BURNSIDE

City of Owen Sound
East Owen Sound Master Servicing Study
Volume 1
Water and Wastewater Servicing

Prepared by

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Executive Summary

Background

R.J. Burnside & Associates Limited was retained by the City of Owen Sound to undertake a Master Servicing Study (MSS) for the water supply servicing, sanitary sewer servicing and stormwater management for the eastern section of the City. The stormwater management component of the study is presented under separate cover. The plan will be known as the "East Owen Sound Master Servicing Study."

The City's initiative to undertake a Master Servicing Study was brought about by several issues and recent events, including flooding on 15th Street B East, ongoing development along the 16th Street (Hwy. 26) corridor and the Sydenham Heights Planning Area, and the need to address servicing requirements for the remaining vacant land in the eastern part of the City. This master plan will serve as a base reference document for the City and property owners wishing to undertake development relative to servicing the remaining vacant land in the eastern part of the City to allow for orderly development.

In consultation with the City, a problem statement was developed for the East Owen Sound Master Servicing Plan. The problem statement was defined as follows:

"Several issues and recent events in the City of Owen Sound have created the need for the City to review its strategies for providing water and sanitary sewer servicing, and stormwater management. As a result, the City needs to consider options to resolve the stormwater management issues on 15th Street B East, 16th Street corridor and the Sydenham Heights Planning Area, and for the servicing of the undeveloped lands on the east side of the study area, that also give due consideration to the constraints and opportunities associated with the existing servicing infrastructure. The intent is to identify an orderly and efficient servicing strategy for the vacant land in the eastern section of the City, while accounting for the technical, environmental, economic, political and social implications of the strategy on the City of Owen Sound's future."

Existing Servicing and Projected Population

According to the 2001 Census Data provided by Statistics Canada, the City of Owen Sound has a current population of approximately 21,500 people. It is anticipated that the population of the City could reach 26,240 by year 2026 and approximately 43,360 at the Ultimate Build-out depending on the final designation of lands on the east side of the City as either industrial or residential. The corresponding demand for water supply will increase from the current maximum daily demand of 21,179 m^3/day to 24,797 m^3/day in year 2026 and 40,925 m^3/day at Ultimate Build-out. The existing Water Treatment Plant (WTP) has a rated capacity of 27,276 m^3/day. Consequently, the capacity of the WTP is adequate to beyond 2026. It is projected that an increase in capacity will be required to meet the Ultimate Build-out demands.

Similarly, the City's Wastewater Treatment Plant (WWTP) is currently rated for an <u>average</u> daily flow of 24,500 m^3/day and the anticipated <u>average</u> daily flow for the Ultimate Build-out planning horizon is 21,747 m^3/d. As a result, the existing plant has adequate capacity to accommodate the projected Ultimate Build-out sewage flows and an expansion of the WWTP will not be required to address average daily flow. It is noted that the existing plant has, on occasion, difficulty handling peak flows under current conditions; as such it will be necessary to locate and correct collection systems deficiencies to bring the infiltration and inflow issues to more reasonable levels, and/or undertake an expansion of the WWTP to ensure that these flows can be handled. A detailed evaluation of this infiltration and peak flow handling issues is outside the scope of this report. Similarly, the existing facility is not equipped to provide the level of treatment typically required, and as such, upgrades to provide additional levels of treatment should be anticipated. The scope and cost of the upgrades is outside of the scope of this report.

Water Supply Servicing Strategy (East Hill Zone)

Three acceptable servicing strategies for the East Hill Pressure Zone were identified; these include E2 – No Storage, E3.1 – New Storage For East Hill Zone or E4 – Shared Storage with the Industrial Zone. The alternatives were presented to committee in June 2007.

The preferred servicing strategy for the East Hill Pressure Zone is to construct an elevated tower to serve the East Hill lands alone. This would include improvements to the East Hill Booster Station and eventually capacity improvements to the R.H Neath Water Filtration Plant (for Ultimate Build-out demands).

A life cycle costs comparison was conducted and demonstrated that the life cycle costs associated with Option E.2 (No Storage) and Option E.3.1 (East Hill Zone Storage) are similar. The estimated capital costs to implement the preferred solution for the East Hill Zone for 2026 horizon is summarized below:

Item	Cost
Upgrades to East Hill Booster Station	$ 760,000
East Hill Zone Water Tower	$2,640,000
Subtotal	$3,400,000
Engineering and Contingencies (25%)	$ 850,000
Total	$4,250,000

Water Supply Servicing Strategy (Industrial Zone)

Three acceptable servicing strategies were identified for the Industrial Pressure Zone; these include I2 – No Storage, I3 – New Storage For the Industrial Zone or I4 – Shared Storage with the East Hill Zone. The alternatives were presented to committee in June 2007.

The preferred servicing strategy for the Industrial Pressure Zone is the alternative to construct an elevated tower to serve the industrial lands alone.

The location of the reservoir and the associated watermain to connect it dramatically affects the capital cost component of the life cycle cost analysis. The closer to the Industrial Zone that the reservoir is located, the closer the life cycle costs are between this solution and the no-storage solution.

The estimated cost to implement the preferred solution for the Industrial Zone is summarized below:

Item	Cost
Industrial Zone Water Tower	$4,800,000
Subtotal	$4,800,000
Engineering and Contingencies (25%)	$1,200,000
Total	$6,000,000

Sanitary Sewer Servicing Strategy

The preferred solution for providing sanitary services for the as yet undeveloped lands along the east and south portions of the study area is option S2. This option involves extending the existing trunk sewer southerly into the undeveloped lands.

This solution also requires that the trunk sewer between the WPCP and the intersection of East Shore Road and 3rd Avenue East be upgraded. This project has been previously identified as necessary and has been designed. These costs are not included below.

The cost of extending the sanitary sewer is estimated to be:

Item	Cost
Extend Existing Trunk Sewer	$1,500,000
Subtotal	$1,500,000
Engineering and Contingencies (25%)	$ 375,000
Total	$1,875,000

Implementation Schedule

The East Hill Zone water storage and East Hill Booster Station upgrade are a short-term priority.

The Industrial Zone water storage option is a medium- to long-term priority.

The sanitary sewer trunk extension is a short-term priority to facilitate development in the southeastern corner of the study lands for development currently being considered.

The upgrade of the existing trunk sewer on 3rd Avenue East is a medium-term priority.

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1.0 Introduction

1.1 Project Background and Objectives

R.J. Burnside & Associates Limited (Burnside) was retained by the City of Owen Sound to undertake a Master Servicing Study (MSS) for the eastern section of the City. The study area is bounded by the Sydenham River and Georgian Bay on the west and by the City limits to the north, east and south as outlined in **Drawing WAT1**. The focus of the East Owen Sound MSS is to recognize the servicing constraints, with respect to water servicing, sanitary sewer servicing and stormwater management, that are facing development of the vacant lands in the study area. The MSS will identify the alternative solutions that are capable of addressing these constraints, evaluate the suitability of each alternative solution, and provide a cost-effective and orderly servicing plan for the development of the lands in the study area.

The water and wastewater aspects of the study are presented in this report. The stormwater management issues are addressed in detail under separate cover.

The City has finalized a major update to its Official Plan and has experienced significant development in recent years. A number of independent studies have been undertaken by the City on the water, sanitary and storm systems and associated infrastructure. There are many servicing recommendations spread across these reports and some of them are becoming dated. The objective of the study is to consolidate this information into a servicing strategy, which will ensure orderly serving of the vacant lands in the study area. The updated Land Use Plan from the Official Plan for the City of Owen Sound has been altered for simplicity, such that all types of land use are classified as one of the four general land uses: Residential, Commercial, Industrial and Other. The simplified land uses are displayed on Drawing SAN3 located in **Appendix A**.

The primary issues to be addressed as part of this study, in order of precedence, include occasional flooding of basements on 15^{th} Street B East, ongoing development along the 16^{th} Street (Hwy. 26) corridor and the Sydenham Heights Planning Area, and the need to address servicing of the vacant land in the eastern part of the City to allow for orderly development of those lands. The MSP would serve as a consolidated, up-to-date reference document for the servicing issues associated with the vacant lands available for development within the updated Official Plan.

The identification and evaluation of alternatives have been conducted using an approach consistent with the framework outlined for Master Plans as identified in the Municipal Class Environmental Assessment (EA) framework. Stakeholder involvement has included meetings and presentations to the City and one public meeting with regard to the issues on 15^{th} Street East.

The terms of reference require that the study be focused on the east side of the city. Where services currently extend beyond the boundaries of the city, these are to be maintained, but there is to be no provision for additional servicing outside of the City boundaries.

1.2 Previous Studies

Over the last thirty years, the City of Owen Sound has carried out a number of studies that contribute information and data that is relevant to the City’s water servicing, sanitary servicing and stormwater management. The MSS for the East Side of Owen Sound draws upon work previously completed to obtain an understanding of the existing services, and previously identified servicing strategies. Documents of particular relevance to this study have been reviewed and a list is provided in each servicing section that outlines the studies that have been reviewed in the preparation of the MSS.

1.3 Class Environmental Assessment Process

A Municipal Class EA is a planning process developed to ensure that potential social, economic and natural environmental effects are considered during the planning of municipal projects with reasonably predictable environmental impacts. The Municipal Class EA allows for input and approval by interested agencies and the public at the local level and beyond. The Class EA process has been developed by the Municipal Engineers Association for municipal works projects, and when fully implemented, meets the requirements of the Ontario Environmental Assessment Act.

It is important to recognize that under the Class EA process, all reasonable planning and design alternatives and potential impacts must be given appropriate consideration.

1.4 Municipal Class EA’s “Master Plan” Provisions

The Municipal Class EA is most often associated with a specific and single project. However, the Class EA process also recognizes the need for a mechanism that will enable a municipality to plan “a group of related projects,” such as those associated with the development of a strategy for water and sewage works. This enables the municipality to develop a master plan, which may include the planning of a number of individual projects. With the completion of the master plan approach, each project arising from the master plan must still comply with the residual, project-specific requirements set out within the Class EA’s planning and design process.

The Class EA recognizes that environmental impacts will vary with each type of project and this is accommodated by categorizing projects under different schedules, specifically schedules A, B and C. Schedule C projects have the greatest potential for adverse impact and therefore normally require the most work and time to complete. Although a Schedule C project will involve up to a maximum of five phases, the fundamental objective of developing a project as part of a master plan normally involves only two of the five phases required for a Schedule C project:

- Phase 1 – Problem or Opportunity Identification –Involves the development of a clear statement of the issue that the municipality wishes to resolve. In this situation, this is the development of the East Owen Sound Master Servicing Plan.

- Phase 2 – Identification and Evaluation of Alternative Solutions – Involves identifying and describing reasonable and feasible solutions in sufficient detail to address the problem or opportunity defined in Phase 1 so that there is a good understanding of their respective advantages, disadvantages and impact. Phase 2 concludes with the selection of a “preferred alternative," or group of alternatives, and this is where master plans for municipal infrastructure typically finish. The detailed evaluation of project-specific environmental effects and mitigation measures occurs in subsequent project-specific studies, which for Schedule C projects are carried out under Phase 3 of the Class EA..

2.0 Identification and Description of the Problem

2.1 Problem Statement

The problem statement that is used as the basis for the East Owen Sound Master Servicing Study is defined as follows:

"Several issues and recent events in the City of Owen Sound have created the need for the City to review its strategies for providing water and sanitary sewer servicing, and stormwater management. As a result, the City needs to consider options to resolve the stormwater management issues on 15th Street B East, 16th Street corridor and the Sydenham Heights Planning Area, and for the servicing of the undeveloped lands on the east side of the study area, that also give due consideration to the constraints and opportunities associated with the existing servicing infrastructure. The intent is to identify an orderly and efficient servicing strategy for the vacant land in the eastern section of the City, while accounting for the technical, environmental, economic, political and social implications of the strategy on the City of Owen Sound's future."

2.2 Public, Agency and Stakeholder Consultation

A fundamental feature of the Class EA process is the opportunity for an open dialogue involving the public, regulatory agencies and stakeholders. The objective of having public, agency and stakeholder consultation is not only to meet the requirements of the Class EA, but to also enhance the acceptance of the selected alternative since it was determined through a collaborative process.

As previously noted, stakeholder involvement has included meetings and presentations to the City and Operational Advisory Committee, and one public meeting with regard to the issues on 15th Street B East.

To date, there has not been a formal advertisement or agency circulation associated with this project.

2.3 Criteria for Evaluation of Alternatives

The evaluation of the alternative solutions for each aspect of the servicing strategy was carried out by considering the impact of each solution with regard to the following criteria:

- technical feasibility
- environmental impact that would result from the implementation of a particular alternative
- economic viability and sustainability
- social impact
- other considerations

2.4 Technical Feasibility

The technical feasibility is the fundamental criterion in the assessment of alternative solutions. An alternative must first be technically feasible before it can proceed to further evaluation. Technical feasibility is assessed on the basis that the undertaking can be carried out, that the technology involved has been proven, or that the risks associated with adopting the alternative can be accepted.

2.4.1 Environmental Impact

The evaluation of the alternatives for potential environmental impact is based on the following criteria:

- Does the alternative comply with current environmental regulations?
- Are the environmental impacts known, or can they be predicted?
- Can the environmental impacts be mitigated?

2.4.2 Economic Viability and Sustainability

The economic viability and sustainability of an alternative is evaluated based on the following criteria:

- the relative life cycle costs (capital and operation and maintenance costs)
- the financial implications for the residents
- impact on economic development opportunities and the local business community

2.4.3 Social Impact and Other Considerations

Social impact and other considerations include:

- impact on land use and the urban structure
- impact on the quality of life in the immediate and surrounding communities
- the schedule for implementation of alternatives and disruption to the community
- the long-term planning considerations
- multi-jurisdictional issues, which involve the interaction between the City of Owen Sound, the neighbouring municipalities and various upper tier governments

3.0 Current and Projected Population

According to the 2001 Census Data provided by Statistics Canada, the City of Owen Sound has a current population of approximately 21,500 people. Between the years of 1981 and 2001, the City experienced an average annual growth rate of only 0.4 percent per year, which is considerably low when compared to a growth rate of 1.4 percent for all of Ontario. However, it is anticipated that the City's population will increase at a higher rate based on the "Share of Growth" approach outlined in the City's Official Plan Background Study dated October 2003. Appendix B of the updated Official Plan suggests that under the "Share of Growth Scenario," there will be a population increase of approximately 3,036 people between the years 2006 and 2026. As a result, it can be determined that the projected growth rate for the twenty-year planning horizon (2026) will be approximately 0.8 percent.

As part of this study, population projections have been provided for the five-year and twenty-year planning horizons, the Official Plan horizon, and the Ultimate Greenfield Build-out horizon. The population projection for the five-year planning horizon is based on the four developments that are currently proposed, which would accommodate approximately 874 persons. These developments are:

- Andpet Subdivision
- Telfer Creek Subdivision
- Adash Place Subdivision (Phases I and II)
- Greyfair Subdivision

The projection for the twenty-year horizon is based on a growth rate of 0.8 percent. As such, the current or existing population of 22,197 persons is expected to increase by 4,043 persons to 26,240 persons by the year 2026.

There are many factors that impact the rate of growth. As a result, it is difficult to determine with accuracy the amount of time it will take for the Official Plan and Ultimate Greenfield Build-out horizons to be achieved. The population projections for these scenarios are based on projected population density for the identified lands at build-out.

The simplified land use is illustrated on Drawing SAN3 located in **Appendix A**.

3.1.1 Population Density

The current vacant land use plan indicates a mix between residential, industrial and commercial uses. For the purpose of this study the demands associated with these various demand categories are represented as an equivalent population. The Official Plan identifies the following population densities.

Table 3.1: Population Projections for the City of Owen Sound

OP Land Use	OP Population Density
Existing Lands	25.6 persons/ha
Future Residential Development	48.3 persons/ha
Commercial	24.4 persons/ha
Industrial	48.9 persons/ha

This approach is appropriate for master planning; however, it should be noted that water use at large industrial facilities varies widely depending on the nature of the industry. As such, any significant proposal should be carefully evaluated at the time of the proposal to confirm that the specific needs of the industry can be accommodated at the proposed site.

3.1.2 Projected Population

Table 3.2 summarizes the projected populations for the time frames noted above.

Table 3.2: Population Projections for the City of Owen Sound

Year	Population
2001 (2001 Census)	21,500
2006 (Existing)	22,197
2011 (5-Year Proposed Developments)	23,071
2026 (20-Year)	26,240
Official Plan	27,464
Ultimate Greenfield Build-out Horizon	41,412

3.1.3 Allocation of Growth and Servicing Limits

For the purposes of this study, it is assumed that the forecasted growth over the various time horizons will occur entirely with the lands designated in the study area. While minor infilling may occur on City lands outside of the study area, this type of development is not anticipated to materially affect the recommendations with regard to the study area.

It is noted that historical reports include many servicing strategies for extending the City's water system to serve adjacent communities. For this report the City has directed that the servicing strategy be focused on lands within the boundaries of the City.

4.0 Water System

4.1 Water Servicing

The City is served by a municipal water system. The principal components of the system are the R.H. Neath Water Filtration Plant, located along the east shore of Owen Sound; the Norm Robertson Reservoir, located at the intersection of 8th Street East and 9th Avenue East; the East Hill Booster Pumping Station, located adjacent to the Norm Robertson Reservoir on 8th Street East; and the Beattie Street Booster Station, located in the southwest corner of the municipality.

4.1.1 Water Treatment Plant

The R.H. Neath Water Filtration plant has recently been upgraded to provide the level of treatment required under the current drinking water regulations. The current rating of the Owen Sound WTP is 27,276 m^3/d (315.7 L/s).

Treated water is temporarily stored at the Water Filtration Plant before being pumped to the consumers via the water distribution system. The Water Filtration Plant includes two distinct high lift pumping systems referred to as the Municipal Plant and the Industrial Plant. The Municipal Plant supplies water for a major portion of the city. The principal lands excluded from this system are the industrial lands, generally north of 16th Street and east of 9th Avenue East. The industrial lands are served by the Industrial Plant.

The existing Municipal Plant has a firm pumping capacity of 18,184 m^3/d.

The existing Industrial Plant has a firm pumping capacity of 22,703 m^3/d.

The firm pumping capacity is defined as the capacity that a system can provide with its largest pump out of service.

The R.H. Neath Water Filtration Plant is equipped with standby power.

4.1.2 Existing Distribution System

The Owen Sound water distribution system is a relatively complex system. The system consists of several pressure zones as a result of the substantial variation in elevation across the City. The pressure zones have been created to ensure that water supply pressures at the tap are maintained within acceptable minimums and maximums. There are currently five pressure zones in the east section of the City, and they are as follows:

- Municipal
- Industrial
- East Hill
- East Hill Reduced
- Spring

It is noted that the East Hill Booster Station draws water from the Municipal Zone and pumps it into the East Hill Zone. Water from the East Hill Zone can cascade to the East Hill Reduced Zone and Spring Zone.

4.1.3 Existing Water Storage Facilities

Within the distribution system, there is currently one municipal water storage facility. The Norm Robertson Reservoir is located at the intersection of 8th Street East and 9th Street East. This is a reinforced concrete grade level reservoir with a capacity of 16,277 m^3. The facility was recently upgraded to improve circulation through the reservoir. The reservoir “floats” on the Municipal Zone and provides equalization, emergency and fire capacity to the Municipal Zone. The Norm Robertson Reservoir also serves as the water source for the East Hill Booster Pumping Station.

There is currently no water storage facility in the Industrial Zone. Since 1993, the water servicing strategy for the Industrial Zone has included plans for a grade level reservoir which would “float” on the Industrial Zone and provide equalization, emergency and fire flows.

The exiting water system is shown schematically in **Figure 4.1**.

4.1.4 Previous Studies

As previously identified, the City has commissioned many studies on the water supply and distribution system. Relevant studies were reviewed to ascertain the historical approach to servicing the lands on the east side of Owen Sound. The key studies included:

- Assessment of Alternatives for Upgrading of the East Hill Booster Pumping Station, Henderson, Paddon and Associates Limited, April 1997.
- Master Plan Study for the Owen Sound and Area Water System, Henderson, Paddon & Associates Limited, May 1999.
- Water Pressure Improvement Study, Thompson Rosemount Group, March 2004.

4.1.5 Historical Servicing Strategy

Based upon a review of previous studies and discussions with the City, the anticipated servicing strategy for the East Side lands was identified. Only a portion of the Municipal Zone is actually located within the East Side Study Area. The majority of these lands are already developed. The R.H. Neath Water Filtration Plant is intended to supply water to meet the maximum day demand in the municipal zone, and the Norm Robertson Reservoir supplements the supply to meet peak hour demands and fire flows.

The East Hill Booster Station draws water from the Municipal Zone/Norm Robertson Reservoir and pumps it into the East Hill Pressure Zone, which in turn cascades to the East Hill Reduced and Spring zones. The East Hill Booster Pumping Station is required to meet the peak demands of the East Hill Zone, the East Hill Reduced Zone and the Spring Zone, as well as provide fire flows in conjunction with maximum day demands for the East Hill Zone, the East Hill Reduced Zone and the Spring Zone. An upgrade path has been identified for the East Hill Booster Pumping Station that allows it to meet forecasted flows and fire demands associated with the OSCVI and Grey Bruce Regional Health Centre on an interim basis. The historical approach has identified that at some point in the future the Industrial Zone Reservoir will be constructed and that the Industrial Zone Reservoir would be able to provide fire flows to significant portions of the East Hill, East Hill Reduced and Spring zones. The proposed reservoir is to be located 0.8 km south of the study area on lands already owned by the City.

The historical servicing approach for the Industrial Lands envisions the construction of “floating” storage for the Industrial Zone. Currently, the Industrial Plant at the R.H. Neath Water Filtration Plant is required to provide peak flows to the Industrial Zone, as well as the maximum day demand in conjunction with fire demand to the Industrial Zone. Once constructed, the Industrial Zone Reservoir would supplement the capacity of the Industrial Plant to provide peak flows and fire flows.

A trunk watermain has been constructed from the R.H. Neath Water Filtration Plant, through the Industrial Zone to the current limit of the Industrial Zone at 16th Street East. The trunk main is initially 600mm in diameter, but is reduced to 450mm in diameter in the upper portion of the zone. It was envisioned that this trunk main would eventually be extended to the proposed site for the Industrial Zone Reservoir.

4.1.6 Fire Flows

Previous studies (Henderson, Paddon & Associates Limited, April 1997) have identified estimated fire flows for key buildings in the East Hill Zone based upon the guidelines published by the Fire Underwriters Survey. These include:

• OSCVI	97.35 L/s
• Grey Bruce Regional Health Centre	166.67 L/s
• Townhouse Area at 10th Street and 11th Avenue East	183.33 L/s

In addition to these specific locations, the study identified a fire flow of 227.12 L/s for a typical one story commercial or industrial building with a floor area of 3700 m^2 and with average combustible contents.

4.1.7 Historical Water Demands

The R.H. Neath Water Treatment Plant, which is located at 2600 3rd Avenue East on the east side of Georgian Bay, currently supplies all pressure zones throughout the City; however, the Industrial Zone is a closed loop system that is pressurized independently from the rest of the water system by the industrial high lift pumps located at the water plant. Recent records obtained from the City are broken down into two categories, Industrial and Municipal, and they indicate that the average day demand throughout the system is approximately 8,804 m^3/day and 2,963 m^3/day for the Municipal and Industrial distribution systems, respectively.

The historical records for the industrial plant correspond to an average water demand of 10.6 m^3/ha/day for the lands currently serviced by the industrial plant.

There are approximately 22,197 persons currently serviced by the municipal plant, and as such, the average day demand is 397 L/capita/day.

The combined (industrial/municipal) maximum day and peak hour factors for the City of Owen Sound are 1.8 and 2.7, respectively.

4.1.8 Analysis of the Existing Water System

As part of a previous study, the existing water system was modeled using WaterCad Version 6.5, Haestad Methods, and was last updated in March 2004 by The Thompson Rosemount Group Inc.

As part of this study, Burnside has updated the water model to WaterCad Version 8.09. While the scope of the study is limited to the East Side of Owen Sound, the WaterCad still model includes the City's entire water system.

The various elements in the model, including pipes, pumps and demands were reviewed and updated as appropriate to make the existing model current. This included adjusting average demands across the model to reflect recent water production records.

Elevations and pipe roughness factors remain generally unchanged from the previous version of the model. Pipe roughness expressed as Hazen Williams 'C' value in the existing model ranges from 54 to 150 and reflects work done previously to calibrate the model.

Four Scenarios were run for the existing model. These included Average Day, Maximum Day, Peak Hour and Maximum Day Plus Fire.

4.1.8.1 Water Pressure

The predicted water pressures under the various scenarios are presented in the following table for the Average Day Demand (ADD), the Maximum Day Demand (MDD) and the Peak Hour Demand (PHD).

Table 4.2 –Range of Water Pressures by Zone (psi)

	ADD		MDD		PH	
	Max	Min	Max	Min	Max	Min
East Hill Pressure Reduced Zone	72.9	36.6	72.9	35.5	72.9	34.2
Municipal Zone	103.3	41	100.5	40.4	99.1	36.6
Spring Zone	74.5	48.9	73.9	44.9	73	38.5
East Hill Pressure Zone	101.8	46.8	100.2	41.1	99.5	29.6
Industrial Zone	164.8	44.3	156	43.9	137.8	43.2

The pressures in the east side of the City generally fall within the MOE's recommended range, with the exception of a few areas where higher or lower pressures are experienced as a result of the elevation changes; however, overall, the operating pressures within the existing distribution system are generally sufficient. There are a number of watermains that have diameters of less than 150mm. These should be upgraded to 150mm diameter or larger to facilitate maintenance and improved fire flows.

It is recommended that all future development in the City meet the required minimum system pressure of 50 psi under average and maximum day conditions and a minimum of 40 psi under peak hour conditions.

4.1.8.2 Fire Flows

An analysis of the available fire flow under maximum day demand, while maintaining a minimum pressure of 20 psi in the system, was conducted for the existing model. The Junction Reports for each of these scenarios are included in **Appendix D,** provided under separate cover.

4.1.8.3 Water Storage

The current available storage consists of an in-ground reservoir located in the Municipal Zone, and has a total active volume of 16,277 m^3. The existing storage reservoir provides peak hour and fire flows to the Municipal Zone. In addition to that, the East Hill Booster Pumping Station pumps directly from the reservoir to supply domestic demands and fire flows to the East Hill Pressure Zone.

As noted previously, the majority of residents are located in the Municipal Zone. Based on a firm capacity of the municipal side of the WTP (22,730 m3/d) the MOE recommends a storage volume of approximately 11,600 m^3. Based on the MOE Guidelines, the existing reservoir is adequately sized for current conditions and some time to come.

The Industrial Zone lacks distribution system storage. Floating distribution system storage provides many benefits, including maintenance of water supply during power outages, improved fire protection and reduced operating costs.

Similarly, the East Hill Zone does not have floating storage and as a result would benefit from the provision of floating storage. These benefits include maintenance of water supply during water power outages, improved fire protection and reduced operating costs.

4.1.9 Projected Water Demands

Table 4.3 below summarizes the water supply requirements for the Existing, 20-Year, Official Plan and Ultimate Build-out planning horizons.

The projected demands for the various planning horizons have been determined based on the projected populations identified in Section 3.

The projected demands consist of two parts; the existing demand and the projected demand associated with the anticipated future population. For the purpose of this study, the per capita flow allowance for the future population is 397 L/capita/day. This is consistent with historical flows.

The approved capacity of the R.H. Neath Water Filtration Plant was compared to the forecasted demand in **Figure 4.1**. It is assumed in this forecast that there is adequate in-plant storage to supply the Industrial Zone during periods when the demand in the Industrial Zone exceeds the maximum day demand for that zone.

Figure 4.1: WTP Rating vs. Forecasted MDD

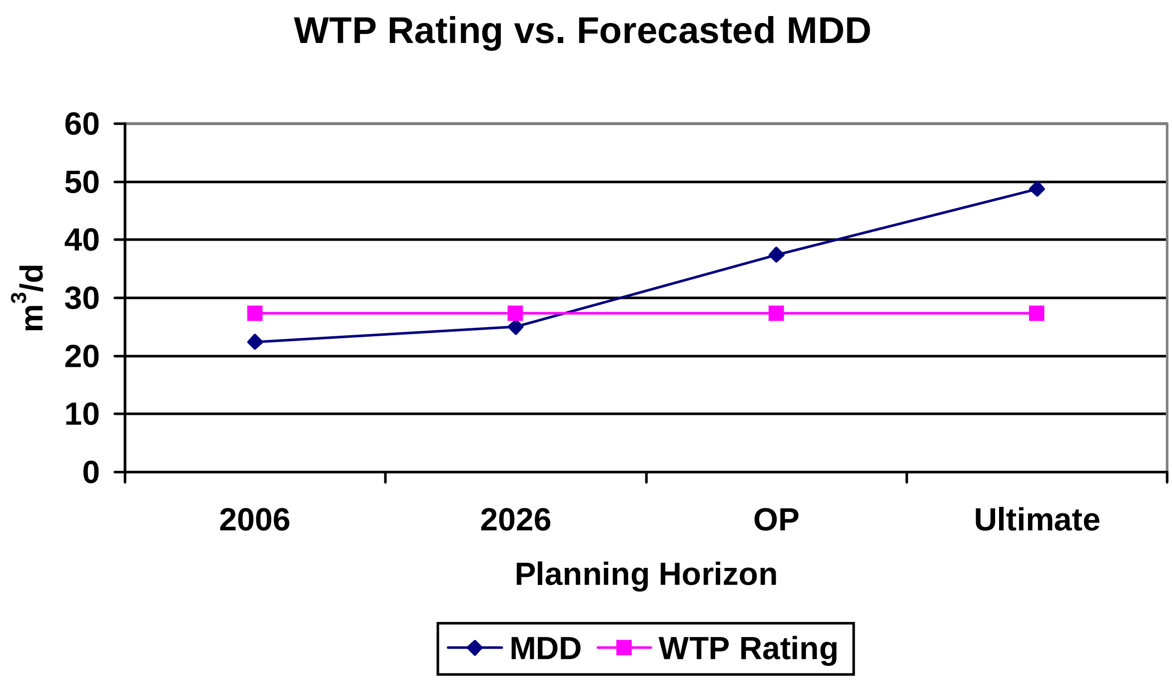


Figure 4.1 illustrates that the approved rating of the water treatment plant is expected to be adequate beyond 2026. However, an expansion would be required prior to reaching the population projections associated with the Official Plan.

The pumping capacity of the Municipal Plant at the R.H. Neath Water Filtration Plant was compared to the forecasted MDD for the municipal zone in **Figure 4.2**.

Figure 4.2: Municipal Plant Rating vs. Forecasted MDD

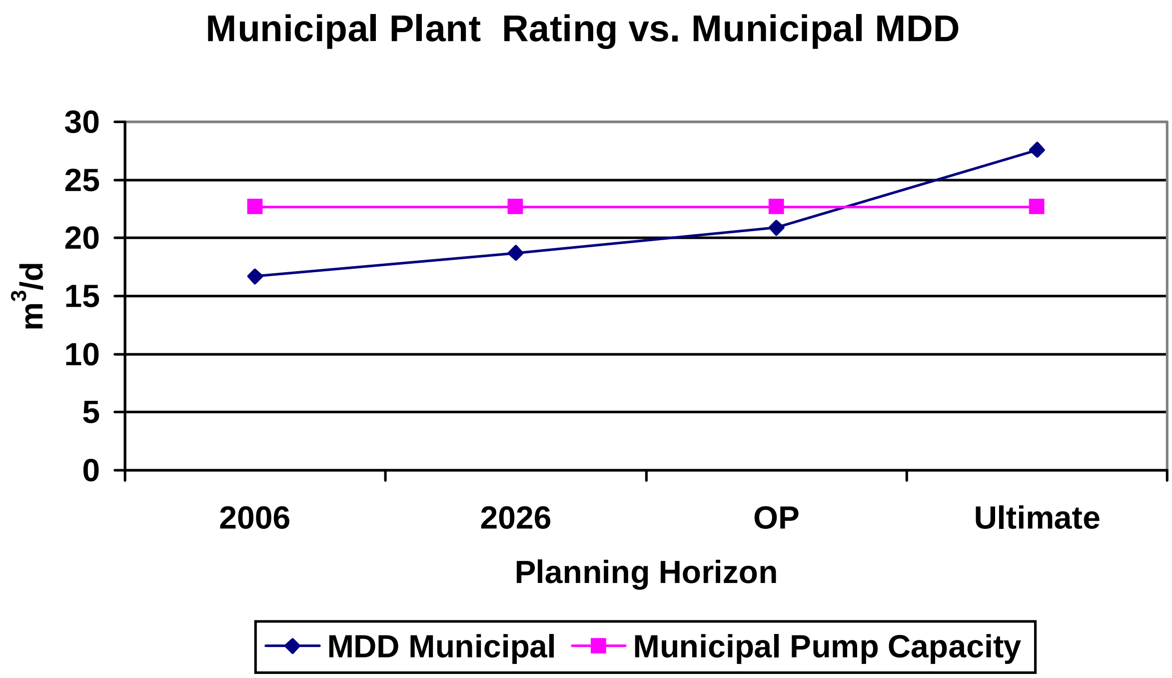
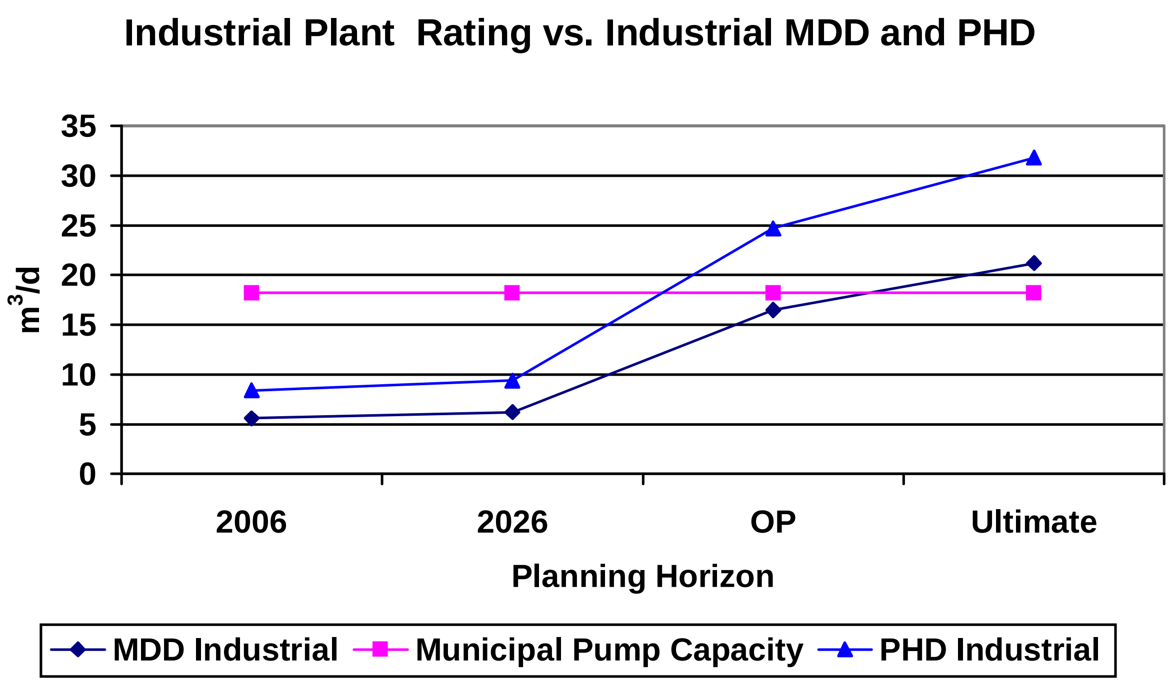


Figure 4.2 illustrates that the Municipal Plant high lift pumping capacity is adequate to meet the projected demands up to and including the Official Plan forecasted demand. The Municipal Plant high lift pumping capacity would need to be increased to meet the forecasted demand at the Ultimate Build-out Horizon.

The firm pumping capacity of the Industrial Plant was compared to both the Maximum Day Demand for the Industrial Zone and the Peak Hour Demand from the Industrial Zone in **Figure 4.3**.

Figure 4.3: Industrial Plant Rating vs. Forecasted MDD and PHD



If the Industrial Zone continues to be operated as a closed system with no distribution system storage, then the peak hour demand of the Industrial Zone must be met by the firm supply capacity of the Industrial Plant. The capacity of the Industrial Plant would be exceeded prior to reaching forecasted demands associated with the Official Plan Horizon. If the Industrial Zone is provided with distribution system storage, then the Industrial Plant will only need to provide maximum day flows and thus would be adequate to meet the demands associated with the Official Plan Horizon. An increased in the Industrial Plant Pumping Capacity would be required prior to reaching the Ultimate Buildout Horizon.

Table 4.3 - Summary of Water Supply Requirements

				Municipal High Lift Plant				Industrial High Lift Plant		Total WTP Flow	
Scenario	Population (persons)	Demand Condition	Peaking Factor	Municipal Plant Flow minus East Hill Flow (m^3/d)	East Hill Booster Station Flow (m^3/d)	Total Municipal High Lift Pump Demand (m^3/d)	Spare Capacity in the Municipal High Lift Pumps (m^3/d)	Industrial Plant High Lift Pump Demand (m^3/d)	Spare Capacity in the Industrial High Lift Pumps (m^3/d)	Total WTP Flow (m^3/d)	Spare Capacity in the WTP (m^3/d)
Existing (2006)	22,197	Average Day Demand (ADD)		5072.4	3731.1	8803.5	13926.5	2962.8	15221.2	11766.3	15509.7
		Maximum Day Demand (MDD)	1.9	9637.6	7089.1	16726.7	6003.4	5629.3	12554.7	22356.0	4920.0
		Peak Hour (PH)	2.85	14456.3	10633.6	25090.0	(2360.0)	8444.0	9740.0	33534.0	(6258.0)
20-Year (2026)	26,240	Average Day Demand (ADD)		5072.4	5336.2	10408.6	12321.4	3498.6	14685.4	13907.2	13368.8
		Maximum Day Demand (MDD)	1.8	9130.3	9605.1	18735.4	3994.6	6297.5	11886.5	25033.0	2243.0
		Peak Hour (PH)	2.7	13695.5	14407.7	28103.1	(5373.1)	9446.3	8737.7	37549.4	(10273.4)
Official Plan	27,464	Average Day Demand (ADD)		6051.6	5565.3	11616.9	11113.1	9148.9	9035.1	20765.8	6510.2
		Maximum Day Demand (MDD)	1.8	10892.9	10017.5	20910.4	1819.6	16468.1	1715.9	37378.5	(10102.5)
		Peak Hour (PH)	2.7	16339.4	15026.3	31365.6	(8635.6)	24702.1	(6518.1)	56067.8	(28791.8)
Ultimate Build-out	41,412	Average Day Demand (ADD)		7131.8	8198.5	15330.3	7399.7	11788.7	6395.3	27119.0	157.0
		Maximum Day Demand (MDD)	1.8	12837.3	14757.2	27594.5	(4864.5)	21219.7	(3035.7)	48814.2	(21538.2)
		Peak Hour (PH)	2.7	19255.9	22135.9	41391.8	(18661.8)	31829.5	(13645.5)	73221.3	(45945.3)

Table 4.4 - Summary of MOE Fire Flows and Storage Requirements

			Municipal		Industrial	TOTAL	Industrial Plus East Hill
Scenario	MOE Fire Flow (L/s)	MOE Fire Duration (hrs)	Municipal Plant Area minus East Hill (m^3)	East Hill Booster Zone (m^3)	Industrial Plant (m^3)	Total Area (m^3)	Industrial plus East Hill Booster Station (m^3)
Existing (2006)	250	4	A = 3,600 B = 2,409 C = 1,502 Total = 7,511	A = 3,600 B = 1,772 C = 1,343 Total = 6,715	A = 3,600 B = 1,407 C = 1,252 Total = 6,259	A = 3,600 B = 5,589 C = 2,297 Total = 11,486	A = 3,600 B = 3,180 C = 1,695 Total = 8,475
20-Year (2026)	250	4	A = 3,600 B = 2,283 C = 1,471 Total = 7,354	A = 3,600 B = 2,401 C = 1,500 Total = 7,501	A = 3,600 B = 1,574 C = 1,294 Total = 6,468	A = 3,600 B = 6,258 C = 2,465 Total = 12,323	A = 3,600 B = 3,976 C = 1,894 Total = 9,470
Official Plan	318	5	A = 5,724 B = 2,723 C = 2,112 Total = 10,559	A = 5,724 B = 2,504 C = 2,057 Total = 10,285	A = 5,724 B = 4,117 C = 2,460 Total = 12,301	A = 5,724 B = 9,345 C = 3,767 Total = 18,836	A = 5,724 B = 6,621 C = 3,086 Total = 15,432
Ultimate Build-out	380	6	A = 8,165 B = 3,209 C = 2,844 Total = 14,218	A = 8,165 B = 3,689 C = 2,9634 Total = 14,818	A = 8,165 B = 5,305 C = 3,367 Total = 16,837	A = 8,1645 B = 12,204 C = 5,092 Total = 25,461	A = 8,165 B = 8,994 C = 4,290 Total = 21,449

4.1.10 Hydraulic Modeling

As part of a previous study, the existing water system was modeled using WaterCAD Version 6.5, Haestad Methods, and was last updated in March 2004 by The Thompson Rosemount Group Inc.

The water model has since been expanded by Burnside as part of the MSS to include the undeveloped lands on the east side of the City. The model encompasses the distribution system, storage reservoir and water treatment plant, and it evaluates the pressures and flows throughout the City's water system for the Existing, 20-Year, Official Plan and Ultimate Buildout planning horizons noted above.

Each node, pump, reservoir and valve entered into the model was given an elevation based on the Ontario Base Maps (OBMs), and pipe friction factors were assigned in accordance with the Ministry of Environment Guidelines. The Hazen-Williams 'C' values used are:

- 150mm diameter watermains C = 100
- 200mm to 250mm diameter watermains C = 110
- 300mm to 600mm diameter watermains C = 120

In order to better predict maximum day, peak hour, and maximum day plus fire flow system pressures, field data should be collected and used to further calibrate the model. This will also allow the impact of future distribution system upgrades to be modeled in order to confirm that the proposed replacement watermains or the installation of new watermains are adequately sized.

The water distribution pressure goals are in accordance with the Ministry of Environment Guidelines as recommended in the "Guidelines for the Design of Water Distribution Systems, MOE, July 1985." These are:

- Under Average Day and Maximum Day conditions, water pressures should be between 50 psi and 80 psi (350 kPa to 550 kPa).
- Under Peak Hour, water pressures should be between 40 psi and 80 psi (275 kPa to 550 kPa).
- Under Maximum Day plus Fire Flow, the minimum residual pressure in the zone should be 20 psi (140 kPa).
- Maximum pressures in the distribution system should not exceed 100 psi (700 kPa).

4.2 Water Servicing Alternatives

4.2.1 Identification of Alternative Solutions

In developing the alternative solutions for the East Side lands, there are two distinct pressure zones to consider: the East Hill Pressure Zone (including the East Hill Reduced and Spring Zones) and the Industrial Zone. Both of these zones are currently considered to be closed loop systems and lack distribution system storage. Closed loop systems are typically used on small-scale systems that lack fire protection. The majority of municipal systems are designed with a water treatment facility that provides maximum day demands and a water storage facility in the distribution system to meet peak and fire demands. Systems with "floating" storage are generally more energy efficient, and they provide protection during emergencies, such as power outages, as well as superior fire protection.

Based on the existing conditions, as well as the results of the computer modeling noted above, a number of water servicing alternatives for the different pressure zones have been developed. The options are as follows:

Table 4.5: East Hill Pressure Zone

E1	Do Nothing – The "Do Nothing" option consists of no further action by the City to optimize the current supply and distribution system.
E2.1	No Storage – Upgrades at the Water Treatment Plant and the East Hill Booster Station to increase pumping capacity in order to meet future demands and fire flows.
E2.2	No Storage and New Booster Station – Upgrades at the Water Treatment Plant and construction of a new booster station to supplement the East Hill Booster Station to increase pumping capacity in order to meet future demands and fire flows.
E3.1	New Storage Facility for the East Hill Pressure Zone – The construction of an elevated storage facility in the East Hill Pressure Zone to meet projected peak hour demands and fire flows to the East Hill Pressure Zone. Upgrading of the Water Treatment Plant and East Hill Booster Station to increase pumping capacity in order to meet future demands and fire flows.
E3.2	New Storage Facility for the East Hill Pressure Zone and New Booster Station – The construction of an elevated storage facility in the East Hill Pressure Zone to meet projected peak hour demands and fire flows to the East Hill Pressure Zone. Upgrades at the Water Treatment Plant and construction of a new booster station to supplement the East Hill Booster Station to increase pumping capacity in order to meet future demands.
E4	New Storage Facility Shared with Industrial Zone - The construction of a shared storage facility on lands owned by the City, south of the study area. Upgrading of the Water Treatment plant and East Hill Booster Station to increase pumping capacity in order to meet future demands and fire flows.

Table 4.6: Industrial Pressure Zone

I1	Do Nothing – The "Do Nothing" option consists of no further action by the City to optimize the current supply and distribution system.
I2	No Storage – Upgrades at the Water Treatment Plant to increase pumping capacity in order to meet future domestic demands and fire flows.
I3	New Storage Facility for the Industrial Pressure Zone – The construction of a grade level storage facility on lands south of the city limits to serve the Industrial Pressure Zone. Upgrading of the Water Treatment Plant to increase pumping capacity in order to meet future demands.
I4	New Storage Facility Shared with Industrial Zone - The construction of a shared storage facility on lands owned by the City, south of the study area. Upgrading of the Water Treatment Plant and East Hill Booster Station to increase pumping capacity in order to meet future domestic demands and fire flows.

4.3 Evaluation of Water Supply Servicing Alternatives

Tables 4.7 and **4.8** identify the impact of each alternative with respect to the technical, environmental and social criteria identified in Section 2 above. The tables provide a systematic evaluation of these alternatives, as well as the associated capital costs of implementation.

The water supply servicing alternatives that were considered to be feasible components of the overall servicing strategy to meet the City's needs for the 20-Year planning horizon, the Official Plan horizon, as well as the Ultimate Greenfield Build-out planning horizon, along with the respective cost estimates, are summarized below.

