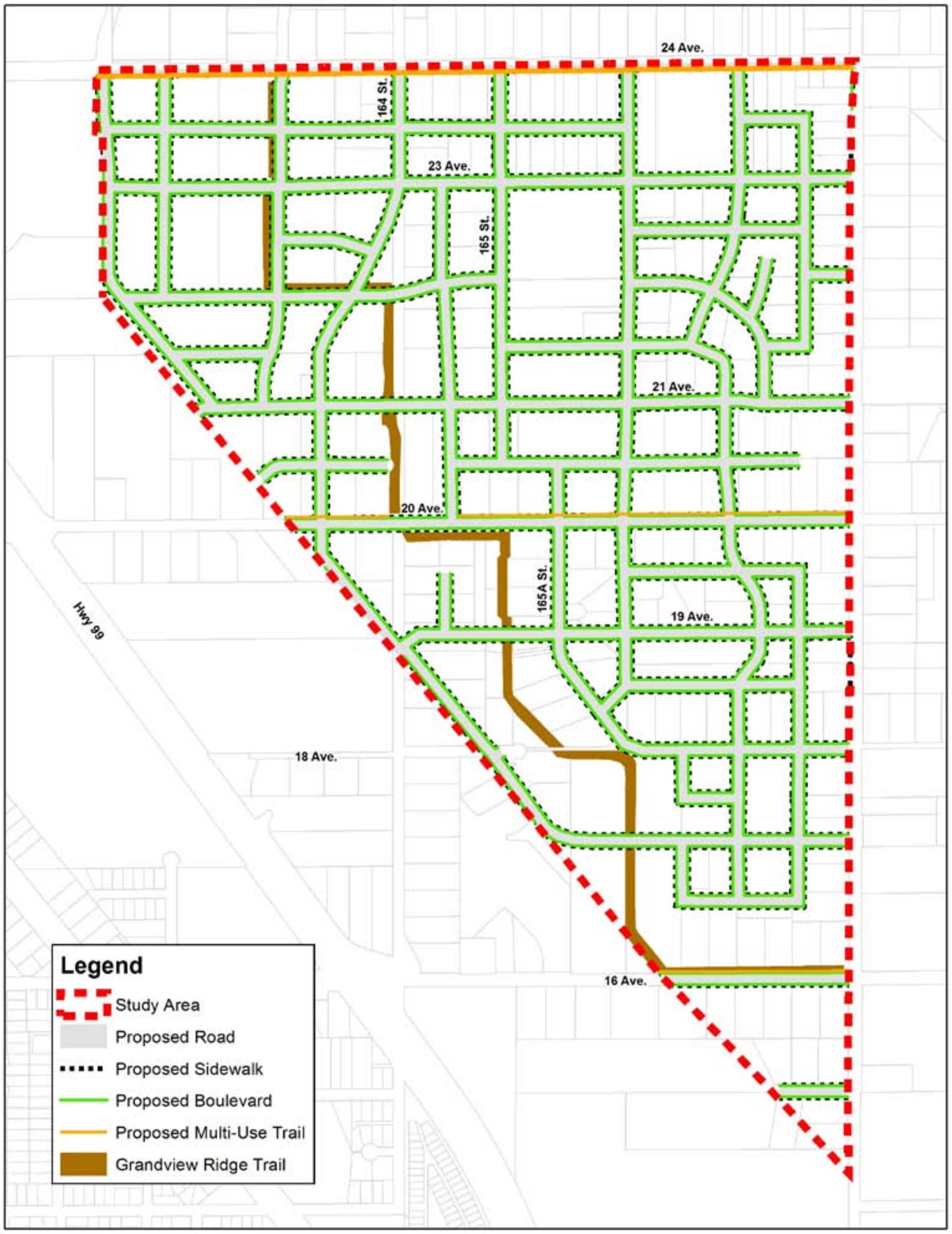
Walking and Cycling Network Plan

The connectivity of the local road network within the study area has an impact on the amount of walking trips. As the street grid and land use are denser within the study area, pedestrians have more opportunities and quicker routes to get to their destination.

All local roadways are to be built to Surrey's standard and will include sidewalks on both sides in order to provide an adequate walkway network within the study area. These will be especially important to provide safe access to schools and parks and commercial areas.

The following map highlights the network of sidewalks and walking trails that will be included as part of the transportation plan for Grandview Heights Area #2. The following sub-section provides a description of some of the key facilities in the study area.

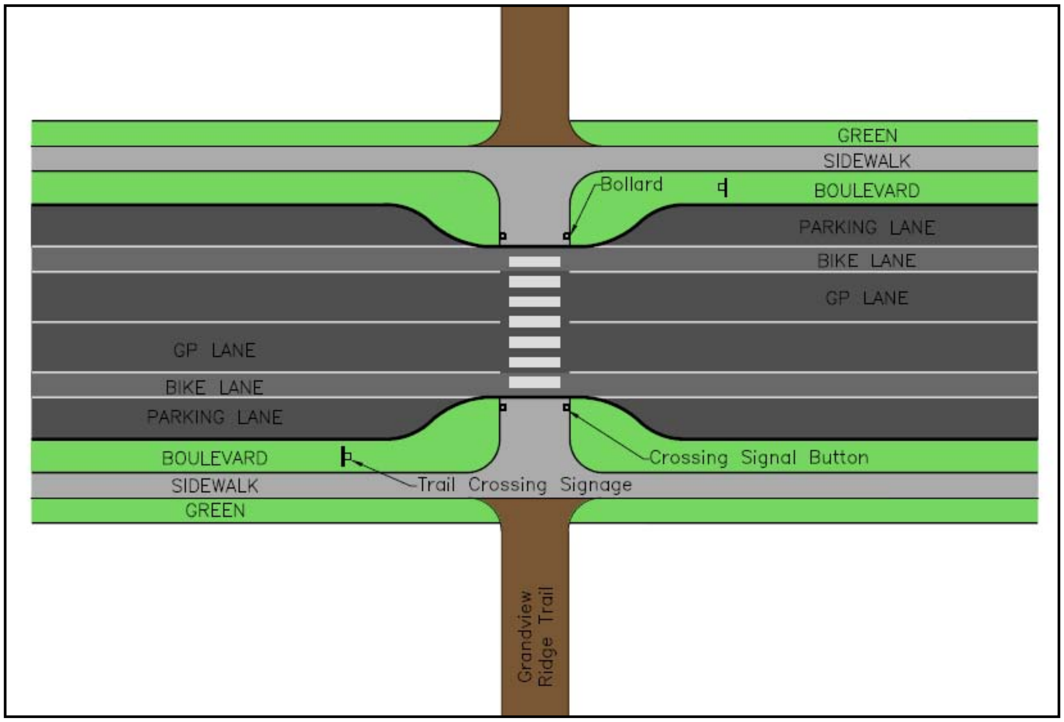
Figure 4.17: Proposed Pedestrian Network within Grandview Heights Area #2



Grandview Ridge Trail

A pedestrian pathway has been identified in the land use plan for this area that will provide a continuous north-south connection. This will also provide a recreational facility for residents to enjoy the natural features of this area. Special treatments at roadway crossings will be required since visibility will likely be obstructed by trees and shrubbery and a trail crossing might not be immediately obvious for auto drivers. The following map highlights some of the recommended safety features for Grandview Ridge trail crossings at collector roadways.

Figure 4.18: Grandview Ridge Trail Safety Features at Collector Roadway Crossings



Treatments at all roadway crossings including local streets should include similar features that generally enhance the safety and visibility of pedestrians. At local roadway crossings, features such as curb bulges, bollards and pedestrian crossing lane markings would enhance the comfort for trail users. Additional features at collector roadway crossings such as 20th Ave and 164th St could also include signage and possible pedestrian crossing signals to showcase walking as a more prominent mode of transport.

Multi-Use Corridors

Multi-use pathways have been identified along key corridors to provide a safe facility for pedestrians, cyclists, roller bladers and other vulnerable users that are physically separated from the roadway. Three such corridors have been identified along 16th, 20th and 24th Avenues. A multi-use corridor has been identified along 20th Avenue to provide a continuous east-west linkage to the Semiahmoo Town Centre. This is to be provided as a 4.0 m facility on the north side of the roadway.

Cycling Lanes

As part of the 16th and 24th Avenue arterial widening projects, 1.8 m cycling lanes will be provided on both sides of the roadway. Furthermore, the upgrading of 20th Ave and 164th St to the updated collector standard will include extra roadway width to provide a safe route for cyclists. In order to provide safe access to 24th Avenue, a bicycle activation button should be included at the intersections controlled by traffic signals.

Transit Services and Facilities Plan

As mentioned earlier, TransLink has identified a number of transit improvements as part of the South of Fraser Area Transit Plan. In order to maximize the ridership on these new routes, there are enhancements that would be necessary to improve pedestrian access to these new services.

In addition to the above walking network improvements, we want to ensure that the future Rapid Transit route (bus, light rail, or streetcar) along 24th Avenue connecting Semiahmoo Town Centre to Langley City Centre via Campbell Heights has adequate bus stop facilities. It is planned to accommodate Rapid transit within designated travel lanes, one lane per direction. These should include two bus bays in both the east and westbound directions as per TransLink's standard bus stop spacing. The likely location of these would be the far side at the 164th and 168th Street intersections. Each bus bay should include sheltered and lit waiting areas, walkway or sidewalk connections to the pedestrian network.

For the new Community Shuttle route, planned for 164th Street, adequate bus stop facilities should be provided along the proposed route. The 164th Street alignment meets TransLink's criteria for both the catchment area and pedestrian accessibility. These should include bus bulges or bus bays, shelters, benches, lighting and info tubes with schedule information to enhance the travel experience for transit users. Similar to the bus stops along 24th Avenue, adequate sidewalk and other pedestrian facilities should be provided to improve walk access to these bus stops.

Roadway Network and Intersection Plan

To accommodate walking, cycling, transit and parking needs, the City of Surrey has developed proposed pavement widths for the various categories of roadways. These widths are shown in **Figures 4.19 and 4.20** with allocation for the various roadway users including space for medians, boulevards and other features that would provide a network of complete streets.

The roadways developed as part of this Grandview Heights Area #2 NCP will be in accordance to the standards shown in **Figure 4.19 and 4.20**. Typical road cross-sections where there are drainage corridors are graphically shown in **Figures 4.9 and 4.10**.

Figure 4.19: Proposed Arterial Roads

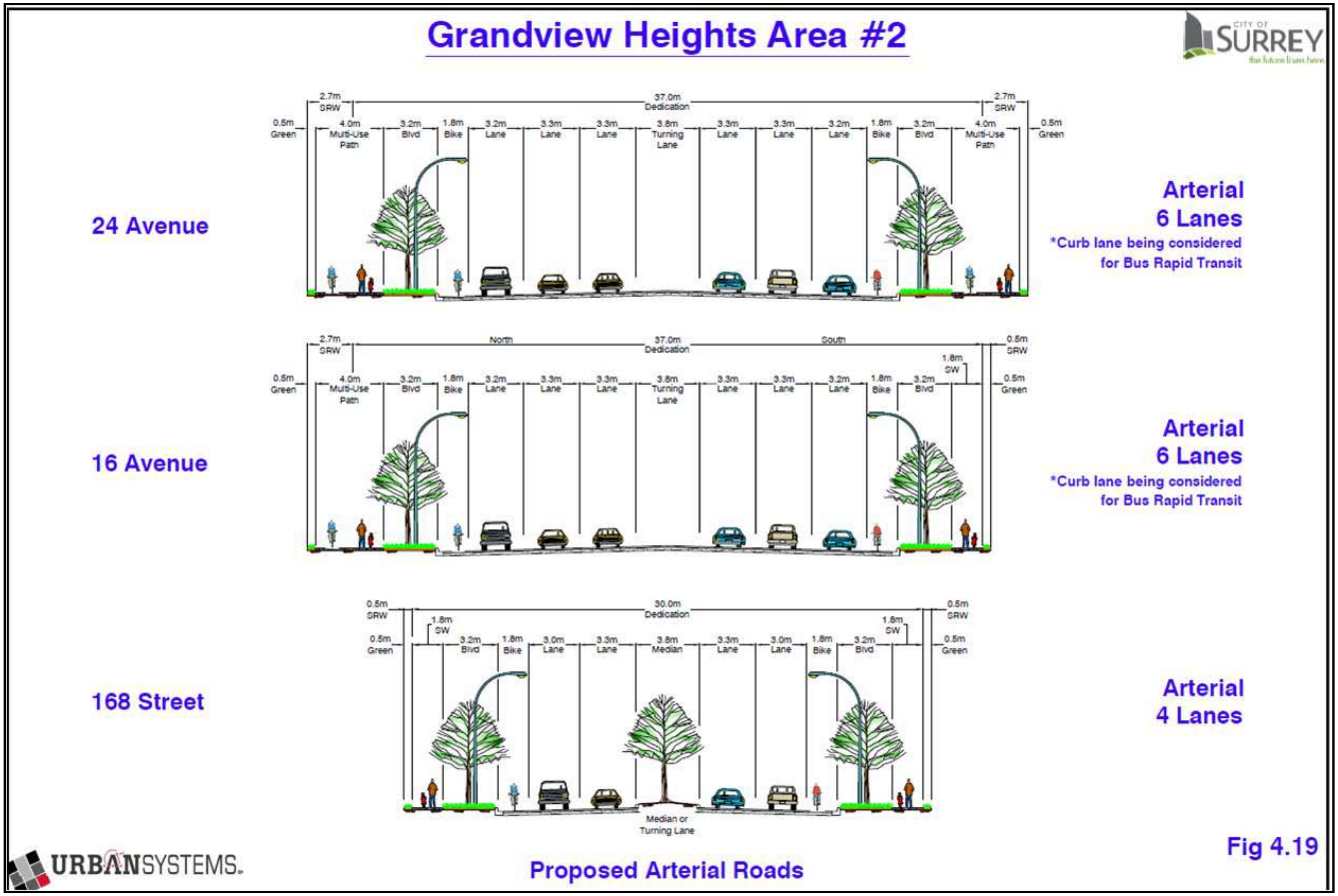
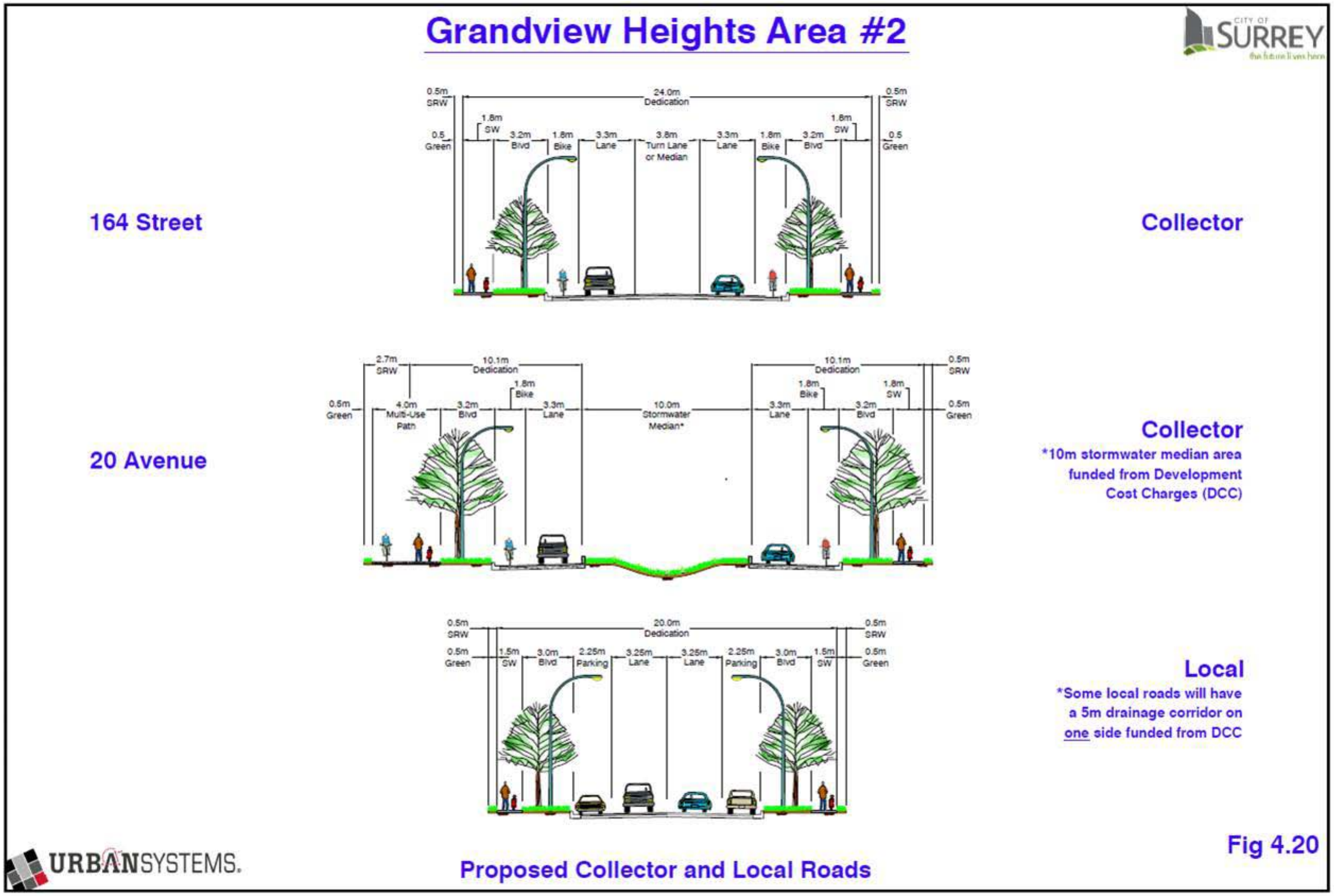


Figure 4.20: Proposed Collector and Local Roads



4.4.6 Required Roadway Network Improvements

Based on the traffic analysis outlined above, the improvements to the various components of the roadway network required to support increased traffic demands are as follows:

Intersections

24th Avenue/164th Street

- Upgrade to signalized intersection (all four approaches already contain left turn bays)
- Add channelized right turns at all four approaches

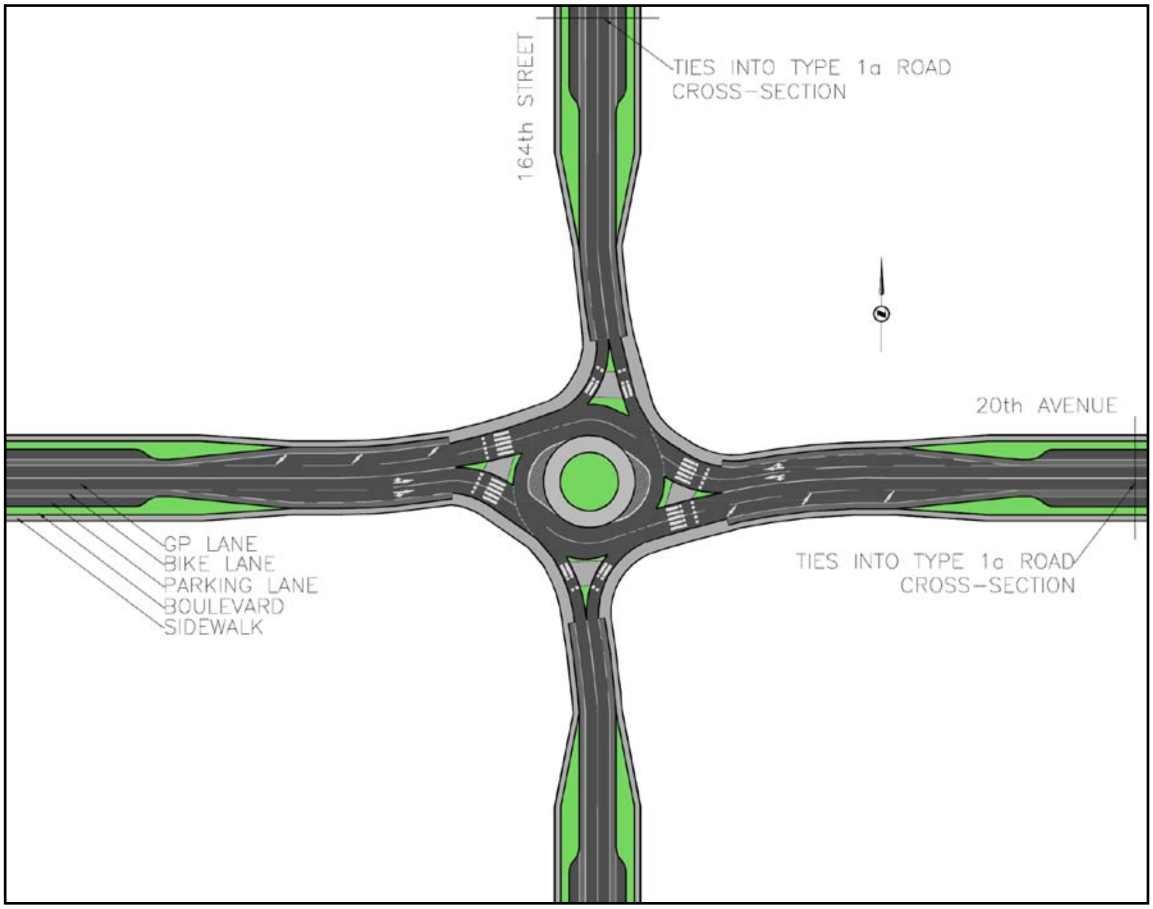
24th Avenue/168th Street

- Upgrade signal to accommodate protected left turn phasing
- Add additional through lanes east and westbound
- Add channelized right turns for all four approaches

20th Avenue/164th Street

- Upgrade intersection to a roundabout
- East and westbound approach volumes warrant a two lane roundabout with north and southbound volumes only requiring one lane
- The following conceptual configuration with major and minor approach links should be considered:

Figure 4.21: Grandview Area #2 Future 20th Avenue/164th Street Roundabout



20th Avenue/168th Street

- Upgrade to signalized intersection
- Add minimum 30 m left turn bays at all four approaches

16th Avenue/168th Street

- Upgrade signal to accommodate protected left turn phasing
- Add additional through lanes east and westbound with channelized right turns

Arterial and Collector Roadways

The intersection upgrades mentioned above can accommodate the increased volumes due to the Grandview Heights Area #2 development, but the arterial roadways will need to be widened to achieve reasonable levels of service in the future given the overall growth trends in the South

Surrey area. The additional traffic from the Grandview Heights Area #2 does not trigger the need to widen either 24th or 16th Avenue as most of the current and future traffic on these arterials is attributed to through traffic. 16th Avenue has been identified for future widening as part of Surrey's 10 Year Servicing Plan and 24th Avenue has been indentified in longer term plans.

164th Street does not currently exist between 20th Ave and 23rd Ave; however there is an existing right-of-way (ROW) allowance that follows the existing grid pattern for numbered streets. It was determined early in the draft NCP process that constructing a road within the existing 164th Street ROW would not be feasible due to costs resulting from the earthwork and impacts to existing properties along that alignment. As a result, a "re-alignment" routing was chosen and incorporated into the NCP.

As the process of finalizing the NCP continued, the city retained Urban Systems to prepare preliminary alignment designs and comparative construction cost estimates for both of the options. The results of the investigation determined that using the existing 164th Street corridor would be more costly in terms of construction, the design geometry less desirable and the environmental impacts would be greater, which would also result in additional mitigation requirements elsewhere in the NCP study area. As such, the proposed alignment for 164th St presented in this report is the preferred option for going forward.

Internal Roadway Network

The approved land use plan identified corridors for the local roadway network as shown in Figure 4.25 below. This network is intended to provide a much more continuous street grid for better traffic circulation, access to neighbourhoods as well as a more complete pedestrian network with sidewalks. The principles used to develop the internal roadway network were to encourage internal connectivity with no cul-de-sacs, open and connected neighbourhoods and safer streets for walking and cycling. This finer grid also allows traffic to disperse throughout the network lowering the amount of vehicle volumes on any specific local street. Access to single family developments would be through laneways providing additional connectivity and dispersal of automobile traffic.

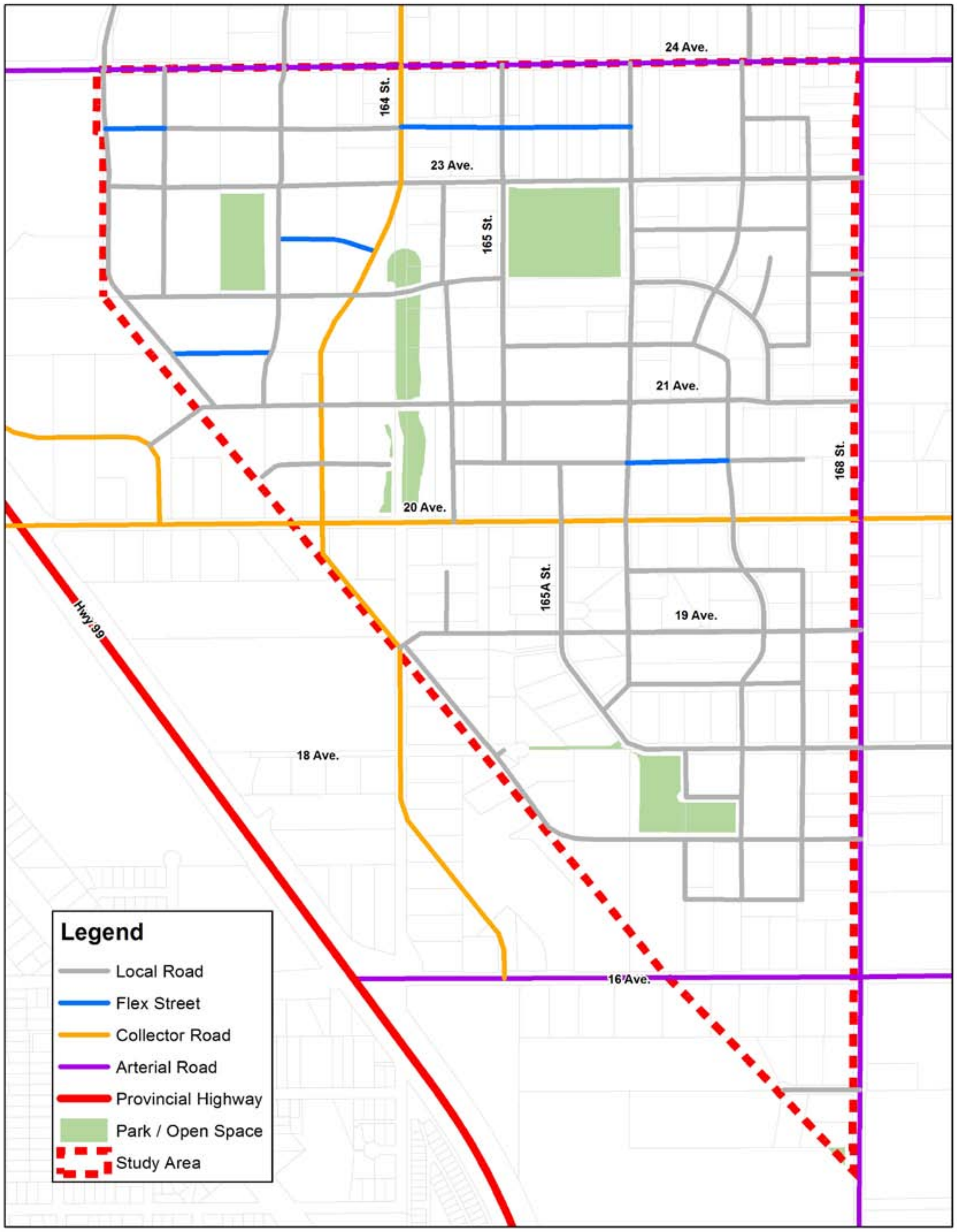
The network identifies a number of what are termed "flex streets". These streets provide a critical element of connectivity but their exact alignment is flexible. Provided that these streets provide the same degree of connectivity as the ones identified in the land use plan alternative alignments may be acceptable.

All local roadways should be built to Surrey's standard two-way road with parking on both sides with 11 m of pavement. The intersection at 21st Avenue and 164th Street should be stop control considering that 21st Avenue will be a through local across the drainage corridor. Consideration should also be given for possible traffic circles at local roadway intersections. With the local roadway cross section providing wider lanes for cyclists and sidewalks on both sides with boulevards, there is little need for any additional traffic calming. Furthermore, having parking on both sides of the streets provides for additional traffic calming as motorists would be less likely to speed through areas with parked cars.

Access to and from collectors and arterials should be provided with stop control with allowance for left turns both inbound and outbound from the study area to maintain adequate traffic circulation between the local and collector/arterial networks.

Traffic circles are identified in the Land Use Plan on the diagonal section of 161 A Street at 22, 21 and 19th Avenues, which would be a development requirement when these roads are widened or constructed as part of adjacent development. As has been discussed in Section 4.4.6 a more major roundabout has been identified at the intersection of two collector roads 164 Street and 20 Avenue. This roundabout at the intersection of the collectors is a DCC funded item.

Figure 4.22: Grandview Area #2 Future Roadway Network Plan



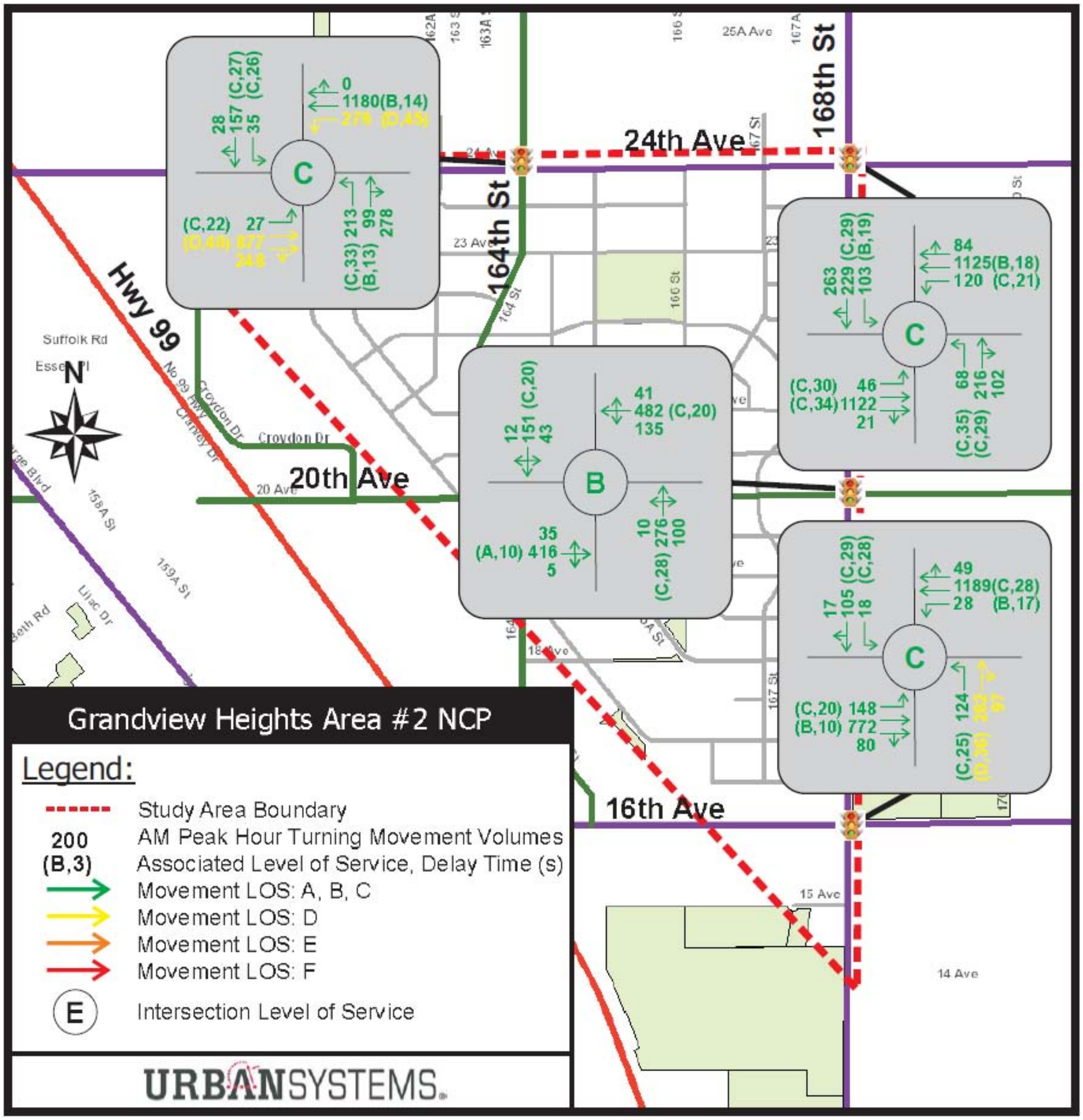
Parking Management Plan

On-street parking will be provided along both sides of all local and collector roadways within the study area. Parking on both sides of the street will also provide additional traffic calming as motorists will drive slower alongside parked vehicles.

Summary of Transportation Improvements

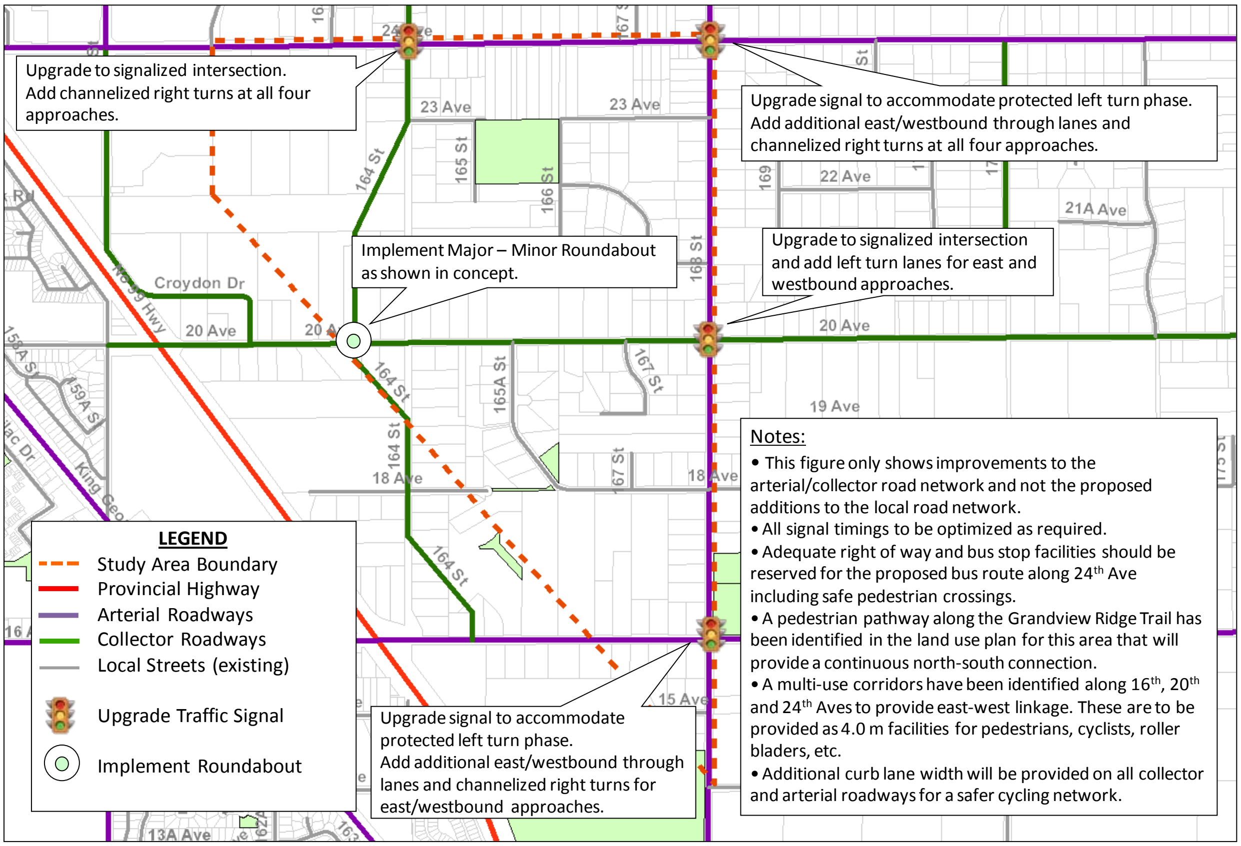
The above mentioned improvements will help facilitate the movement of people and traffic throughout the Grandview Heights Area #2 as it develops. **Figure 4.23** below summarizes the future turning movements and levels of service with the improved roadway network. **Figure 4.24** on the following page provides an overall summary of the transportation network improvements.

Figure 4.23: Traffic Operations for Future PM Conditions with Network Improvements



Based on the future traffic volumes and level of service analysis with the recommended roadway improvements, all movements are at LOS D or better. These improvements satisfy the need for traffic mobility and provide enough roadway capacity for acceptable levels of service for future conditions.

Figure 4.24: Summary of Transportation Improvements



Notes: Future widening of 16th and 24th Avenues are needed based on overall growth in South Surrey traffic, not solely triggered by Area #2 traffic.

4.4.7 Cost Estimates and Financing Approach

The cost estimates for the infrastructure needed for growth are based on the principle that development is responsible for funding the local and collector road infrastructure that fronts and/or is adjacent to the development lands. Because there is a higher standard for collector roads compared to local roads, an upsizing approach is utilized with the cost to upgrade from the local to the collector road standard being included as a DCC eligible item. Where there is a collector arterial intersection only the collector road component of the works has been shown as arterial road works are treated separately and are funded through the overall city wide arterial road DCC program. DCC eligible items include collector road works and other items that serve the overall NCP. This financing approach for Collector Roads is summarized in **Table 4.33**.

Table 4.34: Collector Road Cost Estimates and Financing Approach

Capital Item	Total Cost	Costs Recovery Approach for Area 2	
		City-Wide DCCs	Other
24 Ave / 164 St Traffic Signal	$150,000	$150,000	$0
20 Ave / 164 St Roundabout	$1,534,000	$1,534,000	$0
20 Ave / 168 St Traffic Signal	$150,000	$150,000	$0
20 Ave Upgrade to Collector Standard	$970,000	$970,000	$0
164 St Upgrade to Collector Standard	$870,000	$870,000	$0
Total	**$3,674,000**	**$3,674,000**	**$0**

Notes:

1. Costs updated to January 2010 construction costs

As shown in **Table 4.34**, anticipated transportation DCC revenues from Area #2 are expected to exceed the costs of making needed transportation improvements to support development in Area #2.

As mentioned above Arterial Roads are treated on an overall city wide basis rather than an NCP by NCP basis. This is primarily due to the fact that the impact of arterial traffic is spread out over a wider area than the individual NCP. Also, as outlined previously the analysis does not indicate that traffic from the NCP triggers the need for any arterial widening other than the upgrading of 168th Street at the intersection with 20th Avenue and the upgrading of the intersection at 24th Avenue and 168th Street. Widening of the arterial roads through and adjacent to the NCP will be driven by overall growth in city wide traffic. However, to confirm that in the longer term there will be sufficient DCCs collected from this NCP to fund the cost to widened the NCP side of adjacent arterials, 168th Street 16th – 24th Avenues 16 Avenue Hydro Corridor to 168 Street and 24th Avenue 161A – 168th Street has been estimated to be $13.25 million. As can be seen from **Table 4.35** below there is a substantial surplus in the arterial DCCs which can be used for arterial road needs in the wider Grandview – South Surrey area such as a contribution towards the new 20th Avenue overpass at Highway 99.

Table 4.35: Estimated DCC Revenues and Expenditures – Transportation

	Estimated DCC Revenues	Estimated Additional DCC Expenditures	Balance
Non-Arterial Roads	$5,370,000	$3,674,000	$1,696,000
Arterial Roads	$24,576,000	$13,250,000	$11,326,000

Notes:
1. DCCs based on the average development yield for the area.
2. DCC revenues do not include potential DCC revenues from commercial or institutional development within Area #2.
3. Arterial Road expenditures are long term needs and are not triggered by traffic growth in this NCP alone.

4.4.8 Ten Year Servicing Plan

It is recommended that the City review its 2010-2019 10 Year Servicing Plan to determine whether the works recommended in this report overlap with current projects included in the 10 Year Servicing Plan. **Table 4.36** lists projects currently identified in the 10 Year Servicing Plan that fall within the transportation study area. These projects should be reviewed.

Table 4.36: 10 Year Servicing Plan Projects to Review – Transportation

10 Year Servicing Plan Project ID		
7453	10619	10627
10628	10637	11754

4.5 Utilities (Power, Telecommunications, Natural Gas)

4.5.1 Power

Currently NCP Area #2 is provided with electrical power by overhead power lines (except for a number of existing 1 acre subdivisions, which have underground power internal to the subdivision). All new hydro lines needed to service NCP Area #2 will be installed underground as per current City policy. BC Hydro will expand its system as development proceeds.

4.5.2 Telecommunications/Cable

Currently, NCP Area #2 is serviced by overhead telephone lines. As development proceeds, new lines will have to be installed underground to comply with the City's Subdivision and Development Bylaw. New telephone and cable service will be extended as needed as development proceeds.

4.5.3 Natural Gas

The gas system that currently services NCP Area #2 will be improved and expanded as needed.

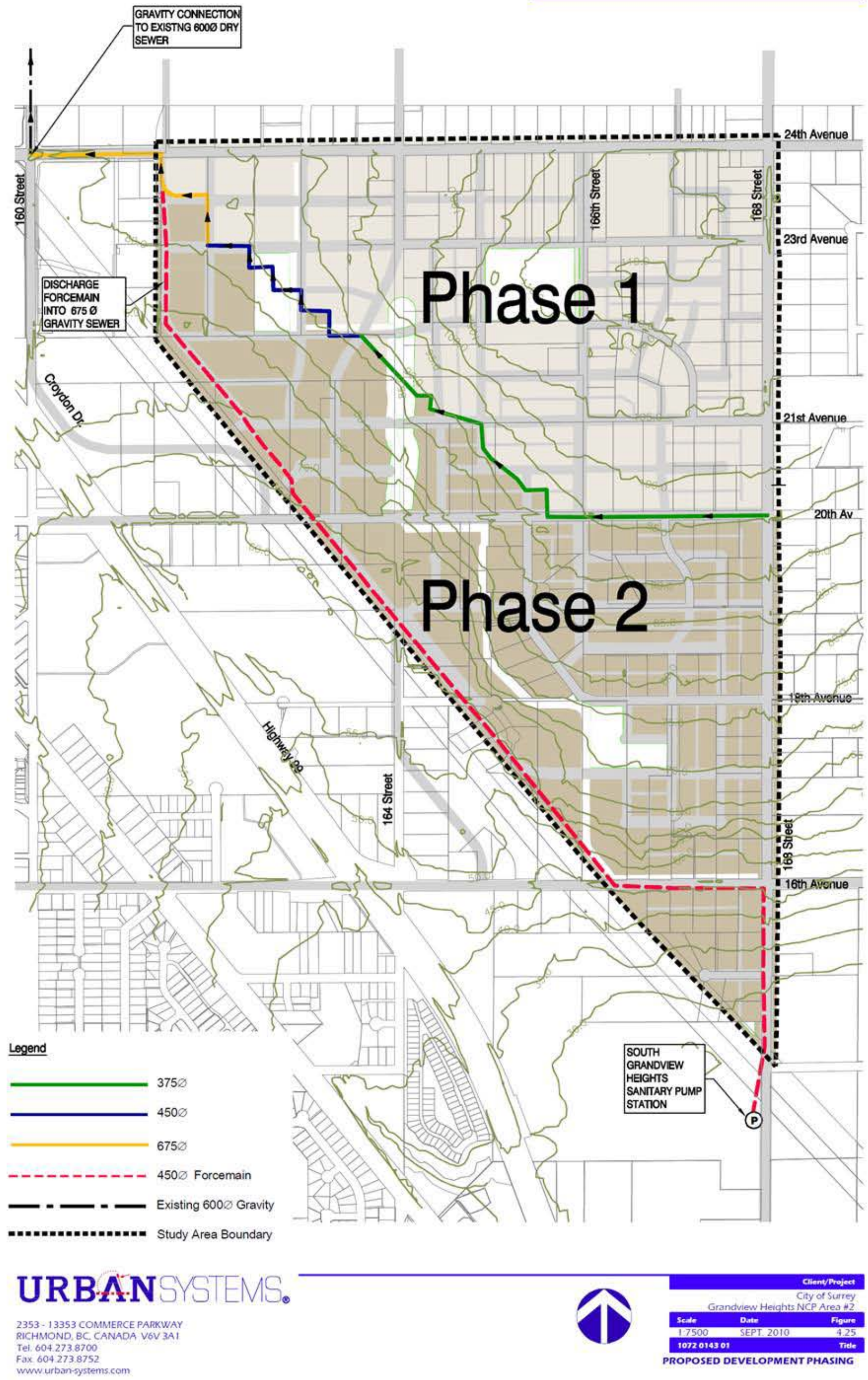
4.6 Development Phasing

The phasing of development within Grandview Heights NCP Area #2 will be dictated by the provision of sanitary sewer services. Under the proposed land use plan, all new development will require a sanitary sewer connection to the City's system. Those properties that can be connected to the City's sanitary sewer system by gravity will likely develop before properties that require pumping.

The sanitary sewer gravity catchment will service a large area upstream of the approximately 90 m contour extending form 24th Avenue south to approximately 20th Avenue – this area is considered Phase 1 (see **Figure 4.25**). The remaining area of NCP #2, which requires the construction of a pump station and force main, is considered Phase 2. The pump station will be located south of 14th Avenue just east of 168th Street. The force main will be constructed from the new pump station parallel to the BC Hydro right-of-way until 20th Avenue then located under a future road west of 164th Street to a connection at approximately 23rd Avenue and 162nd Street.

The pump station and force main must be constructed first before any development within Phase 2. Once the pump station is operational, development can proceed in conjunction with the collection system.

Figure 4.25: Proposed Development Phasing



4.7 Infrastructure Financing and Funding

This Section summarizes cost estimates for providing needed water, sanitary sewer, storm drainage, and transportation infrastructure to NCP Area #2 and provides recommendations for financing these costs.

4.7.1 Financing Approach

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

1. The long-term DCC revenues and expenditures for major collector roads, water, sanitary and drainage works must balance within NCP Area #2. Arterial road widening is assumed to be funded over time through DCCs and not DCCs solely generated from the NCP area. If the NCP's total DCCs are less than the expenditures, the NCP may still go ahead, but the costs above the revenues generated through the specific NCP DCCs will only be provided by the City when the works become a City priority.
2. The short-term annual DCC revenues and expenditures must also balance, or the development community within the NCP must address the short-term cash flow problem.
3. City Council has stated that City will not specify sequencing of development among NCPs at this time.
4. The City will not fund interim works.
5. The City-wide based DCC collection and expenditure program is the basis of all DCC capital works.
6. The City of Surrey has endorsed the use of DCC Front-ender Agreements as a method of reimbursing developers for front ending the cost of major engineering infrastructure that is within the current 10 Year Servicing Plan.
7. A Development Works Agreement can be considered to cover the cost of major infrastructure items that are not included in the DCC program.

4.7.2 Financing Summary

In addition to frontage works (to be funded fully by the developer), the development of NCP #2 will require investments in the major engineering infrastructure components. As discussed in previous sections, these major components will be funded primarily through DCCs, with the need for other funding mechanisms (i.e. Development Works Agreement) for the sanitary sewer pump station and force main (see **Table 4.37** and Section 4.7.4).

Table 4.37: Major Engineering Infrastructure Costs to Service NCP Area #2

Infrastructure	Estimated Costs (allocated to Area 2)	City-Wide DCCs	Development Works Agreement or Area Specific DCC
Sanitary Sewer	$10,742,000	$5,653,000	$5,089,000
Water	$4,313,910	$4,313,910	$0
Stormwater Management	$24,483,000	$6,582,000	$17,901,000
Collector Roads	$3,674,000	$3,674,000	$0
Arterial Roads	$13,250,000	$24,576,000	
Total	**$56,462,910**	**$44,798,910**	**$22,990,000**

Notes:
1. Does not include local servicing costs.

4.7.3 DCC Revenues and Expenditures

The following table summarizes the estimated DCC revenues and construction costs for each engineering service. The revenues are based on the City's proposed DCC Bylaw and growth estimates from the Stage 1 Land Use Concept. Because the Stage 1 NCP contained both high and low growth estimates, DCC revenues were calculated under both scenarios and then averaged. Estimated DCC revenues do not include potential revenues from the commercial node or from institutional development (e.g., the school site). The detailed DCC revenue calculation is shown in **Appendix B**. Both costs and revenues are in 2010 dollars.

Table 4.38: Estimated DCC Revenues and Expenditures to Build-Out of NCP Area #2

Infrastructure	Estimated DCC Revenues	Estimated Additional DCC Eligible Costs	Balance
Sanitary Sewer	$5,653,000	$10,742,000	-$5,089,000
Water	$4,335,000	$4,313,910	$21,090
Stormwater Management	$6,715,000	$24,483,000	-$17,768,000
Non Arterial	$5,370,000	$4,156,000	$1,214,000
Subtotal	***$22,073,000***	***$43,694,910***	***-$21,621,910***
Arterial	$24,576,000	$11,700,000	$12,876,000
TOTAL	**$46,649,000**	**$55,394,910**	**-$8,745,910**

Notes:
1. DCCs based on the average development yield for the area.
2. DCC revenues do not include potential DCC revenues from commercial or institutional development within Area #2.
3. Arterial roads are dealt with on a city-wide basis, not on an NCP-by-NCP basis.

The sanitary sewer deficit for the pump station and force main will need to be covered through other funding mechanisms, and a Development Works Agreement is proposed. The stormwater deficit for specific drainage corridor BMP costs as noted in Section 4.3.6 is recommended to be funded through an area specific DCC, further discussion is included in Section 4.7.5.

4.7.4 Sanitary Sewer Pump Station and Force Main

As identified in Section 4.1.5 there is a shortfall between what is generated by DCCs and the trunk/pump station needs typically funded by DCCs. This shortfall is created by one item, namely the sewer pump station to service Catchment 2 (the southern catchment). This pump station also services other areas, comprising the Highway 99 Corridor, (which provides a $1.8 million contribution) and the future NCPs Grandview Area #3 and a portion of Area #5. However, because Areas #3 and #5 are in the future and have no official status, funding from these areas cannot be built into the financial model at this time. Deferring the pumping capacity for NCP Area # 3 and #5 reduces the pump station cost to $10.1 million. This leaves a $5.089 million shortfall for the pump station to be funded by NCP Area #2. This funding situation is further complicated due to the fact that Catchment 1 (the northern catchment) does not physically need the pump station to be able to develop.

The proposed funding approach to overcome this shortfall and fund the pump station for Catchment 2 would be through a Development Works Agreement. Under this approach a developer, or group of developers, would frontend the pump station with cost recovery through a combination of a DCC Front-enders Agreement over the entire NCP area ($3.23 million) and a Development Works Agreement ($5.089 million) over Catchment 2.

A Development Works Agreement requires assent of the property owners within the defined benefiting area namely Catchment 2. To recover the $5.089 million shortfall, the Development Works Agreement charge would be about $44,000 an acre, based on a net developable area in Catchment 2 of 116.0 ac. Catchment 2 also has the option of waiting until NCP Area # 3 and #5 are finalized and then jointly funding the pump station and force main with these two other NCPs.

4.7.5 Financing Drainage Corridors

Land

As discussed in Sections 4.3.5.6 and 4.3.5.7 to implement the drainage corridors requires an additional road allowance width of 5 metres and in some cases 10 metres. While most properties have some form of drainage corridor adjacent to them there are some locations that do not.

To equalize the impact of road dedications between the 10 metre and 5 metre requirement (as discussed in Section 4.3.5.7) it is proposed that the cost of the 5 metre differential width be reimbursed to the fronting property owner from the city wide drainage DCC (sufficient DCCs being generated in the NCP to do this). This reimbursement would be at the rate of $750,000 an acre.

