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CORPORATE REPORT

NO: **R077** COUNCIL DATE: **April 23, 2012**

REGULAR COUNCIL

TO: **Mayor & Council** DATE: **April 18, 2012**

FROM: **General Manager, Engineering** FILE: **6520-20 (A/T)**
1209-0006/01

SUBJECT: **Engineering Servicing Strategy and Related Financial Strategy for the Anniedale-Tynehead Neighbourhood Concept Plan (NCP) – Stage 2**

RECOMMENDATIONS

The Engineering Department recommends that Council:

1. Approve the engineering servicing strategy and the related financial strategy as documented in this report and as contained in the Anniedale-Tynehead Neighbourhood Concept Plan (NCP) as a means of managing the provision of engineering services for development in this NCP area;

2. Approve the road network for the NCP as illustrated on the map attached as Appendix III to this report;

3. Approve amendments to the Road Classification Map and Road Allowance Map as contained in the Surrey Subdivision & Development By-law, 1986, No. 8830 to reflect the road network for the NCP;

4. Authorize the City Clerk to bring forward for the required readings an amendment by-law to Surrey Subdivision & Development By-law, 1986, No. 8830 to address necessary amendments to the Road Classification Map and Road Allowance Map;

5. Authorize staff to bring forward amendments to the City's 10-Year (2012-2021) Servicing Plan for the Development Cost Charge (DCC)-eligible infrastructure related to water, stormwater, sanitary sewer, and transportation for the NCP as documented in Appendix VII attached to this report; and

6. Authorize staff to bring forward amendments to Surrey Development Cost Charge By-law, 2012, No. 17539, to establish area-specific DCC rates for this NCP area as described in this report.

INTENT

The purpose of this report is to provide an overview of and obtain Council approval of the engineering servicing strategy and the related financial strategy for the Anniedale-Tynehead NCP in support of the Anniedale-Tynehead NCP– Stage 2 Final Report, which is to be forwarded for consideration by Council at the same meeting as this report is to be considered.

BACKGROUND

Council approved-in-principle the Stage 1 Land Use Concept Plan for the Anniedale-Tynehead NCP area at its Regular meeting on October 4, 2010 (Corporate Report No. R212;2010). That report noted that there were a number of engineering and financial issues to be resolved as part of the Anniedale-Tynehead NCP - Stage 2 process. The Stage 2 report for the Anniedale-Tynehead NCP has been completed based on the Council-approved Land Use Concept Plan.

DISCUSSION

An engineering servicing analysis and financial plan for the Anniedale-Tynehead NCP has been completed. A copy of this Stage 2 servicing strategy is attached as Appendix I to this report.

Only those works that normally form part of the City's DCC program, such as major trunk sewer and water grid mains, collector and arterial roads, and major stormwater management infrastructure, are included in the NCP servicing strategy. Local engineering servicing will be addressed on a site-by-site basis during the development application review process, which is the usual practice of the City for development in NCP areas.

The following provides a description of each of the principal elements of the Engineering Servicing Strategy for the Anniedale-Tynehead NCP area.

Water

The area is currently serviced by private wells and a few localized small-diameter City water mains. The existing water infrastructure has insufficient capacity to service the NCP. The 96 Avenue feeder main that runs through the area supplies the Port Kells industrial area to the north side of Highway 1.

New water supply sources and distribution and feeder mains are required to support the proposed land uses and densities within the NCP area, as illustrated in Appendix II. The design of the proposed water distribution network will allow for the phased development of the area.

The topography of the area requires that two separate pressure zones be established. Lands located at higher elevations of the NCP area will be serviced by a high pressure zone (135m), as illustrated in Appendix II. To service this high pressure zone, a new connection to the existing feeder main will be provided at Cherry Hill Crescent and 168 Street located on the north side of Highway 1. The remainder of the NCP area falls within the lower pressure zone (90 m) which will be supplied by a new reservoir Metro Vancouver will construct next to the Fleetwood Pumping Station at 154 Street and 90 Avenue in Meagan Anne MacDougall Park. This reservoir is projected to be in service in 2017. To accommodate development proposals as and when they are received throughout the NCP area in the interim, the Cherry Hill connection can be utilized to supply some of the low pressure zone on an interim, first-come/first-served basis, which will be

prioritized by a completed building permit. Depending on the pace of development in the NCP area, the City may not be able to accommodate every development application that it receives, and some development applications may need to be deferred until the new reservoir and related supply network are constructed.

Transportation

The transportation plan for the NCP is based on the guiding principles contained in the City's Transportation Strategic Plan. It involves a modified grid road system that takes into account property lines, tree and environmental protection, greenway connections and drainage infrastructure, all as illustrated in Appendix III. The modified grid system provides a level of street connections comparable with other NCPs that have been approved over the last few years including East Clayton, Sunnyside Heights and Orchard Grove and establishes block sizes in the range of 100 by 200m, which are considered reasonable for development outside of City Centre and Town Centres. The interconnectedness of the street system creates a more livable urban community and supports the objectives of the City's Transportation Strategic Plan.

Regional Traffic

The NCP area is at or adjacent to the junction of three major regional transportation corridors - Highway 15, Highway 1 (under Ministry of Transportation and Infrastructure jurisdiction) and 96 Avenue/Golden Ears Way (under TransLink jurisdiction). As these corridors are important regional connections, both agencies have strict restrictions on providing additional vehicular connections to these highways. The NCP traffic analysis demonstrated the following key findings:

1. The land use in the Anniedale Triangle north of Golden Ears Way and east of Highway 15 could not support commercial or business park land use designations due to there being only one permitted access point to the area off Golden Ears Way (GEW) at 180 Street and an access point by way of an overpass over GEW to allow a connection of 96 Avenue with the new Anniedale Road collector.
2. An overpass of Highway 15 at 94 Avenue (Ridgeline Drive) is required to provide improved connectivity between the Anniedale and Tynehead communities. This will also help to reduce the impact of NCP-development-related traffic on the adjacent arterial roads and highways.
3. To meet standards for acceptable levels of service, volume to capacity ratios and delay performance targets, a grade separated interchange may be required at the intersection of Highway 15 and 96 Avenue/Golden Ears Way prior to build out of the NCP. A supplemental study was undertaken for this intersection to determine the preferred interchange configuration. The Ministry and TransLink were involved in this study, but there are no commitments for funding. The planned road allowance necessary for the interchange footprint is well beyond the typical fronting obligation required of developments. The cost of the land required for the interchanges is therefore planned to be recovered through DCCs generated from this NCP.

Walking & Cycling

Local, collector and arterial roads will have sidewalks on both sides and will be complemented by a good system of Multi-Use Pathways. Greenways are also planned for the area including the continuation of the Port Kells Greenway, which will connect to East Clayton, and the Green Timbers Greenway, which will connect to the Guildford and Newton communities. All of the

planned collector and arterial roads will have bike lanes. In summary, the network of greenways, pathways, and the public road system will support effective circulation routes for walking and cycling within the community and to/from adjacent communities.

Transit

TransLink's South of Fraser Area Transit Plan identifies each of the Frequent Transit Network (FTN) routes, Conventional routes and Community Shuttle routes in the NCP area. The arterial and collector roads will accommodate the delivery of effective public transit service in the NCP area. Each of 96 Avenue, 180 Street and 92 Avenue are planned for FTN service with the NCP designating adjacent lands with land uses and densities that reflect this level of transit service.

Commercial Traffic & Trucks

The NCP area is currently served with three existing Designated Truck Routes; these being, Highway 15, 96 Avenue/Golden Ears Way, and 88 Avenue west of Highway 15. Pending the implementation of the 192 Street interchange at Highway 1 by Transportation Investment (TI) Corp./Ministry of Transportation and Infrastructure (MoTI), it is expected that 88 Avenue from Highway 15 to 200 Street in Langley and 192 Street between Golden Ears Way and 88 Avenue should become designated truck routes as well in conjunction with improvements to these roads.

General Purpose Traffic / Vehicles

The modified grid road network is designed to provide connectivity within the NCP area and with the transportation network in areas adjacent to the NCP. It will also distribute traffic reasonably throughout the neighbourhood so as to minimize impacts on any particular street. Some of the local residential roads are shown as 'Flex Roads' to highlight the need for connectivity but allow flexible alignments and/or cross sections to address tree protection or other matters that are important to building a great neighbourhood. On-street parking will be permitted on both sides of most of the local and collector roads within the NCP. A number of unique cross sections were developed for the NCP in recognition of the Agricultural Land Reserve and utility corridors and to maximize opportunities for environmental protection.

The existing arterial roads in the NCP area are 96 Avenue, 192 Street, 88 Avenue, and 168 Street. The traffic analysis undertaken in support of the NCP demonstrates that each of these roads should be upgraded to an ultimate four-lane cross section during the process of building out the NCP. Additionally the analysis concluded that several changes need to be made to the City's R-91 Road Classification Map (Schedule D to Subdivision & Development By-law, No. 8830) to accommodate the traffic volumes that are expected as this NCP area develops. The changes to the collector road system are focused on providing service for the proposed land uses and to ensuring the appropriate connectivity between local roads within the various areas of the NCP and to the arterial road network within and adjacent to the NCP area.

The following streets are to be reclassified as arterials in support of the development in the NCP area:

- 180 Street between Golden Ears Way and 88 Avenue;
- 184 Street between 92 Avenue and 80 Avenue, to provide connections between the NCP area and Clayton;
- 92 Avenue between 180 Street and Harvie Road; and

- 90 Avenue between Harvie Road and 192 Street.

Both 92 Avenue and 90 Avenue will need to be widened to four lane roads as development in the NCP area occurs with a view to accommodate traffic to/from 192 Street. 92 Avenue will accommodate on-street parking until such time as traffic volumes and related delays warrant its removal to facilitate traffic flow. 180 Street has connections with 88 Avenue and 184 Street has connections with East and West Clayton, Cloverdale, and Campbell Heights. Both of these arterial roads run through the Agricultural Land Reserve. A meeting was held with the Agricultural Advisory Committee (AAC) in June 2010 to inform them of the road network planned for this NCP area. Any future road widening within the ALR would be reviewed in advance with the AAC and will require ALC approval.

Lot Consolidation Areas

There are a number of parcels and irregularly shaped lots within the NCP area that should be consolidated for the purposes of development. These are illustrated in Appendix IV and will provide for efficient development by eliminating remnant parcels that would otherwise be more difficult to develop due to encumbrances such as significant stands of trees or transportation infrastructure. Consolidation will assist in ensuring that dedications for road connections within the NCP area and the construction costs of these connections are distributed equitably. Generally, these costs should be shared between benefitting properties in a land assembly area based on the probable unit yield of each property. The assembly areas shown on the map can be larger than those illustrated.

Sanitary Sewer

There is no City sanitary sewer system in the NCP area at this time. Individual property owners rely on the use of in-ground disposal systems for sewage disposal.

Four new pumping stations along with three low pressure systems and a network of gravity sewers and forcemains are required to service the NCP area, all as illustrated in Appendix V.

In general the proposed sewer system is designed to flow by gravity to a series of pump stations which will pump the sewage to a gravity trunk sewer that will discharge into the MV North Surrey Interceptor at 104 Avenue and 173 Street north of Highway 1.

Due to the topography of the area the 184 Street pump station, and a portion of the collection network, is located south of the NCP area on residential land (zoned RA) located within the Fraser Sewerage Area and outside of the Agricultural Land Reserve.

The approach to servicing the area with multiple pumping stations and forcemains will allow for the phased development of the area. One area of exception is located in Anniedale where a proposed pump station was eliminated in order to lower servicing costs. By doing so, development within this subcatchment is dependent on the construction of a pump station and associated infrastructure in the neighbouring downstream catchment being constructed.

Stormwater

The area is currently serviced to a rural/agricultural standard with open ditches, culverts, a pump station, and a few storm sewers which drain to either the Fraser River or the Serpentine River.

In addition to the above-referenced system, TransLink owns and operates a small storm sewer system that services Golden Ears Way and which drains east then north under Highway 1 to discharge to the Fraser River.

Based on the characteristics of the watershed and the receiving watercourses, the stormwater objectives for the NCP are:

- Protect downstream lands from exacerbated flooding;
- Protect receiving watercourses from erosion;
- Maintain base flows in creeks;
- Maintain water quality in creeks, ditches and storm systems;
- Safely convey runoff to the river systems; and
- Protect the natural environment adjacent to watercourses.

The servicing plan consists of both offsite and onsite measures that together meet the above-stated stormwater objectives. The following is a brief description of the measures recommended in the NCP.

1. *On-Site Stormwater Management Controls*

   On-site stormwater management controls are to be incorporated into each development site within the NCP area with the intention of maximizing infiltration and evapo-transpiration of rainwater. The following table summarizes the intended on-site controls by land use.

Land Use	On-Site Stormwater Management Control Requirements
Single-family Residential	• A minimum 300mm depth of amended topsoil on residential lawn areas, and • Discharge roof leaders directly to lawns (no hard pipe connections to the storm sewer system).
Multi-family Residential, Commercial, Industrial and Institutional	• Capture and retain on site 50% of the Average Annual Return rainfall event (35mm in 24 hours = 350 cubic metres per hectare of impervious surface), and • Provide oil/water separators in parking lots.

2. *Stormwater Management Ponds*

   The stormwater management strategy for the NCP includes the implementation of two stormwater detention ponds and six water quality ponds all as illustrated in Appendix VI.

   The stormwater detention ponds will mitigate peak flows in watercourses related to major rain events. The stormwater detention ponds will also mitigate downstream flooding related to runoff from new development within the NCP area. The design of the ponds relies upon the successful implementation of on-site stormwater controls as referenced above.

   The water quality ponds act to provide adequate base flows to natural watercourses to support fish life while mitigating erosion and maintaining or enhancing water quality for aquatic purposes and downstream users. The footprint for each water quality pond is approximately 0.5 hectares.

Sites have been selected for each pond based on best fit/lowest cost principles and are supported by the Citizens Advisory Committee (CAC). Any development applicant will retain the opportunity to further study the sub-catchment area for any pond for the purpose of identifying an alternate acceptable location for the pond but regardless of the location of each pond within each sub-catchment, the land for each pond must be secured in favour of the City before development proceeds within its catchment area, which is consistent with City Policy. Similarly, the pond must be constructed in advance of any development proceeding within the NCP area (i.e., be constructed in parallel with the construction of engineering servicing for the first development site in the NCP).

3. *Additional Secondary Measures*

In addition to the primary measures as referenced above, exfiltration-type storm sewer systems within roadways, infiltration-enhanced boulevards and rain gardens in traffic calming bulges are also part of the stormwater servicing plan for this NCP and will be constructed where site conditions allow.

Impacts on the Serpentine and Nicomekl Lowlands Flood Control Project

The purpose of the Serpentine and Nicomekl Lowlands Flood Control Project is to control flooding within the agricultural floodplain along these rivers in support of agricultural activities on the floodplain lands. The standard that is being applied in relation to flood control is referenced as the ARDSA Criteria (Agri-Food Regional Development Subsidiary Agreement). This standard seeks to:

- Restrict flooding to a maximum of 5 days in duration for the 10-year return, 5-day winter storm (November 1 to February 28).
- Restrict flooding to a maximum of 2 days in duration for the 10-year return, 2-day growing season storm (March 1 to October 31).
- Maintain a minimum baseflow level of 1.2 m below adjacent ground level in ditches between storm events during the growing season.

Development in the Anniedale-Tynehead NCP area will not negatively impact the ARDSA Criteria in relation to the lowlands in the Serpentine River floodplain.

Infrastructure Summary and Financial Analysis

The following table summarizes the projected DCC revenues and construction costs for the infrastructure projects that are required to service development within this NCP area. The revenues are based on the current DCC rates that came into effect on March 15, 2012. The revenues include the DCC municipal assist factor for each utility.

Services	Estimated DCC Revenues	DCC Expenditures on Eligible Works in the NCP Area	Shortfall
Sanitary Sewer	$17,100,000	$28,800,000	$11,700,000
Water	$13,100,000	$20,100,000	$7,000,000
Drainage	$21,800,000	$26,600,000	$4,800,000
Non-Arterial Roads	$14,400,000	$21,500,000	$7,100,000
Arterial Roads	$66,200,000	$75,000,000	$8,800,000

As is documented in the preceding table, the estimated DCC revenues from the NCP area cannot support the financing of projects in any of the engineering services.

Appendix VII provides the list of the sanitary sewer, water, drainage and transportation infrastructure projects, respectively, to support development within this NCP area and that are eligible to be included in the City's 10-Year Servicing Plan. It also provides for each project the component of its total cost that will need to be covered by DCCs.

Financing Alternatives

The costs to service this NCP area are very high due to the limited amount of infrastructure in and around the area, its topography, and its location. At the time of approval of the Stage 1 component of the NCP, Council was advised that any financial strategy for servicing this NCP area may need to include an area-specific DCC program, such as similar programs that have been developed for Campbell Heights and the Highway 99 Corridor.

Establishing area-specific DCC rates provides an equitable way to distribute the costs of needed infrastructure. An area-specific DCC program is also administratively simple to implement and manage in comparison to other approaches to finance the installation of engineering services. Staff has concluded that an area-specific DCC program should be developed for this NCP area.

The following table provides a comparison of current DCC rates in Surrey with an estimate of area-specific DCC rates for the Anniedale-Tynehead NCP area. These were developed in accordance with guidelines contained in the DCC Best Practices Guide as published by the Ministry of Community, Sport and Cultural Development.

Land Use	Existing DCC Rate (effective March 15, 2012)	Proposed Area-Specific DCC Rate	Proposed as a % of Existing
SF (RF, RF-12, RFC)	$26,248 / lot	$36,356 / lot	139%
SF Small Lot (RF-9, RF-SD)	$22,779 / lot	$31,494 / lot	138%
RM-10, RM-15 & RM-30	$14.90 / sq. ft.	$19.63 / sq. ft.	132%
RM-45 and RM-70	$16.46 / sq. ft.	$21.91 / sq. ft.	133%
Commercial (ground floor)	$9.37 / sq. ft.	$13.66 / sq. ft.	146%
Industrial	$72,879 / acre	$108,017 / acre	148%

The initial developers in this area will be required to construct a considerable amount of infrastructure to service the overall NCP. These developers will then typically enter into a DCC Front-ending Agreement with the City by which they will recover over time from the DCC revenues collected by the City from other development within the NCP area the costs that they

incurred in constructing the eligible front-ended engineering servicing works. This approach has been successfully applied in other NCP areas in Surrey.

Implementation

In January 2012, Council adopted an updated 10-Year (2012-2021) Servicing Plan and related DCC By-law. The Servicing Plan is reviewed annually. The most recent Servicing Plan review was undertaken in late 2011 and the related adjustments to the DCC rates took effect on March 15, 2012.

The City's 10-Year (2012-2021) Servicing Plan needs to be revised to include DCC-eligible infrastructure projects for this NCP area as documented in Appendix VII, and the City's DCC By-law needs to be amended to include area-specific DCCs for this NCP area. Subject to Council's approval of the recommendations of this report, staff will forward for Council's consideration a Corporate Report including recommendations related to amending the City's 10-Year (2012-2021) Servicing Plan and DCC By-law in accordance with the above-stated intentions.

SUSTAINABILITY CONSIDERATIONS

The approval of the engineering servicing strategy and the related financial strategy for the Anniedale-Tynehead NCP will assist in achieving the objectives of the City's Sustainability Charter; more particularly the following action items:

- EC3: Sustainable infrastructure maintenance and replacement;
- EC4: Sustainable Fiscal Management Practices;
- Ec7: Sustainable Building and Development Practices;
- EC9: Quality of Design in New Development and Redevelopment;
- EN8: Sustainable Engineering Standards and Practices;
- EN9: Sustainable Land Use Planning and Development Practices;
- EN12: Enhancement and Protection of Natural Areas, Fish Habitat and Wildlife Habitat;
- EN13: Enhancing the Public Realm;
- EN15: Sustainable Transportation Options;
- EN16: Land, Water and Air Quality Management;
- EN17: Enhance Biodiversity; and
- SC 13: Create a fully accessible City.

CONCLUSION

The strategies articulated in this report will support the land uses and related development as proposed in the Anniedale-Tynehead NCP. The financial strategy as proposed is consistent with the "development-pay" principle, which requires that each NCP area be financially self-sufficient.

Based on the above discussion, the Engineering Department recommends that Council:

- Approve the engineering servicing strategy and the related financial strategy as documented in this report and as contained in the Anniedale-Tynehead Neighbourhood Concept Plan (NCP) as a means of managing the provision of engineering services for development in this NCP area;

- Approve the road network for the NCP as illustrated on the map attached as Appendix III to this report;

- Approve amendments to the Road Classification Map and Road Allowance Map as contained in the Surrey Subdivision & Development By-law, 1986, No. 8830 to reflect the road network for the NCP;

- Authorize the City Clerk to bring forward for the required readings an amendment by-law to Surrey Subdivision & Development By-law, 1986, No. 8830 to address necessary amendments to the Road Classification Map and Road Allowance Map;

- Authorize staff to bring forward amendments to the City's 10-Year (2012-2021) Servicing Plan for the Development Cost Charge (DCC)-eligible infrastructure related to water, stormwater, sanitary sewer, and transportation for the NCP as documented in Appendix VII attached to this report; and

- Authorize staff to bring forward amendments to Surrey Development Cost Charge By-law, 2012, No. 17539, to establish area-specific DCC rates for this NCP area as described in this report.

Vincent Lalonde, P.Eng.
General Manager, Engineering

DM/JA/JLU/brb

Appendix I - Stage 2 Servicing Strategy
Appendix II - Water Servicing Strategy
Appendix III - Transportation Network
Appendix IV - Lot Consolidation Areas
Appendix V - Sanitary Servicing Strategy
Appendix VI - Stormwater Servicing Strategy
Appendix VII - 10-Year Servicing Plan Projects

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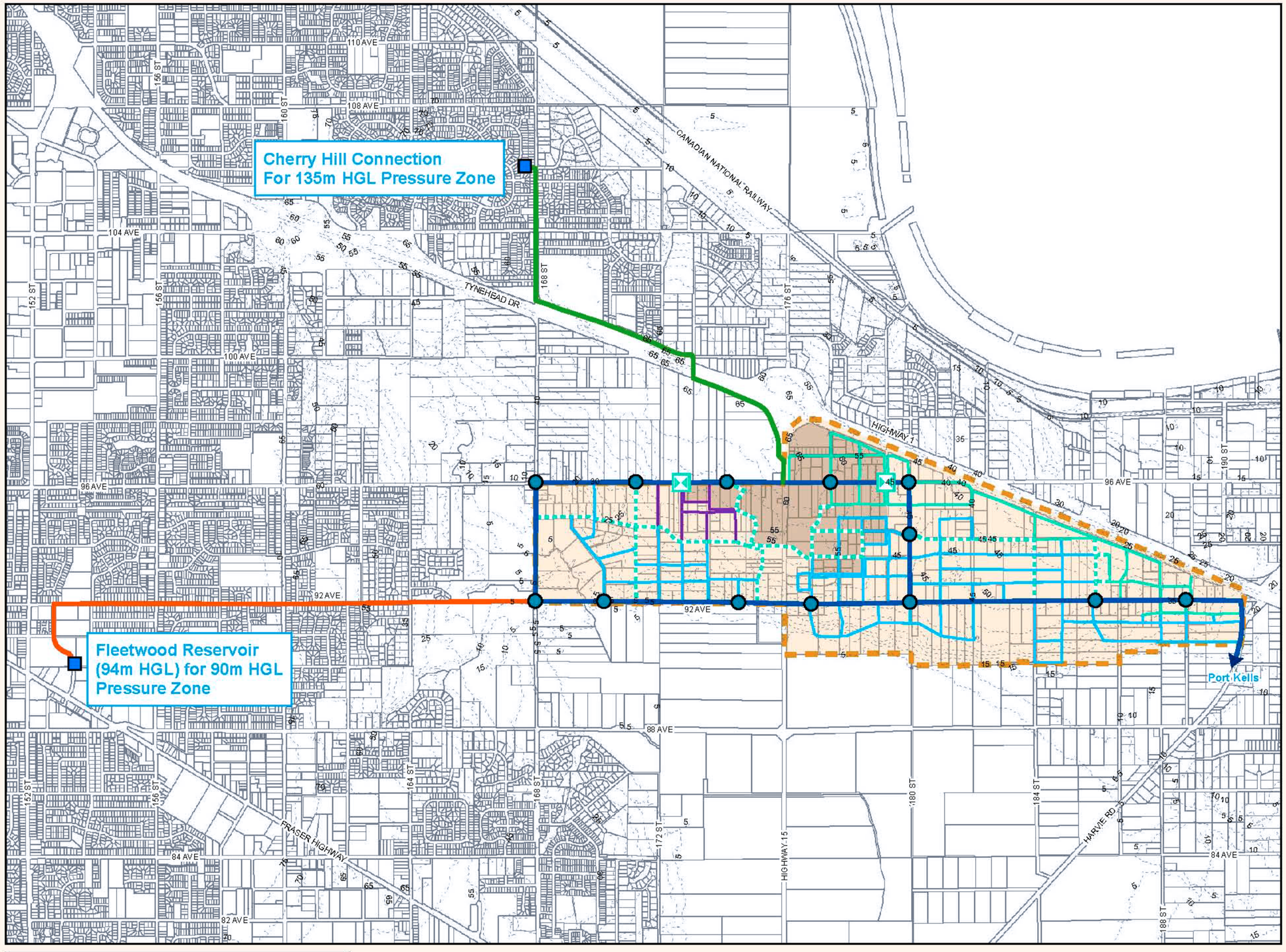

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Legend

- NCP Area
- 135m HGL Pressure Zone (all other areas 90m HGL)
- 200 Ø
- 250 Ø
- 300 Ø
- Water Main upsized to 300 Ø (see note below)
- Proposed Feeder Main
- Cherry Hill Supply Main
- Fleetwood Supply Main
- PRV
- Contour (5m Interval)
- Assumed (modeled) Local System Connections to Trunk Main (Actual connection points to be confirmed as part of design).

Note: In recognition that the ultimate looped system will be constructed over time, with some areas requiring larger pipes to provide adequate service and fire protection in the interim, some local water mains have been upsized from minimum sizes to account for staged development.

APPENDIX II

WATER SERVICING STRATEGY

0 250 500 1,000
Metres

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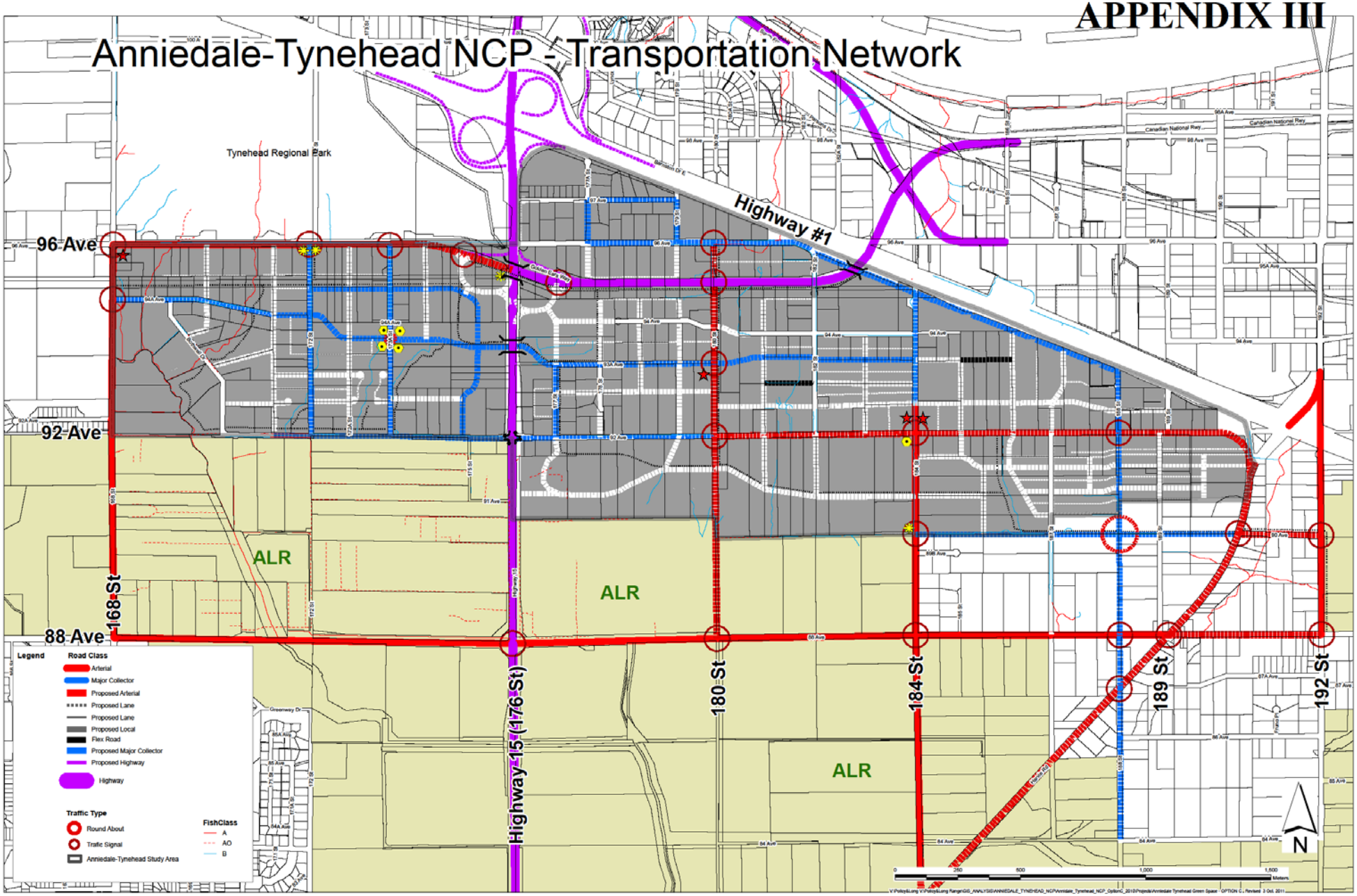
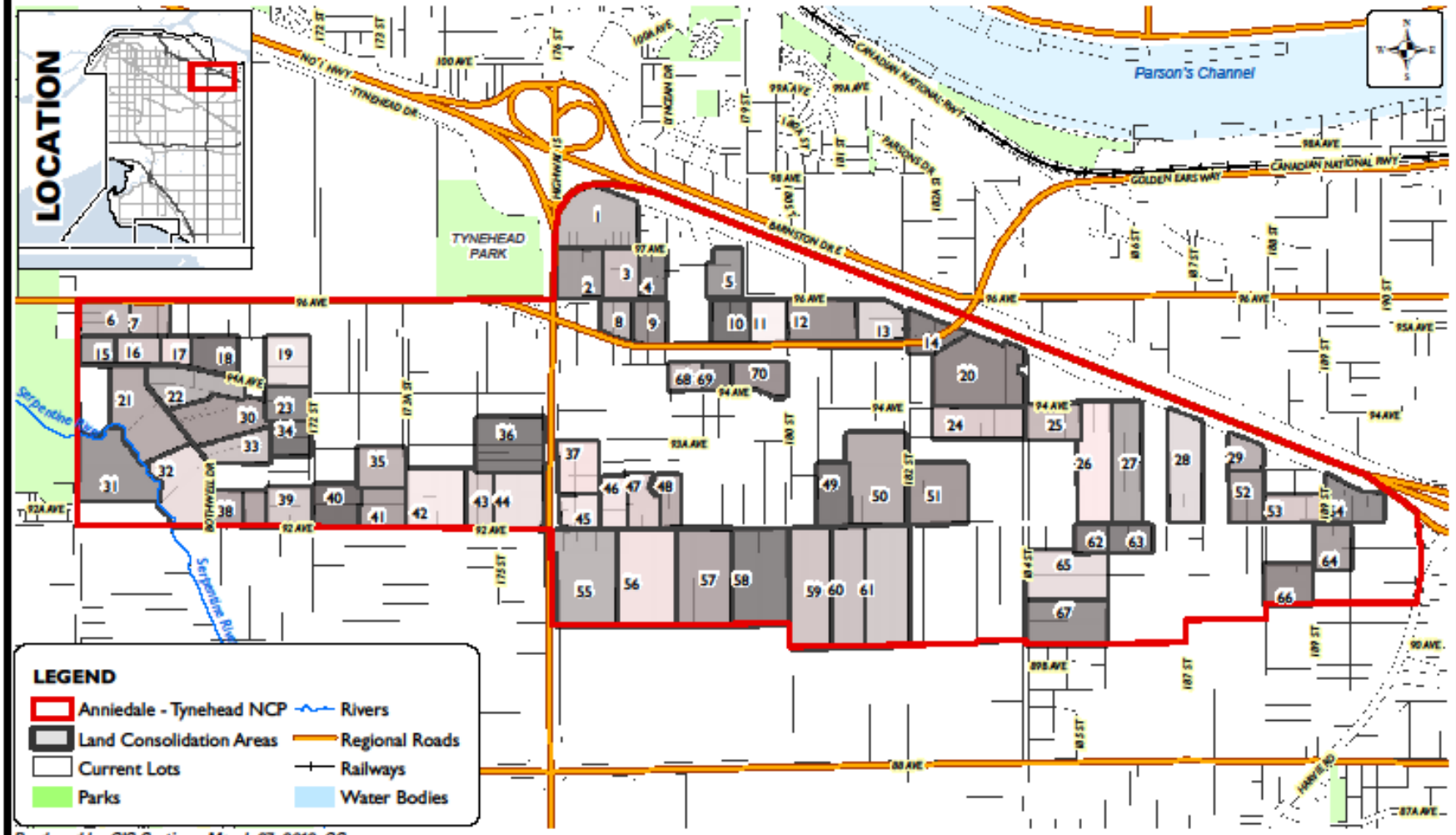
APPENDIX III



APPENDIX IV
SITE MAP



Produced by GIS Section: March 27, 2012, CS

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ANNIEDALE - TYNEHEAD NCP
LOT CONSOLIDATION AREAS

The data provided is compiled from various sources and IS NOT warranted as to its accuracy or sufficiency by the City of Surrey.
This information is provided for information and convenience purposes only.
Lot sizes, Legal descriptions and encumbrances must be confirmed at the Land Title Office.

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ENGINEERING DEPARTMENT

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Legend

PHASE	GRAVITY	FORCEMAIN
1		
2		
3		
4		
5		

- General Flow Direction
- PS — Pump Station
- Anniedale / Tynehead Development Areas
- Low Pressure Sewer Areas

APPENDIX V

SANITARY SERVICING STRATEGY

Tie-In to Existing Metro Vancouver N.S.I.

Fraser Heights Pocket

Abby Ridge Catchment

Anniedale 'A' West 1

Anniedale 'A' West 2

Anniedale 'A' East 1

Anniedale 'B' 1

Anniedale 'B' 2

Anniedale 'B' 3

Anniedale 'B' 4

Tynehead

Port Kells Industrial Catchment

Port Kells

Potential ROW Required

172 ST PUMP STATION

176 ST PUMP STATION

184 ST PUMP STATION

187 ST PUMP STATION

189 ST PUMP STATION

600Ø (1-5)
650Ø (2-9)
400Ø (1-4)
400Ø (2-2)
375Ø (2-1)
400Ø (1-3)
500Ø (2-8)
375Ø (1-1)
400Ø (1-2)
250Ø (4-4)
450Ø (5-2)
250Ø (4-3)
450Ø (5-3)
300Ø (2-5)
300Ø (3-1)
375Ø (2-4)
375Ø (2-3)
400Ø (2-7)
375Ø (2-6)
600Ø (4-2)
525Ø (4-1)
400Ø (5-1)

0 250 500 1,000
Metres

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See Figure 3.3-7B for additional detail at pond sites.
See Table 3.3-6 for trunk sewer and pond sizing.

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Legend

NCP Land Uses
- NCP Boundary
- NCP Area
- Future Road Network
- Proposed Trails, Buffers & Riparian Areas
- 15m and 30m Watercourse Class B Buffer

Watercourse Classifications
- Class A (red-coded)
- Class A(O) (red-dash)
- Class B (yellow-coded)
- Class C (green-coded)
- Unclassified

Existing Drainage Infrastructure
- PS — Existing Pump Station
- Existing Storm Sewer (outside NCP)
- Existing Storm Sewer (Translink)

Proposed Drainage Infrastructure
- Proposed Sub-Catchments
- Contributing Catchments Outside NCP Area
- Proposed Trunk Storm Sewer
- Potential Local Storm Sewer Network
- Proposed Pond
- Land Required for Pond
- Ditch Improvement Reaches

APPENDIX VI

STORMWATER SERVICING STRATEGY

1:15,000

0 250 500 1,000
Metres

APPENDIX VII

10-Year Servicing Plan Projects

The projects listed in the following tables are eligible for the inclusion into the 10-Year Servicing Plan.

Water

Project	Project Cost	Non-Growth Component (DCC)	Ultimate Growth Component (DCC)
1,060 of 450mm diameter 168 Street: 106 Avenue - Hwy 1	$901,000		$901,000
1,060 of 450mm diameter Hwy 1: 168 Street - 173 Street	$901,000		$901,000
1,060 of 450mm diameter Hwy 1: 173 - Hwy 15/96 Avenue	$901,000		$901,000
350m of 450mm diameter 96 Avenue: Hwy. 15 - 178 Street	$297,500		$297,500
505m of 300mm diameter 96 Avenue: Hwy. 15 - 173A Street	$373,700		$373,700
PRV station 96 Avenue/173 Street	$115,000		$115,000
MV Connection Cherry Hill Cresc./168 Street	$102,500		$102,500
135m Pressure Zone Total Estimate			**$3,591,700**
PRV station 96 Avenue/180 Street	$115,000		$115,000
550m of 750mm diameter 153 Street: 90 - 92 Avenue	$935,000		$935,000
3,000m of 750mm diameter 92 Avenue: 153 - 168 Street	$5,100,000		$5,100,000
2,405 of 750mm diameter 92 Avenue: 168 - 180 Street	$4,088,500		$4,088,500
955m of 600mm diameter 92 Avenue: 180 - 185 Street	$1,260,600		$1,260,600
780m of 450mm diameter 92 Avenue: 185 - 189 Street	$663,000		$663,000
760m of 350mm diameter 168 Street: 96 - 92 Avenue	$585,200		$585,200
770m of 350mm diameter 180 Street: 96 - 92 Avenue	$592,900		$592,900
440m of 300mm diameter 96 Avenue: 177 - 180 Street	$325,600		$325,600
1,095m of 300mm diameter 96 Avenue: 173 - 168 Street	$814,000		$814,000
9,345m of 300mm diameter upsizing mains 200 to 300mm diameter	$1,869,000		$1,869,000

1,595m of 300mm diameter upsizing mains 250 to 300mm diameter	$159,500		$159,500
		90m Pressure Zone Total Estimate	**$16,508,300**
		GRAND TOTAL	**$20,100,000**

Sanitary Sewer

Project	Project Cost	Non-Growth Component (DCC)	Ultimate Growth Component (DCC)
355m of 375mm diameter 92 Avenue: 171 - 172 Street	$85,200		$85,200
835m of 400mm diameter 92 Avenue: 176 - 172 Street	$810,785		$810,785
Tynehead forcemain odour control Hwy 15	$60,000		$60,000
980m of 400mm diameter Hwy 15: 96 - 92 Avenue	$951,580		$951,580
1150m of 400mm diameter Hwy 1: 176 - 173 Street	$1,116,650		$1,116,650
800m of 600mm diameter 173 Street: Hwy 1 - 104 Avenue	$1,132,800		$1,132,800
Tynehead Trunk ROW Tynehead Park	$90,000		$90,000
Hwy 1 crossing Hwy 1/173 Street	$500,000		$500,000
South Port Kells odour control 173 Street	$660,000		$660,000
270m of 250mm diameter upsizing mains to 250mm diameter	$17,280		$17,280
160m of 300mm diameter upsizing mains to 300mm diameter	$21,760		$21,760
435m of 375mm diameter upsizing mains to 375mm diameter	$104,400		$104,400
Tynehead Pump Station 92 Avenue/172 Street	$3,300,000		$3,300,000
		Tynehead Sub-Total	**$8,850,455**
1000m of 375mm diameter Golden Ears Way: 182 - 187 Street	$240,000		$240,000
2140m of 400mm diameter Hwy 1: 187 - 176 Street	$2,077,940		$2,077,940
Anniedale A odour control 96 Avenue	$60,000		$60,000
265m of 375mm diameter 92 Avenue: 178 - 177 Street	$63,600		$63,600
390m of 375mm diameter 92 Avenue: 177 - 176 Street	$93,600		$93,600

Project	Project Cost	Non-Growth Component (DCC)	Ultimate Growth Component (DCC)
690m of 300mm diameter 91 Avenue: 180 - 178 Street	$93,840		$93,840
135m of 375mm diameter 90A Avenue: 178 - 176 Street	$32,400		$32,400
200m of 400mm diameter Hwy 15: 91 - 92 Avenue	$194,200		$194,200
Anniedale B4 odour control Hwy 15	$60,000		$60,000
980m of 500mm diameter Hwy 15: 92 - 96 Avenue	$1,065,260		$1,065,260
1150m of 650mm diameter Hwy 15: 96 Avenue - 173 Street	$1,396,100		$1,396,100
Hwy 15 crossing Hwy 15 /97 Avenue	$200,000		$200,000
1,135m of 250mm diameter upsizing mains to 250mm diameter	$72,640		$72,640
350m of 300mm diameter upsizing mains to 300mm diameter	$47,600		$47,600
75m of 375mm diameter upsizing mains to 375mm diameter	$18,000		$18,000
Anniedale Pump Station Hwy 1/187 Street	$3,600,000		$3,600,000
Anniedale B4 Pump Station 176 Street/91 Avenue	$3,500,000		$3,500,000
		Anniedale A/B1/B4 Sub-Total	**$12,815,180**
220m of 300mm diameter 91 Avenue: 180 - 181 Street	$29,920		$29,920
Anniedale B3 Trunk ROW 91 Avenue	$225,000		$225,000
100m of 300mm diameter upsizing mains to 300mm diameter	$13,600		$13,600
		Anniedale B3	**$268,520**
890m of 525mm diameter 90A Avenue: 189 - 186 Street	$412,960		$412,960
190m of 600 diameter 90 Avenue: 186 - 184 Street	$107,920		$107,920
Anniedale B2 Trunk ROW 89 Avenue	$235,000		$235,000
400m of 250mm diameter 184 Street: 90 - 92 Avenue	$304,000		$304,000
920m of 250mm diameter 92 Avenue: 184 - 180 Street	$699,200		$699,200
850m of 250mm diameter 92 Avenue: 180 - 176 Street	$646,000		$646,000
Anniedale B2 odour control 90 Avenue	$60,000		$60,000

Project	Project Cost	Non-Growth Component (DCC)	Ultimate Growth Component (DCC)
Anniedale B2 pump station 184 Street/89 Avenue	$4,400,000		$4,400,000
		Anniedale B2	**$6,865,080**
		GRAND TOTAL	**$28,799,235**

Drainage

Project	Project Cost	Non-Growth Component (DCC)	Ultimate Growth Component (DCC)
160m of 1050mm diameter 180 Street: 96 Avenue - Golden Ears Way	$297,000		$297,000
65m of 1050mm diameter 96 Avenue/180 Street	$108,000		$108,000
250m of 900mm diameter 97 Avenue:179 - 180 Street & 180 Street: 97 - 96 Avenue	$347,000		$347,000
		Sub-Catchment N-1	**$752,000**
200m of 1050mm diameter 94 Avenue: 183 - 184 Street	$371,000		$371,000
150m of 1050mm diameter 184 Street: 94 - 95 Avenue	$279,000		$279,000
1050m of 1050mm diameter Hwy 1: 184 - 187 Street	$1,624,000		$1,624,000
		Sub-Catchment N-2	**$2,274,000**
150m of 900mm diameter 173A Street: 92 - 93 Avenue	$249,000		$249,000
350m of ditch improvement 92 Avenue: 173A - 176 Street	$47,000		$47,000
		Sub-Catchment S-2	**$296,000**
350m of 900mm diameter 176 Street: 90 - 92 Avenue	$809,000		$809,000
170m of 600mm diameter 177 Street: 93 - 92 Avenue	$217,000		$217,000
150m of 750mm diameter 92 Avenue: 176 - 177 Street	$220,000		$220,000
		Sub-Catchment S-3	**$1,246,000**
150m of 450mm diameter 180 Street: 91 - 92 Avenue	$134,000		$134,000
270m of 525mm diameter 180 Street: 91 - 92 Avenue	$266,000		$266,000
400m of ditch improvement & ROW 180 Street: 90 - 88 Avenue	$509,000		$509,000
		Sub-Catchment S-4	**$909,000**

Project	Project Cost	Non-Growth Component (DCC)	Ultimate Growth Component (DCC)
290m of 900mm diameter 184 Street: 91A Avenue - 90 Avenue	$482,000		$482,000
400m of ditch improvement 184 Street: 90 - 88 Avenue	$54,000		$54,000
		Sub-Catchment S-5	**$536,000**
150m of 750mm diameter 172 Street: 93 - 92 Avenue	$220,000		$220,000
		Sub-Catchment W-2	**$220,000**
100m of ditch improvement Harvie Rd: 91 -90 Avenue	$14,000		$14,000
		Sub-Catchment E-1	**$14,000**
200m of ditch improvement 92 Avenue: 173 - 173A Street	$27,000		$27,000
		Sub-Catchment S-1	**$27,000**
250m of ditch improvement 187 Street: 89 - 90 Avenue	$34,000		$34,000
		Sub-Catchment S-6	**$34,000**
		GRAND TOTAL	**$6,308,000**

Drainage - Ponds

Project	Project Cost	Non-Growth Component (DCC)	Ultimate Growth Component (DCC)
Anniedale 7 detention pond 96 Avenue/180 Street (N-1)	$4,888,000		$4,888,000
Anniedale 8 water quality pond 187 Street/Hwy 1 (N-2)	$2,217,000		$2,217,000
Anniedale 6 detention pond 96 Avenue/Harvie Rd (E-1)	$3,279,000		$3,279,000
Tynehead 1 water quality pond 173A Street/92 Avenue (S-2)	$2,122,000		$2,122,000
Anniedale 2 water quality pond 90 Avenue/Hwy 15 (S-3)	$2,967,000		$2,967,000
Anniedale 3 water quality pond 180 Street/92 Avenue (S-4)	$1,738,000		$1,738,000
Anniedale 4 water quality pond 184 Street/90 Avenue (S-5)	$1,679,000		$1,679,000
Anniedale 5 water quality pond 90 Avenue/187 Street (S-6)	$1,439,000		$1,439,000
		GRAND TOTAL	**$20,329,000**

Transportation

Project	Project Cost	Ultimate Anniedale-Tynehead Growth Component (DCC)	External Funding	Development Obligation
ARTERIALS				
Highway 15 at Golden Ears Way Interchange	$48,263,000	$12,065,750	$36,197,250	
Highway 1 at 192 Street Interchange	$20,000,000	$5,000,000	$15,000,000	
088 Avenue - 168 Street to 192 Street (Ultimate Arterial Widening)	$43,530,500	$10,882,625	$32,647,875	
090 Avenue - Harvie Road to 192 Street (Ultimate Arterial Widening)	$3,030,300	$1,515,150	$1,515,150	
092 Avenue - 180 Street to Harvie Road/90 Avenue (Interim Arterial Upsizing) Special Section II	$16,016,000	$16,016,000		
168 Street - 88 Avenue to 96 Avenue (Ultimate Arterial Widening)	$10,914,800	$5,457,400	$5,457,400	
180 Street - 88 Avenue to 96 Avenue (Ultimate Arterial Widening & New Arterial) Including Special Section HH	$11,425,400	$11,425,400		
184 Street - 80 Avenue to 93 Avenue (Ultimate Arterial Widening & New Arterial)	$15,082,860	$7,541,430	$7,541,430	
192 Street - 80 Avenue to 92 Avenue (Ultimate Arterial Widening)	$5,573,100	$2,786,550	$2,786,550	
Arterials - Roads & Structures Sub-Total	**$173,835,960**	**$72,690,305**	**$101,145,655**	**$ -**

ARTERIAL INTERSECTION IMPROVEMENTS				
88 Avenue at 180 Street (Traffic Signal)	$180,700	$45,175	$135,525	
88 Avenue at 184 Street (Traffic Signal)	$180,700	$45,175	$135,525	
88 Avenue at 188 Street (Traffic Signal)	$180,700	$45,175	$135,525	
88 Avenue at 192 Street (Traffic Signal) 10 YSP or at Harvie Road?	$180,700	$45,175	$135,525	
90 Avenue at Harvie Road (Traffic Signal)	$180,700	$90,350	$90,350	
90 Avenue at 192 Street (Traffic Signal)	$180,700	$90,350	$90,350	
92 Avenue at 180 Street (Traffic Signal)	$180,700	$180,700		
92 Avenue at 184 Street (Traffic Signal)	$180,700	$180,700		
96 Avenue at 173A Street (Traffic Signal)	$180,700	$90,350	$90,350	
92 Avenue at 188 Street (Traffic Signal)	$180,700	$180,700		
168 Street at Ridgeline Dr (94A Avenue) |Traffic Signal	$180,700	$90,350	$90,350	
180 Street at Ridgeline Dr (93A Avenue) | Traffic Signal	$180,700	$180,700		
180 Street at 96 Avenue | Traffic Signal	$180,700	$180,700		
184 Street at 90 Avenue | Traffic Signal	$180,700	$90,350	$90,350	
184 Street at 80 Avenue | Traffic Signal	$180,700	$90,350	$90,350	
192 Street at 80 Avenue | Traffic Signal	$180,700	$90,350	$90,350	
Arterials - Traffic Signals Sub-Total	**$2,891,200**	**$1,716,650**	**$1,174,550**	**$ -**

ARTERIALS TOTAL	**$176,727,160**	**$74,406,955**	$102,320,205	**$ -**

Project	Project Cost	Ultimate Anniedale-Tynehead Growth Component (DCC)	External Funding	Development Obligation
COLLECTOR UPSIZING, STRUCTURES & INTERSECTION IMPROVEMENTS				
Anniedale Road Overpass of GEW | Structure	$3,360,000	$3,360,000		
Ridgeline Dr (94 Avenue) overpass at Highway 15 | Structure	$4,670,000	$4,670,000		
Ridgeline at 173A Street | Roundabout | Intersection Improvements	$500,000	$500,000		
90 Avenue at 188 Street | Roundabout | Intersection Improvements	$500,000	$250,000	$250,000	
90 Avenue - 184 Street to 187 Street (Upsizing) ** 187 Street to Harvie Road in SPK	$1,806,800	$600,600		$1,206,200
92 Avenue - 172 Street to 176 Street (Upsizing & South Side) Special Section CC	$2,270,580	$613,470		$1,657,110
92 Avenue - 176 Street to 180 Street (Upsizing)	$31,122,000	$653,562		$30,468,438
Ridgeline Dr - 168 Street to 184 Street (Upsizing & South Side of 94A Avenue) Special Section AA Included	$13,175,760	$2,966,270		$10,209,490
95 Avenue - 172 Street to 175 Street (Upsizing) Special Section DD	$1,107,600	$147,638		$959,962
96 Avenue - 177A Street to 181A Street (Upsizing)	$2,511,600	$527,440		$1,984,160
Anniedale Road - 181 Street to 188 Street (Upsizing & East Side) Special Section GG	$6,366,360	$3,188,640		$3,177,720
97 Avenue & 177A Street & 179 Street in Anniedale Triangle (Upsizing)	$2,987,400	$679,770		$2,307,630
172 Street - 92 Avenue to 96 Avenue (Upsizing)	$2,870,400	$602,780		$2,267,620
173A Street - 92 Avenue to 96 Avenue (Upsizing)	$2,870,400	$602,780		$2,267,620
175 Street - 92 Avenue to 95 Avenue (Upsizing) Including Special Section EE	$1,544,400	$532,116		$1,012,284
177 Street - 92 Avenue to Ridgeline Dr (93A Avenue) (Upsizing)	$1,004,640	$210,970		$793,670
184 Street - 92A Avenue to Anniedale Road (Upsizing)	$1,474,200	$309,582		$1,164,618
188 Street - 90A Avenue to Anniedale Road (9300 Block) (90A Avenue south SPK)	$3,533,400	$742,010		$2,791,390
COLLECTORS TOTAL	**$83,675,540**	**$21,157,628**	**$250,000**	**$62,267,912**

CITY OF SURREY
the future lives here.

Anniedale-Tynehead

Neighbourhood Concept Plan (NCP)

April 2012

City of Surrey

SECTION 2: ENGINEERING, IMPLEMENTATION AND FINANCING

ENGINEERING APPENDICES

SECTION 2

ENGINEERING, IMPLEMENTATION & FINANCING

SECTION 2: ENGINEERING, IMPLEMENTATION & FINANCING

What are the Engineering and Infrastructure Requirements?

The following section describes the Transportation, Sanitary Sewer, Storm Water and Water System infrastructure based on the recommended servicing plan.

PART 5 Transportation Infrastructure

Photo: 96 Avenue Road Widening Near Tynehead Park, Surrey

PART 5: TRANSPORTATION INFRASTRUCTURE

5.0.0 EXISTING TRANSPORTATION CONDITIONS

Existing Road Network

At present, the City's existing road network in the Anniedale-Tynehead area is relatively sparse and discontinuous, with predominately 2 lane rural-standard roads and unsignalized traffic control. The existing roadway laning and traffic control in the study area is illustrated in **Figure 5.0**. This network operates relatively well now because of the existing low density suburban residential land use which generates little vehicle traffic, transit, or cycling trips.

With the redevelopment of Anniedale-Tynehead, it can be expected that the internal neighbourhood Collector road system, in particular, will be improved with new, realigned and widened urban-standard roadways. Along with improvements to the Arterial & Collector road network, the Local Road network will also have to be considerably developed to provide access to new developments as well as supporting internal, multi-modal neighbourhood circulation.

Existing Traffic Generation

At present, there are approximately 1,425 residents and 145 jobs in the Anniedale-Tynehead NCP neighbourhoods. If the Port Kells neighbourhood is included, there are approximately 2,235 residents and 400 jobs in all of South Port Kells (SPK).

During the development of the General Land Use Plan for South Port Kells, a travel demand forecasting model using EMME/2 software was developed to estimate the existing traffic generation of the area. During the Weekday PM Peak Hour, SPK currently generates about 825 vph, of which 344 are entering SPK and 499 are exiting SPK. Of these 825 PM Peak Hour trips, approximately 0.7% or 6 trips are internal trips, 41% or 337 are Internal-External Trips, and 58% or 483 are External-Internal Trips.

File Name

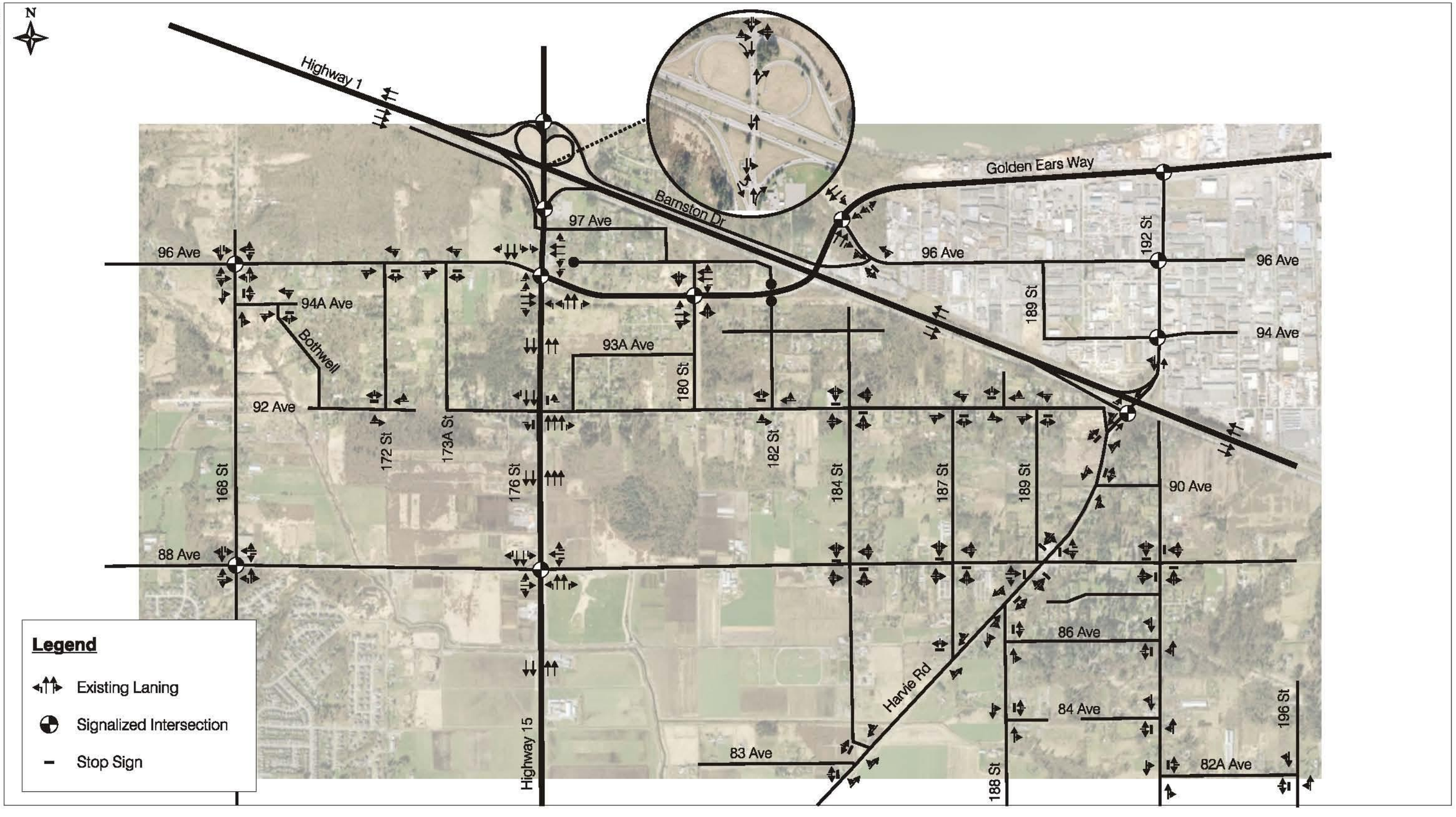

Figure 5.0

Existing Laning and Traffic Control

Anniedale / Tynehead Stage 1 NCP Road Network Study, Surrey BC
4027.15 February 2011 Scale NTS

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Existing Traffic Volumes & Operations

Figure5.1 illustrates available 2004 AM and PM Peak Hour traffic volume data in the South Port Kells area, which was collected prior to the Golden Ears Bridge and Golden Ears Way construction, and prior to the conversion of Highway 15/92 Avenue to right-in/out only. It can be seen that Highway 1 and Highway 15 are by far the busiest routes, with 88 and 96 Avenues also carrying significant volumes. 168 Street, 192 Street and Harvie Road are currently lower-volume Arterials. While little traffic data is available on internal Anniedale – Tynehead roads, it is likely peak hour volumes do not exceed 200 vph on either 180 Street or 92 Avenue, the busiest internal Collector roads in the two neighbourhoods. Based on recent traffic data from 2009 Golden Ears Way is now carrying peak hour traffic volumes in the same order of magnitude as 96 Avenue, about 1,200 vph just east of Highway 15.

Traffic operations at the key intersections in the study network were evaluated based on the capacity analysis methods outlined in the 2000 Highway Capacity Manual (HCM) using the Synchro 6.0 analysis software for signalized and stop-controlled intersections. Reported operational performance measures include Volume-to-Capacity (V/C) ratios and delay-based Level of Service (LOS).

For the purposes of road network planning, the City applies threshold values for operational performance measures of V/C = 0.90 or less, and Level of Service (LOS) "D" or better. Table 5.2 summarizes the overall Volume-Capacity (V/C) ratio and Level of Service (LOS) for the Highway 15 / Golden Ears Way (GEW) intersection for the Existing (2004 and 2009) Weekday PM Peak traffic condition.

Table 5.0 - Intersection Performance for Existing (2004 and 2009) PM Peak Traffic Conditions

Intersection	Year**	V/C	LOS
Golden Ears Way / Highway 15	2009	0.57	C
88 Avenue / Highway 15	2004	0.70	C
88 Avenue / Harvie Road*	2004	-	F
88 Avenue / 192 Street*	2004	-	C
96 Avenue / 168 Street	2004	0.63	C

*Highway Capacity Manual do not report overall V/C ratio for 4-way stop-control intersections.
** 2004 = before GEW open; 2009 = after GEW open

Clearly all the studied intersections within the Anniedale-Tynehead study area are operating within capacity under the Existing (2004 and 2009) PM Peak Traffic conditions, with the exception of 88 Avenue and Harvie Road where long delays are experienced in the southbound approach on Harvie Road. This is due to the heavy southbound through and right-turn volumes travelling from the Port Kells Industrial area north of Highway 1, which share a single lane approach to this 4-way stop controlled intersection.

File Name

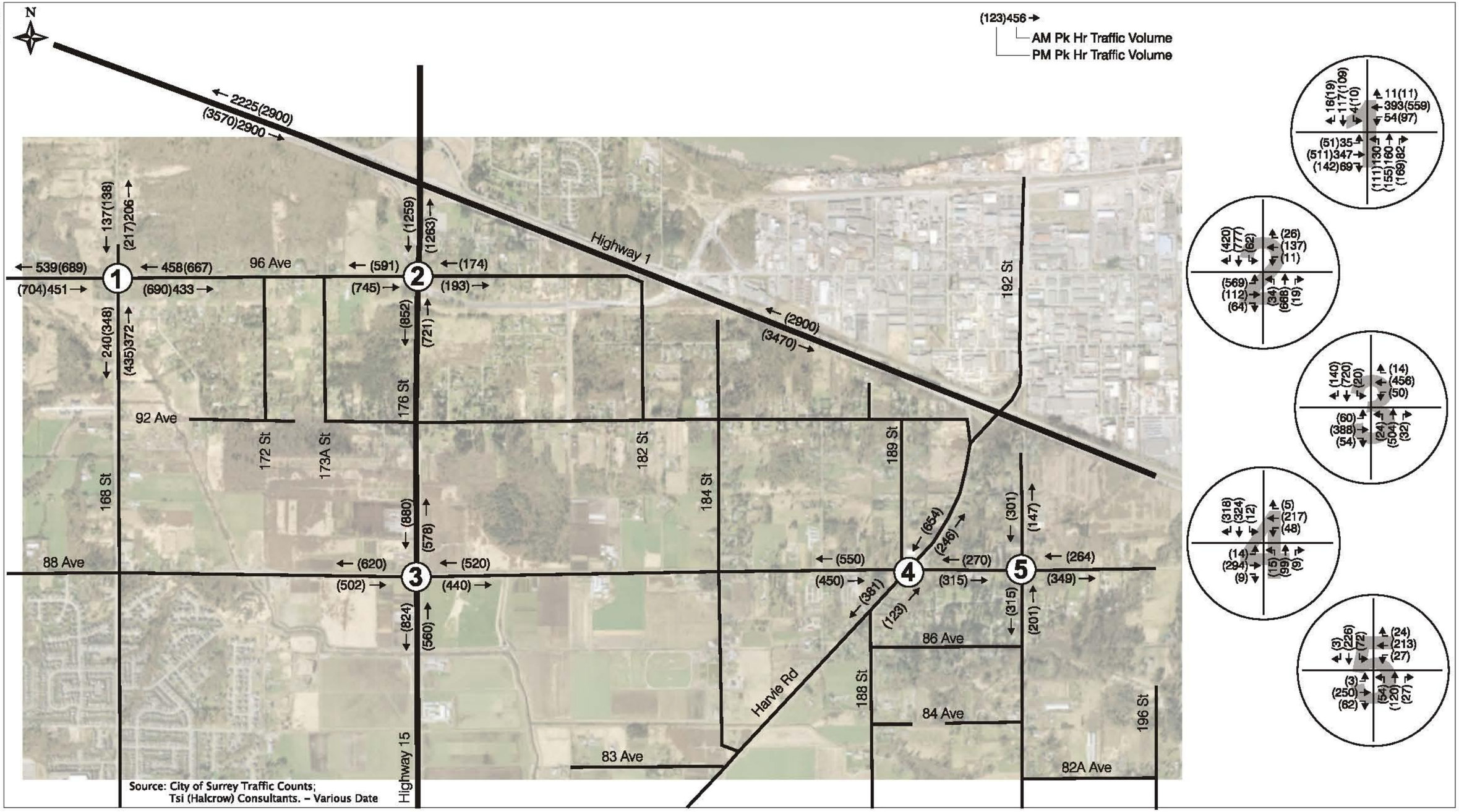

Figure 5.1

2004 (Pre-Golden Ears Bridge) Peak Hour Traffic Volumes

Anniedale / Tynehead Stage 1 NCP Road Network Study, Surrey BC
4027.15 February 2011 Scale NTS

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Existing Transit Network

Figure 5.2 illustrates the current transit network in the vicinity of Anniedale-Tynehead. There is only one peak period transit route (#388) that originally was routed along GEW, Highway 15 and 88 Avenue through SPK linking Walnut Grove in Langley to the 22nd Street SkyTrain Station in New Westminster. This route originally had no stops in the SPK area so effectively, the area had no transit service and therefore transit mode split was therefore negligible. During the NCP development the City worked with TransLink and Coast Mountain Bus Company to revise the routing and utilize bus stops constructed as part of the recent 96 Avenue widening program completed in late 2010. The route currently travels along GEW, 96 Avenue, and 168 Street to 88 Avenue.

Existing Cycling & Pedestrian Network

Existing bicycle facilities as well as elements of the City's current bicycle plan relevant to the Anniedale-Tynehead neighbourhoods are discussed below. **Figure 5.3** illustrates both existing and currently planned bicycle facilities in the area. Existing on-street and off-street facilities are described below.

Most of the existing roadways within the neighbourhood are currently built to rural standards with no sidewalks, although they may have narrow shoulders and carry very low traffic volumes; hence, they are reasonably attractive for walking and cycling. Harvie Road has wider paved shoulders which make it attractive for cycling and is identified by the City as a 'shared-traffic' cycling route. Golden Ears Way (GEW) has marked bicycle lanes on both side of the street between Highway 15 and 96 Avenue east of Highway 1. 96 Avenue between Highway 15 and 168 Street has on-street bicycle lanes. Paved shoulders are available on both sides of Highway 15, although the heavy traffic volumes on Highway 15, as well as its vertical grade and limited access points are significant barriers at present to walking and cycling on and across Highway 15. Golden Ears Way also creates a walking/cycling barrier between the Anniedale "Triangle" and the rest of the South Port Kells area.

There is an existing off-street multi-use path on the south side of GEW that starts from Highway 15 in the west connecting to 196 Street. The City of Surrey recently completed construction of a pedestrian /cycle overpass across Highway 1 on 168th Street, which was opened in the summer of 2011 and which will ultimately connect into the future Tynehead Park pathway.

File Name

N

To Surrey City Centre and beyond

Barnston Drive

Golden Ears Way

To Golden Ears Bridge

96 Avenue

Tynehead

Anniedale A

96 Avenue

To Walnut Grove (Langley)

Anniedale B

Highway 15

To 22nd Street SkyTrain Station (New Westminster)

88 Avenue

	Existing Routes		
	Number	Name	Peak Frequency
	388	22nd Street Station / Walnut Grove	30 min.
	501	Surrey Central Station / Langley Centre	15 min.
	509	Surrey Central Station / Walnut Grove	20 min.
	590	Surrey Central Station / Langley South	15 min.

Figure 5.2

Existing Transit Network

Anniedale / Tynehead Stage 1 NCP Road Network Study, Surrey BC
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File Name

N

Tynehead Pedestrian / Cyclist Overpass on Highway 1

Marked Bike Lanes to be provided with 96 Avenue Ultimate Arterial Widening (post 2010)

Tynehead Perimeter Trail (Metro Vancouver)

96 Avenue

Barnston Drive

Golden Ears Way

To Golden Ears Bridge

Telegraph Trail

96 Avenue

Anniedale A

Tynehead

Crossing location of off-street path to be determined

Anniedale B

Green Timbers Greenway (Long-term)

Highway 15

Port Kells Greenway to connect to East Clayton (Alignment and type of facility to be confirmed)

88 Avenue

192 Street

Legend - Cycling Facilities

- Existing Marked Bike Lanes
- Existing On-Street Bicycle Route shared with Traffic
- Existing Off-street Bicycle Path
- Future Marked Bike Lanes
- Future Off-street Bicycle Path
- Future Bicycle Route (On-street or Off-street)
- Pedestrian / Cyclist Overpass

Figure 5.3

Existing / Currently Planned Bicycle Network Elements

Anniedale / Tynehead Stage 1 NCP Road Network Study, Surrey BC
4027.15 July 2011 Scale NTS

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5.1.0 BACKGROUND TRANSPORTATION PLANS AND POLICIES

The transportation component of the NCP was developed based on the guiding principles identified in the City's Transportation Strategic Plan and supplementary Walking and Cycling Plans, as well as TransLink's South of Fraser Area Transit Plan. It is also consistent with, or an improvement upon , the Highway and Traffic By-law and City policies and practices in regards to traffic operations, and truck routes.

Transportation Strategic Plan – General Road Network Layout, Spacing & Density

The 2008 *Transportation Strategic Plan* was developed to set out the vision, objectives and principles for transportation in Surrey. The six major strategic guiding principles are as follows

1. Effective And Efficient Network Management
2. More Travel Choice
3. Safer, Healthier Communities
4. Successful Local Economies
5. Protection Of Our Built And Natural Environment
6. Transportation Integration

In support of these principles, the general road network objectives for this NCP are:

- Provide an open, inter-connected and continuous grid or modified grid road network that is integrated with established and planned future roads within and surrounding the study area;
- Develop a major road network with Arterials spaced at ½ mile (800m) maximum and Collectors at ¼ mile (400m) maximum;
- Maintain Local Road intersections with Arterials & Collectors spaced 100m (min.) to 200m (max);
- Keep Local Road intersections with internal neighbourhood Collectors and other Local Roads to 100m (min.) to 200m (max) spacing;
- Align intersections of minor roads together across major roads to provide better inter-connection of neighbourhoods and avoid offset T-intersections;
- Avoid use of cul-de-sacs, unless these are required to avoid environmental or other impacts. If possible, favour loop roads over cul-de-sacs to ensure a minimum two entry/exit points to all developments.

Walking Plan

The City of Surrey published the first edition of the Walking Plan in 2011 as an update to the 1997 Pedestrian Master Plan. The document builds on the recognition that everyone at some point in their trip is a pedestrian and as such, walking is a critically important travel mode in achieving the broader six guiding transportation principles. The document outlines various guiding principles which should be applied to the Anniedale / Tynehead NCP including:

- Promote walking as a viable, and sustainable alternative to the private car for many trips and in turn increase access to health services, education, shopping, employment, cultural events, and recreation;
- Deliver policies and strategies that recognize that walking is about more than just building sidewalks and, as a result, examine everything that would encourage walking;
- Create a culture that integrates and expands walking with both strategic and "street-level" decision-making and planning across multiple departments;

Cycling Plan

The process of updating the 1994 "Bicycle Blueprint" with the official Cycling Plan was underway during the development of the NCP. As indicated earlier, **Figure 5.3** illustrates the current Bicycle Network Plan in the Anniedale-Tynehead area which includes both existing and proposed on-street bicycle lanes and off-street multi-use pathway and Greenway routes. Although, the Plan will be updated to reflect the recommended cycling plan for this NCP the then current network was assumed to be the starting point for developing a future bicycle network in Anniedale-Tynehead . The key cycling policies considered for the NCP were:

- All new Arterial and Collector Roads will have marked bicycle lanes on both sides;
- Off-street multi-use pathways should have lighting and/or be in wide open corridors, adjacent to roads , or have to meet CPTED (Crime Prevention Through Engineering Devices) principles; and
- Connect to the nearest (preferably signalized) intersection when crossing roadways to avoid mid-block crossings where possible.

Two planned major Greenway multi-use pathways are located in the NCP:

1. The Green Timbers Greenway is planned to connect with the existing multi-use pathway in the Golden Ears Way corridor through the Tynehead area using the BC Hydro right-of-way, which is south of and parallel to 96 Avenue.
2. A new greenway connecting the Anniedale, Port Kells and North/East Clayton neighbourhoods has been identified to connect these communities in the long-term.

As the current Zoning By-law does not include provision for end-of-trip facilities except for short term bicycle racks for multi-family and commercial developments, as a general policy for developments in the NCP, particularly employment lands, new development should also provide other supporting end-of-trip facilities including. The City plans to review the zoning bylaw for bicycle parking in due course to tackle this issue.

- long term bicycle parking (in the form of safe and secure bicycle storage rooms or bicycle lockers)
- lockers, showers and washrooms to support commuting by bicycle.

South of Fraser Area (SofA) Transit Plan:

In 2007, TransLink prepared the South of Fraser Area (SoFA) Transit Plan, which outlined the Long Range Transit Plan and Vision for all levels of transit to 2031, including the Analyses of the Network for 2031 as well as the Short-term Implementation Plan to 2013 for the municipalities south of the Fraser River including Surrey, Delta, Langley Township, Langley City and White Rock.

In the NCP area, future Local and Neighbourhood Bus services and routes were proposed and identified in the SoFA Plan, typically connecting to major transfer points such as Guildford, Surrey City Centre and Walnut Grove. One of the proposed routes was considered to be a candidate for inclusion as part of the Frequent Transit Network (FTN) which would provide service frequency at a minimum of 15 minutes for 15 hours a day, 7 days a week. Service on the proposed routes in the NCP would have connections to existing higher-capacity services such as SkyTrain and planned Bus or Light Rapid Transit on 104 Avenue and Highway 1. Since publication of the SoFA plan in 2007, it has been undergoing updates and refinements. TransLink has confirmed that the SoFA plan routing and timing of implementation could be adjusted to effectively accommodate the increase in density of residents and employment in the NCP area.

Road Access:

The Highway & Traffic By-law (No. 13007) and the Engineering Design Criteria Manual regulate access to roads of all classifications. The following policies for the NCP are consistent with the Bylaw, or are an improvement to it, and can be summarized as follows;

- Provide primary access via Local Roads and maximize the number of access routes and permeability of the street system;
- Manage direct access on Arterials and maintain rear lane access for all residential land uses fronting Arterials.
- Minimize direct access on Collectors through the development of rear lanes or back access roads particularly in higher density and mixed use areas to improve pedestrian environment on fronting street and increase on-street parking supply. If direct access is unavoidable, follow principles of good access management in terms of location, spacing, sight distance and permitted movements;
- Avoid any frontage roads or gated private communities or neighbourhoods.

Truck Route Background & Policies

The City's Highway & Traffic By-law No. 13007 also regulates the streets designated as truck routes. **Figure 5.4** shows the current designated truck routes in the South Port Kells area, with includes City of Surrey truck routes as well as Provincial/Regional truck routes. The City maintains a designated truck route plan in order to focus larger commercial vehicles on appropriate roadways and minimize impacts to residents. This bylaw states that no person shall drive, operate, or park a heavy truck on any highway in the City other than on a truck route except for:

- any heavy truck operating for or on behalf of the City;
- as authorized by a permit issued by the City Engineer;
- where it is necessary to deviate from a truck route for the purpose of delivering or receiving goods or other such common commercial purpose by the shortest route from the nearest truck route with the least impact on residential area; or
- where heavy trucks on any highway or part of a highway have been properly authorized as a temporary detour truck route.