Table 4.7: Water Supply Servicing Alternatives – East Hill Pressure Zone – Identification and Evaluation of Impacts

Criteria	Alternative E1 Do Nothing	Alternative E2.1 No Storage	Alternative E2.2 No Storage and New Booster Station.	Alternative E3.1 Storage Facility in the East Hill Pressure Zone	Alternative E3.2 Storage Facility in the East Hill Pressure Zone and New Booster Station	Alternative E4 – Storage Facility Shared with the Industrial Pressure Zone
Description	The "Do Nothing" option consists of no further action by the City to optimize the current water supply and distribution system.	No Storage. Upgrades at the Water Treatment Plant and the existing East Hill Booster Station to increase pumping capacity. Upgrades to the Municipal high lift pumps are only required at Ultimate Build-Out.	Construct a new booster pumping station in the Industrial Zone that utilizes the industrial water supply from the Water Treatment Plant. This booster station will directly feed the East Hill Zone. This option also includes upgrades to the high lift pumps at the Water Treatment Plant to increase pumping capacity.	The construction of an elevated storage facility in the East Hill Pressure Zone to meet projected peak demands and fire flows for East Hill. Minimal upgrades at the existing East Hill Booster Station are required to provide redundancy at Ultimate Build-out only. Upgrades are required at the Water Treatment Plant to increase pumping capacity.	The construction of an elevated storage facility in the East Hill Pressure Zone to meet projected peak demands and fire flows for East Hill. Construct a new booster station in the Industrial Zone that utilizes the industrial water supply. This booster station will directly feed the East Hill Zone. Upgrades are required at the Water Treatment Plant to increase pumping capacity.	Construction of a grade level storage facility south of the City limits with a dedicated watermain to the Industrial Pressure Zone. Also included in this option are upgrades to the East Hill booster pumping station in, which will include higher capacity pumps to meet future domestic demands and fire flows. Upgrades at the Water Treatment Plant to increase pumping capacity are required for Ultimate Build-out.
Meets Study Objective	• The existing Water Treatment Plant and East Hill Booster Station are capable of meeting the 20-year planning horizon. • Official Plan and Ultimate Build-out demands cannot be met.	• Future and Ultimate Build-out demands can be met. • Level of service remains the same as existing.	• Future and Ultimate Built-out demands can be met. • Increased level of service with respect to fire protection in the East Hill Zone.	• Future and Ultimate Build-out demands can be met. • Increased level of service with respect to fire protection and storage in the East Hill Zone.	• Future and Ultimate Build-out demands can be met. • Increased level of service with respect to fire protection and storage in the East Hill Zone.	• Future and Ultimate Build-out demands can be met. • Increased level of service with respect to fire protection in all zones and storage in the Industrial Zone.
Impact to Natural Environment	Aquatic and Terrestrial Environment: Low • No proposed works in surface water Climate Effects: Low	Aquatic and Terrestrial Environment: Low • No proposed works in surface water • No water crossings anticipated Climate Effects: Low	Aquatic and Terrestrial Environment: Low • No proposed works in surface water • No water crossings anticipated • Construction of booster station will cause some vegetative disturbances • Possible impacts resulting from expansion of distribution system and interconnection of two pressure zones Climate Effects: Moderate • Local effects to snow accumulation, sun and shade at storage facility	Aquatic and Terrestrial Environment: Low • No proposed works in surface water • Construction of storage facility will cause some vegetative disturbances • No water crossings anticipated Climate Effects: Moderate • Local effects to snow accumulation, sun and shade at storage facility	Aquatic and Terrestrial Environment: Low • No proposed works in surface water • Construction of storage facility will cause some vegetative disturbances • No water crossings anticipated Climate Effects: Moderate • Local effects to snow accumulation, sun and shade at storage facility	Aquatic and Terrestrial Environment: Low to Moderate • No proposed works in surface water • Possible water crossings as result of dedicated watermain installation • Construction of storage facility will cause some vegetative disturbances • Construction of dedicated watermain will cause some vegetative disturbances Climate Effects: Moderate • Local effects to snow accumulation, sun and shade at storage facility
Temporary Disturbances (Construction)	Low	Low • Impacts of construction can be mitigated to minimize permanent environmental damage	Moderate to High • Construction of booster station • Impacts of construction can be mitigated to minimize permanent environmental damage	Moderate to High • Construction of storage facility • Impacts of construction can be mitigated to minimize permanent environmental damage	High • Construction of storage facility and booster station • Impacts of construction can be mitigated to minimize permanent environmental damage	High • Construction of storage facility and dedicated watermain • Impacts of construction can be mitigated to minimize permanent environmental damage

Criteria	Alternative E1 Do Nothing	Alternative E2.1 No Storage	Alternative E2.2 No Storage and New Booster Station.	Alternative E3.1 Storage Facility in the East Hill Pressure Zone	Alternative E3.2 Storage Facility in the East Hill Pressure Zone and New Booster Station	Alternative E4 – Storage Facility Shared with the Industrial Pressure Zone
Required Time to Complete (Design, Construction, Commissioning)	Low	Low • An amendment to the existing Certificate of Approval will be required • Upgrades to existing high lift pumps at Water Treatment Plant and existing booster station	Moderate to High • An amendment to the existing Certificate of Approval will be required for any upgrades to existing system • City to obtain a new Certificate of Approval for booster station • Construction of booster station • Interconnection of Industrial and East Hill Pressure Zones • Upgrades to existing high lift pumps at Water Treatment Plant • Site Specific EA may be required	Moderate • An amendment to the existing Certificate of Approval will be required for any upgrades to existing system • City to obtain a new Certificate of Approval for storage facility • Construction of storage facility • Upgrades to existing high lift pumps at Water Treatment Plant and existing booster station • Site Specific EA may be required	Moderate • An amendment to the existing Certificate of Approval will be required for any upgrades to existing system • City to obtain a new Certificate of Approval for storage facility and booster station • Construction of storage facility and booster station • Upgrades to existing high lift pumps at Water Treatment Plant and existing booster station • Site Specific EA may be required	High • An amendment to the existing Certificate of Approval will be required for any upgrades to existing system • City to obtain a new Certificate of Approval for storage facility and dedicated watermain • Construction of storage facility and dedicated watermain • Upgrades to existing high lift pumps at Water Treatment Plant and existing booster station • Site Specific EA may be required
Impact to Social Environment	Aesthetic: Low Agricultural: Low Socio-Economic: Low • Utilizes existing system Heritage Resources: Low	Aesthetic: Low • Possible minor visual impacts Agricultural: Low Socio-Economic: Low • Maximizes the efficiency of the existing system • Permits future growth of the City Heritage Resources: Low	Aesthetic: Low to Moderate • Possible visual impacts of booster station • Potential traffic impacts during construction Agricultural: Low Socio-Economic: Low to Moderate • Possible requirement for land acquisition • Permits future growth of the City Heritage Resources: Low	Aesthetic: High • Possible visual impacts of storage facility • Potential traffic impacts during construction Agricultural: Low Socio-Economic: Moderate • Possible requirement for land acquisition • Permits future growth of the City • Persons outside study area may be affected Heritage Resources: Low	Aesthetic: High • Possible visual impacts of storage facility and booster station • Potential traffic impacts during construction Agricultural: Low Socio-Economic: Moderate • Possible requirement for land acquisition • Permits future growth of the City • Persons outside study area may be affected Heritage Resources: Low	Aesthetic: Moderate to High • Possible visual impact of storage facility • Potential traffic impacts during construction Agricultural: Low Socio-Economic: High • Possible requirement for land acquisition • Permits future growth of the City • Persons outside study area may be affected Heritage Resources: Low
Capital Costs	Low • Replacement costs for existing equipment	Moderate • High lift pumping capacity upgrades required at the Municipal plant for Ultimate Build-out only (approximately \$1.0 M) • Upgrades to the existing booster station will be required under all planning horizons (20 yr = \$450 K, OP = \$550 K and	Moderate to High • Construction of a new booster pumping station at the Industrial Zone Boundary to feed part of East Hill Zone (20 yr = \$0.9M, OP = 1.0 M, Ultimate = \$1.8M). • Upgrades to the existing distribution system and interconnection of the East Hill and Industrial Pressure Zones	High • Upgrades to the existing booster station will be required for Ultimate Build-out only (approximately \$950K) • Construction of a new storage facility will be required under all planning horizons (20 yr = \$3.3 M, OP = \$3.5 M and Ultimate Build-out = \$4.8 M) • Possible requirement for land acquisition • Estimated total:	High • Construction of a new booster pumping station at the Industrial Zone Boundary to feed part of East Hill Zone (Ultimate Build-out= \$1.8M). • High lift pumping capacity upgrades will be required at the Industrial plant for OP and Ultimate (OP = \$1.2 M and Ultimate Build-out = \$1.5 M) • Construction of a new storage facility	High • High lift pumping capacity upgrades required at the Municipal plant for Ultimate Build-out only (approximately \$1.0M) • High lift pumping capacity upgrades will be required at the Industrial plant for Ultimate Build-out only (approximately \$1.3M) • Upgrades to the existing booster station

Criteria	Alternative E1 Do Nothing	Alternative E2.1 No Storage	Alternative E2.2 No Storage and New Booster Station.	Alternative E3.1 Storage Facility in the East Hill Pressure Zone	Alternative E3.2 Storage Facility in the East Hill Pressure Zone and New Booster Station	Alternative E4 – Storage Facility Shared with the Industrial Pressure Zone
		Ultimate Build-out = $1.5 M) • Estimated totals: 20-Year (2026) = $450K Official Plan = $550K Ultimate Build-out = $2.5M	• High lift pumping capacity upgrades will be required at the Industrial plant for OP and Ultimate (OP = $1.2 M and Ultimate Build-out = $1.5 M) • Possible requirement for land acquisition • Estimated totals: 20-Year (2026) = $0.9M Official Plan = $2.2 M Ultimate Build-out = $3.3 M	20-Year (2026) = $3.3M Official Plan = $3.5M Ultimate Build-out = $4.8M	will be required under all planning horizons (20 yr = $3.3 M, OP = $3.5 M and Ultimate Build-out = $4.8 M) • Possible requirement for land acquisition • Estimated total: 20-Year (2026) = $3.3 M Official Plan = $4.7 M Ultimate Build-out = $8.1 M	will be required under all planning horizons (20 yr = $450 K, OP = $550 K and Ultimate Build-out= $1.5 M) • Construction of a new grade level storage facility will be required under all planning horizons (20 yr = $4.3 M, OP = $4.3 M and Ultimate Build-out = $6.8 M) • Potential to utilize land already owned by the City for the grade level reservoir • Estimated total: 20-Year (2026) = $4.8M Official Plan = $4.9M Ultimate Build-out = $10.6M
Operation and Maintenance Costs	Low to Moderate • Potential increase in operation and maintenance costs associated with increased demands as the City grows • Cost of maintaining older equipment • Additional sampling requirements as the City grows and with the expansion of the distribution system	Low • Upgrades to the existing system will keep operation and maintenance costs low • Additional sampling requirements as the City grows and with the expansion of the distribution system	Moderate • Additional operation and maintenance costs associated with the operation of a new booster pumping station • Additional sampling requirements as the City grows and with the expansion of the distribution system	Moderate to Low • Increase in operation and maintenance costs associated with the operation of a new storage facility • Additional sampling requirements as the City grows and with the expansion of the distribution system • Maximizes the use of existing infrastructure	Moderate to High • Increase in operation and maintenance costs associated with the construction of a new storage facility and booster station • Additional sampling requirements as the City grows and with the expansion of the distribution system • Maximizes the use of existing infrastructure	

Table 4.8 - Water Supply Servicing Alternatives - Industrial Pressure Zone –Identification of Impacts and Evaluation

Criteria	Alternative I1 Do Nothing	Alternative I2.1 No Storage	Alternative I3.1 Storage Facility For the Industrial Pressure Zone	Alternative I4 – Storage Facility Shared with the East Hill Pressure Zone
Description	The "Do Nothing" option consists of no further action by the City to optimize the current supply and distribution system.	No Storage. Upgrades at the Water Treatment Plant and the existing booster station to increase pumping capacity. Upgrades to the Municipal high lift pumps are only required at Ultimate Build-Out.	Construction of a grade level storage facility south of the City limits with a dedicated watermain to the Industrial Pressure Zone. Also included in this option are upgrades to the existing booster pumping station in East Hill, which will include higher capacity pumps to meet future domestic demands and fire flows. Upgrades at the Water Treatment Plant to increase pumping capacity are required for Ultimate Build-out.	Construction of a grade level storage facility south of the City limits with a dedicated watermain to the Industrial Pressure Zone. Also included in this option are upgrades to the existing booster pumping station in East Hill, which will include higher capacity pumps to meet future domestic demands and fire flows. Upgrades at the Water Treatment Plant to increase pumping capacity are required for Ultimate Build-out. This option includes provision for water to flow from the Industrial Zone reservoir to the East Hill Zone under emergency conditions. Supply to the East Hill would be at pressures lower than normal for the East Hill Zone under these conditions.
Meets Study Objective	• The existing Water Treatment Plant and East Hill booster station are capable of meeting the 20-year planning horizon. • Official Plan and Ultimate Build-out demands cannot be met.	• Future and Ultimate Build-out demands can be met. • Level of service remains the same as existing (ie. fire protection/storage).	• Future and Ultimate Build-out demands can be met. • Increased level of service with respect to fire protection in all zones and storage in the Industrial Zone.	• Future and Ultimate Build-out demands can be met. • Increased level of service with respect to fire protection in all zones and storage in the Industrial Zone.
Impact to Natural Environment	Aquatic and Terrestrial Environment: Low • No proposed works in surface water Climate Effects: Low	Aquatic and Terrestrial Environment: Low • No proposed works in surface water • No water crossings anticipated Climate Effects: Low	Aquatic and Terrestrial Environment: Low to Moderate • No proposed works in surface water • Possible water crossings as result of dedicated watermain installation • Construction of storage facility will cause some vegetative disturbances • Construction of dedicated watermain will cause some vegetative disturbances Climate Effects: Moderate • Local effects to snow accumulation, sun and shade at storage facility	Aquatic and Terrestrial Environment: Low to Moderate • No proposed works in surface water • Possible water crossings as result of dedicated watermain installation • Construction of storage facility will cause some vegetative disturbances • Construction of dedicated watermain will cause some vegetative disturbances Climate Effects: Moderate • Local effects to snow accumulation, sun and shade at storage facility
Temporary Disturbances (Construction)	Low	Low • Impacts of construction can be mitigated to minimize permanent environmental damage	High • Construction of storage facility and dedicated watermain • Impacts of construction can be mitigated to minimize permanent environmental damage	High • Construction of storage facility and dedicated watermain • Impacts of construction can be mitigated to minimize permanent environmental damage
Required Time to Complete (Design, Construction, Commissioning)	Low	Low • An amendment to the existing Certificate of Approval will be required • Upgrades to existing high lift pumps at Water Treatment Plant and existing booster station • Site Specific EA may be required	High • An amendment to the existing Certificate of Approval will be required for any upgrades to existing system • City to obtain a new Certificate of Approval for storage facility and dedicated watermain • Construction of storage facility and dedicated watermain • Upgrades to existing high lift pumps at Water Treatment Plant and existing booster station • Site Specific EA may be required	High • An amendment to the existing Certificate of Approval will be required for any upgrades to existing system • City to obtain a new Certificate of Approval for storage facility and dedicated watermain • Construction of storage facility and dedicated watermain • Upgrades to existing high lift pumps at Water Treatment Plant and existing booster station • Site Specific EA may be required

Criteria	Alternative I1 Do Nothing	Alternative I2.1 No Storage	Alternative I3.1 Storage Facility For the Industrial Pressure Zone	Alternative I4 – Storage Facility Shared with the East Hill Pressure Zone
Impact to Social Environment	Aesthetic: Low Agricultural: Low Socio-Economic: Low • Utilizes existing system Heritage Resources: Low	Aesthetic: Low • Possible minor visual impacts Agricultural: Low Socio-Economic: Low • Maximizes the efficiency of the existing system • Permits future growth of the City Heritage Resources: Low	Aesthetic: Moderate • Possible visual impact of storage facility • Potential traffic impacts during construction Agricultural: Low Socio-Economic: High • Possible requirement for land acquisition • Permits future growth of the City • Persons outside study area may be affected Heritage Resources: Low	Aesthetic: Moderate • Possible visual impact of storage facility • Potential traffic impacts during construction Agricultural: Low Socio-Economic: High • Possible requirement for land acquisition • Permits future growth of the City • Persons outside study area may be affected Heritage Resources: Low
Capital Costs	Low • Replacement costs for existing equipment	Moderate • High lift pumping capacity upgrades will be required at the Industrial plant for both the Official Plan and Ultimate Build-out scenarios (OP = $1.1 M and Ultimate Build-out = $1.5 M) • Estimated totals: Official Plan = $1.1M Ultimate Build-out = $1.5M	High • High lift pumping capacity upgrades will be required at the Industrial plant for Ultimate Buildout only (approximately $1.0M) • Construction of a new grade level storage facility will be required under all planning horizons (20 yr = $6.0 M, OP = $7.5 M and Ultimate Build-out = $8.5 M) • Potential to utilize land already owned by the City for the grade level reservoir • Estimated total: 20-Year (2026) = $6.0M Official Plan = $7.5M Ultimate Build-out = $9.5M	High • High lift pumping capacity upgrades required at the Municipal plant for Ultimate Build-out only (approximately $1.0M) • High lift pumping capacity upgrades will be required at the Industrial plant for Ultimate Build-out only (approximately $1.3M) • Upgrades to the existing booster station will be required under all planning horizons (20 yr = $450 K, OP = $550 K and Ultimate Build-out = $1.5 M) • Construction of a new grade level storage facility will be required under all planning horizons (20 yr = $6.5 M, OP = $8.0 M and Ultimate Build-out = $9.0 M) • Potential to utilize land already owned by the City for the grade level reservoir • Estimated total: 20-Year (2026) = $7.0M Official Plan = $8.6M Ultimate Build-out = $10.3M
Operation and Maintenance Costs	Low to Moderate • Potential increase in operation and maintenance costs associated with increased demands as the City grows • Cost of maintaining older equipment • Additional sampling requirements as the City grows and with the expansion of the distribution system	Low • Upgrades to the existing system will keep operation and maintenance costs low • Additional sampling requirements as the City grows and with the expansion of the distribution system	Moderate to High • Increased operation and maintenance costs associated with the construction of a new grade level reservoir • Additional sampling requirements as the City grows and with the expansion of the distribution system • Maximizes the use of existing infrastructure	Moderate to High • Increased operation and maintenance costs associated with the construction of a new grade level reservoir • Additional sampling requirements as the City grows and with the expansion of the distribution system • Maximizes the use of existing infrastructure

4.4 Selection of Preferred Alternative

4.4.1 East Hill Zone

Based upon the analysis presented, there are three acceptable servicing strategies for the East Hill Pressure Zone. These include E2 – No Storage, E3.1 – New Storage For East Hill Zone or E4 – Shared Storage with the Industrial Zone. The selection was presented to committee in June 2007. Subsequently, a Focusing Report was prepared and presented to the City in July 2007 that further documents the rationale for the election of the preferred alternative. The Focusing Report is enclosed as **Appendix B**.

The preferred servicing strategy for the East Hill Pressure Zone is the alternative to construct an elevated tower to serve the East Hill lands alone. This would include improvements to the East Hill Booster Station and the R.H Neath Water Filtration Plant. Costs for improvements in the R.H. Neath Water Filtration Plant are not included in the following figures.

The principal advantages of this solution are:

- Provides a high level of service for all lands located within the East Hill Pressure Zone.
- East Hill Pressure Zone customers see no change in water pressure.
- Lower operating cost in comparison to Alternative E2 – No Storage.
- Is not reliant on completion of the Industrial Reservoir in order to be implemented.

The principal disadvantage of this option is:

- Capital costs are greater than they would be under Alternative E4 where the East Hill Zone receives flows from the industrial reservoir during periods of peak demand, emergencies or under fire conditions.

A life cycle costs comparison was conducted, which demonstrated that the life cycle costs associated with Option E2 (No Storage) and Option E3.1 (East Hill Zone Storage) are similar. The estimated capital costs to implement the preferred solution for the East Hill Zone for 2026 horizon are summarized below:

Item	Cost
Upgrades to East Hill Booster Station	$760,000
East Hill Zone Water Tower	$2,640,000
Subtotal	$3,400,000
Engineering and Contingencies (25%)	$850,000
Total	$4,250,000

As identified in the Focusing Report, upgrades for the East Hill Booster Station and provision of the Water Storage Facility for the East Hill Zone should be implemented in the near future.

4.4.2 Industrial Zone

Based upon the analysis presented, there are three acceptable servicing strategies for the East Hill Pressure Zone. These include I2 – No Storage, I3 New Storage for East Hill Zone or I4 Shared Storage with the Industrial Zone. The selection was presented to committee in June 2007. Subsequently, a Focusing Report was prepared and presented to the City in July 2007 that further documents the rationale for the election of the preferred alternative. The Focusing Report is enclosed as **Appendix B**.

The preferred servicing strategy for the Industrial Pressure Zone is the alternative to construct an elevated tower to serve the industrial lands alone. This would include improvements to the R.H Neath Water Filtration Plant. Costs for improvements in the R.H. Neath Water Filtration Plant are not included in the following figures.

The principle advantages of this solution are:

- Provides a high level of service for all lands located with in the Industrial Zone.
- Delays the time to expansion of the Water Treatment Plant.

The principal disadvantages of this option are:

- Capital costs are greater than they would be under Alternative I3 (No Storage).

The location of the reservoir and the associated watermain to connect dramatically affects the capital cost component of the life cycle cost analysis. The closer to the Industrial Zone that the reservoir is located, the closer the life cycle costs are between the two solutions.

The estimated cost to implement the preferred solution for the Industrial Zone is summarized below:

Item	Cost
Industrial Zone Water Tower	$4,800,000
Subtotal	$4,800,000
Engineering and Contingencies (25%)	$1,200,000
Total	$6,000,000

As identified in the Focusing Report, the provision of the Water Storage Facility for the Industrial Zone should be considered in the mid to long range.

5.0 Sanitary Sewer System

5.1 Sanitary Servicing

5.1.1 Wastewater Treatment Plant

The Owen Sound Wastewater Treatment Plant (WWTP) is located on the east side of Owen Sound Bay and treats sewage at a primary level, which generally provides the settling of solids, phosphorus reduction, sludge stabilization and disinfection. The WWTP has an average day rated capacity of 24,500 m^3/day. A previous study completed in 1998 by Henderson, Paddon & Associates Limited and CH2M Gore & Storrie Limited, titled the *"City of Owen Sound – Wastewater Treatment Plant Optimization and Sanitary Sewer Collection System Study,"* determined that the peak capacity of the sewage treatment plant is approximately 75,000 m^3/day, which was based on capacity analysis of the different components of the plant.

5.1.2 Existing Sanitary Sewer Collection System

According to the Henderson, Paddon & Associates Limited and CH2M Gore & Storrie Limited report, as of 1998 there was approximately 100km of sanitary sewer in the City's collection system, ranging from 100mm diameter to 1,000mm diameter, and approximately 2.6km of the collection system was combined sewers. In 1998, the sanitary collection system consisted of ten (10) sewage pumping stations, including the West Side Sewage Pumping Station (WSSPS), each with emergency sewage overflow pipes, as well as twenty-four locations for sewage bypass to the near shore waters of Georgian Bay, the Pottawatomi and Sydenham rivers. There are also two (2) sewage siphons, which transport sewage from the west side to the east side of the City under the Sydenham River. The City's sanitary sewer collection system is divided into three (3) sewerage areas: WSSPS Sewerage Area, Central Sewerage Area and Industrial Sewerage Area.

The *"City of Owen Sound – Wastewater Treatment Plant Optimization and Sanitary Sewer Collection System Study"* concluded that approximately 72 percent of the raw sewage for the City must flow through the east side interceptor sewer in order to reach the WWTP during average flow conditions and an estimated 85 percent during peak flow conditions. Historically, the City's sewage flows have been highly influenced by infiltration and since the east side interceptor was undersized for peak flows at that time, significant sewage bypass occurred during wet weather conditions. Based on the major flow restrictions identified in the City's collection system and to eliminate or reduce the sewage bypassing, it was recommended that the WSSPS be upgraded and a new sanitary sewer forcemain be constructed directly from the west side SPS to the WWTP should occur. However infiltration and WWTP influent works upgrading are being implemented to achieve the same results.

Drawing SAN1 shows the existing sewer system layout for the lands within the study area, including size and locations of gravity sewers and forcemains, pumping stations and the sewage treatment plant.

The purpose of this study is to provide a general overview of the existing sanitary sewer collection system for the east side of the City, to identify existing deficiencies, and to develop and evaluate servicing options for the vacant lands. Drawing SAN2 represents the existing and future service areas for the east side of the City and delineates the various catchment areas used to support existing sewage flows and determine the future sewage flows for the vacant lands.

5.1.3 Previous Studies

As previously identified, the City has commissioned many studies of the wastewater treatment plant and the sanitary sewer collection system. Relevant studies were reviewed to ascertain the historical approach to servicing the lands on the east side of Owen Sound. The key studies included:

- City of Owen Sound, Wastewater Treatment Plant Optimization Study and Sanitary Sewer Collection System, Volume I and II, May 1998
- Needs Study for Sanitary Sewage Collection System in the City of Owen Sound, Volumes I and II, September 1991

5.1.4 Historical Servicing Strategy

The developed portion of the east side lands is served by a municipal sanitary sewer collection system that conveys sanitary sewage to the Owen Sound Water Pollution Control Plant.

These lands contribute sewage to both the Central Sewerage District and the Industrial Sewerage District. Sewers in the east side lands generally fall to the west and north to the east side interceptor sewer, which drains northward to the Water Pollution Control Plant. Similarly, lands which contribute to the Industrial Sewerage Area generally drain to the west and north. These lands do not drain to the east side interceptor sewer. A large diameter (600mm) sanitary trunk sewer has been constructed through the eastern portion of the Industrial Sewerage Area. This sewer was designed to accommodate sewage flows from the as yet undeveloped lands along the east side of the study limit, referred to in the Wastewater Treatment Plant Optimization Study by Henderson, Paddon and Associated Limited, May 1998 as NE-1, NE-2, SE-1 and SE-2. There are lower reaches of this trunk sewer, primarily along 3rd Avenue East, north of the WWTP that have yet to be constructed.

There are five small pumping stations spread along the western limit of the study area.

5.1.5 Historical Sewage Flows

The City of Owen Sound provided data which identified that the average day flow at the WPCP is approximately 13,000 m^3/d, or approximately 53 percent of the rated average day capacity of the plant.

Not all of this spare capacity is necessarily available for new development. The amount of development available for new development is referred to by the MOE as hydraulic reserve capacity.

The calculation of the hydraulic reserve capacity of the Owen Sound Water Pollution Control Plant is outside of the scope of this report.

It is noted that during wet weather conditions, peak flows can reach as high as 90,000 m^3/d, which exceeds the peak flow capacity of the WPCP.

5.1.6 Sanitary Sewage Flow Monitoring

As part of the study, sanitary sewage flow modeling has been conducted at three locations. The results of the full program are documented in a summary report located in **Appendix C**.

The results of the monitoring program are summarized in **Table 5.1**

Table 5.1 – Summary of Flow Monitoring

ID	Location	Basin Description	Average (L/s)	Peak (L/s)
OW1	21st Street and 5th Avenue East	Residential / Commercial	18	104
OW2	17th Street East and 5th Avenue East	Residential	8	29
OW3	CP Rail Corridor North of 28th Street East	Industrial	9	37

It is noted these observations would include any impact from infiltration.

The observed peaking factors at the monitored locations were 5.8 for OW1 basin, 3.6 for OW2 basin, and 4.1 in OW3 basin. The observed results showed general agreement with the flow predicted by the Hydra model, with the exception of the peak flow at monitoring station OW1.

The observed increase in flows in response to rainfall/snowmelt events at OW1 was extreme. The nature of the response suggests the extraneous flows are attributable to infiltration and not direct inflows.

OW2 exhibited a typical residential flow pattern and OW3 exhibited a typical industrial pattern, which matches the overall basin description for both sites. At both sites the response to higher intensity rainfall was noticeable and indicates inflow and infiltration is a concern.

It is recommended that future monitoring be conducted at OW1 with additional stations added upstream to help isolate the inflow and/or infiltration sources for this large catchment.

The Ministry guidelines for these land use categories recommend, in the absence of specific data, the following allowances, exclusive of infiltration:

- Average residential sewage flow of 11.25 $m^3/ha.d$

- Average commercial sewage flow of 28 m^3/ha.d
- Average industrial sewage flow of 35 – 55 m^3/ha.d

The MOE residential allowance assumes 25 persons per hectare at 450 L/person/day.

As actual flows are generally less than typical MOE allowances, this suggests an opportunity for using reduced allowances for future planning.

The observed peaking factors generally exceed typical MOE factors and as such, it is anticipated that inflow and infiltration may be contributing to the peak flows in the existing sewer system.

5.2 Projected Sewage Demands for the Study Area

The projected sewage demands for the study area are derived based upon the forecasted growth presented in section 3.1.2.

Sewage flows for a study area to be fully serviced are typically calculated based on the forecasted water demand for residential, commercial, institutional and industrial flows, and include an allowance for extraneous flows. A peaking factor is also applied to acknowledge the variation in flow rates throughout the day. The peaking factor is also a function of the projected service population, and decreases with increases in service population.

Sewers are then selected that will be able to convey the peak sewage flow, including infiltration. When designing sanitary sewage collection systems, consideration must also be given to the non-peak flows, ensuring that sufficient flows and velocities exist in the sewers to transport solids.

The projected sewage demands conveyed by each sewer is a function of the land use mix in each catchment area. The catchment areas are shown in Drawing SAN2. The flows are a function of the land use designations from the City of Owen Sound Official Plan as presented on Drawing SAN3.

Using MOE-recommended design values for estimating future sewage flows is considered very conservative for the City of Owen Sound. The historical industrial water demand is relatively low compared to the MOE guidelines, and as such, the MOE method of calculating peak flows will result in values that are excessive when compared to current patterns (MOE values of 35 m^3/ha.d to 55 m^3/ha.d versus the City's historical value of 11 m^3/ha.d).

The following criteria were used to calculate the future sewage flows and to obtain the approximate sizes of trunk sewers for the vacant lands on the east side of the City. The trunk sewer size may need to be adjusted during final design, subject to the grade of the pipe and fine-tuning of house densities and drainage areas.

- 25.6 persons per hectare for existing lands
- 48.3 persons per hectare for future development
- Residential average daily flow of 450 L/capita.day

- Industrial average daily flow of 11 m^3/ha.day
- Commercial average daily flow of 22 m^3/day
- Peak extraneous flow of 0.2 L/ha.sec
- Harmon peaking factor

Table 5.2 summarizes the projected sewage flows for the Existing, 20-Year, Official Plan and Ultimate Build-out planning horizons based on the above design criteria and the projected populations as determined using the Hydra program. The gross average contribution per person equivalent is currently 464 L/person/day and drops to approximately 435 L/person/day exclusive of infiltration. The variation reflects the different blend of land uses for each planning horizon.

Table 5.2 - Projected Sewage Flows at the WPCP

Scenario	Population	Average Daily Flow* (m^3/d)	Peaking Factor	Peak Flow (m^3/d)
Existing	22,197	10,716	2.61	27,992
Ultimate Build-out	41,412	18,020	2.34	42,166
*Assumes 450 L/person/day and no infiltration Peak Flow Calculated using Harmon Peaking Factors				

Assuming an infiltration allowance of 90 L/person per day (MOE), the ultimate ADF including infiltration would be approximately 21,747 m^3/d, suggesting that the WPCP is large enough, based upon average day demands (the typical criteria for design of WPCPs).

Assuming an infiltration allowance of 227 L/person per day (MOE), the ultimate PF including infiltration would be approximately 51,566 m^3/d, suggesting that the WPCP is large enough, based upon peak flows.

It is noted that the wet weather flows already occasionally exceed the peak flow handling capacity of the WPCP, and as such, inflow and infiltration appears to be a significant issue in the City.

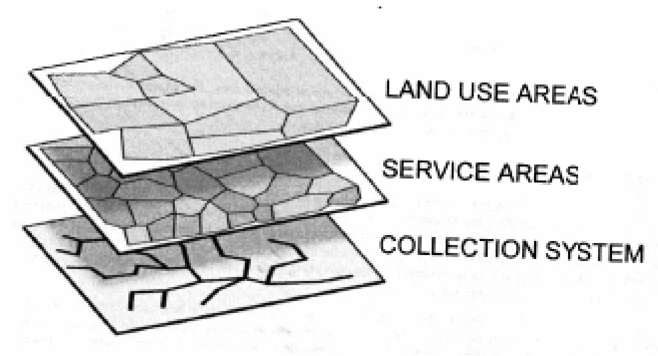
Similarly, the level of treatment provided by the Owen Sound WWTP is less than that typically required and this facility will require upgrading to provide additional treatment in the future. An analysis of the scope and timing of this upgrade is outside of the terms of reference for this study.

5.3 Hydraulic Modeling

The terms of reference required that the sanitary sewage collection system be modeled using a software package called Hydra.

The sanitary collection system was modeled using Hydra Version 6.4.0.43, with updated hydraulic engine version 6.4.13.2. The model was based upon on AutoCAD Map file of the collection system provided by the City.

The Hydra software analyses the data provided in three distinct layers: a land use layer, a catchment layer and the pipe network layer. The model is dynamic and considers such factors as travel time when determining the peak flows in a particular pipe segment.



The land use layer has no direct connection with the collection system. The service area layer must be used in conjunction with the land use layer in order to pass the flows through to the collection system layer. The land use layer consists of residential, industrial and commercial designations. This is where the data for the different design scenarios is entered. The residential land data includes the population, the percent of that population that contributes to the system, and the per capita contribution. The industrial and commercial areas incorporate the total flow in litres per day and the percent contributing to the system.

The service area layer is divided into subcatchments and each catchment is associated with a receiving sewer in the collection system layer. The software determines the mix of land uses and associated flows generated in each catchment area.

In addition to the data entered in each layer, general modeling parameters must be set for such things as infiltration and peaking factor value.

Sewage flows records on an area basis were not available. In order that the model was representative of actual conditions, a number of assumptions have to be made regarding sewage contributions from areas outside of the study area.

As previously noted, the existing ADF for the WWTP is approximately 13,000 m^3/d. There are three locations where sewage enters the modeled system from areas outside of the study area. These are the 10th Street syphon, the 8th Street siphon, and a gravity crossing at the intersection of 2nd Avenue East and the Sydenham River. This was necessary to adequately model flows in the East Side interceptor and total flows to the Water Pollution Control Plant. The sanitary collection system on the west side was not modeled.

In order to estimate the sewage flows at each of the three points, the sewage generation rate was assumed to be constant across the west-side lands, and the flows allocated to each point assumed to be in proportion to the service area associated with that point.

There are many ways to model infiltration and exfiltration using Hydra. For the purposes of this study, infiltration has been modelled as an allowance of 0.20 m^3/ha under peak flow conditions, and exfiltration has been conservatively assumed to be zero.

Existing sewers and future sewers were assumed to have the following characteristics for the purposes of the modeling using actual diameters and slopes and assumed pipe roughness expressed as a Manning's "n" of 0.013.

The model supports analysis based entirely upon diurnal curves for the various land uses. For the purposes of this analysis, as a result of specific data on existing diurnal patterns, modeling has been conducted using the more traditional peaking factor approach that also provides consistency with previous design work.

Existing and proposed forcemains were analyzed based upon existing diameters and a pipe roughness expressed as a Hazen Williams co-efficient of C=100.

Each node was designated as a manhole, a split manhole, a diversion structure or a pumping station. These nodes were assigned invert and ground elevations, as well as specific design criteria for each type of node.

The sanitary sewer system includes approximately ten locations at which sanitary sewage bypass could occur. These diversions have not been included within the Hydra model. Inadequate detail was available to include these diversions in the model.

The east side study includes five small pumping stations. These stations have been modeled using the following assumptions.

Table 5.3 – Summary of Sanitary Sewage Pumping Stations

Pumping Station ID	Location	Wet Well Volume (m^3)	Peak Flow (m^3/s)
SPS1	Shoreline Road, 400m north of 32nd Street	1.2	0.0076
SPS2	Shoreline Road and 32nd Street	1.2	0.0079
SPS3	4th Street East and 5th Avenue East	0.4	.0079
SPS4	5th Avenue East	1.2	0.0066
SPS5	5th Street East	N/A	N/A

SPS 5 was not modeled as a pumping station; rather, it was incorporated directly as a catchment.

5.4 Planning Horizons

The following is a summary of the planning horizons used in the system model.

5.4.1 Existing

The model of the existing uses the current population and land use designations for all serviced lands on the east and west sides of the City. This scenario is intended to reflect current servicing conditions. For this scenario, population and flow data are not included for the vacant land to the east of the limit of service area or for the hazard and open-space land.

5.4.2 20-Year

This 20-Year scenario consists of the vacant land east of the limit of service area, and also includes the existing system. The 20-Year population was first determined based on a growth rate for the City. For the purposes of the report, all the growth over the next twenty years is anticipated to occur on the east side of Owen Sound within the study limits, and more specifically, on lands already designated for development under the Office Plan. Within this twenty-year horizon, not all of the designated lands are anticipated to be developed.

For this scenario, it was assumed that East Hill will initially start to develop at the limit of service area and then move eastward; as a result, some of the designated lands at the east side of the study area will not be developed under this scenario. The west side remains at existing levels.

5.4.3 Official Plan

The Official Plan scenario reflects the servicing demands when all of the lands designated on the east side of Owen Sound are built upon. The west side remains at existing levels. As there are many factors that can affect the growth rate in the community, the amount of time until the OP lands are fully developed has not been estimated. However, it appears that time will exceed twenty years.

This land is modeled in accordance with the existing Official Plan land use designations.

5.4.4 Ultimate Build-out

The Ultimate Build-out scenario consists of all the land on the east side of the City being fully developed. As there are many factors that can affect the growth rate in the community, the amount of time until Ultimate Build-out has not been determined.

The east side lands identified as Rural in the Official Plan are considered to be residential lands under the build-out scenario. The west side lands remain at existing levels.

5.4.5 Analysis of the Existing Sanitary Collection System

The Hydra model identified a number of constraints in the existing sanitary sewer collection system that suggest that under current conditions, during periods of peak flow, the existing sewers may lack adequate capacity.

5.5 Existing Deficiencies

There are three short reaches of sewer which are the last reaches of pipe before the collector sewers enter the east side interceptor pipe. These are generally small-diameter, steep, pressure-rated pipes and are not a concern.

5.6 Identification of Alternative Solutions for Sanitary Servicing

One of the objectives of the study is to identify and evaluate alternative solutions for providing sanitary services to the unserviced lands within the study area. These lands generally fall from north to south and east to west.

The key alternative solutions considered are

1. Do Nothing
2. Connect to Existing Trunk Sewer

5.7 Evaluation of Alternative Solutions

Table 4.6 identifies the impact of each alternative with respect to the technical, environmental and social criteria identified in Section 3.0 above; it also provides a systematic evaluation of these alternatives, as well as the associated capital costs of implementation.

The 20-Year, OP and Ultimate Build-out Scenarios were analyzed to determine to assess the ability of the existing and proposed sewer under the various planning horizon.

The sanitary sewer servicing alternatives that were considered to be feasible components of the overall servicing strategy to meet the City's needs for the 20-Year planning horizon, the Official Plan horizon, as well as the Ultimate Greenfield Build-out planning horizon, along with the respective cost estimates, are summarized **Table 5.4** below.

The existing sanitary sewer on 3rd Avenue East from the WPCP to East Bayshore Road is anticipated to be at capacity as early as year 2017. The replacement of this pipe has previously been identified and designed. This project should proceed to construction as soon as funding permits or as actual flows dictate.

The proposed trunk main location and main diameters are shown on Drawing SAN2 in **Appendix A**.

Table 5.4: Sanitary Servicing Alternatives Industrial Pressure Zone – Identification of Impact and Evaluation

Criteria	Alternative S1 Do Nothing	Alternative S2 Connect to Existing Trunk Sewer
Description	The "Do Nothing" option consists of no further action by the City to optimize the current collection system.	The vacant lands requiring servicing would be connected to either the existing trunk sewer, or an extension of the trunk sewer into the southeast portion of the study area.
Meets Study Objective	• Would not meet the study objective as the lands in the southeast and north-east corner of the study area would not be serviced.	• Ultimate Build-out demands can be met through an extended trunk sewer. • The lower reaches of trunk sewer will be required to be constructed. The need for this upgrade has been previously identified and the sewer has already been designed. • Assuming the current issue with excessive peak flow is addressed, the WWTP has adequate capacity to handle the flow under the Ultimate Build-out conditions. The level of treatment provided by the plant will eventually need to be upgraded.
Impact to Natural Environment	Aquatic and Terrestrial Environment: Low • No proposed works in surface water.	Aquatic and Terrestrial Environment: Moderate • No proposed works in surface water. • No water crossings anticipated. • Moderate impact associated with upgraded WWTP.
Impact to Natural Environment	Aquatic and Terrestrial Environment: Low • No proposed works in surface water.	Aquatic and Terrestrial Environment: Low • No proposed works in surface water. • No water crossings anticipated.
	Climate Effects: Low	Climate Effects: Low
Temporary Disturbances (Construction)	Low	Low • Impact of construction can be mitigated to minimize permanent environmental damage.
Required Time to Complete (Design, Construction, Commissioning)	Low	Moderate • A new certificate of Certificate of Approval will be required for the sewers. • Amended Certificate of Approval for WWTP.

Criteria	Alternative S1 Do Nothing	Alternative S2 Connect to Existing Trunk Sewer
		• A site-specific EA may be required for the WWTP upgrade.
Impact to Social Environment	Aesthetic: Low	Aesthetic: Low • Possible minor visual impact associated with plant. • Nominal impact associated with sewer.
	Agricultural: Low Socio-Economic: Low • Utilizes existing system.	Agricultural: Low Socio-Economic: Low • Maximizes the efficiency of the existing system. • Permits future growth of the City.
	Heritage Resources: Low	Heritage Resources: Low
Capital Costs	Low • Replacement costs for existing equipment.	Moderate • Costs of extending trunk sewer (Ultimate Build-out = $1.9 M). • Costs associated with upgrading trunk sewer on 3rd Avenue East (not determined). • Cost associated with upgrading WWTP (not determined).
Operation and Maintenance Costs	Low • Cost of maintaining older equipment.	Low • Cost of maintaining older equipment.

5.8 Selection of Preferred Alternative

Based upon the analysis presented, the preferred solution for providing sanitary services for the as yet undeveloped lands along the east and south portions of the study area is option S2, which involves extending the trunk sewer southerly into the undeveloped lands.

The principal advantages of this solution are:

- Takes advantage of capacity allocated for this area in the existing trunk sewer.
- Low operating cost associated with gravity sewers.
- Allows development to proceed in an orderly manner along the route of the proposed sewer.

The principal disadvantage of this option is:

- Requires that the trunk sewer between the WPCP and approximately the intersection of East Bayshore Road with 3rd Avenue West be upgraded; however, this project has been previously identified as necessary and is already designed.

This solution requires that the trunk sewer between the WPCP and the intersection of East Bayshore Road and 3rd Avenue East be upgraded. This project has been previously identified as necessary and has been designed. These costs are not included below.

The cost of extending the trunk sanitary sewer is estimated to be:

Item	Cost
Extend Existing Trunk Sewer	$1,500,000
Subtotal	$1,500,000
Engineering and Contingencies (25%)	$ 375,000
Total	$1,875,000

The timing of the construction of the extension of the trunk sewer will be a function of the pressure for development in the area.

The existing trunk sewer on 3rd Avenue is estimated to be at 56 percent of its capacity. Based upon the projected growth, it is anticipated that the upgrade would need to be in place by 2017. Actual flow in the sewer should be monitored on a regular basis to ensure that any change in sewage flows, albeit from a change in use or infiltration, is identified and assessed for its impact on the projected date for the need for this upgrade.

The trunk sewer upgrading should be scheduled for construction as soon as funds permit, or when actual flows dictate it.

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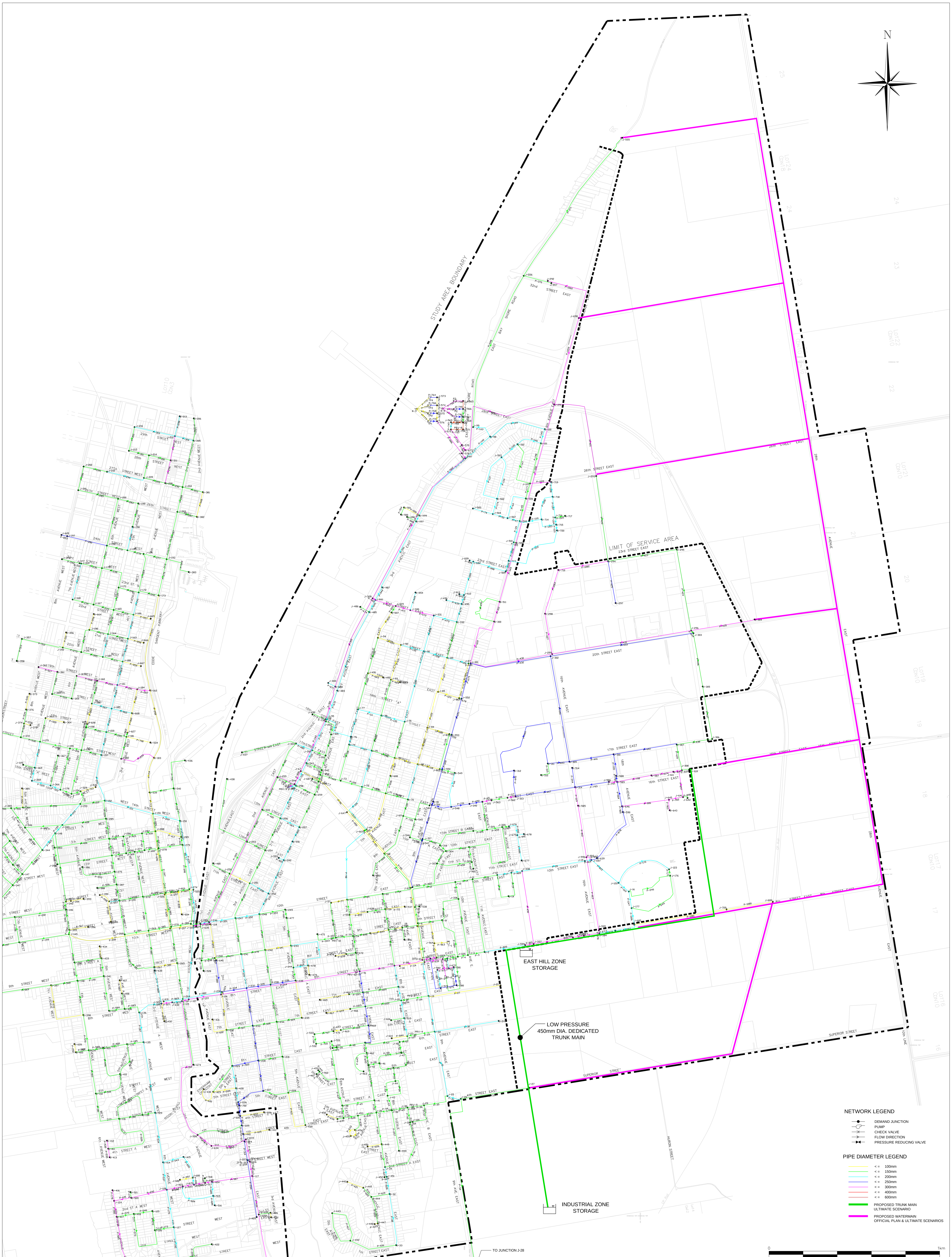
Appendix A
Drawings



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4. Do not scale the drawings.

