March 2009

Sanitary Sewer Evaluation Survey (SSES) Plan

HAMPTON ROADS SANITATION DISTRICT


SANITARY SEWER EVALUATION SURVEY (SSES) PLAN

Prepared for
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LIST OF ACRONYMS

AC	Asbestos Cement
CA	Condiotn Assessment
CCTV	Closed Circuit Television
CIP	Cast Iron Pipe
DEQ	(Virginia) Department of Environmental Quality
DIP	Ductile Iron Pipe
EPA	(United States) Environmental Protection Agency
ESVC	Extra Strength Vitrified Clay
FM	Force Main
HDPE	High Density Polyethylene
MACP	Manhole Assessment and Certification Program
MOM	Management, Operations and Maintenance
PACP	Pipeline Assessment and Certification Program
PCCP	Prestressed Concrete Cylinder Pipe
PE	Polyethylene
PRS	Pressure Reducing Station
PS	Pumping Station
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
RCCP	Reinforced Concrete Cylinder Pipe
RTS	Regional Technical Standards
SCADA	Supervisory Control and Data Acquisition
SP	Steel Pipe
SSO	Sanitary Sewer Overflow
STP	Sewage Treatment Plant
TBD	To Be Determined
VC	Vitrified Clay

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1. INTRODUCTION

The Hampton Roads Sanitation District (HRSD) sanitary sewer system in southeast Virginia includes approximately 430 miles of pressure sewer mains (and associated valves and appurtenances), approximately 50 miles of gravity sewer mains (and associated manholes, siphons, and vaults), and 81 pumping facilities which include 65 wet well pumping stations and 16 pressure reducing stations. The HRSD sanitary sewer system takes pumped flow and gravity flow from surrounding communities and transports the flows to its thirteen sewage treatment plants (STPs). Tables A-1, A-2, and A-3 in Appendix A present an inventory of the HRSD sanitary sewer pipe network and pumping facilities, with sanitary sewer system infrastructure maps included in Appendix A. The information provided in these tables continues to be refined and further developed through field and other activities.

1.1 Purpose of the SSES Plan

The purpose of this report is to develop a Sanitary Sewer Evaluation Survey (SSES) Plan for the Hampton Roads Sanitation District (HRSD) that will meet the requirements established in the regional Special Order by Consent (Consent Order) effective September 26, 2007. This plan will provide methodology for conducting a condition assessment of HRSD's sanitary sewer system that will meet the requirements of the Regional Technical Standards (RTS) which are included as an attachment to the Consent Order.

HRSD will be conducting condition assessments of assets within its sanitary sewer system for the purpose of locating conditions that present a "material risk of failure". For the purposes of this document, "failure" means any condition resulting in a sanitary sewer overflow, pipe leakage, or interruption of service to HRSD's customers, due to a physical condition defect in the system. The goal of the SSES Plan is to develop a working plan and schedule for inspecting, assessing, and prioritizing HRSD's sanitary sewer system assets. The SSES Plan will provide standard methods for evaluating the physical condition of the sanitary sewer assets in order to identify assets that present a "material risk of failure".

As set forth in the Consent Order, SSES planning involves the identification and prioritization of service areas which will require SSES field activities and subsequent analysis. The criteria for identifying SSES Basins are defined in the RTS Section 5.1 as follows:

- Basins with unresolved wet-weather SSOs, except where SSOs have only resulted during rainfall conditions in excess of a 10 year, 24 hour rainfall recurrence interval
- Basins with unresolved SSOs caused by infrastructure defects (i.e., pipe sags, offset joints, broken pipe, etc.)
- Basins exceeding an actual peak flow of 775 gallons per day per equivalent residential unit plus 3 times commercial water consumption plus actual major industrial flows, where this peak flow is estimated to occur during rainfall conditions up to a 10-year, 24-hour rainfall recurrence interval
- Basins served by pump stations that exhibit excessive pump run time

These criteria were developed in the Consent Order as a means to identify portions of the sewer system where field investigations are warranted. These field investigations are intended to evaluate the condition of sewer assets that may contribute to high peak flows and/or sanitary sewer overflows. The HRSD sanitary sewer system is a regional conveyance and transmission system that has limited numbers of directly connected customers. For the most part, connections come from Locality systems or private permitted systems. In addition, HRSD regularly performs inspections of pump stations, gravity sewers, and manholes that it owns; thereby, obviating the need for "identification of SSES Basins." Due to the interconnected nature of the Localities' systems with HRSD's system, there may be information from HRSD's facilities that affects conclusions made about Localities' facilities. Details on pump station run times, sanitary sewer overflows, and high level alarms is provided in Section 2, which will be used by HRSD in prioritization of its SSES Field Activities and shared with the appropriate Localities.

This plan has been structured to outline HRSD's Condition Assessment Program for gravity sewers, force mains, and pumping facilities, while identifying situations that lead to investigative approaches that may vary from approaches used by Localities. An example of this is the limited applicability of smoke testing of the HRSD system due to the large size of the lines and significant flows conveyed by its gravity sewers. This SSES Plan will document the process and procedures that HRSD intends to implement for Condition Assessment of its collection system.

1.2 SSES Plan Approach

The HRSD sanitary sewer system is comprised of five sanitary sewer asset types: force mains, pumping stations, pressure reducing stations, SCADA systems, and gravity systems. The SSES Plan will include condition assessment standards for each of the five sanitary sewer asset types. The approach for conducting the SSES Plan will be organized into three distinct parts that address the asset types as described below:

- **Force Main Condition Assessment** - The force main condition assessment will be conducted in two phases. The first phase will be an initial screening of HRSD force main assets, utilizing selected criteria, to identify segments that require further analysis, and possibly field inspection. Initial screening will be conducted using a desktop Criticality Model which assesses the likelihood and consequence of failure of each force main segment. This information along with previous failure history will be used to identify assets that will be considered to have the **potential** for "material risk of failure," and in the second phase, these assets will undergo further assessment if the assessment is cost effective relative to rehabilitation and/or replacement. If rehabilitation or replacement of a portion of the force main is deemed more cost effective then further condition assessment activities, these activities will be discontinued and the segment will be placed in the Rehabilitation Plan.
- **Pumping Facility Condition Assessment** - The pumping facility condition assessment will include assessment of wet well pumping station assets and pressure reducing station assets within the HRSD system. SCADA assets within the HRSD system will be assessed as part of the Pumping Facility Condition Assessment since these are predominantly located at the pumping facilities. Pumping facilities and critical components that have the **potential** for material risk of failure have been identified in a screening process for prioritization in the assessment schedule.
- **Gravity System Condition Assessment** - The gravity system condition assessment will evaluate the gravity sewer system assets within the HRSD system, including gravity pipeline and manhole assets where accessible. Gravity sewer assets that are at material risk of failure will be identified in a screening process and the existing assessment schedule will be adjusted as needed.

Once the initial screening is completed, HRSD will develop a Preliminary Condition Assessment Report that documents the results of this work and details the SSES Field Activities. Upon completion of field activities, the Final Condition Assessment Report will be developed with a Rehabilitation Plan and schedule. The Rehabilitation Plan will identify specific assets that will be rehabilitated or replaced in order to mitigate the actual material risk of failure. This process is shown in Figure 1-1.

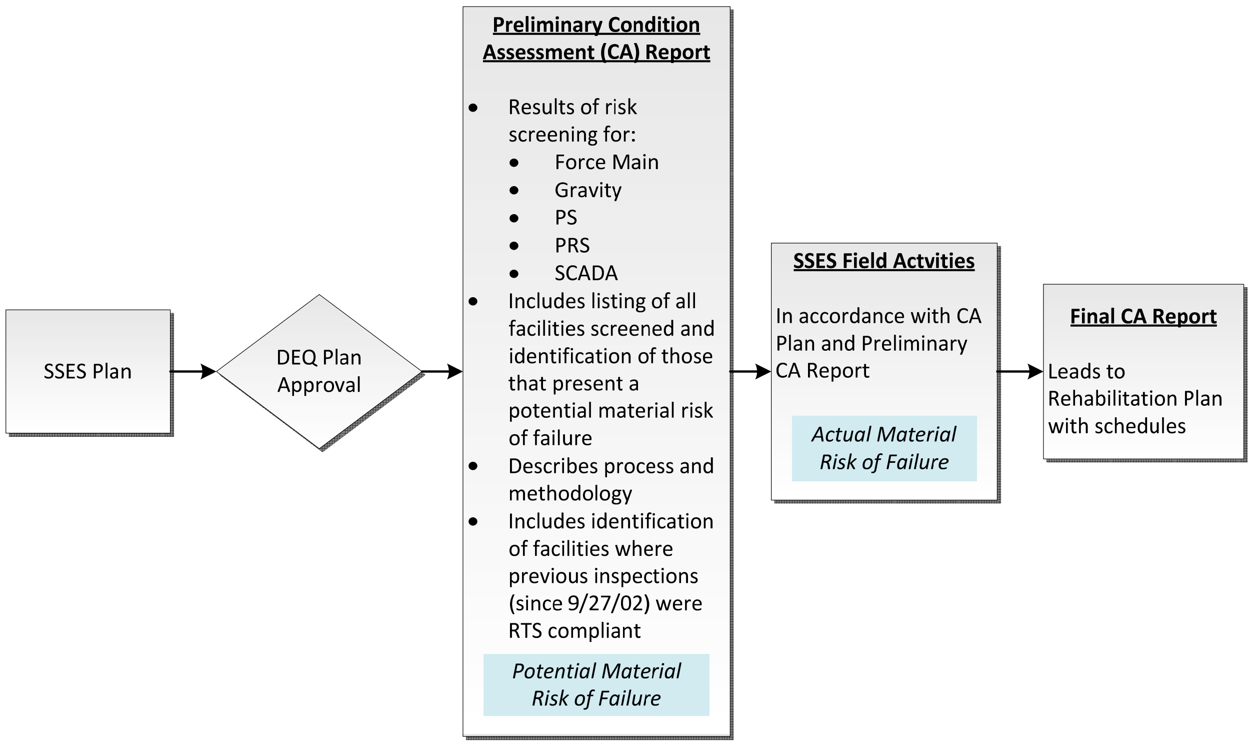

Figure 1-1. SSES Program Phasing

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2. SANITARY SEWER SYSTEM ANALYSIS

HRSD includes Condition Assessment as part of its normal operation and maintenance of the collection system, and has done so since its formation. As part of this SSES Plan, HRSD will research it recent records (within the past 5 years) to obtain pertinent existing inspection reports related to any condition assessment studies that may be useful in the development of the SSES Plan. Regional Technical Standards (RTS) have been developed and are included in the Special Order by Consent dated September 26, 2007, between HRSD, the Virginia State Water Control Board, and thirteen flow contributing Localities, which provide specific details on assessment activities. Areas with prior investigatory work conducted since September 27, 2002, that substantially meets the requirements of the RTS and is adequate to develop rehabilitation measures may be excluded from further condition assessment activities within the SSES Plan; however, the results of that work will be included in the Final Condition Assessment Report.

2.1 Excluded Sanitary Sewer Assets

The Regional Technical Standards (RTS) allows for the exclusion of SSES activities for sanitary sewer infrastructure that is considered to be less critical and where the probability of wet weather SSOs is small. Among the excluded sanitary sewer assets are vacuum sewer systems, sewer assets associated with small pump stations (under 25 gpm) and low pressure force main systems provided there are no unresolved overflows within these systems.

Vacuum Sewer Systems – HSRD operates one vacuum pumping facility (Camden Avenue). Although excluded from the SSES per the RTS, this facility will be evaluated by HRSD.

Small Pump Stations (less than 25 gpm) - The 81 pumping facilities within the HRSD sanitary sewer system collect and distribute much larger flows than 25 gpm (at design pressure). HRSD currently does not own or operate any small pump stations as defined within the RTS.

Low Pressure Force Main Systems - HRSD currently does not own or operate any stand alone low pressure force main systems. Although the pressure force mains within the HRSD system operate at fairly low pressures and velocities, they are not considered low pressure force main systems as defined within the RTS. Therefore, there are no force main assets within the HRSD system that can be excluded from the SSES Plan under this qualifier.

2.2 Review of Historical Records

2.2.1 Review of Available SSES Related Inspections

Research of HRSD's records will be conducted to obtain pertinent existing inspection reports related to any SSES and condition assessment studies that may be useful in the development of the SSES Plan. Per the Consent Order, only SSES and condition assessment work completed within a 5-year period prior to the execution date of the Consent Order (September 26, 2007) is considered relevant. Based on this schedule, SSES-related inspections dating back to September 27, 2002 will be researched to determine their compliance with RTS standards. In accordance with the Consent Order, if documentation of prior investigatory work substantially meets the requirements of the RTS and is adequate to develop rehabilitation measures, the sanitary sewer assets may be excluded from the condition assessment activities within the SSES Plan.

2.2.1.1 Force Main Inspections

HRSD routinely inspects exposed portions of its force main interceptor system as well as assets associated with the force mains within vaults or pits (i.e., in-line valves, pressure control valves, air release valves). These records will be reviewed for applicability with the RTS for exclusion from the SSES Plan. Inspections that meet the criteria will be documented in the Preliminary Condition Assessment Report.

2.2.1.2 Pumping Facility Inspections

HRSD performs routine inspections and preventive maintenance of its pumping facilities; however, additional inspections will be performed at each pumping station and pressure reducing station as part of the SSES field investigations for HRSD's pumping facilities. Particular aspects of HRSD's routine pumping facility inspections (e.g., wet well inspections, generator testing) will be reviewed for applicability with the RTS for exclusion from the SSES Plan. The HRSD SCADA system exists for the most part at HRSD pumping facility sites. These systems have been inspected routinely by HRSD staff including alarm testing and wiring assessments. This data will be reviewed for applicability with the RTS for exclusion from the SSES Plan. Inspections that meet the criteria will be documented in the Preliminary Condition Assessment Report.

2.2.1.3 Gravity Sewer Inspections

HRSD routinely performs internal inspection of nearly every segment of gravity sewer within its system, including manhole inspections. Mainline inspection using CCTV has been completed using the NASSCO Pipeline Assessment and Certification Program (PACP) to provide standardization and consistency in the evaluation of sewer pipe condition. PACP trained and certified staff have been using PACP compliant software since September 2005. This data will be reviewed for applicability with the RTS for exclusion from the SSES Field Activities. HRSD has also implemented a NASSCO Manhole Assessment and Certification Program (MACP); however, most existing manhole inspections were completed prior to MACP implementation and will not meet the requirements of the RTS. Inspections that meet the criteria will be documented in the Preliminary Condition Assessment Report.

2.2.2 Summary of Past Sanitary Sewer Rehabilitation Efforts

For the purpose of the SSES Plan, HRSD's rehabilitations of the sanitary sewer system since September 27, 2002 will be reviewed. In addition, facilities constructed since September 27, 2002 will be identified. As set forth in the RTS, these assets may be excluded from the SSES Plan. Rehabilitation efforts that meet the criteria of the RTS and recently constructed facilities will be documented in the Preliminary Condition Assessment Report.

2.3 Analysis of Sanitary Sewer System Data

HRSD collects various operations data from its collection system at numerous locations including flow measurements, pump station run time, pump station high level alarms, sanitary sewer overflow data. This data is available upon request from the Localities, and data specifically identified in this SSES Plan will be shared with the associated Localities. HRSD continues to expand its network of flow, pressure, and rainfall monitoring sites, and the Localities have been provided web access to HRSD's Telog server which houses the data. The following sections detail HRSD's analysis of data collected on these items.

2.3.1 Sanitary Sewer Overflow (SSO) Analysis

The RTS defines SSOs as "the unauthorized intentional or unintentional spill, release, or discharge to waters of the State of untreated wastewater from any portion of a sanitary sewer system before the headworks of a Wastewater Treatment Facility". As part of the Consent Order requirements, all recorded unresolved SSOs must be identified and addressed in order to avoid potential reoccurrences.

HRSD compiled a list of all recorded SSOs from October 2002 to December 2008 in a GIS geodatabase. Based on the SSO database, there were slightly more than 250 recorded SSOs from HRSD's facilities since early October 2002. The SSO database was sorted into three distinct infrastructure asset groups: force mains, pumping facilities, and gravity sewers. Table C-1 in Appendix C lists the SSOs that have appear to be associated with an HRSD pumping facility in this time period. Similar documentation will be provided for the gravity sewer and force main system in the Preliminary Condition Assessment Report. Table C-2 narrows the list of SSO occurrences by eliminating those caused by major storms (those associated with LOP exclusion), operator error, or third party action. This information is used in the screening and prioritization of Section 3.