The use of the city wide DCC to fund the additional 5 metres still leaves the issue of how to fund the initial 5 metre dedications needed from most properties. If this initial 5 metres is set as a development requirement then the issue arises that not all properties will need such a dedication however there are insufficient DCCs generated in the NCP (at the current city wide rate) to fund them.

Other funding options such as a Development Works Agreement are not applicable as the land and works are dispersed throughout the NCP and individual works do not have a defined benefiting area. Various other options have been reviewed and the recommended option is to fund the 5 metre corridors through an Area Specific DCC. Reimbursement to developers who dedicate land required for the 5 metre drainage corridors will be at the rate of $750,000 an acre.

The 20 metre drainage corridors in the higher density multifamily areas would remain a development requirement and are not included in the area specific DCC.

Construction

It is proposed that the City Wide DCC fund the construction of the bioswale in the 10 metre median drainage corridors. This is due to the facts that there is no directly fronting property, and that this construction needs to be done in conjunction with work on the city's collector or arterial road network and is best done as part of an overall city road contract.

There is however insufficient DCCs generated in the NCP to fund the construction of the other bioswales. Construction of the bioswales that are immediately adjacent to fronting or flanking properties could potentially be made a development requirement of those properties. But not all properties directly front or flank a bioswale; consequently to share the cost of the bioswales as equally as possible it is proposed to include their construction cost in the Area Specific DCC.

Area Specific Stormwater DCC

It is recommended that an area specific NCP#2 stormwater DCC be developed to fund the land required for the 5 m stormwater corridors, 5 m of the 10 m stormwater corridors and the cost of the 5 m stormwater corridors and 10m side swales. **Table 4.38** summarizes costs that would be assigned to this DCC.

Table 4.39: Summary of Items Included in the Area Specific DCC and in the City Wide DCC

Items	Cost In City Wide DCC	Cost In Area Specific DCC
Trunks	$ 3,546,000	
Erosion Protection	$ 63,900	
Land for 5 m corridors	$ -	$ 7,942,500
Land for 10 m corridors	$ 2,054,300	$ 2,054,300
Construction in 5 m corridors		$ 7,181,400
Construction in 10 m median corridors	$ 917,600	
Construction in 10 m side swales		$ 723,000
TOTAL	**$6,581,800**	**$ 17,901,200**

Notes:
1. 5 m base width in the area specific DCC, additional 5 m width in the city wide DCC.

At current development projections and using the average between the high and low growth rates the area specific DCC is estimated at approximately, $8,800 per Single Family lot with other land uses being proportionately lower or higher in accordance with the current DCC rate structure. A detailed DCC background report will be required prior to seeking Council approval and referral of the area specific stormwater DCC bylaw to the Province.

There are a number of issues relating to the use of a special area DCC, the primary of which are:

- Provincial approval of the DCC bylaw will be required.
- There will likely be cash flow problems to reimburse developers as, at least initially, there may not be sufficient DCC revenues to fully reimburse fronting property owners for land and bioswale construction.

PART 5: COMMUNITY SERVICES & AMENITIES

To address the amenity needs of the proposed new development in Sunnyside Heights, all development proposals at the time of rezoning or building permit issuance will be required to make a monetary contribution toward the provision of new police, fire protection and library services and toward the development of the parks, open spaces and pathways.

The monetary contributions toward police, fire and library materials will offset the capital costs of providing these services to the new development and are applied on a standardized basis in all of Surrey's Neighbourhood Concept Plan areas. The monetary contributions toward parks, open spaces and pathway development are based upon an estimate of the capital costs of these improvements for this particular NCP area. The total cost is divided by the anticipated number of dwelling units and acreages in the case of non-residential development to ensure an equitable contribution arrangement.

5.1 Services and Amenities

5.1.1 Parkland Development

The Sunnyside Heights community will contain one neighbourhood school/park site, two neighbourhood park areas, and a riparian area. The Open Space areas include the Grandview Ridge Trail, a 2 km trail that runs at the top of a ridge line running north –south through the plan area. Portions of this trail run through park areas, and portions through multi-family sites.

Two gateway features are to be constructed at 20th Avenue & 168 Street at the eastern entrance into Sunnyside Heights from 168 Street. The remaining entrance features will be constructed through the development of multi- family sites.

The estimated cost of developing park and related amenities in the future Sunnyside Heights community is approximately $2,972,427.00. This amount includes estimated amounts for the construction of the gateway features along 168 Street. This results in a contribution of $1,082.00 (in 2010 dollars) per dwelling unit.

5.1.2 Library and Library Material

A study of library requirements in Surrey's new neighbourhoods has established that a contribution of $135.54 (in 2010 dollars) per dwelling unit (non-residential development is exempt) is necessary to cover the capital costs for library materials and services, which is sensitive to population growth. Consequently, a total of approximately $372,463.92 will be collected from Sunnyside Heights towards materials such as books, computers and CDs.

5.1.3 Fire and Police Protection

Future development in this neighbourhood will drive the need to upgrade existing fire and police protection facilities. A study of fire protection requirements in Surrey's new neighbourhoods has established that a contribution of $260.24 per dwelling unit and $1,040.96 per acre of non-residential development (in 2010 dollars) will cover the capital costs for fire protection. A contribution of $60.25 per dwelling unit and $240.92 per acre of non-residential development will cover the capital costs for police protection. This will result in a total capital contribution from Sunnyside Heights of approximately $1,002,444.48 toward fire protection and $232,060.92 toward police protection.

5.2 Summary of Amenity Funding Arrangements

A summary of the applicable amenity contributions (per dwelling unit or hectare/acre) and the estimated revenue the City can expect to receive from the Sunnyside Heights NCP area is documented in the following table.

Table 5.1 Summary of Amenity Funding Arrangements

SUNNYSIDE HEIGHTS NEIGHBOURHOOD CONCEPT PLAN AMENITY CONTRIBUTIONS			
	Per Unit Contribution All Residential *Approx. 2748 dwelling units (@ base densities*	**Per Acre Contribution All Non-Residential *Approx. 276 acres 112 ha.)***	**Anticipated Revenue**
Police Protection	$60.25 per dwelling	$240.92 per acre	$232,060.92
Fire Protection	$260.24 per dwelling	$1,040.96 per acre	$1,002,444.48
Development of Park/Pathways and Placemaking Features	$1,082.00 per dwelling	n/a	$2,973,336.00
Library Materials	$135.54 per dwelling	n/a	$372,463.92
Total Contribution (per unit or per acre)	**$1,538.03 per dwelling**	**$1,281.88 per acre**	
Total Anticipated Revenue	$4,226,506.44	$353,798.88	$4,580,305.32

The above-noted per unit amenity contributions are derived from estimated base densities in the residential designations and the number of dwelling units (excluding any coach houses and secondary suites) anticipated. The estimated costs of the various amenities are distributed evenly to each dwelling unit. Therefore, if the number of dwelling units in a proposed development is lower than that anticipated by the NCP, the applicant will be expected to "top up" the amenity fees based on the number of the dwelling units used to calculate the amenity charge to ensure that there is no shortfall in the funding for the proposed amenities.

PART 6.0 IMPLEMENTATION

6.1 OCP Amendments

The entire area covered by the Sunnyside Heights NCP is currently designated Suburban in the OCP. Although the NCP Land Use Plan anticipates changes to the OCP designations in Sunnyside Heights, the determination of the precise boundaries of these changes cannot be established until a detailed survey plan is presented. It is, therefore, recommended that any necessary changes to the OCP designations in the Sunnyside Heights area proceed concurrently with site specific rezoning applications as has been the City's normal practice.

6.2 Rezoning

The residential lands will need to be rezoned before development can proceed. Rezoning will be completed in a logical staged manner. Areas suitable for development will be rezoned when owners make application consistent with this plan.

6.3 Subdivision

Future subdivision will be consistent with both the NCP and the ultimate zoning. As noted in the section on phasing, subdivision will be dependent upon market conditions and at a pace determined by the landowners. Detailed subdivision patterns will be determined at the subdivision application stage.

6.4 Development Permit Area Guidelines

All multiple residential developments will be reviewed in accordance with the Development Permit Guidelines of the Official Community Plan and the requirements of this NCP.

6.5 Design Guidelines

The Neighbourhood Concept Plan contains design guidelines for land uses that are intended to provide general direction to achieve the desired neighbourhood character, preserve and enhance natural space, encourage pedestrian access to destination areas, and achieve the overall development objectives defined in the final Neighbourhood Concept Plan.

The design guidelines make recommendations regarding the interface between residential areas and public spaces, stormwater corridors and on-site drainage works, as well as architectural elements appropriate for residential and commercial buildings. These guidelines will be used by City staff to guide the developers in coordinating the design among individual development applications and to ensure that the desired neighbourhood character is achieved in Sunnyside Heights.

The Design Guidelines will be implemented through Building Schemes for single family developments, which will be registered on the lots and administered by design consultants hired by the developers and approved by the City. For row housing, town housing and other multiple unit residential developments, commercial and business park developments, the Design Guidelines will be implemented through Development Permits.

6.6 Amenity Contributions

Surrey's policy is that NCPs address funding arrangements for the provision of community facilities, amenities, and services (such as park development, police, fire, and library materials) that are translated into specific contribution requirements and adopted by Council in the Zoning Bylaw. The amenity contribution is payable upon subdivision for single-family subdivisions or upon issuance of building permits for multiple development and other uses.

The bylaw provides that the base rates for amenity contributions are adjusted annually on March 1st based on Vancouver's annual average consumer price index (CPI) for the preceding year.

6.7 Zoning By-law Amendment

To enact the amenity contribution requirements, the Zoning By-law requires an amendment to add Sunnyside Heights to the list of Neighbourhood Concept Plans within which monetary contributions are required. The proposed amendments to Schedule G of the Zoning By-law, to incorporate the amenity fees for Sunnyside Heights, were proposed concurrently with the approval of the Stage 2 plan.

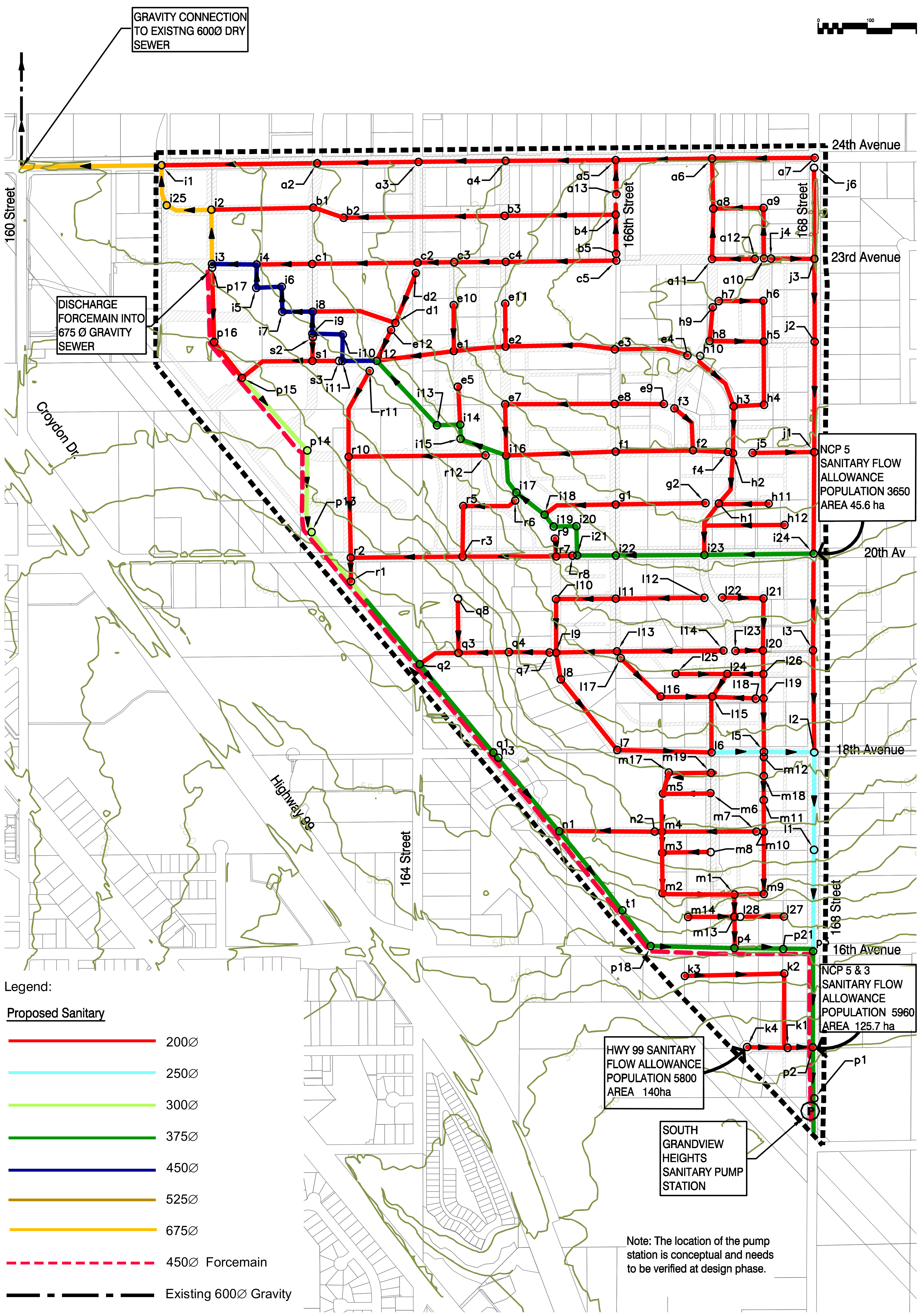
6.8 NCP Amendments

Any proposed major or minor amendments to this Neighbourhood Concept Plan must be undertaken in accordance with Council's approved Neighbourhood Concept Plan amendment policy contained in Part 5, Division A of the OCP.

APPENDICES

APPENDIX A.1 Sanitary Sewer

NOTE: The proposed sanitary network and analysis contained in **Appendix A.1** is based on a prior version of the final road network. The sanitary network should be refined at the detailed design phase with the City's approval.



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This plan based on a prior version of the proposed road network; detailed design may be adjusted with City's approval.

Client/Project		
City of Surrey Grandview Heights NCP Area #2		
Scale	Date	Figure
n.t.s.	07-11-01	4.2
1072 0143 01		Title
PROPOSED SANITARY SEWER		

Unit Demand	350 l/person/day	Project Grandview heights
Infiltration	0.130 l/s/ha	Client City of Surrey
Manning's Coefficient (n)	0.013	USL Job 1072.0143.01

					Peak Dry Weather Flow			Infiltration Flow		PWWF	Sanitary Design				
											Pipe Capacity (l/s)			Check	Velocity
Zone	Up stream Note	Down stream Node	Area (Hec)	Population	Acc. Popl'n	Peak Factor	Flow (l/s)	Accum. Area (ha)	Flow (l/s)	(l/s)	Assumed Grade	Size (mm)	Capacity (50% of Pipe Full)	Qdes / Qcap	(m/s)
1H	J4	J3	0.84	129	129	4.21	2.20	0.84	0.11	2.31	0.5%	200	11.60	0.20	#NAME?
1H	j6	J3	1.5	165	165	4.18	2.80	1.50	0.19	2.99	0.5%	200	11.60	0.26	#NAME?
1H	J3	J2	1.48	109	404	4.02	6.58	3.82	0.50	7.07	0.5%	200	11.60	0.61	#NAME?
1H	J2	J1	2.07	155	559	3.95	8.94	5.89	0.76	9.71	1.0%	200	16.38	0.59	#NAME?
1H	J5	J1	0.59	63	63	4.29	1.10	0.59	0.08	1.17	0.5%	200	11.60	0.10	#NAME?
1H	J1	I24	1.88	140	762	3.87	11.96	8.36	1.08	13.04	3.1%	200	29.01	0.45	#NAME?
NCP5		I24	45.6	3648	3648	3.37	49.79	45.60	5.91	55.70					
1G	I24	I23	1.19	90	4500	3.29	59.94	55.15	7.15	67.09	0.5%	375	86.78	0.77	#NAME?
1G	H7	H6	0.41	47	47	4.32	0.82	0.41	0.05	0.87	1.1%	200	17.56	0.05	#NAME?
1G	H6	H5	0.5	49	95	4.25	1.64	0.91	0.12	1.76	0.5%	200	11.60	0.15	#NAME?
1G	H9	H8	0.15	17	17	4.39	0.30	0.15	0.02	0.32	1.0%	200	16.40	0.02	#NAME?
1G	H8	H5	0.14	16	33	4.35	0.58	0.29	0.04	0.62	0.6%	200	12.70	0.05	#NAME?
1G	H5	H4	0.91	92	220	4.13	3.68	2.11	0.27	3.96	1.1%	200	17.24	0.23	#NAME?
1G	H4	H3	0.19	22	242	4.12	4.03	2.30	0.30	4.33	0.5%	200	11.60	0.37	#NAME?
1G	H10	H3	0.78	89	89	4.26	1.53	0.78	0.10	1.63	2.5%	200	25.70	0.06	#NAME?
1G	H3	H2	0.15	17	347	4.05	5.70	3.23	0.42	6.12	2.1%	200	23.99	0.26	#NAME?
1G	H2	H1	0	0	347	4.05	5.70	3.23	0.42	6.12	3.3%	200	29.63	0.21	#NAME?
1G	H11	H1	0.4	42	42	4.33	0.73	0.40	0.05	0.79	0.5%	200	11.60	0.07	#NAME?
1G	H1	H13	0	0	389	4.03	6.35	3.63	0.47	6.82	0.5%	200	11.60	0.59	#NAME?
1G	H12	H13	0.5	53	53	4.31	0.93	0.50	0.06	0.99	0.5%	200	11.60	0.09	#NAME?
1G	H13	I23	0	0	442	4.00	7.17	4.13	0.54	7.71	3.4%	200	30.05	0.26	#NAME?
1F	I23	I22	1.24	90	5032	3.24	66.11	60.52	7.85	73.95	0.5%	375	86.78	0.85	#NAME?
1F	I22	I21	0.52	54	5086	3.24	66.73	61.04	7.91	74.64	2.2%	375	183.32	0.41	#NAME?
1F	I21	I20	0	0	5086	3.24	66.73	61.04	7.91	74.64	0.5%	375	86.78	0.86	#NAME?
1F	I20	I19	0	0	5086	3.24	66.73	61.04	7.91	74.64	0.5%	375	86.78	0.86	#NAME?
1F	I19	I18	0.2	33	5119	3.24	67.10	61.24	7.94	75.04	0.5%	375	86.78	0.86	#NAME?
1F	G2	G1	1.42	143	143	4.20	2.44	1.42	0.18	2.62	1.7%	200	21.17	0.12	#NAME?
1F	G1	I18	0.77	127	270	4.10	4.49	2.19	0.28	4.77	4.7%	200	35.70	0.13	#NAME?
1E	I18	I17	0.32	53	5442	3.21	70.79	63.75	8.26	79.05	0.5%	375	86.78	0.91	#NAME?
1E	I17	I16	0.44	73	5515	3.21	71.62	64.19	8.32	79.94	0.5%	375	86.78	0.92	#NAME?
1E	F3	F2	0.54	61	61	4.30	1.07	0.54	0.07	1.14	2.8%	200	27.47	0.04	#NAME?
1E	F4	F2	0.52	59	59	4.30	1.03	0.52	0.07	1.10	0.5%	200	11.60	0.09	#NAME?
1E	F2	F1	0.99	92	213	4.14	3.56	2.05	0.27	3.83	0.7%	200	13.65	0.28	#NAME?
1E	F1	I16	1.59	195	407	4.02	6.63	3.64	0.47	7.11	4.0%	200	32.72	0.22	#NAME?
1E	I16	I15	0.41	43	5965	3.17	76.70	68.24	8.85	85.55	1.6%	375	156.85	0.55	#NAME?
1E	I15	I14	0	0	5965	3.17	76.70	68.24	8.85	85.55	0.5%	375	86.78	0.99	#NAME?
1D	I14	I13	0	0	5965	3.17	76.70	68.24	8.85	85.55	0.5%	375	86.78	0.99	#NAME?
1D	I13	I12	0.53	0	5965	3.17	76.70	68.77	8.91	85.61	0.5%	375	86.78	0.99	#NAME?
1D	E4	E3	3.65	50	50	4.32	0.87	3.65	0.47	1.35	0.5%	200	11.60	0.12	#NAME?
1D	E3	E2	4.39	154	204	4.15	3.42	8.04	1.04	4.46	1.0%	200	16.20	0.28	#NAME?
1D	E2	E1	0.7	104	308	4.07	5.08	8.74	1.13	6.21	9.4%	200	50.30	0.12	#NAME?
1D	E9	E8	0.77	67	67	4.29	1.16	0.77	0.10	1.26	0.6%	200	12.47	0.10	#NAME?
1D	E8	E7	1.52	173	240	4.12	4.00	2.29	0.30	4.30	3.0%	200	28.52	0.15	#NAME?
1D	E7	E6	0.1	11	251	4.11	4.18	2.39	0.31	4.49	8.3%	200	47.21	0.10	#NAME?
1D	E6	E5	0.94	107	358	4.05	5.87	3.33	0.43	6.30	0.5%	200	11.60	0.54	#NAME?
1D	E5	E1	0	0	358	4.05	5.87	3.33	0.43	6.30	0.5%	200	11.60	0.54	#NAME?
1D	E11	E10	0.55	63	63	4.30	1.09	0.55	0.07	1.16	8.1%	200	46.71	0.02	#NAME?
1D	E10	E1	0.78	86	149	4.19	2.53	1.33	0.17	2.70	2.3%	200	24.93	0.11	#NAME?
1D	E1	I12	0.53	27	841	3.85	13.12	13.93	1.81	14.92	5.5%	200	38.45	0.39	#NAME?
1D	E12	I12	0.47	77	77	4.27	1.33	0.47	0.06	1.39	6.9%	200	43.13	0.03	#NAME?
1C	I12	I11	0.16	23	6906	3.11	87.09	83.33	10.80	97.89	0.5%	450	141.12	0.69	#NAME?
1C	I11	I10	0	0	6906	3.11	87.09	83.33	10.80	97.89	0.5%	450	141.12	0.69	#NAME?
1C	I10	I09	0	0	6906	3.11	87.09	83.33	10.80	97.89	0.5%	450	141.12	0.69	#NAME?
1C	I09	I08	0	0	6906	3.11	87.09	83.33	10.80	97.89	0.5%	450	141.12	0.69	#NAME?
1C	D2	D1	0.28	54	54	4.31	0.94	0.28	0.04	0.97	3.8%	200	31.90	0.03	#NAME?
1C	D1	I08	0.9	172	226	4.13	3.78	1.18	0.15	3.93	4.6%	200	35.30	0.11	#NAME?
1C	I08	I07	0	0	7132	3.10	89.54	84.51	10.96	100.49	0.5%	450	141.12	0.71	#NAME?
1C	I07	I06	0.34	65	7197	3.10	90.24	84.85	11.00	101.24	0.5%	450	141.12	0.72	#NAME?

Unit Demand					350 l/person/day	Project	Grandview heights								
Infiltration					0.130 l/s/ha	Client	City of Surrey								
Manning's Coefficient (n)					0.013	USL Job	1072.0143.01								
					Peak Dry Weather Flow			Infiltration Flow		PWWF	Sanitary Design				
											Pipe Capacity (l/s)			Check	Velocity
Zone	Up stream Note	Down stream Node	Area (Hec)	Population	Acc. Popl'n	Peak Factor	Flow (l/s)	Accum. Area (ha)	Flow (l/s)	(l/s)	Assumed Grade	Size (mm)	Capacity (50% of Pipe Full)	Qdes / Qcap	(m/s)
1C	I06	I05	0	0	7197	3.10	90.24	84.85	11.00	101.24	0.5%	450	141.12	0.72	#NAME?
1C	I05	I04	0	0	7197	3.10	90.24	84.85	11.00	101.24	0.5%	450	141.12	0.72	#NAME?
1C	C5	C4	0.93	154	154	4.19	2.61	0.93	0.12	2.73	4.1%	200	33.12	0.08	#NAME?
1C	C4	C3	0.78	129	282	4.09	4.68	1.71	0.22	4.90	3.4%	200	30.18	0.16	#NAME?
1C	C3	C2	0.26	43	325	4.06	5.36	1.97	0.26	5.61	2.5%	200	26.16	0.21	#NAME?
1C	C2	C1	1.34	257	582	3.94	9.29	3.31	0.43	9.72	4.3%	200	34.14	0.28	#NAME?
1C	C1	I04	0.99	146	728	3.89	11.45	4.30	0.56	12.01	3.4%	200	30.08	0.40	#NAME?
1B	I04	I03	0.3	72	7997	3.05	98.83	89.45	11.60	110.43	1.8%	450	264.19	0.42	#NAME?
Phase2										255.00					
1B	I03	I02	1	191	8188	3.04	100.87	90.45	11.73	367.59	0.5%	675	416.07	0.88	#NAME?
1B	B5	B4	0.94	56	56	4.31	0.98	0.94	0.12	1.10	0.5%	200	11.60	0.09	#NAME?
1B	B4	B3	1.56	258	314	4.07	5.18	2.50	0.32	5.50	4.3%	200	33.92	0.16	#NAME?
1B	B3	B2	1.15	190	504	3.97	8.11	3.65	0.47	8.58	2.1%	200	23.60	0.36	#NAME?
1B	B2	B1	1.42	272	776	3.87	12.16	5.07	0.66	12.82	4.0%	200	32.85	0.39	#NAME?
1B	B1	I02	1.85	315	1091	3.78	16.68	6.92	0.90	17.58	3.0%	200	28.59	0.61	#NAME?
				0											
1A	I02	I25	0	0	9278	2.99	112.27	97.37	12.62	379.89	0.5%	675	416.07	0.91	#NAME?
1A	I25	I01	0	0	9278	2.99	112.27	97.37	12.62	379.89	0.5%	675	416.07	0.91	#NAME?
1A	A12	A11	0.28	32	32	4.35	0.56	0.28	0.04	0.60	0.6%	200	12.70	0.05	#NAME?
1A	A11	A08	0.6	0	32	4.35	0.56	0.88	0.11	0.68	0.6%	200	12.70	0.05	#NAME?
1A	A10	A09	0.74	142	142	4.20	2.41	0.74	0.10	2.51	0.5%	200	11.60	0.22	#NAME?
1A	A09	A08	0	0	142	4.20	2.41	0.74	0.10	2.51	0.5%	200	11.60	0.22	#NAME?
1A	A08	A06	0	0	174	4.17	2.93	1.62	0.21	3.14	0.5%	200	11.60	0.27	#NAME?
1A	A07	A06	1.66	301	301	4.08	4.97	1.66	0.22	5.18	0.5%	200	11.60	0.45	#NAME?
1A	A06	A05	1.33	0	474	3.99	7.66	4.61	0.60	8.25	0.5%	200	11.60	0.71	#NAME?
1A	A13	A05	0.38	58	58	4.30	1.01	0.38	0.05	1.06	5.7%	200	39.02	0.03	#NAME?
1A	A05	A04	0.71	68	600	3.93	9.55	5.70	0.74	10.29	3.1%	200	28.66	0.36	#NAME?
1A	A04	A03	0.51	50	649	3.91	10.29	6.21	0.81	11.10	1.6%	200	20.58	0.54	#NAME?
1A	A03	A02	0.61	71	720	3.89	11.34	6.82	0.88	12.22	3.4%	200	30.27	0.40	#NAME?
1A	A02	I01	1.09	145	865	3.84	13.46	7.91	1.03	14.49	2.5%	200	25.95	0.56	#NAME?
				0											
1Z	I01		0	0	10144	2.949	121.1803	105.28	13.64741	389.83					

* Capacity based on 50% of pipe full capacity when flows are less then 40 l/s, and 70% of pipe full capacity when flows are greater then 40 l/s

** Velocity based on normal depth flow.

Unit Demand	350 l/person/day	Project	Grandview heights
Infiltration	0.130 l/s/ha	Client	City of Surrey
Manning's Coefficient (n)	0.013	USL Job	1072.0143.01

					Peak Dry Weather Flow			Infiltration Flow		PWWF	Sanitary Design				
											Pipe Capacity (l/s)			Check	**Velocity
Zone	Up stream Note	Down stream Node	Area (Hec)	Population	Acc. Popl'n	Peak Factor	Flow (l/s)	Accum. Area (ha)	Flow (l/s)	(l/s)	Assumed Grade	Size (mm)	*Capacity (l/s)	Qdes / Qcap	(m/s)
2H	P17	P16	3.57	662	662	3.91	10.49	3.57	0.46	10.95	3.8%	200	32.15	0.34	#NAME?
2H	P16	P15	2.94	478	1140	3.76	17.38	6.51	0.84	18.23	1.7%	200	21.15	0.86	#NAME?
2H	S2	S1	0.53	115	115	4.23	1.96	0.53	0.07	2.03	4.3%	200	34.07	0.06	#NAME?
2H	S3	S1	0.22	25	25	4.37	0.44	0.22	0.03	0.47	3.9%	200	32.41	0.01	#NAME?
2H	S1	P15	0	0	140	4.20	2.38	0.75	0.10	2.47	5.7%	200	39.11	0.06	#NAME?
2H	P15	P14	3.99	746	2026	3.58	29.40	11.25	1.46	30.86	0.7%	300	39.00	0.79	#NAME?
2H	P14	P13	2.91	545	2571	3.50	36.44	14.16	1.84	38.28	2.8%	300	80.38	0.48	#NAME?
2H	P13	R1	0	0	2571	3.50	36.44	14.16	1.84	38.28	1.8%	300	65.05	0.59	#NAME?
2G	R6	R5	0.46	52	52	4.31	0.91	0.46	0.06	0.97	4.5%	200	34.93	0.03	#NAME?
2G	R5	R4	0.71	0	52	4.31	0.91	1.17	0.15	1.06	11.3%	200	55.15	0.02	#NAME?
2G	R4	R3	0	0	52	4.31	0.91	1.17	0.15	1.06	0.5%	200	11.60	0.09	#NAME?
2G	R8	R7	0.16	17	17	4.39	0.29	0.16	0.02	0.31	3.6%	200	31.32	0.01	#NAME?
2G	R9	R7	0.21	25	25	4.37	0.44	0.21	0.03	0.47	0.6%	200	12.70	0.04	#NAME?
2G	R7	R3	0.96	73	114	4.23	1.95	1.33	0.17	2.12	5.9%	200	39.91	0.05	#NAME?
2G	R3	R2	0.66	0	166	4.18	2.81	3.16	0.41	3.22	5.2%	200	37.26	0.09	#NAME?
2G	R11	R10	1.97	285	285	4.09	4.73	1.97	0.26	4.98	4.8%	200	36.09	0.14	#NAME?
2G	R12	R10	0.84	17	17	4.39	0.29	0.84	0.11	0.40	5.3%	200	37.60	0.01	#NAME?
2G	R10	R2	1.27	304	605	3.93	9.64	4.08	0.53	10.17	4.3%	200	33.97	0.30	#NAME?
2G	R2	R1	0.24	57	829	3.85	12.93	7.48	0.97	13.90	5.2%	200	37.25	0.37	#NAME?
2G	R13	R1	2.87	686	686	3.90	10.84	2.87	0.37	11.21	1.9%	200	22.87	0.49	#NAME?
2G	R1	Q2	0	0	4086	3.33	55.06	24.51	3.18	58.23	0.5%	375	86.78	0.67	#NAME?
2F	Q6	Q5	0.46	52	52	4.31	0.91	0.46	0.06	0.97	5.2%	200	37.28	0.03	#NAME?
2F	Q5	Q4	0	0	52	4.31	0.91	0.46	0.06	0.97	4.0%	200	32.94	0.03	#NAME?
2F	Q7	Q4	0.37	26	26	4.37	0.46	0.37	0.05	0.51	8.8%	200	48.61	0.01	#NAME?
2F	Q4	Q3	0	0	78	4.27	1.36	0.83	0.11	1.46	10.4%	200	52.77	0.03	#NAME?
2F	Q8	Q3	1.62	351	351	4.05	5.76	1.62	0.21	5.97	2.9%	200	27.96	0.21	#NAME?
2F	Q3	Q2	1.92	406	836	3.85	13.04	4.37	0.57	13.61	3.2%	200	29.49	0.46	#NAME?
2F	Q2	Q1	0.87	155	5078	3.24	66.63	29.75	3.86	70.48	0.5%	375	86.78	0.81	#NAME?
2F	Q1	N3	0	0	5078	3.24	66.63	29.75	3.86	70.48	0.5%	375	86.78	0.81	#NAME?
2E	N2	N1	0.35	165	165	4.18	2.80	0.35	0.05	2.84	5.7%	200	39.24	0.07	#NAME?
2E	N3	N1	2.44	121	5199	3.23	68.02	32.19	4.17	72.19	0.8%	375	108.86	0.66	#NAME?
2E	N1	T1	0	0	5364	3.22	69.90	32.54	4.22	74.12	3.6%	375	233.61	0.32	#NAME?
2D	T1	P18	1.36	82	5446	3.21	70.83	33.90	4.39	75.23	3.9%	375	243.90	0.31	#NAME?
2D	P18	P04	0.76	21	5466	3.21	71.06	34.66	4.49	75.55	0.9%	375	116.49	0.65	#NAME?
2C	M6	M5	1.8	161	161	4.18	2.73	1.80	0.23	2.97	0.5%	200	11.60	0.26	#NAME?
2C	M19	M17	0.34	39	39	4.34	0.68	0.34	0.04	0.72	2.0%	200	23.43	0.03	#NAME?
2C	M17	M5	0	0	39	4.34	0.68	0.34	0.04	0.72	4.1%	200	33.03	0.02	#NAME?
2C	M5	M4	0.35	40	240	4.12	4.00	2.49	0.32	4.32	2.8%	200	27.42	0.16	#NAME?
2C	M7	M4	0.82	93	93	4.25	1.61	0.82	0.11	1.71	0.5%	200	11.60	0.15	#NAME?
2C	M4	M3	0	0	333	4.06	5.48	3.31	0.43	5.91	6.3%	200	41.29	0.14	#NAME?
2C	M8	M3	0.68	77	77	4.27	1.34	0.68	0.09	1.43	0.5%	200	11.60	0.12	#NAME?
2C	M3	M2	0.35	31	441	4.00	7.15	4.34	0.56	7.71	14.8%	200	63.04	0.12	#NAME?
2C	M2	M1	0.72	45	487	3.98	7.85	5.06	0.66	8.50	0.5%	200	11.60	0.73	#NAME?
2C	M16	M18	0.33	38	38	4.34	0.66	0.33	0.04	0.70	1.2%	200	17.62	0.04	#NAME?
2C	M12	M18	0.1	9	9	4.42	0.16	0.10	0.01	0.18	3.9%	200	32.44	0.01	#NAME?
2C	M18	M11	0.24	22	68	4.29	1.19	0.67	0.09	1.27	5.7%	200	39.06	0.03	#NAME?
2C	M11	M10	0.24	22	90	4.26	1.56	0.91	0.12	1.67	5.3%	200	37.58	0.04	#NAME?
2C	M10	M9	0.32	18	108	4.23	1.86	1.23	0.16	2.02	11.3%	200	55.10	0.04	#NAME?
2C	M9	M1	0.2	11	120	4.22	2.05	1.43	0.19	2.23	1.0%	200	16.45	0.14	#NAME?
2C	M1	M13	0	0	606	3.93	9.65	6.49	0.84	10.49	8.1%	200	46.70	0.22	#NAME?
2C	M14	M13	0.44	20	20	4.38	0.36	0.44	0.06	0.41	1.0%	200	16.40	0.03	#NAME?
2C	M13	P04	0	0	626	3.92	9.95	6.93	0.90	10.85	5.9%	200	39.73	0.27	#NAME?
2B	P04	P21	0.63	10	6103	3.16	78.22	42.22	5.47	83.69	0.5%	375	86.78	0.96	#NAME?
2B	L28	L27	0.24	5	5	4.44	0.10	0.24	0.03	0.13	1.1%	200	16.93	0.01	#NAME?
2B	L27	P21	0	0	5	4.44	0.10	0.24	0.03	0.13	6.7%	200	42.46	0.00	#NAME?
2B	P21	P03	0	0	6108	3.16	78.29	42.46	5.50	83.79	0.5%	375	86.78	0.97	#NAME?
2B	L04	L03	1.61	113	113	4.23	1.94	1.61	0.21	2.15	4.5%	200	34.84	0.06	#NAME?
2B	L03	L02	1.69	115	228	4.13	3.82	3.30	0.43	4.25	4.8%	200	36.07	0.12	#NAME?
2B	L12	L11	1.18	118	118	4.22	2.02	1.18	0.15	2.18	0.5%	200	11.60	0.19	#NAME?

Unit Demand	350 l/person/day	Project Grandview heights
Infiltration	0.130 l/s/ha	Client City of Surrey
Manning's Coefficient (n)	0.013	USL Job 1072.0143.01

Zone	Up stream Note	Down stream Node	Area (Hec)	Population	Peak Dry Weather Flow			Infiltration Flow		PWWF	Sanitary Design				
											Pipe Capacity (l/s)			Check	**Velocity
					Acc. Popl'n	Peak Factor	Flow (l/s)	Accum. Area (ha)	Flow (l/s)	(l/s)	Assumed Grade	Size (mm)	*Capacity (l/s)	Qdes / Qcap	(m/s)
2B	L11	L10	0.69	78	197	4.15	3.31	1.87	0.24	3.55	4.2%	200	33.53	0.11	#NAME?
2B	L10	L09	0	0	197	4.15	3.31	1.87	0.24	3.55	1.1%	200	17.36	0.20	#NAME?
2B	L14	L13	1.06	66	66	4.29	1.15	1.06	0.14	1.28	0.5%	200	11.60	0.11	#NAME?
2B	L13	L09	0.49	33	99	4.25	1.70	1.55	0.20	1.90	1.9%	200	22.74	0.08	#NAME?
2B	L09	L08	0	0	296	4.08	4.89	3.42	0.44	5.33	1.2%	200	17.92	0.30	#NAME?
2B	L08	L07	2.83	240	535	3.96	8.59	6.25	0.81	9.40	3.5%	200	30.64	0.31	#NAME?
2B	L07	L06	1.32	63	598	3.93	9.53	7.57	0.98	10.51	0.5%	200	11.60	0.91	#NAME?
2B	L17	L16	0.79	90	90	4.26	1.55	0.79	0.10	1.65	2.0%	200	23.06	0.07	#NAME?
2B	L16	L15	0.77	88	177	4.17	2.99	1.56	0.20	3.20	0.5%	200	11.60	0.28	#NAME?
2B	L18	L15	0.53	60	60	4.30	1.05	0.53	0.07	1.12	0.5%	200	11.60	0.10	#NAME?
2B	L25	L24	0.57	65	65	4.29	1.13	0.57	0.07	1.20	0.5%	200	11.60	0.10	#NAME?
2B	L26	L24	0.3	34	34	4.35	0.60	0.30	0.04	0.64	0.6%	200	12.70	0.05	#NAME?
2B	L24	L15	0	0	99	4.25	1.70	0.87	0.11	1.81	2.1%	200	23.98	0.08	#NAME?
2B	L15	L06	0	0	336	4.06	5.53	2.96	0.38	5.91	5.4%	200	38.19	0.15	#NAME?
2B	L06	L05	0.43	30	964	3.81	14.88	10.96	1.42	16.30	0.5%	250	21.02	0.78	#NAME?
2B	L22	L21	0.55	63	63	4.30	1.09	0.55	0.07	1.16	0.6%	200	12.48	0.09	#NAME?
2B	L21	L20	0.44	35	97	4.25	1.67	0.99	0.13	1.80	3.1%	200	28.65	0.06	#NAME?
2B	L23	L20	0.24	16	16	4.39	0.28	0.24	0.03	0.31	1.0%	200	16.40	0.02	#NAME?
2B	L20	L19	0.26	24	137	4.20	2.33	1.49	0.19	2.52	3.4%	200	30.06	0.08	#NAME?
2B	L19	L05	0.28	20	157	4.19	2.66	1.77	0.23	2.88	6.0%	200	40.32	0.07	#NAME?
2B	L05	L02	0	0	1121	3.77	17.10	12.73	1.65	18.75	0.5%	250	21.02	0.89	#NAME?
2B	L02	L01	1.68	124	1473	3.69	22.00	17.71	2.30	24.29	3.7%	250	57.25	0.42	#NAME?
2B	L01	P03	1.97	111	1584	3.66	23.50	19.68	2.55	26.06	9.7%	250	92.63	0.28	#NAME?
2A	P03	P02	1.57	75	7767	3.06	96.38	63.71	8.26	104.64	6.5%	375	313.74	0.33	#NAME?
Hwy99		K4	140	5800	5800	3.19	74.83	140.00	18.15	92.98					
2A	K3	K2	0.97	31	31	4.35	0.55	0.97	0.13	0.67	0.6%	200	12.70	0.05	#NAME?
2A	K2	K1	0	0	31	4.35	0.55	0.97	0.13	0.67	5.8%	200	39.56	0.02	#NAME?
2A	K4	K1	2.58	66	5866	3.18	75.59	142.58	18.48	94.07	0.9%	450	187.54	0.50	#NAME?
2A	K1	P02	0	0	5897	3.18	75.92	143.55	18.61	94.53	0.5%	450	141.12	0.67	#NAME?
NCP 5,3		P02	125.7	5956	5956	3.17	76.58	125.70	16.29	92.87					
2A	P02	P01	0.54	8	19628	2.66	211.58	333.50	43.23	254.81	3.1%	450	350.26	0.73	#NAME?
2Z	P01	LS	0	0	19628	2.66	211.58	333.50	43.23	254.81	0.6%	600	345.99	0.74	#NAME?

* Capacity based on 50% of pipe full capacity when flows are less then 40 l/s, and 70% of pipe full capacity when flows are greater then 40 l/s
** Velocity based on normal depth flow.

Grandview Heights NCP Area 2 Sanitary Phase 1 Collection System DCC cost table (DRAFT)

Sub Catchment	US node	DS node	Pipe Size (mm)	Pipe Length	Depth Upstream	Depth Donwstream	Depth Average	Unit Price	Link Price	Road Classification	Trunk	DCC upsizing unit price	DCC premium for upsizing cost	Trunk Main Cost
1H	J4	J3	200	88.7	2.00	2.44	2.22	$ 848	$ 75,182	N	N	$ -	$0	$ -
1H	J6	J3	200	206.6	2.00	4.03	3.02	$ 848	$ 175,223	N	N	$ -	$0	$ -
1H	J3	J2	200	169.3	4.08	3.01	3.55	$ 848	$ 143,608	N	N	$ -	$0	$ -
1H	J2	J1	200	225.6	3.06	2.00	2.53	$ 848	$ 191,340	N	N	$ -	$0	$ -
1H	J5	J1	200	126.1	3.50	4.21	3.85	$ 848	$ 106,905	N	N	$ -	$0	$ -
1H	J1	I24	200	207.7	4.26	2.00	3.13	$ 848	$ 176,128	N	N	$ -	$0	$ -
1G	I24	I23	375	223.2	2.00	4.05	3.02	$ 1,088	$ 242,816	N	N	$ 240	$53,562	$ -
1G	H7	H6	200	91.2	2.00	2.00	2.00	$ 848	$ 77,329	N	N	$ -	$0	$ -
1G	H6	H5	200	83.6	2.05	2.51	2.28	$ 848	$ 70,853	N	N	$ -	$0	$ -
1G	H9	H8	200	69.3	2.00	2.78	2.39	$ 848	$ 58,768	N	N	$ -	$0	$ -
1G	H8	H5	200	110.6	2.83	2.57	2.70	$ 848	$ 93,798	N	N	$ -	$0	$ -
1G	H5	H4	200	129.0	2.62	2.00	2.31	$ 848	$ 109,395	N	N	$ -	$0	$ -
1G	H4	H3	200	62.0	2.05	2.37	2.21	$ 848	$ 52,550	N	N	$ -	$0	$ -
1G	H10	H3	200	123.8	2.00	2.00	2.00	$ 848	$ 104,972	N	N	$ -	$0	$ -
1G	H3	H2	200	95.7	2.42	2.00	2.21	$ 848	$ 81,128	N	N	$ -	$0	$ -
1G	H2	H1	200	106.8	2.05	2.00	2.03	$ 848	$ 90,581	N	N	$ -	$0	$ -
1G	H11	H1	200	100.9	2.00	3.06	2.53	$ 848	$ 85,555	N	N	$ -	$0	$ -
1G	H1	H13	200	52.9	3.11	2.42	2.77	$ 848	$ 44,855	N	N	$ -	$0	$ -
1G	H12	H13	200	162.2	2.00	3.41	2.71	$ 848	$ 137,581	N	N	$ -	$0	$ -
1G	H13	I23	200	62.4	3.46	2.00	2.73	$ 848	$ 52,874	N	N	$ -	$0	$ -
1F	I23	I22	375	180.9	3.35	2.47	2.91	$ 1,088	$ 196,826	N	N	$ 240	$43,418	$ -
1F	I22	I21	375	79.0	2.97	2.00	2.48	$ 1,088	$ 85,978	N	N	$ 240	$18,966	$ -
1F	I21	I20	375	59.7	2.44	4.10	3.27	$ 1,088	$ 64,955	N	N	$ 240	$14,328	$ -
1F	I20	I19	375	46.5	4.60	3.15	3.88	$ 1,088	$ 50,617	N	N	$ 240	$11,165	$ -
1F	I19	I18	375	30.6	3.20	3.37	3.29	$ 1,088	$ 33,323	N	N	$ 240	$7,351	$ -
1F	G2	G1	200	183.3	2.00	2.00	2.00	$ 848	$ 155,479	N	N	$ -	$0	$ -
1F	G1	I18	200	146.8	2.05	2.00	2.03	$ 848	$ 124,521	N	N	$ -	$0	$ -
1E	I18	I17	375	73.2	3.23	2.76	3.00	$ 1,088	$ 79,683	N	N	$ 240	$17,577	$ -
1E	I17	I16	375	78.2	2.81	5.18	3.99	$ 1,088	$ 85,119	N	N	$ 240	$18,776	$ -
1E	F3	F2	200	93.8	2.00	2.00	2.00	$ 848	$ 79,562	N	N	$ -	$0	$ -
1E	F4	F2	200	71.5	3.50	4.06	3.78	$ 848	$ 60,602	N	N	$ -	$0	$ -
1E	F2	F1	200	158.2	4.11	3.50	3.80	$ 848	$ 134,166	N	N	$ -	$0	$ -
1E	F1	I16	200	223.6	3.55	2.00	2.78	$ 848	$ 189,604	N	N	$ -	$0	$ -
1E	I16	I15	375	118.1	4.87	2.00	3.43	$ 1,088	$ 128,500	N	Y	$ -	$0	$ 128,500
1E	I15	I14	375	29.3	2.05	4.40	3.22	$ 1,088	$ 31,842	N	Y	$ -	$0	$ 31,842
1D	I14	I13	375	31.6	4.45	2.37	3.41	$ 1,088	$ 34,374	N	Y	$ -	$0	$ 34,374
1D	I13	I12	375	180.1	3.23	4.33	3.78	$ 1,088	$ 195,989	N	Y	$ -	$0	$ 195,989
1D	E4	E3	200	148.9	2.00	2.25	2.13	$ 848	$ 126,291	N	N	$ -	$0	$ -
1D	E3	E2	200	223.5	2.30	2.00	2.15	$ 848	$ 189,558	N	N	$ -	$0	$ -
1D	E2	E1	200	108.6	2.05	2.00	2.03	$ 848	$ 92,077	N	N	$ -	$0	$ -
1D	E9	E8	200	100.6	3.50	3.50	3.50	$ 848	$ 85,321	N	N	$ -	$0	$ -
1D	E8	E7	200	223.7	3.55	2.00	2.78	$ 848	$ 189,686	N	N	$ -	$0	$ -
1D	E7	E6	200	43.5	2.05	2.00	2.03	$ 848	$ 36,901	N	N	$ -	$0	$ -
1D	E6	E5	200	65.7	2.05	3.10	2.58	$ 848	$ 55,736	N	N	$ -	$0	$ -
1D	E5	E1	200	57.1	3.15	4.65	3.90	$ 848	$ 48,437	N	N	$ -	$0	$ -
1D	E11	E10	200	93.3	2.00	2.00	2.00	$ 848	$ 79,122	N	N	$ -	$0	$ -
1D	E10	E1	200	109.9	2.05	2.00	2.03	$ 848	$ 93,219	N	N	$ -	$0	$ -
1D	E1	I12	200	157.4	2.05	2.00	2.03	$ 848	$ 133,513	N	N	$ -	$0	$ -
1D	E12	I12	200	69.5	2.00	2.00	2.00	$ 848	$ 58,897	N	N	$ -	$0	$ -
1C	I12	I11	450	70.3	6.03	2.58	4.31	$ 1,192	$ 83,833	N	Y	$ -	$0	$ 83,833
1C	I11	I10	450	54.1	2.63	4.60	3.62	$ 1,192	$ 64,462	N	Y	$ -	$0	$ 64,462
1C	I10	I09	450	62.3	4.65	3.27	3.96	$ 1,192	$ 74,304	N	N	$ 344	$21,443	$ -
1C	I09	I08	450	44.9	3.32	5.11	4.21	$ 1,192	$ 53,574	N	N	$ 344	$15,461	$ -
1C	D2	D1	200	110.4	2.00	2.00	2.00	$ 848	$ 93,616	N	N	$ -	$0	$ -
1C	D1	I08	200	170.5	2.05	2.00	2.03	$ 848	$ 144,620	N	N	$ -	$0	$ -
1C	I08	I07	450	61.8	4.50	2.73	3.61	$ 1,192	$ 73,657	N	N	$ 344	$21,257	$ -
1C	I07	I06	450	51.1	2.78	5.29	4.04	$ 1,192	$ 60,969	N	N	$ 344	$17,595	$ -
1C	I06	I05	450	51.9	5.34	3.03	4.19	$ 1,192	$ 61,848	N	N	$ 344	$17,849	$ -
1C	I05	I04	450	47.9	3.08	4.61	3.85	$ 1,192	$ 57,091	N	N	$ 344	$16,476	$ -
1C	C5	C4	200	225.9	2.00	2.00	2.00	$ 848	$ 191,542	N	N	$ -	$0	$ -
1C	C4	C3	200	105.6	2.05	2.00	2.03	$ 848	$ 89,544	N	N	$ -	$0	$ -
1C	C3	C2	200	74.8	2.05	2.00	2.03	$ 848	$ 63,457	N	N	$ -	$0	$ -
1C	C2	C1	200	215.3	2.05	2.00	2.03	$ 848	$ 182,564	N	N	$ -	$0	$ -
1C	C1	I04	200	113.4	2.05	2.00	2.03	$ 848	$ 96,203	N	N	$ -	$0	$ -
1B	I04	I03	450	91.3	4.00	3.55	3.77	$ 1,192	$ 108,835	N	N	$ 344	$31,409	$ -
1B	I03	I02	675	111.1	3.60	4.39	4.00	$ 1,528	$ 169,780	N	N	$ 680	$75,557	$ -
1B	B5	B4	200	100.8	2.00	2.13	2.06	$ 848	$ 85,515	N	N	$ -	$0	$ -
1B	B4	B3	200	227.0	2.18	2.00	2.09	$ 848	$ 192,490	N	N	$ -	$0	$ -
1B	B3	B2	200	177.0	2.05	2.00	2.03	$ 848	$ 150,102	N	N	$ -	$0	$ -
1B	B2	B1	200	214.0	2.05	2.00	2.03	$ 848	$ 181,504	N	N	$ -	$0	$ -
1B	B1	I02	200	208.2	2.05	2.00	2.03	$ 848	$ 176,580	N	N	$ -	$0	$ -
1A	I02	I25	675	91.8	2.90	2.66	2.78	$ 1,528	$ 140,312	N	N	$ 680	$62,443	$ -
1A	I25	I01	675	82.4	2.71	2.82	2.77	$ 1,528	$ 125,832	N	N	$ 680	$55,999	$ -
1A	A12	A11	200	87.3	2.00	3.52	2.76	$ 848	$ 74,038	N	N	$ -	$0	$ -
1A	A11	A08	200	103.0	3.57	3.75	3.66	$ 848	$ 87,341	N	N	$ -	$0	$ -
1A	A10	A09	200	103.2	2.00	2.41	2.21	$ 848	$ 87,538	N	N	$ -	$0	$ -
1A	A09	A08	200	102.6	2.46	3.64	3.05	$ 848	$ 86,965	N	N	$ -	$0	$ -
1A	A08	A06	200	102.4	3.80	3.74	3.77	$ 848	$ 86,867	N	N	$ -	$0	$ -
1A	A07	A06	200	209.7	2.00	4.05	3.02	$ 848	$ 177,821	N	N	$ -	$0	$ -
1A	A06	A05	200	197.0	4.10	2.08	3.09	$ 848	$ 167,086	N	N	$ -	$0	$ -
1A	A13	A05	200	69.8	2.00	2.00	2.00	$ 848	$ 59,228	N	N	$ -	$0	$ -
1A	A05	A04	200	224.8	2.13	2.00	2.07	$ 848	$ 190,625	N	N	$ -	$0	$ -
1A	A04	A03	200	178.1	2.05	2.00	2.03	$ 848	$ 151,042	N	N	$ -	$0	$ -
1A	A03	A02	200	207.0	2.05	2.00	2.03	$ 848	$ 175,526	N	N	$ -	$0	$ -
1A	A02	I01	200	318.1	2.05	1.97	2.01	$ 848	$ 269,722	N	N	$ -	$0	$ -
offsite	I01	existing	675	300.0	2.00	2.00	2.00	$ 1,528	$ 458,400	N	Y	$ -	$0	$ 458,400
Total									$ 9,427,373		$9,427,373	Total	$520,631	$997,401