No.	Issue / Revision	Date
1.	ISSUED – DRAFT REPORT	OCTOBER 12, 2007
2.	ISSUED – FINAL REPORT	DECEMBER 2007

BURNSIDE

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Client
CITY OF OWEN SOUND
808 SECOND AVENUE E.
OWEN SOUND, ONTARIO
N4K 2H4

Drawing Title
OWEN SOUND
WATER NETWORK MODEL
EXISTING & PROPOSED SYSTEMS

Drawn By	Checked By	Drawing No.
K.M.G.	J.L.L	WAT1
Scale: 1:10,000	Project No.: MCG 10665	

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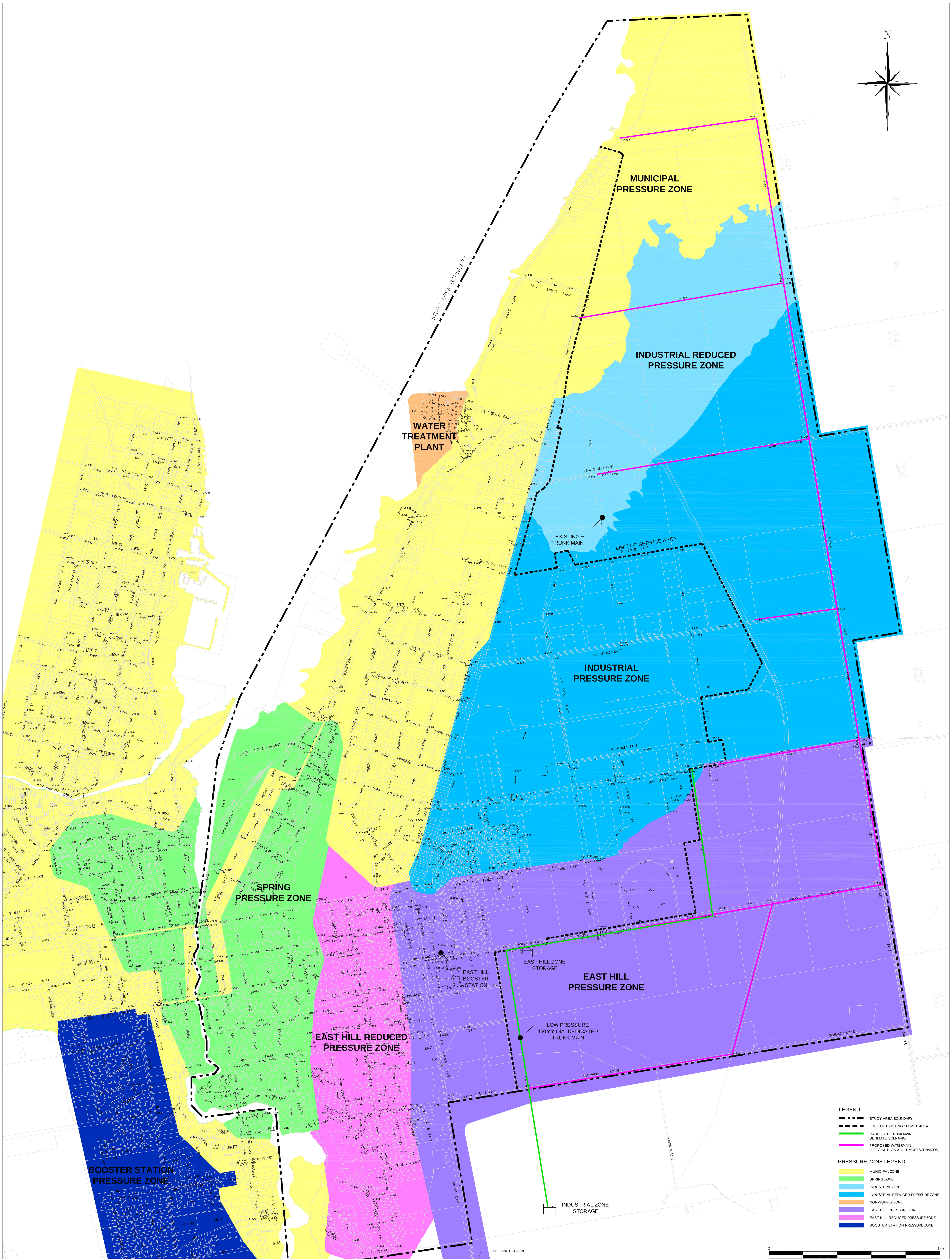

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Client
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OWEN SOUND, ONTARIO
N4K 2H4

Drawing Title
OWEN SOUND
WATER NETWORK MODEL
EXISTING & PROPOSED PRESSURE ZONES

Drawn By	Checked By	Drawing No.
K.M.G.	J.L.L.	WAT2
Scale	Project No.	
1:10,000	MCG 10665	

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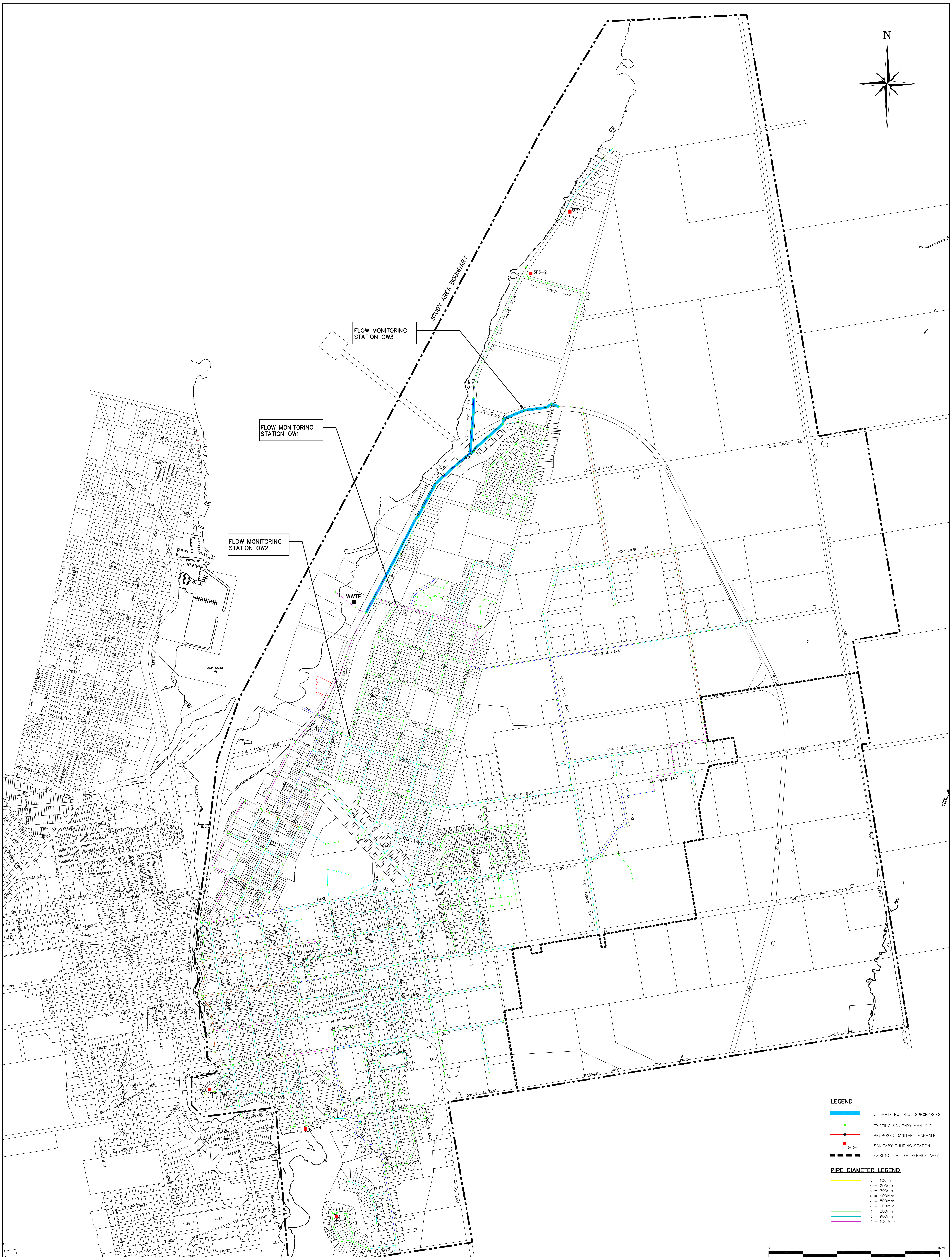

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1.	ISSUED – DRAFT REPORT	OCTOBER 15, 2007
2.	ISSUED – FINAL REPORT	DECEMBER 2007

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Client
CITY OF OWEN SOUND
808 SECOND AVENUE E.
OWEN SOUND, ONTARIO
N4K 2H4

Drawing Title
OWEN SOUND
SANITARY SEWER PLAN – EXISTING

Drawn By: J.L.K./J.D.R.
Checked By: J.L.L
Drawing No.: SAN1
Scale: 1:10,000
Project No.: MCG 10665

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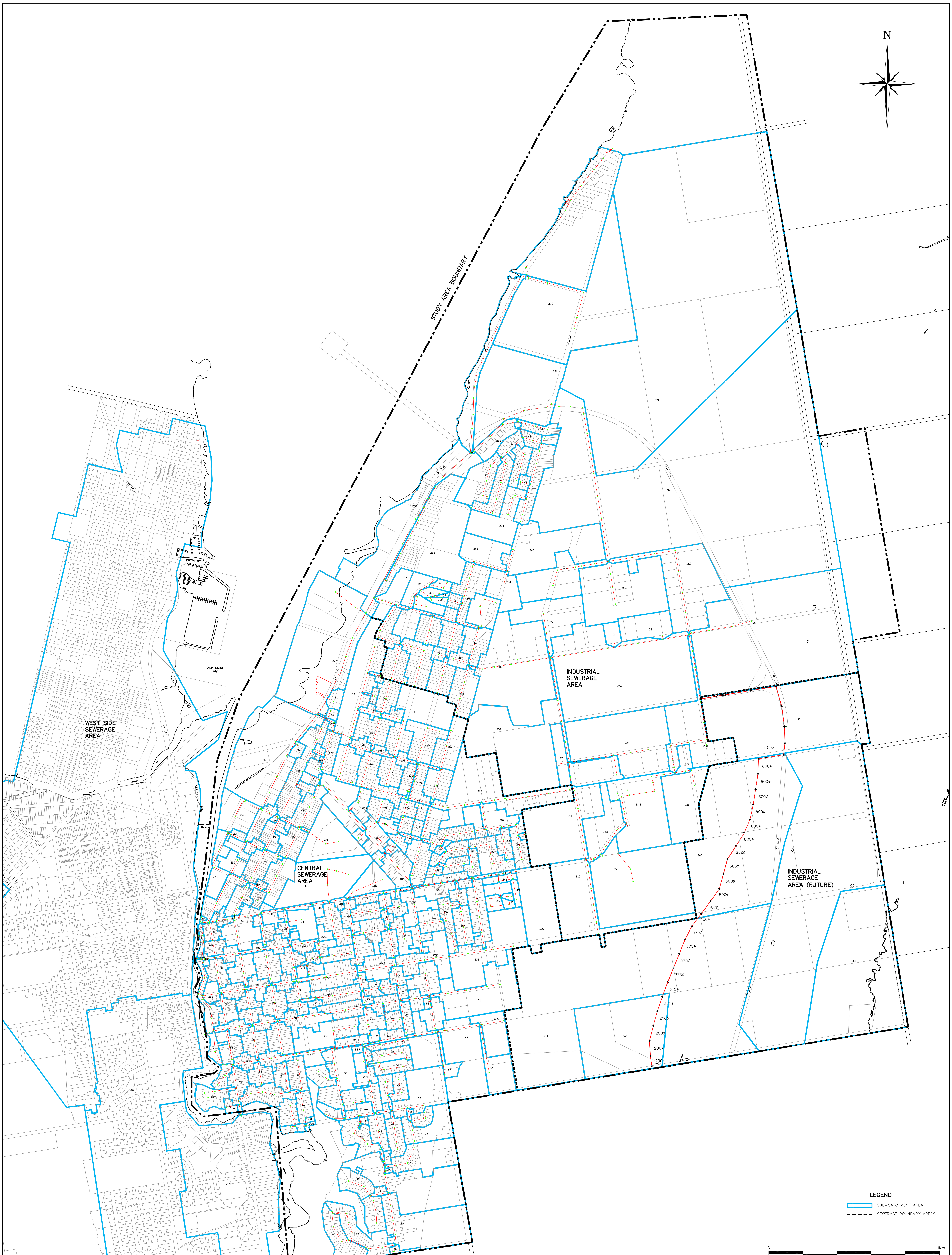

No.	Issue / Revision	Date
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2.	ISSUED – FINAL REPORT	DECEMBER 2007

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Client
CITY OF OWEN SOUND

808 SECOND AVENUE E.
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Drawing Title
OWEN SOUND
SANITARY SEWER
SUB-CATCHMENT PLAN

Drawn By	Checked By	Drawing No.
J.L.K./J.D.R.	J.L.L	SAN2
Scale	**Project No.**	
1:10,000	MCG 10665	

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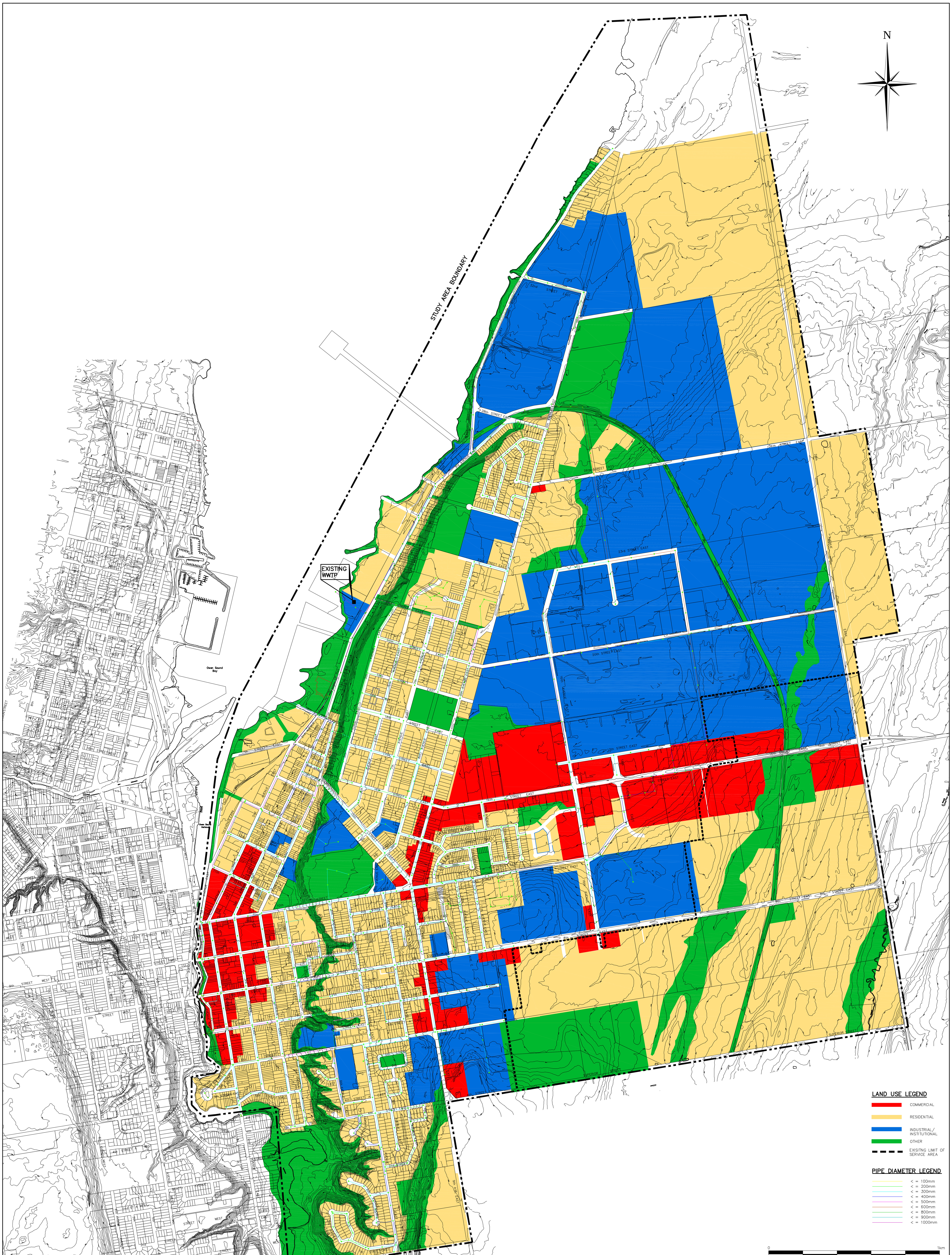

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2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.
4. Do not scale the drawings.

No.	Issue / Revision	Date
1.	ISSUED – DRAFT REPORT	OCTOBER 15, 2007
2.	ISSUED – FINAL REPORT	DECEMBER 2007

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web www.rjburnside.com

Client
CITY OF OWEN SOUND
808 SECOND AVENUE E.
OWEN SOUND, ONTARIO
N4K 2H4

Drawing Title
OWEN SOUND
LAND USE PLAN

Drawn By	Checked By	Drawing No.
J.L.K./J.D.R.	J.L.L	SAN3
Scale: 1:10,000	Project No.: MCG 10665	

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Appendix B
Focusing Report Water

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City of Owen Sound
East Side Master Servicing Study
Focusing Report - Water

Prepared by

R.J.Burnside & Associates Limited
3 Ronell Crescent Collingwood ON L9Y 4J6 Canada

July 2007

File No: MCG10665

Table of Contents

1 Background

R.J. Burnside & Associates Limited was retained by the City of Owen Sound to undertake a Master Servicing Study (MSS) for the water supply servicing, sanitary sewer servicing and stormwater management for the eastern section of the City. The Master Plan approach enables the City to identify the projects and initiatives to implement the servicing strategy. The plan is referred to as the "East Owen Sound Master Servicing Plan".

Master plans define the problem faced by a municipality relating to its infrastructure and identify and evaluate alternative solutions to the problem, and identify a "preferred alternative".

The City's initiative to undertake a Master Servicing Plan was brought about by several issues and recent events including flooding on 15th Street B East, ongoing development along the 16th Street (Hwy 26) corridor and the Sydenham Heights Planning Area, and the need to address servicing requirements for the remaining vacant land in the eastern part of the City. This master plan will serve as a base reference document for the City and property owners wishing to undertake development to service the remaining vacant land in the eastern part of the City to allow for orderly development.

On June 20, 2007 a presentation of the East Side Master Serving Plan was made to the committee and interested members of the public. The municipality has requested an additional report for the review and consideration of the committee, focused on the water servicing aspects of the study.

2 Introduction

The City is served by a municipal water system. The principle components of the system are the R.H. Neath Water Filtration Plant, located along east shore of Owen Sound, the Norm Robertson Reservoir located at the intersection of 8th Street East and 9th Avenue East, the East Hill Booster Pumping Station located adjacent to the Norm Robertson Reservoir on 8th Street East and the Beattie Street Booster Station located in the south west quadrant of the municipality.

The current rating of the Owen Sound WTP is 27,276 m^3/d (315.7 L/s). The Water Filtration Plant includes two distinct high lift pumping systems that send water to the distribution system. These are referred to as the Municipal Plant, and the Industrial Plant. The Municipal plant supplies water for a major portion of the city. The principal lands excluded from this system are the industrial lands, generally north of 16th Street and east of 9th Avenue. The industrial lands are served by the Industrial Plant.

The Owen Sound water distribution system is a relatively complex system. The system consists of several pressure zones as a result of the substantial variation in elevation across the City. The pressure zones have been created to ensure that water supply pressures at the tap are maintained within acceptable minimums and maximums. There are currently five pressure zones in the east section of the City and they are as follows:

- Municipal
- Industrial
- East Hill
- East Hill Reduced

- Spring

The East Hill Booster Station draws water from the Municipal Zone and pumps it into the East Hill Zone. Water from the East Hill Zone can cascade to the East Hill Reduced Zone, and Spring Zone.

Within the distribution system there is currently one water storage facility. The Norm Robertson Reservoir is located at the intersection of 8th Street East and 9th Street East. This is a reinforced concrete grade level reservoir with a capacity of 16,277 m^3. The facility was recently upgraded to improve circulation through the reservoir. The reservoir "floats" on the Municipal Zone and provides equalization, emergency and fire capacity to the Municipal Zone.

There is currently no water storage facility in the Industrial Zone. Since 1993, the water servicing strategy for the Industrial Zone has included plans for a grade level reservoir which would "float" on the Industrial Zone and provide equalization, emergency and fire flows.

Similarly there is no water storage facility for the East Hill Zone (and therefore the East Hill Reduced and Spring Zone)

3 Historical Servicing Approach

Based upon a review of previous studies and discussions with the City, the anticipated servicing strategy for the East Side lands was identified.

The R.H. Neath Water Filtration Plant is intended to supply the water to meet the maximum day demand in the Municipal Zone. The Norm Robertson Reservoir supplements the supply to meet peak hour demands and fire flows.

The East Hill Booster Station draws water from the Municipal Zone/Norm Robertson Reservoir and pumps it into the East Hill Pressure Zone, which in turn cascades to the East Hill Reduced and Spring Zones. The East Hill Booster Pumping Station is required to meet the peak demands of the East Hill Zone, the East Hill Reduced Zone and the Spring Zone, as well as provide fire flows in conjunction with maximum day demands for the East Hill Zone, the East Hill Reduced Zone and the Spring Zone. An upgrade path has been previously identified for the East Hill Booster Pumping Station that allows it to meet forecasted flows and fire demands associated with the OSCVI and Grey Bruce Regional Health Center on an interim basis. The historical approach has identified that at some point in the future the Industrial Zone Reservoir will be constructed and that the Industrial Zone reservoir would be able to provide fire flows to the Industrial Zone as well as portions of the East Hill, East Hill Reduced and Spring Zones. The proposed reservoir was to be located 0.8 km south of the study area on lands already owned by the City

The historical servicing approach for the Industrial Lands envisions the construction of "floating" storage for the Industrial Zone. Currently the Industrial Plant at the R.H. Neath Water Filtration plant, is required to pump peak flows to the Industrial Zone and during a fire must pump the maximum day demand in conjunction with fire demand to the Industrial Zone. Once constructed the Industrial Zone Reservoir would supplement the capacity of the Industrial Plant to provide peak flows and fire flows.

A trunk watermain has been constructed from the R.H. Neath Water Filtration Plant, through the Industrial Zone to the current limit of the Industrial Zone at 16th Street East. The trunk main is initially 600 mm in diameter, but is reduced to 450 mm in diameter in the upper portion of the zone. It was envisioned that this trunk main would eventually be extended to the proposed site for the Industrial Zone Reservoir.

4 Level of Service

In developing a recommended solution for the municipality, the principle questions to be addressed relates to the level of service that the municipality desires to provide.

A municipal water system must be capable of providing the greater of the peak hour demand, and or the maximum day demand plus fire demand.

The traditional approach for a municipality is to develop the source (the WTP) to provide the maximum day demand and to meet the peak hour demands and fire demands from storage. In some cases, usually on smaller systems the source will be developed to meet all the demands and storage is not provided in the distribution system. Where these smaller systems need to provide fire flows water is often required to be stored at the WTP for use should it be necessary to fight a fire.

For many years Owen Sound has used distribution system storage to meet the peak, fire and emergency flows for most of the community. The spring reservoir located on eight street east near eighth avenue east fulfilled this purpose for many years. As the town expanded its boundaries out and up, it was necessary to construct new larger water storage facilities at a higher location. This facility is known as the Norm Robertson Reservoir. As the town continues to grow out and up it is necessary to provide additional water storage facilities, again at a higher elevation.

The industrial zone has never been provided with storage.

As early as 1993 a municipal class EA was completed for the construction of additional water storage facilities that would serve the industrial lands and most of the development lands on the east side. The municipality went so far as obtaining ownership of these lands, but has not proceeded to construction.

When a service areas is located at these higher elevations, and the area to be served is small, a booster pumping station can be provided as an alternate to storage. This is often an interim solution until the service area can be expanded and water storage provided.

4.1 Benefits of Elevated Storage vs. Booster Pumping Stations

The principle advantage of elevated storage over booster stations is the "instant on" protection that it provides using gravity as opposed to a mechanical pumping system. Elevated storage can be in the form of a water tower, a standpipe, or a grade level facility. The appropriate selection is a function of the elevation of the storage site. The advantages and disadvantages of each are presented below.

Elevated Storage	Booster Station
• Requires source be developed to maximum day demand	• Requires source to be developed to meet peak hour, or maximum day plus fire.
• Works during a power outage	• Requires Standby Power to work during a power outage
• Meets variation in demands without operator interaction	• Pumping system must adjust to meet variation in demands
• Fire Flows available on demand	• Fire Pump must start to provide fire flow
• Reliable Gravity System	• Less Reliable Mechanical System • Standby Pumping equipment must be available
• Water Reservoirs have a long expected life	• Mechanical Systems have a shorter expected life span
• Low operating costs	• Higher operating cost (energy, maintenance)
• Higher capital costs	• Lower Capital Costs

Despite a typically higher capital costs, elevated water storage is typically the preferred municipal approach for communities as small as 2500 persons because of the level of service and ease of operations it provides. For example in this area Wiarton, Meaford and Thornbury all rely on elevated water storage.

The selection of the form of the water storage (water tower, standpipe or grade level) is function of the available sites and the required size.

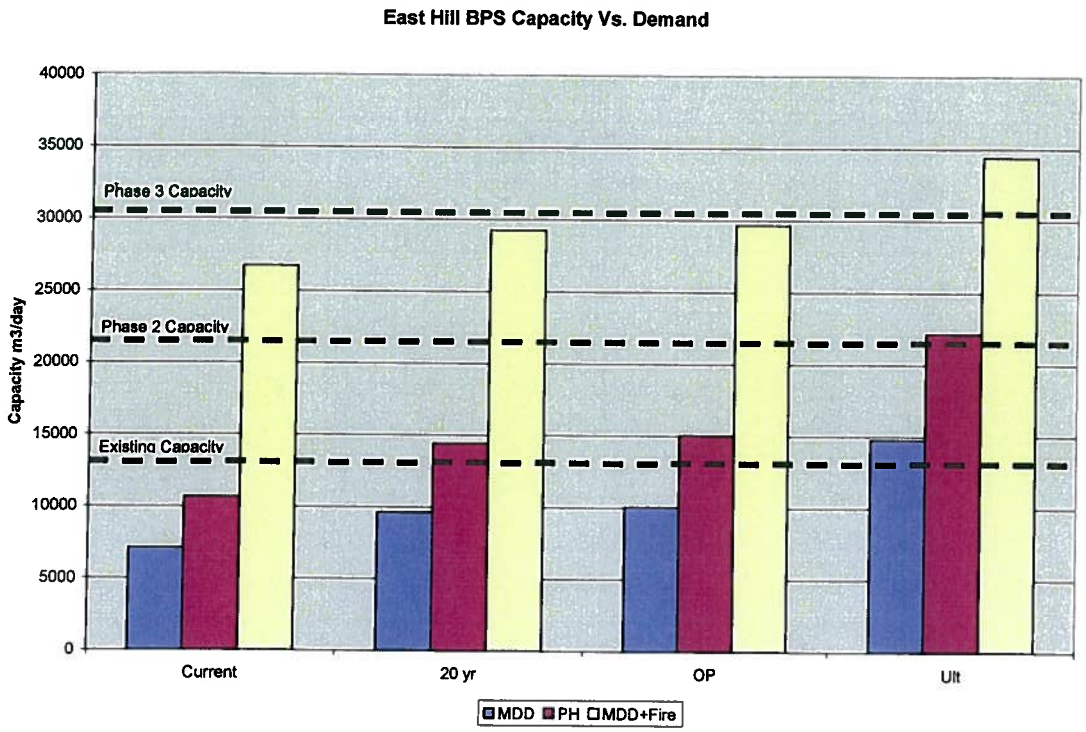
5 Specific Decisions: East Hill Zone

A report by Henderson and Paddon in 1997 identified a three phase upgrade path to service the east hill zone using the East Hill Booster Station. This report also noted the benefits of feeding the zone using storage. The first phase of this upgrade was completed to address the needs of the then proposed new high school. Having completed this upgrade the firm pumping capacity of this station is currently 157.73 L/sec. The Phase 2 upgrades would take this expansion to a firm capacity of 252.26 L/and the Phase 3 upgrades would take this expansion to firm capacity 353.18 L/s.

The Phase 2 expansion cost is currently estimated to be $800,000 including engineering and contingencies.

The Phase 3 expansion cost is currently estimated to be $150,000 including engineering and contingencies.

At the Official Plan horizon, the East Hill Booster Pumping Station will be required to provide a maximum day demand of 115.94 L/s plus a fire flow allowance of 227.13 L/s for a combined The anticipated demand of 343.06 L/s can handled by the previously proposed upgrades to the East Hill Booster Station up to and including the OP build out level. The facility is currently deficient in terms of available fire fighting capacity until the Phase 3 upgrade is completed.



In the event that storage was provided in the East Zone, as recommended in the Master Servicing Plan Presentation, the East Hill Booster Station would only need to provide the maximum day demand and hence would be adequate to meet the needs of the East Hill Zone without upgrading beyond the current capacity of the facility up to and including the OP horizon.

The required storage capacity for a facility specific to the East Hill Zone at the OP horizon, providing a fire flow of 227 L/s for 3 hours is 6195 m^3.

The estimated cost of such a facility is 3.3 million dollars.

5.1 Life cycle costs: East Hill Zone

Water storage facilities generally have a longer life time and lower operating costs than booster pumping stations. Assuming water storage facility would last 60 years and the booster station would last 30 years, the booster station would need to be replaced once during the life of the tower.
The principle energy savings comes in the form of savings in charges for electricity as use of the storage facility allows the pumps to run during off peak hours.

A simple life cycle comparison is presented as Schedule A. Based on this analysis it is apparent that the two alternatives have similar life cycle cost. Therefore the use of storage is preferred as it provides a higher level of service at the same costs.

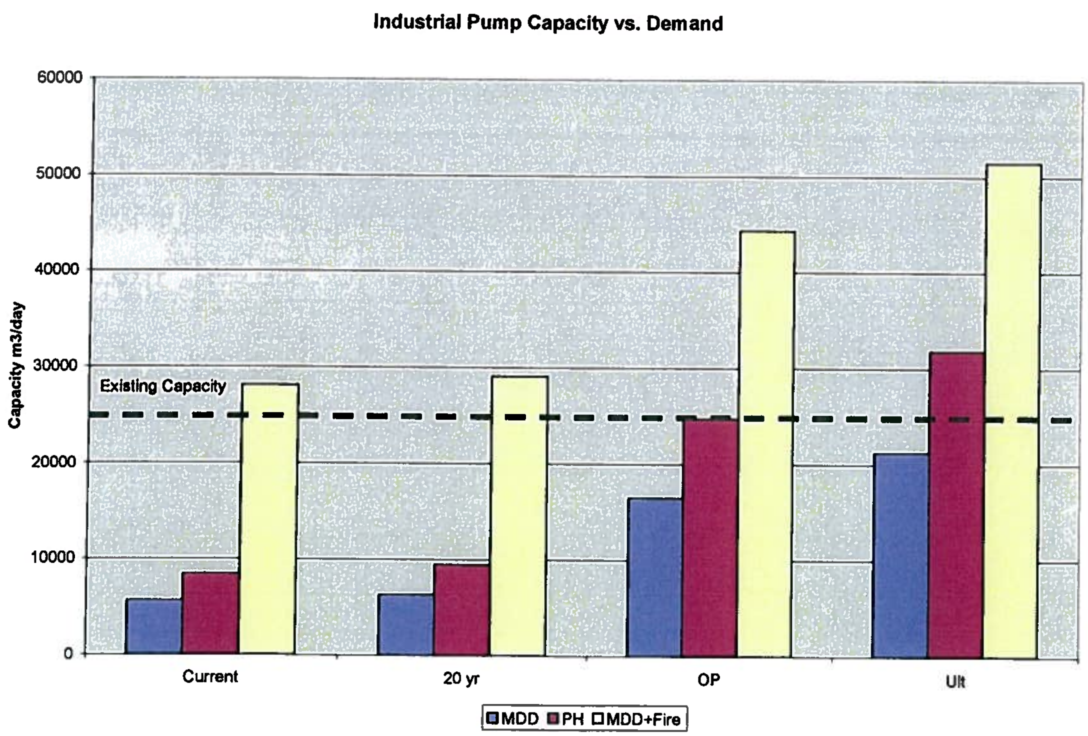
5.2 Recommendation: East Hill Zone

It is recommended that the East Hill Zone be serviced by adding elevated storage to the zone. As the East Hill Zone, does not currently have the desired level of fire protection these works should be completed as soon as possible.

6 Specific Decisions: Industrial Zone

The water demands for the Industrial Zone are met by the Industrial High Lift Pumps at the WTP. There are no municipal water storage facilities in the Industrial Zone. A class EA was completed in 1993 that would provide elevated storage for the Industrial Zone. To date this facility has not been constructed.

The existing Industrial Plant has a firm pumping capacity of 22,703 m^3/d. The existing pumping capacity is compared to the anticipated demand in the following figure.



If the current mode of operation (i.e. no storage) is left unchanged the pumping capacity on the Industrial High Lift pumps will need to be increased in order to meet the anticipated peak demands at the OP horizon. The clearwell at the WTP may also need to be expanded at the time that the highlift pumps are upgraded. In addition it is noted that the existing facility does not have a firm pumping capacity in excess of the current maximum day plus fire demand.

It is estimated that in order to increase the pumping capacity to the level required to meet the peak OP demand an expenditure of approximately 1.1 million dollars will be required. If the upgrades include the supply of fire flows the estimated upgrade cost to meet the OP demands is 1.6 million dollars.

In the event that storage was provided for the Industrial Zone, as recommended in the Master Servicing Plan Presentation, the Industrial High Lift Pumps would only need to provide the maximum day demand and hence would be adequate to meet the needs of the Industrial Zone without further upgrading up to and including the OP horizon. Peak flows and fire flows would be met from the storage facility.

The 1999 Master Plan Study for the Owen Sound and Area Water System confirmed the servicing strategy identified as early as 1993 when a Class EA was performed to support the construction of a storage facility to serve the industrial lands.

In order to meet the needs of the industrial lands (including a fire flow allowance of 227 L/s for 3 hours) the recommended size of the reservoir is 8211 m^3.

The cost of constructing this water storage facility at the currently owned site is approximately 4 million for the reservoir and 2 million dollars for the connection watermain construction, for a total cost of 6 million dollars.

6.1 Life cycle costs: Industrial Zone

Water storage facilities generally have a longer life time and lower operating costs than pumping stations. Assuming water storage facility would last 60 years and the booster station would last 30 years, the booster station would need to be replaced once during the life of the tower.
The principle energy savings comes in the form of savings in charges for electricity as use of the storage facility allows the pumps to run during off peak hours.

A simple life cycle comparison is presented as Schedule B. The location of the proposed reservoir adds considerably to the cost of the life cycle cost for the storage option. If the cost are corrected for to reflect the cost of the watermains, the cost would be similar. While the cost of the storage solution is significantly higher than the pump based solution, storage is still preferred as a result of the superior level of service provided. A storage facility located more directly in the Industrial Zone would significantly reduce the cost of the option and make it more attractive financially.

6.2 Recommendation: Industrial Zone

It is recommended that the Industrial Zone be serviced by adding elevated storage to the zone. As the Industrial Zone, does not currently have the desired level of fire protection these works should be completed as soon as possible.

7 Summary

The preferred solution is to provide elevated storage in the East Hill Zone and elevated storage in the Industrial Zone. These are envisioned to be separate facilities. In the both cases, this will eliminate the needs for capacity improvement to the pumping systems feeding these zones until the OP horizon is reached.

The exact configuration, and location of these facilities would need be determined through the Municipal Class EA process.

As noted in previous studies there are number of hybrid options with benefits that could extend beyond the East Side Master Servicing Plan Study Area.

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Schedule A

City of Owen Sound
East Hill Zone
Life Cycle Cost Comparison of Options

Discount Factor	6%				
Booster Station					
Capital Works			Annual	Initial	NPV
Expansion				$ 950,000	$ 950,000
PS Replacement (year 30)					$ 1,698,113
Annual Costs					
Labour					
1 hour per day 5 days a week	50 /hr		$ 13,000		$ 209,704
Maintenance			$ 5,000		$ 80,656
Energy			$ 43,250		$ 697,671
Subtotal NPV Booster					**$ 3,636,144**
Water Tower					
Capital Costs					
Initial				$ 3,300,000	$ 3,300,000
Refurbishment (year 30)					$ 283,019
Operating and Maintenance					
Labour					
1 hour per week @$50/hr	50 /hr		$ 2,600		$ 41,941
Maintenance			$ 1,000		$ 16,131
Energy		40%	$ 17,300		$ 279,068
Subtotal NPV Storage					**$ 3,920,159**

Schedule B

City of Owen Sound
Industrial Zone
Life Cycle Cost Comparison of Options

Discount Factor	6%							
Industrial Pumping Station								
Capital Works				Annual		Initial		NPV
Expansion					$	1,600,000	$	1,600,000
PS Replacement (year 30)							$	1,509,434
Annual Costs								
Labour								
1 hour per day 5 days a week	50 /hr		$	13,000			$	209,704
Maintenance			$	7,500			$	120,983
Energy			$	37,084			$	1,212,089
Subtotal NPV Booster							**$**	**4,652,211**
Water Tower								
Capital Costs								
Initial (Storage)					$	4,000,000	$	4,000,000
Refurbishment (year 30)							$	377,358
Initial (Watermain)					$	2,000,000	$	2,000,000
Operating and Maintenance								
Labour								
2 hour per week @$50/hr	50 /hr		$	5,200			$	83,882
Maintenance			$	2,000			$	32,262
Energy		40%	$	14,834			$	239,282
Subtotal NPV Storage							**$**	**6,732,785**

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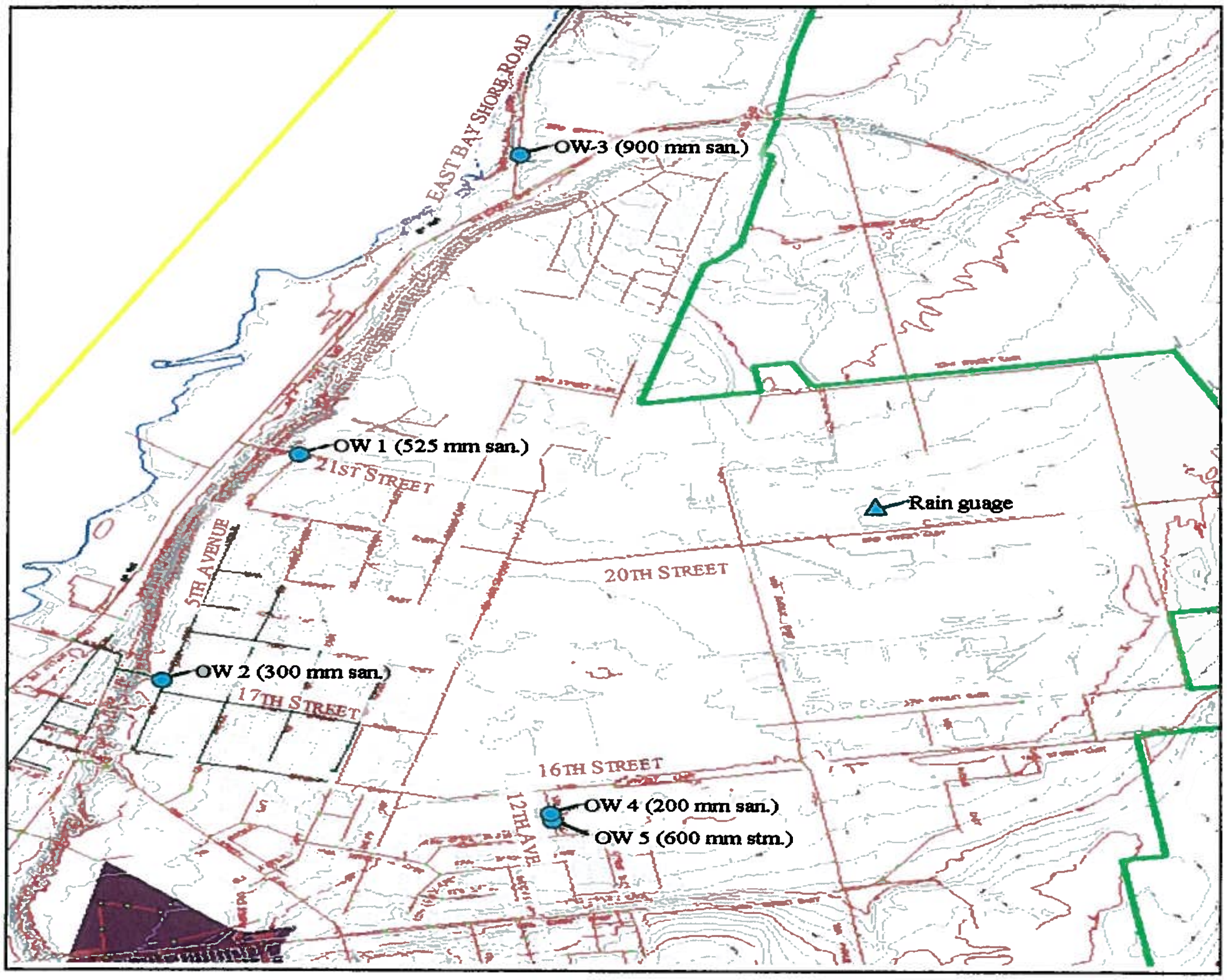
Appendix C
Flow Monitoring Study

Report on

2006-2007 Sewer Flow Monitoring in Northeast Owen Sound

for R.J. Burnside & Associates Limited



THOMPSON FLOW INVESTIGATIONS INC.
Hydrotechnical Specialists

October, 2007

R. J. Burnside & Associates Limited
3 Ronell Crescent,
Collingwood, Ontario
L9Y 4J6

October 17, 2007

Attention: Mr. Don McNalty, P.Eng.
Project Manager

Dear Mr. McNalty

Re: 2006-2007 Sewer Flow Monitoring in Northeast Owen Sound

We are pleased to provide final flow data in plot form for this work, along with some basic documentation. The balance of this letter is organized under the following headings:

- Monitoring Program
- Presentation of Results
- Comments
- Recommendations

Multi-colour flow plots are attached in four appendices as follows:

- Appendix A: Sanitary Sewer System – Event Flow Plots
- Appendix B: Storm Sewer System – Event Flow Plots
- Appendix C: Sanitary Sewer System – Bi-Weekly Flow Plots
- Appendix D: Storm Sewer System – Weekly Flow Plots

MONITORING PROGRAM

At the project startup meeting on March 31, 2006 the desired scope of the monitoring program was established (changed from proposal). The City first wished to have 3 key sanitary sewer monitoring stations in the study area operated as long as possible within the budget (ideally 1 year) along with a rain gauge. They also urgently required data covering a small residential area just south of 16th Street which had experienced significant stormwater street ponding/flooding. In this second area flow data was required for a 600mm storm sewer and a 200mm sanitary sewer. We were advised that the total monitoring budget available was $50,000.

The sanitary sewer monitoring stations consisted of TQI proprietary custom compound weirs instrumented with level sensors and data loggers, and measured outflow from their respective manholes. A Sigma model 910 area/velocity (A/V) meter was utilized in the storm sewer (upstream

TQI - 4129 Varden Court, Mississauga, ON L5L 4A7 tqi@sympatico.ca Ph: 905-607-2728 Fax:905-607-9180

end of manhole) since it was known to surcharge. The monitors were set to record data at 10 minute intervals on eastern standard time.

The location of the stations is shown on the enclosed location plan and described below :

- **OW1:** located just past the north end of 5th Avenue (525mm pipe)
- **OW2:** located on 5th Avenue just north of 17th Street (300 mm).
- **OW3:** located about 150m from East Bay Shore Road alongside a graveled trail (900 mm).
- **OW4:** located on 12th Avenue south of 16th Street across from Shoppers Drug Mart (200mm)
- **OW5:** located in storm sewer on 12th Avenue south of 16th Street across from Shoppers Drug Mart (600mm).

A TBM3 tipping bucket rain gauge was located on the roof of the Engineering Services building at 1900 20th Street east. Photographs of stations OW1 – OW4 may be found on photo sheets 1-4.

Sanitary sewer stations OW1-OW4 were activated on April 3, 2006. The rain gauge and storm sewer station OW5 were installed at the first data retrieval visit on April 19, 2006.

It was intended that stations OW4 & OW5 on 12th Avenue would be in operation for 2 months. A loose battery caused some data loss for the A/V meter at OW5 (May 22-July 7, 2006) and both stations were left in operation longer to compensate. Station OW4 was in operation until August 1, 2006 (almost 4 months data) and OW5 until September 1 (3 months data). Stations OW1 – OW3 were left in operation until May 16, 2007 (span of over 13 months). Some minor problems were experienced with level sensors at OW1 & OW2 and the affected data has not been converted to flows. In late August of 2006 a heavy layer of hard foam appeared on the surface of the flow at station OW3. This impacted the sensor there until a different type of sensor was installed on Jan. 1, 2007. Alternate monitors were utilized at stations OW1-OW3 at different times and are shown on plots and in the database as OW1T-OW3T (Telogs). There are periods of overlap when it can be seen that both monitors at a given station have equivalent results (OW2 for May 17-31, 2006). Capture of good data in the last 4.5 months was virtually 100% .

The stations were normally visited for data retrieval and servicing twice per month throughout the monitoring duration. All equipment (including weirs) was removed when stations were shut down. "Raw" levels recorded in the field by the monitors were adjusted to "heads" on the weirs based on offsets determined from manual measurements at service visits. The "heads" were converted to flow rates according to the rating curves for each weir.

