Master Plans for
Urban Water Infrastructure in
The City of Vaughan

City-Wide Water & Wastewater Master Plan Class EA

APPENDIX G
Wastewater Collection System Modelling Technical memorandum

JUNE 2014

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VAUGHAN URBAN WATER MASTER PLANS

Wastewater Modeling Report

OCTOBER 2013

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1 Introduction

The Municipal Infrastructure Group Ltd. (TMIG) were retained by the City of Vaughan (the City) to undertake a Class Environmental Assessment (Class EA) of the projected development in the City of Vaughan.

The City of Vaughan's water and wastewater models were a key tool to identify and evaluate servicing options. This report documents the status, assumptions, and modifications that TMIG made with respect to the wastewater model for this project.

1.1 Master Plan Model

TMIG were provided with the City's existing hydraulic models that were developed by others for planning purposes. These models were developed using SewerCAD modeling software. It is TMIG's responsibility to complete and return a working model of the entire city system to the City.

Once a system model has been developed, TMIG had to investigate the following:

- General Review of the model
- Confirm that the previous modeling decisions and philosophies are consistent with the goals of a comprehensive planning tools
- Incorporate the long-term planning projections into distinct modeling scenarios
- Recommend changes to design criteria or policies (if any)
- Identify the opportunities and constraints within the existing system
- Identify required modifications or upgrades

1.1.1 Model Extents

The system to be developed will be city-wide and identify the connections to other cities/municipalities. The model will also include the Region of York's infrastructure within the City of Vaughan's limits.

2 Wastewater Master Plan Model

2.1 Model Development

From the City of Vaughan, TMIG received five separate models in SewerCAD format:

- Jane Street
- Woodbridge
- Maple
- OPA 332
- Kleinburg

Throughout the project, discussions between the City and TMIG resulted in a scope change. The models provided to TMIG were in SewerCAD format. The City-wide wastewater models were converted into InfoWorks modeling software, making them compatible with the York Region's wastewater model. Additional work was required prior to joining all SewerCAD models into one City-Wide model.

SewerCAD and InfoWorks are not compatible. However, the data was extracted from the SewerCAD models and import into InfoWorks.

The only issue that was encountered for each model was the extraction and import of the drainage areas (subcatchments). The subcatchments are linked to a manhole or node where the flows from the area will discharge to. This is a vital piece of information that is linked to each subcatchment. In the case of extracting and importing this information into InfoWorks, the links do not appear (i.e. it is unsure where each subcatchment is supposed to discharge to).

After the separate models were replicated in InfoWorks, each model was initialized and a run was completed to see if it would work. After debugging any issues that appeared and confirming that the models were running properly, the next step was to join all the models into one large "entire city network" model.

Combining the models into one large City model was done in a similar fashion as the SewerCAD to InfoWorks conversion. Essentially, all nodes, pipes, and subcatchments were copied from each model individually, and then pasted into the City system model (within InfoWorks). Again, once everything was in the City system model, the scenario was run and any issues were resolved.

The biggest challenge was the inclusion of the Region of York infrastructure. It appeared that the City models contained information of the Region's system, but it wasn't easily distinguished, such that when the Region's infrastructure was added into the City system model, there appeared to have four pipes where there should only be two (etc.). To add to the confusion, there were occurrences where the 'doubled' pipes do not have the same pipe size. Additional information was requested from the City and the Region to confirm which pipes are active and which (if any) is abandoned.

With the five received models and the Region information, there appeared to be large gaps in the model (i.e. there were no pipes in Blocks 1, 2, 10, etc.). Yet, the aerial images of the area demonstrate it is clearly developed land. Under these circumstances, the City's GIS information was relied upon to complete the model. In some cases, there was known development but it was not modelled or no GIS data existed. In this case, information requests were sent to the City to provide the necessary data for the area in question.

After the completion of the design criteria investigation and an agreement between which criterions to use moving forward, it was now acceptable to run scenarios.

2.2 Model Flows

Within InfoWorks, flows are calculated through the subcatchments (or drainage areas). The subcatchments can use persons, trade flow (m^3/s), and additional foul flow (m^3/s) to account for any flows in the area.