Trunk and upsizing costs use "all up" unit rate provided by the City of Surrey, Feb 2010. $9,427,373

$9,427,373

Grandview Heights NCP Area 2 Sanitary Phase 2 Collection System DCC cost table (DRAFT)

Sub Catchment	US node	DS node	Pipe Size (mm)	Pipe Length	Depth Upstream	Depth Donwstream	Depth Average	Unit Price	Link Price	Road Classification	Trunk	DCC upsizing unit price	DCC premium for upsizing cost	Trunk Main Cost
2H	P17	P16	200	152.2	2.00	2.00	2.00	$ 848	$ 129,070	N	N	$ -	$0	$ -
2H	P16	P15	200	92.7	2.05	2.00	2.03	$ 848	$ 78,613	N	N	$ -	$0	$ -
2H	S2	S1	200	48.2	2.00	2.00	2.00	$ 848	$ 40,895	N	N	$ -	$0	$ -
2H	S3	S1	200	54.3	2.00	2.00	2.00	$ 848	$ 46,016	N	N	$ -	$0	$ -
2H	S1	P15	200	148.0	2.05	2.00	2.03	$ 848	$ 125,534	N	N	$ -	$0	$ -
2H	P15	P14	300	191.1	3.50	3.50	3.50	$ 984	$ 188,013	N	N	$ 136	$25,986	$ -
2H	P14	P13	300	139.3	3.55	2.00	2.78	$ 984	$ 137,060	N	N	$ 136	$18,943	$ -
2H	P13	R1	300	220.5	2.05	2.00	2.03	$ 984	$ 217,000	N	N	$ 136	$29,992	$ -
2G	R6	R5	200	132.9	2.00	2.00	2.00	$ 848	$ 112,697	N	N	$ -	$0	$ -
2G	R5	R4	200	42.6	2.05	2.00	2.03	$ 848	$ 36,161	N	N	$ -	$0	$ -
2G	R4	R3	200	101.6	2.05	2.06	2.06	$ 848	$ 86,122	N	N	$ -	$0	$ -
2G	R8	R7	200	33.1	2.00	2.00	2.00	$ 848	$ 28,077	N	N	$ -	$0	$ -
2G	R9	R7	200	36.7	2.00	2.08	2.04	$ 848	$ 31,108	N	N	$ -	$0	$ -
2G	R7	R3	200	198.1	2.13	2.00	2.07	$ 848	$ 168,030	N	N	$ -	$0	$ -
2G	R3	R2	200	200.2	2.11	2.00	2.06	$ 848	$ 169,734	N	N	$ -	$0	$ -
2G	R11	R10	200	175.9	2.00	2.00	2.00	$ 848	$ 149,180	N	N	$ -	$0	$ -
2G	R12	R10	200	253.8	2.00	2.00	2.00	$ 848	$ 215,212	N	N	$ -	$0	$ -
2G	R10	R2	200	205.4	2.05	2.00	2.03	$ 848	$ 174,204	N	N	$ -	$0	$ -
2G	R2	R1	200	98.8	2.05	2.00	2.03	$ 848	$ 83,770	N	N	$ -	$0	$ -
2G	R13	R1	200	182.3	3.50	3.50	3.50	$ 848	$ 154,625	N	N	$ -	$0	$ -
2G	R1	Q2	375	297.1	3.55	3.23	3.39	$ 1,088	$ 323,219	N	N	$ 240	$71,298	$ -
2F	Q6	Q5	200	81.7	3.50	3.50	3.50	$ 848	$ 69,295	N	N	$ -	$0	$ -
2F	Q5	Q4	200	108.8	3.55	2.00	2.78	$ 848	$ 92,240	N	N	$ -	$0	$ -
2F	Q7	Q4	200	83.4	2.00	2.00	2.00	$ 848	$ 70,683	N	N	$ -	$0	$ -
2F	Q4	Q3	200	102.8	2.05	2.00	2.03	$ 848	$ 87,139	N	N	$ -	$0	$ -
2F	Q8	Q3	200	78.0	2.00	2.00	2.00	$ 848	$ 66,116	N	N	$ -	$0	$ -
2F	Q3	Q2	200	121.3	2.05	2.00	2.03	$ 848	$ 102,878	N	N	$ -	$0	$ -
2F	Q2	Q1	375	107.5	3.28	2.69	2.98	$ 1,088	$ 116,958	N	N	$ 240	$25,800	$ -
2F	Q1	N3	375	14.8	2.74	2.61	2.68	$ 1,088	$ 16,124	N	N	$ 240	$3,557	$ -
2E	N2	N1	200	154.0	2.00	2.00	2.00	$ 848	$ 130,610	N	N	$ -	$0	$ -
2E	N3	N1	375	225.0	2.66	2.00	2.33	$ 1,088	$ 244,765	N	N	$ 240	$53,992	$ -
2E	N1	T1	375	178.3	2.05	2.00	2.03	$ 1,088	$ 194,029	N	Y	$ -	$0	$ 194,029
2D	T1	P18	375	102.1	2.05	2.00	2.03	$ 1,088	$ 111,134	N	Y	$ -	$0	$ 111,134
2D	P18	P04	375	165.3	2.05	2.00	2.03	$ 1,360	$ 224,793	A	N	$ 240	$39,669	$ -
2C	M6	M5	200	221.6	3.50	3.94	3.72	$ 848	$ 187,892	N	N	$ -	$0	$ -
2C	M19	M17	200	98.0	2.00	2.00	2.00	$ 848	$ 83,071	N	N	$ -	$0	$ -
2C	M17	M5	200	59.0	2.05	2.00	2.03	$ 848	$ 50,028	N	N	$ -	$0	$ -
2C	M5	M4	200	102.4	3.99	2.00	2.99	$ 848	$ 86,820	N	N	$ -	$0	$ -
2C	M7	M4	200	220.4	2.00	3.01	2.51	$ 848	$ 186,927	N	N	$ -	$0	$ -
2C	M4	M3	200	49.2	3.06	2.00	2.53	$ 848	$ 41,689	N	N	$ -	$0	$ -
2C	M8	M3	200	218.7	2.00	2.64	2.32	$ 848	$ 185,421	N	N	$ -	$0	$ -
2C	M3	M2	200	49.8	2.69	2.00	2.35	$ 848	$ 42,251	N	N	$ -	$0	$ -
2C	M2	M1	200	174.3	2.05	3.06	2.55	$ 848	$ 147,845	N	N	$ -	$0	$ -
2C	M16	M18	200	104.0	2.00	2.00	2.00	$ 848	$ 88,195	N	N	$ -	$0	$ -
2C	M12	M18	200	41.7	2.00	2.00	2.00	$ 848	$ 35,388	N	N	$ -	$0	$ -
2C	M18	M11	200	46.3	2.05	2.00	2.03	$ 848	$ 39,232	N	N	$ -	$0	$ -
2C	M11	M10	200	101.3	2.05	2.00	2.03	$ 848	$ 85,880	N	N	$ -	$0	$ -
2C	M10	M9	200	101.4	2.05	2.00	2.03	$ 848	$ 85,975	N	N	$ -	$0	$ -
2C	M9	M1	200	60.1	2.05	2.00	2.03	$ 848	$ 50,984	N	N	$ -	$0	$ -
2C	M1	M13	200	38.4	3.11	2.00	2.55	$ 848	$ 32,573	N	N	$ -	$0	$ -
2C	M14	M13	200	174.0	2.00	3.25	2.62	$ 848	$ 147,543	N	N	$ -	$0	$ -
2C	M13	P04	200	65.6	3.30	2.00	2.65	$ 848	$ 55,620	N	N	$ -	$0	$ -
2B	P04	P21	375	103.1	2.05	2.33	2.19	$ 1,360	$ 140,185	A	N	$ 240	$24,738	$ -
2B	L28	L27	200	101.5	2.00	2.00	2.00	$ 848	$ 86,087	N	N	$ -	$0	$ -
2B	L27	P21	200	63.4	2.05	2.00	2.03	$ 848	$ 53,772	N	N	$ -	$0	$ -
2B	P21	P03	375	57.4	2.38	4.07	3.23	$ 1,360	$ 78,038	A	N	$ 240	$13,771	$ -
2B	L04	L03	200	197.5	2.00	2.00	2.00	$ 848	$ 167,480	N	N	$ -	$0	$ -
2B	L03	L02	200	208.6	2.05	2.00	2.03	$ 848	$ 176,875	N	N	$ -	$0	$ -
2B	L12	L11	200	181.0	3.50	3.72	3.61	$ 848	$ 153,521	N	N	$ -	$0	$ -
2B	L11	L10	200	122.0	3.77	3.50	3.64	$ 848	$ 103,476	N	N	$ -	$0	$ -
2B	L10	L09	200	109.6	3.55	2.00	2.78	$ 848	$ 92,925	N	N	$ -	$0	$ -
2B	L14	L13	200	217.9	2.00	2.33	2.17	$ 848	$ 184,771	N	N	$ -	$0	$ -
2B	L13	L09	200	124.1	2.38	2.00	2.19	$ 848	$ 105,226	N	N	$ -	$0	$ -
2B	L09	L08	200	55.4	2.05	2.00	2.03	$ 848	$ 47,018	N	N	$ -	$0	$ -
2B	L08	L07	200	184.7	2.05	2.00	2.03	$ 848	$ 156,601	N	N	$ -	$0	$ -
2B	L07	L06	200	192.9	2.05	3.48	2.77	$ 848	$ 163,572	N	N	$ -	$0	$ -
2B	L17	L16	200	115.1	2.00	2.00	2.00	$ 848	$ 97,644	N	N	$ -	$0	$ -
2B	L16	L15	200	106.0	2.05	2.32	2.18	$ 848	$ 89,920	N	N	$ -	$0	$ -
2B	L18	L15	200	90.3	2.00	2.09	2.04	$ 848	$ 76,540	N	N	$ -	$0	$ -
2B	L25	L24	200	108.3	2.00	2.60	2.30	$ 848	$ 91,803	N	N	$ -	$0	$ -
2B	L26	L24	200	77.8	2.00	2.62	2.31	$ 848	$ 65,934	N	N	$ -	$0	$ -
2B	L24	L15	200	54.4	2.67	2.00	2.34	$ 848	$ 46,093	N	N	$ -	$0	$ -
2B	L15	L06	200	102.0	2.37	2.00	2.18	$ 848	$ 86,454	N	N	$ -	$0	$ -
2B	L06	L05	250	106.9	3.53	4.15	3.84	$ 912	$ 97,476	N	N	$ 64	$6,840	$ -
2B	L22	L21	200	84.1	3.50	3.50	3.50	$ 848	$ 71,329	N	N	$ -	$0	$ -
2B	L21	L20	200	106.4	3.55	2.00	2.78	$ 848	$ 90,216	N	N	$ -	$0	$ -
2B	L23	L20	200	56.0	2.00	2.21	2.11	$ 848	$ 47,504	N	N	$ -	$0	$ -
2B	L20	L19	200	105.2	2.26	2.00	2.13	$ 848	$ 89,181	N	N	$ -	$0	$ -
2B	L19	L05	200	102.1	2.05	2.00	2.03	$ 848	$ 86,597	N	N	$ -	$0	$ -
2B	L05	L02	250	102.9	4.20	4.43	4.32	$ 912	$ 93,872	N	N	$ 64	$6,587	$ -
2B	L02	L01	250	199.4	4.48	2.00	3.24	$ 912	$ 181,848	N	N	$ 64	$12,761	$ -
2B	L01	P03	250	207.4	2.05	2.00	2.03	$ 912	$ 189,115	N	N	$ 64	$13,271	$ -
2A	P03	P02	375	196.3	4.12	2.00	3.06	$ 1,360	$ 266,946	A	N	$ 240	$47,108	$ -

Grandview Heights NCP Area 2 Sanitary Phase 2 Collection System DCC cost table (DRAFT)

Sub Catchment	US node	DS node	Pipe Size (mm)	Pipe Length	Depth Upstream	Depth Donwstream	Depth Average	Unit Price	Link Price	Road Classification	Trunk
2A	K3	K2	200	203.2	2.00	3.07	2.54	$ 848	$ 172,311	N	N
2A	K2	K1	200	152.2	3.12	2.00	2.56	$ 848	$ 129,070	N	N
2A	K4	K1	200	82.8	3.50	3.50	3.50	$ 848	$ 70,203	N	N
2A	K1	P02	200	51.4	3.55	3.56	3.56	$ 848	$ 43,552	N	N
2A	P02	P01	375	172.4	2.05	2.00	2.03	$ 1,360	$ 234,460	A	N
2Z	P01	LS	525	100.0	2.05	2.03	2.04	$ 1,640	$ 164,000	A	Y
Total									$ 10,146,050		$10,146,050

Trunk and upsizing costs use "all up" unit rate provided by the City of Surrey, Feb 2010. $10,146,050

$10,146,050

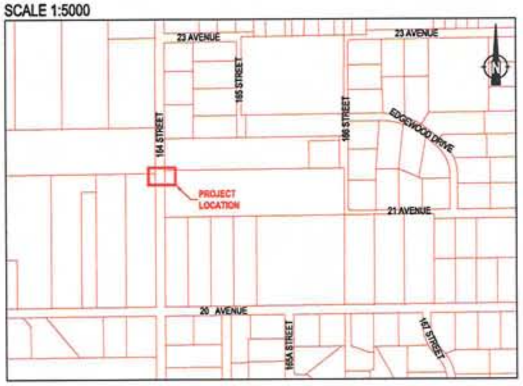
DCC upsizing unit price	DCC premium for upsizing cost	Trunk Main Cost
$ -	$0	$ -
$ -	$0	$ -
$ -	$0	$ -
$ -	$0	$ -
$ 240	$41,375	$ -
$ -	$0	$ 164,000
Total	**$435,691**	**$469,163**

Grandview Area 2 NCP Sanitary Sewer Upsizing and Trunk Element Costs

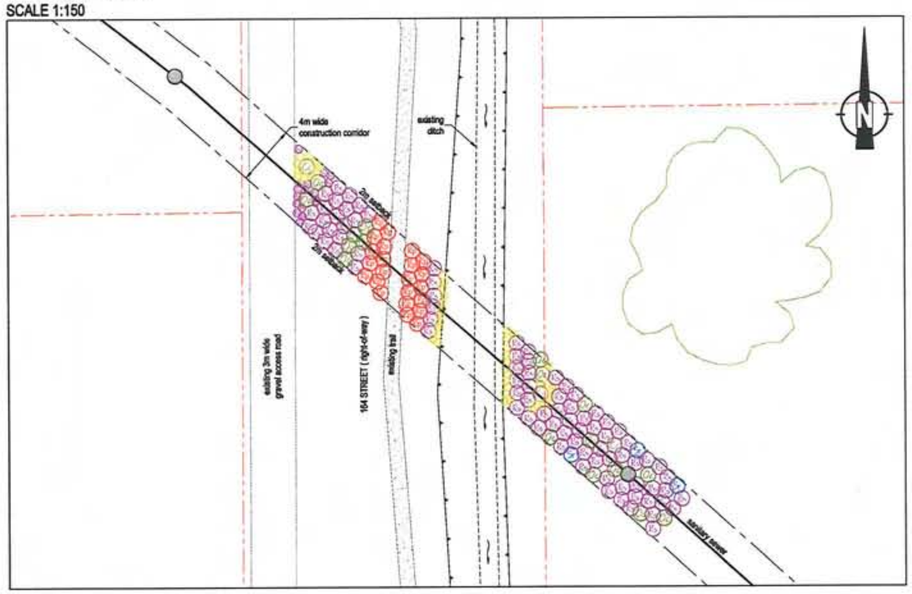
Phase	Upsizing Cost	Trunk Cost	Total
1	$ 520,000	$ 998,000	$ 1,518,000
2	$ 436,000	$ 469,000	$ 905,000
Total	$ 956,000	$ 1,467,000	$ 2,423,000

Costs are based on unit rates for upsizing and construction provided by the City of Surrey Feb 2010

LOCATION
SCALE 1:5000



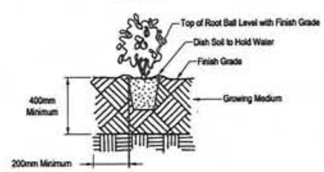
LANDSCAPE PLAN
SCALE 1:150



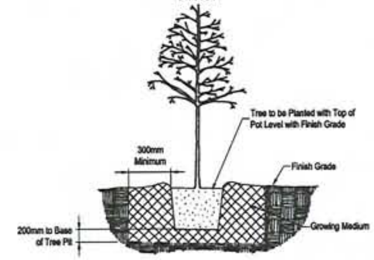
PLANT SPECIES LIST AND SPECIFICATIONS

SYMBOL	COMMON NAME	LATIN NAME	NUMBER	COMMENTS
Oc	indian plum	*Oemleria cerasiformis*	17	no. 2 pot; densely branched; well established
Sr	red elderberry	*Sambucus racemosa*	3	no. 2 pot; densely branched; well established
Cc	beaked hazelnut	*Corylus cornuta*	3	no. 2 pot; densely branched; well established
Rp	thimbleberry	*Rubus parviflorus*	23	no. 2 pot; multi-stemmed; densely branched; well established
Rs	salmonberry	*Rubus spectabilis*	85	no. 2 pot; multi-stemmed; densely branched; well established
	salmonberry	*Rubus spectabilis*	18	no. 1 pot; well established
	sword fern	*Polystichum munitum*	45	no. 1 pot; well established

TYPICAL CONTAINER SHRUB AND No. 2 POT TREE PLANTING DETAIL
N.T.S.



TYPICAL CONTAINER (No. 7 POT) TREE PLANTING DETAIL
N.T.S.



GENERAL LANDSCAPE SPECIFICATIONS

1. All works are to be conducted in accordance with the sediment control provisions of the "Land Development Guidelines for the Protection of Aquatic Habitat" jointly published by the provincial Ministry of Water, Land and Air Protection and the federal Department of Fisheries and Oceans.
2. All plant material is to be inspected and approved by Envirowest prior to installation.
3. Growing medium is to be free of any subsoils, roots, noxious grass, weeds, toxic materials, stone over 30 mm diameter, foreign objects, and possess an acidity range (pH) of 5.5 to 7.5. Growing medium to be inspected by Envirowest prior to placement.
4. All blackberry (*Rubus discolor* and *R. laciniatus*) to be cleared and grubbed from project site.
5. All debris and/or excess material from landscape operations are to be collected and disposed offsite in accordance with all regulatory requirements.
6. Disturbed areas to be seeded with red fescue (*Festuca rubra*) augmented with fireweed (*Epilobium angustifolium*) and goldenrod (*Solidago canadensis*) seed; percentage composition and application rate of final seed mix to be determined by Envirowest.
7. The contractor is to provide one (1) year of plant maintenance. Plant maintenance is to include watering, selective pruning and clearing of blackberry. Species survivorship is to equal one-hundred (100) percent one (1) year from planting. Replacement of dead stock may be required to fulfill this specification.

REFERENCE DRAWINGS
1. EMAIL: BAS 1072 0143 01 164st.dwg. Received February 07, 2008. Urban Systems Limited.
2. EMAIL: C3D 2007 1072 0143 01 164th St Crossing PP.dwg. Received February 07, 2008. Urban Systems Limited.

URBAN SYSTEMS LIMITED
Richmond, BC

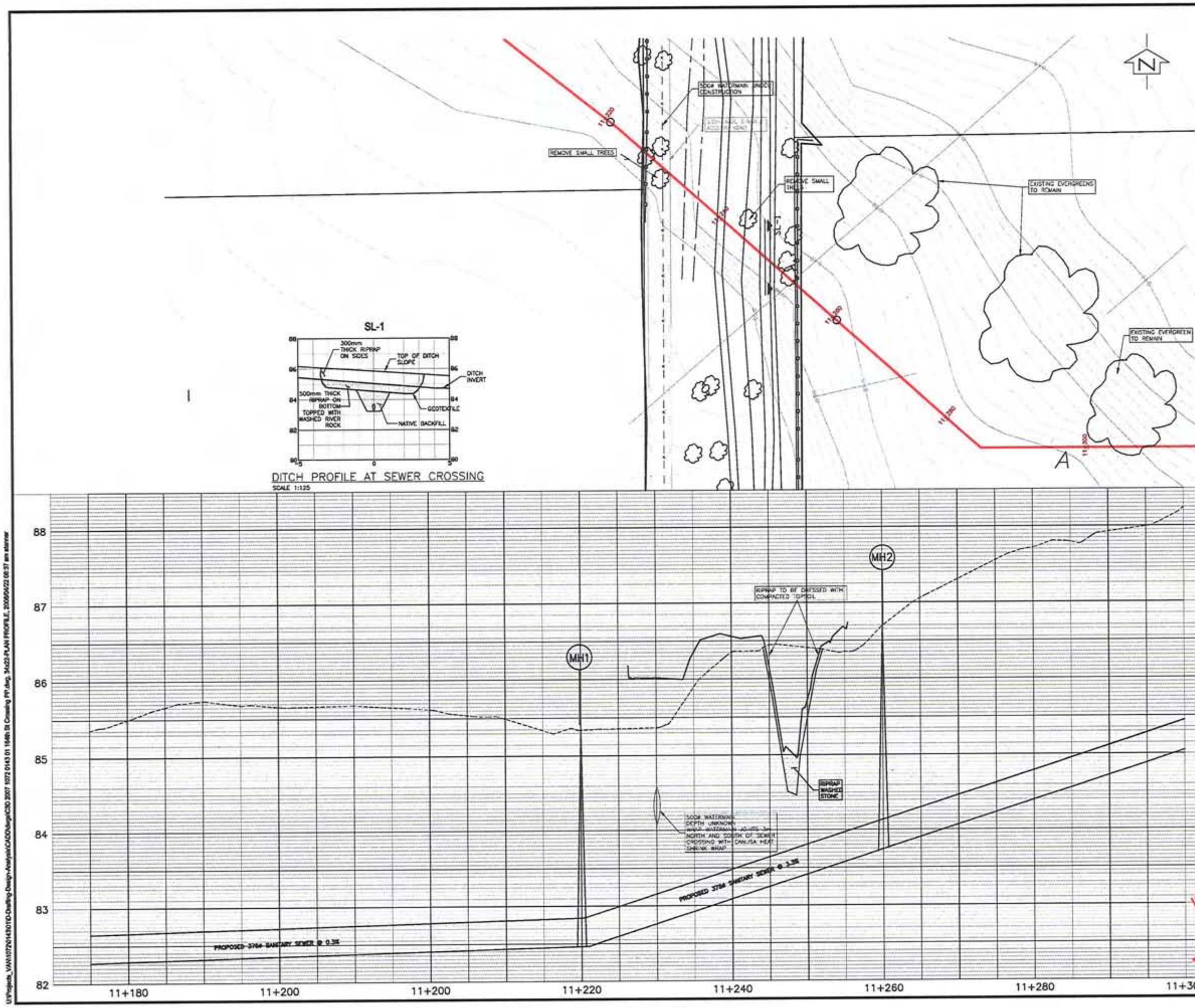
SANITARY SEWER
164 STREET NEAR 20 AVENUE
Surrey, BC

envirowest
ENVIRONMENTAL CONSULTANTS

ECL ENVIROWEST CONSULTANTS LIMITED
Suite 130 - 3700 North Fraser Way
Burnaby, B.C. V5J 5J4
www.ecl-envirowest.bc.ca
voice: 604-451-0505
facsimile: 604-451-0557

LANDSCAPE PLAN

DESIGN:	DRAWN:	CHECKED:	REVISION:	REVISION DATE:
MWC	CFE		00	
SCALE: As Shown			DRAWING NUMBER: 484-21-01	
DATE: March 28, 2008				



EXISTING UTILITIES
PRIOR TO AND DURING CONSTRUCTION THE CONTRACTOR SHALL VERIFY THE LOCATION OF ANY UTILITIES SHOWN ON THIS PLAN (INCLUDING UNDER GROUND, SURFACE, AND OVERHEAD) AS WELL AS ANY UTILITIES NOT SO SHOWN. THE CONTRACTOR WILL BE RESPONSIBLE FOR ANY AND ALL DAMAGES TO UTILITIES.

THIS DRAWING IS THE PROPERTY OF URBAN SYSTEMS LTD. AND MUST BE RETURNED TO URBAN SYSTEMS LTD. UPON REQUEST. ANY INFORMATION OBTAINED BY INSPECTION OF THIS DRAWING SHALL NOT BE USED FOR ANY PURPOSE NOT INTENDED OR AUTHORIZED BY URBAN SYSTEMS LTD.

ISSUES

NO.	DESCRIPTION	DATE (yy/mm/dd)
1	FOR APPROVAL	-
2	FOR TENDER	-
3	FOR CONSTRUCTION	-
4	FOR RECORD	-
5	FOR ARCHIVE	-

LEGEND

LINE TYPES

WATER MAIN
SANITARY SEWER
SANITARY FORCEMAIN
STORM SEWER
GAS
TELEPHONE
CABLE
HYDRO/TEL
UNDERGROUND UTILITY
PAVEMENT EDGE
GRAVEL EDGE

REVISION/ISSUE

NO.	DATE	DESCRIPTION	BY	APP'D
7				
6				
5				
4				
3				
2				
1				

DES.
DWN.
DATE YYYY-MM-DD
CHK.

SCALE

URBANSYSTEMS.

CLIENT NAME

GRANDVIEW HEIGHTS NCP #2

164th ST SANITARY SEWER CROSSING PRELIMINARY DESIGN

PROJECT No. 1072.0143.01

SHEET 1 OF 1

DESTROY ALL PRINTS PRIOR TO

DRAWING NAME Cxx

Option 1 (single pump station at bottom of hill) Class D Updated Cost Estimate 2010

Item no.	Description	Unit	Estimated Quantity	Unit Price	Amount
	Pump Station				
1.1	General Requirements (5% of subtotal)	LS	1	$270,000	$270,000
1.2	Site Preparation (shored excavation, dewatering, etc.)	m^3	1760	$1,000	$1,760,000
1.3	Cast Concrete Wet Well	m^3	40	$2,200	$88,000
1.4	Cast Concrete Off Line Storage (20mx20mx4m) walls 300mm	m^3	420	$2,200	$924,000
1.5	Supply and Install 3 Pumps (250 hp submersibles each)	LS	1	$400,000	$400,000
1.6	Mechanical systems and piping (valves, meters, pipes, etc)	LS	1	$100,000	$100,000
1.7	Valve and Flow Meter Chamber (cast concrete)	m^3	20	$2,000	$40,000
1.8	Washdown system mechanical	LS	1	$10,000	$10,000
1.9	75mm water service with backflow prevention system	LS	1	$5,000	$5,000
1.10	Control/Generator Building	m^2	85	$1,700	$144,500
1.11	Electrical/Controls	LS	1	$500,000	$500,000
1.12	Supply and install Generator (600 kW assumed, inside building)	LS	1	$200,000	$200,000
1.13	Hydro Supply to Station (3 phase) assume off 168th	LS	1	$20,000	$20,000
1.14	Hydraulic Surge Protection (allowance)	LS	1	$370,000	$370,000
1.15	Odour Control Systems (allowance)	LS	1	$500,000	$500,000
1.16	Land Acquisition	LS	1	$100,000	$100,000
				Subtotal	$5,400,000
	Engineering and Contingency (15% eng, 5% admin, 20% contingency, excluding land)				$2,130,000
	Force Main (includes E & C)				
2.1	450mm diameter	m	2500	$1,040	$2,600,000
2.2	Land Acquisition (shared with gravity sewer, 3m wide only for FM and only in locations where there is no road or trail 500m long)	m^2	1500	$185	$277,950
				Subtotal	$2,900,000
				Total	**$10,400,000**

2353 - 13353 Commerce Parkway, Richmond, BC V6V 3A1
Telephone: 604-273-8700 Fax: 604-273-8752

URBANSYSTEMS®

February 14, 2008 (updated February 27, 2008) File: 1072.0143.01 c1

City of Surrey
14245 - 56th Ave.
Surrey , BC V3X 3A2

Attention: Robert Lee, PEng.

RE: Grandview Heights Sanitary Pump Station and Force Main

As part of our investigation into servicing Grandview Heights NCP area 2 we have reviewed the pump station and force main requirements and options. The following letter report presents our findings, conclusions and recommendations.

1 Executive Summary

The southern side of Grandview Heights will require sanitary sewer pumping as outlined in the Earth Tech report: Grandview Heights South Sanitary Sewer Servicing Plan Study prepared in 2006. This report puts forward a number of options; however, the backbone of the recommended system is a primary pump station near 168th Street and 14th Ave. This pump station would service NCP Area 2, 3, 5 and Hwy 99 Corridor.

Figure number 1 illustrates the area of NCP Area 2 for which pumping is required.

Servicing NCP Area 2 with sanitary sewer will require consideration of a number of aspects, including: force main route, odour control, pump station location/s and pump station configuration.

Three potential options for the force main route are illustrated in figure number 1. Option 1 is the preferred option, with a tie in to the trunk sewer near 162nd. The other two options are either more costly or would significantly impact the phasing flexibility of development.

With this pump station there will initially be odour concerns due to the low flow. Although there are benefits to twinning the force main, including less risk of odour problems the benefits are not sufficient to justify the additional cost. We do not recommend twinning of the force main. To reduce the risk of odour problems at the pump station and the force main discharge; we recommend an odour control system.

Given the additional cost and risk to future development of the lower catchment we do not recommend a second pump station at mid elevation in NCP Area 2. Although there are some benefits to a mid elevation pump station the life cycle costs are significantly greater with two stations. A lift station at this location also has potential to result in a significant delay to development of lands below this location. We recommend a single triplex pump station be installed near 14th Ave and 168th Street.

2 Force main Alignment

Three force main alignment options have been reviewed. The key aspect of each option is the location of the force main discharge and the route taken from the pump station that will be near 168th street and

14th Ave. Option 1 involves discharging the force main near 162nd and 23rd Ave with the route generally following proposed roads. See figure 1 for illustration of force main route options. The second option is to discharge at 164th street near 21A Ave with the route generally following proposed roads; however, there is a stretch within a proposed park corridor. The third option is to follow 168th north to 20th Ave. Both options 2 and 3 discharge into the proposed gravity trunk sewer (that bounds gravity from pumped catchment), which adds considerable flow, requiring an upsize of the trunk sewer. The following table summarizes the route options

Option	Force Main Length (m)	Static Head (m)	TDH @ 254 L/sec	Estimated Force Main Cost	Gravity Sewer upgrade cost	Relative Total FM Cost
1	2500	62	76	$1,250,000	$0	$1,250,000
2	2300	67	79	$1,150,000	$115,000	$1,265,000
3	1300	75	81	$650,000	$315,000	$965,000

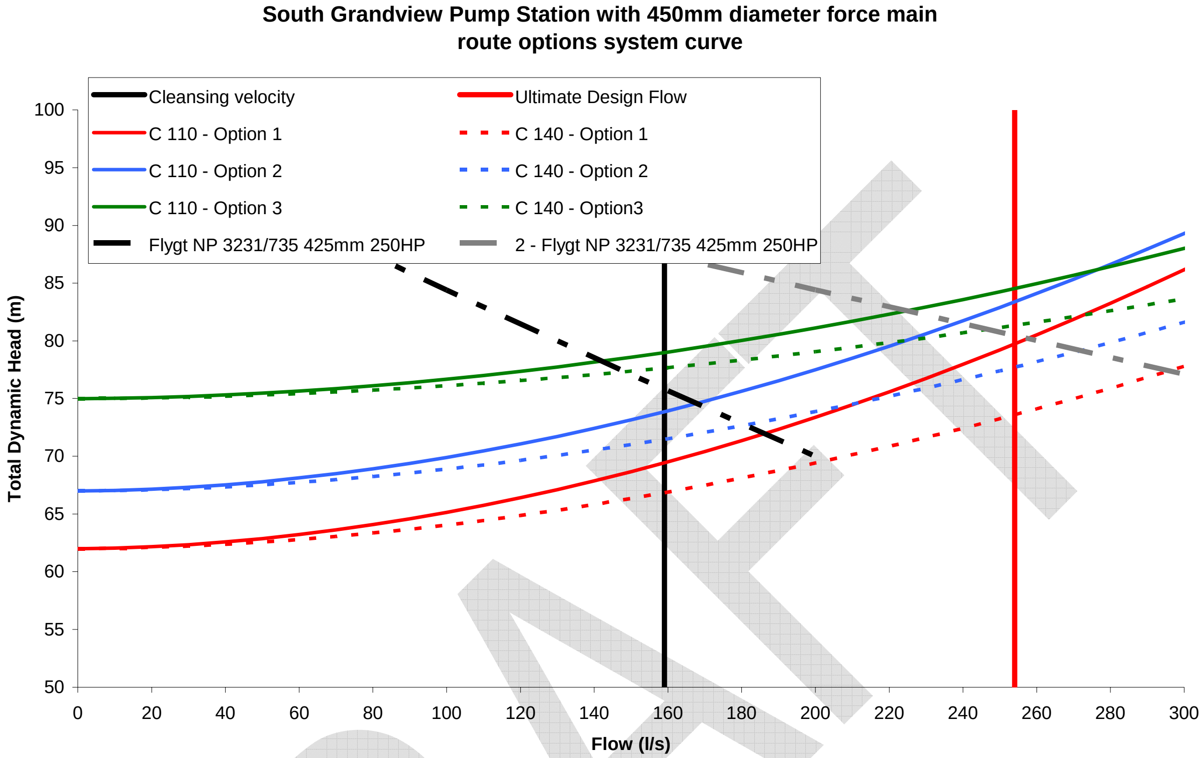
As can be seen in the table, the second option is expected to be the most costly. With option 2 there is also, a disadvantage in phasing of the works that will be elaborated on below. In addition, Option 2 would require a dedicated utility ROW adjacent to the existing watermain (under construction) on 164th between 20th and 21A. The offset from the watermain would be a minimum of 3m and an access/maintenance road would be required. This area (164th ROW between 20th and 23rd) has been set aside as a park and also contains a yellow listed watercourse. Obtaining permission (from parks and fisheries) for this alignment of the force main may be a challenge. For the watermain route there was considerable resistance from parks.

Option 3 is expected to be the least costly option; however, it would cause a very significant disadvantage with phasing of development.

The disadvantage with options 2 and 3 are that they rely on the presence of the trunk sewer serving the north catchment. If options 2 or 3 are chosen the pump station could not be constructed until the trunk sewer is built to at least the tie in point. This would significantly reduce the flexibility in phasing development for lands served by the pump station. This would also have a delaying effect on construction of the pump station.

Other options were reviewed that included extending the force main north along the BC Hydro corridor; however, review of aerial photographs suggests that there is significant development in progress to the west of the NCP Area near 22nd street. This existing development, which includes a large pond, would likely mean that routing the force main past 20A Avenue along the Hydro corridor would be challenging.

The following graphic illustrates the pumping requirements for each of the three route options.



For the second and third options higher head pumps would be required for the initial conditions where less flow is required. This means that the pumping costs for the second and third options would be higher initially (pump cost and electricity cost). This initial condition could last for many years resulting in higher total energy consumption over the life of the pump station.

To retain the flexibility in phasing development and to keep pumping costs down we recommend that force main route Option 1 (tie in at 162nd) be chosen.

3 Odour Control

If the age of the sewage within the system exceeds 4 hours, there is risk of odorous gases becoming entrained within the fluid. With new pump stations in newly developed areas infrequent cycling of the pumps will result in odour problems. Odour generally occurs when gases become airborne (leave the fluid) which can often be a result of turbulence. Careful design of the pump station and force main hydraulics will reduce the risk of entrained gases escaping. In addition to careful design, there are ways of reducing the risk of odour problems. For the purposes of this report, two ways of reducing the risk of odour were reviewed: twinning of the force main and odour control systems. Each option is presented below.

3.1 Force Main Twinning

The report titled Grandview Heights South Sanitary Sewer Servicing Plan Study[1] contains some discussion on whether the force main should be installed as a twin or a single pipe. The argument is centered on the issue of odour and the residence time of sewage. When the station is first constructed it will have little flow and the residence time could on average be longer than normally desired for odour control.

Initial sizing of the force main has revealed that a 450mm diameter pipe will be adequate for the ultimate condition. The force main will be approximately 2500 m long depending on the final alignment. The minimum average flow to keep the residence time in the force main below 4 hours is about 28 L/sec.

It is expected that some flow will be diverted from the Highway 99 corridor once the pump station is operational subject to funding and securing the ROW. The flow criterion of 28 L/sec is equivalent to flow from approximately 6900 persons. Unless there is considerable pre existing development within Hwy 99 corridor there will be insufficient initial flow to keep the sewage age below 4 hours.

The following table summarizes the approximate number of units and people needed to achieve the 4 hr criteria within both single and twin force mains.

Force Main Diameter (mm)	Force Main Volume (cu. m)	4 hour flow (L/sec)	Minimum population	Minimum Number of Units*
450	397	28	6912	2160
350	240	16.7	4122	1288

*Assuming 3.2 people per unit

It is much more likely that there will be sufficient flow to meet the minimum sewage age with a twinned force main. The minimum flow required for a twinned force main is about 2/3 that of a single pipe.

There would be a premium for twinning the force main, both in additional trench width and material costs. Twinning the force main would require a wider trench to allow for compaction room between the pipes in addition to the extra pipe. We estimate an additional 0.5m in trench width would be required. This additional trench width would add approximately 2000 cubic meters of extra backfill over the length of the force main along with a proportional increase for the removal of surplus excavation.

In addition to the material costs for twinning, there would be additional effort required to place and lay the pipe.

The estimated costs for the two pipe size combination options are shown below:

Configuration (diameter in mm)	Total Cost Per Meter	Total Force Main Cost (2500m)
450	$500/m	$1,250,000
350 and 350	$650/m	$1,625,000

[1] Earthtech, 2006

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The additional cost for twinning is expected to be approximately $400,000. The unit cost for twinning the force main is only applicable if both pipes are constructed at the same time. If two 350mm diameter pipes were installed at separate times, the premium for twinning would be closer to double the price for a single 450mm pipe. The additional expense with twinning would reduce the risk of initial odour issues; however, there is still concern that they would not be solved by twinning. Although the average age of sewage is targeted to be less than 4 hours, there can be times during the day when the overall flow rate is too low to achieve this. During these low flow times, controlling odour even with a twinned force main would be problematic.

The following table summarizes the force main options.

Criteria	350mm diameter	2 x 350mm diameter	450mm diameter
Q_{min} minimum velocity (cleansing) 1m/sec	96 L/sec	192 L/sec	159 L/sec
Q_{max} (ultimate flow)	N/A	254 L/sec	254 L/sec
Initial TDH @ Q_{min}	68 m	N/A	66 m
Ultimate TDH @ Q_{max}	N/A	73	75 m

Note: The duty points indicated in the table above are based on a 2500m long force main.

The decision between twinning and not twinning the force main appears to be heavily dependent on the perceived timing of demand on the pump station. There are a number of NCP Areas that will ultimately contribute flows and each one will ultimately develop at a different rate and time.

Advantage of twinning:

- Sewage turn over rate to reduce odour issues more easily achieved
- By initially using only one of the two mains pump station can operate using smaller horse power pumps
- Two forcemains provide greater operational flexibility
- Easier to phase in pump station upgrades if rate of development slows.

Disadvantages of twinning:

- Increased cost (especially if the pipes are not constructed at the same time)
- Will not completely solve the odour issue
- Additional ROW width required

Given that twinning is expected to cost significantly more than a single pipe, and that it is not certain to solve the odour issues we do not recommend twinning. The final decision for twinning or not should be made at the time of preliminary design once the initial flows to the station are understood more clearly.

3.2 Odour Control Systems

To ensure there are no odour issues with this pump station and force main, an odour control system could be installed. This might consist of chemical addition, aeration, and/or filtration beds. This odour control system would ensure that there are no odour issues regardless of the rate of development. Given our current understanding of the development rate in the pump station catchment we recommend that an odour control system be installed.

4 Pump Station

4.1 Location and Options

There are two options that Surrey wishes to consider for the pump station configuration. Option 1 is to have a single pump station located at the south end of NCP Area 2; Option 2 would add a permanent pump station near 18th Ave. With both options, the primary station at the bottom of the hill would service NCP Area 2, 3 and 5 as well as Hwy 99 corridor. In Option 2 the second pump station would service only those portions of the Area 2 below the gravity trunk sewer that are able to flow to the potential location. There are benefits and disadvantages of both options, which will be discussed below.

With Option 2 the benefit of having an intermediate station is that some of the total flows would be intercepted at a higher elevation and would require less energy input during pumping.

With two pump stations the question arises about how to configure the force main. Each pump station would discharge to the same point and it would make sense to use the same ultimate line; however, the second station would not be able to achieve cleansing velocity on its own. In order to solve this problem (before the primary station is operational) either the second pump station would need its own smaller forcemain or oversizing of the pumps or routine pigging of the forcemain would be required.

Another disadvantage with the two pump station configuration is that there would ultimately be two pump stations to both construct and maintain. This would mean duplication of, pumps, control building or kiosk, standby electrical generator, hydro service, emergency storage volume and surge protection systems just to name a few. This duplication would require considerable additional labour and effort to construct and maintain. See next section for a discussion of costs.

The installation of an intermediate pump station in NCP Area 2 would leave the lowest density parts of the Area 2 unserviced by sewer until the larger more costly station were constructed. This may impact the ability of the remaining areas to finance the second pump station effectively sterilizing it to development. With the majority of the planned higher density already serviced at mid elevation with an intermediate station it would be challenging for a developer to justify the cost of constructing the pump station at the bottom of the hill. Installation of the intermediate station would also leave the Hwy 99 corridor and the other NCP Areas that will ultimately depend on the larger station unserviced.

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4.2 Costs

The following table summarizes the expected costs for both Options 1 and 2 (one or two pump stations)

Pump Station Options Capital Cost

Option	Station Location	Estimated Pump Station and Force Main Capital Cost 100% DCC ($)	Area 2 Collection System DCC cost	Sewer System DCC Total Cost	Expected Area 2 DCC Sewer revenue	DCC Sewer Shortfall
1	Bottom of Hill	$7,000,000	$890,000	$7,890,000	$4,700,000	-$3,190,000
2	Mid Elevation Bottom of Hill	$3,000,000 $6,600,000		$10,490,000	$4,700,000	-$5,790,000

Pump Station Options Ongoing Costs

Option	Station Location	O&M Net Present Cost (35 year life cycle) * and **	Replacement Net Present Cost (35 year life cycle) **	Total Net Present Cost
1	Bottom of Hill	$3,100,000	$4,430,000	$7,520,000
2	Mid Elevation Bottom of Hill	$4,650,000	$6,070,000	$10,720,000

*Based on 2008 utility and labour rates
**net present value with discount rate of 3%

Pump Station Options Total Costs

Option	Station Location	Total Life Cycle Cost
1	Bottom of Hill	$14,520,000
2	Mid Elevation Bottom of Hill	$20,320,000

Both the capital cost and ongoing costs for Option 2 are more costly. The total life cycle cost for Option 2 is significantly more than for option 1 as well as creating an additional weak point in the overall system, therefore we recommend choosing Option 1. From this point in the document it is assumed that the single pump station option will be chosen.

4.3 Pump Arrangements

It is expected that the pump station would operate either in a duplex or triplex arrangement. With duplex there are two pumps each capable of meeting the duty point, the second pump is there for standby purposes. With a triplex arrangement two pumps working together meet the duty point and the third pump is for standby. In each of these arrangements the individual pumps rotate sequentially between duty and standby mode.

The duty point is a relatively high head application for a sanitary sewage application; however, we have found pumps suitable for both the duplex and triplex arrangement from two suppliers. The two suppliers reviewed are Flygt and Cornell. Series pumping is not necessary. The pumps evaluated in detail were the Flygt models.

See the attached system and pump curves for duplex and triplex. Please note the duplex curves have not been updated since the previous submission of the document and reflect a slightly different duty point.

The duplex option uses very large high power pumps. The pumps are estimated to be approximately 450 hp each and to meet the initial duty point would require Variable Frequency Drives (VFD). The pumps would weigh over 3000kg each. According to Flygt they have no existing applications of submersible sewage pumps this size in BC. It would be a non typical pump station.

The VFDs for pumps with 450 hp would be costly. If no VFDs were used there would be no point to twinning the force main since the pumped flows would be the same as the ultimate. Initially the disadvantage would be that the pump would turn on for a short period of time and then remain idle for a long time while the wet well filled. This relates back to the sewage age and odour issue discussed previously.

BC Hydro levies a demand charge in addition to the energy charge for business customers with demands over 35 kW (47 hp). Higher power demands are charged at a premium. For the duplex arrangement with the high hp pumps there would be a significant demand charge each time the pumps operated. With triplex there would be less demand charge than duplex.

The triplex option uses smaller pumps and may not require VFDs. Soft starters could be used for the triplex option; however, the initial flow would be about 130L/sec. This flow may be more than desirable and VFDs may be necessary to keep the flow lower. Alternatively, an interim impellor may be used that would meet the initial duty point.

Preliminary costs for the duplex and triplex options indicate that for the pumps only, the three pumps (triplex) would be less costly than the two pumps (duplex).

The advantage with a triplex is that it can be initially constructed with only two pumps allowing for a reduced initial capital cost. The reduced initial capital cost with only two pumps would extend to the electrical system and potentially the generator. This would allow development to proceed and the collection of DCCs to put towards the upgrade to ultimate capacity (additional pump).

4.3 Station Configuration

It is anticipated that either the duplex or triplex arrangement would be constructed with a cast in place concrete wet well and submersible pumps. A wet pit – dry pit arrangement would also be feasible; however, in recent years that has fallen out of favour partly due to the safety concerns with confined space and pump maintenance.

The geometry of the wet well will depend on the pump arrangement and pumps chosen; and should be evaluated during preliminary design. The inlet design should allow even distribution of the flow to each of the pumps. The optimal inlet design will depend on the pump arrangement and thus should be carefully evaluated at the design stage.

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We recommend the triplex arrangement as it provides the most flexibility and allows the upgrade costs to be collected over time after the pump station is initially in operation.

Given the size and importance of this pump station protection against power failures and emergency situations is critical. To ensure pumping can continue during a power failure, a standby generator will be required. The Surrey Design Criteria Manual indicates that for stations without standby power a minimum of 1 hour storage at Peak Wet Weather Flow is required. It is our understanding that with this station Surrey is willing to accept 30 minutes of storage given the size of the station and that standby power will be present on site.

The storage requirement of 254 L/sec for 30 min equates to 458 cubic meters. This volume can be taken up either in the upstream pipes or at the pump station. The relatively steep topography doesn't allow for significant storage within the upstream pipes and most of the volume will need to be contained at the pump station. The storage volume required is significantly more than is available in the wet well, which would need to be enlarged or an offline storage tank provided. The approximate size of this storage tank would be 15m x 15m with a cycle depth of 2m. A tank of that size would be cumbersome to maintain as a wetwell and would create operational difficulties such as wall cleaning. An offline storage tank is recommended that would only activate when the sewage level in the wet well reached the maximum allowable height.

The offline storage tank would have a pipe entrance set a little higher than the maximum normal sewage level in the wet well. Once the sewage level in the wet well reached the pipe it would spill into the offline tank that would provide the 30min of total storage time. The offline tank would drain back to the wet well through a flap gate near the low water level of the station. When the offline tank were activated and drained there would be residual sewage remaining in the tank. This residual would create an odour problem if left without cleaning. The tank would require a cleaning system such as a large sprinkler or tipping bucket mechanism. Manual cleaning would also be feasible; however, this would be a confined space exercise and would need to be considered based on the expected use frequency of the tank. The geometry of the tank would need to be configured so it would drain any solids that had entered during an event. This would mean a filleted or tapered bottom sloped to the outlet pipe.

With either of the pump station configurations protection against fluid transients in the force main will be required. Transients in sewage force mains are typically less severe than for clear water situations due to the entrained air in the sewage. The magnitude of the transient is related to the wave speed within the pipe and the entrained air acts as a cushion to slow down the wave speed. There are a number of ways to reduce or protect against transients, such as: material selection of the forcemain, surge anticipator/relief valves, pump flywheels, air valves, and compressed air vessels. The detailed requirements for the transient protection systems should be determined at the design stage.

Given allowance for the offline storage tank, wet well, valve chamber, and control building the total foot print of the station would be considerable. The control building would likely be a minimum of two rooms, one for the standby generator and one for the pump controls and electrical. If a compressed air tank is required for transient control it may require a separate room in the building. The total land footprint of the station is expected to be at least 30m x30m, and construction area may be even more.

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5 Conclusions and Recommendations

With the three potential options for the force main route there is one that stands out as preferred. That route is Option 1 with a tie in to the trunk sewer near 162nd. The other two options either are more costly or would significantly impact the phasing flexibility of development.

With this pump station there will initially be odour concerns due to the low flow. Although there are benefits to twinning the force main, including less risk of odour problems the benefits are not sufficient to justify the additional cost. We do not recommend twinning of the force main. To reduce the risk of odour problems at the pump station and the force main discharge; we recommend an odour control system.

Given the additional cost and risk to future sterilization of the lower catchment we do not recommend a second pump station at mid elevation in NCP Area 2. Although there are some benefits to a mid elevation pump station the life cycle costs are significantly greater with two stations. We recommend a single triplex pump station be installed at 14th Ave and 168th Street.

We look forward to discussing these options and results with you; please let me know if you have any questions.

Yours truly,

URBAN SYSTEMS LTD.

Poul Rosen, EIT
Design Engineer

Dave Kirsop, PEng.
Principal

/pr

Document2

2353 - 13353 Commerce Parkway, Richmond, BC V6V 3A1
Telephone: 604-273-8700 Fax: 604-273-8752

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TECHNICAL MEMORANDUM

date:	September 17, 2007
to:	Robert Lee, PEng.
cc:	
from:	Poul Rosen, EIT
file #:	1072.0143.01 c1
subject:	**GRANDVIEW HEIGHTS NCP #2 PRELIMINARY INTERCEPTOR SEWER ALIGNMENT**

Robert,

We have reviewed the feasibility of constructing a sanitary interceptor sewer for Grandview Heights NCP #2.

As you know there is a recently constructed 600mm diameter (currently dry) sanitary sewer located at the intersection of 24th Ave. and 160th Street. This sewer flows to the north on 160th, and is planned to accept flows from Grandview Heights NCP #2 and other local development. The commissioning date for this sewer is unknown.