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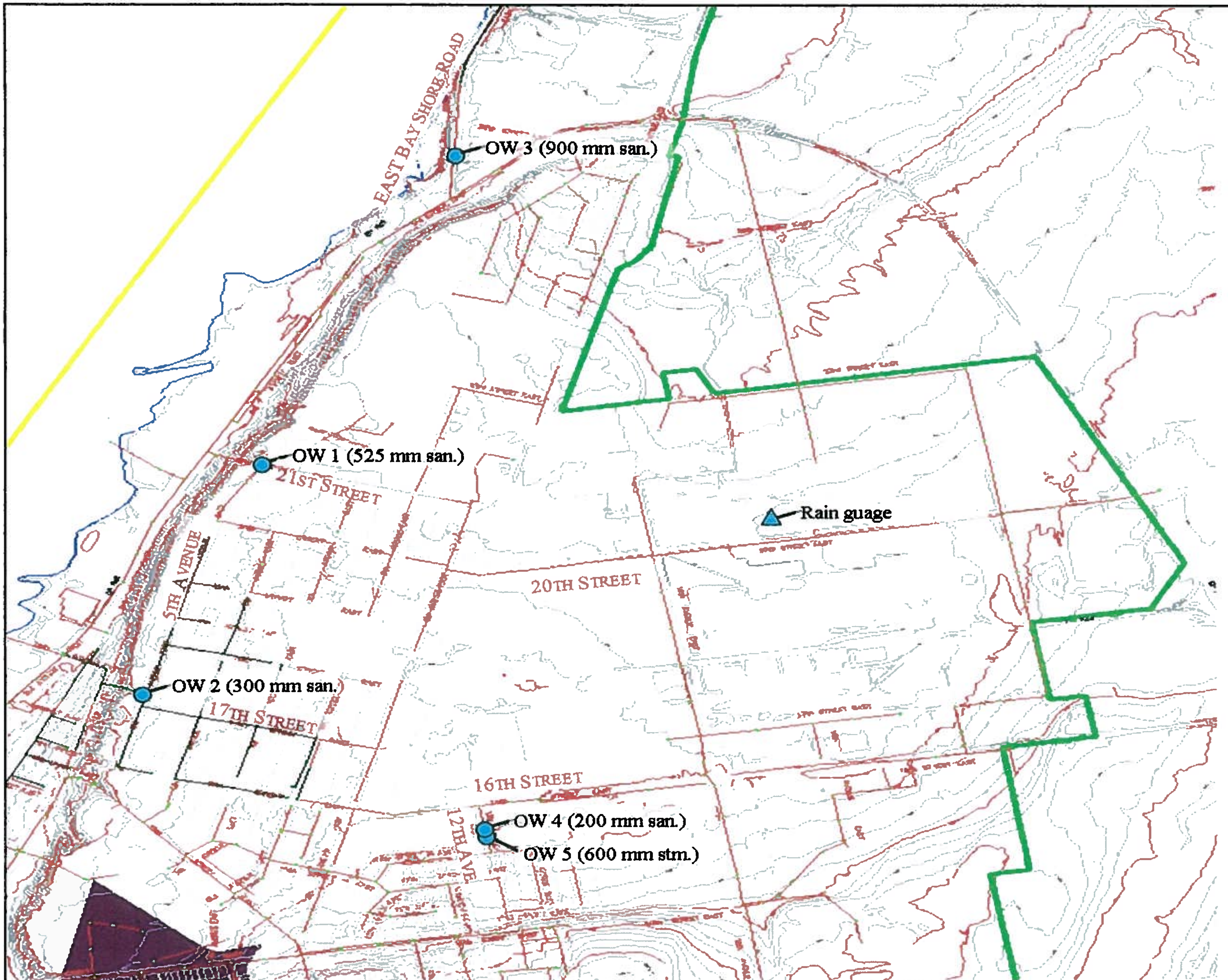


LEGEND

- Flow Monitor
- Rain Gauge

Owen Sound Flow Monitoring Locations

Based on Sanitary Plan Subcatchment Areas by R.J. Burnside and Associates Limited

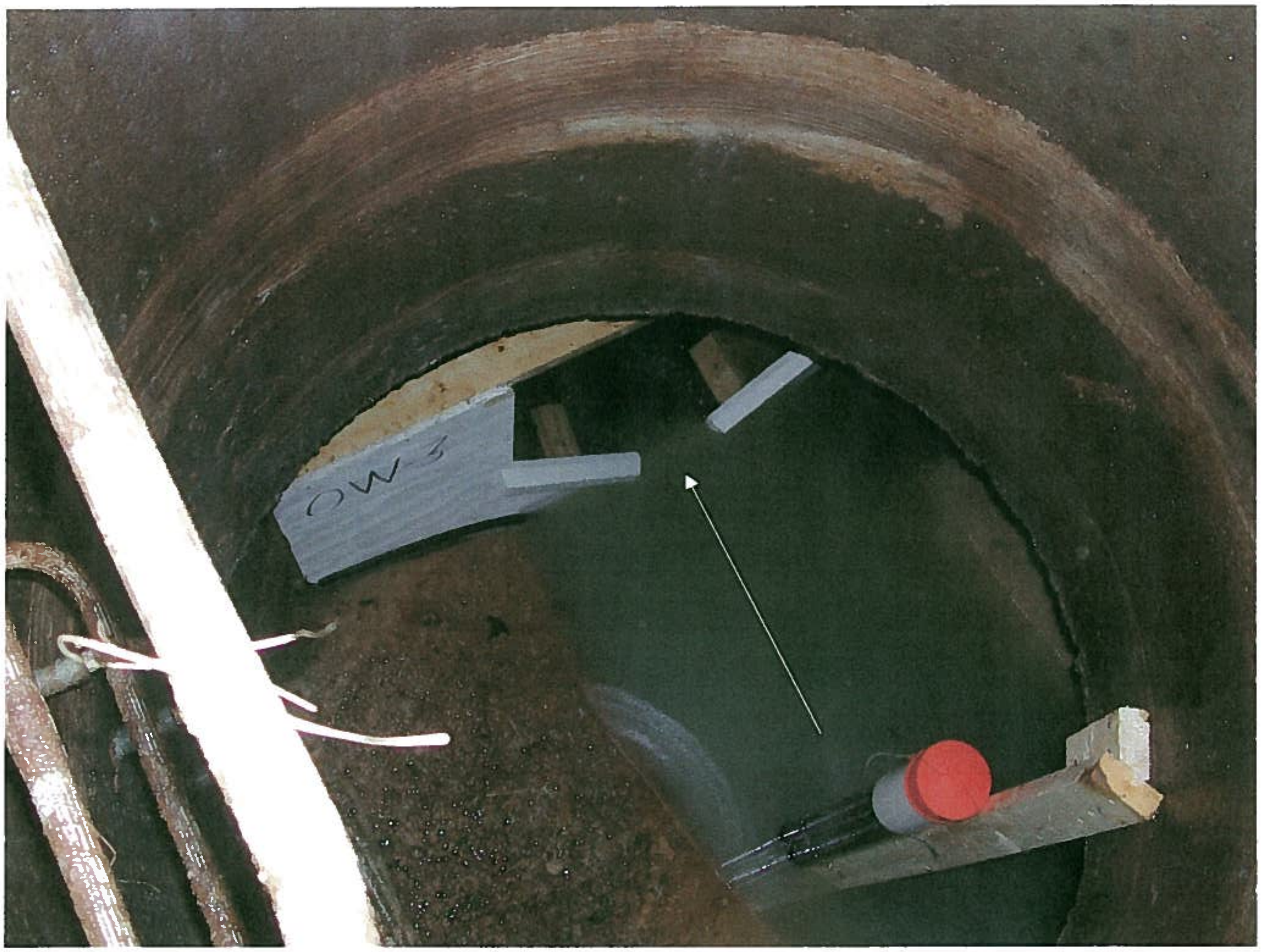
THOMPSON FLOW INVESTIGATIONS INC. Hydrotechnical Specialists

THOMPSON FLOW INVESTIGATIONS INC.
Hydrotechnical Specialists

PHOTOSHEET 1: OWEN SOUND
STATION OW-1

THOMPSON FLOW INVESTIGATIONS INC.
Hydrotechnical Specialists

PHOTOSHEET 2: OWEN SOUND
STATION OW-2



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PHOTOSHEET 3: OWEN SOUND
STATION OW-3

THOMPSON FLOW INVESTIGATIONS INC.
Hydrotechnical Specialists

PHOTOSHEET 4: OWEN SOUND
STATION OW-4

PRESENTATION OF RESULTS

Multi-colour bi-weekly(sanitary) and weekly(storm) flow plots (each plot covers a Monday to Sunday period) have been produced using a proprietary TQI plotting package. The detailed 10 minute data is presented in this way in Appendices C & D. A daily average flow plot has also been produced and follows; this plot shows longer term flow trends.

A list of significant rainfall events with total rainfall & peak 10 minute intensity is presented in Table 1. There were a wide variety of rainfall events in terms of total rain, peak intensity and antecedent conditions.

Shorter duration "event plots" have been produced for 10 of these for the sanitary sewers and 4 for the storm sewer (Appendices A and B respectively). The scales of all plots have been chosen so that an engineers scale may be used to read off flow values at desired times.

COMMENTS

Analysis of the flow monitoring data was not part of our contracted scope of services for this project but we will make some brief comments about the flows observed at each of the sanitary stations.

The base flows for station OW1 were always high relative to the daily peaks (almost always over 50%) but this may be due to some industrial flow generation "24/7". The response to rainfall here appears highly correlated with rainfall magnitude, intensity and antecedent moisture conditions. The lag time is significant at roughly 6 hours which indicates that the majority of the response is not due to directly connected impervious surfaces (eg. roof downspouts). The response to snowmelt/rainfall in the spring is extreme in terms of both peak flow rates and volumes of flow.

Station OW2 exhibits a typical residential flow pattern and its response to low intensity rainfall is minimal even for fairly large storms. There is a noticeable response to higher intensity rainfall and the response time is much less than for station OW1.

There is a pronounced industrial type flow pattern at station OW3 with weekend flows much less than weekday flows. Response to even high intensity rainfall is moderate but there is a significant response to snowmelt.

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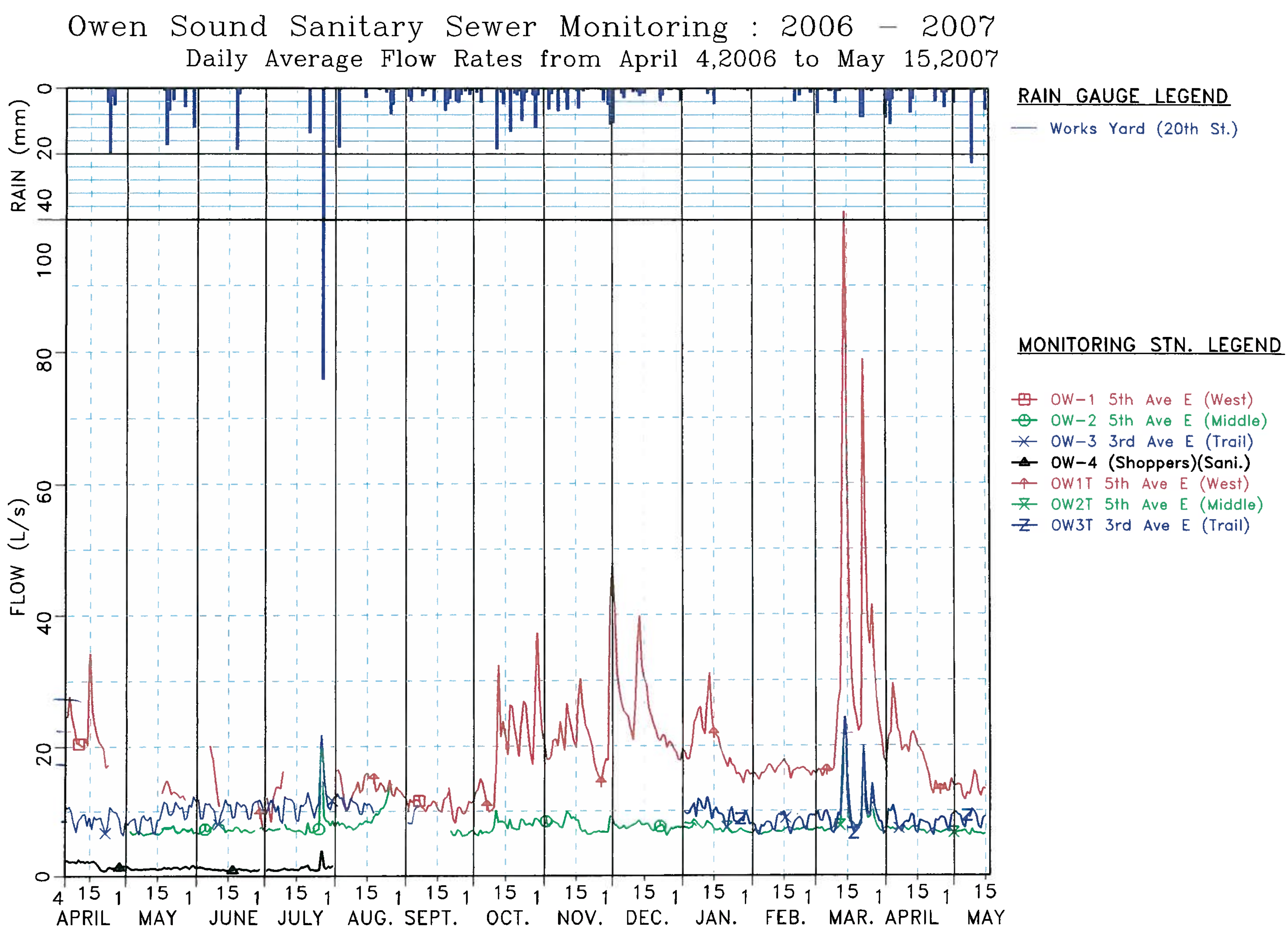
Table 1: Significant Rainfall Events		
Date	Total Rain (mm)	Peak 10 minute intensity (mm/hr)
Sunday, April 28, 2006	19.6	7.2
Thursday May 18, 2006	17.2	4.8
Tuesday May 30, 2006	11.8	45.6
Sunday June 18, 2006	18.6	16.8
Thursday July 20, 2006	13.6	25.2
Wednesday July 25, 2006	88.2	87.6
Wednesday August 2, 2006	17.8	19.2
Friday August 25, 2006	13.0	4.8
Sunday September 3, 2006	9.8	9.6
Monday September 18, 2006	13.2	16.8
Saturday September 23, 2006	10.2	50.4
Wednesday October 4, 2006	10.8	19.2
Wednesday October 11, 2006	36.0	28.8
Tuesday October 17, 2006	20.4	7.2
Sunday October 22, 2006	15.0	4.8
Saturday October 28, 2006	24.0	9.6
Friday November 3, 2006	11.8	4.8
Tuesday November 7, 2006	13.2	26.4
Thursday November 16, 2006	14.8	9.6
Wednesday November 29, 2006	7.8	14.4
Thursday November 30, 2006	22.0	14.4
Friday December 1, 2006	21.0	7.2
Monday January 15, 2007	11.2	4.8
Tuesday February 20, 2007	7.8	4.8
Friday March 2, 2007	15.0	7.2
Wednesday March 21, 2007	8.6	4.8
Thursday March 22, 2007	8.6	8.4
Tuesday April 3, 2007	10.8	3.6
Wednesday May 9, 2007	22.6	25.2



Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Daily Average Flow Rates from April 4,2006 to May 15,2007
RAIN (mm)
0
20
40
FLOW (L/s)
100
80
60
40
20
0
4 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15 1 15
APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB. MAR. APRIL MAY
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW-1 5th Ave E (West)
OW-2 5th Ave E (Middle)
OW-3 3rd Ave E (Trail)
OW-4 (Shoppers)(Sani.)
OW1T 5th Ave E (West)
OW2T 5th Ave E (Middle)
OW3T 3rd Ave E (Trail)

Station OW4 was only monitored during the late Spring and early summer period. This is a small catchment with corresponding very low dry weather flows. There is however a pronounced response to high intensity rainfall which may be due to ponding at a few manholes susceptible to excessive inflow.

RECOMMENDATIONS

1. A significant amount of sanitary sewage and rainfall data has been collected which is deserving of systematic analysis. It is recommended that the system response to rainfall be analyzed at stations OW1-OW4 with correlation to service area, antecedent conditions and comparison to design allowances for I/I. This will include assessment of the probable nature of I/I sources in each service area. Our cost to carry out and document this analysis for the existing data would be $4000.00 (exclusive of gst).
2. An extreme amount of springtime I/I is generated within the OW1 catchment. From a cursory examination of the data, and based on our over 20 years experience in other areas it is believed likely that significant reductions in such I/I can be made at moderate cost and without undue inconvenience to system users. It is recommended that station OW1 be re-activated for the March to May season of 2008 with one or 2 stations added upstream of it to help isolate sources of I/I in this large catchment. We can provide a firm cost for this work once we have some information regarding service area and sewer system connectivity.
3. A wastewater analysis should be carried out on the data for stations OW1-OW3. This will establish the residential and industrial generation rates (l/cap/day & l/ha/day) as well as peaking factors which can then be compared to current design allowances. This will provide an indication of the factor of safety provided by the current design allowances. We have developed a proprietary, fairly automated procedure for this type of work. Our cost to carry this out and document it for these stations would be $1000.00 exclusive of gst.
4. After analysis of the data it is probable that intensive smoke testing will be deemed worthwhile for portions of the study area. We have developed and apply an intensive approach to such testing wherein we isolate 2-3 pipes at a time and pressurize each portion to a much greater degree than was done in the past. With this approach we typically locate far more direct and also **indirect** sources of I/I than is possible with simpler techniques while still keeping costs reasonable. The cost for such work on a pipe basis ($/pipe tested) is a function of the number of pipes being covered but would likely be in the range of $70 to $90 per pipe, exclusive of gst and delivery of notification flyers.

TQI - 4129 Varden Court, Mississauga, ON L5L 4A7 tqi@sympatico.ca Ph: 905-607-2728 Fax:905-607-9180

CONCLUDING REMARKS

We look forward to continuing to work with you and the City to solve problems in this study area. If you have questions, please contact us at your convenience.

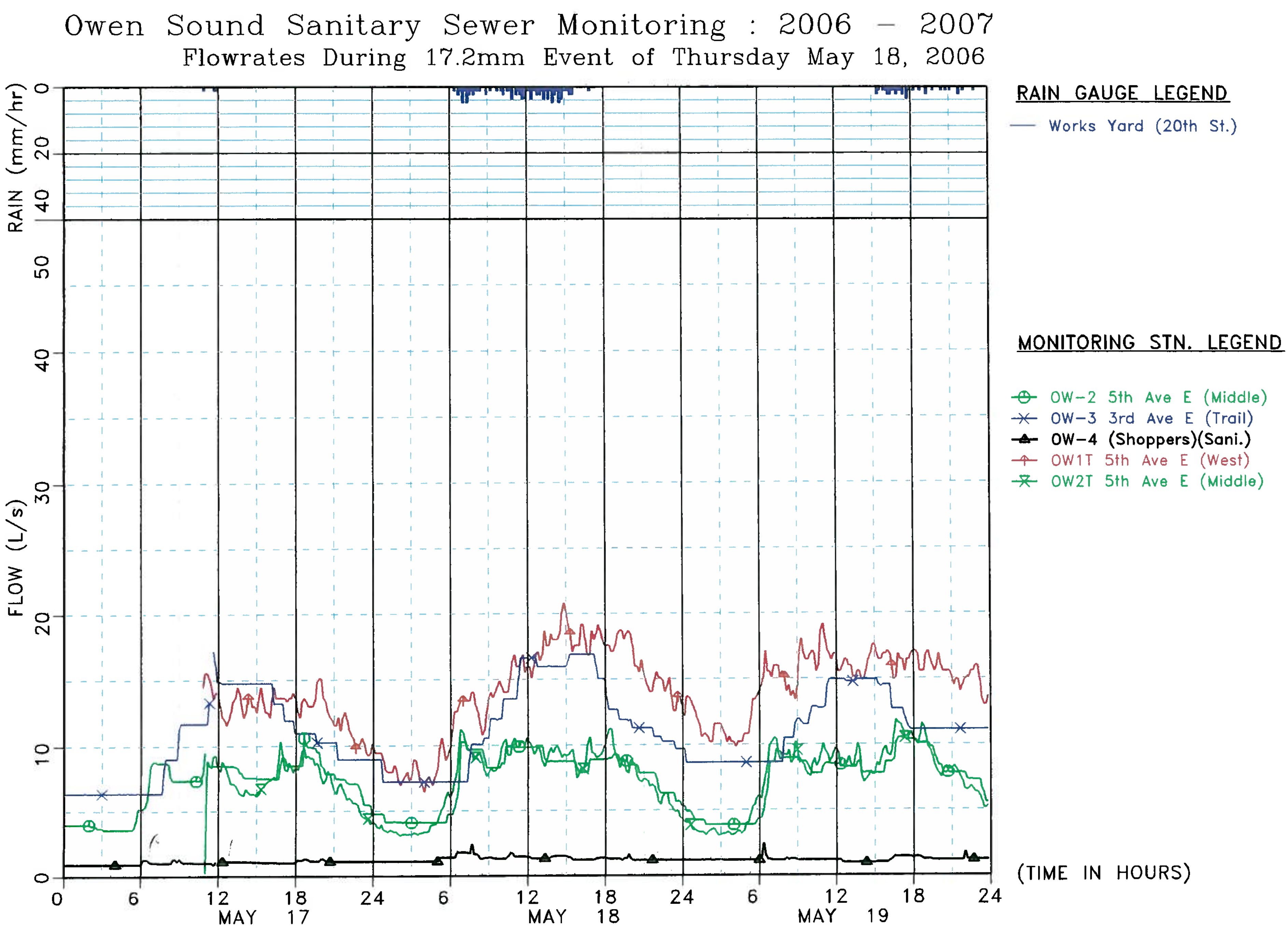
Yours truly,
Thompson Flow Investigations Inc. (TQI)

Larry Thompson

Larry R. Thompson, M. A. Sc., P. Eng., President,
Thompson Flow Investigations Inc.
(905-607-2728)   (Cell: 416-606-6349)

APPENDIX A:

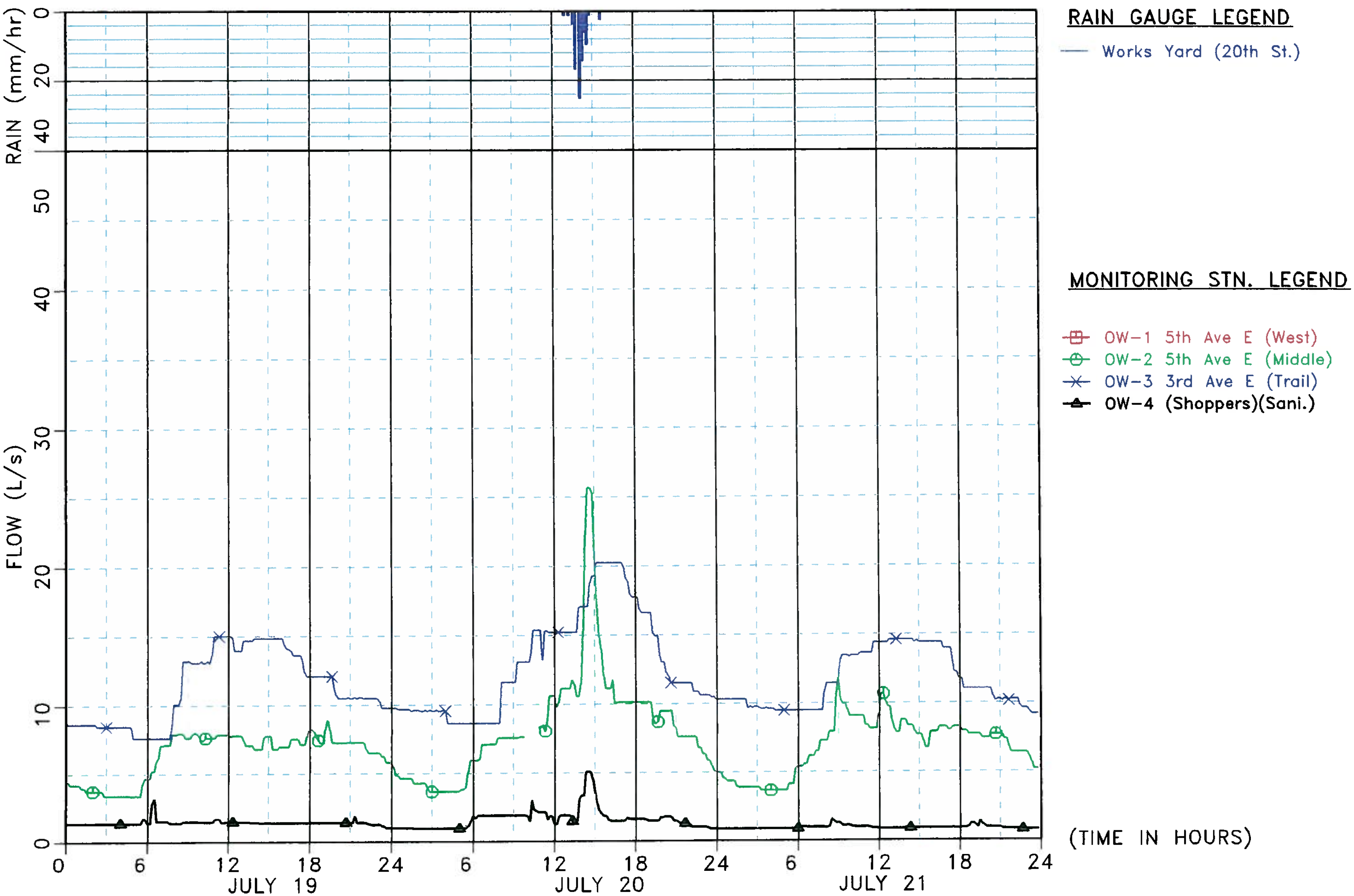
SANITARY SEWER SYSTEM EVENT FLOW PLOTS



Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flowrates During 17.2mm Event of Thursday May 18, 2006
RAIN (mm/hr)
0
20
40
FLOW (L/s)
50
40
30
20
10
0
0
6
12
18
24
6
12
18
24
6
12
18
24
MAY 17
MAY 18
MAY 19
(TIME IN HOURS)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW-2 5th Ave E (Middle)
OW-3 3rd Ave E (Trail)
OW-4 (Shoppers)(Sani.)
OW1T 5th Ave E (West)
OW2T 5th Ave E (Middle)

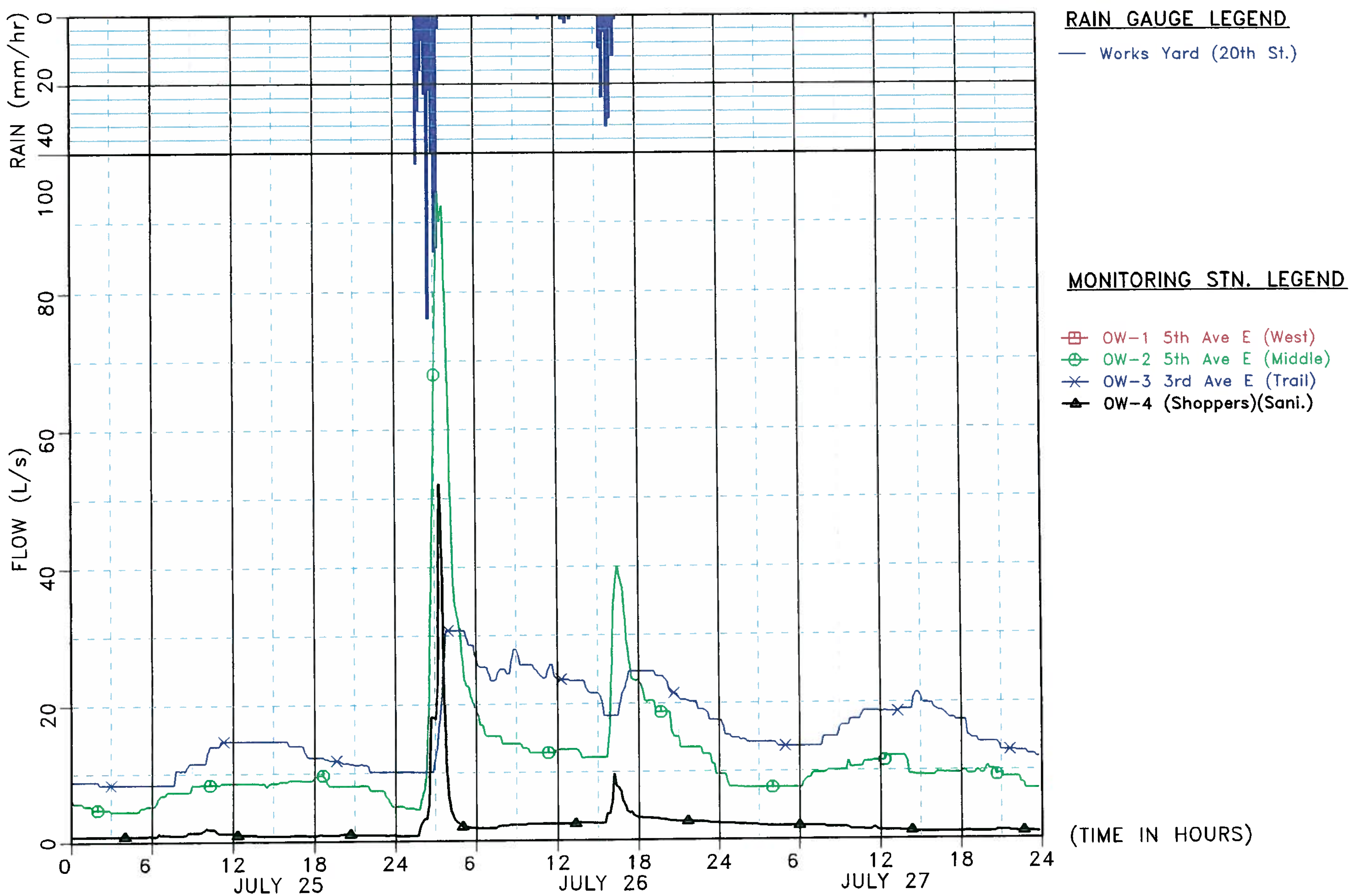
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

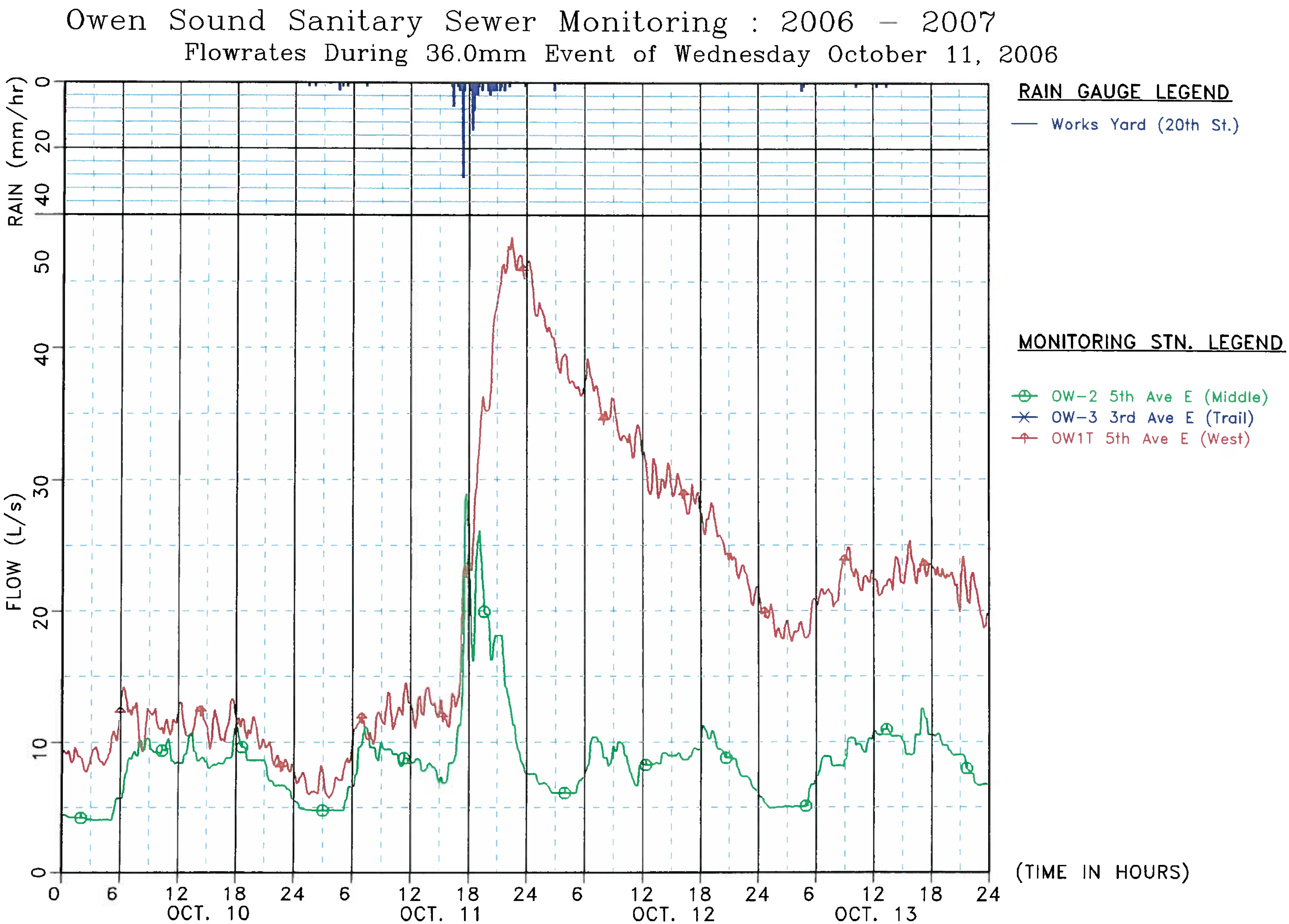
Flowrates During 13.6mm Event of Thursday July 20, 2006



Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

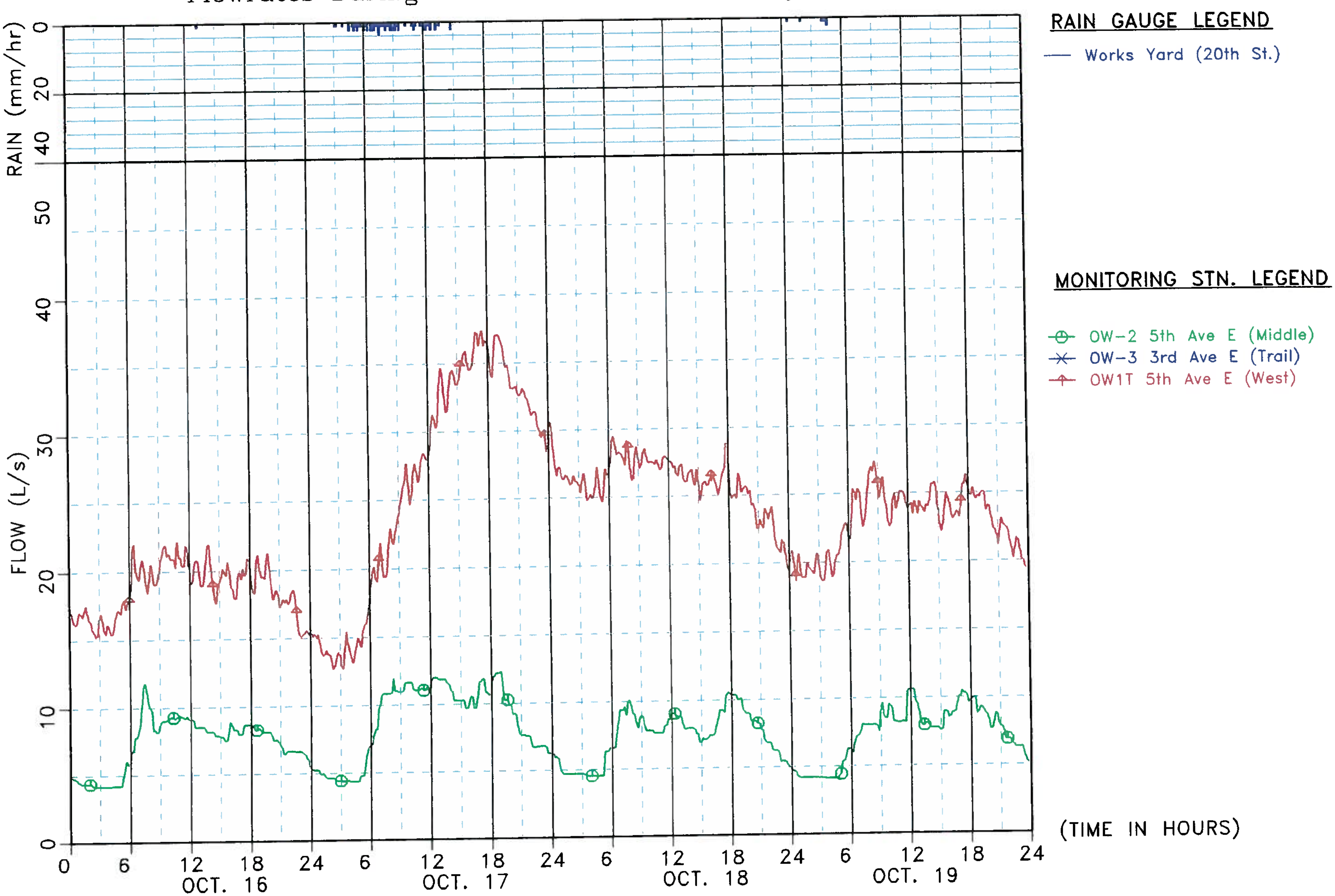
Flowrates During 88.2mm Event of Wednesday July 26, 2006




Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flowrates During 36.0mm Event of Wednesday October 11, 2006
RAIN (mm/hr)
0
20
40
FLOW (L/s)
0
10
20
30
40
50
0 6 12 18 24 6 12 18 24 6 12 18 24 6 12 18 24
OCT. 10
OCT. 11
OCT. 12
OCT. 13
(TIME IN HOURS)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW-2 5th Ave E (Middle)
OW-3 3rd Ave E (Trail)
OW1T 5th Ave E (West)

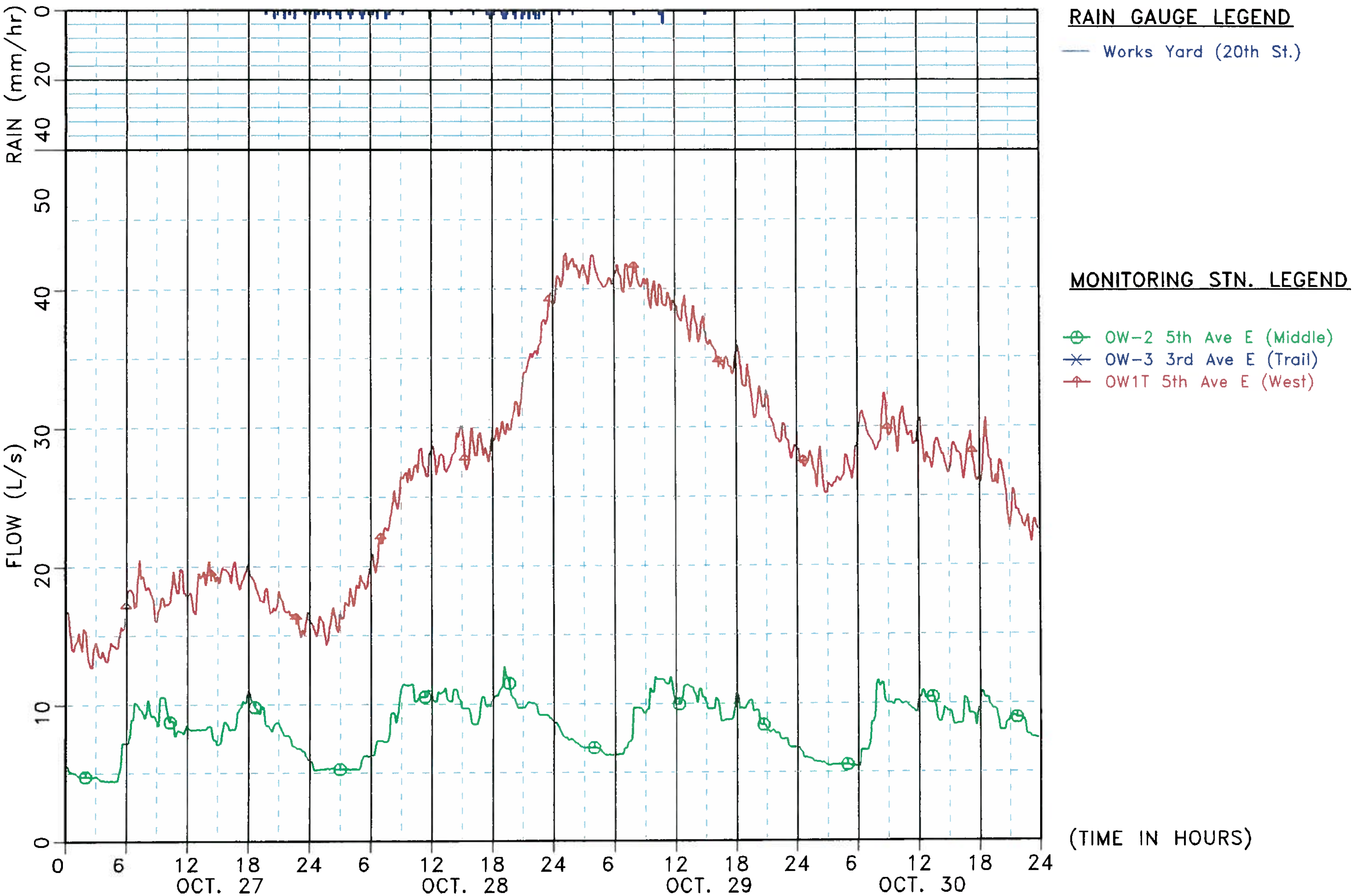
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

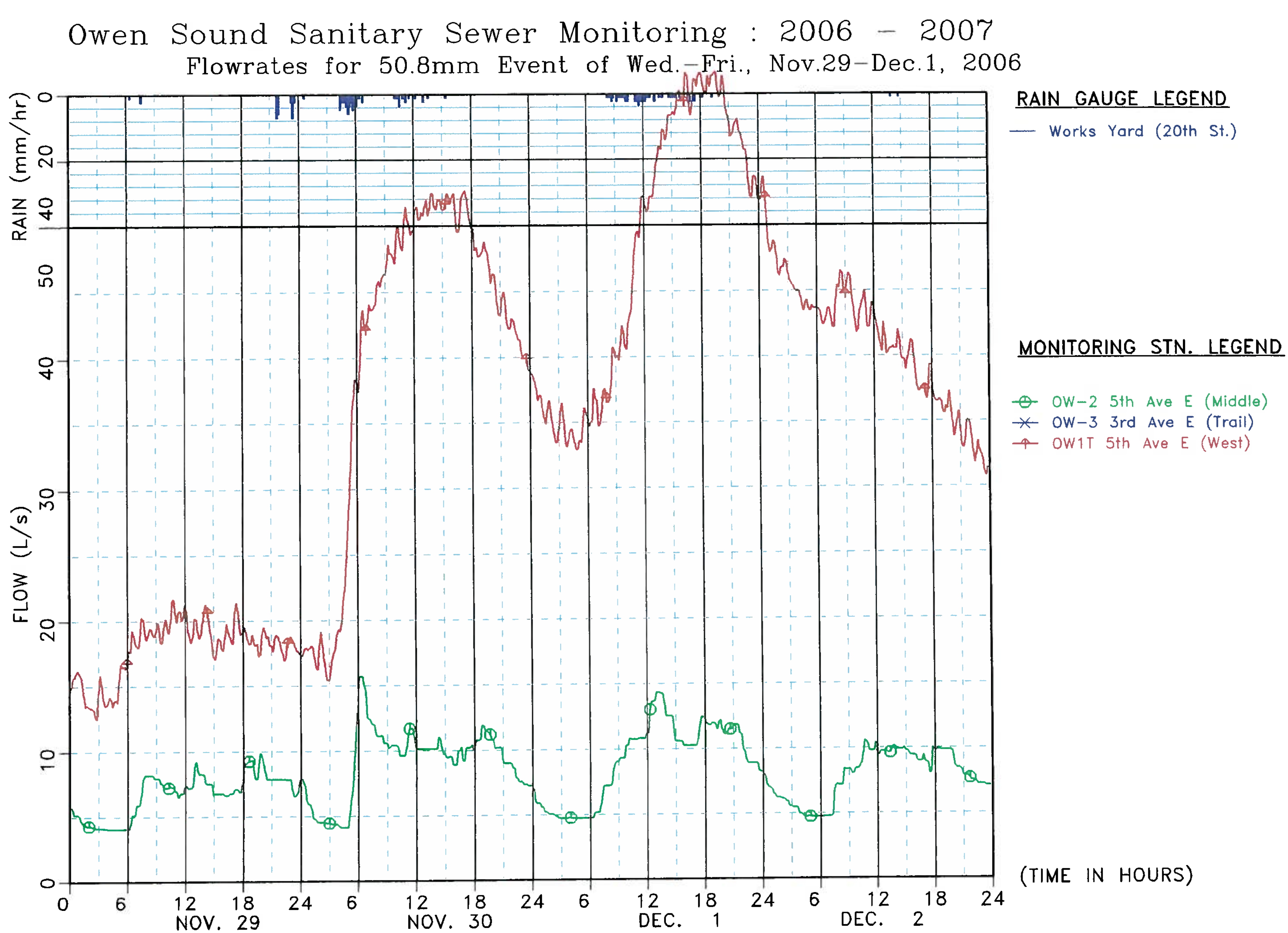
Flowrates During 20.4mm Event of Tuesday October 17, 2006



Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

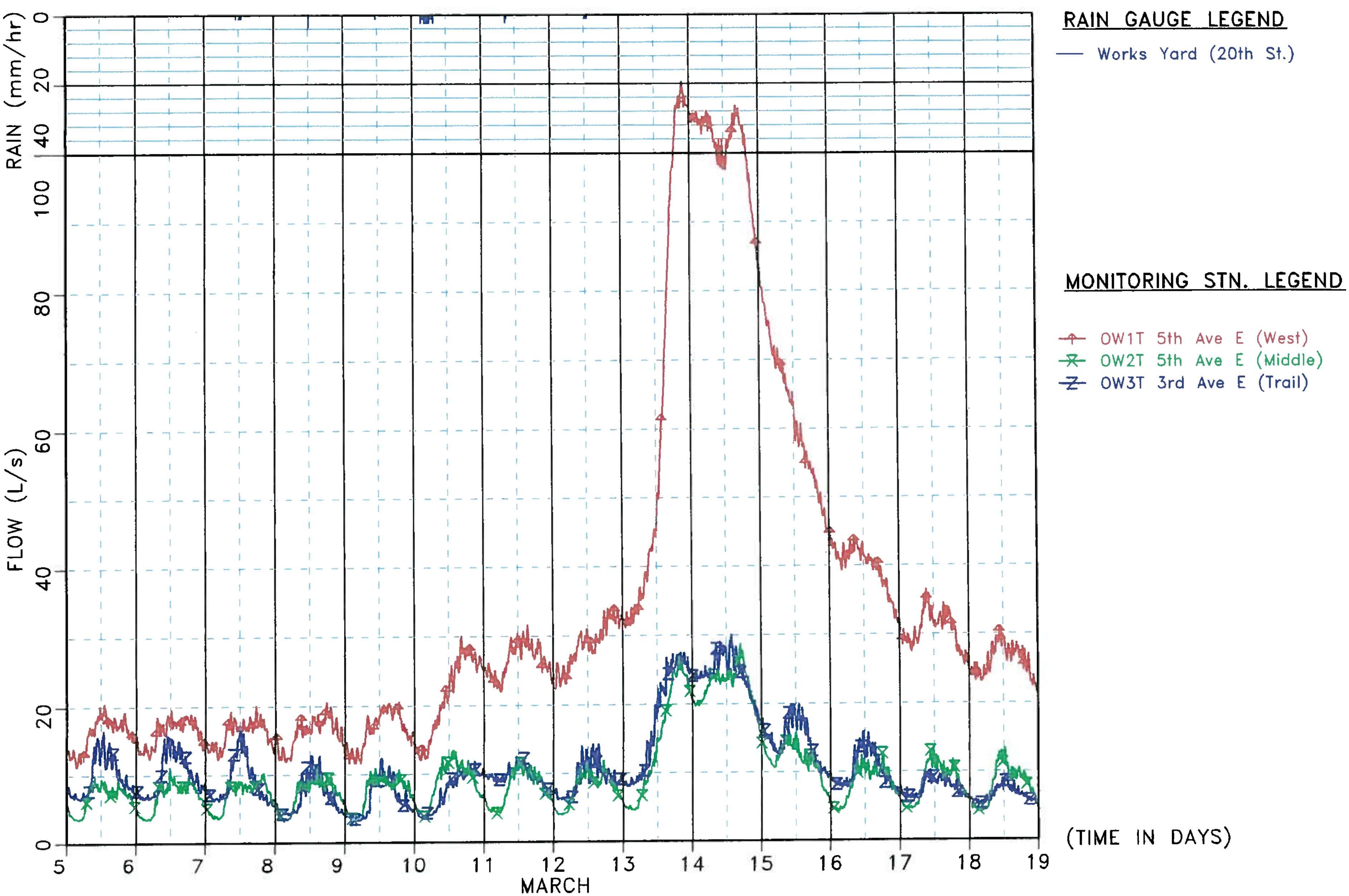
Flowrates for 28.0mm Event of Fri.–Sat., Oct.27–28, 2006




Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flowrates for 50.8mm Event of Wed.–Fri., Nov.29–Dec.1, 2006
RAIN (mm/hr)
0
20
40
FLOW (L/s)
50
40
30
20
10
0
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW-2 5th Ave E (Middle)
OW-3 3rd Ave E (Trail)
OW1T 5th Ave E (West)
(TIME IN HOURS)
0 6 12 18 24
NOV. 29
6 12 18 24
NOV. 30
6 12 18 24
DEC. 1
6 12 18 24
DEC. 2