In order to include a peaking factor, wastewater profiles were created. These profiles are approximate peaks for a specified population range (i.e. 0-1000 persons). As well as specifying a population/flow for each subcatchment, it is also necessary to specify a "Wastewater Profile". The wastewater profiles are split up as follows:

1. Population < 1000 persons
2. 1001 persons < Population < 2500 persons
3. 2501 persons < Population < 5000 persons
4. 5001 persons < Population < 15000 persons
5. 15001 persons < Population
6. When no peak is needed.

The model will "peak" population and the additional foul flow. In times when no peak is needed, the subcatchment is set with a wastewater profile of "6" to ensure any flow being added to the system through that subcatchment will not be peaked.

These subcatchments also contain the areas covered. Using these areas, inflow/infiltration flow can be added under "base flow" parameter within the subcatchment information. This flow will not be peaked.

2.3 Pumping Station Operation

The pumping stations in the Master Plan model were set up as "Outfalls". Rather than using pump curves and forcemains, it was more applicable to model them as "Outfalls". It is not the purpose of the Master Plan model to present necessary upgrades to existing pumping stations.

To account for these flows, the total flow at an Outfall (or the pumping station capacity) is then placed as an "Additional foul flow" where the forcemain discharges into the gravity system. The pumping station capacities are as follows:

Table 2-1: Pumping Station Capacities

Pumping Station Name	Location	Firm Capacity (L/s)
Block 40/47 P.S.	Block 40	274
Block 12 P.S.	Block 12	222
Kleinburg WPTP	Block 54	33.3
Sevilla P.S.	Block 54	25
Camlaren P.S.	Block 54	25
Kerrowood P.S.	Block 62	12
Nashville P.S.	Block 54	49
Pine Valley South P.S.	Block 38/45	328
Northdale P.S.	Block 20	17.05
Maplewood P.S.	Block 20	58.55
Block 39 P.S.	Block 39	50
Pinegrove P.S.	Block 44	10
Wonderland P.S.	Block 32	101
Kleinburg P.S.	Block 62	60

3 Results

The City-wide wastewater model used several scenarios to account for different conditions resulting in the projected growth and the modifications to the design criteria. Different pipe sets were used representing existing (2006) and 2031 conditions, including the recommended system improvements. The following scenarios were completed and discussed below:

Model Year	Pipe Set	Design Criteria	See Results
2006	Existing	Existing (pre-2012)	Figure 3-1
2031	Existing	Existing (pre-2012)	Figure 3-2
2031	Existing	Proposed	Figure 3-3
2031	Proposed	Proposed	Figure 3-4

New growth areas are connected to the most appropriate discharge point, based on topography and existing reserve capacity.

3.1 2006 Results (450 Lpcd)

The figure shows some locations where modelling results indicate surcharging, but discussions with City and Region staff indicated that there are no operational concerns in these areas, specifically;

- Pine Valley Collector,
- Islington Collector,
- Kleinburg Collector,
- Clarence Collector

Additional investigation into the results revealed the following:

- Recent reconfiguration of Regional mains is not correctly represented in the models.
- The Pine Valley Collector is shown to be surcharging based on the model input. The modelled surcharging is not believed to be real, but this area will be reviewed for any impact on future scenarios. This is therefore an existing condition, unrelated to the growth projections.
- The Islington Collector consists of both City and Regional sewers with multiple supposed connections between them. No connections were included

in the previous models, and no connection details could be located during the present update.

- Modelling results indicate surcharging of the Clarence Collector. This modelled surcharging is not believed real, but this area will be reviewed for any impact on future scenarios. This is an existing condition and is unrelated to the growth projections.
- The Kleinburg Collector appears to be surcharging within the model. This area is currently under design improvements.

3.2 2031 Results (existing pipes with 450 Lpcd)

This scenario uses the same pipe set as the previous scenario, but includes the 2031 population projections. Since this scenario has increased population numbers, the results show increased surcharging over the 2006 results, as expected. It is believed that the City's design criteria (based on the Ministry of Environments guidelines established in the 1980's) are overly conservative, and will result in recommending upgrades that might not really be required. Discussions with the City have led to improved design criteria that are more consistent with the Region's criteria.

3.3 2031 Results (existing pipes with 364 Lpcd)

This scenario uses the same pipe set as the previous two scenarios, includes the 2031 population projections and used the proposed Master Plan design criteria. Although changing the design criteria to something more realistic helps to fix some of the model indicated surcharging, it does not remove the requirement for new projects to accommodate all of the proposed growth.