2.3.2 Pump Run Time Analysis

2.3.2.1 Objective

This section discusses the methods for identifying pump stations that trigger the Excessive Pump Run Time threshold defined in the RTS. The 81 pumping facilities within HRSD's sanitary sewer system include 65 wet well pump stations and 16 pressure reducing stations (PRSs). The pump run time threshold analysis was conducted only for the 65 wet well pumping facilities, and all 16 PRSs were excluded from the analysis since they are in-line pumping stations. Of the 65 wet well pump stations, 23 are pumped at variable speeds, either through Variable Frequency Drives (VFD) or through Flomatcher systems. Variable speed pumping stations are typically excluded from the run time threshold analysis under RTS requirements, unless the pumps are operating at full speed. Since a large percentage of HRSD's wet well pump stations are variable speed stations, these 23 pumping stations were compared to the Excessive Pump Run Time threshold to provide a more complete representation of the HRSD sanitary sewer system.

Section 2.3.2.3 shows which pumping stations assets have exceeded the Excessive Pump Run Time threshold. This information will be used in the screening and prioritization of Section 3.

2.3.2.2 Methodology

The equation given in Section 2 of the RTS was used to determine which pump stations trigger the Excessive Pump Run Time threshold. The analysis was applied to every wet well pump station in the HRSD sanitary sewer system (including variable speed stations). Excessive Pump Run Time can be identified by evaluating the daily total run time for all pumps within a pump station under wet weather/peak flow conditions. Excessive Pump Run Time exists when the total run time for all pumps within a pump station exceeds an average of 24 hours per day for a two-pump station, 48 hours for a three-pump station, or 72 hours for a four-pump station. DEQ regulations state that pump stations shall be able to handle flows received with the largest capacity pump out of service. If a pump station exceeds the Excessive Pump Run Time threshold (either 24, 48, or 72 hours per day) with all pumps operational, there is an increased risk of a potential SSO should one pump be out of service while experiencing the same amount of flow. This threshold was calculated using the following equation:

Excessive Pump Run Time threshold = [(Number of Pumps)-1] x 24 hours

Excel with Visual Basic was used as the platform for performing this analysis. Hourly pump run time data, spanning from 04/01/08 to 01/28/09, was used as the dataset for this analysis. The data set used included all run-time data available at the time of the analysis. Visual basic code evaluated every 24-hour time period within the dataset, and reported the peak run time events for each pump station. In order to successfully capture all Excessive Pump Run Time periods, each 24-hour period was evaluated at each one hour increment. This approach allows for identification of excessive run times that may span from one day to the next day. This procedure is performed for every hour for the entire data set in order to evaluate run time threshold exceedance. Peak events that exceeded the run time threshold were reported as well as the maximum 24-hour total that exceeded the Excessive Pump Run Time threshold.

2.3.2.3 Results

Excessive Pump Run Time results were split into two categories: wet well pump stations containing constant speed pumps only, and wet well pump stations with VFDs or pumps with Flomatcher controls. The results for these two categories are depicted in Tables 2-1 and Table 2-2, respectively.

As a result of the way variable speed pumping stations operate, the threshold is not as clear as for the constant speed pumping stations; however, the data is provided in Table 2-2.

Table 2-1. Excessive Pump Run Time Analysis - Constant Speed Pumps

Pump Station No.	Pump Station Name	No. of Pumps	Excessive Pump Run Time Threshold (hrs)	Maximum Period of Total Pump Run Time (hrs)	Time Stamp of Peak Occurrence	Comments
NORTH SHORE						
219	Newmarket	3	48	53	4/21/2008 15:00	Peak occurrence is associated with wet weather event on 4/21/08
SOUTH SHORE						
102	Ashland Circle	2	24	28	8/10/2008 10:00	Also, long pump runs in early-July 2008
109	Dozier's Corner	2	24	41	12/11/2008 12:00	Peak occurrence is associated with wet weather event on 12/11/08
119	Park Avenue	2	24	25	12/11/2008 16:00	Peak occurrence is associated with wet weather event on 12/11/08
147	Chesterfield Blvd	2	24	32	12/11/2008 4:00	Peak occurrence is associated with wet weather event on 12/11/08

Table 2-2. Excessive Pump Run Time Analysis - VFD or Flomatcher Controls						
Pump Station No.	Pump Station Name	No. of Pumps	Excessive Pump Run Time Threshold (hrs)	Excessive Run Time Calculation (hrs)	Time Stamp of Peak Occurrence	Comments
NORTH SHORE						
217	Langley Circle	3	48	60	4/22/2008 10:00	Peak occurrence is associated with wet weather event on 4/22/08
218	Morrison	2	24	32	12/11/2008 3:00	Peak occurrence is associated with wet weather event on 12/11/08
221	Patrick Henry	2	24	28	12/11/2008 8:00	Peak occurrence is associated with wet weather event on 12/11/08
225	Willard Ave	3	48	58	12/11/2008 14:00	Peak occurrence is associated with wet weather event on 12/11/08
231	Ford's Colony	2	24	35	12/11/2008 13:00	Peak occurrence is associated with wet weather event on 12/11/08
232	Greensprings	2	24	30	4/21/2008 13:00	Peak occurrence is associated with wet weather event on 4/22/08
SOUTH SHORE						
116	Norchester Street	2	24	34	9/24/2008 23:00	Peak occurrence is associated with wet weather event on 9/25/08
135	Suffolk	2	24	48	4/22/2008 9:00	Peak occurrence is associated with wet weather event on 4/22/08
145	Rodman Avenue	3	48	63	12/11/2008 12:00	Peak occurrence is associated with wet weather event on 12/11/08
146	Camden Avenue	3	48	69	12/11/2008 19:00	Peak occurrence is associated with wet weather event on 12/11/08

NOTE: Information on excessive pump run time for variable speed pumps is provided for consideration only and should not be viewed as fitting the RTS definition.

2.3.3 Pump Station Wet Well Levels

Data was analyzed for the 65 wet well pump stations within the HRSD sanitary sewer in order to determine which pump stations have a recorded history of high level alarms. The data set used for this analysis spanned over an 8-month period from 04/01/08 to 12/15/08 in hourly increments. It should be noted that there were data gaps in the SCADA database for the following dates: 7/1/08, 7/31/08 through 8/11/08, 9/30/08, and 12/31/08. The Pine Chapel pump station was excluded from the high level alarm analysis since this station is no longer in service.

A pump station was labeled as having a recorded high level alarm for a specific calendar day if the pump station SCADA system recorded at least one high level alarm between midnight and the following midnight on that particular calendar day. Table C-3 in Appendix C lists the wet well pump stations which had recorded high level alarms that were not caused by operational procedures such as preventative maintenance execution and alarm testing. This table displays the number days that a legitimate high level alarm was recorded, as well as the date that the high level alarm occurred. An alarm was considered legitimate if it was not determined to be a test alarm, low level alarm, or caused by maintenance activities at the pumping station. This information is used in the screening and prioritization of Section 3.

2.3.4 Infiltration/Inflow Hydrographs

HRSD is a regional service provider that conveys wastewater flows from the Localities' systems with a relatively small amount of gravity sewer pipelines compared to its extensive force main network. As further described in this document, HRSD maintains an on-going program of gravity sewer inspection to identify defects in this limited gravity sewer system.

To collect data for development and calibration of the Regional Hydraulic Model, HRSD installed gravity sewer flow monitors in 2008 to measure flows in its significant gravity sewer lines. In practice, HRSD intends to build the Regional Hydraulic Model based on the input flows from the Localities contributing flow in the system, and use the results of the gravity sewer flow monitoring to provide additional model calibration data. Only areas where HRSD owned a significant amount of gravity sewer upstream of its pumping station were considered for gravity flow monitoring.

Appendix C includes hydrographs from each of the gravity sewer flow monitors documenting the peak flow event for each site and the date periods vary per site. The actual flow values for each site have been fitted to a simple hydrologic model to represent the average flow pattern and match the peak wet weather flow. This is shown as the light blue Total Flow line in the graphs. The modeled Base Flow (the brown line) includes Base Sewage Flow and Dry Weather Infiltration. The rainfall amounts are shown inverted on a secondary Y-axis for each graph. By subtracting the Total Flow (light blue) from the Base Flow (brown), the rainfall dependent infiltration/inflow value has been calculated as shown in the dark blue line.

Table C-6 in Appendix C lists the rain event associated with each I/I Hydrograph presented. To show the rainfall derived I/I at each site, the most significant peak flow was selected from the available data, and as such, not all hydrographs present the date period where the largest amount of rain fell. For example, Site 26 received a 1 year rain event on September 26, 2008, however, the December 11, 2008, hydrograph (less than a 1 year event) presented the highest peak flow from the available flow monitoring data.

HRSD is building its Regional Hydraulic Model using inputs from the Localities' hydrologic models. Per the Consent Order, the Localities are required to develop model inputs to HRSD's model using hydrologic methods. As such, HRSD will not be building separate hydrologic models for the downstream collection point of these Locality inputs. The I/I Hydrographs discussed in this section have been developed based on raw flow monitoring data and will be used to develop the Regional Hydraulic Model. No comparison has been made between the flow monitoring data collected and the Peak Flow Threshold, as this is the responsibility of the Localities.

3. SSES SCREENING AND PRIORITIZATION

As discussed in Section 1, this SSES Plan is structured to outline HRSD's Condition Assessment Program for force mains, pumping facilities, and gravity sewers. Specific SSES Basins have not been identified as part of the SSES Plan as HRSD is proposing a comprehensive investigation program for pumping facilities and gravity sewers and a risk-based assessment for force mains. SSES field investigations will be performed on HRSD's sanitary sewer assets to provide an appropriate level of system information to support sound rehabilitation and/or replacement decisions.

HRSD will use a screening process in two ways: to prioritize gravity sewer and pumping facility inspection, and to identify and prioritize force main segments for field investigation that have the potential for material risk of failure.

The first steps in the Condition Assessment process will be a screening of HRSD assets to identify those at **potential** material risk of failure.

3.1 Material Risk of Failure

The term "material risk of failure" is used throughout this document, although it is relatively uncommon in the industry. HRSD has interpreted this terminology as applying to assets that have a high potential for failure based on condition assessments performed. Failure is understood to imply any condition related event that results in a sanitary sewer overflow, pipe leakage, or interruption of service to HRSD's customers.

Prior to SSES Field Activities, the screening process described in this section will identify assets with the potential to be at material risk of failure. For the purposes of this SSES Plan, material risk of failure will focus on physical condition defects that could lead to failure, rather than capacity limitations. An assessment of capacity will be completed in a separate evaluation which includes flow monitoring and development of a hydraulic system model.

3.2 Force Main Screening

The HRSD system of Force Main Interceptors is comprised of more than 430 miles of pipes ranging from 6-inch to 60-inch. The physical inspection of every HRSD force main offers several challenges, is impractical, and wastes resources. The force mains are buried and difficult to access, the mains can not be taken out of service for long periods of time due to the numerous connections from Locality pumping stations, they are difficult to dewater and they are constructed of a variety of materials each of which may require different testing methods. Development of inspection technologies for pressure mains in the sewer industry has been underway for some time and, although there are a number of technologies available, most of these technologies are relatively new and some are very new.

In traditional force main systems, the pipeline begins at a pumping station and connects directly to a downstream manhole or treatment plant headworks. These types of pressure mains are easily isolated allowing for more flexibility in assessment approaches. The HRSD force main system is far more complex, with many interconnections and multiple beginning and end points. Therefore, it has been determined that a screening process will be implemented to identify those force main segments having the **potential** for material risk of failure.

HRSD's force main screening is based on a criticality (risk) framework that will be applied to identify which segments of force mains within HRSD's wastewater collection system have the potential for material risk of failure and will need to be further evaluated and possibly field inspected. Criticality is evaluated in objective fashion using available data sources. In establishing risk, the analysis considers a variety of data from two perspectives; first, what is the **likelihood** of a particular failure to occur and second, what are the **consequences** if that failure does occur.

3.2.1 Segmentation

The first task to be undertaken in the Force Main Screening Phase is the identification and delineation of the discrete force main segments to be assessed. The purpose of the segmentation is to ensure that the Condition Assessment is performed on discrete, identifiable segments which are uniform in terms of their characteristics.

The primary sources of data for the force main segmentation effort are the HRSD Geographic Information System (GIS) and the electronic files of record drawings maintained by HRSD. These data included plans and profiles from original construction contract record drawing sets and valve guides for specific inline valves, air release valves (ARV's) and force main junctions.

The intent of the segmentation process is to assist in the development of the criticality model and to facilitate the actual field inspection of the force mains. This is necessary since the HRSD force main system is highly complex and interconnected, with many changes in material and diameter. The force main segmentation criteria are planned as follows:

- A maximum length of 5,000 feet. This was based on the maximum continuous length which can typically be inspected on a single equipment insertion.
- Consistent pipeline material. Since many inspection technologies are designed for specific pipe materials, each segment must be consistent in material type in order to facilitate inspection.
- Consistent pipeline diameter. Some inspection technologies are limited to certain pipe size ranges so each segment must be consistent in diameter. In addition, the size of the force main will have an impact on the evaluation of the consequences of a failure, with larger mains posing a greater risk.
- Between line valves. With few exceptions, internal inspection equipment can not negotiate many line valves. This criterion also applies to line valves at junctions of force mains.

Each of the HRSD Force Main Lines listed in Table A-1 of Appendix A will be segmented according to these criteria. An initial pilot test indicated that this approach to segment the lines was effective as long as the changes in pipe material type or diameter were significant changes (at least 2 pipe sizes), and not, for instance, short runs of pipe installed as point repairs. For instance, one joint length of ductile iron pipe that was used to repair a cast iron force main would not be considered a separate segment. In contrast, a short section of ductile iron pipe installed under a waterway within a longer PCCP main, for example, would be considered a significant change in material because of the significant change in installation conditions and would be identified as a separate segment for assessment.

The segment data will be maintained in a GIS database specifically set up for this work. Each segment will be given a unique identifier based on the tributary area, North or South Shore and a four digit segment number. The segment numbering will begin at the tributary area treatment facility and generally work its way upstream. As an example, the first force main segment discharging to the Nansemond STP would be given the identifier of "NA-SS-0001". Once this segment is established and identified by its end points, the attribute data would be added to the database.

3.2.2 Failure History and Likelihood of Failure

The RTS indicate that force main condition assessments should be performed where there is a history of failures. HRSD maintains a data set of all force main failures in the system extending back through 1989. An initial review of failure records and the spatial distribution of failed segments did not reveal any clear factor or combination of factors as being a consistent cause of the failures, or indicating a parameter that would increase the likelihood of failure. Pipe age, material, number of connections, and gas venting records have been reviewed for correlation with force main failures. Rather it appears to be a mix of factors that has changed somewhat with time as old materials are phased out, new materials are introduced and as operational practices are initiated, expanded or improved. The failures are distributed throughout the North Shore and South Shore service areas with no clear concentrations which could be attributed to soils, groundwater, elevation or history of urban development. Therefore, the previous occurrence of a failure will be used as the indicator of the potential for future failures, consistent with the RTS.

3.2.3 Consequence of Failure

To quantitatively compare the HRSD force main segments to each other, a model will be developed to determine the consequence of failure for each segment. The rankings are developed using a numerical scoring system. The approach consists of the following steps:

- Identify the criteria for assessing the consequences of failure. Criteria that may be evaluated for consequence of failure include: pipe diameter, proximity to state waters, proximity to public drinking water supply, and difficulty/cost to repair or replace.
- For each criterion, identify a range of parameters or measures and assign values covering the range of parameters.
- Assign a weighting factor to each criterion. The weighting helps characterize the criteria that are more important than others in defining risk.
- Evaluate the ranking of each force main segment for each criterion based on field staff observations.
- Calculate the criterion score for each force main by multiplying the criterion value times the criterion weight.
- The total score for each force main is calculated as the sum of all the weighted criterion scores for the consequences of failure.
- The ranking of the force main segments is then based on the ranking of the scores, with the highest score representing the force main segment with the highest consequence of failure.

Table 3-1. Summary of Force Main Scoring Criteria

SCORING CRITERIA	RANGE OF VALUES	CRITERIA WEIGHT	MAX SCORE
Consequence of Failure			
1. Pipe Diameter	1,5 or 10	10	100
2. Proximity to State Waters	2,4,6,8 or 10	9	90
3. Likelihood of Discharge to Water Supply	0,5 or 10	10	100
4. Difficulty of Repair – Depth or location	1,5 or 10	8	80
5. Difficulty of Repair – Material Type	2 or 10	5	50
Maximum Consequence of Failure Score			420

See Appendix C for detailed description of the range of values for each scoring criteria.