Flows from Grandview NCP #2 that are not able to reach this location by gravity will flow downhill to the south and require pumping. The capital and ongoing costs of pumping are a strong incentive to capture as much flow by gravity as possible. The design goal for this interceptor sewer was to maximize the area serviced by gravity flow to the intersection of 24th Ave. and 160th Street.

The alignment of the interceptor sewer was chosen based on topography and compatibility with the proposed roads and landuse plan. The alignment was placed within roads where possible; however, there were some instances where lots were traversed. When it was required to cross a lot, it was taken at right angles to roads so as to minimize the impact. The impacts to lots from traversing them with the sewer were not considered as part of this exercise.

The design principles were as follows:

- Minimum cover
    - 1.0m under non roads
    - 1.5 m under roads
- Maximum invert depth, 5.0 meters
- Preferred invert depth 2.0 to 3.5 meters
- Design flow < 70% of internal diameter
- Minimum slope of 0.3%
- Preferred minimum slope of 0.5%

The existing ground was taken based on 1m contours provided by Surrey. In addition to the contours, preliminary road profiles were prepared for the locations of crossings and routing within the roads. Preliminary record drawing information was available for the recently constructed sanitary sewer on 24th Ave. between 160th and 162nd. The record drawings were used to provide invert elevations for the tie in point manhole and the elevation of 24th Ave road between 160th and 162nd. It should be noted that the capacity of the existing 250mm (70% full) sanitary sewer is about 35 L/sec. Maximum discharge for this pipe is about 45 L/sec.

The demand on the interceptor sewer will depend on the final location of the alignment; however, the interceptor sewer in its current location could see flows as high as 77 L/sec (high population) and 55 L/sec (low population). These potential demands exceed the capacity of the existing sewer installed on 24th between 160th and 162nd. To handle flows from the interceptor sewer, this stretch of sewer would require either twinning, or replacement with a higher capacity pipe.

The diameter of the interceptor sewer will vary as it climbs up the hill and the service area drops. In the lower reaches where the slope is shallow and the flows are highest the diameter could be as much as 450mm. In the upper reaches it will likely reach minimum diameter.

There are a few locations along the proposed alignment that are worth noting.

1. Sewer crossing of existing 164th Street ROW. The 164th ROW in this area is reported to be a stream channel with some environmental significance. In fact the planned future location of 164th has been relocated to the west to avoid impacting the watercourse. The details of this crossing have not been considered; aside from identifying that it will likely be a constraint for detailed design. The elevations of the stream and the impact on the sewer profile were not reviewed as part of this preliminary design. The stream channel may have significantly different elevations from that shown by the contours, thus necessitating a review of the crossing location and or elevation.
2. The crossing of 21st Ave near 165th Street will be a challenge. 21st Street in this zone is a multiuse corridor; however, the topography here makes it a challenge to continue south on 165A street. As it is shown on the drawing there is a short stretch of sewer that is close to 5m deep.
3. The stretch between 10+480 to 10+580 is currently shown at the edge of a parcel. It may be possible to move the sewer from the front of the lot to the back. Alternatively, it might be worth considering shifting the road to the east to suit the sewer grade.

The alignment shown on the drawing should be considered preliminary. There is some room for minor adjustment of location to suit property lines and land use; however, the general concept and location should be accepted or a least discussed before continuing. Final design and alignment should proceed in conjunction with development of NCP Area 2.

Once you have had a chance to review the alignment, perhaps we could meet to go over the details.

URBAN SYSTEMS LTD.

Poul Rosen, EIT
Design Engineer

/pr

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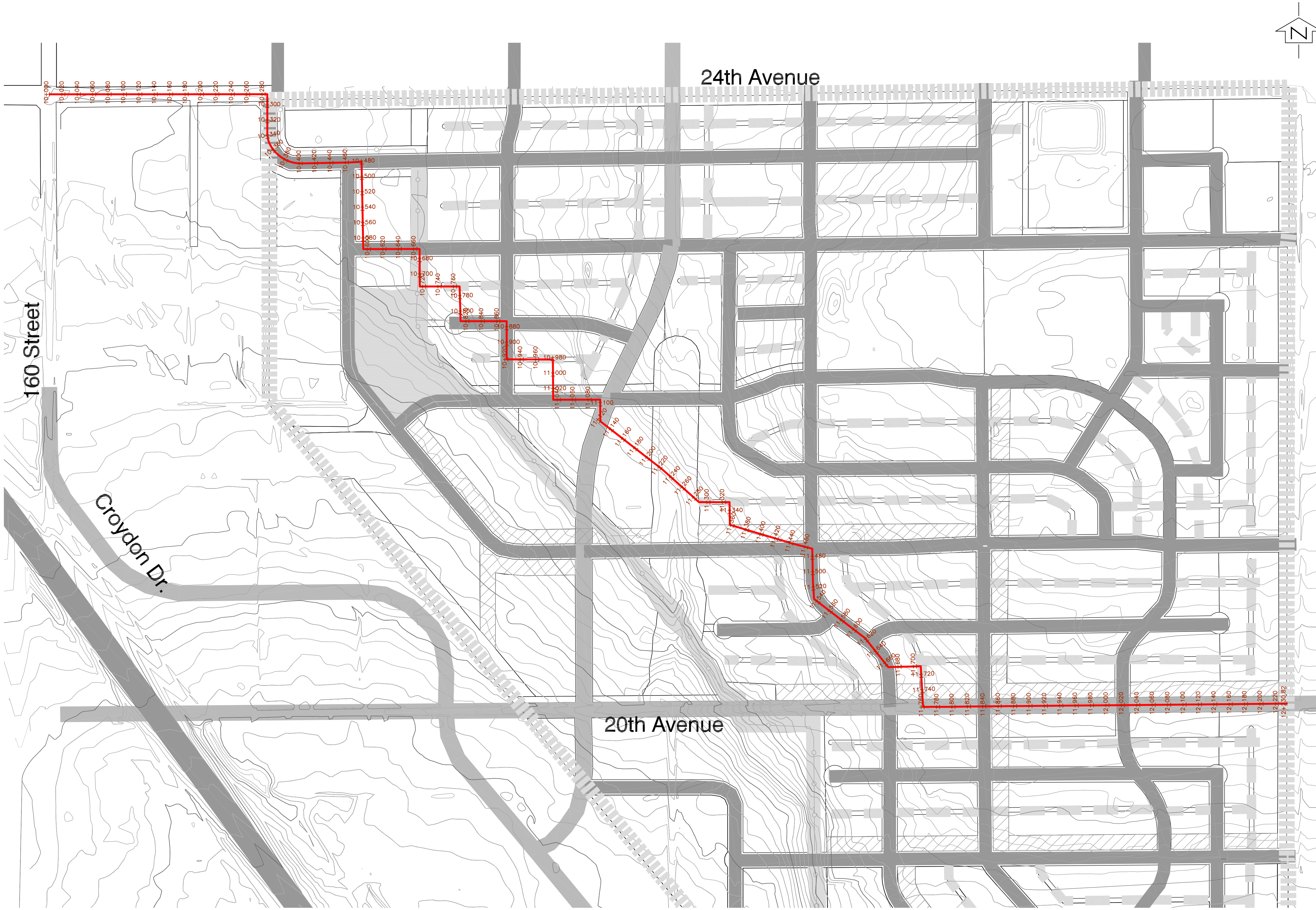

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SURREY CITY OF PARKS

Grandview Heights NCP #2
Sanitary Interceptor

Keyplan

PROJECT No. 1072 0143 01

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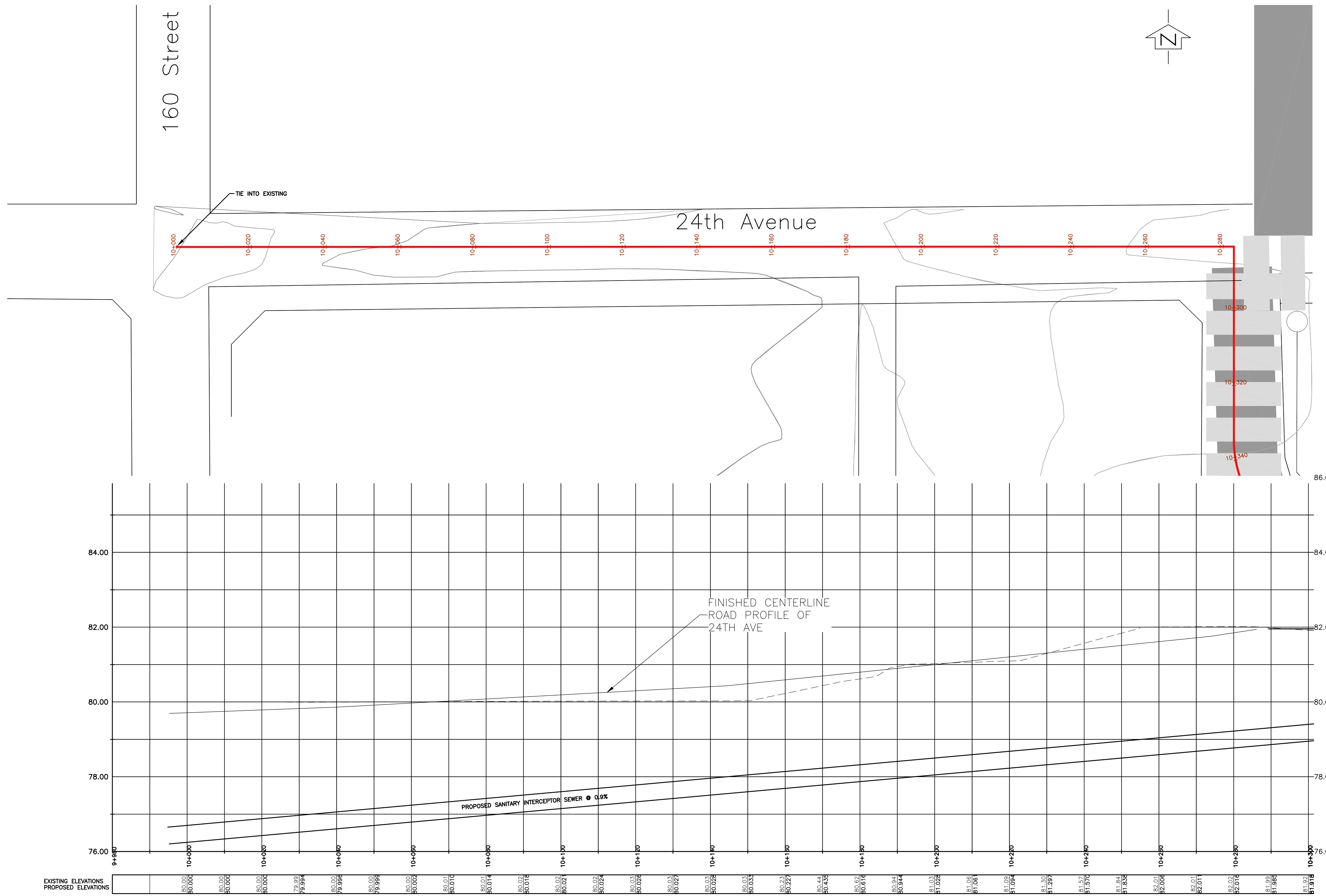

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Grandview Heights NCP #2
Sanitary Interceptor

Plan Profile Stn 10+000 to Stn 10+300

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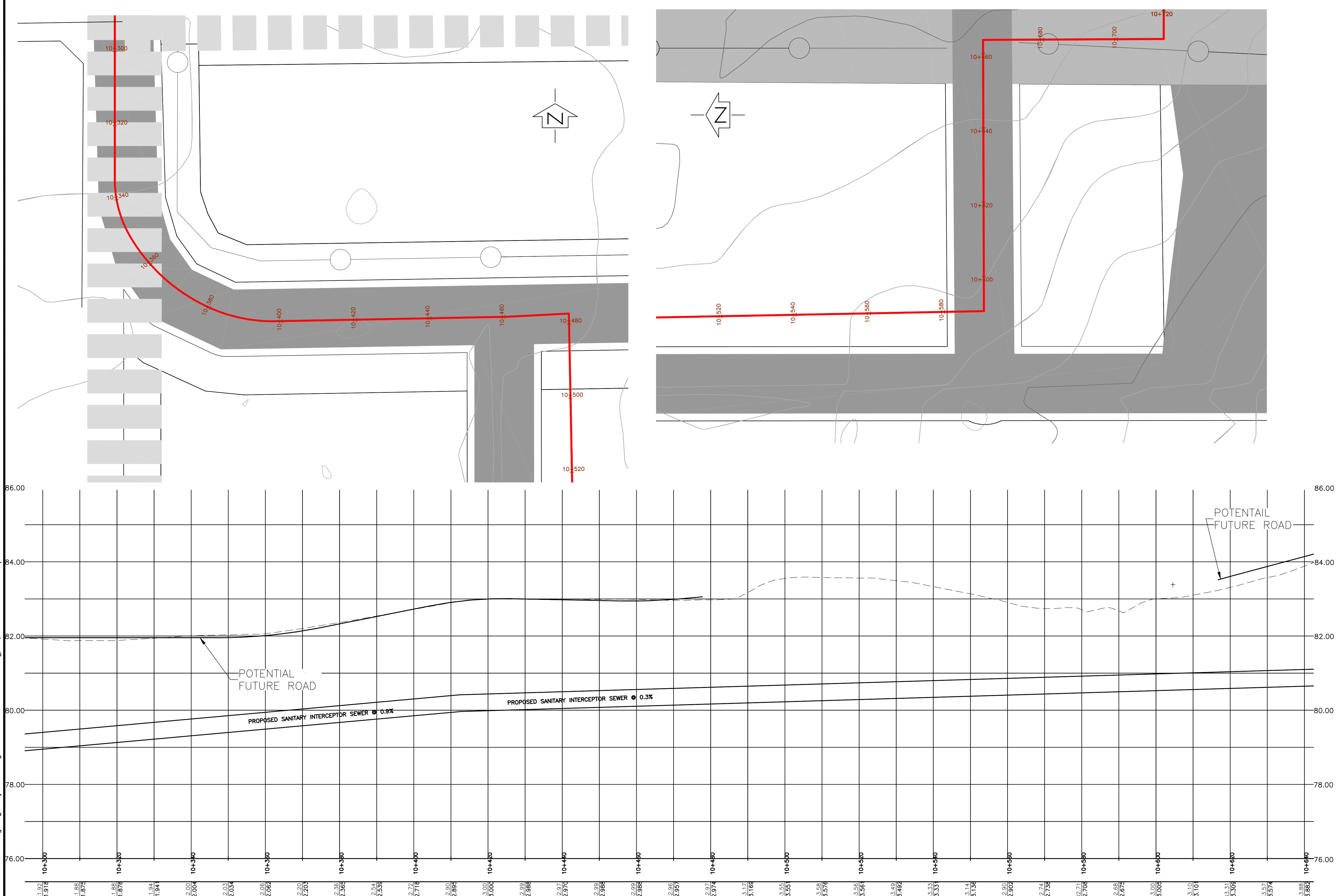

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Sanitary Interceptor

Plan Profile Stn 10+300 to Stn 10+640

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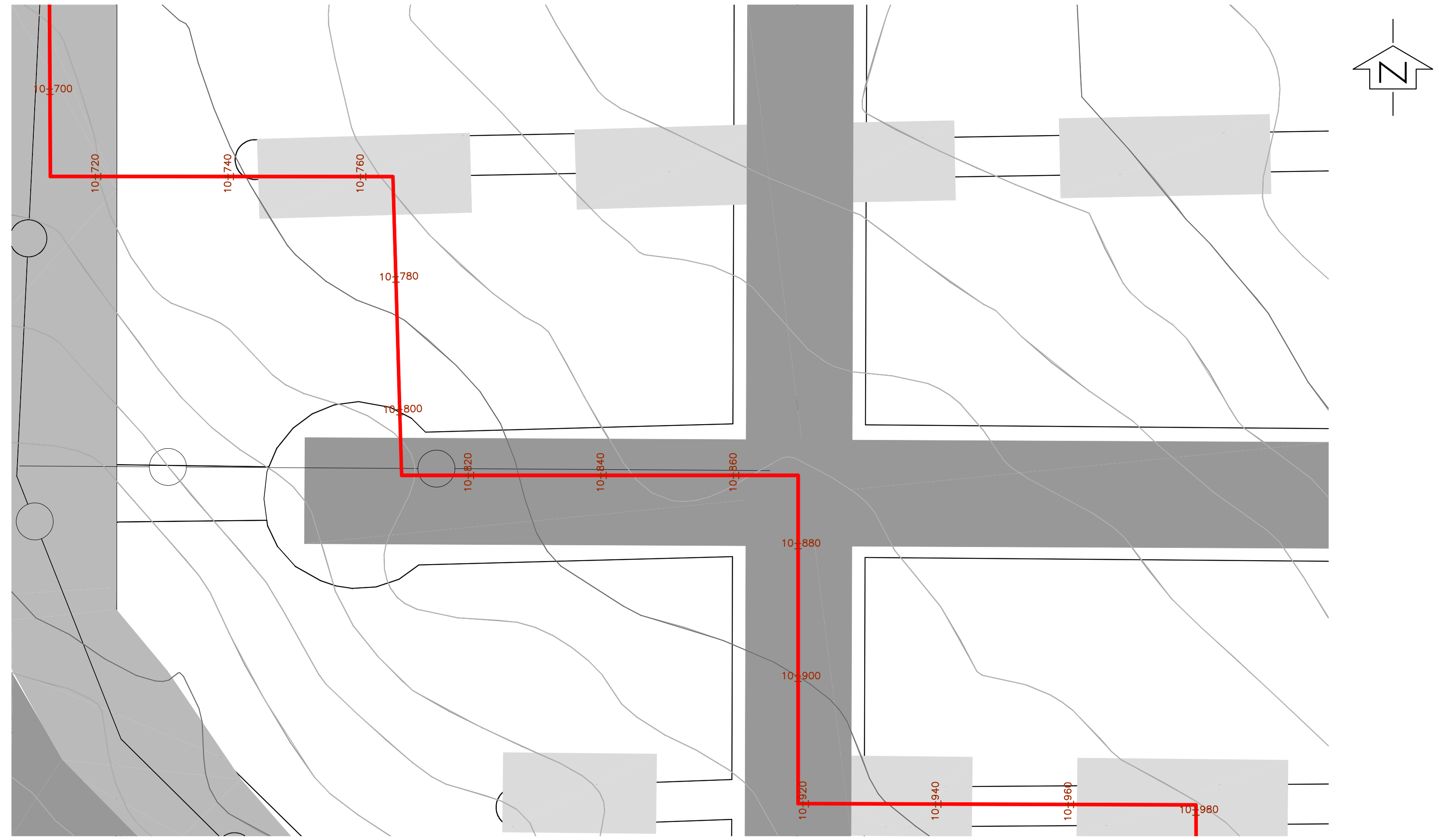

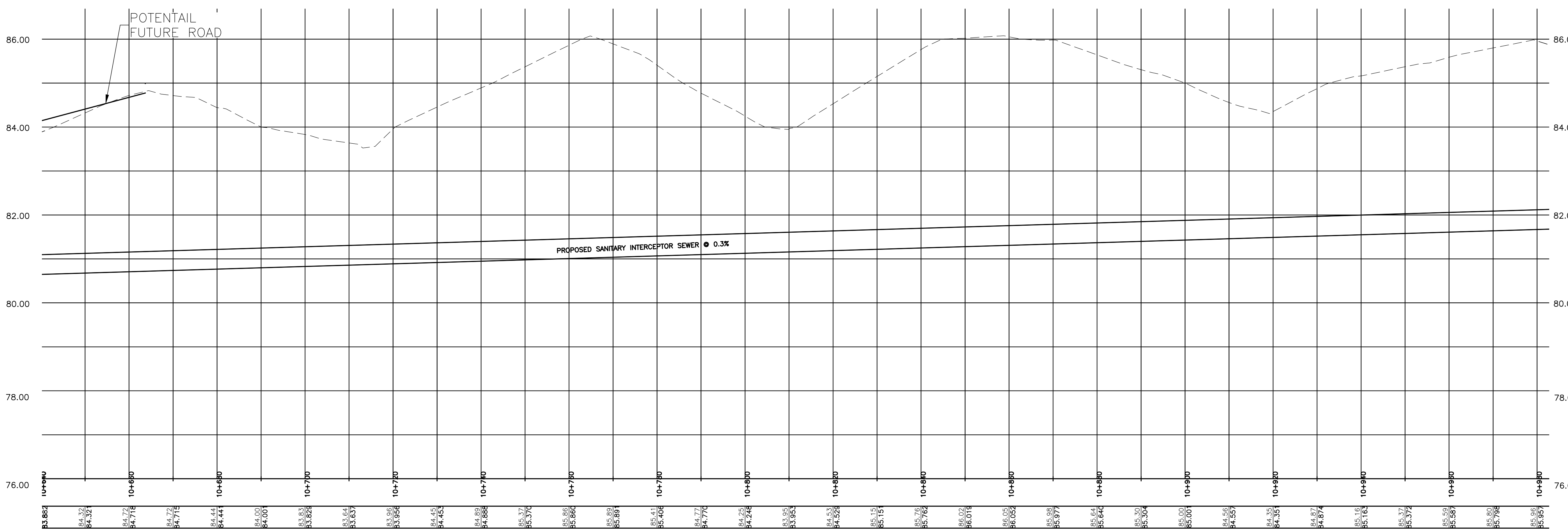

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SURREY
CITY OF PARKS

Grandview Heights NCP #2
Sanitary Interceptor

Plan Profile Stn 10+640 to Stn 10+980

PROJECT No. 1072 0143 01

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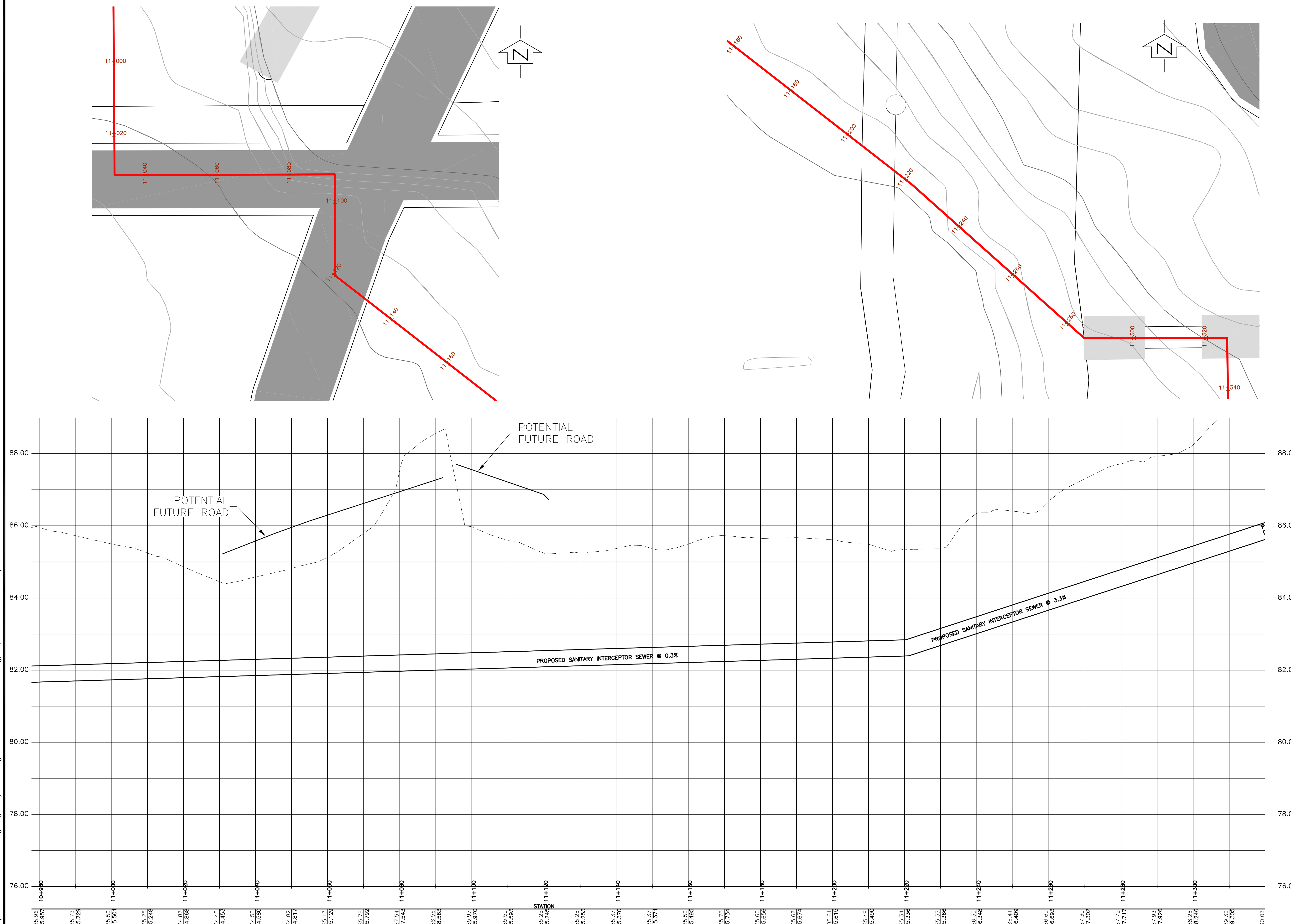

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SURREY
CITY OF PARKS

Grandview Heights NCP #2
Sanitary Interceptor

Plan Profile Stn 10+980 to Stn 11+320

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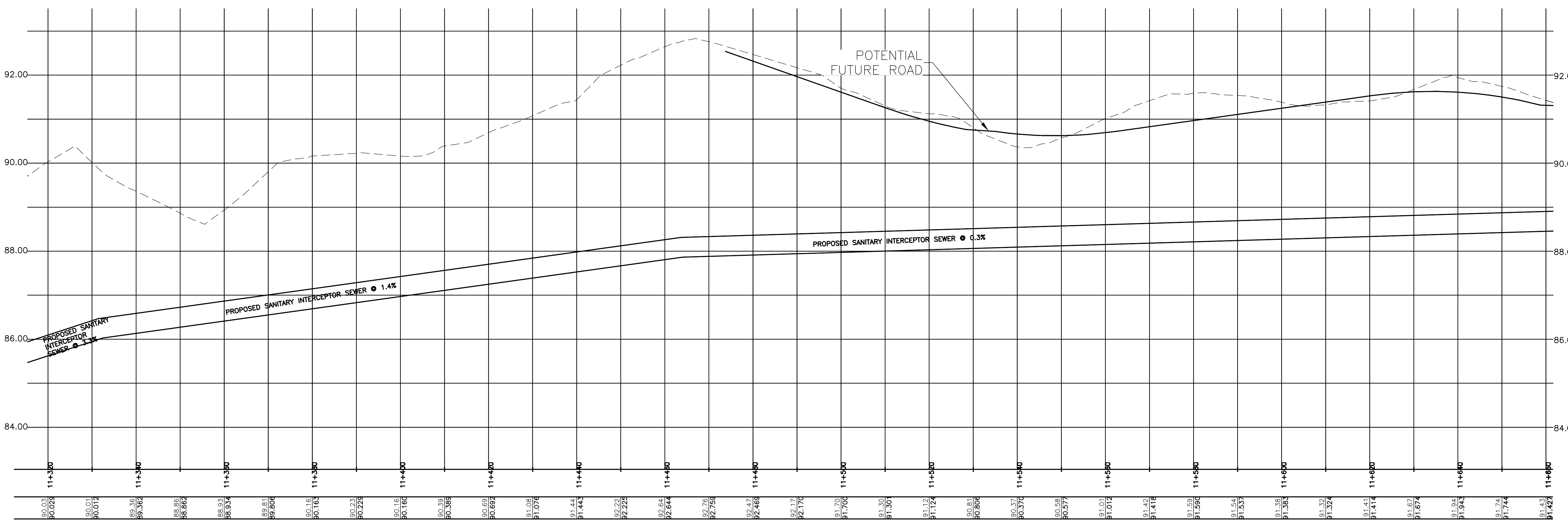

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SURREY CITY OF PARKS

Grandview Heights NCP #2
Sanitary Interceptor

Plan Profile Stn 11+320 to Stn 11+660

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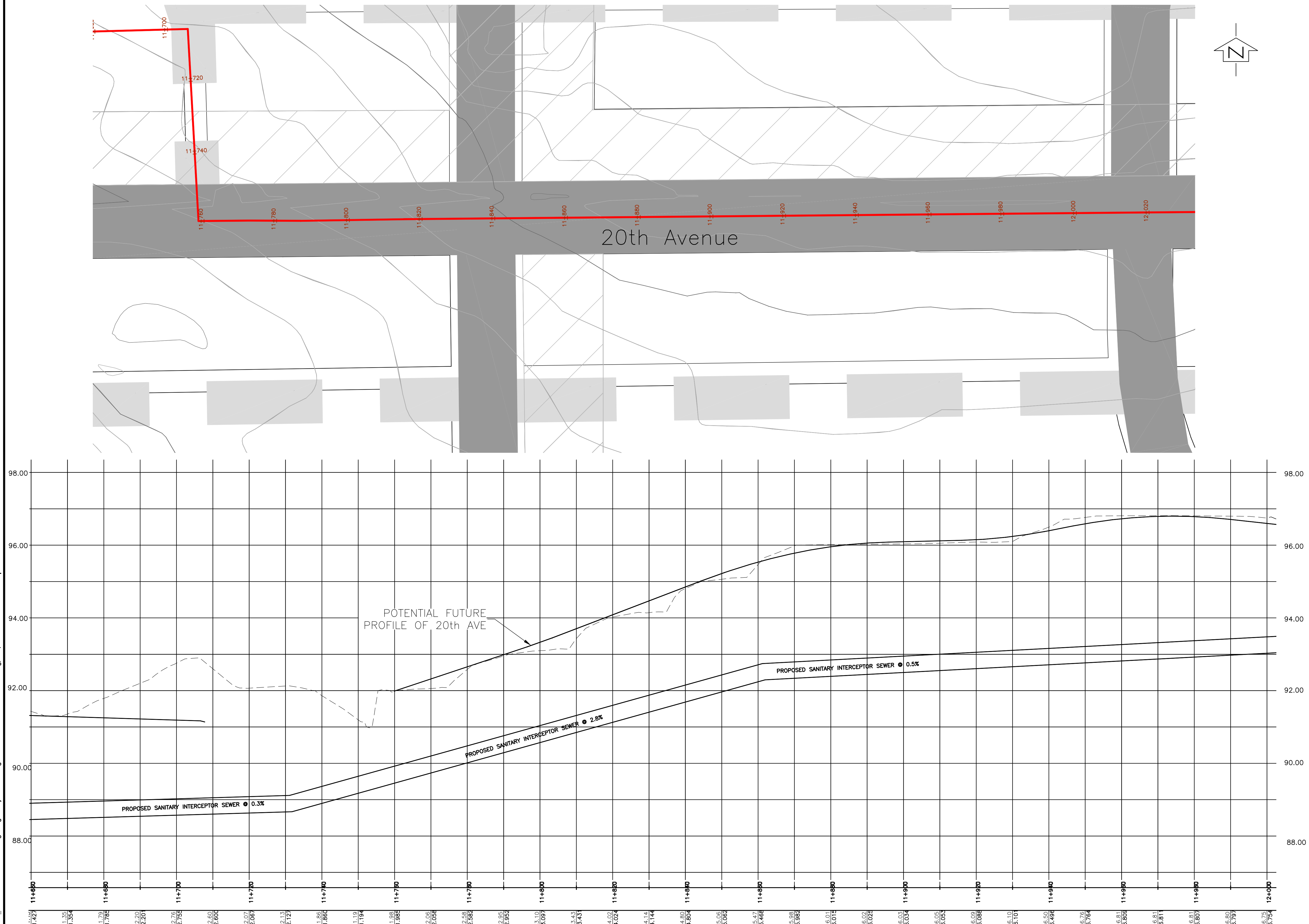

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5	FOR ARCHIVE	–

PRELIMINARY
SEPT. 17th, 2007
URBANSYSTEMS.

NO.	yyyy-mm-dd	DESCRIPTION	BY	APP'D
7				
6				
5				
4				
3				
2				
1				

REVISION/ISSUE

DES.
DWN. S.T.
DATE 07/09/17
CHK.

SCALE 1:500 H
1:50 V

URBANSYSTEMS.
SURREY
CITY OF PARKS

Grandview Heights NCP #2
Sanitary Interceptor

Plan Profile Stn 11+660 to
Stn 12+000

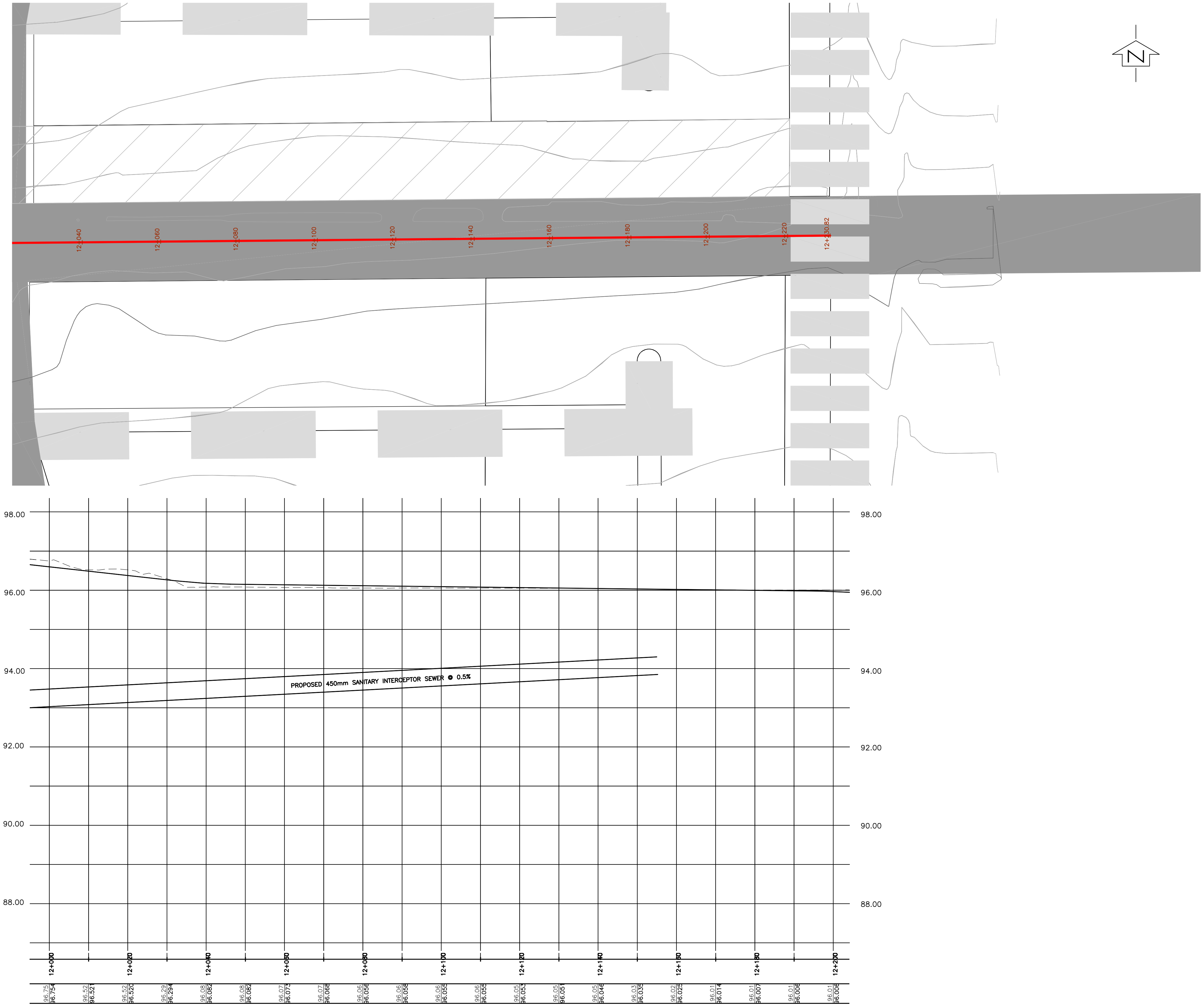
PROJECT No. 1072 0143 01

SHEET 6 OF ?

DESTROY ALL PRINTS PRIOR TO

DRAWING NAME C06 1072 0143 01

0



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ISSUES		
NO.	DESCRIPTION	DATE (yy/mm/dd)
1	FOR APPROVAL	07/09/17
2	FOR TENDER	–
3	FOR CONSTRUCTION	–
4	FOR RECORD	–
5	FOR ARCHIVE	–

PRELIMINARY
SEPT. 17th, 2007
URBAN SYSTEMS.

NO.	yyyy-mm-dd	DESCRIPTION	BY	APP'D
7				
6				
5				
4				
3				
2				
1				

REVISION/ISSUE

DES.
DWN. S.T.
DATE 07/09/17
CHK.

SCALE 1:500 H
1:50 V

URBAN SYSTEMS.
SURREY
CITY OF PARKS

Grandview Heights NCP #2
Sanitary Interceptor

Plan Profile Stn 12+000 to Stn 12+200

PROJECT No. 1072 0143 01
SHEET 7 OF ?
DESTROY ALL PRINTS PRIOR TO
DRAWING NAME C07 1072 0143 01
0

APPENDIX A.2 Water

NOTE: The proposed water network and analysis contained in **Appendix A.2** is based on a prior version of the final road network. The water network should be refined at the detailed design phase with the City's approval.

Grandview Heights NCP Area 2 Water System DCC eligible costs
prepared by Urban Systems Ltd. 2007, revised by Urban Systems Ltd. Oct. 11, 2010

Distribution System

		Location						
Label	**Scaled Length (m)**	**On**	**From**	**To**	**Diameter (mm)**	**Upgrade required**	**Upsize unit price**	**Premium for upsizing pipes beyond 200mm dia.**
P-39	253	162 St	Edgewood Dr	23A Ave	300	yes	$90	$22,770
P-66	530	17 Ave	Croydon Dr	168 St	300	yes	$90	$47,700
P-75	93	167A St	17 Ave	18 Ave	300	yes	$90	$8,370
P-85	200	167 St	23 Ave	24 Ave	350	yes	$120	$24,000
P-87	109	23A Ave	161A St	162 St	300	yes	$90	$9,810
P-126	160	167 A St	17 Ave	18 Ave	300	yes	$90	$14,400
P-128	14	Edgewood Dr	17A Ave		300	yes	$90	$1,260
P-130	100	161A St	23A Ave	24 Ave	300	yes	$90	$9,000
P-131	116	162 St	23 Ave	23A Ave	300	yes	$90	$10,440
P-138	226	23 Ave	165 St	166 St	300	yes	$90	$20,340
P-140	113	166 St	23 Ave	23A Ave	350	yes	$120	$13,560
P-141	200	166 St	23 Ave	24 Ave	350	yes	$120	$24,000
P-146	208	23 Ave	162 St	163 St	300	yes	$90	$18,720
P-152	214	23 Ave	163 St	164 St	300	yes	$90	$19,260
P-154	114	164 St	23 Ave	23A Ave	300	yes	$90	$10,260
P-158	320	162 St	21 Ave	Edgewood Dr	300	yes	$90	$28,800
P-159	295	21 Ave	164 St	165 St	300	yes	$90	$26,550
P-161	73	23 Ave	164 St	Btwn 164 St and 165 St	300	yes	$90	$6,570
P-162	102	23 Ave	Btwn 164 St and 165 St	165 St	300	yes	$90	$9,180
P-167	102	165 St	21 Ave	21A Ave	300	yes	$90	$9,180
P-168	122	165 St	21A Ave	22 Ave	300	yes	$90	$10,980
P-172	87	165 St	22 Ave	22A Ave	300	yes	$90	$7,830
P-173	86	165 St	22A Ave	23 Ave	300	yes	$90	$7,740
P-177	82	167 St	22A Ave	23 Ave	300	yes	$90	$7,380
P-189	113	Edgewood Dr	20A Ave	21 Ave	300	yes	$90	$10,170
P-192	116	Edgewood Dr	20 Ave	20A Ave	300	yes	$90	$10,440
P-201	222	21 Ave	165 St	166 St	300	yes	$90	$19,980
P-211	154	165 St	20A Ave	21 Ave	300	yes	$90	$13,860
P-212	94	165 St	20 Ave	20A Ave	300	yes	$90	$8,460
P-229	43	167 St	Edgewood Dr	22 Ave	300	yes	$90	$3,870
P-230	87	167 St	22 Ave	22A Ave	300	yes	$90	$7,830
P-260	123	Edgewood Dr	18A Ave	19 Ave	300	yes	$90	$11,070
P-261	226	Croydon Dr	18 Ave	19 Ave	300	yes	$90	$20,340
P-262	258	Croydon Dr	17 Ave	18 Ave	300	yes	$90	$23,220
P-268	47	164 St	20 Ave	Btwn 20 Ave and 20A Ave	300	yes	$90	$4,230
P-270	200	167 St	23 Ave	24 Ave	350	yes	$120	$24,000
P-271	28	24 Ave	Fronting reservoir		300	yes	$90	$2,520
P-274	30	Fronting reservoir	24 Ave		300	yes	$90	$2,700
								$1,528,170

	Location						
Scaled Length (m)	**On**	**From**	**To**	**Diameter (mm)**	**Upgrade required**	**Full Cost unit price**	**Full Cost**
200	20 Ave	162 St	164 St	350	yes	$770	$154,000
1160	168 St	20 Ave	14 Ave	300	yes	$740	$858,400
160	21 Ave	166 St	168 St	300	yes	$740	$118,400
300	16 Ave	166 St	168 St	300	yes	$740	$222,000
817	18 Ave	166 St	168 St	300	yes	$740	$604,580
182	167 St	19 Ave	20 Ave	300	yes	$740	$134,680
101	167 St	18 Ave	18A Ave	300	yes	$740	$74,740
308	23 Ave	168 St	166 St	300	yes	$740	$227,920
222	Edgewood Dr	21 Ave	22 Ave	300	yes	$740	$164,280
151	18 Ave	Croydon Dr	Hydro right of way	300	yes	$740	$111,740
							$2,670,740

Upsizing and new construction costs use "all up" unit rates provided by the City of Surrey, Feb 2010

APPENDIX A.3 Stormwater Management

APPENDIX A.3

Appendix A.3 consists of five sections of supplementary information to support the stormwater servicing discussion in the main text:

- Additional information on bioswales, including examples of typical installations;
- Hydrograph plots showing results of the hydrologic modeling;
- Pollutant loading computations;
- Cost estimates for proposed stormwater infrastructure; and
- Memorandum describing preliminary assessment of a detention pond for two catchments in Grandview Heights Area #2.

BIOSWALES

This part of Appendix A3 presents additional information concerning the bioswales proposed for use in Grandview Heights Area #2. Bioswales are essentially shallow ditches that have been designed and constructed to promote removal and treatment of runoff pollutants and, where local soils conditions are suitable, to promote infiltration of runoff. Pollutant removal and treatment is accomplished through a combination of physical, chemical and biological processes, including settling, filtering, sorption, and uptake. As noted in the main text, bioswales for Grandview Heights Area #2 will be designed to capture runoff resulting from rain events in size up to one-half the Mean Annual Rainfall (MAR), or 30 mm of rain in 24 hours.

The bioswale feature of the stormwater corridors will typically have a profile slope of less than 3 percent. In corridors with steeper slopes, up to 8 percent maximum, a series of step weirs or grade control structures will be used to flatten grades to 3 percent or under. The weirs/grade control structures, with drops of 300-600 mm each, will be constructed of timbers, boulders or other natural materials to obtain a “nature-like” feel. A typical bioswale will be 4 to 6 metres across and 400 to 750 mm deep.

Where subsurface soil conditions are unfavourable, a perforated underdrain will be provided. Runoff will either sheet flow into the bioswales or, where a curb and gutter is present, be directed into the bioswale via curb cuts. A lawn basin will typically be provided at the end of each block as an overflow to redirect runoff into a storm sewer when necessary. Bioswales may be either grass-lined or landscaped with native vegetation (flowers; shrubs) and cobbles or boulders. Generous use of tree planting within the stormwater corridors will supplement the stormwater functioning of the bioswales.

Figure A3.1 shows cross sections of a grassed bioswale as proposed for use in the 5-metre stormwater corridors and a landscaped bioswale as proposed for use in the 10- and 20-metre corridors. Following Figure A3, there are photographs of typical bioswale installations from around the Pacific Northwest.

Typical bioswale maintenance tasks are listed below; not all tasks may be required, dependent in part on the type of landscaping chosen for the bioswale (e.g., grass or other vegetation; boulders; cobble swale bottom; etc.):

After major rain events:

- Check for standing water (24-36 hours after storm)
- Remove obstructions to inlets, lawn basin, etc.

Annually, or as needed:

- Inspect all components (lawn basin, etc); repair as needed
- Mow (if grass); maintain at suitable height (100-150 mm, but not below design water level)
- Remove and replace dead and diseased vegetation (if bushes & flowers)

- Remove litter and debris
- Remove undesirable vegetation (i.e, invasive species) (especially important during first few years of vegetation establishment)
- Stabilize eroded areas (side slopes; bottom)
- Dethatch swale bottom and remove
- Disc or aerate swale bottom, if needed
- Remove mulch and replace with new layer

5-year cycle:

- Scrape swale bottom and remove sediment to restore original cross section and profile
- Disc bottom to restore infiltration capacity
- Seed or sod to restore ground cover (if grass)

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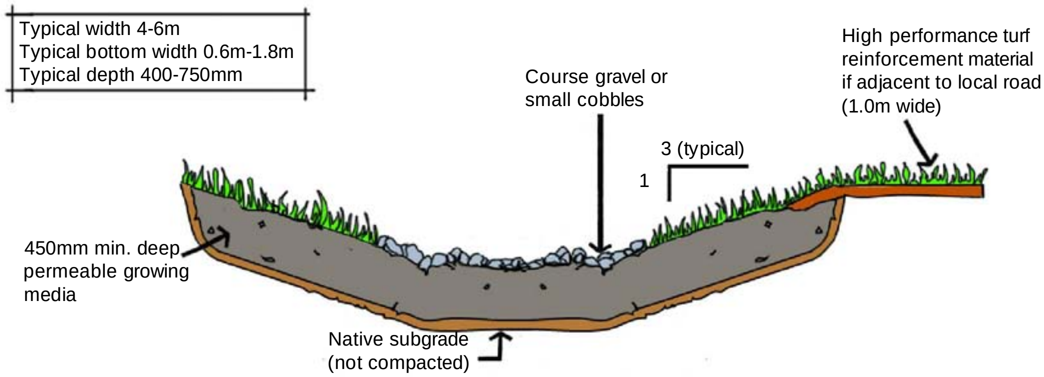
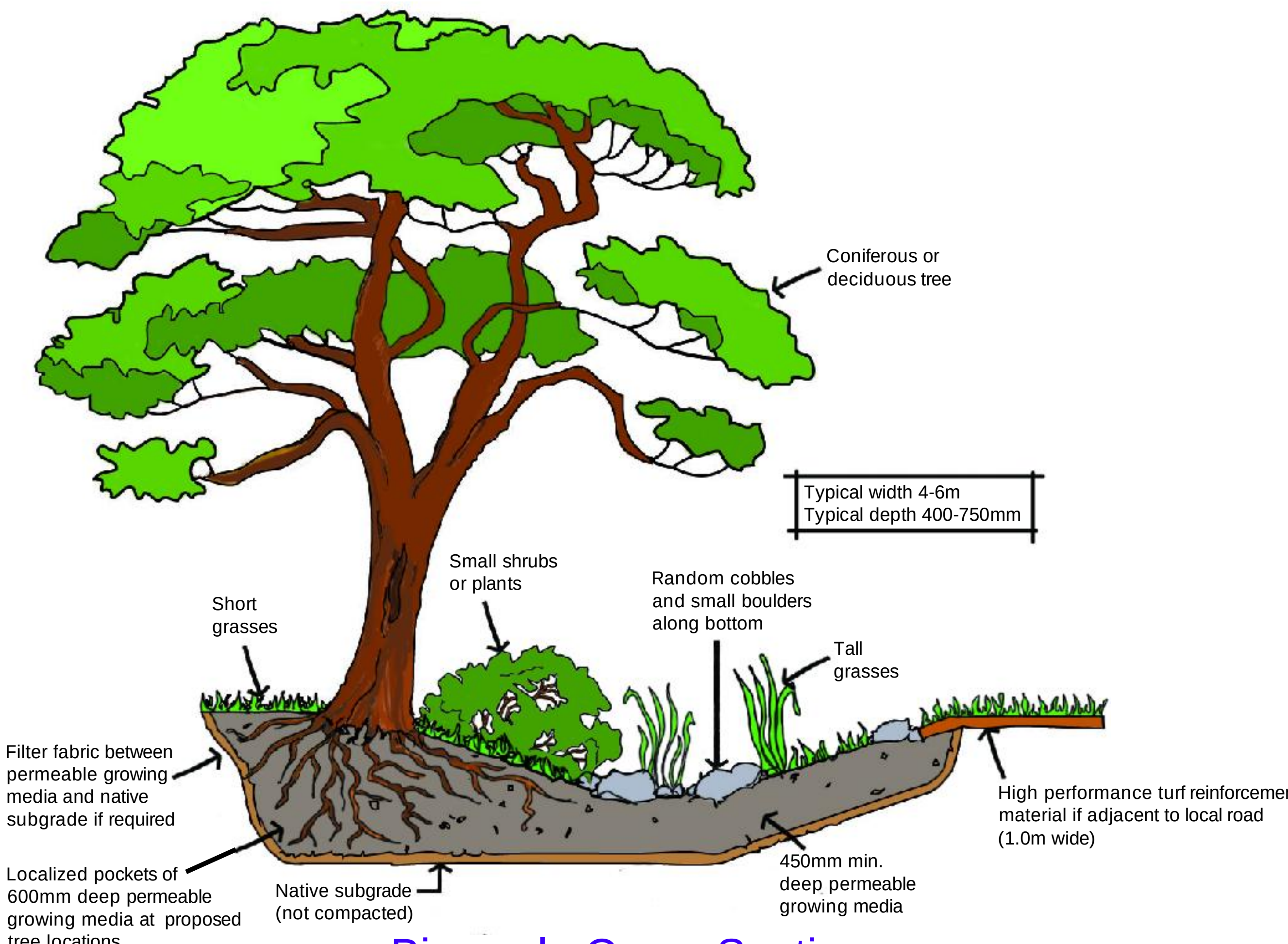
Grandview Heights Area #2

Grassed Bioswale



Landscaped Bioswale



Bioswale Cross Sections

(Typical Sections)

Fig A3.1

Date: 04/05/10
Scale: n.t.s.