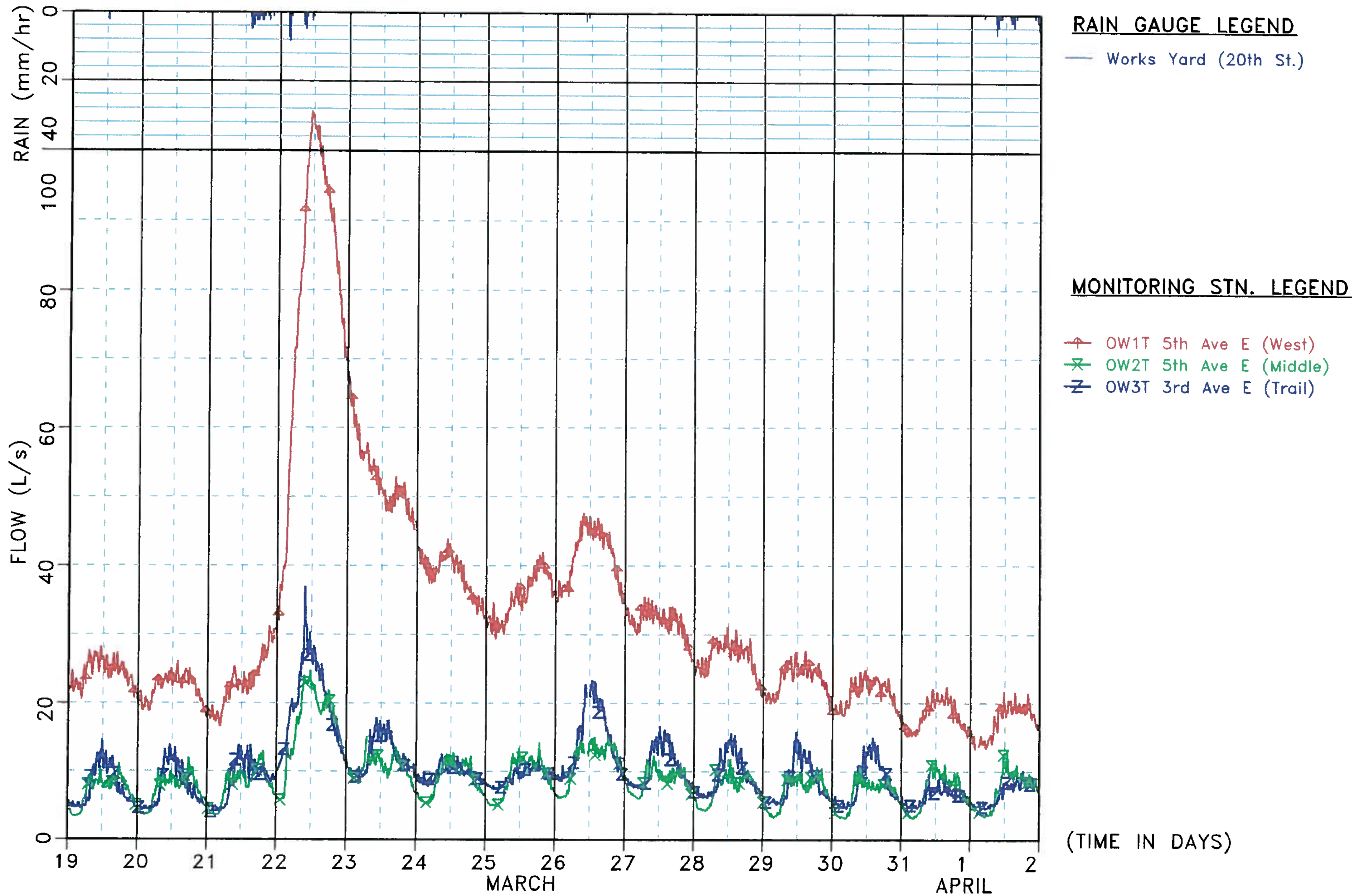
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Snowmelt Event of Tuesday – Wednesday, March 13–14, 2007



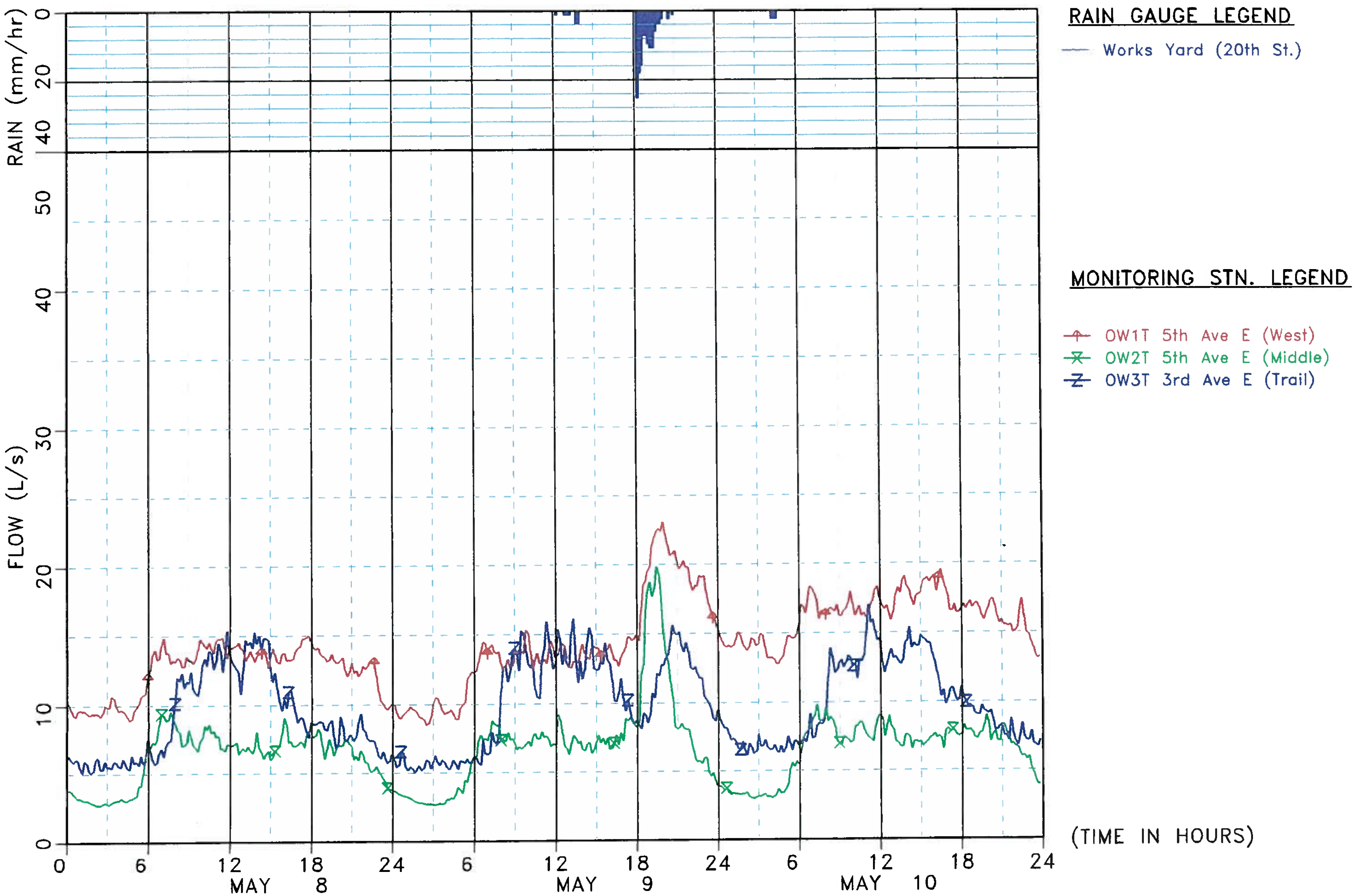
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

17.2mm rain + Snowmelt Event of Thurs.-Fri. Mar. 21-22, 2007



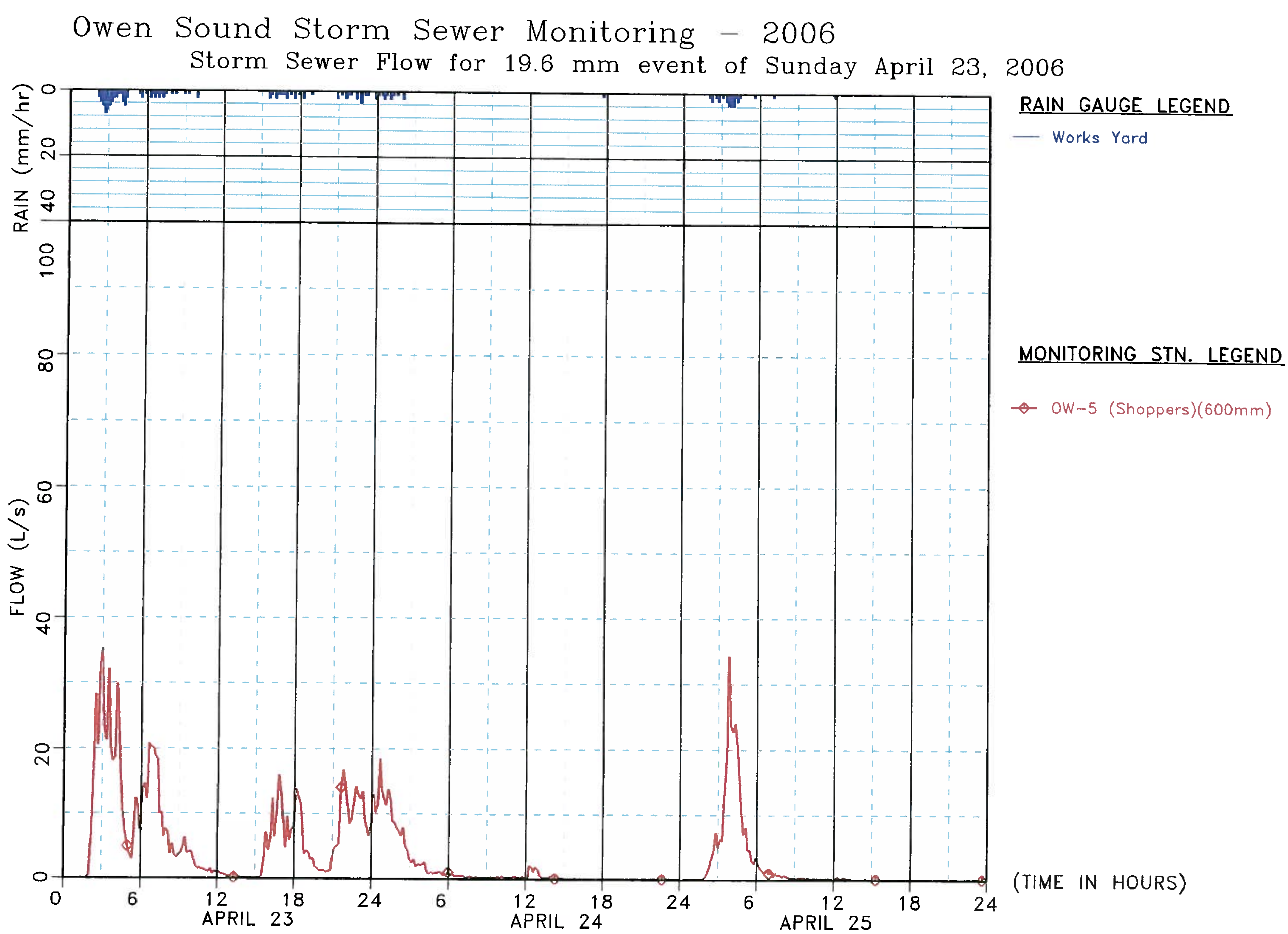
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flowrates During 22.6mm Event of Wednesday, May 9, 2007



APPENDIX B:

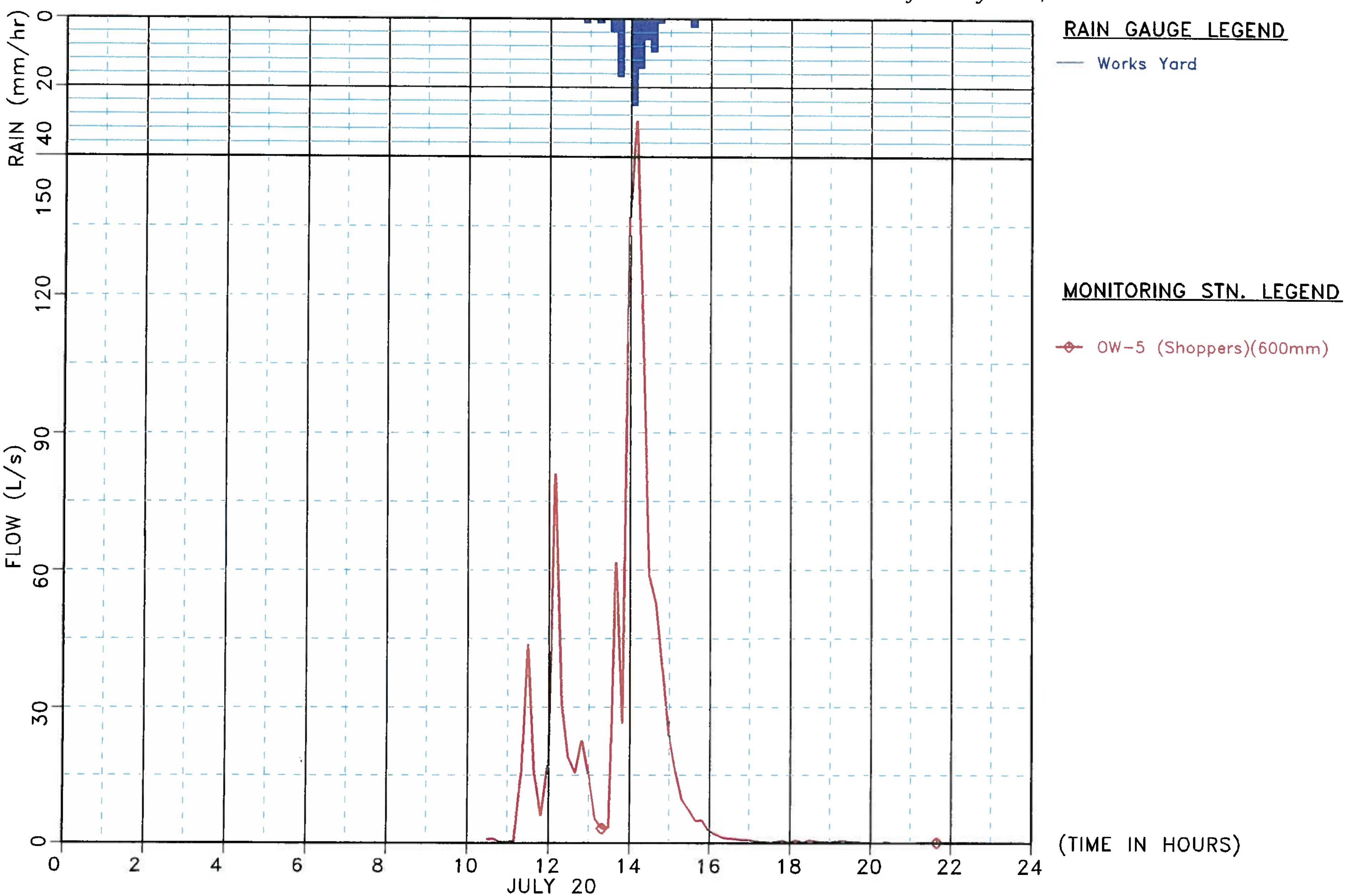
STORM SEWER SYSTEM EVENT FLOW PLOTS

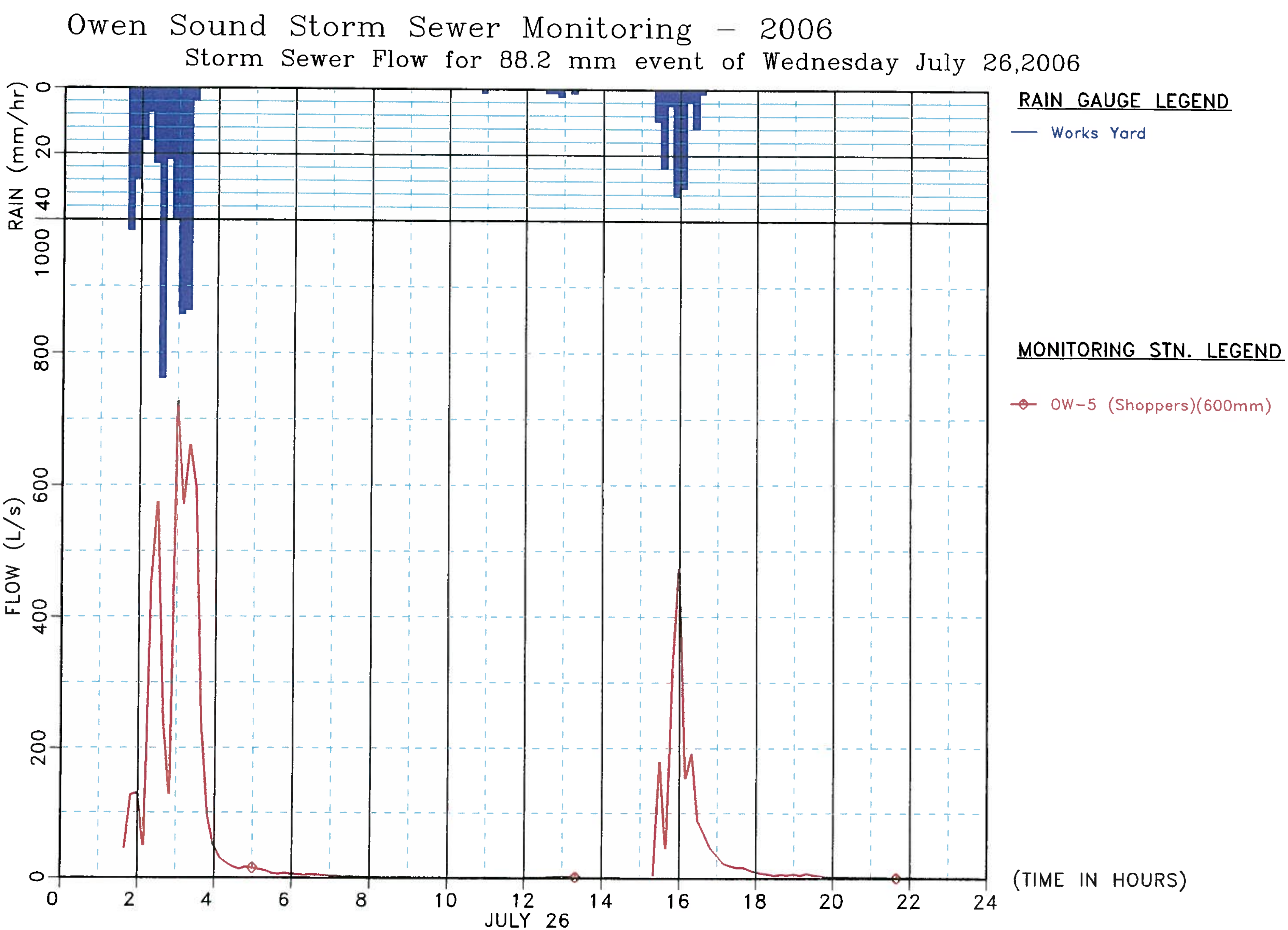


Owen Sound Storm Sewer Monitoring – 2006
Storm Sewer Flow for 19.6 mm event of Sunday April 23, 2006
RAIN (mm/hr)
0
20
40
100
80
60
40
20
0
FLOW (L/s)
0
6
12
18
24
6
12
18
24
6
12
18
24
APRIL 23
APRIL 24
APRIL 25
(TIME IN HOURS)
RAIN GAUGE LEGEND
Works Yard
MONITORING STN. LEGEND
OW-5 (Shoppers)(600mm)

Owen Sound Storm Sewer Monitoring – 2006

Storm Sewer Flow for 13.6 mm event of Thursday July 20,2006

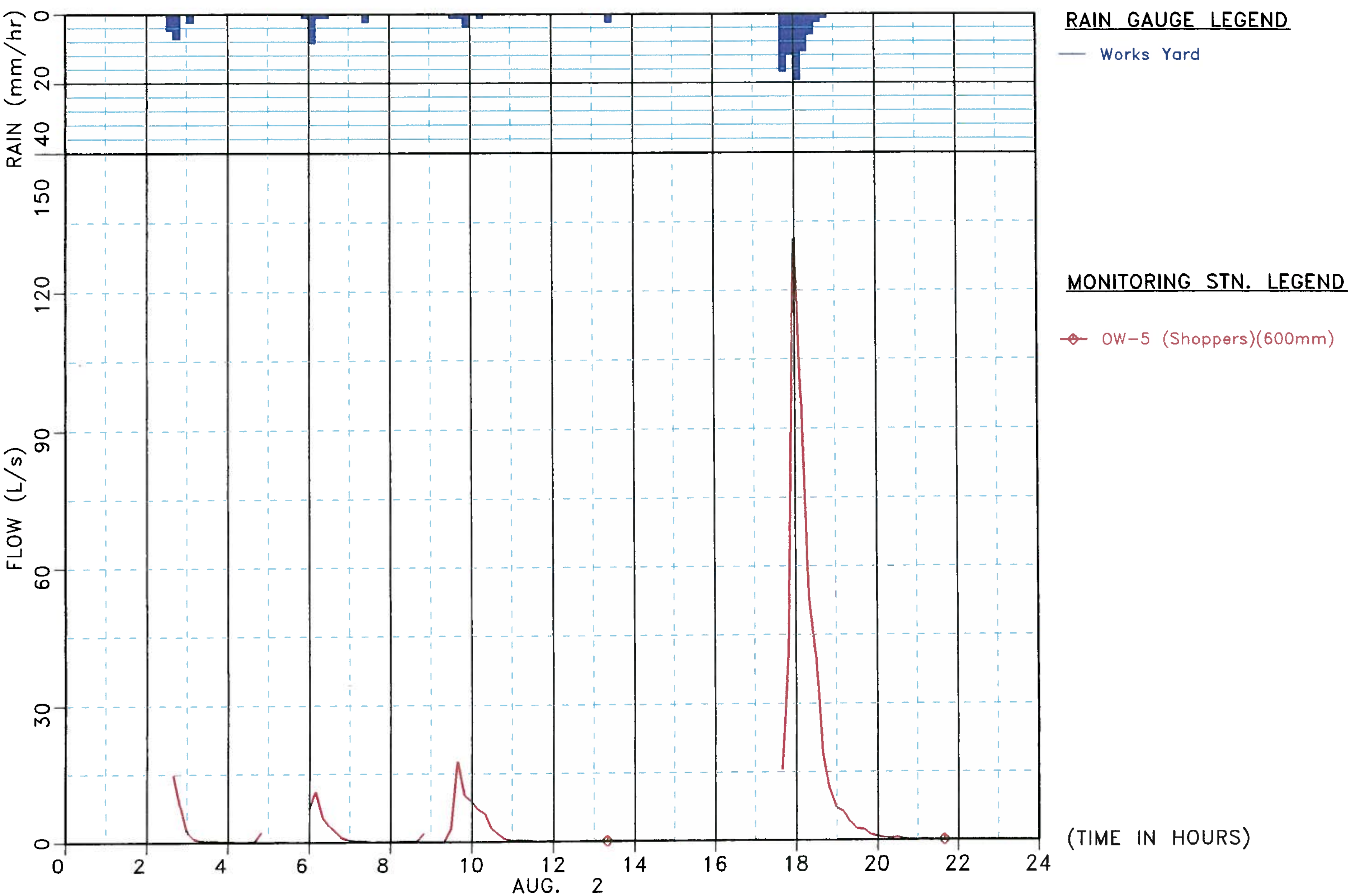




Owen Sound Storm Sewer Monitoring – 2006
Storm Sewer Flow for 88.2 mm event of Wednesday July 26,2006
RAIN (mm/hr)
0
20
40
FLOW (L/s)
1000
800
600
400
200
0
0
2
4
6
8
10
12
14
16
18
20
22
24
JULY 26
(TIME IN HOURS)
RAIN GAUGE LEGEND
Works Yard
MONITORING STN. LEGEND
OW–5 (Shoppers)(600mm)

Owen Sound Storm Sewer Monitoring – 2006

Storm Sewer Flow for 17.8 mm event of Wednesday Aug. 2,2006



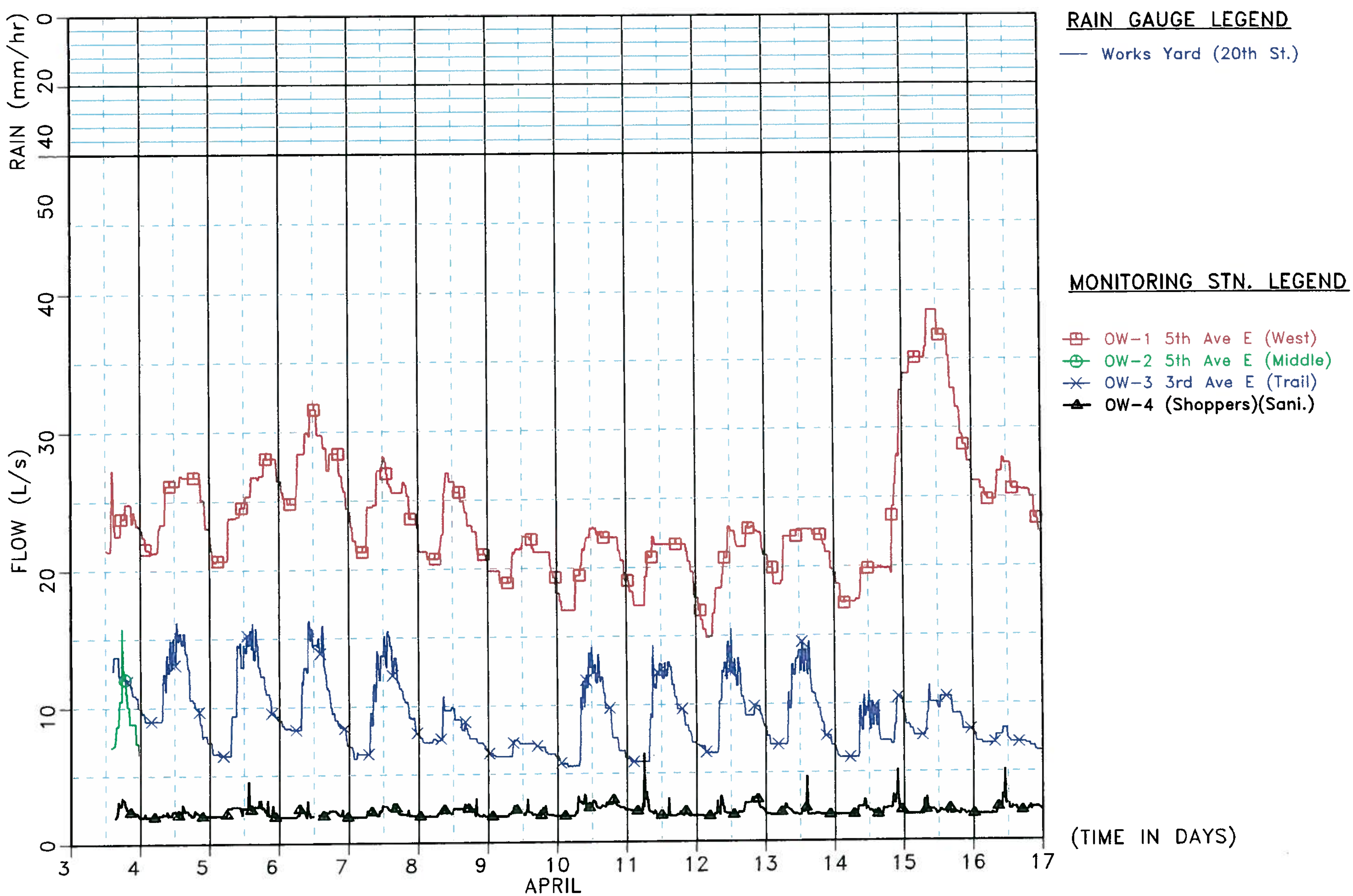
APPENDIX C:

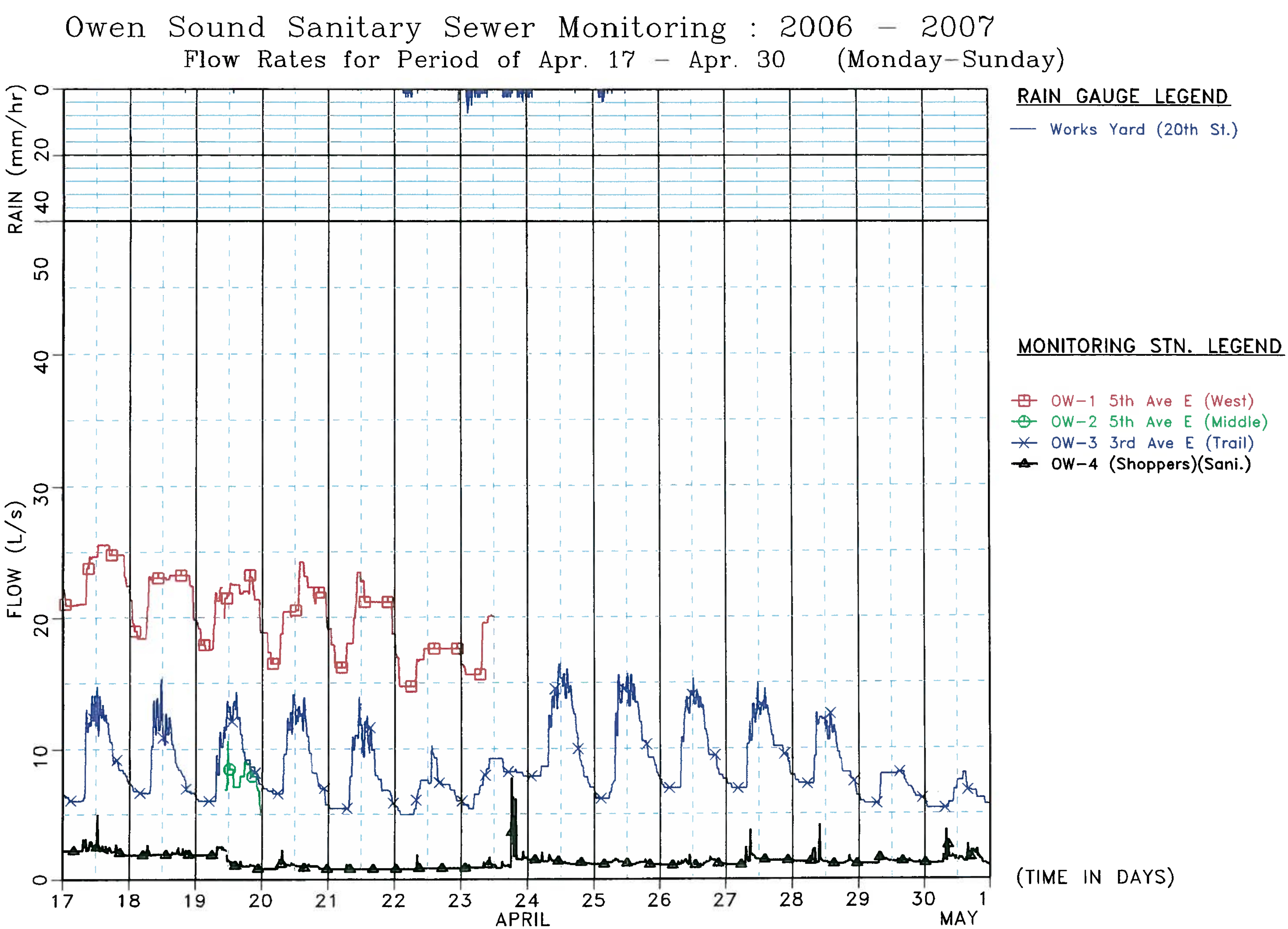
SANITARY SEWER SYSTEM

BI-WEEKLY FLOW PLOTS

Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Apr. 03 – Apr. 16 (Monday–Sunday)

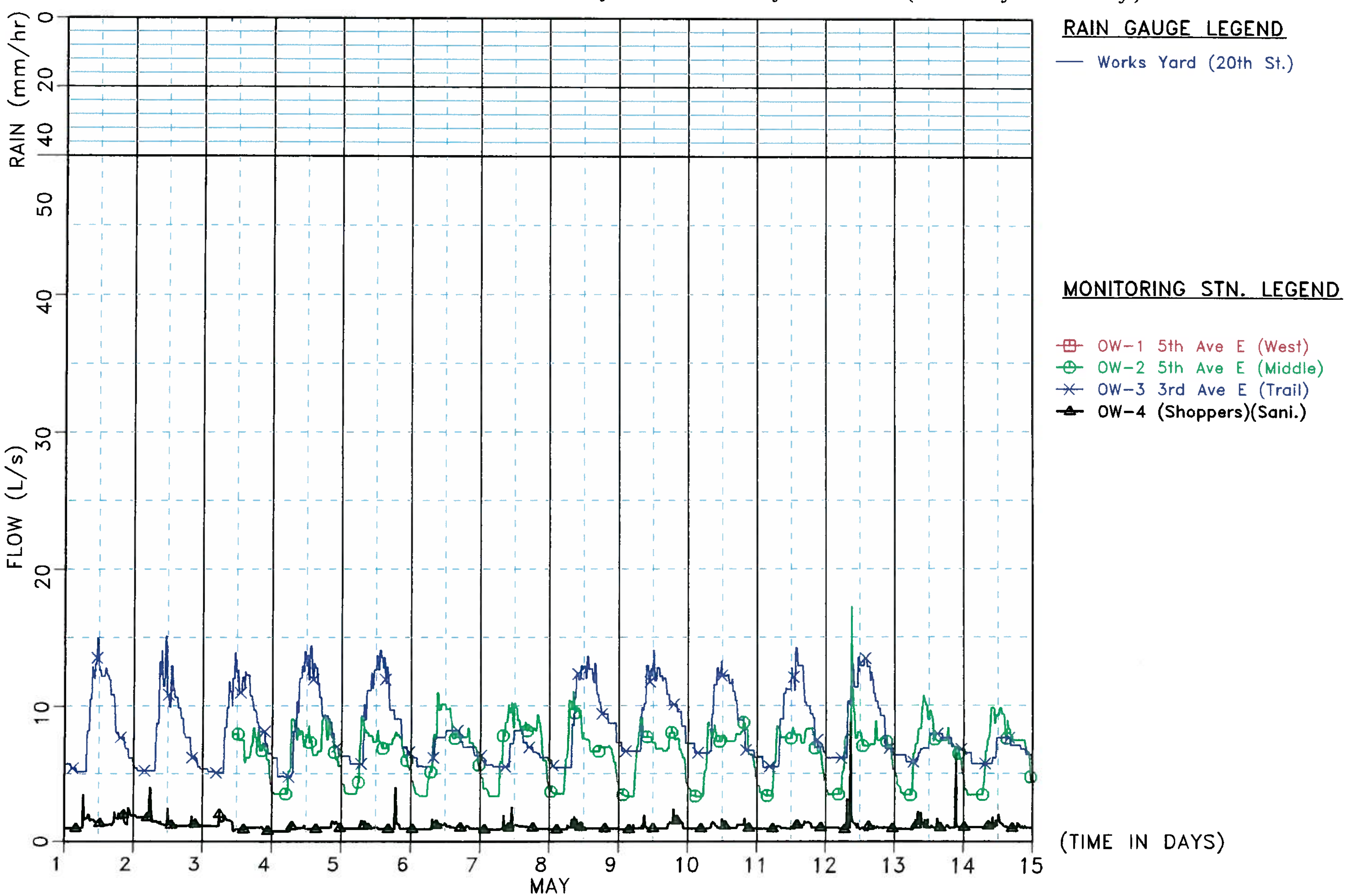




Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flow Rates for Period of Apr. 17 – Apr. 30 (Monday–Sunday)
RAIN (mm/hr)
0
20
40
50
40
30
20
10
0
FLOW (L/s)
17
18
19
20
21
22
23
24
25
26
27
28
29
30
1
APRIL
MAY
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW–1 5th Ave E (West)
OW–2 5th Ave E (Middle)
OW–3 3rd Ave E (Trail)
OW–4 (Shoppers)(Sani.)
(TIME IN DAYS)

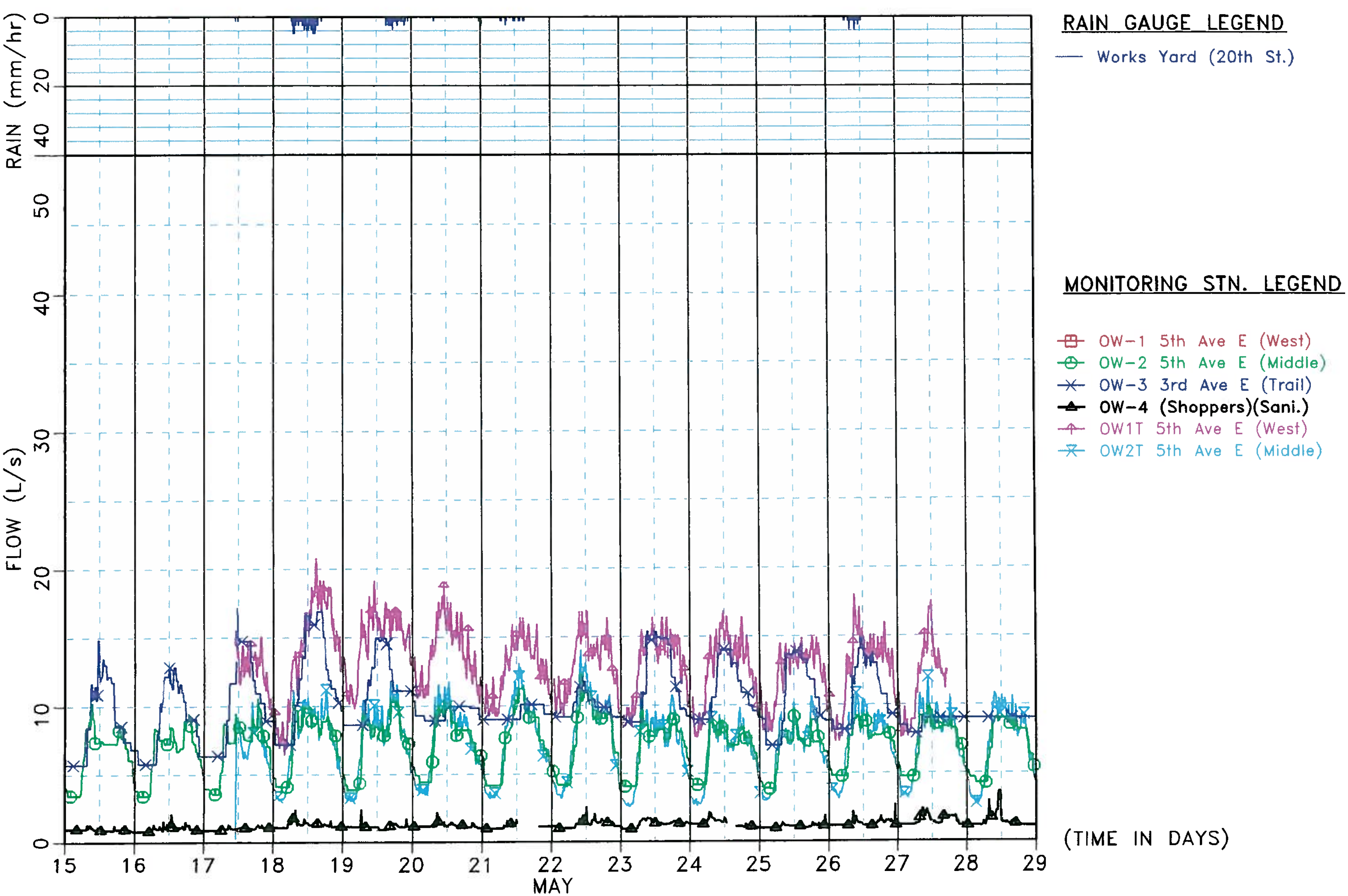
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of May 1 – May 14 (Monday–Sunday)



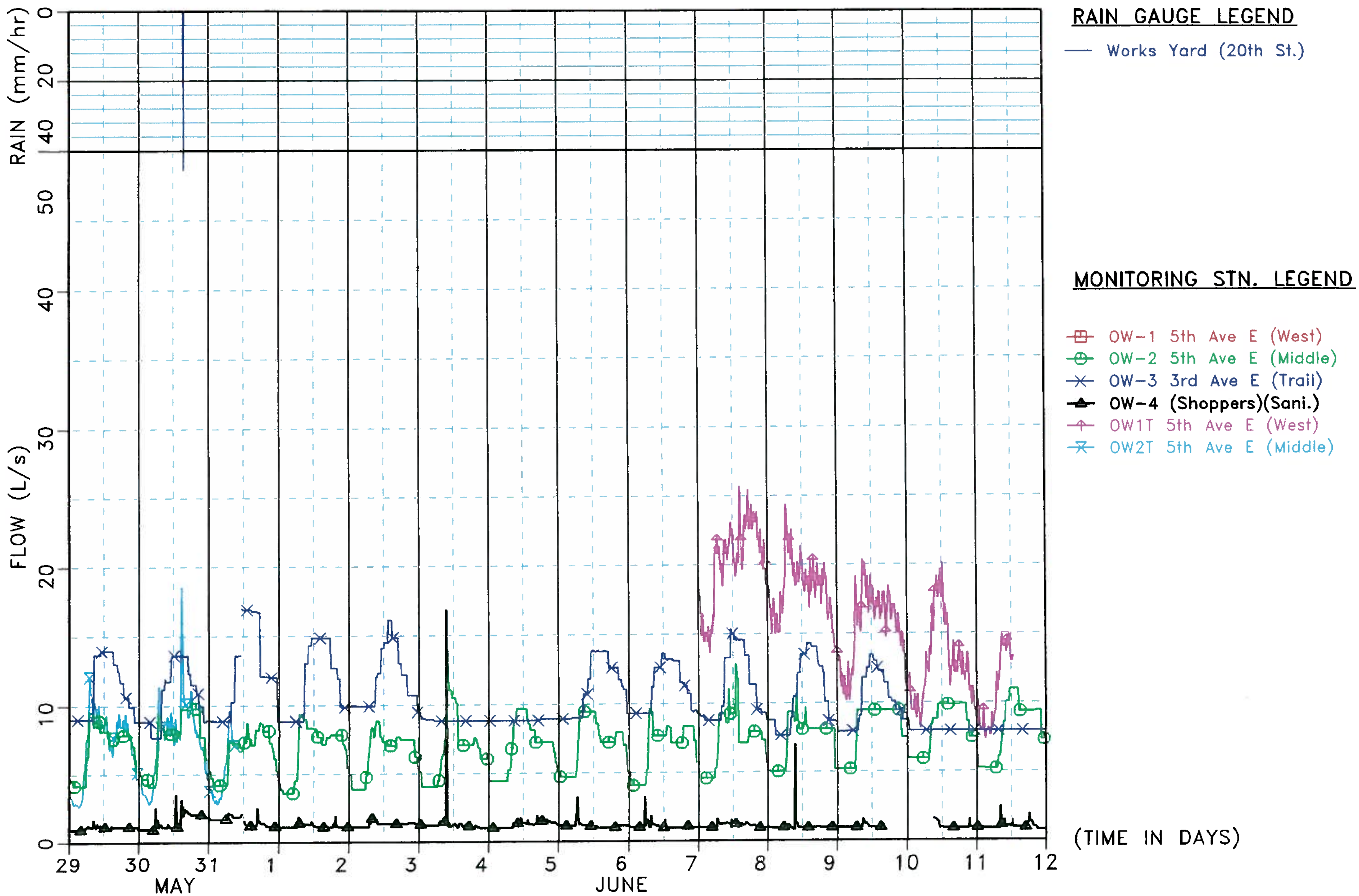
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of May 15 – May 28 (Monday–Sunday)



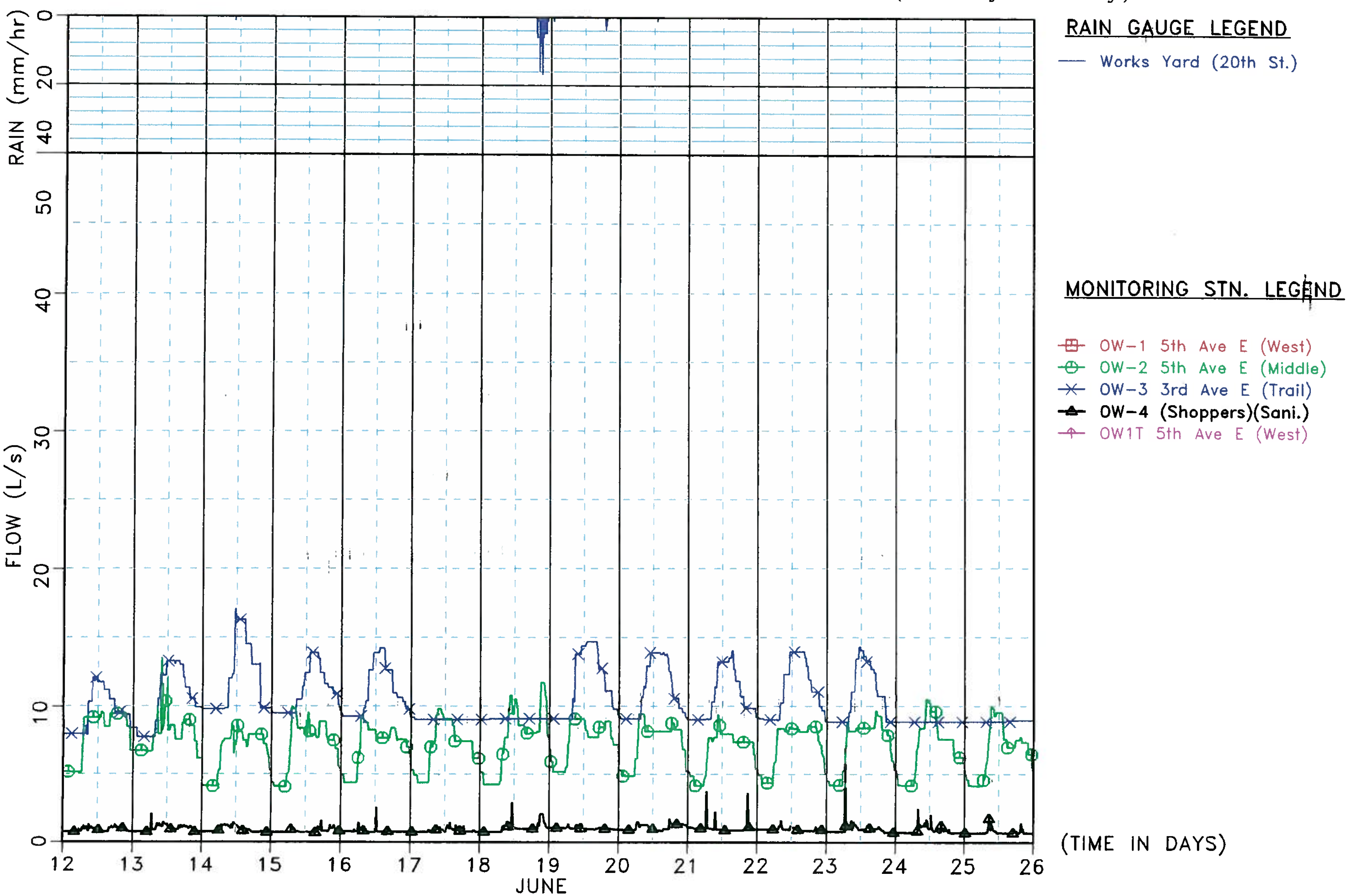
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