3.4 2031 Results with Proposed Projects

This scenario uses the existing infrastructure, with the proposed improvements and the 2031 population projects with the new design criteria. The previous locations where the model reported surcharging in the 2006 scenario have been examined for this scenario and are discussed below:

- Pine Valley Collector: Model results indicate that this stretch of sewer is surcharging under this scenario. Since a similar level of surcharging was shown under the existing conditions (2006 scenario), it is believed that this is an existing condition and was not caused nor worsened by the future population projections.
- Islington Collector: Similar to the Pine Valley Collector, modelling results indicate that the Islington Collector is surcharged under this ultimate condition. As expected, the same level of surcharging exists between the existing (2006) conditions and this scenario. As such, it is believed that this is an existing condition and was not caused or worsened by the future population projections.
- Kleinburg Collector: Modelling results indicate surcharging under this scenario. This collector is currently under design and will be implemented in the future. Using the information available, it is shown that the existing (2006)

conditions and the ultimate (2031) conditions results in the same amount of surcharging within the model. This condition will be alleviated with the construction of the proposed improvements.

- Clarence Collector: Model results indicate that this stretch of sewer is surcharging under this ultimate (2031) scenario. A similar level of surcharging was discovered between this scenario and existing (2006) conditions. It is believed that this is an existing condition and was not caused or worsened by the population projections.