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BIOSWALE PHOTOGRAPHS

Grassed Bioswale, High Point Development, Seattle, Washington
(Note curb drop to allow runoff to enter swale from street, in lower left of photo)

Landscaped Bioswale, High Point Development, Seattle, Washington

Bioswales, High Point Development, Seattle, Washington
(Note mix of grassed and landscaped swales in same block)

Typical bioswale overflow structure (prior to final vegetation planting)

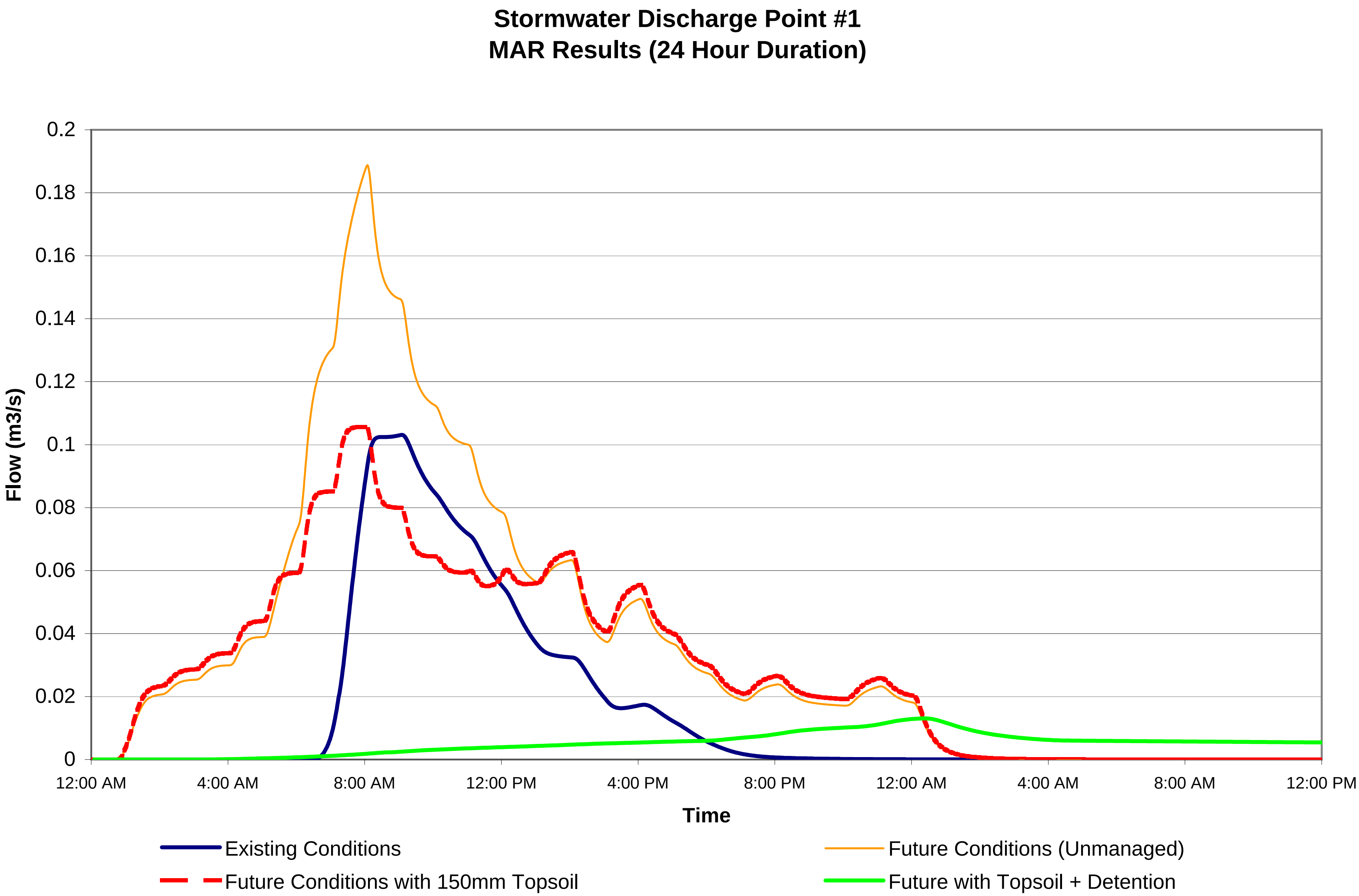
Landscaped Bioswale, SEA Street, Seattle, Washington

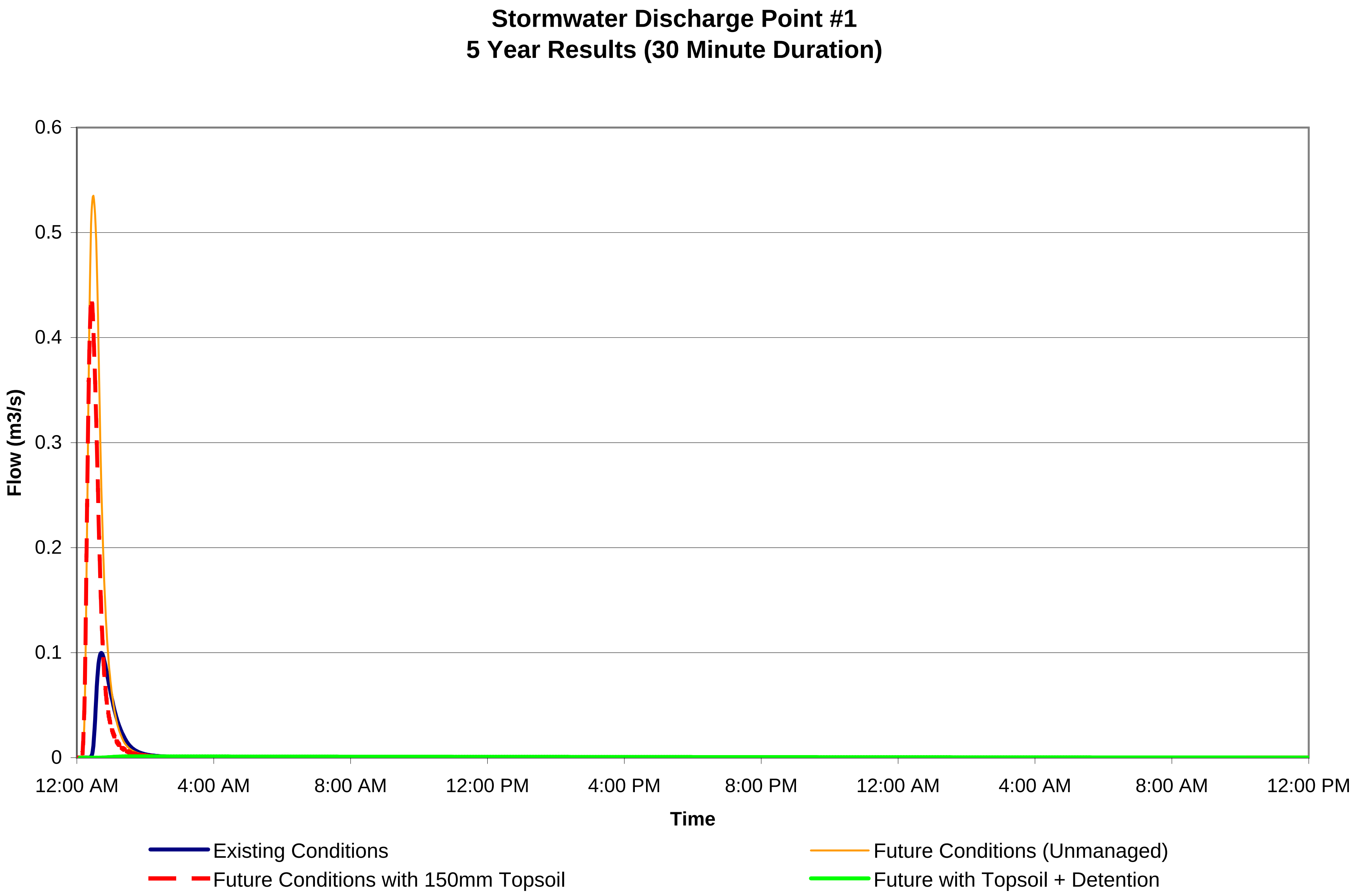
Grassed Bioswale, Crown Street, Vancouver, BC
(Note access across swale at center of photo)

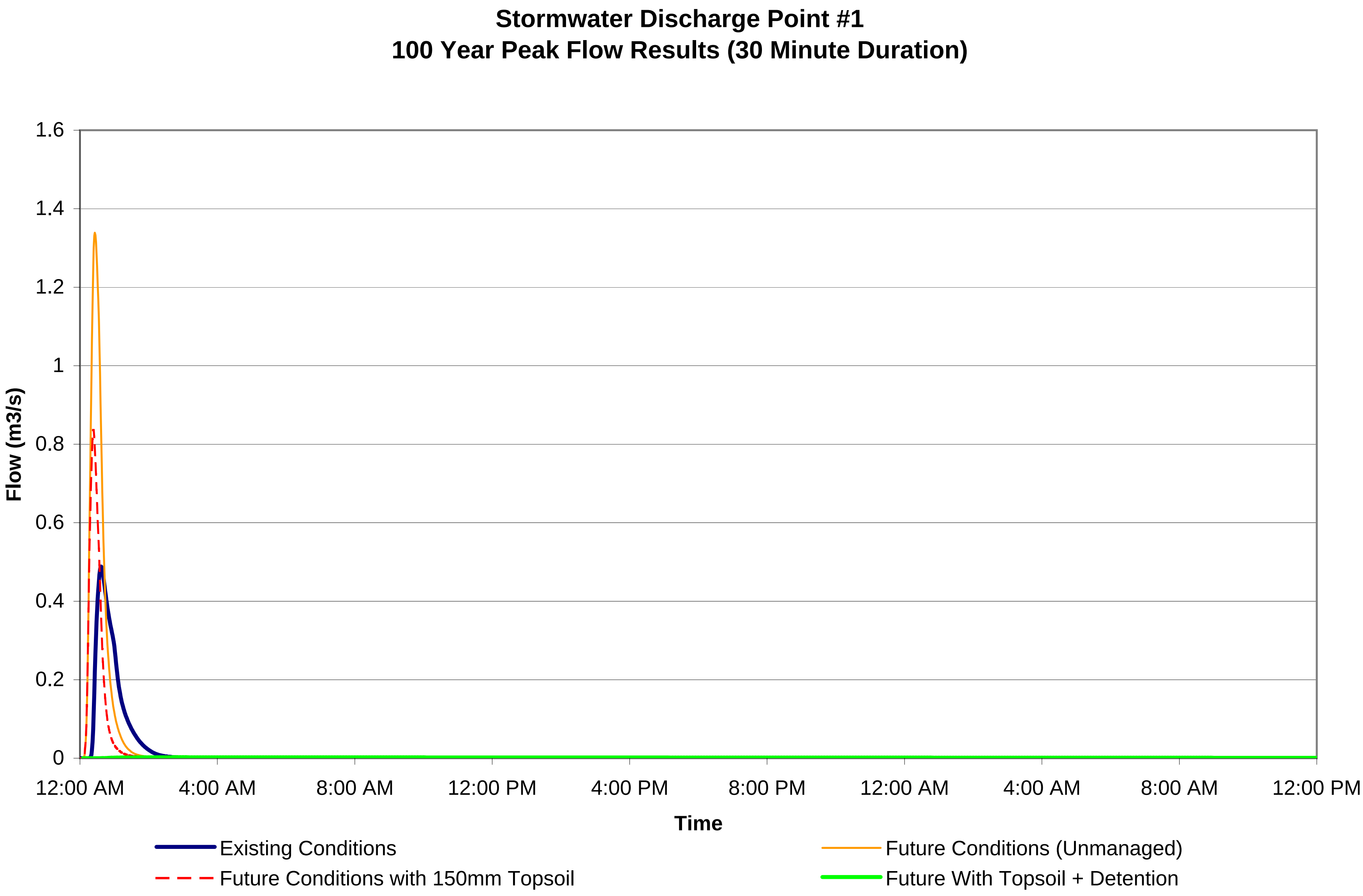
Bioswale, Maple Ridge, BC

Bioswale with grade control structures
Crown Street, Vancouver, BC

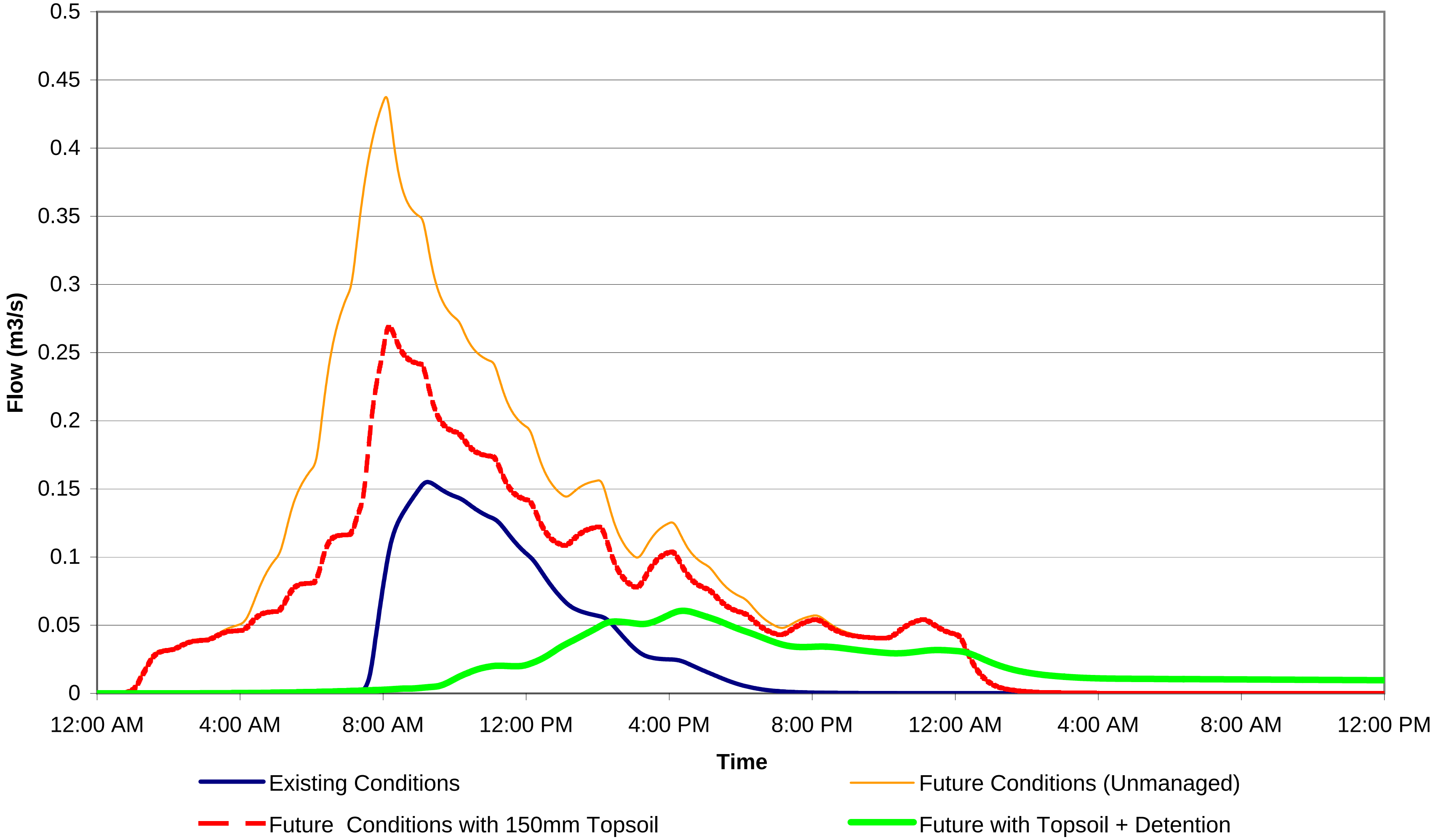
Grass Bioswale with wild flowers, Portland, Oregon (winter view)

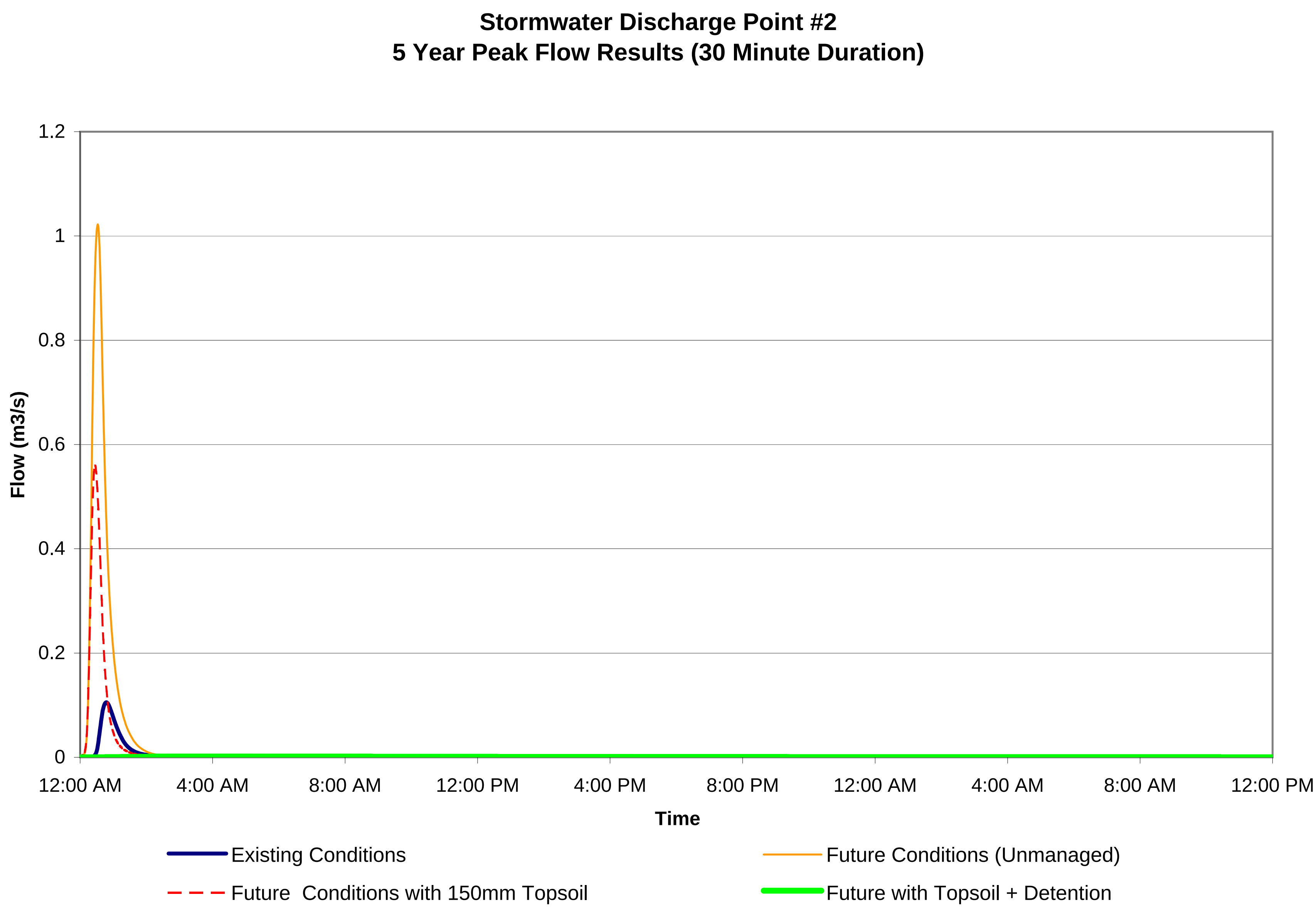

Stormwater Discharge Point #1
MAR Results (24 Hour Duration)
Flow (m3/s)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

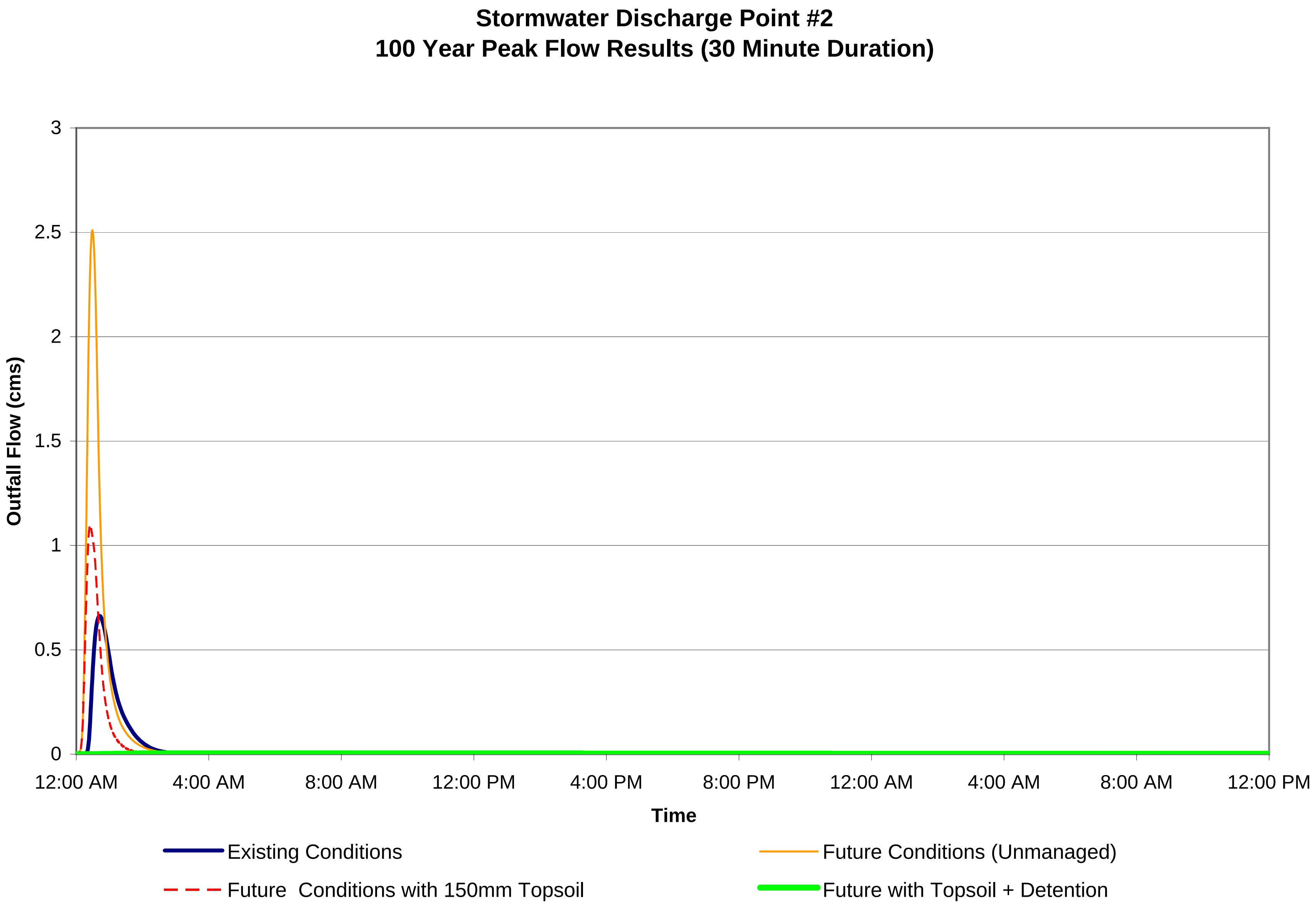

Stormwater Discharge Point #1
5 Year Results (30 Minute Duration)
Flow (m3/s)
0.6
0.5
0.4
0.3
0.2
0.1
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

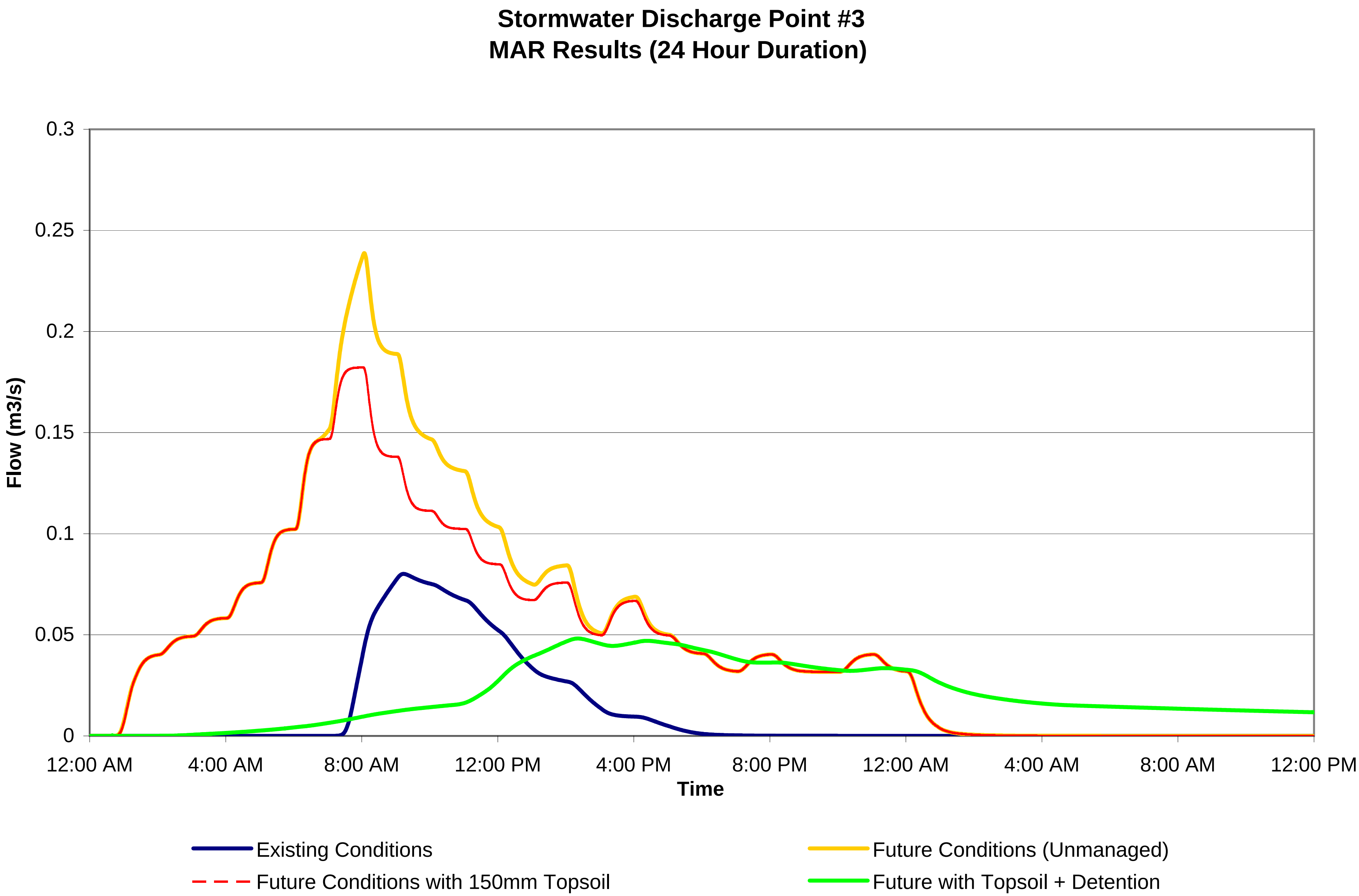

Stormwater Discharge Point #1
100 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future With Topsoil + Detention

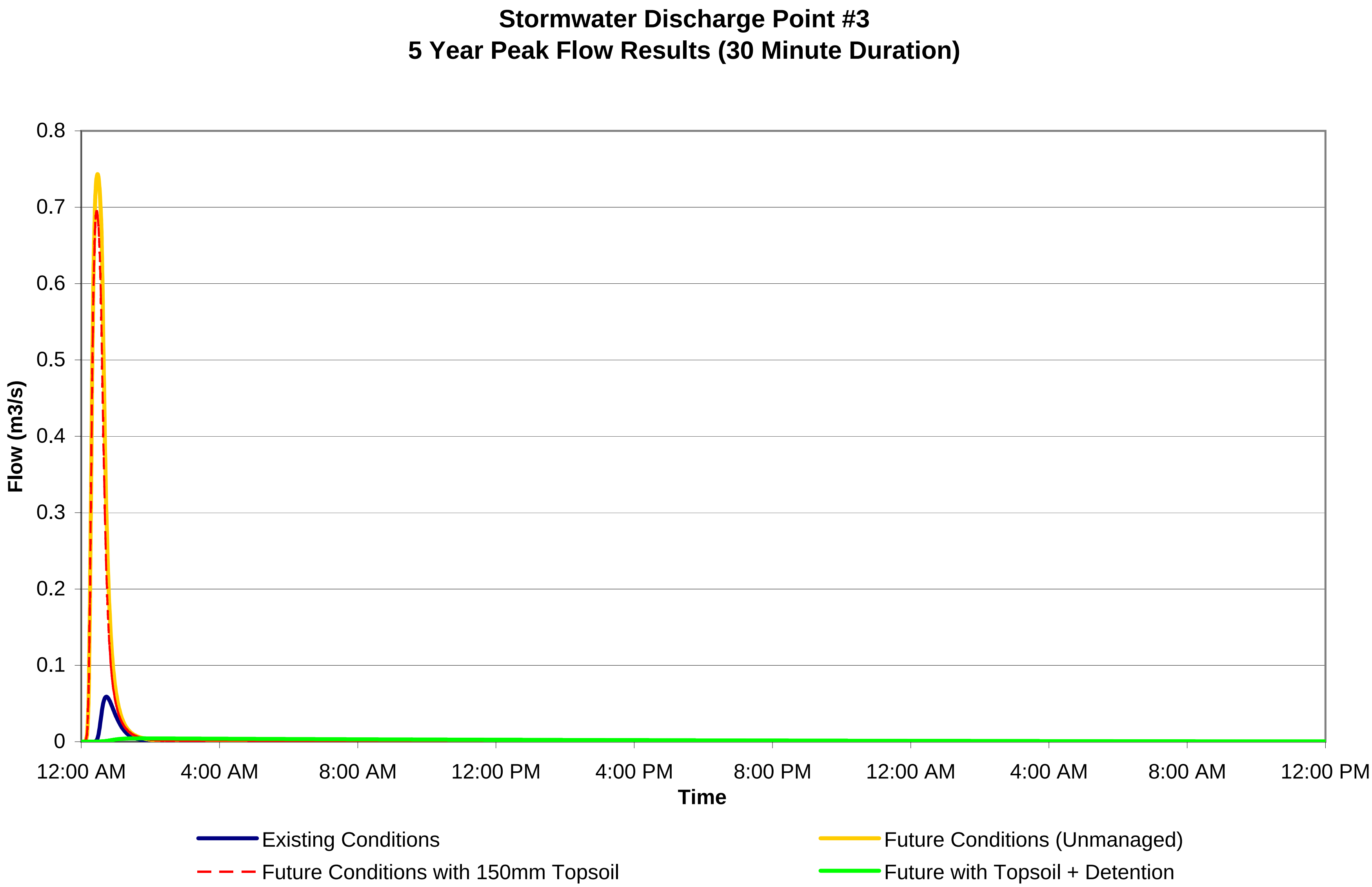
Stormwater Discharge Point #2
MAR Results (24 Hour Duration)

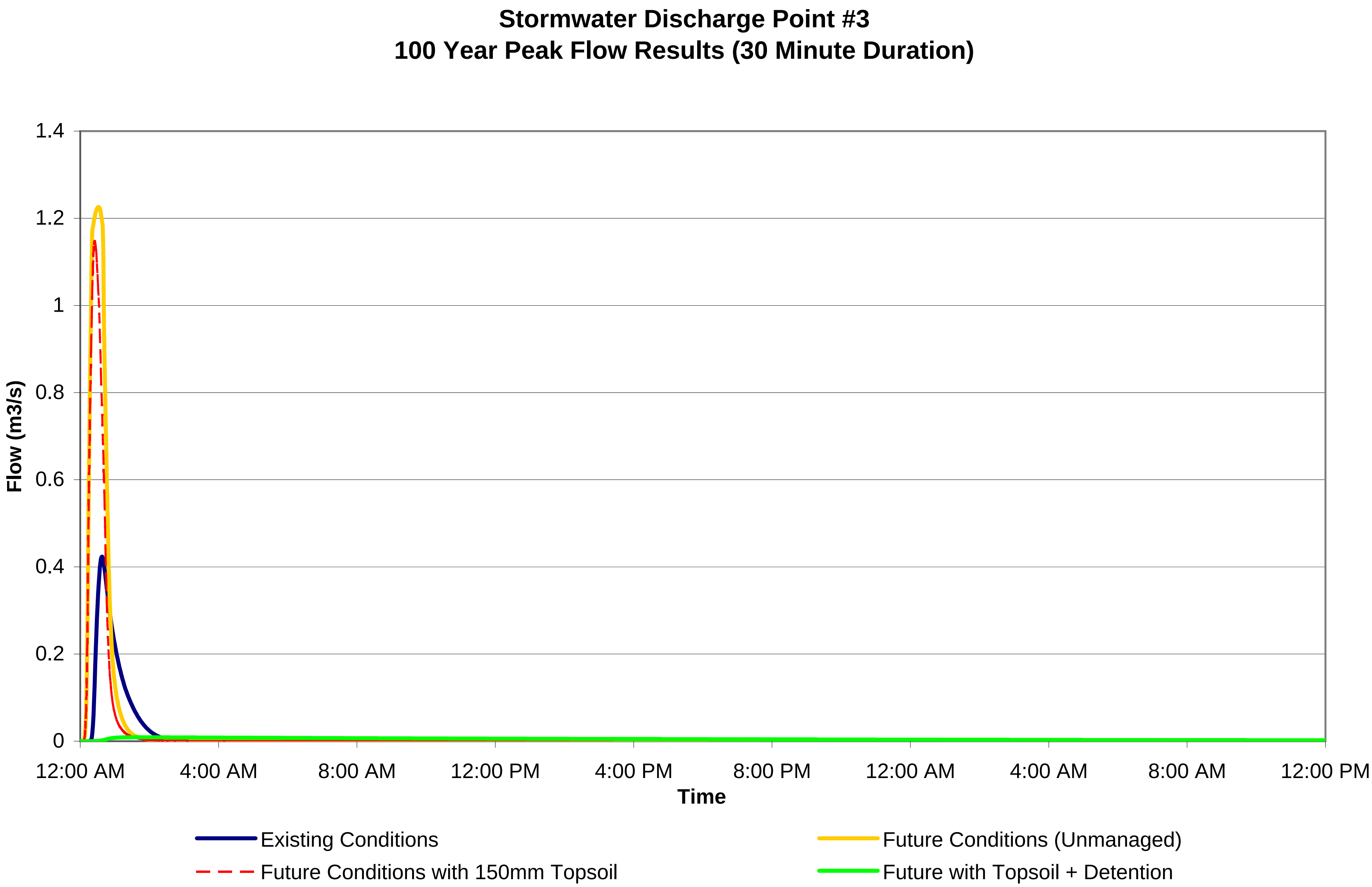


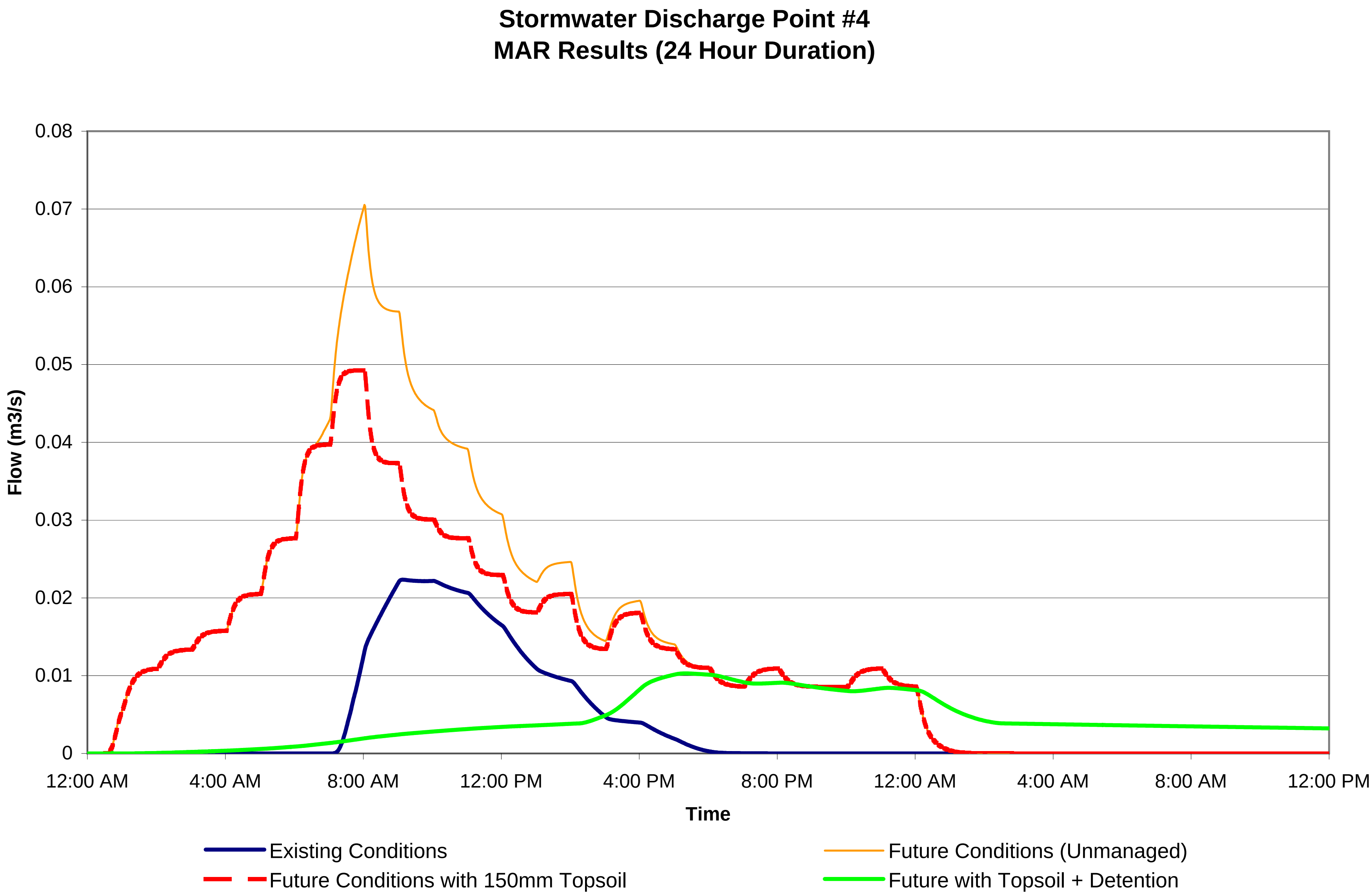

Stormwater Discharge Point #2
5 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
1.2
1
0.8
0.6
0.4
0.2
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

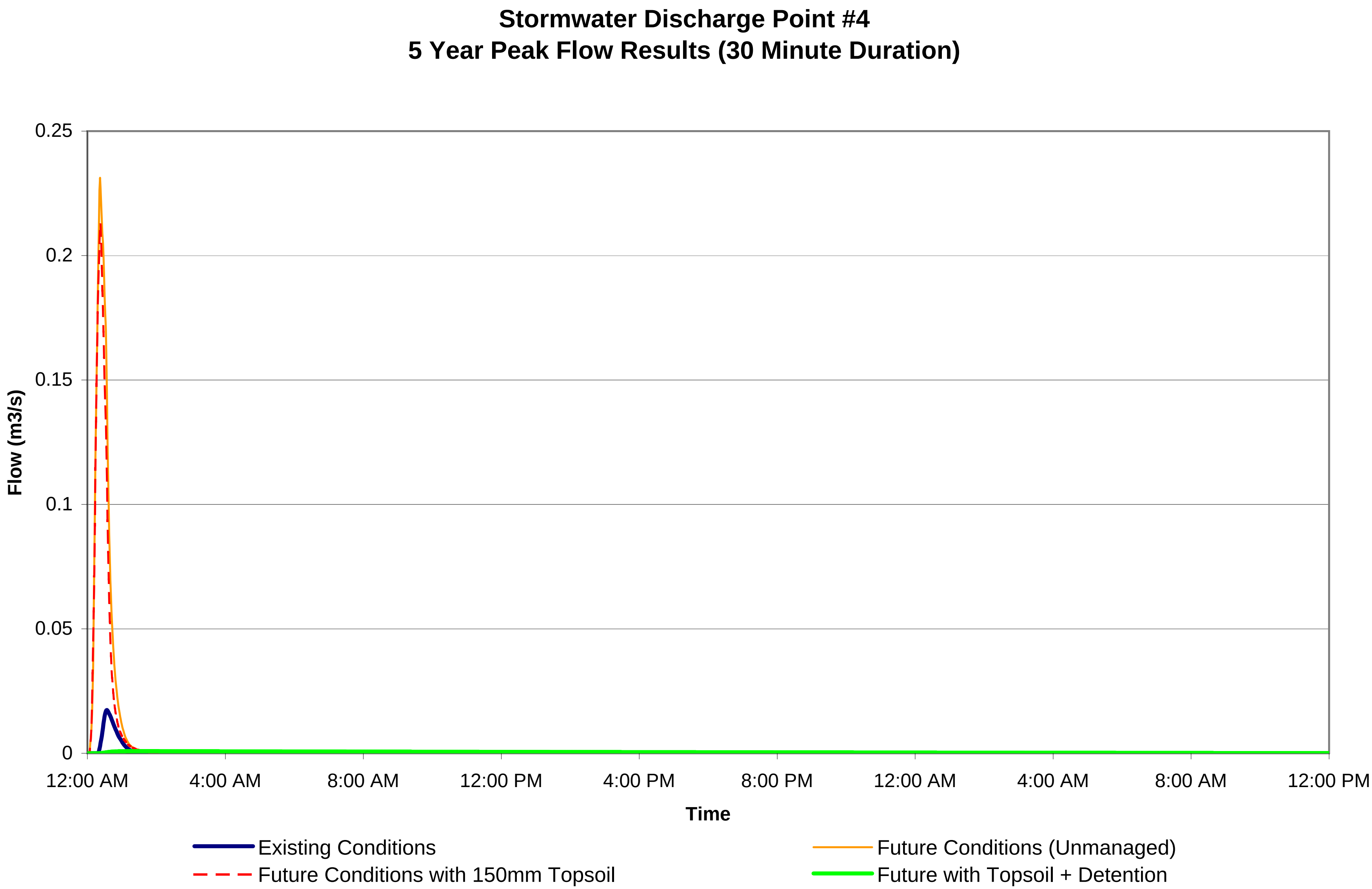

Stormwater Discharge Point #2
100 Year Peak Flow Results (30 Minute Duration)
Outfall Flow (cms)
3
2.5
2
1.5
1
0.5
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

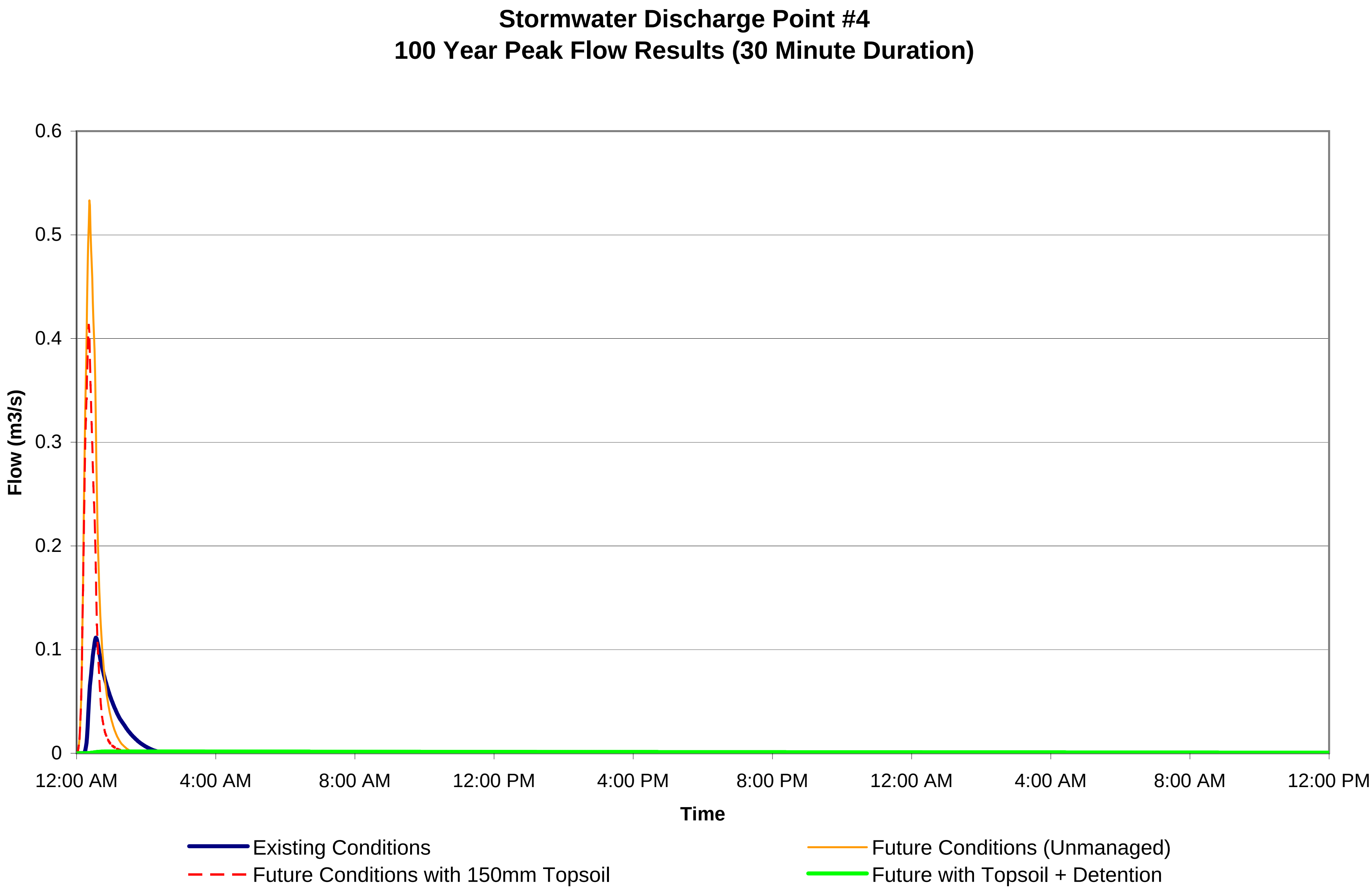

Stormwater Discharge Point #3
MAR Results (24 Hour Duration)
0.3
0.25
0.2
0.15
0.1
0.05
0
Flow (m3/s)
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions with 150mm Topsoil
Future Conditions (Unmanaged)
Future with Topsoil + Detention


Stormwater Discharge Point #3
5 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

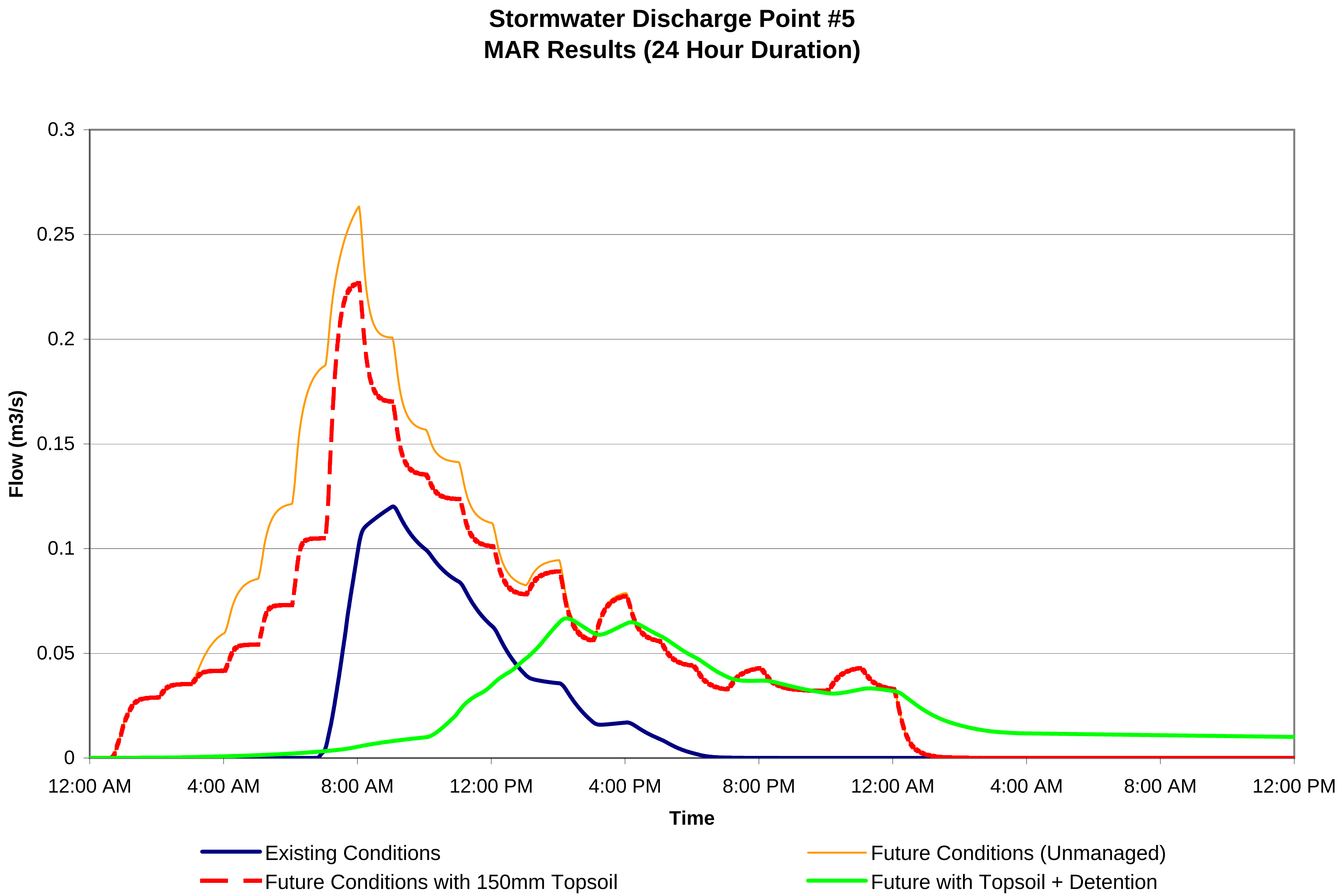

Stormwater Discharge Point #3
100 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

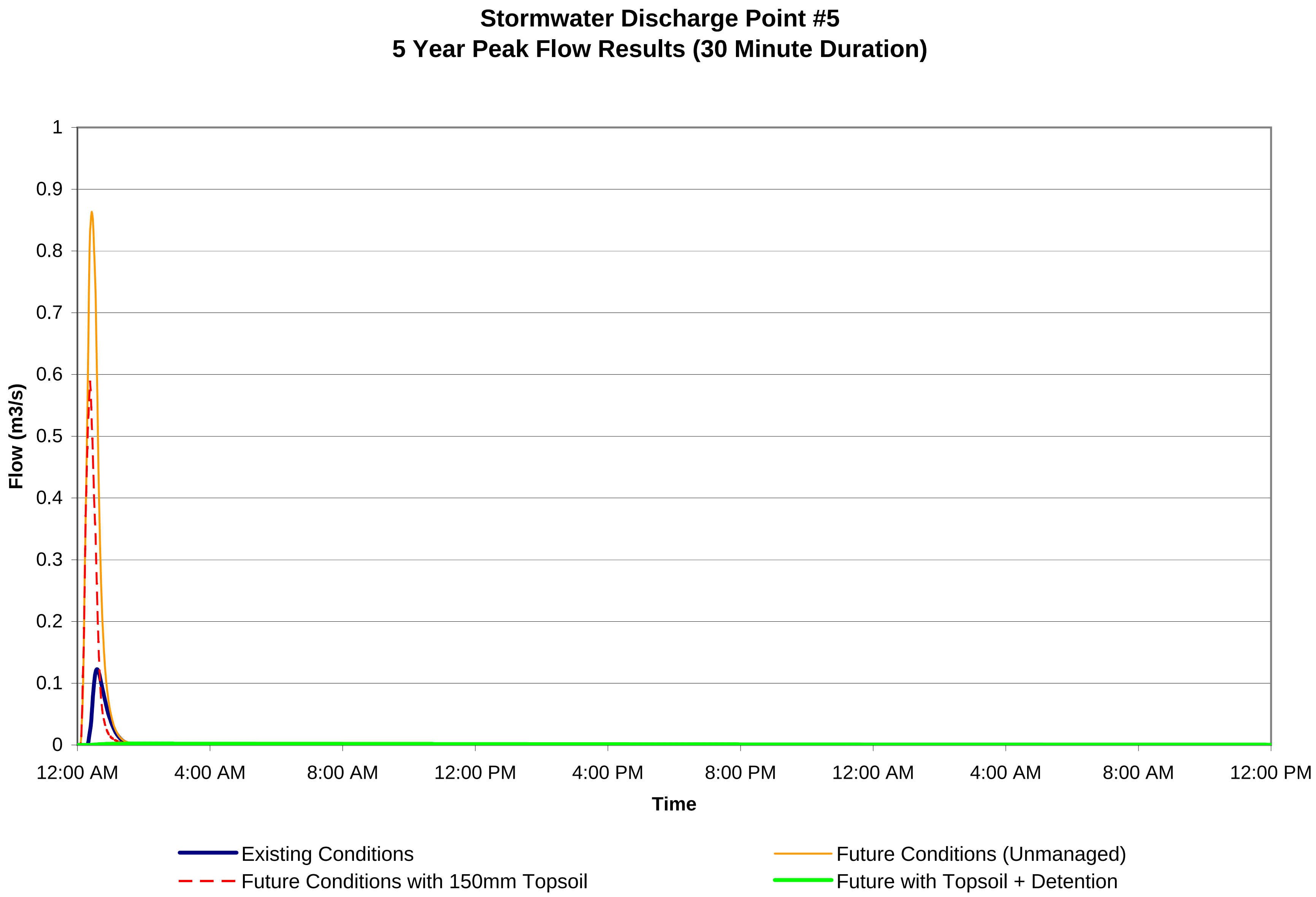

Stormwater Discharge Point #4
MAR Results (24 Hour Duration)
Flow (m3/s)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

