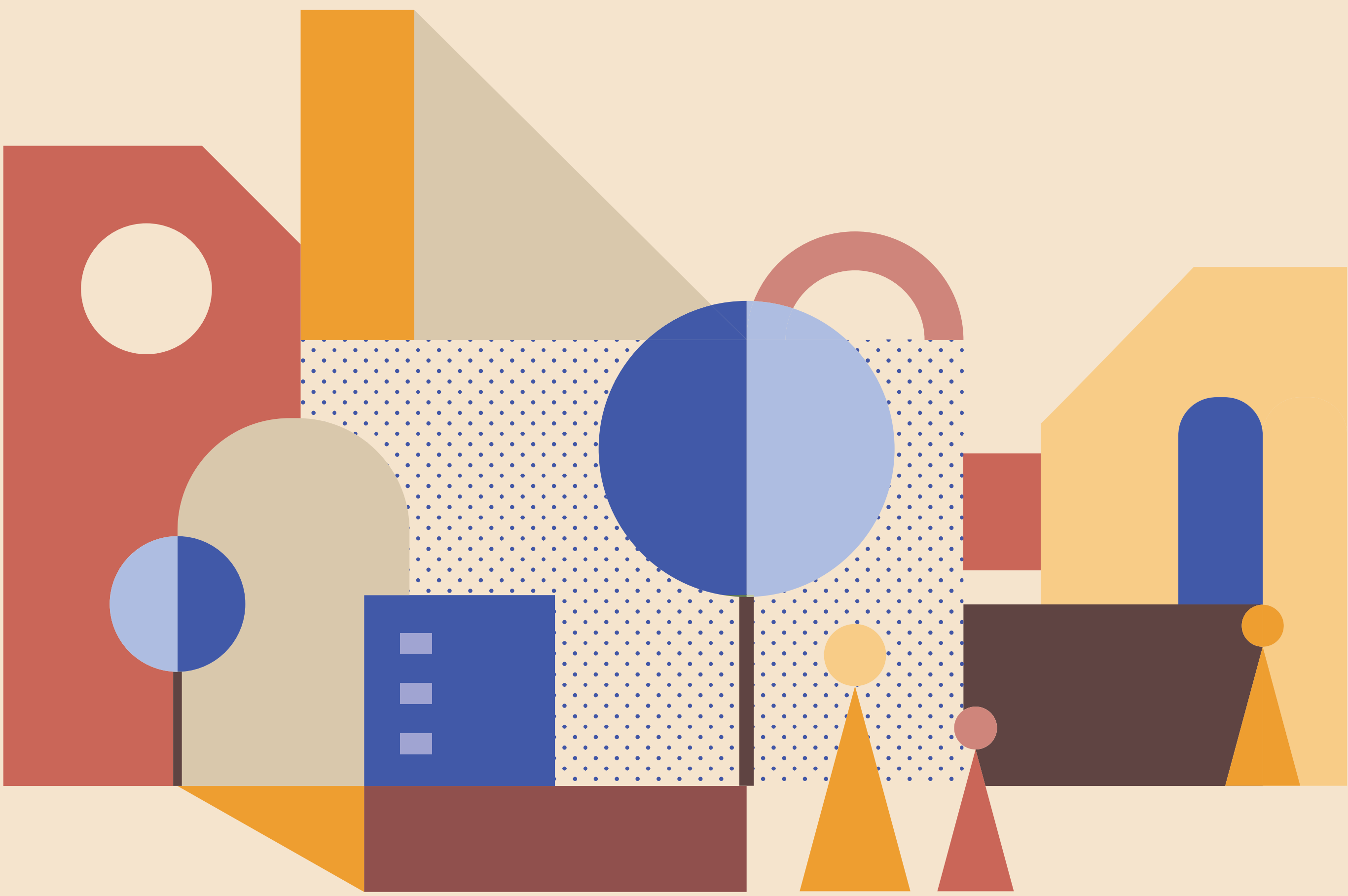
north york at the centre

Servicing Background Report

July 2024



TORONTO

City of Toronto

North York at the Centre – Servicing Background Report

Project Website: toronto.ca/nycentre

LAND ACKNOWLEDGEMENT

We acknowledge that North York Centre is located on lands within the City of Toronto that are the traditional territory of the Anishnabeg, Haudenosaunee and Wendat peoples, and now home to many diverse First Nations, Inuit and Métis peoples. The lands in Toronto where North York Centre is located are covered by Treaty 13 with the Mississaugas of the Credit First Nation.

AFRICAN ANCESTRAL ACKNOWLEDGEMENT

The City of Toronto acknowledges all Treaty peoples – including those who came here as settlers – as migrants either in this generation or in generations past – and those of us who came here involuntarily, particularly those brought to these lands as a result of the Trans-Atlantic Slave Trade and Slavery.
We pay tribute to those ancestors of African origin and descent.

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LIST OF ABBREVIATIONS

Abbreviation	Description
bgs	Below Ground Surface
CB	Catchbasin
CIPP	Cured in Place Pipe
CSO	Combined Sewer Overflow
DWF	Dry Weather Flow
EA	Environmental Assessment
ESA	Environmental Significant Area(s)
FCS	Flow Control Structure(s)
GIS	Geographical Information System
GPS	Global Positioning System
ICI	Industrial/Commercial/Institutional
I&I	Infiltration and Inflow
MH	Maintenance Hole/Manhole(s)
PVC	Polyvinyl Chloride
SAN	Sanitary
SCSO	Sanitary-Combined Sewer Overflow
STM	Storm
STS	Sanitary Trunk Sewer
TIN	Triangulated Irregular Network
TM	Technical Memorandum
TRCA	Toronto Region Conservation Authority
TOR	Terms of Reference
UTM	Universal Transverse Mercator (coordinate system)
WPR	Wastewater Production Rate
WWFMG	Wet Weather Flow Management Guidelines
WWFMP	Wet Weather Flow Master Plan
m	Metre(s)

Abbreviation	Description
mm	Millimetre(s)
m3/y	Cubic Metres per Year
ha	Hectare(s)
L/d	Litres per Day
km	Kilometre(s)
lpcd	Litres per Capita per Day
L/d/ha	Litres per Day per Hectare
L/s/ha	Litres per Second per Hectare

01. Introduction

01. INTRODUCTION

The City of Toronto retained WSP to complete a Secondary Plan Study for the North York Centre, which at its center has the Yonge Street and Sheppard intersection and is roughly bounded by Highway 401 to the south and Drewry Avenue/Cummer Avenue to the north.

This report documents the results of Phase 1 of the Municipal Servicing Background Review for North York at the Centre. The report documents data collection, data review and analysis, and preliminary assessment of water distribution, wastewater collection system, and stormwater conveyance system and storm management (SWM).

The methods by which the main scope items are achieved for each of Water, Wastewater, and the Storm Conveyance System & Storm Management (SWM) may differ slightly, but the overall objective will be the same: complete a background review for each servicing system while identifying boundaries for each study and establish boundary conditions at discharge points and undertake hydraulic analyses to confirm the adequacy of existing municipal servicing infrastructure. These existing conditions studies will inform the identification of deficiencies, constraints, concerns, and opportunities to be presented in a Strength, Weaknesses, Opportunities and Threats (SWOT) analysis.

1.1 Background and Objectives

Having identified system boundaries that are inline with City inputs and technical requirements for each servicing system, the servicing study was carried out to assess the existing major and minor stormwater systems, the sanitary sewerage system, and water distribution system to establish boundary conditions and undertake hydraulic analyses to confirm the adequacy of existing municipal servicing infrastructure. Hydraulic models of each system were compiled and calibrated/validated to available background data and then used to quantify the existing performance of each system. Bottlenecks and capacity constraints were identified for upgrade considerations, while opportunities to support growth were highlighted to be relied on in later phases of North York at the Centre.

1.2 Study Area

The Study Area has five components, including the Primary Study Area defined by the Secondary Plan area's existing boundary, and Complementary Study Areas where the Community Services and Facilities (CS&F) Strategy, Mobility and Public Realm Strategy, Functional Servicing Assessment, and Boundary Expansion assessment will apply.

The Primary Study Area aligns with the boundaries of the North York Centre Secondary Plan and the Urban Growth Centre identified in the provincial Growth Plan, running linearly along Yonge Street from Sheppard Avenue to north of Finch Avenue at Cummer/Drewry Avenue. The CS&F Study Area is bounded by Steeles Avenue to the north, Highway 401 to the south, Bathurst Street to the west and the Bayview Avenue to the east. The Primary Study Area boundaries are shown in **Figure 1-1**.

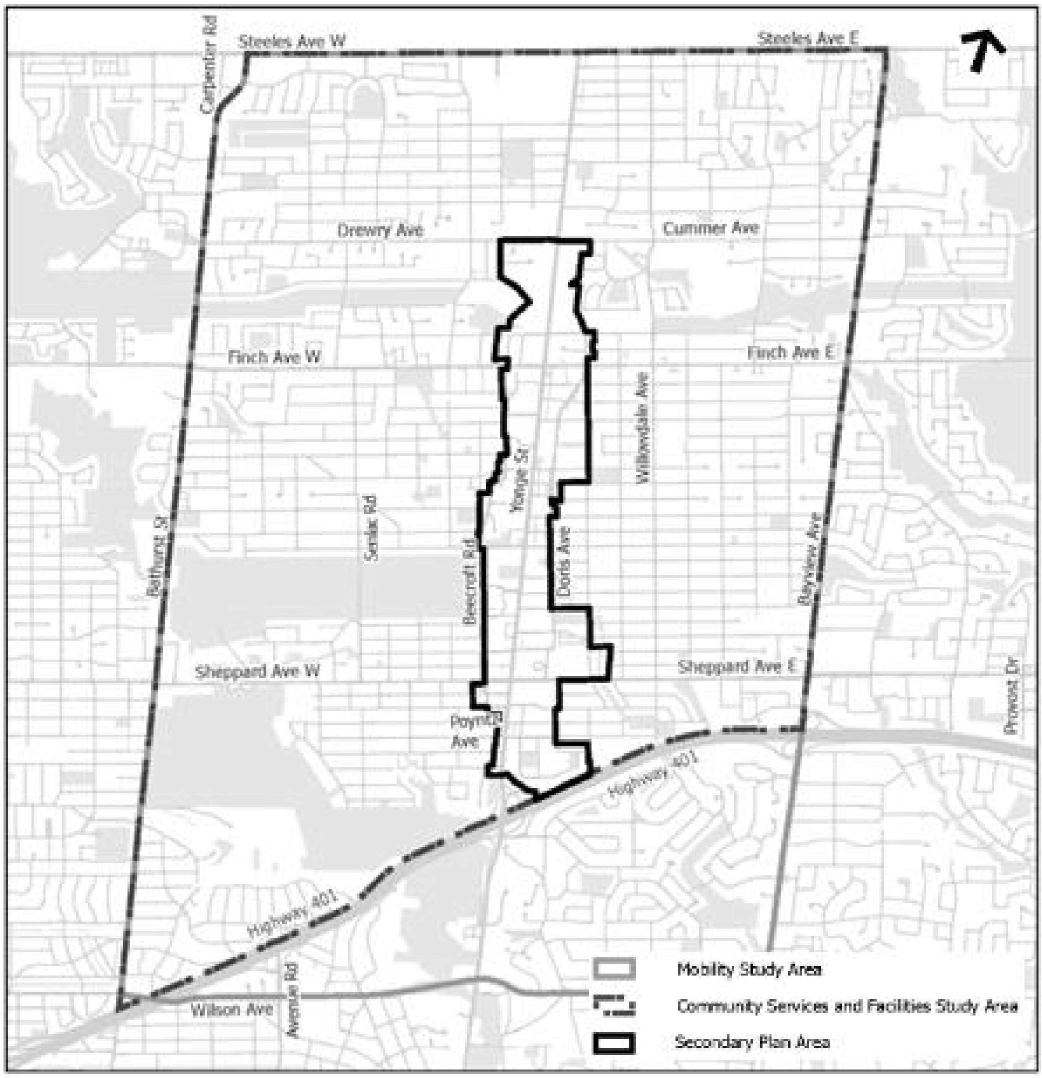

Figure 1-1 Primary Study Area Boundary from the Project RFP

For the purposes of this report, the term “Study Area” refers to Functional Servicing Assessment boundary, which has been defined for the sanitary, storm, and water distribution systems in **Section 2** to **Section 4**, respectively.

1.3 Report Overview

Chapter 2 of the report documents the following components for wastewater collection system:

- Review sewershed specific modelling study areas;
- Collection and review of essential relevant information;
- Review and update existing condition model;
- Evaluate existing system sanitary capacity performance; and
- Identify planned improvements.

Chapter 3 of the report documents the following components for stormwater conveyance system and storm management:

- Review storm drainage study areas;
- Collection and review of essential relevant information;
- Review the existing condition model;
- Evaluate the adequacy of existing storm system; and
- Identify planned improvements.

Chapter 4 of the report documents the water distribution system and study:

- Review of SCADA data for the study area;
- Collection and review of field data for the study area;
- Model build and calibration of stand-alone water hydraulic model; and
- Evaluation of the existing water distribution network performance.

Summary, conclusion, and recommendations for each wastewater collection, stormwater, and water distribution system can be found in **Chapter 5**.

02. Wastewater Conveyance System

02. WASTEWATER CONVEYANCE SYSTEM

2.1 Existing Sanitary Study Area

The study area boundary was delineated primarily by sewershed of the receiving sanitary trunk sewers. Sanitary sewer data for Basement Flooding Area 24, 25, 26, 27, 28 were provided by the City. The sanitary sewershed consists of sewers servicing the secondary plan study area as well as external catchments that drain to/from the study area. Sanitary sewer study area in this report is defined as sewershed excluding the external areas, as shown in red on **Figure 2-1**.

The sanitary sewer study area is within basement flooding Area 26 and Area 28 boundaries. Both these areas are serviced by separate sanitary and storm sewer system. The sanitary sewers within the study area vary in diameter from 200 mm to 1500 mm. **Figure 2-1** illustrates extent of the secondary plan area, sanitary sewer study area, sanitary sewers and the flow direction.

The wastewater from sewers in Area 26, areas south of Finch Street within the study area, flows south towards the Wilket Creek, and Yonge Relief sanitary trunk sewers. The entry point of the trunk sewer is at Yonge Street north of Churchill Avenue. Area 28 sanitary sewers within the sanitary study area are discharging to the Newtonbrook Creek sanitary trunk sewer.

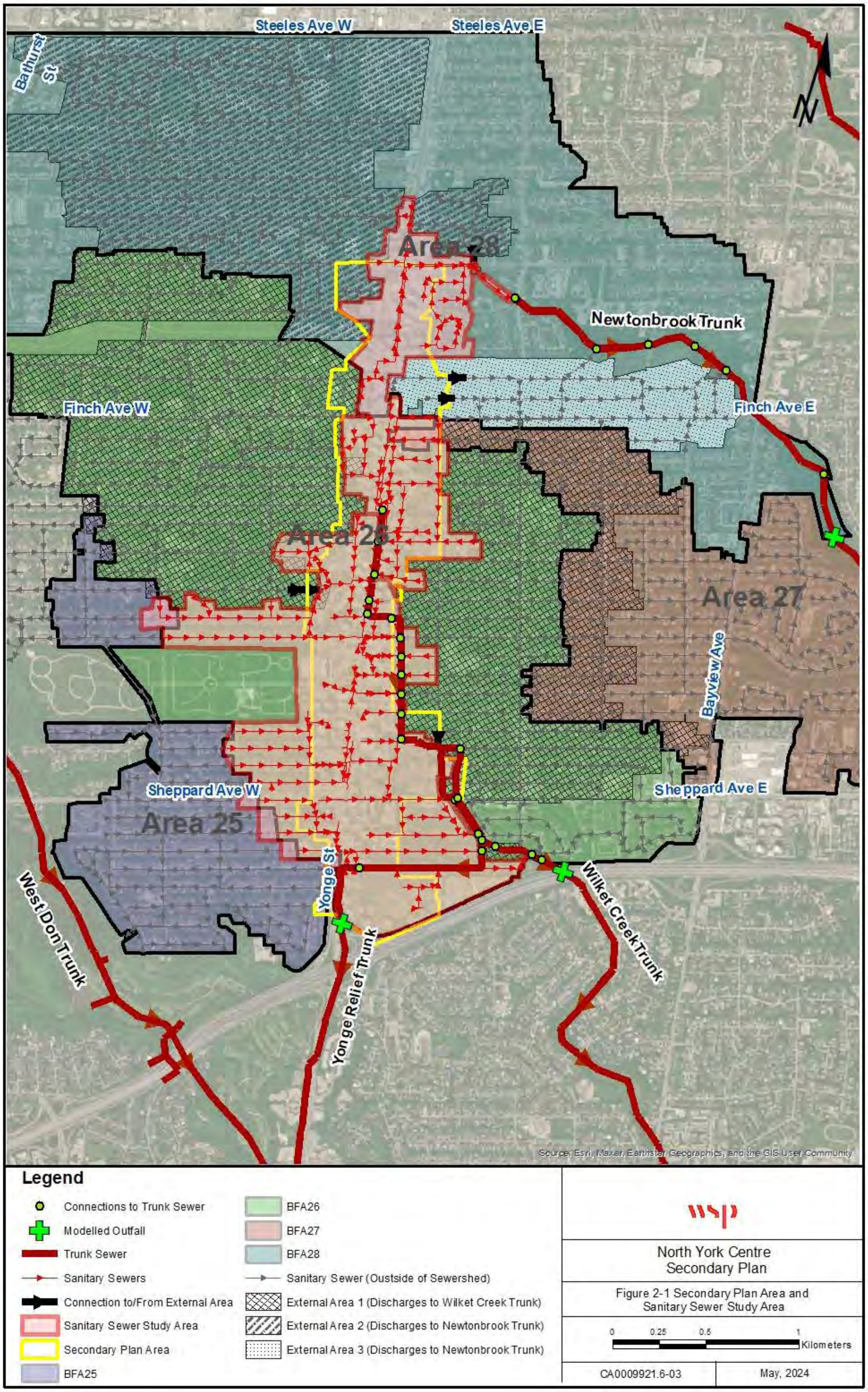

Figure 2-1: Secondary Plan Area and Sanitary Sewer Study Area

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2.2 Data Collection and Review

The relevant data and information for Sanitary Study Area were collected from the City. The collected data and information are used for model updates to assist in interpreting the modelling results for identifying the sanitary system capacity and level of service under existing condition sewer network. This section discusses data available from public records and City including previous studies, investigations, analyses, and reports. It also summarizes the process of data collection, and the review and findings of the essential relevant information.

2.2.1 Sewer Network Data

City provided the physical system data for the sewer system within the sanitary study area in geodatabase format. This information defines the collection system network including pipe geometry such as size, invert, length and slope, as well as other relevant information such as material and construction date. In addition, maintenance hole (manhole, MH) data was provided which included information such as ground elevation and invert elevations. The information available from the collection system datasets (line and point) forms the basis for the model review and update. Information for the sanitary sewer system provided by the City support the update of the hydraulic model.

2.2.2 Baseline InfoWorks Model

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The City provided the existing InfoWorks ICM sanitary system models for Areas 24, 25, 26, 27 as well as the InfoWorks CS model for Area 28. WSP created a consolidated InfoWorks ICM model from the two received models and update the model coordinate system to the most recent coordinate system used by the City (i.e., NAD_1983_CSRS_MTM_10). This consolidated model is used as the baseline in this study and is referred to as the “baseline model” throughout this report. The GIS data is used to validate or update the model, where deemed necessary. The details of the baseline model review and model setup are presented in **Section 2.3**.

2.2.3 Population

2021 census population data were collected and used to update the baseline model population. The 2021 census data is based on parcels enclosed within polygon boundaries in the study area. The provided data include residential and employment data. The servicing population is used to calculate the dry weather flow and is determined based on the land use. **Section 2.3.4** provides additional information on the process of updating the subcatchments in the baseline model to create the updated existing condition scenario, using 2021 data.

2.2.4 Land Use Classification

The land use information is necessary to establish the dry weather flows (DWF) for the sanitary sewer modelling, as sanitary flows are calculated based on population for residential areas and employment/office space for industrial, commercial and institutional (ICI) areas.

Table 2-1 presents a summary of land use classification within the sanitary study area. The land use has been processed based on the sanitary service boundary defined for the study area. The predominant land use is residential which comprises approximately 64% of the service area. The next highest level of land use is ICI with approximately 26% of the service area. The percentage of the open areas is about 10%.

Table 2-1: Land Use Classification

Land Use	Area (ha)	Percentage
Residential	135	63.4%
Industrial, Commercial, and Institutional (ICI)	55	25.8%
Open areas	23	10.8%
Total	213	100%

Note: Landuse classification provided is based on 2021 data.

2.2.5 Infrastructure Improvements and Rehabilitations

The City provided information on the upgrades in the sanitary sewer system and planned infrastructure in the form of Geodatabase "CP.gdb". This information will be used to update the baseline model. Further details on how the sewers were updated in the baseline model for the existing condition scenario are explained in **Section 2.3.3**.

2.2.6 Ortho Photography

The 2022 ortho-imagery was used for the study. The high-resolution ortho-imagery of the study area was found to be generally consistent with the land use data. The ortho-images were used as a reference to assist in defining land use information that was listed as "other", "unknown", etc.

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2.3 Model Updates

The calibrated sanitary models for Areas 24-27 and Area 28 were received from the City of Toronto in transportable database format. The basement flooding Area 24 to 27 model was completed in 2016 and Area 28 model was completed in 2008. Area 26 model was updated later by WSP in PD design models. In 2019, Engineering and Construction Services (ECS) commenced working on the preliminary design of assignments recommended in the Study Area 26 EA Study. During the preliminary design some areas of concerns were identified in the model and recommendations were made to improve the model.

A consolidated baseline model was developed to cover the entire sanitary study area by merging the baseline models for Area 24 to 28. The merged model was then updated to include further changes in Area 26 model as well as the relevant capital projects within the sanitary study area. The "*Existing Condition Mode*l" in this report refers to the baseline model with the updated sewer network and population.

2.3.1 Modeling Software

InfoWorks ICM version 2023.2.3 is used for the existing condition analysis and recommended to be used for entire duration of this project. InfoWorks model incorporates full-solution modelling of open channel and closed pipe networks simulating complex hydraulic conditions of backwater effects and reverse flow, trunk sewers, complex pipe connections and complex auxiliary structures for dual drainage system that connects the overland (major) system and piped (minor) system. InfoWorks hydrologic routine generates wastewater flows, groundwater infiltration (GWI) as well as storm related flows – rainfall dependent infiltration and inflow (RDII).

2.3.2 Model Set Up

Data Flagging

The data flags from the City's baseline model were used to preserve the records of the previous modelling works by the City. To record and track all changes made for this study, new data flags are added as per City Modeling Guideline.

Coordinate System

The projection system for the baseline model is NAD_1983_CSRS_MTM_10. See **Section 2.2.2** for more information.

Simulation Parameters

The simulation parameters in Area 24-27 InfoWorks ICM model provided by the City is maintained and all other simulation parameters follow the software's default values.

2.3.3 Sewer Improvements

Improvements to the sewer systems are defined as any modifications or additions to the sewer system since the original models were developed. The following sources were used to update the sewer network:

- The City provided shapefiles detailing recent sewer rehabilitation and replacement records, including fields indicating the start date and end dates. The assignments that are constructed and other planned improvements were confirmed with the City, and are as illustrated in **Figure 2-2**.
- Area 26 Change Order Number 6 and "RM-021 Review" Technical Memorandum; and
- Sanitary sewer network GIS data.