When the existing truck weigh scale on Highway 1 between 152 Street and 176 Street (Highway 15) is relocated east of Highway 15 as part of the Highway 1 widening project and the South Fraser Perimeter Road is complete by 2013, the City will designate 96 Avenue west of Highway 15 as a truck route. Also, it is likely 88 Avenue east of Highway 15 to the Langley border will also ultimately be designated a truck route, since it is on TransLink's Major Road Network (MRN).

Traffic Operations & Control Policies

As part of the Transportation Strategic Plan, the City has recognized the need and importance of managing the network on a day to day basis. Maintaining a safe and efficient transportation system with properly managed traffic operations is critical to supporting efficient movement of goods, regional, and local traffic. As well, it reduces the potential for through traffic to use local streets. Example principles are:

- Plan for likely locations of traffic signals (All Arterial/Arterial and Arterial/Collector intersections) but only install when warrants are met based on minimum vehicle volumes, delay and collision history.
- Optimize spacing of traffic signals on Arterial Roads at 400m for good signal progression;
- Consider roundabouts as alternatives to a traffic signal or all-way stop, if conditions are appropriate;
- Install traffic calming devices on Local Roads as per the City's Traffic Calming Policies and Practices, or in special circumstances where considered appropriate.

File Name

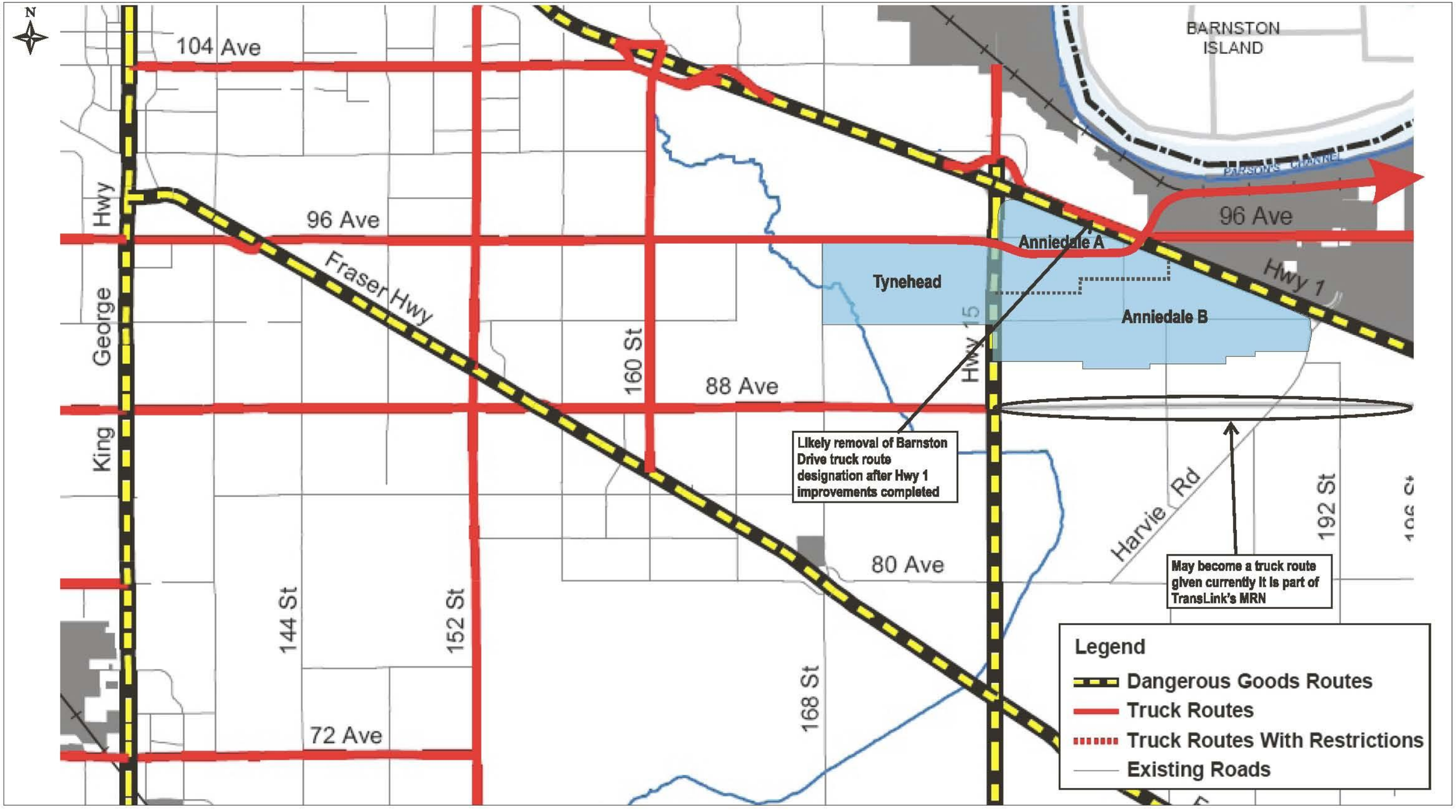

Figure 5.4

Existing Truck Routes

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5.1.1 Major Road Network Plan

The City defines roads 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.
- **Arterial Roads –** generally function to carry through traffic from one area to another with as little interference as possible from adjacent land uses and may provide limited 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 lower volume neighbourhood streets that provide access to individual properties

The City maintains a long range arterial and collector classification network plan, identified in the Subdivision Bylaw, as Schedule "D" (R-91) Road Classification and "K" Major Road Allowance maps. These plans designate all existing and proposed new Arterial and Collector Roads, and the Road Allowance necessary, to support full build-out of the City according to the current Official Community Plan.

The City's Major Road network hierarchy plan and identified Ten Year Servicing Plan projects in, and adjacent to, the Anniedale-Tynehead prior to the implementation of the NCP is illustrated on Figure 5.3. Current designated Arterials in the area are 88 Avenue, 96 Avenue, 168 Street, 192 Street and Harvie Road and designated collectors are 92 Avenue east of Highway 15, 182 Street between Golden Ears Way, 92 Avenue, 184 Street south of 92 Avenue and 90 Avenue between Harvie Road and 192 Street.

The current R-91 Plan designated road classifications assume Anniedale-Tynehead would be developed at lower residential densities than are contemplated in the NCP. The current plan also does not reflect changes that occurred as part of the construction of Golden Ears Way such as the down classification of 96 Avenue east of Highway 15 and the revision of the principle north south connection to 180 Street instead of 182 Street. Although the basic framework of the Arterial and Collector road system as illustrated on **Figure 5.5** is assumed to be the starting point in developing a long range road network plan for the NCP it is understood that the development of the NCP will result in significant changes required to the R-91 Plan.

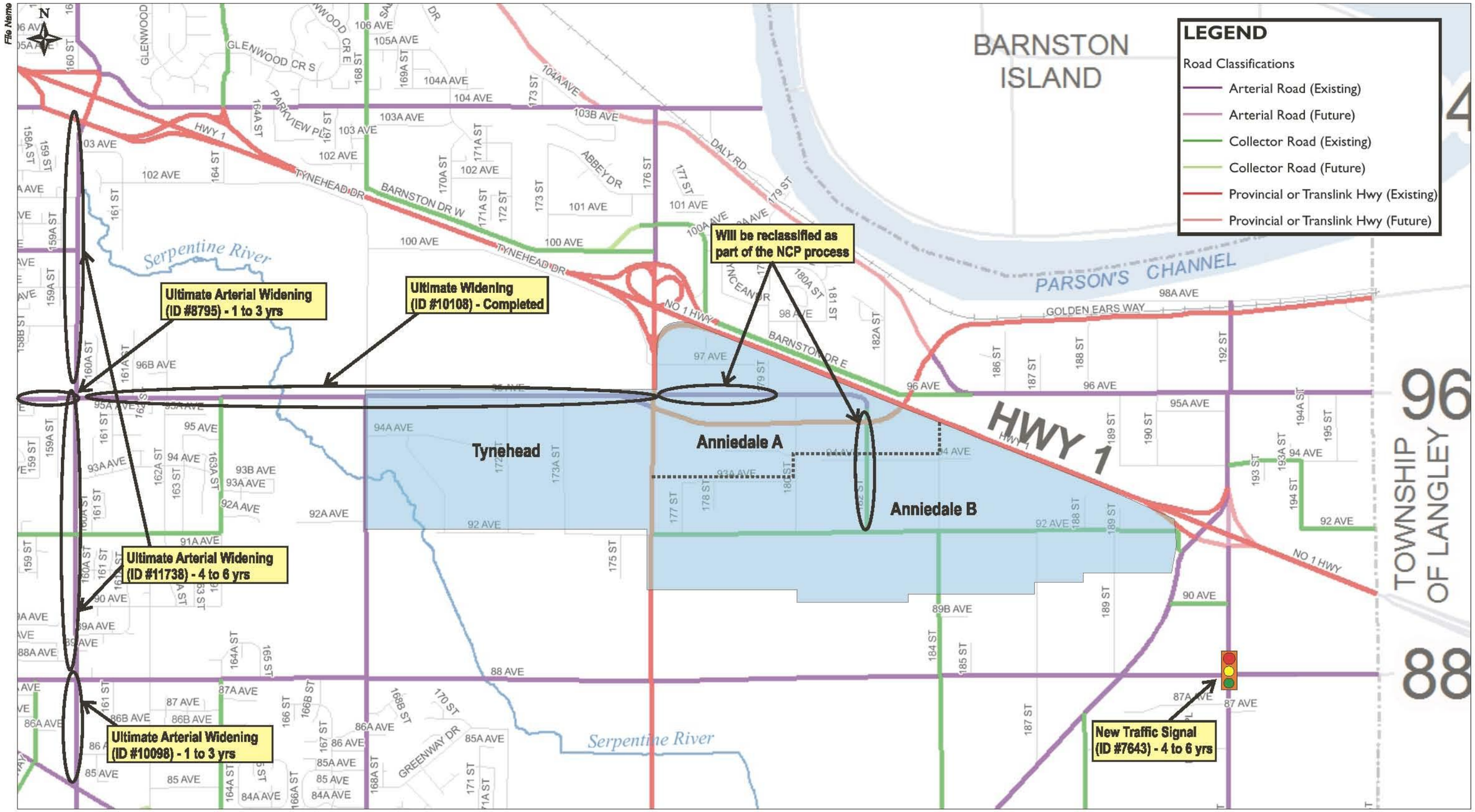

Figure 5.5

R91 Road Network Plan & Current 10 Year Servicing Plan Improvements

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Table 5.1 below describes the hierarchy of roads within the NCP and provides a detailed listing of the City's standard road classifications and their design elements, including required road allowance dedications, occasionally referred to as road right-of-way (ROW). As development occurs over time, the City will require developers, as part of the Subdivision By-law, to dedicate road allowance either along their property frontages or for new roads planned within their properties in accordance with these roadway standards.

Table 5.1 - City of Surrey Road Classes & Design Features

Road Classifications			Design Features				
Type	**Sub-Type**	**Land Use**	**No. Lanes**	**Right-Of-Way**	**Pavement Width + Median**	**Sidewalks**	**Bicycle Facilities**
Provincial / Regional Jurisdiction							
Highway	Freeway	---	4 to 8	Varies	varies	n/a	n/a
	Expressway	---	4 to 6	Varies	varies	varies	possibly, varies
City Jurisdiction							
Arterial	Divided Urban	---	4 plus median/ left turn bays	30m	20m	2 @ 1.8m	1.8m bike lanes
	Divided Rural	---	4 with two way left turn lane	30m + Statutory ROW for roadside ditches as required	20m	n/a	1.8m bike lanes
Collector	---	---	2 + left turn bays or 2 with parking lanes	24m	14m	2 @ 1.8m	1.7m bike lanes
Local	Through [3]	Commercial /Industrial	2	20m	11m	2 @ 1.5m)	Share traffic lane
		Single Family [1] Residential	2	18m or 20m	8.5m or 10.5m	2 @ 1.5m	Share traffic lane
		Medium to High [2] Density Residential	2	20m	10.5m or 11m	2 @ 1.5m	Share traffic lane

Table Notes:
Arterial and Collector road standards based on cross section information received from Engineering Department (November 2010);
The City of Surrey has Alternative Residential Road Standards. The smaller dimensions under Right of Way Dedication and Pavement Width for Residential Streets reflect the narrower Alternative Standards.

(1) 'Single Family' is considered A-1 to RF Zone Designation;
(2) 'Medium to High" is RF-12 and denser;
(3) Limited Local designations will be considered where physical constraints prevent through local connections and are subject to Design Criteria.

5.1.2 External Agencies Road Network Plans

Highway Improvements
There are several major Provincial (Ministry of Transportation & Infrastructure) and Regional (TransLink) roadway projects recently completed or underway within or adjacent to Anniedale-Tynehead that have impacted or will impact traffic volumes and traffic patterns in the study area. These are described below.

Gateway Program
The Gateway Program was established by the Ministry of Transportation & Infrastructure (MoTI) to address the impact of growing regional congestion and to improve the movement of people, goods and transit throughout Greater Vancouver. Of all the projects that are undertaken by the Gateway Program, two of them will have direct impact to the Anniedale-Tynehead area:

- Port Mann Bridge / Highway 1 Project; and,
- South Fraser Perimeter Road.

The proposed Port Mann Bridge / Highway 1 Project is part of the overall Gateway Program, and will include the construction of a new 10-lane Port Mann Bridge, widening of Highway 1 from 1st Avenue in Vancouver to 200th Street in Langley to 8 lanes (6 general purpose lanes plus 2 High Occupancy Vehicle (HOV) lanes) and upgrading of the interchanges. These improvements are currently under construction and expected to be completed by 2013.

Within the Anniedale-Tynehead study area, key Gateway project elements are the widening of Highway 1, the re-construction of the Highway 15/Highway 1 interchange, widening of Highway 15 south from 104 Avenue to Golden Ears Way (GEW), and modifications to the Harvie Road interchange to provide movements to/from the north (for all traffic) and east (for trucks only).

To date, the only completed construction in the study area has been the widening of Highway 15 south from Highway 1 and through the GEW intersection to 4 lanes, undertaken in conjunction with the opening of GEW. Four through lanes have been provided on Highway 15 through the signalized intersection, along with dual left turn lanes on both the north and southern legs. However, Highway 15 has been constructed to ultimately permit 6 through lanes at GEW, which represents the "maximum footprint" of the intersection. On the north side of the Highway 1 / Highway 15 interchange, the north-south portion of Barnston Drive East connecting to 100A Avenue has now been upgraded and widened as part of the interchange improvement works.

The South Fraser Perimeter Road (SFPR) will be a new four-lane arterial highway (expessway) route along the south shore of the Fraser River extending from the Deltaport Way in the southwest Delta to 176th Street and the Golden Ears Bridge connector road in Surrey and Langley. The SFPR is anticipated to be completed by 2013. The completion of the SFPR will provide some relief to the traffic demand through the city's east-west arterial roads as well as the Highway 1 corridor. While not within the study area, the SFPR is expected to shift traffic (particularly truck traffic) off Highway 1 and east-west roadways in the City of Surrey, including 96 Avenue and Golden Ears Way in Anniedale-Tynehead.

Border Infrastructure Program

The Border Infrastructure Program (BIP) was a jointly funded Federal-Provincial initiative to improve the movement of goods to and from the Lower Mainland's four border crossings. The Highway 15 project component of the BIP included the widening of Highway 15 (176th Street) in Surrey to four lanes from 32 Avenue to Golden Ears Way (GEW). The focus of the Highway 15 improvements was the widening to 4 lanes but also access management. The only access permitted between 88 Avenue and Highway 1 (besides minor driveways which will ultimately be closed when properties redevelop) was a right-in/right-out access at 92 Avenue. The Ministry of Transportation & Infrastructure has confirmed that this is the only direct access permitted to the Anniedale-Tynehead neighbourhood from Highway 15.

Golden Ears Way

The Golden Ears Bridge (GEB) is a six-lane tolled bridge across the Fraser River connecting the Township of Langley with Pitt Meadows and Maple Ridge, generally following the 200th Street alignment and with connector roads in the north and south shores. The GEB was opened to traffic in 2009. Of key importance to the Anniedale-Tynehead study area was inclusion of a new east-west arterial route, known as Golden Ears Way (GEW) which generally follows the 95 and 96 Avenue alignment, passing under Highway 1 to connect with Highway 15 at 96 Avenue.

TransLink controls all access to GEW and in the Anniedale-Tynehead area, access is limited to a new signal located at 180 Street. No additional direct access will be permitted, according to the Master Municipal Agreement between TransLink and the City of Surrey. At the GEW/Highway 15 intersection, 4 though lanes and dual eastbound and westbound left turn bays have been provided on GEW as well as separate right turn lanes on the east and west legs.

TransLink has confirmed that the right-of-way for GEW was established for a four lane roadway and there are currently no plans to ultimately widen it to 6 lanes in the study area. It is noted that the GEB and GEW were planned in 2003-2005 and the designs were based on Design Hour Volumes (DHV) that did not contemplate any major redevelopment in the Anniedale-Tynehead area.

TransLink Major Road Network

TransLink is responsible for the shared funding of maintenance, rehabilitation and development of over 2,100 lane-km of Major Road Network (MRN) across the region. The designation of MRN is based on the road providing access to important activity centres in the region, and meeting criteria related to trip lengths, traffic volumes, transit ridership and commercial vehicle demand. Since 1999, as part of TransLink's MRN Capital Development Program, they have invited municipalities to submit funding requests for 50-50 cost sharing on improvements to MRN roadways. Within the study area, 88 Avenue, 96 Avenue and Golden Ears Way are all designated MRN roads.

5.2.0 ANALYSIS

Approach

The road network plan for Anniedale-Tynehead was developed by forecasting future peak hour traffic demands generated by the proposed land uses for both neighbourhoods, and superimposing this demand on future background traffic demands assigned to a series of road network options. These road network options included different strategies to address the anticipated increase in traffic generation in the area. Then, detailed analysis of traffic flow patterns, link and intersection capacities was undertaken to determine the most effective and best-performing elements of the future road network options. Ultimately, a Preferred Road Network was selected which was then used as the framework for developing truck, bicycle and potential future transit plans for the Anniedale-Tynehead neighbourhoods.

Future Traffic Generation

To estimate traffic generation, the study area, covering Anniedale, Tynehead and also the Port Kells neighbourhood was first divided into approximately 60 traffic zones and then a peak hour traffic generation estimate prepared for each zone. The City of Surrey's policy is to use land use-based trip rates when forecasting NCP traffic, as this is the basis for the City's Development Cost Charge (DCC) calculations. Therefore, vehicle trips during the Weekday PM Peak Hour were estimated for each traffic zone based upon the draft NCP land uses provided by the City, applying rates from standard industry sources or previous relevant studies. More information on the methodology and assumptions in estimating future traffic generation can be found in the Anniedale-Tynehead Stage One NCP Road Network Study.

Table 5.2 below summarizes the future traffic generation of the Anniedale-Tynehead. The table lists traffic generation by land use type and also by neighbourhood. Note that this traffic generation estimate was for the Anniedale-Tynehead NCP land use plan as it was in November, 2010; the land use plan has changed slightly since then but these changes have not resulted in any substantive changes to the forecasted traffic generation.

Table 5.2 - November 2010 PM Peak Hour Traffic Generation Forecast

Land Use/Area	In	Out	Total
By Land Use type within Anniedale- Tynehead			
Residential	3,024	1,583	4,607
Institutional	18	36	54
Recreational	75	84	130
Commercial	1,268	1,409	2,678
Industrial	365	1,073	1,439
All Uses	*4,750*	*4,185*	*8,908*
By Area within in Anniedale- Tynehead			
Anniedale	2,726	2,212	4,938
Anniedale Triangle	173	345	518
Tynehead	1,852	1,628	3,480
All Areas	*4,750*	*4,185*	*8,908*

5.2.1 Road Network Options and Modelling

Five NCP road networks were developed and tested: A "Base Network" which represented the draft April 2010 road network plan; and, four alternatives to the Base Network. These alternatives were developed to test the impacts of various overall road network element strategies, including improvements to key congested intersections and new or widened Arterials and Collectors.

The road network options were analyzed using two types of transportation computer models: a VISUM travel demand model (to forecast future traffic on the road network options) and a Synchro traffic operations model (to assess the quality of future traffic operations including V/C ratios and Level of Service).

For the travel demand forecast modelling, the EMME software was used initially to develop a detailed sub-area model of the South Port Kells area, including the Anniedale, Tynehead and Port Kells traffic zones. The sub-area model was based on the Gateway Program's 2031 Sub-area model Version 5.0 (GSAM V5.0) using the Growth Management Strategy Version 5.2 land uses, which in turn was based on TransLink's regional travel demand forecasting model. GSAM 5.0 was used in this study as the Metro Vancouver regional model was in the process of being updated to 2041 and was unavailable for use.

The EMME NCP sub-area model (EMME NCP SAM) was employed to extract regional travel patterns due to major changes in the regional network external and internal to the NCP area. These changes included the planned upgrades to the Patullo Bridge, tolling on the Port Mann and Patullo Bridges, implementation of a new full movement interchange at Highway 1 & 192 Street, possible implementation of a new interchange at Highway 15 & Golden Ears Way (GEW) and the extension southward of 180 Street from GEW to 88 Avenue. All of these network modifications would have implications for longer distance travel patterns through the NCP study area road network. A number of EMME SAM scenarios were developed that reflected these network changes and then traversal Origin-Destination Matrices within and across a cordon line outside of the NCP study area were extracted from the model runs.

Once the traversal OD matrices were extracted from EMME, the VISUM software was used to assign traffic to the neighbourhood roadway network and external gates to the study area. The VISUM models were also employed in assessing major traffic patterns and in evaluating overall network comparison statistics such as total vehicle-km of travel.

For operational analysis modelling, the intersection volume outputs from the VISUM models were transferred to the Synchro software to create traffic models for the assessment of traffic operations. The Synchro analysis focused on key major intersections and assisted in refining laning arrangements and proposed traffic controls. The Synchro analysis results were also employed to refine the road network plan options based on capacity and queue assessments.

For further more detailed information on the network options and the analysis of these options, refer to the Anniedale-Tynehead Stage One NCP Road Network Study

5.3.0 PROPOSED TRANSPORTATION SYSTEM

The Preferred Road Network is illustrated on **Figure 5.6** Elements of the Preferred Road Network and its rationale is discussed below, based upon the findings of the detailed modelling analysis.

Highway 15 / Golden Ears Way (GEW) Interchange

All of the traffic forecasting and analysis work conducted for the previous South Port Kells GLUP study as well as the Anniedale-Tynehead NCP study identified major capacity constraints at the Highway 15 & GEW intersection by full build out of Anniedale-Tynehead in 2041. Therefore, it was concluded that to support the growth anticipated in Anniedale-Tynehead, operational improvements to the intersection beyond the "maximum footprint" already planned by MoTI/TransLink should be considered. Various means to achieve operational improvements at the Highway 15 & GEW intersection were investigated, including:

- Reducing the trip generation of Anniedale-Tynehead;
- Implementing adjacent road network improvements to shift traffic away from the intersection;
- Widening GEW to 6 lanes through the intersection; and,
- Upgrading the intersection to provide either a non-conventional at-grade intersection or a grade separated interchange.

Based on the analysis of these options, the Preferred Network includes:

- 6 lanes on Highway 15 through the intersection;
- Direct access to Highway 15 at 92 Avenue which, combined with the 92 Avenue overpass, allows all-way movements in/out of both Anniedale and Tynehead from Highway 15 without using Golden Ears Way;
- A full movement interchange at Highway 1 & 192 Street; and,
- 180 Street connected through to 88 Avenue.

In addition, the land use designation in the Anniedale Triangle area was modified from its initial draft April 2010 "Business Park" designation to "low impact Industrial" to reduce traffic volumes at both the Highway 15 & GEW and GEW & 180 Street intersections.

However, even with these network and land use changes, the capacity of an at-grade signalized intersection at Highway 15 & GEW did not meet the City's desired threshold V/C ratio of 0.90. Also, with an at-grade intersection, the traffic forecasting model indicated that inappropriately high (700 vph) volumes of longer-distance municipal and regional traffic could use 180 Street between Golden Ears Way and 88 Avenue, due to significant congestion and poor Level of Service at the Highway 15 & GEW intersection. Therefore the Preferred Network as illustrated on **Figure 5.6** includes a grade separated interchange at Highway 15 and GEW.

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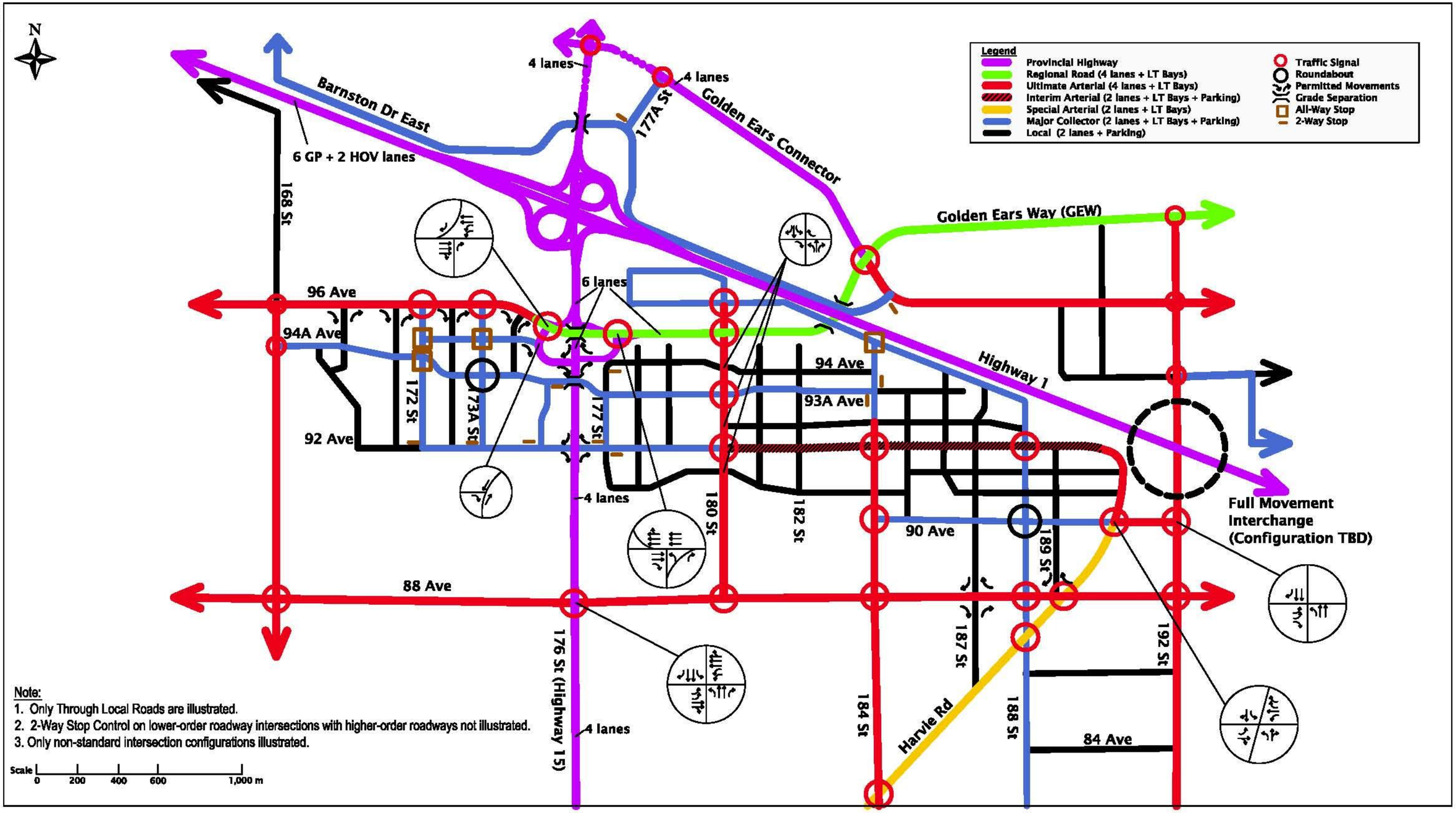

Figure 5.6

Preferred Road Network

Anniedale/Tynehead Stage 1 NCP Road Network Study, Surrey BC
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Once it was concluded that a grade separate interchange would be required to meet the City's performance objectives at the Highway 15 & GEW intersection, further work was undertaken to select a preferred interchange configuration, establish the required right-of-way footprint and develop "Class D" cost estimates. Five interchange design concepts were developed and evaluated using a comprehensive Multiple Account Evaluation process which included criteria such as cost, customer service, and environmental, economic development and socio-community impacts. This work is described in detail in the Highway 15 and Golden Ears Way Intersection Study.

Figure 5.7 illustrates the preferred conceptual design of the City's preferred interchange layout for the Highway 15 and Golden Ears Way interchange. The preferred layout has the following features:

- 4 through lanes on 96 Avenue/Golden Ears Way, with dual left turns lanes at the west intersection and right turn exit lanes at both intersections;
- Single lane direct ramps and loops, with dual lanes tapering to a single lane to accept the dual westbound to southbound left turn lanes at the west intersection, and dual left turn lanes for the northbound to westbound movement at the east intersection;
- 6 lanes on Highway 15 north and south of the interchange;
- 4 lanes on Highway 15 generally within the interchange between the exit/entrance ramps with acceleration and deceleration lanes at ramps;
- 96 Avenue/Golden Ears Way crossing over Highway 15 using 6% grades that flatten at intersection locations;
- A clear span overpass structure over Highway 15; and,
- A 4 m wide multi-use path on the south side of 96 Avenue/Golden Ears Way over the structure to connect planned cycling facilities on the 96 Avenue/Golden Ears Way corridors across Highway 15 via a grade-separate crossing.

Representatives of the Ministry of Transportation & Infrastructure, the Gateway Program and TransLink were consulted during the development and evaluation of interchange alternatives. Currently, these agencies are unable to either endorse the conclusion that a grade separated interchange may ultimately be required, nor the preferred design concept. Due to the unknown timeline and budget availability these agencies are unable to commit to contributing any funding for the future interchange.

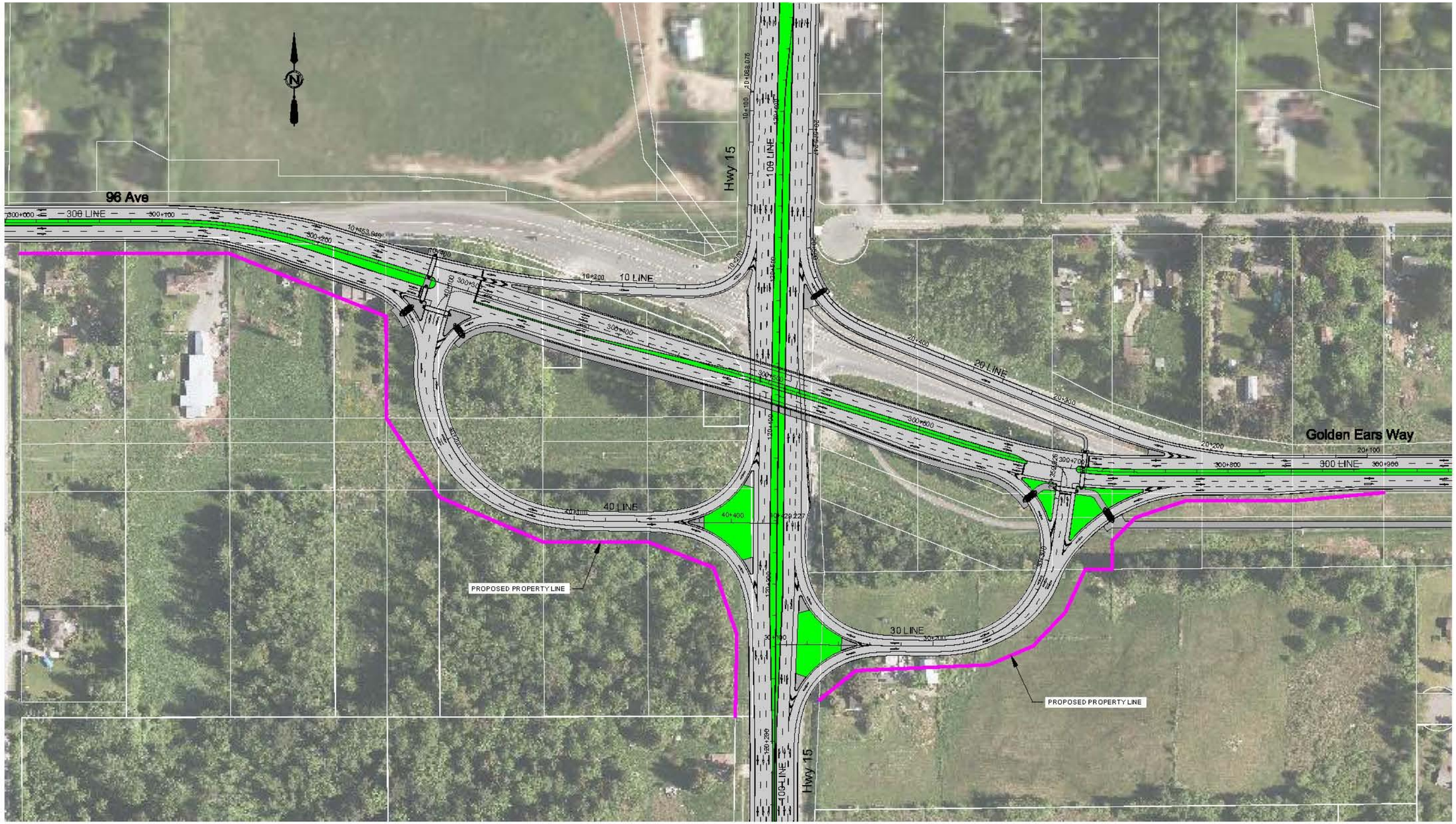

Figure 5.7

HWY 15 / GEW INTERCHANGE OPTIONS
INTERCHANGE OPTION 3 - Laning

Dwg. No.: 20112805-00-SK018
Date: November 01, 2011

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Associated Engineering

P:\20112805000_Hwy15_GEWEngineering\03.11_Progress_Issues\20120110-Report Exhibits\20112805_Exhibit 5.2.dwg
DATE: 2012-01-10, Evelyn Aguila

Highway 15 & 88 Avenue

Even with westbound dual left turn lanes assumed at Highway 15 & 88 Avenue, desired traffic operations thresholds could not be met without adding through lanes on 88 Avenue (or alternatively, Highway 15). This improvement has been shown on the Preferred Network, but it is noted that the volumes at this intersection are highly dependent on whether 180 Street is connected directly to 88 Avenue. When this connection is in place, it may attract through traffic between GEW and Highway 15 south of 88 Avenue or between GEW and 88 Avenue west of Highway 15, resulting in very high westbound to southbound left turn and westbound through movements at the intersection.

New Arterial Road Classifications

In the Preferred Road Network, two additional roadway sub-classifications to the City's R-91 Road Classifications were introduced, specific to the Anniedale-Tynehead neighbourhood: "Special Arterial" and "Interim Arterial."

The "Special Arterial" standard is applied solely to Harvie Road, which includes 2 lanes plus left turn bays with paved shoulders for walking and cycling. This standard was considered necessary to reflect the required traffic operations while recognizing the historical importance of Harvie Road, as it was originally a dedicated right-of-way for the original rail corridor connection to the United States. While remaining only 2 lanes, Harvie Road provides a strategic connection between the Port Kells neighbourhood and the future 192 Street interchange in the north, to 188 Street and Fraser Highway in the south. Traffic forecasting and analysis work showed that while future volumes are expected to remain relatively low for an Arterial Road, Harvie Road will carry longer distance traffic and continue to play an important role in the City's major road network.

The section of 92 Avenue between 180 Street in the west and its transition to Harvie Road in the east is classified as an "Interim Arterial". With this designation, the City will protect 30m of right-of-way as per a typical 4 lane Arterial standard, but in the interim will construct a different roadway cross section. In the Preferred Road Network, 92 Avenue is proposed to be constructed as a 2 lane Interim Arterial with left turn bays and parking on both sides permitted between intersections. This cross section would permit future upgrading to full 4-lane Arterial standard by simply removing on-street parking, if ever required.

95 Avenue – 175 Street Collector Road

An east-west Collector Road is proposed approximately on the 95 Avenue alignment within the major commercial parcels in the Tynehead neighbourhood in conjunction with a potential "Entry-only" access connecting this roadway to the proposed southbound on-ramp from Golden Ears Way to Highway 15.

This direct access to the interchange ramp is proposed as it will provide better connectivity for all vehicles from Tynehead to travel to the south. However, it will be contingent on the configuration of the intersection/interchange at Highway 15 & GEW as well as approval from the agency or agencies ultimately responsible for the ramp.

With subsequent refinement of the grade-separated interchange design the ability to connect 95 Avenue with 175 Street allows flexibility for increasing connectivity to the 92 Avenue right-in right-out access with Highway 15 should the direct ramp access not be permitted.

Local Road Class Designations

Figure 5.8 illustrates the Local Road class designations for the Proposed Road Network. The various Local Road classes are listed and described in details in the **Table 5.1** previously.

File Name

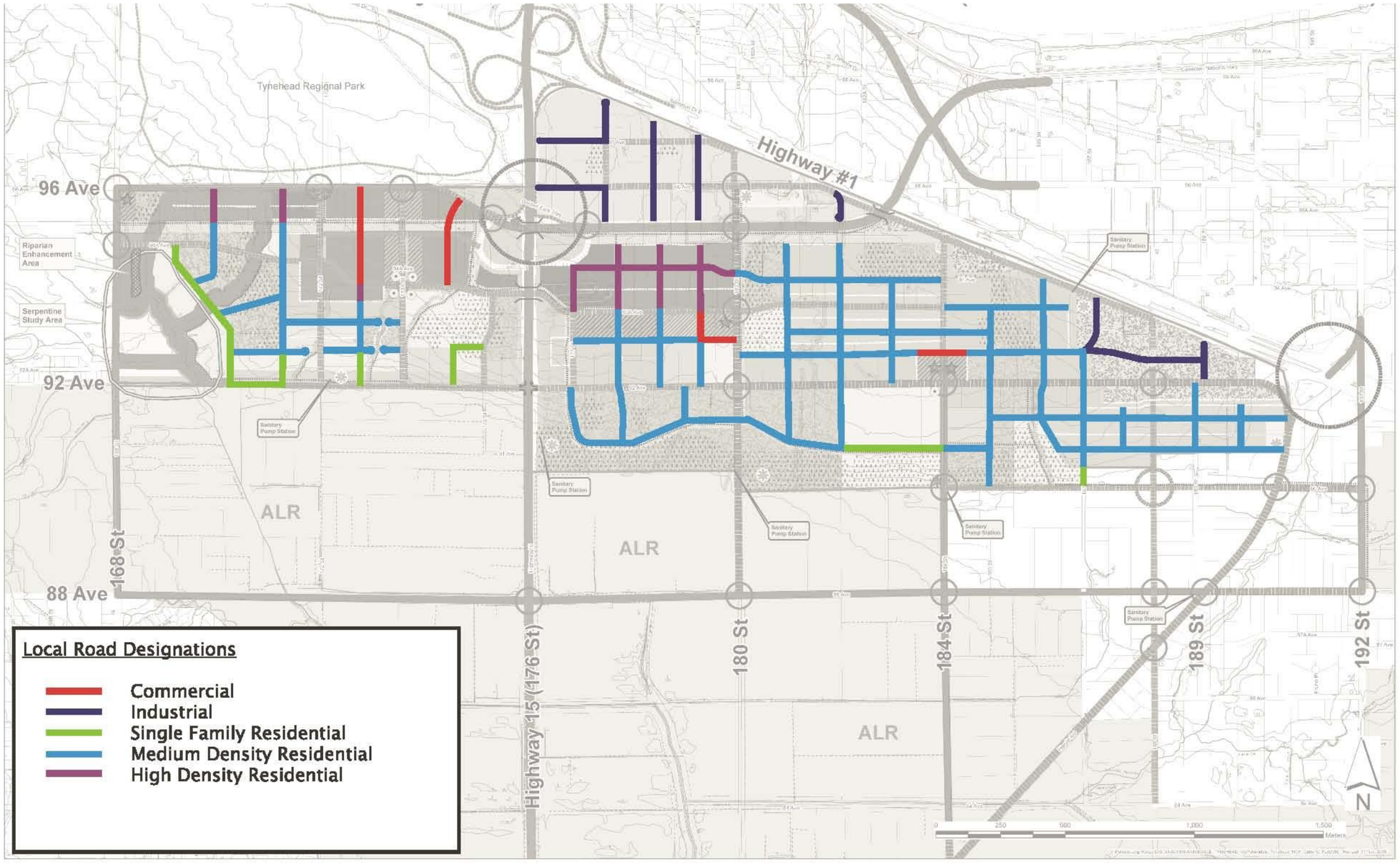

Figure 5.8

Preliminary Local Road Designations

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5.3.1 Future Traffic Assignment

Figures **5.9** and **5.10** summarize the Weekday PM Peak Hour traffic distribution for the Preferred Road Network. **Figure 5..11** illustrate the VISUM model's traffic assignment to the Preferred Network and Figure **5.13** illustrates the Synchro model plot of key intersection turning movements. **Table 5.3** below provides the Weekday PM Peak Hour directional screenline volumes on the Preferred Network.

Table 5.3 - Weekday PM Peak Hour Screenline Volumes

Screenline Description		Dir	Preferred Network 2031/2041
South of 96 Ave/ GEB		S	4,237
		N	2,598
North of 92 Ave		S	3,926
		N	3,272
South of 88 Ave		S	4,473
		N	4,029
East of 173A		E	2,005
		W	2,976
East of 180		E	3,235
		W	3,585
East of 187		E	1,545
		W	2,137
External Zones	North	OUT	7,429
		IN	6,332
	South	OUT	3,544
		IN	4,144
	East	OUT	6,779
		IN	5,942
	West	OUT	8,095
		IN	9,096

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Draft Reports\NCP Stage One Draft Report\Graphics\Exh 4.4 - 4.6 Preferred Network.cdr

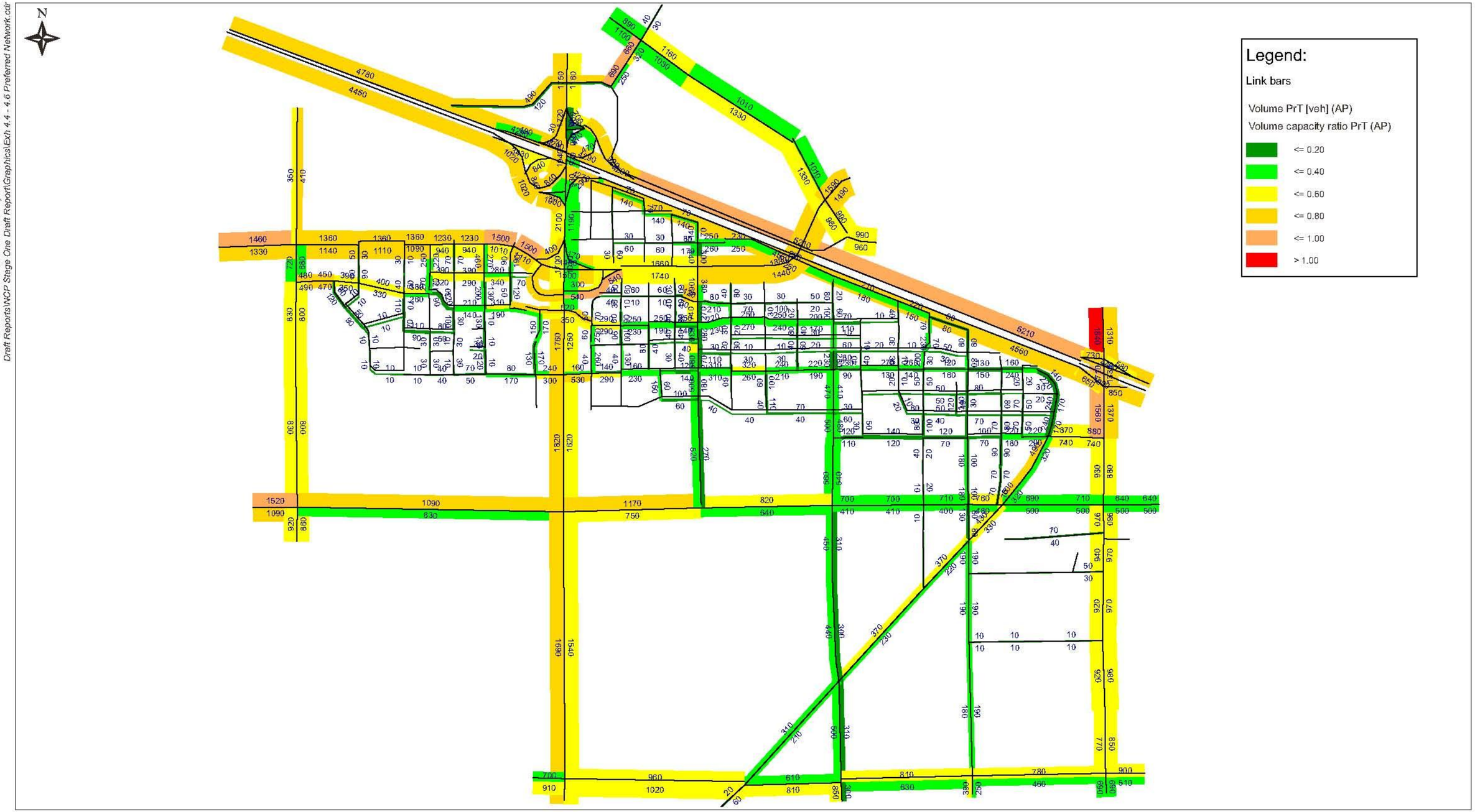

Figure 5.9

Preferred Network Weekday PM Peak Hour Assignment Plot

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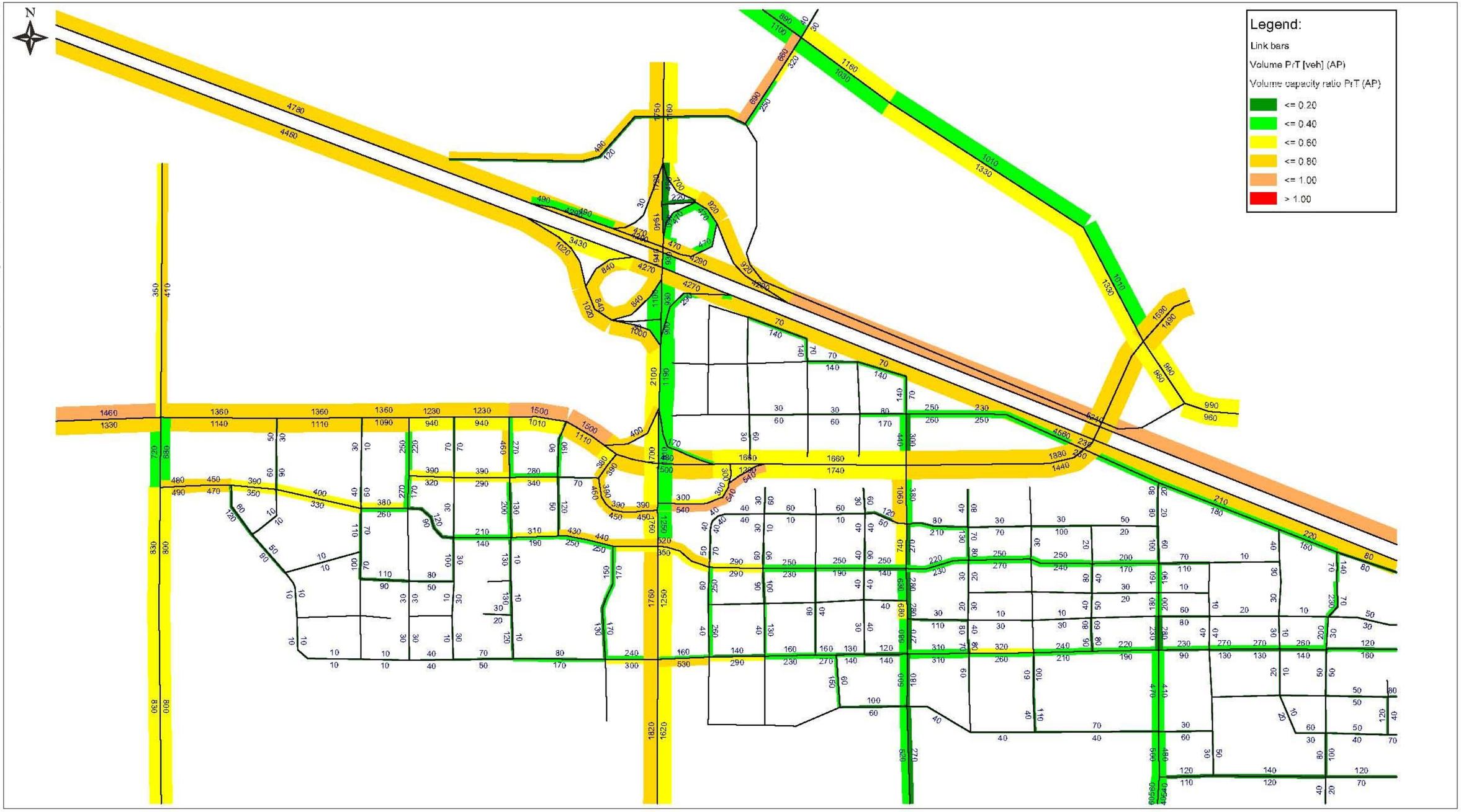

Figure 5.10

Preferred Network Weekday PM Peak Hour Assignment Plot Detail

Anniedale / Tynehead Stage 1 NCP Road Network Study, Surrey BC
4027.15 February 2011 Scale NTS

bunt & associates

File Name

Figure 5.11

Synchro Model Plot for Key Intersections of Preferred Network

Anniedale / Tynehead Stage 1 NCP Road Network Study, Surrey BC
4027.15 February 2011 Scale NTS

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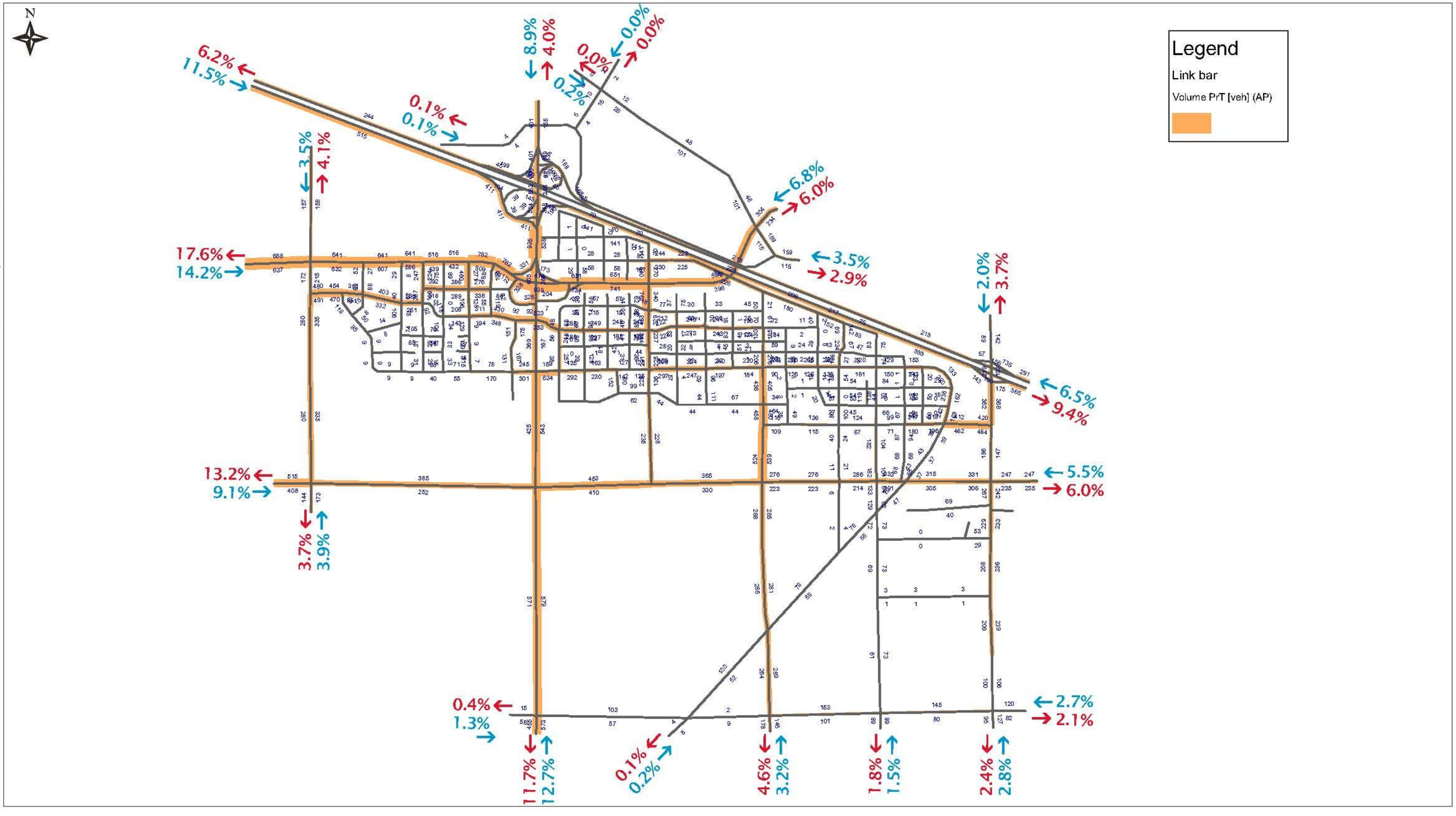

Figure 5.12
Preferred Network Trip Distribution

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4027.15 February 2011 Scale NTS

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5.3.2 Future Traffic Operations

Traffic operations at the critical intersections on the Preferred Network were evaluated based on the capacity analysis methods outlined in the 2000 Highway Capacity Manual (HCM) using the Synchro 6.0 analysis software for signalized and stop-controlled intersections. Initial laning assumptions, based upon the VISUM traffic assignments, were entered into Synchro and the model run; results were then reviewed and laning/traffic control assumptions refined to optimize operations. Except for the closely spaced signals on 96 Avenue and Golden Ears Way between 172 Street and 180 Street, all signalized intersections were assumed to operate independently. **Table 5.4** below summarizes the overall Volume-Capacity (V/C) ratio and Level of Service (LOS) for the key intersections in the study network for the Preferred Network.

Table 5.4 - Summary of Intersection Performance for Key Intersections in NCP

Intersection	Preferred Network Performance Measures	
	V/C	LOS
GEW / 180 ST	0.81	D
GEW / HWY 15 Interchange (EAST)	0.51	A
GEW / HWY 15 Interchange (WEST)	0.66	A
96 AVE / 173A ST	0.65	B
96 AVE / 172 ST	0.58	B
96 AVE / 168 ST	0.87	C
96 AVE / 180 ST	0.36	B
93A AVE / 180 ST	0.32	A
92 AVE / 180 ST	0.29	B
88 AVE / 180 ST	0.58	B
88 AVE / HWY 15	0.87	D
88 AVE / 168 ST	0.73	C
88 AVE / 184 ST	0.53	B
88 AVE / HARVIE RD	0.59	B
88 AVE / 192 ST	0.82	D

It can be seen that all of the major Arterial/Arterial and Arterial /Collector intersections in the Preferred Network are expected to operate satisfactorily at build-out in 2041.

5.3.3 Truck Route Plan

Figure 5.13 shows the Truck Route Plan for Anniedale-Tynehead NCP. The plan reflects the City's recent designation of 96 Avenue west of Highway 15 as a truck route to connect with the existing truck designated facility of Golden Ears Way. The plan also identifies two anticipated additions to the City Designated Truck Route Network:

- 88 Avenue east of Highway 15 to the Langley will ultimately be added because it is currently part of TransLink's Major Road Network (MRN) and typically all MRN roads are designated Truck Routes; and,
- At a minimum, 192 Street between 88 Avenue and Highway 1 should be designated a truck route in order to connect the future full movement interchange planned on Highway 1 at 192 Street with the future 88 Avenue designated truck route.

Additionally, an extension of the Truck Route designation on 192 Street to Fraser Highway would merit consideration for inclusion in the City's Truck Route Plan at a future date.

Within the Anniedale and Tynehead neighbourhoods, the following routes, while not recommended to be designated truck routes, could be used relatively frequently by trucks to legitimately depart and return to designated truck routes:

- 180 Street (provides link between Anniedale Triangle Industrial area, Golden Ears Way and 88 Avenue);
- 184 Street (provides link to Anniedale Triangle Industrial area and Business Park to 92 Avenue and 88 Avenue);
- 92 Ave east of 184 St / Harvie Road, north of 90 Ave / 90 Ave between Harvie Rd and 192 Street; and,
- All the collector roads within the Industrial / Business Park areas.

File Name

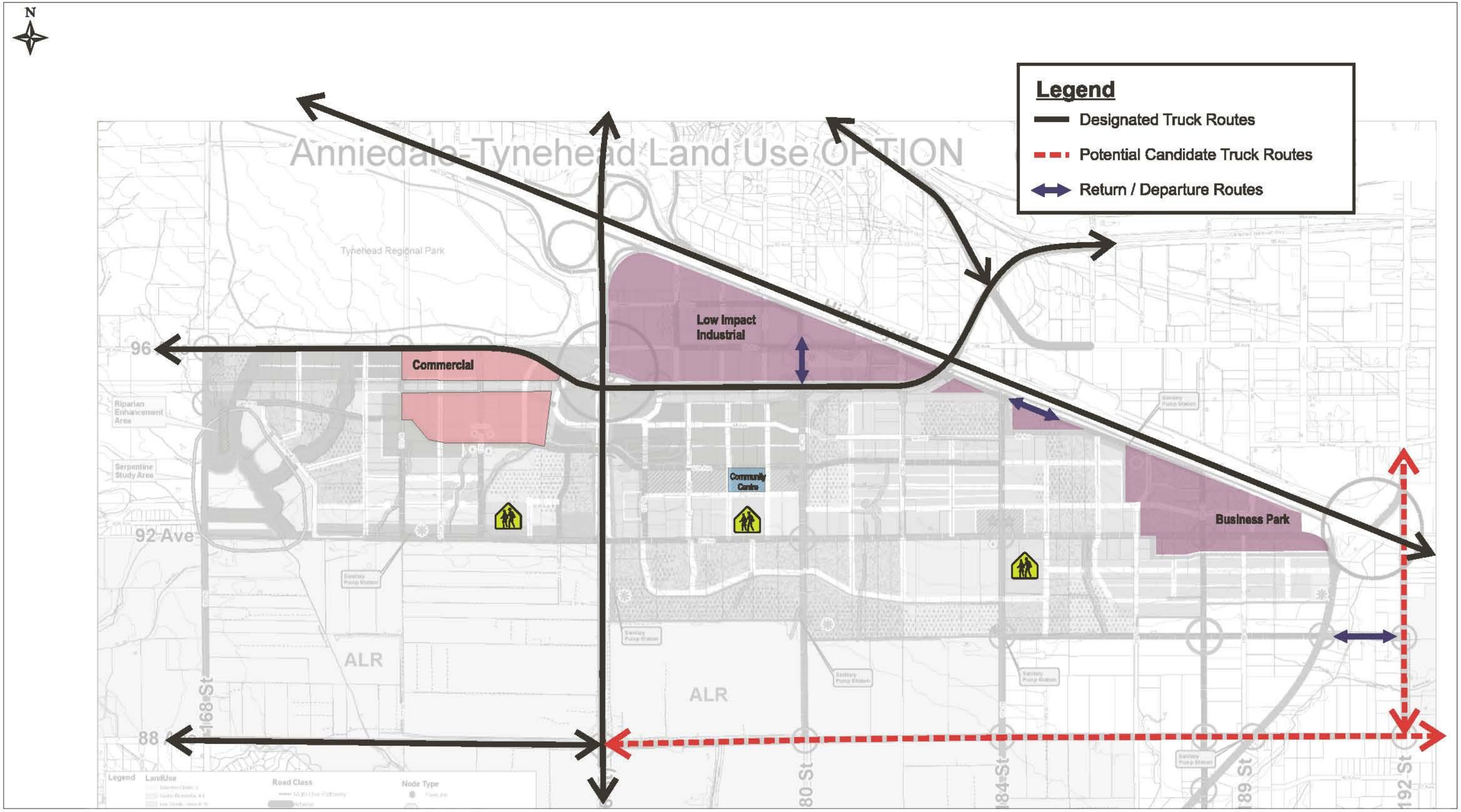

Figure 5.13

Preliminary Truck Route Plan

Anniedale / Tynehead Stage One NCP Road Network Study, Surrey BC
4027.15 July 2011 Scale NTS

bunt & associates

5.3.4 Cycling and Walking Plan

The City's road cross-section requirements for all new Arterials and Collector roads includes marked bicycle lanes and sidewalks on both sides. Therefore, implementation of the Preferred Road Network in itself will provide an excellent, interconnected on-street cycling and sidewalk network for the Anniedale-Tynehead neighbourhoods.

On- street bicycle lanes will be 1.8 metres wide on Arterial roads, while bicycle lanes on Collector roads will be 1.7 metres wide as per City's Road Standards. Sidewalks on all Arterial and Collector roads will be a minimum of 1.8m wide, and 1.5m on local roads. In commercial areas and near civic buildings such as recreation centres and schools, consideration for wider sidewalks is recommended.

On-street bicycle lanes on major roads will be complemented with off-street multi-use paths and Local Road Neighbourhood Bicycle Routes, all of which will be accompanied with wayfinding signage for cyclists and pedestrians.

Figure 5.14 illustrates the Bicycle Network Plan for Anniedale-Tynehead NCP. Where multi-use pathways are proposed to be located next to roads additional statutory right-of-way beyond that required just for the roadway will be required to accommodate the pathway. Also illustrated on **Figure 5.14** are potential locations of bicycle/pedestrian-actuated signals to assist cyclists and walkers in crossing major roadways where traffic signals are not present; however, actual installations of such bicycle/pedestrian-actuated signals will continue to be based on meeting City-defined warrant criteria. Interim crossing measures, such as raised medians to allow two-stage crossings, could be employed until pedestrian/cyclist and traffic volumes would justify full signal installation.

There are several proposed off-street multi-use pathway routes proposed on the Bicycle Network Plan, including an extension of the Green Timbers Greenway proposed to be located on the existing utility Right-of-Way available just south of 96 Avenue / Golden Ears Way. This pathway is proposed to cross Highway 15 at the GEW interchange on the south side.

The other major off-street multi-use pathway on the Bicycle Network Plan is the Port Kells Greenway, which will connect Anniedale to Port Kells Village and East Clayton. This off-street multi-use path follows the alignment of 180 Street between Golden Ears Way to the local street just south of 92 Avenue. It then turns east to follow the alignment of the local street, crossing 184 Street and eventually turns south on 192 Street to connect to the planned greenway in East Clayton via 90 Avenue.

Other proposed new off-street multi-use pathways include:

- 92 Avenue in Tynehead neighbourhood;
- North-south connection between the commercial centre in Tynehead to 92 Avenue;
- Off-street path on Ridgeline Drive Overpass;
- North-south path east of Highway 15 between Golden Ears Way and the local street just south of 92 Avenue, continuing east to 180 Street;
- Off-street path along the southern edge of the Business Park connecting to 90 Avenue.

File Name

N

Pedestrian / Cycle Overpass on Highway 1, works to be completed by City of Surrey

Off-Street Multi-use path to be constructed by Metro Vancouver

Configuration of pathway and bike lanes subject to further study

Legend

- Marked Bike Lanes (1.8m - City Arterial Standards)
- Marked Bike Lanes (1.7m - City Collector Standards)
- Off-Street Multi-Use Paths (4.0m Path and 6.0m ROW - City Standards; Paved or Compacted Granular Surface)
- Green Timbers Greenway
- Port Kells Greenway
- Paved Shoulders
- Potential Pedestrian / Bicycle Signal
- Bike Lanes on Golden Ears Way
- Local Street Bike Routes

Anniedale-Tynehead Land Use

Tynehead Regional Park

Employment

Commercial

Community Centre

Employment

96

92 Ave

88

ALR

ALR

80 St

189 St

192

Riparian Enhancement Area

Serpentine Study Area

Sanitary Pump Station

Legend LandUse Road Class Node Type

Figure 5.14

Preliminary Bicycle Network Plan

Anniedale / Tynehead Stage One NCP Road Network Study, Surrey BC
4027.15 July 2011 Scale NTS

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5.3.5 Transit Network Plan

TransLink Transit Service Planning representatives were consulted during the initial planning process for the Anniedale- Tynehead NCP, as well as after Council approval of the Stage One NCP Land Use Plan, to discuss potential transit services in the study area. **Figure 5.15** shows a proposed transit service plan for the Anniedale-Tynehead neighbourhood which reflects the outcome of these consultations with TransLink staff. This plan shows both routes and potential bus stops and major transfer points.

Actual routing of transit services will ultimately be selected and implemented by TransLink and Coast Mountain Bus Company in consultation with the City of Surrey. Also, bus stop/transfer locations are illustrative only and highly preliminary. Finally, the timing of provision of these services will also be controlled by TransLink but generally would follow the progress of neighbourhood redevelopment after thresholds for anticipated ridership are met.

The following provides a brief summary of each of the routes identified in the draft transit plan:

- 388 Service| 88 Ave via 96 Ave – Existing services to be re-routed to travel along 96 Avenue;
- 396 Service| 96 Ave via 88 Ave – Revised South of Fraser Area Transit Plan (SoFA) routing to use existing roads;
- N-C25 Service| 189 St via 94 Ave – The South of Fraser Area Transit Plan identified a community/local route that connects Anniedale and the Walnut Grove transit exchange in Langley. It is suggested this route be modified to provide service between Tynehead, Clayton, and Cloverdale;
- 501 Service| Surrey Central to Langley Centre, BRT – Revised SoFA routing to reflect the future construction of a highway underpass at Barnston Drive;
- 392 Service| 192 St via 92 Ave – A new express route proposed from Langley Town Centre to Guildford BRT Station that runs through heart of East Clayton and Anniedale, and offers express service to Guildford via Highway 1.

File Name

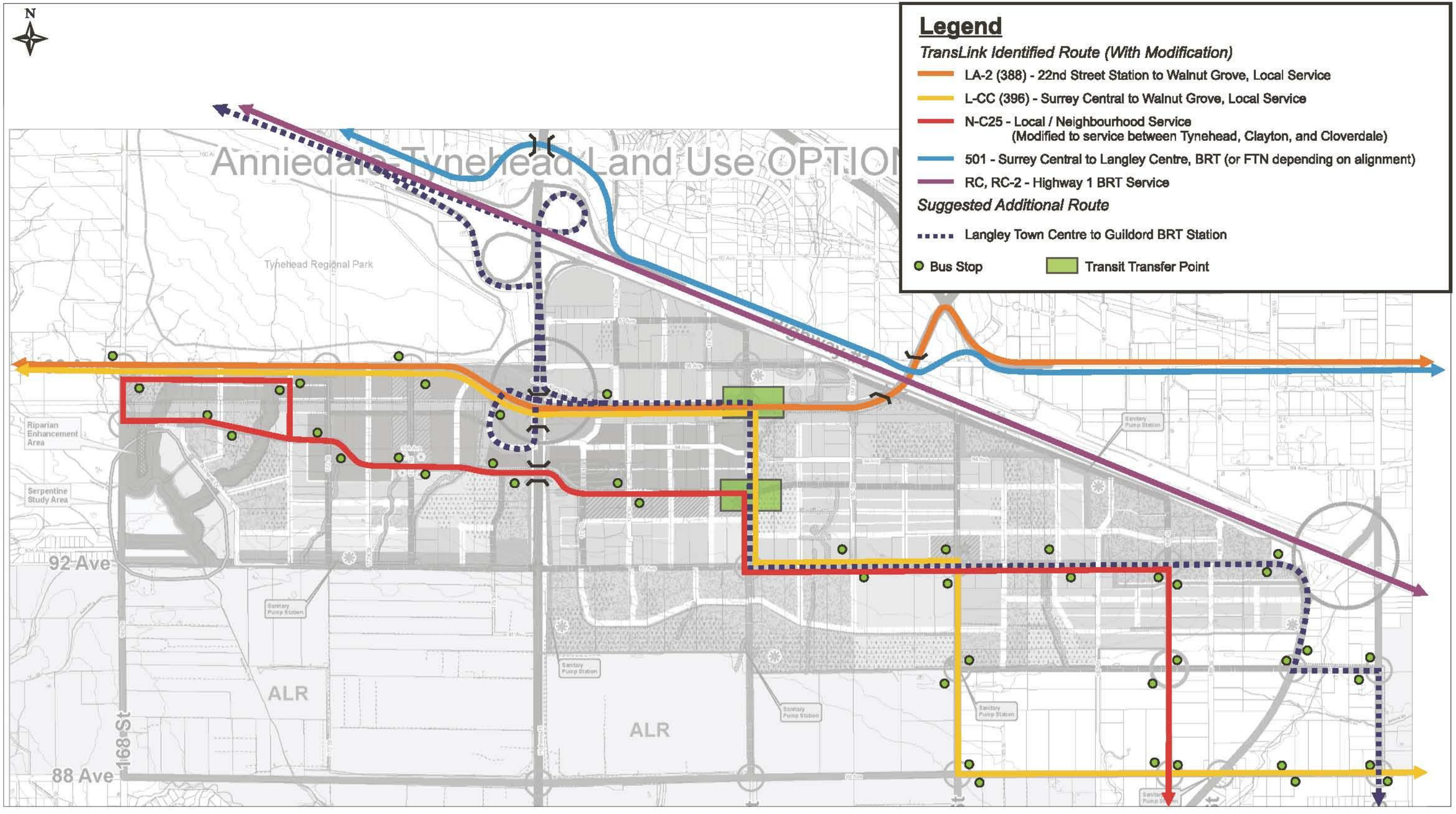

Figure 5.15

Preliminary Transit Network Plan

Anniedale / Tynehead Stage One NCP Road Network Study, Surrey BC
4027.15 February 2011 Scale NTS

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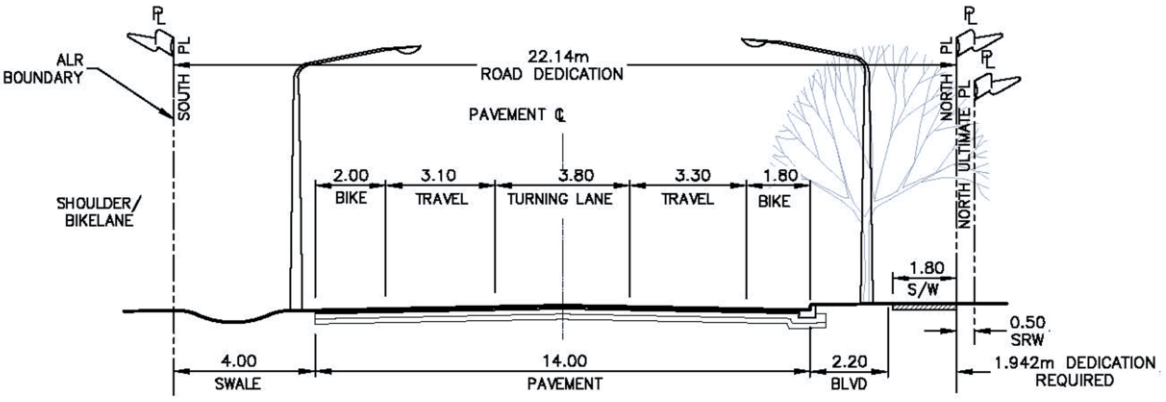
5.3.6 Road Cross Sections

Typical road cross sections in Anniedale Tynehead will adhere to the City standards for Arterial, Collector, and Local roads. However, there some cross sections required for the NCP, which were developed in recognition of unique conditions, and are identified in **Table 5.6** below.