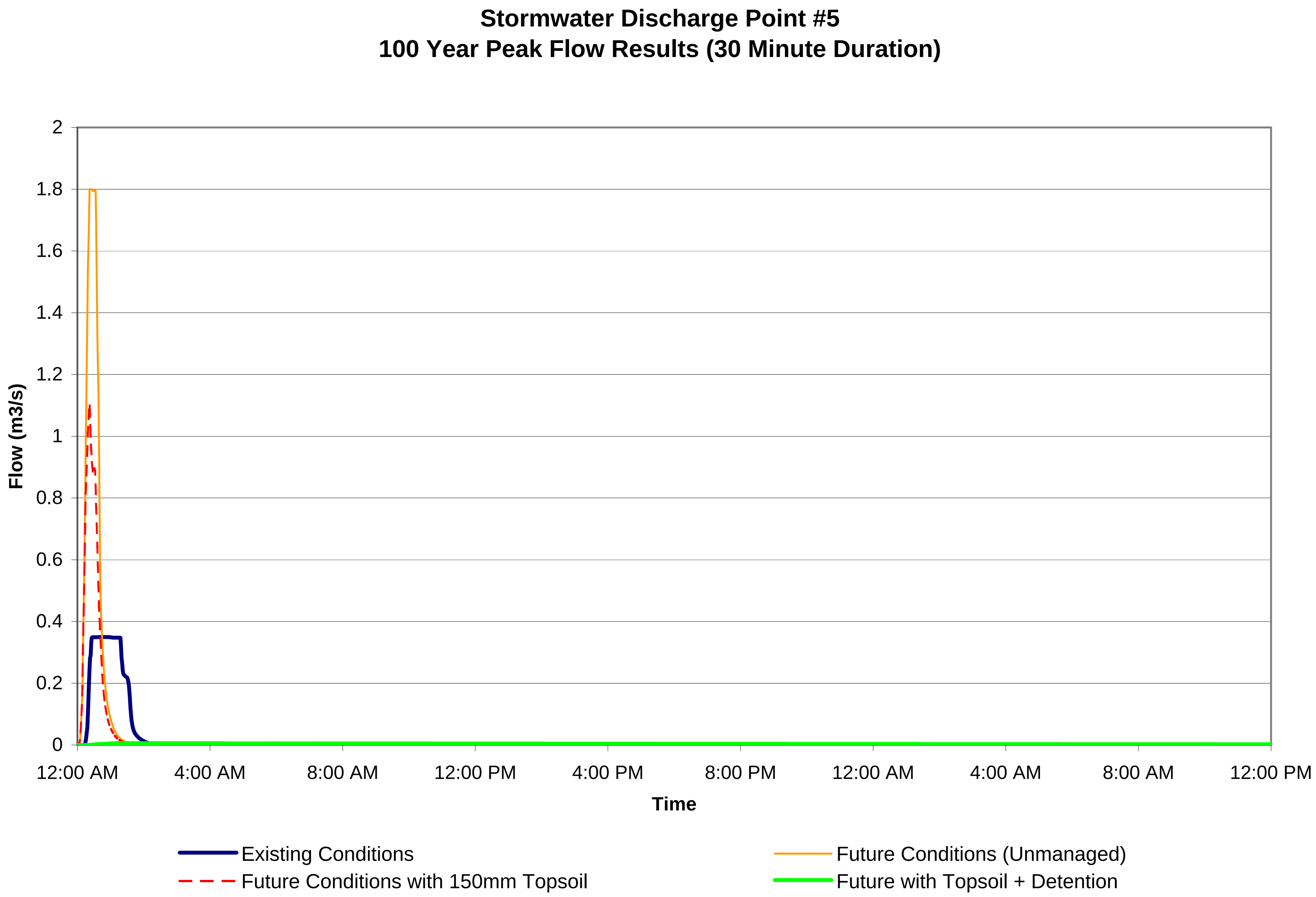

Stormwater Discharge Point #4
5 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.25
0.2
0.15
0.1
0.05
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

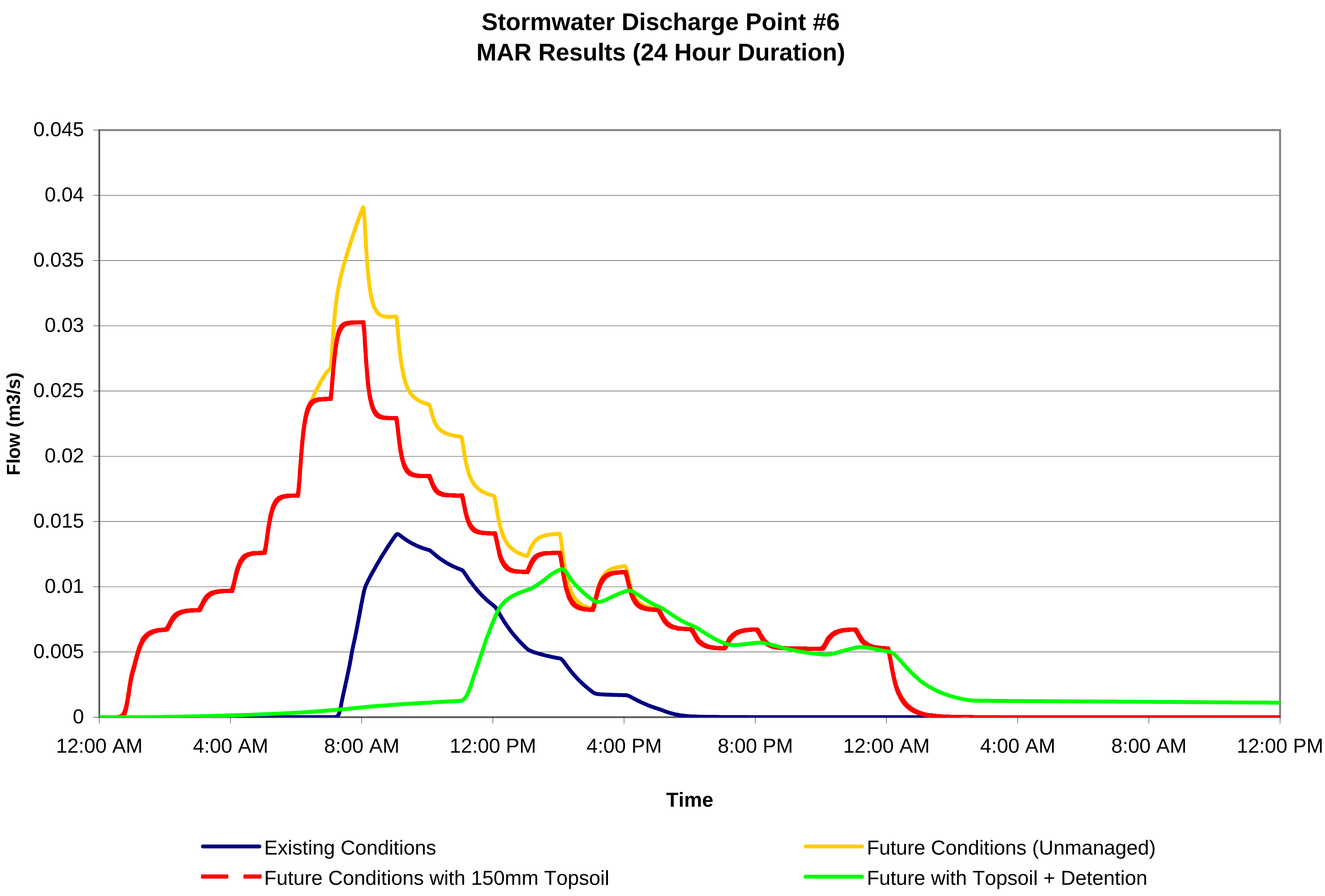


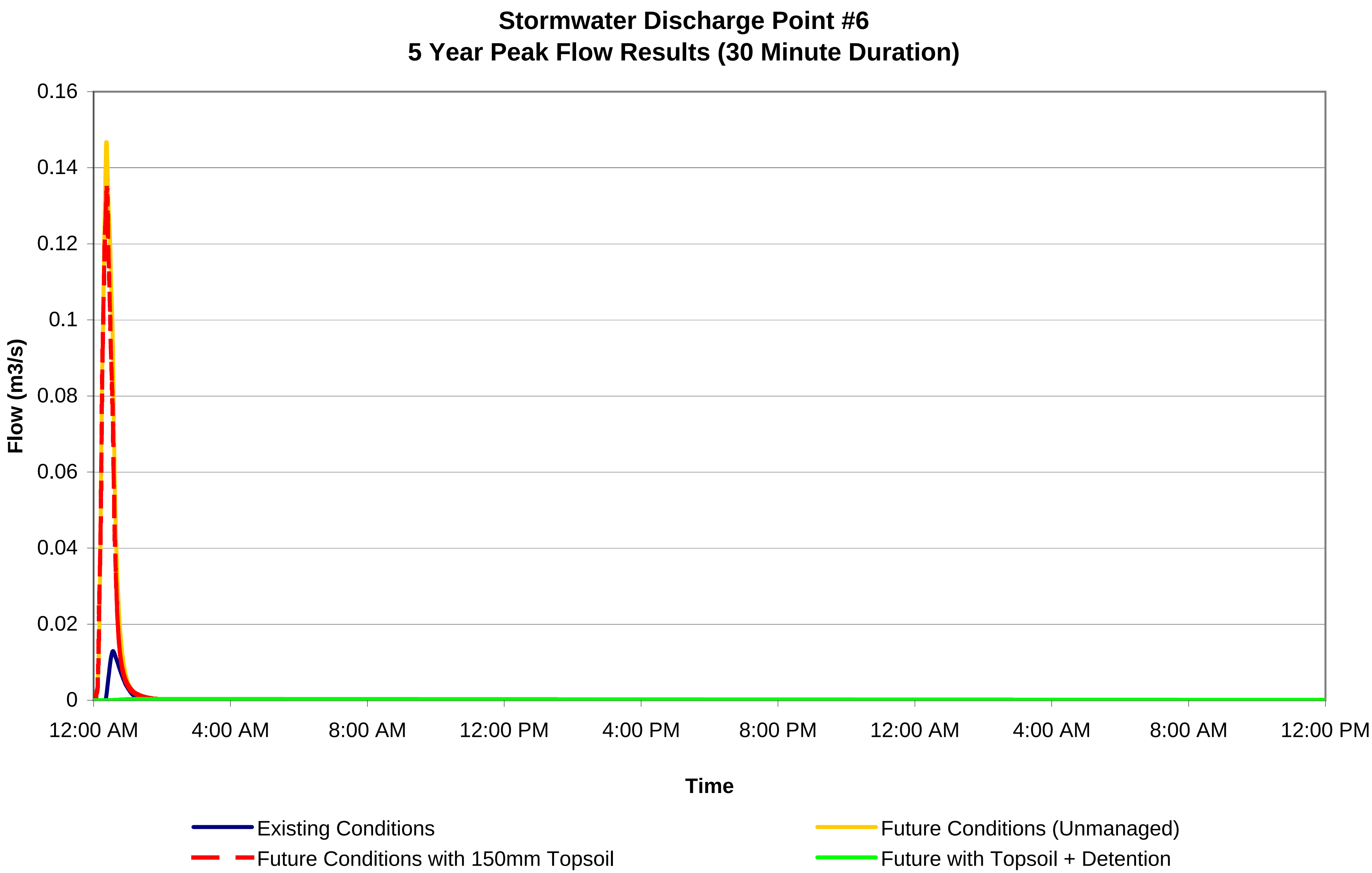
Stormwater Discharge Point #4
100 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.6
0.5
0.4
0.3
0.2
0.1
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention


Stormwater Discharge Point #5
MAR Results (24 Hour Duration)
Flow (m3/s)
0.3
0.25
0.2
0.15
0.1
0.05
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

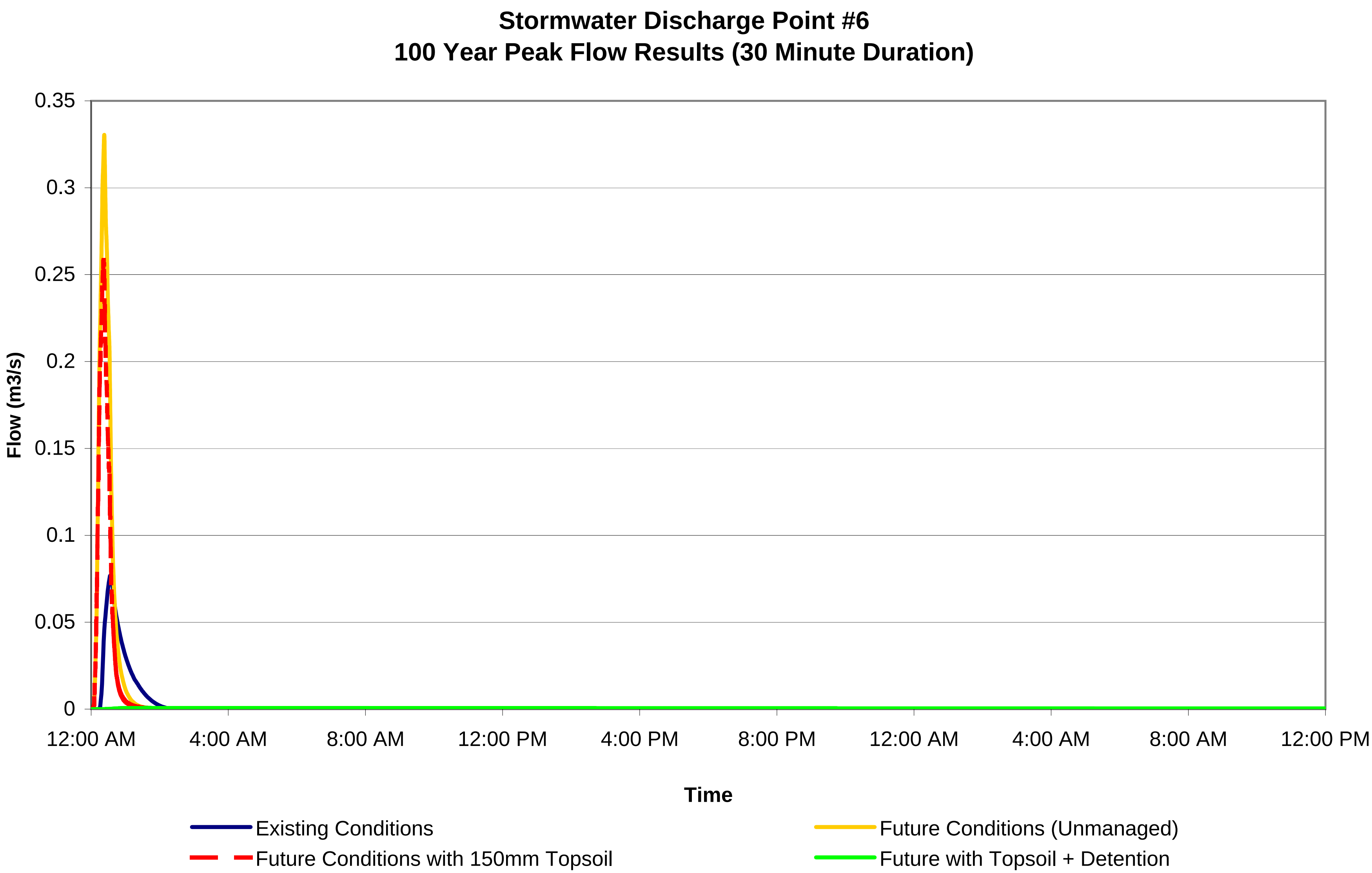

Stormwater Discharge Point #5
5 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

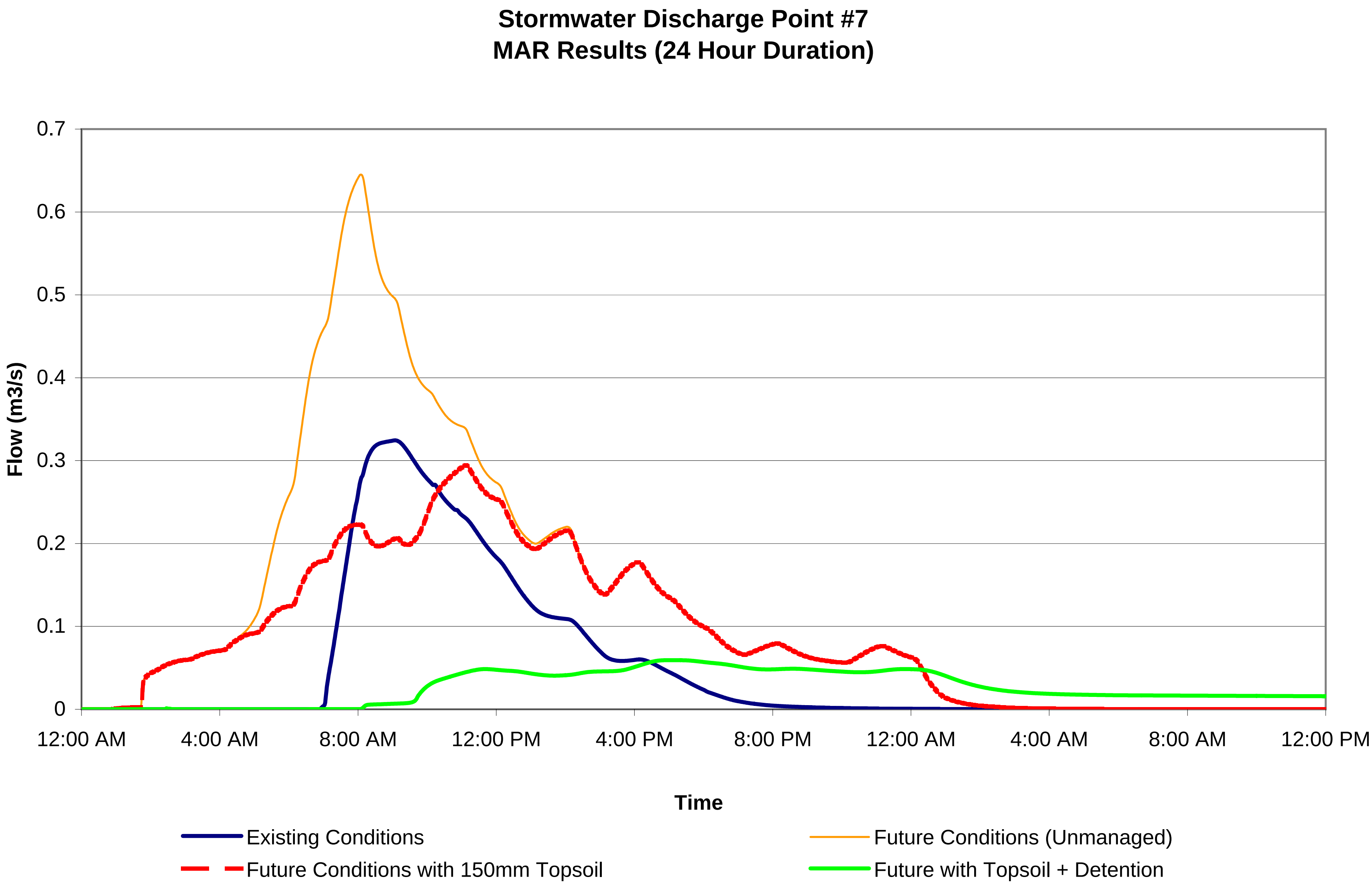

Stormwater Discharge Point #5
100 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

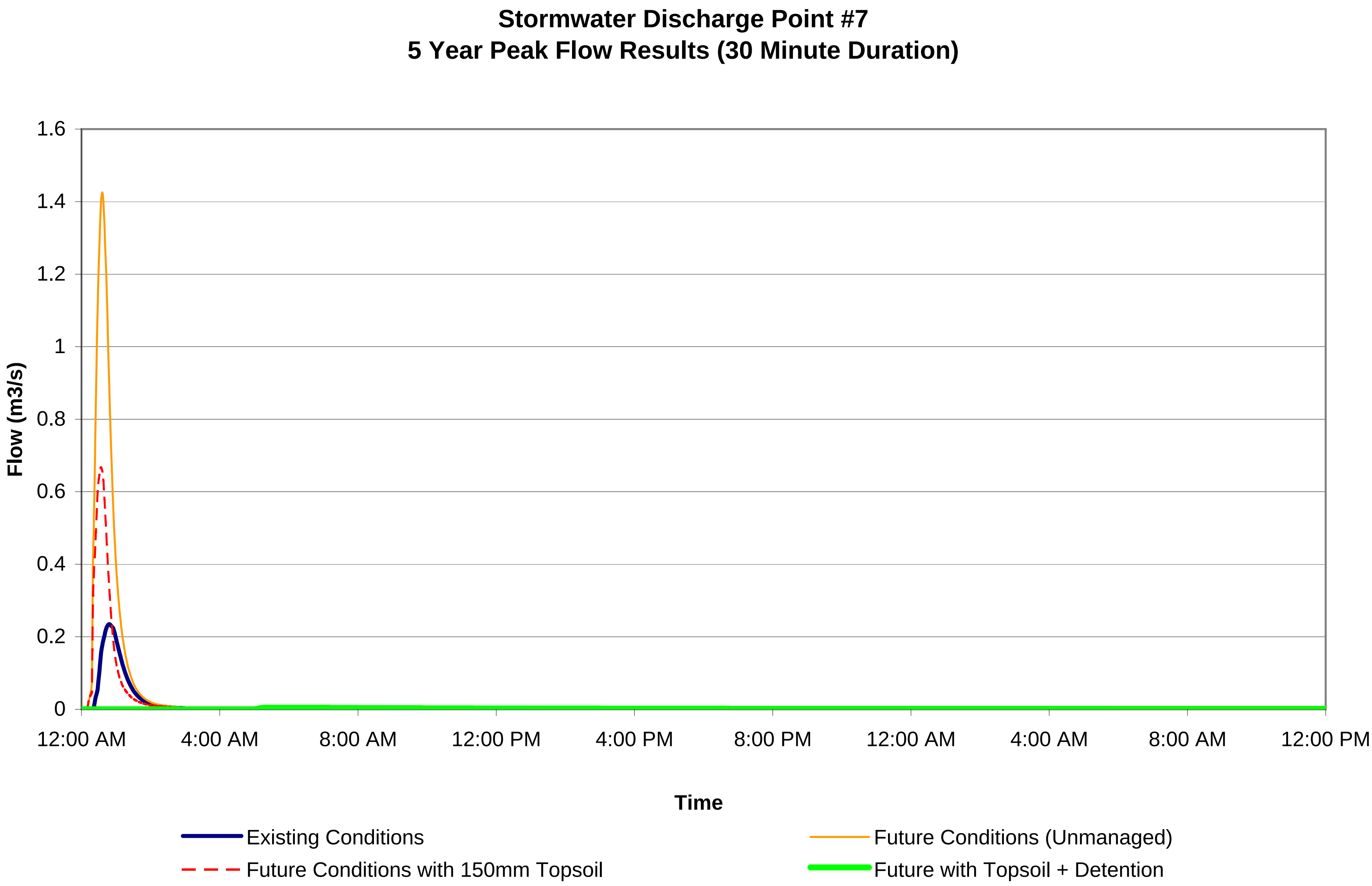

Stormwater Discharge Point #6
MAR Results (24 Hour Duration)
Flow (m3/s)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

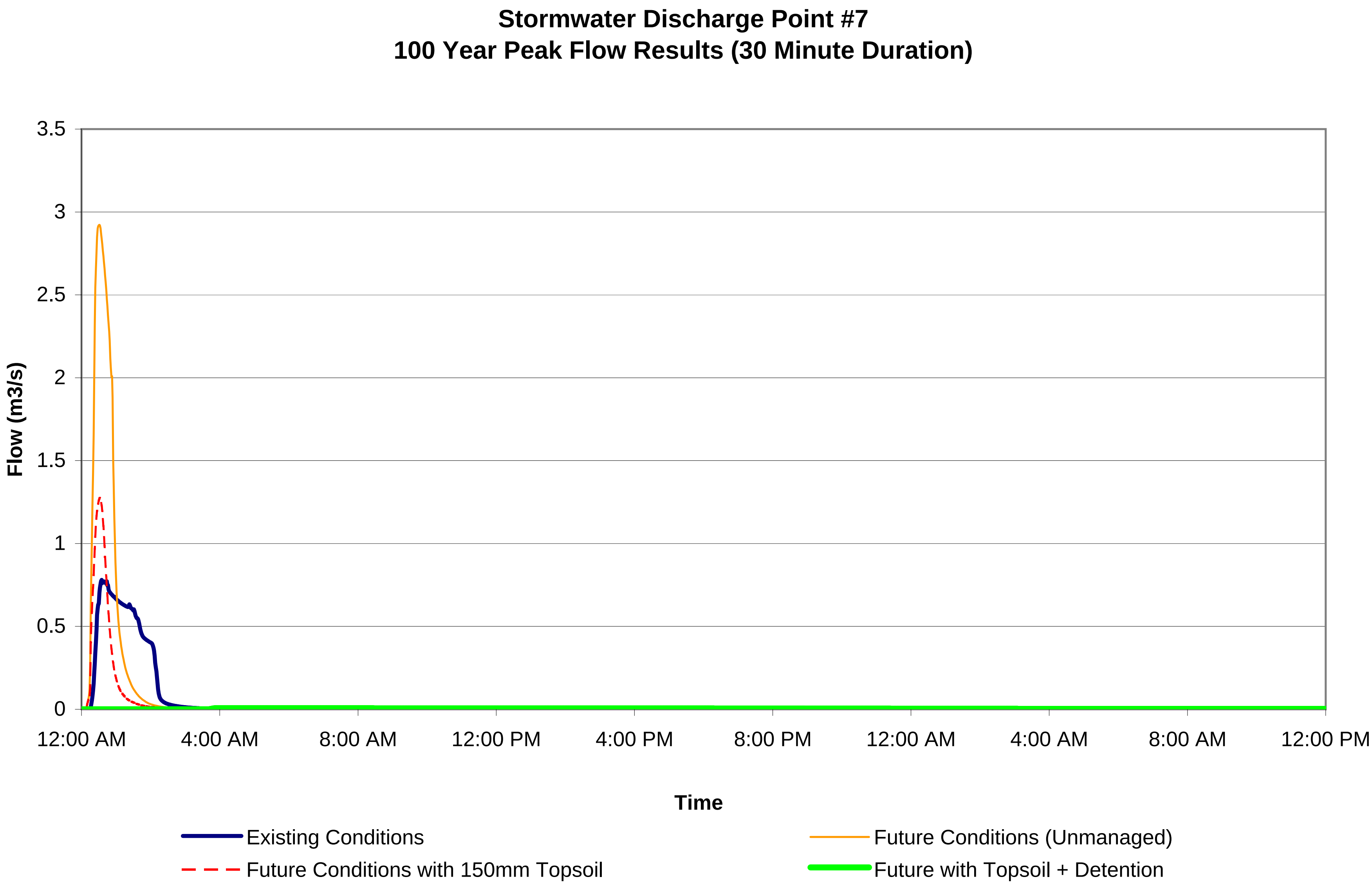


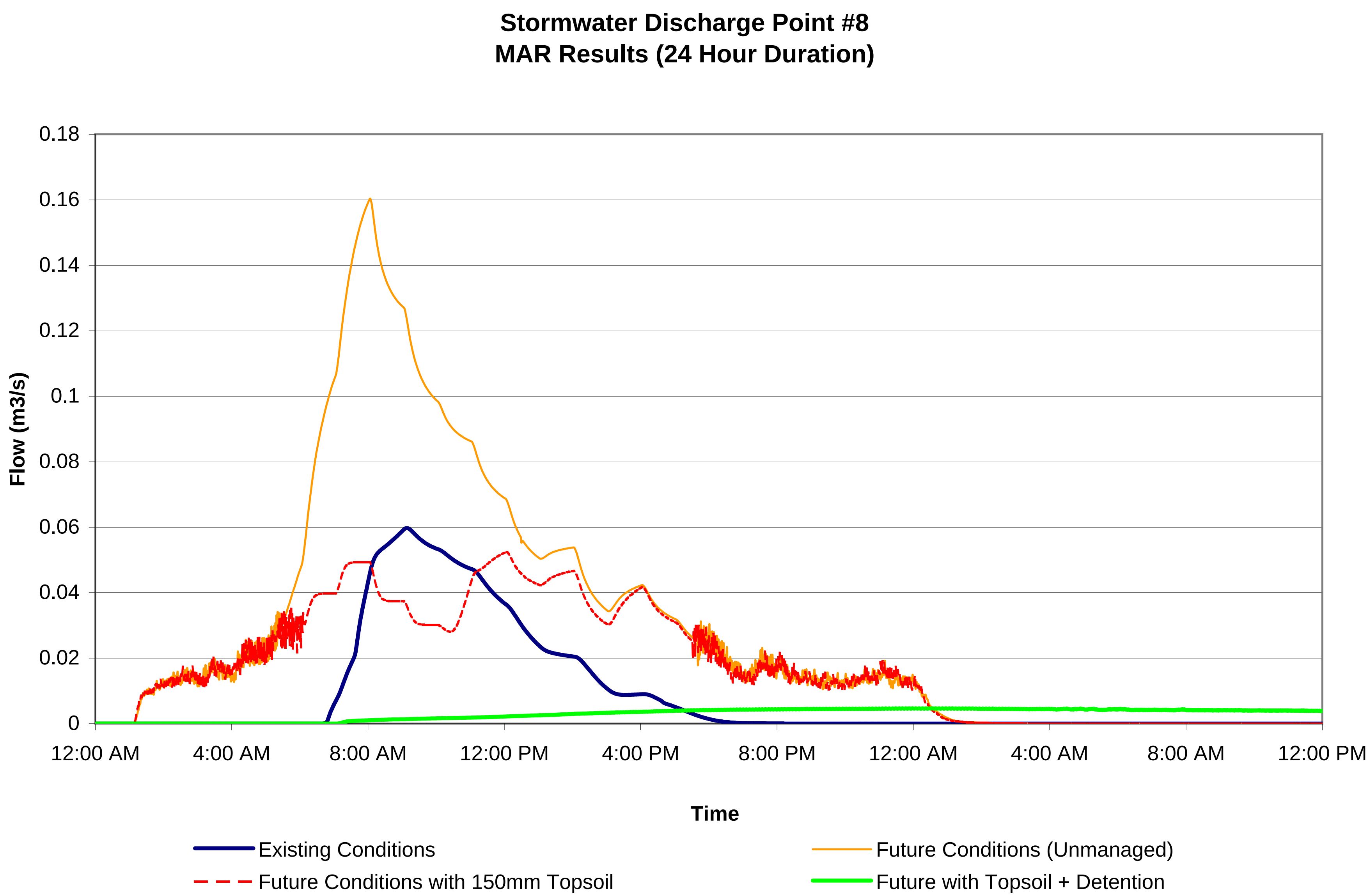
Stormwater Discharge Point #6
5 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

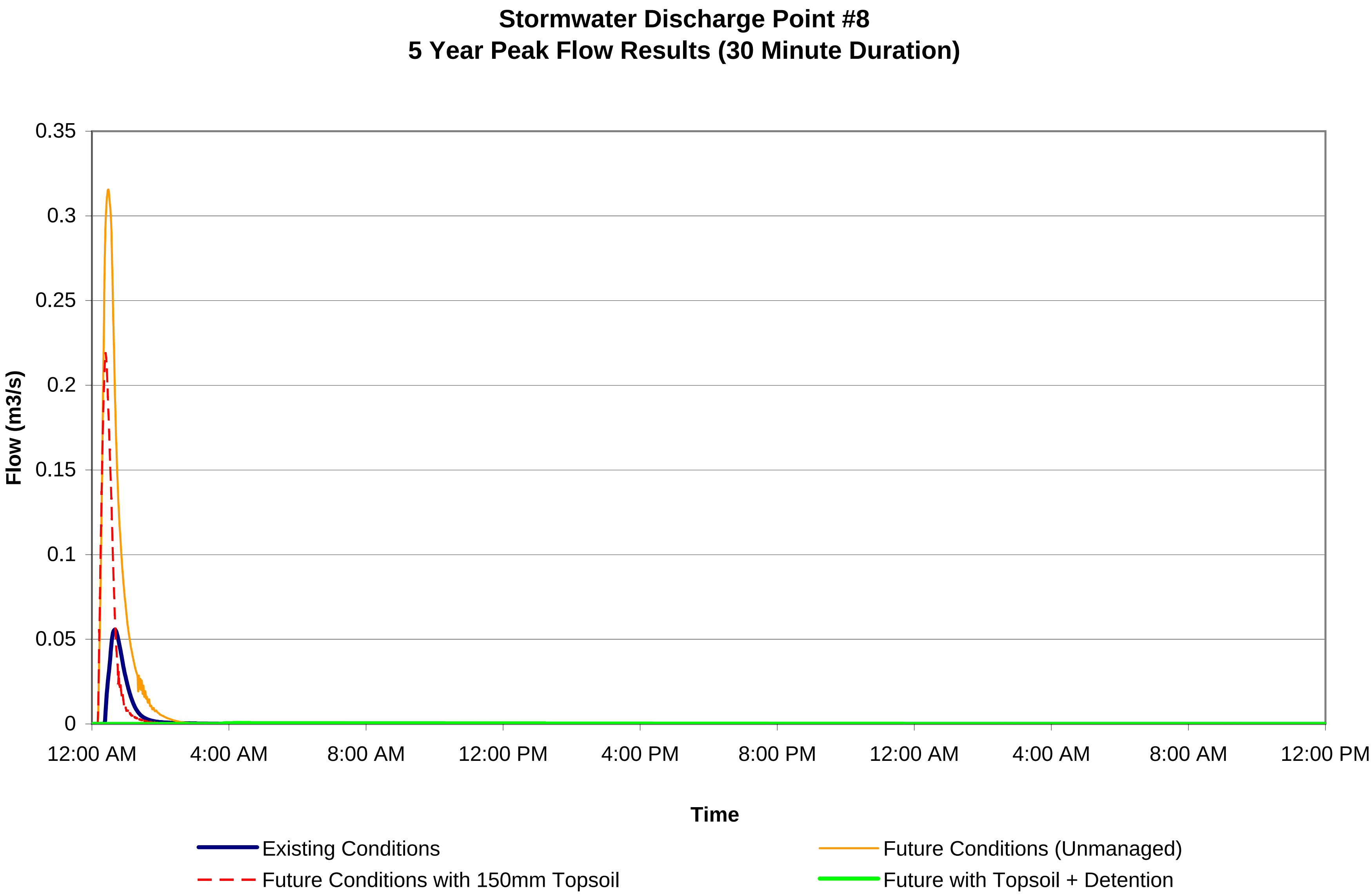

Stormwater Discharge Point #6
100 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

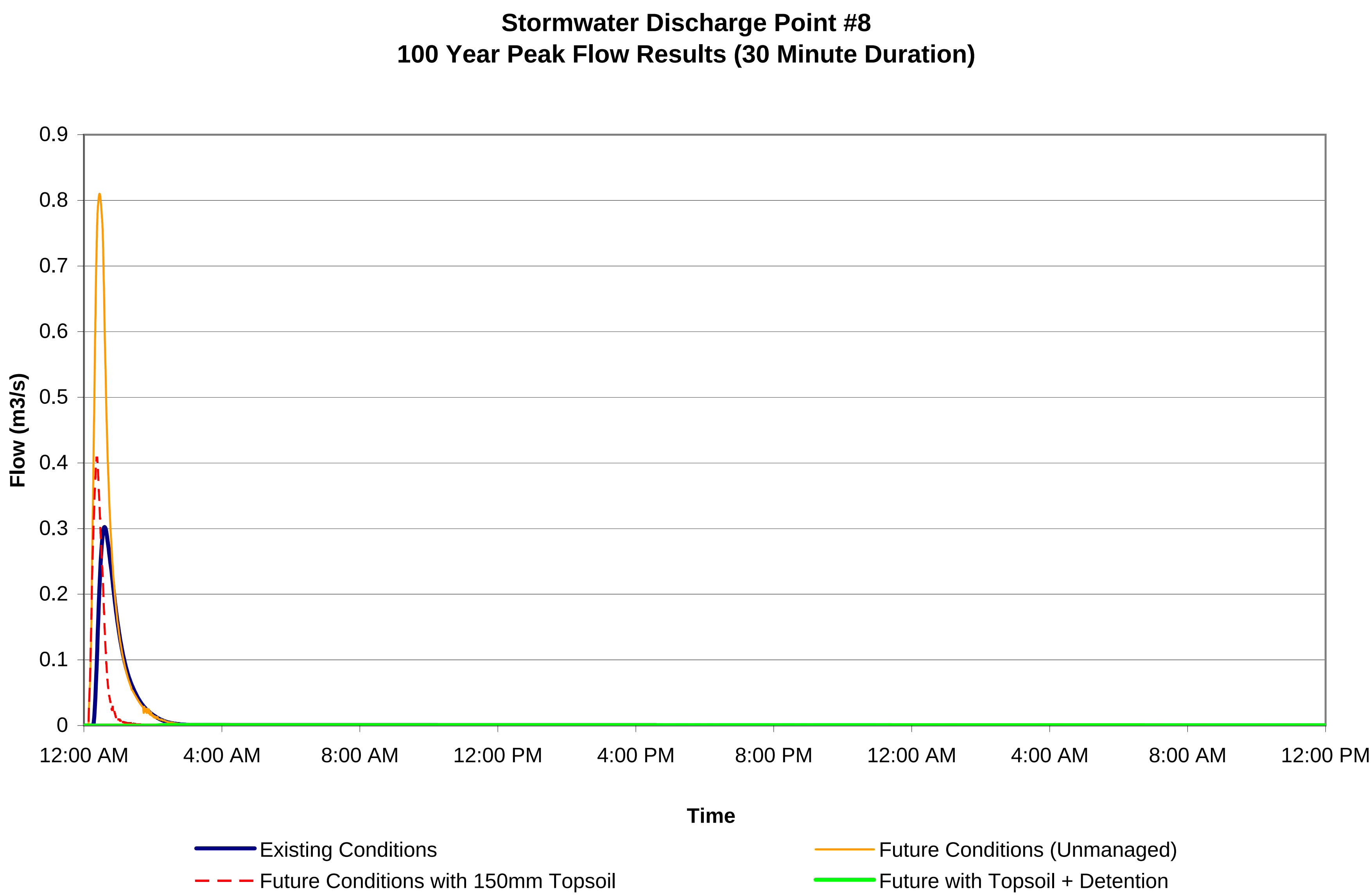

Stormwater Discharge Point #7
MAR Results (24 Hour Duration)
Flow (m3/s)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention


Stormwater Discharge Point #7
5 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention


Stormwater Discharge Point #7
100 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
3.5
3
2.5
2
1.5
1
0.5
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

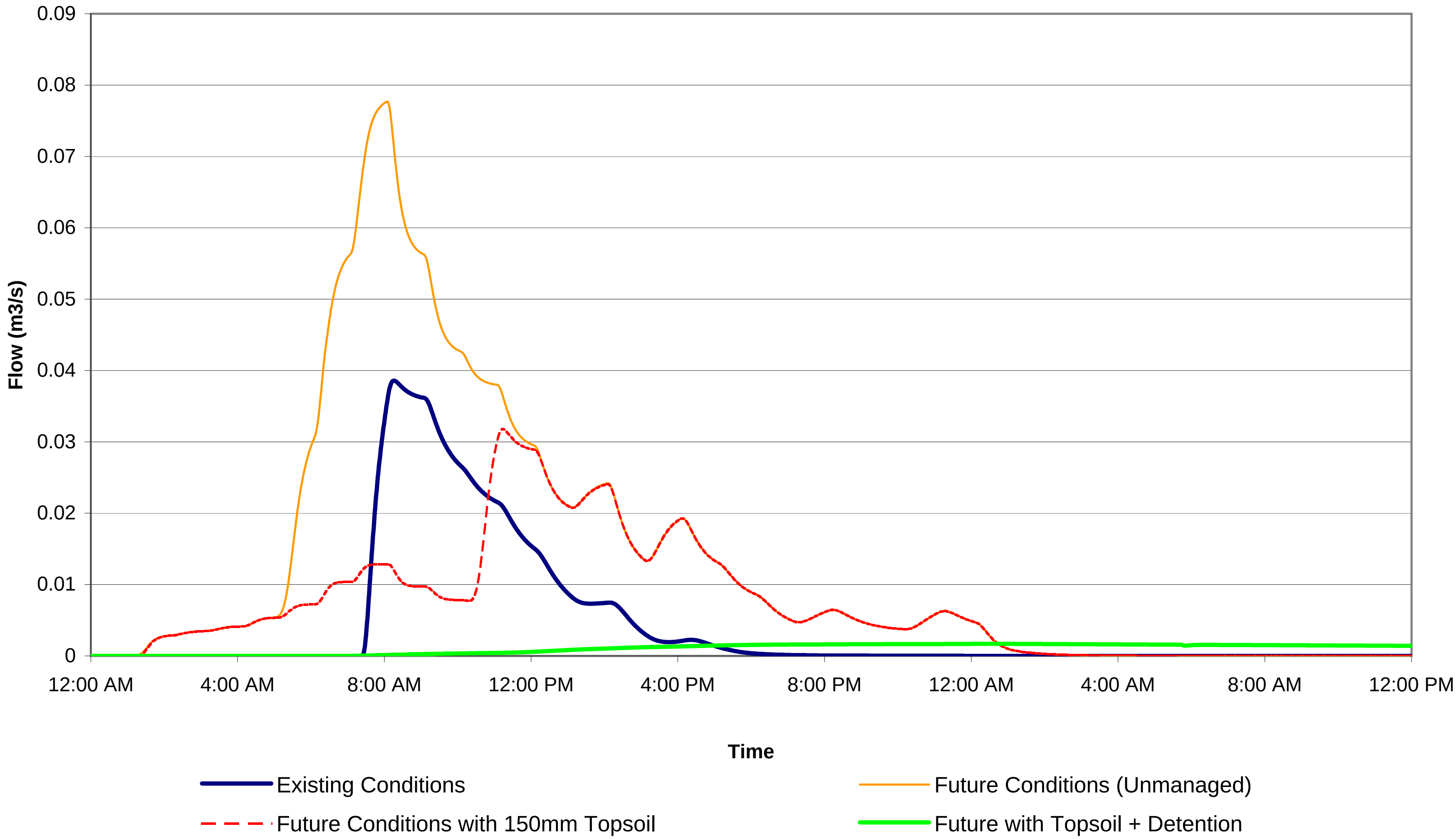

Stormwater Discharge Point #8
MAR Results (24 Hour Duration)
Flow (m3/s)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

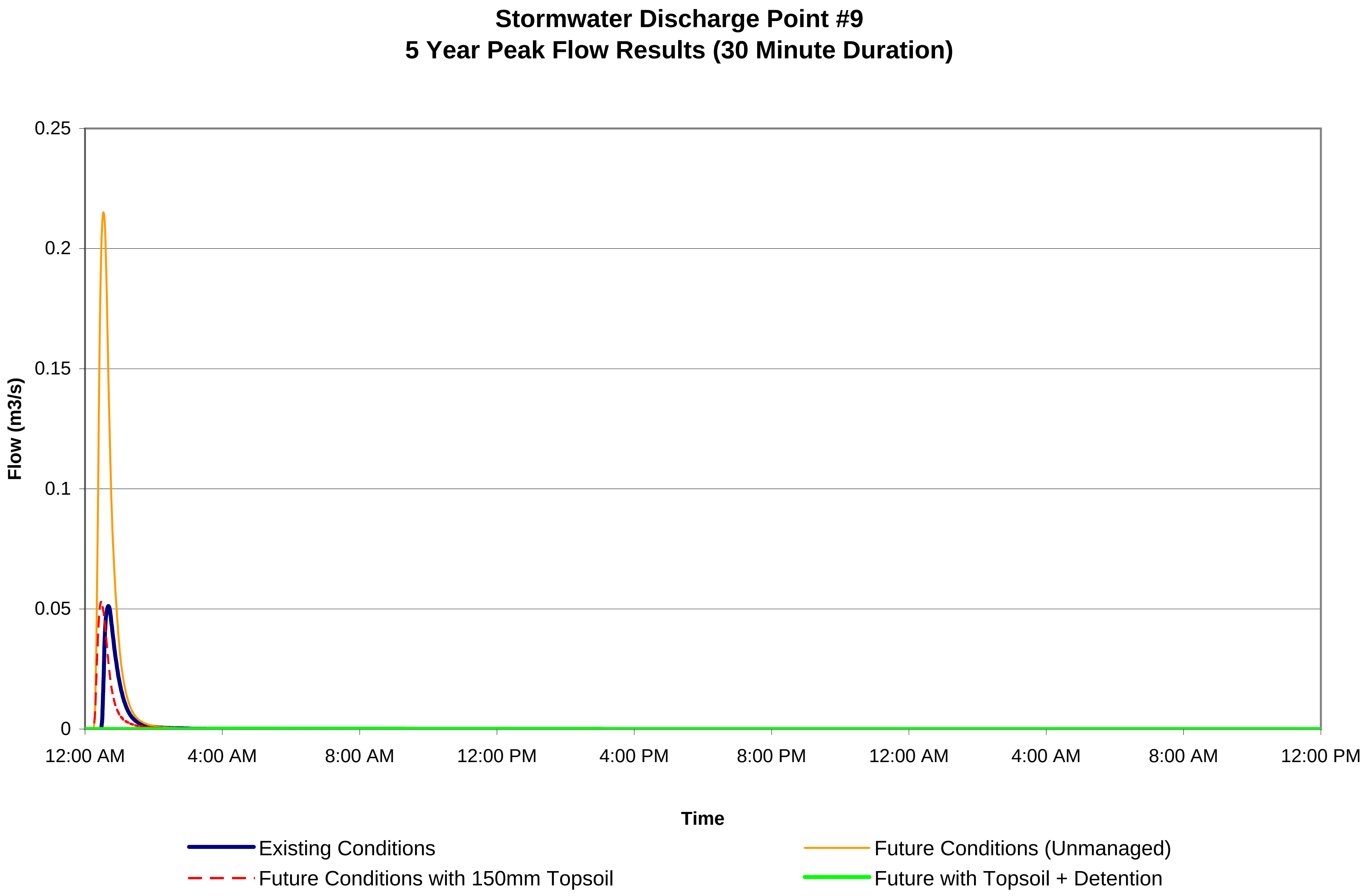

Stormwater Discharge Point #8
5 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

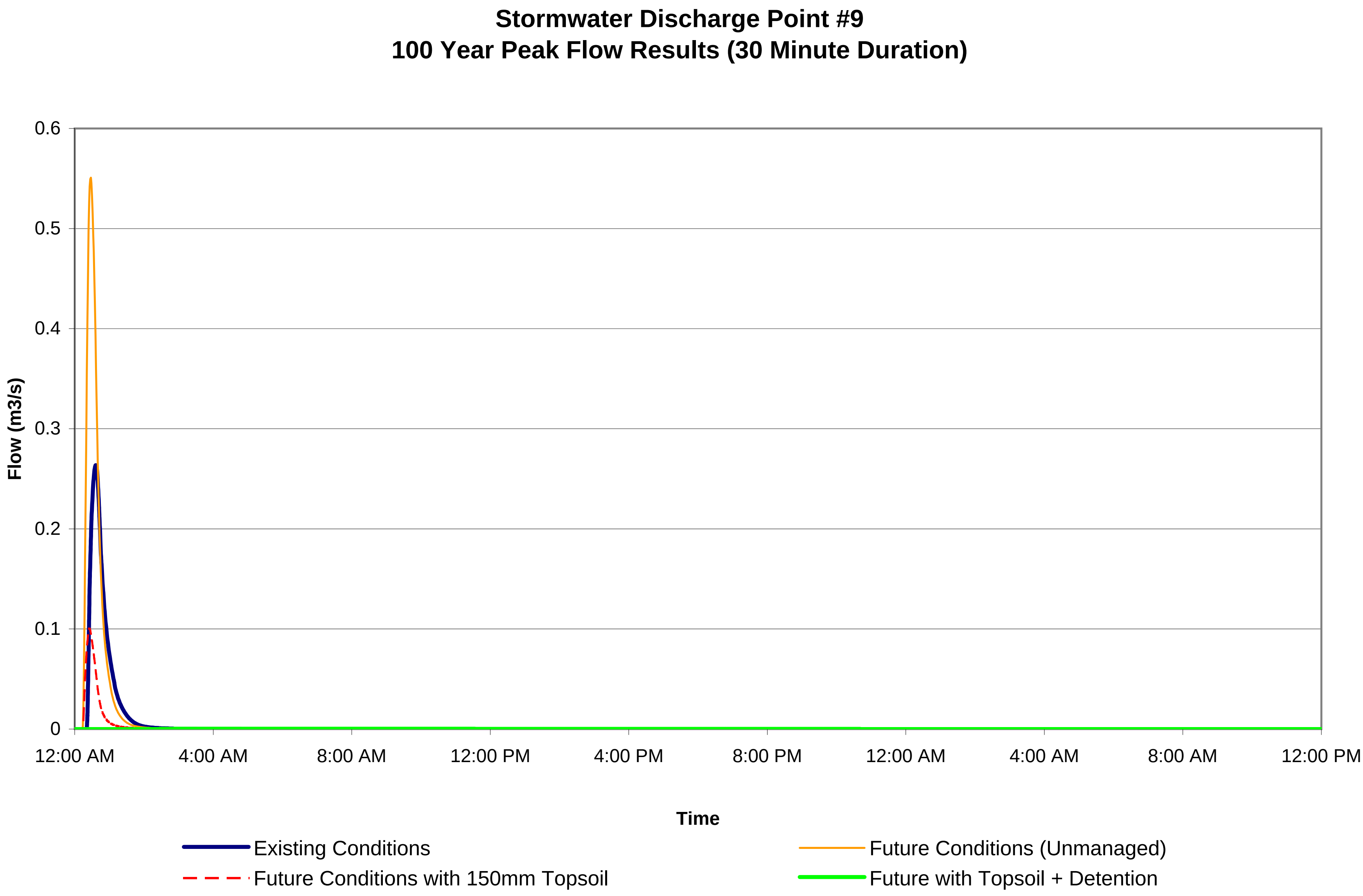


Stormwater Discharge Point #8
100 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

Stormwater Discharge Point #9
MAR Results (24 Hour Duration)




Stormwater Discharge Point #9
5 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.25
0.2
0.15
0.1
0.05
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention