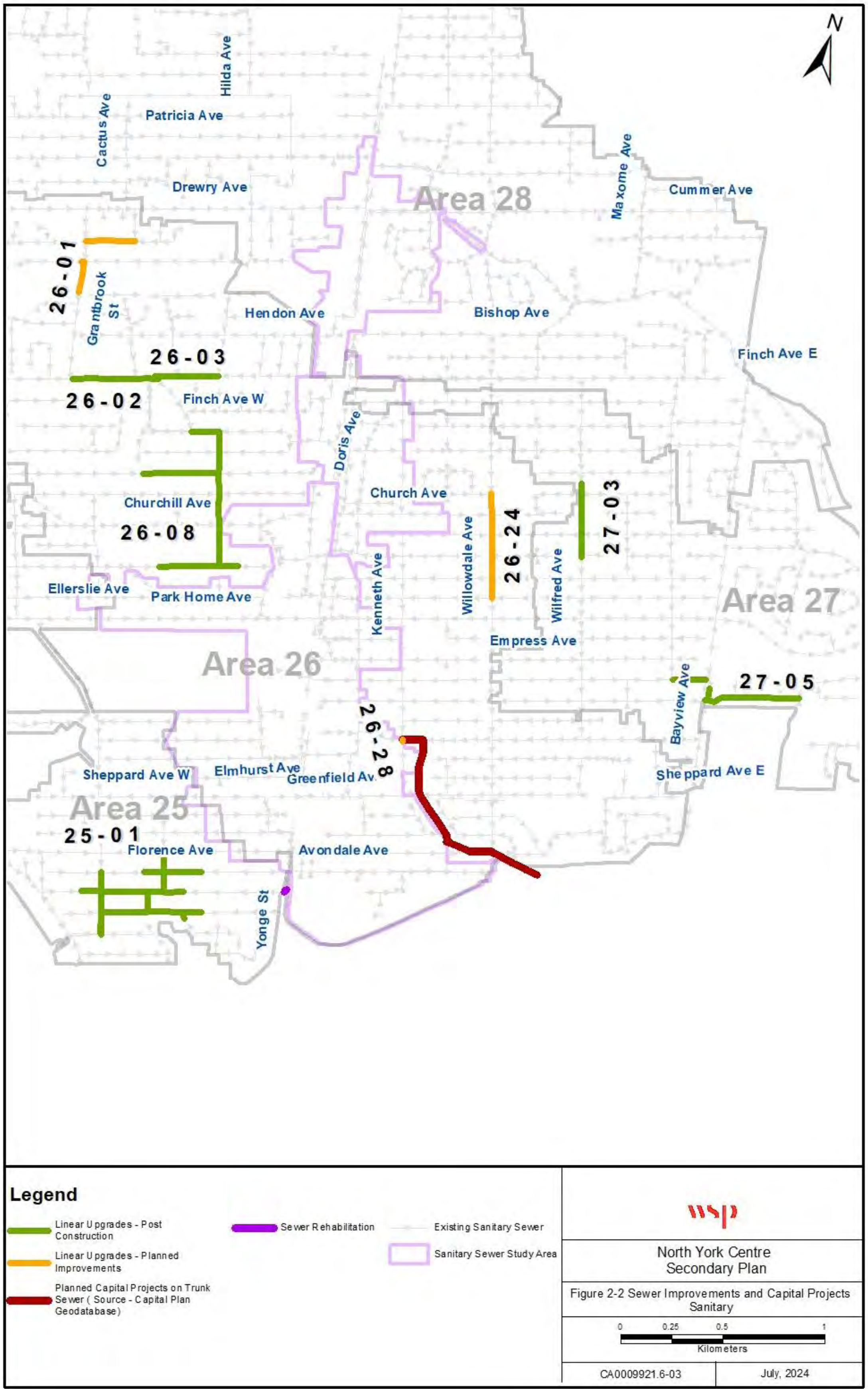

Figure 2-2: Sewer Improvements and Capital Projects – Sanitary

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The sanitary sewer system improvements and updates applied in the model are provided in **Table 2-2**.

Table 2-2: Sanitary Sewer Updates in the Model

Project ID	Description	Location	Source
BFPP 26-02	Upgrade existing 300 – 375 mm diameter sanitary sewer with a 525 mm diameter sanitary sewer	Finch Avenue West	Capital Plan
BFPP 26-03	Upgrade existing 250 mm diameter sanitary sewer with a 300 mm diameter sanitary sewer.	Finch Avenue West	Capital Plan
BFPP 26-08	Upgrade existing sanitary sewers - multiple pipes	Tamworth Road Ellerslie Avenue Hounslow Avenue Holcolm Road	Capital Plan
BFPP 25-01	Upgrade existing sanitary sewers - multiple pipes	South of Florence Avenue	Preliminary Design Upgrades & Capital Plan
BFPP 27-03	Upgrade existing 300-375 mm diameter sanitary sewers with 450 mm diameter sanitary sewers.	Wilfred Avenue	Capital Plan
BFPP 27-05	Upgrade existing 250 mm diameter sanitary sewers with 900 mm diameter sanitary sewers.	Foxwarren Drive	Preliminary Design Upgrades
N/A	Upgrade Wilket Creek Trunk Sewer from 675mm to 750mm	Glendora Park Trail Willowdale Park Trail	Capital Plan
N/A	Missing Sewers in the base model were added	Beecroft Road and Ellerslie Avenue	GIS data
N/A	Missing Sewers in the base model were added	Doris Avenue	GIS data

2.3.4 Subcatchment Modelling

The flow components are modelled using subcatchments in InfoWorks model. As illustrated in **Figure 2-3**, the components of flow in a sanitary sewer system include the following.

- Dry Weather Flow (DWF) in the sewer system consists of sanitary wastewater flow (SWF) and groundwater infiltration (GWI).
  - SWF is the sewage flow resulting from sanitary flow from the residential and ICI population.
  - GWI is the flow that enters the sanitary sewer from foundation drains or cracks along the sewer.
- Wet Weather Flow (WWF): The combination of DWF and RDII components is the WWF. RDII is defined as rainfall dependant infiltration and inflow that enters the wastewater collection system.

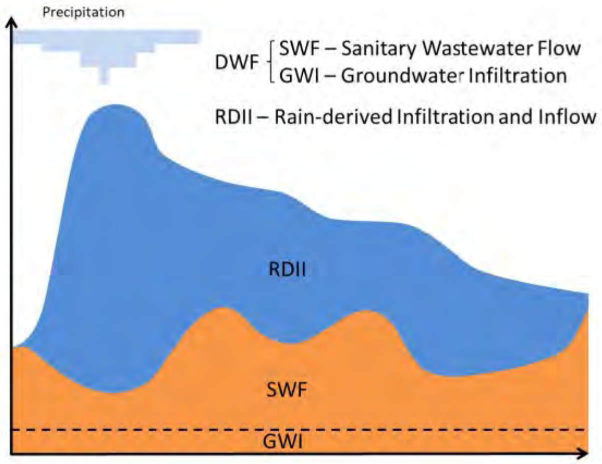

Figure 2-3: Components of Wastewater Flow Hydrograph

Dry Weather Flow

The components of the DWF in the model are baseflow, wastewater profiles and population. The baseflows were obtained from the baseline model. The SWF was modelled using subcatchment population coupled with weekday and weekend wastewater profiles that define the wastewater diurnal patterns and per capita flow rate (Lpcd). The same wastewater profiles as the baseline model were assumed for each subcatchment. The population, however, was updated using the 2021 census data.

The City provided the 2021 residential and ICI population for the census polygon boundaries that cover basement flooding areas 24 to 28. The residential and ICI population data were assigned to the subcatchments in the model according to the land use of the overlapping parcels. To distribute the census population, first the residential population per hectare was calculated for each census polygon. All subcatchments which fall in the residential land use were selected and the population was calculated and assigned to the residential subcatchments based on the subcatchment area and population per hectare of the overlaying census polygon(s). The same approach was used to distribute the employment population to the ICI subcatchments.

A comparison of population in received models and the existing conditions model is tabulated in **Table 2-3**. The total population within the sanitary sewer study area in the existing model is 77,668 which is less than the total population used in the received models. Note that the population polygons provided by the City were on a planning level and not parcel level, hence the distribution was carried out using area-weighted method incorporating land-use. The population densities within the sanitary study area are illustrated in **Figure 2-4**.

Table 2-3: Population Updates in the Model

Source	Residential Population	Employment Population	Total	Comments
Population in EA Models	139,148[1]	44,909	184,057	Total population in the EA model is higher than total population in 2021 Census polygons.
Population in the updated existing condition model[2]	136,054	44,929	180,983	Population in the updated existing condition model[2] distributed based on Land use and Area-weight using 2021 Census polygons. The Distributed population matches the population in received 2021 Census polygons. Note that Census data is on a planning level and not parcel level.
Population in EA Models within sanitary sewer study area	38,785	53,511	92,296	Population in the EA model is higher than total population in received 2021 Census polygons.
Population in the updated existing condition model2 within sanitary sewer study area	25,552	52,116	77,668	Population in the updated existing condition model2 distributed based on Land use and Area-weight using Received 2021 Census polygons. Note that Census data is on a planning level and not parcel level.

Note:

1 Sum of population from catchments with suffix R and population from catchments without any suffix.

2 Updated existing conditions model refers to the model updated with population and landuse data from 2021.

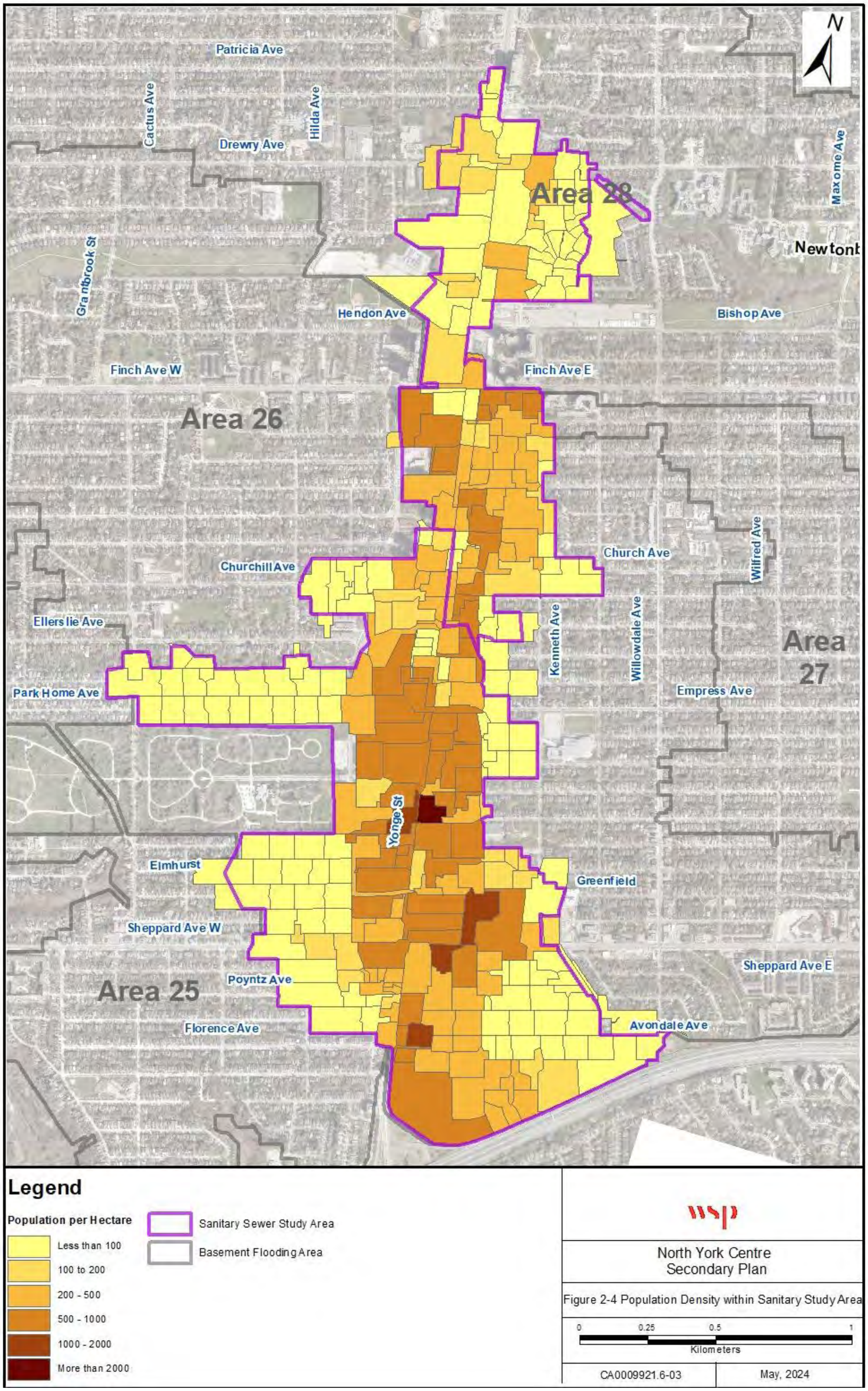

Figure 2-4: Population Density within Sanitary Study Area

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West Weather Flow

As explained above, WWF is defined as the combination of DWF and RDII components that enter the wastewater collection system during rainfall events. The City's baseline models for Area 24 to 28 use Real Time Kinematic (RTK) method to calculate WWF draining from each subcatchment to the sanitary system. The RDII component in the existing model is generated by the same approach. RTK values and contributing areas remain the same as the baseline models. In the areas where additional subcatchments were added to represent the ICI population, the contributing area was set to zero. Therefore, the amount of RDII discharging from each area to the sewer system remains the same as the baseline model.

2.4 Sanitary System Capacity Analysis

The updated InfoWorks model (Existing Condition Model) was used to evaluate the performance of the existing sanitary servicing system. The available capacity of the existing system was assessed to investigate if the system operates under an acceptable level of service during dry-weather flow as well as extreme wet-weather conditions. This section discusses the criteria for the acceptable level of service as well as capacity of the existing system under different conditions.

2.4.1 Acceptable Level of Service

At each maintenance hole, the sewer performance level was evaluated using the water level in the sewer system and ground elevations and categorized into three groups:

- At or above surface level,
- Within basement level (HGL freeboard between 0 m to 1.8 m), and,
- Below basement level (HGL freeboard greater than 1.8 m).

Surcharge state was used to indicate whether the flow rate in the system exceeded the capacity of the sanitary sewer network to the extent that levels rose within manholes at any time during the simulation. Three surcharge state conditions are defined:

- **No Surcharge:** The water level is below the soffit level at both ends of the pipe. In this condition, surcharge state is calculated as the ratio of water depth (d) to pipe height (D).
- **Surcharge by Depth (Backwater Effect):** This condition shows that water level at the upstream or downstream end of the pipe is above the soffit level, and the flow is less than or equal to the pipe's full capacity. Backwater effect, with a reported maximum surcharge state of 1, indicates that there is a downstream capacity constraint.
- **Surcharge by Flow (Bottleneck):** Under this condition, water level at the upstream or downstream end of the pipe is greater than the soffit level, and the flow is greater than the pipe's full capacity. When sewers are surcharged by flow, with reported maximum surcharge state of 2, the pipe is overloaded, and flow exceeds the pipe capacity.

The following level of service (LOS) criteria for the capacity assessment were used under dry-weather and wet-weather conditions.

Dry Weather Condition (DWF)

Sanitary sewer shall operate under free flow conditions (no surcharge).

Extreme Wet Weather Condition

The maximum hydraulic grade line (HGL) of the sanitary system shall be maintained below basement elevation (1.8 m below the ground elevation) during a storm equivalent to the May 12, 2000 storm as gauged at the City's Oriole Yard (Station 102) located at Sheppard Avenue and Leslie Street.

Exception to the Criteria

According to City's Capacity Assessment Guideline, above mentioned criteria may be waived for flat or shallow sewers, or sewer buried in ravines, passing through easements, parks etc., where there is no connection from houses. These exceptions may evolve in later stage and more exceptions may be included based on discussions with City.

2.4.2 Boundary Conditions

Three outfall locations were identified for the sanitary study area as shown in **Figure 2-5**. To obtain the boundary conditions during May 12, 2000 storm, following data were studied,

- Flow monitoring Data: Maximum observed depth at or the nearest flow monitor to the outfall locations.
- City Sanitary Trunk Model results for May 12, 2000 Storm Event: Max flood levels at the outfall locations.

The sanitary boundary conditions used in the model are as listed in **Table 2-4**. The highest of columns 1 and 2 was used as a constant boundary condition for the sanitary model. Free flow is assumed at all outlets during the DWF conditions.

Table 2-4: Sanitary Boundary Conditions for May 12, 2000 Storm Event

Outfall #	Location	Size (mm)	Ground Level (m)	Invert Level (m)	Obvert Level (m)	(1) Max Level from Trunk Model for May 12, 2000 Storm Event (m)	(2) Max Level from Flow Monitoring (m)	Recommended Constant Boundary Condition (m)
1	Outfall to Yonge Relief Trunk, North York Diversion STS (4597912128)	1500	175.898	160.266	161.766	160.795	160.708 (160.266+0.442)	160.795
2	Outfall to Wilket Creek STS (4659113180)	750*	167.59	161.33	162.08	164.468	162.292** (161.33+0.962)	164.468
3	Outfall to Newtonbrook STS (4872414044)	675	150.145	144.96	145.635	146.044	147.623*** (144.96+2.663)	147.623

Note:
*The Capital Plan GIS data provided by the City states the 675mm trunk will be upgraded to 750mm under SWR_TRUNK Program (2019-2021), hence 750mm is assumed as the current existing size.
*Interpolated based on observed max surcharged depth of 0.962m recorded at upstream flow monitoring location 600 m away
***Interpolated based on observed max surcharged depth of 2.663 m recorded at downstream flow monitoring location 500 m away

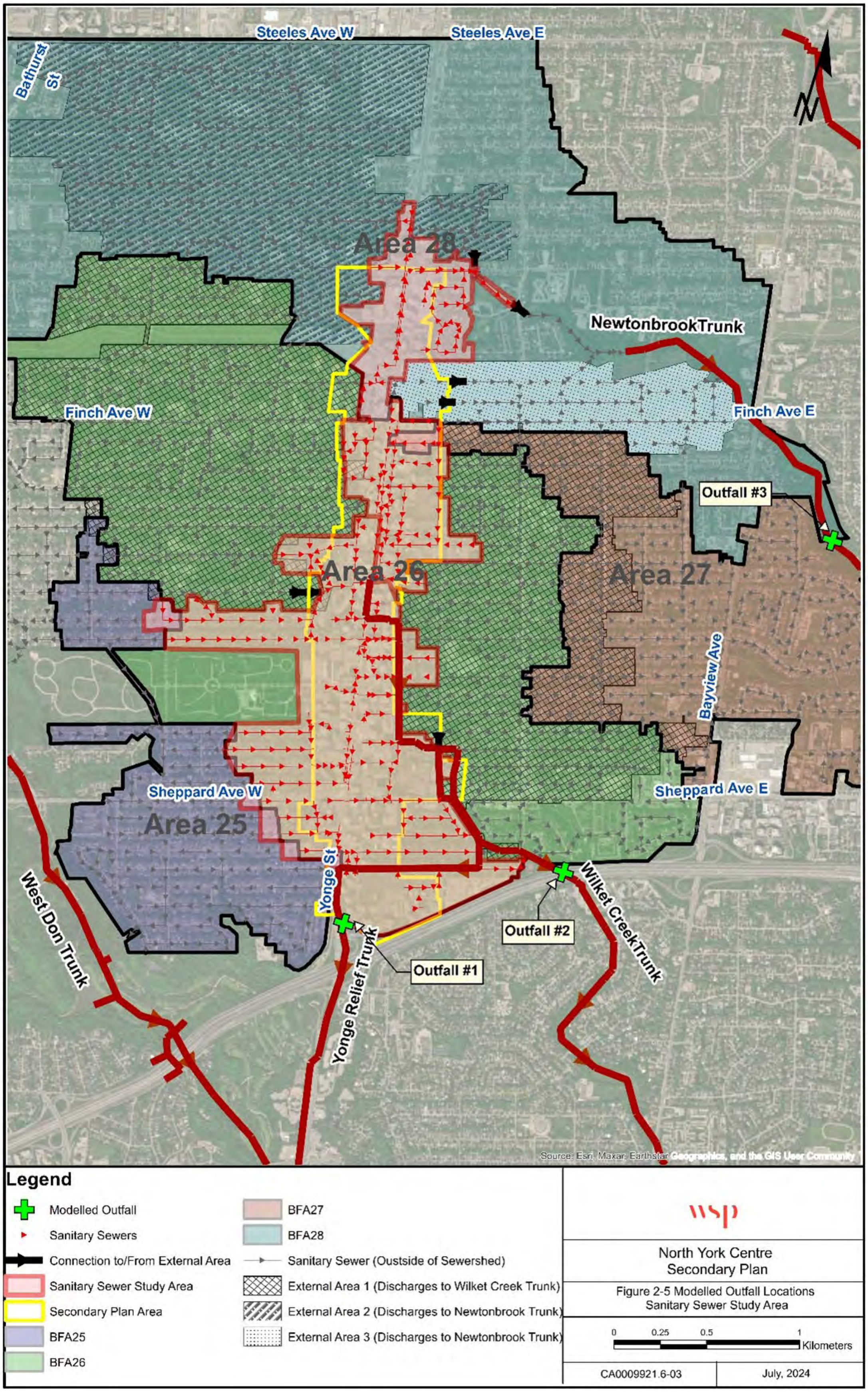

Figure 2-5: Modelled Outfall Locations - Sanitary Sewer Study Area

2.4.3 Sanitary System Performance Under DWF Conditions

The performance results of the existing condition sanitary sewer system under the dry weather condition are shown in **Figure 2-6**. No surcharge is observed within the sanitary study area during DWF conditions, and all sewers are operating under free flow. Note that, as mentioned in the previous section, free flow is assumed at the outlet during the DWF conditions.

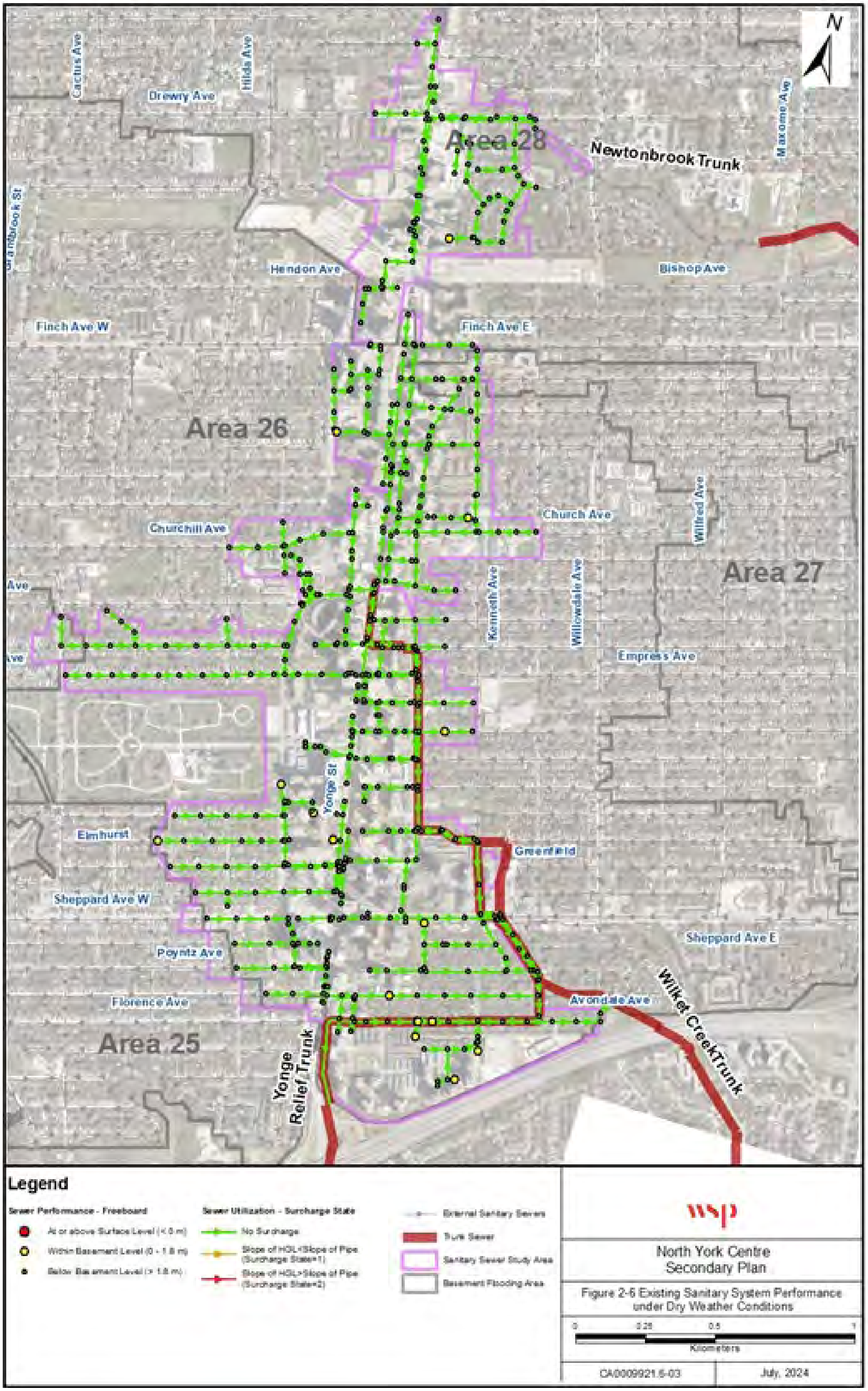

Figure 2-6: Existing Sanitary System Performance under Dry Weather Conditions

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2.4.4 Sanitary System Capacity Analysis Under WWF Conditions

To evaluate system performance against the basement flooding design criteria, the May 12, 2000 storm event as measured at Oriole Yard station was simulated to evaluate performance of the existing sanitary sewer system. Based on the results of the analysis, the potential risk of basement flooding was considered if HGL in the sanitary sewer is less than 1.8 m below the surface elevation, which is the assumed basement elevation for homes with direct basement connections to the sanitary sewer.