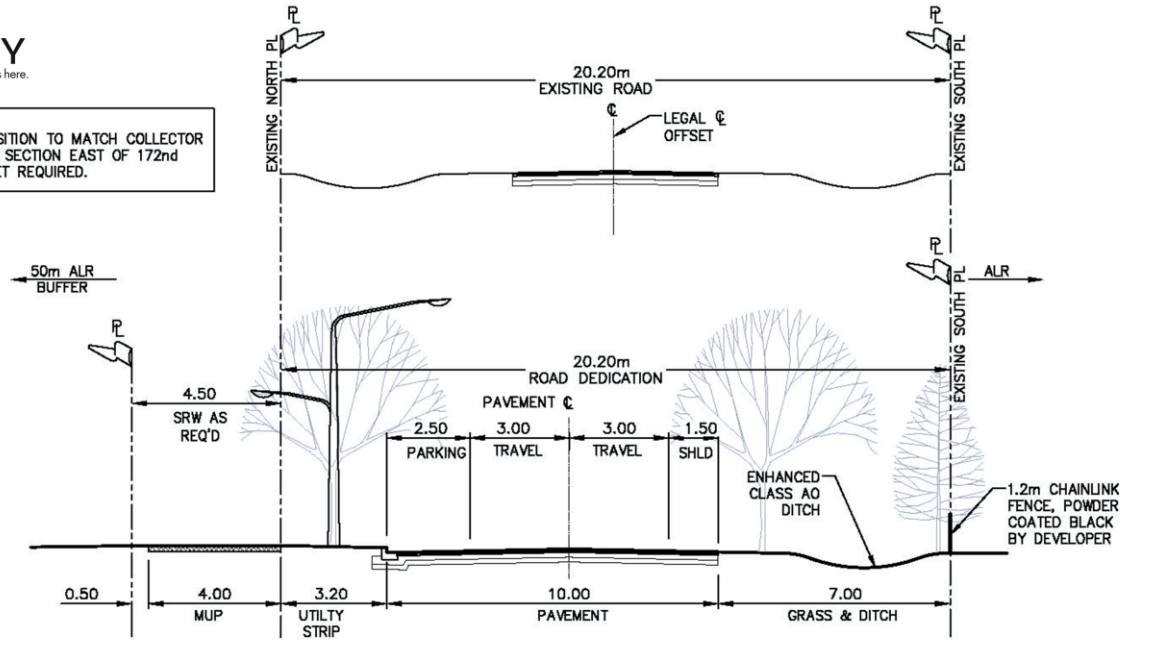
Table 5.6 - Anniedale-Tynehead NCP - Typical Road Cross Sections

ANNIEDALE-TYNEHEAD ROAD CROSS SECTIONS
A-A | "Ridgeline Dr" – 16900 Block 94A Ave – Collector
B-B | 92 Avenue – 172 Street to Bothwell – Local
C-C | 92 Avenue – 172 Street to 176 Street – Collector
D-D | 95 Avenue – Collector in Tynehead
E-E | 175 Street – Collector Adjacent to Park
F-F | Lakiotis Drive – Local
G-G | Anniedale Road – Collector
H-H | 180 Street – Arterial
I-I | 92 Avenue – Arterial
J-J | 186 Street – 91 Avenue to 92 Avenue – Local
K-K | 90 Avenue – 18500 Block to 187 Street – Collector
L-L | Lane south of 92 Avenue
M-M | 172 Street, 177 Street & 93A Avenue (Ridgeline Dr) – Collector with MUP



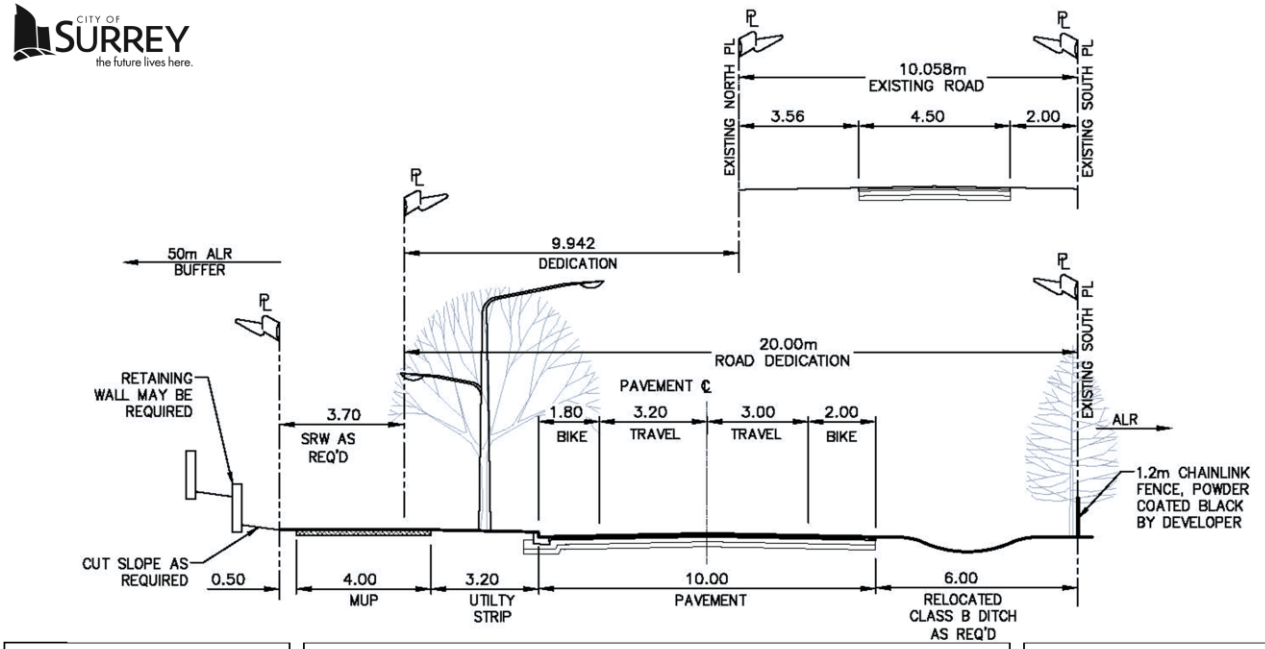
Anniedale-Tynehead NCP	Ridgeline Drive 94A Ave 168 St – 16900 Block	Cross Section AA

Reduced total dedication width, and open drainage swale requirements next to ALR boundary



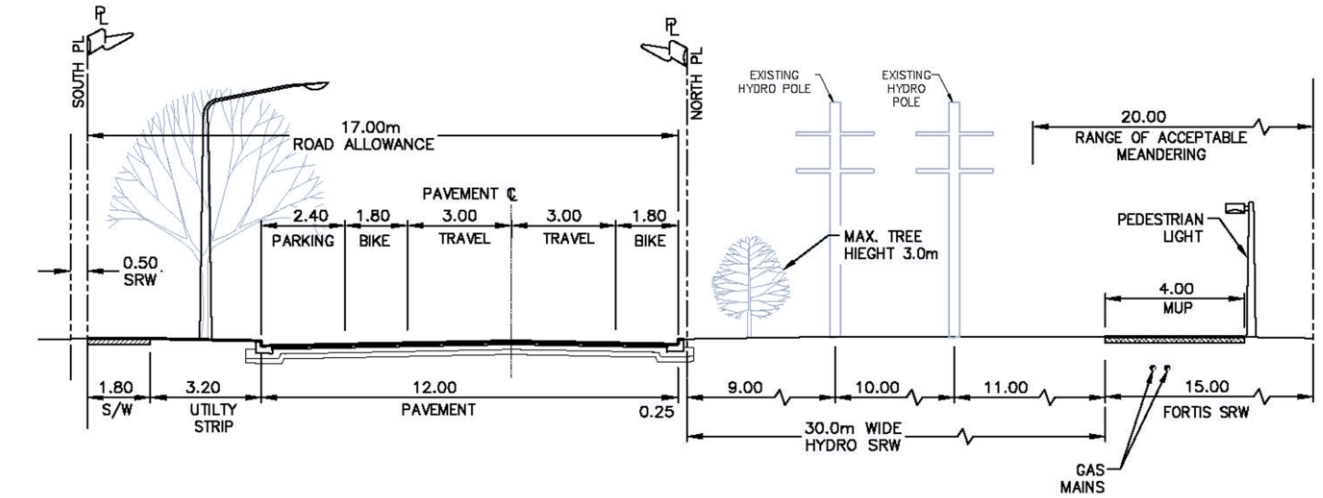
Anniedale-Tynehead NCP	92 Avenue 172 Street - Bothwell	Cross Section BB

Paved shoulder and improved Class AO ditch adjacent to the ALR boundary, plus continuation of next-to-road 4.0m wide Multi-Use Pathway



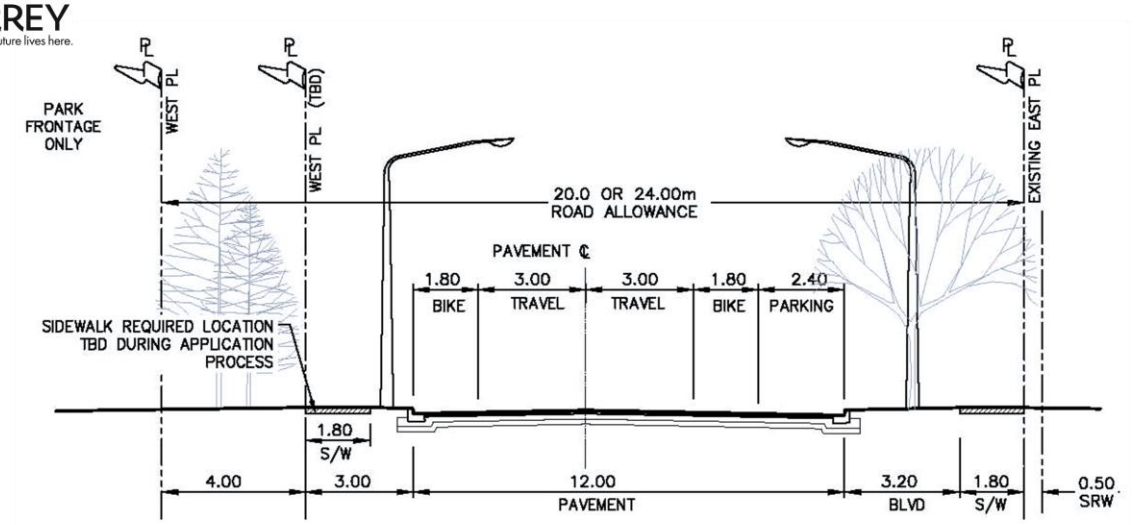
Anniedale-Tynehead NCP	92 Avenue 172 Street – 176 Street	Cross Section CC

Revised pavement location, and reduced pavement width with no on-street parking, to reflect existing offset 10.0m road allowance, anticipated Class B Ditch adjacent to ALR, plus continuation of next-to-road 4.0m wide Multi-Use Pathway, while minimizing road dedication requirements.



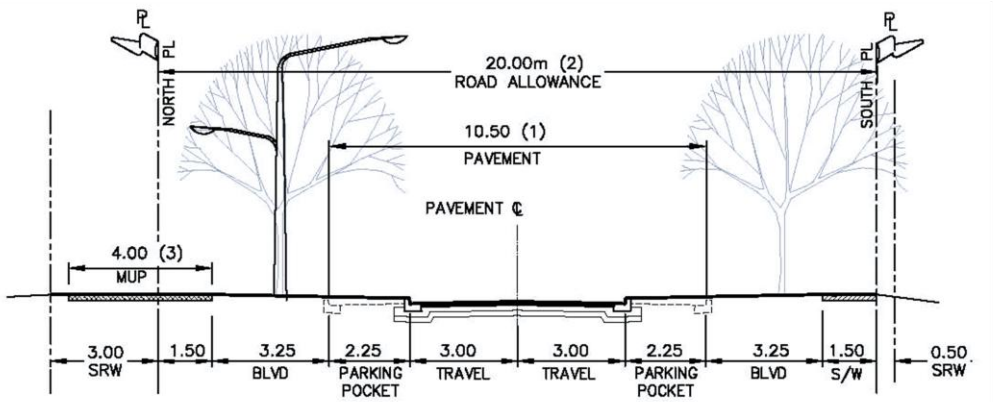
Anniedale-Tynehead NCP	95 Avenue Collector - Tynehead	Cross Section DD

Reduced pavement width, with parking one side only, that will minimize road allowance requirements, and to reflect approximate location of utilities corridor and MUP location



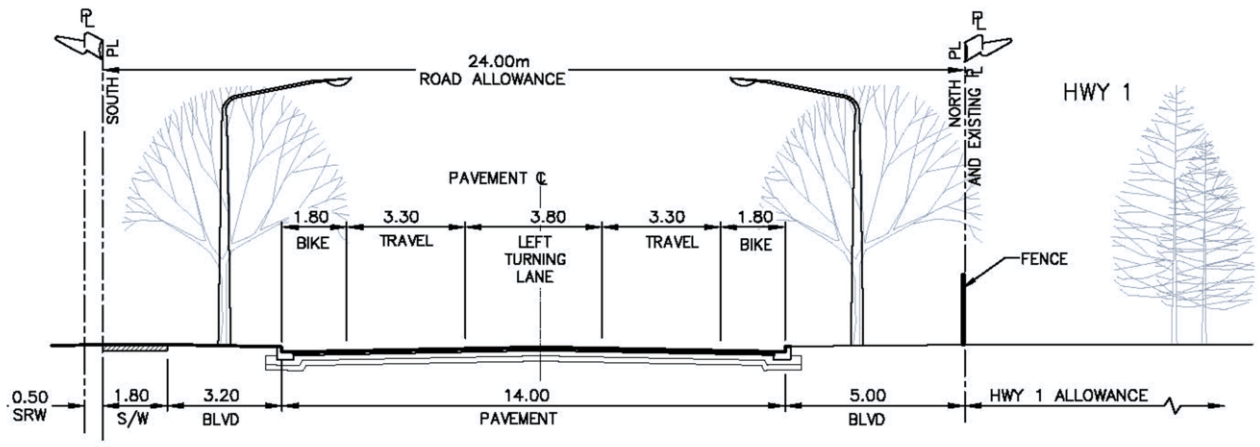
Anniedale-Tynehead NCP	175 Street Collector	Cross Section EE

Reduced pavement width in order to minimize road allowance requirements, and maximize significant tree retention with sidewalk potentially meandering into Park.



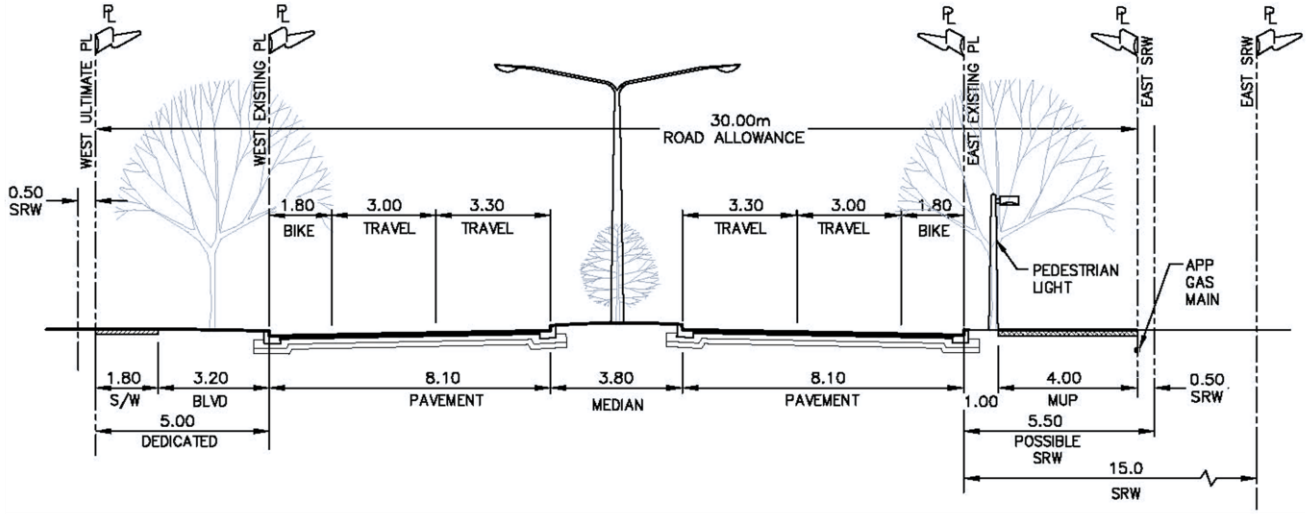
Anniedale-Tynehead NCP	Lakiotis Drive – 91 Avenue Local	Cross Section FF

Unique local road with adjacent 4.0m wide MUP, and parking both sides, with alignment through park that will have reduced road allowance and pavement width and potential for meandering and narrowing for shorter pedestrian crossing distance opportunities.



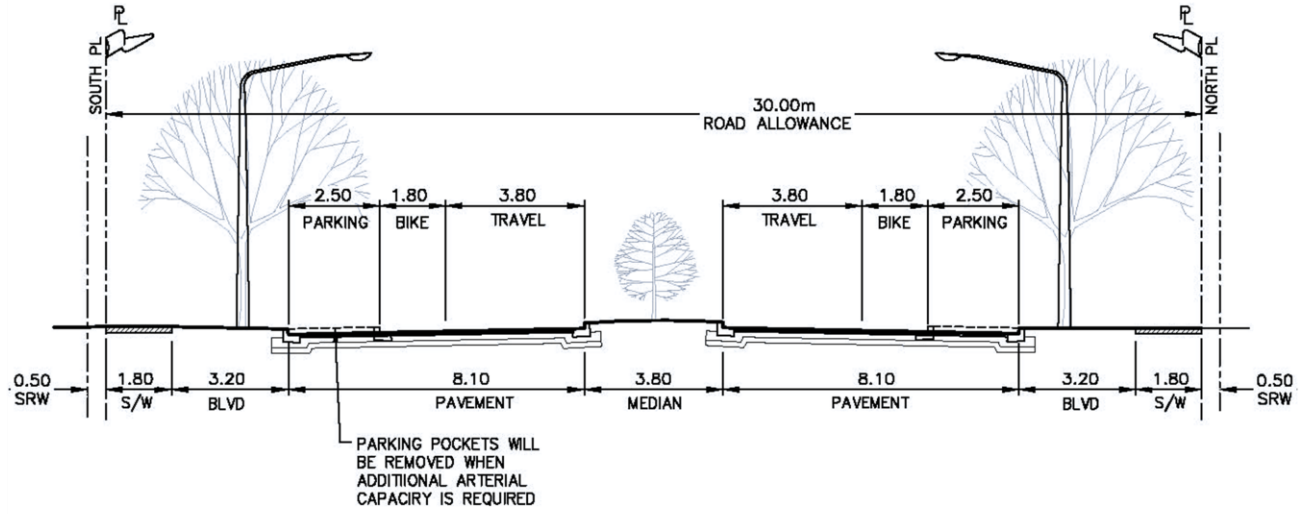
Anniedale-Tynehead NCP	Anniedale Road Collector	Cross Section GG

Industrial/Business Park service road with no sidewalk adjacent to Highway 1, replaced with potential for additional landscaping and fencing as required.



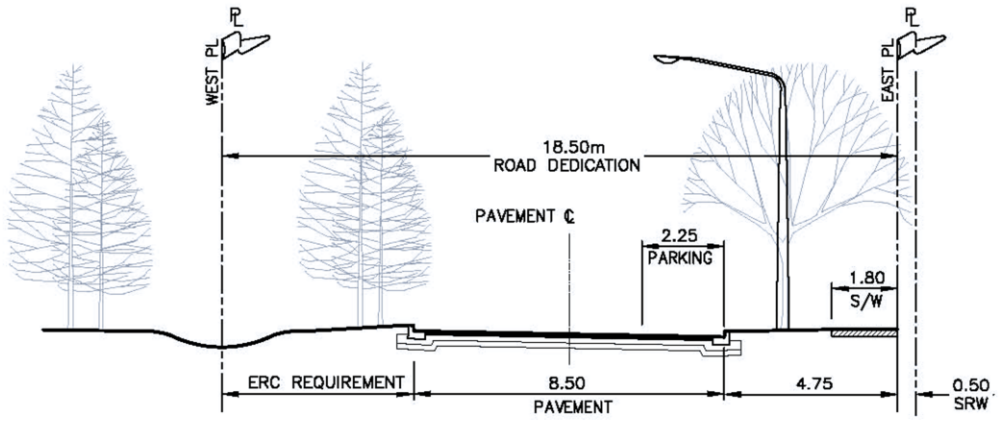
Anniedale-Tynehead NCP	180 Street Arterial	Cross Section HH

Arterial road dedication requirements off-set from existing Fortis Gas corridor and with 4.0m wide MUP in corridor.



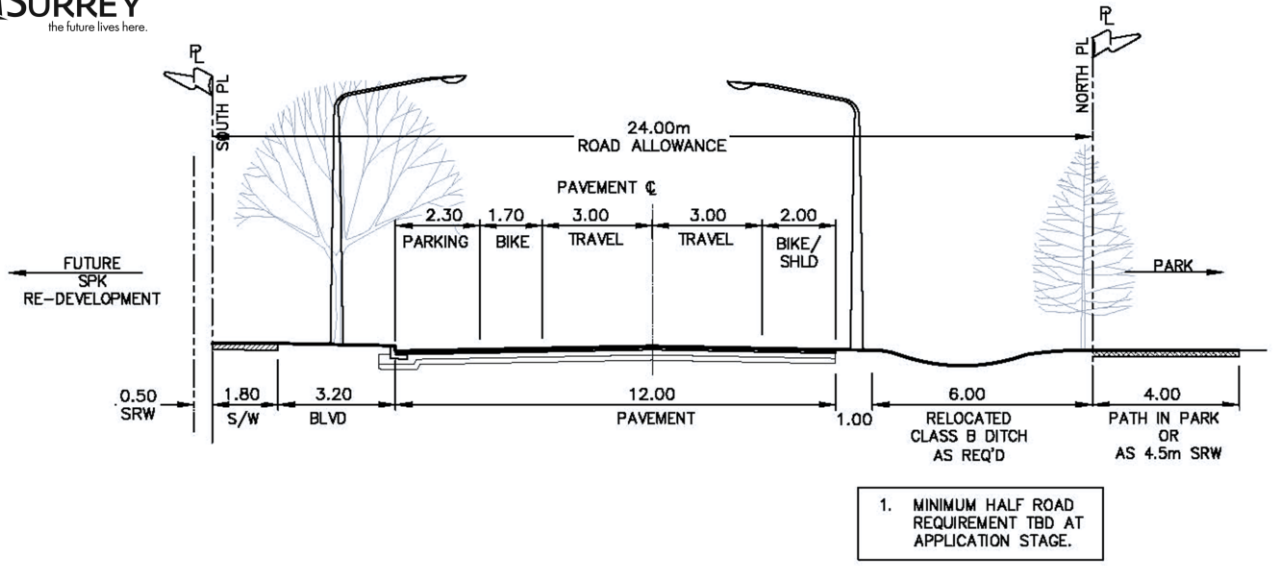
Anniedale-Tynehead NCP	92 Avenue Arterial	Cross Section II

Interim arterial with permitted on-street parking, and curb extensions that may be removed should traffic demands on 92 Avenue warrant additional on-street capacity.



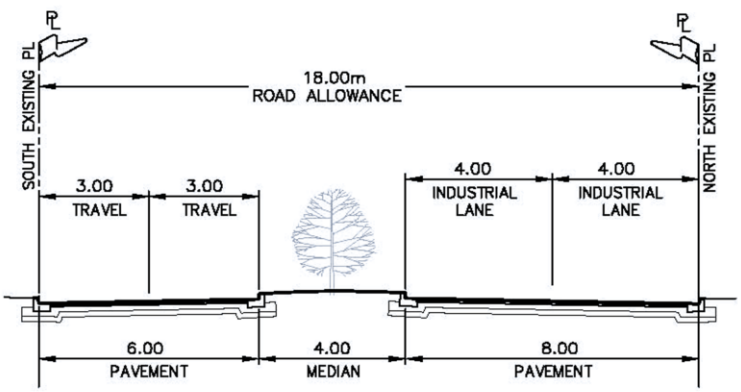
Anniedale-Tynehead NCP	186 Street 91 Avenue – 92 Avenue	Cross Section JJ

Reduced dedication and pavement width in order to protect existing Class B watercourse.



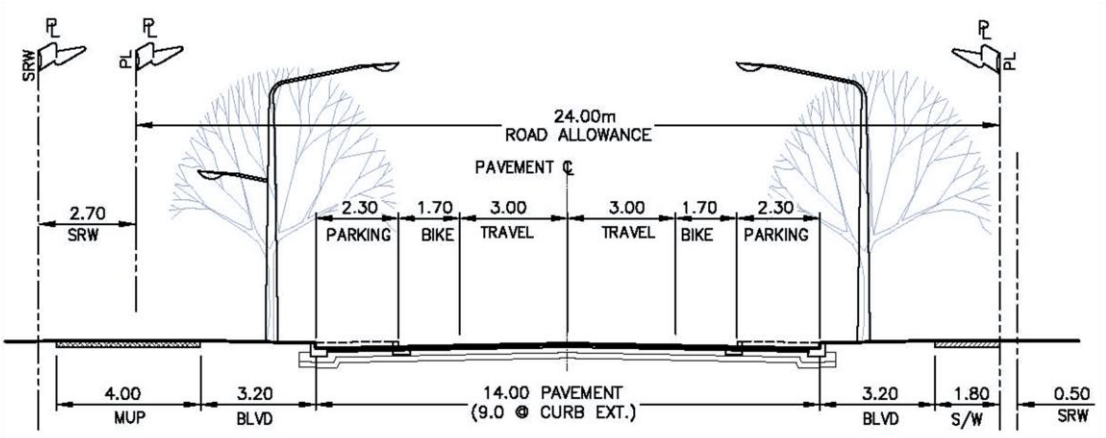
Anniedale-Tynehead NCP	90 Avenue 18500 Block – 187 Street	Cross Section KK

Reduced pavement width with parking one-side only for protection of exiting Class B watercourse, and MUP alignment in Park.



Anniedale-Tynehead NCP	Lane South of 92 Avenue 92 Avenue - Arterial	Cross Section LL

Separate residential and industrial lanes with 4.0m median buffering between land uses.



Anniedale-Tynehead NCP	172 Street, 177 Street and 93A Avenue Collector with Multiuse Pathway (MUP)	Figure

Typical next to road 4.0m wide MUP requirements.

5.4.0 TEN YEAR SERVICING PLAN AND INFRASTRUCTURE COSTS

The cost estimates for the transportation infrastructure needed for the servicing of the NCP are based on the principle that development is responsible for funding the local road and collector roads that fronts and/or are adjacent to the development lands. Because there is a higher standard for collector roads compared to local roads an upsizing approach has been utilized with the additional cost component of the higher standard being included as a DCC eligible item.

There are also collector road needs that do not front development lands or need to be funded on a wider area DCC basis, such as the collector road overpasses, Industrial Road at Golden Ears Way and 94 Avenue at Highway 15, where a component of the costs of these structures has been allocated to the NCP. There are certain other critical collector road needs the costs of which have been assigned to the overall NCP. Total Non-Arterial DDC eligible infrastructure costs are estimated at **$21,500,000**.

Arterial Road needs are usually treated on an overall City wide basis due to the fact that the impact of traffic is spread over a larger area than an individual NCP. However, because of the particular transportation challenges faced by this NCP a detailed assessment of the arterial road needs compared with the DCCs generated has been carried out. This assessment has looked at the proportionate impact on the arterial road system that this NCP generates and assigned that proportionate share to the cost of the infrastructure needed. Total Arterial DCC eligible infrastructure costs are estimated at **$75,000,000**.

Cost estimates for the transportation servicing requirements are shown in Appendix A.

Current Projects on the 10 Year Servicing Plan

There is one project identified in the 10 Year Servicing Plan that fall within the study area. Project ID 7648 Traffic Signal at 88 Ave and 192 St is included as a Long Term, 7-10 year priority.

PART 6 SANITARY SEWER INFRASTRUCTURE

PART 6: SANITARY SEWER INFRASTRUCTURE

6.0 EXISTING AND FUTURE – SERVICING CATCHMENTS AND DETAILS

Existing System

There are no existing City sanitary systems within the Anniedale-Tynehead area. All existing lots with residential dwellings are currently serviced with private septic fields.

Previous Studies

The City of Surrey previously commissioned Earth Tech (Canada) Inc. (now AECOM) to complete the *South Port Kells Sanitary Service Concept Study* in November, 2006. The study presented four gravity sewer and four pump station / forcemain servicing options. The two servicing strategy options recommended by Earth Tech were identified as Options 2b and 2c (both pump station options).

Option 2b utilized three large pump stations to service the study area (one pump station to service Port Kells[1]). Option 2c utilized five pump stations to service the study area (one pump station to service Port Kells).

Option 2c was chosen as the preferred servicing option during Stage 1, as it provides more versatile servicing flexibility for progressive development. Option 2c serves as the foundation for servicing of the Anniedale-Tynehead area.

For Stage 2 works, a parcel level review of the local sewer system was completed to confirm the serviceability of all areas in the study area. Servicing strategy Option 2c has been modified slightly to incorporate the results of the local system review. In order to minimize the number and costs of pump stations servicing the Anniedale-Tynehead area, the originally proposed 180th Street Pump Station has been removed from the servicing strategy, resulting in a total of four pump stations servicing the study area (one pump station to service Port Kells). The servicing strategy is now referred to as Option 2c-ii.

[1] Port Kells is outside the Anniedale-Tynehead study area.

6.1 DESIGN CRITERIA AND ANALYSIS

Design Criteria

The City of Surrey Design Criteria Manual has been utilized for the establishment of the servicing criteria for this NCP. A summary of key applicable design criteria is presented below with some criteria modified, for the specific requirements of the NCP.

Sanitary Flows:

- Average daily sanitary flows of 350 L/cap/day
- Peaking factor as per Harmon's formula
- An Inflow and Infiltration rate of 11,200 L/ha/day

Gravity Interceptor and Trunk Sewer Systems (Q>=40 L/s):

- Manning's 'n' of 0.013 for all pipes
- Trunk and interceptor sewer flow shall not exceed 70% of internal diameter
- Minimum velocity (at 70% peak dry weather flow (PDWF)) of 0.6 m/s
- Pipe grades less than 0.5% may be used if velocity >= 0.6 m/s at 70% PDWF

Local Gravity Sewer Systems (Q<40 L/s):

- Manning's 'n' of 0.013 for all pipes
- Local sewer flow shall not exceed 50% of internal diameter
- Terminal sections of sanitary sewer, servicing 6 (or less) house service connections, shall have a minimum grade of 1.0%
- A sanitary sewer, servicing the 7th to 12th house service connections, shall have a grade of 0.6% or greater.
- A sanitary sewer, servicing the 13th house service connection (or more), shall have a grade of 0.5% or greater.
- Pipe grades less than 0.5% may be used if velocity >= 0.6 m/s at 70% PDWF
- Sewers to be installed at a nominal depth between 2.0 m and 3.5 m from finished ground surface to pipe invert.
- Depths up to 4.5m may be tolerated for short lengths (generally less than 40m)

Forcemain and Pump Station Systems:

- Pipe flow formula: Hazen Williams, with friction coefficient C=120 for capacity (C=140 for pump over-run)
- Minimum velocity of 1.0 m/s, maximum of 2.4 m/s (max of 1.6 m/s preferred)
- Minimum pump efficiency of 70%

- Pumps sized to convey greater of peak wet weather flow (PWWF) and governing velocity criteria
- Common forcemain sized assuming all pumps pumping simultaneously

Servicing Strategy

Figure 6.1 outlines the conceptual layout of the future trunk sewer system (Option 2c-ii). The figure also shows development areas within the Anniedale-Tynehead Study Area. Trunk infrastructure is color-coded by phase, which has been based on anticipated development phasing. It should be noted that trunk infrastructure phasing is contingent on development occurring as anticipated and presented in this report. Should the nature or rate of development growth differ than that presented forthwith, phasing of infrastructure will need to be reconfirmed. Development Phasing is discussed in further detail in subsequent sections.

The proposed trunk sewer system is comprised of a total of four pump stations within the Anniedale-Tynehead area and one station outside the study area, and a number of trunk gravity sewers and forcemains. All sanitary sewerage from the Anniedale-Tynehead area is conveyed to a proposed gravity trunk sewer on 173 Street which ties into the existing Metro Vancouver North Surrey Interceptor (N.S.I) Sewer at 104 Avenue and 173 Street. The local systems are comprised of gravity sewers that convey sewerage to the 4 pump stations, with the exception of 3 local areas, proposed to be serviced via Low Pressure Sewer (LPS). An LPS sewer system consists of common low-pressure forcemain(s) and individual or local pumps. The low-pressure forcemain ties into the gravity system.

Figures 6.2 to 6.5 outline the conceptual layout of the future local sewer system for each pump station catchment area, based on a serviced parcel - level review. The figures outline the layout of the sewer system, for which sewer alignments generally coincide with the proposed travel corridors throughout the study area. Anticipated pipe diameters and flow directions are shown on the figures. Flow results and associated calculations are discussed in subsequent sections. It should be noted that the proposed local sewer system shown on the above noted figures are based on existing lots, as well as the current proposed land use plan. Additional sewers may be required based on proposed future developments.

CITY OF SURREY
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Legend

PHASE GRAVITY FORCEMAIN

1
2
3
4
5

General Flow Direction

PS Pump Station

Anniedale / Tynehead Development Areas

Low Pressure Sewer Areas

Tie-In to Existing Metro Vancouver N.S.I.

Fraser Heights Pocket

Abby Ridge Catchment

Port Kells Industrial Catchment

Anniedale 'A' West 1

Anniedale 'A' West 2

Anniedale 'A' East 1

Anniedale 'B' 1

Anniedale 'B' 2

Anniedale 'B' 3

Anniedale 'B' 4

Tynehead

Port Kells

Potential ROW Required

172 ST PUMP STATION

176 ST PUMP STATION

184 ST PUMP STATION

187 ST PUMP STATION

189 ST PUMP STATION

Canadian National Rwy

No 1 Hwy

Barnston Dr W

Barnston Dr E

Tynehead Dr

Golden Ears Way

Greenway Dr

Highway 15

Harvie Rd

Daly Rd

Triggs Rd

Abbey Dr

Bothwell Dr

Wildwood Pl

Fruno Pl

Chestnut Pl

Cherryhill Cr

Tilbury Pl

Glenwood Cr S

Parkview Pl

650Ø (2-9)

600Ø (1-5)

400Ø (1-4)

400Ø (2-2)

400Ø (1-3)

500Ø (2-8)

400Ø (1-2)

375Ø (1-1)

375Ø (2-1)

375Ø (2-6)

375Ø (2-4)

375Ø (2-3)

250Ø (4-4)

250Ø (4-3)

450Ø (5-2)

450Ø (5-3)

300Ø (2-5)

300Ø (3-1)

400Ø (2-7)

600 Ø (4-2)

525Ø (4-1)

400Ø (5-1)

0 250 500 1,000
Metres

Anniedale/Tynehead NCP
Stage 2

Sanitary Servicing Option 2c-ii

Figure 6.1

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\Sanitary_Figures_Phase2\Figure 3.4-1 - Servicing Option 2c-ii.mxd Last revised by bpauls on 14/10/2011 at 10:46:17 AM

The proposed sewers shown here are based on existing lot layout; more sewers may be required based on proposed developments.

LPS-North Sub-Catchment

West Sub-Catchment

Center-West Sub-Catchment

Center-East Sub-Catchment

East Sub-Catchment

LPS-South Sub-Catchment

Center Sub-Catchment

South-East Sub-Catchment

172nd St Pump Station

94A Ave

96 Ave

92 Ave

168 St

172 St

173A St

175 St

PS

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Legend

- Major Culvert
- Potential Local Pumping Required
- Potential No Basement
- Pump Station
- Contour (2m)
- Critical Pipe Sections*
- Low Pressure System

Local Sanitary Mains

- 200mm
- 250mm
- 300mm
- 375mm

*Critical Sections include sewers with depths greater than 3.5m and sewers at culvert crossings of major watercourses.

Anniedale/Tynehead NCP Stage 2

172nd Street Sanitary Pump Station Catchment

Figure 6.2

0 50 100 200
Metres

U:\Projects_VAN\107201730\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\Sanitary_Figures_Phase2\Figure 3.4-2 - Colour - Pump Station Catchment 172nd St.mxd Last revised by bpauls on 03/02/2012 at 2:57:59 PM

The proposed sewers shown here are based on existing lot layout; more sewers may be required based on proposed developments.

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Legend

- Potential Local Pumping Required
- Contour (2m)
- Critical Pipe Sections*
- Low Pressure System

Local Sanitary Mains

- 200mm
- 250mm
- 300mm
- 375mm

*Critical Sections include sewers with depths greater than 3.5m and sewers at culvert crossings of major watercourses.

Anniedale/Tynehead NCP Stage 2

187th Street Sanitary Pump Station Catchment

Figure 6.3a

URBANSYSTEMS.

0 125 250 500
Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\Sanitary_Figures_Phase2\Figure 3.4-3a - Colour - Pump Station Catchment Anniedale.mxd Last revised by bpauls on 03/02/2012 at 2:46:39 PM

The proposed sewers shown here are based on existing lot layout; more sewers may be required based on proposed developments.

Barnston Dr E
Golden Ears Way
96 Ave
186 St
187 St
188 St
189 St
95A Ave
190 St
No 1 Hwy
94 Ave
184 St
92 Ave
168 St
189 St

Center-North Sub-Catchment

Center Sub-Catchment

187th St Pump Station

Center-East Sub-Catchment

South-West Sub-Catchment

East Sub-Catchment

LPS Sub-Catchment

049 048 047 041 040 039 016 015 014 017 003 002 034 026 025 018 084 085 090 097 091 098 028 027 021 020 019 013 009 008 004 001 099 029 024 023 022 012 010 005 086 092 033 031 032 011 007 006 088 087 095 094 093 096 089

Legend

- Potential Local Pumping Required
- PS Pump Station
- Contour (2m)
- Critical Pipe Sections*
- Low Pressure System

Local Sanitary Mains

- 200mm
- 250mm
- 300mm
- 375mm

*Critical Sections include sewers with depths greater than 3.5m and sewers at culvert crossings of major watercourses.

Anniedale/Tynehead NCP
Stage 2

187th Street Sanitary Pump Station Catchment

Figure 6.3b

0 125 250 500
Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\Sanitary_Figures_Phase2\Figure 3.4-3b - Colour - Pump Station Catchment Anniedale.mxd Last revised by bpauls on 03/02/2012 at 2:49:58 PM

The proposed sewers shown here are based on existing lot layout; more sewers may be required based on proposed developments.

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Legend

- Potential Local Pumping Required
- Pump Station
- Contour (2m)
- Critical Pipe Sections*

Local Sanitary Mains

- 200mm
- 250mm
- 300mm
- 375mm
- 525mm
- 600mm

*Critical Sections include sewers with depths greater than 3.5m and sewers at culvert crossings of major watercourses.

West Sub-Catchment

Center-North Sub-Catchment

North-East Sub-Catchment

East Sub-Catchment

South Sub-Catchment

176th St Pump Station

96 Ave

Golden Ears Way

No 1 Hwy

176A St

Barnston Dr E

180 St

93A Ave

92 Ave

89B Ave

184 St

Highway 15

Anniedale/Tynehead NCP
Stage 2

176th Street Sanitary Pump Station Catchment

Figure 6.4

0 50 100 200
Metres

The proposed sewers shown here are based on existing lot layout; more sewers may be required based on proposed developments.

Center-West Sub-Catchment

East Sub-Catchment

LPS Sub-Catchment

Center-East Sub-Catchment

Center Sub-Catchment

West Sub-Catchment

184th St Pump Station

189th St Pump Station

Allowance for Port Kells Pump Station

92 Ave

90 Ave

89B Ave

88 Ave

184 St

185 St

187 St

188 St

189 St

Harvie Rd

007 006 005 013 012 027 026 025 051 050 043 040 042 041 022 004 011 020 019 023 039 038 036 037 049 048 024 021 032 034 035 003 065 010 018 017 033 031 030 047 046 052 002 029 044 045 028 001 009 014 015 016 008

PS

Legend

- Potential Local Pumping Required
- Pump Station
- Contour (2m)
- Critical Pipe Sections*
- Low Pressure System

Local Sanitary Mains

- 200mm
- 250mm
- 300mm
- 375mm
- 525mm
- 600mm

*Critical Sections include sewers with depths greater than 3.5m and sewers at culvert crossings of major watercourses.

Anniedale/Tynehead NCP Stage 2

184th Street Sanitary Pump Station Catchment

Figure 6.5

URBANSYSTEMS.

0 50 100 200

Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\Sanitary_Figures_Phase2\Figure 3.4-5 - Colour - Pump Station Catchment 184th St.mxd Last revised by bpauls on 03/02/2012 at 3:10:36 PM

Model Analysis

The system capacity was assessed using a standard spreadsheet method using Manning's equation to size gravity mains, and using the Hazen Williams friction method to size forcemains.

All lengths are based on the latest land use plan, with manholes located at all pipe and road intersections. Additional mid-block manholes were placed in critical areas in order to better define anticipated pipe slopes and characteristics, as well as meet the maximum allowable distance of 150m between manholes. Pipe slopes and depths were estimated using existing ground elevations from LiDAR survey.

A conceptual finished ground was developed for assessing critical sections. This is discussed in the next section.

Table 6.1 presents anticipated phasing used to assess the system.

Table 6.1: Anticipated Development Phasing (2012)

Development	Implementation Year	Phase
Tynehead – commercial	2012 – 2015	1a
Tynehead – residential	2014 – 2018	1b
Anniedale A – West 1 **Anniedale A – East 1** **Anniedale B1**	2016 – 2024	2a*
Anniedale B4 **Anniedale A – West 2**	2016 – 2024	2b*
Anniedale B3	2025 – 2031	3
Anniedale B2	2031 – 2041	4
Port Kells	2041+	5

*2a or 2b could proceed before the other.

Analysis Results

Analysis results are presented in **Appendix B**, as well as **Figures 6.1 to 6.5**.

Population Estimates and Demands

Populations for the study area were calculated using parcel size and zoning densities as outlined in Table 2.6 of the City of Surrey Engineering Department Design Criteria Manual.

The future land use for the 171 ha Port Kells area (which is outside of the Anniedale-Tynehead study area, but part of the sanitary service area) is yet to be determined. However, for purposes of this sanitary review, potential flow from Port Kells was estimated using 2 different methods:

- Using 10 upa (units per acre) density with an occupation rate of 3.2 persons/unit (corresponding to the Guilford Area, as per section 2.6 in the City of Surrey Engineering Department Design Criteria Manual)
- Using 89 PPha (corresponding to RF-12 SF Residential as per section 2.6 in the City of Surrey Engineering Department Design Criteria Manual)

The developable area was reduced to 60% of the total area, to account for RoWs, parks, etc. The resulting equivalent populations for each method were 8,100 and 9,100 persons, respectively. The average population of 8,600 persons was used in the analysis.

The total equivalent build out population is presented in **Table 6.2** below and categorized by Pump Station Catchment. Unit rates as specified above were applied to the populations to determine respective demands for each catchment.

PDWF was estimated using the Harmon peaking factor equation.

Table 6.2: Population and Catchment Flow Summary for Land Use Option

Pump Station Catchment	Development Areas	Total Equiv. Population	Gross Land Area (ha)	ADWF (L/s)	Peaking Factor (Harmon's)	PDWF (L/s)	I&I (L/s)	PWWF (L/s)
Anniedale PS	Anniedale A – West 1 Anniedale A – East 1 Anniedale B1	8082	105.1	32.7	3.05	99.7	13.6	113.3
184th St PS	Anniedale B2	3621	54.5	12.8	4.09	52.4	6.0	58.4
176th St PS	Anniedale B3 Anniedale B4 Annidale A – West 2	10674	125.1	43.2	2.93	126.6	16.2	142.8
172nd St PS	Tynehead	6661	121.0	25.4	3.49	88.6	13.7	102.3
Port Kells PS	Port Kells	8600	171.0	34.8	3.02	105.2	22.2	127.4
TOTAL		**37,638**	**376.7**	**148.9**				

6.2 SERVICING OPTIONS, PROPOSED SYSTEM AND COSTS

Local System

The majority of the system can be adequately serviced using 200 mm gravity mains, and have sufficient slope and flow to achieve the required cleansing velocity. Where cleansing velocity cannot be achieved, sewers have been proposed at minimum slopes per the design criteria as outlined in **Section 6.1**. Where parcels could not be serviced via gravity sewers, a Low Pressure Sewer (LPS) system is proposed. These areas are identified on **Figures 6.2 to 6.5**. The LPS systems tie into the gravity system and eventually to one of the four pump stations.

The figures also highlight critical sections of sewer that require further review at design stages. These critical sections include: sewers with depth greater than 3.5 m and sewers at culvert crossings for major watercourses. Profiles of the critical sections are provided in **Appendix B**. Although minimum required grades of 1.0% and 0.6% have been achieved for upstream most sections of sewer, these sections have not been included in the critical section figures for simplicity.

Critical sections of sewer also include conceptual finished ground elevations based on an assumed adjustment of the local ground elevations. It should be noted that the conceptual finished ground elevation does not take into account any review of road profiles or geometry, and is considered conceptual only.

All profiles of the proposed sewers have been based on existing topography, which is considered as the best available information, in the absence of preliminary road profiles. As such, all sewer profiles should be reconfirmed after road profiles have been developed.

Trunk System

As the timing of development of all phases is unclear at this time, it is recommended that all infrastructure sizing be reconfirmed at the time of detailed design. It is recommended that all forcemains with velocities > 1.6 m/s and below 1.0 m/s be reviewed again at the detailed design stage. Also, transient analyses will be required before the detailed design of any pump systems, including forcemains and surge attenuation measures.

Costs

Detailed costs are provided in **Appendix B** for reference. **Table 6.3** below summarizes the DCC expenditures on eligible works in the NCP Area for each phase of development, as outlined in previous sections. Costs associated with servicing of the Port Kells area have been omitted.

Table 6.3: DCC Expenditure on Eligible Works in the NCP Areas

Development	Cost
Phase 1	$ 8,800,000
Phase 2	$ 12,800,000
Phase 3	$ 300,000
Phase 4	$ 6,900,000
TOTAL	***$ 28,800,000***

Proposed System Infrastructure Phasing

As noted previously, servicing strategy Option 2c-ii (as shown on **Figure 6.1**) is the preferred sanitary system for Anniedale-Tynehead, due to the servicing flexibility congruent with development growth. Phasing of works is anticipated to follow the phasing as outlined in **Table 6.1**. Based on the anticipated phasing, the following sections outline in general terms, all major infrastructure required prior to development of each major phase. Refer to **Figure 6.1** and **Table 6.3** and **Appendix B** for additional details. Note that all forcemains are assumed to be HDPE (High-Density Polyethylene).

Table 6.4: Phase 1 - Tynehead

The following new infrastructure is required prior to development of Phase 1:

Description	Ref. No.	Nominal Dia. (mm)	Inside Dia. (mm)	Length (m)	Force Main DR-Class
Tynehead Trunk Sewer	1-1	375	375	355	-
Tynehead Forcemain	1-2	400	343	835	13.5
Tynehead – Anniedale Forcemain	1-3	400	343	980	13.5
South Port Kells Forcemain	1-4	400	343	1150	13.5
Tynehead Pump Station (172 St. PS)	-	-	-	-	-
South Port Kells Trunk Sewer	1-5	600	600	800	-

Table 6.5: Phase 2

2a: Anniedale A – West 1, Anniedale A – East 1, Anniedale B1

2b: Anniedale B4, Anniedale – West 2

The following new infrastructure is required prior to development of Phase 2:

Description	Ref. No.	Nominal Dia. (mm)	Inside Dia. (mm)	Length (m)	Force Main DR-Class
Anniedale A Trunk	2-1	375	375	1000	-
Anniedale A Forcemain	2-2	400	356	2140	17
Anniedale B4 Trunk – 1	2-3	375	375	265	-
Anniedale B4 Trunk – 2	2-4	375	375	390	-
Anniedale B3 Trunk – 2	2-5	300	300	690	-
Anniedale B3 Trunk – 3	2-6	375	375	135	-
Anniedale B4 Forcemain	2-7	400	343	200	13.5
Tynehead – Anniedale Forcemain Twin	2-8	500	428	980	13.5
South Port Kells Forcemain Twin	2-9	650	557	1150	13.5
Anniedale Pump Station (187 St. PS)	-	-	-	-	-
Anniedale B4 Pump Station (176 St. PS)	-	-	-	-	-

Twinning of the Tynehead – Anniedale Forcemain and South Port Kells Forcemain is based on the concurrent pumping from both the 172nd Street Pump Station and 176th Street Pump Station. As such, twinning of the forcemains should be completed prior to development proceeding beyond Phase 1.

Table 6.6: Phase 3 - Anniedale B3

The following new infrastructure is required prior to development of Phase 3:

Description	Ref. No.	Nominal Dia. (mm)	Inside Dia. (mm)	Length (m)	Force Main DR-Class
Anniedale B3 Trunk – 1	3-1	300	300	220	-

Table 6.7: Phase 4 - Anniedale B2

The following new infrastructure is required prior to development of Phase 4:

Description	Ref. No.	Nominal Dia. (mm)	Inside Dia. (mm)	Length (m)	Force Main DR-Class
Anniedale B2 Trunk – 1	4-1	525	525	310	-
Anniedale B2 Trunk – 2	4-2	600	600	770	-
Anniedale B2 Forcemain	4-3	250	236	1320	15.5
Anniedale B Forcemain	4-4	250	236	850	15.5
Anniedale B2 Pump Station (184 St. PS)	-	-	-	-	-

Table 6.8: Phase 5 - Port Kells

Note: This phase is outside the current NCP study area. The following information is provided to illustrate the future impact to the planned infrastructure within this NCP. Details of all proposed infrastructure within this NCP need to be reviewed once the land use of the Port Kells area has been finalized.

The following new infrastructure is required prior to development of Phase 5 (note that Port Kells is located outside of the NCP area):

Description	Ref. No.	Nominal Dia. (mm)	Inside Dia. (mm)	Length (m)	Force Main DR-Class
Port Kells Forcemain	5-1	400	380	530	32.5
Anniedale B2 Forcemain Twin	5-2	450	395	1320	15.5
Anniedale B Forcemain Twin	5-3	450	395	850	15.5
Port Kells Pump Station (189 St. PS)	-	-	-	-	-

Twinning of the Anniedale B2 Forcemain and Anniedale B Forcemain is based on full development of Phase 5. As such, twinning of the forcemains should be completed prior to development proceeding beyond Phase 4. In addition, development of Port Kells may also require further upgrades to both the Tynehead – Anniedale Forcemain and the South Port Kells Forcemain. This will need to be confirmed prior to the development of Port Kells. A review will be required to confirm the flow anticipated from the future 189 Street Pump Station.

Refer to **Part 7.2** regarding Environmental Considerations and approvals when designing the proposed system.

6.3 TEN YEAR SERVICING PLAN AND INFRASTRUCTURE COSTS

The required sanitary system will comprise the following three major components: upsizing of mains to achieve sizes greater than the base 200mm (base 250mm in industrial areas), trunk sewers for flows greater than 40 L/s, and force mains and lift stations to carry flow from the Anniedale-Tynehead NCP catchment to the North Surrey Interceptor extension. The works have been divided into five Phases. The first 4 Phases will service the Anniedale-Tynehead NCP and the 5th phase of works will include the Port Kells area.

Consistent with current practice, developers will be required to fund frontage works, including costs associated with 200 mm or 250mm 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.

The estimated DCC eligible infrastructure costs for the gravity sewers, force mains and pump stations (including RoW costs for the force main, land costs for the pump station, and engineering and contingency costs) to service the Anniedale-Tynehead catchment area Phases 1 to 4 is **$28.8 million**. The Phase 5 works include the 189th Street pump station and force mains that serve the future Port Kells development. This area is currently suburban and un-sewered; consequently, until this area completes a land use plan to a greater level of certainty, no contribution from these areas can be relied on at this time.

Current Projects in the 10 Year Servicing Plan

There are no projects currently identified in the 10 Year Servicing Plan that fall within the sanitary sewer study area.

PART 7 STORMWATER INFRASTRUCTURE

Photo: Detention Pond and Park in East Clayton, Surrey

PART 7: STORMWATER INFRASTRUCTURE

7.0 EXISTING AND FUTURE – SERVICING CATCHMENTS AND DETAILS

General Description of Study Area

The proposed Anniedale-Tynehead Neighbourhood **(see Figure 7.1)**, covering an area of approximately 415 hectares, lies across a broad east to west trending ridge. The north side of the ridge (approximately 30% of the neighbourhood) drains towards the Fraser River via the Parsons Channel, while the south side of the ridge (approximately 70% of the neighbourhood) drains towards the Serpentine River **(see Figure 7.2)**. The north-eastern and southern parts of the study area are slightly steeper than the rest of the neighbourhood area. Overall, the average slope within the neighbourhood area ranges between 0% and 10%.

Numerous natural and artificial watercourses are present in Anniedale-Tynehead **(Figure 7.2)**. Many of these, including a number of roadside ditches, have identified fish habitat value, due to the presence (or potential presence) of fish (both salmonid and non-salmonid). A number of other watercourses have designated value as sources of food and nutrients to downstream fish populations. In addition, both the Fraser and Serpentine Rivers, to which runoff from the neighbourhood ultimately discharges, are fisheries. In addition to controlling runoff to prevent flooding and loss of property and life, runoff control must address maintenance of these fisheries resource values.

Land Use – Existing and Proposed Future

Currently the land of the proposed Anniedale-Tynehead neighbourhood is predominantly low density residential area with open spaces, large trees and pastures. As shown on **Figure 7.3**, most of the existing residential development (approximately 80%) falls within the One-Acre Residential Zone (RA), which permits one single-family residence on suburban lots of one acre or larger. The maximum allowable lot coverage of all buildings and structures is 20%. This zone also permits agricultural and horticultural uses on lots that are at least 5 acres.

Approximately 20% of the study area is currently zoned as General Agricultural area (A-1). The A-1 Zone permits agricultural uses (as well as a single family dwelling) on lots that are at least 5 acres in size. Lot coverage of buildings and structures is generally limited to 10%.

Two other zones are also present, covering only a small fraction of the area. Two lots fall into the Assembly Hall 1 Zone (PA-1), one being a church and the other a community centre. A single lot, in the northeast corner of Highway 15 and 96th Avenue, is designated as Comprehensive Development Zone (CD); the site supports a convenience store and office space.

Future land development within the Study Area will be guided by this Anniedale-Tynehead NCP, which generally envisions a mix of low density, medium and medium high density residential developments and commercial/industrial employment centres. A high density residential area is proposed to the south side of the Golden Ears Way between 176th Street and 180th Street. As shown on the NCP map, the north and northeast portions of the neighbourhood are proposed for (light) industrial development. Several small village commercial areas are proposed within the neighbourhood, though the bulk of

commercial development will be located south of 96 Avenue just west of Highway 15 (176 Street). As shown on the proposed land use map; the NCP also identifies significant areas of parks, trails, buffers and riparian zones to protect environmentally sensitive areas and preserve natural areas. Refer to the Land Use Plan discussed in Part 1, for details.

Overall, when compared with the current land use conditions, the proposed land use condition will decrease open space area, especially wooded areas, and increase the total amount of impervious (or "hard") surface within the area. If unmitigated or unmanaged, this will result in increased runoff, which will also carry greater levels of non-point source pollutants, than under existing conditions; this in turn will impact the receiving watercourses and could cause flooding, water quality problems or erosion downstream of the neighbourhood. The proposed servicing plan, as discussed in more detail in subsequent sections, will address these issues in order to maintain the area's watershed health and prevent loss of property or life.

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Legend

- Road
- Freeway
- Waterways
- Waterbodies
- City of Surrey Boundary
- Study Area

Anniedale/Tynehead NCP Stage 2 - Drainage

General Location Map

Figure 7.1

URBANSYSTEMS.

1:70,000

0 1,250 2,500 5,000

Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\StormwaterFigures_Phase2\Figure 3.3-1 - General Location Map.mxd Last revised by: bpauls on 26/09/2011 at 11:40:25 AM

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Legend

Watercourse Classifications

- Class A (red-coded): Year-round salmonid presence. Non-salmonid species also present.
- Class A(O) (red-dash): Inhabited during overwintering periods by salmonids. Non-salmonid species present year-round.
- Class B (yellow-coded): Provides food and nutrient value to downstream fish populations. No potential for fish presence.
- Class C (green-coded): No fish presence. Does not provide food and nutrient value to fish bearing watercourses.
- Unclassified
- Contours - 5m
- Major Watershed Divide
- NCP Boundary

Areas draining to Fraser River

Areas draining to Serpentine River

168 St
Barnston Dr W
No 1 Hwy
176 St
100 Ave
Leoran Brk
Fraser River
Canadian National Rwy
98 Ave
Barnston Dr E
96 Ave
Golden Ears Way
182 St
92 Ave
90 Ave
Bartasko Brk
Lakiotis Crk
Serpentine River
Highway 15
88 Ave
Swanson Brk
Lakiotis
184 St
Harvie Rd
Old Sawmill Creek
188 St
Latimer Crk

Anniedale/Tynehead NCP
Stage 2 - Drainage

Fisheries Overview

Figure 7.2

URBANSYSTEMS.

1:15,000

0 250 500 1,000
Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\StormwaterFigures_Phase2\Figure 3.3-2 - Drainage Overview.mxd Last revised by: bpauls on 26/09/2011 at 11:41:34 AM

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Legend

Open Channel

Zoning Classes

- Assembly Hall 1 Zone (PA-1)
- Comprehensive Development Zone (CD)
- General Agricultural Zone (A-1)
- One Acre Residential Zone (RA)
- NCP Boundary

Anniedale/Tynehead NCP
Stage 2 - Drainage

Current Zoning

Figure 7.3

URBANSYSTEMS.

1:15,000

0 250 500 1,000
Metres

Soils and Groundwater

Understanding local soils and hydrogeologic conditions is essential to understanding local hydrology and to assessing the applicability and design of certain stormwater control methods, specifically those that are infiltration-based.

Across the City of Surrey there are generally three dominant layers of sediments that lie beneath the land surface. These layers of sediment, deposited by past glaciers and other land-forming geological activity, control the groundwater conditions of the region. The top layer, named the "Capilano Sediments", is generally between 1 and 12 metres thick and consists of a mix of permeable and less permeable sediments. It is this sediment layer that is most critical to surface runoff and to stormwater systems; further discussion of this upper sediment layer is provided later in this section. Beneath the Capilano Sediments lie highly consolidated till, sand and gravel; this layer is called the "Vashon Drift". The layer is quite impermeable and generally restricts downward movement of percolated rainwater from the upper Capilano Sediments into an aquifer below located within the third dominant layer, called the "Quadra Sands". The Quadra Sands consist of glacial outwash sand and gravel materials; it is very permeable, with high groundwater storage capacity and high hydraulic conductivity.

In some areas of Surrey, the Quadra Sands are exposed yielding groundwater in the form of springs or seeps, but under the Anniedale-Tynehead neighbourhood it is not exposed and the Quadra Sands are considered a confined aquifer. (This confined aquifer extends beyond the neighbourhood, underlying much of Surrey.) Most rainwater that percolates into the upper Capilano Sediments will be constrained, though not entirely prevented, from percolating downward when it reaches the top of the Vashon Drift layer. Instead, it will tend to move laterally downslope, forming a shallow groundwater flux or movement. This flow will generally be confined to the top metre or so of soils. Some of this shallow groundwater flow will discharge into depressions, ditches and native watercourses, while some will feed springs that occur at lower slopes, particularly in the southern, south-facing part of the neighbourhood.

Soils characteristics of the Capilano Sediments vary within the neighbourhood, but the bulk of these soils tend to be moderately well to well drained, and rapidly pervious in the upper more gravelly part but only slowly pervious in the more dense subsoils[2]. Sampling undertaken for the NCP's environmental assessment indicated that sandy loams and silt loams represent approximately 48% and 43%, respectively, of soils in the area[3]. Sandy clay loam and silt clay loam textured soils are also observed in the area.

Poorly to very poorly drained soils are present in a few areas, notably in several low-lying areas along Highway 1, along the Serpentine River on the western part of the neighbourhood and just east of Highway 15 (176th) along the southern neighbourhood boundary. **Figure 7.4** shows the different soil types found in the area, categorized by general drainage (or percolation) characterization.

Those areas of the neighbourhood with moderately to well drained soils are candidates for the use of low impact runoff infiltration as a stormwater control method. Site specific conditions must be evaluated and found suitable before installing infiltration systems.

[2] Province of British Columbia. (1980). "Soils of the Langley-Vancouver Map Area", RAB Bulletin 18, Volume 3.

[3] Madrone Environmental Services. (2009).

If construction is carefully managed, the sandy to silty loam textured soils of the area are not necessarily prone to erosion or compaction; however erosion can occur under certain conditions, such as the use of heavy machinery when soils are wet. Erosion and sediment control practices must be used to prevent this erosion. In and along open watercourses, these soils will erode when hydrologic conditions change rapidly due to urbanization or other land use changes. Stormwater controls are required to mitigate stream erosion and prevent sedimentation of downstream watercourses.

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Legend

- Open Channel
- NCP Boundary

Soil Drainage Characteristics

- Well to moderately well
- Moderately well
- Poor
- Poor to very poor
- Very poor

SOILS NAMES*

BO - Bose Soils
CD - Cloverdale Soils
CV - Carvolth Soils
HN - Heron Soils
JN - Judson Soils
LM - Lumbum Soils
MR - Monroe Soils
N - Nicholson Soils
RS - Ross Soils
SC - Scat Soils
SS - Sunshine Soils
W - Whatcom Soils

*Note: Soil data source - Soils of the Langley-Vancouver Map Area, RAB Bulletin 18, Ministry of Environment, 1980.

Anniedale/Tynehead NCP
Stage 2 - Drainage

Soil Drainage Classification

Figure 7.4

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Hydrology and Hydraulics – Existing and Future Conditions

Rainwater runoff from the Anniedale-Tynehead area ultimately drains to two major watercourses, Serpentine River to the south and Fraser River to the north. There are few natural watercourses in the north side of the study area, though there are a number of drainage ditches along the roads. In the southern two-thirds of the study area, along moderately steep slopes, several natural watercourses originate from forested areas. Drainage ditches are also present here, paralleling road networks and in agricultural areas.

The existing drainage infrastructure in the study area is currently serviced to the City's rural/agricultural standard, comprising open ditches, culverts and only a few storm sewers. A recent addition is the storm sewer system along Golden Ears Way, which drains east then north under Highway 1; this system services the roadway only and is owned and maintained by the Golden Ears Bridge concessionaire (Translink). **Figure 7.5** shows the overall existing drainage infrastructure for the study area. Though satisfactory now, the existing infrastructure is inadequate to service the proposed land use plan.

Other than conveyance, at this time there are no known stormwater control systems in place within the neighbourhood. This means that runoff is collected and conveyed without intentional reductions in peak or volume and without direct application of methods for reducing or mitigating non-point source pollution in the runoff. Advanced stormwater management has been applied to the 96th Avenue corridor, along the neighbourhood's border, as part of recent water system and road upgrade projects.

For purposes of formulating a servicing strategy, the neighbourhood has been divided into four major catchments, one draining north and three draining south; these are shown in **Figure 7.6**. Briefly, the catchments are:

- 'West catchment' - drains directly to the Serpentine River via several small tributaries;
- 'North catchment' - drains directly to the Fraser River via tributaries (including Lorean Brook) and storm sewers lying north of Highway 1 in Port Kells;
- 'East catchment' - drains directly to Latimer Creek, which in turn joins the Serpentine River south of the neighbourhood; and
- 'South catchment' - drains through lowlands towards the Serpentine River, where a dyke and drainage pump station (and flood box) provide flood protection for the agricultural lowland area.

The distribution of proposed land use type and related impervious cover varies by catchment and, as will be discussed in the next section, the priority stormwater management objectives vary by catchment as well.

From the background information relevant to the Anniedale-Tynehead neighbourhood area, a summary of previously identified stormwater conditions, outstanding issues and concerns, proposed infrastructure improvements, and recommended stormwater management measures including in-stream habitat enhancements can be found in **Table A.1 (Appendix C)**. These studies identified issues primarily related to topography, watercourses and vegetation, but not specifically to drainage servicing.

The proposed changes to land use types and patterns within the neighbourhood, as envisioned by the NCP, could have a significant impact on the hydrologic conditions of the area's watercourses if not

adequately addressed. Two key factors that can be used as indices to these impacts are the total amount of impervious ("hard") surfaces which are constructed and the total amount of vegetated, open space (in particular forested land) which remains. Significant increases in the former accompanied by decreases in the latter will lead to increased runoff volume and peak flows and to increased washoff of pollutants (sometimes called "non-point source pollution").

For Anniedale-Tynehead, the estimated total imperviousness for existing conditions is 12% and for future conditions is 62%; this impervious surface increase will yield significant changes in hydrology (larger peak flows and greater annual volume of runoff) and non-point source pollution. As shown on the NCP land use map, there will remain significant land dedicated as riparian areas, protected forested areas, and open spaces and parks within the neighbourhood. Nonetheless, stormwater controls must be applied to maintain and enhance catchment health.

The City's 10 year servicing plan did include a detention pond to the southeast of 95th Avenue and 168th Street, which was recommended as part of the Master Drainage Plan (MDP) for the Upper Serpentine, Fleetwood and Greenway Basin. Further, the South Port Kells General Land Use Plan (GLUP) allowed for two detention ponds to service the area, one within the Anniedale-Tynehead neighbourhood area along Highway 1 and another just outside the study area (east of Harvie Road and north of 88th Avenue). These remnants of earlier planning efforts were taken into consideration for the proposed stormwater servicing plan but they have been modified significantly to suit a more integrated stormwater management planning approach to the area.

Protection of the lowland agricultural area to the south is a key concern for the City and for land owners in the lowlands. A functional plan to provide this protection was prepared in the late 1990's, and subsequently verified and updated shortly thereafter[4]. The two key elements of that plan are the Upper Serpentine Pump Station (along with flood box) and the extensive storage/conveyance ditch system within the lowlands. About two-thirds of the runoff from Anniedale-Tynehead will drain through the lowlands, thus these facilities must be able to handle any increases in runoff due to future development, mitigation efforts must be applied to reduce future runoff increases, or a combination of the two must be implemented.

[4] Associated Engineering. (1998). "Upper Serpentine Pump Station, Project 4898-714, Functional Plan".

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Legend

- Pump Station
- Drainage Manhole
- Drainage Main (Surrey)
- Drainage Main (Translink)
- Open Channel
- Drainage Catchments*
- Area Draining to Pump Station**
- NCP Boundary

* As per City of Surrey

** As per "Upper Serpentine Pump Station Project 4898-714 Functional Plan", Associated Engineering (BC) Ltd., August 1998.

Anniedale/Tynehead NCP Stage 2 - Drainage

Existing Drainage Infrastructure

Figure 7.5

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U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\StormwaterFigures_Phase2\Figure 3.3-5 - Existing Drainage Infrastructure.mxd Last revised by: bpauls on 26/09/2011 at 11:40:54 AM

CITY OF SURREY
the future lives here.

Legend

- Existing Watercourses
- Overall Runoff Direction
- Future Sub-Catchment Boundaries
- Future Major Catchment Boundaries
- Contributing Catchments Outside NCP Area
- Discharge Points

WEST CATCHMENT: Drains directly into Serpentine River

NORTH CATCHMENT: Drains North to Fraser River via Leoran Brook and various storm sewers

EAST CATCHMENT: Drains to ditches connected to Old Sawmill Creek, then into Latimer Creek

SOUTH CATCHMENT: Drains South to Upper Serpentine Pump Station, then into Serpentine River

West Catchment
North Catchment
South Catchment
East Catchment

W-1 W-2 S-1 S-2 S-3 S-4 S-5 S-6 N-1 N-2 E-1

Barnston Dr W
No 1 Hwy
Tynehead Dr
Barnston Dr E
Golden Ears Way
Daly Rd
Triggs Rd
Canadian National Rwy
Fraser River
Abbey Dr
Lyncean Dr
Bothwell Dr
Highway 15
Greenway Dr
Harvie Rd
Fruno Pl

Leoran Brk
Leoran Brk
Austin Brk
Swanson Brk
Lakiotis
Lakiotis Crk
Serpentine River
Serpentine River
Old Sawmill Creek
Latimer Crk

102 Ave, 102A Ave, 101 Ave, 101A Ave, 100A Ave, 100 Ave, 99A Ave, 98 Ave, 98A Ave, 97 Ave, 96 Ave, 96'Ave, 94A Ave, 94 Ave, 93A Ave, 92A Ave, 92 Ave, 90 Ave, 88 Ave, 87 Ave, 87A Ave, 86A Ave, 86 Ave, 85A Ave, 85 Ave

168 St, 170A St, 171A St, 172 St, 173 St, 173A St, 175A St, 176 St, 177 St, 178 St, 179 St, 180 St, 180A St, 181 St, 182 St, 182A St, 184 St, 185 St, 186 St, 187 St, 188 St, 189 St, 190 St

Anniedale/Tynehead NCP
Stage 2 - Drainage

Major Drainage Catchments

Figure 7.6

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Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\StormwaterFigures_Phase2\Figure 3.3-6 - Drainage Catchments.mxd Last revised by: bpauls on 26/10/2011 at 2:10:51 PM

Historical Studies and Reports

The following key background reports and studies were reviewed in the course of preparing this stormwater servicing plan for the Anniedale-Tynehead neighbourhood; the most pertinent of these are relatively old and do not address the City's more recent standards for stormwater management:

- "Upper Serpentine, Fleetwood and Greenway Basin Master Drainage Plan", 1996;
- "Upper Serpentine Pump Station, Project 4898-714, Functional Plan", 1998;
- "Latimer Creek Dyke, Tie-In Functional Plan", 1998;
- "Verification of the Functional Plan for the Upper Serpentine Pump Station", 1999;
- "Verification of the Functional Plan for Latimer Creek Dyke Tie-In", 1999;
- "Latimer Creek Master Drainage Plan", 2003;
- "South Port Kells General Land Use Plan", 2005; and
- "10 Year Servicing Plan, 2010-2019", 2010.

Critical Servicing Issues

The Anniedale-Tynehead Neighbourhood is sparsely developed at this time and drainage is adequately handled by the existing infrastructure. A review of background materials indicates no significant issues have been identified. As development begins, there are several key objectives which will dictate the types and extent of stormwater management which must be applied to meet the City's servicing standards:

- Avoid or minimize local flooding;
- Protect downstream lands, particularly those in the ALR lands to the south, from uncontrolled flooding;
- Maintain current runoff volumes to the adjacent ALR lands to the south, upgrade the conveyance ditches and Upper Serpentine Pump Station capacity as required, or a combination of these;
- Manage runoff peaks within the capacity of downstream watercourses and storm sewers to the north OR upgrade the storm sewers as required;
- Protect receiving watercourses from erosion due to increased runoff;
- Maintain base flows in those creeks designated for preservation and which support fisheries values; and
- Maintain the quality of water in all drainage systems.

7.1 DESIGN CRITERIA, ANALYSIS AND SERVICING STANDARDS

Key design standards and guidelines that govern the stormwater servicing for Anniedale-Tynehead are established by the City; there are guidelines from both the provincial and federal level that were also considered in the development of this servicing plan.

Planning for drainage systems to meet the needs of growth must satisfy four basic criteria which form the fundamental aspects of the City's Drainage Policy:

- A minor system conveyance capacity up to the 1:5-year return period storm to minimize inconvenience of frequent surface runoff;
- A major system conveyance capacity up to the 1:100-year return period storm to provide safe conveyance of flows to minimize damage to life and property;
- Where erosion is a concern, satisfy the more stringent of the two following criteria:
  - Control the 5-year post-development flow to 50% of the 2-year post-development rate; or
  - Control the 5-year post-development flow to 5-year pre-development flow rate; and
- Maintain a flood control and drainage system in the lowlands that meets provincial ARDSA guidelines as follows:
  - Restrict flooding to a maximum of 5 days in duration for the 10 year, 5 day winter storm (November to February);
  - Restrict flooding to a maximum of 2 days in duration for the 10 year, 2 day growing season storm (March to October); and
  - Between storm events, maintain the base flow in ditches at 1.2 m below the average ground level to provide free outlet for drains.

In addition, though not listed here, the City's design standards cover the specific details of drainage system components, such as minimum pipe sizes and profile slopes, inlet spacing, etc.

Consistent with the City's commitment to protecting and maintaining the health of its watercourses, development must reduce the volume of runoff it generates and instead promote natural hydrologic processes such as infiltration and evapotranspiration. In order to reduce the volume of runoff generated by the neighbourhood, new development must capture 50% of the Mean Annual Rainfall[5] (MAR) at the source (building lots and streets) and infiltrate, evaporate, or reuse it. The MAR in the Anniedale-Tynehead area is approximately 70 mm in 24 hours, thus 50% of the MAR is 35 mm. Where infiltration systems are not suitable, a rate of discharge equal to the calculated release rate of an infiltration system may be applied to other on-site stormwater control practices[6]. Satisfying this requirement will serve to

[5] MAR is defined as the 24-hour rain event with a 2.33 year return period; about 90% of the total rainfall volume in a typical year occurs in rain events smaller than the MAR. For the Anniedale-Tynehead neighbourhood the MAR is approximately 70 mm, thus the requirement is to retain the first 35 mm of rainfall on-site.

[6] While general soil conditions indicate the application of infiltration methods, there may be instances where infiltration systems are not suitable. For example, a lot near a ravine is proposed to be developed; the soils at the site have an infiltration rate of 12 mm/hr. A potential choice for on-site rainwater control is a rock trench that captures ½ the MAR and exfiltrates it at that rate. However, due to proximity to the ravine, a geotechnical engineer raises concerns for ravine slope stability. In this case, the rainwater may be captured in an underground tank and then released to the ravine or a local storm sewer at a volumetric rate comparable to that which would have been used for the rock trench design.

support base flow in watercourses and to provide water quality treatment. The requirement is in general agreement with provincial and federal stormwater guidelines.

Hydrologic Analysis

Hydrologic modeling was completed to quantify both existing and future hydrologic conditions; subsequently the future conditions model was used to evaluate alternative management options. Both "design storm event" and "continuous" (or extended period) simulations were used in the modeling effort.

Briefly, the target hydrologic conditions for the neighbourhood are based on the results of an existing conditions hydrologic model developed using the software package MIKE SHE. MIKE SHE was run first in a continuous simulation mode to establish minimum base flows (summer; winter) and allowable discharges from the area's sub-catchment. MIKE SHE is a 2-D, distributed, process-based model that links surface and subsurface flow regimes and is well-suited to simulating hydrology in a largely undeveloped area such as Anniedale-Tynehead. A separate PCSWMM model was then developed for future conditions and used to establish a mix of detention ponds and source controls to manage the neighbourhood's rainwater using the SHE existing conditions results as the targets. PCSWMM is 1-D, lumped, process-based model that is well suited for simulating urban drainage systems.

The models used in this analysis as the basis for the stormwater servicing plan were not calibrated to local data. They are, however, based on the application of accepted modeling principles and parameter values for computing runoff in Surrey. The results should be considered reliable for purposes of this plan, but should be confirmed during the development process with more detailed analysis.

The primary purpose of modeling existing conditions was to establish key runoff flows and volumes as benchmarks for developing the future stormwater management strategy. Hydraulic capacity analysis of the existing drainage infrastructure (culverts and storm sewers) was not conducted since the projected future development will require almost complete replacement of what currently exists within the boundaries of the NCP.

"Pre-development conditions" are generally the baseline for considering the impact of future land use, and thus hydrologic, changes in an area. The City of Surrey generally defines pre-development conditions as those which existed in 1979. The Anniedale-Tynehead NCP area is very rural, and while some development has occurred since 1979, existing conditions have been used as the pre-development conditions since hydrologically there is little difference between the two. The key existing conditions are:

- Only 12% of the study area is impervious; and
- Only about 1% of impervious surfaces are directly-connected to a storm sewer.

This means that most runoff generated on impervious surfaces has a chance to infiltrate, or at least be attenuated, as it passes over pervious surfaces.

Table 7.1 and 7.2 show the key results of the existing (i.e., pre-development) conditions modeling; **Figure 7.6** shows the locations of the various catchments. The tables list peak discharges at key points around the boundary of the neighbourhood for 2, 5 and 100-year return periods and for summer and winter base flows. These results establish the benchmark to be attained by stormwater management

strategies for future development conditions. The estimates include upslope contributing flow from areas outside the NCP boundaries (Sub-catchments W-1, W-2 and S-1).

Table 7.1 – Catchment Data Summary for Existing Conditions

Catchment	Catchment Area*	2 Yr, 24 hr Peak Flow	5 Yr, 24 hr Peak Flow	100 Yr, 24 hr Peak Flow
	(ha)	(m3/s)	(m3/s)	(m3/s)
West				
W-1	121.1 (47.7)	1.22 (0.48)	1.77 (0.67)	3.18 (1.25)
W-2	39.8 (23.1)	0.40 (0.23)	0.56 (0.33)	1.04 (0.61)
North				
N-1	63.9	0.50	0.67	1.06
N-2	55.9	0.44	0.58	0.92
East				
E-1	30.9	0.50	0.70	1.41
South				
S-1	53.5 (16.1)	0.46 (0.14)	0.59 (0.18)	0.85 (0.26)
S-2	30.4	0.26	0.33	0.49
S-3	64.6	0.56	0.71	1.03
S-4	32.6	0.28	0.36	0.52
S-5	30.7	0.27	0.34	0.49
S-6	18.5	0.16	0.20	0.30

*Catchment area within NCP boundaries are shown in parentheses for those sub-catchments also receiving runoff from upslope areas located outside the NCP.

Table 7.2 – Estimated Base Flow* Contributions from Major Catchments

Catchment	Catchment Area** (ha)	Summer Base Flow (L/s)	Winter Base Flow (L/s)
West Catchment: To Serpentine River	160.9	2.5-3.5	19-21
North Catchment: To Leoran Brook	119.9	2.5-3.5	3-5
East Catchment: To Harvie Rd Ditch ***	30.9	0.5-1.5	1-3
South Catchment: To Lowland Ditches	230.4	2.5-3.5	30--32

*Ranges have been listed in order to highlight that they have been estimated with an uncalibrated model.

**Includes upslope areas outside the NCP boundaries.

***Ditch eventually crosses Harvie Road and discharges to Old Sawmill Creek, a tributary of Latimer Creek.

Future ("post-development") conditions were modeled using the designated land use distribution from the Land Use Plan. The future conditions model assumes that all areas have been developed to the full extent of the NCP and that storm sewer systems have been constructed to serve the neighbourhood, but that no other stormwater controls have been applied. No land use changes beyond the NCP boundary have been assumed. The results do account for compliance with the City requirement that single family residential roof leaders discharge to lawns, not directly to storm sewers. **Table 7.3** shows the results of this analysis.