Screening Approach

Based on the preliminary failure history review, HRSD will base its determination of force main segments having the **potential** for material risk of failure using a set of criteria listed below:

- Force main segments which have a recorded failure during the previous ten years (1999 though 2008). These segments present the highest potential risk for additional failures.
- Of the segments that have had a failure in the previous records (from 1989 through 1998), the consequence of failure will be evaluated. The consequence of failure scores from the criticality analysis ranged up to 420, as illustrated in Table 3.1. For this analysis, segments with a consequence of failure score of 200 or greater, that have had a failure from 1989 through 1998, will be included in the Condition Assessment Activities.

The above process will identify all force main segments which have the **potential** for material risk of failure. Any of the identified force main segments that are already scheduled for repair, replacement or rehabilitation in HRSD's Capital Improvement Program will be removed from the list. Inspection will not be needed since those segments are already scheduled for improvement.

Once identified during the screening process, the segments which are not in the Capital Improvement Program will be prioritized during working sessions with HRSD field and operations staff familiar with each segment. The purpose of these work sessions will be to tap the 'institutional knowledge' of the HRSD staff to identify those segments with the most severe problems. The segments will then be ranked according to the severity of the problems and on their consequence of failure score, as determined by the procedure in Appendix C. The prioritization will be adjusted based on proximity and shut-down sequencing to provide efficiency in completing the field activities. See Section 5 for additional schedule details. The results of the screening, prioritization, and scheduling of force main inspections will be provided in the Preliminary Condition Assessment Report.

3.3 Pump Station and Pressure Reducing Station Screening

3.3.1 Screening Approach

Although HRSD intends to perform condition assessment of each of its pumping facilities, a screening system was developed to prioritize the SSES Field Activities. Each pumping facility was prioritized based on several weighted criteria and relative criticality factors. The rankings were developed using a numerical scoring system. The approach consists of the following steps:

- Identification of the qualifying criteria.
- Assign a weighting factor (score) to each criterion. The weighting factor helps characterize the criterion that is more critical than others.
- For each criterion, identify a range of parameters or measures and assign values covering the range of parameters.
- Calculate the criterion score for each pumping facility by multiplying the criterion ranking times the criterion weight.
- The total score for each facility is calculated using the following formula:

$$\text{Criteria Weighted Ranking} = \frac{(\text{No. of Pumping Facilities} + 1) - (\text{Score for the Criterion})}{(\text{No. of Pumping Facilities})} \times \text{No. of Weighting Points for the Criterion}$$

Where:

No. of Pumping Facilities = Total number of pumping facilities included for SSES Field Activities

Score for the Criteria = Based on a ranking of the pumping facility within the qualifying criteria.

No. of Weighting Points for the Criterion = Weighting Factors as assigned in Tables 3-2 and 3-3

- The prioritization of the pumping facility is then based on the sum of the individual criteria weighting points, with the highest total points representing the pumping facilities with highest priority for further evaluation.

The screening process for HRSD pumping facilities was divided into two independent models: one for wet well pump stations and one for pressure reducing stations. The qualifying criteria for wet well pump stations and pressure reducing stations within the HRSD system were independently established due to the variation of infrastructure components between these two types of pumping systems. For example, the use of high level alarm activation is an applicable qualifying criterion for prioritization of wet well pump stations, but is not an applicable qualifying criterion for pressure reducing stations due to their closed-system configurations. The qualifying criteria and prioritization methodology for Wet Well Pump Stations and Pressure Reducing Stations are presented respectively as follows:

Wet Well Pump Stations

The qualifying criteria to prioritize wet well pump stations for SSES Field Activities are listed in Table 3-2. The wet well pump station prioritization analysis did not include the Lodge Road Pump Station (PS-233), since it is a newly acquired pump station (acquired by HRSD in 2008) that has been previously identified by HRSD as requiring condition assessment activities.

Table 3-2. Wet Well Pump Station Qualifying Criteria		
Qualifying Criteria	Description	Weighting Factor
Pump Station Size Based on Capacity	Pump Station size based on real time flow data derived from pump draw down tests, with the assumption that the largest pump is out of service.	30
SSOs Not Related to Major Storm Events, Operator Error, or Third Party Actions	Pump Station-related SSOs which occurred between the dates of Oct. 2002 and Dec. 2008 and were not caused by Major Storm events as listed in the November 26, 2007 LOP letter (e.g., tropical storms), Operator Error (e.g., incorrect valve operation or bypass pump failure), Third Party Actions (e.g., infrastructure damage by Contractor), or uncontrolled events (e.g., lightning strike).	40
Excessive Pump Run Time	Pump Stations which exceeded the Excessive Pump Run Time threshold, as defined in the RTS, between the dates of April 2008 and Jan. 2009.	10
Number of Days with High Level Alarms	The number of days in which a Pump Station had at least one recorded high level alarm between the dates of April 2008 and Dec. 2008.	20
TOTAL AVAILABLE POINTS		100

The prioritization criteria were applied to each of the 65 wet well pump stations analyzed, using a consistent ranking methodology and based on the operational data reviewed in Section 2 of this Plan.

1) Pump Station Size Based on Capacity **(WEIGHT 30)**

What is the *relative* size of the wet well pump station as compared to the total number of wet well pump stations in the HRSD system?

Value Range	Rank
Very Large	1
Large	16
Medium	48
Small	65

2) SSOs Not Related to Major Storm Events, Operator Error, Third Party Actions **(WEIGHT 40)**

The value range for this criterion is the number of pump station-related SSOs not caused by Major Storm Events, Operator Error, or Third Party Actions during the past 5-year period.

Value Range	Rank
>4 SSOs	1
2 or 3 SSOs	16
1 SSO	48
0 SSOs	65

3) Excessive Pump Run Time **(WEIGHT 10)**

Do the pumps at the pump station experience excessive pump run time within the data range analyzed?

Value Range	Rank
Yes	1
No	65

4) Number of Days with High Level Alarms **(WEIGHT 20)**

The value range for this criterion is the number of days that the pump station had at least one recorded high level alarm within the data range analyzed.

Value Range	Rank
>5 Days	1
2 to 4 Days	16
1 Day	48
0 Days	65

Pressure Reducing Stations

The qualifying criteria to prioritize pressure reducing stations (PRSs) for SSES activities are listed in Table 3-3. There are 16 PRSs in the HRSD system, all of which were included in the prioritization model for pressure reducing stations.

Table 3-3. Pressure Reducing Station Qualifying Criteria

Qualifying Criteria	Description	Weighting Factor
Pump Station Size Based on Capacity	Pump Station size based on pump card data specific to installed pumps, with the assumption that the largest pump is out of service.	40
Pump Station Age	Pump Station age based on record drawings.	60
TOTAL AVAILABLE POINTS		100

The prioritization criteria were applied to each of the 16 pressure reducing stations analyzed, using a consistent ranking methodology as follows.

1) Pump Station Size Based on Capacity **(WEIGHT 40)**

What is the *relative* size of the wet well pump station as compared to the total number of pressure reducing stations in the HRSD system?

Value Range	Rank
Very Large	1
Large	5
Medium	10
Small	15

2) Pump Station Age **(WEIGHT 60)**

The value range for this criterion is the general age of the facility. Although components of the facility may have been replaced since the original construction, the overall facility age base on Record Drawings has been used in this process.

Value Range	Rank
>35 Years Old	1
30 to 35 Years Old	5
20 to 29 Years Old	10
<20 Years Old	15

3.3.2 Screening Results

The prioritization of the pumping facilities was based on the sum of the individual criteria weighting points, with the highest total points representing the pumping facilities with highest priority for SSES Field Activities. As this is a desktop model based on a variety of data, the accuracy to predict precise priority for SSES Field Activities is low. The fact that a particular facility received a higher score in this model does not necessarily imply that it is in worse condition than a lower ranking facility. Instead, HRSD has utilized this data to separate the pumping facility assets into three groups (Group 1, Group 2, and Group 3) for prioritization of SSES Field Activities. The results of this screening are shown in Appendix C with the schedule detailed in Section 5.

SCADA screening corresponds to the pumping facility screening and SSES Field Activities will be performed according to the same prioritization. Additional records of HRSD's alarms and SCADA system failures were reviewed to identify particular remote assets that have a chronic history of failures.

3.4 Gravity System Screening

HRSD has been conducting condition assessment activities of its gravity sewer mains for a number of years. The approximately 50 miles of gravity sewer pipes are inspected on a five year cycle and certain higher risk segments are inspected annually. The CCTV inspections have and will continue to utilize PACP compliant terminology and methods for defect rating and categorization. This existing program has previously identified many of the significant defects which have been scheduled for rehabilitation. New significant defects are infrequently found as a result of this continuous program.

HRSD will review its planned inspection schedule and compare it to available screening data for the gravity sewer system. If the data shows a gravity sewer line that has cause to be adjusted in the planned schedule, then HRSD will assess it for reprioritization. The main source of data HRSD intends to use for screening to prioritize SSES field investigations is sanitary sewer overflows and previous line failures.

HRSD will prioritize the field inspection of the gravity systems, giving higher weight to those with a previous history of multiple sanitary sewer overflows and/or a direct connection to a locality overflow point (LOP). The second group of inspections will include those with a previous history of a non-recurring sanitary sewer overflow (only one overflow occurrence). Those parts of the gravity systems that do not have any known operational or condition issues from the data collected will be inspected based on their routine prioritization. Also, if previous inspection data that meets the criteria for acceptance by the RTS is available, it will be identified.

A breakdown of the prioritization and inspection schedule will be included in the Preliminary Condition Assessment Report. If a sanitary sewer overflow or line failure occurs during this program, HRSD will redirect its resources to investigate that asset in an expedited manner.

3.5 Preliminary Condition Assessment Report

Upon completion of the screening process, HRSD will prepare and submit a Preliminary Condition Assessment Report (“Preliminary Report”) to the DEQ according to the schedule in Section 5 of this Plan. The Preliminary Report will describe the results of the screening and preliminary risk assessment for HRSD’s force mains, gravity sewers, pumping stations, pressure reducing stations, and SCADA system. The report will include a listing of all facilities that were screened and which are identified as having the potential for material risk of failure. The Preliminary Report will also describe the process and methodologies utilized for determining the potential for material risk of failure, as well as include a schedule for SSES Field Activities.

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4. SSES FIELD ACTIVITIES

The SSES Field Activities will be the investigation performed by HRSD for the pumping stations, pressure reducing stations, SCADA system, gravity sewers, and those force mains identified in the screening process described in Section 3. The data collected during these investigations will be combined with the previous condition assessment activities described in Section 2 to prepare a Final Condition Assessment Report. The following sub-sections describe the planned field assessments that will be refined in the Preliminary Condition Assessment Report. Each asset will have a blend of characteristics that require a specific program for field investigation. These sub-sections will outline the planned approach for each asset class.

4.1 Field Investigation Approach

The objective of the SSES Field Activities is to provide an appropriate level of system information to support sound rehabilitation and/or replacement decisions for HRSD's sanitary sewer system. In order to accomplish this, an investigation approach must be in place which allows the tracking and evaluation of a wide range of factors. The objectives of a standardized field investigation approach are:

- Progressively evaluate sewer assets without expending unnecessary time and resources
- Utilize previously-executed investigation and/or rehabilitation efforts, where appropriate
- Prioritize investigation activities according to identified problem areas

As discussed in Section 1, HRSD's sanitary sewer system has been grouped into distinct asset types which will undergo condition assessment activities in three parts: Force Main Condition Assessment, Pumping Facility Condition Assessment (including pumping stations, pressure reducing stations, and SCADA systems), and Gravity System Condition Assessment. Field investigations will be conducted according to these three condition assessment groupings as shown below:

Force Main Condition Assessment	**Pumping Facility Condition Assessment**	**Gravity System Condition Assessment**
Inspection of Force Main Segments having the potential for Material Risk of Failure	Inspection of Pumping Stations, Pressure Reducing Stations, and SCADA Systems	Inspection of Gravity Pipelines and Manholes

Figure 4-1. Condition Assessment Groupings

For each condition assessment grouping, the investigation approach has been outlined herein. This section of the Plan provides details on the standardized methods for conducting the necessary field investigations within the HRSD sanitary sewer system as deemed necessary by the phased field investigation approach. Certain asset conditions will warrant prompt action when found during the course of the SSES Field Activities. As described in the RTS, prompt action is warranted when asset defects are determined to meet one or more of the following criteria:

- Pose an immediate threat to the environment
- Pose an imminent threat to the health and safety of the public
- Create operational problems that may result in SSOs
- Contribute substantial inflow to the system

Section 4.7, Find and Fix, provides details regarding the prompt repair of defects that meet the above criteria. Information collected during field investigation activities will be documented as defined in Section 4.6, Final Condition Assessment Report.

4.1.1 Force Main Condition Assessment – Investigation Approach

Force main condition assessments will be conducted using the investigation approach logic as depicted on Figure 4-2. This approach logic will be followed as shown to collect sufficient data to adequately assess the condition of HRSD force mains that are determined to have the potential for material risk of failure.

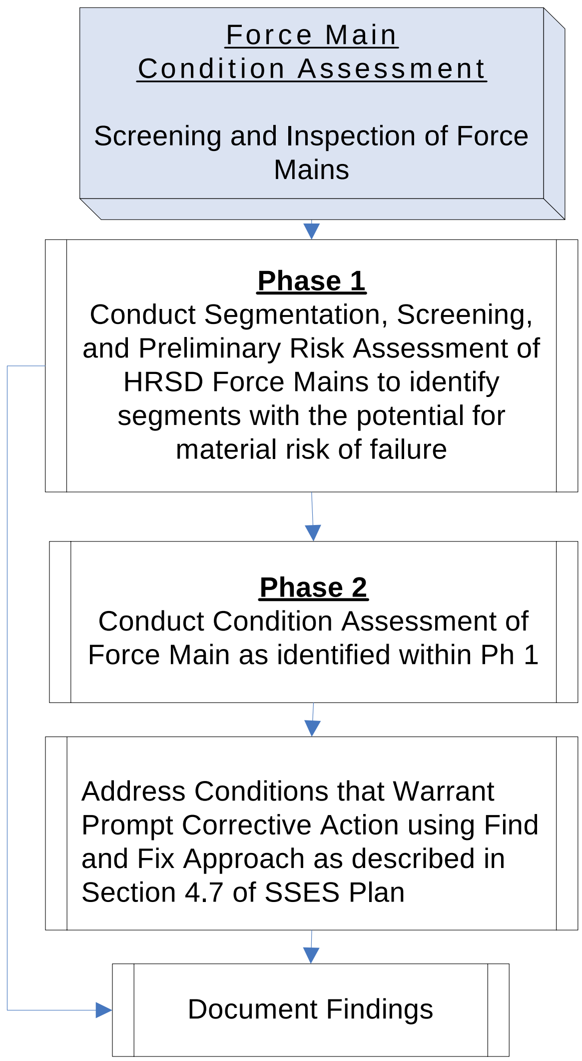


Figure 4-2. Force Main Condition Assessment – Investigation Approach

4.1.2 Pumping Facility Condition Assessment – Investigation Approach

Pumping facility condition assessments will be conducted using the investigation approach logic as depicted on Figure 4-3. This approach logic will be followed to collect sufficient data to adequately assess the condition of HRSD pumping facilities in conformance with the requirements of the RTS.

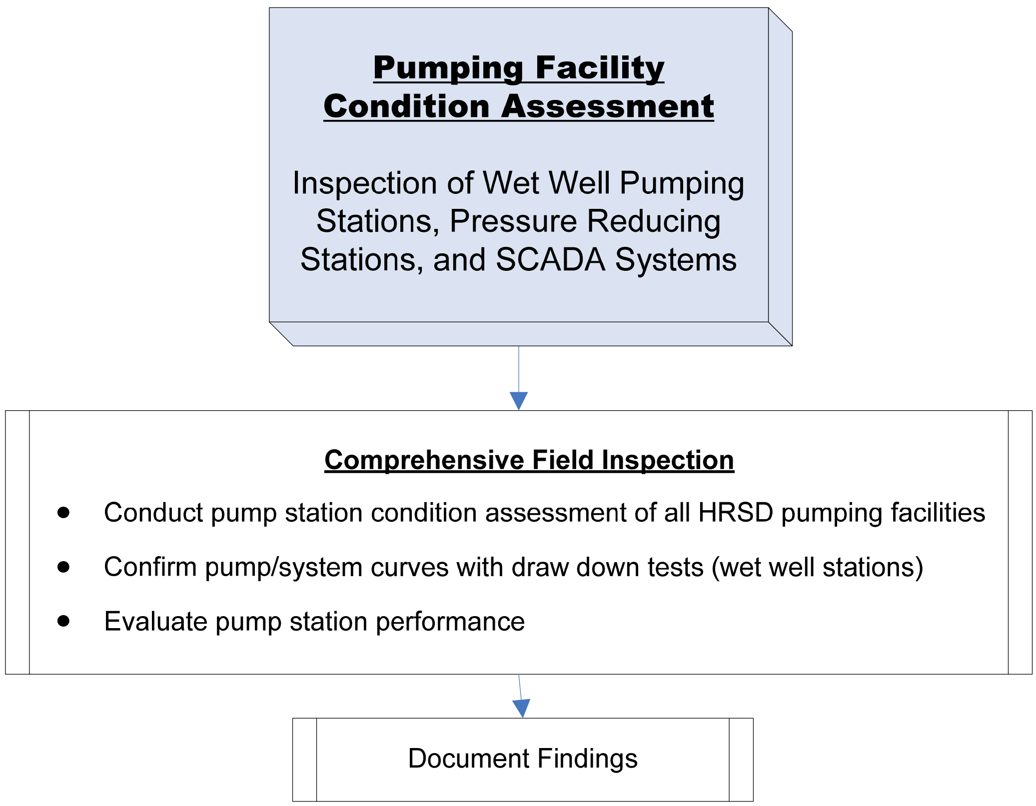


Figure 4-3. Pumping Facility Condition Assessment – Investigation Approach

Gravity System Condition Assessment – Investigation Approach

Gravity system condition assessments will be conducted using the investigation approach logic as depicted on Figure 4-4. This approach logic will be followed to collect sufficient data to adequately assess the condition of HRSD gravity sewer pipelines and gravity sewer manholes in conformance with the requirements of the RTS.