Summary of the sanitary sewer performance is presented in **Table 2-5**. According to the model results, acceptable level of service is not met during the existing condition in 17 shallow manholes scattered in the study area, mostly located south of Shepperd Avenue east of Yonge Street. While the model results shows that the sewers connected to these pipes are not surcharging during the extreme WWF conditions, City's criteria mentions that these shallow sewers should be lowered to at least 1.8 m below ground if feasible.

Sewer surcharging (i.e., backwater or bottleneck) is observed on Ellerslie Avenue, Parkview Avenue, Empress Avenue, Kingsdale Avenue, Greenfield Avenue, Beecroft Road north of Park Home Avenue, Churchill Avenue, and Keneth Avenue. Surcharging is also observed upstream of the outfall to Yonge Relief Trunk on Avondale Avenue, due to the water level in the outlet trunk. The performance results of the sanitary sewer system under May 12, 2000 storm event are shown in **Figure 2-7**.

As part of this servicing study, the sanitary model was updated with latest sewer network data, population, landuse and boundary conditions. No significant deviations were observed from EA except at the following locations,

- Beecroft Road - This was not modelled during the EA study.
- Wilket Creek STS along Glendora Park Trail - During EA, a constant level of 163m was used as boundary condition. However, during this study, as discussed and agreed with the City, a boundary condition of 164.468m is used at the modelled outfall on Wilket Creek. This was the maximum depth observed in the trunk during available flow monitoring period.

Table 2-5: Sanitary Sewer System Performance Summary Under extreme WWF Conditions

Design Event	Freeboard (No. of Manholes)			Surcharge State (No. of Pipes)		
	At or Above Surface Level	Within Basement Level	Below Basement Level	No Surcharge (Surcharge State < 1)	Slope of HGL < Slope of Pipe (Surcharge State = 1)	Slope of HGL > Slope of Pipe (Surcharge State = 2)
May 12, 2000	5	35	507	481	60	20

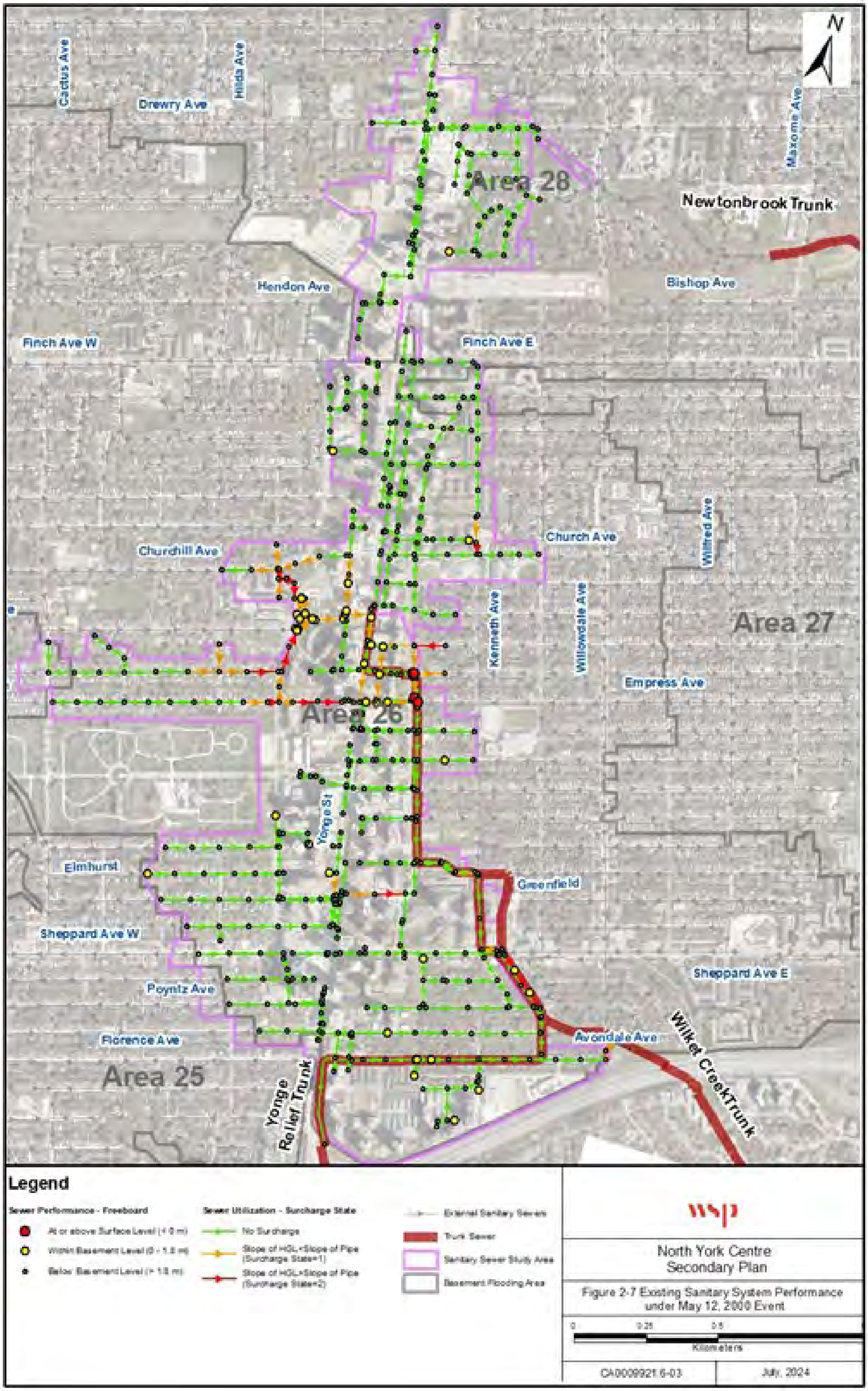

Figure 2-7: Existing Sanitary System Performance under May 12, 2000 Event

2.4.5 Trunk System Capacity

The performance results of the sanitary trunk sewers under May 12, 2000 storm event are shown in **Figure 2-8**. Backflow is observed in Wilket Creek. Other than the backflow from the outlets, surcharge by flow (bottleneck) is observed in the Wilket Creek Trunk on Glendora Park Trail, south of Sheppard Avenue East. Also, freeboard less than 1.8 m was observed on Willowdale Park Trail south of Spring Garden Avenue and on Glendora Park Trail south of Shepperd Avenue. No flooding is observed on Newtonbrook STS and on Yonge Relief Trunk. Surcharge by flow is observed at three sections of Newtonbrook Trunk, south and north of Cummer Avenue.

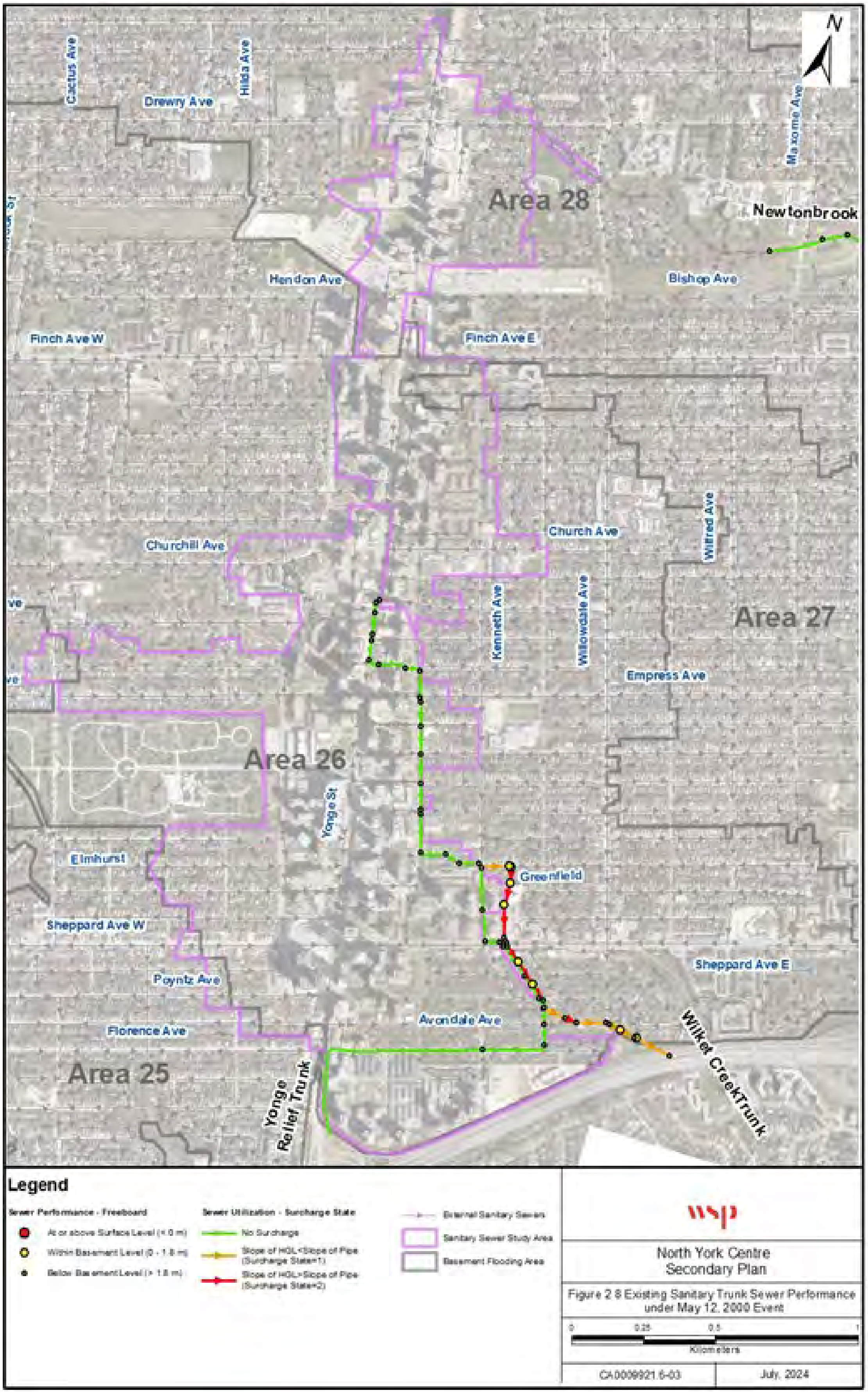

Figure 2-8: Existing Sanitary Trunk Sewer Performance under May 12, 2000 Event

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2.5 Assumptions and Limitations

Area 24-28 models were merged to develop the Existing Condition Sanitary Model. The following assumptions were made during model development.

- The missing sewer network was added based on GIS data. Locations where rim-elevations were unavailable were inferred from DEM and missing inverts were inferred using inference tool.
- Capital plan improvements were incorporated in the model. This data included only the sewer sizes and not inverts. Hence updates were made for sewer sizes maintaining the inverts as-is.
- Population data was available on a planning boundary level. Hence it was distributed based on available land use data and area-weighted method.
- The sewer network data in Area 24-27 is assumed to precede the sewer network data in Area 28. At overlaps/interfaces between the areas, the network in Area 24-27 is retained.
- The simulation parameters from Area 24-27 model were used for this analysis.
- Considering the assumptions made for population, the model developed and used in this report is only prepared for the purpose of this study and should not be used for other purposes.

The model is limited by the available data and assumptions made based on best professional judgment. Throughout the development process, every effort has been made to document assumptions and to base assumed parameters on available documentation, guidance and experience. However, there are some inherent limitations with this model, as outlined below:

- The wastewater generation rates and diurnal patterns were maintained as in the received models. The recent changes, if any, within the study area were not taken into account.
- Population data was available on a planning boundary level. The assessment can be improved if the data is available on parcel level.
- The ground elevations in the received models were maintained as-is. The rim-elevations at shallow manholes shall be verified with as-built or field data.
- The model was calibrated and validated during the EA and it is recommended to validate the model against recent flow monitoring data

2.6 Planned Improvements

Planned improvements within BFPP 26-01, 26-24 and 26-28 will be included in the future condition model in Phase 2 of the study. See **Table 2-6** the details of these projects.

Table 2-6: Planned Improvements – Sanitary

Project ID	Description	Location	Source
BFPP 26-01	Upgrade existing sanitary sewer inverts.	Charlton Blvd	Preliminary Design Upgrades
	Upgrade existing 250 mm diameter sanitary sewer with 300-375 mm diameter sanitary sewer.	Tefley Road	Capital Plan
	Upgrade existing 350 mm diameter sanitary sewer with a 450 mm diameter sanitary sewer.	Grantbrook Street	Capital Plan
BFPP 26-24	Upgrade existing sanitary sewers to inline storage of size 3000mm width x 1800mm height.	Willowdale Avenue	Preliminary Design Upgrades
BFPP 26-28	Propose new 900mm sanitary sewer.	Kenneth Avenue	Preliminary Design Upgrades

03. Storm System

03. STORM SYSTEM

3.1 Existing Storm Sewer System

Storm sewer data of Basement Flooding Areas 24, 25, 26, 27, and Basement Flooding Area 28 were provided by the City and used to delineate watersheds of the receiving outfalls to cover the entire secondary plan area. The delineated watershed, with catchments within basement flooding areas 26 and 28, consists of sewers servicing the secondary plan study area as well as external catchments that drain to/from the study area. The storm system study area in this report is defined as the delineated watershed excluding the external areas. **Figure 3-1** displays the secondary plan area, storm system study area, external areas, and outfall locations. The figure also shows the storm sewers and flow direction within the study area.

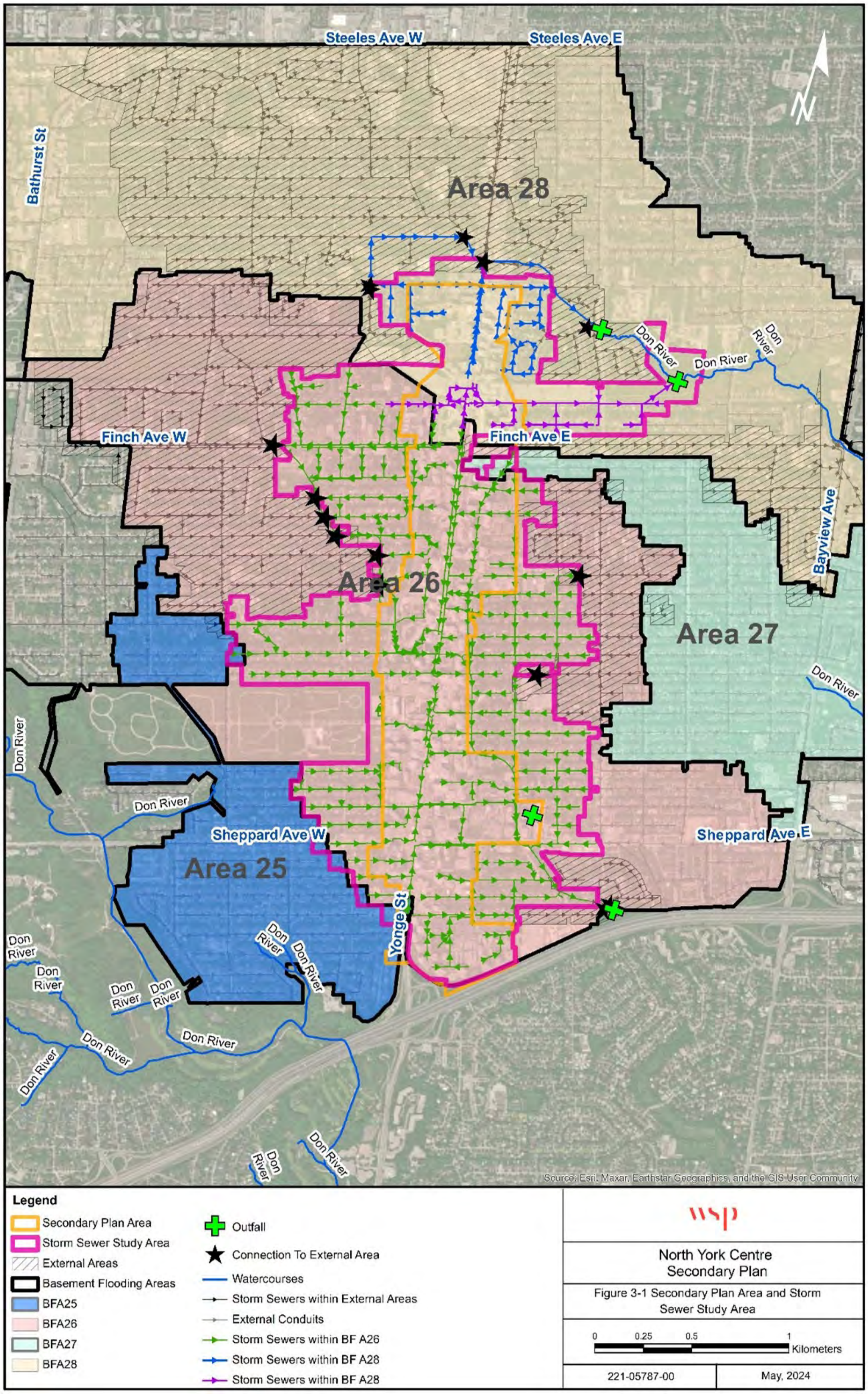

Figure 3-1: Secondary Plan Area and Storm Sewer Study Area

03

3.2 Data Collection and Review

This section discusses the data related to the storm system, including the sewer network data, baseline model, and other supporting GIS data and describes how the data was used in the study. The collected data and information are used for model updates.

3.2.1 Physical & Sewer Network Data

City provided the physical system data for the storm sewer system. This information defines the collection system network including pipe geometry such as size, invert, length and slope, as well as other relevant information such as material and construction date. In addition, maintenance hole (manhole, MH) data was provided which included information such as ground elevation and invert elevations. The information available from the collection system datasets was used for the model review and update.

3.2.2 Baseline InfoWorks Model

The City provided the existing InfoWorks ICM storm system model for Areas 24, 25, 26, 27, and InfoWorks CS model for Area 28. WSP created a consolidated model from the received models in NAD_1983_CSRS_MTM_10 coordinate system to be consistent with the sewer network and other GIS data provided by the City. This consolidated model is used as the baseline in this study and is referred to as the “baseline storm model” throughout this report. The details of the baseline model review and model setup are presented in **Section 3.3**.

3.2.3 Ortho Photography

The 2022 ortho-imagery was used for the study. The high-resolution ortho-imagery of the study area was found to be generally consistent with the land use data. The ortho-images were used as a reference to assist in defining land use information that was listed as “other”, “unknown”, etc.

3.2.4 Sewer System Improvements and Rehabilitations

City’s provided upgrades in the storm sewer system and planned infrastructure in the form of Geodatabase “CP.gdb”. This information will be used to update the baseline model. Further details on how the sewers were updated in the baseline model for the existing condition scenario are explained in **Section 3.3.3**.

3.3 Model Updates

The calibrated storm models for Areas 24 to 28 were received from the City of Toronto in transportable database format. The basement flooding Area 24 to 27 model was completed in 2016 and Area 28 model was completed in 2008. Area 26 Model was updated later by WSP in PD design models. In 2019, Engineering and Construction Services (ECS) commenced working on the preliminary design of assignments recommended in the Study Area 26 EA Study. During the preliminary design some areas of concerns were identified in the model and recommendations were made to improve the model.

A consolidated baseline model was developed to cover the entire storm study area by merging the baseline models. Manholes and sewers at the boundary of the standalone models were validated against the GIS data and duplicated pipes and manholes were removed. Also, overlapping subcatchments in the boundary of Area 28 and Area 26 and 27 were reviewed and adjustments were made using Ortho data, as required. The merged model was then updated to include further updates in Area 26 model as well as the relevant capital projects within the storm study area. The "*Existing Condition Storm Model*" in this report refers to the consolidated model with the updated storm sewer network and subcatchments.

3.3.1 Modeling Software

Similar to sanitary model, InfoWorks ICM version 2023.2.3 is used for the existing condition analysis and recommended to be used for entire duration of this project.

3.3.2 Model Set Up

Data Flagging

The data flags from the City's baseline model were used to preserve the records of the previous modelling works by the City. To record and track all changes made for this study, new data flags are added as per City Modeling Guideline.

Coordinate System

The projection system for the baseline model is NAD_1983_CSRS_MTM_10.

Simulation Parameters

The simulation parameters in Area 24-27 InfoWorks ICM model provided by the City is maintained and all other simulation parameters follow the software's default values.

3.3.3 Sewer Improvements

Improvements to the sewer systems are defined as any modifications or additions to the sewer system since the original models were developed. The City provided shapefiles detailing recent sewer rehabilitation and replacement records, including fields indicating the start date and end dates. The assignments that are constructed were confirmed with the City. Additionally, the information from Area 26 Change Order Number 6, "RM-021 Review" technical memorandum, and sewer network GIS data were used to update the model to reflect the recent improvements in the system. **Figure 3-2** shows the locations of the sewer rehabilitation/replacement works that have been completed. **Table 3-1** summarizes the details provided in the records for sewer system improvements with respect to sewer replacements/upsizing.

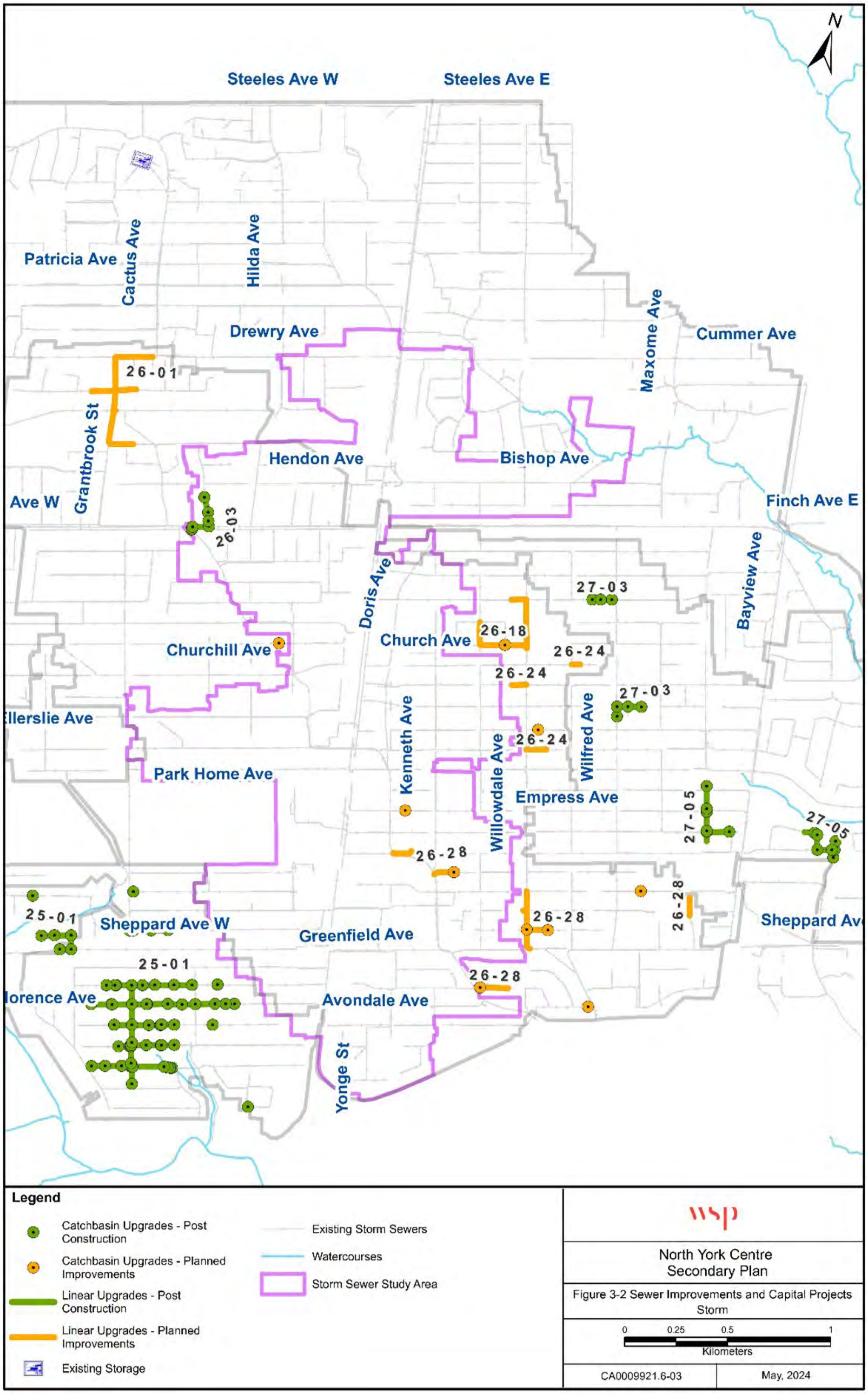

Figure 3-2: Sewer Improvements and Capital Projects – Storm

Table 3-1: Storm Sewer Updates in the Model

Project ID	Description	Location	Source
26-03	Upgrades existing storm sewer to 750mm.	Altamont Road	Capital Plan
25-01	Upgrades existing storm sewers – multiple sewers.	South of Florence Avenue	Capital Plan and Preliminary Design Upgrades
27-03	Upgrade existing 300 mm diameter storm sewer with a 375 mm diameter storm sewer.	Wedgeport	Capital Plan and Preliminary Design Upgrades
27-05	Upgrade existing 375 mm diameter storm sewer with a 450 mm diameter storm sewer.	Estelle Avenue Milgate Cresent	Capital Plan and Preliminary Design Upgrades
Other	Catch basin upgrades, ICDs, HIC.	Multiple	Capital Plan and Preliminary Design Upgrades

03

3.3.4 Subcatchment Modeling

The flow components are modelled using subcatchments in the model. Subcatchments in the consolidated storm model consist of one or more runoff surfaces representing impervious areas, connected roofs, disconnected roofs, and pervious areas. The model uses the following methods to calculate wet weather flow (WWF) draining from each subcatchment to the storm system:

- To determine how much of the rainfall runs off the catchment into the storm system, Horton and Fixed Runoff Volume Models are used for pervious and impervious surfaces, respectively.
- To determine how quickly rainfall enters the storm system from the subcatchments, SWMM Routing Model is used. The SWMM runoff module requires the specification of runoff surface types and the basic hydrologic parameters for each type of runoff surface.