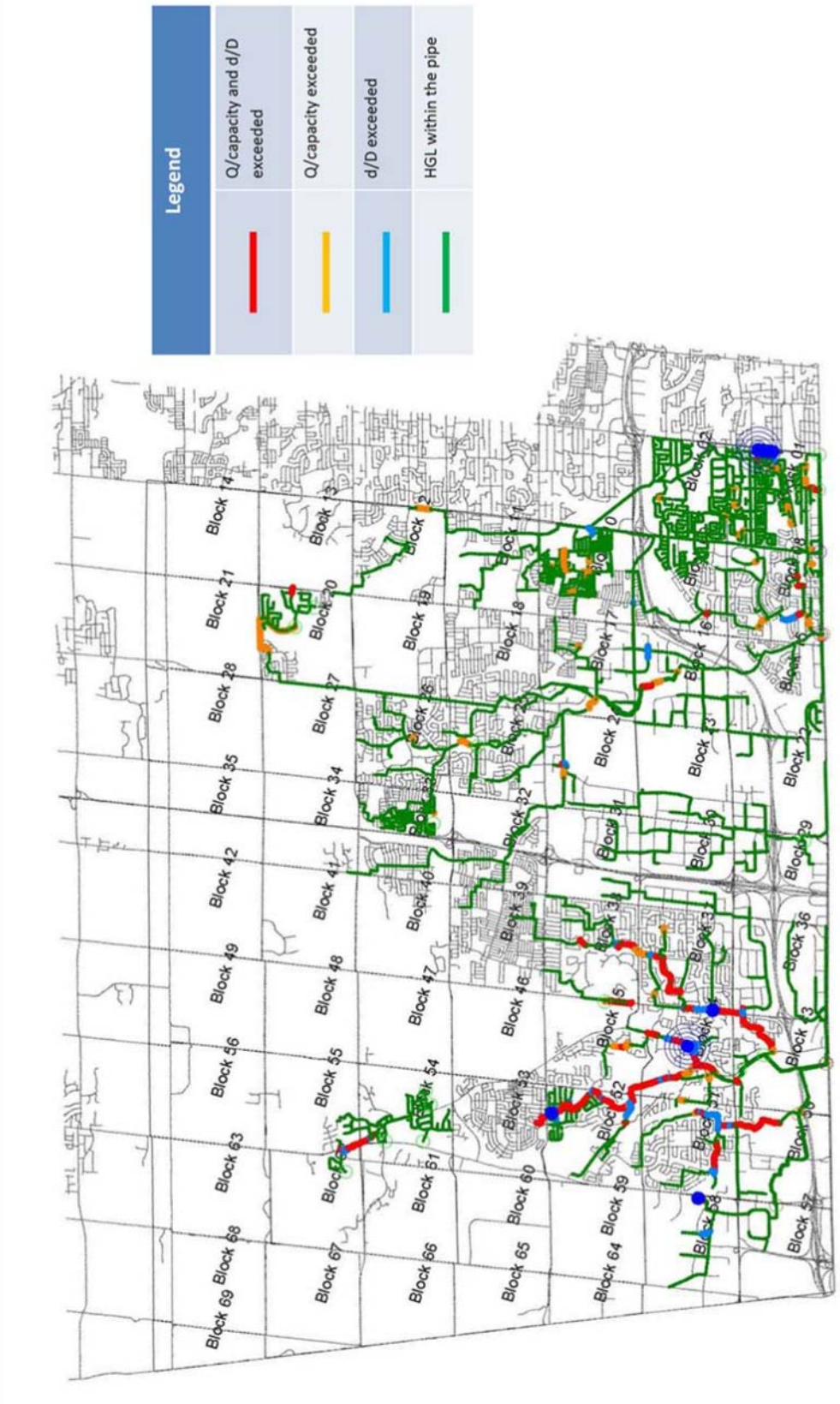

Figure 3-1: 2006 Scenario with existing (pre-2012) design criteria

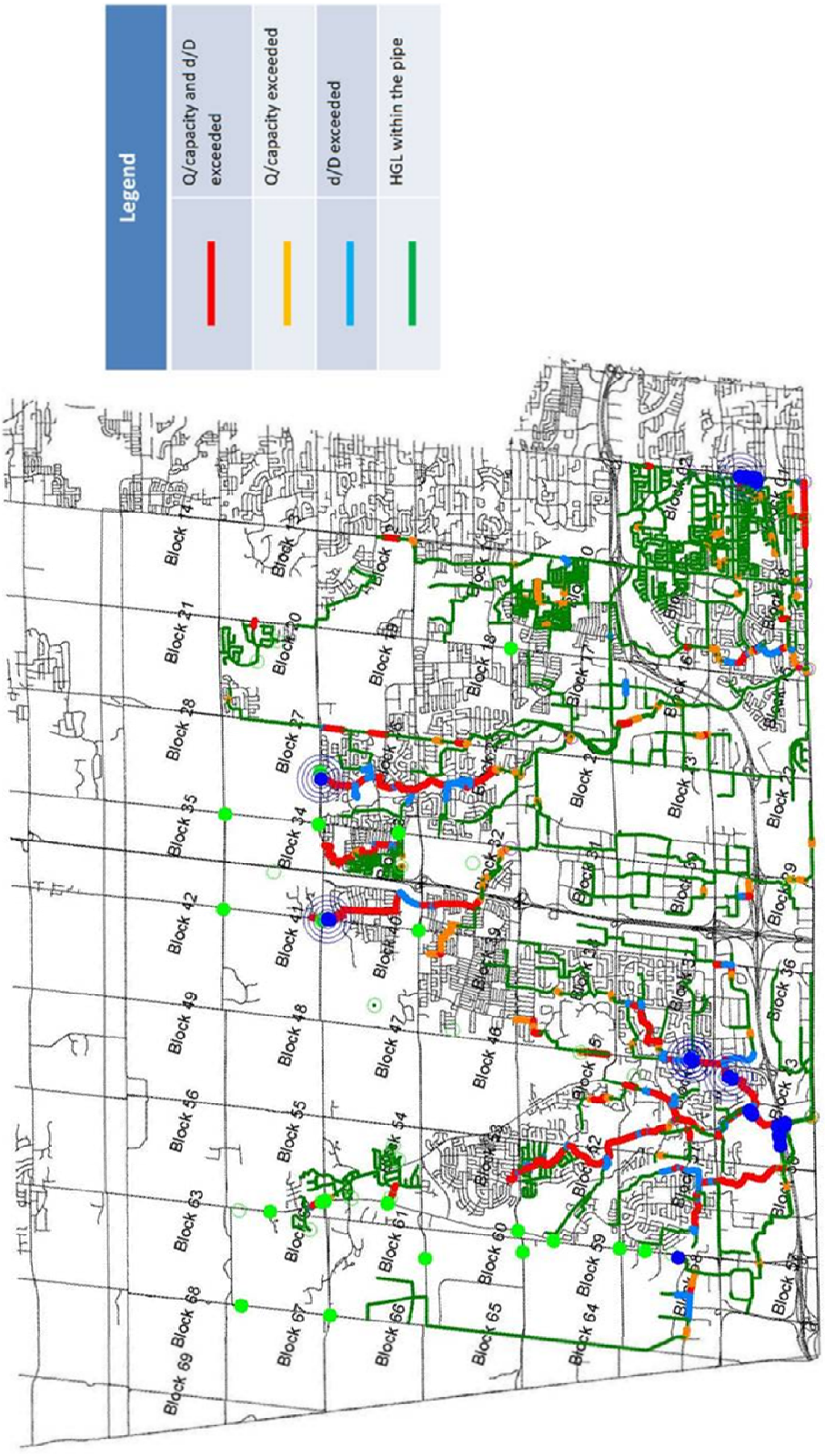