These results highlight the significant hydrologic changes that occur as a result of development within the neighbourhood as well as the necessity of applying stormwater controls. Total impervious area (TIA) fraction across the neighbourhood for the future land use condition is 62%, with about 42% effective impervious area (EIA) after accounting for roof leaders that discharge to lawns instead of storm sewers; this compares with about 12% and 1% for existing conditions, respectively.

Table 7.3 – Catchment Data Summary for Future Conditions (Without Application of Stormwater Management Controls)

Catchment	Catchment Area*	2 Yr, 24 hr Peak Flow	5 Yr, 24 hr Peak Flow	100 Yr, 24 hr Peak Flow
	(ha)	(m3/s)	(m3/s)	(m3/s)
West				
W-1	121.1 (47.7)	1.80 (1.06)	2.58 (1.45)	4.43 (2.51)
W-2	39.8 (23.1)	0.68 (0.51)	0.94 (0.70)	1.65 1.21)
North				
N-1	63.9	1.61	2.17	3.61
N-2	55.9	1.41	1.90	3.16
East				
E-1	30.8	0.80	1.11	1.71
South				
S-1	53.5 (16.1)	0.72 (0.40)	0.98 (0.57)	1.59 (0.99)
S-2	30.4	0.75	1.07	1.87
S-3	64.6	1.59	2.27	3.98
S-4	32.6	0.80	1.15	2.01
S-5	30.7	0.76	1.08	1.89
S-6	18.5	0.46	0.65	1.14

* Catchment area within NCP boundaries are shown in parentheses for those sub-catchments also receiving runoff from upslope areas located outside the NCP.

As will be described in **Part 7.2**, the proposed stormwater management system will control runoff from the neighbourhood to meet servicing and environmental objectives. **Table 7.4** shows the modeling results after application of the proposed servicing plan. The TIA fraction across the neighbourhood is still 62%, but the use of LID measures reduces the EIA fraction from 42% to about 16%. The proposed servicing plan includes both on-lot stormwater controls and City-owned and maintained detention ponds.

As determined by the Upper Serpentine Pump Station Functional Plan, the lowland flood control system (consisting of ditches, culverts and the pump station with flood boxes) will accommodate a fully

developed upland area having a TIA fraction of 82% and no stormwater controls in place. The proposed land use for Anniedale-Tynehead will have a lower impervious area fraction and stormwater controls (LID measures) will be applied. Thus, the additional runoff volume generated by development of the NCP will be within the overall capacity of the Functional Plan's system. For this reason, the proposed management strategy for these south facing catchments is less focused on peak flow volume attenuation, but more on water quality and retention at the lower end of the rainfall spectrum. As a result, and as shown by **Table 7.4**, Sub-Catchments S-1 to S-6 will generate and discharge runoff to lowland agricultural areas at rates greater than existing conditions for infrequent storm events. The recommendations of the Functional Plan, upon which the NCP is dependent, have been implemented and are able to accept changed hydrology from the NCP area. However, capacity and access to conveyance systems in the transition zone between the NCP boundary and the lowland flood control systems have not yet been addressed; these are therefore included in the proposed program, as discussed later in **Part 7.2**.

Table 7.4 – Catchment Data Summary for Future Conditions (With Application of All Recommended Stormwater Management Controls)

Catchment	Catchment Area*	2 Yr, 24 hr Peak Flow	5 Yr, 24 hr Peak Flow	100 Yr, 24 hr Peak Flow
	(ha)	(m3/s)	(m3/s)	(m3/s)
West				
W-1	121.1 (47.7)	1.27 (0.53)	1.73 (0.69)	3.86 (1.93)
W-2	39.8 (23.1)	0.43 (0.26)	0.57 (0.34)	1.37 (0.93)
North				
N-1	63.9	0.50	0.67	1.39
N-2	55.9	0.44	0.58	1.22
East				
E-1	30.8	0.48	0.70	1.61
South				
S-1	53.5 (16.1)	0.49 (0.17)	0.67 (0.26)	1.41 (0.81)
S-2	30.4	0.32	0.49	1.53
S-3	64.6	0.68	1.03	3.24
S-4	32.6	0.34	0.52	1.64
S-5	30.7	0.32	0.49	1.54
S-6	18.5	0.19	0.30	0.93

* Catchment area within NCP boundaries are shown in parentheses for those sub-catchments also receiving runoff from upslope areas located outside the NCP. It is assumed that any future development within these upslope areas will meet City guidelines for runoff flow control.

Non-Point Source Pollutant Analysis

Urban development will affect not only runoff peaks and volumes but also the quality of that runoff as well as the total load of pollutants that can be carried into receiving watercourses. 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., use of 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 in this section. The model uses catchment area, impervious cover, average annual precipitation and typical pollutant concentrations as the basis for the assessment.

To estimate annual pollutant loadings, one or more of six basic land use categories was assigned to each catchment. The basic categories are: residential; commercial; industrial; institutional; highways and open space. For each land use category, median pollutant concentrations were applied. The method was applied to both existing and future "unmanaged" conditions. As will be discussed in part 7.3, stormwater controls are being recommended to manage this non-point source (NPS) pollution.

Total suspended solids (TSS), oil and grease (O&G), and two trace metals (copper and zinc) were selected for demonstrating the potential change in pollutant loading due to development; all four are non-point source pollutants typically found in runoff from urban and suburban areas. TSS is often used as the surrogate measure of water quality. High levels of TSS can damage fish and aquatic invertebrates and degrade instream habitat where the material settles onto gravel and cobble substrates. Besides simply producing an unsightly sheen to water, petroleum hydrocarbons (as represented by oil and grease) can be directly toxic to aquatic life. Copper and Zinc are primary trace metals of concern because of their adverse impacts on fisheries. Copper interferes with fish sensory systems related to predator avoidance, juvenile growth and migratory success. Zinc alters behavior, blood and serum chemistry, impairs reproduction and reduces growth.

Figures A.1 to A.4 (Appendix C) show the results for both existing and future conditions. As shown, pollutant loads can be expected to increase nearly 4-fold from existing to fully developed conditions if no controls are applied. Also shown are the estimated loadings with implementation of the stormwater controls adopted for the NCP.

Reduction in total annual volume of runoff from the neighbourhood through use of low impact best management practices (BMPs) will also directly reduce discharge of runoff-generated pollutants. For example, runoff that is properly infiltrated also effectively removes pollutants from surface discharge to local streams. Absorbent landscaping (i.e., deep amended soil), disconnected roof drains, rain gardens, subsurface bioswales and similar low impact BMPs will promote infiltration. Even in specific locations where perforated under drains 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.

7.2 SERVICING OPTIONS AND PROPOSED SYSTEM

Servicing Options

Over the past decade or so, the City has begun to request and use more sustainable approaches to stormwater control that explicitly address issues such as runoff quality and preservation of base flows in watercourses; such an approach has been incorporated in recently completed ISMPs and NCPs[7] and is

[7] For example, Fergus Creek Integrated Stormwater Management Plan and Grandview Heights #2 NCP Servicing Strategy.

clearly embodied in the Provincial and DFO guidelines noted in **Part 7.1**. One specific outcome of this shift in servicing has been an increased use of low impact development (LID) best management practices (BMPs) that are not currently listed or specifically described in City design standards and guidelines. Many of these LID measures are on-site source controls which must be implemented on individual properties, although some are installed within road rights-of-way.

While it may be feasible to utilize an approach to stormwater management in the neighbourhood that relies exclusively on LID, there are a variety of reasons this might not in fact work in specific cases. Notably, there is significant concern that long-term maintenance by property owners of on-site measures will not happen, leaving such measures vulnerable to failure or at least to inadequate environmental benefits being realized. Further, enforcement of design and maintenance standards for LID measures will require an unacceptable level of effort by the City. Thus, a hybrid approach was formulated that could incorporate a variety of these emerging LID practices alongside more traditional runoff detention measures and achieve a desired level of environmental stewardship during and after development. This approach does not minimize a continued requirement and need for on-site measures.

As described in **Part 7.1**, the neighbourhood area was divided into four major catchments based on the existing drainage pattern and boundary conditions. Stormwater management objectives were formulated for each of these catchments after considering the watershed issues of most importance in each catchment:

- West Catchment - This catchment drains to the Serpentine River which is a major fisheries resource. Past studies have indicated the need for some erosion control works in the Upper Serpentine. This catchment is very small compared to the total Upper Serpentine watershed, thus downstream flood control is not the highest priority. The priority objectives of stormwater management for this catchment are:

    1. Provide adequate base flows to the Serpentine tributaries within the catchment, as well as to Serpentine River, to support fisheries;
    2. Mitigate creek erosion and reduce erosion potential; and
    3. Maintain or enhance water quality in local watercourses.

- North Catchment - This catchment drains to the Fraser River via Leoran Brook, Lyncean Creek and another unnamed water course, as well as storm sewer systems in some cases. All three watercourses are designated as ‘red’ coded in the fish sensitivity map. The City’s 10 year Capital Plan shows long term erosion prevention works along the Leoran Brook and the Lyncean Creek E. Thus, the priority objectives of stormwater management for this catchment are:

    1. Provide adequate base flows to Leoran Brook;
    2. Mitigate creek erosion and reduce downstream erosion potential; and
    3. Maintain or enhance water quality.

- East Catchment – This catchment discharges to a ditch along Harvie Road which in turn discharges to Old Sawmill Creek (located east of Harvie Road) which is part of the Latimer Creek watershed; Old Sawmill Creek and Latimer Creek are designated as ‘red’ coded in the fish

sensitivity map. Similar to the West Catchment, the East Catchment area is very small compared to the overall Latimer watershed thus flood control is not a high priority issue. Since there are no local creeks within the catchment, erosion control is not a critical factor. Thus, the priority objectives of stormwater management for this catchment are:

1. Provide adequate base flows in support of the Old Sawmill Creek fisheries;
2. Reduce downstream erosion potential; and
3. Maintain or enhance water quality.

- South Catchment - This catchment includes several short channels and, based on the fish sensitivity map, no fish presence has been documented in these channels. Therefore baseflow preservation or generation is not considered a priority objective within the NCP catchment. In the proposed land use plan, 15m to 30m buffers are provided for the channels and several parks and trails are proposed to promote infiltration and generation of base flow. However, the runoff from this catchment eventually reaches the Upper Serpentine Pump Station via the lowland ditches, many of which are rated highly as fisheries resources. Thus, the priority objectives for stormwater management in this catchment are:

  1. Mitigate downstream flooding due to new development;
  2. No net increase in runoff volume beyond the design capacity of the receiving ditches and Pump station; and
  3. Maintain or enhance water quality.

These objectives can only be met through a combination of detention pond storage, water quality pond treatment and on-site LID measures; the use of detention ponds alone will not meet these objectives. In some areas of the neighbourhood, application of LID practices will suffice to meet the objectives (notably in the West Catchment), while in other areas, a combination of traditional and emerging LID methods will work well. On site LID measures should capture and retain 50% of the MAR, or 350 m^3 per hectare of impervious surface.

The overall goal of LID is to minimize disruption of the predevelopment hydrologic cycle by minimizing impervious surfaces, creating hydraulic disconnects, lengthening runoff flow paths, dispersing runoff, and providing on-site water retention and infiltration. This further reduces the detrimental impacts of high runoff volumes, supports summer base flows in creeks and contributes to pollutant removal, key aspects of maintaining healthy fisheries habitat in downstream watercourses. However, not all these objectives are equally critical or important in all parts of the neighbourhood. There are areas where water quality is of higher priority than the flooding issue; similarly in some areas maintenance of base flows is more important than water quality. Site specific conditions are another important factor to consider for the design and implementation of an effective LID feature. High groundwater table, steep topography and impervious soils conditions often pose challenges to successful implementation of LID, but this should not be an obstacle if site specific conditions are accounted for. Last, but not least, costs of implementation, operation and maintenance are important aspects of the LID features.

Recently, the City has been working with an outside consultant to prepare a list of LID measures along with basic standards for their design for use in the City. The intent is not to limit use to the list, but rather to begin to standardize the designs that are being proposed based on local experience. This

preliminary list was screened for applicability to Anniedale-Tynehead. **Table A.2 in Appendix C** offers potential LID options for use with the various land use types proposed for the neighbourhood. As will be discussed in the next section, with the exception of single family residential areas, developers will be able to choose which LID measures will be installed on each property and inclusion of **Table A.2** is not intended to preclude developers from proposing other applicable LID measures.

Proposed Servicing Plan

The proposed servicing plan consists of a mix of public and private measures that together will meet the stormwater servicing objectives discussed in the previous section. **Figure 7.7A** shows the locations for proposed ponds (both detention and water quality) and trunk storm sewers. A general layout of local sewers is also shown for illustrative purposes as well. **Figure 7.7B** provides additional detail of pipe routing at the proposed ponds. **Table 7.5** provides specific details related to trunk storm sewer and pond sizing, water quality control requirements and on-site stormwater measures.

The alignments and dimensions of all proposed facilities shown on **Figure 7.7A** are conceptual and must be confirmed at the time of design. Specifically, the locations for ponds may be adjusted somewhat at time of design as long as the objectives and design criteria of this servicing plan are still met.

No upgrades are proposed for the lowland flood control system identified in the Upper Serpentine Pump Station Functional Plan. As noted previously, the changes in runoff conditions within the NCP area can be accommodated by the current lowland system as long as the measures identified in this proposed servicing plan are implemented. As shown on **Figure 7.7A**, there are several ditches in the transitional zone between the NCP area and the lowland flood control system that may require general conveyance improvements to ensure that runoff reaches the lowland system; the extent of these improvements should also be confirmed at design. An allowance for this work has been included in the cost estimates for the servicing plan.

The first developer in a sub-catchment requiring a detention or water quality pond shall secure the land and construct the pond before or as development begins.

In conjunction with the proposed infrastructure features previously described, the following LID requirements are proposed:

- For single family residential properties – Provide 300 mm of amended growing media ("top soil") for all yard area; discharge roof leaders directly to yards, not to the storm sewer[8];
- All other land use types, including high density residential, commercial and industrial land uses – Meet the requirements listed in **Table 7.5**; developers may choose from among a variety of LID measures to meet the requirements, some examples of which are provided in **Table A.2** in **Appendix C**; and
- Local roads – Use parallel exfiltration-type storm sewer systems; provide 300 mm of amended growing media ("top soil") for boulevards; install rain gardens in traffic calming bulges.

[8] This has been standard practice in the City for a number of years. It is fully consistent with LID approaches to stormwater management and is regularly included in requirements and guidelines for LID in other jurisdictions across North America.

It shall be the responsibility of the owners of private property to maintain and repair as necessary LID features installed on that property.

Groundwater Issues

As previously discussed in Part 7.1 for "Soils and Groundwater", a local groundwater flow condition is present in the Anniedale-Tynehead in the upper, near surface soils layers. This is a result of well-drained soils overlying highly impermeable soils. Construction of roads and utilities can intercept this local groundwater, leading to the development of artificial springs in cut areas, with resulting potential for icing on pavement and sidewalks, and rerouted groundwater through the utility trenches. To control this, French drains shall be installed upslope of sidewalks and roads in cut areas and clay dams shall be installed in utility trenches on steep slopes (greater than 10% or as determined through geotechnical analysis).

Flood Control and Soil Erosion

The servicing plan proposed for the Anniedale-Tynehead neighbourhood specifically addresses the need to manage runoff to prevent flooding of areas outside the area. The proposed stormwater facilities, that is, the detention ponds and LID measures, are sized to meet the requirements of flood control. In conjunction with the proposed stormwater measures, the lowland flood control system will continue to operate as planned and, as a result, induced flooding in the agricultural area due to development will not occur.

The proposed stormwater measures are also sized to meet the requirements of erosion control of watercourses within and outside the neighbourhood. Soil erosion that could occur during construction will be addressed through application and enforcement of the City's existing Erosion and Sediment Control Bylaw.

Environmental Considerations

Department of Fisheries and Oceans Canada (DFO) recommend that the Anniedale-Tynehead NCP include measures to reduce impacts to fish and fish habitat through the application of current stormwater/rainwater management practices, and that all new (and updated) planning processes over the long-term also address stormwater based on current and relevant guidelines. Stormwater management needs to integrate stormwater infrastructure planning with relevant municipal planning processes (e.g. Official Community Plans, Neighbourhood Concept Plans, recreation and parks plans, and strategic transportation plans) in order to address the impacts of stormwater/rainwater on fish and fish habitat. DFO has been providing advice to proponents at the Environmental Review Committee on a site-by-site basis; however, DFO staff suggest that it is more appropriate and effective to consider impacts from stormwater/rainwater on a watershed scale in order to reduce adverse impacts to watercourses and aquatic life.

Additionally, DFO has requested that the GVRD standards and DFO guideline standards be met in all plans as well as for all property developments in areas under NCP, proposed local development areas and for individual property development. Stormwater/rainwater management should include application of Low Impact Development (LID) wherever technically feasible, which should be supported by infrastructure as overflow systems.

DFO recommends that planning and development processes adopt the GVRD Source Control Design Guidelines (2005), and meet at minimum the DFO **"Urban Stormwater Guidelines and Best Management Practices for Protection of Fish and Fish Habitat"**.

Preliminary discussions have taken place with DFO staff regarding the conceptual layout of city utilities, and the possible locations of watercourse crossings, all of which generally follow the conceptual road layout for the NCP. Each watercourse crossing requires DFO approval. An assessment of what is most appropriate for the crossing must be prepared by a Registered Biologist or other approved professional. DFO preference is for clear span crossings extending from bank to bank across Class 'A' watercourses. Culvert crossings may trigger the environmental review process and habitat compensation. Where approved by DFO, directional drilling is the preferred method of pipe installation over open cut construction methods. The assessment and design of all crossings should also consider wildlife migration and watercourse setbacks from top of bank.

The Bothwell Drive area is an area of interest to DFO due to the Serpentine River and may require additional assessment and riparian enhancements.

Proposed construction activitity, both on-site and off-site, may require a Sediment and Erosion Control Permit as issued by the City under the Erosion and Sediment Control By-law. The by-law sets mandatory standards ensuring Best Management Practices are implementated and managed to limit the amount of sediment and sediment laden water entering the City drainage systems.

7.3 TEN YEAR SERVICING PLAN AND INFRASTRUCTURE COSTS

The cost estimates for the Development Cost Charge (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, detention and water quality ponds and other items that serve overall catchments equal to or greater than 20 hectares in size.

Costs for Proposed Stormwater Controls

Costs for trunk storm sewers, minor ditch improvements, and detention and water quality ponds are shown in **Tables A.3 and A.4 (Appendix C)**. The total estimated DCC eligible infrastructure costs for these improvements are **$26.6 million**, including engineering, administration, contingencies and land purchase costs.

10 Year Servicing Plan
There are no projects currently identified in the 10 Year Servicing Plan that fall within the study area.

See Figure 3.3-7B for additional detail at pond sites.
See Table 3.3-6 for trunk sewer and pond sizing.

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Legend

NCP Land Uses

- NCP Boundary
- NCP Area
- Future Road Network
- Proposed Trails, Buffers & Riparian Areas
- 15m and 30m Watercourse Class B Buffer

Watercourse Classifications

- Class A (red-coded)
- Class A(O) (red-dash)
- Class B (yellow-coded)
- Class C (green-coded)
- Unclassified

Existing Drainage Infrastructure

- PS Existing Pump Station
- Existing Storm Sewer (outside NCP)
- Existing Storm Sewer (Translink)

Proposed Drainage Infrastructure

- Proposed Sub-Catchments
- Contributing Catchments Outside NCP Area
- Proposed Trunk Storm Sewer
- Potential Local Storm Sewer Network
- Proposed Pond
- Land Required for Pond
- Ditch Improvement Reaches

Anniedale/Tynehead NCP
Stage 2 - Drainage
Proposed Infrastructure

Figure 7.7a

1:15,000

0 250 500 1,000
Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\StormwaterFigures_Phase2\Figure 3.3-7A - Proposed Infrastructure.mxd Last revised by: bpauls on 03/02/2012 at 9:42:54 AM

See Table 3.3-6 for trunk sewer and pond sizing.

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Legend

NCP Land Uses

- NCP Boundary
- NCP Area
- Future Road Network
- Proposed Trails, Buffers & Riparian Areas
- 15m and 30m Watercourse Class B Buffer

Watercourse Classifications

- Class A (red-coded)
- Class A(O) (red-dash)
- Class B (yellow-coded)
- Class C (green-coded)
- Unclassified

Existing Drainage Infrastructure

- PS — Existing Pump Station
- Existing Storm Sewer (outside NCP)
- Existing Storm Sewer (Translink)

Proposed Drainage Infrastructure

- Proposed Sub-Catchments
- Contributing Catchments Outside NCP Area
- Proposed Trunk Storm Sewer
- Potential Local Storm Sewer Network
- Proposed Pond
- Land Required for Pond
- Ditch Improvement Reaches

Anniedale/Tynehead NCP Stage 2 - Drainage

Proposed Pond Details

Figure 7.7b

1:15,000
(Pond Detail 1:5,000)

0 250 500 1,000
Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\StormwaterFigures_Phase2\Figure 3.3-7B - Pond Detail.mxd Last revised by: bpauls on 03/02/2012 at 9:42:11 AM

Table 7.5 Details of Proposed Stormwater Servicing Plan, by Subcatchment
(Refer to Figures 7.7A and 7.7B for general layout of proposed stormwater systems)

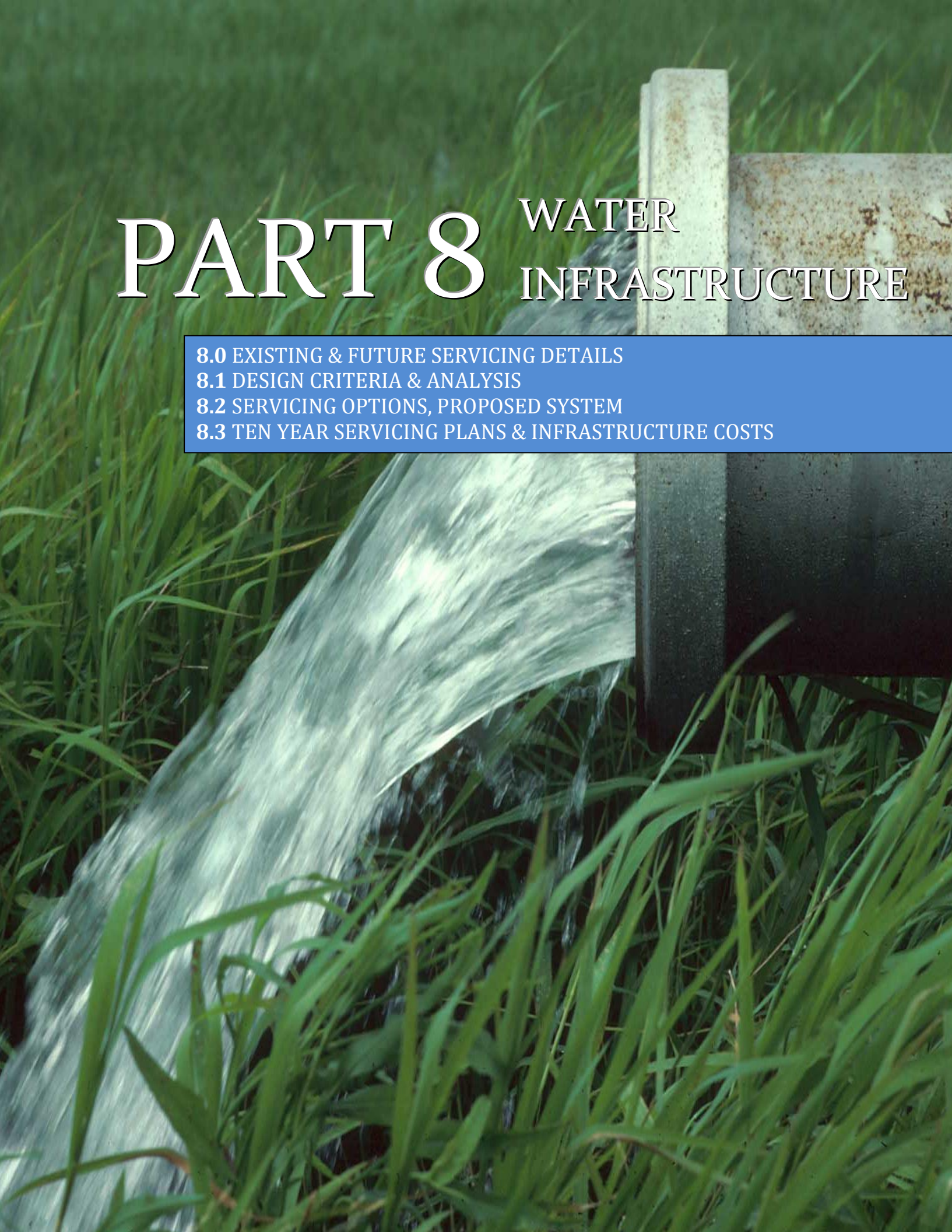
Sub-Catchment	Area (ha)	Discharge Point(s)			Peak Flows (24 hour duration) (m^3/s)		Trunk Storm Sewer Data	Pond Data	Other Requirements
		Existing	Future	Acquisition/Construction Requirements	Existing	Future, with Controls Implemented	(Design Flows based on 30 minute duration storm)		Water Quality and LID Requirements, applicable throughout Anniedale-Tynehead Neighbourhood
W-1	121.1 (47.7)	Four unnamed creeks traverse the sub-catchment; all discharge to Serpentine River	Same	N/A	2 year: 1.22 5 year: 1.71 100 year: 3.18	2 year: 1.27 5 year: 1.73 100 year: 3.86	N/A	N/A	**Water Quality Controls:** • Remove >80% of Total Suspended Solids • Remove Oil & Grease to <10 mg/L Provide oil/water separators for parking lots in commercial, industrial, institutional and multi-family residential usage. **On-Site LID Requirements:** • Provide 300 mm of amended topsoil on all single family residential lawn areas; • Discharge roof leaders in single family residential lots directly to lawns (not to the storm sewer); and • Capture and retain on site 50% of the Mean Annual Rainfall depth (that is, 35 mm in 24 hours, which is equivalent to 350 m^3 per hectare of impervious surface) on all high density and multi-family residential, commercial and industrial lots. Typical capture volumes for various land use designations are: • Village commercial (90% impervious) – 315 m3/ha • Cluster residential 4-6 upa (50% impervious) – 175 m3/ha • Cluster residential 6-10 upa (57% impervious) – 200 m3/ha • Cluster residential 10-15 upa (65% impervious) – 230 m3/ha • Low density urban 6-10 upa (57% impervious) – 200 m3/ha • Medium high density residential 10-15 upa (65% impervious) –
W-2	39.8 (23.1)	Discharge to west-flowing ditch, north side of 92 Ave	Same	N/A	2 year: 0.40 5 year: 0.56 100 year: 1.04	2 year: 0.43 5 year: 0.57 100 year: 1.37	**172 Street** Design flow (100 yr): 2.27 m^3/s Diameter: 750 mm Length: 150 m	N/A	
N-1	63.9	Discharge to upper Leoran Brook	Same	N/A	2 year: 0.50 5 year: 0.67 100 year: 1.06	2 year: 0.50 5 year: 0.67 100 year: 1.39	**97 Avenue** Design flow (100 yr): 2.14 m^3/s Diameter: 900 mm Length: 250 m **180 Street** Design flow (100 yr): 1.18 m^3/s Diameter: 1050 mm Length: 160 m **96 Avenue** Design flow (100 yr): 2.25 m^3/s Diameter: 1050 mm Length: 65 m	**Pond 7 (Detention Pond)** Design flow in (5 yr): 1.56 m^3/s Design flow out (pre-5yr): 0.67 m^3/s Active detention volume: 9,585 m^3 Estimated excavation volume: 23,000 m^3 Pond surface footprint at maximum stage: 6,420 m^2 Site footprint: 1.23 ha	
N-2	55.9	To Hwy 1 cross culvert	Same	N/A	2 year: 0.44 5 year: 0.58 100 year: 0.92	2 year: 0.44 5 year: 0.58 100 year: 1.22	**94 Avenue** Design flow (100 yr): 2.54 m^3/s Diameter: 1050 mm Length: 200 m **184 Street** Design flow (100 yr): 3.00 m^3/s Diameter: 1050 mm Length: 150 m **Along Hwy 1 Frontage** Design flow (100 yr): 3.28 m^3/s Diameter:1050 mm Length: 600 m	**Pond 8 (Water Quality Pond)** Design Flow (2 yr): 1.37 m^3/s Minimum water quality treatment volume: 2,500 m^3 Estimated excavation volume: 7,250 m^3 Pond surface footprint at maximum stage: 1,000 m^2 Site footprint: 0.50 ha Incorporate bypass system for flows exceeding the design flow	
E-1	30.9	Eastern and northern areas drain to ditch on west side of Harvie Rd, then to unnamed branch of	Same	Ditch improvements, as required, to ditch along Harvie Rd (100 m); to be	2 year: 0.50 5 year: 0.70 100 year: 1.41	2 year: 0.48 5 year: 0.70 100 year: 1.61	N/A	**Pond 6 (Detention Pond)** Design flow in (5 yr): 1.11 m^3/s Design flow out (pre-5yr): 0.70 m^3/s Active detention volume: 4,040 m^3 Estimated excavation volume: 11,720 m3	

Sub-Catchment	Area (ha)	Discharge Point(s)			Peak Flows (24 hour duration) (m^3/s)		Trunk Storm Sewer Data	Pond Data	Other Requirements
		Existing	Future	Acquisition/Construction Requirements	Existing	Future, with Controls Implemented	(Design Flows based on 30 minute duration storm)		Water Quality and LID Requirements, applicable throughout Anniedale-Tynehead Neighbourhood
		Old Sawmill Creek under the road; Western areas drain to ditches along 188 St and 189 St, which feed upper end of the same branch of Old Sawmill Creek		confirmed at design				Pond surface footprint at maximum stage: 3,100 m^2 Site footprint: 0.71 ha	230 m3/ha • Medium high density residential 15-25 upa (65% impervious) – 230 m3/ha • High density residential 25-45 upa (90% impervious) – 315 m3/ha • High density residential 30-45 upa (90% impervious) – 315 m3/ha • Industrial Low Impact (90% impervious) – 315 m3/ha • Industrial Business Park (90% impervious) – 315 m3/ha **Local Roads:** • Install parallel, exfiltration-type storm sewer systems • Provide 300 mm of amended topsoil in boulevards • Install in traffic calming bulges
S-1	16.1 (53.5)	Discharge to east-flowing ditch, north side of 92 Ave	Same	Ditch improvements, as required, west of Pond 1 site (in S-2) (200 m); to be confirmed at design	2 year: 0.46 5 year: 0.59 100 year: 0.85	2 year: 0.49 5 year: 0.67 100 year: 1.41	N/A	N/A	
S-2	30.4	Discharge to east-flowing ditch, north side of 92 Ave, thence to Hwy 15 ditch	Same	Ditch improvements, as required (350 m); to be confirmed at design	2 year: 0.26 5 year: 0.33 100 year: 0.49	2 year: 0.32 5 year: 0.49 100 year: 1.53	**173A Street** Design flow (100 yr): 3.08 m^3/s Diameter: 900 mm Length: 150 m	**Pond 1 (Water Quality Pond)** Design Flow (2 yr): 0.32 m^3/s Minimum water quality treatment volume: 1,370 m^3 Estimated excavation volume: 3,975 m^3 Pond surface footprint at maximum stage: 1,125 m^2 Site footprint: 0.64 ha	
S-3	64.6	To Hwy 15 ditches	Same	N/A	2 year: 0.56 5 year: 0.71 100 year: 1.03	2 year: 0.68 5 year: 1.03 100 year: 3.24	**177 Street** Design flow (100 yr): 0.84 m^3/s Diameter: 600 mm Length: 170 m **92 Avenue** Design flow (100 yr): 0.92 m^3/s Diameter:750 mm Length: 150 m **176 Street / Hwy 15** Design flow (100 yr): 3.87 m^3/s Diameter: 900 mm Length: 350 m	**Pond 2 (Water Quality Pond)** Design Flow (2 yr): 0.68 m3/s Minimum water quality treatment volume: 2,900 m^3 Estimated excavation volume: 8,410 m^3 Pond surface footprint at maximum stage: 1,160 m^2 Site footprint: 0.74 ha Incorporate bypass system for flows exceeding the design flow	
S-4	32.6	To lowland ditch within narrow (10 m) 180 St ROW	Same	Acquire additional 5 m ROW along existing 10 m ROW (400 m) and improve ditch, as required, south to 88 Ave (400 m);	2 year: 0.28 5 year: 0.36 100 year: 0.52	2 year: 0.34 5 year: 0.52 100 year: 1.64	**180 Street** Design flow (100 yr): 0.63 m^3/s Diameter:450 mm Length: 150 m **180 Street** Design flow (100 yr): 1.50 m^3/s Diameter:525 mm	**Pond 3 (Water Quality Pond)** Design Flow (2 yr): 0.34 m^3/s Minimum water quality treatment volume: 1,470 m^3 Estimated excavation volume: 4,250 m^3 Pond surface footprint at maximum stage: 590 m^2 Site footprint: 0.47 ha	

Sub-Catchment	Area (ha)	Discharge Point(s)			Peak Flows (24 hour duration) (m^3/s)		Trunk Storm Sewer Data	Pond Data	Other Requirements
		Existing	Future	Acquisition/Construction Requirements	Existing	Future, with Controls Implemented	(Design Flows based on 30 minute duration storm)		Water Quality and LID Requirements, applicable throughout Anniedale-Tynehead Neighbourhood
				to be confirmed at design			Length: 270 m	Incorporate bypass system for flows exceeding the design flow	
S-5	30.7	Ditch and short section (200 m) of 450 mm storm sewer along 184 St	Same	Remove storm sewer and restore / improve ditch system south to 88 Ave (400 m); to be confirmed at design (Note: Work could be coordinated with upgrade of 184 St in future)	2 year: 0.27 5 year: 0.34 100 year: 0.49	2 year: 0.32 5 year: 0.49 100 year: 1.54	**184 Street** Design flow (100 yr): 3.47 m^3/s Diameter:900 mm Length: 290 m	**Pond 4 (Water Quality Pond)** Design Flow (2 yr): 0.32 m^3/s Minimum water quality treatment volume: 1,380 m^3 Estimated excavation volume: 4,000 m^3 Pond surface footprint at maximum stage: 550 m^2 Site footprint: 0.46 ha Incorporate bypass system for flows exceeding the design flow	
S-6	18.5	Ditch along west side of 187 St	Same	Ditch improvements, as required south to culvert under Harvie Rd (250 m); to be confirmed at design	2 year: 0.16 5 year: 0.20 100 year: 0.30	2 year: 0.19 5 year: 0.30 100 year: 0.93	N/A	**Pond 5 (Water Quality Pond)** Design Flow (2 yr): 0.19 m^3/s Minimum water quality treatment volume: 830 m^3 Estimated excavation volume: 2,410 m^3 Pond surface footprint at maximum stage: 375 m^2 Site footprint: 0.45 ha Incorporate bypass system for flows exceeding the design flow	

Notes:

1. Refer to **Figures 7.7A and 7.7B** for general layout of proposed trunk storm sewers and ponds.
2. Areas listed in parentheses are for the NCP portion of the sub-catchment only.
3. Ditch improvements include general cleaning, establishing consistent cross section and profile slope, and minor capacity expansion, as required.
4. Pond footprints are based on a minimum 10 m buffer around the pond at maximum stage plus 600 mm freeboard.
5. Sizes and dimensions for trunk sewers and ponds are preliminary and must be confirmed at desig



PART 8 WATER INFRASTRUCTURE

PART 8: WATER INFRASTRUCTURE

8.0 EXISTING AND FUTURE SERVICING DETAILS

Existing System

The existing water system for the study area is shown on **Figure 8.1**, along with the study area boundary. The majority of the Anniedale-Tynehead NCP area is currently serviced by private wells, with a small portion of the area being serviced from small diameter City water mains which connect to the existing 525mm City feeder main on 96 Avenue. The existing system in the study area operates within the 90m HGL (Hydraulic Grade Line) pressure zone.

The aforementioned 525mm City feeder main supplies the existing North Port Kells industrial area, as well as the existing residential areas north of Hwy 1 and north of the study area. The existing 525mm main is directly connected to the main Metro Vancouver supply trunk at 95 Avenue and 164 Street. It should be noted that the existing 525mm main on 96 Avenue was financed by and committed to service the North Port Kells area only. As such, no capacity from this main has been allocated to provide service to the Anniedale-Tynehead area.

No reservoirs are located in the Anniedale-Tynehead area. Metro Vancouver is proposing to construct a new reservoir in Fleetwood with an estimated in-service date of 2017. The new reservoir would be located off Fleetwood Way in Meagan Anne MacDougall Park and have a Top Water Level (TWL) of 96m. For the purpose of the analysis for this study, an average HGL of 94m was assumed to be provided from the new reservoir.

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Legend

- NCP Area
- Existing Water Main
- Hydrant

Anniedale/Tynehead NCP
Stage 2

Existing Water System

Figure 8.1

URBANSYSTEMS.

0 250 500 1,000
Metres

U:\Projects_VAN\1072\0173\01\D-Drafting-Design-Analysis\GIS\Projects\mxds\Water_Figures_Stage_2\Figure 1 - Overview.mxd Last revised by sfadum on 06/04/2011 at 1:21:15 PM

Future System

The Anniedale-Tynehead area is expected to be redeveloped over a 30 year horizon and include a mix of land uses from industrial to high-density residential. As such, the Anniedale-Tynehead area will need an extensive water distribution system to support development.

Due to the topography within the study area, two separate pressure zones are proposed. The existing 90m HGL pressure zone, and a higher 135m HGL pressure zone. With an operating HGL of 94m, it is assumed that the proposed Fleetwood reservoir will supply the lower 90m pressure zone by gravity.

In order for the Fleetwood Reservoir to supply the upper pressure zone, a booster station would be required. However, an alternate supply source from upstream of the existing Cherry Hill Pressure Reducing Valve (PRV) would be available to supply water to the upper pressure zone of the Anniedale-Tynehead area. This connection point receives water from the City's Whalley Pump Station, which operates at an HGL of 135m. This connection could provide supply to the higher pressure zone without additional pressure boosting. The Cherry Hill connection is proposed to service the upper pressure zone of the Anniedale-Tynehead area to build-out. Further details are provided in subsequent sections.

8.1 DESIGN CRITERIA AND ANALYSIS

Design Criteria

The City of Surrey Design Criteria Manual has been utilized for the establishment of the servicing criteria for this NCP. A summary of key applicable design criteria is presented below with some criteria modified, for the specific requirements of the NCP

- Average Day Demand (ADD) of 500 L/cap/day
- Maximum Day Demand (MDD) of 1,000 L/cap/day
- Peak Hour Demand (PHD) of 2,000 L/cap/day
- Hazen-Williams Coefficient of 125 for all water mains 250mm nominal diameter and larger
- Hazen-Williams Coefficient of 100 for all water mains 200mm nominal diameter and smaller
- A minimum required residual of 28m hydraulic head (275 kPa) at all nodes under PHD
- A minimum required residual fire flow pressure (Pff) at the fire flow node of the greater of:
  a) 14m or
  b) $P_{ff} = 7 + 1083*Q^2$ m (where Q is the flow rate through each hydrant in m^3/s)
- A minimum residual fire flow pressure at all non-fire flow nodes of 14m within 400m of flow hydrant, 21m outside.
- Fire Flow Design Requirements derived from Table 3.2(b) of the Design Criteria Manual
- Hydraulic grade in mains larger than 250mm diameter shall not exceed 0.5%
- The velocity of flow shall not exceed 2 m/s for PHD ultimate design flows

- Interim fire flow velocity shall not exceed 3.25 m/s
- The minimum size of a new water main shall be 200 mm nominal diameter, except in the City and Town Centers where the minimum size of a new water main shall be 250mm nominal diameter. Minimum size of water main servicing any industrial zoned lots shall be 300mm nominal diameter.

Servicing Strategy

The following guidelines were followed in developing a conceptual layout of the water system for the study area:

- Provide service to all lots
- Ensure there are no dead-end mains in the system, except in single family residential cul-de-sacs where the length is limited to no more than 100m and the maximum water main size is 100mm
- Limit hydrant spacing to a maximum 200m on all fronting roads

Figure 8.2a outlines the conceptual layout of the future trunk water system. **Figure 8.2b** outlines the conceptual layout of the future local water system; and **Figure 8.2c** outlines the total future water system. The figures outline supply sources for the various analysis scenarios, as well as PRV locations.

Water main alignments have been based on the conceptual road network layout for Land Use Option C (December, 2010). The proposed boundary of the 135m HGL pressure zone is also shown on the figures. The alignment of the pressure zone boundary has been based on current topography to provide service to build-out of the upper pressure zone.

The feeder main system (**Figure 8.2a**) for Anniedale-Tynehead will consist of a loop around the core of the study area which runs east-west on 92 Avenue and 96 Avenue from 168 Street to 180 Street, extending to Harvie Road on 92 Avenue. Feeder main also runs north-south on 168 Street and 180 Street from 92 Avenue to 96 Avenue. In order to account for providing service to the Port Kells area, a nominal length of feeder main was accounted for in the analysis, which would extend to the core of Port Kells. The cost for infrastructure required to service the Port Kells area is presented separately from the total costs, as Port Kells is not included in the Anniedale-Tynehead study area. This is discussed further in subsequent sections.

As previously noted, the future Fleetwood Reservoir is proposed to be the main supply source for the lower pressure zone in Anniedale-Tynehead under normal operating conditions. The proposed Cherry Hill Connection is proposed to be the sole supply source for the upper pressure zone in Anniedale-Tynehead under normal operating conditions.

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Cherry Hill Connection
For 135m HGL Pressure Zone

Fleetwood Reservoir
(94m HGL) for 90m HGL
Pressure Zone

Port Kells

Legend

- NCP Area
- 135m HGL Pressure Zone (all other areas 90m HGL)
- Proposed Feeder Main
- Cherry Hill Supply Main
- Fleetwood Supply Main
- PRV
- Contour (5m Interval)

Anniedale/Tynehead NCP
Stage 2

Future Major Water System (Build Out)

Figure 8.2a

0 250 500 1,000
Metres

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Legend

- NCP Area
- 135m HGL Pressure Zone (all other areas 90m HGL)
- 200 Ø
- 250 Ø
- 300 Ø
- Water Main upsized to 300 Ø (see note below)
- Contour (5m Interval)

Note: In recognition that the ultimate looped system will be constructed over time, with some areas requiring larger pipes to provide adequate service and fire protection in the interim, some local water mains have been upsized from minimum sizes to account for staged development.

Anniedale/Tynehead NCP Stage 2

Future Local Water System (Build Out)

Figure 8.2b

0 250 500 1,000
Metres

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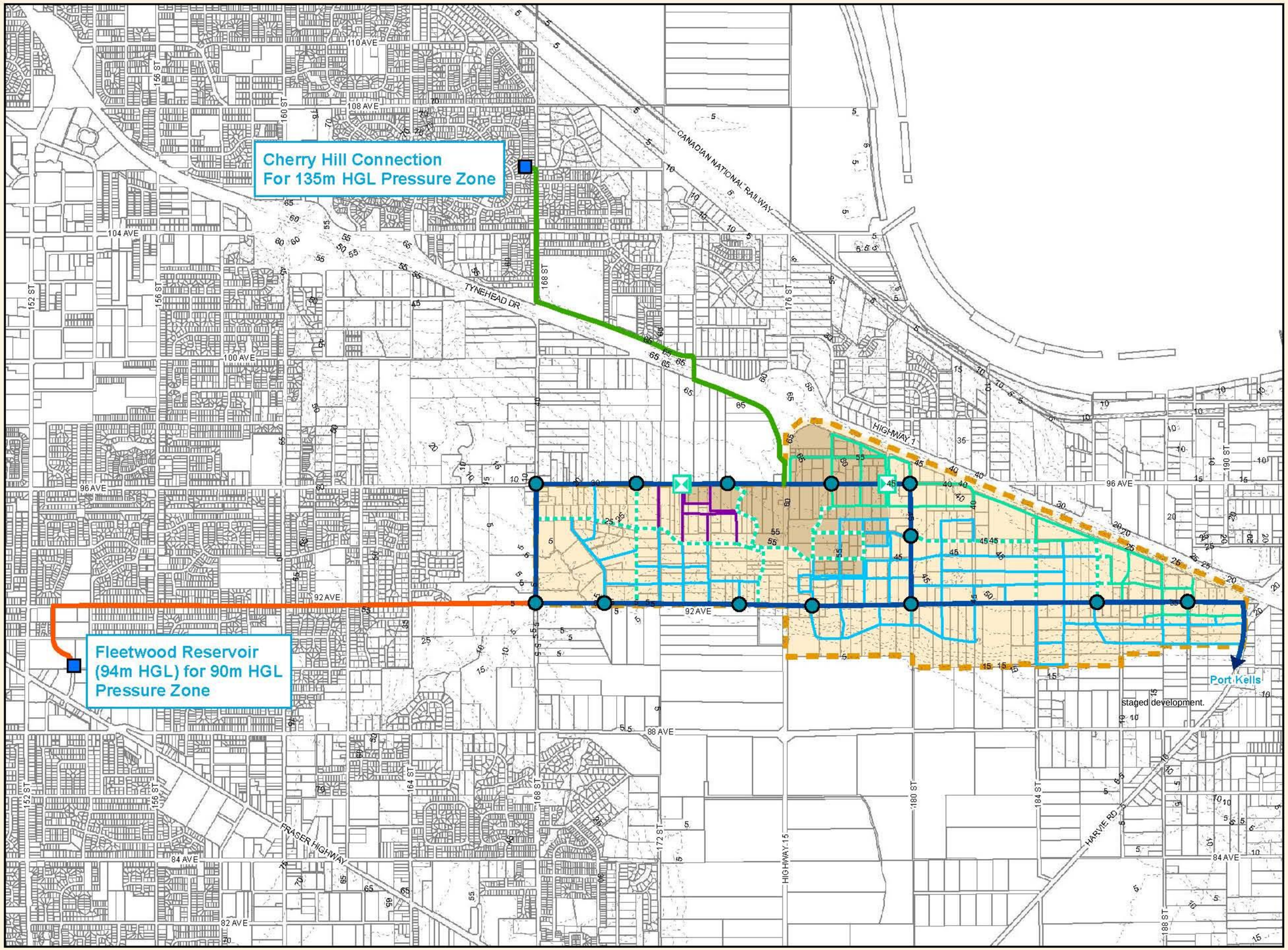

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Legend

- NCP Area
- 135m HGL Pressure Zone (all other areas 90m HGL)
- 200 Ø
- 250 Ø
- 300 Ø
- Water Main upsized to 300 Ø (see note below)
- Proposed Feeder Main
- Cherry Hill Supply Main
- Fleetwood Supply Main
- PRV
- Contour (5m Interval)
- Assumed (modeled) Local System Connections to Trunk Main (Actual connection points to be confirmed as part of design).

Note: In recognition that the ultimate looped system will be constructed over time, with some areas requiring larger pipes to provide adequate service and fire protection in the interim, some local water mains have been upsized from minimum sizes to account for

Anniedale/Tynehead NCP Stage 2

Future Water System (Build Out)

Figure 8.2c

URBANSYSTEMS.

0 250 500 1,000
Metres

As the Fleetwood Reservoir has an estimated in-service date of 2017, any development occurring in the lower pressure zone prior to the new reservoir coming online could be fed through a PRV via the Cherry Hill Connection. This connection would be considered as a temporary supply source only. PRVs between the two pressure zones will remain in place for future conditions for emergency supply only, with no inter-pressure zone flow under normal demand scenarios.

No hydrants or service connections will be connected directly from the proposed feeder mains. The local water system as shown on **Figure 8.2b** includes mains that run parallel to the trunk infrastructure. All hydrant and service connections are to be made from these local mains.

It is recognized that the ultimate looped system will be constructed over time and some areas will require larger pipes to provide adequate service and fire protection in the interim. As such, a number of water mains in the local water system have been upsized from their minimum required sizes (based on a grid system capable of servicing the ultimate development) in order to account for staged development. The upsized mains are shown on **Figure 8.2b**.

There would be a number of required connections between the feeder main system and local water main system for water distribution. For the purposes of this study, several connections were made, which are shown on **Figure 8.2c**. These connection locations are only conceptual in nature. The actual connection locations may differ than those shown, and should be confirmed through the preliminary and detailed design stages.

Model Analysis

The City of Surrey - North Surrey Distribution System model (Bentley WaterCAD V8*i)*, was used to complete the analysis. Review of the water system included analysis of 3 separate, strategically selected development horizons. These include:

- Initial development scenario
  - Includes anticipated development in the initial short term (1-2 year timeframe)
- 2016 development horizon scenario
  - Includes all anticipated development to occur prior to the commissioning of the Fleetwood Reservoir (est. 2017)
- Full build-out scenario
  - Includes full development to build-out of the study area

Table 8.1 below outlines the anticipated development phasing in the Anniedale-Tynehead area.

Table 8.1: Anticipated Development Phasing (2012)

Development	Implementation Year	Phase
Tynehead – commercial	2012 – 2015	1a
Tynehead – residential	2014 – 2018	1b
Anniedale A – West 1 **Anniedale A – East 1** **Anniedale B1**	2016 – 2024	2a*
Anniedale B4 **Anniedale A – West 2**	2016 – 2024	2b*
Anniedale B3	2025 – 2031	3
Anniedale B2	2031 – 2041	4
Port Kells	2041+	5

*2a or 2b could proceed before the other.

The following capacities (domestic flow under PHD) are available from the Cherry Hill Connection for the listed scenarios (see **Table 8.2**). Required fire flows are confirmed to be available from this supply point at build-out. The available capacity is greatest under the initial development scenario and decreases over time due to other increased City demands.

Table 8.2 Cherry Hill Connection Available Domestic Capacity

Development Scenario	Capacity (L/s) under PHD
Initial development scenario	200
2016 development horizon scenario	120
Full build-out scenario	120

Although the available capacity under PHD for the initial development scenario is 200 L/s, as the capacity reduces to 120 L/s beyond 2016, 120 L/s is considered as the maximum available domestic flow capacity for all development scenarios. Demands are summarized in the subsequent sections.

To build the model, the proposed Anniedale-Tynehead bulk water supply and feeder main infrastructure was incorporated into the existing North Surrey model. The model was then used to size the feeder mains to meet both PHD and MDD + Fire Flow conditions. The model was also used to model required PRVs.

As no reservoirs are proposed to be constructed in the Anniedale-Tynehead area, supply infrastructure has been sized to provide the higher flow between PDD and MDD + fire flow. PRVs have been configured to provide the required zone HGL. PRVs separating the pressure zones have been configured for ultimate emergency supply only, with no inter-pressure zone flow under normal demand scenarios. However, the PRVs may provide domestic and fire flow to the lower pressure zone, on a temporary basis, via the Cherry Hill Connection Supply point, as noted previously.

The local pipe distribution system (as shown in **Figure 8.2b**) was modeled as part of the analysis to confirm fire flow delivery adequacy.

Load Allocation

Domestic demands were allocated to 12 nodes (11 in the Anniedale-Tynehead study area, and 1 in the Port Kells area). Fire flows were also allocated to the nodes, along with 5 other nodes (to ensure adequate fire flow coverage). The demand allocation nodes are shown on **Figure 8.3**, along with corresponding service areas. Node elevations used in the analysis correspond to the highest development parcel elevation to ensure that the pressure requirements are met at all points within each service area.

The proposed land use and estimated residential populations were used to estimate future water demands for the Anniedale-Tynehead area. The anticipated demands from Institutional, Commercial and Industrial (ICI) areas were estimated using an Equivalent Population Factor of 90 PPha as per Table 2.6 in the City of Surrey Engineering Department Design Criteria Manual.

The residential population for the 171 ha Port Kells area was estimated per the methodology outlined in the **Sanitary Sewer Part 6.1.**

The total equivalent build-out population is presented in **Table 8.3** and categorized by service area. Unit rates per the listed design criteria were applied to the populations to determine respective demands for each service area.

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Legend

- Service Area
- Proposed Feeder Main
- Node For Model
- PRV

Anniedale/Tynehead NCP
Stage 2

Water Service Areas

Figure 8.3

URBANSYSTEMS.

0 250 500 1,000
Metres

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Table 8.3. Full Build Out Population

Service area	Estimated Population	ICI Equivalent Population	Total Equivalent Population
1	915	0	915
2	2,152	561	2,713
3	1,436	482	1,918
4	2,764	351	3,115
5	0	2,053	2,053
6	2,993	0	2,993
7	0	761	761
8	2,098	154	2,252
9	2,758	196	2,954
10	5,334	518	5,852
11	1,197	1,314	2,511
Port Kells	8,600	0	8,600
TOTAL	**30,247**	**6,390**	**36,637**

Initial Development Scenario

Based on City derived growth projections, the initial development has been identified to occur on the west side of 176 Street designated 'commercial'. The equivalent population for this area equates to 500 persons at build-out. The estimated current population in the Anniedale-Tynehead area is 1,540. Therefore, the anticipated total serviced population for this scenario is 2,040 persons.

It should be noted that while the existing population has been included in calculating the anticipated maximum demand for this scenario, existing services on existing water mains and existing wells would remain in service until new fronting infrastructure (from new supply connections) is constructed.

2016 Scenario

City derived growth projections estimate an increase in residential population in the Anniedale-Tynehead study area of 1,000 persons. If we include the equivalent population of 500 persons from the initial commercial development west of 176 Street, the anticipated total serviced population for this scenario is 3,040 persons.

Fire Flow Requirements

Fire flow demand is based on the highest required fire flow for all land use types within each service area. **Table 8.4** outlines the fire flow requirements of each service area.

Table 8.4 Fire Flow Requirements per Demand Service Area

Service Area	Junction	Land Use / Zoning with Highest Fire Flow Demand	Required Fire Flow (L/s)
1	Cat-1	Cluster Residential, 6-10	120
2	Cat-2	High Density Residential, 25-45	120
3	Cat-3	High Density Residential, 25-45	120
4	Cat-4	Commercial	120
5	Cat-5	Industrial	250
6	Cat-6	High Density Residential, 25-45	120
7	Cat-7	Industrial	250
8	Cat-8	High Density Residential, 25-45	120
9	Cat-9	Cluster Residential, 10-15	120
10	Cat-10	Industrial	250
11	Cat-11	Industrial	250
Port Kells	Port Kells	Village Commercial	90

** Fire flows above 120 L/s are assumed to be delivered via a minimum of 2 hydrants.*

Supply Capacity

As previously noted, the maximum available capacity of the Cherry Hill connection is 120 L/s. This capacity is meant to supply only the upper 135m HGL pressure zone in the study area at build-out. However, in the interim, this capacity could be used to provide service to all areas within Anniedale-Tynehead on a first come, first served basis until the capacity is reached, which will be prioritized by a completed building permit.

In order for part of this capacity to service the lower 90m HGL pressure zone on an interim basis, at least one PRV would need to be constructed. It is assumed that the PRV(s) and all associated infrastructure required to service development in the 90m HGL pressure zone would be front-ended or constructed via a latecomer agreement where appropriate.

The 120 L/s capacity (PHD) equates to an equivalent population of 5,184 persons. Once the demand from the supply has reached this limit, any new services will need to be serviced from an alternate source (ie. Fleetwood Reservoir). As development proceeds towards build-out, the Cherry Hill connection will become the sole supply for the upper pressure zone, and the Fleetwood Reservoir will become the sole supply for the lower pressure zone.

It should be noted that once the maximum capacity of the Cherry Hill connection is reached, a developer and/or the City may be required to frontend the cost of the Fleetwood Supply Infrastructure to support any additional development.

Analysis Results
Analysis results are presented on **Figure 8.4** and **Figure 8.5**. Both figures outline node information such as available fire flows and residual pressures.

8.2 SERVICING OPTIONS, PROPOSED SYSTEM AND COSTS

Full Build-Out
Analysis results for the Full Build-Out scenario are presented on **Figure 8.4**. As shown on the figure, the connection from the future Fleetwood Reservoir is sized at 750mm diameter. This diameter is needed in order to limit the maximum pipe velocity to 2 m/s (which occurs under PHD). The Cherry Hill Connection to the study area is sized at 450mm diameter. This diameter is needed to meet MDD + Fire Flow requirements.

The remaining feeder main system has been sized to meet PHD pressure and MDD + fire flow requirements. Feeder mains vary in size from 300mm to 750mm in diameter. PRVs are shown on the feeder mains at the boundary between the 90m and 135m HGL pressure zones.

For the 90m HGL pressure zone, both PHD pressure requirements and MDD + fire flows can be supplied from the Fleetwood Reservoir without the need for additional pressure boosting. The 135m HGL pressure zone can also be supplied both PHD pressure requirements and MDD + fire flows via the Cherry Hill Connection without the need for additional pressure boosting.

Start Node	Stop Node	Pipe ID	Length (m)	Nominal Diameter (mm)	Actual Diameter (mm)	Material	Hazen-Williams C	PIID		
								Flow (l/s)	Velocity (m/s)	Headloss Gradient (%)
Fleetwood	92-168	USL-01	3550	750	789.2	Ductile Iron	125	728.4	1.5	0.25
92-168	Cat-1	USL-02	445	750	789.2	Ductile Iron	125	665.6	1.4	0.21
Cat-1	Cat-3	USL-03	860	750	789.2	Ductile Iron	125	644.5	1.3	0.20
Cat-3	Cat-6	USL-04	475	750	789.2	Ductile Iron	125	600.1	1.2	0.17
Cat-6	Cat-9	USL-05	625	750	789.2	Ductile Iron	125	530.8	1.1	0.14
Cat-9	Cat-10	USL-06	955	600	633.7	Ductile Iron	125	392.7	1.2	0.23
Cat-10	Cat-11	USL-07	780	450	474.7	Ductile Iron	125	257.2	1.5	0.43
Cat-11	Port Kells	USL-08	2380	450	474.7	Ductile Iron	125	199.1	1.1	0.27
92-168	96-168	USL-09	760	350	369.6	Ductile Iron	125	62.8	0.6	0.11
96-168	Cat-2	USL-10	775	300	318	Ductile Iron	125	62.8	0.8	0.22
Cat-2	96-173 A-90m HGL	USL-11	320	300	318	Ductile Iron	125	0.0	0.0	0.00
96-173 A-90m HGL	PRV-96	USL-12	15	300	318	Ductile Iron	125	0.0	0.0	0.00
Cherry Hill	Hwy 15-96	USL-13	3180	450	474.7	Ductile Iron	125	119.6	0.7	0.10
Hwy 15-96	Cat-4	USL-14	355	300	318	Ductile Iron	125	72.1	0.9	0.28
Cat-4	96-173 A-135m HGL	USL-15	125	300	318	Ductile Iron	125	0.0	0.0	0.00
96-173 A-135m HGL	PRV-96	USL-16	10	300	318	Ductile Iron	125	0.0	0.0	0.00
Hwy 15-96	Cat-5	USL-17	350	450	474.7	Ductile Iron	125	47.5	0.3	0.02
Cat-5	PRV-180	USL-18	310	300	318	Ductile Iron	125	0.0	0.0	0.00
PRV-180	Cat-7	USL-19	135	300	318	Ductile Iron	125	0.0	0.0	0.00
Cat-7	Cat-8	USL-20	345	350	369.6	Ductile Iron	125	17.6	0.2	0.01
Cat-8	Cat-9	USL-21	425	350	369.6	Ductile Iron	125	69.7	0.4	0.13

Node Name	Elevation[1] (m)	PHD			MDD			MDD +Fire Flow			
		Total Service Area Demand (L/s)	Hydraulic Grade (m)	Residual Pressure[1] (m)	Demand (L/s)	Hydraulic Grade (m)	Residual Pressure[1] (m)	Fire Flow Required (L/s)	Required Residual Pressure[1] (m)	Available Fire Flow (L/s)	Residual Pressure[1] at Required Fire Flow (m)
92-168	4.0	0.0	85.1	80.9	0.0	91.5	87.4	60.0	14.1	>500	86.6
96-168	12.5	0.0	84.3	71.6	0.0	91.3	78.7	120.0	22.6	317.3	73.1
96-173A -90m HGL	50.0	0.0	82.6	32.5	0.0	90.8	40.8	120.0	22.6	129.7	24.7
96-173A -135m HGL	50.0	0.0	106.0	55.9	0.0	127.1	76.9	120.0	22.6	180.2	57.2
Cat-1	30.0	21.2	84.2	54.1	10.6	91.3	61.2	120.0	22.6	>500	59.2
Cat-2	50.0	62.8	82.6	32.5	31.4	90.8	40.8	120.0	22.6	144.1	27.0
Cat-3	53.5	44.4	82.5	28.9	22.2	90.8	37.2	120.0	22.6	>500	35.0
Cat-4	61.0	72.1	106.0	44.9	36.1	127.1	65.9	120.0	22.6	222.1	48.4
Cat-5	64.5	47.5	106.9	42.3	23.8	127.3	62.7	250.0	23.9	244.7	22.7
Cat-6	52.0	69.3	81.7	29.6	34.6	90.6	38.5	120.0	22.6	>500	36.0
Cat-7	47.0	17.6	80.2	33.2	8.8	90.2	43.1	250.0	23.9	255.1	24.5
Cat-8	49.0	52.1	80.3	31.2	26.1	90.2	41.1	120.0	22.6	307.7	36.2
Cat-9	45.0	68.4	80.8	35.7	34.2	90.3	45.3	120.0	22.6	>500	42.5
Cat-10	50.0	135.5	78.5	28.5	67.7	89.7	39.6	250.0	23.9	396.9	31.0
Cat-11	42.0	58.1	75.2	33.2	29.1	88.1	46.0	250.0	23.9	278.9	26.9
Hwy15 - 96	63.0	0.0	107.0	43.9	0.0	127.4	64.2	250.0	23.9	260.6	26.3
Port Kells	20.0	199.1	84.1	44.0	99.5	85.0	64.9	90.0	15.8	384.5	57.0

1 - Applies to highest development parcel elevation within the service area

Cherry Hill Connection For 135m HGL Pressure Zone

Fleetwood Reservoir (94m HGL) for 90m HGL Pressure Zone

Upper Pressure Zone
Total PHD = 119.6 L/s
MDD + Max Fire Flow = 309.8 L/s

Lower Pressure Zone
Total PHD = 728.4 L/s
MDD + Max Fire Flow = 614.2 L/s

96-173A-135m HGL
96-173A-90m HGL
96-168
Cat-2
Cat-4
Cat-5
Cat-7
Hwy 15-96
Cat-8
92-168
Cat-1
Cat-3
Cat-6
Cat-9
Cat-10
Cat-11
Port Kells

110 AVE
108 AVE
104 AVE
100 AVE
96 AVE
92 AVE
84 AVE
82 AVE
156 ST
160 ST
168 ST
176
180 ST
184 ST
188 ST
190 ST
TYNEHEAD DR
HIGHWAY 1
FRASER HIGHWAY
HARVIE RD

Legend

- NCP Area
- 135m HGL Pressure Zone (all other areas 90m HGL)
- 300 Ø
- 350 Ø
- 450 Ø
- 500 Ø
- 600 Ø
- 750 Ø
- Node For Model
- PRV

Anniedale/Tynehead NCP
Stage 2

Water Model Results Full Build Out

Figure 8.4

0 500 1,000 2,000
Metres

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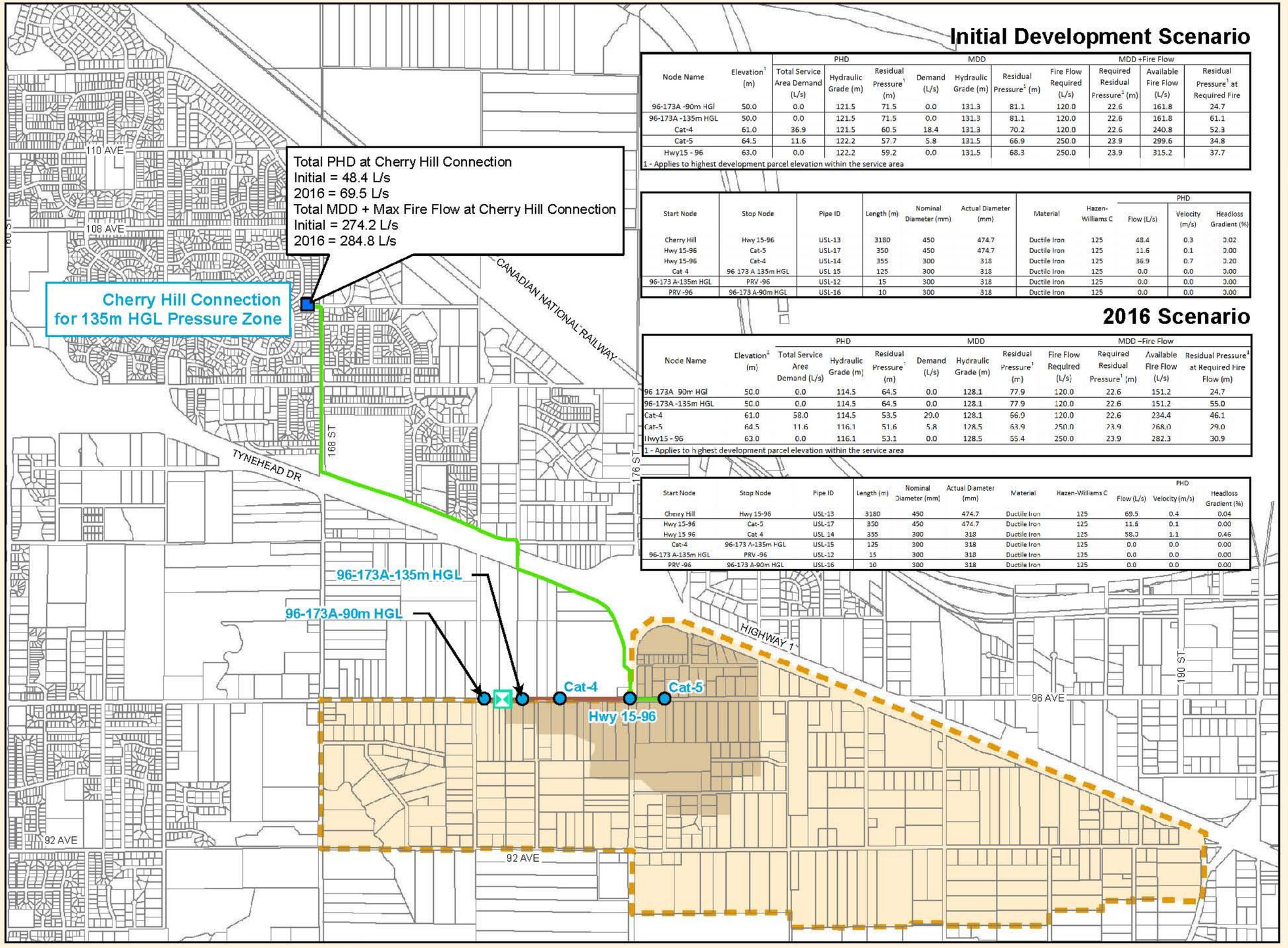

Initial Development Scenario

Node Name	Elevation[1] (m)	PHD Total Service Area Demand (L/s)	PHD Hydraulic Grade (m)	PHD Residual Pressure[1] (m)	MDD Demand (L/s)	MDD Hydraulic Grade (m)	MDD Residual Pressure[1] (m)	MDD +Fire Flow Fire Flow Required (L/s)	MDD +Fire Flow Required Residual Pressure[1] (m)	MDD +Fire Flow Available Fire Flow (L/s)	MDD +Fire Flow Residual Pressure[1] at Required Fire
96-173A -90m HGl	50.0	0.0	121.5	71.5	0.0	131.3	81.1	120.0	22.6	161.8	24.7
96-173A -135m HGL	50.0	0.0	121.5	71.5	0.0	131.3	81.1	120.0	22.6	161.8	61.1
Cat-4	61.0	36.9	121.5	60.5	18.4	131.3	70.2	120.0	22.6	240.8	52.3
Cat-5	64.5	11.6	122.2	57.7	5.8	131.5	66.9	250.0	23.9	299.6	34.8
Hwy15 - 96	63.0	0.0	122.2	59.2	0.0	131.5	68.3	250.0	23.9	315.2	37.7

1 - Applies to highest development parcel elevation within the service area

Start Node	Stop Node	Pipe ID	Length (m)	Nominal Diameter (mm)	Actual Diameter (mm)	Material	Hazen-Williams C	PHD Flow (L/s)	PHD Velocity (m/s)	PHD Headloss Gradient (%)
Cherry Hill	Hwy 15-96	USL-13	3180	450	474.7	Ductile Iron	125	48.4	0.3	0.02
Hwy 15-96	Cat-5	USL-17	350	450	474.7	Ductile Iron	125	11.6	0.1	0.00
Hwy 15-96	Cat-4	USL-14	355	300	318	Ductile Iron	125	36.9	0.7	0.20
Cat 4	96 173 A 135m HGL	USL 15	125	300	318	Ductile Iron	125	0.0	0.0	0.00
96-173 A-135m HGL	PRV -96	USL-12	15	300	318	Ductile Iron	125	0.0	0.0	0.00
PRV -96	96-173 A-90m HGL	USL-16	10	300	318	Ductile Iron	125	0.0	0.0	0.00

2016 Scenario

Node Name	Elevation[1] (m)	PHD Total Service Area Demand (L/s)	PHD Hydraulic Grade (m)	PHD Residual Pressure[1] (m)	MDD Demand (L/s)	MDD Hydraulic Grade (m)	MDD Residual Pressure[1] (m)	MDD –Fire Flow Fire Flow Required (L/s)	MDD –Fire Flow Required Residual Pressure[1] (m)	MDD –Fire Flow Available Fire Flow (L/s)	MDD –Fire Flow Residual Pressure[1] at Required Fire Flow (m)
96 173A -90m HGl	50.0	0.0	114.5	64.5	0.0	128.1	77.9	120.0	22.6	151.2	24.7
96-173A -135m HGL	50.0	0.0	114.5	64.5	0.0	128.1	77.9	120.0	22.6	151.2	55.0
Cat-4	61.0	58.0	114.5	53.5	20.0	128.1	66.9	120.0	22.6	234.4	46.1
Cat-5	64.5	11.6	116.1	51.6	5.8	128.5	63.9	250.0	23.9	268.0	29.0
Hwy15 - 96	63.0	0.0	116.1	53.1	0.0	128.5	65.4	250.0	23.9	282.3	30.9

1 - Applies to highest development parcel elevation within the service area

Start Node	Stop Node	Pipe ID	Length (m)	Nominal Diameter (mm)	Actual Diameter (mm)	Material	Hazen-Williams C	PHD Flow (L/s)	PHD Velocity (m/s)	PHD Headloss Gradient (%)
Cherry Hill	Hwy 15-96	USL-13	3180	450	474.7	Ductile Iron	125	69.5	0.4	0.04
Hwy 15-96	Cat-5	USL-17	350	450	474.7	Ductile Iron	125	11.6	0.1	0.00
Hwy 15 96	Cat 4	USL 14	355	300	318	Ductile Iron	125	58.0	1.1	0.46
Cat-4	96-173 A-135m HGL	USL-15	125	300	318	Ductile Iron	125	0.0	0.0	0.00
96-173 A-135m HGL	PRV -96	USL-12	15	300	318	Ductile Iron	125	0.0	0.0	0.00
PRV -96	96-173 A-90m HGL	USL-16	10	300	318	Ductile Iron	125	0.0	0.0	0.00

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Legend

- NCP Area
- 135m HGL Pressure Zone (all other areas 90m HGL)
- 300 Ø
- 450 Ø
- Node For Model
- PRV

Anniedale/Tynehead NCP
Stage 2

Water Model Results Initial Development / 2016

Figure 8.5

0 500 1,000 2,000
Metres

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The PHD flow for build-out of the higher 135m HGL pressure zone is estimated to be 119.6 L/s, which is just below the estimated capacity of the Cherry Hill connection of 120 L/s. The PHD flow for build-out of the lower 90m HGL pressure zone is estimated to be 728.4 L/s.

Initial Development Scenario

Analysis results for the Initial Development scenario are presented on **Figure 8.5**. Due to the interim nature of this scenario, further analysis was not completed to determine required interim infrastructure. However, the total demand for the Initial Development Scenario is less than the total demand for the upper pressure zone at build-out. Feeder mains are only shown to the core of the proposed initial industrial development area, east of Highway 15, and to the west boundary of the upper pressure zone.

2016 Scenario

Analysis results for the 2016 scenario are also presented on **Figure 8.5**. Although this scenario assumes some development in the lower pressure zone, feeder mains are only shown to the same limits as described for the Initial Development Scenario. Any development in the lower pressure zone under this scenario would require additional trunk infrastructure. This additional infrastructure has been omitted in the presentation and costs, as the level and extent of development in the lower pressure zone for the 2016 scenario is unknown.

Table 8.5 summarizes flows (under PHD) from each of the supply sources for different development horizons.

Table 8.5. Supply Demands under PHD Flow

Development Horizon	Cherry Hill Connection	Fleetwood Reservoir
	PHD Flow (L/s)	PHD Flow (L/s)
Initial	48.4	N/A
2016	69.5	N/A
Build-Out	119.6	728.4

Port Kells

Although the new supply main from the proposed Fleetwood Reservoir and feeder main on 92 Avenue is required to service the lower pressure zone in Anniedale-Tynehead, extension of this infrastructure can also provide service to Port Kells. In order to account for an apportionment to Port Kells for this infrastructure, a separate analysis scenario was completed in WaterCAD to determine the upsizing requirements of adding future Port Kells demand to the system.

Costs

Costs associated with the Port Kells area are not included in the development scenario costs, and are provided separately. All costs provided below include 10% Engineering fees and a 5% allowance for tender increases (additional contingency is not included). Costs pertaining to permitting, RoW and land acquisition have been omitted. Note that costs do not include local distribution system costs (fronting mains). However, upsizing costs from minimum required pipe sizes for the local system have been accounted for and are included in the costs below. Detailed cost estimates are provided in **Appendix D** for reference.

Initial Development Scenario

Table 8.6 outlines costs for required trunk infrastructure from the proposed Cherry Hill Connection to service the upper pressure zone (135m HGL) in the Anniedale-Tynehead area. The limit of works is the core of the proposed industrial area east of Highway 15 and the western boundary of the upper pressure zone, immediately downstream of the 96 Avenue PRV. The costs below do not include any costs associated with the Fleetwood Reservoir or its connection to the Anniedale-Tynehead area.

Table 8.6 - Initial Development Trunk Infrastructure Costs

(Major Distribution System from Cherry Hill)

Subtotal Pipe Works	$ 3,374,200
Subtotal Other Fees/Works	$ 115,000
Construction Total	**$ 3,500,000**

Full Build-Out

Table 8.7 outlines the additional costs for required trunk infrastructure to fully service the Anniedale-Tynehead area at build-out. The costs below do not include the costs summarized in **Table 8.6**. Costs do not include any costs associated with construction of the proposed Fleetwood Reservoir by Metro Vancouver.