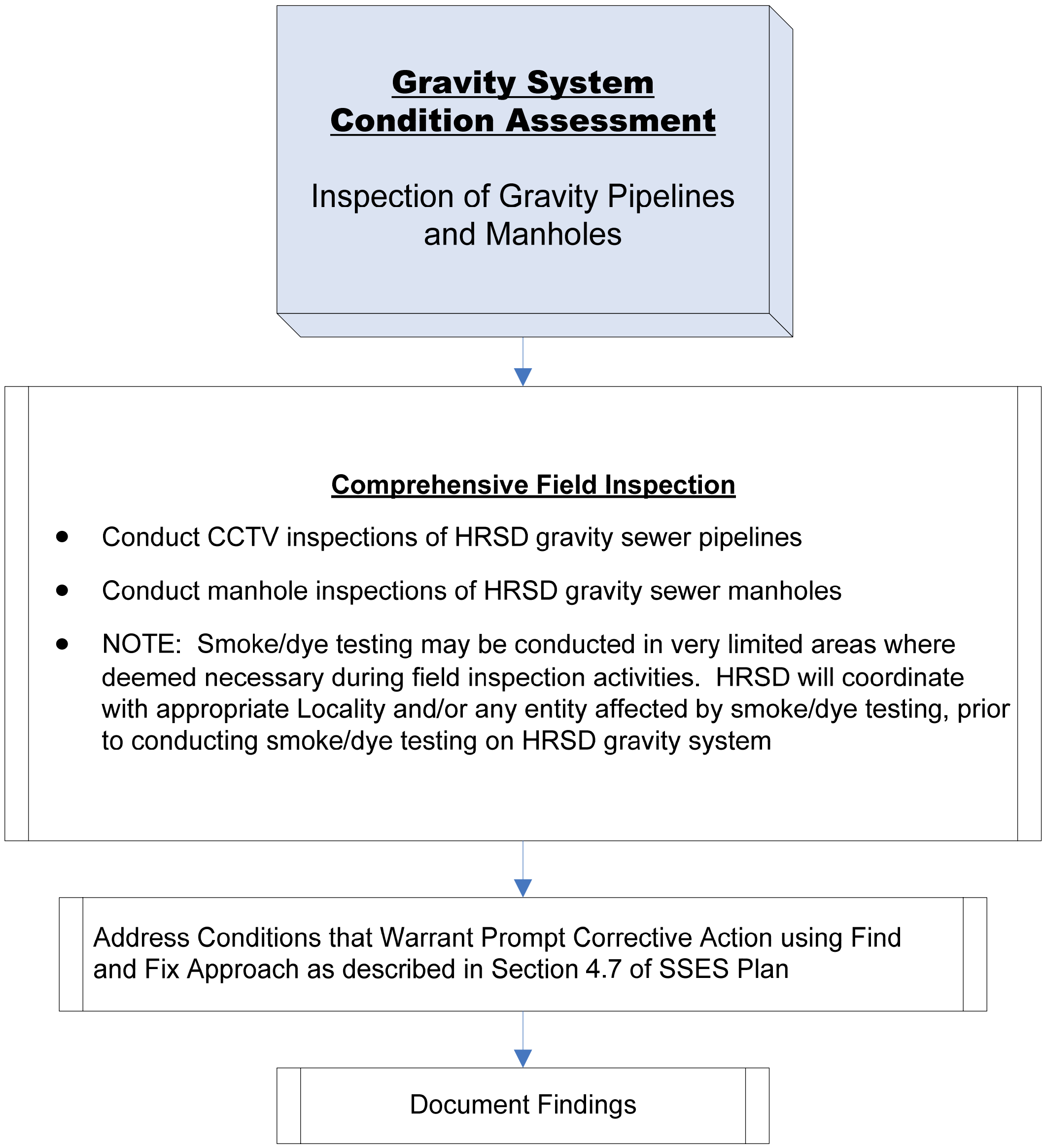


Figure 4-4. Gravity System Condition Assessment – Investigation Approach

4.2 Procedures for Condition Assessment Activities

The condition of assets in HRSD's sanitary sewer system will be assessed using data collection methods specific to three distinct infrastructure groups: **force mains, pumping facilities, and gravity systems.** It is imperative that uniform assessments be conducted to aid in the evaluation of data and provide a common basis for assessing rehabilitation needs. Databases and GIS systems will be used by HRSD to store and manage asset condition data collected during the assessment activities. Standardized field investigation activities will be performed as defined in the field investigation approach contained within Section 4.1, Field Investigation Approach. The following sections review the assessment activities to be implemented, and a general summary of these assessment activities is presented below:

Force Main Condition Assessment

- Force Main Field Inspection
- Air Vent Inspection
- Aerial Crossing Inspection

Pumping Facility Condition Assessment

- Building Condition Inspection
- Pump and Motor Inspection
- Wet Well Inspection
- Corrosion of Ancillary Equipment
- Dry Well Inspection
- Piping Inspection
- Emergency Equipment Inspection
- SCADA Equipment Inspection

Gravity Sewer Condition Assessment

- Manhole Inspection
- Pipeline CCTV Inspection
- Smoke Testing (as needed to complement CCTV inspection in very limited areas)
- Dye Testing (as needed to complement CCTV inspection in very limited areas)

4.3 Force Main Condition Assessment

The HRSD sanitary sewer system contains approximately 430 miles of force mains, of varying ages, materials, diameters, and physical conditions. The HRSD force main system is unique in that the force mains are extensively interconnected with numerous in line valves and junctions and many points of inputs from Locality pumping stations. The force mains identified in the Condition Assessment Screening process as presenting the **potential** for material risk of failure will be evaluated in the field to ascertain their physical condition and to identify whether repair, rehabilitation or replacement is needed, unless renewal or replacement is already scheduled for that segment.

A detailed Force Main Condition Assessment program has been developed, as part of HRSD's Condition Assessment Plan submitted to the EPA and DEQ, which outlines the technologies and approach to evaluating the HRSD force main network. The proposed Force Main Condition Assessment program will provide a balanced approach that will develop the data needed to assess the condition of each force main segment and which will also present minimal operational and financial risk.

4.3.1 Condition Assessment of Remaining Force Mains

Those force mains determined to not have potential for material risk of failure, and thereby not assessed in the field, will be monitored and reviewed periodically in accordance with HRSD's Management, Operations and Maintenance (MOM) Program. If a failure occurs due to a condition defect (and not from third party actions), HRSD will review the failure specifics to determine if condition assessment using the procedures detailed in this section are warranted.

4.3.2 Assessment of Force Main Appurtenances

HRSD will field inspect and conduct functional assessment of line valves, air release valves, and other accessible appurtenances in the force main system. Assets that are not functioning or present a material risk of failure will be identified in the Final Condition Assessment Report and potentially addressed through the Find and Fix Program detailed in Section 4.7, if the RTS criteria are met.

4.3.3 External Pipe Inspections

HRSD will inspect the exterior of each force main pipe at locations where the pipe is exposed, either at existing exposed locations such as aerial crossing, or during internal inspections where the pipe is exposed. These inspections will include visual assessment for structural damage and integrity of protective coatings, and spot checks with ultrasonic wall thickness testing, where appropriate. Assets that present a potential of material risk of failure will be identified in the Final Condition Assessment Report, and potentially addressed through the Find and Fix Program detailed in Section 4.7, if the RTS criteria are met.

4.3.4 Cathodic Protection

Where records indicate that a cathodic protection system was installed, the system will be inspected for its condition and adequacy. For those metallic force mains where no cathodic protection was recorded, the need for such a system will be evaluated based on soil conditions from soil maps. Historical data indicates that external corrosion of force mains is not a significant or widespread challenge in the HRSD system. Assets that present a material risk of failure will be identified in the Final Condition Assessment Report.

4.3.5 Force Main Condition Assessment Documentation

The data collected at each type and level of inspection will be recorded using a data management system compatible with HRSD databases and GIS, and modified as appropriate for the criteria and parameters being assessed with each technology. A modified version of a PACP-type program may be used if available at the time of the inspection. A data logging system will be developed which can be used to record the pertinent data from each inspection technology. Reports will be required from each inspection firm on a regular basis during the Force Main Condition Assessment Activities. All recordings from the inspections will be required in digital form.

4.4 Pumping Facility Condition Assessment

Pumping facilities within the HRSD sanitary sewer system will be inspected for physical condition, SCADA and systemic issues which may negatively impact performance. Each issue will be evaluated depending on the facility type, either pumping station or pressure reducing station. Typical issues include, but are not limited to:

- Grease: Grease buildup interferes with station operation by inhibiting the operation of level sensors
- Impeller wear: Entry of sandy soil and grit into the wet well by way of structural defects in the gravity sewers reduces the effective wet well capacity and causes excessive impeller wear
- Mechanical and electric anomalies and/or failures: Reduce reliability and performance
- Excessive pump run times: Can be an indicator of capacity issues or equipment wear
- Influent surcharge: Improper "pump on" set point or inlets constructed close to pump centerline can lead to influent pipeline surcharge. Note that some stations are set up for minimal surcharging to minimize air entrainment.
- Wet-well surcharge, SSOs: System head on manifolded networks that exceeds the pumping capability of the pumping station, or influent flow that exceeds pumping capacity can lead to overflows and excessive pump run times
- SCADA instrumentation calibration: SCADA instruments are out of calibration

Pumping facility inspections and evaluations will be conducted in a consistent manner. Some key information that may be obtained during a pumping facility inspection is outlined below:

Building Condition – Visually inspect the interior, exterior, and roof of the building for physical or structural problems and record defects that may lead to SSOs or unsafe conditions.

Pumps, Motors, and Drives – From the manufacturer's data plates and any up-to-date maintenance information, record the pump head in feet, the capacity in gallons per minute and the impeller diameter in inches for each pump. Record the listed horsepower and RPM for the motors. Observe the pumps and motors for vibrations, sounds, temperature and odor. The operating logs will be reviewed. The operations staff will be consulted to determine under what conditions and how long all pumps operate at the same time.

Wet Well – Inspect the wet well in a drawn down state to ensure a proper visual inspection. Accumulation of debris, sediment and grease buildup will be removed when the wet well is drawn down for the inspection. The walls will be observed for coating condition, spalling or softness of concrete, erosion of concrete and the condition of bottom fillets.

Corrosion of Ancillary Equipment – While the wet well is in a drawn down state and after cleaning, inspect the ventilation system ducts and fans, access hatch, interior railing, access ladder and platforms, pump control system, pump rails, and interior piping for corrosion.

Dry Well – Inspect the dry well for structural conditions of concern.

Piping – While the pump station is on-line, visually inspect the piping, valves (check, isolation, surge relief and air relief) and other fittings for corrosion, leakage, coating system condition, and proper operation.

Emergency Generator/Pump – Observe the generator/pump while running under typical daily load to verify its operation, noting excessive noise, excessive vibration, dark exhaust, and ease of generator/pump starting. Test to ensure that the device will automatically start upon loss of power.

SCADA Equipment/Programming – Check alarms in the SCADA system. The following alarms at the pumping facilities will be tested, if existing:

- Wet well high level and low level alarms
- Dry well flood alarms
- Dry well sump pumping failure
- Any of the following power anomalies:
  - Loss of three phase power
  - Single phase condition
  - Over-voltage and under-voltage
  - Use of standby power
  - Failure of standby power
  - Use of alternate power source
  - Loss of alternate power source
- Pump failure

Pump Draw-down Tests – Perform pump draw-down tests at HRSD wet well pumping stations to determine actual pump operating conditions. These results will be compared to manufacturers' curves to identify anomalies that may be indications of excessive wear.

Lightning Strike Protection – Evaluate the protection, if any, in place at each pumping station against lightning strikes. Grounding equipment will be inspected and documented. Records and operators' knowledge will be reviewed to identify whether a station is prone to lightning strikes which cause an outage that results in SSOs.

The procedures discussed in this section and in Appendix B provide details for assessing the condition of HRSD's pumping facilities. In this assessment methodology, pumping station assets are evaluated in terms of physical condition.

The pump station condition assessment procedure is organized as follows:

- Pumping Facility Condition Rankings – The condition scoring protocols are listed for each pumping facility asset;
- Pumping Facility Condition Assessment Form – Information regarding how to complete the Pumping Facility Condition Assessment Form is provided; and
- Pumping Facility Asset Inspection Procedures – The step by step protocol to be followed while performing the assessment. These procedures are provided in Appendix B.

4.4.1 Pumping Facility Condition Rankings

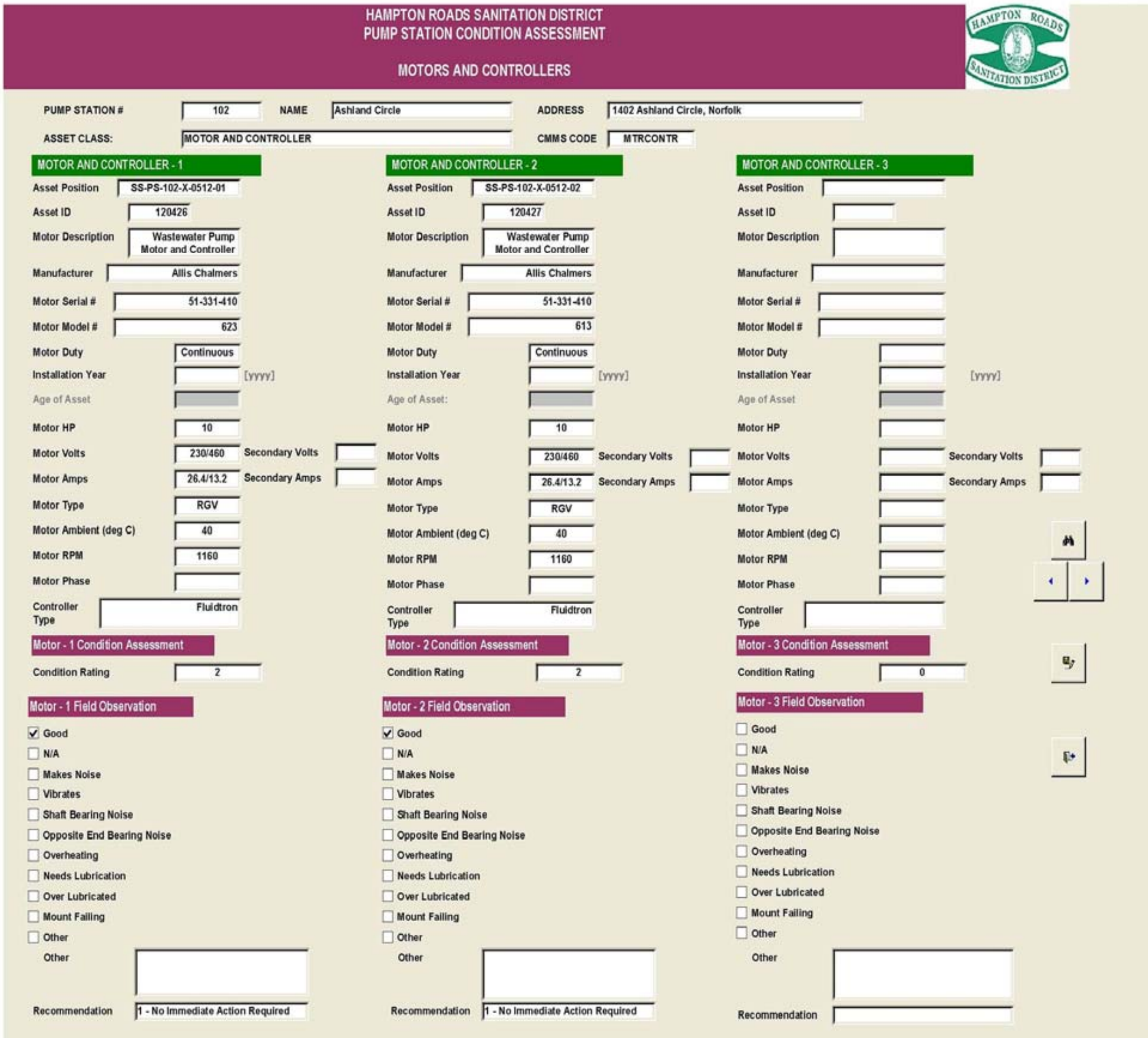
Each asset should be scored (1-5) according to the following guidelines:

Condition

1. Excellent – No Visible Degradation
2. Slight Visible Degradation
3. Visible Degradation
4. Integrity of Component Moderately Compromised
5. Integrity of Component Severely Compromised

4.4.2 Pumping Facility Condition Assessment Form

The condition assessment form (either electronic or paper version) will be completed for the pumping facilities where a condition assessment is performed. In order to standardize documentation, a single set of forms will be created; however, not all data on the forms will be able to be collected at all pumping facilities. A screenshot of a typical condition assessment form for the Motors and Controllers asset class can be seen below.