3.4 Storm System Capacity Analysis

The Existing Condition Storm Model was used to evaluate the performance of the existing minor and major storm systems. The available capacity of the existing system is assessed to investigate if the system operates under an acceptable level of service during the design storms. This section discusses the criteria for the acceptable level of service as well as existing system capacity under different conditions.

3.4.1 Acceptable Level of Service

Storm Sewer System (Minor System)

The 2- and 100-year Chicago design storm events are used to simulate and evaluate the performance of the existing storm sewer system. Based on the results of the analysis in terms of water level in the sewer system, the acceptable level of service is defined as following:

- The sewer system does not surcharge under 2-year design storm,
- Under 100-year design storm, HGL in the storm sewer is less than 1.8 m below the surface elevation, which is the assumed basement elevation for homes with direct basement connections to the storm sewer; and,
- No surcharge level is acceptable for shallow sewers under 100-year design storm.

Overland Flow (Major System)

The level of service used in EA study was also used to evaluate the performance of the overland flow in this report. The overland depth under the City's 100-year design storm must meet the following criteria. This level of service may be updated for Phase 2 based on discussions with City.

Surface water level do not exceed the surface elevation (gutter elevation) by more than 300mm.

3.4.2 Boundary Conditions

Four outfall locations were identified for the storm study area as shown in **Figure 3-3**. The field survey data from EA studies and TRCA Hec-RAS model results were reviewed to obtain the boundary conditions at these locations.

The storm boundary conditions used in the model are as listed in **Table 3-2**.

Table 3-2: Storm Boundary Conditions for 100yr and 2yr Design Storms

Outfall #	Location	Size (mm)	Ground Level (m)	Invert Level (m)	Obvert Level (m)	Boundary Condition 100yr (m)	Boundary Condition 2yr (m)	Notes
1	North of Highway 401, near Glendora Ave and Avondale Ave (4658513017)	4724 x 4039	169.092	157.47	161.509	Free Flow	Free Flow	This is a dummy outfall. Outfall location is at a higher elevation and is 2.3kms away from the flood lines of Wilket Creek where it ultimately drains to. Hence, free outfall condition is assumed at this location.
2	Silverview Dr, East of Willowdale Ave (4941912085)	3000 x 2250	185.312	178.99	181.24	181.02	180.04	Flood levels obtained from TRCA Hec-Ras steady flow simulations.
3	North of Bishop Ave near Hydro-corridor (4927712537)	1650	176.932	174.624	176.274	175.46	Free Flow	Flood levels obtained from TRCA Hec-Ras steady flow simulations.
4	East of Kenneth Ave, North of Sheppard Ave E (4692612473)	375	169.308	167.216	167.59	Free Flow	Free Flow	This is a local outfall on Willowdale park trail. Free outfall condition is assumed at this location.

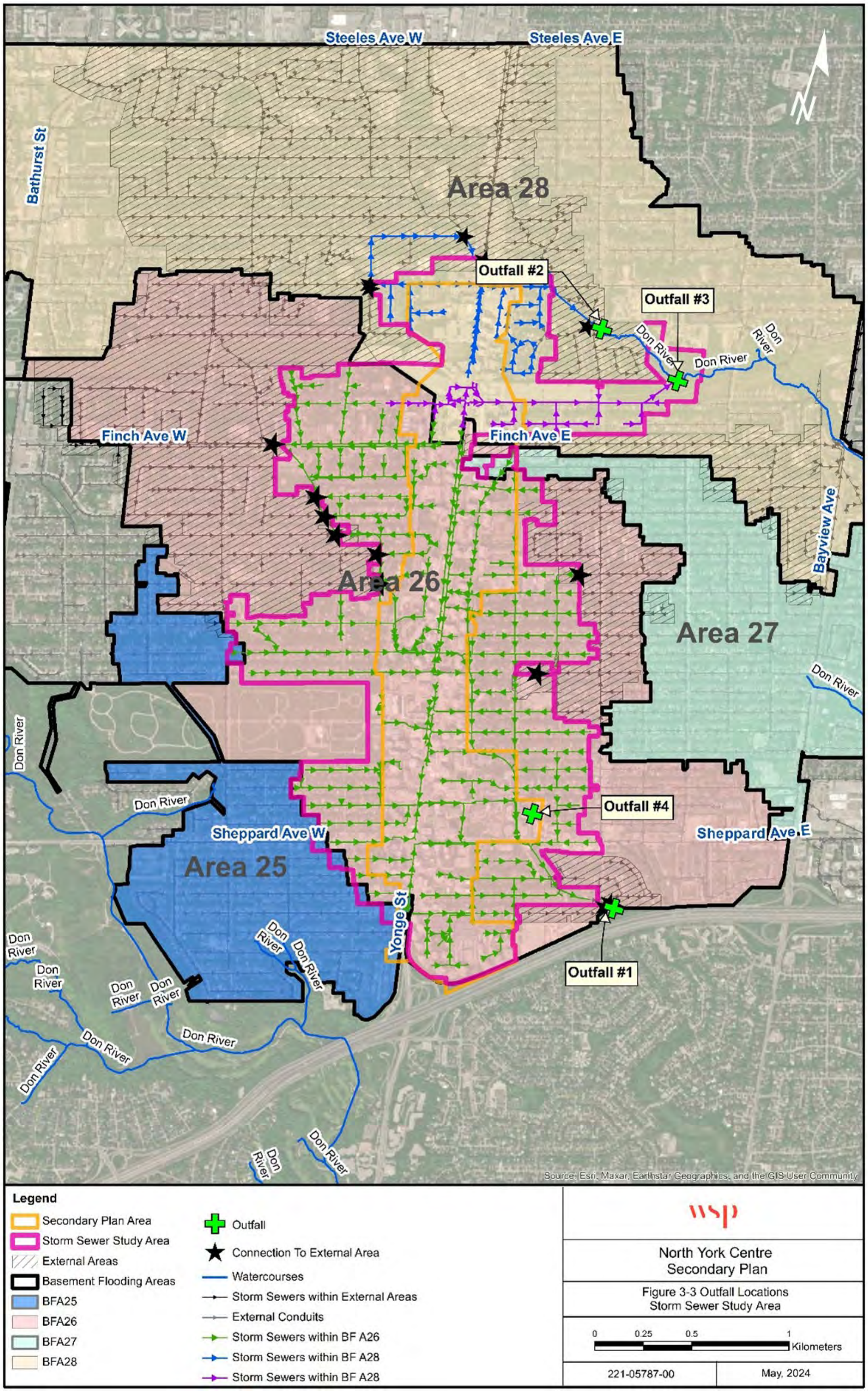

Figure 3-3: Outfall Locations – Storm Sewer Study Area

3.4.3 Minor System Performance Analysis

The performance of the existing storm system was first simulated under the 2-year Chicago design storm to evaluate if the system runs under free flow. The 100-year Chicago design storm event was then simulated to evaluate performance of the existing storm sewer system against the basement flooding design criteria. Based on the results of the analysis in terms of water level in the sewer system, the potential of basement flooding was considered if:

- HGL in the storm sewer is less than 1.8 m below the surface elevation, which is the assumed basement elevation for homes with direct basement connections to the storm sewer.
- Pipe is surcharged with surcharge states of 1 or 2 in case of a shallow storm sewer. A surcharge state of 1 indicates sewer backup as a result of capacity constraints in the downstream pipe(s), and a surcharge state of 2 indicates the pipe is overloaded and flow exceeds the capacity.

Figure 3-4 and **Figure 3-5** illustrate the performance of the storm sewer system within the study area under 2- and 100-year design storm events, respectively. At each maintenance hole, HGL freeboard (i.e. distance between ground level and water level in the sewer system) was calculated and categorized into three (3) groups: at or above surface level, within basement level, and below basement level. Similarly, surcharge state of each pipe was reported and categorized into three groups: no surcharge (free flow; state <1), surcharge by depth (state =1) and surcharge by flow (state =2).

As shown in **Figure 3-4** the storm sewers did not meet the free flow criteria under the 2-year design storm were mainly laterals and one siphon on North York Boulevard.

Figure 3-5 shows the results under the 100-year design storm. As summarized in **Table 3-3**, model predicted that potential basement flooding could occur in 89 locations in storm sewer system under a 100-year design storm, including 10 locations where the HGL is at or above surface level and 79 locations where HGL is below surface but within basement level. Model also predicted that 86 storm pipes could be surcharging by depth (i.e. downstream constraint and backwater effects) and 89 of the pipes could be surcharging by flow (i.e. capacity constraint) under 100-year design storm.

Areas where the design criteria are not met include the following:

- Residential areas north of Hendon Avenue, south of Drewery Avenue on both sides of Yonge Street;
- Residential areas near Silverview Drive
- Residential and ICI areas in Hendon Avenue and Yonge Street
- Residential and ICI areas near Bishop Avenue and Yonge Street;
- Scattered areas on Santa Barbara Road and Basswood Road, and Church Avenue;
- Park Home Avenue and Yonge Street;
- Betty Ann Drive, west of Beecroft Road;
- Scattered Areas on Hollywood Avenue and Elmwood Avenue east and west of Kenneth Avenue;
- Sheppard Avenue and Yonge Street to Doris Avenue on east and Elmhurst Avenue to the north;

- Residential areas on Maplehurst Avenue and Oakburn Crescent; and
- Scattered locations on Yonge Street

As part of this servicing study, the storm model was updated with latest sewer network data and boundary conditions. No significant deviations were observed from EA except at Yonge Street near Sheppard Avenue, Sheppard Avenue West and East, Maplehurst Avenue, and Avondale Avenue. The deviations in results can be attributed to the recent upgrades in the storm network.

Table 3-3: Storm Sewer System Performance Summary

Design Event	Freeboard (No. of Manholes)*			Surcharge State (No. of Pipes)		
	At or Above Surface Level	Within Basement Level	Below Basement Level	No Surcharge (Surcharge State < 1)	Slope of HGL < Slope of Pipe (Surcharge State = 1)	Slope of HGL > Slope of Pipe (Surcharge State = 2)
2-Year	0	29	631	889	12	14
100-Year	10	79	615	740	86	89

*Note: Shallow manholes which are connected to pipes with free flow are excluded.

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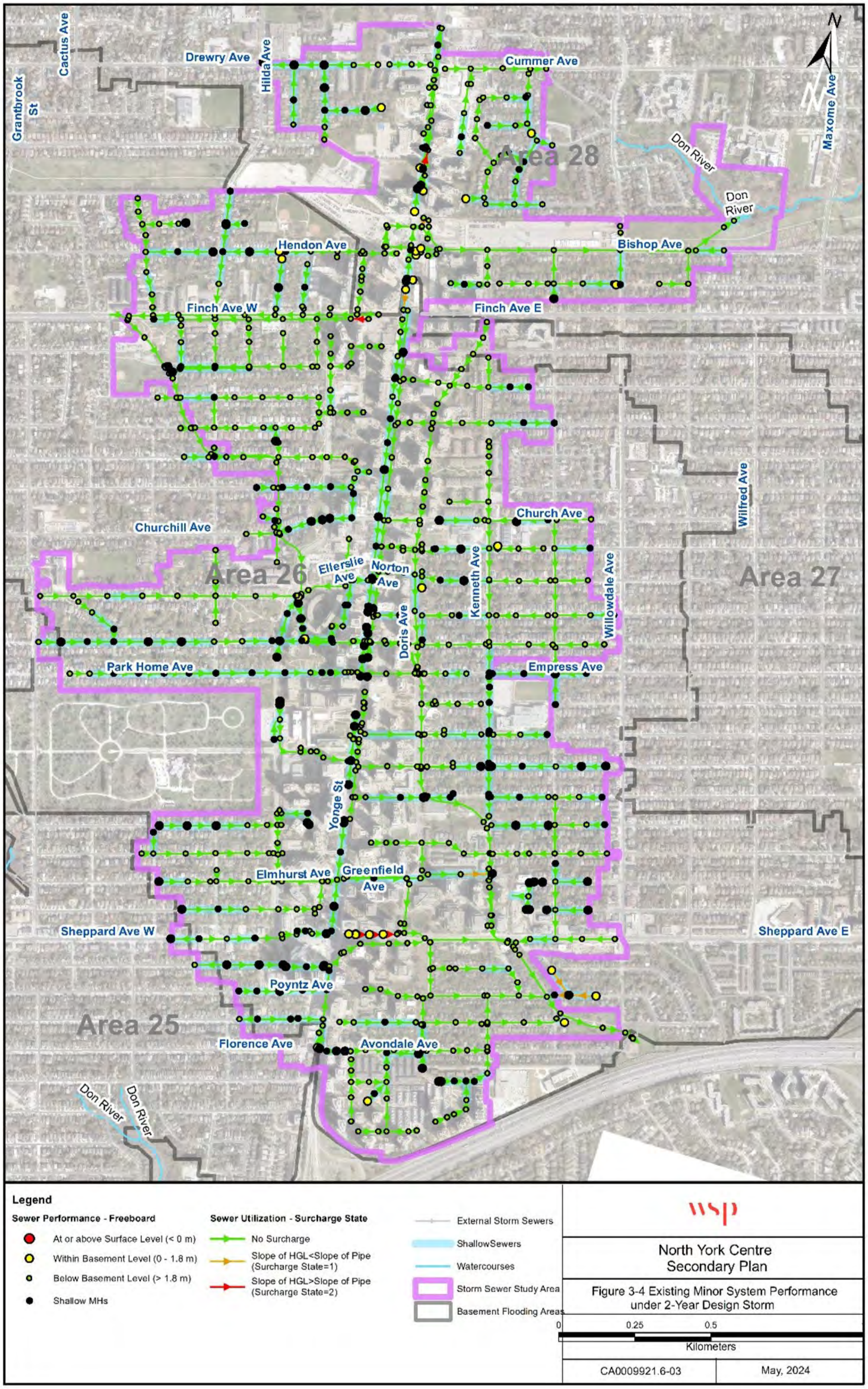

Figure 3-4: Existing Minor System Performance Under 2-Year Design Storm

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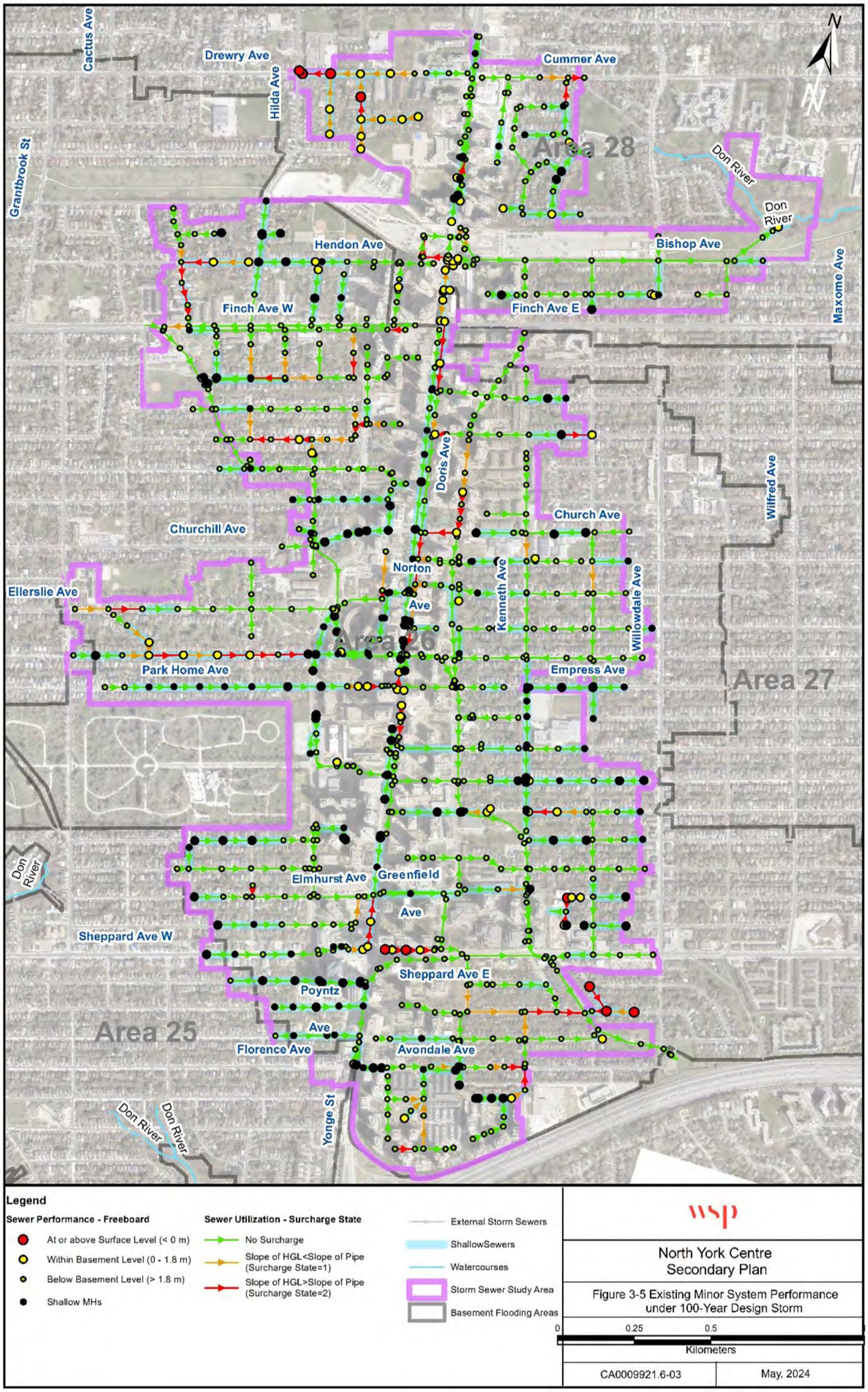

Figure 3-5: Existing Storm System Performance Under 100-Year Design Storm

3.4.4 Major System Performance

As part of the storm dual drainage, the performance of the overland system was evaluated under 100 Year design storm event. The overland system performance is evaluated at each municipal maintenance hole. Based on the reported maximum flow depth at each manhole, the potential of surface flooding was considered if the depth does not meet the level of service targets (i.e., depth of overland flow is above permissible overland flow depth) as summarized in **Section 3.4.1**.

Table 3-4 provides a summary of overland system performance under 100-year design storm. Model predicted that 18 locations do not meet the permissible overland depth criteria under 100-year design storm.

Table 3-4: Overland System Performance Summary

Design Event	Overland flow depth (No. of Manholes)	
	Meet The Criteria	Do Not Meet The Criteria
100-Year Design Storm	721	19

Figure 3-6 illustrates the performance of the overland system under 100-year design storm. At each maintenance hole, overland flow depth was taken as the depth of water above ground level. The overland flow depth was compared against the corresponding permissible overland flow depth. The result was categorized into two groups: meet the criteria (colour coded as green) and do not meet the criteria (colour coded as red). These areas are mainly located in the following locations:

- Hendon Avenue, east of Talbot Road to Yonge Street
- Yonge Street north of Finch Street to the northern boundary of the study area at Drewery Avenue
- Yonge Street near Byng Avenue and Parkview Avenue

Some scattered areas were also observed on Finch Street near Dudley Avenue, Shepperd Avenue, Hillcrest Avenue, Glendora Avenue, Alfred Avenue and Beecroft Road.

As part of this servicing study, the model was updated with latest sewer network data and boundary conditions. No significant deviations were observed from EA except at Beecroft Road. The overland path along Beecroft Avenue was not modelled during EA study and updated as part of Bundle A capacity assessment project.

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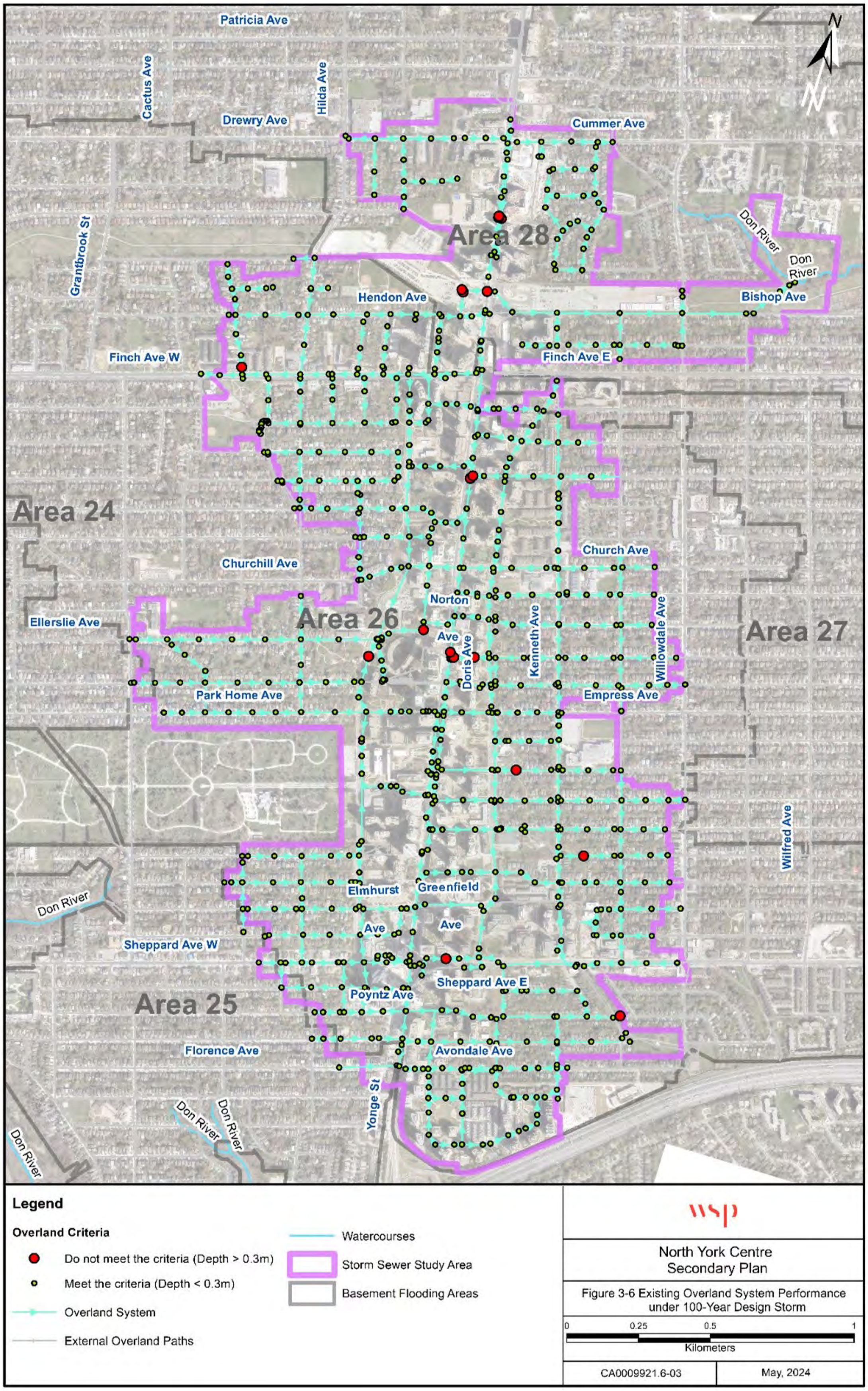

Figure 3-6: Existing Overland System Performance Under 100-Year Design Storm

3.5 Assumptions and Limitations

Area 24-27 and Area 28 models were merged to develop Existing Condition Storm Model. The following assumptions were made during model development.