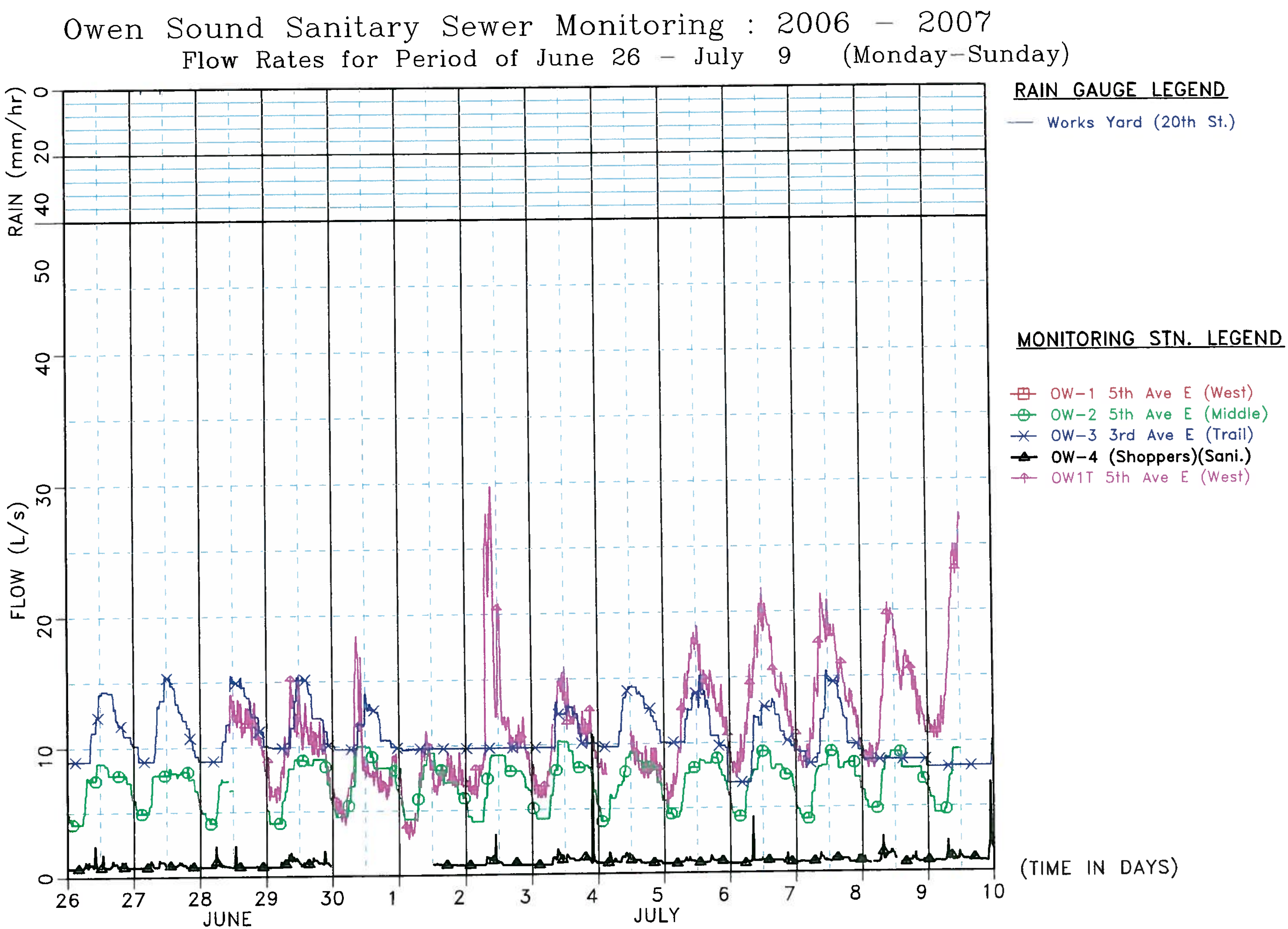
Flow Rates for Period of May 29 – June 11 (Monday–Sunday)



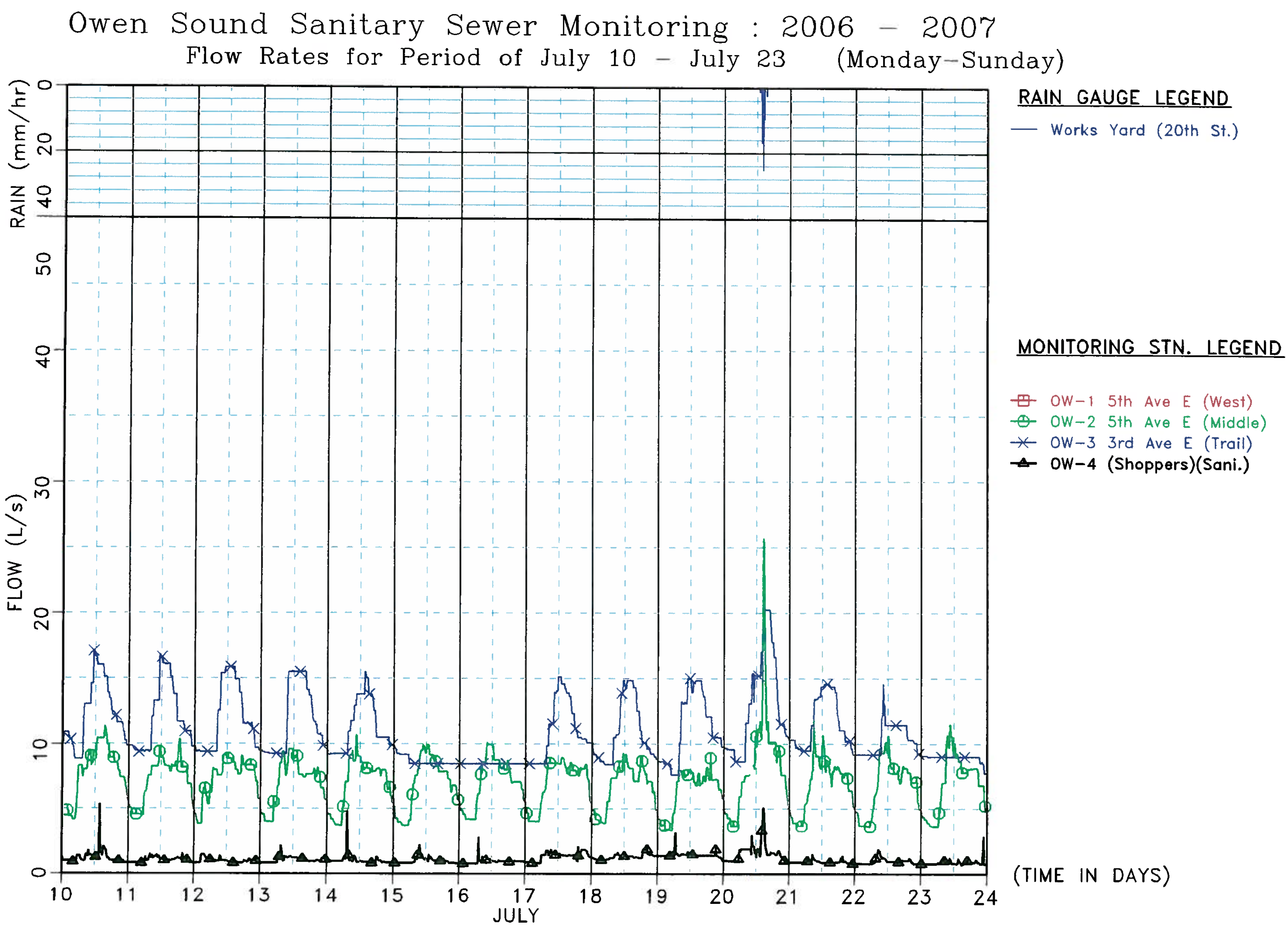
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

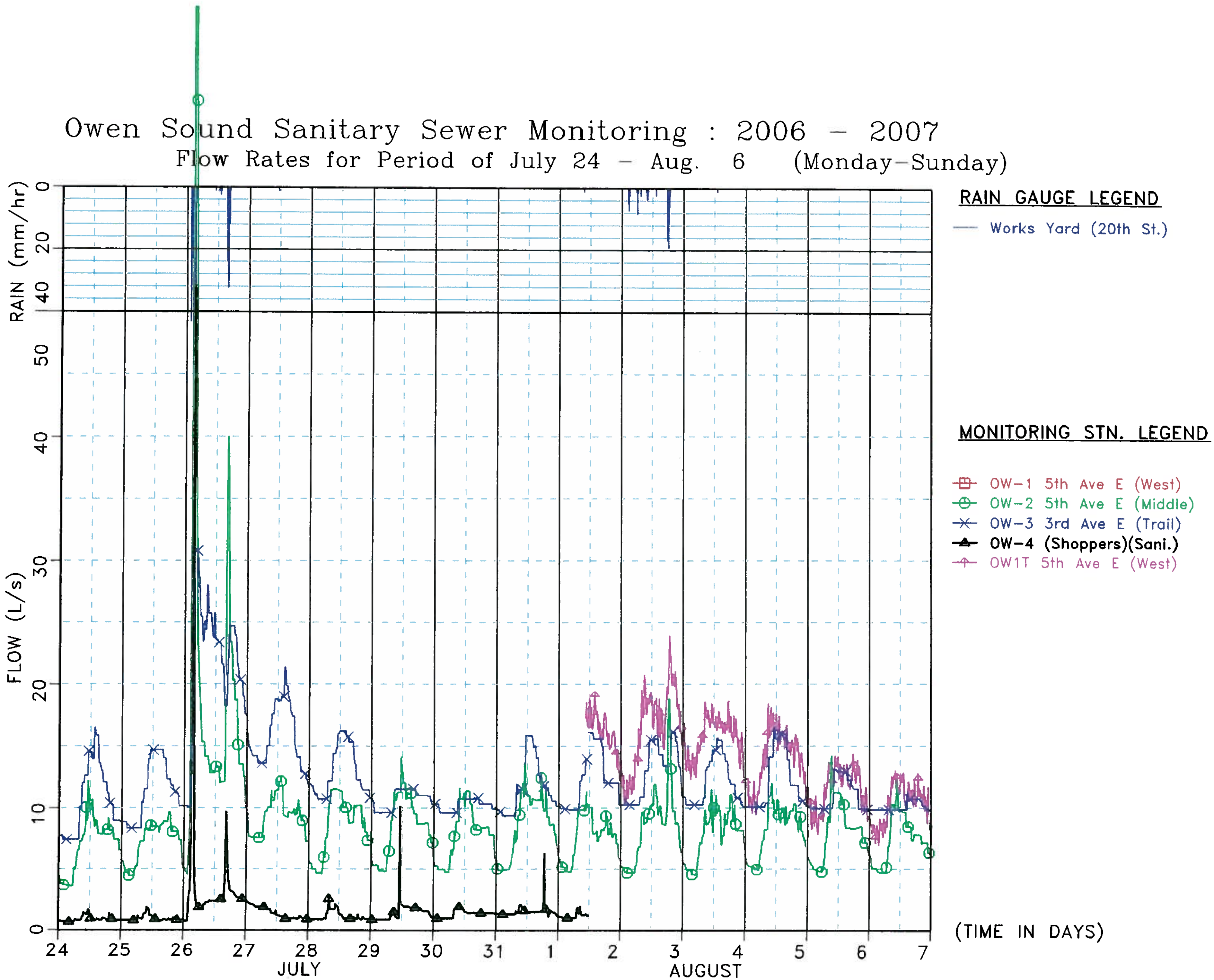
Flow Rates for Period of June 12 – June 25 (Monday–Sunday)





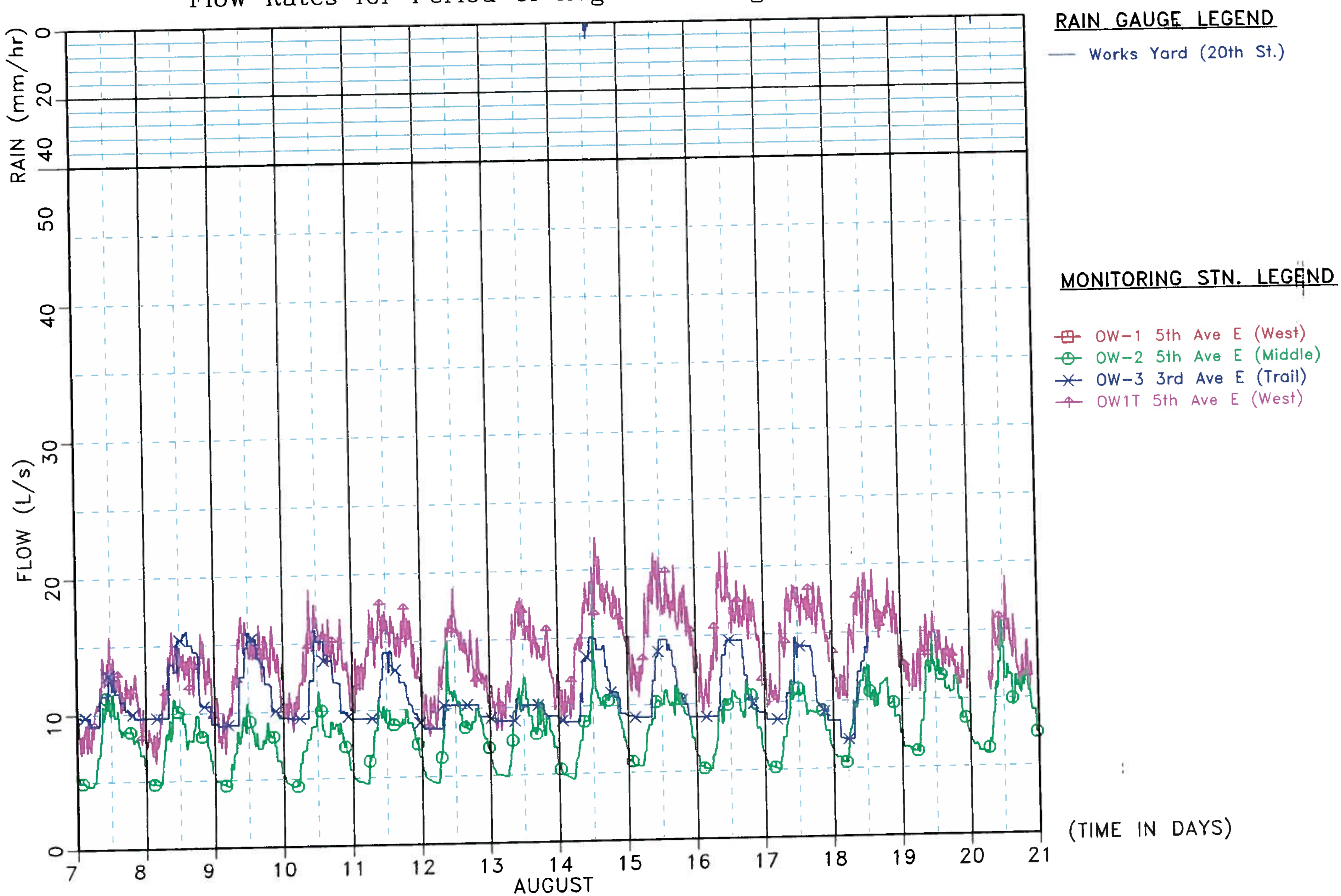
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flow Rates for Period of June 26 – July 9 (Monday–Sunday)
RAIN (mm/hr)
0
20
40
FLOW (L/s)
50
40
30
20
10
0
26
27
28
29
30
JUNE
1
2
3
4
5
6
7
8
9
10
JULY
(TIME IN DAYS)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW–1 5th Ave E (West)
OW–2 5th Ave E (Middle)
OW–3 3rd Ave E (Trail)
OW–4 (Shoppers)(Sani.)
OW1T 5th Ave E (West)


Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flow Rates for Period of July 10 – July 23 (Monday–Sunday)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW–1 5th Ave E (West)
OW–2 5th Ave E (Middle)
OW–3 3rd Ave E (Trail)
OW–4 (Shoppers)(Sani.)
RAIN (mm/hr)
0
20
40
FLOW (L/s)
0
10
20
30
40
50
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
JULY
(TIME IN DAYS)


Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flow Rates for Period of July 24 – Aug. 6 (Monday–Sunday)
RAIN (mm/hr)
0
20
40
50
40
30
20
10
0
FLOW (L/s)
24
25
26
27
28
29
30
31
1
2
3
4
5
6
7
JULY
AUGUST
(TIME IN DAYS)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW–1 5th Ave E (West)
OW–2 5th Ave E (Middle)
OW–3 3rd Ave E (Trail)
OW–4 (Shoppers)(Sani.)
OW1T 5th Ave E (West)

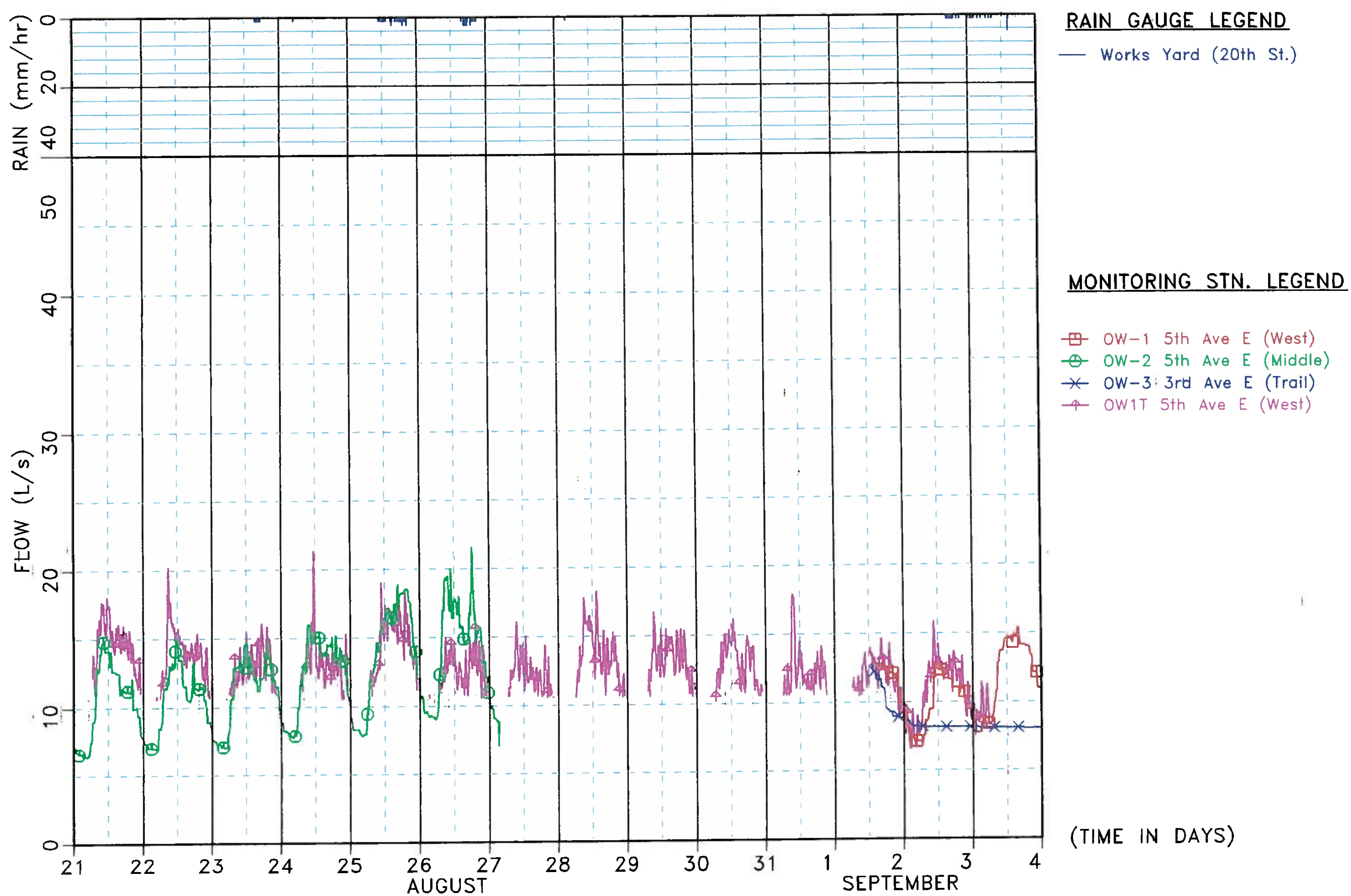
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

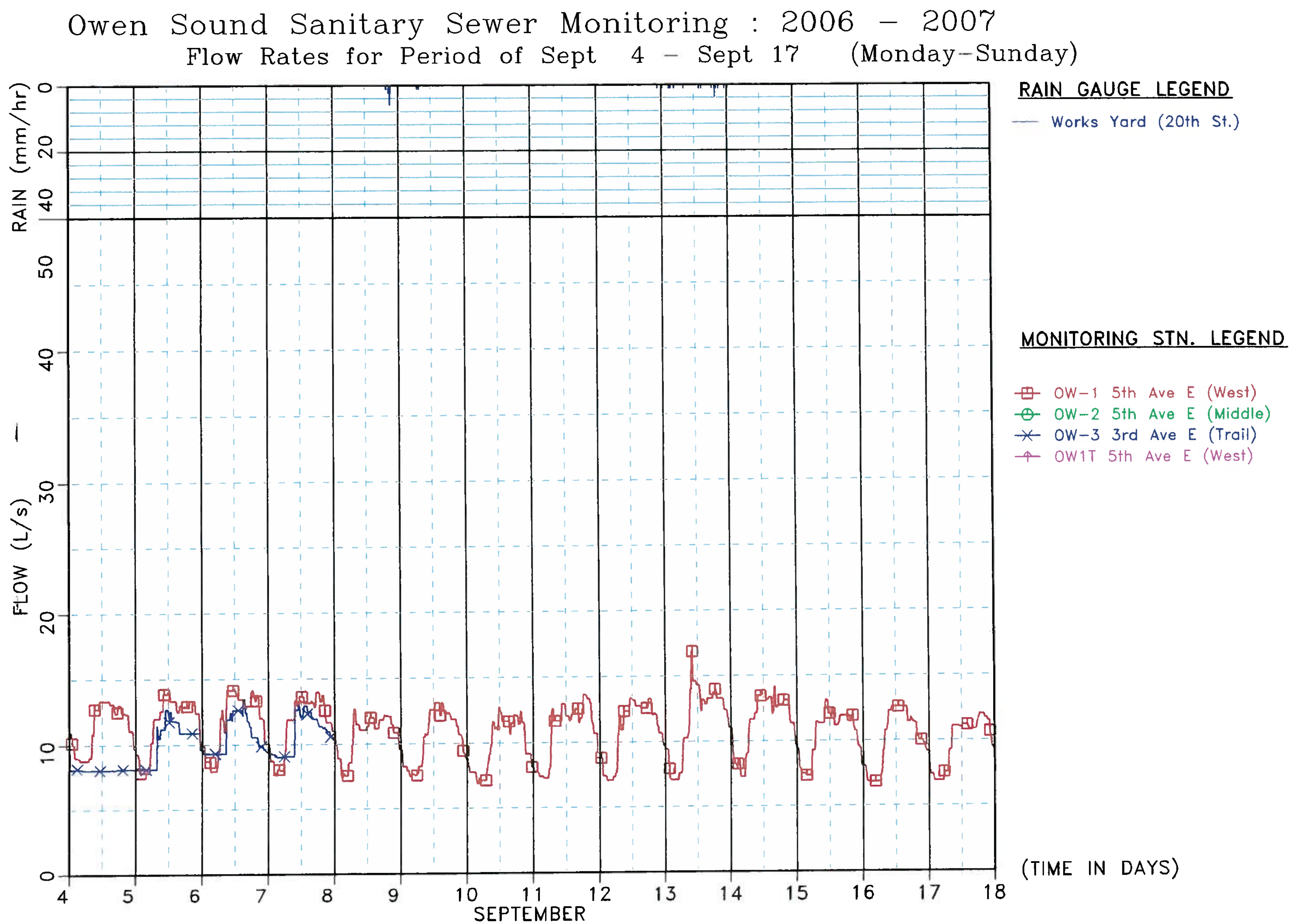
Flow Rates for Period of Aug. 7 – Aug. 20 (Monday–Sunday)



Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

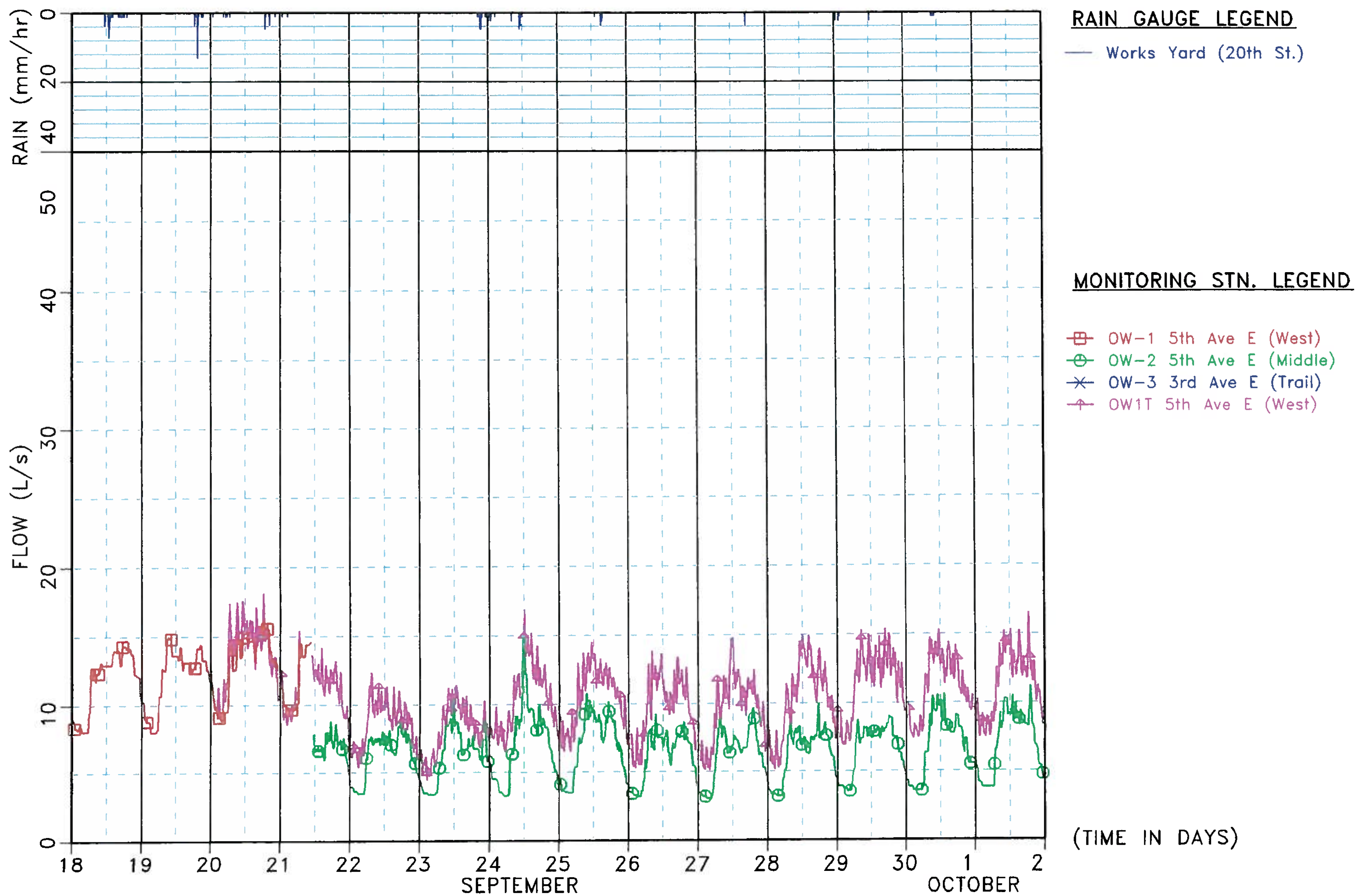
Flow Rates for Period of Aug. 21 – Sept 3 (Monday–Sunday)

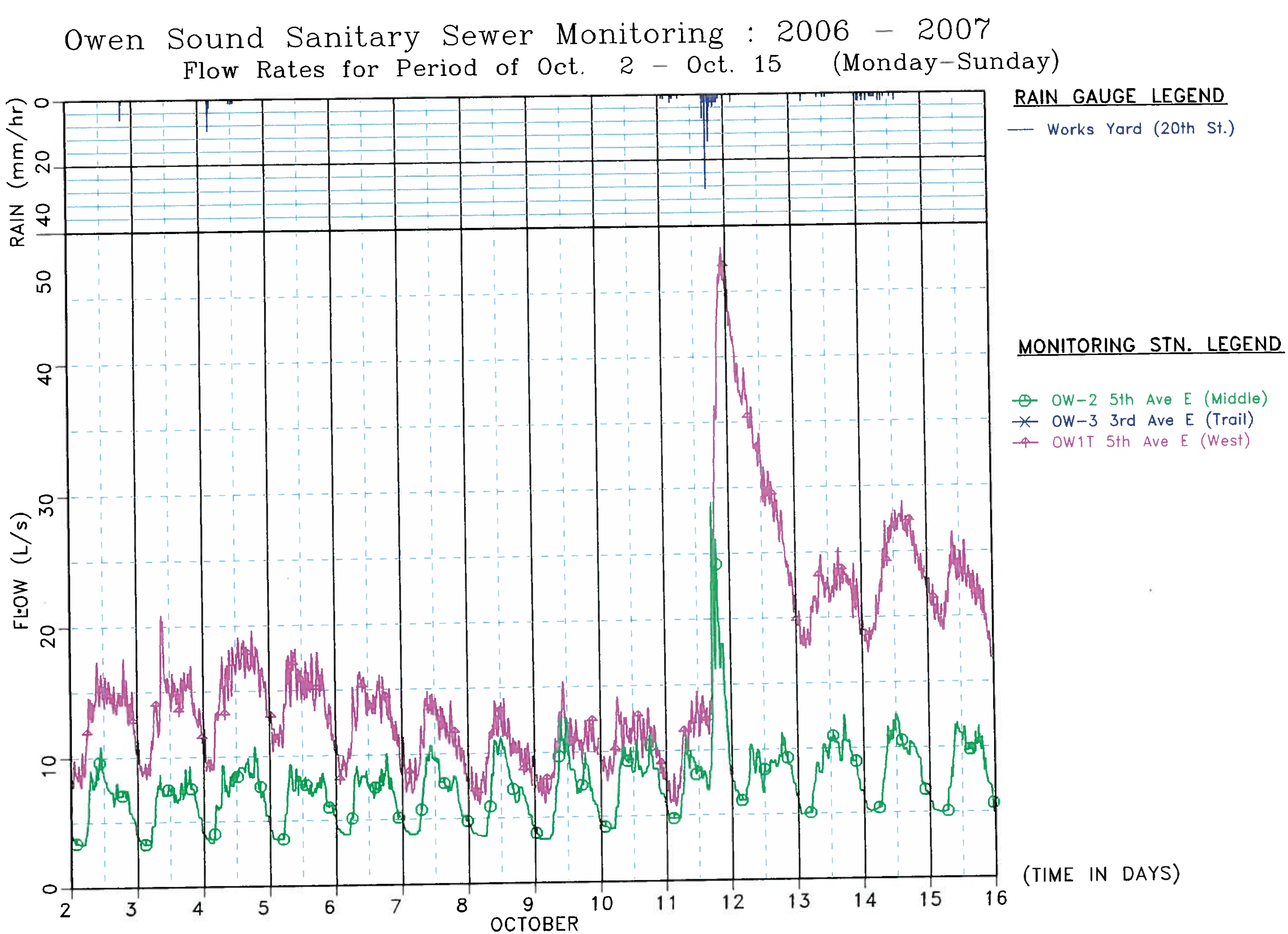



Owen Sound Sanitary Sewer Monitoring : 2006 - 2007
Flow Rates for Period of Sept 4 - Sept 17 (Monday-Sunday)
RAIN (mm/hr)
0
20
40
50
40
30
20
10
0
FLOW (L/s)
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
SEPTEMBER
(TIME IN DAYS)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW-1 5th Ave E (West)
OW-2 5th Ave E (Middle)
OW-3 3rd Ave E (Trail)
OW1T 5th Ave E (West)

Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Sept 18 – Oct. 1 (Monday–Sunday)

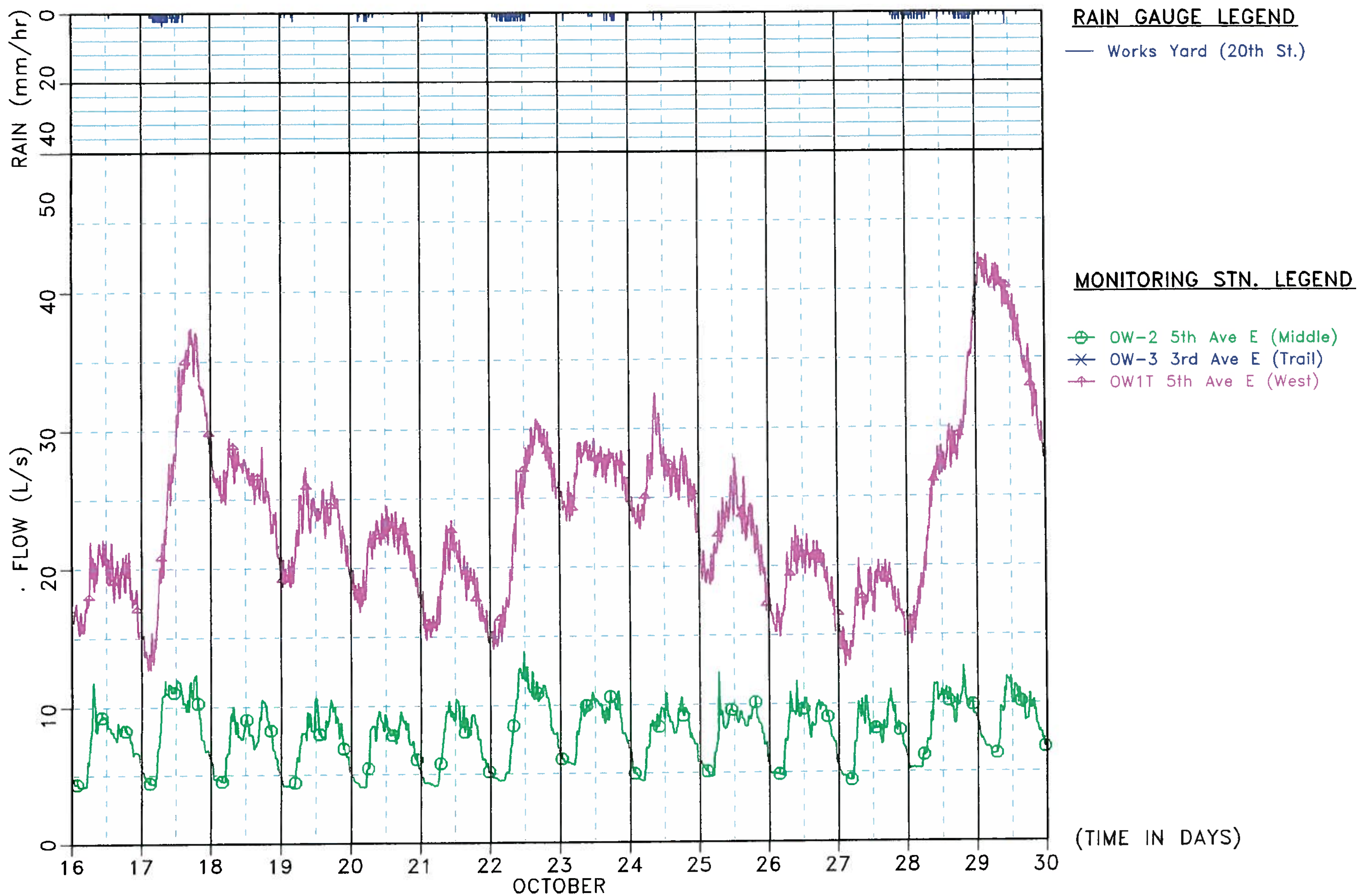




Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flow Rates for Period of Oct. 2 – Oct. 15 (Monday–Sunday)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW–2 5th Ave E (Middle)
OW–3 3rd Ave E (Trail)
OW1T 5th Ave E (West)
RAIN (mm/hr)
0
20
40
FLOW (L/s)
0
10
20
30
40
50
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
OCTOBER
(TIME IN DAYS)

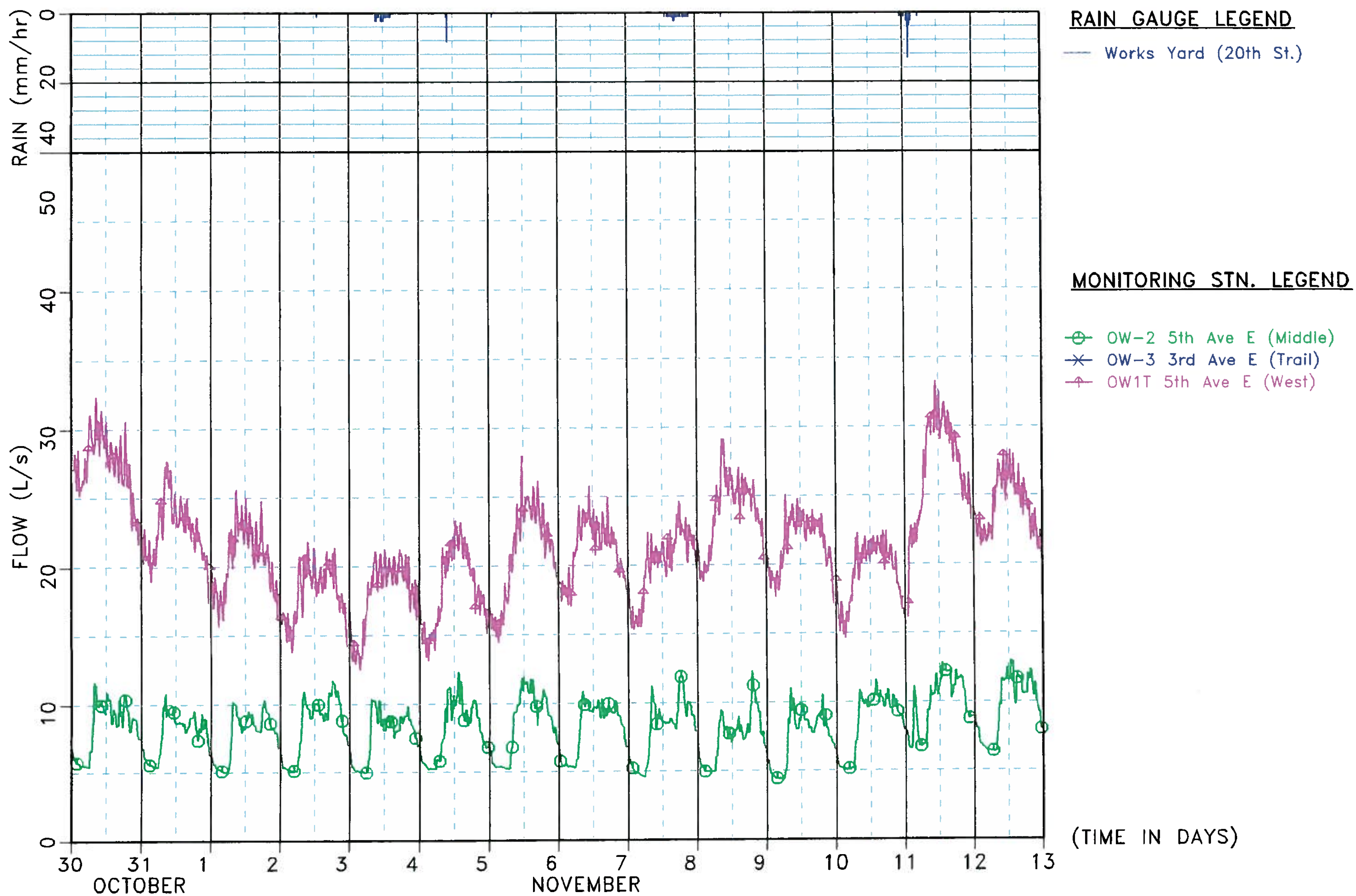
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Oct. 16 – Oct. 29 (Monday–Sunday)



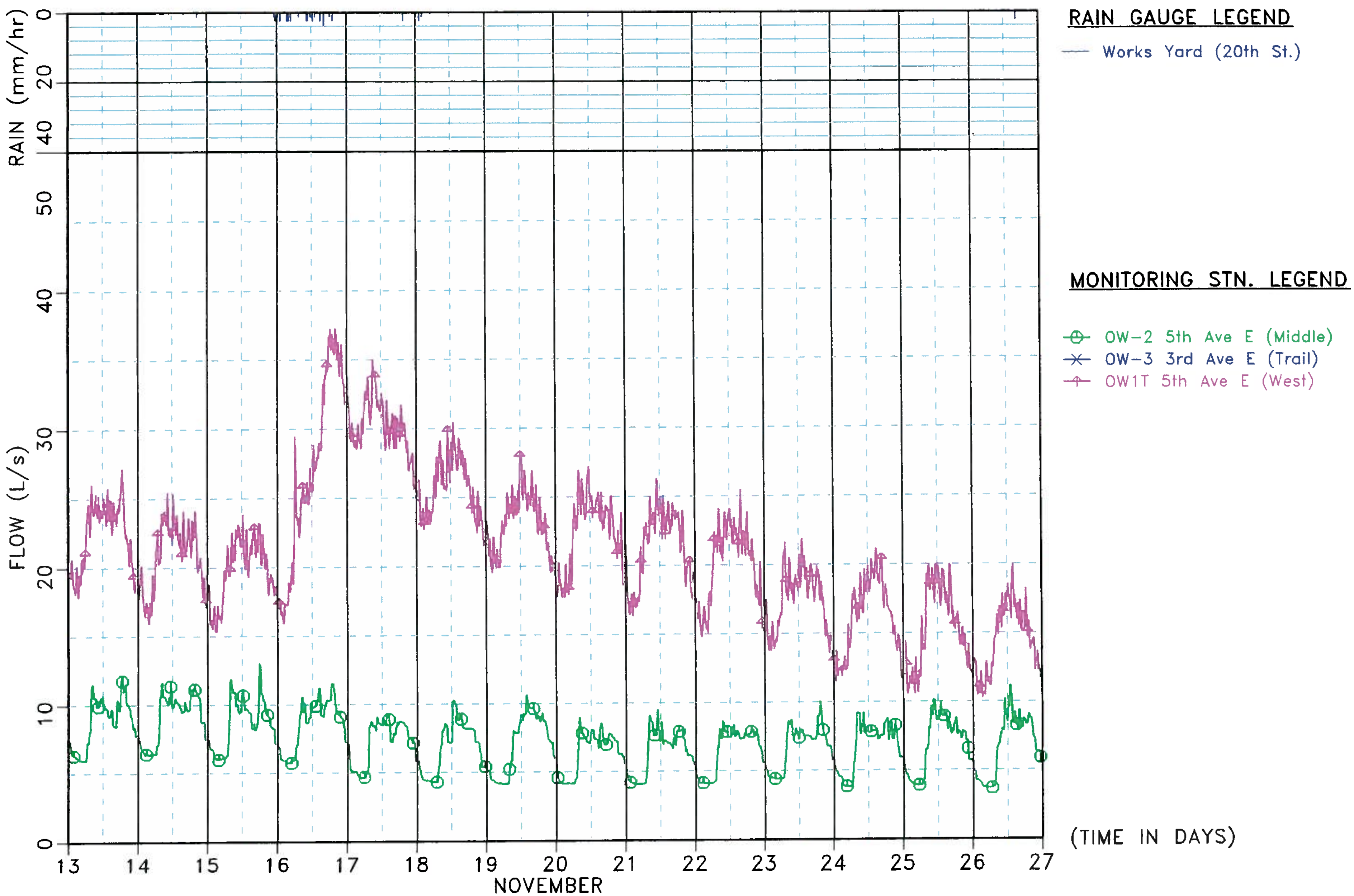
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

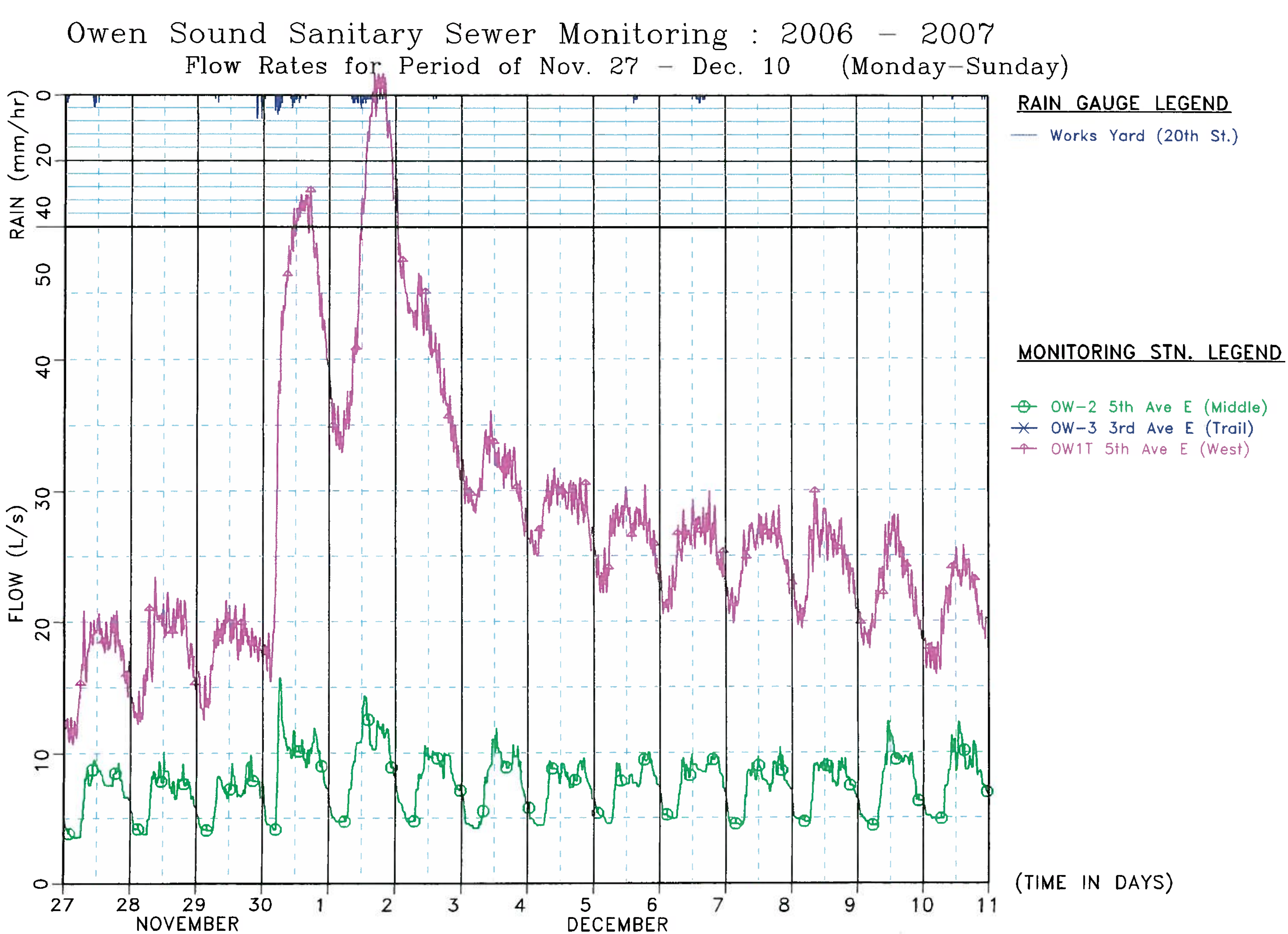
Flow Rates for Period of Oct. 30 – Nov. 12 (Monday–Sunday)



Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Nov. 13 – Nov. 26 (Monday–Sunday)