HAMPTON ROADS SANITATION DISTRICT
PUMP STATION CONDITION ASSESSMENT

MOTORS AND CONTROLLERS

PUMP STATION # 102 NAME Ashland Circle ADDRESS 1402 Ashland Circle, Norfolk

ASSET CLASS: MOTOR AND CONTROLLER CMMS CODE MTRCONTR

	MOTOR AND CONTROLLER - 1	MOTOR AND CONTROLLER - 2	MOTOR AND CONTROLLER - 3
Asset Position	SS-PS-102-X-0512-01	SS-PS-102-X-0512-02	
Asset ID	120426	120427	
Motor Description	Wastewater Pump Motor and Controller	Wastewater Pump Motor and Controller	
Manufacturer	Allis Chalmers	Allis Chalmers	
Motor Serial #	51-331-410	51-331-410	
Motor Model #	623	613	
Motor Duty	Continuous	Continuous	
Installation Year [yyyy]			
Age of Asset			
Motor HP	10	10	
Motor Volts	230/460	230/460	
Secondary Volts			
Motor Amps	26.4/13.2	26.4/13.2	
Secondary Amps			
Motor Type	RGV	RGV	
Motor Ambient (deg C)	40	40	
Motor RPM	1160	1160	
Motor Phase			
Controller Type	Fluidtron	Fluidtron	

	Motor - 1 Condition Assessment	Motor - 2 Condition Assessment	Motor - 3 Condition Assessment
Condition Rating	2	2	0

	Motor - 1 Field Observation	Motor - 2 Field Observation	Motor - 3 Field Observation
Good	☑	☑	☐
N/A	☐	☐	☐
Makes Noise	☐	☐	☐
Vibrates	☐	☐	☐
Shaft Bearing Noise	☐	☐	☐
Opposite End Bearing Noise	☐	☐	☐
Overheating	☐	☐	☐
Needs Lubrication	☐	☐	☐
Over Lubricated	☐	☐	☐
Mount Failing	☐	☐	☐
Other	☐	☐	☐
Other			
Recommendation	1 - No Immediate Action Required	1 - No Immediate Action Required	

Figure 4-5. Example of Pumping Facility Condition Assessment - Screenshot

The pump station information at the top of the form includes the pumping facility number, name, and address, and the asset class and code. When using the electronic database, the asset information section includes the asset position, ID, and description, which are auto populated (if available) and require no input during field data collection.

Condition ranking will be completed for the assets that are present in the pumping facility by using the guidelines mentioned in the previous section, "Condition Rankings". These rankings will be determined by the visual inspection, and any additional observation will be mentioned in the "Field Observation / Comments" section. Any observations not listed will be noted in the "Other" text box.

Condition assessment forms similar to the example shown in Figure 4-5 will be developed for the following asset classes:

- Batteries and Charger
- Air Compressors
- Electrical Systems
- Diesel Engine
- Generator
- HVAC
- Instrumentation
- Motors, Drives and Controllers
- Pumps
- SCADA
- Structural and Wet Well
- Tanks
- Transfer Switch
- Valves

HRSD will develop Condition Assessment reports that can be output from the database to provide documentation for the Final Condition Assessment Report.

In addition, HRSD will evaluate each pumping facility for its potential for damage due to flooding. HRSD will review records for each pumping facility from the previous 5 years to identify previous instances of flooding and determine which have a material susceptibility to damage from flooding.

4.5 Gravity Sewer Condition Assessment

Gravity sewers within the HRSD sanitary sewer system will be inspected for structural integrity and maintenance issues. These assessment activities will include manhole inspections, pipeline inspections and limited smoke/dye testing where feasible and deemed necessary as designated in the field investigation approach. Pipeline inspection techniques may include CCTV, laser and/or sonar, as appropriate. The work will be performed in accordance with NASSCO standards.

4.5.1 Assessment Standards for Gravity Sewer System

4.5.1.1 Pipeline Assessment and Certification Program (PACP)

The National Association of Sewer Service Companies (NASSCO), along with the assistance of the Water Research Centre (WRC), has developed a national certification program to establish a viable solution to standardize the identification, categorization, evaluation, and prioritization of sanitary sewer or storm sewer infrastructure through CCTV investigations. This standardized certification program can be used to ensure consistent record-keeping when compiling CCTV reports into a common database which can then be used for operation and maintenance (O&M) activities as well as pipe rehabilitation and replacement.

NASCCO PACP standards will be used to conduct CCTV investigations and document findings. The PACP defect descriptions are organized into the following general categories:

- Structural Defect Coding: This group includes the type of defects where the pipe is considered to be damaged ranging from a minor case defect to a more severe case, depicted as pipe failure. The Structural Defect Coding group includes defects described as: cracks, fractures, broken pipe, holes, deformities, collapsed pipe, joint defects, surface damage defects, weld failures, point repair codes, brickwork defects, and lining failures.
- Operation and Maintenance Coding: This group includes the various codes that involve the spectrum of defects that may impede the operation and maintenance of the sewer piping system. The Operation and Maintenance Coding group includes defects comprised of roots, infiltration, deposits and encrustations, obstacles/obstructions, and vermin.
- Construction Features Coding: This group includes the various codes associated with the typical construction of the sewer piping system. The Construction Features Coding group includes taps, intruding seal material, pipe alignment codes, and access points.
- Miscellaneous Features Coding: This group includes observation codes such as water levels (detection of sags), pipe material changes, and dye testing notes.

PACP Condition Grading System

The tables below describe the grading system for structural and O&M defects, and general guidelines regarding deterioration rates. Each defect can be scored with a grade ranging from 1 to 5, where a grade 5 has the most potential for pipe failure.

Table 4-1. Structural and O&M Defects Grading Table

Grade	Grade Description	Grade Definition
5	Immediate Attention	Defects requiring immediate attention
4	Poor	Severe defects that will become Grade 5 defects within the foreseeable future
3	Fair	Moderate defects that will continue to deteriorate
2	Good	Defects that have not begun to deteriorate
1	Excellent	Minor defects

Table 4-2. General Guidelines Regarding Deterioration Rates

Grade	Grade Definition
5	Pipe has failed or will likely fail within the next 5 years
4	Pipe will probably fail in 5 to 10 years
3	Pipe may fail in 10 to 20 years
2	Pipe unlikely to fail for at least 20 years
1	Failure unlikely in the foreseeable future

The time estimated for pipe deterioration will vary based on local conditions.
The grade definitions are to be used as a general guideline only.

4.5.1.2 Manhole Assessment Certification Program (MACP)

NASSCO has developed the Manhole Assessment Certification Program (MACP) to provide an industry standard to evaluate the overall condition of manholes or different types of sewer access points. MACP uses the same coding/grading system as PACP and incorporates much of the manhole standards from the American Society of Civil Engineers (ASCE) as well.

Manhole condition assessments will include the documentation of the various components of manhole construction, any structural or operations and maintenance defects, as well as identification of I/I. In addition, influent and effluent pipe assets and condition assessments will be collected. HRSD's manhole assessment methodology utilizes an electronic database to record defect observations, defect descriptions, and a condition scoring system that is substantially consistent with the MACP certification program.

4.5.1.3 Lateral Assessment Certification Program (LACP)

HRSD is a regional collection agency, and therefore has limited directly connected laterals from individual customers tying into the HRSD gravity sewer system. Lateral Assessment will not be included in HRSD's SSES Plan.

4.5.2 Gravity Sewer Asset Identification

HRSD's sanitary sewer manholes have unique identifiers as follows: **XG-YYY-STA**, where "**XX**" represents the geographical location of the gravity sewer line on which the manhole is installed (i.e., North Shore (NG) or South Shore (SG)). The "**YYY**" represents the contract line number in which the manhole is located. The "**STA**" represents that station number at which the manhole is located. For example, a manhole located in the North Shore system that was constructed under contract NG-105 and is located at station number 14+60 would be assigned a manhole identifier as follows: "**NG-105-14+60**". The manhole identification numbers will be used during field investigation activities associated with the gravity sewer condition assessment.

If an identified manhole can not be located in the field, or an unidentified manhole is found in the field during condition assessment activities, HRSD will resolve the discrepancy and update its databases as required. In order to prevent delays, the personnel performing the condition assessment activities will designate an interim manhole identifier to any unidentified manholes found in the field. Unidentified manholes will be tracked using the upstream and downstream manhole identifiers. For example, if an unidentified manhole is found between manholes SG-200-6+65 and SG-200-9+75, then the unidentified manhole and connecting pipes will be tracked as "**SG-200-6+65 to SG-200-6+65-NEW and SG-200-6+65-NEW to SG-200-9+75.**" This temporary naming convention will be used during the gravity sewer system condition assessment activities and will be temporarily recorded on paper for presentation to HRSD. Upon completion of condition assessment activities, HRSD will perform surveys to capture the coordinates of the unidentified manhole(s), integrate the manhole into GIS, and assign standard manhole identifiers to the unidentified manholes as required.

4.5.3 Manhole Inspections

Sanitary sewer manhole inspections are an important component of the gravity sewer system assessment due to the susceptibility of manholes to structural defects and/or I/I which may contribute to SSOs. Manhole inspections not only provide valuable information on the physical condition of the manholes, but also an opportunity to observe pipe diameters, inverts, network connectivity, and surcharging within mainline gravity sewers. The results of manhole inspections can be used as a guide for identifying additional assessment needs such as CCTV.

The data collected during manhole inspections will be recorded using HRSD's *Manhole Field Inspection Form* (a sample of which is included in Appendix B). HRSD will manage the data collected using electronic database systems and develop its Final Condition Assessment Report using this data.

Manhole inspections may be performed using a pole camera capable of recording digital video and digital still images (in electronic format) of the manhole and each pipeline entering or exiting the manhole. **Sanitary sewer manholes are considered confined spaces.** If a pole camera is not used, any personnel entering a manhole must adhere to OSHA and HRSD protocol for confined space entry at all times while within the structure.

Color photographs (in electronic format) will be taken of the manhole to show, at a minimum, the above ground location, looking down at the manhole invert, and looking into the incoming and outgoing pipelines. Manhole defects will be recorded using standardized observation codes as indicated on the standard *Manhole Field Inspection Form*. Manhole inspections will normally be performed during daylight hours, however, when night time inspections are required they will only be conducted when site conditions are deemed safe. HRSD will be notified when manholes are found to be surcharged at the time of inspection and downstream blockage is determined to be the probable cause of the surcharging. HRSD personnel will work to mitigate the cause of the surcharge so that a re-inspection of the manhole can be conducted. If the surcharge can not be mitigated, the surcharged manhole will be re-inspected during a lower flow period.

The sanitary sewer manhole condition assessment procedure is organized as follows:

- **Manhole Inspection Observation Codes** – Standardized codes/observations will be used to perform manhole inspections as described in this section.
- **Manhole Condition Scoring** – The manhole condition scoring protocols are described in this section.
- **Manhole Field Inspection Form** – Information regarding how to complete the *Manhole Field Inspection Form* is provided in this section.
- **Manhole Inspection Procedure** – The step by step protocol to be followed while performing the manhole inspection is described in this section.

Manhole Inspection Observation Codes – Field observation codes for identifying and/or classifying defects during manhole inspections will be recorded in a standardized manner. HRSD's standard *Manhole Field Inspection Form* is organized so that data can be collected using common observation codes that are recorded using checked boxes or free-hand comment boxes. Observations of manhole defects or points of interest that are not listed in the standard *Manhole Field Inspection Form* should be recorded in the "Additional Information" section of the form.

Manhole Condition Scoring – To assist in prioritizing any warranted maintenance or repair of sanitary sewer manholes within the HRSD system, a condition scoring system will be used to weigh the manhole defects that are observed during manhole inspections. The condition scoring system will be based on the PACP/MACP system for grading structural and O&M defects, as defined in Table 4-2. Each manhole will be scored (1-5) according to these MACP manhole condition assessment standards. These guidelines should be used at all times during the manhole inspection procedures

Manhole Field Inspection Form – The standard *Manhole Field Inspection Form* will be completed for manholes where a condition assessment is performed. After recording the manhole number, the inspector's name, and the date and time of the inspection at the top of the form, all remaining sections of the *Manhole Field Inspection Form* will be completed by checking the appropriate boxes or using free-hand descriptions where required.

Manhole Inspection Procedure – The *Manhole Field Inspection Form* will be completed by the personnel performing the manhole inspection. Prior to conducting inspections of manhole components, a non-entry (topside) manhole inspection will be conducted to determine the overall condition of the manhole as viewed from the ground surface. The surrounding area will be observed and noted if manholes or adjacent cleanouts are located in areas that are conducive to flooding, ponding, or tidal conditions that allow water to enter the sanitary sewer system. Data gathered from the topside inspection will be entered into "Additional Comments" field of the standard *Manhole Field Inspection Form*.

In lieu of manual entry, pole camera technology may be used to perform non-entry (topside) manhole inspections provided that site conditions are appropriate and that sufficient data can be captured and recorded to determine if more detailed manhole inspection activities are warranted.

The following documentation will be collected at each manhole:

<u>Manhole Photographs</u>

- The above ground location of the manhole
- The interior of the manhole looking down at the manhole invert and looking into the incoming and outgoing pipelines
- Potential issues and points of interest for documentation purposes
- Significant defects which are observed during the manhole assessment
- Photographs will be stored in electronic format
- A log of the photos taken will be included in the "Additional Information" field

<u>Field Sketches</u>

- A "profile view" field sketch of the manhole will be created, using the schematic diagram on the Manhole Field Inspection Form, showing changes in manhole dimensions and depths to any significant changes within the manhole structure
- A "connectivity" field sketch of the manhole will be created, using the schematic diagram on the Manhole Field Inspection Form, showing information regarding connecting pipes (e.g., pipe size, pipe depth to invert, connecting manhole structure identifiers, etc.)

4.5.4 CCTV Inspections

Closed circuit television (CCTV) inspection will be performed to assess the condition of most of HRSD's gravity sewer pipelines and confirm the location and magnitude of structural defects, points of inflow and infiltration, undocumented/illegal connections, existing pipe lining (if any), and blockages within the gravity sewer system. Where appropriate, laser and/or sonar inspection may be used in addition to, or in lieu of, CCTV.

CCTV inspections will be conducted in accordance with NASSCO PACP standards. Personnel performing CCTV inspections will be PACP-certified and will complete all inspections using standard PACP codes for all defects and observations during the inspection. CCTV data will be managed in a PACP-compliant software product. CCTV inspections will be recorded in color using a pan-and-tilt, radial-viewing inspection camera, and the resulting video/image must be sufficiently clear to easily observe sewer line defects and features including the location of service laterals. Blurred, foggy, or otherwise out of focus video/images are not acceptable and CCTV inspections will be re-commenced where unacceptable video/images are recorded. Simultaneous audio recording of defects observed during the CCTV inspection will also be conducted.

Prior to conducting CCTV inspections, the gravity sewer pipes and manholes will be cleaned as required. Cleaning will consist of normal hydraulic jet cleaning or other appropriate means to facilitate the internal CCTV inspection. In general, gravity sewer lines and manholes undergoing CCTV inspections must be cleaned sufficiently to ensure that the CCTV equipment can easily pass through the gravity sewer system and record defects and observations per PACP standards. CCTV inspections will not be performed in sewer lines with flow depths that do not allow the CCTV equipment to freely pass through the gravity sewer system at the time of inspection.