- The missing sewer network was added based on GIS data. Locations where rim-elevations were unavailable, were inferred from DEM and missing inverts were inferred using inference tool.
- Capital plan improvements were incorporated in the model. This data included only the sewer sizes and not inverts. Hence updates were made for sewer sizes maintaining the inverts as-is.
- Overland paths at the locations where storm sewers were added or modified were checked and updated based on Google Streetview and Google Earth profiles.
- Roof catchments were not modelled at Avondale Road/Oakburn Crescent in the received model. No updates were done at this location as this is towards downstream and has minor impact at the outfall.
- The sewer network data in Area 24-27 is assumed to precede the sewer network data in Area 28. At overlaps/interfaces between the areas, the network in Area 24-27 is retained.
- The head discharge curves for nodes at interfaces between the areas, the curves from area 24-27 were used.
- Area 28 EA model considered fewer catchbasins than existing. Hence, the number of catchbasins in area 28 falling within the secondary plan study area was updated based on data available on DCAD.
- The boundary conditions at locations discharging to the flood plain were obtained from TRCA's Hec Ras model.
- The model was calibrated and validated during the EA and it is recommended to validate the model against recent flow monitoring data.

The model is limited by the available data and assumptions made based on best professional judgment. Throughout the development process, every effort has been made to document assumptions and to base assumed parameters on available documentation, guidance, and experience. However, there are some inherent limitations with this model, as outlined below:

- The flow generation parameters were maintained as in the received models. The recent changes, if any, within the study area were not taken into account.
- The overland basement flooding criteria followed during EA stage is adopted for assessing the overland system in this analysis.

3.6 Planned Improvements

Table 3-5 summarizes the list of the capital projects that will be included in the future condition model in Phase 2 of the study.

Table 3-5: Planned Improvements - Storm

Project ID	Description	Location	Source
26-01	Upgrades existing storm sewers – multiple sewers	Tefley Road Dallas Road Charlton Blvd Drewry Avenue	Capital Plan and Preliminary Design Upgrade
26-18	Upgrades existing storm sewers – multiple sewers	North of Church Avenue	Capital Plan
26-24	Upgrades existing storm sewers – multiple sewers	Kingsdale Avenue Mckee Avenue Waring Crescent	Capital Plan
26-28 (Projects outside storm study area)	Upgrades existing storm sewers – multiple sewers	Willowdale Avenue Anndale Drive Maplehurst Avenue	Capital Plan and Preliminary Design Upgrade

04. Water Distribution Network

04. WATER DISTRIBUTION NETWORK

To achieve the scope of this study, WSP assembled a “stand-alone” model of the North York Secondary Plan Area, built using GIS layers from the City of Toronto and calibrated to both available City of Toronto data and field test data collected by WSP as part of this study. The Study Area covers the portion of Pressure District 5 (PD5) of the City of Toronto’s water distribution network bounded by Steeles Avenue East to the north, Highway 401 to the south, Bayview Avenue to the east, and Bathurst Street to the west. Phase 1 of the review involved building and calibrating the stand-alone model to evaluate the existing conditions within the Study Area.

To evaluate the impact of potential growth in the area, WSP was retained to complete a review of the existing water network with the purpose of establishing a baseline performance for the servicing system. In this section of the report, WSP will provide an overview and hydraulic analysis of the existing conditions and identify existing capacity constraints or bottlenecks that may intensify with the addition of population within the Study Area. Assessing the impacts of additional population within the study area will be the subject of a future report.

4.1 Data Collection and Review

As a part of constructing the stand-alone model of the North York Centre Study Area, the City of Toronto provided shapefiles of watermains and other water assets. The City also provided WSP with Average Day Demands in the form of 2021 AMR data for services within the Study Area. Additional data was provided including SCADA data for the Armour Heights Pumping Station and pressure monitoring data taken at the Edithvale Community Centre and a Revenue Meter located on Willowdale Boulevard north of Steeles Avenue East. To supplement the data provided by the City and to assist in calibrating the model, field tests were also performed by WSP that included Pressure Monitoring, Hydrant Flow Tests and C-Factor Tests, and are discussed in the Macro Calibration **Section 4.3** and **Section 4.4** of this report.

4.1.1 SCADA

In completing a model calibration, SCADA data and field tests were used to compare the model conditions to “real world” conditions. SCADA data from the Armour Heights Pumping Station located at the south end of the Study Area was provided for the months of September 2022 to September 2023. An average of the discharge pressures measured at the pumping station was taken for the fall season of 2022 to represent the Average Day conditions and used in the macro calibration step, discussed in **Section 4.3**.

Pressure monitoring data was taken from the Edithvale Community Centre located at Bevdale Road and Edithvale Drive between September 2022 and September 2023. Similarly, SCADA data was provided for the Armour Heights Pumping Station. An average of the monitored pressures from the fall months were used to estimate the Average day conditions at this location in the model. In addition to generally being representative of Average Day Conditions, the falls month were selected as these months generally overlap with the timeframe of WSP’s field test program. Selecting fall months from SCADA provides an additional layer of consistency between the various sources of data and layers in reliability into the results of the model.

Figure 4-1 shows the locations where pressure monitoring data was provided by the City. **Table 4-1** highlights the junction IDs within the model that were used to approximate the locations of the pressure monitoring data.

Table 4-1: City SCADA Data Locations

Monitoring Point	Location	Junction ID in Model
Armour Heights PS Discharge	Wilson Avenue & Eastbourne Avenue	WJ4022804
Edithvale Community Centre	Bevdale Road and Edithvale Drive	WJ4016558
Revenue Meter 359-04	Willowdale Avenue and Steeles Avenue East	N/A*

*Revenue Meter 359-04 was not included as a junction or used in calibration as it is located north of the modelled area

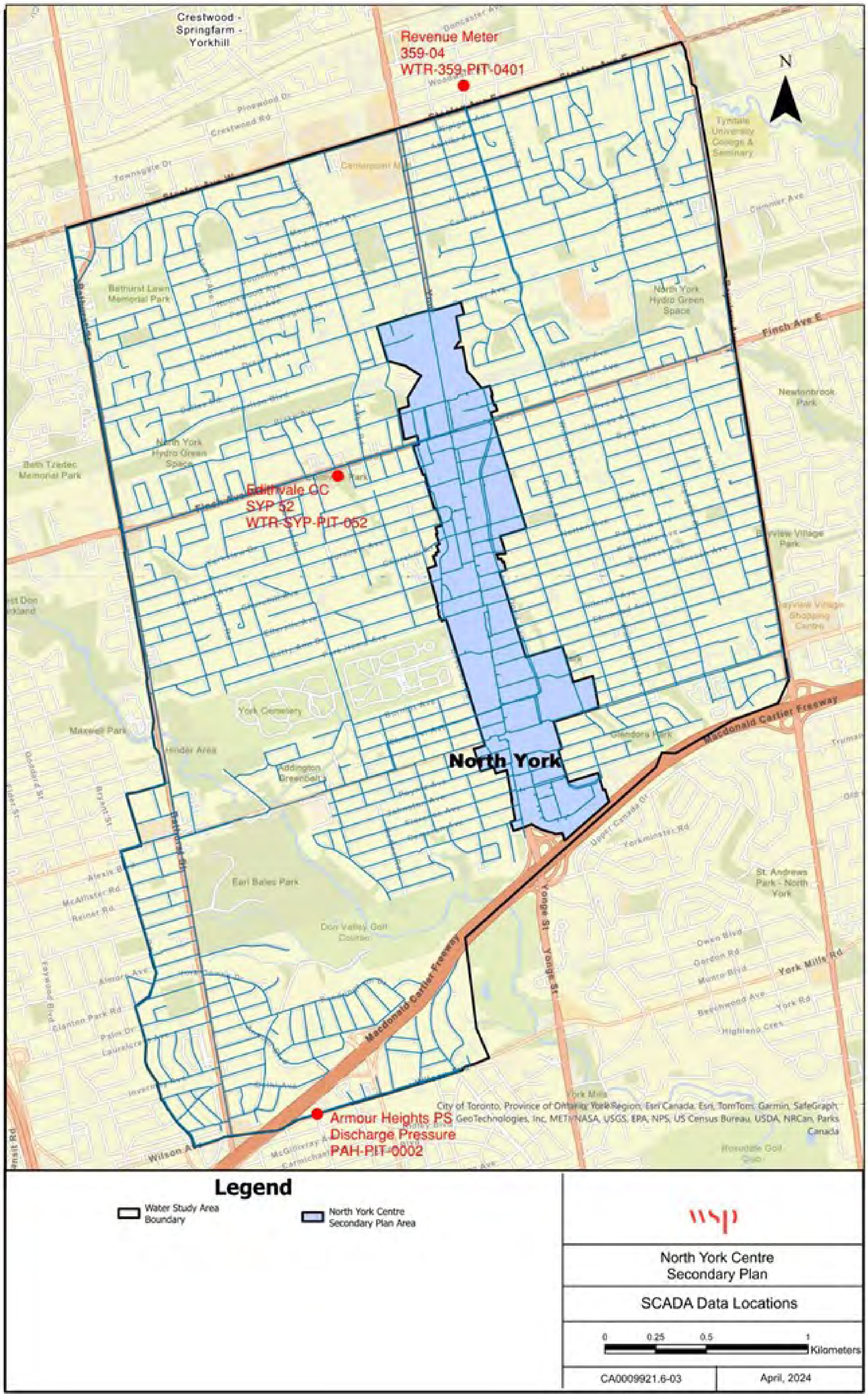

Figure 4-1: SCADA Data Locations

4.1.2 Demands

The 2021 aggregated AMR data, representing water consumption within the Study Area, were provided by the City of Toronto, representing Average Day Demand (ADD) condition. The demands were loaded into the hydraulic model and peaked for Maximum Day (MDD) and Peak Hour (PHD) conditions based on the peaking factors outlined in the City of Toronto Design Criteria for Sewers and Watermains (January 2021). **Table 4-2** lists the factors used to calculate demands.

Table 4-2: Demand Factors from the City of Toronto Design Guidelines

Demand Factor	Value
Minimum Hour (Residential)	0.8
Maximum Day (Residential)	1.5
Peak Hour (Residential)	2.25

It should be noted that the City of Toronto Design Criteria provides peaking factors classified by land use, but the provided AMR data does not identify the difference in land use. For the purpose of this study, the peaking factors for residential land use were used as under MDD, residential was the highest peaking factor (most conservative for MDD), and under MHD residential was the lowest peaking factor (most conservative). For PHD. The residential peaking factor was also used for consistency. The majority of the Study Area can also be classified as residential land, so the residential peaking factors were considered to be the most accurate overall. **Table 4-3** summarizes the total demand loadings in the model for the existing populations.

Table 4-3: Water Demand Loading in Model

Demand	Minimum Hour (l/s)	Average Day (L/s)	Maximum Day (L/s)	Peak Hour (L/s)
Existing (2021) Demands	340	425	638	957

4.1.3 Model Setup

For this study, WSP built a stand-alone model of the Study Area. The Study Area is in Pressure District 5 (PD5) of the City of Toronto water distribution network and is approximately bounded by Steeles Avenue East to the north, Highway 401 to the south, Bayview Avenue to the east, and Bathurst Street to the west.

The stand-alone model reflects the Study Area and is supplied by three (3) “dummy” fixed-head reservoirs (RES9002, RES90004, and RES9006) that have an initial Hydraulic Grade Line (HGL) that generates system pressures that match the seven (7) day monitoring pressure data collected by WSP in November 2023, as well as the SCADA and pressure monitoring data provided by the City of Toronto for the period between September 2022 and September 2023. These reservoirs do not exist in the real network and are meant to supply the model with hydraulic head and flow along the primary supply paths into the area. One of the “dummy” reservoirs was set to be representative of the Armour Heights Pumping Station within the model. The reservoir “RES9002” was added to the model at the location of the pumping station while the pumping station was made inactive. The reservoir HGL was set so that the pressure at the exit of the pumping station matched the discharge pressure from SCADA data. An overview of the model can be seen in **Figure 4-2**.

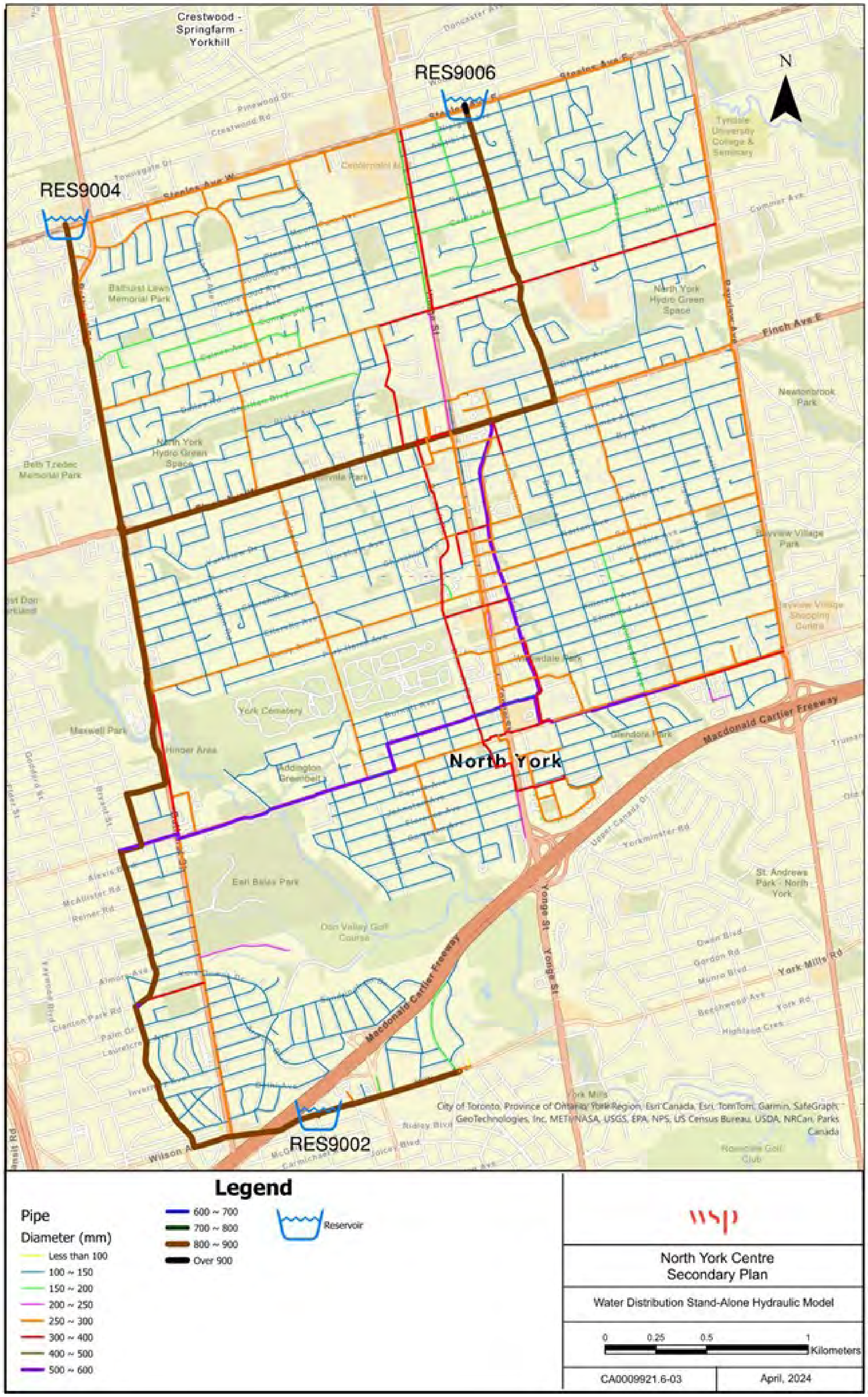

Figure 4-2: Overview of the Stand-Alone Hydraulic Model

4.1.4 Data Gaps, Modelling Assumptions, Constraints and Limitations

It should be noted that the stand-alone hydraulic model comes with a few limitations based on the available data and modelling assumptions. Some of the assumptions, which were previously mentioned in this report, include the demands that were loaded into the model. The peaking factors that were used when calculating demands for Minimum Hour, Maximum Day, and Peak Hour demand scenarios assumed that the entirety of the Study Area could be classified as residential land-use. This assumption was used because the aggregated AMR data provided did not specify land-use, so the most conservative estimate had to be chosen. The AMR data was also only provided for 2021, meaning that some changes in the following years would not be reflected in the demands loaded into the model.

Using a stand-alone model to represent the system also has its limitations. It is assumed that the three (3) dummy reservoirs can be used to represent the boundary conditions of the entire study area. In reality, the Study Area falls within the much larger Pressure District 5 (PD5) of the City of Toronto's water distribution network. The reservoirs in the model cannot represent the sum of the interactions between the Study Area and the greater distribution network to 100% accuracy. In addition to this, it is possible that the stand-alone model does not capture the Pressure District's point of highest elevation since it only covers a small portion of PD5. Missing the highest elevations in the Pressure District could cause modelled fire flows to be slightly higher than in reality.

The accuracy of the calibration of the model is also limited to the accuracy of the City SCADA data provided and the accuracy of WSP's field tests, which represent only a small snapshot of the system at any given time.

4.2 Calibration Approach

Ahead of using the model to identify challenges and opportunities, it was calibrated to three (3) unique sets of data at a macro and micro calibration level:

1. SCADA Provided by the City of Toronto

2. WSP Pressure Monitoring

3. WSP Hydrant Flow Test (HFT) and C-factor Test (CFT) results (includes static and residual data)

Field tests were completed in November 2023 and considered to be representative of the ADD conditions, given the time of year of the tests (fall). An average of the SCADA data and pressure monitoring provided by the City was taken from the fall months (September to December of 2022) to represent the ADD conditions. Selecting similar time periods overall, from independent data sources, also provides consistency and reliability to the calibration. Measured data was used to calibrate the ADD scenario and that calibration was carried into the MDD and PHD conditions – meaning the only difference in inputs between ADD, MDD and PHD scenarios are the demands that cause the expected decrease in system HGL and results pressures.

4.2.1 Calibration Criteria

The calibration of the hydraulic model was completed in two steps, under the Average Day Demand Scenario:

- **Step 1 – Macro Calibration:** Completed by setting the source HGL at the supply "dummy" fixed head reservoirs to an initial HGL value that generated static pressures in the network matching pressure monitoring and SCADA pressures to a margin of 5%, in accordance with the American Water Work Association (AWWA) M32. WSP conducted this calibration in two parts; using the September 2022 – September 2023 SCADA data to set an initial hydraulic head, followed by using WSP's pressure monitoring data from November 2023 to further refine the initial settings.
- **Step 2 – Micro Calibration:** The micro calibration focuses on the residual pressure and system behaviour during "flow" conditions. It is completed by adjusting the C-Factors throughout the model to have static and residual pressures match the results of HFT. C-Factors were adjusted using a combination of WSP's CFT results and the MECP guidelines to supplement when data gaps were identified.

Table 4-4 and **Table 4-5** summarize the acceptable pressures for each calibration point in the model for the macro and micro calibrations, respectively based on a +/- 5% range from the monitored average pressures.

Table 4-4: Calibration Targets for Macro Calibration

Location	Average Monitoring Pressure		Acceptable Pressure Range for Calibration (+/- 5%)	
	kPa	psi	kPa	psi
Pumping Station Discharge	477	69	453-501	66-73
Edithvale Community Centre	398	58	378-418	55-61
HY4006498	762	111	724-800	105-116
HY4037279	513	74	487-539	71-78
HY4032598	512	74	486-538	71-78
HY22581	417	60	396-438	57-64
HY4018111	308	45	293-323	42-47
HY4039947	340	49	323-357	47-52
HY4042441	283	41	269-297	39-43
HY16136	479	69	455-503	66-73

Table 4-5: Calibration Targets for Micro Calibration

Location	Average Monitoring Pressure		Acceptable Pressure Range for Calibration (+/- 5%)	
	kPa	psi	kPa	psi
HY4039949	342	50	325-359	47-52
HY4017558	325	47	309-341	45-49
HY9990174	464	67	441-487	64-71
HY4008122	464	67	441-487	64-71
HY4034038	486	70	462-510	67-74
HY4035139	486	70	462-510	67-74

4.3 Macro Calibration

4.3.1 SCADA Data

The macro calibration of the North York Secondary Plan water model involved matching simulated pressures to two (2) SCADA locations within the Study Area. “Dummy” Reservoirs were set along 900 mm watermains feeding directly to the SCADA locations at the Edithvale community Centre and the Armour Heights Pumping Station. The SCADA pressures were to be represented by adjusting the HGL of the reservoirs until the modeled pressures matched the average pressures identified as for Average Day Demand (ADD) conditions. **Table 4-6** summarizes the average pressures at the monitoring locations and the HGLs set at the corresponding “dummy” reservoirs. More details on the monitoring data were provided in a plot which is appended to this report.

Table 4-6: Model Calibration Comparison to SCADA Data

Location	Average Monitoring Pressure		Acceptable Pressure Range for Calibration (+/- 5%)		Difference (%)
	kPa	psi	kPa	psi	
Pumping Station Discharge	477	69	499	72	4.5%
Edithvale Community Centre	398	58	417	60	4.8%

Table 4-6 summarizes the system monitored static pressure compared to the simulated static pressure in the model at both City of Toronto SCADA locations. The match is within 5% and complies with the AWWA M32 calibration standard.

4.3.2 Pressure Monitoring

The second step of the macro calibration involved matching simulated static pressures to the average pressures monitored by WSP during the field testing conducted in November of 2023. Eight (8) pressure monitoring locations were chosen to provide adequate coverage across the network. Selected locations captured low and high elevations, the influence of pumping facilities, large demand/critical users, and at the study area boundaries. A map of the pressure monitoring locations is shown in **Figure 4-3**.

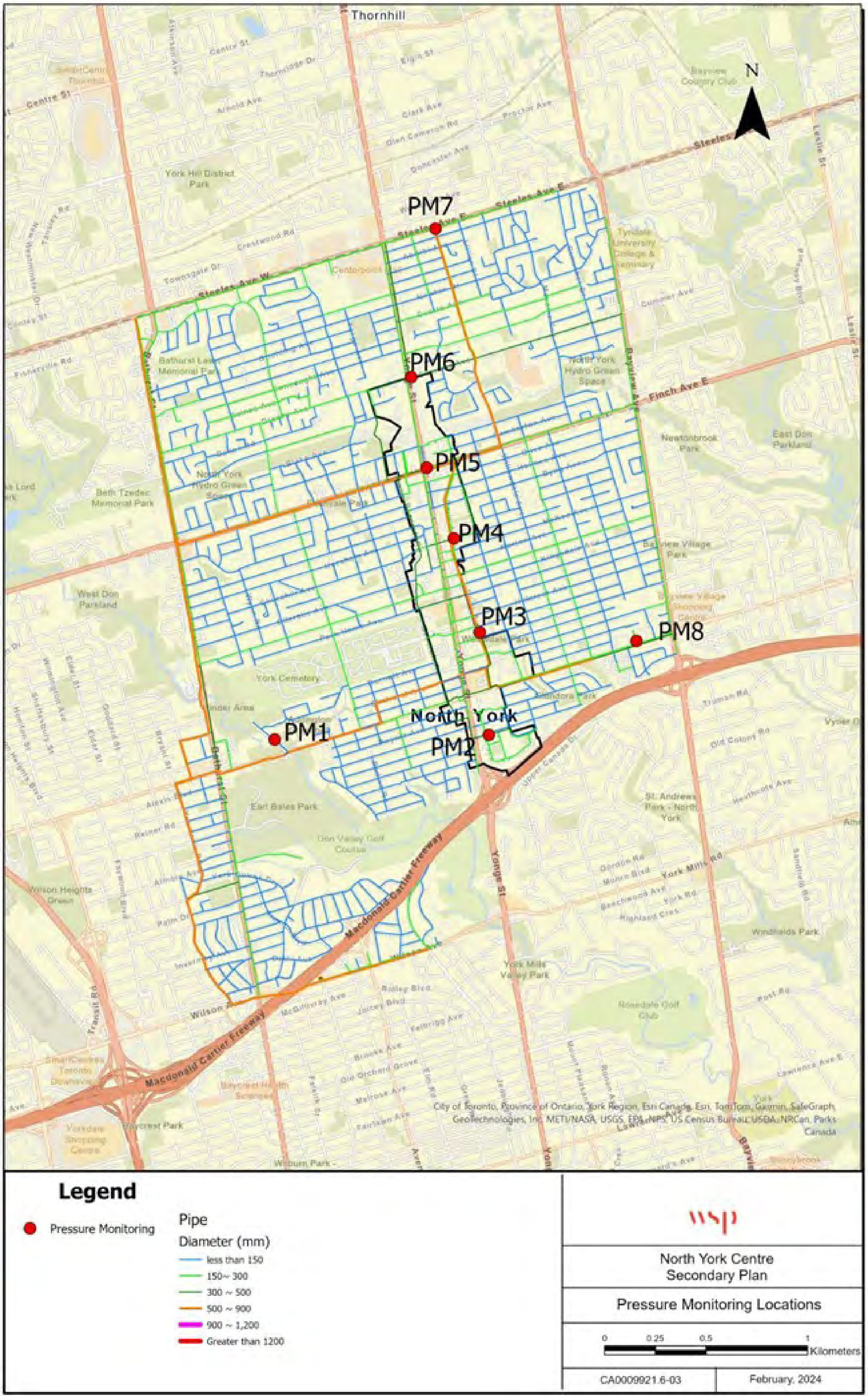

Figure 4-3: WSP Field Program Pressure Monitoring Locations

Table 4-7 summarizes the average pressures at WSP's pressure monitoring locations and the modeled static pressures from the corresponding junctions in the model. As shown below, the monitored pressures in the system match the simulated pressures in the model at all locations generally well and within a 5% margin, except for at HY4037279 (pressure monitoring point 2). At this location, there was consistently a 6.5% difference between the monitored and modeled pressures throughout the calibration, which could have been due in part to a 600mm watermain upstream providing excessively high flows to local mains when the HGLs in the dummy reservoirs were set to match pressures. To refine the results, flow monitoring could be done at this location to validate flow results. The averaged monitored pressure was determined to be 513 kPa (74 psi) at this location and WSP simulated the pressure to be 480 kPa (70 psi) – this indicated that the model remained conservative when comparing pressure monitoring.