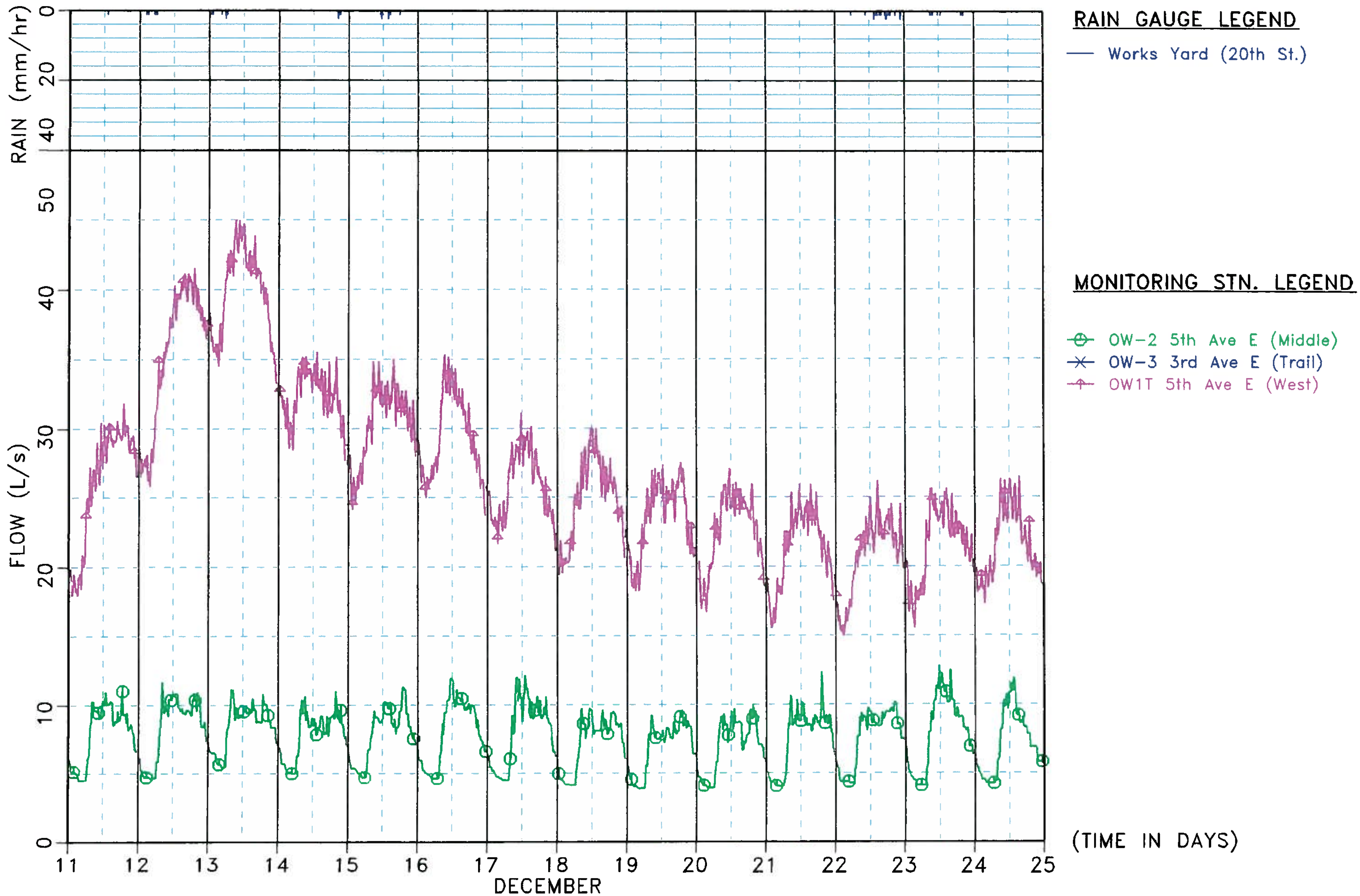




Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flow Rates for Period of Nov. 27 – Dec. 10 (Monday–Sunday)
RAIN (mm/hr)
0
20
40
FLOW (L/s)
50
40
30
20
10
0
27
28
29
30
1
2
3
4
5
6
7
8
9
10
11
NOVEMBER
DECEMBER
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW-2 5th Ave E (Middle)
OW-3 3rd Ave E (Trail)
OW1T 5th Ave E (West)
(TIME IN DAYS)

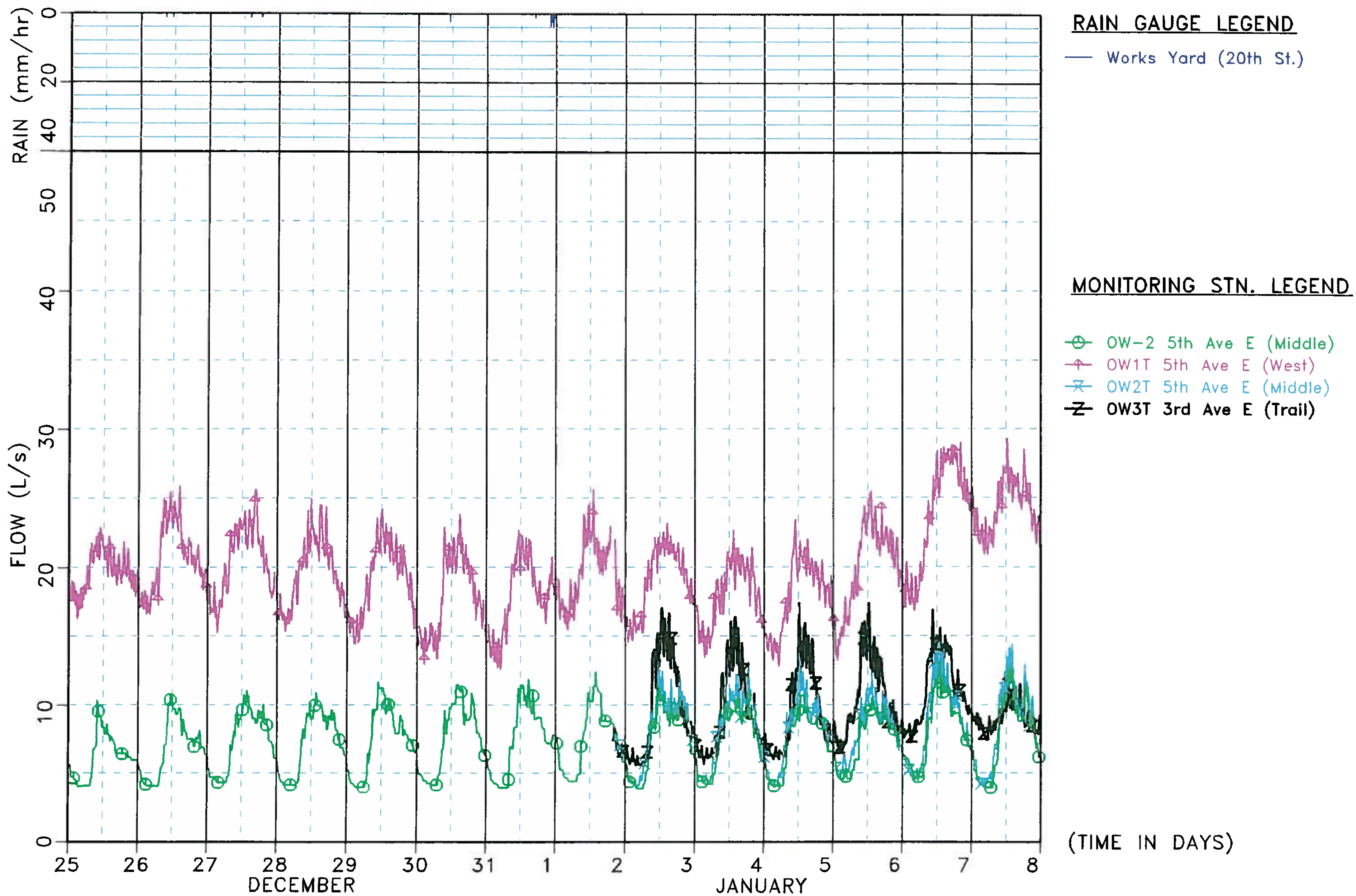
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Dec. 11 – Dec. 24 (Monday–Sunday)



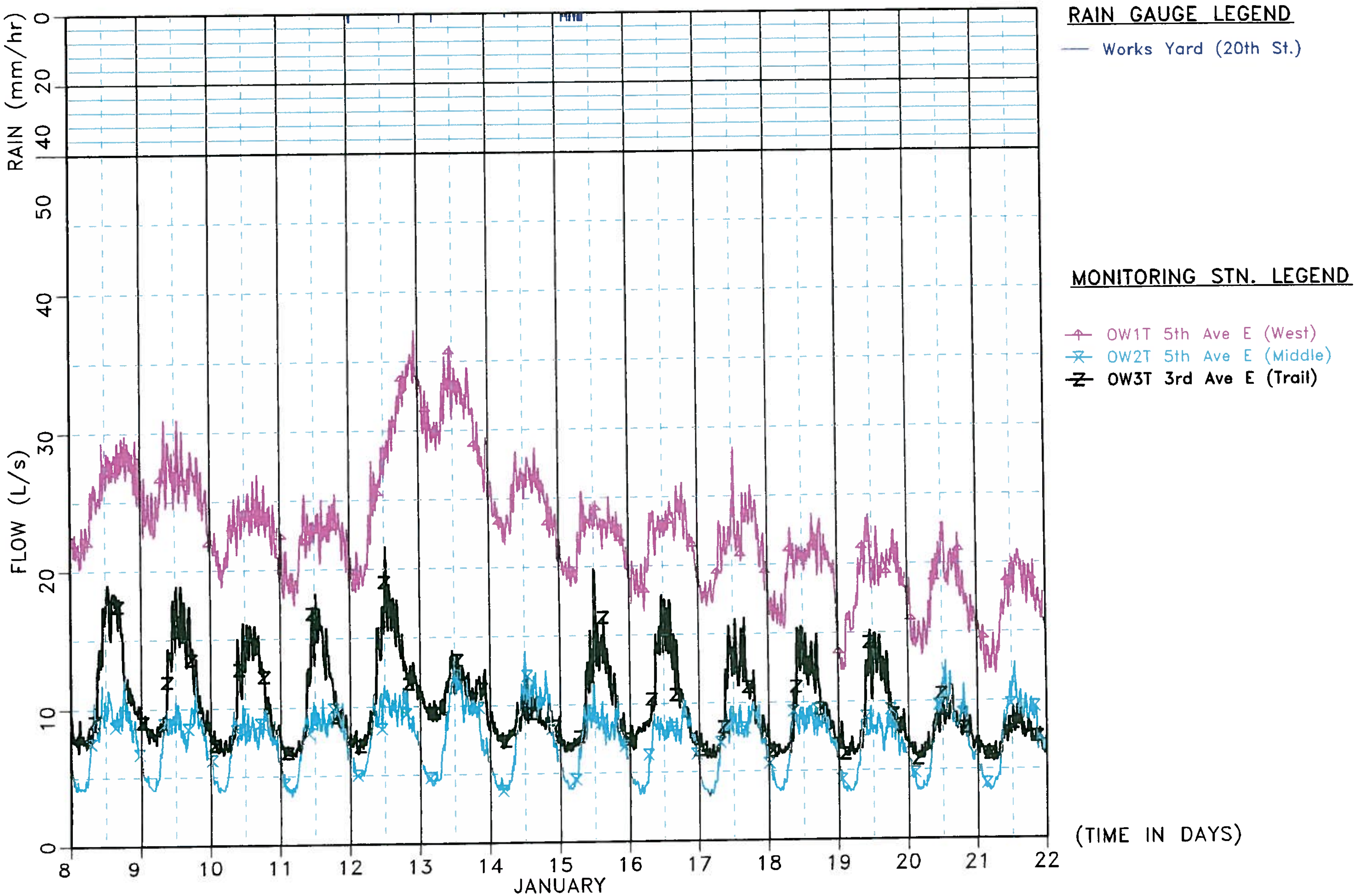
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Dec. 25 – Jan. 7 (Monday–Sunday)



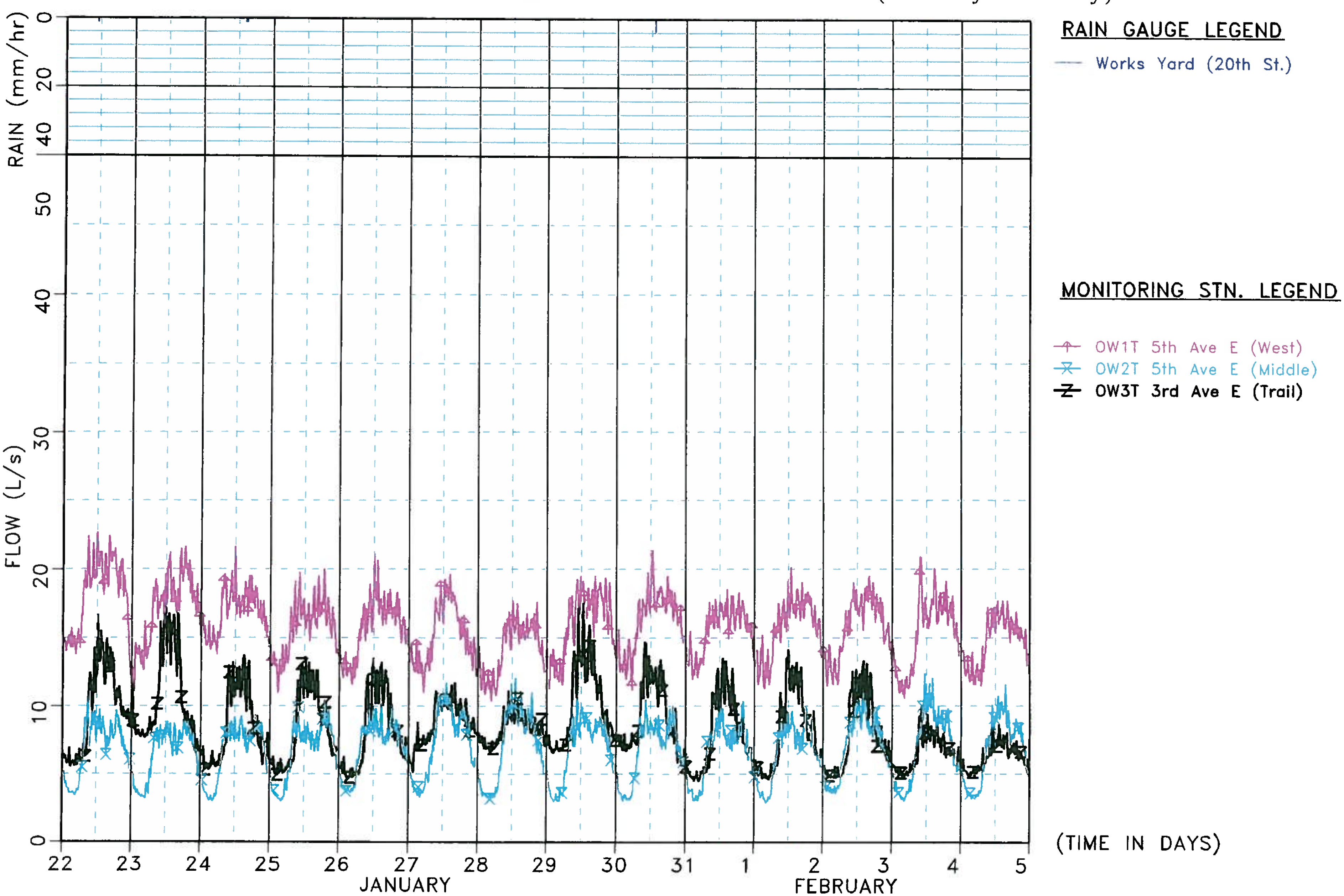
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Jan. 8 – Jan. 21 (Monday–Sunday)



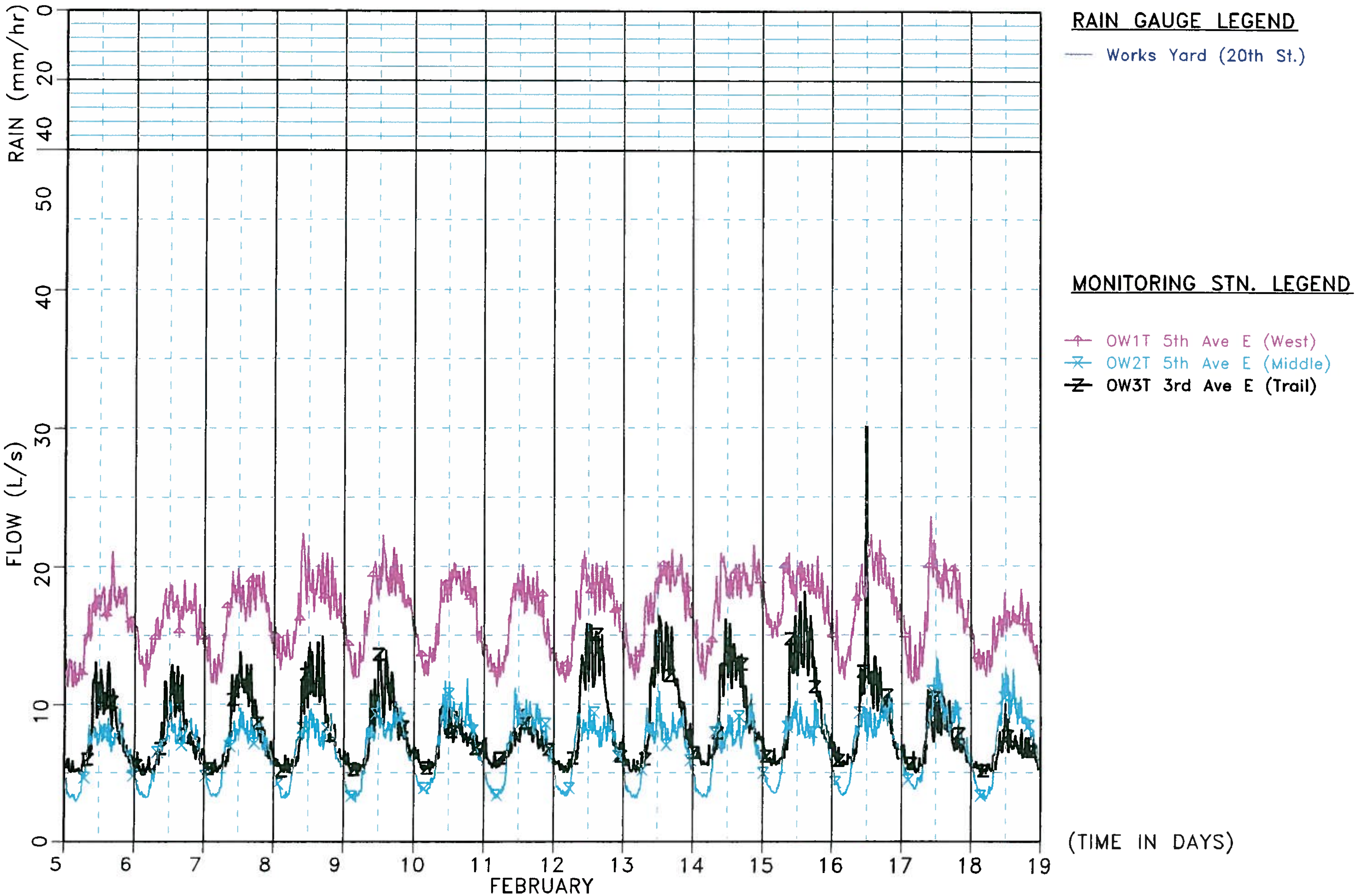
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

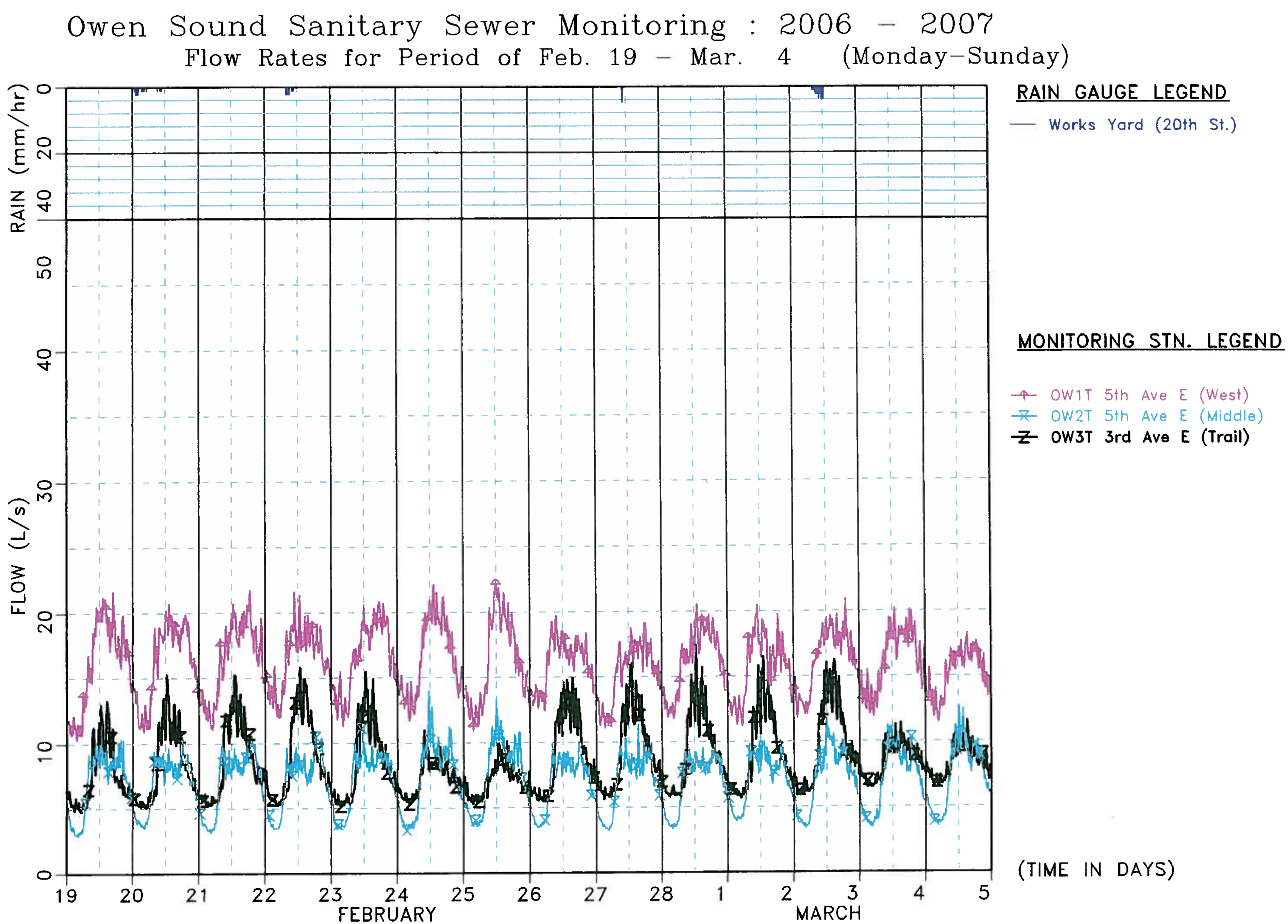
Flow Rates for Period of Jan. 22 – Feb. 4 (Monday–Sunday)

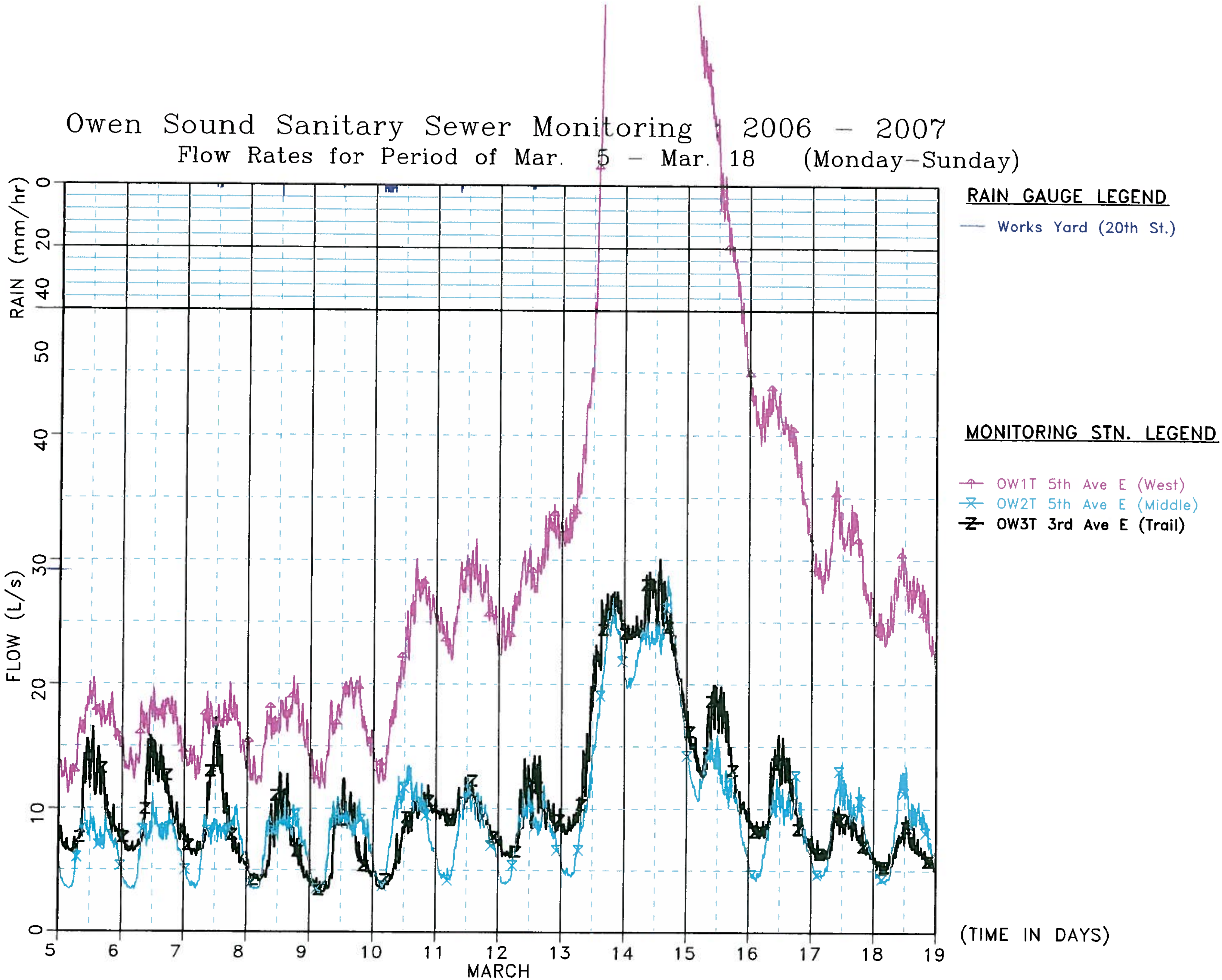


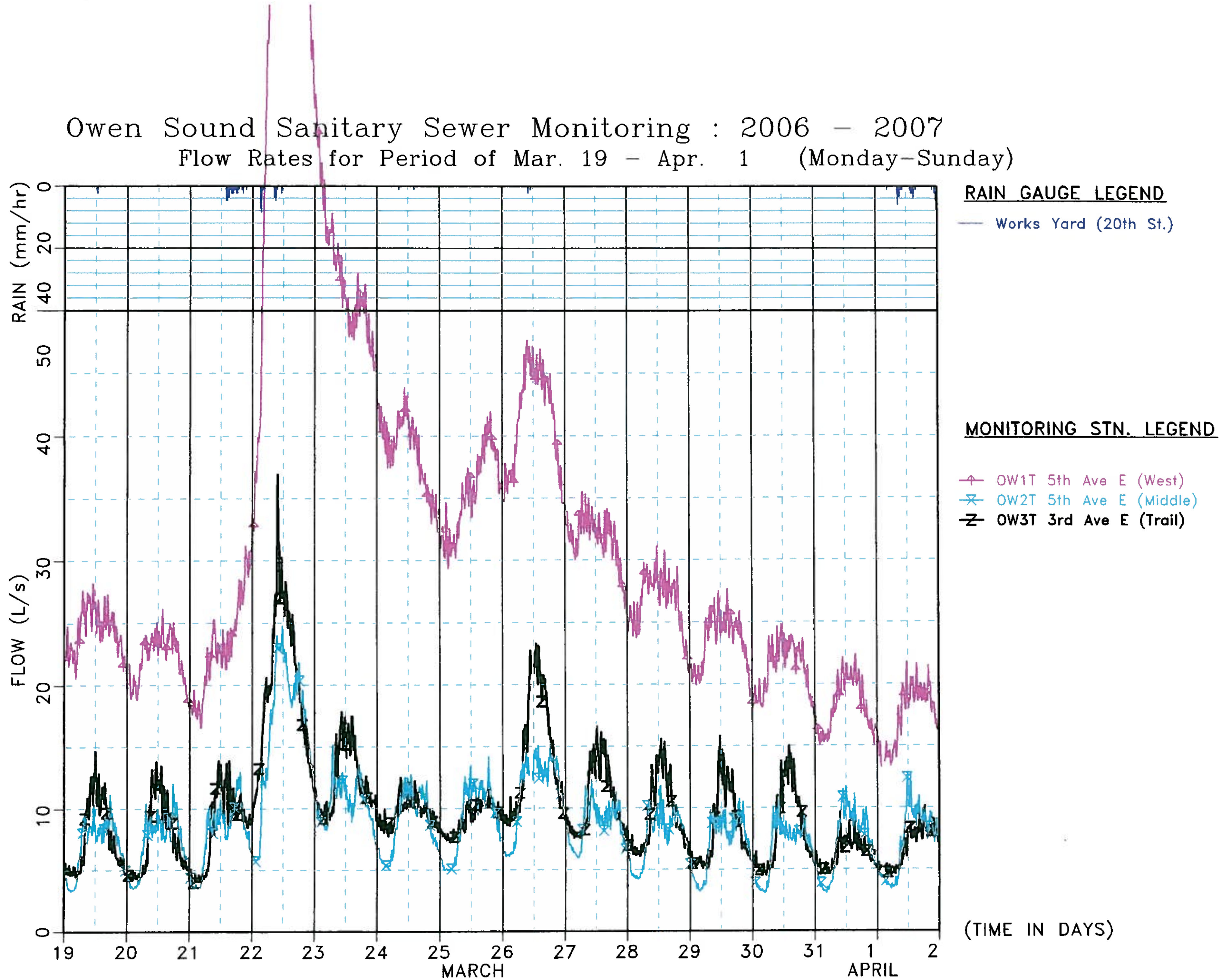
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Feb. 5 – Feb. 18 (Monday–Sunday)



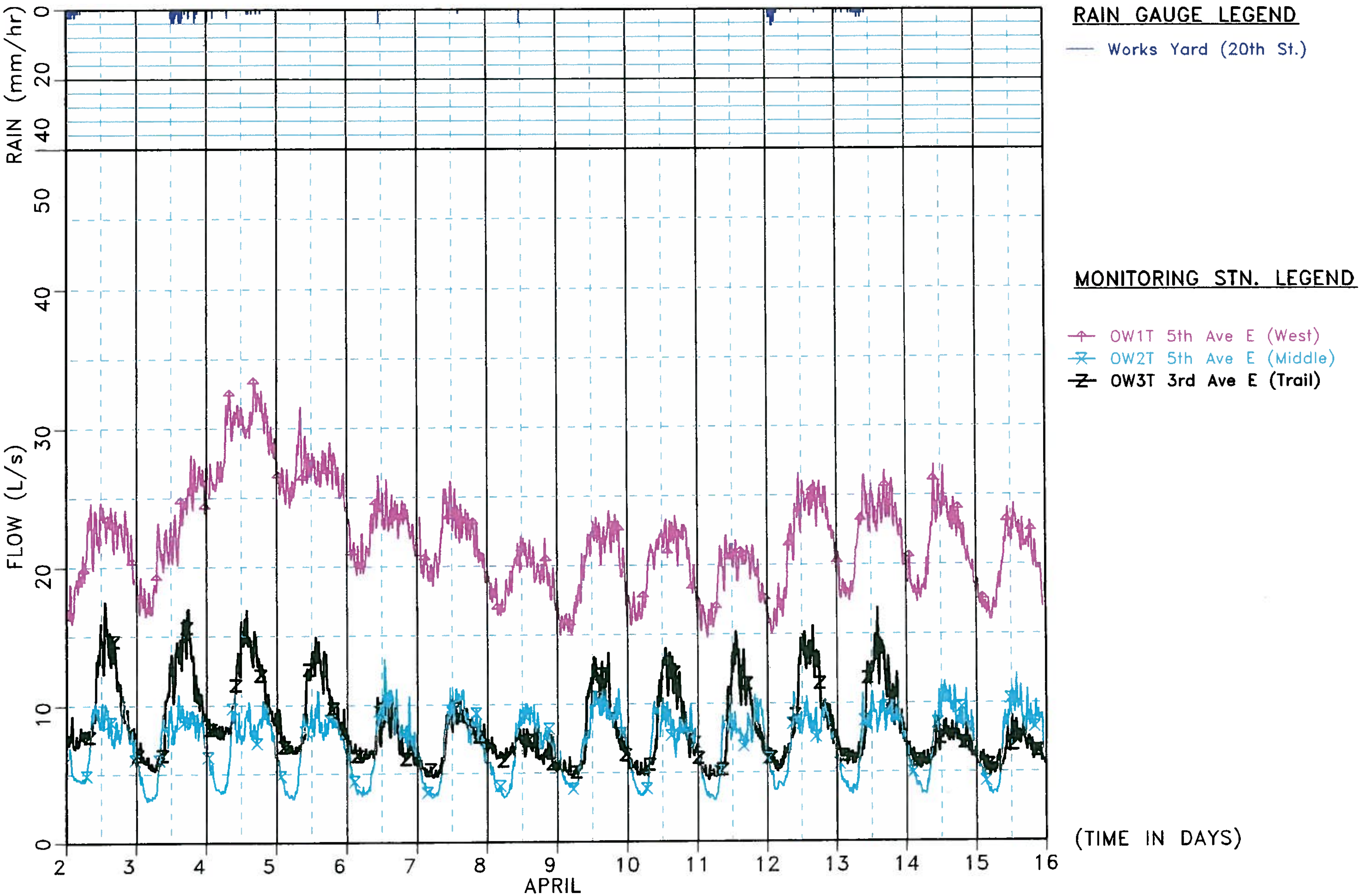

Owen Sound Sanitary Sewer Monitoring : 2006 - 2007
Flow Rates for Period of Feb. 19 - Mar. 4 (Monday-Sunday)
RAIN (mm/hr)
0
20
40
50
40
30
20
10
0
FLOW (L/s)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW1T 5th Ave E (West)
OW2T 5th Ave E (Middle)
OW3T 3rd Ave E (Trail)
(TIME IN DAYS)
19
20
21
22
23
24
25
26
27
28
1
2
3
4
5
FEBRUARY
MARCH


Owen Sound Sanitary Sewer Monitoring 2006 - 2007
Flow Rates for Period of Mar. 5 - Mar. 18 (Monday-Sunday)
RAIN (mm/hr)
0
20
40
FLOW (L/s)
50
40
30
20
10
0
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
MARCH
(TIME IN DAYS)
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW1T 5th Ave E (West)
OW2T 5th Ave E (Middle)
OW3T 3rd Ave E (Trail)


Owen Sound Sanitary Sewer Monitoring : 2006 – 2007
Flow Rates for Period of Mar. 19 – Apr. 1 (Monday–Sunday)
RAIN (mm/hr)
0
20
40
FLOW (L/s)
50
40
30
20
10
0
19
20
21
22
23
24
25
26
27
28
29
30
31
1
2
MARCH
APRIL
RAIN GAUGE LEGEND
Works Yard (20th St.)
MONITORING STN. LEGEND
OW1T 5th Ave E (West)
OW2T 5th Ave E (Middle)
OW3T 3rd Ave E (Trail)
(TIME IN DAYS)

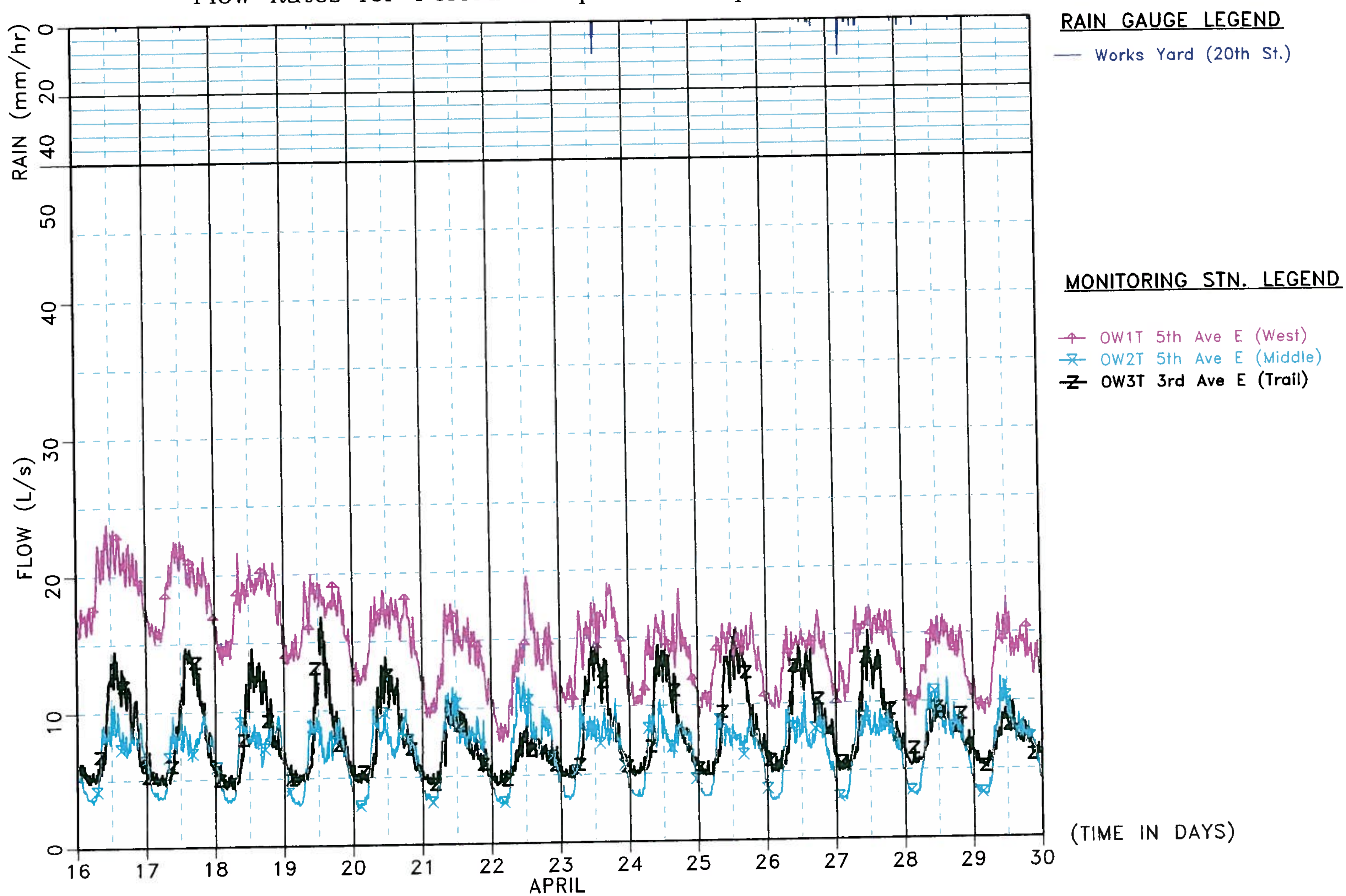
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Apr. 2 – Apr. 15 (Monday–Sunday)



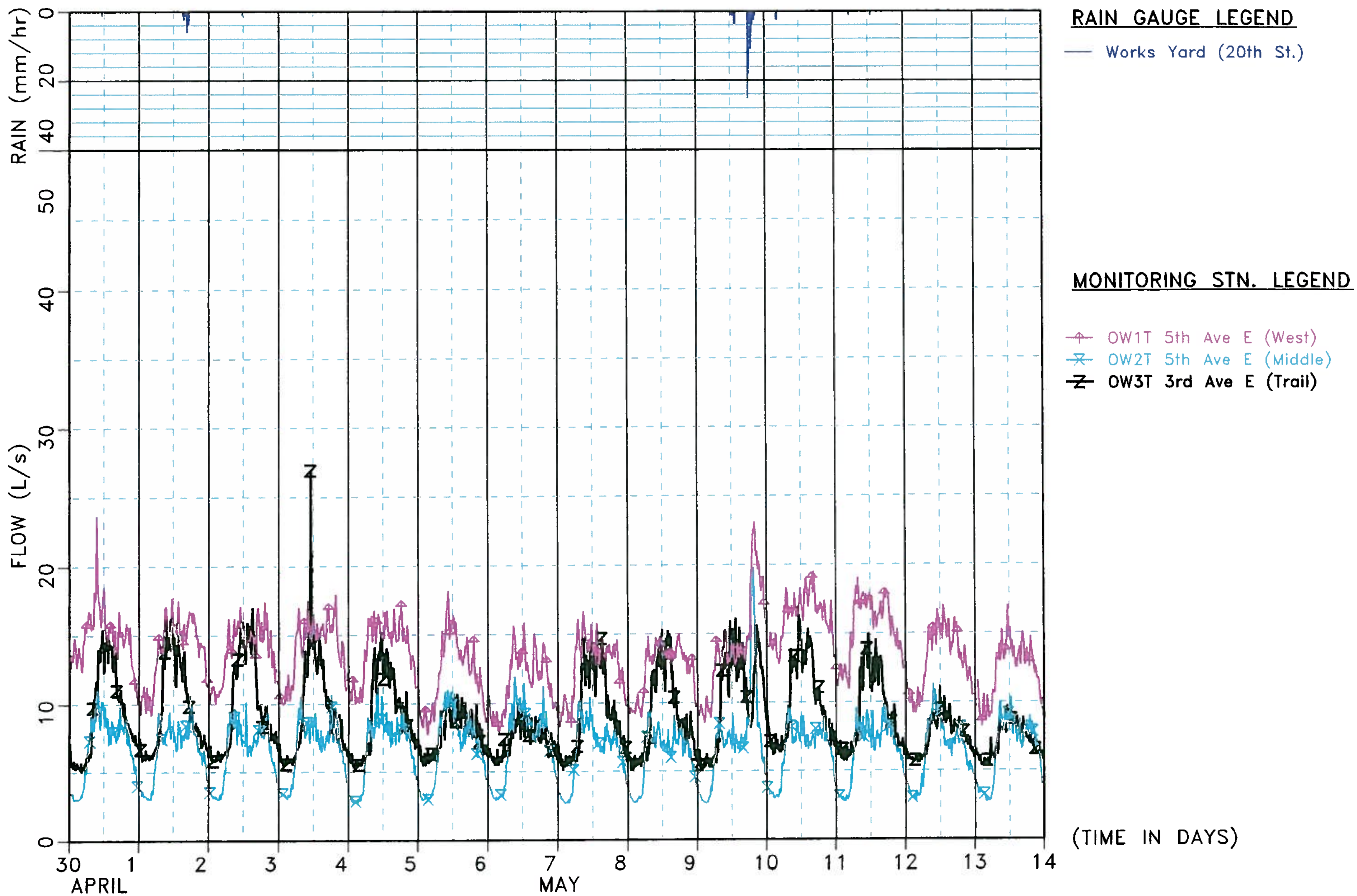
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Apr. 16 – Apr. 29 (Monday–Sunday)



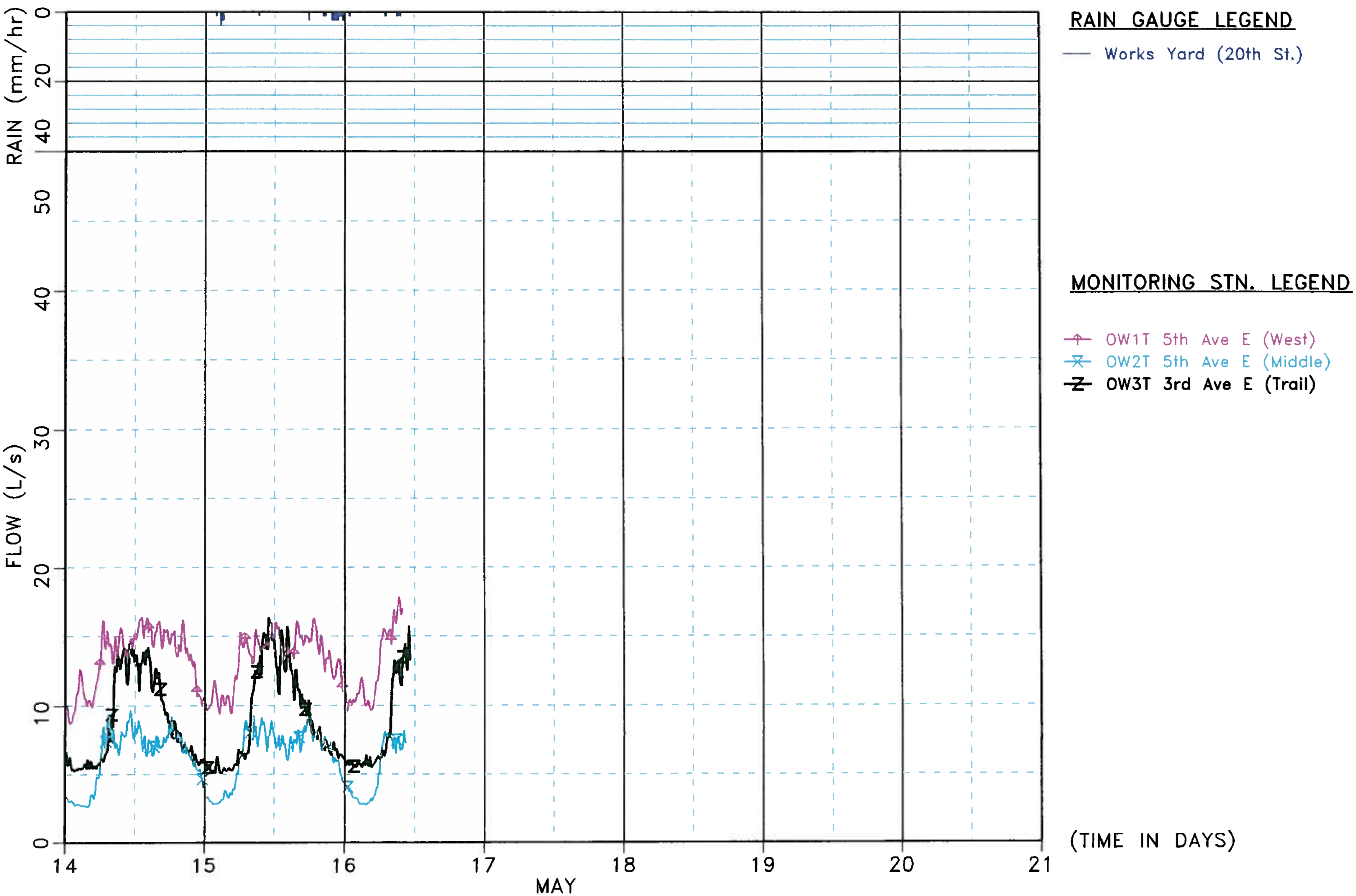
Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

Flow Rates for Period of Apr. 30 – May 13 (Monday–Sunday)