Gravity main inspections will be identified and tracked by recording the upstream and downstream manholes using HRSD's manhole identifiers. CCTV inspections will be conducted from an upstream manhole to a downstream manhole in the direction of gravity sewer flow to minimize splashing and to allow a smoother pass of the CCTV equipment. The entire length of sewer line undergoing inspection will be recorded in this direction unless site conditions make it necessary to stop the CCTV inspection, in which case a reverse-flow set-up may be attempted. During the CCTV inspection, the CCTV camera must be temporarily stopped at each observed defect or service lateral in order to obtain a clear still picture and video image, as well as a verbal description of the observation.

Gravity Sewer Line Condition Assessment – To assist in prioritizing any warranted maintenance or repair of gravity sewer lines within the HRSD system, a condition assessment grading system compliant with PACP standards will be used to weigh the gravity sewer line defects that are observed during CCTV inspections. The PACP system assigns a distinct code (1-5) for each structural defect and operational and maintenance defect observed during the CCTV inspection. The interface software used during CCTV inspections will assign these PACP codes and record them in an information database. A sample of the CCTV inspection report for Condition Assessment is provided in Appendix B.

4.5.5 Smoke/Dye Testing

Smoke testing and/or dye testing may be conducted only in very limited areas to complement CCTV inspection work in order to identify and pin-point the location of possible I/I sources. Smoke testing and/or dye testing are economical and relatively fast methods for identifying the location of inflow sources such as structural damage in sewer pipes or manholes, cross connections including but not limited to roof leaders, foundation drains, yard drains, storm sewers, and undocumented/illegal connections. To perform these tests, sections of sewer must often be sealed off from all connections, which is not feasible for most parts of HRSD's regional interceptor system.

Smoke Testing

Limited smoke testing may be conducted as part of the phased field investigation approach to help determine which gravity sewer system components may require additional assessment through limited and/or comprehensive dyed water testing.

Smoke testing will be conducted during periods of dry weather with low groundwater, and with at least 24 hours having elapsed from the previous rain event. Smoke testing will not be performed during or following weather conditions that may impair the detection of escaping smoke, when groundwater is high or the ground is frozen, or on days of high winds, rain, snow, or fog.

Dye Testing

Dye testing may be conducted as part of the phased field investigation approach to complement smoke testing where applicable for verifying direction of flow, sources of I/I, and the presence of illicit connections to HRSD's sanitary sewer system. Dye testing is used to confirm sewer system connectivity that cannot be confirmed through smoke testing or CCTV inspection activities. Dye testing may be performed in conjunction with CCTV inspection on a limited basis.

4.6 Final Condition Assessment Report

After completion of the SSES Field Activities, documentation will be prepared that reviews the scope of work performed, references the field procedures used, and presents the condition assessment results. These documents will be used to prepare a prioritized Rehabilitation Plan for the HRSD sanitary sewer system. The report will provide specific details on each asset group assessed.

4.6.1 Pumping Facilities

HRSD will provide detailed information regarding the assessment completed according to Section 4.4 for each pumping station and pressure reducing station. The Final Condition Assessment Report will include:

- A description of each pumping facility;
- Information regarding the results of the evaluation of each pumping facility;
- The results of pump draw-down test performed at each wet well pumping station;
- Information about the back up power and emergency pumping capability of each pumping facility;
- Information regarding lightning strike protection equipment at each pumping facility, where applicable;
- Descriptions of the history of failures at each pumping facility, including power-loss-related and lightning strike-related SSOs during the past 5 years;
- Information on the evaluation of flooding potential at each pumping facility and description of previous flooding events for the past 5 years;
- Information on the SCADA systems at each pumping facility and their ability to fulfill the designed functions; and
- Identification of pumping station components that present a material risk of failure.

4.6.2 Gravity System

HRSD will provide detailed information regarding the assessment completed according to Section 4.5 for the HRSD gravity system, including manholes and sewer pipelines. The Final Condition Assessment Report will include:

- A summary of the results of the PACP-compliant field investigations for HRSD's gravity sewer pipelines;
- A summary of the results of the MACP-compliant manhole inspections;
- Information on the history of all SSOs from HRSD's gravity system that occurred during the past 5 years; and
- A list of all gravity system assets that present a material risk of failure, or are a significant source of I/I.

4.6.3 Force Main System

HRSD will provide detailed information regarding the assessment completed according to Section 4.2 for the HRSD force main system. The Final Condition Assessment Report will include:

- Information regarding the results of the evaluation of each line valve and air release valve;
- Information about the assessment of HRSD's cathodic protection system;
- Information about the external pipeline inspections performed;
- Information about the force main pipe inspections performed, including internal inspections;
- Descriptions of the history of failures for each force main segment that resulted in an SSO during the past 5 years; and
- A list of all HRSD force main assets that have been identified through field inspection as presenting an actual material risk of failure, with a characterization of the nature of the risk of failure associated with its condition.

4.6.4 Rehabilitation Plan

The output of the Final Condition Assessment Report will be a detailed list of those assets in the system at material risk of failure. This information will be used to develop a Rehabilitation Plan which will include a prioritized list of improvements and implementation schedule. HRSD will also, in parallel, be performing a Capacity Assessment of Specified Portions of the Regional Sanitary Sewer System. It is HRSD's intent to efficiently implement appropriate improvements that address condition and capacity related issues. Therefore, HRSD will utilize the output of the Capacity Assessment during development of the Rehabilitation Plan to minimize the rehabilitation or replacement of facilities that may need to be upgraded due to capacity challenges. The Rehabilitation Plan will include a schedule for design and construction of repairs, rehabilitation, improvements or replacement, as applicable. Capital cost estimates for the improvements will be included with the Rehabilitation Plan.

4.7 Find and Fix

The Find and Fix concept provides a process by which critical system repairs can be made in a more timely and cost-effective fashion. Find and Fix methodology employs the concept that when critical failures or deficiencies warranting prompt repair(s) are found during condition assessment activities, actions will be taken to correct the problem(s) either by internal personnel or external on-call contractors. It is the responsibility of the personnel conducting the SSES Field Activities investigation to identify defects that may meet the prompt repair criteria described below, and to present the findings to HRSD. HRSD will make a final evaluation against the criteria. The internal personnel or external contractors performing Find and Fix procedures will be capable of assessing and performing repairs according to acceptable HRSD standards.

A standardized Find and Fix approach will be used for addressing critical deficiencies that have been identified during the SSES Plan investigation approach as warranting prompt corrective action. The SSES Plan investigation procedures as detailed in Section 4 of this report will facilitate consistent definitions, data collection techniques, and documentation methods regarding the nature and severity of critical defects warranting prompt repair as they are identified during the SSES investigation approach. The assets addressed by the Find and Fix approach may include force mains, pumping facilities, gravity pipes, and sanitary sewer manholes.

Prompt repairs of sanitary sewer infrastructure assets are warranted when critical defects are found. The assets containing these critical defects may be operable at the time of discovery but could be at material risk of failure and have the potential for severe consequences. Defects found during the SSES investigation approach will warrant prompt repair where such defects are determined to meet one or more of the following criteria:

- Pose an immediate threat to the environment,
- Pose an imminent threat to public health and safety,
- Create operational problems that may result in SSOs, or
- Contribute substantial inflow to the system

HRSD has a system in place to address assets requiring prompt attention in the collection system. Once identified, information on the defect is reported to the responsible HRSD Chief. The HRSD Chief will either direct field crews to make a point repair or temporary repair, if feasible, or engage the Engineering Department to utilize an outside contractor.

4.8 Private Source of Infiltration and Inflow (I/I)

HRSD is a regional wastewater service provider for the Localities and private permitted systems. Infiltration or inflow contributed to the system would come from either of these two parties. HRSD maintains a Pretreatment and Pollution Prevention (P3) Program to review and permit the private systems that connect to HRSD, whose responsibility includes minimizing I/I.

HRSD and the Localities have committed to address private sources of I/I in a regionally consistent manner per the Consent Order. It is anticipated that program will be developed over the next few years.

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5. SSES PLAN IMPLEMENTATION

The SSES Plan described in this document includes a series of dependent tasks that will, when completed, provide a detailed evaluation of the physical condition of HRSD's wastewater collection system. The three overall tasks are as follows with a planned project schedule in Section 5.4.

5.1 Preliminary Condition Assessment Report

As described in Section 4.6 of this document, HRSD will complete a Preliminary Condition Assessment Report ("Preliminary Report") that details the data collection and screening performed to identify those assets that have the potential for material risk of failure. This document will refine the methodology and provide results of the screening, which will generate a list of assets for field inspection and detailed schedule for completion of those activities. Upon approval by the DEQ, HRSD will perform the SSES Field Activities to confirm or eliminate the asset as presenting a material risk of failure. As shown in the Plan Schedule of Section 5.4, HRSD will complete the Preliminary Report within 120 calendar days of written receipt of SSES Plan approval by the DEQ.

5.2 SSES Field Activities

The field inspection activities specified in the Preliminary Report will be conducted by HRSD according to the final schedule in that report. The schedule provided in Section 5.4 provides macro-level completion dates with general timeframes for assessment activities. HRSD has grouped the asset inspection schedule into prioritized sets that can be more fully detailed after completion of data collection and screening. The SSES Field Activities will be completed by November 26, 2011.

5.3 Final Condition Assessment Report

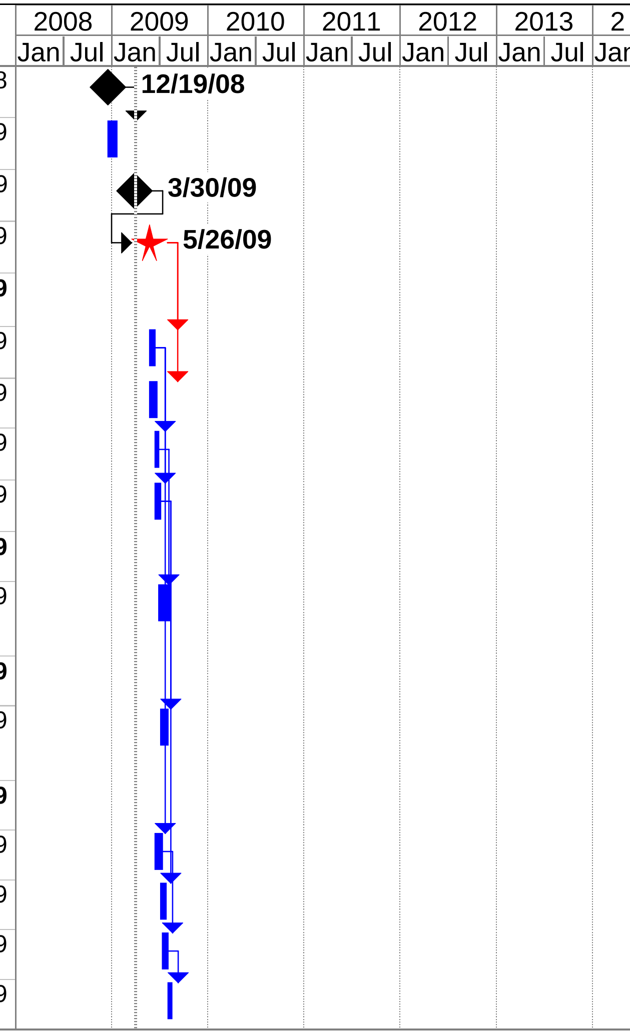
Following completion of SSES Field Activities, HRSD will prepare the Final Condition Assessment Report that is detailed in Section 4.6. This document will be completed along with the Rehabilitation Plan, and will provide detailed assessments, proposed improvements, implementation schedule, and cost estimates. The Final Condition Assessment Report and Rehabilitation Plan will be submitted by November 26, 2012 for review and approval by the DEQ. HRSD will begin implementation of the proposed Rehabilitation Plan upon written receipt of approval from the DEQ.

5.4 SSES Plan Implementation Schedule

As previously described, the detailed assessment schedule can not be finalized until the screening process is completed with the Preliminary Report. Although DEQ may have comments that impact the SSES Field Activities, HRSD has begun preliminary field inspections. The overall SSES Plan schedule is included on Figure 5-1.

HRSD SSES Plan
FIGURE 5-1. SSES PLAN SCHEDULE

ID	Task Name	Duration	Start	Finish
1	**Submittal of SSES Plan**	0 days	Fri 12/19/08	Fri 12/19/08
2	**DEQ Review of SSES Plan**	34 days	Fri 12/19/08	Thu 1/22/09
3	**Re-submittal of SSES Plan**	0 days	Mon 3/30/09	Mon 3/30/09
4	**Approval from DEQ (Assume 2 Months)**	0 days	Tue 5/26/09	Tue 5/26/09
5	**Preliminary Condition Assessment Report**	**120 days**	**Tue 5/26/09**	**Wed 9/23/09**
6	Gather and Review Data	21 days	Tue 5/26/09	Tue 6/16/09
7	Review Previous Condition Assessment Activities	28 days	Tue 5/26/09	Tue 6/23/09
8	Review Operation and Maintenance History	14 days	Tue 6/16/09	Tue 6/30/09
9	Review Failure History and SSOs	21 days	Tue 6/16/09	Tue 7/7/09
10	**Pumping Facility Screening**	**42 days**	**Tue 6/30/09**	**Tue 8/11/09**
11	Finalize existing prioritization of pumping facility inspections	42 days	Tue 6/30/09	Tue 8/11/09
12	**Gravity Sewer System Screening**	**28 days**	**Tue 7/7/09**	**Tue 8/4/09**
13	Review SSO data to prioritize gravity sewer inspections	28 days	Tue 7/7/09	Tue 8/4/09
14	**Force Main Screening**	**64 days**	**Tue 6/16/09**	**Wed 8/19/09**
15	Segment force main system	28 days	Tue 6/16/09	Tue 7/14/09
16	Review force main failure history	21 days	Tue 7/7/09	Tue 7/28/09
17	Develop criticality model	21 days	Tue 7/14/09	Tue 8/4/09
18	Identify FM for inspection and prioritize	15 days	Tue 8/4/09	Wed 8/19/09

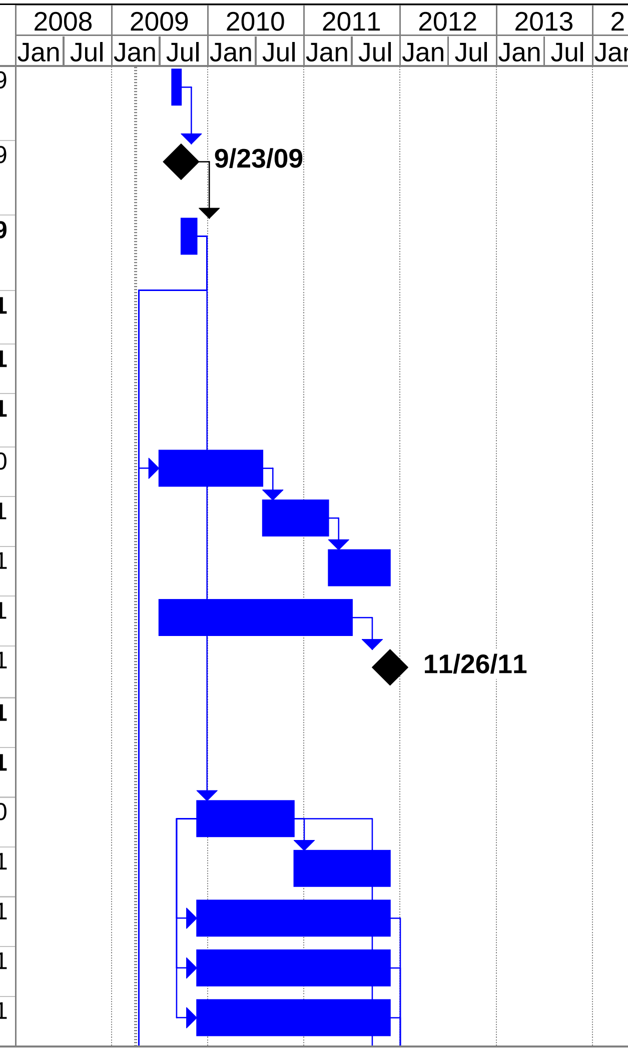


Date: Mon 3/30/09 | 1 | Task | Milestone

Dates shown in this schedule are based on regulatory approval of the SSES Plan and interim deliverables described in the Plan. Any delay beyond the duration shown for approval may extend the completion dates for some milestones.