Overall, there was an average difference of 0.0% between the modeled pressures and the average monitored pressures and all modelled pressures were within 5 psi of monitored pressures, indicating that the stand-alone model can accurately represent static pressures throughout the Study Area.

Table 4-7: Model Calibration Comparison to Pressure Monitoring Data

Test Number	Hydrant ID	Average Monitoring Pressure		Model Junction Pressure		Difference (%)
		kPa	psi	kPa	psi	
PM1	HY4006498	762	111	762	111	0.0%
PM2	HY4037279	513	74	480	70	-6.5%
PM3	HY4032598	512	74	513	74	0.3%
PM4	HY22581	417	60	419	61	0.5%
PM5	HY4018111	308	45	308	45	0.2%
PM6	HY4039947	340	49	354	51	4.1%
PM7	HY4042441	283	41	274	40	-3.3%
PM8	HY16136	479	69	502	73	4.7%
Average Difference						0.0%
Standard Deviation						3.6%

4.4 Micro Calibration and Validation

Once the macro calibration was deemed complete and met the AWWA standards as specified in **Section 4.2.2**, a micro calibration was completed using WSP HFT's and WSP CFT's results to calibrate the model. The micro calibration step focuses on network wide statics and residual pressures and pipe characteristics.

WSP conducted a total of six (6) hydrant flow tests and six (6) C-Factor tests to aid in the micro calibration step. The objective of the micro calibration is to adjust C-factors to match the residual flow and pressures measured during the field tests. The location of the hydrant flow tests is shown in **Figure 4-4**, and the location of the C-Factor tests is shown in **Figure 4-5**.

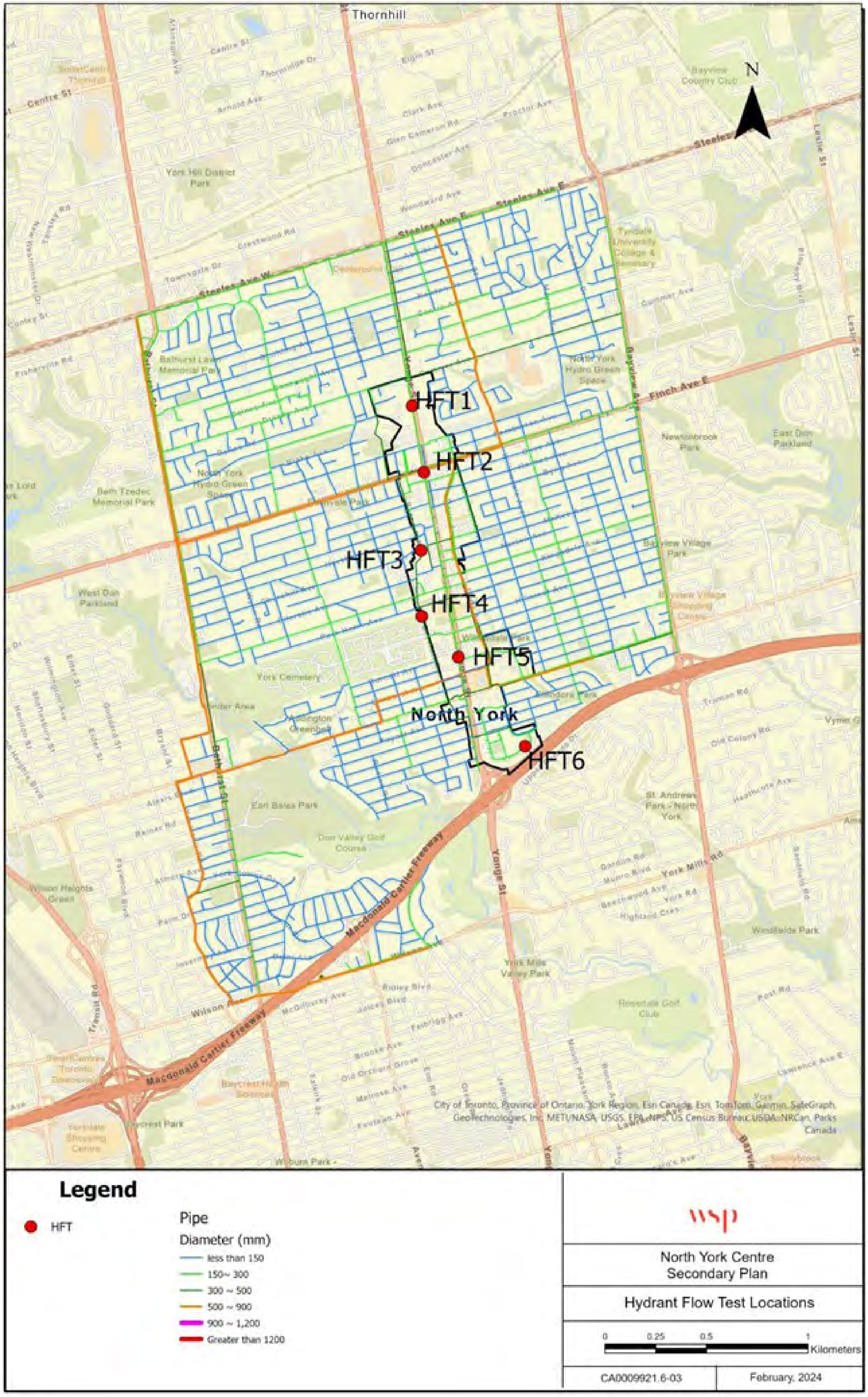

Figure 4-4: Hydrant Flow Test Locations

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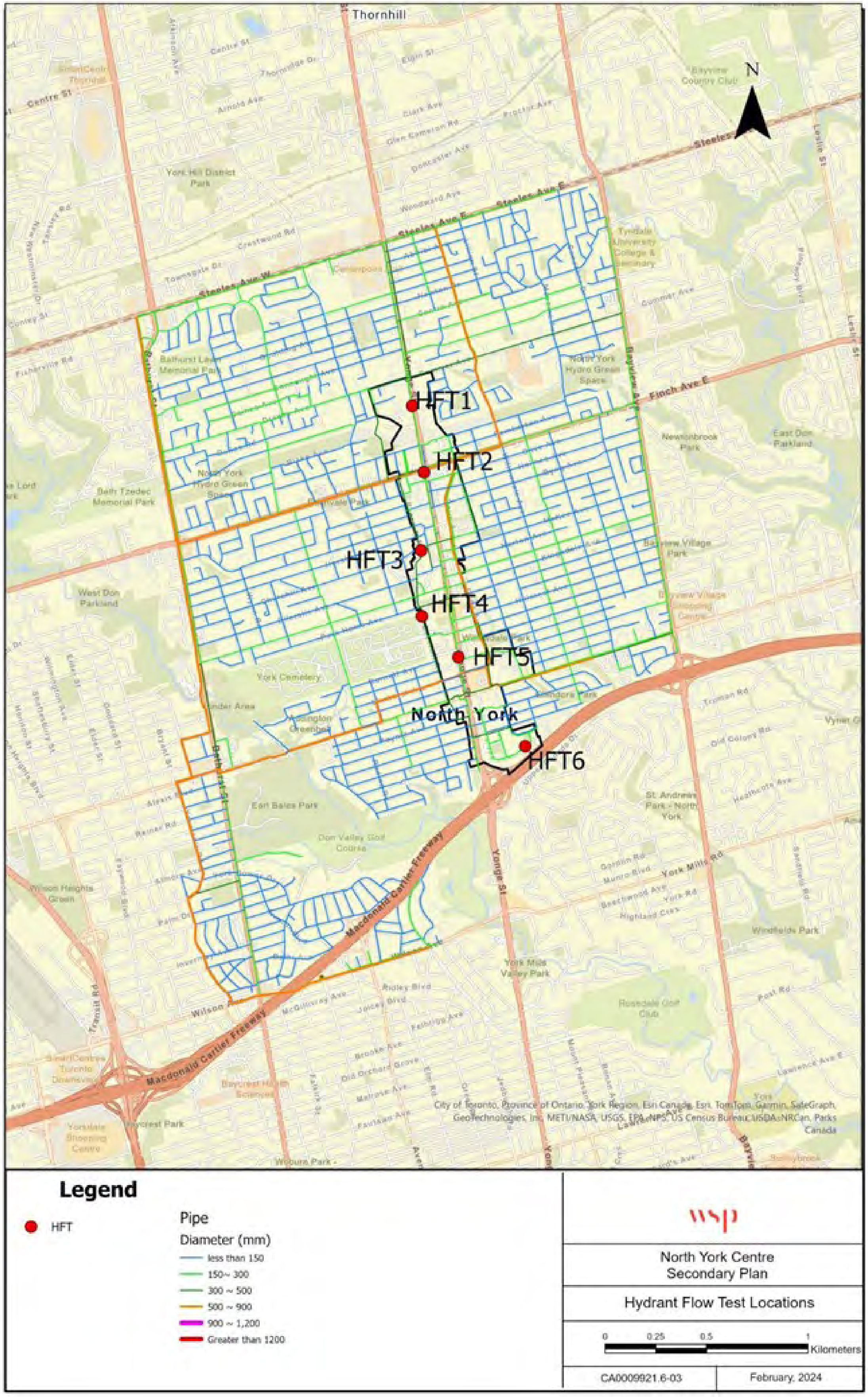

Figure 4-5: C-Factor Test Locations

4.4.1 C-Factor Tests

During the micro calibration process, it was noted that the model required higher C-factors (smoother pipes) than the City of Toronto guidelines suggested. This was supported by the C-Factor testing completed by WSP in October and November of 2023 which showed similar or higher C-factors than City of Toronto guidelines for the sizes of pipes that were tested. **Table 4-8** shows the results of the C-factor tests that WSP conducted while **Table 4-9** highlights the City of Toronto design guidelines for C-factors. A combination of the Test results and the City of Toronto C-factors was used to represent the system more accurately.

Table 4-8: C-Factor from WSP Test Results

Pipe Diameter	Year of Installation	Material	C-Factor
150mm	2009	PVC	114
150mm	1952	CI	129
300mm	1952	CI	103
400mm	2000	PVC	132

Table 4-9: City of Toronto Design Criteria Hazen-Williams C-Factors

Pipe Diameter	C-Factor
150mm	100
200mm or 250mm	110
300mm to 600mm	120
Over 600mm	130

A full summary of how the C factors were assigned to pipes in the model is shown in **Table 4-10**, and a colour coded map of the C-Factors is included in **Figure 4-6**. Generally, WSP took all pipes from the City of Toronto GIS layer and “binned” them into categories according to size, material and age. From there, C-Factors were applied in accordance with test results that matched the size/material/age of tested C-Factors, with the remaining C-Factors being allocated in accordance with the MECP.

Table 4-10: C-Factors Assigned in Model

Pipe Diameter	Year of Installation	Material From GIS Layers	C-Factor
100mm	All	All	100
150mm	2000-2024	All	114
150mm	1950-2000	All	103
150mm	Pre-2000	Cast Iron	103
150mm	All	PVC	114
150mm	Pre-1950	All	100
200mm, 250mm	1950-2024	All	115
200mm, 250mm	Pre-1950	All	110
300mm	1990-2024	All	132
300mm	All	PVC	132
300mm	Pre-1990	All	120
400mm	1950-2000	All	129
400mm	Pre-1950	All	120
400mm	2000-2024	All	129
500mm-600mm	All	All	130
Over 600mm	All	All	130

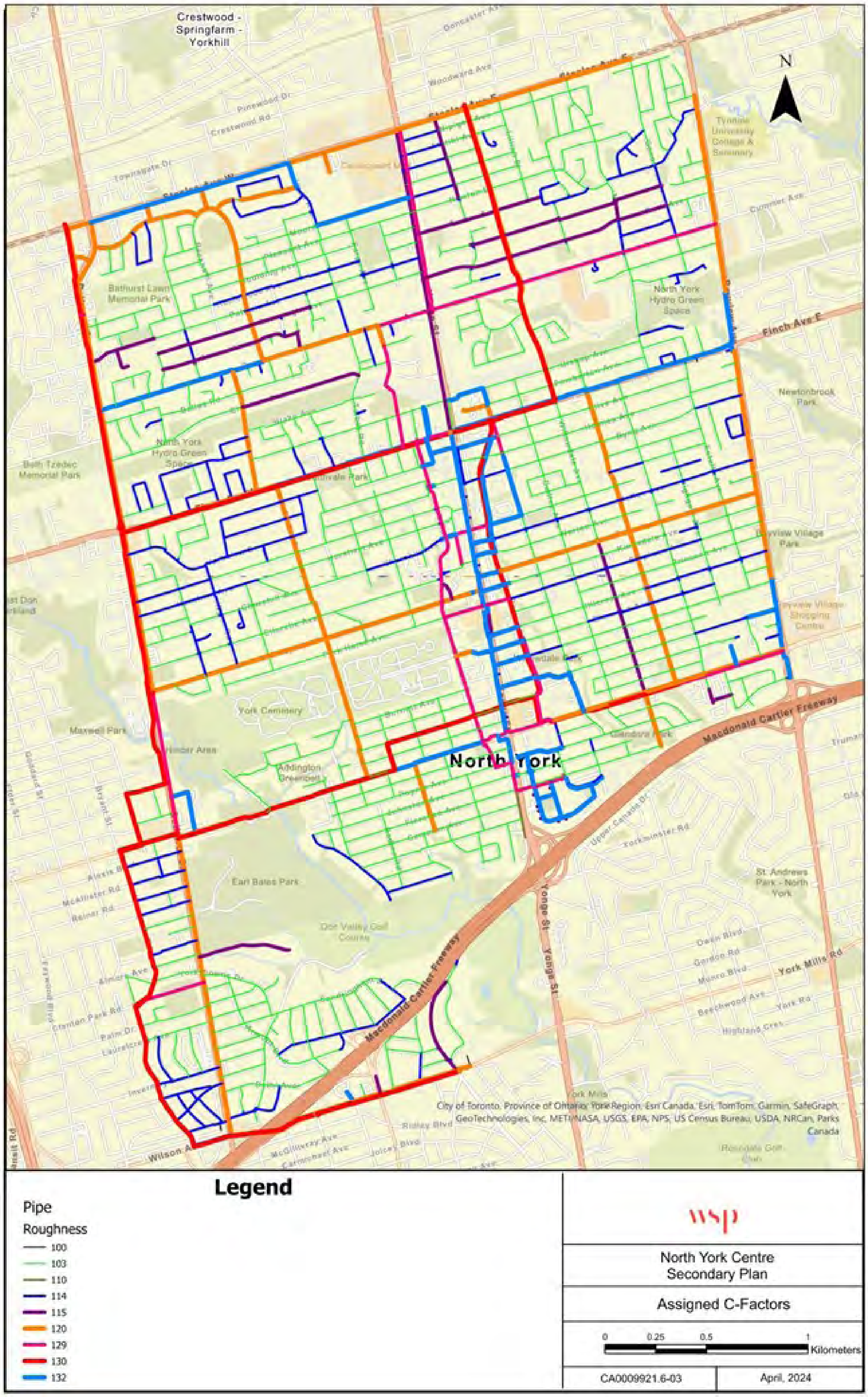

Figure 4-6: Assigned C-Factors Map

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4.4.2 Hydrant Flow Tests

Comparisons between the HFT results and the modelled hydrant flow curves were completed for each of the hydrant flow test locations listed in **Section 4.4**. From the comparison between the results of the HFT and the modelled hydrant flow curves, after making C-Factor adjustments as discussed in **Section 4.4.1**, it was found that the modelled static pressures were within five percent (5%) of the HFT static pressures. **Table 4-11** compares the modelled static pressures at each hydrant to the measured static pressures taken during each HFT.

Appendix C provides detailed results of the hydrant test and model verification.

Table 4-11: Hydrant Flow Test Static Pressures Versus Model Static Pressures

HFT	Hydrant ID	Model Pressure		Measured Pressure		Difference (%)
		kPa	psi	kPa	psi	
1	HY4039949	330	48	342	50	-3.6%
2	HY4017558	314	46	325	47	-3.2%
3	HY9990174	469	68	464	67	1.1%
4	HY4008122	474	69	464	67	2.2%
5	HY4034038	484	70	486	70	-0.4%
6	HY4035139	505	73	486	70	3.8%
Average Difference						0.0%
Standard Deviation						3.0%

4.5 Analysis of Existing Conditions

4.5.1 Acceptable Level of Service

As stipulated by the City of Toronto Design Criteria for Sewers and Watermains (January, 2021), the system pressures under any non-fire flow conditions must not be less than 275 kPa (40 psi) and the maximum static pressure in the system should not exceed 700 kPa (102 psi). The minimum allowable pressure under MDD plus Fire Flow is 140 kPa (20 psi) at the location of the fire and everywhere else in the pressure district. These pressures are consistent with MECP guidelines, which also stipulate a required pressure range of 275 kPa (40 psi) to 690 kPa (100 psi) under all non-fire flow scenarios. Additionally, there are preferred design pressure ranges for each demand scenario according to the City of Toronto Guidelines, which are as follows:

- Average Day and Maximum Day: 350 kPa - 550 kPa (51 psi – 80 psi)
- Minimum Hour and Peak Hour: 275 kPa – 700 kPa (40 psi – 102 psi)

The City of Toronto Design Criteria also states that pressures outside of the preferred design pressure ranges for each demand scenario are not desirable but are acceptable as long as they remain between 275 kPa (40psi) for all scenarios, and 690 kPa (100 psi) for Average Day and Minimum Hour scenarios.

Note that any service pressures which are above 550 kPa (80 psi) may require Pressure Reducing Valves (PRVs) at buildings to reduce pressure to the acceptable range as per the Ontario Building Code (OBC).

In addition to the pressure requirements above, the City requires that maximum head loss allowed in the distribution system under peak hour operating conditions (excluding fire flow situations) is 2 to 5 m/km.

4.5.2 System Pressures & Available Fire Flow

WSP simulated the existing conditions based on the calibration completed for the Study Area that reflects the demands established in **Section 4.1.2**. Simulated service pressures are summarized in **Table 4-12**. Detailed pipe and node results are included in **Appendix B**. The modelling indicated that the expected service pressures within the North York Centre Secondary Plan Area ranged between approximately 295 kPa (43 psi) and 573 kPa (83 psi) under existing conditions. Pressures that are outside the MECP and City of Toronto requirements are located outside of the Secondary Plan Area, but within the Service Study Area.

In addition to areas in which pressures fell outside of the MECP requirements, there were additional junctions within the Service Study Area under all scenarios that were either below or above the preferred pressure ranges for their demand scenarios. Some junctions within the Secondary Plan Area also fell outside of these preferred pressure ranges for the ADD and MDD scenarios. The modelled pressure ranges as the compare to the preferred design pressure ranges are shown in **Table 4-12**.

As the model was calibrated based on the Average Day Demand conditions, pressures during Maximum Day Demand and Peak Hour scenarios may vary from those shown in the modelling based on water consumption from outside the Study Area and based on varying pumping conditions.

Table 4-12: Simulated Service Pressures under Existing Conditions

Demand Scenario	Average Day	Maximum Day	Minimum Hour	Peak Hour	Percentage of Junctions Falling within MECP Pressure Range (275-690 kPa) (%)
Existing (North York Centre)	303-571(kPa) 44-83 (psi)	299-567 (kPa) 43-82 (psi)	324-573 (kPa) 47-83 (psi)	295-562 (kPa) 43-82 (psi)	100%
Existing (Entire Model)	280-760 (kPa) 41-110 (psi)	279-757 (kPa) 40-110 (psi)	281-761 (kPa) 41-110 (psi)	277-753 (kPa) 40-109 (psi)	99.4%
Preferred Pressure Range	350-550 (kPa) 51-80 (psi)	350-550 (kPa) 51-80 (psi)	275-700 (kPa) 40-102 (psi)	275-700 (kPa) 40-102 (psi)	

Note: Pressure drops from Average Day to Maximum Day and Maximum Date to Peak Hour are caused by the increase in demand within the Study Area only. Percentage of junctions falling within acceptable pressure range was determined based on the absolute minimum acceptable pressure of 275 kPa (40 psi) and absolute maximum acceptable pressure of 690 kPa (100 psi), not the preferred design pressure ranges.

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In addition to the table above, there are maps which show the pressures at all modelled junctions and head loss gradient in all pipes within the Study Area. These maps help to identify existing capacity constraints or bottlenecks that may intensify with the addition of new developments within the Study Area. **Figure 4-11**, **Figure 4-13** and **Figure 4-14** show colour coded maps of pressure and head losses on junctions and pipes under ADD, MDD and PHD conditions within the Study Area.

All junctions within the Primary Study Area met the pressure requirements under all scenarios, however there were other junctions within the model, outside of the Primary Study Area which did not. There were several junctions that were modelled with pressures at or above 700 kPa (100 psi) under Maximum Day and Peak hour scenarios, as well as pressures above 690 kPa (100 psi) under Average Day and Maximum Day scenarios. The junctions which do not fall within the acceptable range of pressures are summarized in **Table 4-13** below. These junctions are not expected to be significantly impacted by future changes within the North York Centre, so they are not recommended for upgrades at this time. It should be noted that some junctions fall below the minimum preferred pressure for their design scenarios, but according to the City's guidelines, are still acceptable as long as they remain above 275 kPa.

Table 4-13: Junctions with Simulated Pressures Outside of Acceptable Range According to MECP Guidelines

Junction ID	Minimum Hour	Average Day	Maximum Day	Peak Hour
WJ4018159	693 (kPa) 101 (psi)	692 (kPa) 100 (psi)	689 (kPa) 100 (psi)	687 (kPa) 100 (psi)
WJ4003953	697 (kPa) 101 (psi)	696 (kPa) 101 (psi)	694 (kPa) 101 (psi)	692 (kPa) 100 (psi)
WJ4004177	700 (kPa) 102 (psi)	699 (kPa) 101 (psi)	697 (kPa) 101 (psi)	694 (kPa) 101 (psi)
WJ4003958	711 (kPa) 103 (psi)	711 (kPa) 103 (psi)	708 (kPa) 103 (psi)	706 (kPa) 102 (psi)
WJ4018148	719 (kPa) 104 (psi)	718 (kPa) 104 (psi)	716 (kPa) 104 (psi)	713 (kPa) 103 (psi)
WJ4017178	728 (kPa) 106 (psi)	727 (kPa) 105 (psi)	724 (kPa) 105 (psi)	719 (kPa) 104 (psi)
WV4005035	734 (kPa) 106 (psi)	733 (kPa) 106 (psi)	722 (kPa) 105 (psi)	728 (kPa) 106 (psi)
WJ4014458	748 (kPa) 108 (psi)	746 (kPa) 108 (psi)	731 (kPa) 106 (psi)	738 (kPa) 107 (psi)
WJ4020275	758 (kPa) 110 (psi)	757 (kPa) 110 (psi)	754 (kPa) 109 (psi)	750 (kPa) 109 (psi)
WJ4020278	761 (kPa) 110 (psi)	759 (kPa) 110 (psi)	757 (kPa) 110 (psi)	753 (kPa) 109 (psi)

Of the junctions modeled with service pressures above 690 kPa (100 psi) under ADD & MDD, and above 700 kPa (102 psi) under PHD and MHD scenarios, the majority were located at the north-east boundary of the model at Steeles Avenue East and Bayview Avenue. The pressure challenge in the area is likely the result of the watermain on Bayview Avenue being modeled as a dead-end watermain due to the boundary of the Study Area. This idea can be validated by the pressure monitoring results from Pressure Monitoring Site 7. Despite it not being along Bayview Avenue, PM7 is representative of the expected pressure along the northern boundary of the study area. Its ADD pressure was taken as 283 kPa (41 psi). The junctions on the north end of Bayview have an average elevation approximately 30 to 40 m lower than those at the pressure monitoring location, which indicate that slightly higher pressures in this area are expected. A plot of the elevations from the Pressure Monitoring Site 7 to the area with high pressures at Bayview Avenue and Steeles Avenue East is shown in **Figure 4-7**.