Table 8.7 Full Build-Out Trunk Infrastructure Costs

(Major Distribution System from Fleetwood)

Subtotal Pipe Works	$ 16,393,300
Subtotal Other Fees/Works	$ 115,000
Construction Total	**$ 16,600,000**

Port Kells

The above costs do not include the proposed 450mm diameter feeder water main from node 'Cat-11' to node 'Port Kells' (nominal distance to Port Kells core), as this section of water main is required to service the Port Kells area only. The cost of this section of water main is estimated to be **$2.1M**.

Apportioned costs for Port Kells for upsizing of infrastructure, as discussed in the previous section, are estimated to be **$1.4M** (upsizing of main from Fleetwood Reservoir to 'Cat-11').

Proposed System

The Cherry Hill Connection can adequately service proposed development of the upper pressure zone in Anniedale-Tynehead to final build-out. This supply connection could also potentially service the lower pressure zone in Anniedale-Tynehead through PRVs in the interim on a first come, first served basis, prior to commissioning of the Fleetwood Reservoir. However, the extent to which interim supply could be provided is dependent on the actual rate of growth, which is unclear at this time.

The proposed Fleetwood Reservoir will supply the lower pressure zone in Anniedale-Tynehead once the reservoir is commissioned. The trunk infrastructure has been sized to convey required flows via gravity, without the need for pressure boosting.

Refer to **Part 7.2** regarding Environmental Considerations and approvals when designing the proposed system.

Total cost for bulk water servicing to build-out is approximately **$20.1M**.

8.3 TEN YEAR SERVICING PLAN AND INFRASTRUCTURE COSTS

To satisfy anticipated peak hour demands and provide adequate fire flows, the Anniedale-Tynehead NCP will ultimately need a new reservoir in Fleetwood, additional feeder water mains, as well as new PRVs on 96th Avenue. As previously noted there are two Phases to service the Anniedale-Tynehead NCP excluding the Port Kells area. The initial development period is prior to the construction of the new Fleetwood reservoir and the full build-out scenario follows completion of the new reservoir. The construction cost of the initial development Phase is estimated at **$3.5 million** and the additional cost to allow for full build-out is estimated at **$16.6 million**. The total costs of DCC eligible infrastructure is **$20.1 million.**

Further details on the initial, full build-out development and Port Kells upsizing cost estimates are included in **Appendix D**.

10 Year Servicing Plan

There are no projects currently identified in the 10 Year Servicing Plan that fall within the study area.

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PART 9

SERVICES, AMENITIES & IMPLEMENTATION

Photo: Tynehead Cycling and Pedestrian Overpass Spanning Highway #1 at 168 St

PART 9: SERVICES, AMENITIES AND IMPLEMENTATION

9.0 COMMUNITY SERVICES AND AMENITIES

To address the amenity needs of the proposed new development in Anniedale-Tynehead, 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.

Parkland Development

The Anniedale-Tynehead community will contain six neighbourhood park sites, and several riparian areas and trails. The Open Space areas include the Lakiotis Ridge Trail, Green Timber Greenway, and a proposed trail by the Serpentine River.

Entrance features are planned in three areas of the plan. One will be located at 172 Street and 96 Avenue to mark the entrance into Tynehead Park, another at 176 Street and 96 Avenue as an entrance into the northern end of neighbourhood, the third feature at 184 Street and 90 Avenue as the southern entrance into the community park.

The estimated cost of developing park and related amenities in the future Anniedale-Tynehead community is approximately $8,416,931.00. This results in a contribution of $1,294.91 (in 2012 dollars) per dwelling unit.

Library and Library Material

A study of library requirements in Surrey's new neighbourhoods has established that a contribution of $ 141.15 (in 2012 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 $917,475.00 will be collected from Anniedale-Tynehead 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 $ 271.01 per dwelling unit and $1,084.07 per acre of non-residential development (in 2012 dollars) will cover the capital costs for fire protection. A contribution of $ 62.74 per dwelling unit and $ 250.90 per acre of non-residential development (in 2012 dollars) will cover the capital costs for police protection. This will result in a total capital contribution from Anniedale-Tynehead of approximately $2,032,582.50 toward fire protection and $470,535.00 toward police protection.

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 Anniedale-Tynehead NCP area is documented in the following table.

The 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 amenity.

ANNIEDALE-TYNEHEAD NEIGHBOURHOOD CONCEPT PLAN AMENITY CONTRIBUTIONS			
	Per Unit Contribution All Residential *Approx. 6500 dwelling units (@ base densities*	**Per Acre Contribution All Non-Residential *Approx. 250 acres (101 ha.)***	**Anticipated Revenue**
Police Protection	$62.74 per dwelling	$ 250.90 per acre	$470,535.00
Fire Protection	$ 271.01 per dwelling	$ 1,084.07 per acre	$2,032,582.50
Development of Park/Pathways and Placemaking Features	$1,294.91 per dwelling	n/a	$8,416,915.00
Library Materials	$ 141.15 per dwelling	n/a	$917,475.00
Total Contribution (per unit or per acre)	**$1,769.81 per dwelling**	**$1,334.97 per acre**	
Total Anticipated Revenue	$11,503,765.00	333,742.50$	$11,837,507.50

9.1 EXTERNAL UTILITY AGENCIES

The external utility agencies were included in the planning process for the NCP and Interagency Meetings held on June 17, 2009 and October 16, 2009. Subsequent to those meetings, all external utilities including BC Hydro, Fortis (formally Terason Gas), Telus and Shaw Cable were provided with the final growth projections, Land Use Plan and Engineering Services Plan. The external utilities have indicated that they will include this NCP in the planning of their service distribution systems. At this time, no details of the new works or upgrades required to provide utility servicing are available from the agencies. Infrastructure for providing servicing is normally constructed as development takes place.

BC Hydro and Fortis Comments

Comments from BC Hydro and Fortis have been received on the use of their 96 Avenue transmission line right of way for trail purposes. BC Hydro has requested that no pathways be constructed in between the poles and guy wires/anchors and that pathways should go around these structures. Plans of any proposed pathways should be sent to BC Hydro for their review to ensure safe electrical clearance and a review of any other impact to their facilities within the transmission line.

BC Hydro has also provided a preliminary comment stating that underground piping should be non-metallic on the BC Hydro right of way and should have a 6.0 meter minimum horizontal off-set from poles and anchors. Any metallic pipes must have a minimum 10 meter off-set. In addition, detailed plans are required for each proposal showing vertical and horizontal distances from transmission and distribution works. BC Hydro approval and Work Safe BC requirements are necessary prior to working within their right-of-way.

Fortis commented that they encourage the City's use of its rights of way as multi-use pathways as they are compatible uses and are easier to maintain than gas rights of ways through multiple private properties. For the 96 Avenue transmission line the gas right of way is 50 ft (15.24 m) wide (on the north side) and BC Hydro's is 100 ft (30.48 m) wide. Fortis needs to review any proposed pathways prior to construction and review any proposed roads that cross any of their rights of way.

Both BC Hydro and Fortis will not permit any lands within their rights of way to be dedicated as park, as the lands need to remain as titled lots to avoid the extinguishment of rights.

Other External Agency Comments

Transportation Investment Corporation, a Provincial Crown Corporation, requested that any future utility crossings of the Highway 1 mainline and interchange ramps be premised on the assumption that trenchless means of construction will be required in order to minimize traffic disruptions on these high volume corridors.

Department of Fisheries and Oceans Canada comments are included in **Part 7.2** Environmental Considerations.

9.2 PLAN IMPLEMENTATION

OCP Amendments

The entire area covered by the Anniedale-Tynehead NCP is currently designated Suburban in the OCP. Although the NCP Land Use Plan anticipates changes to the OCP designations in Anniedale-Tynehead , 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 Anniedale-Tynehead area proceed concurrently with site specific rezoning applications as has been the City's normal practice.

Zoning Amendments

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.

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.

Development Permit Area Guidelines

Multiple unit residential, commercial, and industrial and business park developments will be reviewed in accordance with the Development Permit Guidelines of the Official Community Plan and the requirements of this NCP.

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, residential areas and agricultural lands, viewscapes, ecosystem management areas, 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 Anniedale-Tynehead . 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, industrial and business park developments, the Design Guidelines will be implemented through Development Permits.

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.

Zoning By-law Amendments

To enact the amenity contribution requirements, the Zoning By-law requires an amendment to add Anniedale-Tynehead 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 Anniedale-Tynehead , were proposed concurrently with the approval of the Stage 2 plan.

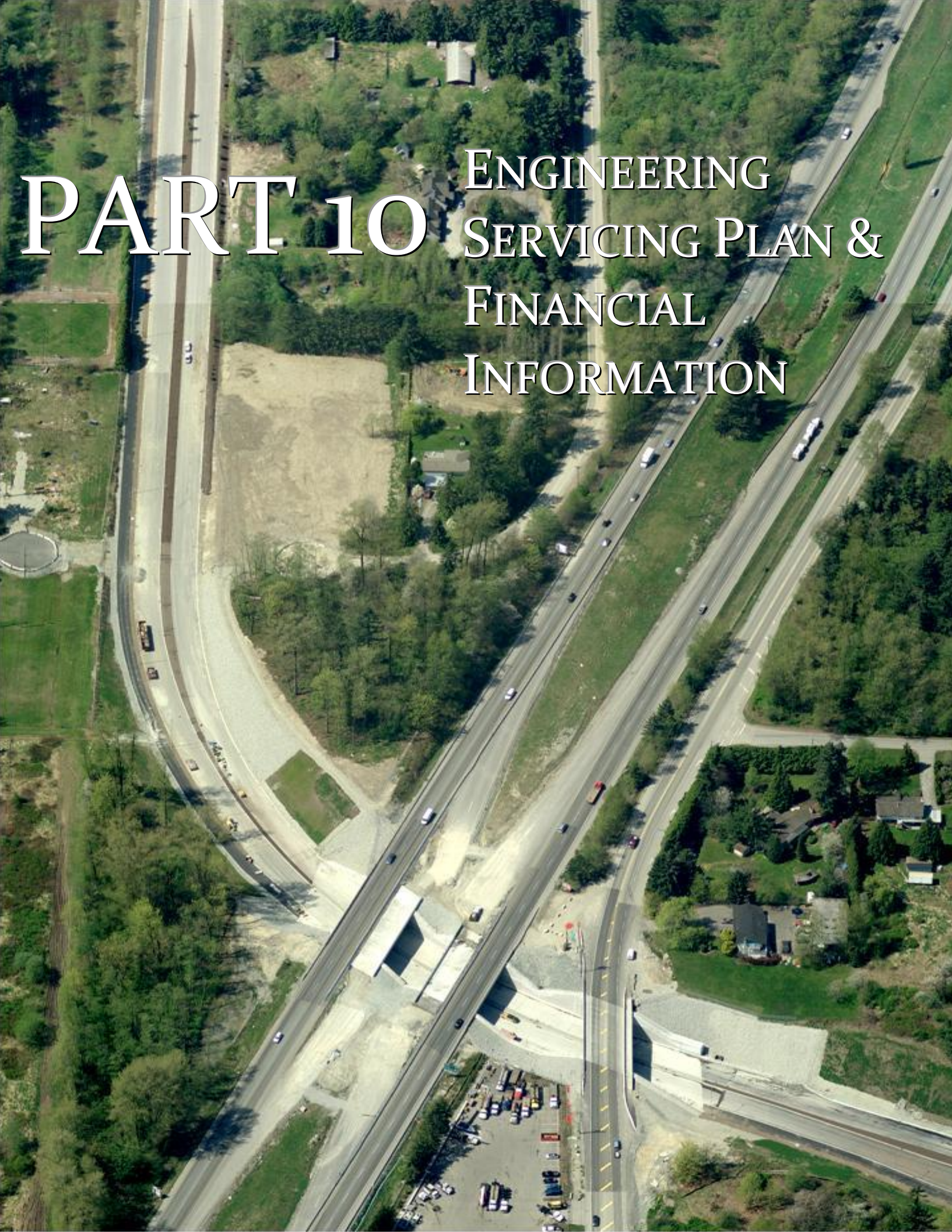
NCP Amendments

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.

Cost Recovery of NCP Preparation

Several Consultants were retained to assist with the preparation of the Anniedale-Tynehead NCP. The cost of the Engineering and Environmental consultant services to the City was $648,480.00. In order to recover the NCP preparation costs through the payment of application surcharge fees, the Fee Imposition By-law will be amended with the approval of this NCP.

The surcharge fee per unit is based on the anticipated 6500 units at the mid-range density, and would result in a per unit fee of $86.46. Should the actual number of proposed units fall below the number anticipated on site, the applicant will be required to make up the shortfall in the surcharge fee to ensure the NCP costs are fully recovered. For non-residential development, similar to other NCPs, the equivalent application surcharge fee will be based on the lot area at a rate of 10 units per hectare (4 units per acre).



PART 10 Engineering Servicing Plan & Financial Information

PART 10: ENGINEERING SERVICING PLAN AND FINANCIAL INFORMATION

This part of the NCP document summarizes the cost estimates for providing needed stormwater, sanitary sewer, water and transportation infrastructure to service the Anniedale-Tynehead NCP.

Major Engineering Infrastructure Costs to Service Anniedale-Tynehead NCP

Infrastructure	Estimated Costs
Stormwater	$26,600,000
Sanitary Sewer	$28,800,000
Water	$20,100,000
Non-Arterial Roads	$21,500,000
Arterial Roads	$75,000,000
Total	**$177,600,000**

Corporate Report No. _____, Engineering Servicing Strategy and Related Financial Strategy for Anniedale-Tynehead Neighbourhood Concept Plan (NCP) to be inserted here.

APPENDICES: ENGINEERING, IMPLEMENTATION AND FINANCING

What are the Engineering, Implementation and Financing Appendices?

A collection of separate and supporting materials such as tables, charts and graphs derived for the Anniedale-Tynehead Neighbourhood Concept Plan Engineering section, which include:

APPENDIX A - TRANSPORTATION
APPENDIX B - SANITARY SEWER
APPENDIX C - STORMWATER
APPENDIX D – WATER

APPENDIX A: TRANSPORTATION

- ☐ Base and Unit Price Component Cost Estimates
- ☐ Road Construction Cost Estimates

BASE AND UNIT COST ESTIMATES

Anniedale-Tynehead NCP
Class D Cost Estimate - Unit Price Components

Road Construction Unit Cost

Section AA - Collector Road (94A Avenue)
14.0 metre pavement, 23 metre R/W, 1 sidewalk, shoulder and ditch on south

12m r/w to developer; 11m r/w to DCC
7m pvmt to dev; 7 m pvmt to DCC

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	28	sq.m.	3.00	13.00	12.00	$ 39.00	$ 36.00	$ 84.00
excavation	6	cu.m.	20.23	3.10	2.90	$ 62.71	$ 58.67	$ 121.38
sub-grade fill & preparation	6	cu.m.	18.67	3.10	2.90	$ 57.88	$ 54.14	$ 112.02
sub-base gravel	10.5	tonne	23.00	5.25	5.25	$ 120.75	$ 120.75	$ 241.50
base gravel	4.2	tonne	28.50	2.10	2.10	$ 59.85	$ 59.85	$ 119.70
asphalt	3.5	tonne	112.00	1.75	1.75	$ 196.00	$ 196.00	$ 392.00
median	0	l.m.	60.00			$ -	$ -	$ -
new curb	1	l.m.	53.27	1.00	0.00	$ 53.27	$ -	$ 53.27
new sidewalk	1	l.m.	87.83	1.00	0.00	$ 87.83	$ -	$ 87.83
shoulder	1	l.m.	11.00	0.00	1.00	$ -	$ 11.00	$ 11.00
restoration	10	sq.m.	12.00	5.50	4.50	$ 66.00	$ 54.00	$ 120.00
drainage allowance	1	l.m.	600.00	1.00	0.00	$ 600.00	$ -	$ 600.00
ditch	1	l.m.	50.00	0.00	1.00	$ -	$ 50.00	$ 50.00
lighting allowance	1	l.m.	122.05	0.50	0.50	$ 61.03	$ 61.03	$ 122.05
pavement markings	6	l.m.	2.80	3.00	3.00	$ 8.40	$ 8.40	$ 16.80
Total for 14 m Collector Road Section AA		l.m.				$ 1,412.72	$ 709.84	$ 2,131.55
					use:	**$ 1,420.00**	**$ 710.00**	

Section BB - Local Road at ALR (92 Avenue)
10.0 metre pavement, 22 metre R/W, 1 sidewalk, shoulder and ditch on south

10m r/w to developer; 12m r/w to DCC
6.0m pvmt to dev; 4.0 m pvmt to DCC

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	24	sq.m.	3.00	13.00	12.00	$ 39.00	$ 36.00	$ 72.00
excavation	6	cu.m.	20.23	2.70	3.30	$ 54.62	$ 66.76	$ 121.38
sub-grade fill & preparation	6	cu.m.	18.67	2.70	3.30	$ 50.41	$ 61.61	$ 112.02
sub-base gravel	8.4	tonne	23.00	5.00	3.40	$ 115.00	$ 78.20	$ 193.20
base gravel	4.2	tonne	28.50	2.50	1.70	$ 71.25	$ 48.45	$ 119.70
asphalt	2.5	tonne	112.00	1.50	1.00	$ 168.00	$ 112.00	$ 280.00
median	0	l.m.	60.00			$ -	$ -	$ -
new curb	1	l.m.	53.27	1.00	0.00	$ 53.27	$ -	$ 53.27
new sidewalk	1	l.m.	87.83	1.00	0.00	$ 87.83	$ -	$ 87.83
shoulder	1	l.m.	11.00		1.00	$ -	$ 11.00	$ 11.00
restoration	10	sq.m.	12.00	6.00	4.00	$ 72.00	$ 48.00	$ 120.00
drainage allowance	1	l.m.	600.00	1.00	0.00	$ 600.00	$ -	$ 600.00
enhanced ditch	1	l.m.	100.00	0.00	1.00	$ -	$ 100.00	$ 100.00
lighting allowance	1	l.m.	122.05	0.50	0.50	$ 61.03	$ 61.03	$ 122.05
pavement markings	6	l.m.	2.80	3.00	3.00	$ 8.40	$ 8.40	$ 16.80
Total for 10 m Local Road Section BB		l.m.				$ 1,380.81	$ 631.45	$ 2,009.25
					use:	**$ 1,380.00**	**$ 635.00**	

Section CC - Local Road at ALR (92 Avenue)
10.0 metre pavement, 20 metre R/W, 1 sidewalk, shoulder and ditch on south

9.4m r/w to developer; 10.6m r/w to DCC
6.0m pvmt to dev; 4.0 m pvmt to DCC

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	22	sq.m.	3.00	10.50	11.50	$ 31.50	$ 34.50	$ 66.00
excavation	5	cu.m.	20.23	2.40	2.60	$ 48.55	$ 52.60	$ 101.15
sub-grade fill & preparation	5	cu.m.	18.67	2.40	2.60	$ 44.81	$ 48.54	$ 93.35
sub-base gravel	8.4	tonne	23.00	5.00	3.40	$ 115.00	$ 78.20	$ 193.20
base gravel	4.2	tonne	28.50	2.50	1.70	$ 71.25	$ 48.45	$ 119.70
asphalt	2.5	tonne	112.00	1.50	1.00	$ 168.00	$ 112.00	$ 280.00
median	0	l.m.	60.00			$ -	$ -	$ -
new curb	1	l.m.	53.27	1.00	0.00	$ 53.27	$ -	$ 53.27
new sidewalk	1	l.m.	87.83	1.00	0.00	$ 87.83	$ -	$ 87.83
multi-use trail	1	l.m.	107.35	1.00		$ 107.35		$ 107.35
shoulder	1	l.m.	11.00		1.00	$ -	$ 11.00	$ 11.00
restoration	10	sq.m.	12.00	6.00	4.00	$ 72.00	$ 48.00	$ 120.00
drainage allowance	1	l.m.	600.00	1.00	0.00	$ 600.00	$ -	$ 600.00
enhanced ditch	1	l.m.	100.00	0.00	1.00	$ -	$ 100.00	$ 100.00
lighting allowance	1	l.m.	122.05	0.50	0.50	$ 61.03	$ 61.03	$ 122.05
pavement markings	6	l.m.	2.80	3.00	3.00	$ 8.40	$ 8.40	$ 16.80
Total for 10 m Local Road Section CC		l.m.				$ 1,468.99	$ 602.72	$ 2,071.70
					use:	**$ 1,470.00**	**$ 605.00**	

Section DD - Collector Road
12 metre pavement, 17 metre R/W, 1 sidewalk, remote multi-use path

17.0 r/w to developer; 0m r/w to DCC
11.0m pvmt to dev; 1.0 m pvmt to DCC

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	19	sq.m.	3.00		19	$ 57.00	$ -	$ 57.00
excavation	5	cu.m.	20.23		5	$ 101.15	$ -	$ 101.15
sub-grade fill & preparation	5	sq.m.	18.67		5	$ 93.35	$ -	$ 93.35

sub-base gravel	9.5	tonne	23.00	8.6	0.90	$ 197.80	$ 20.70	$ 218.50	
base gravel	3.9	tonne	28.50	3.5	0.40	$ 99.75	$ 11.40	$ 111.15	
asphalt	3.1	tonne	112.00	2.8	0.30	$ 313.60	$ 33.60	$ 347.20	
median	0	l.m.	60.00	0		$ -	$ -	$ -	
new curb	2	l.m.	53.27	2		$ 106.54	$ -	$ 106.54	
new sidewalk	1	l.m.	87.83	1		$ 87.83	$ -	$ 87.83	
multi-use path	1	l.m.	195.17	1		$ 195.17	$ -	$ 195.17	
restoration	10	sq.m.	12.00	10		$ 120.00	$ -	$ 120.00	
drainage allowance	1	l.m.	600.00	1		$ 600.00	$ -	$ 600.00	
lighting allowance	1	l.m.	122.05	1		$ 122.05	$ -	$ 122.05	
pavement markings	6	l.m.	2.80	5	1.00	$ 14.00	$ 2.80	$ 16.80	
Total for 12 m Collector Road Section DD		l.m.				$ 2,108.24	$ 68.50	$ 2,176.74	
				use:		**$ 2,100.00**	**$ 70.00**		

Section EE - Collector Road

12 metre pavement, 20 metre R/W, 1 sidewalk, remote multi-use path

10m r/w to developer; 10m r/w to DCC
6.0m pvmt to dev; 6.0 m pvmt to DCC

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	22	sq.m.	3.00	11	11.00	$ 33.00	$ 33.00	$ 66.00
excavation	5	cu.m.	20.23	2.5	2.50	$ 50.58	$ 50.58	$ 101.15
sub-grade fill & preparation	5	sq.m.	18.67	2.5	2.50	$ 46.68	$ 46.68	$ 93.35
sub-base gravel	9.5	tonne	23.00	4.75	4.75	$ 109.25	$ 109.25	$ 218.50
base gravel	3.9	tonne	28.50	1.95	1.95	$ 55.58	$ 55.58	$ 111.15
asphalt	3.1	tonne	112.00	1.55	1.55	$ 173.60	$ 173.60	$ 347.20
median	0	l.m.	60.00	0		$ -	$ -	$ -
new curb	2	l.m.	53.27	1.00	1.00	$ 53.27	$ 53.27	$ 106.54
new sidewalk	2	l.m.	87.83	1.00	1.00	$ 87.83	$ 87.83	$ 175.66
multi-use path	0	l.m.	195.17			$ -	$ -	$ -
restoration	10	sq.m.	12.00	5.00	5.00	$ 60.00	$ 60.00	$ 120.00
drainage allowance	1	l.m.	600.00	1.00		$ 600.00	$ -	$ 600.00
lighting allowance	1	l.m.	122.05	0.50	0.50	$ 61.03	$ 61.03	$ 122.05
pavement markings	6	l.m.	2.80	3.00	3.00	$ 8.40	$ 8.40	$ 16.80
Total for 12 m Collector Road Section EE		l.m.				$ 1,339.20	$ 739.20	$ 2,078.40	
					use:	**$ 1,340.00**	**$ 740.00**		

Section FF is local - no estimate

Section GG - Collector Road

14.0 metre pavement, 22 metre R/W, 1 sidewalk, Noise fence against highway

12m r/w to developer; 10m r/w to DCC
8m pvmt to dev; 6 m pvmt to DCC

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	24	sq.m.	3.00	13.00	12.00	$ 39.00	$ 36.00	$ 72.00
excavation	6	cu.m.	20.23	3.30	2.70	$ 66.76	$ 54.62	$ 121.38
sub-grade fill & preparation	6	cu.m.	18.67	3.30	2.70	$ 61.61	$ 50.41	$ 112.02
sub-base gravel	10.5	tonne	23.00	5.80	4.70	$ 133.40	$ 108.10	$ 241.50
base gravel	4.2	tonne	28.50	2.30	1.90	$ 65.55	$ 54.15	$ 119.70
asphalt	3.5	tonne	112.00	1.90	1.60	$ 212.80	$ 179.20	$ 392.00
median	0	l.m.	60.00			$ -	$ -	$ -
new curb	2	l.m.	53.27	1.00	1.00	$ 53.27	$ 53.27	$ 106.54
new sidewalk	1	l.m.	87.83	1.00	0.00	$ 87.83	$ -	$ 87.83
shoulder	1	l.m.	11.00	0.00	0.00	$ -	$ -	$ 11.00
restoration	10	sq.m.	12.00	5.50	4.50	$ 66.00	$ 54.00	$ 120.00
drainage allowance	1	l.m.	600.00	1.00	0.00	$ 600.00	$ -	$ 600.00
noise fence	1	l.m.	800.00	0.00	1.00	$ -	$ 800.00	$ 800.00
lighting allowance	1	l.m.	122.05	0.50	0.50	$ 61.03	$ 61.03	$ 122.05
pavement markings	6	l.m.	2.80	3.00	3.00	$ 8.40	$ 8.40	$ 16.80
Total for 14 m Collector Road Section GG		l.m.				$ 1,455.65	$ 1,459.18	$ 2,922.82	
					use:	**$ 1,460.00**	**$ 1,460.00**		

Section HH - Divided Arterial Road

16.2 total metre pavement, 30 metre R/W, 1 sidewalk, multi-use path, ped lights

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	32	sq.m.	3.00		32	$ -	$ 96.00	$ 96.00
excavation	8	cu.m.	20.23		8	$ -	$ 161.84	$ 161.84
sub-grade fill & preparation	8	cu.m.	18.67		8	$ -	$ 149.36	$ 149.36
sub-base gravel	12.2	tonne	23.00		12.2	$ -	$ 280.60	$ 280.60
base gravel	5	tonne	28.50		5	$ -	$ 142.50	$ 142.50
asphalt	6.3	tonne	112.00		6.3	$ -	$ 705.60	$ 705.60
median	1	l.m.	434.15		1	$ -	$ 434.15	$ 434.15
new curb	4	l.m.	53.27		4	$ -	$ 213.08	$ 213.08
new sidewalk	1	l.m.	87.83		1	$ -	$ 87.83	$ 87.83
multi-use path	1		195.17		1	$ -	$ 195.17	$ 195.17
restoration	10	sq.m.	12.00		10	$ -	$ 120.00	$ 120.00
drainage allowance	1	l.m.	600.00		1	$ -	$ 600.00	$ 600.00
lighting allowance	1	l.m.	122.05		1	$ -	$ 122.05	$ 122.05
Ped light allowance	1	l.m.	61.03		1	$ -	$ 61.03	$ 61.03
pavement markings	6	l.m.	2.80		6	$ -	$ 16.80	$ 16.80

										$ -
Total for 16.2 m Divided Collector Road Section HH		l.m.					$ -	$ 3,386.01	$ 3,386.01
					use:		**$ -**	**$ 3,400.00**	

Section II - Divided Arterial Road
16.2 total metre pavement, 30 metre R/W, 2 sidewalks

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	32	sq.m.	3.00		32	$ -	$ 96.00	$ 96.00
excavation	8	cu.m.	20.23		8	$ -	$ 161.84	$ 161.84
sub-grade fill & preparation	8	cu.m.	18.67		8	$ -	$ 149.36	$ 149.36
sub-base gravel	12.2	tonne	23.00		12.2	$ -	$ 280.60	$ 280.60
base gravel	5	tonne	28.50		5	$ -	$ 142.50	$ 142.50
asphalt	6.3	tonne	112.00		6.3	$ -	$ 705.60	$ 705.60
median	1	l.m.	434.15		1	$ -	$ 434.15	$ 434.15
new curb	4	l.m.	53.27		4	$ -	$ 213.08	$ 213.08
new sidewalk	2	l.m.	87.83		2	$ -	$ 175.66	$ 175.66
multi-use path	0		195.17		0	$ -	$ -	$ -
restoration	10	sq.m.	12.00		10	$ -	$ 120.00	$ 120.00
drainage allowance	1	l.m.	600.00		1	$ -	$ 600.00	$ 600.00
lighting allowance	1	l.m.	122.05		1	$ -	$ 122.05	$ 122.05
Ped light allowance	0	l.m.	61.03		0	$ -	$ -	$ -
pavement markings	6	l.m.	2.80		6	$ -	$ 16.80	$ 16.80
								$ -
Total for 16.2 m Divided Collector Road Section II		l.m.				$ -	$ 3,217.64	$ 3,217.64
					use:	**$ -**	**$ 3,300.00**	

Section JJ - Local Road at future redevelopment
8.5 metre pavement, 13.5 metre R/W, 1 sidewalk — all to developer

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	16	sq.m.	3.00		16	$ 48.00	$ -	$ 48.00
excavation	4.5	cu.m.	20.23		4.5	$ 91.04	$ -	$ 91.04
sub-grade fill & preparation	4.5	cu.m.	18.67		4.5	$ 84.02	$ -	$ 84.02
sub-base gravel	7.1	tonne	23.00		7.1	$ 163.30	$ -	$ 163.30
base gravel	3.6	tonne	28.50		3.6	$ 102.60	$ -	$ 102.60
asphalt	2.2	tonne	112.00		2.2	$ 246.40	$ -	$ 246.40
median	0	l.m.	60.00		0	$ -	$ -	$ -
new curb	2	l.m.	53.27		2	$ 106.54	$ -	$ 106.54
new sidewalk	1	l.m.	87.83		1	$ 87.83	$ -	$ 87.83
multi-use trail	0	l.m.	107.35		0	$ -		$ -
shoulder	0	l.m.	11.00		0	$ -	$ -	$ -
restoration	10	sq.m.	12.00		10	$ 120.00	$ -	$ 120.00
drainage allowance	1	l.m.	600.00		1	$ 600.00	$ -	$ 600.00
enhanced ditch	1	l.m.	100.00		1	$ 100.00	$ -	$ 100.00
lighting allowance	1	l.m.	122.05		1	$ 122.05	$ -	$ 122.05
pavement markings	1	l.m.	2.80		1	$ 2.80	$ -	$ 2.80
Total for 8.5 m Local Road Section JJ		l.m.				$ 1,874.57	$ -	$ 1,874.57
					use:	**$ 1,850.00**	**$ -**	

Section KK - Collector Road
12 metre pavement, 24 metre R/W, 1 sidewalk, 1 path, ditch on north — 12m r/w to developer; 12m r/w to DCC; 6.0m pvmt to dev; 6.0 m pvmt to DCC

	Qty	unit	unit cost	Qty to Dev	Qty to DCC	cost to dev	cost to DCC	Total
clear & grub	26	sq.m.	3.00	13	13.00	$ 39.00	$ 39.00	$ 78.00
excavation	5	cu.m.	20.23	2.5	2.50	$ 50.58	$ 50.58	$ 101.15
sub-grade fill & preparation	5	sq.m.	18.67	2.5	2.50	$ 46.68	$ 46.68	$ 93.35
sub-base gravel	9.5	tonne	23.00	4.75	4.75	$ 109.25	$ 109.25	$ 218.50
base gravel	3.9	tonne	28.50	1.95	1.95	$ 55.58	$ 55.58	$ 111.15
asphalt	3.1	tonne	112.00	1.55	1.55	$ 173.60	$ 173.60	$ 347.20
median	0	l.m.	60.00			$ -	$ -	$ -
new curb	2	l.m.	53.27	1		$ 53.27	$ -	$ 106.54
new sidewalk	2	l.m.	87.83	1		$ 87.83	$ -	$ 175.66
path	0	l.m.	50.00		1.00	$ -	$ 50.00	$ -
restoration	10	sq.m.	12.00	5	5.00	$ 60.00	$ 60.00	$ 120.00
drainage allowance	1	l.m.	600.00	1		$ 600.00	$ -	$ 600.00
enhanced ditch	1	l.m.	100.00		1.00	$ -	$ 100.00	$ 100.00
lighting allowance	1	l.m.	122.05	0.5	0.50	$ 61.03	$ 61.03	$ 122.05
pavement markings	6	l.m.	2.80	3	3.00	$ 8.40	$ 8.40	$ 16.80
Total for 12 m Collector Road Section KK		l.m.				$ 1,345.20	$ 754.10	$ 2,190.40
					use:	**$ 1,400.00**	**$ 700.00**	

ROAD CONSTRUCTION COST ESTIMATES

Anniedale-Tynehead NCP
Class D Cost Estimate

Road Construction Cost Summary

Description		Section		Cost	
88th Avenue - 168th Street to 192nd Street			$	11,164,502.18	25% NCP
92nd Avenue - 180 Street to Harvie Road		II	$	16,861,631.54	All to DCC
96th Avenue - 168th Street to 176 Street (Highway 15)			$	-	Complete
168th Street - 88th Avenue to 96th Avenue			$	5,598,338.59	50% NCP
180th Street - 88th Ave. to 92nd Ave. & GEW to 96th Ave.			$	8,521,704.36	
180th Street - 92nd Ave. to GEW		HH	$	4,571,450.00	All to DCC
184th Street - 92th Avenue to 80th Avenue			$	12,750,000.00	50% NCP
192nd Street - 88th Avenue to 92nd Avenue			$	5,573,100.00	
Highway 1 at 192 Street			$	5,000,000.00	provided by Surrey April 21, 2010
Highway 15 at Golden Ears Way	$43 mill		$	10,750,000.00	25% Share to Arterial Rds
Total for Arterials			**$**	**80,790,726.67**	
90th Avenue - 184 Street to 187th Street		KK	$	600,600.00	DCC Component
92nd Avenue - Bothwell to 172 and 175 to Highway 15		BB	$	544,830.00	DCC Component
92nd Avenue - 176 Street to 180 Street			$	902,538.00	Upsizing ONLY
92nd Avenue - 172 Street to 175 Street		CC	$	613,470.00	DCC Component
Lakiotis Ridge Drive - 92 Avenue to 180 Street		FF	$	-	Local Road REMOVED - no estimate
93rd Avenue/94A Avenue - 169th Street to 184th Avenue			$	2,766,909.60	Upsizing ONLY
94A Avenue - 168th Street to 16900 Block		AA	$	199,368.00	DCC Component
95th Avenue - 174th Street to 175th Street			$	321,204.00	Upsizing ONLY
95th Avenue - 172nd Street to 174th Street		DD	$	54,600.00	DCC Component
96th Avenue - 177A Street to 181A Street			$	527,436.00	Upsizing ONLY
Industrial Rd - 181A Street to 188th Street		GG	$	3,188,640.00	DCC Component
97th Avenue - 177A Street to 180th Street			$	376,740.00	Upsizing ONLY
172 Street - 92nd Avenue to 96th Avenue			$	602,784.00	Upsizing ONLY
173A Street - 92nd Avenue to 96th Avenue			$	602,784.00	Upsizing ONLY
175th Street - 92nd Avenue to 92A Avenue			$	122,522.40	Upsizing ONLY
175th Street - 92A Avenue to 93A Avenue		EE	$	207,792.00	DCC Component
177 Street - 92 Avenue to 93A Avenue			$	210,974.40	Upsizing ONLY
177A Street - 96 Avenue to 97 Avenue			$	190,008.00	Upsizing ONLY
180 Street - 96 Avenue to 97 Avenue			$	113,022.00	Upsizing ONLY
184 Street - 92A Avenue to 94A Avenue			$	427,518.00	Upsizing ONLY
188 Street - 90A Avenue to 93 Avenue			$	742,014.00	Upsizing ONLY
Industrial Road overpass at GEW			$	3,360,000.00	
94th Avenue overpass at Highway 15			$	4,670,000.00	
Total for Collectors			**$**	**21,345,754.40**	

Notes:
Special section JJ is local and not included in program.
Special section LL is local and not included in program.

Anniedale-Tynehead NCP
Class D Cost Estimate

88th Avenue - 168th Street to 192nd Street

Arterial Road (19m) URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 4 intersections

Cost summary	unit	qty	unit cost		Cost	
Arterial Road	m	4800	3,700.00	$	17,760,000.00	
LT lanes and tapers	m	600	1,300.00	$	780,000.00	
preload plus surcharge	m	3700	1,700.00	$	6,290,000.00	
Signals	each	4	180,690.50	$	722,762.00	
Culvert crossings	each	2	500,000.00	$	1,000,000.00	
Roundabout	LS		2,000,000.00	$	-	
Sub-total estimated cost					**$26,552,762.00**	
Contingency at 30%				$	7,965,828.60	
Sub-total estimated cost					**$34,518,590.60**	
Administration at 5%				$	1,725,929.53	
Engineering at 15%				$	5,177,788.59	
Total Estimated Cost					**$41,422,308.72**	
Property requirements						
Development land		0.77 hectares	2,470,000.00	$	1,901,900.00	3600m @ 10m
ALR land		3.6 hectares	370,500.00	$	1,333,800.00	1.1km @ 7 m
Sub-total Land					**$ 3,235,700.00**	
Total estimated cost with land					**$44,658,008.72**	
Total 25% MRN					**$11,164,502.18**	

Notes:
Additional cost for preload and surcharge included
No allowance for enviromnmental
Signals at 180, 184, 192
Property area and unit costs per City

Anniedale-Tynehead NCP
Class D Cost Estimate

92nd Avenue - 180 Street to Harvie Road

20m Arterial Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost		
Arterial Road	m	2000	3300	$	6,600,000.00		
LT lanes and tapers	m		1300	$	-	incl. in five lane section	
Culvert croissings	each	1	500000	$	500,000.00		
Signals	each	3	180690.5	$	542,071.50		
Sub-total estimated cost				**$**	**7,642,071.50**		
Contingency at 30%				$	2,292,621.45		
Sub-total estimated cost				**$**	**9,934,692.95**		
Administration at 5%				$	496,734.65		
Engineering at 15%				$	1,490,203.94		
Total Estimated Cost				**$**	**11,921,631.54**		
Property requirements							
Development land		2 hectares	2,470,000.00	$	4,940,000.00		2000m @ 10m
ALR land		0 hectares	370,500.00	$	-		1.1km @ 7 m
Sub-total Land				**$**	**4,940,000.00**		
Total estimated cost with land				**$**	**16,861,631.54**		

Notes:
No allowance for enviromnmental or land acquisition
Signals at 180, 184, 192
Property area assumes 2 metre widening continuous

Anniedale-Tynehead NCP
Class D Cost Estimate

96th Avenue - 168th Street to 176 Street (Highway 15) **COMPLETED**
See Doug M email May 16, 2011

19 m Arterial Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 3 intersections

Cost summary	unit	qty	unit cost		Cost		
Arterial Road	m	1500		$	-		
LT lanes and tapers	m	0		$	-	included in five lane section	
Signals	each	4		$	-		
Sub-total estimated cost				**$**	**-**		
Contingency at 30%				$	-		
Sub-total estimated cost				**$**	**-**		
Administration at 5%				$	-		
Engineering at 15%				$	-		
Total Estimated Cost				**$**	**-**		
Property requirements							
Development land		1.01	hectares	$	-		1450m @ 7m
ALR land		0	hectares	$	-		
Sub-total Land				**$**	**-**		
Total estimated cost with land				**$**	**-**		

Notes:
Allowances added to unit costs for preload and signals
No allowance for enviromnmental
Signals at 168, 172, 173A, 175A
Property area assumes 7 metre widening continuous

Anniedale-Tynehead NCP
Class D Cost Estimate

168th Street - 88th Avenue to 96th Avenue

20m Arterial Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost		
Arterial Road	m	1600	3700	$	5,920,000.00		
LT lanes and tapers	m	0	1300	$	-	included in five lane section	
Signals	each	1	180690.5	$	180,690.50		
Sub-total estimated cost				**$**	**6,100,690.50**		
Contingency at 30%				$	1,830,207.15		
Sub-total estimated cost				**$**	**7,930,897.65**		
Administration at 5%				$	396,544.88		
Engineering at 15%				$	1,189,634.65		
Total Estimated Cost				**$**	**9,517,077.18**		
Property requirements							
Development land		0.56 hectares	2,470,000.00	$	1,383,200.00		800m @ 7m
ALR land		0.8 hectares	370,500.00	$	296,400.00		800m @ 10 m
Sub-total Land				**$**	**1,679,600.00**		
Total estimated cost with land				**$**	**11,196,677.18**		
Total 50% CoS				$	5,598,338.59		

Notes:
Additional cost for preload and surcharge included
No allowance for enviromnmental
Signal at 94A
Property area and unit costs per City

Anniedale-Tynehead NCP
Class D Cost Estimate

180th Street - 88th Ave. to 92nd Ave. & GEW to 96th Ave.

20m Arterial Road URBAN SECTION - full width per Section HH
Assume LT lanes at signalized intersections
Signals at 2 intersections

Cost summary	unit	qty	unit cost		Cost		
Arterial Road	km	950	3700	$	3,515,000.00		
LT lanes and tapers	m	0	1300	$	-	included in five lane section	
Preload	m	500	1700	$	850,000.00		
Signals	each	2	180,690.50	$	361,381.00		
Sub-total estimated cost					**$4,726,381.00**		
Contingency at 30%				$	1,417,914.30		
Sub-total estimated cost					**$6,144,295.30**		
Administration at 5%				$	307,214.77		
Engineering at 15%				$	921,644.30		
Total Estimated Cost					**$7,373,154.36**		
Property requirements							
Development land		0.315 hectares	2,470,000.00	$	778,050.00		450m @ 7m
ALR land		1 hectares	370,500.00	$	370,500.00		500m @ 20 m
Sub-total Land					**$1,148,550.00**		
Total estimated cost with land					**$8,521,704.36**		

Notes:
Additional cost for preload and surcharge included
No allowance for enviromnmental
Property area and unit costs per City

Anniedale-Tynehead NCP
Class D Cost Estimate

180th Street - 92nd Ave. to GEW

30m Divided Arterial Road SPECIAL URBAN SECTION HH
Assume LT lanes at signalized intersections
Signals at 2 intersections

			Developer		DCC Cost		
Cost summary	unit	qty	unit cost	Cost			
Arterial Road	km	650	0	$ -	3400	$ 2,210,000.00	
LT lanes and tapers	m	0	1300	$ -	1300	$ -	included in five lane section
Preload	m	0	1700	$ -	1700	$ -	
Signals	each	0	180,690.50	$ -	180,690.50	$ -	
Sub-total estimated cost				**$-**		**$2,210,000.00**	
Contingency at 30%				$ -		$ 663,000.00	
Sub-total estimated cost				**$-**		**$2,873,000.00**	
Administration at 5%				$ -		$ 143,650.00	
Engineering at 15%				$ -		$ 430,950.00	
Total Estimated Cost				**$-**		**$3,447,600.00**	
Property requirements							
Development land		0.455 hectares		$ -	2470000	$ 1,123,850.00	650m @ 20 m
ALR land		0 hectares	370,500.00	$ -	370500	$ -	0m @ 20 m
Sub-total Land				**$-**		**$1,123,850.00**	
Total estimated cost with land				**$-**		**$4,571,450.00**	

Notes:
Additional cost for preload and surcharge included
No allowance for enviromnmental
Property area and unit costs per City

Anniedale-Tynehead NCP
Class D Cost Estimate

184th Street - 92th Avenue to 80th Avenue

20m Arterial Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 1 intersections

Cost summary	unit	qty	unit cost		Cost		
Arterial Road	m	550	3700	$	2,035,000.00		
LT lanes and tapers	m	0	1300	$	-	included in five lane section	
Preload	m	150	1700	$	255,000.00		
Signals	each	0	180,690.50	$	-		
Sub-total estimated cost				**$**	**2,290,000.00**		
Contingency at 30%				$	687,000.00		
Sub-total estimated cost				**$**	**2,977,000.00**		
Administration at 5%				$	148,850.00		
Engineering at 15%				$	446,550.00		
Total Estimated Cost				**$**	**3,572,400.00**		
Property requirements							
Development land		0 hectares	2,470,000.00	$	-		1100m @ 7m
ALR land		1 hectares	370,500.00	$	370,500.00		500m @ 20 m
Sub-total Land				**$**	**370,500.00**		
Total estimated cost with land				**$**	**3,942,900.00**		

Notes:
Additional cost for preload and surcharge included
No allowance for enviromnmental
Property area and unit costs per City

Anniedale-Tynehead NCP
Class D Cost Estimate

192nd Street - 88th Avenue to 92nd Avenue

19m Arterial Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost	Cost		
Arterial Road	m	850	3700	$ 3,145,000.00		
LT lanes and tapers	m	0	1300	$ -	incl. In five lane section	
Signals	each	0	180690.5	$ -		
Sub-total estimated cost				**$3,145,000.00**		
Contingency at 30%				$ 943,500.00		
Sub-total estimated cost				**$4,088,500.00**		
Administration at 5%				$ 204,425.00		
Engineering at 15%				$ 613,275.00		
Total Estimated Cost				**$4,906,200.00**		
Property requirements						
Development land		0.21 hectares	2,470,000.00	$ 518,700.00		300m @ 7m
ALR land		0.4 hectares	370,500.00	$ 148,200.00		550m @ 20 m
Sub-total Land				**$ 666,900.00**		
Total estimated cost with land				**$5,573,100.00**		

Notes:
Additional cost for preload and surcharge included
No allowance for enviromnmental
Property area and unit costs per City

Anniedale-Tynehead NCP
Class D Cost Estimate

90th Avenue - 184 Street to 187th Street

12m Collector Road SPECIAL URBAN SECTION KK
Assume LT lanes at signalized intersections
Signals at 0 intersections

				Developer	DCC Cost
Cost summary	unit	qty	unit cost	Cost	
Collector Road	m	550	1400	$ 770,000.00	700 $ 385,000.00
LT lanes and tapers	m	0	1300	$ -	$ -
Culvert crossings	each	0	500000	$ -	0 $ -
Signals	each	0	180690.5	$ -	$ -
Sub-total estimated cost				**$ 770,000.00**	**$385,000.00**
Contingency at 30%				$ 231,000.00	$ 115,500.00
Sub-total estimated cost				**$1,001,000.00**	**$500,500.00**
Administration at 5%				$ 50,050.00	$ 25,025.00
Engineering at 15%				$ 150,150.00	$ 75,075.00
Total Estimated Cost				**$1,201,200.00**	**$600,600.00**

Property requirements developer provided widenings

Notes:
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

92nd Avenue - 172 Street to 175 Street

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections
ONLY development on north side of road

			Developer		**DCC Cost**	
Cost summary	unit	qty	unit cost	Cost	unit cost	Cost
Collector Road	m	650	1470	$ 955,500.00	605	$ 393,250.00
LT lanes and tapers	m		1300	$ -		$ -
Culvert croissings	each	1	500000	$ 500,000.00	0	$ -
Signals	each	0	180690.5	$ -		$ -
Sub-total estimated cost				**$1,455,500.00**		**$393,250.00**
Contingency at 30%				$ 436,650.00		$ 117,975.00
Sub-total estimated cost				**$1,892,150.00**		**$511,225.00**
Administration at 5%				$ 94,607.50		$ 25,561.25
Engineering at 15%				$ 283,822.50		$ 76,683.75
Total Estimated Cost				**$2,270,580.00**		**$613,470.00**

Notes:
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

92nd Avenue - 176 Street to 180 Street

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost	
Collector Road	m	650	2300	$	1,495,000.00	
Collector Road (10m)	m	0	2000	$	-	see special section BB
LT lanes and tapers	m		1300	$	-	
Culvert croissings	each	1	500000	$	500,000.00	
Signals	each	0	180690.5	$	-	
Sub-total estimated cost					**$1,995,000.00**	
Contingency at 30%				$	598,500.00	
Sub-total estimated cost					**$2,593,500.00**	
Administration at 5%				$	129,675.00	
Engineering at 15%				$	389,025.00	
Total Estimated Cost					**$3,112,200.00**	
Developer responible for 8.5m (71%) of 12m, 3m (29%) from upsizing				$	902,538.00	
Property requirements	developer provided widenings					

Notes:
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

92nd Avenue - Bothwell to 172 and 175 to Highway 15

10m Collector Road SPECIAL URBAN SECTION BB
Assume LT lanes at signalized intersections
Signals at 0 intersections

			Developer		DCC Cost		
Cost summary	unit	qty	unit cost	Cost	unit cost	Cost	
Collector Road	m	350	1380	$ 483,000.00	635	$ 222,250.00	Bothwell to 171
Collector Road	m	200	1380	$ 276,000.00	635	$ 127,000.00	175 to Hwy 15
LT lanes and tapers	m		1300	$ -	1300	$ -	
Culvert crossings	each	0	500000	$ -	500000	$ -	
Signals	each	0	180690.5	$ -	180690.5	$ -	
Sub-total estimated cost				**$ 759,000.00**		**$349,250.00**	
Contingency at 30%				$ 227,700.00		$ 104,775.00	
Sub-total estimated cost				**$ 986,700.00**		**$454,025.00**	
Administration at 5%				$ 49,335.00		$ 22,701.25	
Engineering at 15%				$ 148,005.00		$ 68,103.75	
Total Estimated Cost				**$1,184,040.00**		**$544,830.00**	
Property requirements	developer provided widenings						

Notes:
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

Lakiotis Ridge Drive - 92 Avenue to 180 Street

14m Collector Road URBAN SECTION
Signals at 0 intersections

Cost summary	unit	qty	unit cost	Cost
Collector Road	m	900		$ -
LT lanes and tapers	m			$ -
Culvert croissings	each	1		$ -
Signals	each	0		$ -
Sub-total estimated cost				**$-**
Contingency at 30%				$ -
Sub-total estimated cost				**$-**
Administration at 5%				$ -
Engineering at 15%				$ -
Total Estimated Cost				**$-**

Property requirements developer provided widenings

Notes:
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

93rd Avenue/94A Avenue - 169th Street to 184th Avenue

Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost
Collector Road	m	3020	2300	$	6,946,000.00
LT lanes and tapers	m	0	1300	$	-
Culverty crossings	each	3	500000	$	1,500,000.00
Signals	each	0	180690.5	$	-
Sub-total estimated cost				**$**	**8,446,000.00**
Contingency at 30%				$	2,533,800.00
Sub-total estimated cost				**$**	**10,979,800.00**
Administration at 5%				$	548,990.00
Engineering at 15%				$	1,646,970.00
Total Estimated Cost				**$**	**13,175,760.00**
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$	2,766,909.60
Property requirements	developer provided widenings				

Notes:
Allowances added to unit costs for preload and signals
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

94A Avenue - 168th Street to 16900 Block

Collector Road SPECIAL URBAN SECTION AA
Assume LT lanes at signalized intersections
Signals at 0 intersections

			Developer		DCC	
Cost summary	unit	qty	unit cost	Cost	unit cost	Cost
Collector Road	m	180	1420	$ 255,600.00	710	$ 127,800.00
LT lanes and tapers	m	0	1300	$ -	1300	$ -
Culverty crossings	each	0	500000	$ -	500000	$ -
Signals	each	0	180690.5	$ -	180690.5	$ -
Sub-total estimated cost				**$255,600.00**		**$127,800.00**
Contingency at 30%				$ 76,680.00		$ 38,340.00
Sub-total estimated cost				**$332,280.00**		**$166,140.00**
Administration at 5%				$ 16,614.00		$ 8,307.00
Engineering at 15%				$ 49,842.00		$ 24,921.00
Total Estimated Cost				**$398,736.00**		**$199,368.00**

Property requirements developer provided widenings

Notes:
Allowances added to unit costs for preload and signals
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

95th Avenue - 174th Street to 175th Street

12 Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost
Collector Road	m	100	2100	$	210,000.00
LT lanes and tapers	m	0	1300	$	-
Culverty crossings	each	1	500000	$	500,000.00
Signals	each	0	180690.5	$	-
Sub-total estimated cost				**$**	**710,000.00**
Contingency at 30%				$	213,000.00
Sub-total estimated cost				**$**	**923,000.00**
Administration at 5%				$	46,150.00
Engineering at 15%				$	138,450.00
Total Estimated Cost					**$1,107,600.00**
Developer responible for 8.5m (71%) of 12m, 3m (29%) from upsizing				$	321,204.00
Property requirements	developer provided widenings				

Notes:
Allowances added to unit costs for preload and signals
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

95th Avenue - 172nd Street to 174th Street

12 Collector Road SPECIAL URBAN SECTION DD
Assume LT lanes at signalized intersections
Signals at 0 intersections

			Developer		DCC	
Cost summary	unit	qty	unit cost	Cost	unit cost	Cost
Collector Road	m	500	2100	$ 1,050,000.00	70	$ 35,000.00
LT lanes and tapers	m	0	1300	$ -	1300	$ -
Culverty crossings	each	0	500000	$ -		$ -
Signals	each	0	180690.5	$ -	180690.5	$ -
Sub-total estimated cost				**$1,050,000.00**		**$35,000.00**
Contingency at 30%				$ 315,000.00		$ 10,500.00
Sub-total estimated cost				**$1,365,000.00**		**$45,500.00**
Administration at 5%				$ 68,250.00		$ 2,275.00
Engineering at 15%				$ 204,750.00		$ 6,825.00
Total Estimated Cost				**$1,638,000.00**		**$54,600.00**

Notes:
Allowances added to unit costs for preload and signals
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

96th Avenue - 177A Street to 181A Street

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost	Cost
Collector Road	m	700	2300	$ 1,610,000.00
LT lanes and tapers	m	0	1300	$ -
Signals	each	0	180690.5	$ -
Sub-total estimated cost				**$1,610,000.00**
Contingency at 30%				$ 483,000.00
Sub-total estimated cost				**$2,093,000.00**
Administration at 5%				$ 104,650.00
Engineering at 15%				$ 313,950.00
Total Estimated Cost				**$2,511,600.00**
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$ 527,436.00
Property requirements	developer provided widenings			

Notes:
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

Industrial Rd - 181A Street to 188th Street

14m Service Collector Road SPECIAL URBAN SECTION GG
Assume LT lanes at signalized intersections
Signals at 0 intersections
ONLY development on one side of road

			Developer		DCC	
Cost summary	unit	qty	unit cost	Cost	unit cost	Cost
Collector Road	m	1400	1455	$ 2,037,000.00	1460	$ 2,044,000.00
LT lanes and tapers	m	0	1300	$ -	1300	$ -
Signals	each	0	180690.5	$ -		$ -
Sub-total estimated cost				**$2,037,000.00**		**$2,044,000.00**
Contingency at 30%				$ 611,100.00		$ 613,200.00
Sub-total estimated cost				**$2,648,100.00**		**$2,657,200.00**
Administration at 5%				$ 132,405.00		$ 132,860.00
Engineering at 15%				$ 397,215.00		$ 398,580.00
Total Estimated Cost				**$3,177,720.00**		**$3,188,640.00**

Notes:
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

97th Avenue - 177A Street to 180th Street

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost	Cost
Collector Road	m	500	2300	$ 1,150,000.00
LT lanes and tapers	m	0	1300	$ -
Signals	each	0	180690.5	$ -
Sub-total estimated cost				**$1,150,000.00**
Contingency at 30%				$ 345,000.00
Sub-total estimated cost				**$1,495,000.00**
Administration at 5%				$ 74,750.00
Engineering at 15%				$ 224,250.00
Total Estimated Cost				**$1,794,000.00**
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$ 376,740.00
Property requirements	developer provided widenings			

Notes:
No allowance for enviromnmental or land acquisition

Anniedale-Tynehead NCP
Class D Cost Estimate

172 Street - 92nd Avenue to 96th Avenue

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost	Cost	
Collector Road	m	800	2300	$ 1,840,000.00	
LT lanes and tapers	m	0	1300	$ -	
Signals	each	0	180,690.50	$ -	on intersecting streets
Sub-total estimated cost				**$1,840,000.00**	
Contingency at 30%				$ 552,000.00	
Sub-total estimated cost				**$2,392,000.00**	
Administration at 5%				$ 119,600.00	
Engineering at 15%				$ 358,800.00	
Total Estimated Cost				**$2,870,400.00**	
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$ 602,784.00	

Notes:
No allowance for enviromnmental
No land costs-developer dedication

Anniedale-Tynehead NCP
Class D Cost Estimate

173A Street - 92nd Avenue to 96th Avenue

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost	
Collector Road	m	800	2300	$	1,840,000.00	
LT lanes and tapers	m	0	1300	$	-	
Signals	each	0	180,690.50	$	-	on intersecting streets
Sub-total estimated cost					**$1,840,000.00**	
Contingency at 30%				$	552,000.00	
Sub-total estimated cost					**$2,392,000.00**	
Administration at 5%				$	119,600.00	
Engineering at 15%				$	358,800.00	
Total Estimated Cost					**$2,870,400.00**	
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$	602,784.00	

Notes:
No allowance for enviromnmental
No land costs-developer dedication

Anniedale-Tynehead NCP
Class D Cost Estimate

175th Street - 92nd Avenue to 92A Avenue

14m Collector Road URBAN SECTION
Assume no LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost	Cost	
Collector Road	m	170	2200	$ 374,000.00	one sidewalk
LT lanes and tapers	m	0	1300	$ -	
Signals	each	0	180690.5	$ -	
Sub-total estimated cost				**$374,000.00**	
Contingency at 30%				$ 112,200.00	
Sub-total estimated cost				**$486,200.00**	
Administration at 5%				$ 24,310.00	
Engineering at 15%				$ 72,930.00	
Total Estimated Cost				**$583,440.00**	
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$ 122,522.40	

Notes:
No allowance for enviromnmental
No land costs-developer dedication

Anniedale-Tynehead NCP
Class D Cost Estimate

175th Street - 92A Avenue to 93A Avenue

12m Collector Road SPECIAL URBAN SECTION EE
Assume no LT lanes at signalized intersections
Signals at 0 intersections

			Developer		Parks + DCC	
Cost summary	unit	qty	unit cost	Cost	unit cost	Cost
Collector Road	m	180	1340	$ 241,200.00	740	$ 133,200.00
LT lanes and tapers	m	0	1300	$ -	1300	$ -
Signals	each	0	180690.5	$ -		$ -
Sub-total estimated cost				**$241,200.00**		**$133,200.00**
Contingency at 30%				$ 72,360.00		$ 39,960.00
Sub-total estimated cost				**$313,560.00**		**$173,160.00**
Administration at 5%				$ 15,678.00		$ 8,658.00
Engineering at 15%				$ 47,034.00		$ 25,974.00
Total Estimated Cost				**$376,272.00**		**$207,792.00**

Notes:
No allowance for enviromnmental
No land costs-developer dedication

Anniedale-Tynehead NCP
Class D Cost Estimate

177 Street - 92 Avenue to 93A Avenue

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost
Collector Road	m	280	2300	$	644,000.00
LT lanes and tapers	m	0	1300	$	-
Signals	each	0	180690.5	$	-
Sub-total estimated cost				**$**	**644,000.00**
Contingency at 30%				$	193,200.00
Sub-total estimated cost				**$**	**837,200.00**
Administration at 5%				$	41,860.00
Engineering at 15%				$	125,580.00
Total Estimated Cost					**$1,004,640.00**
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$	210,974.40

Notes:
No allowance for enviromnmental
No land costs-developer dedication

Anniedale-Tynehead NCP
Class D Cost Estimate

177A Street - 96 Avenue to 97 Avenue

Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost	Cost
Collector Road	m	200	2100	$ 420,000.00
LT lanes and tapers	m	0	1300	$ -
Signals	each	0	180690.5	$ -
Sub-total estimated cost				**$420,000.00**
Contingency at 30%				$ 126,000.00
Sub-total estimated cost				**$546,000.00**
Administration at 5%				$ 27,300.00
Engineering at 15%				$ 81,900.00
Total Estimated Cost				**$655,200.00**
Developer responible for 8.5m (71%) of 12m, 3m (29%) from upsizing				$ 190,008.00

Notes:
No allowance for enviromnmental
No land costs-developer dedication

Anniedale-Tynehead NCP
Class D Cost Estimate

180 Street - 96 Avenue to 97 Avenue

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost	Cost
Collector Road	m	150	2300	$ 345,000.00
LT lanes and tapers	m	0	1300	$ -
Signals	each	0	180690.5	$ -
Sub-total estimated cost				**$345,000.00**
Contingency at 30%				$ 103,500.00
Sub-total estimated cost				**$448,500.00**
Administration at 5%				$ 22,425.00
Engineering at 15%				$ 67,275.00
Total Estimated Cost				**$538,200.00**
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$ 113,022.00

Notes:
No allowance for enviromnmental
No land costs-developer dedication

Anniedale-Tynehead NCP
Class D Cost Estimate

184 Street - 92A Avenue to 94A Avenue

Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost
Collector Road	m	450	2100	$	945,000.00
LT lanes and tapers	m	0	1300	$	-
Signals	each	0	180690.5	$	-
Sub-total estimated cost				**$**	**945,000.00**
Contingency at 30%				$	283,500.00
Sub-total estimated cost					**$1,228,500.00**
Administration at 5%				$	61,425.00
Engineering at 15%				$	184,275.00
Total Estimated Cost					**$1,474,200.00**
Developer responible for 8.5m (71%) of 12m, 3m (29%) from upsizing				$	427,518.00
Property requirements		0.28 hectares			

Notes:
No allowance for enviromnmental
No land costs-developer dedication

Anniedale-Tynehead NCP
Class D Cost Estimate

188 Street - 90A Avenue to 93 Avenue

14m Collector Road URBAN SECTION
Assume LT lanes at signalized intersections
Signals at 0 intersections

Cost summary	unit	qty	unit cost		Cost
Collector Road	m	550	2300	$	1,265,000.00
LT lanes and tapers	m	0	1300	$	-
Culvert crossings	each	1	1000000	$	1,000,000.00
Signals	each	0	180690.5	$	-
Sub-total estimated cost					**$2,265,000.00**
Contingency at 30%				$	679,500.00
Sub-total estimated cost					**$2,944,500.00**
Administration at 5%				$	147,225.00
Engineering at 15%				$	441,675.00
Total Estimated Cost					**$3,533,400.00**
Developer responible for 11m (79%) of 14m, 3m (21%) from upsizing				$	742,014.00
Property requirements		0.16 hectares			

Notes:
No allowance for enviromnmental
No land costs-developer dedication

APPENDIX B: SANITARY SEWER

- ☐ Tables 3.4-3 to 3.4.7
- ☐ Critical Section Profiles
- ☐ Sanitary Sewer Cost Estimates

APPENDIX B - SANITARY SEWER
TABLES 3.4.3 TO 3.4.7

Table 3.4-3

	Description	Note	Ref No.	DR-Class	Service Catchment	Area	Population	ADWF	PDWF	PWWF	Equiv. Pipe Dia.	Initial Main Dia. (actual)	Initial Main Dia. (nominal)	Twinned Main Dia. (actual)	Twinned Main Dia. (nominal)	Pipe Length	Force Main Velocity	Head Loss Gradient	Friction Loss	PS Elevation	Static Head	TDH	TDH	Estimated Pump Hydraulic Power	Estimated Pump Brake Power	Estimated Pump Brake Power
						(ha)		(L/s)	(L/s)	(L/s)	(mm)	(mm)	(mm)	(mm)	(mm)	(m)	(m/s)		(m)	(m)	(m)	(m)	(psi)	(kW)	(hp)	(kW)
Phase 1	Tynehead Trunk		1-1		T(p)	54.5	3307	11.8	49.3	54.4	375	375	375			355										
	Tynehead FM		1-2	13.5	T	121.0	6661	25.4	88.6	102.3	343	343	400			835	1.1	0.4%	3.4							
	Tynehead - Anniedale FM	Interim	1-3	13.5	T	121.0	6661	25.4	88.6	102.3	343	343	400			980	1.1	0.4%	4.0							
	South Port Kells FM	Interim	1-4	13.5	T	121.0	6661	25.4	88.6	102.3	343	343	400			1150	1.1	0.4%	4.7							
	Tynehead Pump Station (172 St.)		-		T	121.0	6661	25.4	88.6	102.3									12.2	1.2	61.3	73.5	104.4	73.8	202.0	105.4
	South Port Kells Trunk		1-5		T	121.0	6661	25.4	88.6	102.3	528	528	600			800										
Phase 2	Anniedale A Trunk		2-1		A1+A3+B1(p)	88.2	6629	26.9	84.1	95.5	375	375	375			1000										
	Anniedale A FM		2-2	17	A1+A3+B1	105.1	8082	32.7	99.7	113.3	356	356	400			2140	1.1	0.4%	8.9							
	Anniedale B4 Trunk - 1		2-3		A2(p)+B4	35.3	3351	13.6	46.2	50.8	375	375	375			265										
	Anniedale B4 Trunk - 2		2-4		A2(p)+B4	56.3	5319	21.5	69.4	76.7	375	375	375			390										
	Anniedale B3 Trunk - 2		2-5		B3(p)	19.6	1864	7.6	19.6	24.7	300	300	300			690										
	Anniedale B3 Trunk - 3		2-6		B4(p)	22.7	2131	8.6	22.7	28.1	375	375	375			135										
	Anniedale B4 FM		2-7	13.5	A2+B4	79.0	7450.0	30.1	92.1	104.8	343	343	400			200	1.1	0.4%	0.9							
	Tynehead - Anniedale FM	Twin	2-8	13.5	A2+B4+T	200.0	14111	55.5	180.7	207.1	548	343	400	428	500	980	0.9	0.2%	1.5							
	South Port Kells FM	Twin	2-9	13.5	A+B1+B4+T	305.1	22193	88.2	280.4	320.4	654	343	400	557	650	1150	1.0	0.1%	1.7							
	Anniedale Pump Station (187 St.)		-		A1+A3+B1	105.1	8082	32.7	99.7	113.3									10.6	18.2	44.3	54.9	77.9	61.0	166.9	87.1
	Anniedale B4 Pump Station (176 St.)		-		A2+B4	79.0	7450	30.1	92.1	104.8									4.1	1.7	60.8	64.9	92.1	66.7	182.5	95.3
	Tynehead Pump Station (172 St.)		-		T	121.0	6661	25.4	88.6	102.3									6.6	1.2	61.3	67.9	96.5	68.2	186.6	97.4
Phase 3	Anniedale B3 Trunk - 1		3-1		B3	46.1	3224	13.1	44.6	50.6	300	300	300			220										
	Anniedale B3 Trunk - 2		-		B3 + B4(p)	65.8	5088	20.6	66.7	75.3	300	300	300			690										
	Anniedale B3 Trunk - 3		-		B3 + B4(p)	68.8	5355	21.7	69.8	78.7	375	375	375			135										
	Anniedale B4 FM		-	13.5	A2+B3+B4	125.1	10674	43.2	126.6	142.8	343	343	400			200	1.5	0.8%	1.5							
	Tynehead - Anniedale FM		-	13.5	A2+B3+B4+T	246.1	17335	68.6	215.2	245.1	548	343	400	428	500	980	1.0	0.2%	2.1							
	South Port Kells FM		-	13.5	A+B1+B3+B4+T	351.2	25417	101.3	314.9	358.4	654	343	400	557	650	1150	1.1	0.2%	2.1							
	Anniedale Pump Station (187 St.)		-		A1+A3+B1	105.1	8082	32.7	99.7	113.3									11.0	18.2	44.3	55.3	78.5	61.4	168.1	87.7
	Anniedale B4 Pump Station (176 St.)		-		A2+B3+B4	125.1	10674	43.2	126.6	142.8									5.7	1.7	60.8	66.5	94.4	93.1	254.8	133.0
	Tynehead Pump Station (172 St.)		-		T	121.0	6661	25.4	88.6	102.3									7.6	1.2	61.3	68.9	97.8	69.1	189.2	98.8
Phase 4	Anniedale B2 Trunk -1		4-1		B2(p)	39.0	2616	8.7	39.7	43.6	525	525	525			890										
	Anniedale B2 Trunk -2		4-2		B2(p)	49.3	3433	12.2	50.8	56.1	600	600	600			190										
	Anniedale B2 FM	Interim	4-3	15.5	B2	54.5	3621	12.8	52.4	58.4	236	236	250			1320	1.3	0.9%	11.9							
	Anniedale B FM	Interim	4-4	15.5	B2	54.5	3621	12.8	52.4	58.4	236	236	250			850	1.3	0.9%	7.7							
	Tynehead - Anniedale FM		-	13.5	A2+B2+B3+B4+T	300.6	20956	81.4	267.6	303.5	548	343	400	428	500	980	1.3	0.3%	3.1							
	South Port Kells FM		-	13.5	A+B+T	405.7	29038	114.1	367.3	416.8	654	343	400	557	650	1150	1.2	0.2%	2.7							
	Anniedale Pump Station (187 St.)		-		A1+A3+B1	105.1	8082	32.7	99.7	113.3									11.6	18.2	44.3	55.9	79.4	62.2	170.1	88.8
	Anniedale B2 Pump Station (184 St.)		-		B2	54.5	3621	12.8	52.4	58.4									25.4	12.0	50.5	75.9	107.8	43.5	119.0	62.1
	Anniedale B4 Pump Station (176 St.)		-		A2+B3+B4	125.1	10674	43.2	126.6	142.8									7.3	1.7	60.8	68.1	96.8	95.4	261.2	136.3
	Tynehead Pump Station (172 St.)		-		T	121.0	6661	25.4	88.6	102.3									9.2	1.2	61.3	70.5	100.2	70.8	193.8	101.1
Phase 5	Anniedale B2 Trunk		-		B2(p) +P	210.0	11216	8.7	153.8	155.9	525	525	525			890										
	Anniedale B2 Trunk		-		B2(p) +P	220.3	12033	11.8	176.9	182.0	600	600	600			190										
	Port Kells FM		5-1	32.5	P	171.0	8600	34.8	105.2	127.4	380	380	400			530	1.1	0.4%	2.0							
	Anniedale B2 FM	Twin	5-2	15.5	B2+P	225.5	12221	12.8	179.8	185.8	460	236	250	395	450	1320	1.1	0.3%	3.9							
	Anniedale B FM	Twin	5-3	15.5	B2+P	225.5	12221	12.8	179.8	185.8	460	236	250	395	450	850	1.1	0.3%	2.5							
	Tynehead - Anniedale FM		-	13.5	A2+B2+B3+B4+P+T	471.6	29556	81.4	395.0	430.9	548	343	400	428	500	980	1.8	0.6%	5.8							
	South Port Kells FM		-	13.5	A+B+P+T	576.7	37638	114.1	494.7	544.2	654	343	400	557	650	1150	1.6	0.4%	4.5							
	South Port Kells Trunk				A+B+P+T	576.7	37638	114.1	494.7	544.2	600	600	600			800										
	Anniedale Pump Station (187 St.)		-		A1+A3+B1	105.1	8082	32.7	99.7	113.3									13.4	18.2	44.3	57.7	81.9	64.1	175.5	91.6
	Anniedale B2 Pump Station (184 St.)		-		B2+P	225.5	12221	12.8	179.8	185.8									16.8	12.0	50.5	67.3	95.6	122.7	335.7	175.2
	Anniedale B4 Pump Station (176 St.)		-		A2+B3+B4	125.1	10674	43.2	126.6	142.8									11.9	1.7	60.8	72.7	103.2	101.8	278.6	145.4
	Port Kells Pump Station (189 St.)		-		P	171.0	8600	34.8	105.2	127.4									2.0		13.4	15.4	21.8	19.2	52.6	27.5
	Tynehead Pump Station (172 St.)		-		T	121.0	6661	25.4	88.6	102.3									13.8	1.2	61.3	75.1	106.6	75.4	206.2	107.7

Notes:
- Pipe Flows & Friction losses estimated using PWWF
- Pump Hydraulic Power Requirement estimated using PWWF and TDH
- Pump Brake Horse Power Requirements estimated using pump efficiency of 70%
- Pipe Design Capacity Based on Pipe Flow Depth at 70% of pipe diameter (83.2% of Pipe Full Capacity) for trunks
- Population and Areas calculated from information provided by the City of Surrey
- Per capita demand of 350 L/cap/day used
- Peaking Factor determined by Harmons Equation
- I&I flows based on 11,200 L/ha/day
- Bold red text indicates FM velocities < 1.0 m/s or > 1.6 m/s
- As the landuse of the Port Kells area has not been finalized at this time, any infrastructure affected by flow from the Port Kells area should be reviewed at the detailed design stage
- 'Tynehead - Anniedale B' and 'South Port Kells' forcemains may require upgrades with additional forcemains or alternate sizes in Phase 5 to minimize power requirements at 184 St Pump Station.