HRSD SSES Plan
FIGURE 5-1. SSES PLAN SCHEDULE

ID	Task Name	Duration	Start	Finish
19	Prepare Preliminary Condition Assessment Report	35 days	Wed 8/19/09	Wed 9/23/09
20	Submit Preliminary Condition Assessment Report to DEQ	0 days	Wed 9/23/09	Wed 9/23/09
21	**DEQ Approve Preliminary Condition Assessment Report**	**60 days**	**Wed 9/23/09**	**Sun 11/22/09**
22	**SSES Field Activities**	**878 days**	**Wed 7/1/09**	**Sat 11/26/11**
23	**Pumping Facility Condition Assessment**	**878 days**	**Wed 7/1/09**	**Sat 11/26/11**
24	**Pumping Facilities Condition Assessment**	**878 days**	**Wed 7/1/09**	**Sat 11/26/11**
25	Group 1 Inspections	394 days	Wed 7/1/09	Fri 7/30/10
26	Group 2 Inspections	250 days	Fri 7/30/10	Wed 4/6/11
27	Group 3 Inspections	234 days	Wed 4/6/11	Sat 11/26/11
28	Pump Draw-down Tests	734 days	Wed 7/1/09	Tue 7/5/11
29	Complete Pumping Facility Condition Assessment	0 days	Sat 11/26/11	Sat 11/26/11
30	**Force Main Condition Assessment**	**734 days**	**Sun 11/22/09**	**Sat 11/26/11**
31	**Force Main Field Inspection**	**734 days**	**Sun 11/22/09**	**Sat 11/26/11**
32	Higher Priority Force Main Inspections	369 days	Sun 11/22/09	Fri 11/26/10
33	Lower Priority Force Main Inspections	365 days	Fri 11/26/10	Sat 11/26/11
34	Inspect Force Main Appurtenances	734 days	Sun 11/22/09	Sat 11/26/11
35	Exposed Pipelines (Aerials, etc.)	734 days	Sun 11/22/09	Sat 11/26/11
36	Evaluate Cathodic Protection	734 days	Sun 11/22/09	Sat 11/26/11

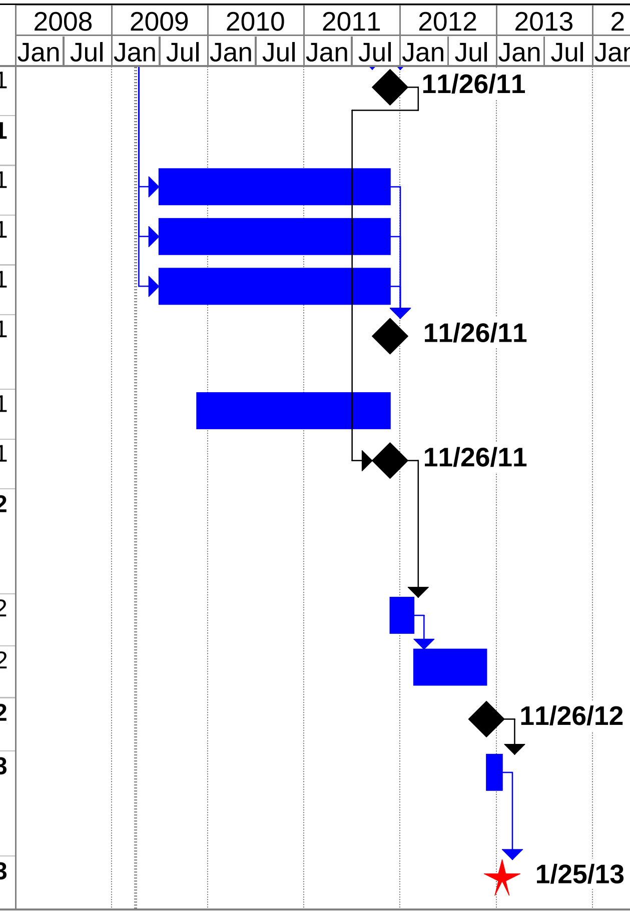


Date: Mon 3/30/09 2 Task Milestone

Dates shown in this schedule are based on regulatory approval of the SSES Plan and interim deliverables described in the Plan. Any delay beyond the duration shown for approval may extend the completion dates for some milestones.

HRSD SSES Plan
FIGURE 5-1. SSES PLAN SCHEDULE

ID	Task Name	Duration	Start	Finish
37	Complete FM Condition Assessment	0 days	Sat 11/26/11	Sat 11/26/11
38	**Gravity Sewer System Condition Assessment**	**878 days**	**Wed 7/1/09**	**Sat 11/26/11**
39	CCTV Inspections (PACP)	878 days	Wed 7/1/09	Sat 11/26/11
40	Manhole Inspections (MACP)	878 days	Wed 7/1/09	Sat 11/26/11
41	Smoke and Dye Testing Program	878 days	Wed 7/1/09	Sat 11/26/11
42	Complete Gravity Sewer System Condition Assessment	0 days	Sat 11/26/11	Sat 11/26/11
43	Find and Fix Program	734 days	Sun 11/22/09	Sat 11/26/11
44	Complete SSES Field Activities	0 days	Sat 11/26/11	Sat 11/26/11
45	**Final Condition Assessment Report and Rehabilitation Plan**	**366 days**	**Sat 11/26/11**	**Mon 11/26/12**
46	Prepare Final Condition Assessment Report	90 days	Sat 11/26/11	Fri 2/24/12
47	Prepare Rehabilitation Plan	276 days	Fri 2/24/12	Mon 11/26/12
48	**Submit Final Report and Rehabilitation Plan to DEQ**	**0 days**	**Mon 11/26/12**	**Mon 11/26/12**
49	**DEQ to approve Final Condition Assessment Report and Rehabilitation Plan**	**60 days**	**Mon 11/26/12**	**Fri 1/25/13**
50	**Begin Implementation of Rehabilitation Plan**	**0 days**	**Fri 1/25/13**	**Fri 1/25/13**



Date: Mon 3/30/09 | 3 | Task | Milestone

Dates shown in this schedule are based on regulatory approval of the SSES Plan and interim deliverables described in the Plan. Any delay beyond the duration shown for approval may extend the completion dates for some milestones.

APPENDIX A: HRSD SEWER SYSTEM MAPS

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
NF-001	13372	8, 18, 24	PCCP
NF-001A	250	12, 14, 18,	DIP, PVC
NF-002	10260	8, 10, 12, 30, 24	DIP
NF-003	10810	4, 8, 12, 24, 30	DIP, PCCP
NF-004	4941	8, 16, 24, 36	PCCP
NF-005	14933	8, 10, 12, 36	PCCP
NF-006	10961	6, 12, 20, 36	PCCP
NF-006X	307	6, 20	CIP
NF-007	9324	8, 12, 24	DIP, CIP
NF-008	31226	4, 6, 8, 10, 12 14, 16, 24	DIP, CIP, PCCP, PE
NF-009	3098	12, 14	DIP, PE
NF-010	7695	8, 12, 16	DIP, AC
NF-011	13905	6, 8, 10, 30, 42	PCCP
NF-011X	15238	6, 8, 10, 12, 16, 30, 36, 42	AC, PCCP
NF-012	9613	2, 8, 16, 24, 48	PCCP
NF-013	3639	6, 8, 10, 14, 16	DIP, CIP, PCCP
NF-014	3480	6, 8, 10, 16	CIP
NF-015	13895	4, 6, 8, 12, 16, 24	CIP
NF-016	7307	6, 8, 18, 24, 30	DIP, CIP, PCCP
NF-017	15310	6, 8, 12, 24, 36	CIP
NF-018	5042	6, 8, 18, 24, 30	DIP, CIP, PCCP
NF-020	5537	8, 10, 12, 14, 16	DIP, CIP
NF-021	1443	10, 12	CIP
NF-022	1868	8, 16, 30	AC, PCCP
NF-023	3357	8, 12, 16, 30	AC, PCCP
NF-024	14262	4, 6, 8, 12, 30	CIP, PCCP
NF-025	7394	18, 30	CIP, RCCP
NF-027	14487	10, 16	DIP
NF-028	2674	12, 36	CIP, RCCP
NF-029	3112	8, 12, 24, 36	CIP
NF-030	3784	6, 8, 12, 36	RCP
NF-031	1061	6, 8, 12	DIP, CIP, PE
NF-032	4823	6, 8, 10, 12, 18	DIP, CIP
NF-033	7112	6, 8, 12, 18	CIP, RCCP
NF-036	3375	6, 10, 12	AC
NF-037	7383	6, 10, 12, 36	CIP, RCCP
NF-038	514	6	CIP
NF-039	6267	30, 36	CIP, SP
NF-040	4147	6, 12, 16	DIP, AC

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
NF-041	6173	12	CIP
NF-042	18414	20	AC
NF-042X	624	12	CIP
NF-043	3945	12	CIP
NF-046	5491	4, 8, 10, 12, 30	CIP
NF-047	9069	30	CIP
NF-048	3351	16, 18, 24, 30	DIP, CIP
NF-049	11761	30	CIP
NF-050	2458	12	CIP
NF-055	542	6	DIP
NF-058	21755	16, 24, 30	DIP, RCCP, CIP
NF-059	2764	12, 18	AC, CIP
NF-060	4452	18	AC
NF-061	10281	30	CIP
NF-065	2719	24	DIP
NF-066	8601	24	DIP
NF-068	1426	12	DIP
NF-071	4051	12	DIP, CIP
NF-073	3676	12	AC
NF-074	2705	16	DIP
NF-077	3682	14	CIP
NF-085	4170	14	CIP
NF-089	5243	24	DIP
NF-091	4784	16	AC, CIP
NF-093	5468	16	AC, CIP
NF-093A	47	16	AC
NF-093B	44	10	ESVC
NF-096	4254	16	CIP
NF-097	6769	16	CIP
NF-100	1085	20	AC
NF-105	4308	10	CIP
NF-107	3251	16	CIP
NF-113	5588	10, 12, 14, 16	CIP
NF-119	861	20	CIP
NF-120	950	16, 24	AC
NF-121	2546	8, 12	CIP
NF-122	269	18	CIP
NF-130	4641	30	DIP
NF-132	1058	12, 14	CIP

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
NF-133	5781	30	DIP, RCCP
NF-153	7890	30	DIP
NF-157	306	30	CIP, RCCP
NF-158	1767	30	RCCP
NF-162	1151	12	CIP
NF-163	9491	18	DIP
NF-165	8645	16	DIP
NF-171	7416	8, 18, 24, 30	DIP, CIP, PCCP
NF-172	14391	12, 24, 30, 36	DIP, PCCP
NF-173	18649	6, 8, 10, 16	AC
NF-177	12073	8, 20, 24	DIP
NF-178	14761	8, 12, 24	DIP
NF-178A	96	24	DIP
NF-178B	81	8, 24	DIP
NF-178C	370	12	DIP
NF-178D	379	12	DIP
NF-179	14418	6, 8, 10, 24	DIP
NF-180	5005	8, 16, 30	DIP
NF-181	3796	30	DIP
NF-182	12570	2, 4, 8, 11, 24, 30	DIP
NF-183	14075	2, 4, 8, 16	DIP
NF-184	13493	2, 4, 6, 8, 16	DIP, PVC
NF-185	13843	2, 4, 8, 20	DIP
NF-186	12846	2, 4, 8, 20	DIP
NF-187	19785	2, 4, 10, 12, 18	DIP
NF-188	6920	2, 4, 8, 16	DIP, PVC
NF-189	7705	2, 4, 8, 16	DIP, PVC
NF-190	36798	8, 20, 24	DIP
NF-191	8489	4, 8, 18	DIP, PVC
NF-191A	351	12	DIP
NF-192	4135	24, 36	DIP
NF-193	12167	30	DIP
NF-194	6955	30	DIP
NF-195	7095	8, 24, 30	DIP
NF-204	4154	20	DIP
NF-205	11675	8, 16, 30, 36	DIP
SF-002	3714	20, 24, 36	DIP, PCCP
SF-004	12100	6, 24	CIP
SF-005	19578	20	CIP, RCP

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
SF-006	2802	10, 12	CIP
SF-007	12704	20	RCP
SF-008	6146	20	CIP
SF-009	9742	20	CIP
SF-010	918	20	CIP
SF-011	2982	20	CIP
SF-012	4481	20, 24	DIP, CIP
SF-013	7805	24, 42	DIP, RCP
SF-014	4010	24, 42	DIP, RCP
SF-015	8468	4, 8, 10, 12, 20	AC, CIP, SP
SF-016	30158	6, 8, 12, 14, 16, 20, 36, 42, 48	DIP, PCCP
SF-017	5815	42	RCP
SF-018	5506	24	DIP
SF-019	4647	20	AC
SF-020	12382	16, 18	AC, CIP
SF-022	17094	16	DIP
SF-023	9483	8, 10, 12, 2, 48	DIP, PCCP
SF-024	4256	10, 42	PCCP
SF-025	8542	6, 8, 10, 36	PCCP
SF-026	9774	8, 10, 12, 30	CIP, PCCP
SF-027	14068	8, 30, 36	DIP, PCCP
SF-028	15445	6, 8, 24, 30	DIP, PCCP
SF-029	9363	6, 8, 10, 16, 30	PCCP
SF-030	5407	8, 14	AC, DIP
SF-031	5957	8, 12, 24	DIP
SF-032	2199	6, 8, 14	CIP
SF-036	1738	14	DIP
SF-037	2514	8, 12	DIP, CIP
SF-038	5038	20	CIP
SF-039	1448	6	CIP
SF-040	1510	8	CIP
SF-042	963	6, 8	CIP
SF-043	1226	8	CIP
SF-046	3740	10	CIP
SF-051	10026	18, 24	DIP, RCP
SF-052	1306	10	CIP
SF-057	3543	30, 39, 42, 48,	DIP, HDPE, RCP
SF-057X	37	24	RC
SF-058	2190	30, 48	RCP

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
SF-059	5942	42	RCP
SF-060	2291	24	RCP
SF-062	981	6	CIP
SF-064	1302	6	CIP
SF-065	1381	16, 18	CIP
SF-066	7423	18	CIP
SF-069	3305	12	CIP
SF-070	2688	16	CIP
SF-071	87	42	PCCP
SF-076	1800	8	CIP
SF-080	3702	10, 24	DIP
SF-081	4129	16, 30, 36	DIP, RCP
SF-082	7199	12, 20	CIP
SF-083	1028	24	RCP
SF-084	1663	8, 24, 30	RCP
SF-086	1126	8	CIP, SP
SF-087	2157	12	CIP
SF-090	2069	12	CIP
SF-091	7753	8, 12	DIP, CIP
SF-092	3569	8	CIP
SF-093	1371	6, 8, 10	CIP
SF-094	2643	8	CIP
SF-095	2729	24	CIP
SF-097	10129	12, 20, 24, 30	DIP
SF-099	3321	8, 10, 20	CIP, PVC
SF-100	3560	6, 8, 10, 12	CIP, PVC
SF-101	2618	6, 8, 10	DIP, CIP
SF-103	5156	10, 16	AC, DIP
SF-106	9191	4, 6, 8, 12	DIP, CIP
SF-109	1983	8, 10, 16	AC
SF-110	1899	8, 10, 14	AC, DIP, CIP
SF-111	2079	4, 10	DIP, CIP
SF-114	966	8, 12, 20, 24	AC
SF-115	2250	8, 12, 1414	AS, CIP
SF-116	4577	8, 16	AS, CIP
SF-117	8606	24	RCP
SF-118	22618	9, 10, 24, 36, 42	DIP, PCCP, SP
SF-119	26182	36	RCP
SF-120	8716	24	RCP

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
SF-121	6279	8, 10, 24	DIP, CIP
SF-122	5057	24	DIP, RCP
SF-123	3232	16, 24	DIP, RCP
SF-124	6946	16	DIP
SF-125	3054	16	DIP
SF-126	6563	16, 30	DIP, RCP
SF-127	10960	18	AC
SF-128	5295	24	DIP
SF-129	6906	16, 24	DIP, RCP
SF-130	8273	16	AC, DIP
SF-131	10588	12, 16	AC, DIP
SF-132	1118	20	AC, CIP, PVC
SF-133	3349	6, 8, 12, 14, 18	CIP
SF-134	14272	30	RCP
SF-135	20553	18, 24, 42	RCCP
SF-136	17804	6, 8, 30	DIP, PCCP
SF-137	16389	8, 30	PCCP
SF-138	14399	8, 10, 24	DIP
SF-139	4139	6, 12	CIP
SF-140	3306	12	CIP
SF-141	6307	6, 8, 10, 16	CIP
SF-142	3831	6, 8, 16, 24	DIP, CIP
SF-143	10026	6, 8, 12, 24, 30	DIP, CIP, PCCP
SF-144	12708	8, 10, 12, 24	DIP, CIP
SF-146	2706	12	CIP, PVC
SF-147	11950	10, 12, 18, 20	DIP, PVC
SF-150	11908	6, 8, 18, 30	DIP
SF-154	929	10	CIP
SF-155	858	6, 12	CIP
SF-156	766	24	DIP
SF-158	4908	8, 10, 24	DIP
SF-159	11278	8, 36	DIP, PCCP, SP
SF-160	14480	8, 14, 16, 18, 30	DIP
SF-163	2223	10	CIP
SF-164	13138	8, 12, 30	DIP, PVC
SF-165	9833	8, 12, 16, 36	DIP, RCP
SF-166	1934	8, 12, 36, 42	PCCP, SP
SF-167	9889	42	PCCP
SF-168	3258	36	PCCP