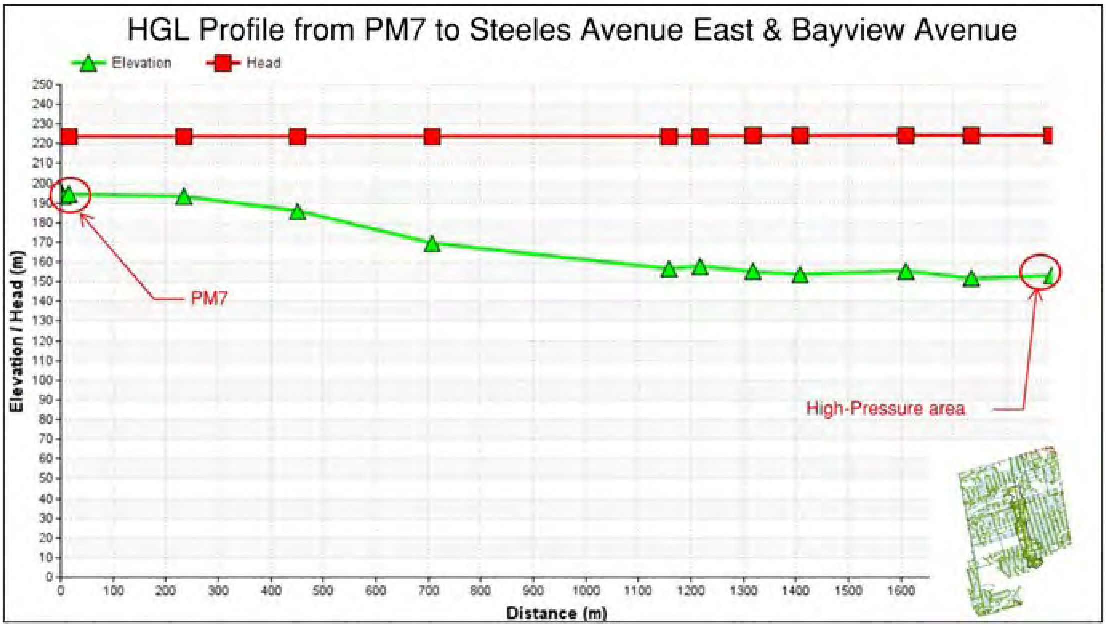

Figure 4-7:HGL Profile from PM7 to High Pressure Junctions on Bayview Avenue

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Additionally, junctions with pressures above 690 kPa (100psi) are seen at Don River Boulevard and Sheppard Avenue West. These junctions are located on a dead-end watermain that is located in close proximity to the Don River, resulting in elevations approximately 20 m lower than the surrounding areas and causing higher pressures in the area. Similarly, junction WV4005035 is located at a low point on the watermain on Bathurst Street, where the elevation dips approximately 30 m lower along the Don River. Junctions WJ4020275 and WJ4020278 are located under a bridge on Sheppard Avenue West, resulting in elevations approximately 20m lower than the surrounding areas, and higher pressures. HGL profiles for the high-pressure junctions in this area are shown in **Figure 4-8**, **Figure 4-9**, and **Figure 4-10**.

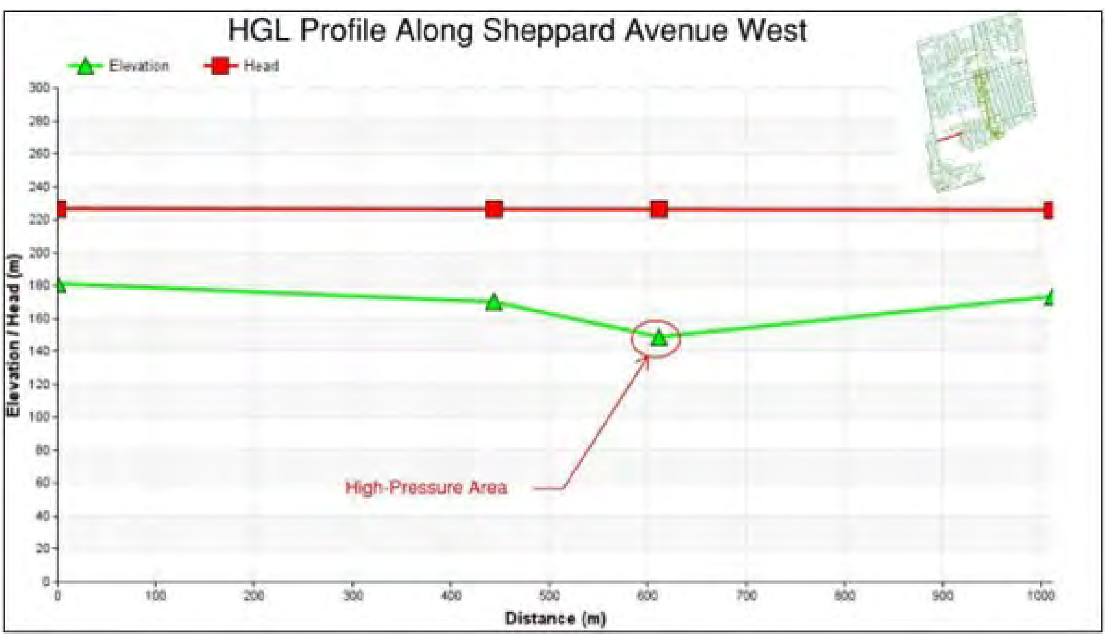

Figure 4-8: HGL Profile Along Sheppard Avenue West

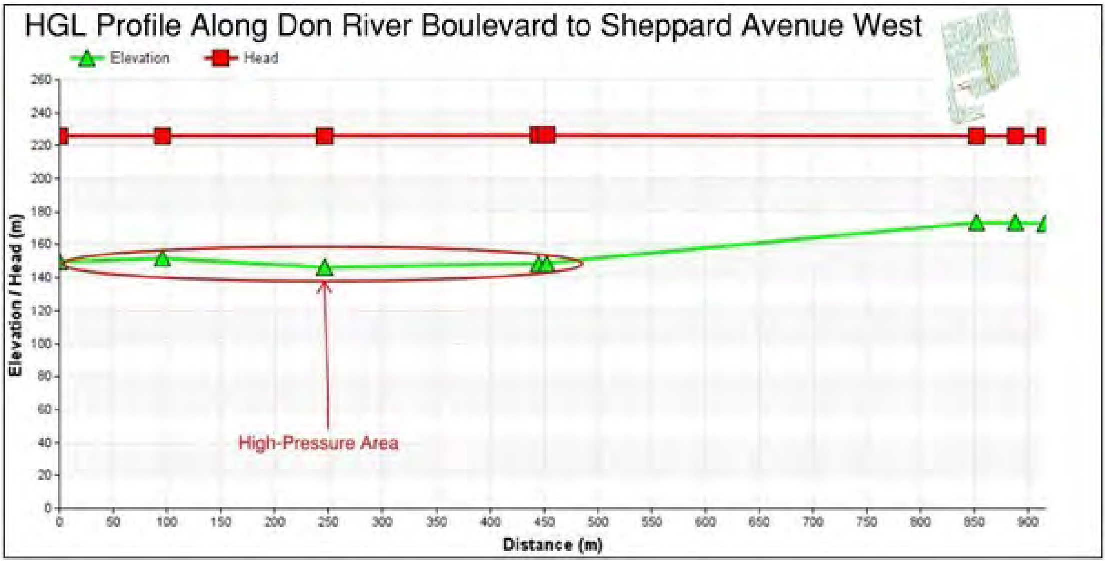

Figure 4-9: HGL Profile Along Don River Boulevard

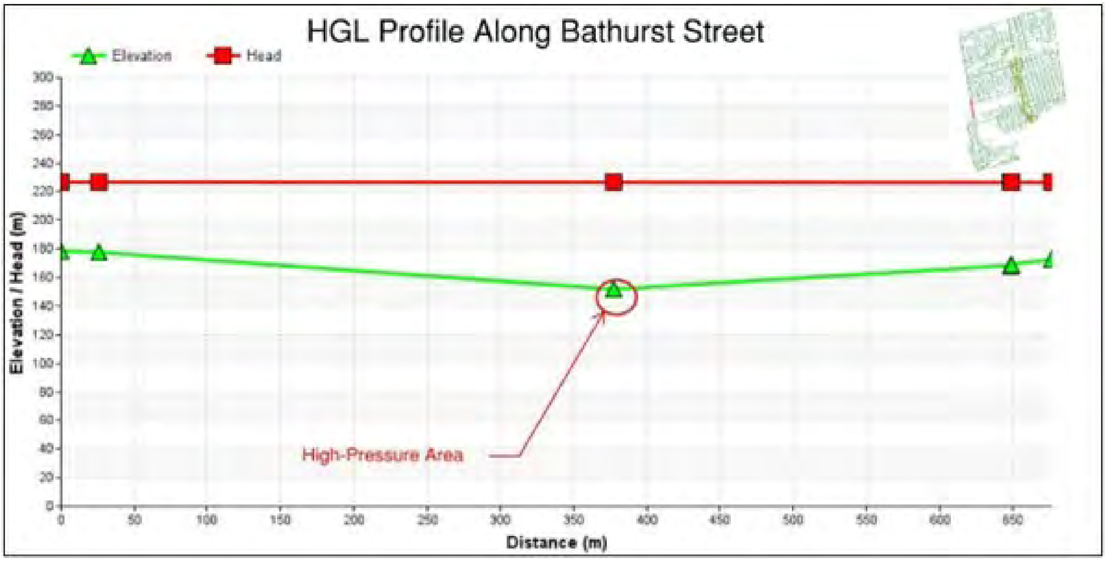

Figure 4-10: HGL Profile Along Bathurst Street

Additionally, head loss gradient in all pipes within the Primary Study Area are expected to operate with head loss below 5 m/km. All pipes throughout the entire network are expected to operate with head loss below 5 m/km except for three segments of 150mm watermains under MDD and PHD conditions. The higher head loss gradients in these areas are likely because these segments of watermains are bounded on either side by larger diameter watermains. They are not expected to be significantly impacted by future changes within the North York Centre, so they are not recommended for upgrades at this time. A summary of the locations and IDs of these pipes is shown in **Table 4-14**.

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Table 4-14: Watermains with Simulated Head Loss Gradient over 5m/km (under MDD and PHD conditions)

Pipe ID	Location	Headloss Gradient under MHD (m/km)	Headloss Gradient under ADD (m/km)	Headloss Gradient under MDD (m/km)	Headloss Gradient under PHD (m/km)	Diameter (mm)	Length (m)
LN4020450	Green Bush Road from Fontainbleau Drive to Tanjoe Crescent	4.7	4.9	5.2	5.3	150	52.1
LN4031618	Bathurst Street North of Sheppard Avenue West	17.4	18.2	15.8	11.2	150	2.4
LN4030927	Bathurst Street North of Dewlane Drive	3.32	4.4	7.4	11.7	150	4.5

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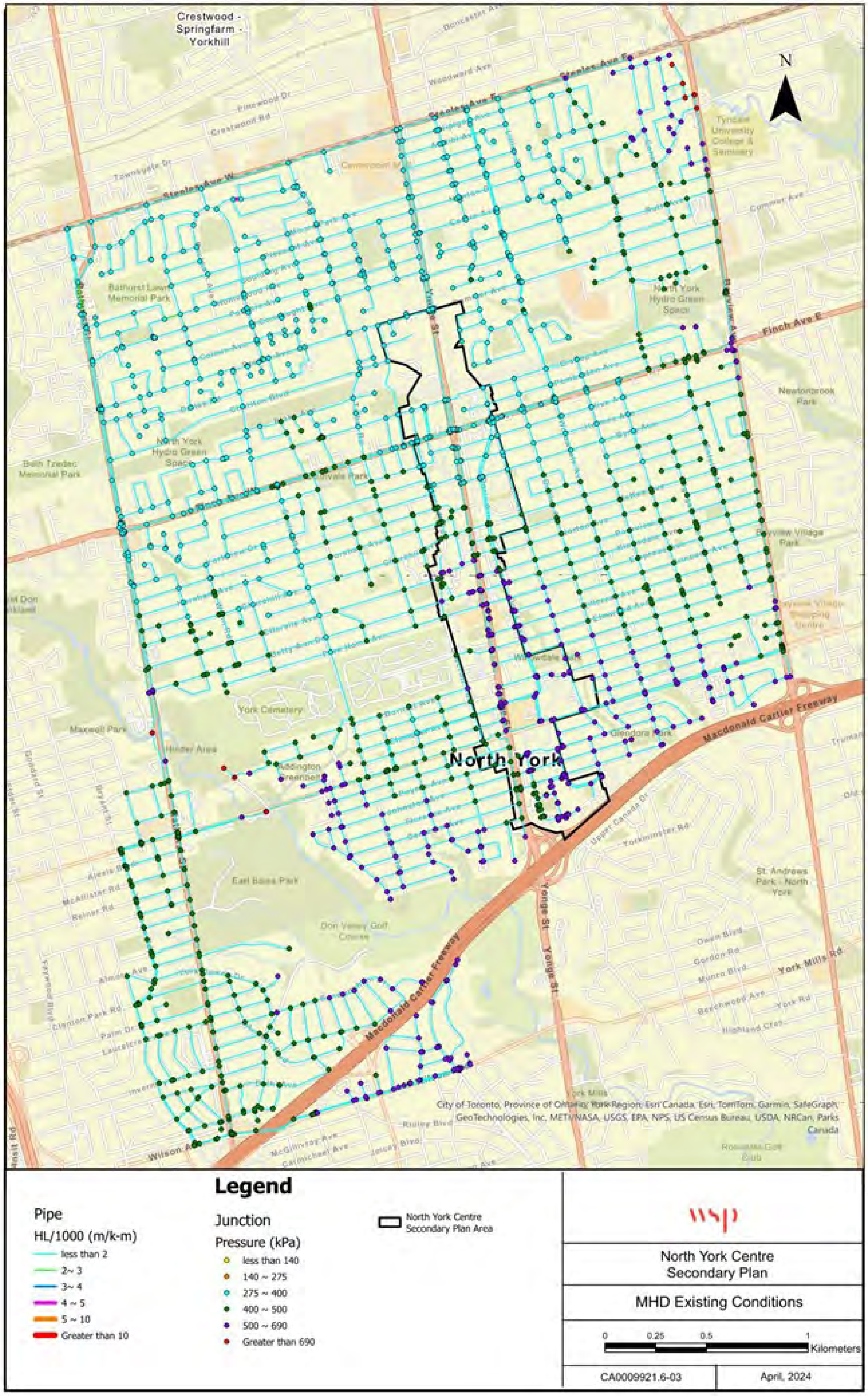

Figure 4-11: Pressure and Head Loss Gradient for MHD under Existing Conditions

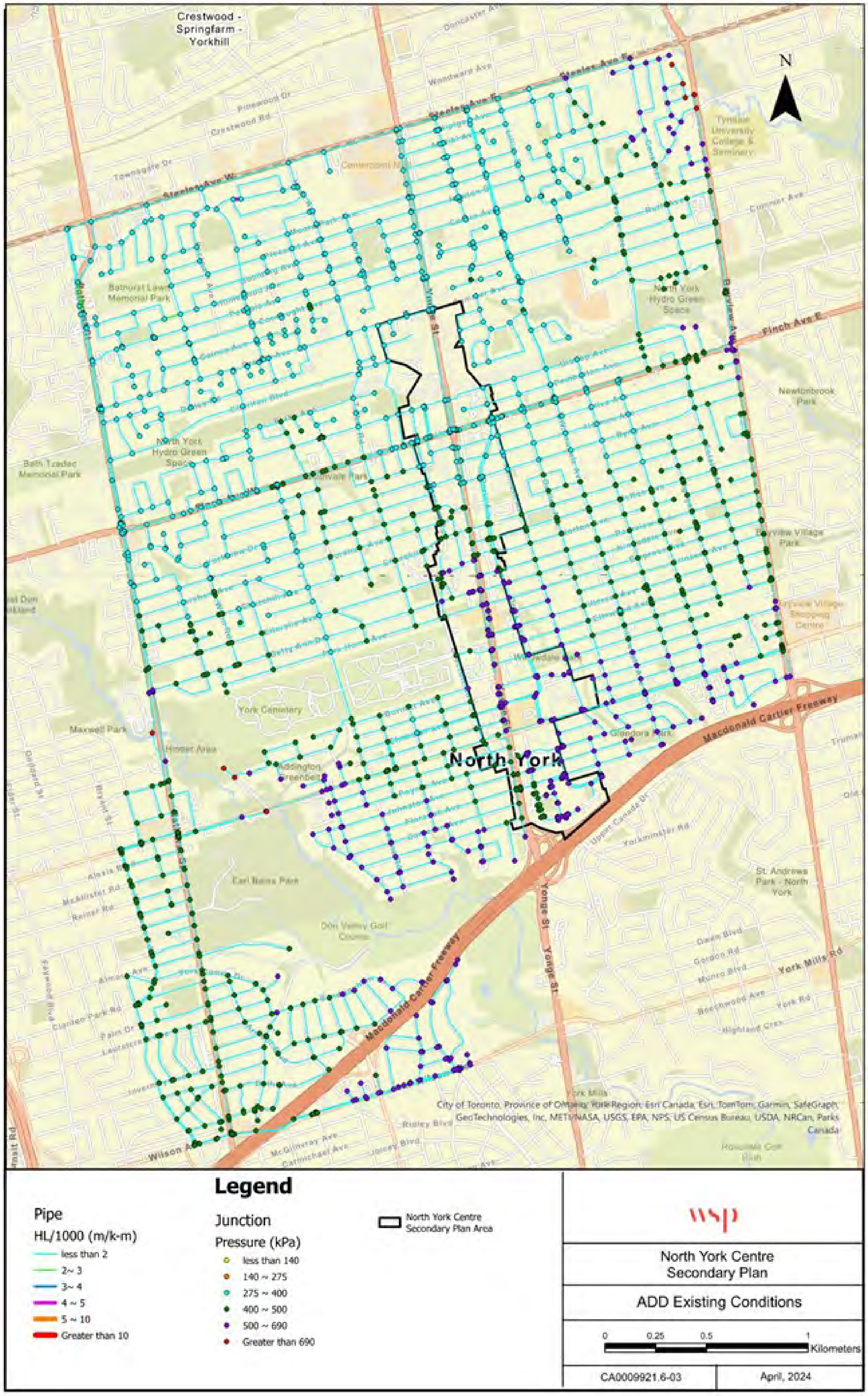

Figure 4-12: Pressure and Head Loss Gradient for ADD under Existing Conditions

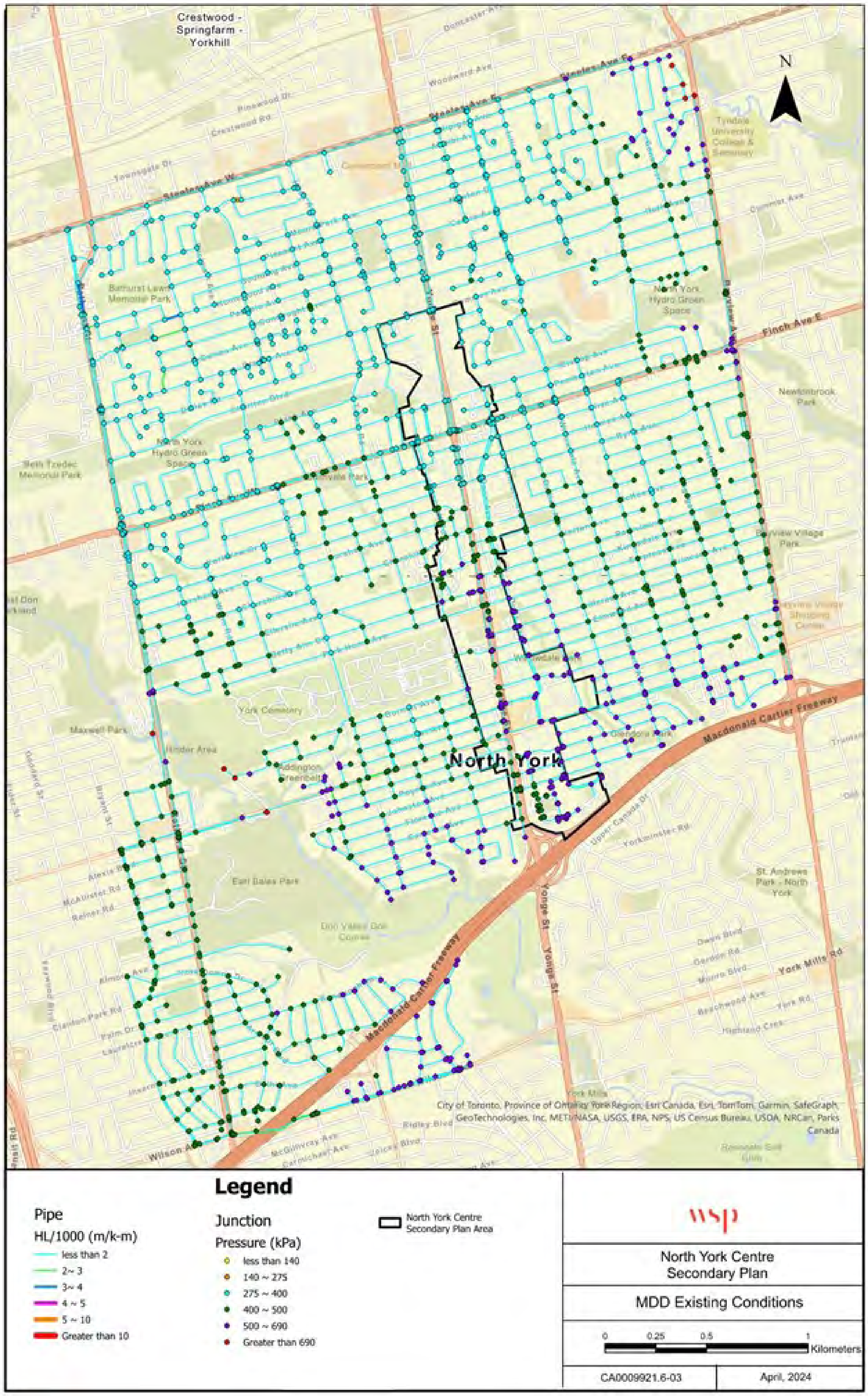

Figure 4-13: Pressure and Head Loss Gradient for MDD under Existing Conditions

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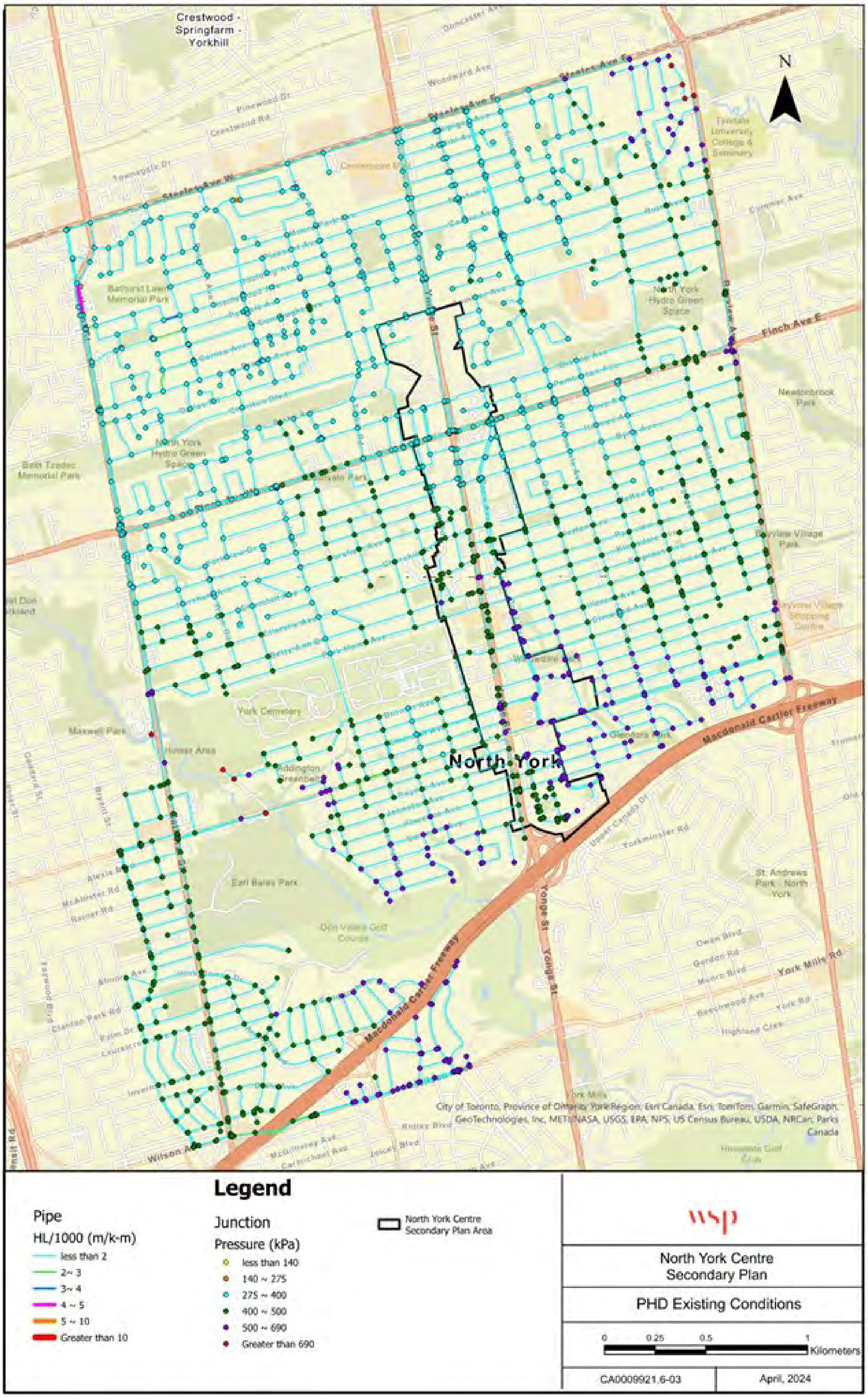

Figure 4-14: Pressure and Head Loss Gradient for PHD under Existing Conditions

The Fire flow scenarios were simulated under Maximum Day Demand conditions for 2021. Available fire flows are summarized in **Table 4-15** and shown in **Figure 4-15**. The available fire flows along the existing watermains within the Study Area ranged between 44 L/s and 883 L/s. There was only one location with a modelled fire flow below the minimum requirement of 63 L/s. This hydrant, with an AFF of 44 L/s is located at the end of a dead-end residential watermain located to the northwest end of the study area (at the end of Inez Court). It should be noted that there is another hydrant less than 100m upstream of this point, which is able to deliver the minimum required fire flow, as such, no upgrades are recommended at this time for this area.