Service Catchment Abbreviations

A1	Anniedale A - West 1
A2	Anniedale A - West 2
A3	Anniedale A - East 1
A	Anniedale A - Total
B1	Anniedale B1
B2	Anniedale B2
B3	Anniedale B3
B4	Anniedale B4
B	Anniedale B - Total
T	Tynehead
P	Port Kells
(p)	partial from catchment

Table 3.4-4

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

172nd Street Pump Station Catchment

Development Area: Tynehead

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
South-East			0.65	*NA*	*0*	*0*																														
South-East			1.05	*RM-10*	*114*	*120*																														
South-East	**105**	104	1.7				*120*	0.0	0.0	120	0.5	4.22	2.0	1.7	0.2	2.3	114	6.10%	200	40.5	6%	22%	1.0	53.0		51.0	46.0		44.0	2.00		2.00				
South-East			0.51	*NA*	*0*	*0*																														
South-East			1.08	*RM-10*	*114*	*123*																														
South-East	**104**	103	1.59				*123*	0.0	0.0	243	1.0	4.12	4.0	3.3	0.4	4.5	72	7.60%	200	45.2	10%	30%	1.3	46.0		44.0	40.5		38.5	2.02		2.00				
South-East	**103**	102					0	0.0	0.0	243	1.0	4.12	4.0	3.3	0.4	4.5	72	12.30%	200	57.5	8%	26%	1.5	40.5		38.5	31.6		29.6	2.02		2.00				
South-East			1.87	*NA*	*0*	*0*																														
South-East	**102**	101	1.87				0	0.0	0.0	243	1.0	4.12	4.0	5.2	0.7	4.7	79	15.90%	200	65.4	7%	24%	1.7	31.6		29.6	19.0		17.0	2.02		2.00				
South-East			0.86	*NA*	*0*	*0*																														
South-East			0.12	*RF*	*66*	*8*																														
South-East			0.24	*RM-10*	*114*	*27*																														
South-East	**101**	100	1.22				*35*	0.0	0.0	278	1.1	4.09	4.6	6.4	0.8	5.4	115	3.00%	200	28.4	19%	40%	1.0	19.0		17.0	15.6		13.6	2.02		2.00				
South-East			1.04	*NA*	*0*	*0*																														
South-East			0.38	*RF*	*66*	*25*																														
South-East	**107**	106	1.42				*25*	0.0	0.0	25	0.1	4.37	0.4	1.4	0.2	0.6	94	8.60%	200	48.1	1%	10%	0.7	39.0		37.0	31.0		29.0	2.00		2.00				
South-East			0.2	*NA*	*0*	*0*																														
South-East			0.34	*PI*	*50*	*17*																														
South-East			0.31	*RF*	*66*	*20*																														
South-East	**106**	100	0.85				*37*	0.0	0.0	63	0.3	4.30	1.1	2.3	0.3	1.4	148	10.40%	200	52.9	3%	16%	1.0	31.0		29.0	15.6		13.6	2.02		2.00				
South-East			0.47	*NA*	*0*	*0*																														
South-East			0.44	*PI*	*50*	*22*																														
South-East	**100**	099	0.91				*22*	0.0	0.0	363	1.5	4.04	5.9	9.6	1.2	7.2	92	7.60%	200	45.2	16%	38%	1.5	15.6		13.5	8.6		6.6	2.02		2.00				
South-East			0.55	*NA*	*0*	*0*																														
South-East	**099**	077	0.55				0	0.0	0.0	363	1.5	4.04	5.9	10.1	1.3	7.2	103	2.00%	200	23.2	31%	52%	0.9	8.6		6.5	6.5		4.5	2.02		2.00				
East			1.1	*NA*	*0*	*0*																														
East			0.45	*RM-45*	*266*	*120*																														
East	**098**	097	1.55				*120*	0.0	0.0	120	0.5	4.22	2.0	1.6	0.2	2.2	91	1.50%	200	20.1	11%	32%	0.6	53.7		51.7	53.0		50.4	2.00		2.63				
East			1	*NA*	*0*	*0*																														
East			0.44	*RM-45*	*266*	*117*																														
East	**097**	096	1.44				*117*	0.0	0.0	237	1.0	4.12	4.0	3.0	0.4	4.3	86	6.20%	200	40.8	11%	30%	1.2	53.0		50.4	47.0		45.0	2.65		2.00				
East			0.22	*NA*	*0*	*0*																														
East			0.08	*C-15*	*90*	*7*																														
East	**096**	089	0.3				*7*	0.0	0.0	244	1.0	4.12	4.1	3.3	0.4	4.5	90	6.70%	200	42.4	11%	30%	1.2	47.0		45.0	41.0		39.0	2.02		2.00				
East			1.06	*NA*	*0*	*0*																														
East			0.45	*C-15*	*90*	*41*																														
East	**095**	093	1.51				*41*	0.0	0.0	41	0.2	4.33	0.7	1.5	0.2	0.9	56	3.70%	200	31.5	3%	16%	0.6	53.8		51.8	51.7		49.7	2.00		2.00				
East			2.98	*NA*	*0*	*0*																														
East			0.41	*C-15*	*90*	*37*																														
East	**094**	093	3.39				*37*	0.0	0.0	37	0.1	4.34	0.6	3.4	0.4	1.1	98	1.20%	200	18.0	6%	22%	*0.4*	52.3		50.3	51.7		49.1	2.00		2.60				
East	**093**	091					0	0.0	0.0	77	0.3	4.27	1.3	4.9	0.6	2.0	43	2.50%	200	25.9	8%	26%	0.6	51.7		49.1	50.0		48.0	2.62		2.00				
East			3.83	*NA*	*0*	*0*																														
East			0.64	*C-15*	*90*	*58*																														
East	**092**	091	4.47				*58*	0.0	0.0	58	0.2	4.30	1.0	4.5	0.6	1.6	100	1.00%	200	16.4	10%	28%	*0.4*	49.4		47.4	50.0		46.4	2.00		**3.58**				
East			0.2	*NA*	*0*	*0*																														
East			0.42	*C-15*	*90*	*38*																														
East	**091**	090	0.62				*38*	0.0	0.0	173	0.7	4.17	2.9	10.0	1.3	4.2	108	1.00%	200	16.4	26%	48%	*0.6*	50.0		46.4	47.3		45.3	**3.60**		2.00				
East			0.17	*NA*	*0*	*0*																														
East			0.49	*C-15*	*90*	*44*																														
East	**090**	089	0.66				*44*	0.0	0.0	217	0.9	4.14	3.6	10.7	1.4	5.0	97	6.50%	200	41.8	12%	32%	1.2	47.3		45.3	41.0		39.0	2.02		2.00				

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

172nd Street Pump Station Catchment

Development Area: Tynehead

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
East			0.42	*NA*	*0*	*0*																														
East			0.51	*C-15*	*90*	*46*																														
East	**089**	088	0.93				*46*	0.0	0.0	507	2.1	3.97	8.2	14.9	1.9	10.1	85	2.80%	200	27.4	37%	58%	1.1	41.0		39.0	38.6		36.6	2.02		2.00			
East	**088**	081					0	0.0	0.0	507	2.1	3.97	8.2	14.9	1.9	10.1	92	3.40%	200	30.2	33%	54%	1.2	38.6		36.6	35.4		33.4	2.02		2.00			
East			0.69	*NA*	*0*	*0*																														
East			1.35	*C-8*	*60*	*81*																														
East	**087**	086	2.04				*81*	0.0	0.0	81	0.3	4.27	1.4	2.0	0.3	1.7	95	3.10%	200	28.9	6%	22%	0.7	50.2		48.2	47.2		45.2	2.00		2.00			
East	**086**	083					0	0.0	0.0	81	0.3	4.27	1.4	2.0	0.3	1.7	42	4.40%	200	34.4	5%	20%	0.8	47.2		45.2	45.4		43.4	2.02		2.00			
East			0.45	*NA*	*0*	*0*																														
East			0.72	*C-15*	*90*	*65*																														
East	**085**	084	1.17				*65*	0.0	0.0	65	0.3	4.29	1.1	1.2	0.2	1.3	52	4.20%	200	33.6	4%	18%	0.7	49.4		47.4	47.2		45.2	2.00		2.00			
East			0.48	*NA*	*0*	*0*																														
East			0.83	*C-15*	*90*	*75*																														
East	**084**	083	1.31				*75*	0.0	0.0	140	0.6	4.20	2.4	2.5	0.3	2.7	86	2.10%	200	23.8	11%	32%	0.7	47.2		45.2	45.4		43.4	2.02		2.00			
East			0.31	*NA*	*0*	*0*																														
East			0.99	*C-8*	*60*	*59*																														
East	**083**	082	1.3				*59*	0.0	0.0	280	1.1	4.09	4.6	5.8	0.8	5.4	98	3.70%	200	31.5	17%	38%	1.1	45.4		43.3	41.7		39.7	2.02		2.00			
East			0.4	*NA*	*0*	*0*																														
East			1.03	*C-8*	*60*	*62*																														
East	**082**	081	1.43				*62*	0.0	0.0	342	1.4	4.05	5.6	7.3	0.9	6.6	104	6.00%	200	40.2	16%	38%	1.3	41.7		39.7	35.4		33.4	2.02		2.00			
East			1.62	*NA*	*0*	*0*																														
East			0.77	*RM-30*	*206*	*159*																														
East	**081**	080	2.39				*159*	0.0	0.0	1007	4.1	3.80	15.5	24.5	3.2	18.7	142	5.90%	200	39.8	47%	64%	1.8	35.4		33.4	27.0		25.0	2.02		2.00			
East			4.95	*NA*	*0*	*0*																														
East	**080**	078	4.95				0	0.0	0.0	1007	4.1	3.80	15.5	29.5	3.8	19.3	103	6.80%	200	42.8	45%	64%	1.9	27.0		25.0	20.0		18.0	2.02		2.00			
East			0.33	*NA*	*0*	*0*																														
East			0.59	*RF-9*	*128*	*76*																														
East	**079**	078	0.92				*76*	0.0	0.0	76	0.3	4.28	1.3	0.9	0.1	1.4	76	1.00%	200	16.4	9%	28%	*0.5*	18.0	18.0	16.0	20.0	19.5	15.2	2.00	2.00	**4.76**	**4.26**		
East			0.41	*NA*	*0*	*0*																														
East			0.75	*PI*	*50*	*38*																														
East	**078**	077	1.16				*38*	0.0	0.0	1120	4.5	3.77	17.1	31.5	4.1	21.2	135	7.90%	200	46.1	46%	64%	2.0	20.0	19.5	15.2	6.5	6.5	4.5	**4.78**	**4.28**	2.00	2.00		
East			0.88	*NA*	*0*	*0*																														
East			0.77	*RF*	*66*	*51*																														
East	**077**	076	1.65				*51*	0.0	0.0	1534	6.2	3.67	22.8	43.3	5.6	28.4	86	1.00%	250	29.7	96%	96%	1.0	6.5		4.5	6.0		3.7	2.02		2.36			
East	**076**	062					0	0.0	0.0	1534	6.2	3.67	22.8	43.3	5.6	28.4	78	1.00%	250	29.7	96%	96%	1.0	6.0		3.7	5.0		2.9	2.38		2.09			
Center-East			0.24	*NA*	*0*	*0*																														
Center-East			0.22	*C-15*	*90*	*20*																														
Center-East	**075**	073	0.46				*20*	0.0	0.0	20	0.1	4.38	0.4	0.5	0.1	0.4	82	3.50%	200	30.7	1%	10%	*0.5*	50.2		48.2	47.3		45.3	2.00		2.00			
Center-East			0.08	*NA*	*0*	*0*																														
Center-East			0.63	*C-15*	*90*	*57*																														
Center-East	**074**	073	0.71				*57*	0.0	0.0	57	0.2	4.30	1.0	0.7	0.1	1.1	95	1.50%	200	20.1	5%	22%	*0.5*	47.7		45.7	47.3		44.3	2.00		3.04			
Center-East	**073**	071					0	0.0	0.0	77	0.3	4.27	1.3	1.2	0.2	1.5	57	2.20%	200	24.3	6%	22%	0.6	47.3		44.3	45.0		43.0	3.06		2.00			
Center-East			0.8	*NA*	*0*	*0*																														
Center-East			0.75	*C-15*	*90*	*68*																														
Center-East	**072**	071	1.55				*68*	0.0	0.0	68	0.3	4.29	1.2	1.6	0.2	1.4	97	1.60%	200	20.7	7%	24%	*0.5*	45.1		43.1	45.0		41.6	2.00		3.44			
Center-East			0.17	*NA*	*0*	*0*																														
Center-East			0.33	*C-15*	*90*	*30*																														
Center-East	**071**	070	0.5				*30*	0.0	0.0	174	0.7	4.17	2.9	3.2	0.4	3.4	94	3.90%	200	32.4	10%	30%	0.9	45.0		41.5	39.9		37.9	3.46		2.00			
Center-East			0.21	*NA*	*0*	*0*																														
Center-East			0.6	*C-15*	*90*	*54*																														
Center-East	**070**	067	0.81				*54*	0.0	0.0	228	0.9	4.13	3.8	4.0	0.5	4.3	105	6.30%	200	41.2	11%	30%	1.2	39.9		37.8	33.3		31.3	2.02		2.00			
Center-East			0.32	*NA*	*0*	*0*																														
Center-East			0.96	*C-15*	*90*	*86*																														

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

172nd Street Pump Station Catchment

Development Area: Tynehead

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																		
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)			
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
Center-East	**069**	068	1.28				*86*	0.0	0.0	86	0.4	4.26	1.5	1.3	0.2	1.7	126	3.90%	200	32.4	5%	22%	0.8	37.4		35.4	32.5		30.5	2.00		2.00	
Center-East	**068**	067					0	0.0	0.0	86	0.4	4.26	1.5	1.3	0.2	1.7	37	0.60%	200	12.7	13%	34%	*0.4*	32.5		30.5	33.3		30.3	2.02		2.95	
Center-East			0.45	*NA*	*0*	*0*																												
Center-East			0.39	*RM-30*	*206*	*80*																												
Center-East	**067**	065	0.84				*80*	0.0	0.0	394	1.6	4.03	6.4	6.2	0.8	7.2	146	4.90%	200	36.3	20%	42%	1.3	33.3		30.3	25.1		23.1	2.97		2.00	
Center-East			0.19	*NA*	*0*	*0*																												
Center-East			0.53	*RM-30*	*206*	*109*																												
Center-East	**066**	065	0.72				*109*	0.0	0.0	109	0.4	4.23	1.9	0.7	0.1	2.0	68	1.00%	200	16.4	12%	32%	*0.5*	23.5	23.5	21.5	25.1	24.5	20.8	2.00	2.00	**4.36**	**3.72**
Center-East			0.19	*NA*	*0*	*0*																												
Center-East			0.19	*RF-9*	*128*	*24*																												
Center-East	**065**	063	0.38				*24*	0.0	0.0	528	2.1	3.96	8.5	7.3	0.9	9.4	105	5.50%	200	38.5	24%	46%	1.4	25.1	24.5	20.8	17.0	17.0	15.0	**4.38**	**3.74**	2.00	2.00
Center-East			0.17	*NA*	*0*	*0*																												
Center-East			0.31	*RF-9*	*128*	*40*																												
Center-East	**064**	063	0.48				*40*	0.0	0.0	40	0.2	4.33	0.7	0.5	0.1	0.8	45	3.00%	200	28.4	3%	16%	*0.6*	18.0		16.0	17.0		14.7	2.00		2.33	
Center-East			0.27	*NA*	*0*	*0*																												
Center-East			0.64	*RF*	*66*	*42*																												
Center-East	**063**	062	0.91				*42*	0.0	0.0	610	2.5	3.93	9.7	8.6	1.1	10.8	132	8.80%	200	48.6	22%	44%	1.8	17.0		14.6	5.0		3.0	2.35		2.00	
Center-East			0.35	*NA*	*0*	*0*																												
Center-East	**062**	061	0.35				0	0.0	0.0	2143	8.7	3.56	30.9	52.3	6.8	37.7	66	0.30%	375	48.0	79%	86%	0.7	5.0		2.9	6.2		2.7	2.09		**3.53**	
Center-East			0.48	*NA*	*0*	*0*																												
Center-East	**061**	000	0.48				0	0.0	0.0	2143	8.7	3.56	30.9	52.8	6.8	37.8	86	0.30%	375	48.0	79%	86%	0.7	6.2		2.7	5.7		2.4	**3.55**		3.25	
Center			0.05	*NA*	*0*	*0*																												
Center			0.21	*C-15*	*90*	*19*																												
Center	**060**	059	0.26				*19*	0.0	0.0	19	0.1	4.38	0.3	0.3	0.0	0.4	142	2.40%	200	25.4	1%	12%	*0.4*	46.7		44.7	44.6		41.2	2.00		3.38	
Center			0.52	*NA*	*0*	*0*																												
Center			1.11	*C-15*	*90*	*100*																												
Center	**059**	057	1.63				*100*	0.0	0.0	119	0.5	4.22	2.0	1.9	0.2	2.3	58	2.70%	200	26.9	8%	28%	0.7	44.6		41.2	41.6		39.6	3.40		2.00	
Center			1.07	*NA*	*0*	*0*																												
Center			0.38	*C-15*	*90*	*34*																												
Center	**058**	057	1.45				*34*	0.0	0.0	34	0.1	4.35	0.6	1.5	0.2	0.8	134	2.00%	200	23.2	3%	18%	*0.5*	43.7		41.7	41.6		39.0	2.00		2.60	
Center			0.45	*NA*	*0*	*0*																												
Center			0.37	*RM-30*	*206*	*76*																												
Center	**057**	056	0.82				*76*	0.0	0.0	229	0.9	4.13	3.8	4.2	0.5	4.4	140	4.60%	200	35.2	12%	32%	1.1	41.6		39.0	34.5		32.5	2.62		2.00	
Center			0.45	*NA*	*0*	*0*																												
Center			2.13	*RM-30*	*206*	*439*																												
Center	**056**	055	2.58				*439*	0.0	0.0	668	2.7	3.91	10.6	6.7	0.9	11.4	119	5.50%	200	38.5	30%	52%	1.5	34.5		32.5	27.9		25.9	2.02		2.00	
Center			0.29	*NA*	*0*	*0*																												
Center			1.25	*RM-30*	*206*	*258*																												
Center	**055**	053	1.54				*258*	0.0	0.0	926	3.7	3.82	14.3	8.3	1.1	15.4	85	8.20%	200	47.0	33%	54%	2.0	27.9		25.9	21.0		19.0	2.02		2.00	
Center			0.27	*NA*	*0*	*0*																												
Center			0.28	*RM-30*	*206*	*58*																												
Center	**054**	053	0.55				*58*	0.0	0.0	58	0.2	4.30	1.0	0.6	0.1	1.1	128	2.50%	200	25.9	4%	18%	*0.6*	23.6		21.6	21.0		18.4	2.00		2.60	
Center			0.56	*NA*	*0*	*0*																												
Center			1.14	*RF-12*	*89*	*101*																												
Center	**053**	051	1.7				*101*	0.0	0.0	1085	4.4	3.78	16.6	10.5	1.4	18.0	108	5.40%	200	38.1	47%	66%	1.7	21.0		18.4	14.6		12.6	2.62		2.00	
Center			0.34	*NA*	*0*	*0*																												
Center			0.46	*RF-12*	*89*	*41*																												
Center	**052**	051	0.8				*41*	0.0	0.0	41	0.2	4.33	0.7	0.8	0.1	0.8	129	3.00%	200	28.4	3%	16%	*0.6*	17.0		15.0	14.6		11.1	2.00		3.46	
Center			0.25	*NA*	*0*	*0*																												
Center			0.51	*RF*	*66*	*34*																												
Center	**051**	000	0.76				*34*	0.0	0.0	1159	4.7	3.76	17.6	12.1	1.6	19.2	128	5.80%	200	39.5	49%	66%	1.8	14.6		11.1	5.7		3.7	3.48		2.00	

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

172nd Street Pump Station Catchment

Development Area: Tynehead

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)			
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
LPS-North			2.55	*NA*	*0*	*0*																													
LPS-North			0.3	*PI*	*50*	*15*																													
LPS-North			0.69	*C-8*	*60*	*41*																													
LPS-North			1.08	*RF-9*	*128*	*138*																													
LPS-North			0.62	*RM-30*	*206*	*128*																													
LPS-North	**LPS-N**	LPS-N	5.24				322	0.0	0.0	322	1.3	4.07	5.3	5.2	0.7	6.0																			
West			0.46	*NA*	*0*	*0*																													
West			0.77	*RF-9*	*128*	*99*																													
West	**022**	021	1.23				*99*	0.0	0.0	99	0.4	4.25	1.7	1.2	0.2	1.9	122	6.50%	200	41.8	4%	20%	1.0	18.0		16.0	10.0		8.0	2.00		2.00			
West			0.93	*NA*	*0*	*0*																													
West			1.47	*RF*	*66*	*97*																													
West			0.4	*RF-9*	*128*	*51*																													
West	**021**	020	2.8				*148*	6.0	6.0	247	1.0	4.11	10.1	4.0	0.5	10.6	75	2.60%	200	26.4	40%	60%	1.2	10.0		8.0	8.0		6.0	2.02		2.00			
West			0.24	*NA*	*0*	*0*																													
West			0.6	*RF-9*	*128*	*77*																													
West	**020**	011	0.84				*77*	0.0	6.0	324	1.3	4.07	11.3	4.9	0.6	11.9	104	0.40%	250	18.8	64%	76%	0.6	8.0	8.0	6.0	8.0	8.0	5.6	2.02	2.02	2.44	2.44		
West			0.43	*NA*	*0*	*0*																													
West			0.82	*RM-30*	*206*	*169*																													
West	**019**	018	1.25				*169*	0.0	0.0	169	0.7	4.17	2.9	1.3	0.2	3.0	141	5.10%	200	37.0	8%	26%	1.0	34.5		32.5	27.3		25.3	2.00		2.00			
West	**018**	016					0	0.0	0.0	169	0.7	4.17	2.9	1.3	0.2	3.0	66	6.00%	200	40.2	8%	26%	1.1	27.3		25.3	23.4		21.4	2.02		2.00			
West			0.68	*NA*	*0*	*0*																													
West			0.8	*RM-30*	*206*	*165*																													
West	**017**	016	1.48				*165*	0.0	0.0	165	0.7	4.18	2.8	1.5	0.2	3.0	145	5.70%	200	39.2	8%	26%	1.1	31.6		29.6	23.4		21.4	2.00		2.00			
West			1.16	*NA*	*0*	*0*																													
West			0.86	*RM-30*	*206*	*177*																													
West	**016**	013	2.02				*177*	0.0	0.0	511	2.1	3.97	8.2	4.8	0.6	8.8	88	3.80%	200	32.0	28%	50%	1.3	23.4		21.4	20.0		18.0	2.02		2.00			
West			2.83	*NA*	*0*	*0*																													
West			1.89	*RF-9*	*128*	*242*																													
West	**015**	014	4.72				*242*	0.0	0.0	242	1.0	4.12	4.0	4.7	0.6	4.6	133	3.40%	200	30.2	15%	36%	1.0	30.0		27.0	25.5		22.5	3.00		3.00			
West	**014**	013					0	0.0	0.0	242	1.0	4.12	4.0	4.7	0.6	4.6	121	3.70%	200	31.5	15%	36%	1.0	25.5		22.5	20.0		18.0	3.02		2.00			
West	**013**	012					0	0.0	0.0	753	3.0	3.88	11.8	9.5	1.2	13.1	110	6.30%	200	41.2	32%	52%	1.7	20.0		18.0	13.0		11.0	2.02		2.00			
West			0.53	*NA*	*0*	*0*																													
West			0.69	*RF-9*	*128*	*88*																													
West	**012**	011	1.22				*88*	0.0	0.0	841	3.4	3.85	13.1	10.7	1.4	14.5	86	5.80%	200	39.5	37%	58%	1.7	13.0		11.0	8.0	8.0	6.0	2.02		2.00	2.00		
West			2	*NA*	*0*	*0*																													
West			1.19	*RF*	*66*	*79*																													
West	**011**	010	3.19				*79*	0.0	6.0	1243	5.0	3.74	24.8	18.8	2.4	27.2	67	0.40%	300	30.6	89%	92%	0.7	8.0	8.0	5.6	8.2	8.0	5.3	2.44	2.44	2.90	2.67		
West	**010**	007					0	0.0	6.0	1243	5.0	3.74	24.8	18.8	2.4	27.2	89	0.40%	300	30.6	89%	92%	0.7	8.2	8.0	5.3	8.9	8.1	5.0	2.92	2.69	**3.89**	3.10		
West			0.71	*NA*	*0*	*0*																													
West			2.63	*RF-9*	*128*	*337*																													
West	**009**	008	3.34				*337*	0.0	0.0	337	1.4	4.06	5.5	3.3	0.4	6.0	104	8.00%	200	46.4	13%	34%	1.4	23.9		21.9	15.5		13.5	2.00		2.00			

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
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172nd Street Pump Station Catchment

Development Area: Tynehead

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
West	**008**	007					0	0.0	0.0	337	1.4	4.06	5.5	3.3	0.4	6.0	121	5.40%	200	38.1	16%	36%	1.3	15.5		13.5	8.9	8.1	6.9	2.02		2.00	
West			0.86	*NA*	*0*	*0*																													
West			1.06	*RF*	*66*	*70*																													
West			0.4	*RF-9*	*128*	*51*																													
West	**007**	006	2.32				*121*	0.0	6.0	1701	6.9	3.64	31.1	24.4	3.2	34.2	74	0.30%	375	48.0	71%	82%	0.7	8.9	8.1	5.0	9.8	8.5	4.8	**3.89**	3.10	**5.05**	**3.73**
West			0.87	*NA*	*0*	*0*																													
West			1.42	*RF*	*66*	*94*																													
West	**006**	004	2.29				*94*	0.0	6.0	1795	7.3	3.62	32.3	26.7	3.5	35.8	93	0.30%	375	48.0	75%	84%	0.7	9.8	8.5	4.8	7.8	8.0	4.5	**5.07**	**3.75**	3.34	**3.52**
West			0.27	*NA*	*0*	*0*																													
West			1.06	*RF-9*	*128*	*136*																													
West	**005**	004	1.33				*136*	0.0	0.0	136	0.5	4.21	2.3	1.3	0.2	2.5	129	8.80%	200	48.6	5%	22%	1.1	19.2		17.2	7.8	8.0	5.8	2.00		2.00	2.19
West			0.14	*NA*	*0*	*0*																													
West			0.66	*RF*	*66*	*44*																													
West	**004**	003	0.8				*44*	0.0	6.0	1974	8.0	3.59	34.7	28.8	3.7	38.4	115	1.00%	375	87.7	44%	62%	1.1	7.8	8.0	4.5	5.3	5.3	3.3	3.34	**3.52**	2.00	2.00
LPS-South			7.55	*NA*	*0*	*0*																													
LPS-South			3	*RH,RH-g*	*22*	*66*																													
LPS-South	**LPS-S**	LPS-S	10.55				66	0.0	0.0	66	0.3	4.29	1.1	10.6	1.4	2.5																			
West	**003**	002					0	2.5	8.5	1974	8.0	3.59	37.2	28.8	3.7	41.0	117	0.30%	375	79.9	51%	64%	0.7	5.3	5.3	3.3	7.2	6.0	2.9	2.00	2.00	**4.21**	3.06
West	**002**	001					0	0.0	8.5	1974	8.0	3.59	37.2	28.8	3.7	41.0	87	0.30%	375	79.9	51%	64%	0.7	7.2	6.0	2.9	5.0	5.0	2.7	**4.23**	3.08	2.34	2.34
Center-West			0.19	*NA*	*0*	*0*																													
Center-West			0.66	*RM-45*	*266*	*176*																													
Center-West	**050**	049	0.85				*176*	0.0	0.0	176	0.7	4.17	3.0	0.9	0.1	3.1	118	6.70%	200	42.4	7%	26%	1.1	48.3		46.3	40.4		38.4	2.00		2.00	
Center-West			0.34	*NA*	*0*	*0*																													
Center-West			0.19	*RM-45*	*266*	*51*																													
Center-West	**049**	048	0.53				*51*	0.0	0.0	226	0.9	4.13	3.8	1.4	0.2	4.0	63	4.00%	200	32.8	12%	32%	1.0	40.4		38.4	37.8		35.8	2.02		2.00	
Center-West			0.28	*NA*	*0*	*0*																													
Center-West			0.14	*RM-45*	*266*	*37*																													
Center-West	**048**	046	0.42				*37*	0.0	0.0	263	1.1	4.10	4.4	1.8	0.2	4.6	52	5.10%	200	37.0	12%	32%	1.2	37.8		35.8	35.1		33.1	2.02		2.00	
Center-West			0.13	*NA*	*0*	*0*																													
Center-West			0.55	*RM-45*	*266*	*146*																													
Center-West	**047**	046	0.68				*146*	0.0	0.0	146	0.6	4.20	2.5	0.7	0.1	2.6	126	6.90%	200	43.1	6%	22%	1.1	43.8		41.8	35.1		33.1	2.00		2.00	
Center-West			1.08	*NA*	*0*	*0*																													
Center-West	**046**	045	1.08				0	0.0	0.0	410	1.7	4.02	6.7	3.6	0.5	7.1	53	2.00%	200	23.2	31%	52%	1.0	35.1		33.1	34.0		32.0	2.02		2.00	
Center-West			0.32	*NA*	*0*	*0*																													
Center-West			0.53	*RM-30*	*206*	*109*																													
Center-West	**045**	043	0.85				*109*	0.0	0.0	519	2.1	3.97	8.3	4.4	0.6	8.9	111	2.70%	200	26.9	33%	54%	1.1	34.0		32.0	31.0		29.0	2.02		2.00	
Center-West			0.1	*NA*	*0*	*0*																													
Center-West			0.31	*RM-30*	*206*	*64*																													
Center-West	**044**	043	0.41				*64*	0.0	0.0	64	0.3	4.29	1.1	0.4	0.1	1.2	125	4.50%	200	34.8	3%	16%	0.7	36.6		34.6	31.0		29.0	2.00		2.00	
Center-West			0.33	*NA*	*0*	*0*																													
Center-West			0.6	*RM-30*	*206*	*124*																													
Center-West	**043**	042	0.93				*124*	0.0	0.0	706	2.9	3.89	11.1	5.8	0.7	11.9	135	4.30%	200	34.0	35%	56%	1.4	31.0		29.0	25.2		23.2	2.02		2.00	
Center-West			0.19	*NA*	*0*	*0*																													
Center-West			0.51	*RM-30*	*206*	*105*																													
Center-West	**042**	041	0.7				*105*	0.0	0.0	811	3.3	3.86	12.7	6.5	0.8	13.5	97	1.30%	200	18.7	72%	82%	1.0	25.2		23.2	23.9		21.9	2.02		2.00	

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

172nd Street Pump Station Catchment

Development Area: Tynehead

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity (m/s) [4]	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
Center-West			0.35	*NA*	*0*	*0*																													
Center-West			0.44	*RF-9*	*128*	*56*																													
Center-West	**041**	039	0.79				*56*	0.0	0.0	868	3.5	3.84	13.5	7.2	0.9	14.4	115	6.90%	200	43.1	34%	54%	1.8	23.9		21.9	16.0		14.0	2.02		2.00			
Center-West			0.21	*NA*	*0*	*0*																													
Center-West			0.59	*RF-12*	*89*	*53*																													
Center-West	**040**	039	0.8				*53*	0.0	0.0	53	0.2	4.31	0.9	0.8	0.1	1.0	85	1.00%	200	16.4	6%	24%	*0.4*	13.0	13.0	11.0	16.0	15.5	10.1	2.00	2.00	**5.85**	**5.35**		
Center-West			0.19	*NA*	*0*	*0*																													
Center-West			0.38	*RF*	*66*	*25*																													
Center-West	**039**	001	0.57				*25*	0.0	0.0	945	3.8	3.82	14.6	8.6	1.1	15.7	126	5.60%	200	38.8	41%	60%	1.7	16.0	15.5	10.1	5.0	5.0	3.0	**5.87**	**5.37**	2.00	2.00		
Center-West			1.28	*NA*	*0*	*0*																													
Center-West	**001**	000	1.28				0	0.0	8.5	2919	11.8	3.45	49.3	38.7	5.0	54.4	149	0.30%	375	79.9	68%	76%	0.8	5.0		2.7	5.7		2.2	2.34		3.47			
Center			0.86	*NA*	*0*	*0*																													
Center			0.77	*RF*	*66*	*51*																													
Center	**000**	PS	1.63				*51*	0.0	8.5	6273	25.4	3.15	88.6	105.2	13.6	102.3								5.7		2.2				3.47					
Pump Station	**PS**									6661	25.4		88.6	121.0		102.3																			

1- ppha from Table 2.6 of surrey Design Criteria
2- Assumed grade based on existing ground elevations. To be confirmed with road profile design.
3- Q Capacity and D Capacity based on 50% of pipes when flows are less then 40 L/s, and 83.2% of pipe full capacity (equivalent to flow with normal depth of 70% of pipe diameter) when flows are greater than 40 L/s.
4- Velocity based on normal depth flow at 70% of PDWF.
5- Conceptual Rim and Depth based on conceptual finished ground. Does not take into account any review of road profile or geometry.

Q > 40 L/s
Size > 200mm
3.6 Pipe depth > 3.5m
0.5 Pipe Velocity < 0.6 m/s

Land Use	**Assumed Zoning**	**Abbr.**
Road	NA	NA
Buffer	NA	NA
Trail	NA	NA
Riparian	NA	NA
Park Acquisition	NA	NA
Potential Park	NA	NA
School	Institutional	PI
Community Centre	Commercial Recreation	CPR
Institutional	Institutional	PI
Commercial	CD (based on C-15)	C-15
Village Commercial	Community Commercial	C-8
Industrial Low Impact	Light Impact Industrial	IL
Industrial Business Park	Business Park	IB
Suburban Cluster	Half-Acre Residential (Gross Density)	RH, RH-G
Low Density Urban 6-10	Single Family Residential - 12m Frontage	RF-12
Cluster Residential 4-6	CD (based on RF)	RF
Cluster Residential 6-10	CD (based on RF-9)	RF-9
Cluster Residential 10-15	CD (based on RM-10)	RM-10
Medium Density 10-15	Single Family Residential - 9m Frontage	RF-9
Medium High Density 15-25	Multiple Residential Development	RM-30
High Density Residential 25-45	CD (based on RM-30)	RM-30
High Density Residential 30-45	CD (based on RM-45)	RM-45
Special Residential 15-25	CD (based on RM-30)	RM-30

Table 3.4-5

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

Anniedale Pump Station Catchment (187 St.)

Development Areas: Anniedale A - West 1, Anniedale A - East 1 & Anniedale B1

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																				
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
LPS			0.32	*NA*	*0*	*0*																														
LPS			2.61	*IB*	*90*	*235*																														
East	**099**	098	2.93				235	0.0	0.0	235	1.0	4.12	3.9	2.9	0.4	4.3	95	1.00%	200	16.4	26%	48%	0.6	27.9		25.9	28.7		25.0	2.00		**3.71**				
East			0.06	*NA*	*0*	*0*																														
East			0.53	*IB*	*90*	*48*																														
East	**098**	097	0.59				48	0.0	0.0	283	1.1	4.09	4.7	3.5	0.5	5.1	118	0.60%	200	12.7	41%	60%	*0.6*	28.7		24.9	26.7		24.2	**3.73**		2.43				
East	**097**	091					0	0.0	0.0	283	1.1	4.09	4.7	3.5	0.5	5.1	11	0.50%	200	11.6	44%	64%	*0.5*	26.7		24.2	28.0		24.2	2.45		**3.84**				
East			0.36	*NA*	*0*	*0*																														
East			0.89	*IB*	*90*	*80*																														
East	**096**	093	1.25				80	0.0	0.0	80	0.3	4.27	1.4	1.3	0.2	1.5	142	1.70%	200	21.4	7%	26%	*0.6*	37.4		35.4	35.0		33.0	2.00		2.00				
East			0.59	*NA*	*0*	*0*																														
East			1.7	*IB*	*90*	*153*																														
East	**095**	094	2.29				153	0.0	0.0	153	0.6	4.19	2.6	2.3	0.3	2.9	135	1.90%	200	22.6	13%	34%	0.7	38.8		36.8	36.2		34.2	2.00		2.00				
East	**094**	093	0				0	0.0	0.0	153	0.6	4.19	2.6	2.3	0.3	2.9	41	3.00%	200	28.4	10%	30%	0.8	36.2		34.2	35.0		33.0	2.02		2.00				
East			0.21	*NA*	*0*	*0*																														
East			0.77	*IB*	*90*	*69*																														
East	**093**	092	0.98				69	0.0	0.0	302	1.2	4.08	5.0	4.5	0.6	5.6	86	3.30%	200	29.8	19%	40%	1.0	35.0		33.0	32.1		30.1	2.02		2.00				
East			0.26	*NA*	*0*	*0*																														
East			0.71	*IB*	*90*	*64*																														
East	**092**	091	0.97				64	0.0	0.0	366	1.5	4.04	6.0	5.5	0.7	6.7	73	5.60%	200	38.8	17%	38%	1.3	32.1		30.1	28.0		26.0	2.02		2.00				
East	**091**	090					0	0.0	0.0	649	2.6	3.91	10.3	9.0	1.2	11.5	139	1.40%	200	19.4	59%	74%	0.9	28.0		24.2	24.3		22.3	**3.84**		2.00				
Center-East			0.16	*NA*	*0*	*0*																														
Center-East			0.85	*IB*	*90*	*77*																														
Center-East	**090**	085	1.01				77	0.0	0.0	726	2.9	3.89	11.4	10.0	1.3	12.7	96	3.00%	200	28.4	45%	64%	1.3	24.3		22.3	21.4		19.4	2.02		2.00				
Center-East			0.37	*NA*	*0*	*0*																														
Center-East			0.27	*IB*	*90*	*24*																														
Center-East			0.35	*RM-30*	*206*	*72*																														
Center-East	**089**	087	0.99				96	0.0	0.0	96	0.4	4.25	1.7	1.0	0.1	1.8	102	6.20%	200	40.8	4%	20%	0.9	41.6		39.6	35.3		33.3	2.00		2.00				
Center-East			0.44	*NA*	*0*	*0*																														
Center-East			0.94	*RM-30*	*206*	*194*																														
Center-East	**088**	087	1.38				194	0.0	0.0	194	0.8	4.15	3.3	1.4	0.2	3.4	61	1.50%	200	20.1	17%	38%	0.7	36.2		34.2	35.3		33.3	2.00		2.00				
Center-East			0.27	*NA*	*0*	*0*																														
Center-East			1.08	*IB*	*90*	*97*																														
Center-East	**087**	086	1.35				97	0.0	0.0	387	1.6	4.03	6.3	3.7	0.5	6.8	96	5.80%	200	39.5	17%	38%	1.3	35.3		33.3	29.7		27.7	2.02		2.00				
Center-East			0.41	*NA*	*0*	*0*																														
Center-East			0.92	*IB*	*90*	*83*																														
Center-East	**086**	085	1.33				83	0.0	0.0	470	1.9	3.99	7.6	5.1	0.7	8.2	126	6.60%	200	42.1	20%	42%	1.5	29.7		27.7	21.4		19.4	2.02		2.00				
Center-East	**085**	084					0	0.0	0.0	1196	4.8	3.75	18.2	15.1	2.0	20.1	58	0.50%	250	21.0	96%	96%	0.7	21.4		19.3	21.0		19.0	2.02		2.00				
Center-East	**084**	000					0	0.0	0.0	1196	4.8	3.75	18.2	15.1	2.0	20.1	42	0.50%	250	21.0	96%	96%	0.7	21.0		19.0	21.2		18.8	2.02		2.36				
Center			1.37	*NA*	*0*	*0*																														
Center			1.75	*RM-30*	*206*	*361*																														
Center	**001**	000	3.12				361	0.0	0.0	361	1.5	4.04	5.9	3.1	0.4	6.3	83	2.70%	200	26.9	23%	46%	1.0	23.4		21.4	21.2		19.2	2.00		2.00				
North			0.02	*NA*	*0*	*0*																														
North			0.16	*IL*	*90*	*14*																														
North	**100**	083	0.18				14	0.0	0.0	14	0.1	4.40	0.2	0.2	0.0	0.3	58	1.30%	200	18.7	1%	12%	*0.3*	66.8		64.8	66.0		64.0	2.00		2.00				
North			0.34	*NA*	*0*	*0*																														
North			1.12	*IL*	*90*	*101*																														

Unit Demand	*350*	L/person/day
Infiltration	*0.130*	L/s/ha
	11200	*L/ha/day*
Manning's Coefficient (n)	*0.013*	

Project	Anniedale Tynehead NCP
Scenario	NCP - December 2010 Landuse
Client	City of Surrey
USL Job	1072.0173.01

Anniedale Pump Station Catchment (187 St.)

Development Areas: Anniedale A - West 1, Anniedale A - East 1 & Anniedale B1

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																		
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS				
North	**083**	082	1.46				101	0.0	0.0	115	0.5	4.23	2.0	1.6	0.2	2.2	123	1.60%	200	20.7	11%	30%	0.6	66.0		64.0	64.0		62.0	2.02		2.00			
North			0.26	*NA*	*0*	*0*																													
North			1.02	*IL*	*90*	*92*																													
North	**082**	080	1.28				92	0.0	0.0	207	0.8	4.14	3.5	2.9	0.4	3.9	133	2.30%	200	24.9	15%	36%	0.8	64.0		62.0	60.9		58.9	2.02		2.00			
North			0.3	*NA*	*0*	*0*																													
North			4.09	*IL*	*90*	*368*																													
North	**081**	080	4.39				368	0.0	0.0	368	1.5	4.04	6.0	4.4	0.6	6.6	111	0.50%	200	11.6	57%	72%	*0.6*	60.0		58.0	60.9		57.4	2.00		3.48			
North			0.2	*NA*	*0*	*0*																													
North			1.02	*IL*	*90*	*92*																													
North	**080**	079	1.22				92	0.0	0.0	667	2.7	3.91	10.6	8.5	1.1	11.7	89	1.30%	200	18.7	62%	76%	0.9	60.9		57.4	58.3		56.3	3.50		2.00			
North			0.46	*NA*	*0*	*0*																													
North			1.29	*IL*	*90*	*116*																													
North	**079**	078	1.75				116	0.0	0.0	783	3.2	3.87	12.3	10.3	1.3	13.6	97	2.80%	200	27.4	50%	66%	1.3	58.3		56.3	55.6		53.6	2.02		2.00			
North			0.19	*NA*	*0*	*0*																													
North			0.77	*IL*	*90*	*69*																													
North	**078**	077	0.96				69	0.0	0.0	852	3.5	3.84	13.3	11.2	1.5	14.7	87	4.80%	200	35.9	41%	60%	1.6	55.6		53.6	51.4		49.4	2.02		2.00			
North			0.3	*NA*	*0*	*0*																													
North			0.29	*IL*	*90*	*26*																													
North	**077**	076	0.59				26	0.0	0.0	878	3.6	3.84	13.6	11.8	1.5	15.2	85	3.20%	200	29.3	52%	68%	1.4	51.4		49.4	48.7		46.7	2.02		2.00			
North			0.17	*NA*	*0*	*0*																													
North			0.41	*IL*	*90*	*37*																													
North	**076**	075	0.58				37	0.0	0.0	915	3.7	3.83	14.2	12.4	1.6	15.8	90	1.10%	200	17.2	92%	94%	1.0	48.7		46.7	47.7		45.7	2.02		2.00			
North	**075**	067					0	0.0	0.0	915	3.7	3.83	14.2	12.4	1.6	15.8	83	0.80%	250	26.6	59%	74%	0.8	47.7		45.7	47.0		45.0	2.02		2.00			
North			0.34	*NA*	*0*	*0*																													
North			2.23	*IL*	*90*	*201*																													
North	**074**	073	2.57				201	0.0	0.0	201	0.8	4.15	3.4	2.6	0.3	3.7	124	2.40%	200	25.4	15%	36%	0.8	64.6		62.6	61.7		59.7	2.00		2.00			
North			0.24	*NA*	*0*	*0*																													
North			1.71	*IL*	*90*	*154*																													
North	**073**	071	1.95				154	0.0	0.0	355	1.4	4.05	5.8	4.5	0.6	6.4	127	1.30%	200	18.7	34%	56%	0.8	61.7		59.7	60.0		58.0	2.02		2.00			
North			0.35	*NA*	*0*	*0*																													
North			0.69	*IL*	*90*	*62*																													
North	**072**	071	1.04				62	0.0	0.0	62	0.3	4.30	1.1	1.0	0.1	1.2	76	2.00%	200	23.2	5%	22%	*0.6*	60.5		58.5	60.0		57.0	2.00		3.05			
North			0.16	*NA*	*0*	*0*																													
North			0.5	*IL*	*90*	*45*																													
North	**071**	070	0.66				45	0.0	0.0	462	1.9	3.99	7.5	6.2	0.8	8.3	87	1.00%	200	16.4	50%	68%	0.8	60.0		56.9	58.0		56.0	3.07		2.00			
North			0.44	*NA*	*0*	*0*																													
North			0.83	*IL*	*90*	*75*																													
North	**070**	069	1.27				75	0.0	0.0	537	2.2	3.96	8.6	7.5	1.0	9.6	102	3.50%	200	30.7	31%	52%	1.2	58.0		56.0	54.5		52.5	2.02		2.00			
North			0.19	*NA*	*0*	*0*																													
North			0.95	*IL*	*90*	*86*																													
North	**069**	068	1.14				86	0.0	0.0	623	2.5	3.92	9.9	8.6	1.1	11.0	87	4.80%	200	35.9	31%	52%	1.4	54.5		52.5	50.3		48.3	2.02		2.00			
North			0.32	*NA*	*0*	*0*																													
North			0.63	*IL*	*90*	*57*																													
North	**068**	067	0.95				57	0.0	0.0	680	2.8	3.90	10.7	9.6	1.2	12.0	82	4.00%	200	32.8	37%	56%	1.4	50.3		48.3	47.0		45.0	2.02		2.00			
North			0.49	*NA*	*0*	*0*																													
North			1.73	*IL*	*90*	*156*																													
North	**067**	065	2.22				156	0.0	0.0	1751	7.1	3.63	25.7	24.2	3.1	28.9	144	2.60%	250	47.9	60%	74%	1.5	47.0		45.0	43.3		41.3	2.02		2.00			
North			0.5	*NA*	*0*	*0*																													
North			0.34	*IL*	*90*	*31*																													
North	**066**	065	0.84				31	0.0	0.0	31	0.1	4.35	0.5	0.8	0.1	0.7	132	1.00%	200	16.4	4%	18%	*0.4*	44.7		42.7	43.3		41.3	2.00		2.00			
North			0.24	*NA*	*0*	*0*																													
North			1.1	*IL*	*90*	*99*																													
North	**065**	064	1.34				99	0.0	0.0	1881	7.6	3.61	27.5	26.4	3.4	30.9	113	1.10%	250	31.2	**99%**	98%	1.1	43.3		41.3	42.1		40.0	2.02		2.07			

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

Anniedale Pump Station Catchment (187 St.)

Development Areas: Anniedale A - West 1, Anniedale A - East 1 & Anniedale B1

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
North			0.46	*NA*	*0*	*0*																														
North			0.66	*IL*	*90*	*59*																														
North	**064**	063	1.12				59	0.0	0.0	1940	7.9	3.60	28.3	27.5	3.6	31.8	104	1.80%	250	39.9	80%	86%	1.3	42.1		40.0	40.1		38.1	2.09		2.00	
North	**063**	062					0	0.0	0.0	1940	7.9	3.60	28.3	27.5	3.6	31.8	107	0.50%	300	34.2	93%	94%	0.8	40.1	40.1	38.1	40.7	40.0	37.6	2.02	2.02	3.11	2.43
North			0.34	*NA*	*0*	*0*																														
North			0.6	*IL*	*90*	*54*																														
North	**062**	050	0.94				54	0.0	0.0	1994	8.1	3.59	29.0	28.5	3.7	32.7	95	0.50%	300	34.2	96%	96%	0.8	40.7	40.0	37.6	41.1	40.5	37.1	3.13	2.45	**4.01**	3.42
North-West			0.12	*NA*	*0*	*0*																														
North-West			0.81	*IL*	*90*	*73*																														
North-West	**061**	060	0.93				73	0.0	0.0	73	0.3	4.28	1.3	0.9	0.1	1.4	68	1.70%	200	21.4	6%	24%	*0.5*	63.0		61.0	61.9		59.9	2.00		2.00	
North-West			0.74	*NA*	*0*	*0*																														
North-West			0.71	*IL*	*90*	*64*																														
North-West	**060**	059	1.45				64	0.0	0.0	137	0.6	4.20	2.3	2.4	0.3	2.6	150	1.70%	200	21.4	12%	32%	0.6	61.9		59.8	59.3		57.3	2.02		2.00	
North-West			0.39	*NA*	*0*	*0*																														
North-West			0.71	*IL*	*90*	*64*																														
North-West	**059**	058	1.1				64	0.0	0.0	201	0.8	4.15	3.4	3.5	0.5	3.8	96	2.60%	200	26.4	14%	36%	0.9	59.3		57.2	56.7		54.7	2.02		2.00	
North-West			0.62	*NA*	*0*	*0*																														
North-West			1.06	*IL*	*90*	*95*																														
North-West	**058**	057	1.68				95	0.0	0.0	296	1.2	4.08	4.9	5.2	0.7	5.6	90	3.70%	200	31.5	18%	40%	1.1	56.7		54.7	53.3		51.3	2.02		2.00	
North-West			0.36	*NA*	*0*	*0*																														
North-West			0.96	*IL*	*90*	*86*																														
North-West	**057**	056	1.32				86	0.0	0.0	382	1.5	4.03	6.2	6.5	0.8	7.1	83	3.10%	200	28.9	25%	46%	1.1	53.3		51.3	50.7		48.7	2.02		2.00	
North-West			0.64	*NA*	*0*	*0*																														
North-West			0.87	*IL*	*90*	*78*																														
North-West	**056**	055	1.51				78	0.0	0.0	460	1.9	3.99	7.4	8.0	1.0	8.5	84	2.30%	200	24.9	34%	54%	1.0	50.7		48.7	48.8		46.8	2.02		2.00	
North-West			0.7	*NA*	*0*	*0*																														
North-West			1.23	*IL*	*90*	*111*																														
North-West	**055**	054	1.93				111	0.0	0.0	571	2.3	3.94	9.1	9.9	1.3	10.4	149	2.60%	200	26.4	39%	60%	1.1	48.8		46.8	44.9		42.9	2.02		2.00	
North-West			1.42	*NA*	*0*	*0*																														
North-West			0.72	*IL*	*90*	*65*																														
North-West	**054**	053	2.14				65	0.0	0.0	636	2.6	3.92	10.1	12.1	1.6	11.7	144	0.50%	250	21.0	55%	72%	0.6	44.9		42.8	44.2		42.1	2.02		2.07	
North-West			1.31	*NA*	*0*	*0*																														
North-West			0.81	*IL*	*90*	*73*																														
North-West	**053**	052	2.12				73	0.0	0.0	709	2.9	3.89	11.2	14.2	1.8	13.0	116	0.80%	250	26.6	49%	66%	0.8	44.2		42.1	43.2		41.2	2.09		2.00	
North-West			0.4	*NA*	*0*	*0*																														
North-West			0.7	*IL*	*90*	*63*																														
North-West	**052**	051	1.1				63	0.0	0.0	772	3.1	3.87	12.1	15.3	2.0	14.1	142	2.90%	250	50.6	28%	50%	1.3	43.2		41.1	38.3	38.4	37.0	2.02		**1.25**	**1.30**
North			0.38	*NA*	*0*	*0*																														
North			0.53	*IL*	*90*	*48*																														
North	**049**	050	0.91				48	0.0	0.0	48	0.2	4.32	0.8	0.9	0.1	1.0	113	1.00%	200	16.4	6%	22%	*0.4*	41.8		39.8	41.1		38.7	2.00		2.36	
North	**050**	051					0	0.0	0.0	2042	8.3	3.58	29.6	29.4	3.8	33.4	102	0.20%	375	39.2	85%	90%	0.6	41.1	40.5	37.1	38.3	38.4	36.9	**4.01**	3.42	**1.42**	**1.48**
North	**051**	042					0	0.0	0.0	2814	11.4	3.47	39.5	44.6	5.8	45.3	30	0.20%	375	65.2	69%	77%	0.7	38.3	38.4	36.9	39.3	38.4	36.8	**1.44**	**1.50**	2.47	**1.56**
Center-North			1.37	*NA*	*0*	*0*																														
Center-North			0.51	*IB*	*90*	*46*																														
Center-North	**048**	047	1.88				46	0.0	0.0	46	0.2	4.32	0.8	1.9	0.2	1.0	106	1.00%	200	16.4	6%	24%	*0.4*	37.5		35.5	37.0		34.4	2.00		2.56	
Center-North	**047**	016	0				0	0.0	0.0	46	0.2	4.32	0.8	1.9	0.2	1.0	134	0.60%	200	12.7	8%	26%	*0.3*	37.0		34.4	36.3		33.6	2.58		2.70	
Center-North			1.39	*NA*	*0*	*0*																														
Center-North			1.38	*RM-10*	*114*	*157*																														
Center-North	**046**	045	2.77				157	0.0	0.0	157	0.6	4.19	2.7	2.8	0.4	3.0	106	1.00%	200	16.4	18%	40%	*0.6*	43.5		41.5	44.3		40.5	2.00		**3.82**	
Center-North			0.68	*NA*	*0*	*0*																														

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

Anniedale Pump Station Catchment (187 St.)

Development Areas: Anniedale A - West 1, Anniedale A - East 1 & Anniedale B1

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																		
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)			
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
Center-North			1.1	*RM-30*	*206*	*227*																												
Center-North	**045**	044	1.78				227	0.0	0.0	384	1.6	4.03	6.3	4.6	0.6	6.9	104	0.60%	200	12.7	54%	70%	0.6	44.3		40.5	42.8		39.8	**3.84**		2.96	
Center-North			0.77	*NA*	*0*	*0*																												
Center-North			0.25	*RM-30*	*206*	*52*																												
Center-North	**044**	042	1.02				52	0.0	0.0	436	1.8	4.01	7.1	5.6	0.7	7.8	106	3.90%	200	32.4	24%	46%	1.2	42.8		39.8	39.3	38.4	35.7	2.98		**3.56**	2.65
Center-North			0.22	*NA*	*0*	*0*																												
Center-North			0.96	*RM-30*	*206*	*198*																												
Center-North	**043**	042	1.18				198	0.0	0.0	198	0.8	4.15	3.3	1.2	0.2	3.5	133	5.10%	200	37.0	9%	28%	1.1	46.9		44.9	39.3	38.4	38.1	2.00		**1.20**	**0.29**
Center-North			0.52	*NA*	*0*	*0*																												
Center-North			0.01	*RM-10*	*114*	*1*																												
Center-North			1.14	*RM-30*	*206*	*235*																												
Center-North	**042**	041	1.67				236	0.0	0.0	3684	14.9	3.37	50.2	53.1	6.9	57.1	127	0.20%	375	65.2	88%	90%	0.7	39.3	38.4	36.8	41.6	40.5	36.5	2.47	**1.56**	**5.06**	**3.96**
Center-North			0.48	*NA*	*0*	*0*																												
Center-North			1.7	*RM-10*	*114*	*194*																												
Center-North			0	*RM-30*	*206*	*0*																												
Center-North	**041**	040	2.18				194	0.0	0.0	3878	15.7	3.35	52.6	55.2	7.2	59.7	117	0.20%	375	65.2	92%	93%	0.7	41.6	40.5	36.5	38.8	38.8	36.3	**5.08**	**3.98**	2.46	2.46
Center-North			0.5	*NA*	*0*	*0*																												
Center-North			1.49	*RM-10*	*114*	*170*																												
Center-North	**040**	039	1.99				170	0.0	0.0	4048	16.4	3.33	54.6	57.2	7.4	62.0	82	1.40%	375	172.6	36%	53%	1.4	38.8	38.8	36.3	36.5	36.5	35.1	2.48	2.48	**1.38**	**1.38**
Center-North			0.37	*NA*	*0*	*0*																												
Center-North			0.77	*RM-10*	*114*	*88*																												
Center-North	**039**	016	1.14				88	0.0	0.0	4136	16.8	3.32	55.6	58.4	7.6	63.2	101	0.20%	375	65.2	97%	97%	0.7	36.5	36.5	35.1	36.3	36.8	34.9	**1.38**	**1.38**	**1.38**	**1.83**
South-West			0.27	*NA*	*0*	*0*																												
South-West			0.61	*RM-10*	*114*	*70*																												
South-West	**038**	037	0.88				70	0.0	0.0	70	0.3	4.28	1.2	0.9	0.1	1.3	94	1.00%	200	16.4	8%	26%	*0.4*	46.7	46.7	44.7	46.0	46.0	43.8	2.00	2.00	2.24	2.24
South-West			0.22	*NA*	*0*	*0*																												
South-West			0.36	*RF-9*	*128*	*46*																												
South-West			0.01	*RM-30*	*206*	*2*																												
South-West	**037**	036	0.59				48	0.0	0.0	118	0.5	4.22	2.0	1.5	0.2	2.2	95	0.60%	200	12.7	17%	38%	*0.4*	46.0	46.0	43.7	46.8	46.3	43.2	2.26	2.26	**3.62**	3.08
South-West			0.34	*NA*	*0*	*0*																												
South-West			0.38	*RF-9*	*128*	*49*																												
South-West	**036**	035	0.72				49	0.0	0.0	167	0.7	4.18	2.8	2.2	0.3	3.1	106	0.50%	200	11.6	27%	48%	*0.4*	46.8	46.3	43.1	47.3	46.5	42.6	**3.64**	3.10	**4.70**	**3.88**
South-West			0.23	*NA*	*0*	*0*																												
South-West			0.39	*RF-9*	*128*	*50*																												
South-West	**035**	034	0.62				50	0.0	0.0	217	0.9	4.14	3.6	2.8	0.4	4.0	99	0.50%	200	11.6	34%	56%	*0.5*	47.3	46.5	42.6	45.4	45.8	42.1	**4.72**	**3.90**	3.33	**3.65**
South-West			0.32	*NA*	*0*	*0*																												
South-West			0.45	*RF-9*	*128*	*58*																												
South-West	**034**	026	0.77				58	0.0	0.0	275	1.1	4.10	4.6	3.6	0.5	5.0	100	0.50%	200	11.6	43%	62%	*0.5*	45.4	45.8	42.1	44.9	44.9	41.6	3.35	**3.67**	3.27	3.27
South-West			0.24	*NA*	*0*	*0*																												
South-West			0.29	*RF-9*	*128*	*37*																												
South-West	**033**	031	0.53				37	0.0	0.0	37	0.1	4.34	0.7	0.5	0.1	0.7	89	1.00%	200	16.4	4%	20%	*0.4*	48.4		46.4	48.5		45.5	2.00		2.98	
South-West			0.23	*NA*	*0*	*0*																												
South-West			0.26	*RF-9*	*128*	*33*																												
South-West	**032**	031	0.49				33	0.0	0.0	33	0.1	4.35	0.6	0.5	0.1	0.6	85	1.00%	200	16.4	4%	18%	*0.4*	48.8		46.8	48.5		45.9	2.00		2.55	
South-West	**031**	029					0	0.0	0.0	70	0.3	4.28	1.2	1.0	0.1	1.3	93	0.60%	200	12.7	11%	30%	*0.4*	48.5		45.5	47.4		44.9	2.98		2.48	
South-West			0.7	*NA*	*0*	*0*																												
South-West			1.15	*RF-9*	*128*	*147*																												
South-West	**030**	029	1.85				147	0.0	0.0	147	0.6	4.19	2.5	1.9	0.2	2.7	147	1.00%	200	16.4	17%	38%	*0.6*	47.6		45.6	47.4		44.1	2.00		3.29	
South-West	**029**	027					0	0.0	0.0	217	0.9	4.14	3.6	2.9	0.4	4.0	87	0.60%	200	12.7	32%	52%	*0.5*	47.4		44.1	46.5		43.6	3.31		2.87	
South-West			0.73	*NA*	*0*	*0*																												
South-West			1.19	*RF-9*	*128*	*152*																												
South-West	**028**	027	1.92				152	0.0	0.0	152	0.6	4.19	2.6	1.9	0.2	2.8	105	1.00%	200	16.4	17%	38%	*0.6*	46.6		44.6	46.5		43.5	2.00		2.94	

Unit Demand	*350* L/person/day		
Infiltration	*0.130* L/s/ha	*11200 L/ha/day*	
Manning's Coefficient (n)	*0.013*		

Project	Anniedale Tynehead NCP
Scenario	NCP - December 2010 Landuse
Client	City of Surrey
USL Job	1072.0173.01

Anniedale Pump Station Catchment (187 St.)

Development Areas: Anniedale A - West 1, Anniedale A - East 1 & Anniedale B1

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
South-West	**027**	026					0	0.0	0.0	369	1.5	4.04	6.0	4.8	0.6	6.7	106	0.60%	200	12.7	52%	68%	*0.6*	46.5		43.5	44.9	44.9	42.9	2.96		2.00	2.00
South-West			0.2	*NA*	*0*	*0*																													
South-West			0.39	*RF-9*	*128*	*50*																													
South-West	**026**	025	0.59				50	0.0	0.0	694	2.8	3.90	11.0	9.0	1.2	12.1	98	0.60%	200	12.7	95%	96%	0.7	44.9	44.9	41.6	44.1	44.1	41.0	3.27	3.27	3.10	3.10
South-West			0.23	*NA*	*0*	*0*																													
South-West			0.42	*RF-9*	*128*	*54*																													
South-West	**025**	018	0.65				54	0.0	0.0	748	3.0	3.88	11.8	9.6	1.2	13.0	107	0.70%	200	13.7	95%	96%	0.8	44.1	44.1	41.0	43.5		40.2	3.12	3.12	3.30	
South-West			0.28	*NA*	*0*	*0*																													
South-West			0.57	*RF-9*	*128*	*73*																													
South-West	**024**	023	0.85				73	0.0	0.0	73	0.3	4.28	1.3	0.9	0.1	1.4	62	1.20%	200	18.0	8%	26%	*0.5*	47.5		45.5	46.7		44.7	2.00		2.00	
South-West			0.39	*NA*	*0*	*0*																													
South-West			0.46	*RF-9*	*128*	*59*																													
South-West	**023**	022	0.85				59	0.0	0.0	132	0.5	4.21	2.3	1.7	0.2	2.5	88	0.60%	200	12.7	19%	42%	*0.4*	46.7		44.7	47.0		44.2	2.02		2.81	
South-West	**022**	019					0	0.0	0.0	132	0.5	4.21	2.3	1.7	0.2	2.5	85	1.40%	200	19.4	13%	34%	0.6	47.0		44.2	45.0		43.0	2.83		2.00	
South-West			0.23	*NA*	*0*	*0*																													
South-West			0.36	*RM-30*	*206*	*74*																													
South-West	**019**	018	0.59				74	0.0	0.0	206	0.8	4.14	3.5	2.3	0.3	3.8	106	1.40%	200	19.4	19%	42%	0.7	45.0		43.0	43.5		41.5	2.02		2.00	
South-West	**018**	017					0	0.0	0.0	954	3.9	3.81	14.7	11.9	1.5	16.3	72	1.90%	200	22.6	72%	82%	1.2	43.5		40.2	40.8		38.8	3.30		2.00	
South-West	**017**	016					0	0.0	0.0	954	3.9	3.81	14.7	11.9	1.5	16.3	91	4.10%	200	33.2	49%	66%	1.5	40.8		38.8	36.3		35.1	2.02		**1.20**	
South-West			0.99	*NA*	*0*	*0*																													
South-West			0.81	*IB*	*90*	*73*																													
South-West	**016**	015	1.8				73	0.0	0.0	5209	21.1	3.23	68.1	74.0	9.6	77.7	145	0.30%	375	79.9	97%	97%	0.9	36.3	36.8	33.6	40.2	38.0	33.2	2.70	3.15	**7.06**	**4.83**
Center			0.84	*NA*	*0*	*0*																													
Center			0.58	*IB*	*90*	*52*																													
Center	**015**	014	1.42				52	0.0	0.0	5261	21.3	3.23	68.7	75.4	9.8	78.5	131	2.50%	375	230.6	34%	51%	1.9	40.2	38.0	33.2	31.9	31.9	29.9	**7.08**	**4.85**	2.00	2.00
Center	**014**	002					0	0.0	0.0	5261	21.3	3.23	68.7	75.4	9.8	78.5	131	6.90%	375	383.2	20%	39%	2.7	31.9	31.9	29.9	22.8		20.8	2.02	2.02	2.00	
Center			0.34	*NA*	*0*	*0*																													
Center			1.56	*RM-10*	*114*	*178*																													
Center	**003**	002	1.9				178	0.0	0.0	178	0.7	4.17	3.0	1.9	0.2	3.3	107	9.20%	200	49.7	7%	24%	1.3	32.6		30.6	22.8		20.8	2.00		2.00	
Center			0.47	*NA*	*0*	*0*																													
Center			0.01	*RM-10*	*114*	*1*																													
Center			2.36	*RM-30*	*206*	*486*																													
Center	**013**	009	2.84				487	0.0	0.0	487	2.0	3.98	7.9	2.8	0.4	8.2	90	0.50%	200	11.6	71%	82%	0.6	44.3		42.3	44.2		41.9	2.00		2.35	
Center			0.28	*NA*	*0*	*0*																													
Center			0.49	*RM-30*	*206*	*101*																													
Center	**012**	010	0.77				101	0.0	0.0	101	0.4	4.24	1.7	0.8	0.1	1.8	85	1.00%	200	16.4	11%	32%	*0.5*	46.7		44.7	46.1		43.8	2.00		2.22	
Center			0.54	*NA*	*0*	*0*																													
Center			0.41	*RM-30*	*206*	*84*																													
Center	**011**	010	0.95				84	0.0	0.0	84	0.3	4.26	1.5	1.0	0.1	1.6	76	3.40%	200	30.2	5%	22%	0.7	48.7		46.7	46.1		44.1	2.00		2.00	
Center	**010**	009					0	0.0	0.0	185	0.7	4.16	3.1	1.7	0.2	3.3	94	1.70%	200	21.4	16%	36%	0.7	46.1		43.8	44.2		42.2	2.22		2.00	
Center			0.25	*NA*	*0*	*0*																													
Center			1.42	*RM-10*	*114*	*162*																													
Center	**009**	008	1.67				162	0.0	0.0	834	3.4	3.85	13.0	6.2	0.8	13.8	101	4.30%	200	34.0	41%	60%	1.5	44.2		41.9	39.5		37.5	2.35		2.00	
Center			0.18	*NA*	*0*	*0*																													
Center			0.79	*RM-10*	*114*	*90*																													
Center	**008**	004	0.97				90	0.0	0.0	924	3.7	3.82	14.3	7.2	0.9	15.2	102	9.40%	200	50.3	30%	52%	2.0	39.5		37.5	29.9		27.9	2.02		2.00	
Center			0.36	*NA*	*0*	*0*																													
Center			0.42	*RM-10*	*114*	*48*																													
Center	**007**	006	0.78				48	0.0	0.0	48	0.2	4.32	0.8	0.8	0.1	0.9	108	4.90%	200	36.3	3%	14%	0.7	47.3		45.3	42.0		40.0	2.00		2.00	
Center			0.34	*NA*	*0*	*0*																													
Center			0.64	*RM-10*	*114*	*73*																													
Center			0.01	*RM-30*	*206*	*2*																													

Unit Demand	*350*	L/person/day	
Infiltration	*0.130*	L/s/ha	*11200 L/ha/day*
Manning's Coefficient (n)	*0.013*		

Project	Anniedale Tynehead NCP
Scenario	NCP - December 2010 Landuse
Client	City of Surrey
USL Job	1072.0173.01

Anniedale Pump Station Catchment (187 St.)

Development Areas: Anniedale A - West 1, Anniedale A - East 1 & Anniedale B1

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																		
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS				
Center	**006**	005	0.99				75	0.0	0.0	123	0.5	4.22	2.1	1.8	0.2	2.3	81	5.60%	200	38.8	6%	22%	1.0	42.0		40.0	37.4		35.4	2.02		2.00			
Center	**005**	004					0	0.0	0.0	123	0.5	4.22	2.1	1.8	0.2	2.3	90	8.30%	200	47.2	5%	20%	1.1	37.4		35.4	29.9		27.9	2.02		2.00			
Center			0.33	*NA*	*0*	*0*																													
Center			0.34	*RM-10*	*114*	*39*																													
Center	**004**	002	0.67				39	0.0	0.0	1086	4.4	3.78	16.6	9.6	1.2	17.9	116	6.10%	200	40.5	44%	62%	1.8	29.9		27.9	22.8		20.8	2.02		2.00			
Center	**002**	000					0	0.0	0.0	6525	26.4	3.14	82.9	86.9	11.3	94.2	123	1.30%	375	166.3	57%	69%	1.6	22.8		20.8	21.2		19.2	2.02		2.00			
Pump Station	**000**						0	0.0	0.0	8082	32.7	3.05	99.7	105.1	13.6	113.3								21.2		18.8	21.2			2.36					
Pump Station	**PS**									8082	32.7		99.7	105.1		113.3																		

1- ppha from Table 2.6 of surrey Design Criteria
2- Assumed grade based on existing ground elevations. To be confirmed with road profile design.
3- Q Capacity and D Capacity based on 50% of pipes when flows are less then 40 L/s, and 83.2% of pipe full capacity (equivalent to flow with normal depth of 70% of pipe diameter) when flows are greater than 40 L/s.
4- Velocity based on normal depth flow at 70% of PDWF.
5- Conceptual Rim and Depth based on conceptual finished ground. Does not take into account any review of road profile or geometry.