Figure 3-2: 2031 Scenario with existing (pre-2012) design criteria

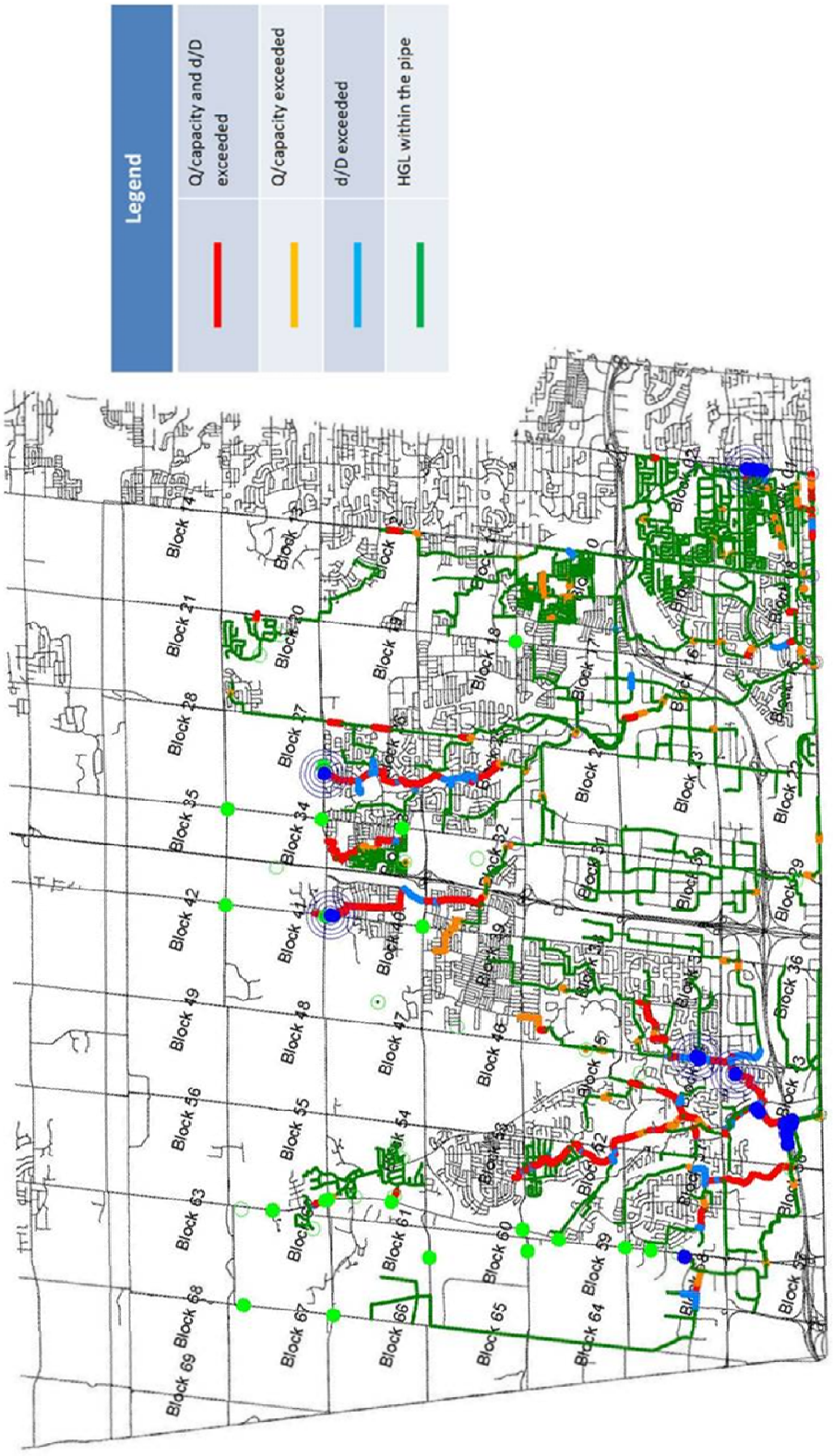

Figure 3-3: 2031 Scenario with