Table 4-15: Simulated Available Fire Flow under Existing Conditions

Demand Scenario	MDD+FF (L/s)
Existing	44-883

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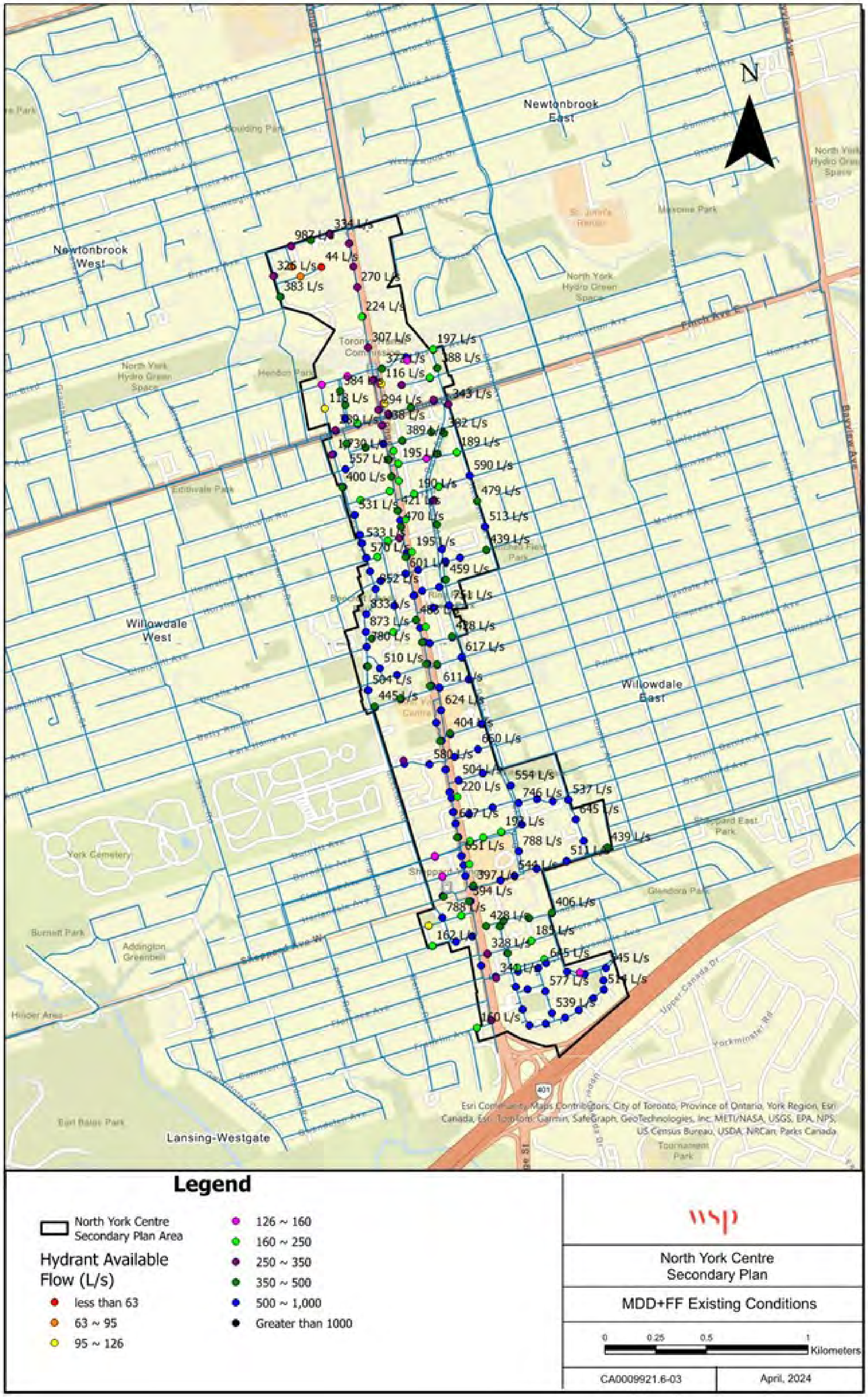

Figure 4-15: Available MDD+FF under Existing Conditions in Model

4.6 Planned Improvements

As a result of the existing study summarized herein, WSP is not recommending any capital projects at this time, however we acknowledge the City's Capital Plan which is highlighted in **Table 4-16** for the Water Study Area. Simulations of future conditions will reflect these projects as applicable. This is subject to review pending the modelling of future conditions.

Table 4-16: Water Network Updates in the Model

Program Name	Description	Location	Source
Watermain Replacement	Abandon 150mm main, transfer all services to 300mm main.	Wilson Ave	Capital Plan
Watermain Replacement	Replace 250mm and 150mm mains with a 300mm main.	Yonge St	Capital Plan
Watermain Replacement	Replace and upsize.	Silverview Dr	Capital Plan
Watermain Structural Lining	Watermain structural lining.	Maxome Ave Senlac Rd Terrace Ave Burnett Ave Wentworth Ave Eddiefield Ave Maxome Ave Bideford Ave Rousseau Rd	Capital Plan

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05. Summary, Conclusions, and Recommendations

05. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Wastewater Collection System

A consolidated model of the sanitary system was developed using Basement Flooding Area 24-28 InfoWorks Models.

The sanitary study area was delineated by the sewershed of the receiving sanitary trunk sewers in Area 26 and 28. Existing sanitary system model was updated to reflect recent changes in infrastructure and population utilizing data provided by the City. Key criteria for an acceptable level of service were established according to City of Toronto criteria. The performance of the existing sanitary sewer system was evaluated under both dry-weather and extreme wet-weather conditions.

Results of the analysis showed that the sanitary collection system meets the criteria under dry-weather conditions. No surcharging was observed within the sanitary study area during DWF conditions, and all sewers were operating under free flow.

Under extreme wet-weather conditions (i.e., during May 12, 2000 storm event) 40 locations experienced freeboard less than 1.8 m. The City's criteria suggest that the instances where shallow sewers are surcharged should ideally be lowered to at least 1.8 m below ground level. Surcharging due to bottleneck in the system or backflow from the downstream pipes were noted on specific streets, including Ellerslie Avenue, Parkview Avenue, Empress Avenue, Kingsdale Avenue, Greenfield Avenue, Beecroft Road north of Park Home Avenue, Churchill Avenue, and Keneth Avenue. Additionally, surcharging was observed upstream of the outfall to the Yonge Relief Trunk on Avondale Avenue, attributed to elevated water levels in the outlet trunk.

As part of this servicing study, the sanitary model was updated with latest sewer network data, population, landuse and boundary conditions. The results of servicing study were comparable with EA except at few locations. Problem locations were identified during this study in addition to the ones identified in EA. In comparison with EA, higher HGLs were observed along Beecroft Road, along Yonge street between Norton Ave and Empress Avenue, and along Doris Avenue between Kingsdale Avenue and Empress Avenue and Wilket Creek STS along Glendora Park Trail. Sewer network on Beecroft Road was not modelled during the EA study. A constant level of 163m was used as boundary condition at outlet of Wilket Creek STS during EA. However, during this study, as discussed and agreed with the City, a boundary condition of 164.468m is used at the modelled outfall on Wilket Creek. This was the maximum depth observed in the trunk during available flow monitoring period. **Figure 5-1** illustrates the differences observed in the servicing study in comparison to EA.

Based on the existing conditions analysis, it is recommended to upsize the sewers surcharging due to capacity constraints or backflow from the downstream pipes to meet the City's level of service. During the next phase of North York at the Centre, the model will be updated to reflect the planned and projected population growth estimates, to determine the infrastructure updates required to meet the level of service. Downstream impacts on the trunk sewers due to developments along Yonge Street will also be considered and recommendations for additional trunk sewer studies made.

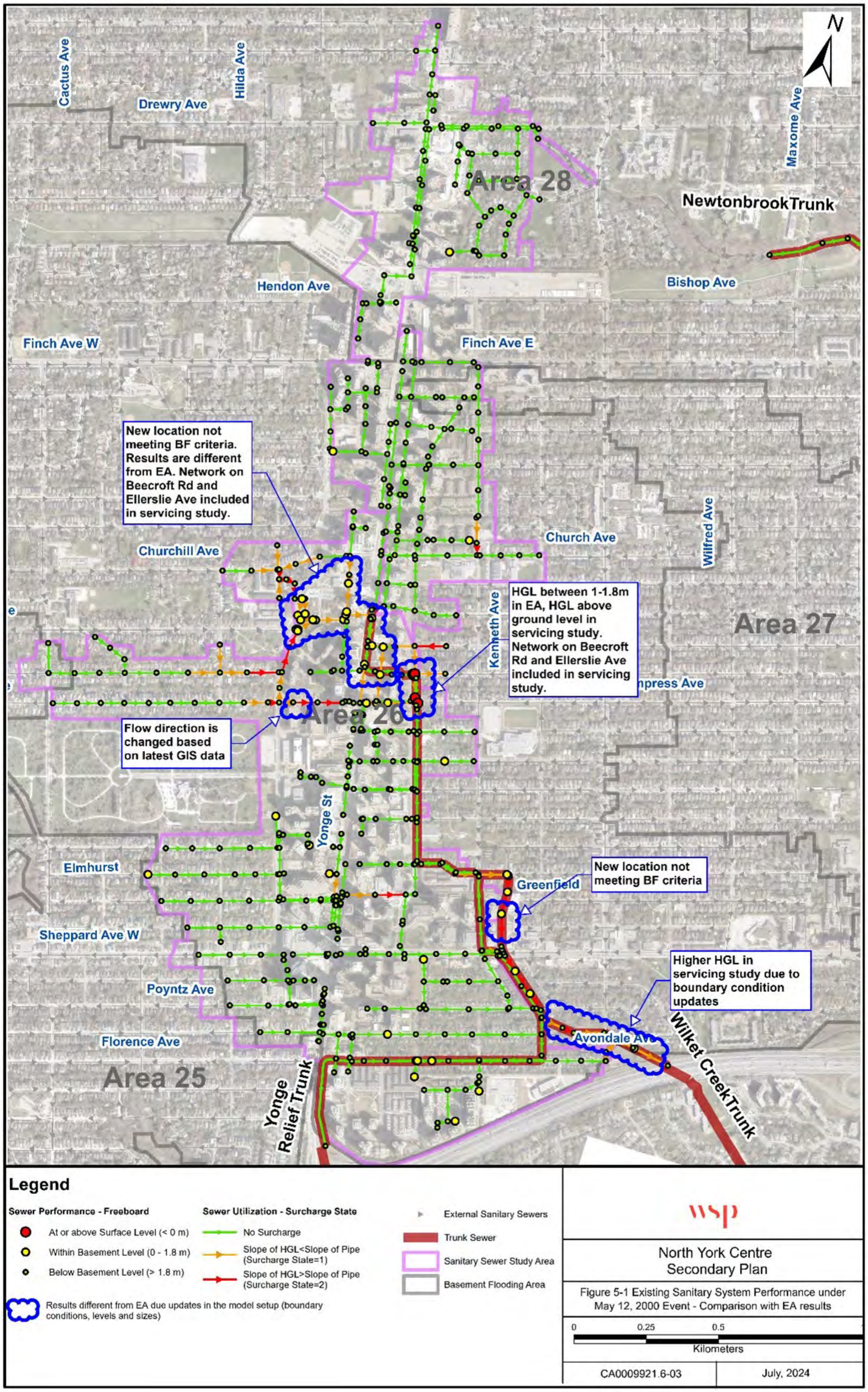

Figure 5-1: Existing Sanitary System Performance under May 12,2000 Event – Comparison with EA results

5.2 Stormwater System

A consolidated model of the storm system was developed using InfoWorks Models for Basement Flooding Area 24-28. The baseline model was updated to reflect the changes after the original models were built. Planned and constructed Capital Projects were included in the model, as discussed in this report.

Acceptable level of service for minor system was defined based on the City's criteria. For major (overland) system, the criteria used in Area 24-27 EA (2016) and Area 28 EA (2008) was considered to evaluate the performance of the storm system. The performance of the existing storm sewer system was assessed for the 2-year and 100-year Chicago design storms. The analysis identified areas where the existing system does not meet the acceptable level of service.

The existing minor (sewer) system's performance was assessed under 2-year and 100-year design storms. Evaluation criteria included ensuring hydraulic gradient line (HGL) in storm sewers remained at least 1.8 m below surface elevation during a 100-year design storm and assessing pipe surcharge states under 2-year design storm. Results revealed that during the 100-year storm event, 89 locations were susceptible to basement flooding. Also, surcharge by depth and surcharge by flow was observed in many storm sewers in the storm study area. The locations susceptible to basement flood are illustrated in **Figure 3-5**.

The overland system's performance was assessed during a 100-year design storm event. The potential for surface flooding was determined based on the EA level of service targets. Results indicated that 19 locations failed to meet the permissible overland depth criteria, as depicted in **Table 3-4** and illustrated in **Figure 3-6**. These areas predominantly include segments of Hendon Avenue, East of Talbot Road to Yonge Street, and Yonge Street North of Finch Street to Drewery Avenue's northern boundary. Additionally, scattered areas of concern were identified along Finch Street near Dudley Avenue, Shepperd Avenue, Hillcrest Avenue, Maplehurst Avenue, Oakburn Crescent, Silverview Drive, Glendora Avenue, and Beecroft Road.

As part of this servicing study, the model was updated with latest sewer network data and boundary conditions. The modelling results of servicing study were comparable with EA except at few locations as illustrated in **Figure 5-2**. Problem locations were identified at Doris Avenue, Sheppard Avenue W, Yonge Street south of Finch Avenue and Maplehurst Avenue due to updates in the model. For the overland system, the results from servicing study were comparable with EA except at Beecroft Road. The overland path along Beecroft Avenue was not modelled during EA study and updated as part of Bundle A capacity assessment project.

No significant deviations are observed from EA except at Yonge Street near Sheppard Avenue, Sheppard Avenue West and East, Maplehurst Avenue, Avondale Avenue. The deviations in results can be attributed to the recent upgrades in the storm network.

Based on the existing conditions analysis it is recommended to upsize the sewers surcharging due to capacity constraints or backflow from the downstream pipes to meet the City's level of service. During the next phase of North York at the Centre, the model will be updated to reflect the planned and projected development and land use changes to determine the infrastructure updates required to meet the level of service. Downstream impacts on the system will also be considered and remedial measures will be recommended accordingly.

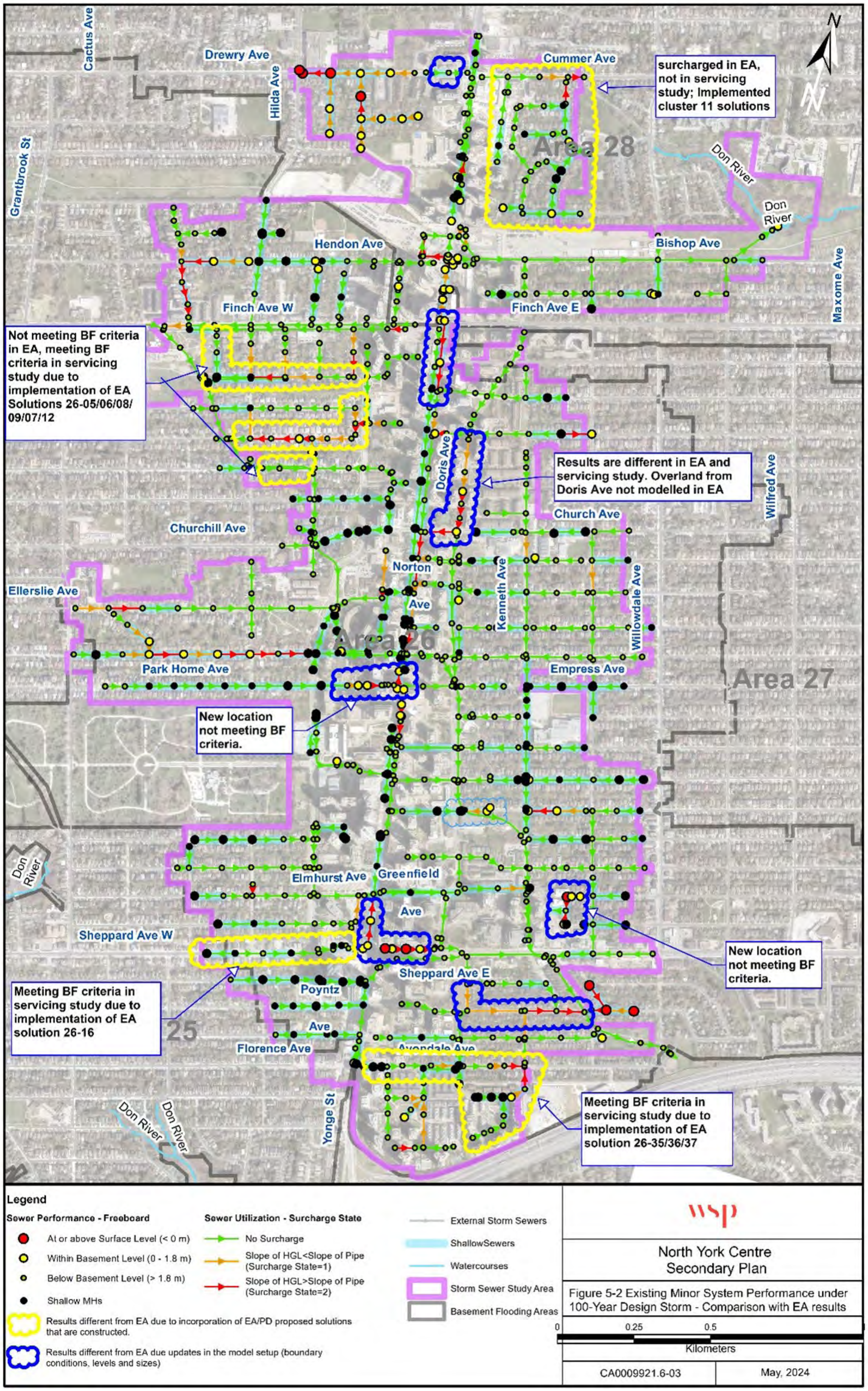

Figure 5-2: Existing Minor System Performance under 100-Year Design Storm – Comparison with EA results

5.3 Water Distribution System

WSP Canada Inc. built and calibrated a 'stand-alone' water model. This process involved utilizing information, including shapefiles provided by the City, that contained data on water assets and were combined with Average Day Demands from 2021 AMR data.

The Existing Conditions Average Day Demand (ADD) was loaded into the hydraulic model and run under both the Maximum Day (MDD) and Peak Hour (PHD) scenarios (ADD was adjusted by applying peaking factors).

The model was calibrated both in terms of macro and micro calibration. Macro calibration relied on observed data, specifically pressure monitoring, which was implemented using two distinct datasets: SCADA data from two points (Armour Heights Pumping Station and Edithvale Community Centre), as well as pressure monitoring data collected by WSP from a total of eight (8) points. In terms of micro calibration, WSP conducted a total of six (6) hydrant flow tests and six (6) C-Factor tests.

WSP selected eight pressure monitoring locations that covered both low and high elevations, considered the influence of pumping facilities, incorporated areas with significant demand or critical users, and were situated at the boundaries of the study area. These locations were used to monitor the average pressures during the field testing conducted in November 2023.

All locations pertinent to both macro and micro calibration were depicted in the figures, and their results have demonstrated a high level of satisfaction. By comparing the model results with observed data from both the SCADA system and WSP pressure monitoring, differences were determined. The average differences between modelled pressure and monitored data in the SCADA monitoring system and WSP pressure monitoring were 4.75% and 0.0%, respectively. These variances were found to be less than the 5% compliance threshold set by the AWWA M32 (American Water Works Association), thereby satisfying the criterion.

In terms of micro calibration, WSP identified six locations for C-factor measurement, encompassing pipelines of varying materials and diameters. Additionally, the roughness factor obtained from the City of Toronto Sewer and Watermain Design Criteria manual (2021) was combined with the results of the C-factor tests. This combined data was then imported into the model.

To assess the results, the modelled hydrant flow was compared to the results of the Hydrant Flow Tests conducted at the six specified locations. The analysis revealed that the average difference between observed data and simulated pressure was approximately 0.1%, with a standard deviation of approximately 3%. None of the differences exceeded 4%, satisfying the criterion outlined in AWWA M32 (5% difference).

All junctions within the North York Centre Study Area met the pressure requirements across all scenarios with the exception of ten (10) junctions outside of the North York Centre Study Area with pressures exceeding 695 kPa (101 psi). The junctions with pressures exceeding 695 kPa (101 psi) are positioned at low points at the northeastern boundary of the model, and low points at Steeles Avenue East and Bayview Avenue.

Under all conditions (ADD, MDD, and PHD), the head loss gradient for all pipelines has been under 5 m/km, which satisfies the condition mentioned in the Design Criteria for Sewers and Watermain (between 2 to 5 meters/1000 meters), with the exception of three segments of 150mm watermains under MDD and PHD conditions.

Overall, water modelling results show room for growth within the North York Centre Secondary Plan Area, with pressures and head loss gradients throughout the water distribution system meeting MECP requirements. Areas within the water distribution system with high pressures are likely to lower with increased water demands associated with future growth, and there are currently no areas with pressures below the minimum requirement.

The 2051 project population will be reviewed in Phase 2 and compared with Planning proposed land use, population growth, and builtform, and applied to evaluate storm, sanitary, water servicing capacities.