Q > 40 L/s
Size > 200mm
3.6 Pipe depth > 3.5m
0.5 Pipe Velocity < 0.6 m/s

Land Use	**Assumed Zoning**	**Abbr.**
Road	NA	NA
Buffer	NA	NA
Trail	NA	NA
Riparian	NA	NA
Park Acquisition	NA	NA
Potential Park	NA	NA
School	Institutional	PI
Community Centre	Commercial Recreation	CPR
Institutional	Institutional	PI
Commercial	CD (based on C-15)	C-15
Village Commercial	Community Commercial	C-8
Industrial Low Impact	Light Impact Industrial	IL
Industrial Business Park	Business Park	IB
Suburban Cluster	Half-Acre Residential (Gross Density)	RH, RH-G
Low Density Urban 6-10	Single Family Residential - 12m Frontage	RF-12
Cluster Residential 4-6	CD (based on RF)	RF
Cluster Residential 6-10	CD (based on RF-9)	RF-9
Cluster Residential 10-15	CD (based on RM-10)	RM-10
Medium Density 10-15	Single Family Residential - 9m Frontage	RF-9
Medium High Density 15-25	Multiple Residential Development	RM-30
High Density Residential 25-45	CD (based on RM-30)	RM-30
High Density Residential 30-45	CD (based on RM-45)	RM-45
Special Residential 15-25	CD (based on RM-30)	RM-30

Table 3.4-6

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

176th Street Pump Station Catchment

Development Areas: Anniedale A - West 2, Anniedale B3 & Anniedale B4

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																		
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
East			0.53	*NA*	*0*	*0*																													
East			*0.84*	*C-8*	*60*	*50*																													
East			*0.78*	*RM-30*	*206*	*161*																													
East	**083**	082	2.15				211	0.0	0.0	211	0.9	4.14	3.5	2.2	0.3	3.8	104	1.00%	200	16.4	23%	46%	0.6	47.7		45.7	48.0		44.6	2.00		3.38			
East			*0.42*	*NA*	*0*	*0*																													
East			*0.81*	*RM-30*	*206*	*167*																													
East	**082**	081	1.23				167	0.0	0.0	378	1.5	4.03	6.2	3.4	0.4	6.6	98	0.60%	200	12.7	52%	68%	*0.6*	48.0		44.6	46.6		44.0	3.40		2.57			
East			*0.45*	*NA*	*0*	*0*																													
East			*0.83*	*RM-30*	*206*	*171*																													
East	**081**	080	1.28				171	0.0	0.0	549	2.2	3.95	8.8	4.7	0.6	9.4	100	1.50%	200	20.1	47%	64%	0.9	46.6		44.0	44.5		42.5	2.59		2.00			
East			*0.28*	*NA*	*0*	*0*																													
East			*0.29*	*RF-9*	*128*	*37*																													
East	**085**	084	0.57				37	0.0	0.0	37	0.1	4.34	0.7	0.6	0.1	0.7	92	2.50%	200	25.9	3%	16%	*0.5*	48.7		46.7	47.4		44.4	2.00		2.98			
East	**084**	080					0	0.0	0.0	37	0.1	4.34	0.7	0.6	0.1	0.7	110	2.50%	200	25.9	3%	16%	*0.5*	47.4		44.4	44.5		41.7	3.00		2.86			
East			*0.28*	*NA*	*0*	*0*																													
East			0.86	*RM-30*	*206*	*177*																													
East	**080**	079	*1.14*				177	0.0	0.0	763	3.1	3.87	12.0	6.4	0.8	12.8	108	2.00%	200	23.2	55%	70%	1.1	44.5		41.7	41.5		39.5	2.88		2.00			
East			*0.28*	*NA*	*0*	*0*																													
East			0.83	*RM-30*	*206*	*171*																													
East	**079**	068	*1.11*				171	0.0	0.0	934	3.8	3.82	14.4	7.5	1.0	15.4	100	1.00%	200	16.4	94%	96%	0.9	41.5		39.4	40.6		38.4	2.02		2.15			
East			*0.65*	*NA*	*0*	*0*																													
East			1.18	*RF-9*	*128*	*151*																													
East	**078**	076	*1.83*				151	0.0	0.0	151	0.6	4.19	2.6	1.8	0.2	2.8	150	1.00%	200	16.4	17%	38%	*0.6*	46.2		44.2	45.5		42.7	2.00		2.85			
East			*1.11*	*NA*	*0*	*0*																													
East			0.66	*RM-10*	*114*	*75*																													
East	**077**	076	*1.77*				75	0.0	0.0	75	0.3	4.28	1.3	1.8	0.2	1.5	44	1.00%	200	16.4	9%	28%	*0.5*	45.4		43.4	45.5		43.0	2.00		2.53			
East	**076**	073					0	0.0	0.0	226	0.9	4.13	3.8	3.6	0.5	4.2	106	1.00%	200	16.4	26%	48%	0.6	45.5		42.7	44.8		41.6	2.85		3.20			
East			0.4	*NA*	*0*	*0*																													
East			*0.84*	*RF-9*	*128*	*108*																													
East	**075**	074	*1.24*				108	0.0	0.0	108	0.4	4.24	1.9	1.2	0.2	2.0	73	1.00%	200	16.4	12%	32%	*0.5*	45.6		42.9	45.0		42.2	2.68		2.83			
East	**074**	073					0	0.0	0.0	108	0.4	4.24	1.9	1.2	0.2	2.0	81	0.60%	200	12.7	16%	38%	*0.4*	45.0		42.1	44.8		41.7	2.85		3.16			
East			*1.17*	*NA*	*0*	*0*																													
East			*0.51*	*RF-9*	*128*	*65*																													
East	**073**	070	1.68				65	0.0	0.0	399	1.6	4.02	6.5	6.5	0.8	7.3	90	0.70%	200	13.7	54%	70%	0.6	44.8		41.6	44.4		41.0	3.20		3.45			
East			*0.24*	*NA*	*0*	*0*																													
East			*0.36*	*RF-9*	*128*	*46*																													
East	**072**	071	0.6				46	0.0	0.0	46	0.2	4.32	0.8	0.6	0.1	0.9	77	1.70%	200	21.4	4%	18%	*0.5*	45.7		43.0	44.4		41.7	2.67		2.67			
East			*0.24*	*NA*	*0*	*0*																													
East			*0.22*	*RF-9*	*128*	*28*																													
East	**071**	070	0.46				28	0.0	0.0	74	0.3	4.28	1.3	1.1	0.1	1.4	83	0.60%	200	12.7	11%	32%	*0.4*	44.4		41.7	44.4		41.2	2.69		3.24			
East	**070**	068	*0*				0	0.0	0.0	473	1.9	3.99	7.6	7.6	1.0	8.6	118	2.00%	200	23.2	37%	58%	1.0	44.4		41.0	40.6		38.6	3.45		2.00			
East			*1.38*	*NA*	*0*	*0*																													
East			1.5	*RM-30*	*206*	*309*																													
East	**069**	068	*2.88*				309	0.0	0.0	309	1.3	4.07	5.1	2.9	0.4	5.5	97	1.00%	200	16.4	33%	54%	0.7	40.4		38.4	40.6		37.4	2.00		3.20			
East	**068**	067					0	0.0	0.0	1716	7.0	3.64	25.3	17.9	2.3	27.6	103	3.00%	200	28.4	97%	98%	1.6	40.6		37.4	36.8		34.3	3.22		2.48			
East	**067**	064					0	0.0	0.0	1716	7.0	3.64	25.3	17.9	2.3	27.6	108	3.00%	200	28.4	97%	98%	1.6	36.8		34.3	33.0		31.0	2.50		2.00			
East			*12.9*	*NA*	*0*	*0*																													
East			*3.45*	*RM-10*	*114*	*393*																													
East	**066**	065	16.35				393	0.0	0.0	393	1.6	4.03	6.4	16.4	2.1	8.5	107	1.10%	200	17.2	50%	66%	0.8	33.0		31.0	31.8		29.8	2.00		2.00			
East			*0.73*	*NA*	*0*	*0*																													
East			*3.53*	*RM-10*	*114*	*402*																													
East	**065**	064	4.26				402	0.0	0.0	795	3.2	3.86	12.4	20.6	2.7	15.1	103	0.30%	250	16.3	93%	94%	*0.6*	31.8		29.8	33.0		29.5	2.02		3.50			

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

176th Street Pump Station Catchment

Development Areas: Anniedale A - West 2, Anniedale B3 & Anniedale B4

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																		
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
South			*0.2*	*NA*	*0*	*0*																													
South			2.02	*RM-10*	*114*	*230*																													
South	**064**	063	*2.22*				230	0.0	0.0	2741	11.1	3.48	38.6	40.8	5.3	43.9	72	0.50%	300	56.9	77%	83%	0.9	33.0		29.5	32.3		29.1	**3.52**		3.22			
South			*0.35*	*NA*	*0*	*0*																													
South			3.81	*RM-10*	*114*	*434*																													
South	**063**	062	*4.16*				434	0.0	0.0	3175	12.9	3.42	44.0	44.9	5.8	49.8	104	0.50%	300	56.9	88%	90%	0.9	32.3		29.1	31.3		28.6	3.24		2.70			
South			*0.77*	*NA*	*0*	*0*																													
South			0.43	*RM-10*	*114*	*49*																													
South	**062**	061	*1.2*				49	0.0	0.0	3224	13.1	3.42	44.6	46.1	6.0	50.6	43	1.10%	300	84.4	60%	70%	1.3	31.3		28.6	30.1		28.1	2.72		2.00			
South			*0.43*	*NA*	*0*	*0*																													
South			2.42	*RM-10*	*114*	*276*																													
South	**061**	060	*2.85*				276	0.0	0.0	3500	14.2	3.39	48.0	49.0	6.3	54.3	82	1.30%	300	91.7	59%	70%	1.4	30.1		28.1	29.0		27.0	2.02		2.00			
South			*0.17*	*NA*	*0*	*0*																													
South			0.85	*RM-10*	*114*	*97*																													
South	**060**	059	*1.02*				97	0.0	0.0	3597	14.6	3.38	49.2	50.0	6.5	55.7	69	2.40%	300	124.6	45%	60%	1.7	29.0		27.0	27.4		25.4	2.02		2.00			
South			*0.34*	*NA*	*0*	*0*																													
South			1.83	*RM-10*	*114*	*209*																													
South	**059**	058	*2.17*				209	0.0	0.0	3806	15.4	3.35	51.7	52.2	6.8	58.5	40	1.20%	300	88.1	66%	76%	1.3	27.4		25.3	26.9		24.9	2.02		2.00			
South			*0.6*	*NA*	*0*	*0*																													
South			3.13	*RM-10*	*114*	*357*																													
South	**058**	057	*3.73*				357	0.0	0.0	4163	16.9	3.32	56.0	55.9	7.2	63.2	98	5.90%	300	195.4	32%	50%	2.5	26.9		24.8	21.1		19.1	2.02		2.00			
South			*0.39*	*NA*	*0*	*0*																													
South			0.62	*RM-10*	*114*	*71*																													
South	**057**	056	*1.01*				71	0.0	0.0	4234	17.2	3.31	56.8	56.9	7.4	64.2	106	10.30%	300	258.2	25%	43%	3.0	21.1		19.1	10.2		8.2	2.02		2.00			
South			*0.28*	*NA*	*0*	*0*																													
South			2.56	*RM-10*	*114*	*292*																													
South	**056**	055	*2.84*				292	0.0	0.0	4526	18.3	3.29	60.2	59.8	7.7	68.0	84	0.80%	300	72.0	94%	94%	1.2	10.2		8.2	10.8		7.5	2.02		3.32			
South			*0.54*	*NA*	*0*	*0*																													
South			3.45	*RM-10*	*114*	*393*																													
South	**055**	054	*3.99*				393	0.0	0.0	4919	19.9	3.25	64.8	63.7	8.3	73.1	99	1.70%	300	104.9	70%	77%	1.6	10.8		7.5	7.8		5.8	3.34		2.00			
South			*0.55*	*NA*	*0*	*0*																													
South			1.48	*RM-10*	*114*	*169*																													
South	**054**	053	*2.03*				169	0.0	0.0	5088	20.6	3.24	66.7	65.8	8.5	75.3	113	3.40%	300	148.4	51%	64%	2.1	7.8		5.8	4.0		2.0	2.02		2.00			
South			*0.2*	*NA*	*0*	*0*																													
South			0.3	*RM-10*	*114*	*34*																													
South	**088**	087	*0.5*				34	0.0	0.0	34	0.1	4.35	0.6	0.5	0.1	0.7	60	12.60%	200	58.2	1%	10%	0.9	27.2		25.2	19.6		17.6	2.00		2.00			
South	**087**	086					0	0.0	0.0	34	0.1	4.35	0.6	0.5	0.1	0.7	47	15.00%	200	63.5	1%	10%	0.9	19.6		17.6	12.5		10.5	2.02		2.00			
South	**086**	053					0	0.0	0.0	34	0.1	4.35	0.6	0.5	0.1	0.7	93	9.20%	200	49.7	1%	10%	0.8	12.5		10.5	4.0		2.0	2.02		2.00			
South			*0.47*	*NA*	*0*	*0*																													
South			*2.04*	*RM-10*	*114*	*233*																													
South	**053**	000	2.51				233	0.0	0.0	5355	21.7	3.22	69.8	68.8	8.9	78.7	134	0.30%	375	79.9	99%	97%	0.9	4.0		1.9	4.7		1.5	2.02		3.17			
North-East			*1.52*	*NA*	*0*	*0*																													
North-East			0.42	*C-8*	*60*	*25*																													
North-East			*1.11*	*RM-30*	*206*	*229*																													
North-East	**052**	051	*3.05*				254	0.0	0.0	254	1.0	4.11	4.2	3.1	0.4	4.6	66	1.00%	200	16.4	28%	50%	0.6	47.0		45.0	46.7		44.3	2.00		2.34			
North-East	**051**	050					0	0.0	0.0	254	1.0	4.11	4.2	3.1	0.4	4.6	36	0.60%	200	12.7	36%	56%	*0.5*	46.7		44.3	46.6		44.1	2.36		2.46			
North-East	**050**	048					0	0.0	0.0	254	1.0	4.11	4.2	3.1	0.4	4.6	58	0.50%	200	11.6	40%	60%	*0.5*	46.6		44.1	47.0		43.8	2.48		3.21			
North-East			*0.41*	*NA*	*0*	*0*																													
North-East			0.88	*RM-30*	*206*	*181*																													
North-East	**049**	048	*1.29*				181	0.0	0.0	181	0.7	4.16	3.1	1.3	0.2	3.2	116	1.00%	200	16.4	20%	42%	*0.6*	48.0		46.0	47.0		44.8	2.00		2.17			
North-East			*0.31*	*NA*	*0*	*0*																													
North-East			0.28	*RM-30*	*206*	*58*																													
North-East	**048**	046	*0.59*				58	0.0	0.0	493	2.0	3.98	7.9	4.9	0.6	8.6	83	0.50%	200	11.6	74%	84%	0.6	47.0		43.8	45.9		43.4	3.21		2.48			

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
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Development Areas: Anniedale A - West 2, Anniedale B3 & Anniedale B4

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								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)			
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
North-East			*0.57*	*NA*	*0*	*0*																												
North-East			0.72	*RM-10*	*114*	*82*																												
North-East	**047**	046	*1.29*				82	0.0	0.0	82	0.3	4.27	1.4	1.3	0.2	1.6	49	1.60%	200	20.7	8%	26%	*0.6*	45.6		43.6	45.9		42.8	2.00		3.02		
North-East			*1.73*	*NA*	*0*	*0*																												
North-East			0.61	*C-8*	*60*	*37*																												
North-East	**046**	045	*2.34*				37	0.0	0.0	612	2.5	3.93	9.7	8.6	1.1	10.8	116	0.70%	200	13.7	79%	86%	0.7	45.9		42.8	44.0		42.0	3.04		2.00		
North-East	**045**	037					0	0.0	0.0	612	2.5	3.93	9.7	8.6	1.1	10.8	136	0.60%	200	12.7	85%	90%	0.7	44.0		42.0	44.0		41.2	2.02		2.84		
North-East			1.25	*NA*	*0*	*0*																												
North-East			*1.01*	*RM-30*	*206*	*208*																												
North-East	**044**	043	*2.26*				208	0.0	0.0	208	0.8	4.14	3.5	2.3	0.3	3.8	110	1.00%	200	16.4	23%	44%	0.6	48.5		46.5	47.4		45.4	2.00		2.00		
North-East	**043**	041					0	0.0	0.0	208	0.8	4.14	3.5	2.3	0.3	3.8	87	0.60%	200	12.7	30%	52%	*0.5*	47.4		45.4	48.4		44.9	2.02		**3.51**		
North-East			*0.17*	*NA*	*0*	*0*																												
North-East			*1.26*	*RM-30*	*206*	*260*																												
North-East	**042**	041	1.43				260	0.0	0.0	260	1.1	4.11	4.3	1.4	0.2	4.5	101	0.80%	200	14.7	31%	52%	0.6	49.0		47.0	48.4		46.2	2.00		2.17		
North-East			*0.29*	*NA*	*0*	*0*																												
North-East			*0.26*	*RM-30*	*206*	*54*																												
North-East	**041**	039	0.55				54	0.0	0.0	522	2.1	3.97	8.4	4.2	0.5	8.9	91	0.70%	200	13.7	65%	78%	0.7	48.4		44.9	46.2		44.2	**3.51**		2.00		
North-East			*0.38*	*NA*	*0*	*0*																												
North-East			*0.65*	*RM-30*	*206*	*134*																												
North-East	**040**	039	1.03				134	0.0	0.0	134	0.5	4.21	2.3	1.0	0.1	2.4	101	1.00%	200	16.4	15%	36%	*0.5*	47.1		45.1	46.2		44.1	2.00		2.13		
North-East	**039**	037					0	0.0	0.0	656	2.7	3.91	10.4	5.3	0.7	11.1	107	1.90%	200	22.6	49%	66%	1.0	46.2		44.1	44.0		42.0	2.15		2.00		
North-East			*0.29*	*NA*	*0*	*0*																												
North-East			1.2	*CPR*	*50*	*60*																												
North-East	**038**	037	*1.49*				60	0.0	0.0	60	0.2	4.30	1.0	1.5	0.2	1.2	76	2.20%	200	24.3	5%	20%	*0.6*	44.7		42.7	44.0		41.1	2.00		2.93		
North-East			*2.68*	*NA*	*0*	*0*																												
North-East			0.02	*PI*	*50*	*1*																												
North-East	**037**	036	*2.7*				1	0.0	0.0	1329	5.4	3.72	20.0	18.0	2.3	22.3	89	1.90%	200	22.6	99%	98%	1.3	44.0		41.0	41.4		39.4	2.95		2.00		
North-East	**036**	035					0	0.0	0.0	1329	5.4	3.72	20.0	18.0	2.3	22.3	91	4.00%	200	32.8	68%	80%	1.7	41.4		39.4	37.7	37.7	35.7	2.02		2.00	2.00	
North-East			0.17	*NA*	*0*	*0*																												
North-East			*1.19*	*PI*	*50*	*60*																												
North-East	**035**	034	*1.36*				60	0.0	0.0	1389	5.6	3.70	20.8	19.4	2.5	23.4	85	0.50%	300	34.2	68%	80%	0.8	37.7	37.7	35.7	37.8	37.8	35.3	2.02	2.02	2.54	2.54	
North-Center			*0.36*	*NA*	*0*	*0*																												
North-Center			*0.96*	*PI*	*50*	*48*																												
North-Center	**034**	023	1.32				48	0.0	0.0	1437	5.8	3.69	21.5	20.7	2.7	24.2	73	0.50%	300	34.2	71%	82%	0.8	37.8	37.8	35.3	38.4	38.4	34.9	2.56	2.56	3.47	3.47	
North-Center			*0.54*	*NA*	*0*	*0*																												
North-Center			*0.28*	*RM-30*	*206*	*58*																												
North-Center	**033**	031	0.82				58	0.0	0.0	58	0.2	4.30	1.0	0.8	0.1	1.1	81	1.20%	200	18.0	6%	24%	*0.4*	51.4		49.4	50.5		48.5	2.00		2.00		
North-Center			*0.97*	*NA*	*0*	*0*																												
North-Center			*1*	*RM-30*	*206*	*206*																												
North-Center	**032**	031	1.97				206	0.0	0.0	206	0.8	4.14	3.5	2.0	0.3	3.7	98	4.10%	200	33.2	11%	32%	1.0	54.5		52.5	50.5		48.5	2.00		2.00		
North-Center			*0.16*	*NA*	*0*	*0*																												
North-Center			*0.26*	*RM-30*	*206*	*54*																												
North-Center	**031**	029	0.42				54	0.0	0.0	318	1.3	4.07	5.2	3.2	0.4	5.7	85	0.60%	200	12.7	45%	64%	*0.6*	50.5		48.4	50.8		47.9	2.02		2.86		
North-Center			*0.18*	*NA*	*0*	*0*																												
North-Center			*0.77*	*RM-30*	*206*	*159*																												
North-Center	**030**	029	0.95				159	0.0	0.0	159	0.6	4.18	2.7	1.0	0.1	2.8	98	3.40%	200	30.2	9%	28%	0.9	54.1		52.1	50.8		48.8	2.00		2.00		
North-Center	**029**	027					0	0.0	0.0	477	1.9	3.99	7.7	4.2	0.5	8.2	89	1.60%	200	20.7	40%	60%	0.9	50.8		47.9	48.5		46.5	2.86		2.00		
North-Center			*0.58*	*NA*	*0*	*0*																												
North-Center			0.66	*RM-30*	*206*	*136*																												
North-Center	**028**	027	*1.24*				136	0.0	0.0	136	0.6	4.21	2.3	1.2	0.2	2.5	106	3.50%	200	30.7	8%	26%	0.8	52.2		50.2	48.5		46.5	2.00		2.00		
North-Center			*0.19*	*NA*	*0*	*0*																												
North-Center			0.58	*RM-30*	*206*	*119*																												
North-Center	**027**	025	*0.77*				119	0.0	0.0	732	3.0	3.88	11.5	6.2	0.8	12.3	110	1.90%	200	22.6	54%	70%	1.1	48.5		46.5	46.4		44.4	2.02		2.00		

Unit Demand	*350*	L/person/day
Infiltration	*0.130*	L/s/ha
	11200	*L/ha/day*
Manning's Coefficient (n)	*0.013*	

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								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)			
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
North-Center			*0.3*	*NA*	*0*	*0*																											
North-Center			0.29	*RM-30*	*206*	*60*																											
North-Center	**026**	025	*0.59*				60	0.0	0.0	60	0.2	4.30	1.0	0.6	0.1	1.1	139	2.40%	200	25.4	4%	20%	*0.6*	49.8		47.8	46.4		44.4	2.00		2.00	
North-Center			*0.13*	*NA*	*0*	*0*																											
North-Center			*0.37*	*RM-30*	*206*	*76*																											
North-Center	**025**	024	*0.5*				76	0.0	0.0	868	3.5	3.84	13.5	7.3	0.9	14.4	67	1.00%	200	16.4	88%	92%	0.9	46.4		44.4	45.8		43.8	2.02		2.00	
North-Center	**024**	023					0	0.0	0.0	868	3.5	3.84	13.5	7.3	0.9	14.4	113	6.50%	200	41.8	35%	56%	1.8	45.8		43.7	38.4	38.4	36.4	2.02		2.00	2.00
North-Center			0.16	*NA*	*0*	*0*																											
North-Center			*0.64*	*RM-30*	*206*	*132*																											
North-Center	**023**	022	*0.8*				132	0.0	0.0	2437	9.9	3.52	34.7	28.8	3.7	38.5	73	0.30%	375	48.0	80%	88%	0.7	38.4	38.4	34.9	38.7	38.0	34.7	3.47	3.47	**4.05**	3.33
North-Center			0.34	*NA*	*0*	*0*																											
North-Center			*0.78*	*RM-30*	*206*	*161*																											
North-Center	**022**	017	1.12				161	0.0	0.0	2598	10.5	3.50	36.8	29.9	3.9	40.7	82	0.30%	375	79.9	51%	64%	0.7	38.7	38.0	34.7	36.8	37.0	34.4	**4.07**	3.35	2.41	2.59
North-Center			*0.37*	*NA*	*0*	*0*																											
North-Center			*0.79*	*RM-30*	*206*	*163*																											
North-Center	**021**	019	1.16				163	0.0	0.0	163	0.7	4.18	2.8	1.2	0.2	2.9	54	4.40%	200	34.4	8%	28%	1.0	51.4		49.4	49.0		47.0	2.00		2.00	
North-Center			*0.33*	*NA*	*0*	*0*																											
North-Center			*0.56*	*RM-30*	*206*	*115*																											
North-Center	**020**	019	0.89				115	0.0	0.0	115	0.5	4.23	2.0	0.9	0.1	2.1	96	1.50%	200	20.1	10%	30%	0.6	49.5		47.5	49.0		46.0	2.00		2.95	
North-Center			*0.23*	*NA*	*0*	*0*																											
North-Center			*1.19*	*RM-30*	*206*	*245*																											
North-Center	**019**	018	1.42				245	0.0	0.0	523	2.1	3.97	8.4	3.5	0.4	8.9	98	5.10%	200	37.0	24%	46%	1.4	49.0		46.0	43.0		41.0	2.97		2.00	
North-Center	**018**	017					0	0.0	0.0	523	2.1	3.97	8.4	3.5	0.4	8.9	85	7.30%	200	44.3	20%	42%	1.6	43.0		41.0	36.8	37.0	34.8	2.02		2.00	2.19
North-Center			*0.58*	*NA*	*0*	*0*																											
North-Center			*0.61*	*RM-30*	*206*	*126*																											
North-Center	**017**	016	*1.19*				126	0.0	0.0	3247	13.2	3.41	44.9	34.5	4.5	49.4	99	0.30%	375	79.9	62%	71%	0.8	36.8	37.0	34.4	37.3	37.3	34.1	2.41	2.59	3.16	3.16
North-Center			0.16	*NA*	*0*	*0*																											
North-Center			*0.24*	*RM-10*	*114*	*27*																											
North-Center			*0.37*	*RM-30*	*206*	*76*																											
North-Center	**016**	004	0.77				104	0.0	0.0	3351	13.6	3.40	46.2	35.3	4.6	50.8	84	0.30%	375	79.9	64%	73%	0.8	37.3	37.3	34.1	36.0		33.8	3.18	3.18	2.16	
West			*1.07*	*NA*	*0*	*0*																											
West			0.91	*RM-45*	*266*	*242*																											
West	**015**	014	*1.98*				242	0.0	0.0	242	1.0	4.12	4.0	2.0	0.3	4.3	114	1.40%	200	19.4	22%	44%	0.7	56.4		54.4	54.8		52.8	2.00		2.00	
West			*0.48*	*NA*	*0*	*0*																											
West			1.92	*RM-45*	*266*	*511*																											
West	**014**	013	*2.4*				511	0.0	0.0	753	3.1	3.88	11.8	4.4	0.6	12.4	86	1.60%	200	20.7	60%	74%	1.0	54.8		52.8	53.5		51.5	2.02		2.00	
West	**013**	009					0	0.0	0.0	753	3.1	3.88	11.8	4.4	0.6	12.4	87	1.50%	200	20.1	62%	76%	1.0	53.5		51.4	52.1		50.1	2.02		2.00	
West			5.07	*NA*	*0*	*0*																											
West			*0.27*	*RM-30*	*206*	*56*																											
West			*0.61*	*RM-45*	*266*	*162*																											
West	**012**	011	5.95				218	0.0	0.0	218	0.9	4.14	3.7	6.0	0.8	4.4	52	1.00%	200	16.4	27%	48%	0.6	52.2		50.2	52.1		49.6	2.00		2.42	
West	**011**	010					0	0.0	0.0	218	0.9	4.14	3.7	6.0	0.8	4.4	69	0.60%	200	12.7	35%	56%	*0.5*	52.1		49.6	51.7		49.2	2.44		2.52	
West	**010**	009					0	0.0	0.0	218	0.9	4.14	3.7	6.0	0.8	4.4	33	0.50%	200	11.6	38%	58%	*0.5*	51.7		49.2	52.1		49.0	2.54		3.10	
West			0.99	*NA*	*0*	*0*																											
West			*0.32*	*RM-30*	*206*	*66*																											
West			*0.92*	*RM-45*	*266*	*245*																											
West	**009**	008	2.23				311	0.0	0.0	1282	5.2	3.73	19.4	12.6	1.6	21.0	112	2.70%	200	26.9	78%	86%	1.4	52.1		49.0	48.0		46.0	3.12		2.00	
West			*0.44*	*NA*	*0*	*0*																											
West			*0.38*	*RM-30*	*206*	*78*																											
West	**008**	005	0.82				78	0.0	0.0	1360	5.5	3.71	20.4	13.4	1.7	22.2	93	8.60%	200	48.1	46%	64%	2.2	48.0		46.0	41.9	41.3	38.0	2.02		**3.91**	3.28
West			*0.59*	*NA*	*0*	*0*																											
West			*1.81*	*RM-30*	*206*	*373*																											
West	**007**	006	2.4				373	0.0	0.0	373	1.5	4.04	6.1	2.4	0.3	6.4	106	7.10%	200	43.7	15%	36%	1.5	47.2	47.2	45.2	38.7	40.0	37.7	2.00	2.00	**1.04**	2.34
West	**006**	005					0	0.0	0.0	373	1.5	4.04	6.1	2.4	0.3	6.4	83	0.60%	200	12.7	50%	68%	0.6	38.7	40.0	37.5	41.9	41.3	37.0	**1.20**	2.50	**4.88**	**4.25**

Unit Demand	*350*	L/person/day
Infiltration	*0.130*	L/s/ha
	11200	*L/ha/day*
Manning's Coefficient (n)	*0.013*	

Project	Anniedale Tynehead NCP
Scenario	NCP - December 2010 Landuse
Client	City of Surrey
USL Job	1072.0173.01

176th Street Pump Station Catchment

Development Areas: Anniedale A - West 2, Anniedale B3 & Anniedale B4

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																	
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)			
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
West			*0.3*	*NA*	*0*	*0*																												
West			0.35	*RM-30*	*206*	*72*																												
West	**005**	004	*0.65*				72	0.0	0.0	1805	7.3	3.62	26.5	16.4	2.1	28.6	85	3.50%	250	55.6	51%	68%	1.7	41.9	41.3	37.0	36.0	36.0	34.0	**4.90**	**4.27**	2.00	2.00
West			*0.33*	*NA*	*0*	*0*																												
West			0.3	*RM-10*	*114*	*34*																												
West			*0.35*	*RM-30*	*206*	*72*																												
West	**004**	003	*0.98*				106	0.0	0.0	5262	21.3	3.23	68.7	52.7	6.8	75.6	86	5.00%	375	326.2	23%	41%	2.4	36.0	36.0	33.8	31.6		29.6	2.16	2.16	2.00	
West			0.37	*NA*	*0*	*0*																												
West			*0.23*	*RM-10*	*114*	*26*																												
West			*0.15*	*RM-30*	*206*	*31*																												
West	**003**	002	0.75				57	0.0	0.0	5319	21.5	3.22	69.4	53.5	6.9	76.3	75	8.90%	375	435.2	18%	36%	3.0	31.6		29.5	24.9		22.9	2.02		2.00	
West			*2.82*	*NA*	*0*	*0*																												
West	**002**	001	*2.82*				0	0.0	0.0	5319	21.5	3.22	69.4	56.3	7.3	76.7	113	10.10%	375	463.6	17%	36%	3.1	24.9		22.9	13.4		11.4	2.02		2.00	
West	**001**	000					0	0.0	0.0	5319	21.5	3.22	69.4	56.3	7.3	76.7	111	7.80%	375	407.4	19%	37%	2.8	13.4		11.4	4.7		2.7	2.02		2.00	
Pump Station	**000**						0	0.0	0.0	10674	43.2	2.93	126.6	125.1	16.2	142.8								4.7		1.5				3.17			
Pump Station	**PS**									10674	43.2		126.6	125.1		142.8																	

1- ppha from Table 2.6 of surrey Design Criteria

2- Assumed grade based on existing ground elevations. To be confirmed with road profile design.

3- Q Capacity and D Capacity based on 50% of pipes when flows are less then 40 L/s, and 83.2% of pipe full capacity (equivalent to flow with normal depth of 70% of pipe diameter) when flows are greater than 40 L/s.

4- Velocity based on normal depth flow at 70% of PDWF.

5- Conceptual Rim and Depth based on conceptual finished ground. Does not take into account any review of road profile or geometry.

Q > 40 L/s

Size > 200mm

3.6 Pipe depth > 3.5m

0.5 Pipe Velocity < 0.6 m/s

Land Use	**Assumed Zoning**	**Abbr.**
Road	NA	NA
Buffer	NA	NA
Trail	NA	NA
Riparian	NA	NA
Park Acquisition	NA	NA
Potential Park	NA	NA
School	Institutional	PI
Community Centre	Commercial Recreation	CPR
Institutional	Institutional	PI
Commercial	CD (based on C-15)	C-15
Village Commercial	Community Commercial	C-8
Industrial Low Impact	Light Impact Industrial	IL
Industrial Business Park	Business Park	IB
Suburban Cluster	Half-Acre Residential (Gross Density)	RH, RH-G
Low Density Urban 6-10	Single Family Residential - 12m Frontage	RF-12
Cluster Residential 4-6	CD (based on RF)	RF
Cluster Residential 6-10	CD (based on RF-9)	RF-9
Cluster Residential 10-15	CD (based on RM-10)	RM-10
Medium Density 10-15	Single Family Residential - 9m Frontage	RF-9
Medium High Density 15-25	Multiple Residential Development	RM-30
High Density Residential 25-45	CD (based on RM-30)	RM-30
High Density Residential 30-45	CD (based on RM-45)	RM-45
Special Residential 15-25	CD (based on RM-30)	RM-30

Table 3.4-7

Unit Demand 350 L/person/day
Infiltration 0.130 L/s/ha 11200 L/ha/day
Manning's Coefficient (n) 0.013

Project Anniedale Tynehead NCP
Scenario NCP - December 2010 Landuse
Client City of Surrey
USL Job 1072.0173.01

184th Street Pump Station Catchment

Development Areas: Anniedale B2 & Port Kells

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
LPS			4.43	*NA*	*0*	*0*																														
LPS			1.44	*IB*	*90*	*130*																														
LPS			2.67	*RF-9*	*128*	*342*																														
LPS	**LPS**	LPS	8.54				471			471	1.9	3.99	7.6	8.5	1.1	8.7																				
East			*0.17*	*NA*	*0*	*0*																														
East			*0.39*	*RF-9*	*128*	*50*																														
East	**052**	046	0.56				50	8.7	8.7	50	0.2	4.32	9.6	0.6	0.1	9.7	91	1.83%	200	22.2	44%	62%	1.0	20.4		18.4	18.7		16.7	2.00		2.00				
East			*1.14*	*NA*	*0*	*0*																														
East			*1.02*	*IB*	*90*	*92*																														
East	**051**	050	2.16				92	0.0	0.0	92	0.4	4.25	1.6	2.2	0.3	1.9	99	1.00%	200	16.4	11%	32%	*0.5*	36.2	36.2	34.2	37.6	35.8	33.2	2.00	2.00	**4.42**	2.57		
East			*0.47*	*NA*	*0*	*0*																														
East			*0.46*	*IB*	*90*	*41*																														
East	**050**	048	0.93				41	0.0	0.0	133	0.5	4.21	2.3	3.1	0.4	2.7	135	4.47%	200	34.7	8%	26%	0.9	37.6	35.8	33.2	29.2	29.2	27.2	**4.44**	2.59	2.00	2.00		
East			*0.18*	*NA*	*0*	*0*																														
East			*0.38*	*RF-9*	*128*	*49*																														
East	**049**	048	0.56				49	0.0	0.0	49	0.2	4.32	0.9	0.6	0.1	0.9	75	1.29%	200	18.6	5%	20%	*0.4*	30.1		28.1	29.2	29.2	27.2	2.00		2.00	2.00		
East			*0.27*	*NA*	*0*	*0*																														
East			*0.78*	*RF-9*	*128*	*100*																														
East	**048**	046	1.05				100	0.0	0.0	282	1.1	4.09	4.7	4.7	0.6	5.3	122	8.53%	200	47.9	11%	30%	1.4	29.2	29.2	27.1	18.7		16.7	2.02	2.02	2.00			
East			*0.32*	*NA*	*0*	*0*																														
East			*0.65*	*RF-9*	*128*	*83*																														
East	**047**	046	0.97				83	0.0	0.0	83	0.3	4.27	1.4	1.0	0.1	1.6	139	2.31%	200	24.9	6%	24%	0.6	21.9		19.9	18.7		16.7	2.00		2.00				
East	**046**	045					0	0.0	8.7	415	1.7	4.02	15.5	6.2	0.8	16.3	68	4.78%	200	35.9	45%	64%	1.7	18.7		16.7	15.5		13.5	2.02		2.00				
East	**045**	044					0	127.4	136.1	415	1.7	4.02	142.9	6.2	0.8	143.7	80	0.30%	525	196.0	73%	80%	1.0	15.5		13.4	15.2		13.2	2.03		2.00				
East	**044**	029					0	0.0	136.1	415	1.7	4.02	142.9	6.2	0.8	143.7	84	0.31%	525	199.6	72%	79%	1.1	15.2		13.2	14.9		12.9	2.03		2.00				

Unit Demand	*350*	L/person/day
Infiltration	*0.130*	L/s/ha *11200 L/ha/day*
Manning's Coefficient (n)	*0.013*	

Project	Anniedale Tynehead NCP
Scenario	NCP - December 2010 Landuse
Client	City of Surrey
USL Job	1072.0173.01

184th Street Pump Station Catchment

Development Areas: Anniedale B2 & Port Kells

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity (m/s) [4]	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
Center-East			*0.39*	*NA*	*0*	*0*																														
Center-East			*0.55*	*IB*	*90*	*50*																														
Center-East	**043**	040	0.94				50	0.0	0.0	50	0.2	4.32	0.9	0.9	0.1	1.0	40	8.99%	200	49.2	2%	14%	0.9	37.5		35.5	33.9		31.9	2.00		2.00				
Center-East			*0.41*	*NA*	*0*	*0*																														
Center-East			*0.8*	*IB*	*90*	*72*																														
Center-East	**042**	041	1.21				72	0.0	0.0	72	0.3	4.28	1.2	1.2	0.2	1.4	102	2.30%	200	24.9	6%	22%	*0.6*	35.4		33.4	33.1		31.1	2.00		2.00				
Center-East	**041**	040					0	0.0	0.0	72	0.3	4.28	1.2	1.2	0.2	1.4	68	0.60%	200	12.7	11%	30%	*0.4*	33.1		31.1	33.9		30.6	2.02		3.29				
Center-East			*0.15*	*NA*	*0*	*0*																														
Center-East			*0.18*	*RF-9*	*128*	*23*																														
Center-East	**040**	036	0.33				23	0.0	0.0	145	0.6	4.20	2.5	2.5	0.3	2.8	79	6.70%	200	42.4	7%	24%	1.1	33.9		30.6	27.3		25.3	3.31		2.00				
Center-East			*0.38*	*NA*	*0*	*0*																														
Center-East			*0.68*	*RF-9*	*128*	*87*																														
Center-East	**039**	038	1.06				87	0.0	0.0	87	0.4	4.26	1.5	1.1	0.1	1.6	127	3.20%	200	29.3	6%	22%	0.7	34.2		32.2	30.2		28.2	2.00		2.00				
Center-East			*0.23*	*NA*	*0*	*0*																														
Center-East			*0.34*	*RF-9*	*128*	*44*																														
Center-East	**038**	036	0.57				44	0.0	0.0	131	0.5	4.21	2.2	1.6	0.2	2.4	123	2.30%	200	24.9	10%	30%	0.7	30.2		28.1	27.3		25.3	2.02		2.00				
Center-East			*0.17*	*NA*	*0*	*0*																														
Center-East			*0.28*	*RF-9*	*128*	*36*																														
Center-East	**037**	036	0.45				36	0.0	0.0	36	0.1	4.34	0.6	0.5	0.1	0.7	63	4.20%	200	33.6	2%	14%	*0.6*	30.0		28.0	27.3		25.3	2.00		2.00				
Center-East			*0.18*	*NA*	*0*	*0*																														
Center-East			*0.26*	*RF-9*	*128*	*33*																														
Center-East	**036**	034	0.44				33	0.0	0.0	344	1.4	4.05	5.7	5.0	0.6	6.3	58	3.70%	200	31.5	20%	42%	1.1	27.3		25.3	25.2		23.2	2.02		2.00				
Center-East			*0.04*	*NA*	*0*	*0*																														
Center-East			*0.35*	*RF-9*	*128*	*45*																														
Center-East	**035**	034	0.39				45	0.0	0.0	45	0.2	4.33	0.8	0.4	0.1	0.8	62	3.70%	200	31.5	3%	16%	0.6	27.5		25.5	25.2		23.2	2.00		2.00				
Center-East	**034**	030					0	0.0	0.0	389	1.6	4.03	6.3	5.4	0.7	7.0	64	6.50%	200	41.8	17%	38%	1.4	25.2		23.2	21.0		19.0	2.02		2.00				
Center-East			*0.33*	*NA*	*0*	*0*																														
Center-East			*1.43*	*RF-9*	*128*	*183*																														
Center-East	**033**	031	1.76				183	0.0	0.0	183	0.7	4.16	3.1	1.8	0.2	3.3	133	3.40%	200	30.2	11%	30%	0.9	26.9		24.9	22.4		20.4	2.00		2.00				
Center-East			*0.25*	*NA*	*0*	*0*																														
Center-East			*0.32*	*RF-9*	*128*	*41*																														
Center-East	**032**	031	0.57				41	0.0	0.0	41	0.2	4.33	0.7	0.6	0.1	0.8	62	7.40%	200	44.6	2%	12%	0.8	27.0		25.0	22.4		20.4	2.00		2.00				
Center-East			*0.26*	*NA*	*0*	*0*																														
Center-East			*0.46*	*RF-9*	*128*	*59*																														
Center-East	**031**	030	0.72				59	0.0	0.0	283	1.1	4.09	4.7	3.1	0.4	5.1	116	1.20%	200	18.0	28%	50%	0.7	22.4		20.4	21.0		19.0	2.02		2.00				
Center-East			*0.16*	*NA*	*0*	*0*																														
Center-East			*0.61*	*RF-9*	*128*	*78*																														
Center-East	**030**	029	0.77				78	0.0	0.0	750	3.0	3.88	11.8	9.2	1.2	13.0	65	9.40%	200	50.3	26%	48%	2.0	21.0		19.0	14.9	14.9	12.9	2.02		2.00	2.00			
Center-East	**029**	028					0	0.0	136.1	1165	4.7	3.76	153.8	15.4	2.0	155.9	146	0.35%	525	211.7	74%	80%	1.1	14.9	14.9	12.9	14.2	14.2	12.4	2.03	2.03	**1.86**	**1.86**		
Center-East	**028**	016					0	0.0	136.1	1165	4.7	3.76	153.8	15.4	2.0	155.9	136	0.35%	525	211.7	74%	80%	1.1	14.2	14.2	12.2	14.0	14.0	11.7	2.03	2.03	2.29	2.29		
Center			*0.85*	*NA*	*0*	*0*																														
Center			*2.32*	*RM-10*	*114*	*264*																														
Center	**027**	026	3.17				264	0.0	0.0	264	1.1	4.10	4.4	3.2	0.4	4.8	143	1.00%	200	16.4	29%	50%	0.7	44.1		42.1	44.0		40.7	2.00		3.32				
Center			*0.18*	*NA*	*0*	*0*																														
Center			*0.44*	*RM-30*	*206*	*91*																														
Center	**026**	025	0.62				91	0.0	0.0	355	1.4	4.05	5.8	3.8	0.5	6.3	125	0.60%	200	12.7	50%	66%	*0.6*	44.0		40.7	42.4		39.9	3.34		2.45				
Center			*0.36*	*NA*	*0*	*0*																														
Center			*0.83*	*RM-30*	*206*	*171*																														
Center	**025**	024	1.19				171	0.0	0.0	526	2.1	3.96	8.4	5.0	0.6	9.1	135	5.10%	200	37.0	25%	46%	1.4	42.4		39.9	35.0		33.0	2.47		2.00				
Center			*0.2*	*NA*	*0*	*0*																														
Center	**024**	017	0.2				0	0.0	0.0	526	2.1	3.96	8.4	5.2	0.7	9.1	115	5.60%	200	38.8	23%	46%	1.5	35.0		33.0	28.5		26.5	2.02		2.00				
Center			*0.27*	*NA*	*0*	*0*																														
Center			*0.26*	*RM-10*	*114*	*30*																														

Unit Demand	*350*	L/person/day
Infiltration	*0.130*	L/s/ha
	11200	*L/ha/day*
Manning's Coefficient (n)	*0.013*	

Project	Anniedale Tynehead NCP
Scenario	NCP - December 2010 Landuse
Client	City of Surrey
USL Job	1072.0173.01

184th Street Pump Station Catchment

Development Areas: Anniedale B2 & Port Kells

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																	
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)			
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity (m/s) [4]	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS
Center			*0.3*	*RM-30*	*206*	*62*																												
Center	**022**	019	0.83				91	0.0	0.0	91	0.4	4.26	1.6	0.8	0.1	1.7	46	7.70%	200	45.5	4%	18%	1.0	37.6		35.6	34.0		32.0	2.00		2.00	
Center			*0.35*	*NA*	*0*	*0*																												
Center			*0.4*	*RM-10*	*114*	*46*																												
Center	**021**	020	0.75				46	0.0	0.0	46	0.2	4.32	0.8	0.8	0.1	0.9	92	3.30%	200	29.8	3%	16%	*0.6*	39.0		37.0	35.9		33.9	2.00		2.00	
Center	**020**	019					0	0.0	0.0	46	0.2	4.32	0.8	0.8	0.1	0.9	84	2.20%	200	24.3	4%	18%	*0.5*	35.9		33.2	34.0		31.3	2.70		2.68	
Center			*0.31*	*NA*	*0*	*0*																												
Center			*0.47*	*RF-9*	*128*	*60*																												
Center	**023**	019	0.78				60	0.0	0.0	60	0.2	4.30	1.0	0.8	0.1	1.1	129	1.50%	200	20.1	6%	22%	*0.5*	36.0		34.0	34.0	34.0	32.0	2.00		2.00	2.00
Center			*0.32*	*NA*	*0*	*0*																												
Center			*0.62*	*RF-9*	*128*	*79*																												
Center	**019**	018	0.94				79	0.0	0.0	277	1.1	4.09	4.6	3.3	0.4	5.0	136	5.20%	200	37.4	13%	34%	1.2	34.0	34.0	31.3	26.2	27.0	24.2	2.70	2.70	2.00	2.82
Center			*0.2*	*NA*	*0*	*0*																												
Center			*0.45*	*RF-9*	*128*	*58*																												
Center	**018**	017	0.65				58	0.0	0.0	334	1.4	4.06	5.5	4.0	0.5	6.0	94	0.50%	200	11.6	52%	68%	*0.5*	26.2	27.0	24.2	28.5	27.3	23.7	2.02	2.84	**4.84**	**3.56**
Center			*0.46*	*NA*	*0*	*0*																												
Center			*0.44*	*RF-9*	*128*	*56*																												
Center	**017**	016	0.9				56	0.0	0.0	917	3.7	3.83	14.2	10.0	1.3	15.5	146	8.00%	200	46.4	33%	54%	1.9	28.5	27.3	23.7	14.0	14.0	12.0	**4.86**	**3.58**	2.00	2.00
Center	**016**	015					0	0.0	136.1	2081	8.4	3.57	166.2	25.5	3.3	169.5	133	0.25%	525	178.9	95%	94%	1.0	14.0	14.0	11.7	13.8	13.8	11.4	2.29	2.29	2.38	2.38
Center			*4.33*	*NA*	*0*	*0*																												
Center	**015**	014	4.33				0	0.0	136.1	2081	8.4	3.57	166.2	29.8	3.9	170.1	132	0.25%	525	178.9	95%	96%	1.0	13.8	13.8	11.4	14.3	14.3	11.1	2.40	2.40	3.27	
Center-West			*0.24*	*NA*	*0*	*0*																												
Center-West			*0.5*	*RF-9*	*128*	*64*																												
Center-West	**014**	009	0.74				64	0.0	136.1	2145	8.7	3.56	167.1	30.5	4.0	171.0	97	0.25%	525	178.9	96%	96%	1.0	14.3	14.3	11.0	14.4	14.4	10.8	3.29	3.29	**3.57**	**3.57**
Center-West			*0.8*	*NA*	*0*	*0*																												
Center-West			*0.73*	*C-8*	*60*	*44*																												
Center-West			*0.73*	*RM-10*	*114*	*83*																												
Center-West	**013**	012	2.26				127	0.0	0.0	127	0.5	4.21	2.2	2.3	0.3	2.5	86	2.20%	200	24.3	10%	30%	0.7	47.7		45.7	45.7		43.7	2.00		2.00	
Center-West			*0.29*	*NA*	*0*	*0*																												
Center-West			*0.25*	*RM-10*	*114*	*29*																												
Center-West			*0.81*	*RM-30*	*206*	*167*																												
Center-West	**012**	011	1.35				195	0.0	0.0	322	1.3	4.07	5.3	3.6	0.5	5.8	131	4.60%	200	35.2	16%	38%	1.2	45.7		43.7	39.7		37.7	2.02		2.00	
Center-West			*0.31*	*NA*	*0*	*0*																												
Center-West			*1.2*	*PI*	*50*	*60*																												
Center-West			*0.85*	*RM-10*	*114*	*97*																												
Center-West	**011**	010	2.36				157	0.0	0.0	479	1.9	3.98	7.7	6.0	0.8	8.5	127	7.80%	200	45.8	19%	40%	1.6	39.7		37.7	29.7		27.7	2.02		2.00	
Center-West			*0.25*	*NA*	*0*	*0*																												
Center-West			*1.14*	*PI*	*50*	*57*																												
Center-West	**065**	010	1.39				57	0.0	0.0	57	0.2	4.30	1.0	1.4	0.2	1.2	103	3.90%	200	32.4	4%	18%	0.7	33.8		31.8	29.7		27.7	2.00		2.00	
Center-West			*0.23*	*NA*	*0*	*0*																												
Center-West			*1.65*	*RF-9*	*128*	*211*																												
Center-West	**010**	009	1.88				211	0.0	0.0	747	3.0	3.88	11.7	9.2	1.2	12.9	148	10.30%	200	52.6	25%	46%	2.0	29.7		27.7	14.4	14.4	12.4	2.02		2.00	2.00
Center-West			*0.32*	*NA*	*0*	*0*																												
Center-West			*0.96*	*RF-9*	*128*	*123*																												
Center-West	**009**	008	1.28				123	0.0	136.1	3016	12.2	3.44	178.2	41.1	5.3	183.5	96	0.20%	600	228.5	80%	84%	0.9	14.4	14.4	10.8	15.1	15.1	10.6	**3.57**	**3.57**	**4.49**	**4.49**
Center-West	**008**	000					0	0.0	136.1	3016	12.2	3.44	178.2	41.1	5.3	183.5	95	0.20%	600	228.5	80%	84%	0.9	15.1	15.1	10.6	15.0	15.0	10.4	**4.51**	**4.51**	**4.60**	**4.60**

Unit Demand	*350*	L/person/day
Infiltration	*0.130*	L/s/ha *11200 L/ha/day*
Manning's Coefficient (n)	*0.013*	

Project	Anniedale Tynehead NCP
Scenario	NCP - December 2010 Landuse
Client	City of Surrey
USL Job	1072.0173.01

184th Street Pump Station Catchment

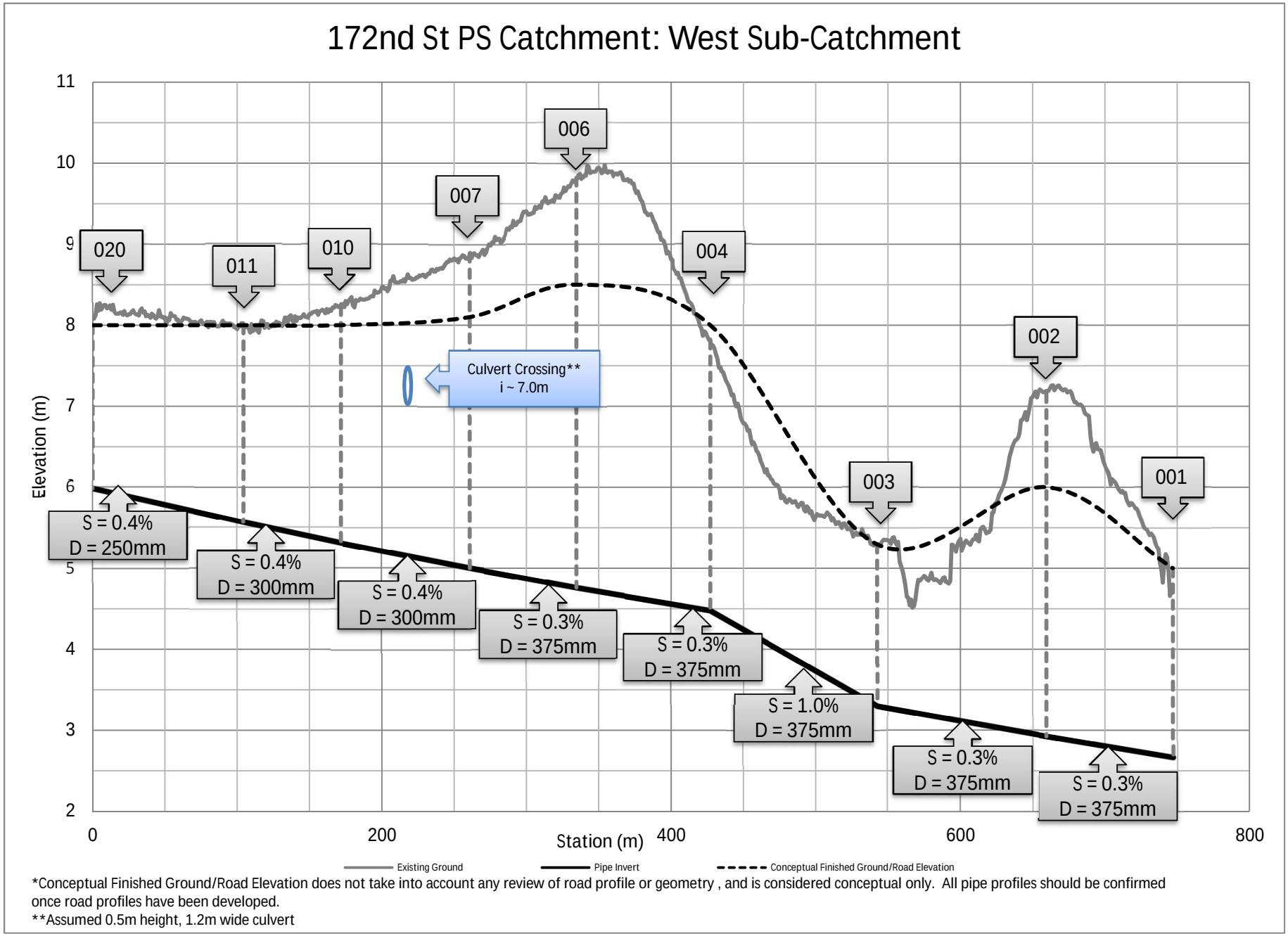
Development Areas: Anniedale B2 & Port Kells

Sub Catchment	US Node	DS Node	Catchment Details					Flow Details									Pipe Design																			
								Point Loads		Average Dry Weather Flow		Peak Dry Weather Flow		Infiltration Flow		PWWF	Pipe Design							US Node Elevation			DS Node Elevation			Depth to pipe invert (m)					
			Area (ha)	Zoning	Population Density (ppha) [1]	Parcel Population	Total Population	(L/s)	Accum. (L/s)	Acc. Popl'n	Flow (L/s)	Peak Factor	Flow (L/s)	Accum. Area (ha)	Flow (L/s)	(L/s)	Length (m)	Assumed Grade [2]	Size (mm)	Design Guideline Capacity [3] (L/s)	Qdes / Qcap [3] (%)	Ddes / Dcap [3] (%)	Velocity [4] (m/s)	Est. Rim	Con. [5] Rim	Est. Invert	Est. Rim	Con. [5] Rim	Est. Invert	US	Con. [5] US	DS	Con. [5] DS				
West			*0.52*	*NA*	*0*	*0*																														
West			*0.29*	*RF-9*	*128*	*37*																														
West	**007**	006	0.81				37	0.0	0.0	37	0.2	4.34	0.7	0.8	0.1	0.8	102	1.00%	200	16.4	5%	20%	*0.4*	48.6		46.6	48.5		45.6	2.00		2.88				
West	**006**	005					0	0.0	0.0	37	0.2	4.34	0.7	0.8	0.1	0.8	119	0.60%	200	12.7	6%	22%	*0.3*	48.5		45.6	47.3		44.9	2.90		2.40				
West			*1.17*	*NA*	*0*	*0*																														
West			*0.47*	*RM-30*	*206*	*97*																														
West	**005**	004	1.64				97	0.0	0.0	134	0.5	4.21	2.3	2.5	0.3	2.6	128	3.90%	200	32.4	8%	26%	0.9	47.3		44.9	41.9		39.9	2.42		2.00				
West			*2.52*	*NA*	*0*	*0*																														
West	**004**	003	2.52				0	0.0	0.0	134	0.5	4.21	2.3	5.0	0.6	2.9	123	6.00%	200	40.2	7%	26%	1.0	41.9		39.9	34.5		32.5	2.02		2.00				
West	**003**	002					0	0.0	0.0	134	0.5	4.21	2.3	5.0	0.6	2.9	80	8.40%	200	47.5	6%	24%	1.1	34.5		32.4	27.8		25.8	2.02		2.00				
West	**002**	001					0	0.0	0.0	134	0.5	4.21	2.3	5.0	0.6	2.9	77	11.50%	200	55.6	5%	22%	1.3	27.8		25.7	19.0		17.0	2.02		2.00				
West	**001**	000					0	0.0	0.0	134	0.5	4.21	2.3	5.0	0.6	2.9	66	6.00%	200	40.2	7%	26%	1.0	19.0		17.0	15.0		13.0	2.00		2.00				
Pump Station	**000**						0	0.0	136.1	3150	12.8	3.43	179.8	46.0	6.0	185.8								15.0		10.4				**4.60**						
Pump Station	**PS**									12221	12.8		179.8	225.6		185.8																			

1- ppha from Table 2.6 of surrey Design Criteria
2- Assumed grade based on existing ground elevations. To be confirmed with road profile design.
3- Q Capacity and D Capacity based on 50% of pipes when flows are less then 40 L/s, and 83.2% of pipe full capacity (equivalent to flow with normal depth of 70% of pipe diameter) when flows are greater than 40 L/s.
4- Velocity based on normal depth flow at 70% of PDWF.
5- Conceptual Rim and Depth based on conceptual finished ground. Does not take into account any review of road profile or geometry.

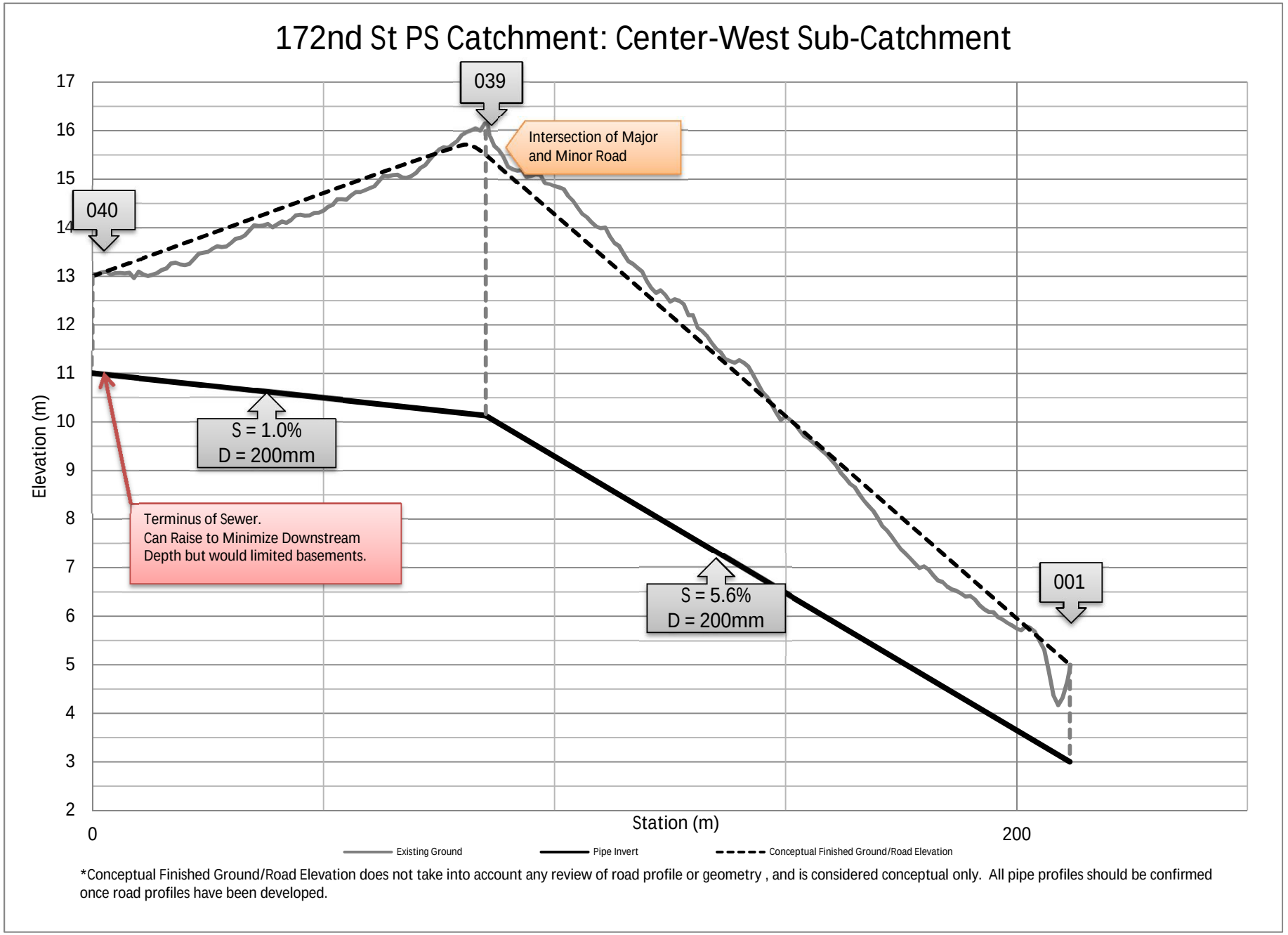
Q > 40 L/s
Size > 200mm
3.6 Pipe depth > 3.5m
0.5 Pipe Velocity < 0.6 m/s

Land Use	**Assumed Zoning**	**Abbr.**
Road	NA	NA
Buffer	NA	NA
Trail	NA	NA
Riparian	NA	NA
Park Acquisition	NA	NA
Potential Park	NA	NA
School	Institutional	PI
Community Centre	Commercial Recreation	CPR
Institutional	Institutional	PI
Commercial	CD (based on C-15)	C-15
Village Commercial	Community Commercial	C-8
Industrial Low Impact	Light Impact Industrial	IL
Industrial Business Park	Business Park	IB
Suburban Cluster	Half-Acre Residential (Gross Density)	RH, RH-G
Low Density Urban 6-10	Single Family Residential - 12m Frontage	RF-12
Cluster Residential 4-6	CD (based on RF)	RF
Cluster Residential 6-10	CD (based on RF-9)	RF-9
Cluster Residential 10-15	CD (based on RM-10)	RM-10
Medium Density 10-15	Single Family Residential - 9m Frontage	RF-9
Medium High Density 15-25	Multiple Residential Development	RM-30
High Density Residential 25-45	CD (based on RM-30)	RM-30
High Density Residential 30-45	CD (based on RM-45)	RM-45
Special Residential 15-25	CD (based on RM-30)	RM-30



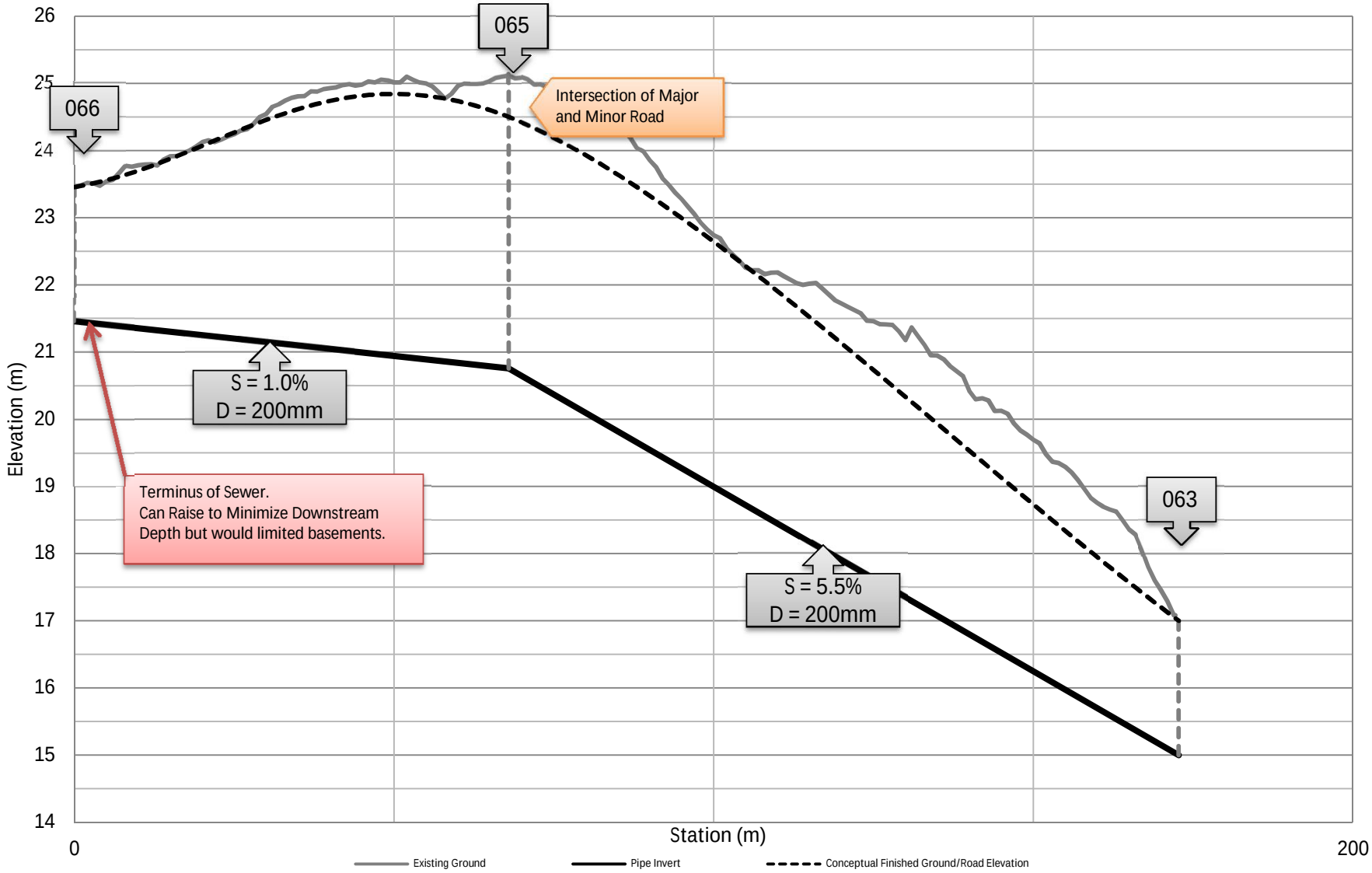
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

**Assumed 0.5m height, 1.2m wide culvert

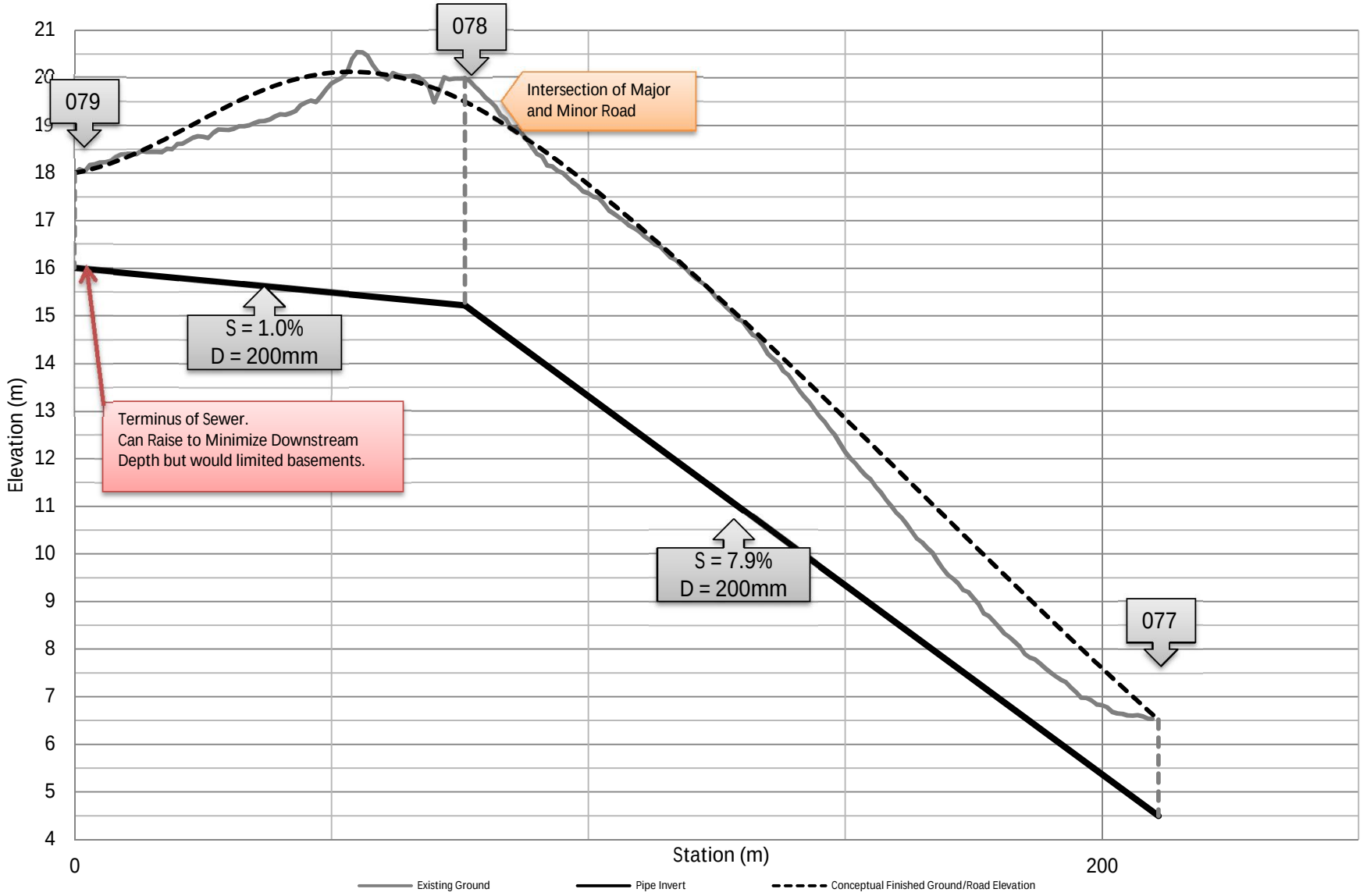


*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

172nd St PS Catchment: Center-East Sub-Catchment

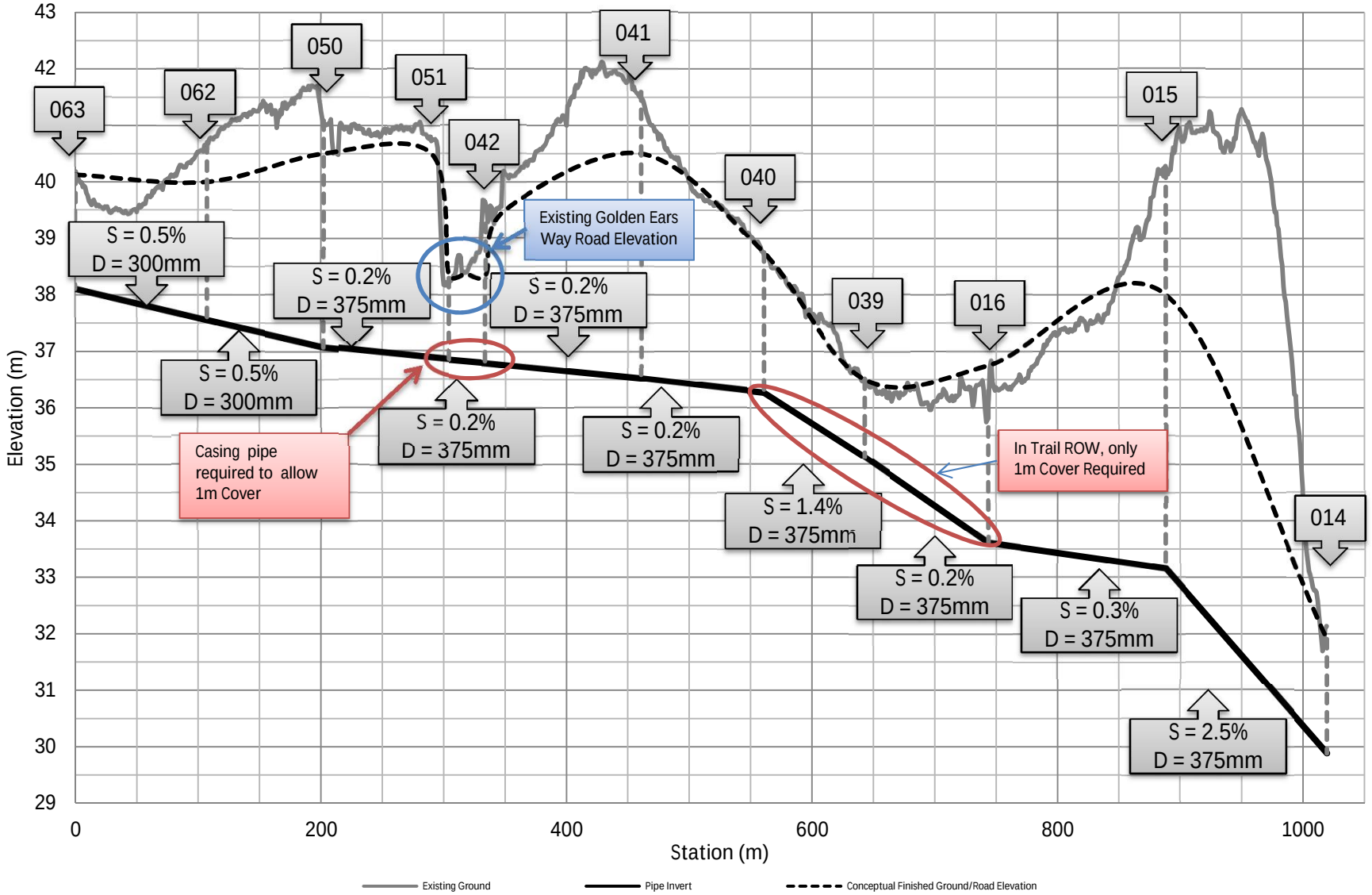


*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.