Stormwater Discharge Point #9
100 Year Peak Flow Results (30 Minute Duration)
Flow (m3/s)
0.6
0.5
0.4
0.3
0.2
0.1
0
12:00 AM
4:00 AM
8:00 AM
12:00 PM
4:00 PM
8:00 PM
12:00 AM
4:00 AM
8:00 AM
12:00 PM
Time
Existing Conditions
Future Conditions (Unmanaged)
Future Conditions with 150mm Topsoil
Future with Topsoil + Detention

Project Description: Grandview Heights NCP #2 By: JMR
Project Number: 1072.0143.01 Date: 22-Nov-07

INPUT

P 1200 mm (annual average rainfall)
Pj 90 % (fraction of rainfall that produces runoff)

Existing Conditions						Estimated Potential Pollutant Load													
						TSS		Phosphorus		Nitrogen		Fecal Coliform		Oil & Grease		Zinc		Copper	
Land Use	Area (Ha)	I%	Rv	R (mm)	Pollutant Land Use Category	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(10^12 Colonies)	(10^12 Colonies/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)
Single Family Residential	66.390	19.94	0.229	247.8	Res	8040	121.1	27.9	0.420	151.0	2.274	13.8	0.207	639.9	9.639	12.0	0.180	2.0	0.030
Multi-Family Residential	0.000	0	0.050	54.0	Res	0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000
Commercial	11.530	5.09	0.096	103.5	Com	500	43.3	1.3	0.114	13.1	1.135	0.5	0.045	55.9	4.850	1.8	0.155	0.2	0.018
Open Space (parks; other)	83.290	8.25	0.124	134.2	Open	5406	64.9	14.5	0.174	85.8	1.030	8.1	0.097	144.9	1.740	4.5	0.054	1.1	0.013
Total	161.210	12.84				13946	86.5	43.7	0.271	249.9	1.550	22.3	0.139	840.7	5.215	18.2	0.113	3.3	0.020

Pollutant Event Mean Concentrations* (EMCs), by Land Use Category:

Pollutant	Res	Com	Ind	Highway	Open	
TSS	49.0	42.0	78.0	99.0	48.5	
COD	55.0	60.0	60.0	100.0	42.1	
P	0.17	0.11	0.11	0.20	0.13	Filtered (i.e., dissolved)
N	0.92	1.10	1.23	1.35	0.77	NH_3 + (NO_2 + NO_3)
Coliform	8345	4300	2500	1700	7200	Fecal
O&G	3.90	4.70	5.00	8.00	1.30	
Zn	0.073	0.150	0.210	0.200	0.040	Total
	43%	39%	53%	26%		Dissolved fraction
Pb	0.012	0.018	0.025	0.025	0.010	Total
	25%	28%	20%	7%		Dissolved fraction
Cu	0.012	0.017	0.022	0.0347	0.0100	Total
	58%	45%	36%	31%		Dissolved fraction
Cr	0.0046	0.0060	0.0140	0.0083	0.0054	Total
		33%	21%	28%		Dissolved fraction
Cd	0.00050	0.00089	0.00200	0.00100	0.00038	Total
		34%	30%	68%		Dissolved fraction
Ar	0.0030	0.0024	0.0040	0.0024	0.0040	Total
						Dissolved fraction

* Values in mg/L, except Fecal coliform in mpn/100 mL

Credits: Method based on "The Simple Method to Calculate Urban Stormwater Loads," Center for Watershed Protection, Ellicott City, MD
(www.stormwatercenter.net, accessed September 26, 2006)
Pollutant EMCs from "The National Stormwater Quality Database (NSQD, version 1.1)," R.E. Pitt, A. Maestre, & R. Morquecho, February 16, 2004
(http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/Mainms4paper.html, accessed July 30, 2007)

Project Description: Grandview Heights NCP #2 By: JMR
Project Number: 1072.0143.01 Date: 2-Apr-10

INPUT

P	1200	mm (annual average rainfall)
Pj	90	% (fraction of rainfall that produces runoff)

Fully Developed Conditions						Estimated Potential Pollutant Load													
						TSS		Phosphorus		Nitrogen		Fecal Coliform		Oil & Grease		Zinc		Copper	
Land Use	Area (Ha)	I%	Rv	R (mm)	Pollutant Land Use Category	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(10^12 Colonies)	(10^12 Colonies/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)
Single Family Residential	80.089	56.23	0.556	600.6	Res	23504	293.5	81.5	1.018	441.3	5.510	40.2	0.502	1870.8	23.358	35.0	0.437	5.8	0.072
Multi-Family Residential	37.731	60.85	0.598	645.5	Res	11901	315.4	41.3	1.094	223.5	5.922	20.4	0.540	947.2	25.105	17.7	0.470	2.9	0.077
Commercial	7.909	64.41	0.630	680.1	Com	2253	284.9	5.9	0.746	59.0	7.461	2.3	0.293	252.1	31.877	8.0	1.017	0.9	0.115
Open Space (parks; other)	32.002	43.14	0.438	473.3	Open	7327	228.9	19.6	0.614	116.3	3.635	10.9	0.341	196.4	6.137	6.0	0.189	1.5	0.047
Total	157.731	55.09				44985	285.2	148.4	0.941	840.1	5.326	73.8	0.468	3266.5	20.709	66.8	0.424	11.1	0.070
					Increase/decrease from existing conditions:	223%		240%		236%		231%		289%		267%		238%	

Pollutant Event Mean Concentrations* (EMCs), by Land Use Category:

Pollutant	Res	Com	Ind	Highway	Open	
TSS	49.0	42.0	78.0	99.0	48.5	
COD	55.0	60.0	60.0	100.0	42.1	
P	0.17	0.11	0.11	0.20	0.13	Filtered (i.e., dissolved)
N	0.92	1.10	1.23	1.35	0.77	$NH_3 + (NO_2 + NO_3)$
Coliform	8345	4300	2500	1700	7200	Fecal
O&G	3.90	4.70	5.00	8.00	1.30	
Zn	0.073	0.150	0.210	0.200	0.040	Total
	43%	39%	53%	26%		Dissolved fraction
Pb	0.012	0.018	0.025	0.025	0.010	Total
	25%	28%	20%	7%		Dissolved fraction
Cu	0.012	0.017	0.022	0.0347	0.0100	Total
	58%	45%	36%	31%		Dissolved fraction
Cr	0.0046	0.0060	0.0140	0.0083	0.0054	Total
		33%	21%	28%		Dissolved fraction
Cd	0.00050	0.00089	0.00200	0.00100	0.00038	Total
		34%	30%	68%		Dissolved fraction
Ar	0.0030	0.0024	0.0040	0.0024	0.0040	Total
						Dissolved fraction

* Values in mg/L, except Fecal coliform in mpn/100 mL

Credits: Method based on "The Simple Method to Calculate Urban Stormwater Loads," Center for Watershed Protection, Ellicott City, MD
(www.stormwatercenter.net, accessed September 26, 2006)
Pollutant EMCs from "The National Stormwater Quality Database (NSQD, version 1.1)," R.E. Pitt, A. Maestre, & R. Morquecho, February 16, 2004
(http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/Mainms4paper.html, accessed July 30, 2007)

Printed: 05/04/2010

Project Description: Grandview Heights NCP #2 By: JMR

Project Number: 1072.0143.01 Date: 2-Apr-10

INPUT

P	1200	mm (annual average rainfall)
Pj	25	% (fraction of rainfall that produces runoff) (i.e., proposed BMPs capture up to ~1/2 of MAR before runoff occurs, throughout area)

Fully Developed Conditions with BMPs Implemented						Estimated Potential Pollutant Load													
Land Use	Area (Ha)	I%	Rv	R (mm)	Pollutant Land Use Category	TSS		Phosphorus		Nitrogen		Fecal Coliform		Oil & Grease		Zinc		Copper	
						(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(10^12 Colonies)	(10^12 Colonies/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)	(Kg)	(Kg/Ha)
Single Family Residential	80.089	19.47	0.225	67.6	Res	2644	33.0	9.2	0.115	49.7	0.620	4.5	0.057	210.5	2.628	3.9	0.049	0.6	0.008
Multi-Family Residential	37.731	60.85	0.598	179.3	Res	3306	87.6	11.5	0.304	62.1	1.645	5.7	0.150	263.1	6.974	4.9	0.131	0.8	0.021
Commercial	7.909	64.41	0.630	188.9	Com	626	79.1	1.6	0.207	16.4	2.072	0.6	0.081	70.0	8.855	2.2	0.283	0.3	0.032
Open Space (parks; other)	32.002	17.91	0.211	63.4	Open	981	30.6	2.6	0.082	15.6	0.487	1.5	0.046	26.3	0.821	0.8	0.025	0.2	0.006
Total	157.731	31.31				7557	47.9	24.9	0.158	143.7	0.911	12.3	0.078	569.9	3.613	11.9	0.076	1.9	0.012
Increase/decrease from existing conditions:						-46%		-43%		-42%		-45%		-32%		-35%		-42%	
Increase/decrease from future conditions w/no controls:						-83%		-83%		-83%		-83%		-83%		-82%		-83%	

Pollutant Event Mean Concentrations* (EMCs), by Land Use Category:

Pollutant	Res	Com	Ind	Highway	Open	
TSS	49.0	42.0	78.0	99.0	48.5	
COD	55.0	60.0	60.0	100.0	42.1	
P	0.17	0.11	0.11	0.20	0.13	Filtered (i.e., dissolved)
N	0.92	1.10	1.23	1.35	0.77	$NH_3 + (NO_2 + NO_3)$
Coliform	8345	4300	2500	1700	7200	Fecal
O&G	3.90	4.70	5.00	8.00	1.30	
Zn	0.073	0.150	0.210	0.200	0.040	Total
	43%	39%	53%	26%		Dissolved fraction
Pb	0.012	0.018	0.025	0.025	0.010	Total
	25%	28%	20%	7%		Dissolved fraction
Cu	0.012	0.017	0.022	0.0347	0.0100	Total
	58%	45%	36%	31%		Dissolved fraction
Cr	0.0046	0.0060	0.0140	0.0083	0.0054	Total
		33%	21%	28%		Dissolved fraction
Cd	0.00050	0.00089	0.00200	0.00100	0.00038	Total
		34%	30%	68%		Dissolved fraction
Ar	0.0030	0.0024	0.0040	0.0024	0.0040	Total
						Dissolved fraction

* Values in mg/L, except Fecal coliform in mpn/100 mL

Credits: Method based on "The Simple Method to Calculate Urban Stormwater Loads," Center for Watershed Protection, Ellicott City, MD

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(http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/Mainms4paper.html, accessed July 30, 2007)

Grandview Heights NCP Area # 2
Class D Construction Cost Estimate

	DESCRIPTION	UNIT	QUANTITY	Construction Location	UNIT PRICE	AMOUNT
163 Street Trunk Storm Sewer (SDP 3)						
1.1	600mm dia. concrete storm sewer	lin.m.	80	raw	$ 1,062	$ 85,000
	Subtotal (163 Street)					$ 85,000
164 Street Trunk Storm Sewer (SDP 2)						
2.1	Concrete storm sewer					
i)	675mm dia.	lin.m.	245	raw	$ 1,146	$ 281,000
	Subtotal (164 Street)					$ 281,000
168 Street Trunk Storm Sewer (SDP 7)						
3.1	Concrete storm sewer					
i)	525mm dia.	lin.m.	415	arterial	$ 1,640	$ 681,000
ii)	600mm dia.	lin.m.	820	arterial	$ 1,770	$ 1,451,000
iii)	750mm dia.	lin.m.	200	arterial	$ 2,040	$ 408,000
	Subtotal (168 Street)					$ 2,540,000
24 Avenue Trunk Storm Sewer (SDP 5)						
4.1	675mm dia. concrete storm sewer	lin.m.	335	arterial	$ 1,910	$ 640,000
	Subtotal (24 Avenue)					$ 640,000
	Subtotal (All trunk storm sewers)					$ 3,546,000
Ditch Erosion Protection						
5.1	Various Locations	LS	1		$ 63,900	$ 63,900
Bioswale Construction Costs (10 meter median corridors)						
6.1	Bioswales in 10m median corridors	lin.m.	1240		$ 740	$ 917,600
	Total for construction					$ 4,527,500
Land in excess of 2.5 meter dedications						
7.1	Compensation for land in excess of the 2.5 meter dedication	ac	2.739		$ 750,000	$ 2,054,250
	Grand Total					**$ 6,581,750**

Notes:

1. SDP = Stormwater Discharge Point.
2. Trunk costs based on unit rates provided by Surrey 16-Feb-2010
3. Total cost does not include GST.
4. Ditch erosion protection applied to 25% of ditches in the NCP area.

2353 - 13353 Commerce Parkway, Richmond, BC V6V 3A1
Telephone: 604-273-8700 Fax: 604-273-8752

URBANSYSTEMS.

MEMORANDUM

date:	September 23, 2010
to:	Jeannie Lee/City of Surrey
cc:	Jeffrey Rice / USL; Fraser Smith/USL
from:	Nazmun Nahar, PhD, P.Eng
file #:	1072.0143.01 – X
subject:	**GRANDVIEW HEIGHTS POND ASSESSMENT**

The City of Surrey requested Urban Systems to complete a feasibility assessment of a community detention pond in the Grandview Heights #2 (GH#2) neighbourhood, which lies within the Fergus Creek watershed. In the Fergus Creek Integrated Stormwater Management Plan (ISMP), a detention pond option was considered for this neighbourhood, but was not carried forward as a recommendation. Congruent with the ISMP, the servicing plan developed by Urban Systems for GH#2 proposes a range of low impact development measures (i.e., amended topsoil, disconnected roof leaders, green corridors) but no surface detention ponds to manage stormwater runoff. However, due to some interest at the City for including a surface water "feature" in GH#2, the City wanted to investigate the potential for a detention pond in lieu of the LID features, to potentially serve the Areas 2 and 3 as identified in the Fergus Creek ISMP. The following paragraphs provide a summary of our investigations.

Detention Pond Assessment

- Detention pond assessment based on the Fergus Creek ISMP

According to the Fergus Creek ISMP (McElhanney Consulting, 2007), a detention pond option was investigated to control runoff from 100 year frequency storm events. However, it is not apparent from the ISMP which of several alternative outflow control approaches were used to establish the target detention volumes. In the ISMP, separate detention ponds were considered for Catchment Areas 2 and 3. The total contributing area for the two ponds is 58.36 ha. As shown in Table 3.1 of the ISMP, the estimated excavation volume for Pond 2 was 28,000 m^3 and for Pond 3 was 16000 m^3.

- Current Detention pond assessment by USL

Initially our investigation focused on combining the two catchments into one community pond. From Figure 4.6 of the Grandview Heights NCP #2 (USL 2010) subcatchments totalling 53.2 ha and roughly matching Areas 2 and 3 from the ISMP were found that could drain to a single pond in the southwest corner of 164th Street and 20th Avenue. This is slightly less than the area approximated in the ISMP. To estimate the detention volume for one pond serving the 53.2 ha area, limited analysis was conducted using XPSWMM modeling software. Following the City of Surrey's design manual, peak flows and pond active storage volumes for 100 year frequency storm events were estimated for a range of storm durations, from 30 minutes to 24 hours. Three different outflow control approaches were followed to estimate the maximum active storage volumes:

- 100 year post-development flows controlled to 100 year pre-development flows;

- 100 year post-development flows controlled to 50% of the 2 year post-development flows; and
- 100 year post-development flows controlled to 5 year pre-development flows

Based on the current analysis, the maximum required active storage volume of 14000 m^3 for one pond was obtained with the 5 year pre-development condition flow as outflow from the pond. The results for one pond analysis are shown in Table 1.

Pond Location and Configuration

Initially the site identified for Area 2 in the ISMP was considered; however, this site was found to be much too steep for use with such a large pond. Thus focus was shifted to the southwest corner of 164th Street and 20th Avenue as a possible detention pond location (Pond Site 1). Using typical pond configuration (side slope 4(H):1(V), active storage depth 2.25 m), this pond site can potentially provide 8,800 m^3 of active storage volume. This is approximately 63% of the estimated required maximum active storage volume of 14,000 m^3. Therefore, to serve the entire catchment, another detention pond would be needed.

To make up the difference in required active storage, a second site, at the northwest corner 20th Avenue and 167th Street, was investigated as a potential location for a second detention pond (Pond Site 2). Again, using a 4(H):1(V) side slope and active storage depth of 2.4m, this additional site can provide 6,000 m^3 of active storage volume. By combining the storage volumes that can be potentially detained by the two ponds, the target storage volume (14,000 m^3) could be met.

Based on modeling with XP-SWMM, it was found that a pond at Site 1 can serve an area of 31.1 ha with a detention volume of 5,300 m^3 required, while a pond at Site 2 can serve an area of 22.1 ha and with a required detention volume of 6,000 m^3. The higher storage volume for Site 2 is attributed to the higher total imperviousness of the contributing areas. Figures 1 and 2 show the layouts and sections for the two ponds. Figures 3(a-b) show the two potential pond sites and the distribution of catchment areas. One advantage of utilizing two ponds, instead of one, is that GH#2 NCP drainage pattern can still be maintained, that is, Pond 1 would still discharge to discharge point SDP 2 and Pond 2 would still discharge to SDP 7 via the trunk sewer along the 168th Street. Results of the two pond analysis are shown in Table 2. Table 3 summarizes the estimated storage volumes and excavation volumes for the two ponds.

No detailed analysis has been completed at this stage; however, based on our preliminary analysis, we anticipate the ponds will be hydraulically feasible.

Diversion Storm Sewer Sizing

To maximize the use of available Pond Site 1, a diversion storm sewer is required along 20th Avenue to convey runoff from several subcatchments that do not naturally drain to the site. Diversion sewer sizing for this single pond alternative depends on how many additional catchments are considered to drain into the pond. In Figure 3a, catchment #29 is shown as a potential catchment to drain into Pond 1 and a diversion sewer of 600 mm will be required to convey flows from this catchment to the pond.

Cost Estimate for Ponds and Storm Sewers

The cost estimate for the one pond option is shown in Table 4. It includes cost estimates for the pond and the storm sewers along the 20th Avenue to convey the flows to the pond. Table 5 shows the cost estimates for the two pond option. The cost estimate for the stormwater corridor and bioswales that would be eliminated by the pond(s) is shown in Tables 6(a-b). As can be seen, for both the one and two pond options, it is actually less costly to implement the currently recommended stormwater corridors than the ponds.

Other Considerations

In addition to

- According to the current land use plan for GH#2, Pond Site 1 lies partially within a riparian protection area. For our current analysis, this was not taken into consideration. This will require further investigation should a pond option be pursued.
- The stormwater corridors currently envisioned along rights-of-way in the GH#2 servicing plan would be abandoned if pond(s) were constructed.
- The use of pond(s) will provide neither base flow maintenance nor water quality control through rainwater infiltration as envisioned by the ISMP and by the current GH#2 servicing plan.
- Due to space constraint, the current analysis did not follow the standard pond design criteria as described in the City of Surrey design manual (7(H): 1(V) side slope).
- A 10 m buffer from the road ROWs was included in this preliminary pond assessment.

We hope that this report provides a summary of the tasks completed to date. Should you have any questions during your review of this report, please do not hesitate to contact me.

Please contact me if you have any questions or concerns.

URBAN SYSTEMS LTD.

Nazmun Nahar, PhD, P.Eng.
Water Resources Engineer

Attachments

/nn

Table 1: One Pond Analysis

Return Period	**Duration**	**Peak Flows at the discharge point**	**Pond Volume (m3)**
		Pre-development flows (m3/s)	Controlled to 5 yr Pre-development flow
5 yr	30mins	0.11	
5 yr	1 hr	0.16	
5 yr	2hr	0.3	
5 yr	6hr	0.35	
5 yr	12hr	0.44	
5 yr	24hr	0.36	
100yr	30mins		5800
100yr	1 hr		6300
100yr	2hr		7600
100yr	6hr		11400
100yr	12hr		**14000**
100yr	24hr		13900

U:\Projects_VAN\1072\0143\01\2010_extra_task\2010SMH_calculation\[2010_08_09_Table2.xlsx]Table 1

Table 2: Two Pond Analysis

Return Period	**Duration**	**Pond at Site 1**		**Pond at Site 2**	
		Pre-development condiiton peak flows at discharge point	Pond Volume by controlling 100 year post-dev flows to 5 yr pre-evelopment flows	Pre-development condiiton peak flows at discharge point	Pond Volume by controlling 100 year post-dev flows to 5 yr pre-evelopment flows
		m3/s	**m3**	**m3/s**	**m3**
5 yr	30mins	0.11		0.04	
5 yr	1 hr	0.16		0.07	
5 yr	2hr	0.3		0.13	
5 yr	6hr	0.35		0.14	
5 yr	12hr	0.44		0.17	
5 yr	24hr	0.36		0.14	
100yr	30mins		2894		2500
100yr	1 hr		3200		2700
100yr	2hr		3700		3100
100yr	6hr		4700		4800
100yr	12hr		**5300**		5800
100yr	24hr		5000		**6000**

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Table 3 : Pond volumes and Excavation volumes

Location	Pond configuration					Storage Volume (m^3)		Excavation Volume (m^3)
	Dead storage depth (m)	Active Storage depth(m)	Freeboard (m)	Side slope	Pond bottom invert (m)	Dead Storage	Active Storage	
Pond Site 1	1.00	2.25	0.60	4(H):1(V)	60.15	2200	8800	26,400
Pond Site 2	1.00	2.40	0.60	4(H):1(V)	92	950	6000	25,000

U:\Projects_VAN\1072\0143\01\2010_extra_task\2010SMH_calculation\[2010_08_09_pond volume calculations.xlsx]table3_pondstorages

Table 4: Grandview Heights NCP - One Pond Option
Class D Construction Cost Estimate

		DESCRIPTION	Size (mm)	UNIT	QUANTITY	Road type	UNIT PRICE	AMOUNT
		STORM SEWERS						
1.1	Between 168th St and 167th St	600mm dia. concrete diversion storm sewer	600	lin.m.	215	collector	$ 1,416	$ 304,000
1.2	Between 167th St and 166th St	900mm dia. concrete storm sewer	900	lin.m.	185	collector	$ 1,848	$ 342,000
1.3	Between 166th St and 164th St	900mm dia. concrete storm sewer	900	lin.m.	310	collector	$ 1,848	$ 573,000
1.4		1200mm dia. concrete storm sewer	1200	lin.m.	85	collector	$ 2,279	$ 194,000
		Subtotal						**$ 1,413,000**

		POND		Land (ha)	Pond Excavation volume (cu.m)	Unit cost		Total Cost
		Pond Site 1: Southwest Corner of 164th St and 20th Ave		0.87	26400	$100		$ 2,640,000
		Service area 31.1 ha						
		(Catchment #29 as shown in Figure 3 can potentially drain to Pond 1 which has an area of 4.1 ha. The total service area becomes 35.2 ha.)						
	Engineering (15%)							$ 396,000
	Administration (5%)							$ 132,000
	Contingency (30%)							$ 792,000
	Land			0.87		$1,875,000		$ 1,631,000
		Subtotal						**$ 5,591,000**
		TOTAL						**$ 7,004,000**

Notes:

1 Trunk costs based on unit rates provided by City of Surrey 16-Feb-2010

2 Total cost does not include GST/HST.

3 Unit land price provided by City of Surrey as $750,000/acre. It was estimated that for one ha land the cost is $1875000 .

Table 5: Grandview Heights NCP - Two Pond Option
Class D Construction Cost Estimate

		DESCRIPTION	Size (mm)	UNIT	QUANTITY	Road type	UNIT PRICE	AMOUNT
		STORM SEWERS						
1.1	Between 168th St and 167th St	1200mm dia. concrete storm sewer	1200	lin.m.	215	collector	$ 2,279	$ 490,000
1.2	Between 166th St and 164th St	750mm dia. concrete storm sewer	750	lin.m.	310	collector	$ 1,632	$ 506,000
1.3		900mm dia. concrete storm sewer	900	lin.m.	85	collector	$ 1,848	$ 157,000
		Subtotal						**$ 1,153,000**
		PONDS		Land (ha)	Pond Excavation volume (cu.m)	Unit cost		Total Cost
		Pond Site 1: Southwest Corner of 164th St and 20th Ave			26400	$100		$ 2,640,000
		Service area 31.1 ha						
	Engineering (15%)							$ 396,000
	Administration (5%)							$ 132,000
	Contingency (30%)							$ 792,000
	Land			0.87		$1,875,000		$ 1,631,000
		Subtotal						**$ 5,591,000**
		Pond Site 2: Northwest Corner of 167th St and 20th Ave			25000	$100		$ 2,500,000
		Service area 22.1 ha						
	Engineering (15%)							$ 375,000
	Administration (5%)							$ 125,000
	Contingency (30%)							$ 750,000
	Land			0.85		$1,875,000		$ 1,594,000
		Subtotal						**$ 5,344,000**
		TOTAL						**$ 12,088,000**

Notes:

1 Trunk costs based on unit rates provided by City of Surrey 16-Feb-2010
2 Total cost does not include GST/HST.
3 Unit land price provided by City of Surrey as $750,000/acre. It was estimated that for one ha land the cost is $1875000 .

	Table 6a:	**Cost of Pond Vs Stormwater Corridor**							
		One Pond Option							
Pond Site 1	Corridors within catchments #4, #19, #34, #33, #28, #31 and potential catchment #29 (as shown in Figure 3)	5m corridors	10m corridors (internal-local road)	10m corridors (boundary-collector)					
		160	150	100					
		200	95	165					
		86	80	90					
		75	80	270					
		130	80	200					
		200							
		200							
		200							
		90							
		30							
		40							
		90							
		70							
		90							
		140							
		65							
	subtotal =	1866	485	825					
	width =	5	10	10					
	total area =	9,330	4,850	0	14,180	m2	22430	m2	
	assumed land cost =	$ 750,000	per ac.		3.504	ac	5.543	ac	
	assumed 5 m corridor construction cost =	$ 620	per m (including 15% Eng, 5% Admin, and 30%						
	assumed 10m corridor construction cost =	$ 740	same						
	assumed 20 m corridor construction cost =	$ 850	same						
	Corridor cost =	$ 4,156,963	10m corridor fully accounted for						
	bioswale construction=	$ 2,126,320	*based on USL bioswale construction rate per m of corridor*						
TOTAL corridor cost (including corridors within catchment #29) =		**$ 6,283,283**							
	USL 2010 Pond Contributing area (Site 1) including catchment #29=		35.2	ha					
	USL 2010 Pond Cost (Site 1) including the storm sewers=	**$7,004,000**							

Table 6b: Cost of Pond Vs Stormwater Corridor

Two Pond Option

POND SITE								
1	Corridors within catchments #4, #19, #34, #33, #28, #31 (as shown in Figure 3)	5m corridors	10m corridors (internal-local road)	10m corridors (boundary-collector)				
		160	150	100				
		200	95	165				
		86	80	90				
		75	80	270				
		130	80					
		200						
		200						
		200						
		90						
		30						
		40						
		90						
		70						
		90						
	subtotal =	1661	485	625				
	width =	5	10	10				
	total area =	8,305	4,850	0	13,155	m2	19405	m2
	assumed land cost =	$ 750,000	per ac.		3.251	ac	4.795	ac
	assumed 5 m corridor construction cost =	$ 620	per m (including 15% Eng, 5% Admin, and 30%					
	assumed 10m corridor construction cost =	$ 740	same					
	assumed 20 m corridor construction cost =	$ 850	same					
	Corridor cost =	$ 3,596,338	10m corridor fully accounted for					
	bioswale construction=	$ 1,851,220	*based on USL bioswale construction rate per m of corridor*					
	TOTAL corridor cost =	**$ 5,447,558**						
	USL 2010 Pond Contributing area (Site 1)=	31.1		ha				
	USL 2010 Pond Cost (Site 1) including the storm sewers=	**$6,254,000**						

POND SITE								
2	Corridors within catchments #17,#9, #13, #1, #7, #8, #29 (as shown in Figure 3)	5m corridors	10m corridors					
		333	200					
		94						
		90						
		140						
		80						
		180						
		70						
		140						
		65						
	subtotal =	1192	200					
	width =	5	10					
	total area =	5,960	0	5,960	m2	7960	m2	full 10m
				1.473	ac	1.967	ac	
	assumed land cost =	$ 750,000	per ac.					
	assumed 5 m corridor construction cost =	$ 620	(including 15% Eng, 5% Admin,					
	assumed 10m corridor construction cost =	$ 740	same					
	assumed 20 m corridor construction cost =	$ 850	same					
	Corridor land cost =	$ 1,475,231	*10m corridors fully accounted for*					
	bioswale construction cost =	$ 887,040	*based on USL bioswale construction rate per m of corridor*					
	TOTAL corridor cost =	**$ 2,362,271**						
	USL 2010 Pond Contributing area (Site 2)=	22.1	ha					
	USL 2010 Pond Cost (Site 2) including the storm sewers=	**$5,834,000**						

POND SITE 1

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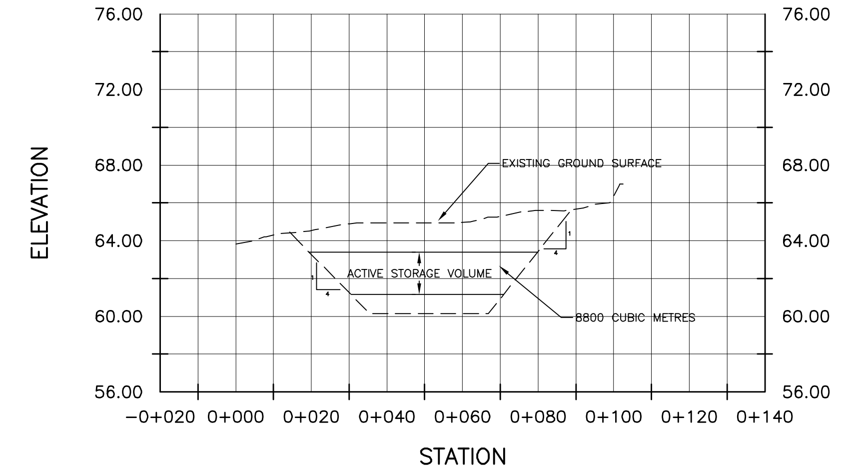
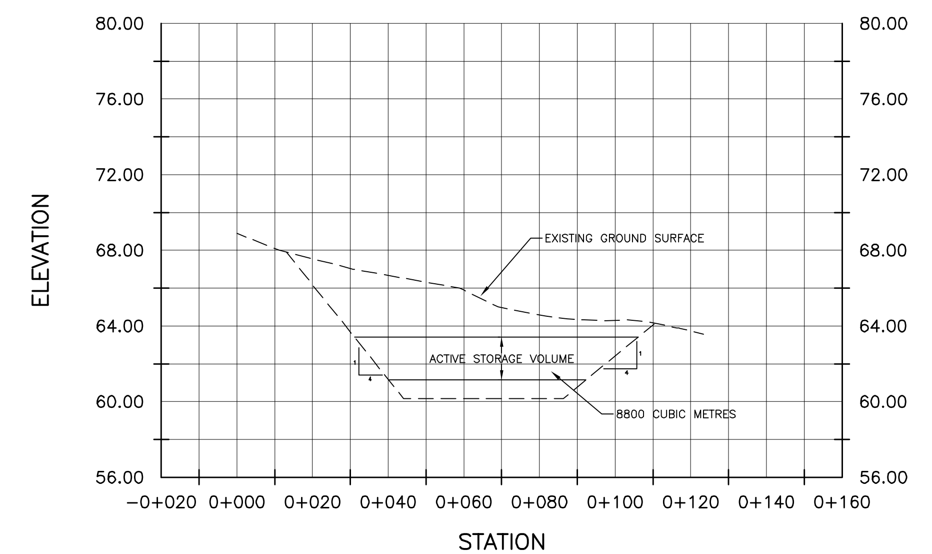


SECTION A-A
HORIZONTAL SCALE: 1:2000
VERTICAL SCALE: 1:400



SECTION B-B
HORIZONTAL SCALE: 1:2000
VERTICAL SCALE: 1:400

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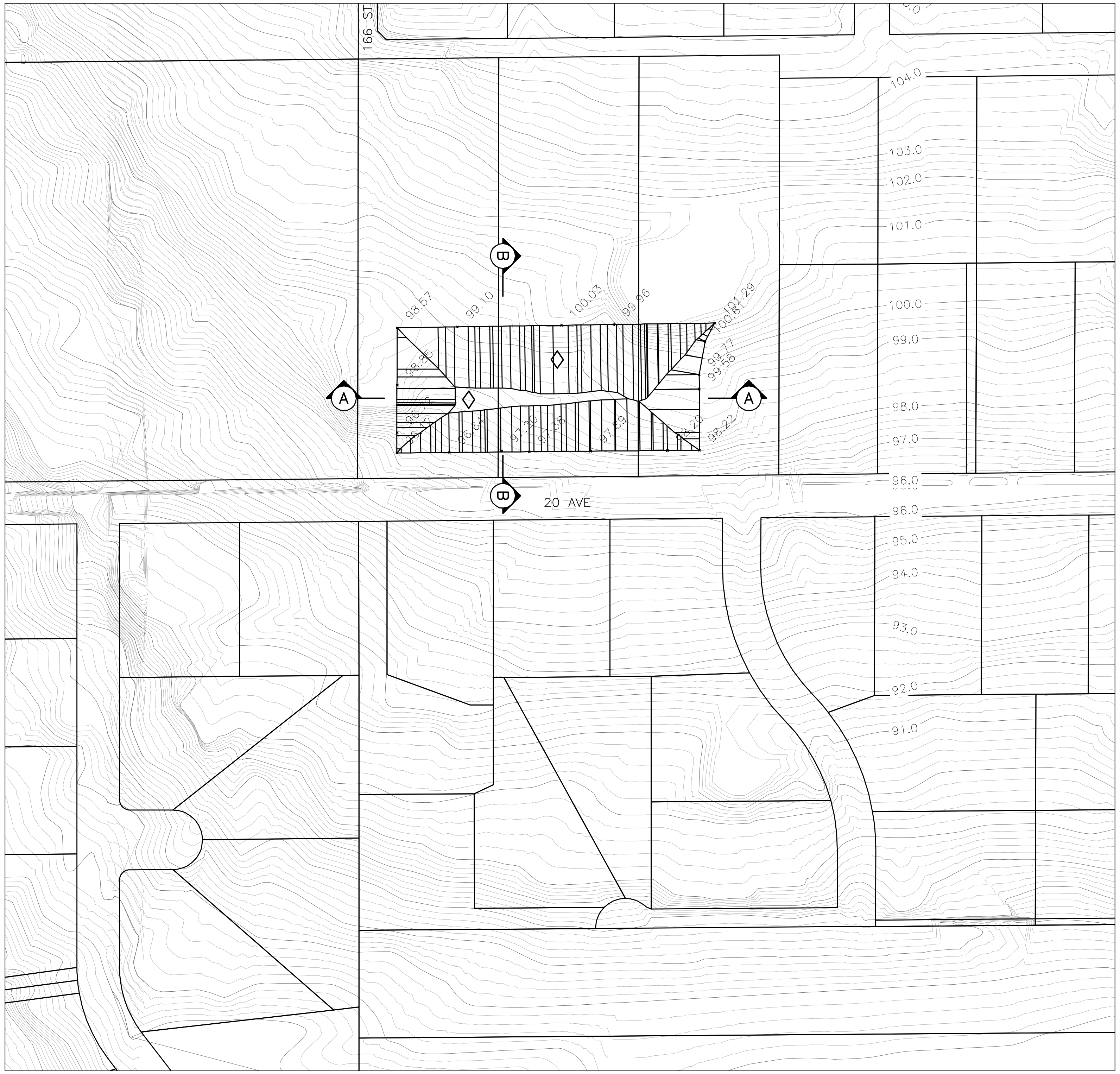
Client/Project		
CITY OF SURREY		
Scale	Date	Figure
AS NOTED	2010-09-17	1
AS NOTED		Title
GRANDVIEW HEIGHTS NCP		



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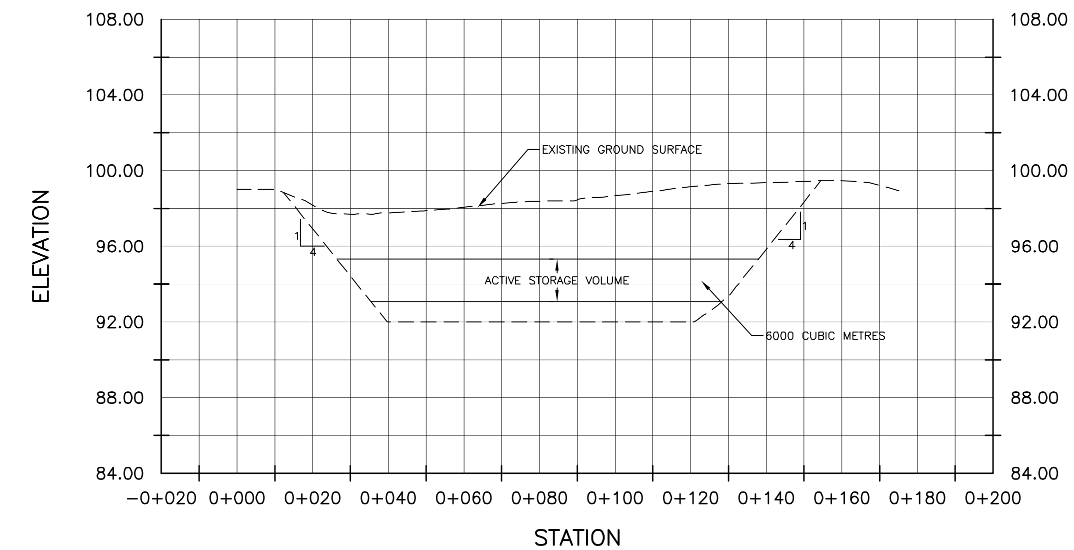

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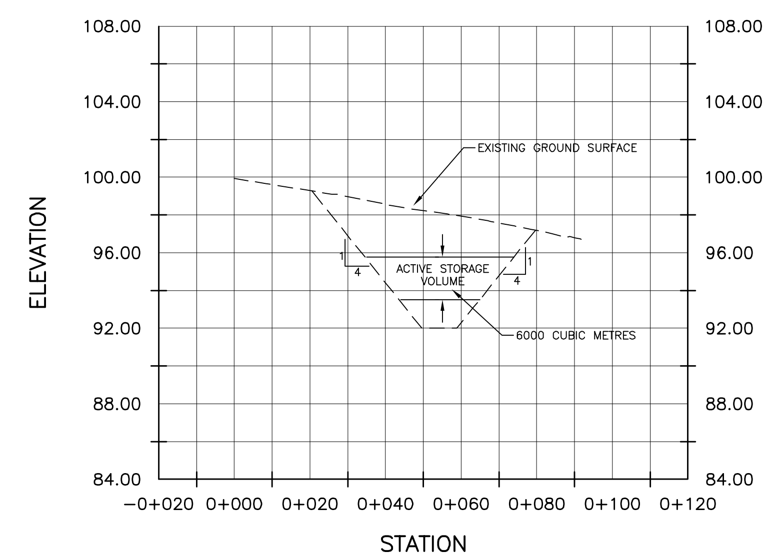

SECTION B-B
HORIZONTAL SCALE: 1:2000
VERTICAL SCALE: 1:400

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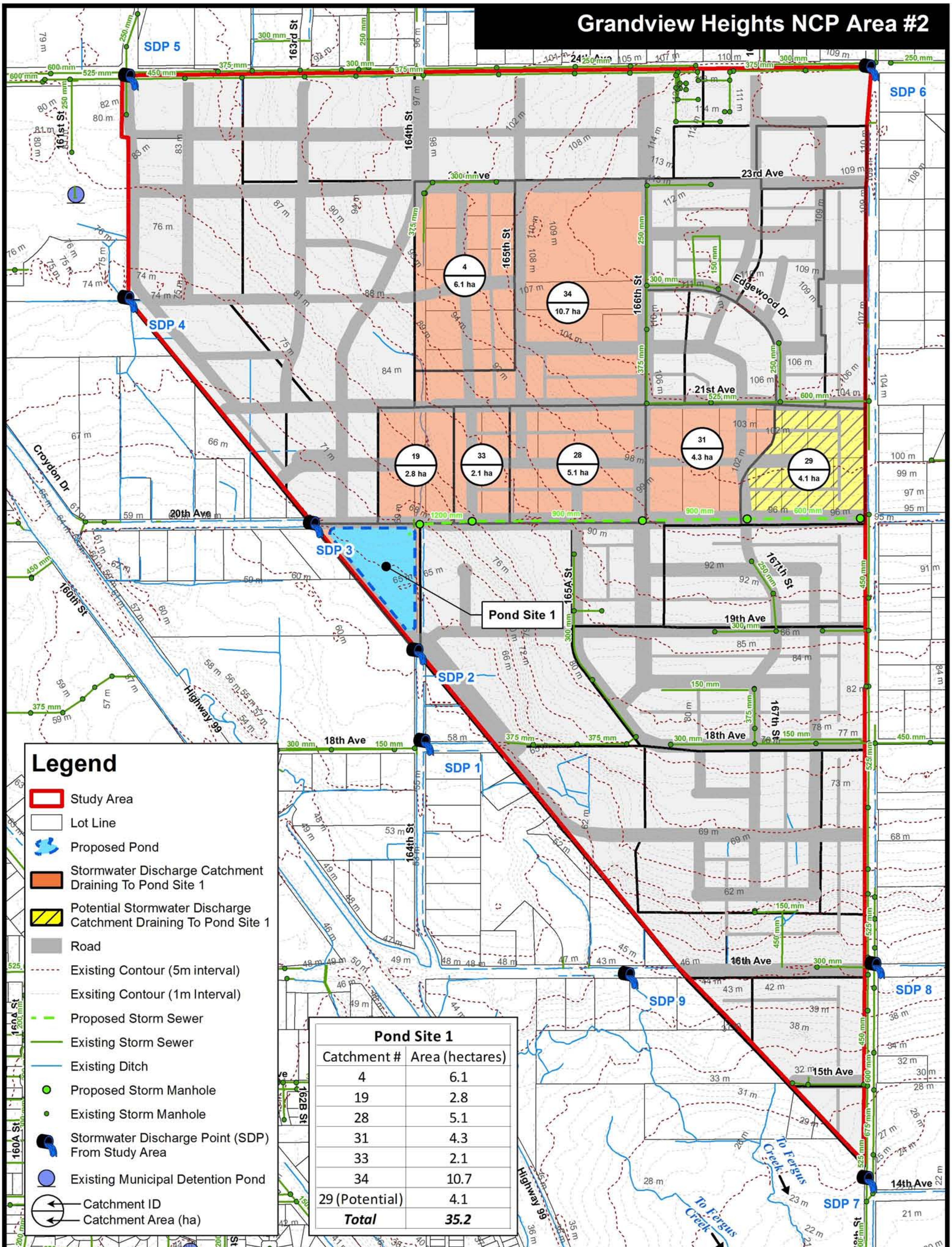
Client/Project		
CITY OF SURREY		
Scale	Date	Figure
AS NOTED	2010-09-17	2
AS NOTED		Title
GRANDVIEW HEIGHTS NCP		



Pond Site 1

Catchment #	Area (hectares)
4	6.1
19	2.8
28	5.1
31	4.3
33	2.1
34	10.7
29 (Potential)	4.1
Total	***35.2***

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0 50 100 200 Metres

Client/Project
City of Surrey
Grandview Heights NCP Area #2

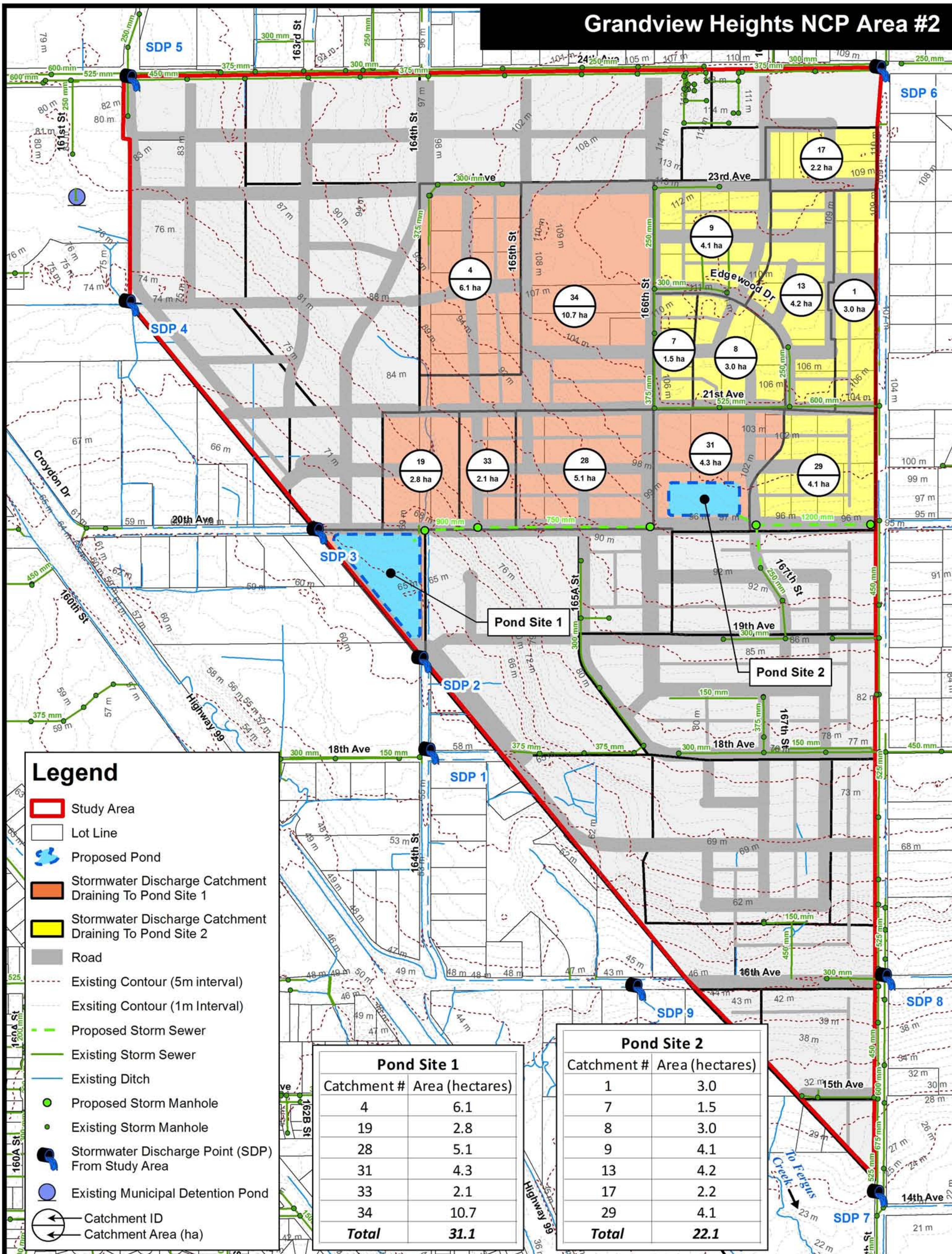
Date	Figure No.
2010-09-21	**Figure 3a**

Job No. - 1072.0143.01 | Title

Contributing Areas For One Pond Option

U:\Projects_VAN\1072\0143\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\2007_10_31_Grandview_Heights_NCP\Grandview Heights Area Pond Analysis 1 Pond Option.mxd Last revised by: sfadum on September 22, 2010 at 10:45:50 AM

Grandview Heights NCP Area #2



Pond Site 1

Catchment #	Area (hectares)
4	6.1
19	2.8
28	5.1
31	4.3
33	2.1
34	10.7
Total	***31.1***

Pond Site 2

Catchment #	Area (hectares)
1	3.0
7	1.5
8	3.0
9	4.1
13	4.2
17	2.2
29	4.1
Total	***22.1***

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Client/Project	
City of Surrey Grandview Heights NCP Area #2	
Date	Figure No.
2010-09-21	Figure 3b
Job No. - 1072.0143.01	Title
Contributing Areas For Two Pond Option	

APPENDIX A.4 Transportation

City of Surrey
Grandview Heights Area #2 NCP
Transportation Cost Estimate

Prepared by: Urban Systems Ltd.				Base Construction		Contingency		Engineering		Administration		Land				
Project ID	Type	Location/Project Name	Base Price ($)	Cost Update Factor	Adjusted Base Price	Level (%)	Cont ($)	Level (%)	Eng ($)	Level (%)	Admin ($)	Land Reqmt (Ha)	Price ($/Ha)	Land ($)	Total Adjusted Cost	Comments
1	Collector	24 Avenue/164 Street - Intersection and Signal Upgrade (164 Street costs only)	$196,968	1.00	$196,968	30%	$59,090	12%	$30,727	5%	$12,803			$0	$299,589	
2	Collector	20 Avenue/164 Street Roundabout	$1,008,785	1.00	$1,008,785	30%	$302,636	12%	$157,371	5%	$65,571			$0	$1,534,362	
3	Collector	20 Avenue/168 Street - Intersection and Signal Upgrade (20 Avenue costs only)	$316,602	1.00	$316,602	30%	$94,981	12%	$49,390	5%	$20,579			$0	$481,551	
4	Collector	20th Avenue - Upgrade to Collector Standard	$637,788	1.00	$637,788	30%	$191,337	12%	$99,495	5%	$41,456			$0	$970,076	
5	Collector	164 Street - Upgrade to Collector Standard	$572,194	1.00	$572,194	30%	$171,658	12%	$89,262	5%	$37,193			$0	$870,308	
														$0	$0	
														$0	$0	
														$0	$0	
													TOTAL All Projects		$4,155,886	

List of Sources

Urban Systems, Transportation - Grandview Heights Area #2 NCP
City of Surrey Appendix E - Transportation Costs - 2008, received Oct 13, 2009 from City of Surrey

Notes:

- Land Acquisition costs have not been included
- Urban Systems has generated estimated unit rates for items not identified within the City of Surrey Appendix E - Transportation Costs - 2008, received Oct 13, 2009 from City of Surrey
- Project #2 includes the full roundabout including 50m approaches in either direction and earthworks allowance for potential cut/fills
- Project #4 and #5 assumes that the developer will construct and/or pay for the local road standard (8m wide road, curb, sidewalks one side, trees, lights, etc). The DCC cost is the upgrade for widening pavement and boulevard area and sidewalk other side.

Project Analysis - Grandview Heights Area #2 - Transportation Projects

March 23, 2010

Budget Estimates

Project Name: 24 Avenue/164 Street - Intersection and Signal Upgrade (164 Street costs only)

Project Number: 1

Estimate Total: $ 196,968

PROJECT OUTLINE:

Description: Upgrade to signalised intersection, add 25m long channelised right turn lanes at all 4 approaches. (Costs reflect collector upgrading for 164 Street only - 24 Avenue is classified arterial.)