Master Plan design criteria

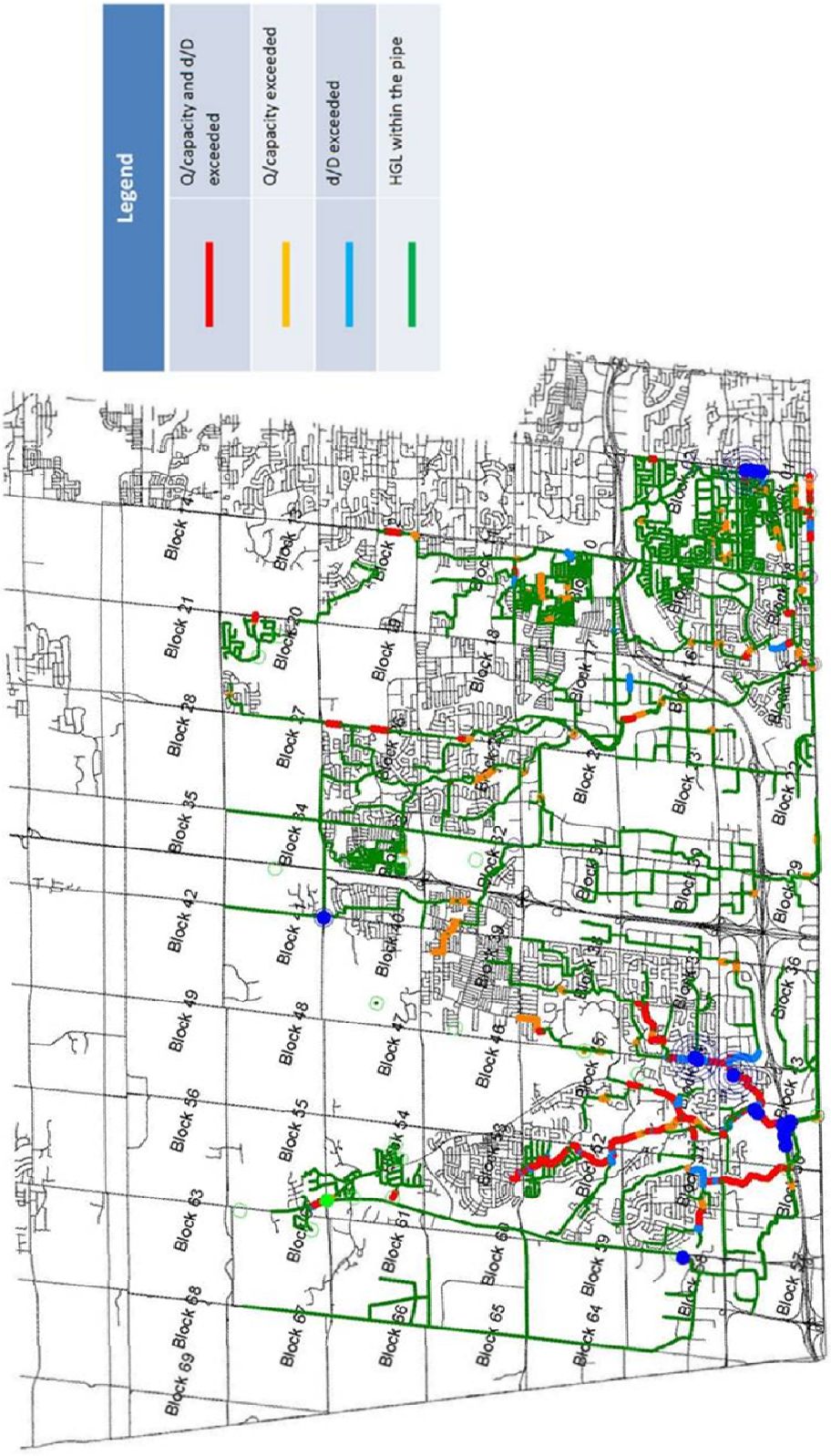

Figure 3-4: 2031 Scenario with Master Plan design criteria and improvements