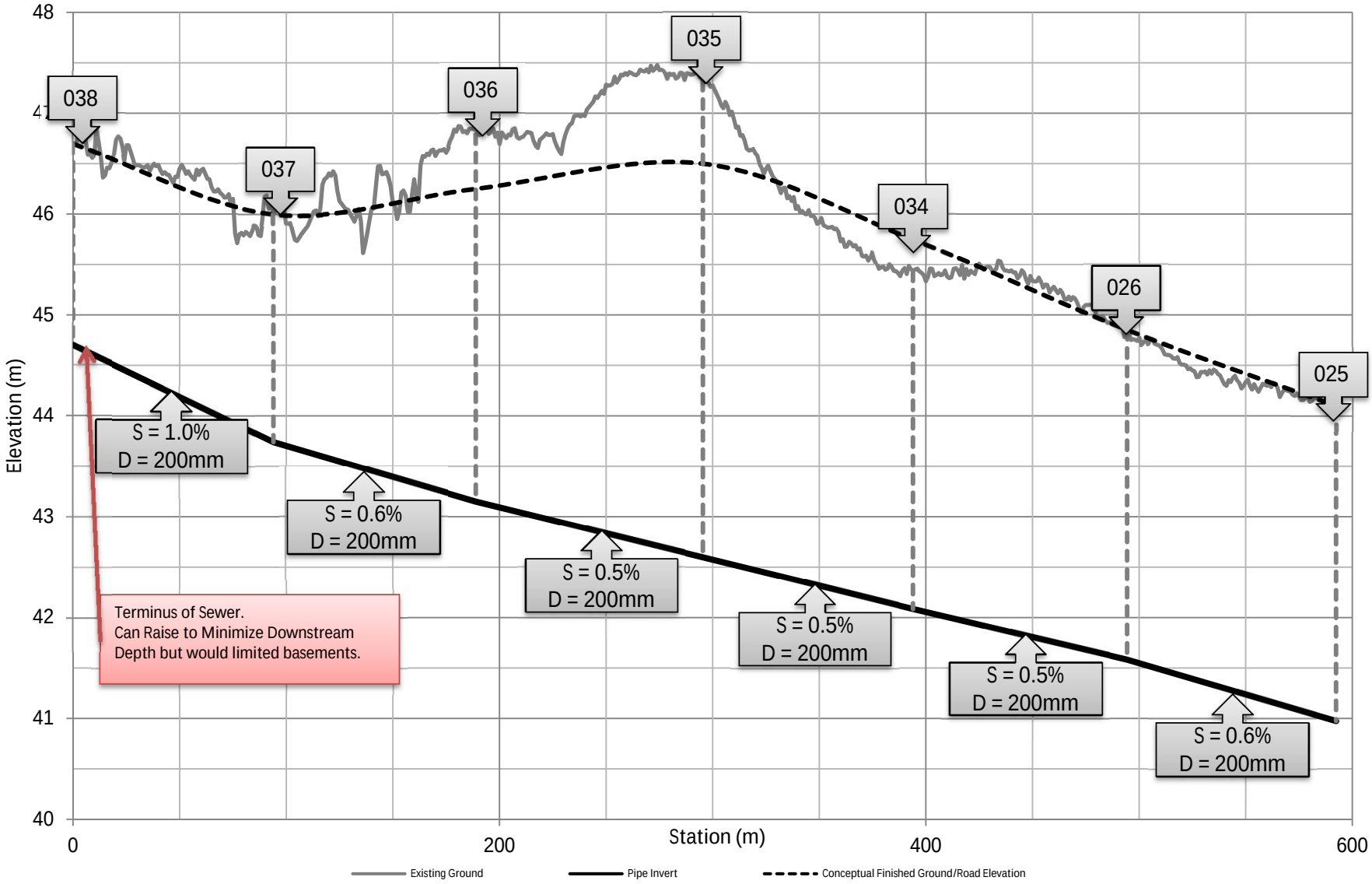
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

Anniedale PS Catchment: Center-North Sub-Catchment



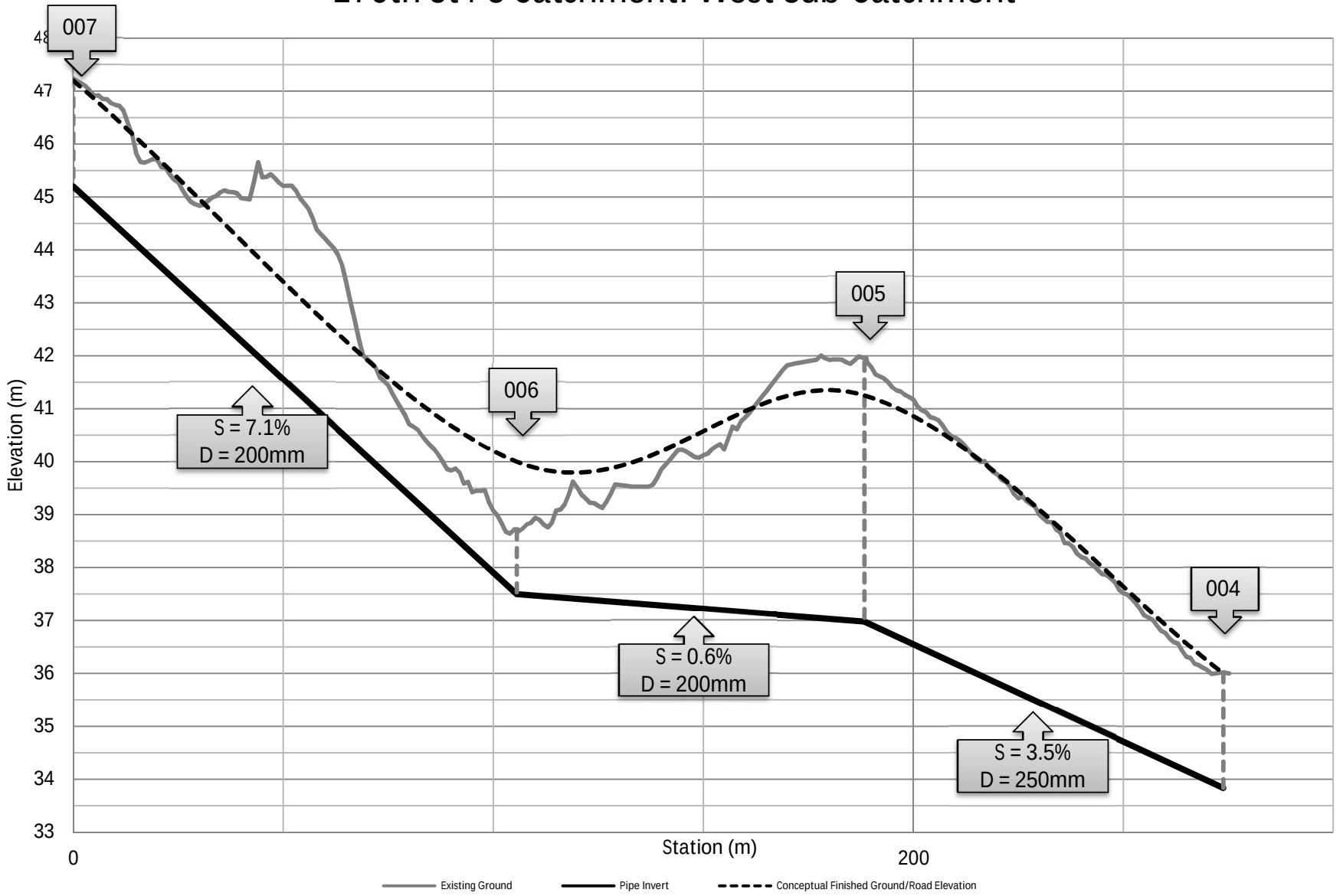
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

Anniedale PS Catchment: South-West Sub-Catchment



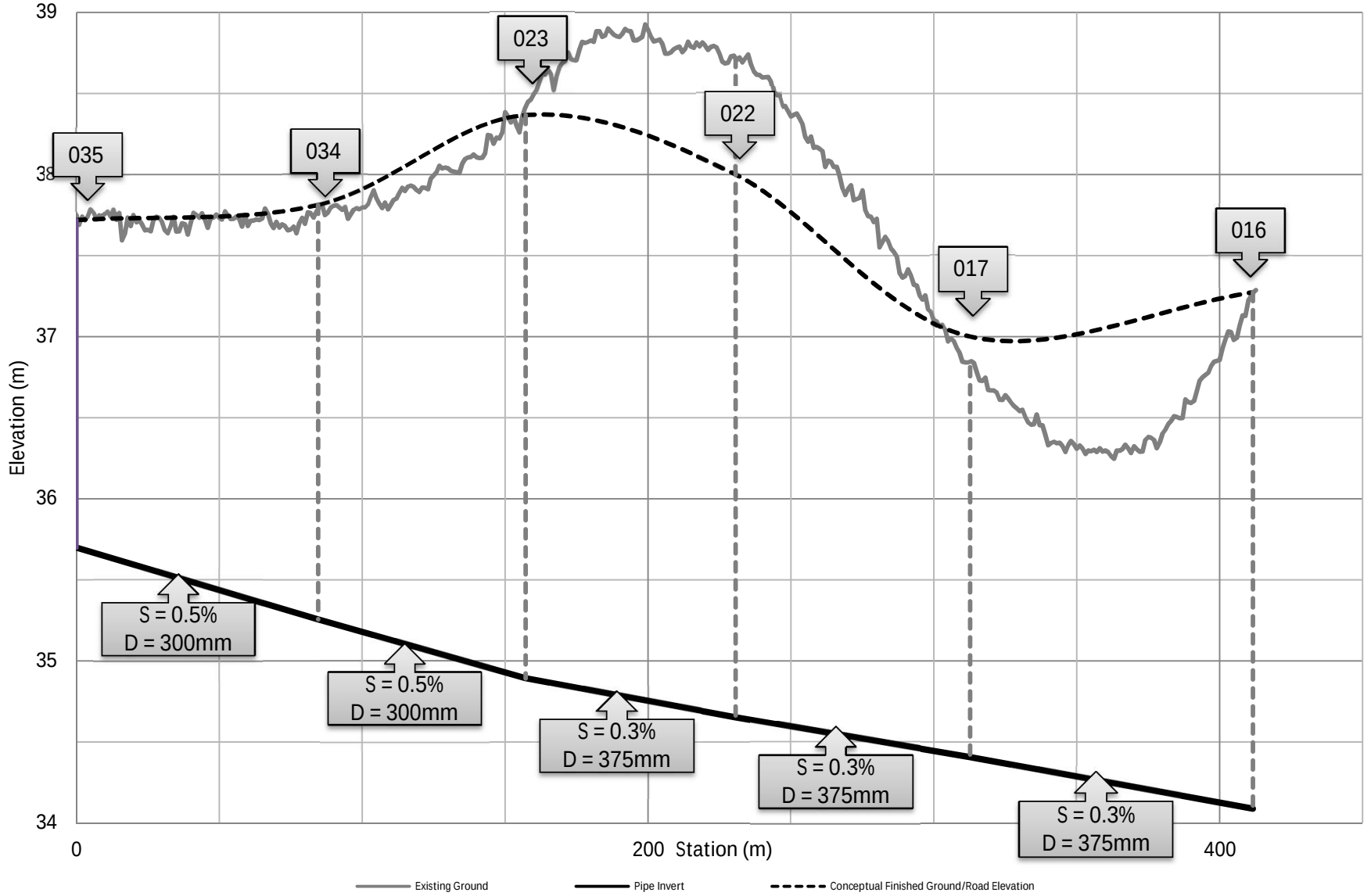
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

176th St PS Catchment: West Sub-Catchment



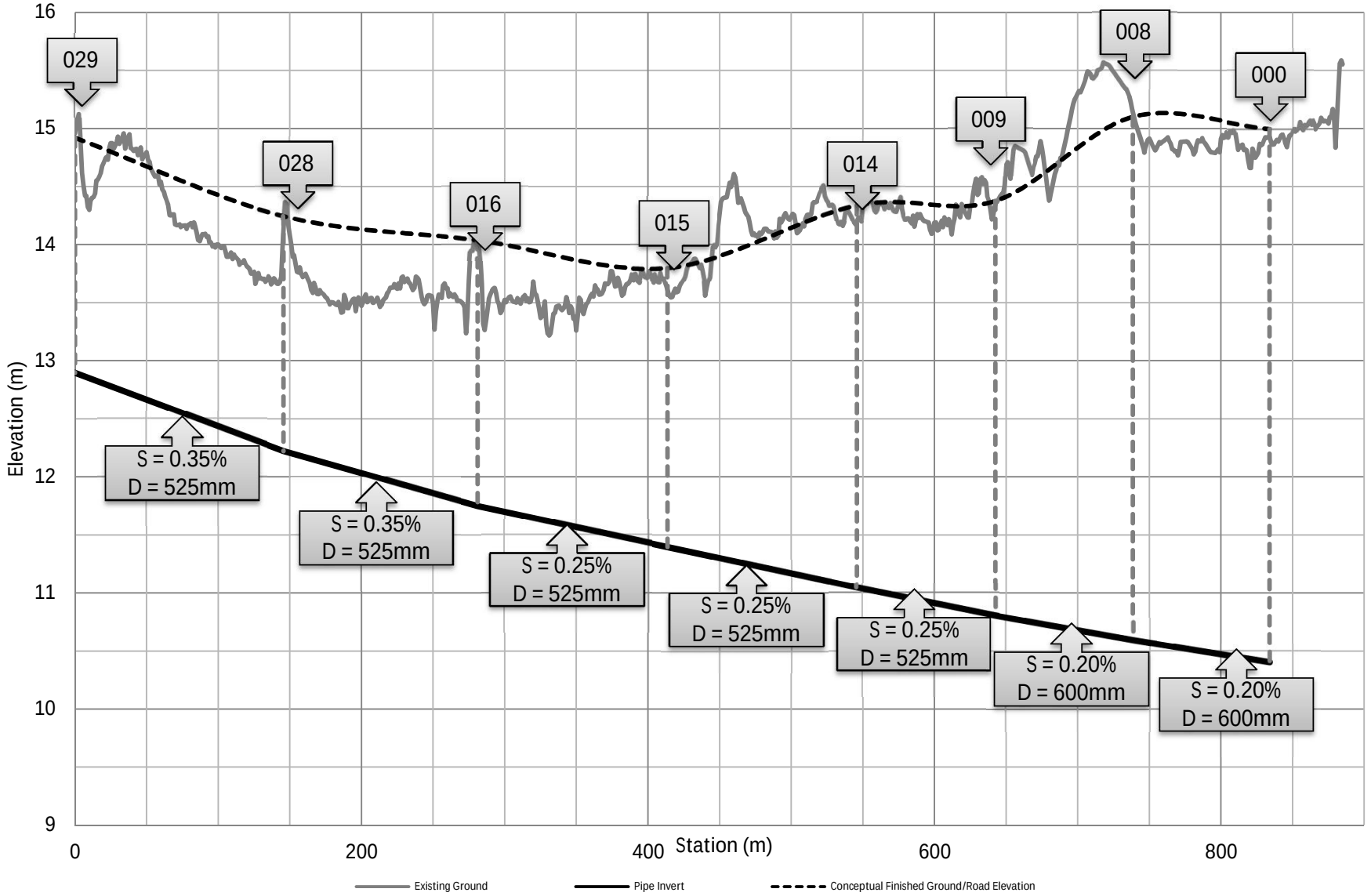
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

176th St PS Catchment: Center-North Sub-Catchment



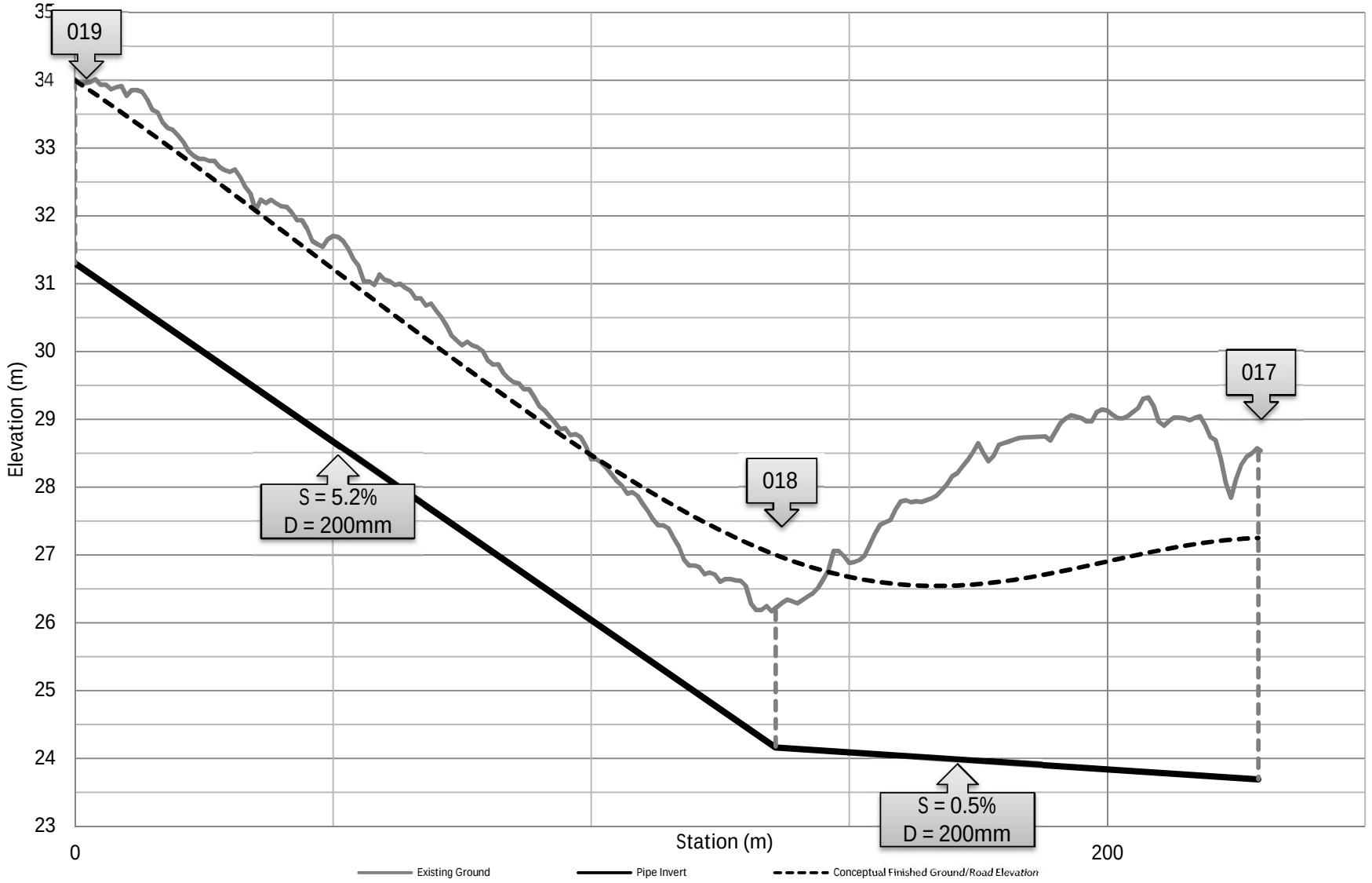
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

184th St PS Catchment: Center-West Sub-Catchment



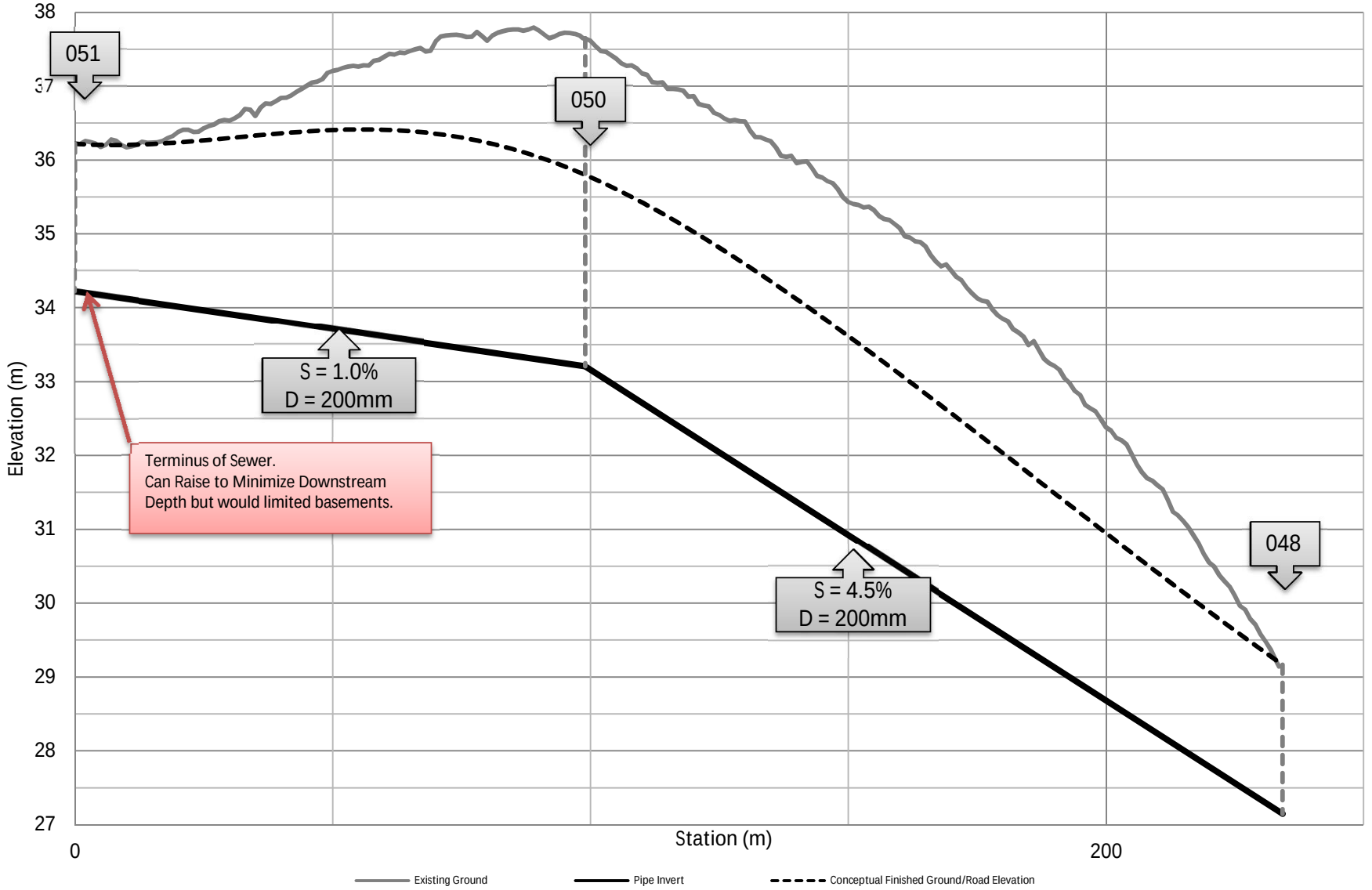
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

184th St PS Catchment: Center Sub-Catchment



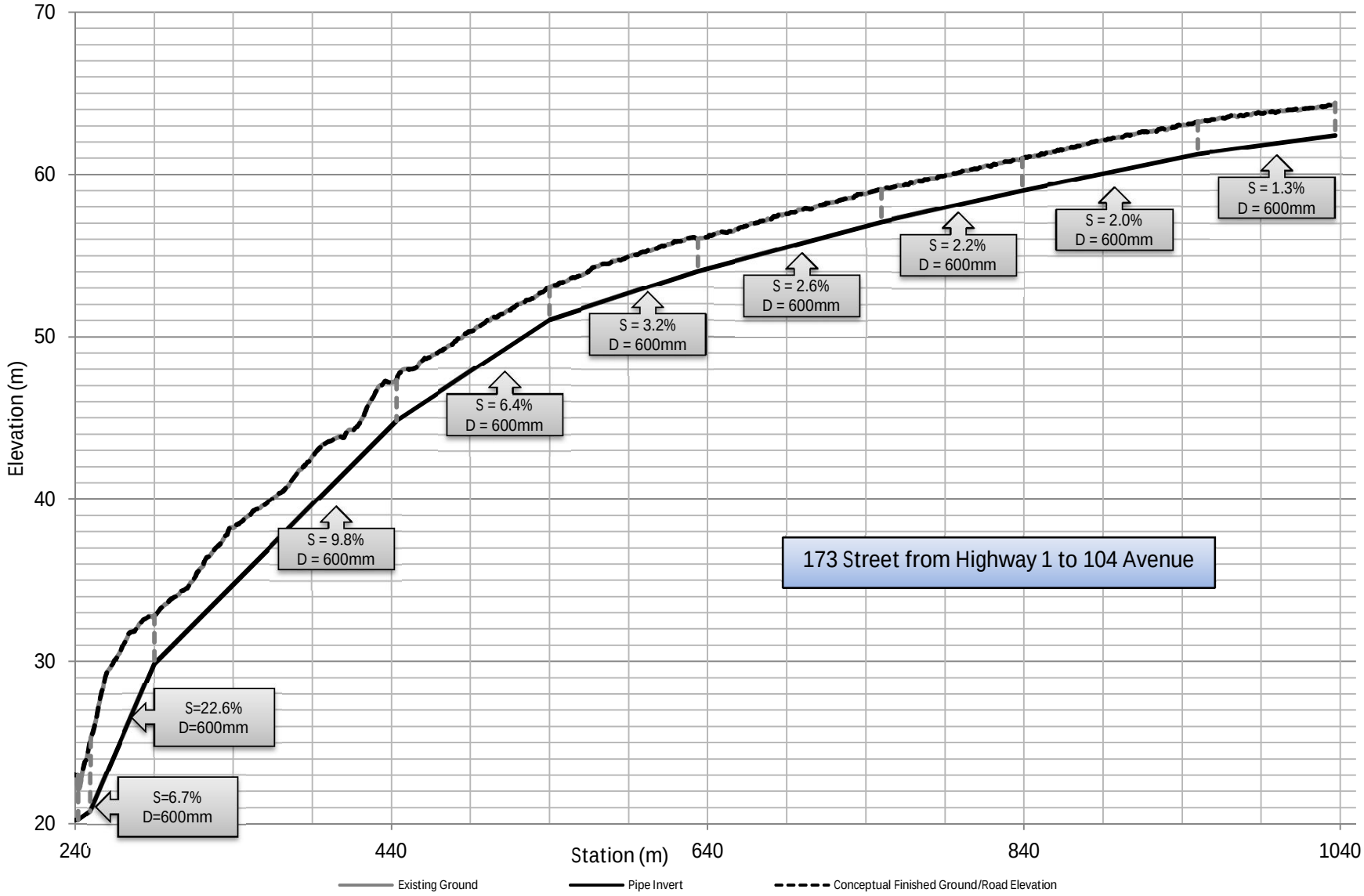
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

184th St PS Catchment: East Sub-Catchment



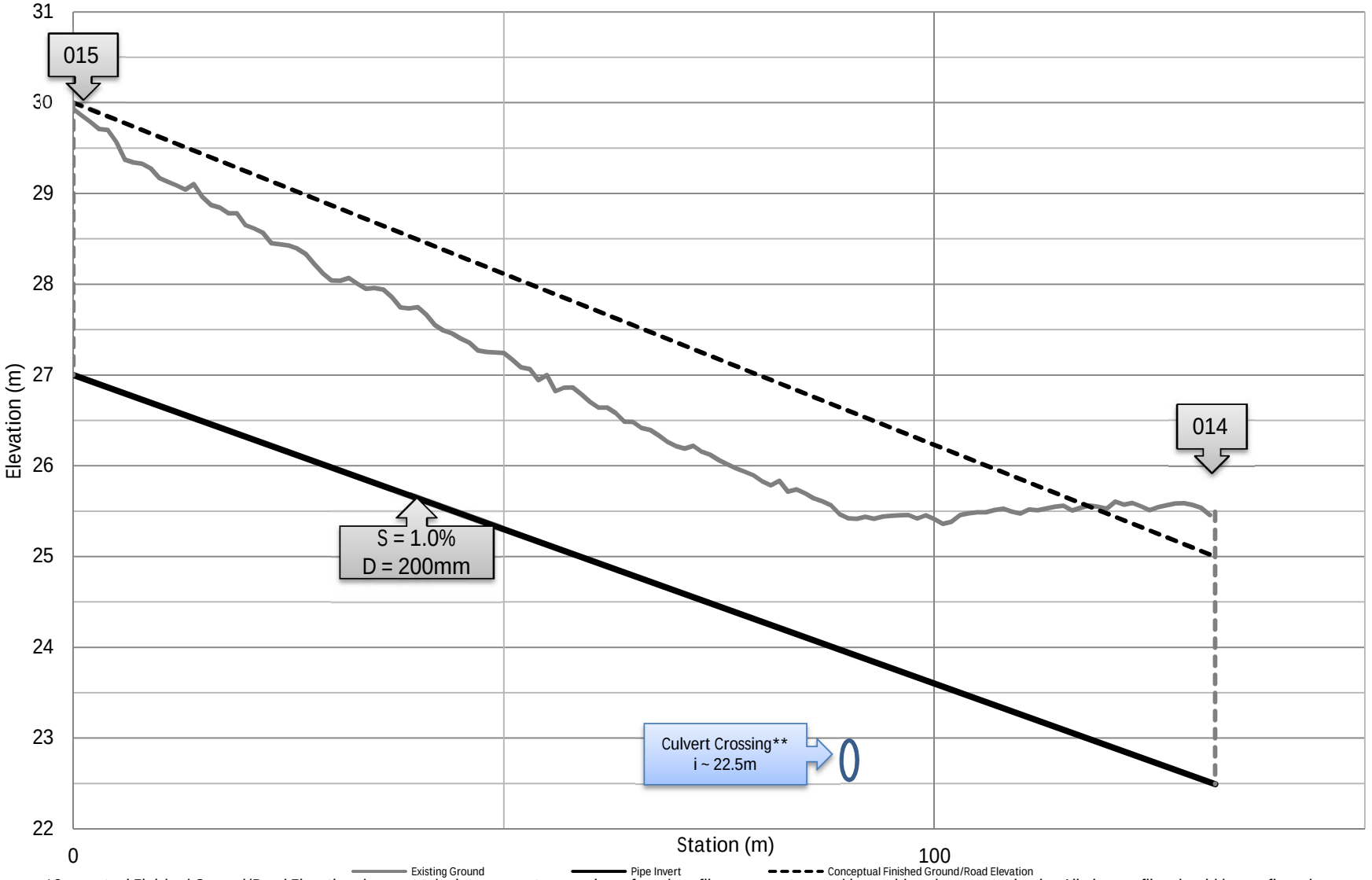
*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

South Port Kells Trunk (Pipe 1-5 Refer to Figure 3.4.1)



*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

176th Street - West (North) - Culvert



*Conceptual Finished Ground/Road Elevation does not take into account any review of road profile or geometry , and is considered conceptual only. All pipe profiles should be confirmed once road profiles have been developed.

**Assumed 0.5m height, 1.2m wide culvert

Anniedale/Tynehead NCP Stage 2
Sanitary System Option 2c-ii
Update - August 2011 - USL

INTERIM AND ULTIMATE CAPITAL COST ESTIMATES (in 2010 dollars)

Ref No.	Description	Size (nominal)	Unit	Unit Price	Unit	Quantity	Cost
	Phase 1						
	Tynehead						
	Forcemain and Gravity Sewer						
1-1	Tynehead Trunk	375	mm	$ 240.00	l.m	355	$ 85,200.00
1-2	Tynehead FM	400	mm	$ 971.00	l.m	835	$ 810,785.00
	Tynehead FM - Odour Control (allowance)			$ 60,000.00	L.S	1	$ 60,000.00
1-3	Tynehead - Anniedale FM	400	mm	$ 971.00	l.m	980	$ 951,580.00
1-4	South Port Kells FM	400	mm	$ 971.00	l.m	1150	$ 1,116,650.00
1-5	South Port Kells Trunk	600	mm	$ 1,416.00	l.m	800	$ 1,132,800.00
	South Port Kells Trunk - RoW (allowance)			$ 90,000.00	L.S	1	$ 90,000.00
	Highway 1 crossing			$ 500,000.00	L.S	1	$ 500,000.00
	South Port Kells Odour Control (w/land)			$ 660,000.00	L.S	1	$ 660,000.00
	Local Main Upsizing Allowance	250	mm	$ 64.00	l.m	270	$ 17,280.00
	Local Main Upsizing Allowance	300	mm	$ 136.00	l.m	160	$ 21,760.00
	Local Main Upsizing Allowance	375	mm	$ 240.00	l.m	435	$ 104,400.00
						Subtotal	$ 5,550,455.00
	Pump Station						
	Tynehead Pump Station (172 St.)	102	L/s	$ 3,300,000.00	L.S	1	$ 3,300,000.00
						Subtotal	$ 3,300,000.00
						Total (rounded)	$ 8,800,000.00
	Phase 2						
	Anniedale A/B1/B4						
	Forcemain and Gravity Sewer						
2-1	Anniedale A Trunk	375	mm	$ 240.00	l.m	1000	$ 240,000.00
2-2	Anniedale A FM	400	mm	$ 971.00	l.m	2140	$ 2,077,940.00
	Anniedale A FM - Odour Control (allowance)			$ 60,000.00	L.S	1	$ 60,000.00
2-3	Anniedale B4 Trunk - 1	375	mm	$ 240.00	l.m	265	$ 63,600.00
2-4	Anniedale B4 Trunk - 2	375	mm	$ 240.00	l.m	390	$ 93,600.00
2-5	Anniedale B3 Trunk - 2	300	mm	$ 136.00	l.m	690	$ 93,840.00
2-6	Anniedale B3 Trunk - 3	375	mm	$ 240.00	l.m	135	$ 32,400.00
2-7	Anniedale B4 FM	400	mm	$ 971.00	l.m	200	$ 194,200.00
	Anniedale B4 FM - Odour Control (allowance)			$ 60,000.00	L.S	1	$ 60,000.00
2-8	Tynehead - Anniedale FM Twin	500	mm	$ 1,087.00	l.m	980	$ 1,065,260.00
2-9	South Port Kells FM Twin	650	mm	$ 1,214.00	l.m	1150	$ 1,396,100.00
	Highway 15 crossing			$ 200,000.00	L.S	1	$ 200,000.00
	Local Main Upsizing Allowance	250	mm	$ 64.00	l.m	1135	$ 72,640.00
	Local Main Upsizing Allowance	300	mm	$ 136.00	l.m	350	$ 47,600.00
	Local Main Upsizing Allowance	375	mm	$ 240.00	l.m	75	$ 18,000.00
						Subtotal	$ 5,715,180.00
	Pump Station						
	Anniedale Pump Station (Hwy 1 @ 187 St.)	113	L/s	$ 3,600,000.00	L.S	1	$ 3,600,000.00
	Anniedale B4 Pump Station (176 St.)	143	L/s	$ 3,500,000.00	L.S	1	$ 3,500,000.00
						Subtotal	$ 7,100,000.00
						Total (rounded)	$ 12,800,000.00
	Phase 3						
	Anniedale B3						
	Forcemain and Gravity Sewer						
3-1	Anniedale B3 Trunk - 1	300	mm	$ 136.00	l.m	220	$ 29,920.00
	Anniedale B3 Trunk - RoW (allowance)			$ 250.00	sq.m	900	$ 225,000.00
	Local Main Upsizing Allowance	300	mm	$ 136.00	l.m	100	$ 13,600.00
						Subtotal	$ 268,520.00
						Total (rounded)	$ 300,000.00
	Phase 4						
	Anniedale B2						
	Forcemain and Gravity Sewer						
4-1	Anniedale B2 Trunk -1	525	mm	$ 464.00	l.m	890	$ 412,960.00
4-2	Anniedale B2 Trunk -2	600		$ 568.00	l.m	190	$ 107,920.00
	Anniedale B2 Trunk - RoW (allowance)			$ 235,000.00	L.S	1	$ 235,000.00
4-3	Anniedale B2 FM	250	mm	$ 760.00	l.m	1320	$ 1,003,200.00
	Anniedale B2 FM - Odour Control (allowance)			$ 60,000.00	L.S	1	$ 60,000.00
4-4	Anniedale B FM	250	mm	$ 760.00	l.m	850	$ 646,000.00
						Subtotal	$ 2,465,080.00
	Pump Station						
	Anniedale B2 Pump Station (184 St.)	58	L/s	$ 4,400,000.00	L.S	1	$ 4,400,000.00
						Subtotal	$ 4,400,000.00
						Total (rounded)	$ 6,900,000.00
	Anniedale/Tynehead (Phases 1 - 4)					TOTAL	$ 28,799,235.00
						BUDGET TOTAL	$ 28,800,000.00

Notes:
- All pipe costs include: 15% contingency, 12% engineering, pavement cut costs, connections, manholes, etc. as provided by City of Surrey.
- All pump station costs include land costs (as provided by City of Surrey), 20% contingency, 15% engineering. Engineering is not applied to land costs. Land costs considered *preliminary* only.
- South Port Kells Trunk RoW allowance based on 6m wide RoW, calculated at $350,000/acre, includes 20% contingency.
- Anniedale B2 Trunk RoW allowance based on 6m wide RoW, calculated at $350,000/acre, includes 20% contingency.
- South Port Kells Odour Control, includes land and 20% contingency.
- Upsizing costs above 200mm.
- All pipe sizes indicated are nominal size.
- Land costs provided by Surrey
- Phase 5 costs have been omitted from this Cost Estimate

Tynehead Pump Station (172 St.) - (Ultimate - 102 L/s)

Item	Description	Unit	Quantity	Unit Price	Total
1	**Pump Station**				
1.01	Site preparation (shored excavation, dewatering, etc.)	m^3	450	$2,000.00	$900,000.00
1.02	Cast concrete wetwell (4mx4mx6m)	m^3	35	$2,200.00	$77,000.00
1.03	Cast concrete off line storage (9mx9mx4m) - 300mm walls	m^3	100	$2,200.00	$220,000.00
1.04	Supply and install 3 pumps (VFD's)	LS	1	$250,000.00	$250,000.00
1.05	Mechanical systems and piping (valves, meters, pipes, etc.)	LS	1	$100,000.00	$100,000.00
1.06	Valve and Flow Meter Chamber (cast concrete)	LS	20	$2,000.00	$40,000.00
1.07	Washdown system mechanical	LS	1	$10,000.00	$10,000.00
1.08	75mm water service with backflow prevention	LS	1	$5,000.00	$5,000.00
1.09	Control/Generator building	m^2	64	$2,000.00	$128,000.00
1.10	Site electrical (incl. generator)	LS	1	$300,000.00	$300,000.00
1.11	Surge control (allowance)	LS	1	$150,000.00	$150,000.00
1.12	Odour control system (allowance)	LS	1	$150,000.00	$150,000.00
1.13	Land Acquisition[1] (Approx. 625 m^2 footprint required)	LS	1	$93,750.00	$93,750.00
				Subtotal	$2,423,750.00
				Engineering and Contingency (15% eng., 20% contingency - eng. not applied to land costs)	$835,000.00
				TOTAL	**$3,300,000.00**

Anniedale Pump Station (187 St.) - (Ultimate - 113 L/s)

Item	Description	Unit	Quantity	Unit Price	Total
1	**Pump Station**				
1.01	Site preparation (shored excavation, dewatering, etc.)	m^3	600	$2,000.00	$1,200,000.00
1.02	Cast concrete wetwell (4mx4mx6m)	m^3	35	$2,200.00	$77,000.00
1.03	Cast concrete off line storage (9mx9mx4m) - 300mm walls	m^3	100	$2,200.00	$220,000.00
1.04	Supply and install 3 pumps (VFD's)	LS	1	$200,000.00	$200,000.00
1.05	Mechanical systems and piping (valves, meters, pipes, etc.)	LS	1	$100,000.00	$100,000.00
1.06	Valve and Flow Meter Chamber (cast concrete)	LS	20	$2,000.00	$40,000.00
1.07	Washdown system mechanical	LS	1	$10,000.00	$10,000.00
1.08	75mm water service with backflow prevention	LS	1	$5,000.00	$5,000.00
1.09	Control/Generator building	m^2	64	$2,000.00	$128,000.00
1.10	Site electrical (incl. generator)	LS	1	$300,000.00	$300,000.00
1.11	Surge control (allowance)	LS	1	$150,000.00	$150,000.00
1.12	Odour control system (allowance)	LS	1	$150,000.00	$150,000.00
1.13	Land Acquisition[1] (Approx. 625 m^2 footprint required)	LS	1	$78,125.00	$78,125.00
				Subtotal	$2,658,125.00
				Engineering and Contingency (15% eng., 20% contingency - eng. not applied to land costs)	$919,000.00
				TOTAL	**$3,600,000.00**

Anniedale B4 Pump Station (176 St.) - (Ultimate - 143 L/s)

Item	Description	Unit	Quantity	Unit Price	Total
1	**Pump Station**				
1.01	Site preparation (shored excavation, dewatering, etc.)	m^3	400	$2,000.00	$800,000.00
1.02	Cast concrete wetwell (4mx4mx6m)	m^3	35	$2,200.00	$77,000.00
1.03	Cast concrete off line storage (11mx11mx4m) - 300mm walls	m^3	120	$2,200.00	$264,000.00
1.04	Supply and install 3 pumps (VFD's)	LS	1	$300,000.00	$300,000.00
1.05	Mechanical systems and piping (valves, meters, pipes, etc.)	LS	1	$100,000.00	$100,000.00
1.06	Valve and Flow Meter Chamber (cast concrete)	LS	20	$2,000.00	$40,000.00
1.07	Washdown system mechanical	LS	1	$10,000.00	$10,000.00
1.08	75mm water service with backflow prevention	LS	1	$5,000.00	$5,000.00
1.09	Control/Generator building	m^2	64	$2,000.00	$128,000.00
1.10	Site electrical (incl. generator)	LS	1	$400,000.00	$400,000.00
1.11	Surge control (allowance)	LS	1	$200,000.00	$200,000.00
1.12	Odour control system (allowance)	LS	1	$150,000.00	$150,000.00
1.13	Land Acquisition[1] (Approx. 1,000 m^2 footprint required)	LS	1	$110,000.00	$110,000.00
				Subtotal	$2,584,000.00
				Engineering and Contingency (15% eng., 20% contingency - eng. not applied to land costs)	$888,000.00
				TOTAL	**$3,500,000.00**

Anniedale B2 Pump Station (184 St.) - (Ultimate - 186 L/s)

Item	Description	Unit	Quantity	Unit Price	Total
1	**Pump Station**				
1.01	Site preparation (shored excavation, dewatering, etc.)	m^3	700	$2,000.00	$1,400,000.00
1.02	Cast concrete wetwell (4mx4mx6m)	m^3	35	$2,200.00	$77,000.00
1.03	Cast concrete off line storage (11mx11mx4m) - 300mm walls	m^3	180	$2,200.00	$396,000.00
1.04	Supply and install 2 pumps (VFD's)	LS	1	$200,000.00	$200,000.00
1.05	Mechanical systems and piping (valves, meters, pipes, etc.)	LS	1	$100,000.00	$100,000.00
1.06	Valve and Flow Meter Chamber (cast concrete)	LS	20	$2,000.00	$40,000.00
1.07	Washdown system mechanical	LS	1	$10,000.00	$10,000.00
1.08	75mm water service with backflow prevention	LS	1	$5,000.00	$5,000.00
1.09	Control/Generator building	m^2	64	$2,000.00	$128,000.00
1.10	Site electrical (incl. generator)	LS	1	$400,000.00	$400,000.00
1.11	Surge control (allowance)	LS	1	$200,000.00	$200,000.00
1.12	Odour control system (allowance)	LS	1	$150,000.00	$150,000.00
1.13	Land Acquisition[1] (Approx. 625 m^2 footprint required)	LS	1	$125,000.00	$125,000.00
				Subtotal	$3,231,000.00
				Engineering and Contingency (15% eng., 20% contingency - eng. not applied to land costs)	$1,113,000.00
				TOTAL	**$4,400,000.00**
1.14	Install 3rd pump / update controls (+ 20% contingency) (Attributable to Port Kells only)	LS	1	$240,000.00	$240,000.00

[1] Costs as provided by City of Surrey.

APPENDIX C: STORMWATER

- ☐ Figures A.1 to A.4
- ☐ Table A.1 to A.4

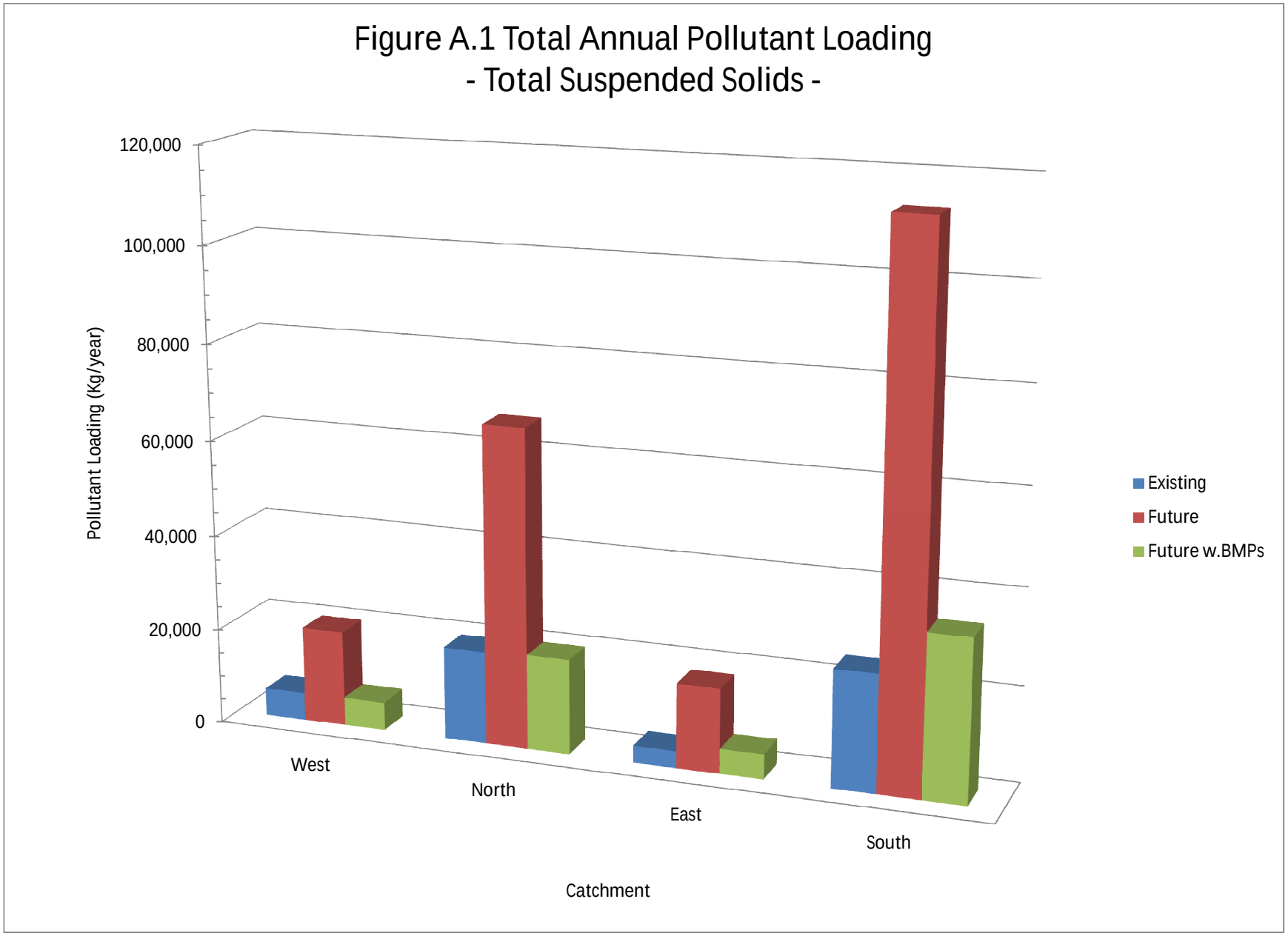


Figure A.1 Total Annual Pollutant Loading
- Total Suspended Solids -
120,000
100,000
80,000
60,000
40,000
20,000
0
Pollutant Loading (Kg/year)
West
North
East
South
Catchment
Existing
Future
Future w.BMPs

Figure A.2 Total Annual Pollutant Loading
- Oil & Grease -

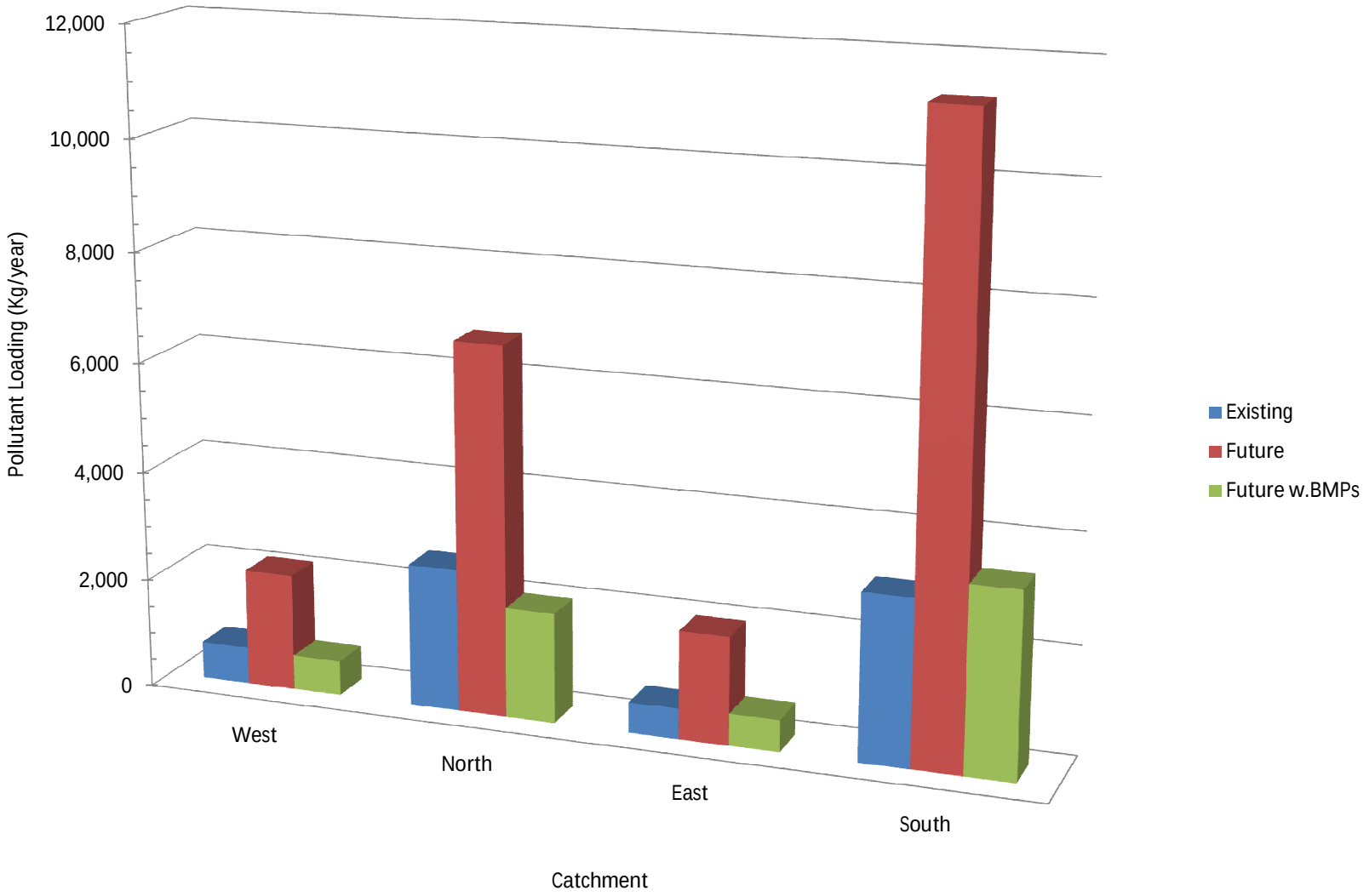


Figure A.3 Total Annual Pollutant Loading
- Total Zinc -

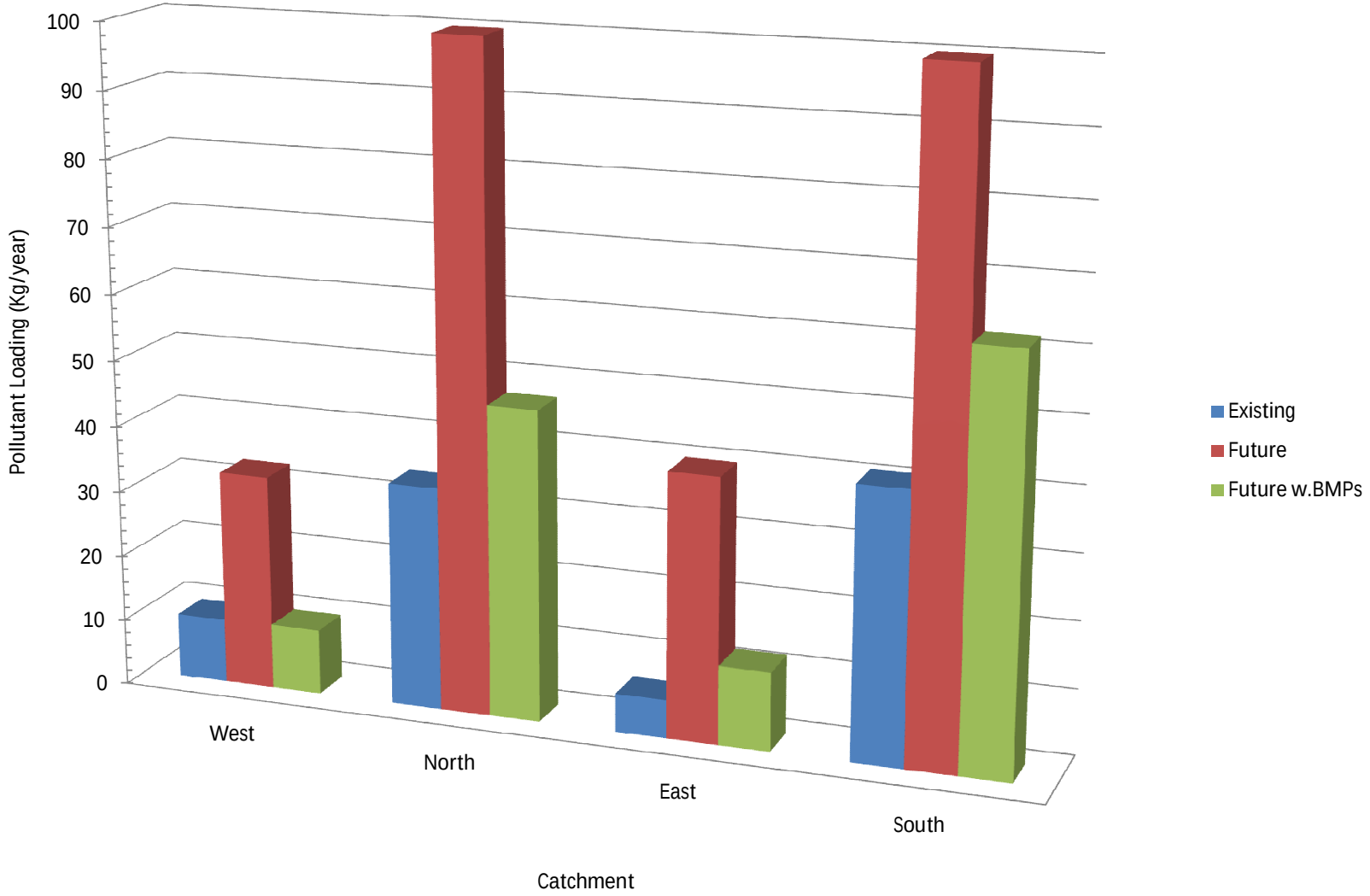
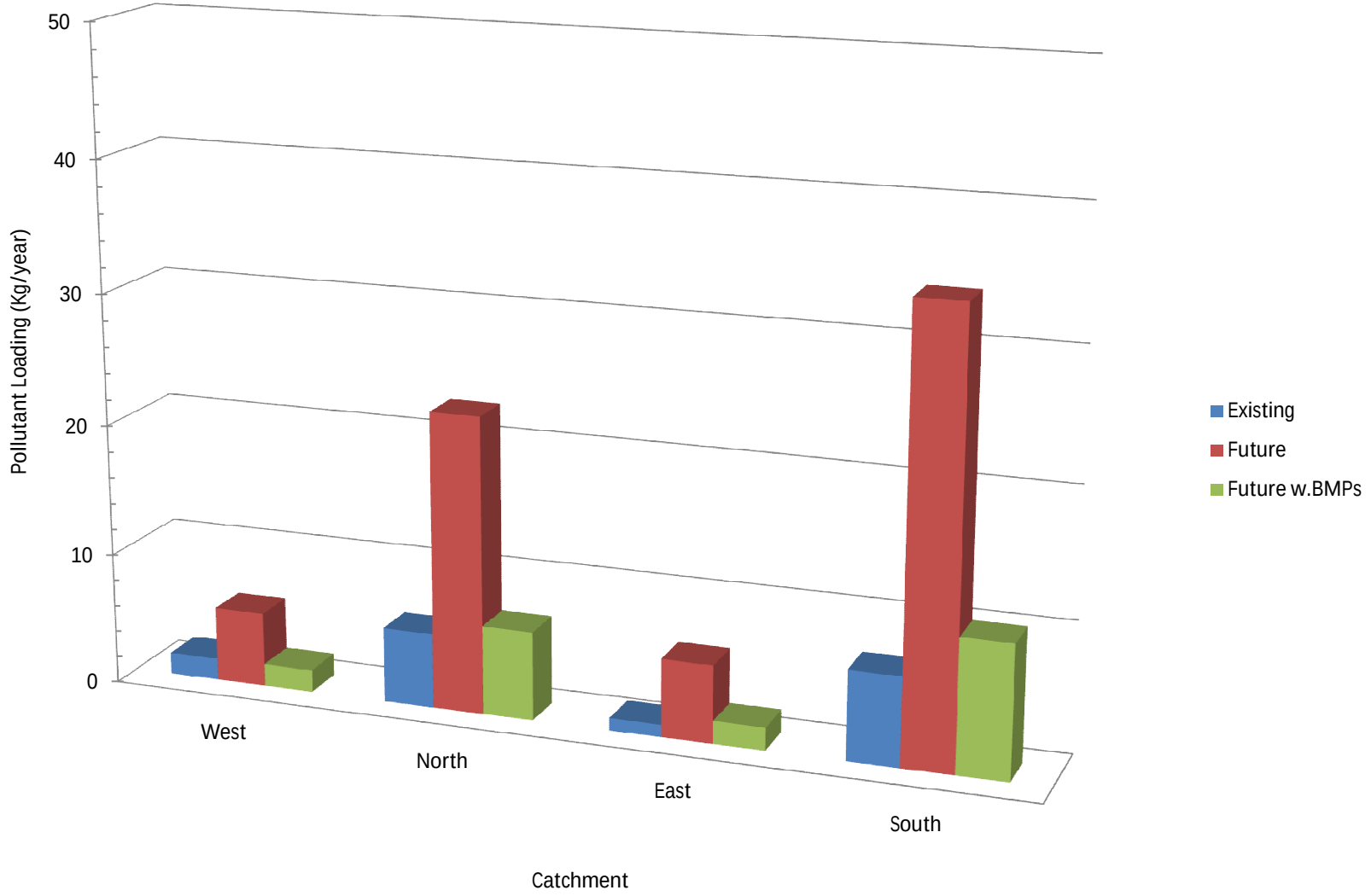


Figure A.4 Total Annual Pollutant Loading
- Total Copper -



TABLES A.1 TO A.4

Table A.1 Summary of Background Drainage Info

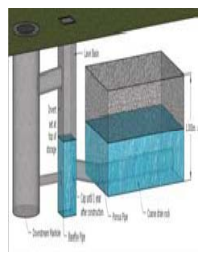
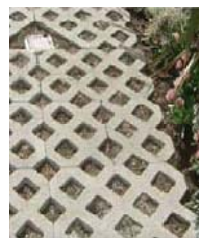
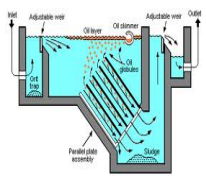
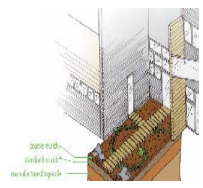
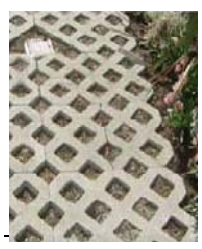
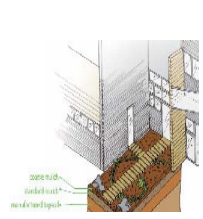
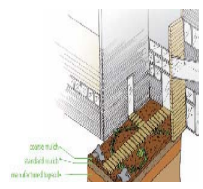
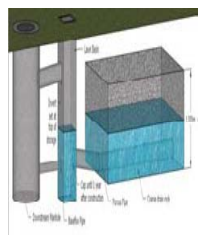
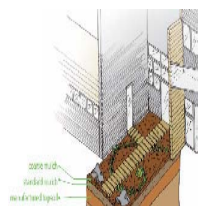
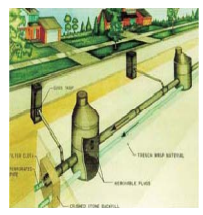
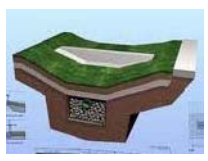
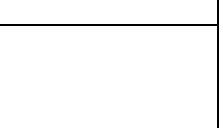
ISSUES		PLAN or STUDY				
		10 year Servicing Plan	Madrone Environmental Assessment	South Port Kells GLUP	North Bluff Drainage and Slope Stability Assessment	Master Drainage Plan Update Upper Serpentime System Environmental Considerations
		2010	2009	2005	2000	1994
Existing Condition	**Hydrology (Groundwater and surface water)**		**P 24, 29** ***The 'study area' as described in this report is the same as the current 'study area'.** • The aquifer underlying the study area is a confined aquifer having low vulnerability, low demand and high productivity. Most water infiltrating in the Anniedale/Tynehead NCP area will flow laterally downslope and confined within the top 1 m of the soil. Recharge of the aquifer occurs via lateral flow from the lowlands south of the study area, rather than directly from the uplands. • Point of diversion (along mid to lower slopes between 15 m and 25 m of asl) mapped on iMapBC indicate two springs in the southern portion of the study area. Two more springs identified at midslopes between 29 m and 31 m asl in the southern part (more steeper than other southern areas).			
	Ecosystem		**P 43** • Over 150 ha of forested rare ecosystems occur in the study area, occupying over 36% of the land base. The majority of these forests are immature and are dominated by broadleaf trees or a mix of broadleaf and coniferous trees. Although they will likely develop into mature conifer forests with time (in some cases centuries) they are still classed as red or blue listed ecosystems.			
	Environmentally Sensitive area		**P 51—referred to Phoenix Report (2004)** • The Serpentine River watershed in the west was identified as ESA #5 from the Phoenix report. This riparian area connects to forests to the north into Tynehead Park and south along the Serpentine River system. Polygons 2, 3, 6, 13, 15, 16, 19, 21, 22, 23, 27, and 28 are rated as moderate to high conservation value. The large forested polygons in the west central region of the study area are referred to as ESA #4 (Polygons 43, 44, and 157). These polygons have a total size of nearly 12 ha. ESA #3 is made up of deciduous and conifer forests and associated drainages from Lakiotis Creek watershed (Polygons 61, 62, 63, 78, 79, 171, 172, 173, 174, 175, 176 and 178). This is a large, relatively undeveloped area that has older agricultural fields and mixed forests.			
	Topography		**P 8** • Four areas with slopes > 30% have been identified (Figure 2: Terrain Map). • Evidence of debris slide at the southern border of the study area.			

ISSUES		PLAN or STUDY				
		10 year Servicing Plan	Madrone Environmental Assessment	South Port Kells GLUP	North Bluff Drainage and Slope Stability Assessment	Master Drainage Plan Update Upper Serpentime System Environmental Considerations
		2010	2009	2005	2000	1994
Existing Issues	Watercourse erosion and other issues		**P 29** • Significant erosion has occurred at the outlet of the culvert at 92nd Avenue, where ditchwater is discharged into a ditch running downslope, draining into a ravine south of 92nd Avenue. At the culvert outlet, the watercourse is deeply incised and undercut banks are present downslope of the culvert, indicating significant erosion and scour. We understand that erosion of this ditch began following the extension of 180th Street. A drainage ditch paralleling 180th Street feeds into the ditch parallel to 92nd Avenue. A culvert connects the ditch paralleling 92nd Avenue to the ditch in question. Erosion of the ditch is likely associated with increased flow due to the extension of 180th Street. Diversion of additional water into this ditch will result in further erosion.			**P 5-10** --Tributaries of Serpentine River flowing from 96th Ave along 172nd St and flowing south from 96th Ave along 173A St reported to be heavily silted, filled with debris and overgrown. Lower reaches are ditched. --A mainstem tributary flowing northwest from Bothwell Drive and 92nd Ave to 168th St was reported to have considerable siltation on river bed and erosion along stream banks. Metal sheet piles immediately downstream of 168th St provide no cover. --Tributary flowing east under 168th St to main stem near 92nd Ave has instream vegetation that makes fish passage difficult in lower section. A waterfall exists about 700 m upstream from 168th St that creates fish barrier. --Tributary flowing southwest from under 96th Ave to mainstem east of 168th St was reported to be silted and choked with vegetation. Stream bed consists of silt and exposed clay.
	Fish Passage		**P 60, 61,** • **Leoran Brook**: The first culvert underneath 96th Avenue upstream of Highway 1 on the Leoran brook drainage appears to be too steep to allow the upstream movement of fish (Photo 5). Upstream of the second culvert (Photo 6), likely impedes upstream fish migration.			
	Fish presence		**P 57, 59** • **Mainstem Serpentine and connected tributaries**: During field assessment, fish presence observed both in the mainstem Serpentine River and connected tributaries (including ditches). The majority of the fish we observed were rearing juvenile coho salmon fry. The mainstem river exhibits a perennial flow regime and offers relatively diverse habitat where it flows through the study area. • **Leoran Brook**: The existence of coastal cutthroat trout was confirmed in drainages located in the study area during fish sampling exercises carried out by Phoenix Environmental Services Ltd. in 2007. Observations of salmonid fish were made by Madrone in late July 2009 while carrying out the fish habitat/riparian assessments, further confirming the presence of fish in this system. The observations were of resident trout (likely coastal cutthroat trout). The fish were located in pool habitat units immediately upstream of the Highway 1 crossing and in the roadside ditch paralleling the northern side of 96th Avenue.			

ISSUES		PLAN or STUDY				
		10 year Servicing Plan	Madrone Environmental Assessment	South Port Kells GLUP	North Bluff Drainage and Slope Stability Assessment	Master Drainage Plan Update Upper Serpentime System Environmental Considerations
		2010	2009	2005	2000	1994
	Riparian Vegetation		**P 64** • Serpentine River generally bounded by open, grassy fields with limited extent of treed riparian vegetation. • Limited riparian (extent and function) vegetation along Leoran Brook. • Limited riparian (extent and function) vegetation along 96th Avenue ditches.			
	Detention	• Detention pond facility south of 95th Ave and E of 168th St.			Detention volume for controlling to 2-year pre development flows is 23,200 m3 and for controlling to 5 year peak flows is 9,050 m3	
Recommended BMPs or other Measures	**Watercourse**	• Erosion and Ravine works between 96th Ave and 168th St.	**P 64, 73, 77** • Four candidate areas (labeled "A" to "D") were identified as having the most potential for habitat restoration and enhancement (Figures 8 and 9). • General opportunities occur throughout areas of existing fish habitat. Instream habitat enhancement projects that would be of benefit include (but are not limited to): log bank cover construction, rock/log weir construction, strategic instream boulder placement, gravel catchment/placement, installing wing/flow deflectors, LWD placement and off channel habitat development. • Minor changes were made to the existing City of Surrey watercourse classification map during the field assessment. Two unclassified drainage ditches were upgraded to "Class C" drainages, due to direct connectivity to larger, fish bearing systems. The majority of the Leoran Brook headwater streams were upgraded from "Class B" drainages to either "Class A" or "AO" drainages, based on direct observations of salmonids during the field assessments and available habitat attributes. Modifications to the drainage network adjacent to the newly installed "Golden Ears Way" were also made, due to inaccurately mapped drainage locations (Figures 8 and 9). • Due to the sensitivity of the habitat and the considerable site potential for the development of riparian habitat, the setback should be no less than 30 m for the Serpentine River regardless of the proposed density of development. In general, when development densities are determined in the future, setbacks will range from 15 m to 30 m adjacent to Class A, AO and B streams. The provincial Riparian Areas Regulation (RAR) methodology could potentially be used by individual developers as a means of further delineating the riparian setback area after the default 15 m or 30 m setback has been applied.	**P 20** Detention ponds to the south of Highway #1 and E of Harvie Rd.		**Tributary 1.1.2a/b** Clearing of debris and inspection/monitoring of culverts to ensure improved fish passage. **Tributary 1.1.3 mainstem** Encourage landowners to plant stabilizing vegetation and install shot rock or gabions at appropriate locations. If possible, replace sheet pile with shot rock and gabion structures that incorporate cover. **Tributary 1.1.3a** --Clean up dumpsite. --Fence off stream trampled by cattle --Clear instream vegetation, maintain necessary flow and reduced sedimentation. **Tributary 1.1.3b** --Gravel cleaning and additional gravel might improve spawning habitat. --Clear away vegetation to improve fish passage.

ISSUES		PLAN or STUDY				
		10 year Servicing Plan	Madrone Environmental Assessment	South Port Kells GLUP	North Bluff Drainage and Slope Stability Assessment	Master Drainage Plan Update Upper Serpentime System Environmental Considerations
		2010	2009	2005	2000	1994
	Wildlife Hubs and Corridor		**P 91** • Recommendations for wildlife hubs and corridors are built on the results of wildlife habitat suitability ratings in conjunction with the results from the vegetation and ecosystem ratings in this report. Figure 11 illustrates the recommendations for best potential wildlife hubs and travel corridors.			

Table A.2 Potential BMP/LID Options for Anniedale/Tynehead NCP Area

LAND USE	BMP/LID OPTIONS	ILLUSTRATIONS		
Village Commercial	1. Pre-fab infiltration trenches or Drain rock Infiltration trenches 2. Permeable Pavement 3. Oil-water separator			
Cluster Residential 4-6 upa Cluster Residential 6-10 upa	1. Disconnected Roof leaders 2. Enhanced topsoil on lawns (depth to be determined later) 3. Rain barrels (rainwater harvesting)			
Cluster Residential 10-15 upa Medium Density 10-15 upa Medium High Density 15-25 upa	1. Permeable Pavement 2. Planter boxes 3. Enhanced topsoil on lawns (depth to be determined later)			
Low Density Urban 6-10 upa	1. Disconnected Roof leaders 2. Enhanced topsoil on lawns (depth to be determined later)			
Cluster Residential 10-15 upa Medium Density 10-15 upa Medium High Density 15-25 upa High Density Residential 25-45 upa High Density Residential 30-45 upa	1. Pre-fab infiltration trenches or Drain rock Infiltration trenches 2. Permeable Pavement 3. Planter boxes			
Road ROW	1. Enhanced topsoil (depth to be determined later) 2. Infiltration Swale 3. Pervious storm sewers			
Industrial Low Impact	1. Oil-water separator (Parking lot) 2. Hydro-dynamic Separator 3. Filter Insert for Catchbasins 4. Pre-fab infiltration chamber or Drainrock infiltration trenches 5. Green Roof 6. Infiltration pond/Constructed wetland			
Industrial Business Park				
All	1. Diversion sewer 2. Detention / WQ ponds 3. Ditch Upgrade/ Pump station Upgrade			

Based on the BMP/LID table (AECOM) provided by the City on January 11, 2011

Table A.3 Anniedale/Tynehead NCP: Drainage Servicing
Class D Cost Estimate for Proposed Ponds

Sub-Catchment	DESCRIPTION	Pond Type	Land Reqmt	Pond Excavation volume	Unit cost	Total Cost
			(ha)	(m^3)		
N-1	**Pond Site 7: 96th Ave**	Detention		23,000	$100	$ 2,300,000
	Engineering, Administration and Contingency				35%	$ 805,000
	Land		0.72		$2,476,000	$ 1,783,000
	Subtotal Sub-Catchment N-1					**$ 4,888,000**
N-2	**Pond Site 8: Industrial Site near Highway 1**	WQ		7,250	$100	$ 725,000
	Engineering, Administration and Contingency				35%	$ 254,000
	Land		0.5		$2,476,000	$ 1,238,000
	Subtotal Sub-Catchment N-2					**$ 2,217,000**
E-1	**Pond Site 6: 90th Ave and Harvie Road**	Detention		11,270	$100	$ 1,127,000
	Engineering, Administration and Contingency				35%	$ 394,000
	Land		0.71		$2,476,000	$ 1,758,000
	Subtotal Sub-Catchment E-1					**$ 3,279,000**
S-2	**Pond Site 1: Northwest Corner of 173A St and 92nd Ave**	WQ		3,975	$100	$ 398,000
	Engineering, Administration and Contingency				35%	$ 139,000
	Land		0.64		$2,476,000	$ 1,585,000
	Subtotal Sub-Catchment S-2					**$ 2,122,000**
S-3	**Pond Site 2: South side of 90A Ave**	WQ		8,410	$100	$ 841,000
	Engineering, Administration and Contingency				35%	$ 294,000
	Land		0.74		$2,476,000	$ 1,832,000
	Subtotal Sub-Catchment S-3					**$ 2,967,000**
S-4	**Pond Site 3: Southeast corner of 180th St and 92nd Ave**	WQ		4,250	$100	$ 425,000
	Engineering, Administration and Contingency				35%	$ 149,000
	Land		0.47		$2,476,000	$ 1,164,000
	Subtotal Sub-Catchment S-4					**$ 1,738,000**
S-5	**Pond Site 4: Northeast corner of 184th St and 89B Ave**	WQ		4,000	$100	$ 400,000
	Engineering, Administration and Contingency				35%	$ 140,000
	Land		0.46		$2,476,000	$ 1,139,000
	Subtotal Sub-Catchment S-5					**$ 1,679,000**
S-6	**Pond Site 5: Southwest corner of 187th St**	WQ		2,410	$100	$ 241,000
	Engineering, Administration and Contingency				35%	$ 84,000
	Land		0.45		$2,476,000	$ 1,114,000
	Subtotal Sub-Catchment S-6					**$ 1,439,000**
					Ponds	**$ 8,716,000**
					Land Only	**$ 11,613,000**
	TOTAL		**4.69**	**64,565**		**$ 20,329,000**

1. Total cost does not include GST/HST.
2. Unit land price provided by City of Surrey is $1,000,000 per acre, or $2,476,000 per hectare.

Table A.4 Anniedale/Tynehead NCP: Drainage Servicing
Class D Cost Estimate for Trunk Storm Sewers

	DESCRIPTION	UNIT	QUANTITY	Existing Status of Street along Proposed Pipe Alignment	UNIT PRICE	AMOUNT
Sub-Catchment N-1						
N-1	180 St - Concrete storm sewer - 1050 mm dia.	Lin.m.	160	Local Road	$ 1,857	$ 297,000
N-1	96 Ave - Concrete storm sewer - 1050 mm dia.	Lin.m.	65	Local Road	$ 1,663	$ 108,000
N-1	97 Ave - Concrete storm sewer - 900 mm dia.	Lin.m.	250	Green Field	$ 1,386	$ 347,000
	Subtotal Sub-Catchment N-1					**$ 752,000**
Sub-Catchment N-2						
N-2	94 Ave - Concrete storm sewer - 1050 mm dia.	Lin.m.	200	Local Road	$ 1,857	$ 371,000
N-2	184 St - Concrete storm sewer - 1050 mm dia.	Lin.m.	150	Local Road	$ 1,857	$ 279,000
N-2	Along Hwy 1 - Concrete storm sewer - 1050 mm dia.	Lin.m.	1050	Green Field	$ 1,547	$ 1,624,000
	Subtotal Sub-Catchment N-2					**$ 2,274,000**
Sub-Catchment S-2						
S-2	173A St - Concrete storm sewer - 900 mm dia.	Lin.m.	150	Local Road	$ 1,663	$ 249,000
	Subtotal Sub-Catchment S-2					**$ 249,000**
Sub-Catchment S-3						
S-3	176 St - Concrete storm sewer - 900 mm dia.	Lin.m.	350	Highway	$ 2,310	$ 809,000
S-3	177 St - Concrete storm sewer - 600 mm dia.	Lin.m.	170	Local Road	$ 1,274	$ 217,000
S-3	92 Ave - Concrete storm sewer - 750 mm dia.	Lin.m.	150	Local Road	$ 1,469	$ 220,000
	Subtotal Sub-Catchment S-3					**$ 1,246,000**
Sub-Catchment S-4						
S-4	180 St - Concrete storm sewer - 450 mm dia.	Lin.m.	150	Green field	$ 894	$ 134,000
S-4	180 St - Concrete storm sewer - 525 mm dia.	Lin.m.	270	Green field	$ 984	$ 266,000
	Subtotal Sub-Catchment S-4					**$ 400,000**
Sub-Catchment S-5						
S-5	184 St - Concrete storm sewer - 900 mm dia.	Lin.m.	290	Local Road	$ 1,663	$ 482,000
	Subtotal Sub-Catchment S-5					**$ 482,000**
Sub-Catchment W-2						
W-2	172 St - Concrete storm sewer - 750 mm dia.	Lin.m.	150	Local Road	$ 1,469	$ 220,000
	Subtotal Sub-Catchment W-1					**$ 220,000**
	Subtotal (All trunk Storm Sewers)					**$ 5,623,000**
Minor Ditch Improvement Works Downstream of Proposed Ponds						
E-1	Allowance for ditch improvements within existing ROW	Lin.m.	100		$ 135	$ 14,000
S-1	Allowance for ditch improvements within existing ROW	Lin.m.	200		$ 135	$ 27,000
S-2	Allowance for ditch improvements within existing ROW	Lin.m.	350		$ 135	$ 47,000
S-4	Allowance for ditch improvements (additional ROW as required)	Lin.m.	400		$ 135	$ 54,000
S-4	Additional ROW for improved ditch (5 m width x 400 m)	Ha.	0.20		$ 2,476,000	$ 495,000
S-5	Allowance for ditch improvements within existing ROW	Lin.m.	400		$ 135	$ 54,000
S-6	Allowance for ditch improvements within existing ROW	Lin.m.	250		$ 135	$ 34,000
	Subtotal (All Ditch Improvements)					**$ 725,000**
	Grand Total					**$ 6,348,000**

Notes:

1 Trunk costs based on unit rates provided by Surrey 16-Feb-2010; engineering and contingency are included in the unit rates.
2 Total cost does not include HST.
3 Unit land price provided by City of Surrey is $1,000,000 per acre, or $2,476,000 per hectare.

APPENDIX D: WATER

☐ Water Cost Estimates

Anniedale / Tynehead NCP

Stage 2 - Bulk Water Servicing Cost Estimate
Cherry Hill Connection (Initial Development)

Item	Description	Unit	Quantity	Unit Price	Total
1	**Pipe Works**				
1.01	450mm Connection from Cherry Hill (to 96 Avenue)	m	3180	$850.00	$2,703,000.00
1.02	450mm Trunk Water Main	m	350	$850.00	$297,500.00
1.03	300mm Trunk Water Main	m	505	$740.00	$373,700.00
	[1, 2]Subtotal Pipe Works				**$3,374,200.00**
2	**Other Fees/Works**				
2.01	PRV Station between 90m and 135m HGL pressure zones	LS	1	$100,000.00	$100,000.00
	Subtotal				$100,000.00
	10% Engineering				$10,000.00
	5% Allowance for Tender Increase				$5,000.00
	Subtotal Other Fees/Works				**$115,000.00**
	CONSTRUCTION TOTAL				**$3,500,000.00**

Notes:
1. Unit prices for pipe works as provided by City of Surrey.
2. Costs for pipe works include mains, appurtenances, tie-ins, service connections, hydrants, pavement cuts (and restoration), 10% Engineering and 5% allowance for tender increase.
3. Costs do not include any permit, RoW, land acquisition costs, or contingencies.
4. Costs do not include any Fleetwood Reservoir connection costs.

Anniedale / Tynehead NCP

Stage 2 - Bulk Water Servicing Cost Estimate

Fleetwood Reservoir Connection (Full Build Out)

Item	Description	Unit	Quantity	Unit Price	Total
1	**Pipe Works**				
1.01	750mm Connection from Fleetwood Reservoir (to 92 Avenue)	m	3550	$1,700.00	$6,035,000.00
1.02	750mm Trunk Water Main	m	2405	$1,700.00	$4,088,500.00
1.03	600mm Trunk Water Main	m	955	$1,320.00	$1,260,600.00
1.04	450mm Trunk Water Main	m	780	$850.00	$663,000.00
1.05	350mm Trunk Water Main	m	1530	$770.00	$1,178,100.00
1.06	300mm Trunk Water Main	m	1540	$740.00	$1,139,600.00
1.07	300mm distribution main upsized from 200mm	m	9345	$200.00	$1,869,000.00
1.08	300mm distribution main upsized from 250mm	m	1595	$100.00	$159,500.00
	[1, 2]Subtotal Pipe Works				**$16,393,300.00**
2	**Other Fees/Works**				
2.01	PRV Station between 90m and 135m HGL pressure zones	LS	1	$100,000.00	$100,000.00
	Subtotal				$100,000.00
	10% Engineering				$10,000.00
	5% Allowance for Tender Increase				$5,000.00
	Subtotal Other Fees/Works				**$115,000.00**
	CONSTRUCTION TOTAL				**$16,600,000.00**

Notes:
1. Unit prices for pipe works as provided by City of Surrey.
2. Costs for pipe works include mains, appurtenances, tie-ins, service connections, hydrants, pavement cuts (and restoration), 10% Engineering and 5% allowance for tender increase.
3. Costs do not include any permit, RoW, land acquisition costs, or contingencies.
4. Costs do not include any Cherry Hill connection costs.
5. Costs do not include any costs associated with Port Kells.

Anniedale / Tynehead NCP

Stage 2 - Bulk Water Servicing Cost Estimate

Port Kells Apportioned Costs - Upsizing

Item	Description	Unit	Quantity	Unit Price	Total
1	**Pipe Works**				
1.01	750mm upsized from 600mm (92-168 to Cat-6)	m	1780	$380.00	$676,400.00
1.02	750mm upsized from 500mm (Cat-6 to Cat-9)	m	625	$615.00	$384,375.00
1.03	600mm upsized from 500mm (Cat-9 to Cat-10)	m	955	$235.00	$224,425.00
1.04	450mm upsized from 400mm (Cat-10 to Cat-11)	m	780	$40.00	$31,200.00
	[1, 2]Subtotal Pipe Works				**$1,316,400.00**
	CONSTRUCTION TOTAL				**$1,400,000.00**

Notes: 1. Unit prices for pipe works as provided by City of Surrey.
2. Costs for pipe works include mains, appurtenances, tie-ins, service connections, hydrants, pavement cuts (and restoration), 10% Engineering and 5% allowance for tender increase.
3. Costs do not include any permit, RoW, land acquisition costs, or contingencies.

- Indicates cost difference calculated from Surrey unit costs