	QUANTITY	UNIT	UNIT COST	AMOUNT	Notes
ROADWORKS:					
- bike lane (1.8m wide)					
- Structure		Lane/m	129.12	-	prices derived from arterial road
- Pavement		Lane/m	82.35	-	prices derived from arterial road
- local road					
- Structure		Lane/m	138.66	-	
- Pavement		Lane/m	108.59	-	
- collector road					
- Structure	50	Lane/m	253.70	12,685.00	
- Pavement	50	Lane/m	223.70	11,185.00	
- arterial road					
- Structure		Lane/m	258.23	-	
- Pavement		Lane/m	164.69	-	
- curb & gutter and sidewalk					
- curb & gutter	50	m	53.27	2,663.50	
- sidewalk (1.5 metre)	25	m	87.83	2,195.75	
- multi-use path		m	328.50	-	
- re+re curb & Gutter		m	100.00	-	
- re+re sidewalk	25	m	150.00	3,750.00	
- streetlights					
- streetlight poles, ducts and luminaires		ea.	4,881.80	-	
- re+re streetlight poles		ea.	3,500.00	-	
- landscaping					
- medians		m	434.15	-	
- boulevard	100	sq.m	24.00	2,400.00	
- trees	4	ea	400.00	1,600.00	
- misc.					
- line eradication		m	15.00	-	
- markings	50	m	16.80	840.00	
- relocate hydrants	2	ea	3,000.00	6,000.00	
STORM SEWER:					
- Storm Sewer 375mm	50	m	459.44	22,972.00	
- Manholes 1050 - 1200mm	2	ea.	3,165.82	6,331.64	
- Catchbasins	2	ea.	2,000.00	4,000.00	
TRAFFIC SIGNALS/CONTROLS:					
- signals at intersections	0.5	L/S	180,690.50	90,345.25	
- Pedestrian Signal		L/S	127,215.25	-	
- Fire Signals		L/S	117,215.25	-	
- Existing Signal Optimization		L/S	15,000.00	-	
- Major Modification - Signal Pole Relocate		L/S	75,000.00	-	
- Major Modification - New Advance Left		L/S	75,000.00	-	
- Signs - Overhead		L/S	10,720.50	-	
UTILITIES RELOCATION:					
- Hydro/tel/cable pole relocations	1	L/S	30,000.00	30,000.00	
- Allowance		L/S	1.00	-	
- gas main relocation		L/S	1.00	-	
LAND ACQUISITION: Not Included	-			-	

TOTAL DIRECT COSTS: $ 196,968

Project Analysis - Grandview Heights Area #2 - Transportation Projects — March 23, 2010

Budget Estimates

Project Name: 20 Avenue/164 Street Roundabout

Project Number: 2 — Estimate Total: $ 1,008,785

PROJECT OUTLINE:

Description: Upgrade intersection to roundabout with 50m inscribed circle - 20 Avenue = 4 lanes, 164 Street = 2 lanes. (Costs include full construction of approach legs to a length of 50m)

	QUANTITY	UNIT	UNIT COST	AMOUNT	Notes
ROADWORKS:					
- local road					
- Structure		Lane/m	138.66	-	
- Pavement		Lane/m	108.59	-	
- collector road					
- Structure	1,050	Lane/m	253.70	266,385.00	
- Pavement	1,050	Lane/m	223.70	234,885.00	
- arterial road					
- Structure		Lane/m	258.23	-	
- Pavement		Lane/m	164.69	-	
- curb & gutter and sidewalk					
- curb & gutter	1,000	m	53.27	53,270.00	
- sidewalk (1.5 metre)	400	m	87.83	35,132.00	
- multi-use path		m	328.50	-	
- re+re curb & Gutter		m	100.00	-	
- re+re sidewalk		m	150.00	-	
- streetlights					
- streetlight poles, ducts and luminaires	10	ea.	4,881.80	48,818.00	
- landscaping					
- remove existing medians		m	200.00	-	
- medians		m	434.15	-	
- boulevard	700	sq.m	24.00	16,800.00	
- trees	40	ea	400.00	16,000.00	
- general landscape	1	LS	75,000.00	75,000.00	
- reinstate existing boulevard landscaping		LS	10,000.00	-	
- misc.					
- line eradication		m	15.00	-	
- markings		m	16.80	-	
- earthworks	1	LS	100,000.00	100,000.00	
STORM SEWER:					
- Storm Sewer 375mm	300	m	459.44	137,832.00	
- Manholes 1050 - 1200mm	4	ea.	3,165.82	12,663.28	
- Catchbasins	6	ea.	2,000.00	12,000.00	
TRAFFIC SIGNALS/CONTROLS:					
- signals at intersections		L/S	180,690.50	-	
- Pedestrian Signal		L/S	127,215.25	-	
- Fire Signals		L/S	117,215.25	-	
- Existing Signal Optimization		L/S	15,000.00	-	
- Major Modification - New Advance Left		L/S	75,000.00	-	
- Signs - Overhead		L/S	10,720.50	-	
UTILITIES RELOCATION:					
- Hydro/tel/cable pole relocations		L/S	5,000.00	-	
- Allowance		L/S	1.00	-	
- gas main relocation		L/S	1.00	-	
LAND ACQUISITION: Not included				-	

TOTAL DIRECT COSTS: $ 1,008,785

Project Analysis - Grandview Heights Area #2 - Transportation Projects March 23, 2010

Budget Estimates

Project Name: 20 Avenue/168 Street - Intersection and Signal Upgrade (20 Avenue costs only)

Project Number: 3 Estimate Total: $ 316,602

PROJECT OUTLINE:

Description: Upgrade to signalised intersection, add left turn lanes on all 4 approaches (35m storage 35m development). (Costs reflect collector upgrading for 20 Avenue only - 168 Street is classified arterial.)

	QUANTITY	UNIT	UNIT COST	AMOUNT	Notes
ROADWORKS:					
- local road					
- Structure		Lane/m	138.66	-	
- Pavement		Lane/m	108.59	-	
- collector road					
- Structure	140	Lane/m	253.70	35,518.00	
- Pavement	140	Lane/m	223.70	31,318.00	
- arterial road					
- Structure		Lane/m	258.23	-	80m northbound + 2 bus bays
- Pavement		Lane/m	164.69	-	80m northbound + 2 bus bays
- curb & gutter and sidewalk					
- curb & gutter	280	m	53.27	14,915.60	
- sidewalk (1.5 metre)	280	m	87.83	24,592.40	
- multi-use path		m	328.50	-	
- re+re curb & Gutter		m	100.00	-	
- re+re sidewalk		m	150.00	-	triple width sidewalk
- streetlights					
- streetlight poles, ducts and luminaires	4	ea.	4,881.80	19,527.20	
- landscaping					
- remove existing medians		m	200.00	-	
- medians		m	434.15	-	
- boulevard	420	sq.m	24.00	10,080.00	
- trees	28	ea	400.00	11,200.00	
- reinstate existing boulevard landscaping		LS	20,000.00	-	
- misc.					
- line eradication	140	m	15.00	2,100.00	
- markings	140	m	16.80	2,352.00	
- demolition/removals conc., asphalt, etc		LS	25,000.00	-	
STORM SEWER:					
- Storm Sewer 375mm	140	m	459.44	64,321.60	
- Manholes 1050 - 1200mm	2	ea.	3,165.82	6,331.64	
- Catchbasins	2	ea.	2,000.00	4,000.00	
TRAFFIC SIGNALS/CONTROLS:					
- signals at intersections	0.5	L/S	180,690.50	90,345.25	
- Pedestrian Signal		L/S	127,215.25	-	
- Fire Signals		L/S	117,215.25	-	
- Existing Signal Optimization		L/S	15,000.00	-	
- Major Modification - New Advance Left		L/S	75,000.00	-	
- Signs - Overhead		L/S	10,720.50	-	
UTILITIES RELOCATION:					
- Hydro/tel/cable pole relocations		L/S	5,000.00	-	
- Allowance		L/S	1.00	-	
- gas main relocation		L/S	1.00	-	
LAND ACQUISITION:	Not Included			-	

TOTAL DIRECT COSTS: $ 316,602

Project Analysis - Grandview Heights Area #2 - Transportation Projects

March 23, 2010

Budget Estimates

Project Name: 20th Avenue - Upgrade to Collector Standard

Project Number: 4

Estimate Total: $ 637,788

PROJECT OUTLINE:

Description: Upgrade 20 Avenue from developer minimum modified Local standard to 14m wide modified Collector standard - includes pavement widening, median curbs, additional lighting and boulevard widening. Assumes the local road built by developer includes drainage median, undergrounding power/tel, curb, sidewalk both sides, trees, lighting, drainage, etc .

	QUANTITY	UNIT	UNIT COST	AMOUNT	Notes
ROADWORKS:					
- bike lane (1.8m wide)					
- Structure		Lane/m	129.12	-	prices derived from arterial road
- Pavement		Lane/m	82.35	-	prices derived from arterial road
- local road					
- Structure		Lane/m	138.66	-	
- Pavement		Lane/m	108.59	-	
- collector road					
- Structure	950.0	Lane/m	253.70	241,015.00	
- Pavement	950.0	Lane/m	223.70	212,515.00	
- arterial road					
- Structure		Lane/m	258.23	-	
- Pavement		Lane/m	164.69	-	
- curb & gutter and sidewalk					
- curb & gutter	1,900	m	53.27	101,213.00	
- sidewalk (1.5 metre)		m	87.83	-	
- multi-use path		m	328.50	-	
- re+re curb & Gutter		m	100.00	-	
- re+re sidewalk		m	150.00	-	
- streetlights					
- streetlight poles, ducts and luminaires	3	ea.	4,881.80	14,645.40	
- re+re streetlight poles		ea.	3,500.00	-	
- landscaping					
- medians		m	434.15	-	
- boulevard	2,850	sq.m	24.00	68,400.00	
- trees		ea	400.00	-	
- misc.					
- line eradication		m	15.00	-	
- markings		m	16.80	-	
- relocate hydrants		ea	3,000.00	-	
STORM SEWER:					
- Storm Sewer 375mm		m	459.44	-	
- Manholes 1050 - 1200mm		ea.	3,165.82	-	
- Catchbasins		ea.	2,000.00	-	
TRAFFIC SIGNALS/CONTROLS:					
- signals at intersections		L/S	180,690.50	-	
- Pedestrian Signal		L/S	127,215.25	-	
- Fire Signals		L/S	117,215.25	-	
- Existing Signal Optimization		L/S	15,000.00	-	
- Major Modification - Signal Pole Relocate		L/S	75,000.00	-	
- Major Modification - New Advance Left		L/S	75,000.00	-	
- Signs - Overhead		L/S	10,720.50	-	
UTILITIES RELOCATION:					
- Hydro/tel/cable pole relocations		L/S	30,000.00	-	
- Allowance		L/S	1.00	-	
- gas main relocation		L/S	1.00	-	
LAND ACQUISITION: Not Included				-	

TOTAL DIRECT COSTS: $ 637,788

Project Analysis - Grandview Heights Area #2 - Transportation Projects

March 23, 2010

Budget Estimates

Project Name: 164 Street - Upgrade to Collector Standard

Project Number: 5

Estimate Total: $ 572,194

PROJECT OUTLINE:

Description: Upgrade 164 Street from developer min. 11.0m modified Local standard to 14m wide modified Collector standard - includes pavement widening, median curbs, additional lighting and boulevard widening. Assumes the local road built by developer includes drainage median, undergrounding power/tel, curb, sidewalk both sides, trees, lighting, drainage, etc .

	QUANTITY	UNIT	UNIT COST	AMOUNT	Notes
ROADWORKS:					
- bike lane (1.8m wide)					
- Structure		Lane/m	129.12	-	prices derived from arterial road
- Pavement		Lane/m	82.35	-	prices derived from arterial road
- local road					
- Structure		Lane/m	138.66	-	
- Pavement		Lane/m	108.59	-	
- collector road					
- Structure	850	Lane/m	253.70	215,645.00	
- Pavement	850	Lane/m	223.70	190,145.00	
- arterial road					
- Structure		Lane/m	258.23	-	
- Pavement		Lane/m	164.69	-	
- curb & gutter and sidewalk					
- curb & gutter	1,700	m	53.27	90,559.00	
- sidewalk (1.5 metre)		m	87.83	-	
- multi-use path		m	328.50	-	
- re+re curb & Gutter		m	100.00	-	
- re+re sidewalk		m	150.00	-	
- streetlights					
- streetlight poles, ducts and luminaires	3	ea.	4,881.80	14,645.40	
- re+re streetlight poles		ea.	3,500.00	-	
- landscaping					
- medians		m	434.15	-	
- boulevard	2,550	sq.m	24.00	61,200.00	
- trees		ea	400.00	-	
- misc.					
- line eradication		m	15.00	-	
- markings		m	16.80	-	
- relocate hydrants		ea	3,000.00	-	
STORM SEWER:					
- Storm Sewer 375mm		m	459.44	-	
- Manholes 1050 - 1200mm		ea.	3,165.82	-	
- Catchbasins		ea.	2,000.00	-	
TRAFFIC SIGNALS/CONTROLS:					
- signals at intersections		L/S	180,690.50	-	
- Pedestrian Signal		L/S	127,215.25	-	
- Fire Signals		L/S	117,215.25	-	
- Existing Signal Optimization		L/S	15,000.00	-	
- Major Modification - Signal Pole Relocate		L/S	75,000.00	-	
- Major Modification - New Advance Left		L/S	75,000.00	-	
- Signs - Overhead		L/S	10,720.50	-	
UTILITIES RELOCATION:					
- Hydro/tel/cable pole relocations		L/S	30,000.00	-	
- Allowance		L/S	1.00	-	
- gas main relocation		L/S	1.00	-	
LAND ACQUISITION: Not Included				-	

TOTAL DIRECT COSTS: $ 572,194

APPENDIX B DCC Revenue Estimates

Grandview Heights Area No. 2 NCP
DCC Revenue Estimates

Low Estimate

	Number of Units	Equivalent Zone	Sanitary DCC Rate	Sanitary DCC Revenue	Water DCC Rate	Water DCC Revenue	Drainage DCC Rate	Drainage DCC Revenue	Collector Roads DCC Rate	Collector Roads DCC Revenue	Arterial Roads DCC Rate	Arterial Roads DCC Revenue
Suburban Res. 1-2 upa	12	RA/RA-G/RH/RH-G/RC	$ 2,193	$ 26,316	$ 1,680	$ 20,160	$ 5,752	$ 69,024	$ 2,395	$ 28,740	$ 10,956	$ 131,472
Suburban Trans. 2-4 upa	8	RH	$ 2,193	$ 17,544	$ 1,680	$ 13,440	$ 5,752	$ 46,016	$ 2,395	$ 19,160	$ 10,956	$ 87,648
Urban Trans. Up to 8 upa	82	RF	$ 2,193	$ 179,826	$ 1,680	$ 137,760	$ 3,287	$ 269,534	$ 2,395	$ 196,390	$ 10,956	$ 898,392
Low Density Res. 6-10 upa	354	RF/RF 12/RF-12C	$ 2,193	$ 776,322	$ 1,680	$ 594,720	$ 3,287	$ 1,163,598	$ 2,395	$ 847,830	$ 10,956	$ 3,878,424
Cluster Res. 6-10 upa	69	RM-15	$ 2,088	$ 144,072	$ 1,602	$ 110,538	$ 2,286	$ 157,734	$ 1,836	$ 126,684	$ 8,406	$ 580,014
Med Density Res. 10-15 upa	229	RF-9/RF-9C/RF-9S/RF-SD	$ 1,976	$ 452,504	$ 1,514	$ 346,706	$ 1,939	$ 444,031	$ 2,180	$ 499,220	$ 9,970	$ 2,283,130
Cluster Res. 10 - 15 upa	232	RM-23/RM-30	$ 1,160	$ 269,120	$ 890	$ 206,480	$ 1,270	$ 294,640	$ 1,020	$ 236,640	$ 4,670	$ 1,083,440
Multiple Res. 10 - 15 upa	95	RM-10/RM-15	$ 2,088	$ 198,360	$ 1,602	$ 152,190	$ 2,286	$ 217,170	$ 1,836	$ 174,420	$ 8,406	$ 798,570
Multiple Res. 15 - 25 upa	384	RM-23/RM-15/RM-30	$ 2,088	$ 801,792	$ 1,602	$ 615,168	$ 2,286	$ 877,824	$ 1,836	$ 705,024	$ 8,406	$ 3,227,904
Multiple Res. 30 - 45 upa	1,161	RM-30/RM-45	$ 1,160	$ 1,346,760	$ 890	$ 1,033,290	$ 1,270	$ 1,474,470	$ 1,020	$ 1,184,220	$ 4,670	$ 5,421,870
Special Res. 15 - 25 upa	71	RM-15/RM-30	$ 2,088	$ 148,248	$ 1,602	$ 113,742	$ 2,286	$ 162,306	$ 1,836	$ 130,356	$ 8,406	$ 596,826
Comm. Res. 25 - 45 upa	51	RM-30/RM-45	$ 1,160	$ 59,160	$ 890	$ 45,390	$ 1,270	$ 64,770	$ 1,020	$ 52,020	$ 4,670	$ 238,170
Total	*2748*			*$ 4,420,024*		*$ 3,389,584*		*$ 5,241,117*		*$ 4,200,704*		*$ 19,225,860*

Dwelling Unit Size (sq. ft.)

RM 15	1800
RM 30, RM 45	1000

High Estimate

	Number of Units	Equivalent Zone	Sanitary DCC Rate	Sanitary DCC Revenue	Water DCC Rate	Water DCC Revenue	Drainage DCC Rate	Drainage DCC Revenue	Collector Roads DCC Rate	Collector Roads DCC Revenue	Arterial Roads DCC Rate	Arterial Roads DCC Revenue
Suburban Res. 1-2 upa	23	RA/RA-G/RH/RH-G/RC	$ 2,193	$ 50,439	$ 1,680	$ 38,640	$ 5,752	$ 132,296	$ 2,395	$ 55,085	$ 10,956	$ 251,988
Suburban Trans. 2-4 upa	16	RH	$ 2,193	$ 35,088	$ 1,680	$ 26,880	$ 5,752	$ 92,032	$ 2,395	$ 38,320	$ 10,956	$ 175,296
Urban Trans. Up to 8 upa	82	RF	$ 2,193	$ 179,826	$ 1,680	$ 137,760	$ 3,287	$ 269,534	$ 2,395	$ 196,390	$ 10,956	$ 898,392
Low Density Res. 6-10 upa	590	RF/RF 12/RF-12C	$ 2,193	$ 1,293,870	$ 1,680	$ 991,200	$ 3,287	$ 1,939,330	$ 2,395	$ 1,413,050	$ 10,956	$ 6,464,040
Cluster Res. 6-10 upa	115	RM-15	$ 2,088	$ 240,120	$ 1,602	$ 184,230	$ 2,286	$ 262,890	$ 1,836	$ 211,140	$ 8,406	$ 966,690
Med Density Res. 10-15 upa	343	RF-9/RF-9C/RF-9S/RF-SD	$ 1,976	$ 677,768	$ 1,514	$ 519,302	$ 1,939	$ 665,077	$ 2,180	$ 747,740	$ 9,970	$ 3,419,710
Cluster Res. 10-15 upa	348	RM-23/RM-30	$ 1,160	$ 403,680	$ 890	$ 309,720	$ 1,270	$ 441,960	$ 1,020	$ 354,960	$ 4,670	$ 1,625,160
Multiple Res. 10 - 15 upa	143	RM-10/RM-15	$ 2,088	$ 298,584	$ 1,602	$ 229,086	$ 2,286	$ 326,898	$ 1,836	$ 262,548	$ 8,406	$ 1,202,058
Multiple Res. 15 - 25 upa	639	RM-23/RM-15/RM-30	$ 2,088	$ 1,334,232	$ 1,602	$ 1,023,678	$ 2,286	$ 1,460,754	$ 1,836	$ 1,173,204	$ 8,406	$ 5,371,434
Multiple Res. 30 - 45 upa	1741	RM-30/RM-45	$ 1,160	$ 2,019,560	$ 890	$ 1,549,490	$ 1,270	$ 2,211,070	$ 1,020	$ 1,775,820	$ 4,670	$ 8,130,470
Special Res. 15 - 25 upa	118	RM-15/RM-30	$ 2,088	$ 246,384	$ 1,602	$ 189,036	$ 2,286	$ 269,748	$ 1,836	$ 216,648	$ 8,406	$ 991,908
Comm. Res. 25 - 45 upa	92	RM-30/RM-45	$ 1,160	$ 106,720	$ 890	$ 81,880	$ 1,270	$ 116,840	$ 1,020	$ 93,840	$ 4,670	$ 429,640
Total	*4250*			*$ 6,886,271*		*$ 5,280,902*		*$ 8,188,429*		*$ 6,538,745*		*$ 29,926,786*

Dwelling Unit Size (sq. ft.)

RM 10, RM 15	1800
RM 30, RM 45	1000

Average number of units 3499

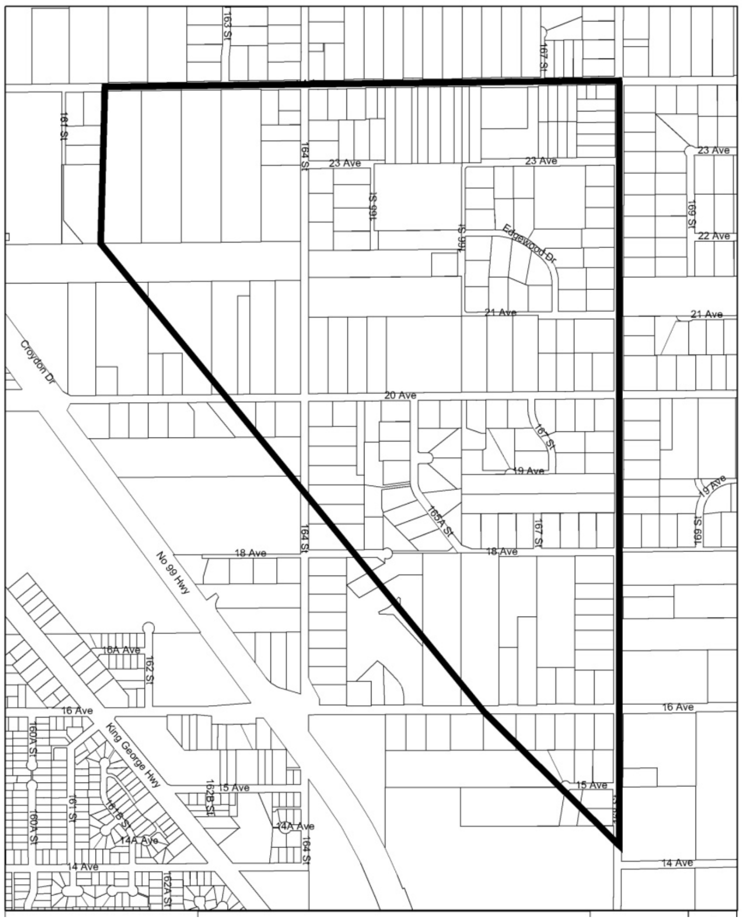
	Sanitary	Water	Drainage	Collector Roads	Arterial Roads
Average DCC Revenues:	$ 5,653,000	$ 4,335,000	$ 6,715,000	$ 5,370,000	$ 24,576,000

Notes:
1) DCC rates from "Surrey Development Cost Charge By-law XXX" to be adopted around Mid-March 2010.
2) DCC revenues do not include revenues from commercial or institutional development in Area #2.

Proposed Amendments to
Surrey Zoning By-law, 1993, No. 12000, as amended

The following amendments are proposed to Surrey Zoning By-law, 1993, No. 12000, as amended:

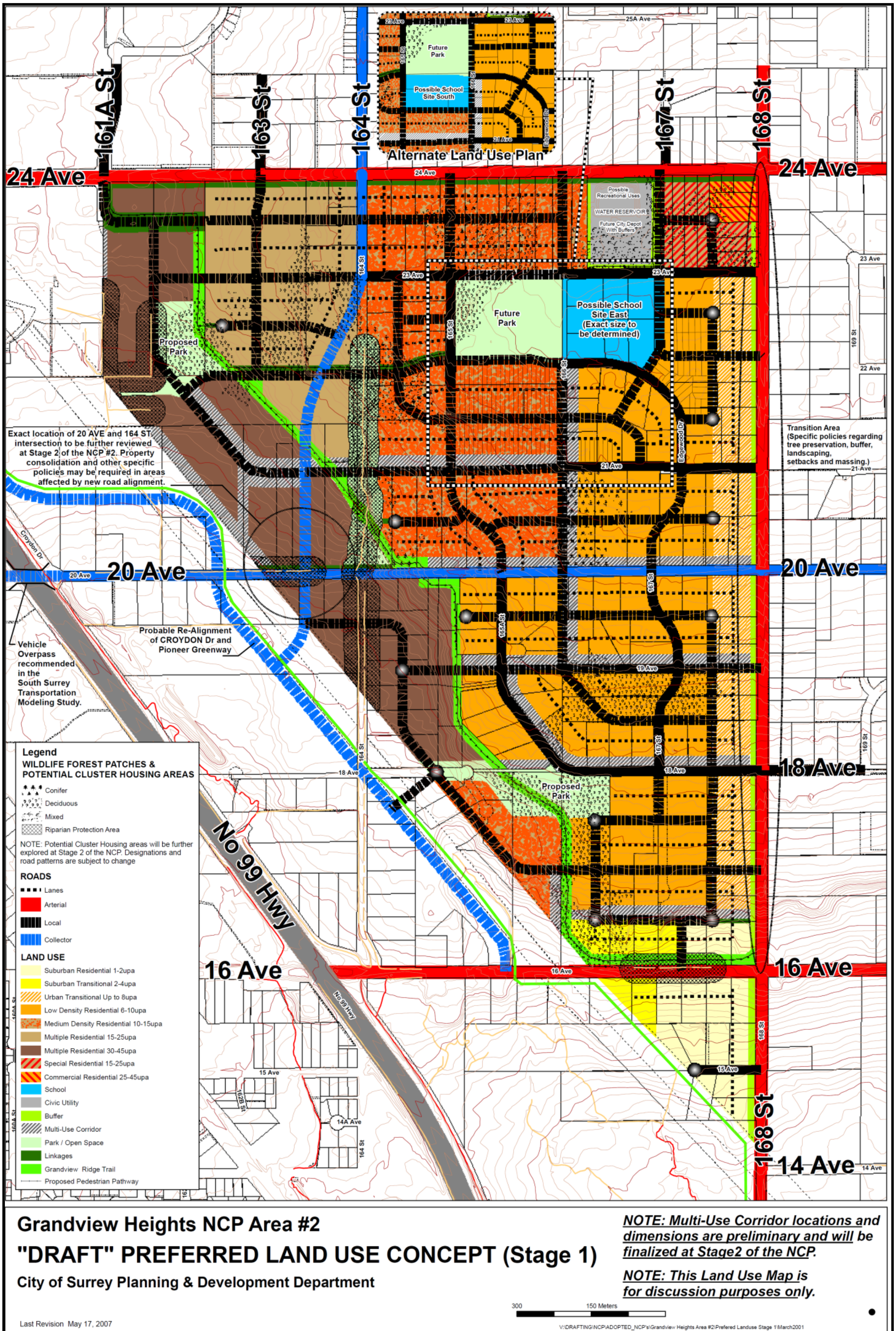
1. Schedule F – Map of Neighbhourhood Concept Plan and Infill Areas is amended by inserting Map 25. - Area XXV for Sunnyside Heights (Grandview Heights Neighbourhood #2), as follows:



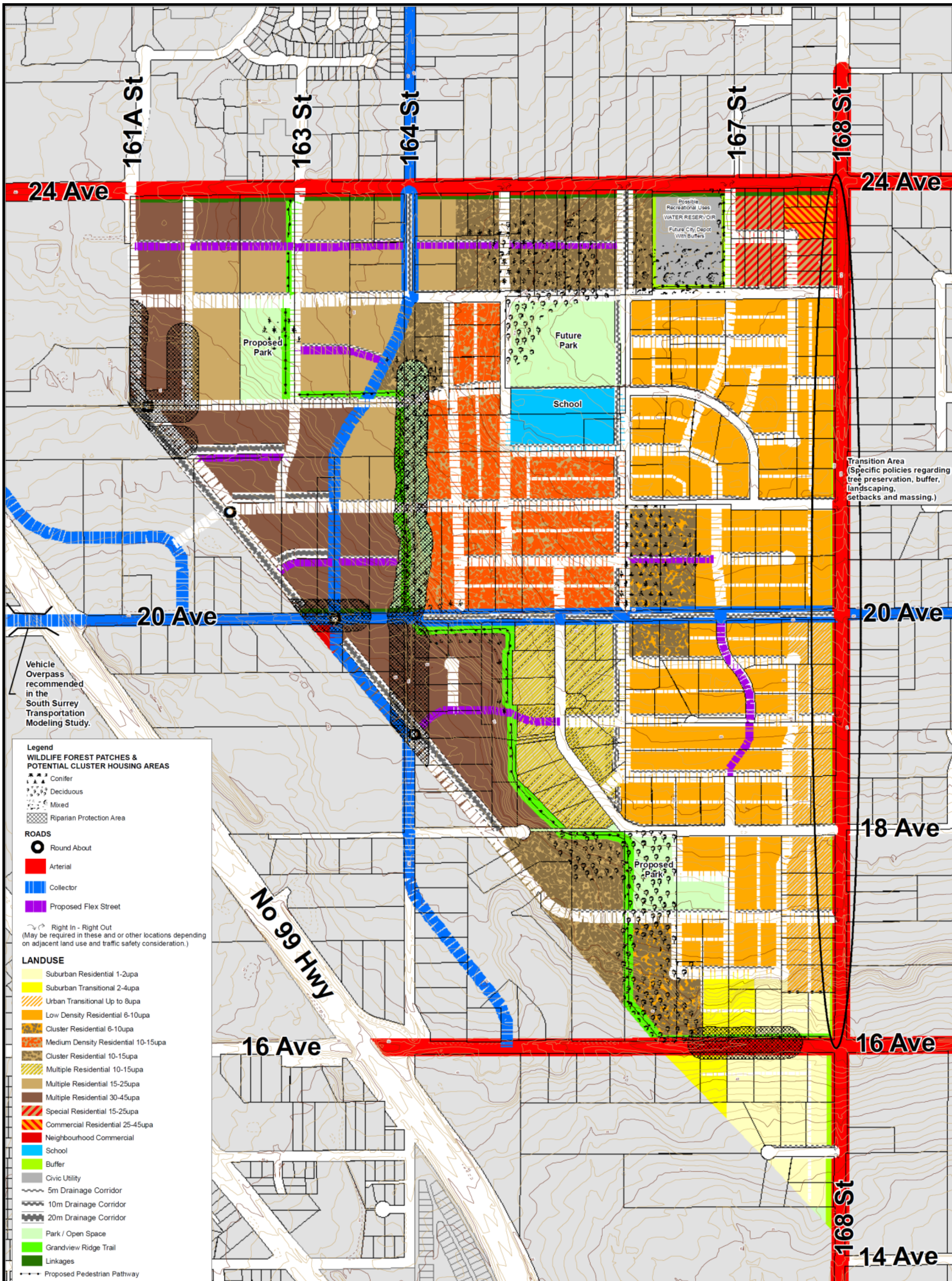
2. Schedule G - Amenity Requirements in Neighbourhood Concept Plan (NCP) and Infill Areas is amended by inserting a new Item 25 after Item 24, as follows:

NCP and Infill Areas		**Amenity**	**Contributions Per *Dwelling Unit***	**Contributions For All Other Land Uses**
25.	Area XXV on Schedule F of this By-law	Parks and Pathways Development Library materials Fire Protection Police Protection	$1,082.00 $135.54 $260.24 $60.25	N/A N/A $1040.96 per acre $240.92 per acre
		Total Amenity Contributions	$1538.03	$1281.88 per acre

Approved Stage 1 Sunnyside Heights Land Use Plan



Stage 2 Sunnyside Heights Land Use Plan



Grandview Heights NCP Area #2 (Sunny Side Heights)

DRAFT Stage 2 Land Use Concept

City of Surrey Planning & Development Department

NOTE: Multi-Use Corridor locations and dimensions are preliminary and will be finalized at Stage 2 of the NCP.

NOTE: This Land Use Map is for discussion purposes only.

0 75 150 300 450 600 Meters

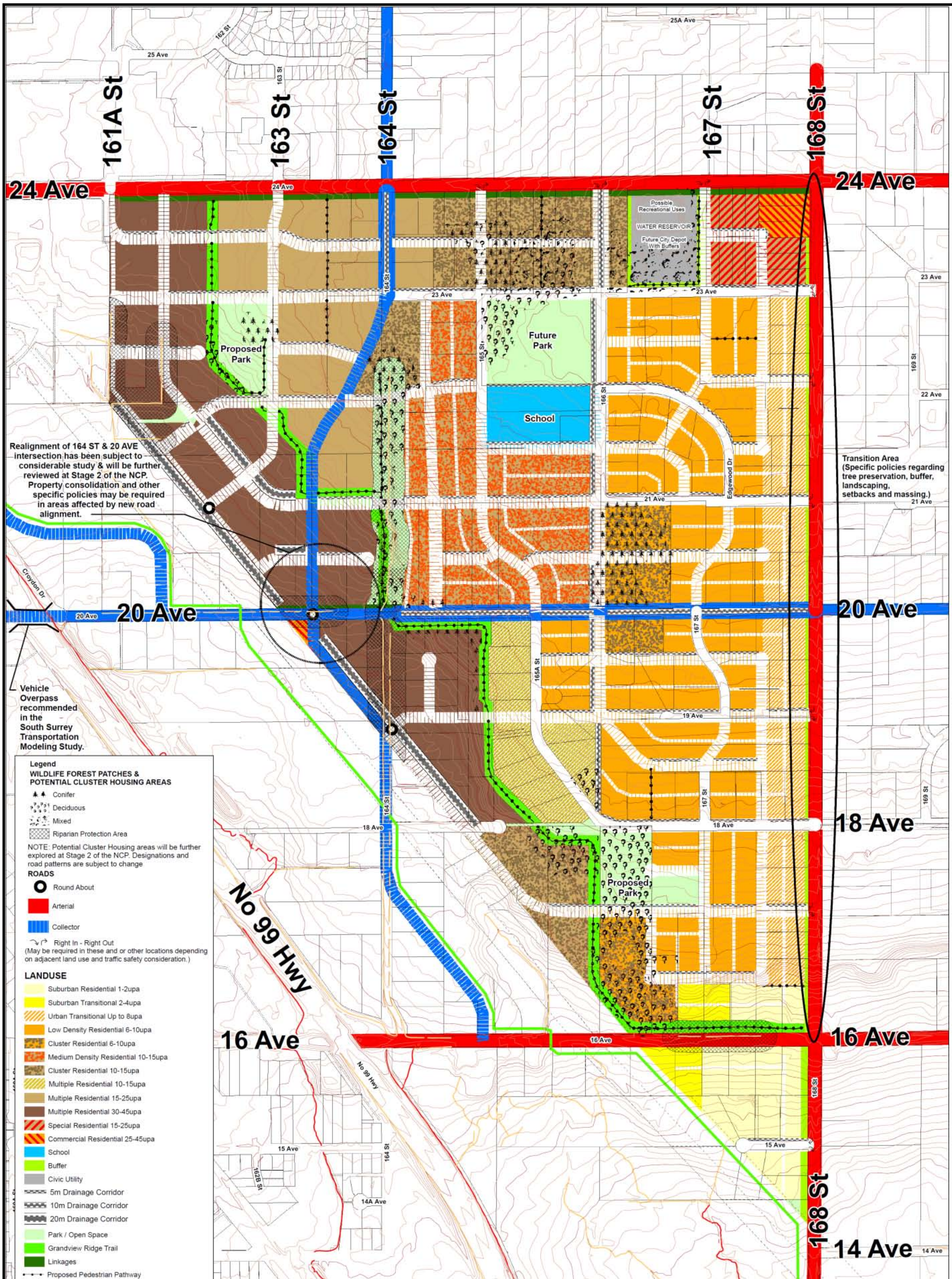
N

Stage 1 Approved By Council: July 26, 2007 Last Amended Oct. 6, 2010

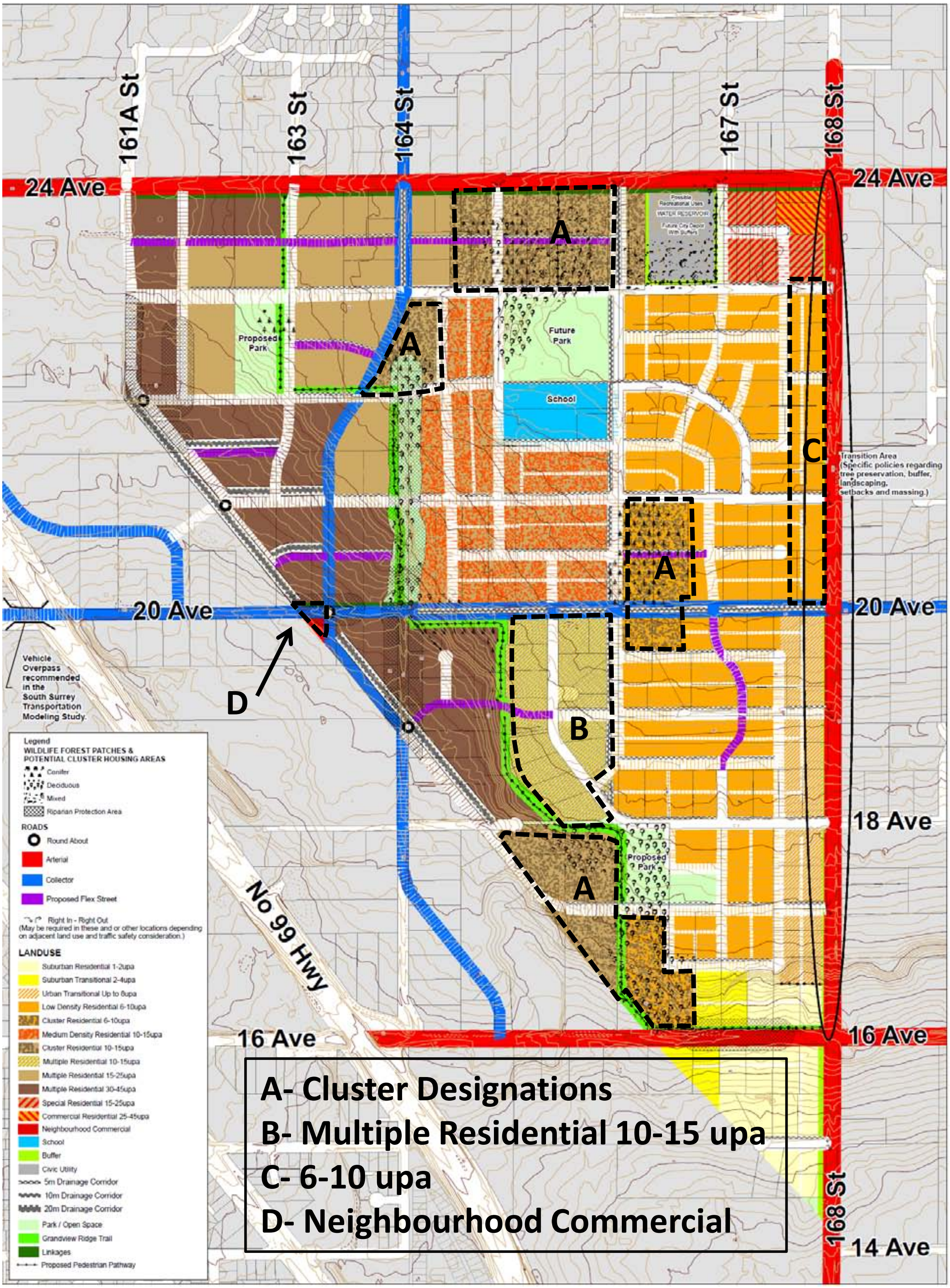
V:\DRAFTING\NCP\ADOPTED_NCP's\Grandview Heights Area #2\May18_2010_OpenHouse\GrandviewHeightsArea#2(SunnySideHeights)Option2_Stage2_Option C_18May2010OpenHouse_REVISED

Revised Stage 1 Land Use Plan presented at May 18, 2010 Open House

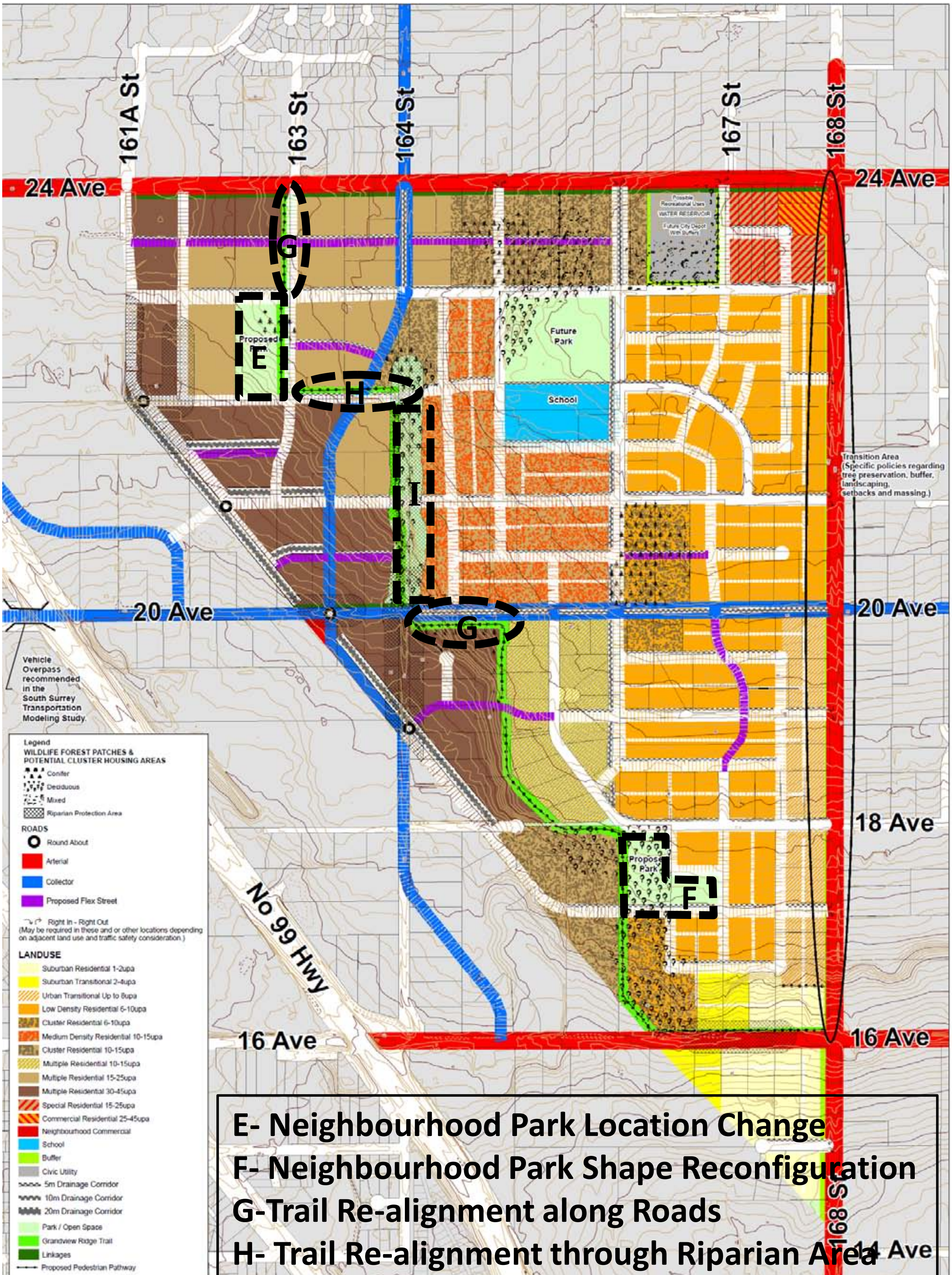
Appendix V



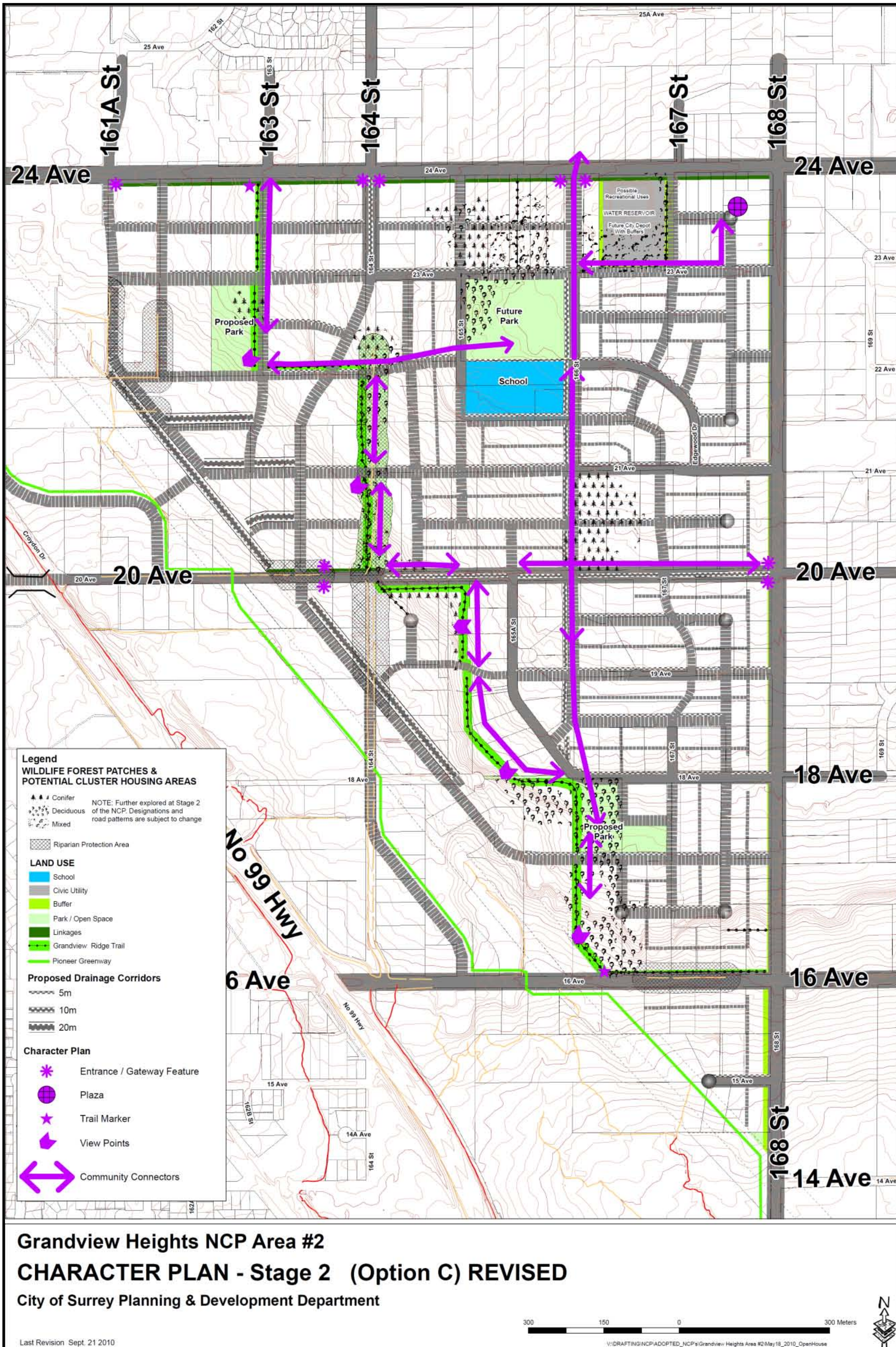
Changes to Residential & Commercial Land Uses



Changes to Park & Trail

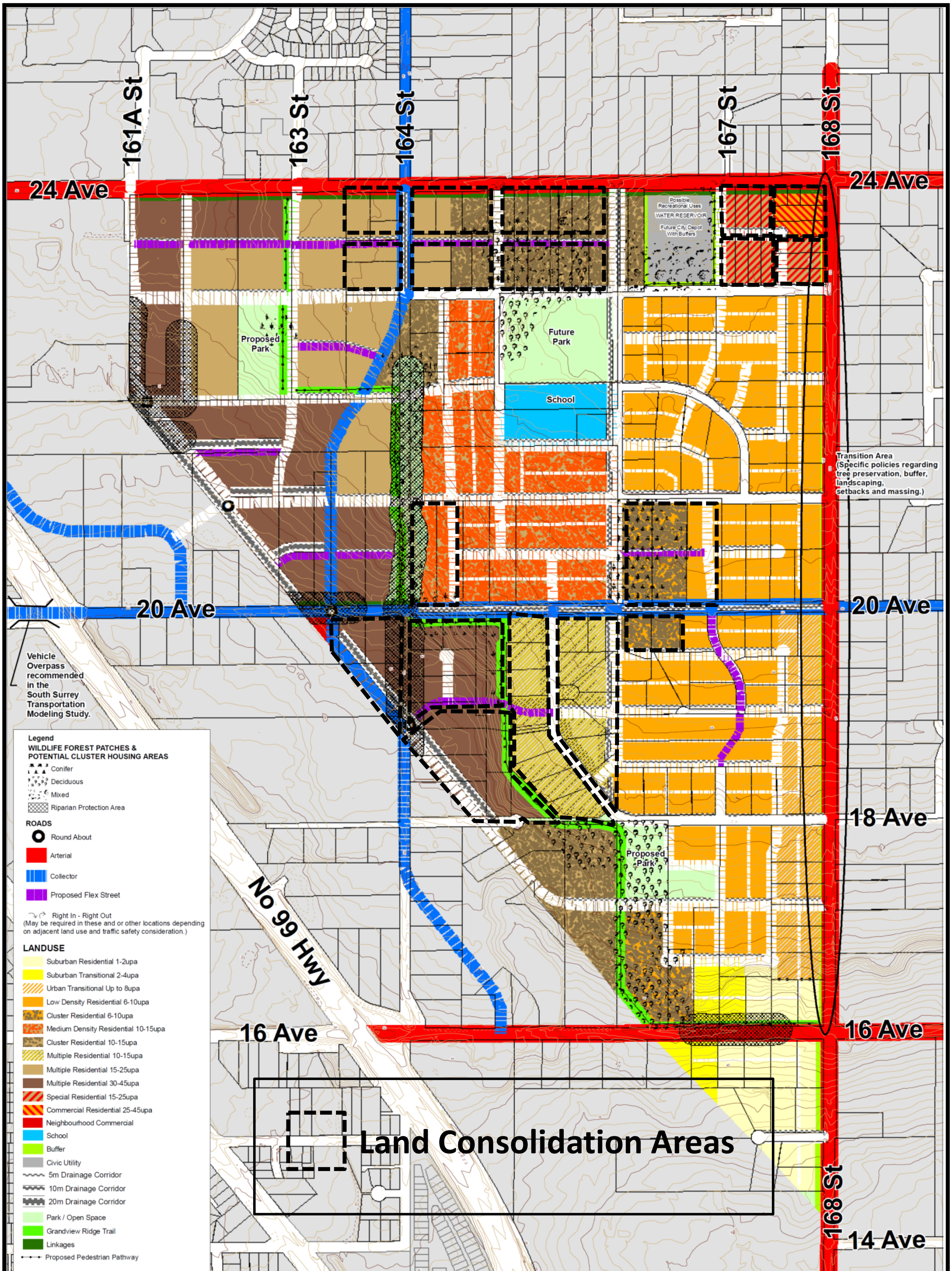


Character Plan



Land Consolidation Areas

Appendix IX



Summary Of Land Use Statistics

Land Use	Acres	Low Projected Units	High Projected Units	Low Projected Population	High Projected Population
Neighbourhood Commercial	0.2	0	0	0	0
Commercial Residential 25-45upa	1.8	45	82	97	175
Suburban Residential 1-2upa	11.6	12	23	37	75
Suburban Transitional 2-4upa	4.0	8	16	26	52
Urban Transitional Up to 8upa	10.2	82	82	264	264
Low Density Residential 6-10upa	58.9	354	589	1,142	1,903
Cluster Residential 10-15upa	23.0	230	645	710	1,996
Cluster Residential 6-10upa	11.4	68	114	220	366
Medium Density Residential 10-15upa	22.7	227	341	704	1,056
Special Residential 15-25upa	4.8	71	119	221	368
Multiple Residential 10-15upa	9.7	97	146	300	451
Multiple Residential 15-25upa	26.3	394	657	1,220	2,033
Multiple Residential 30-45upa	38.6	1,158	1,737	2,479	3,719
Buffer	3.8	0	0	0	0
Linkages	3.4	0	0	0	0
School	5.2	0	0	0	0
Civic Utility	5.0	0	0	0	0
Park / Open Space	19.9	0	0	0	0
Grandview Ridge Trail	8.4	0	0	0	0
Drainage Corridors	19.5	0	0	0	0
Roads	112.1	0	0	0	0
Total	**400.8**	**2,746**	**4,551**	**7,421**	**12,458**