Owen Sound Sanitary Sewer Monitoring : 2006 – 2007

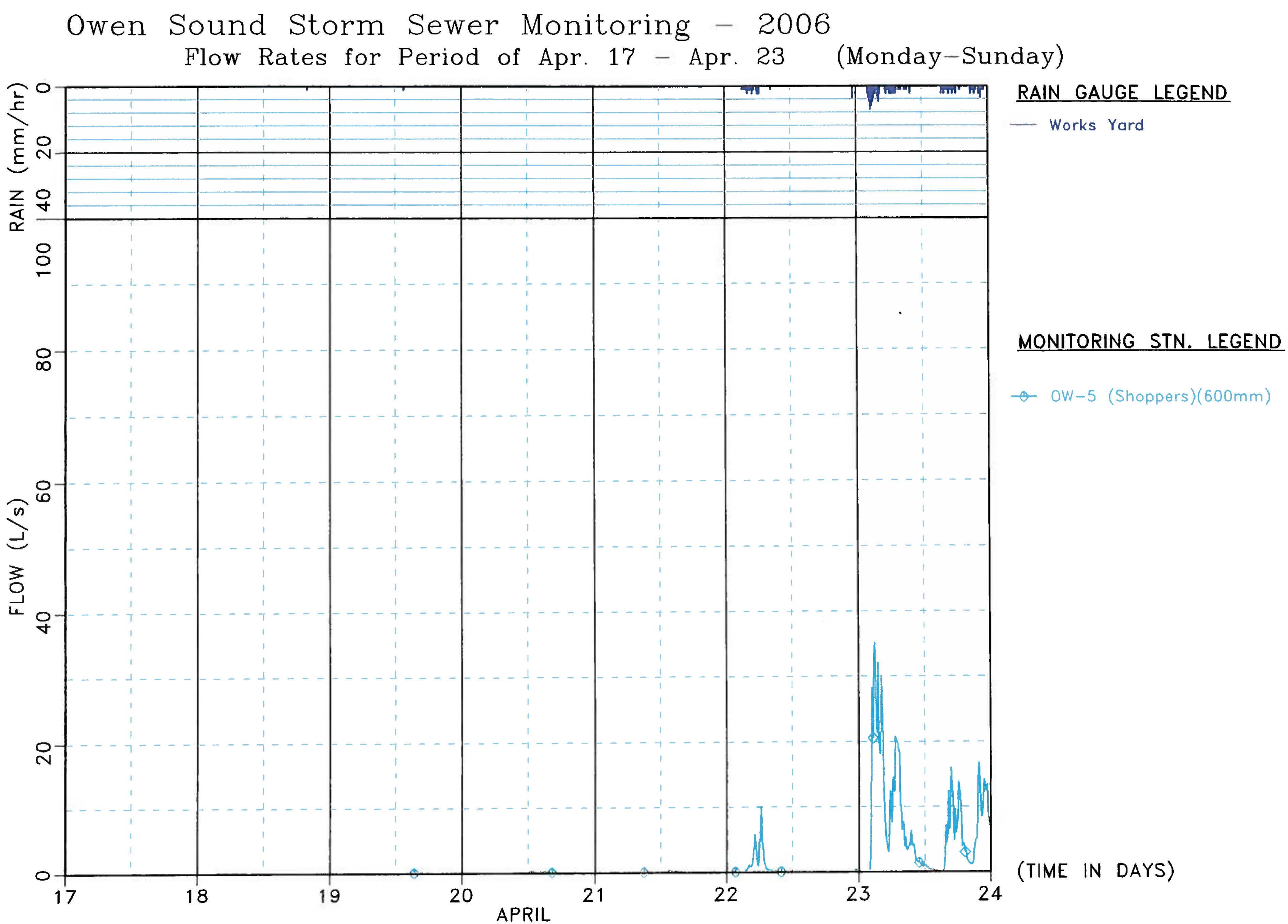
Flow Rates for Period of May 14 – May 20 (Monday–Sunday)



APPENDIX D:

STORM SEWER SYSTEM

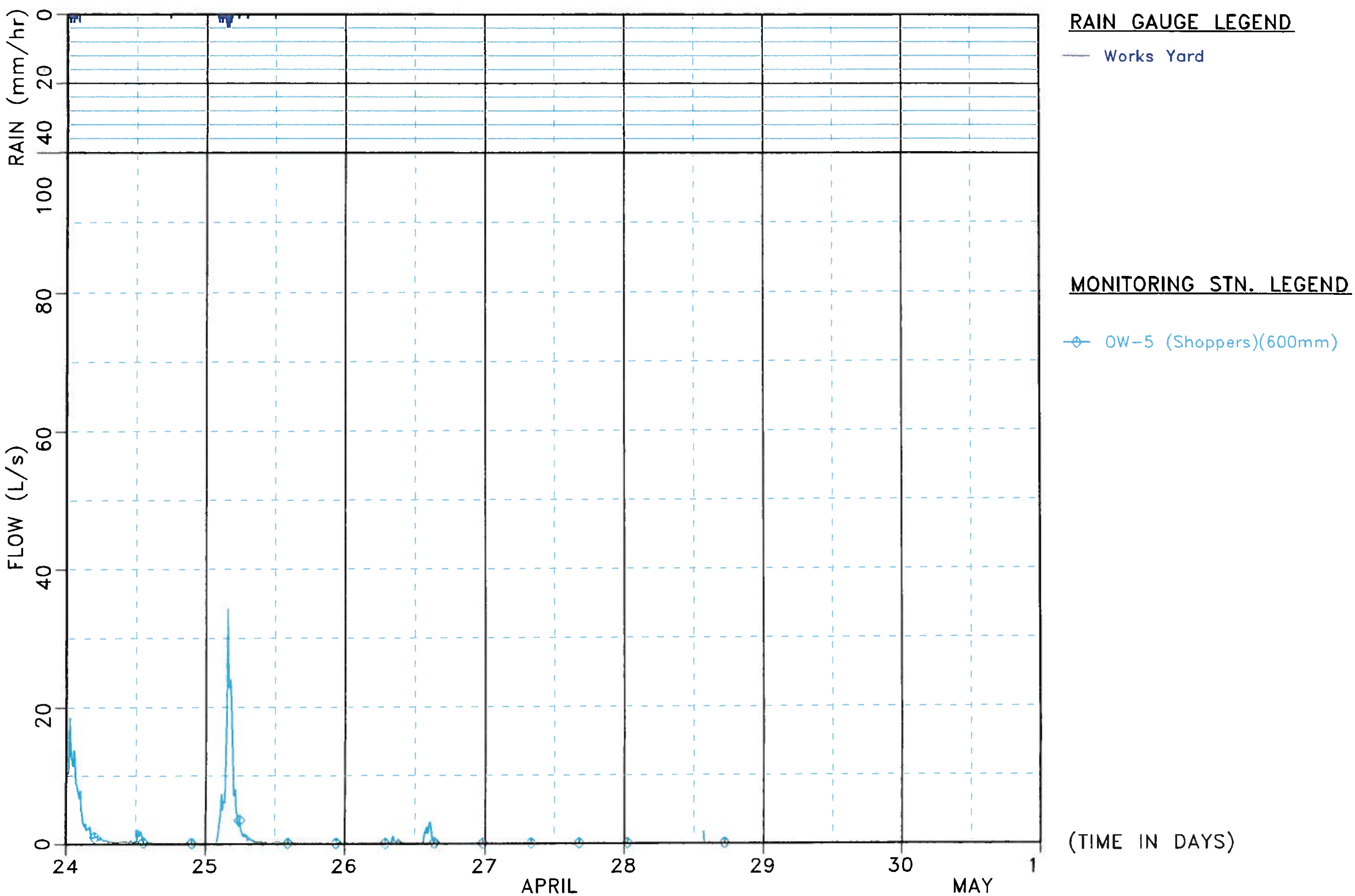
WEEKLY FLOW PLOTS



Owen Sound Storm Sewer Monitoring – 2006
Flow Rates for Period of Apr. 17 – Apr. 23 (Monday–Sunday)
RAIN (mm/hr)
0
20
40
100
80
60
40
20
0
FLOW (L/s)
17
18
19
20
21
22
23
24
APRIL
(TIME IN DAYS)
RAIN GAUGE LEGEND
Works Yard
MONITORING STN. LEGEND
OW-5 (Shoppers)(600mm)

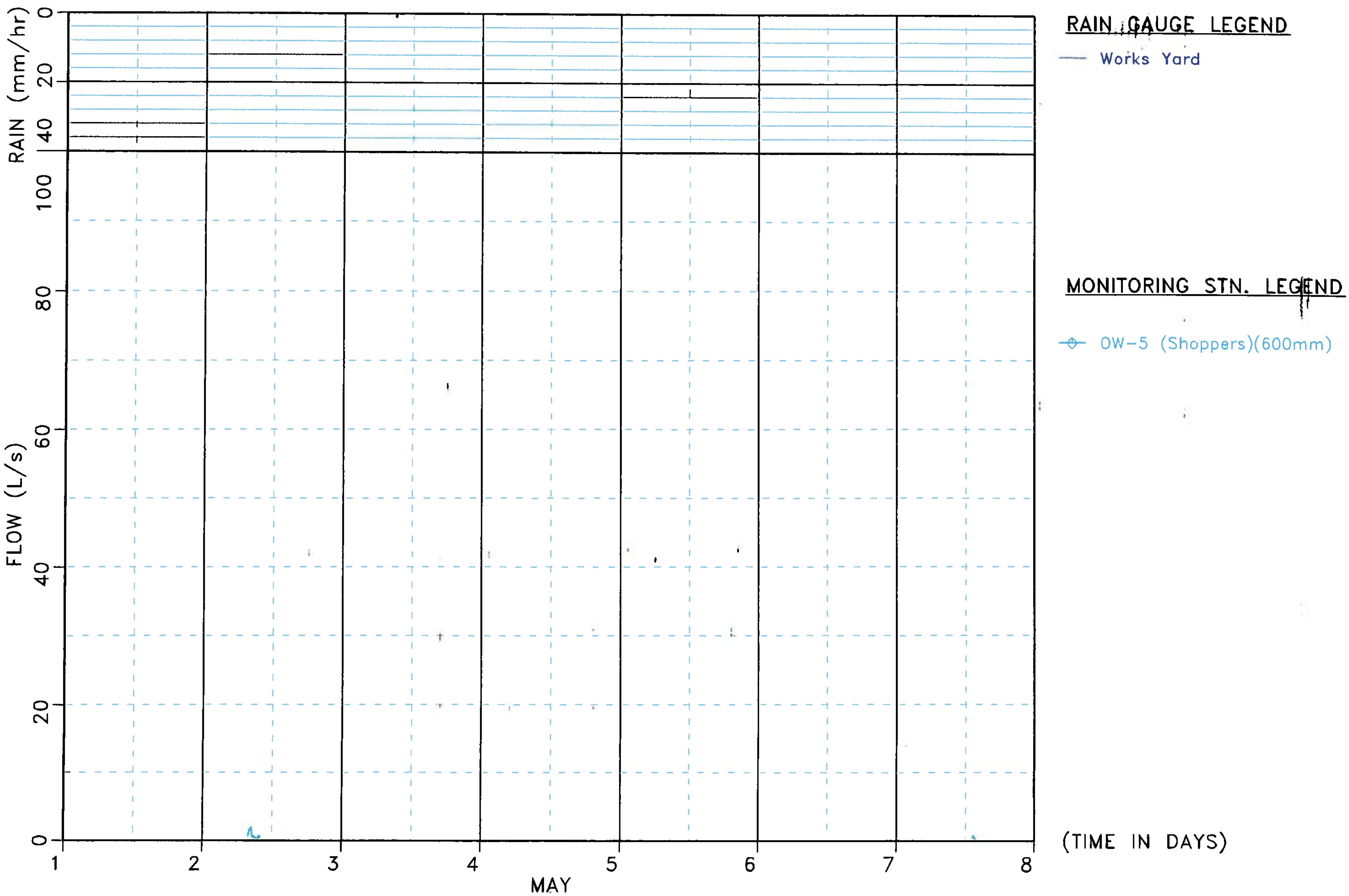
Owen Sound Storm Sewer Monitoring – 2006

Flow Rates for Period of Apr. 24 – Apr. 30 (Monday–Sunday)



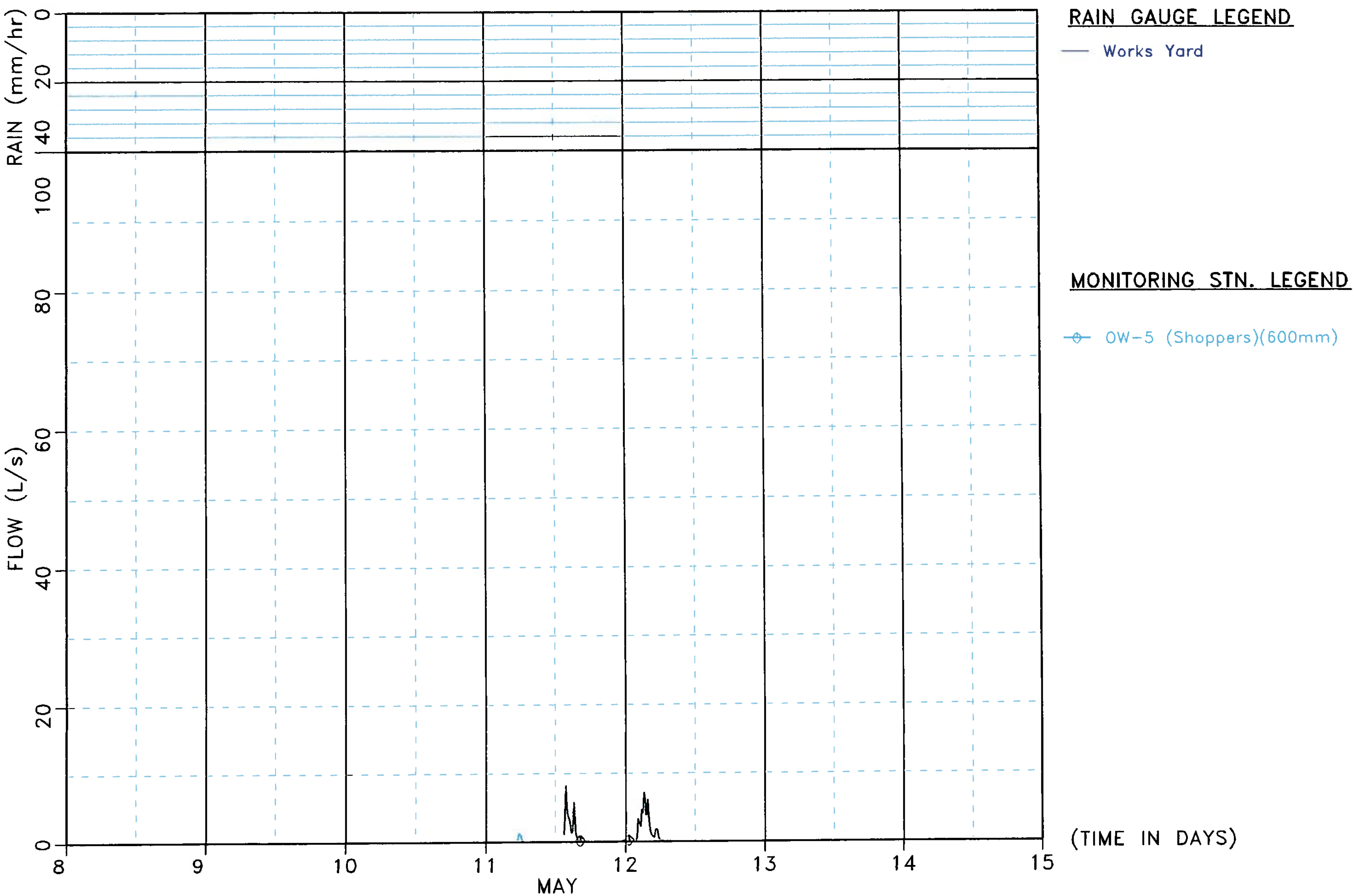
Owen Sound Storm Sewer Monitoring – 2006

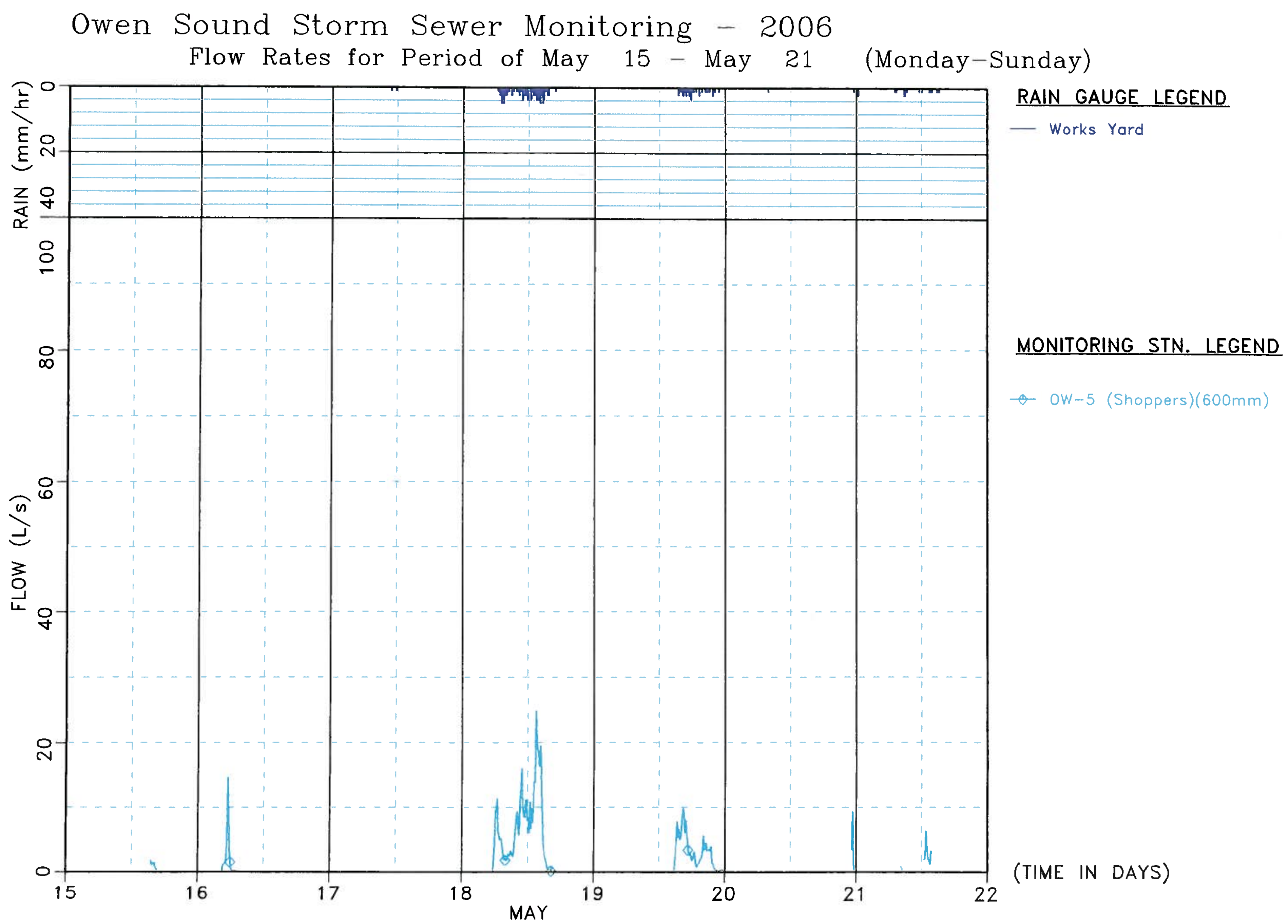
Flow Rates for Period of May 1 – May 7 (Monday–Sunday)



Owen Sound Storm Sewer Monitoring – 2006

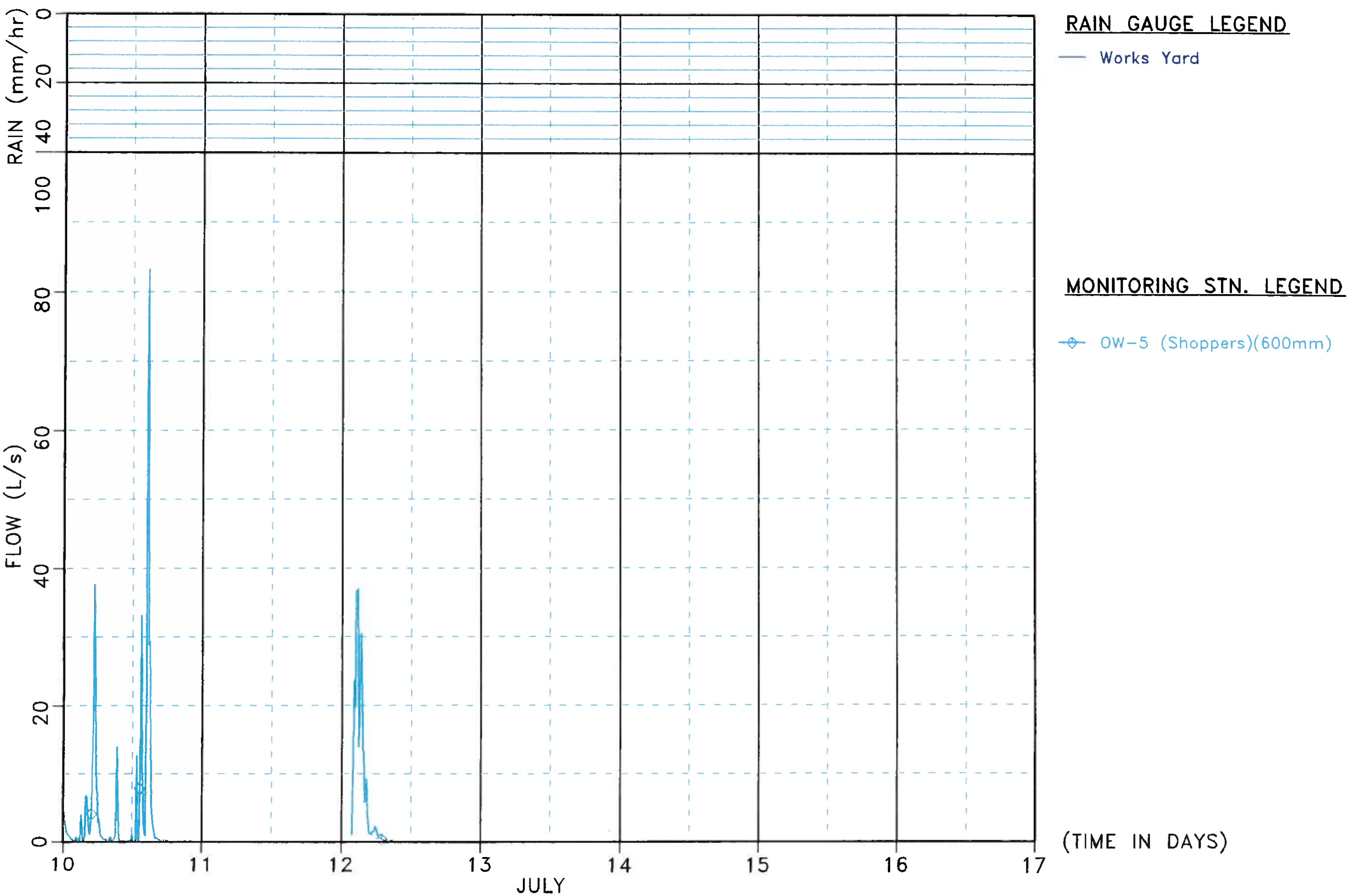
Flow Rates for Period of May 8 – May 14 (Monday–Sunday)




Owen Sound Storm Sewer Monitoring – 2006
Flow Rates for Period of May 15 – May 21 (Monday–Sunday)
RAIN (mm/hr)
0
20
40
FLOW (L/s)
100
80
60
40
20
0
15
16
17
18
19
20
21
22
MAY
(TIME IN DAYS)
RAIN GAUGE LEGEND
Works Yard
MONITORING STN. LEGEND
OW–5 (Shoppers)(600mm)

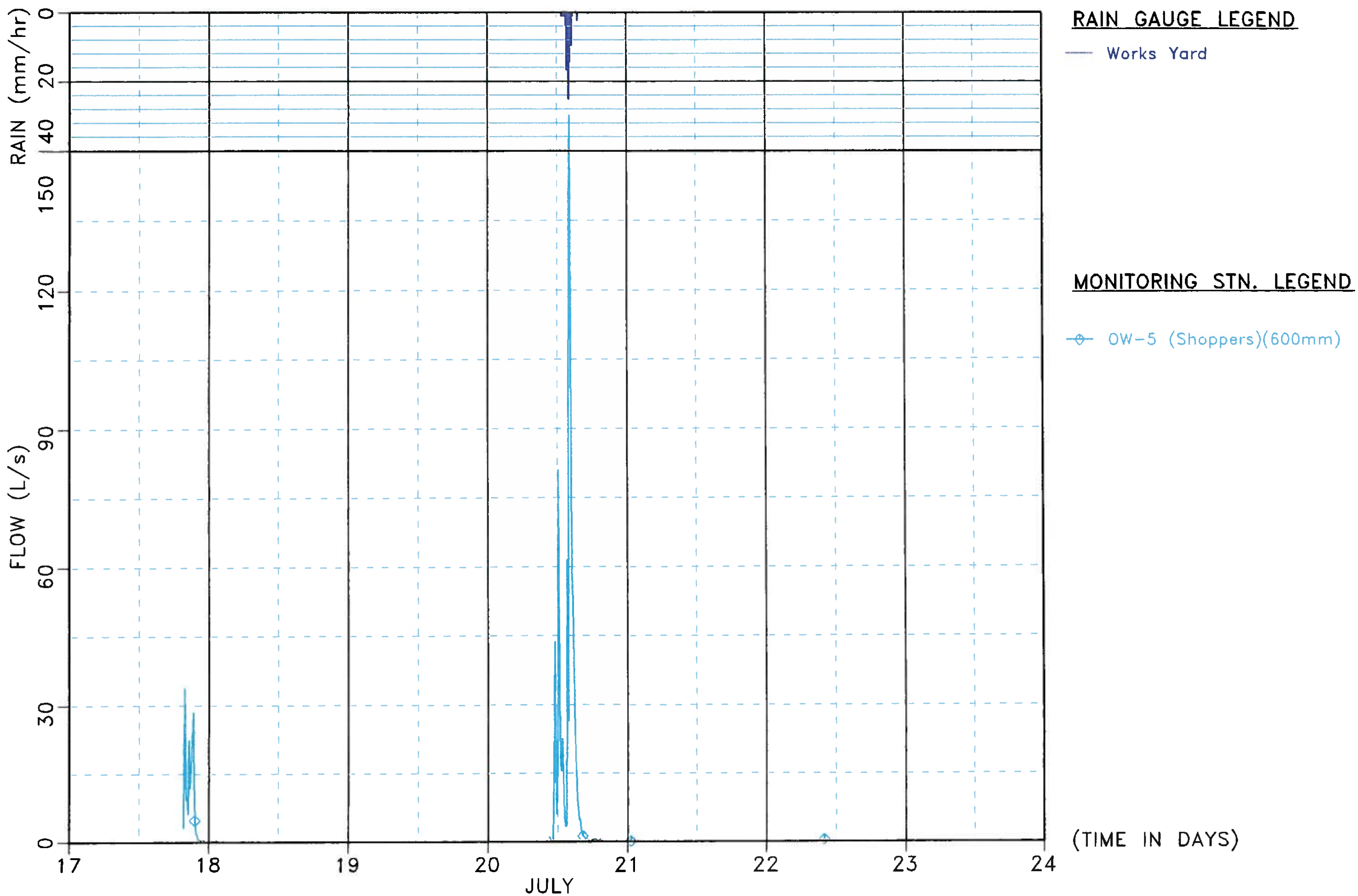
Owen Sound Storm Sewer Monitoring – 2006

Flow Rates for Period of July 10 – July 16 (Monday–Sunday)



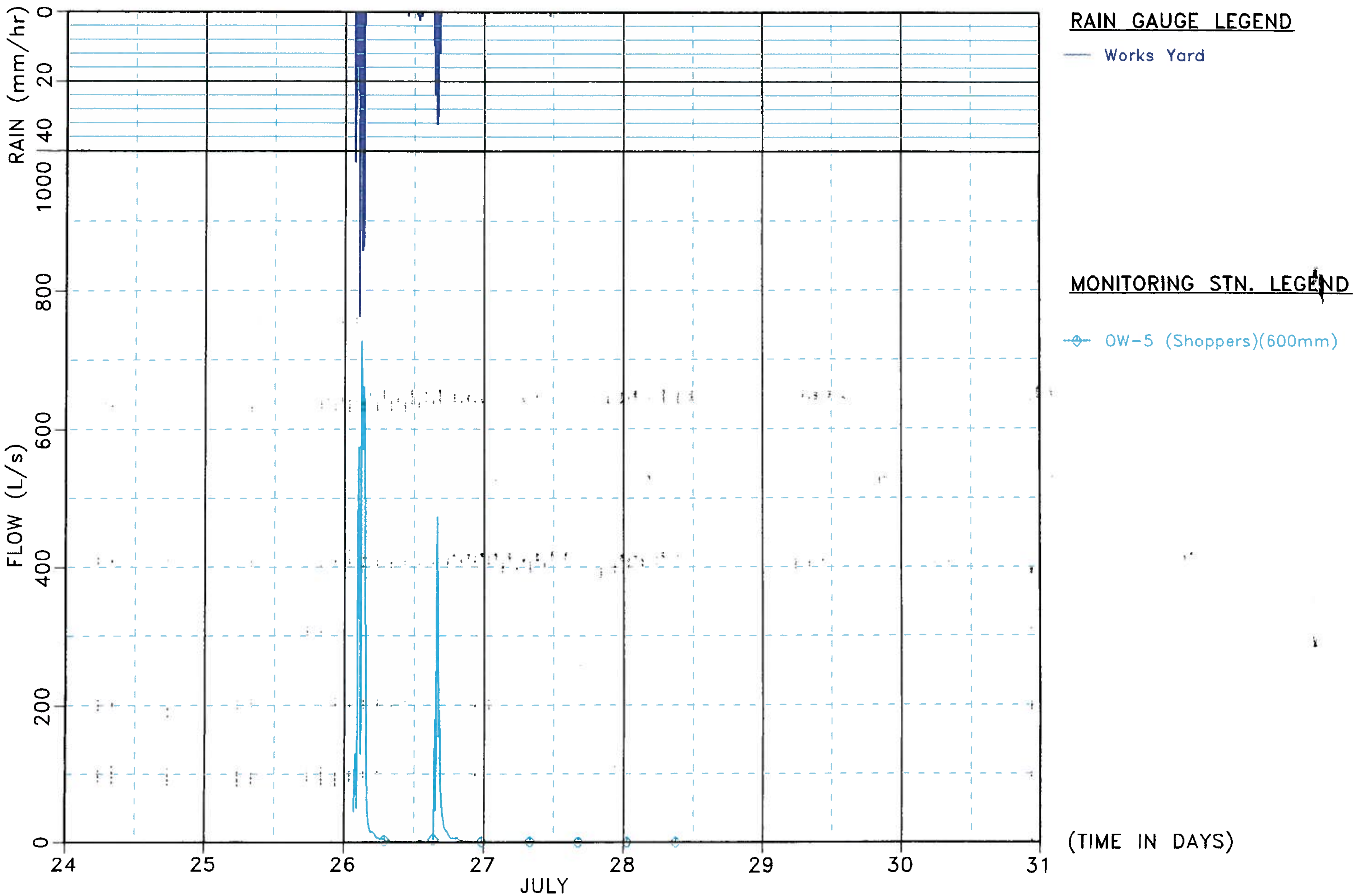
Owen Sound Storm Sewer Monitoring – 2006

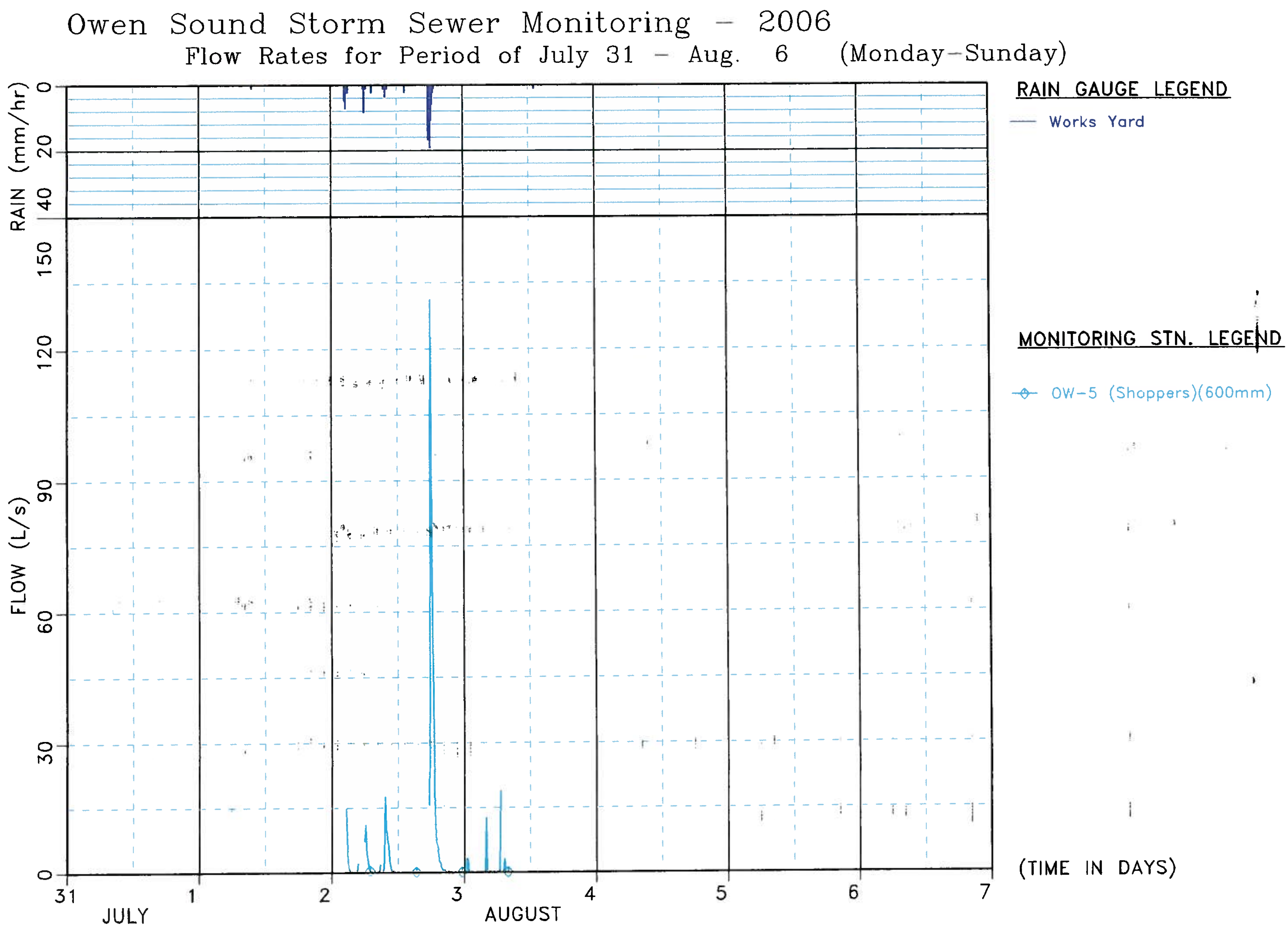
Flow Rates for Period of July 17 – July 23 (Monday–Sunday)



Owen Sound Storm Sewer Monitoring – 2006

Flow Rates for Period of July 24 – July 30 (Monday–Sunday)

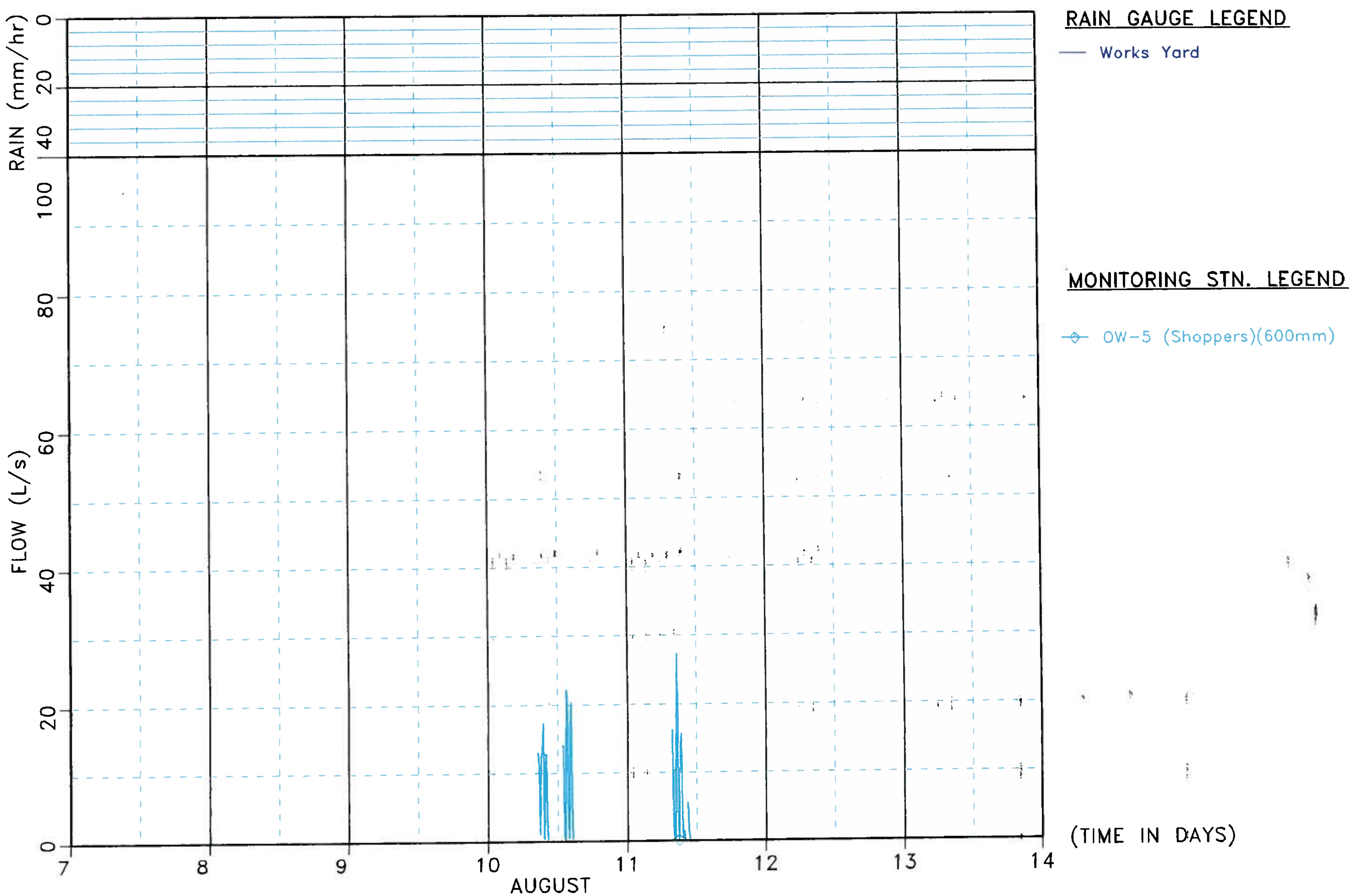




Owen Sound Storm Sewer Monitoring – 2006
Flow Rates for Period of July 31 – Aug. 6 (Monday–Sunday)
RAIN (mm/hr)
0
20
40
FLOW (L/s)
150
120
90
60
30
0
31
1
2
3
4
5
6
7
JULY
AUGUST
(TIME IN DAYS)
RAIN GAUGE LEGEND
Works Yard
MONITORING STN. LEGEND
OW-5 (Shoppers)(600mm)

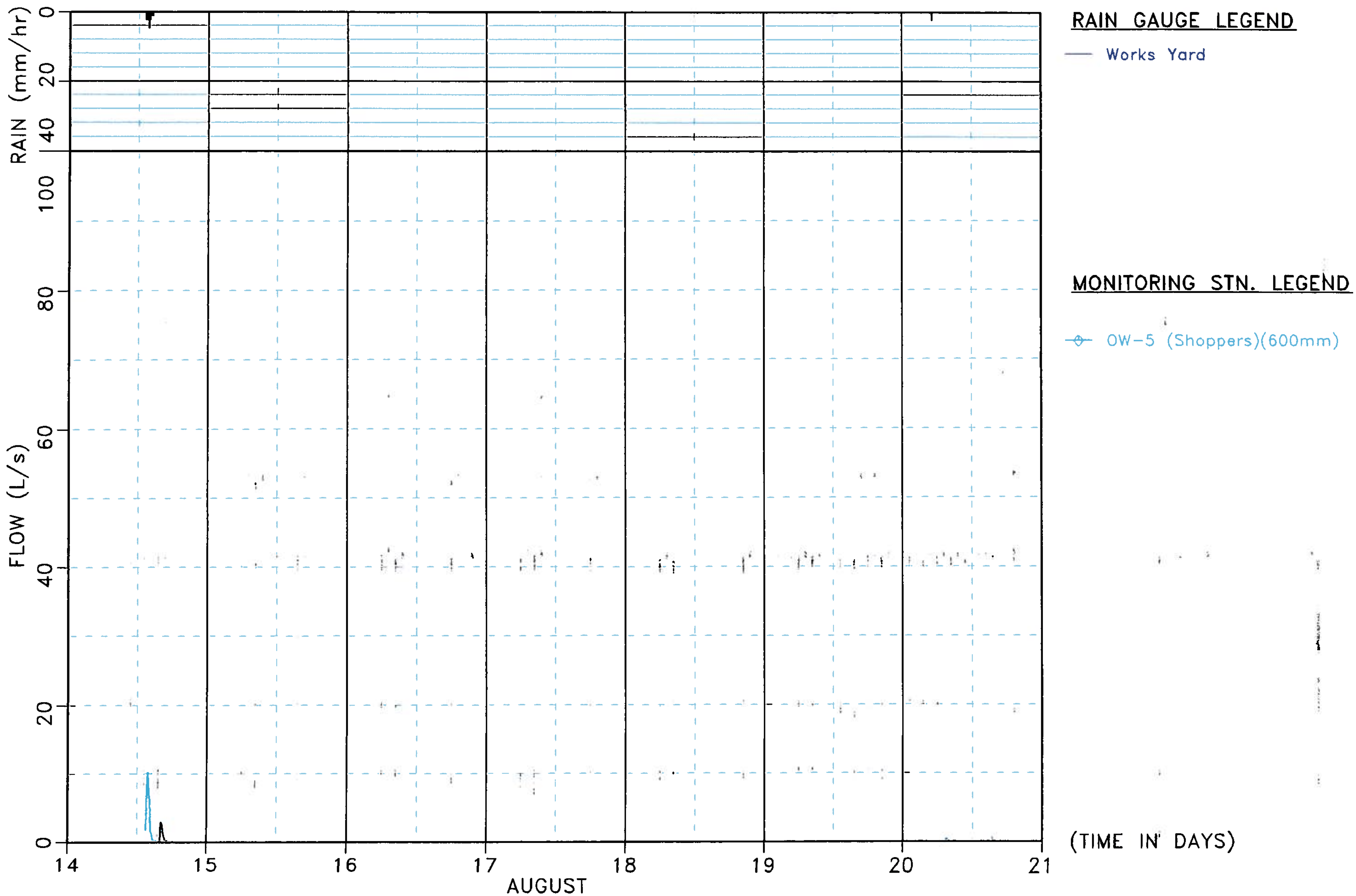
Owen Sound Storm Sewer Monitoring – 2006

Flow Rates for Period of Aug. 7 – Aug. 13 (Monday–Sunday)



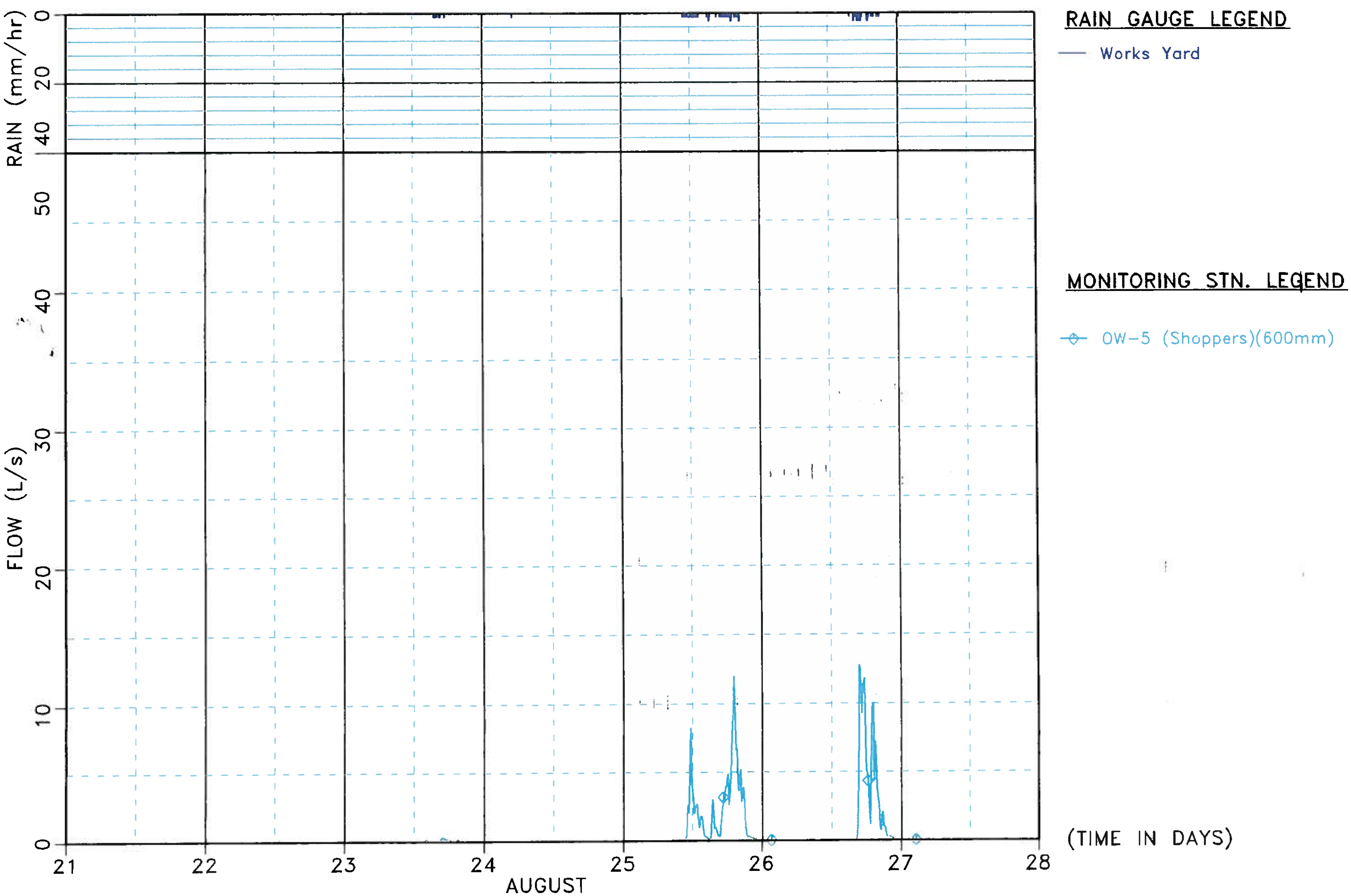
Owen Sound Storm Sewer Monitoring – 2006

Flow Rates for Period of Aug. 14 – Aug. 20 (Monday–Sunday)



Owen Sound Storm Sewer Monitoring – 2006

Flow Rates for Period of Aug. 21 – Aug. 27 (Monday–Sunday)



Owen Sound Storm Sewer Monitoring – 2006

Flow Rates for Period of Aug. 28 – Sept 3 (Monday–Sunday)