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
SF-169	16073	36, 42	PCCP
SF-170	3036	16	DIP
SF-171	20535	42	PCCP
SF-172	13474	30, 42	DIP, PCCP
SF-173	4322	10, 12	AC, DIP
SF-174	5401	42	RCCP
SF-175	8901	42	PCCP
SF-176	2677	12	DIP
SF-177	9587	30, 42	DIP, PCCP
SF-178	7376	8, 20, 24	DIP, CIP
SF-179	946	24	CIP
SF-180	4903	4, 6, 20, 24	DIP, CIP
SF-181	2078	8, 10, 20	DIP
SF-182	9148	2, 8, 16, 20	AC, DIP
SF-183	9196	6, 12, 20	AC, DIP
SF-184	5663	8, 14, 16	AC, DIP
SF-185	1818	6, 8, 10, 24	DIP, PCCP
SF-186	9191	8, 14	AC
SF-187	4697	10, 18	DIP
SF-188	3276	6, 8, 14	AC, DIP
SF-189	7741	8, 20, 24	DIP, CIP, PCCP
SF-190	18945	8, 10, 30	PCCP
SF-194	16092	8, 24, 30	PCCP
SF-195	140	30	RCP
SF-197	6156	24, 30	RCP
SF-198	4162	14, 16, 20	CIP
SF-199	6327	8, 12	AC, DIP
SF-200	1437	6, 8, 10, 12	CIP
SF-203	2460	8, 12	DIP
SF-204	1924	12, 18	CIP
SF-206	5512	6, 8, 12, 16	DIP
SF-208	5296	16	AC
SF-209	5905	6, 8, 16	DIP, PVC
SF-210	16352	4, 8, 12, 16, 30	DIP
SF-211	5447	8, 12, 24, 30	DIP, PCCP
SF-212	8135	2, 4, 8, 10, 24	DIP
SF-213	18838	30, 36, 42	DIP, PCCP, SP
SF-214	12871	8, 12, 24	DIP
SF-216	8305	18, 20, 24	CIP, RCP

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
SF-217	4313	24	RCP
SF-218	5642	30	PCCP
SF-219	13207	24, 20	CIP, RCP
SF-220	2476	30	RCP
SF-221	10850	48	DIP, RCP
SF-222	5708	24, 48	CIP, RCP
SF-223	1405	24	RCP
SF-224	2102	24	RCP
SF-225	1632	30	RCP
SF-226	2572	30, 36	CIP, RCP
SF-227	12598	42, 48	DIP
SF-228	5122	42, 48	DIP, PCCP
SF-229	826	8, 12	DIP
SF-230	687	12, 24	DIP
SF-231	378	14	AC, DIP
SF-232	3245	12, 24	DIP
SF-233	6005	18	DIP
SF-234	16426	8, 12, 24	DIP
SF-235	7865	16, 24, 30	DIP
SF-236	22314	8, 30, 36	DIP
SF-237	12086	6, 8, 10, 16, 18, 36	DIP
SF-238	1568	36	SP
SF-239	2835	12, 24, 36	DIP
SF-240	4898	8, 12, 30, 36	*TBD*
SF-241	4750	30	DIP, SP
SF-242	8217	8, 12, 30	DIP
SF-243	3585	30	SP
SF-244	13205	8, 30	DIP
SF-245	20135	6, 8, 30	DIP
SF-246	6890	8, 12, 30	DIP
SF-247	1871	30	SP
SF-248	11945	10, 24, 30	DIP
SF-249	426	8, 24	DIP
SF-250	1314	24	SP
SF-251	4532	8, 10, 24	DIP
SF-252	2993	8, 18, 20	DIP
SF-253	23508	8, 18, 20, 24	DIP
SF-254	22614	8, 12, 20	DIP
SF-255	6621	8, 20	DIP

Table A-1. HRSD Force Mains			
Line Number	Length (Feet)	Diameter (Inches)	Material
SF-256	8518	42, 48, 54	DIP, SP
SF-258	14249	8, 20, 24	DIP
SF-259	1099	8, 16	DIP
SF-260	10743	42	DIP
SF-262	11908	42	DIP
SF-263	2548	36, 42	DIP
SF-264	5944	8, 12, 18, 30	DIP
SF-267	5938	6, 8, 12, 30	DIP
SF-268	941	30	DIP
SF-269	1589	30	HDPE
SF-270	426	30	DIP
SF-271	8789	12, 42, 48	SP
SF-272	8508	12, 48	SP
SF-273	1966	48	SP
SF-274	2777	10, 30, 48	DIP, SP
SF-275	3925	42	DIP
SF-276	10828	8, 36	DIP
SF-277	11131	8, 12, 36	DIP
SF-278	772	8, 16	DIP
SF-279	2241	16	DIP
SF-NAT	3751	54	PCCP
SF-OUT	366	14	CIP
TOTAL	2,337,527		
SUMMARY	Length (ft)	Size Range (inches)	Percent of System
	41,991	0-10	1.80%
	736,061	12-20	31.49%
	951,764	21-30	40.72%
	441,737	36-42	18.90%
	114,019	48-54	4.88%
	51,955	UNK	2.22%

Table A-2. HRSD Gravity Mains				
Line Number	Length (Feet)	Diameter (Inches)	Material	Number of Manholes
NG-034	2228	24	ESVC	10
NG-035	970	18	ESVC	6
NG-044	3168	18	VC	15
NG-045	3498	21	VC	13
NG-052	662	15, 18	ESVC	2
NG-053	6277	15, 18	ESVC	35
NG-054	2143	21	RCP	10
NG-056	281	10	ESVC	1
NG-057	5666	15	*TBD*	28
NG-062	119	12	VC	1
NG-063	3298	12	VC	18
NG-064	739	8, 20, 21	ESVC	2
NG-067	2860	15, 18, 20, 24	VC	5
NG-078	2362	18	VC	13
NG-082	3459	18	RCP	25
NG-083	930	15	RCP	7
NG-084	829	24, 30	RCP	4
NG-086	3754	15	CIP	22
NG-087	1311	18	ESVC	7
NG-088	4023	10, 12	VC	25
NG-092	1152	16, 18, 24	AC	5
NG-094	1277	15, 18	ESVC	7
NG-095	2752	18	ESVC	19
NG-098	4651	18, 21, 24	ESVC	6
NG-099	3089	18	*TBD*	11
NG-101	612	18, 21	VC	4
NG-102	332	18	RCP	2
NG-103	3831	27	CIP, RCP	21
NG-104	888	21	RCP	9
NG-106	3610	8, 27, 36	RCP	11
NG-108	4630	36	RCP	31
NG-109	6280	6, 10, 24	ESVC	29
NG-110	2601	39, 42	RCP	8
NG-111	1697	15	RCP	9
NG-112	911	24	RCP	3
NG-114	986	42	RCP	3
NG-115	719	24	RCP	4
NG-116	680	18	RCP	2
NG-117	398	18	RCP	3

Table A-2. HRSD Gravity Mains				
Line Number	Length (Feet)	Diameter (Inches)	Material	Number of Manholes
NG-118	400	18	RCP	1
NG-123	1019	8, 12	RCP	10
NG-124	4348	48	RCP	18
NG-125	2884	48	PCCP	11
NG-126	428	18	CIP	2
NG-127	4012	18, 24, 30	DIP, ESVC	17
NG-129	203	18, 20	CIP	8
NG-130X	1063	30	DIP	*TBD*
NG-134	475	42	RCP, PCCP	3
NG-135	175	42	RCP	8
NG-136	1120	42	CIP	4
NG-137	832	24, 30	CIP	2
NG-138	829	42	RCP	6
NG-141	1249	18	VC	5
NG-142	4110	18	VC	18
NG-143	5127	8, 10, 24	RCP	23
NG-146	126	24	CIP	1
NG-147	2305	24	RCP	9
NG-148	3303	24	RCP	8
NG-149	110	24	RCP	2
NG-150	1479	24	RCP	6
NG-151	48	24	RCP	1
NG-152	1832	24	RCP	7
NG-157	613	15	RCP	2
NG-159	3772	24, 30	RCP	18
NG-160	1457	24	RCP	7
NG-164	468	8	*TBD*	3
NG-166	254	25, 20	*TBD*	8
NG-167	100	20	*TBD*	10
NG-168	752	20	*TBD*	12
NG-169	4760	42, 54	*TBD*	9
NG-174	1538	24, 27	PCCP	7
NG-175	1242	18, 21	DIP	8
NG-176	477	21	DIP	3
SG-001	6311	20, 24, 30, 36	RCP	12
SG-003	2581	42, 54	RCP	12
SG-033	1408	18	ESVC	6
SG-034	2034	27	ESVC	7
SG-035	1518	18	ESVC	7

Table A-2. HRSD Gravity Mains				
Line Number	Length (Feet)	Diameter (Inches)	Material	Number of Manholes
SG-041	958	8, 12	CIP	3
SG-044	1074	10	VC	10
SG-045	4305	8, 12	CIP	*TBD*
SG-047	3404	54	RCP	13
SG-048	962	18	VC	4
SG-049	805	30	CIP	3
SG-050	4307	48, 54	RCP	11
SG-053	1108	42	RCP	4
SG-054	270	48	RCP	4
SG-055	838	30	RCP	4
SG-056	200	54	RCP	1
SG-061	3360	24, 30	ESVC	*TBD*
SG-063	2342	10	VC	13
SG-067	1595	12	VC	14
SG-068	995	8	VC	6
SG-068X	230	8	VC	*TBD*
SG-071	769	12	VC	3
SG-072	599	10	VC	4
SG-073	1463	15	VC	12
SG-074	2813	21	VC	12
SG-075	1798	12	VC	9
SG-077	161	18	VC	1
SG-078	859	12	ESVC	7
SG-079	1785	10	ESVC	5
SG-088	3382	27	CIP	21
SG-089	3706	24	CIP	19
SG-096	4203	30	RCP	16
SG-098	3133	24, 30	RCP	15
SG-102	1918	10	VCP	9
SG-104	1642	10	VCP	7
SG-105	1101	8	VCP	8
SG-107	390	8	ESVC	2
SG-108	663	12	ESVC	4
SG-112	793	18	ESVC	6
SG-113	5236	12, 16, 18, 24	CIP	24
SG-145	1293	12	VC	7
SG-148	3520	21	CIP	17
SG-149	3427	24	CIP, ESVC	16
SG-151	5408	18	DIP	16

Table A-2. HRSD Gravity Mains

Line Number	Length (Feet)	Diameter (Inches)	Material	Number of Manholes
SG-152	1289	18	VCPE	6
SG-153	2863	18	CIP, ESVC	18
SG-155	8	6	CIP	*TBD*
SG-157	2171	18	ESVC	11
SG-161	2992	18	VCP	14
SG-162	1126	15	VCP	3
SG-191	5467	24	ESVC	31
SG-192	140	18	CIP	2
SG-193	16109	18	RCP	83
SG-196	1651	36	RCP	7
SG-201	285	8	ESVC	*TBD*
SG-202	1874	12	CIP	11
SG-205	857	6, 8, 10	CIP	7
SG-207	325	12	VC	2
TOTAL	274,664			1,357
SUMMARY	Length (ft)	Size Range (inches)	Percent of System	
	19,696	10	7.17%	
	112,771	12-20	41.06%	
	87,545	21-30	31.87%	
	24,397	36-42	8.88%	
	21,956	48-54	7.99%	
	8,299	UNK	3.02%	

Table A-3. HRSD Pumping Facilities				
PS/PRS Number	Name	Address	Pumping Station	PRS
101	Arctic Avenue	2814 Arctic Ave, Virginia Beach	X	
102	Ashland Circle	1402 Ashland Circle, Norfolk	X	
103	Bainbridge Blvd	801 Bainbridge Blvd, Norfolk	X	
104	Cedar Lane	5915 Cedar Lane, Portsmouth	X	
105	Chesapeake Blvd	5734 Chesapeake Blvd, Norfolk	X	
106	City Park	Ft of La Vallette Avenue, Norfolk	X	
107	Colley Avenue	715 Fairfax Avenue, Norfolk	X	
108	Dovercourt Road	948 Dovercourt Road, Norfolk	X	
109	Dozier's Corner	1121 Keats Street, Norfolk	X	
110	Ferebee Avenue	2812 Bainbridge Blvd, Chesapeake	X	
111	Granby Street	4244 Granby Street, Norfolk	X	
112	Independence Blvd PRS	4562 Southern Blvd, Virginia Beach		X
113	Luxembourg Avenue	3030 Luxembourg Avenue, Norfolk	X	
114	Monroe Place	5808 Monroe Place, Norfolk	X	
115	Newtown Road	115 Newtown Road, Norfolk	X	
116	Norchester Street	935 Norchester Street, Norfolk	X	
117	North Shore Road	1510 1/2 North Shore Road, Norfolk	X	
118	Norview Avenue	869 Norview Avenue, Norfolk	X	
119	Park Avenue	503 Park Avenue, Chesapeake	X	
120	Pine Tree PRS	2924 Virginia Beach Blvd, Virginia Beach		X
121	Plume Street	236 E. Plume Street, Norfolk	X	
122	Powhatan Avenue	1548 Buckingham Avenue, Norfolk	X	
123	Quail Avenue	800 Quail Avenue, Chesapeake	X	
124	Richmond Crescent	128 Richmond Crescent, Norfolk	X	
125	Seay Avenue	3541 Seay Avenue, Norfolk	X	
127	State Street	351 Emmett Place, Norfolk	X	

Table A-3. HRSD Pumping Facilities				
PS/PRS Number	Name	Address	Pumping Station	PRS
128	Steamboat Creek	1900 E. Indian River Road, Chesapeake	X	
129	Taussig Blvd	2017 Taussig Blvd, Norfolk	X	
130	Virginia Beach Blvd	3514 E. Virginia Beach Blvd, Norfolk	X	
131	Washington Plant	1728 Great Bridge Blvd, Chesapeake	X	
132	Willoughby Avenue	1912 Willoughby Avenue, Norfolk	X	
133	Providence Road PRS	5729 Old Providence Road, Virginia Beach		X
134	Pughsville Road PRS	4725 Shoulders Hill Road, Suffolk		X
135	Suffolk	1136 Sanders Drive, Suffolk	X	
137	Bowers Hill PRS	3588 South Military Hwy, Chesapeake		X
138	Deep Creek PRS	1221 Shell Road, Chesapeake		X
139	Quail Avenue PRS	822 Quail Avenue, Chesapeake		X
140	Atlantic Avenue PRS	1085 Old Dam Neck Road, Virginia Beach		X
141	Hanover Avenue	900 Hanover Avenue, Norfolk	X	
142	Jamestown Crescent	858 Jamestown Crescent, Norfolk	X	
143	Shipps Corner PRS	1423 London Bridge Blvd, Virginia Beach		X
144	Elmhurst Lane	600 Elmhurst Lane, Portsmouth	X	
145	Rodman Avenue	2412 Rodman Avenue, Portsmouth	X	
146	Camden Avenue	2203 Camden Ave., Portsmouth	X	
147	Chesterfield Blvd	2731 Chesterfield Blvd, Norfolk	X	
148	Ingleside Road	600 Ingleside Road, Norfolk	X	
151	Kempsville Road PRS	4765 Ferrell Parkway, Virginia Beach		X
152	Terminal Blvd PRS	7808 Newport Avenue, Norfolk		X
153	Laskin Road PRS	590 Fremac Avenue, Virginia Beach		X
154	Route 337 PRS	2472 Gum Road, Chesapeake		X

Table A-3. HRSD Pumping Facilities				
PS/PRS Number	Name	Address	Pumping Station	PRS
201	25th Street	11 25th Street, Newport News	X	
202	33rd Street	85 33rd Street, Newport News	X	
203	Bay Shore	720 Bay Shore Lane, Hampton	X	
204	Bloxoms Corner	5 Beach Rd, Hampton	X	
205	Big Bethel PRS	1431 Big Bethel Rd, Hampton		X
206	Bridge St	4701 Victoria Blvd, Hampton	X	
207	Center Ave	315 Center Ave, Newport News	X	
208	Claremont	1210 Chesapeake Ave, Hampton	X	
209	Copeland Park	4401 City Line Rd, Newport News	X	
210	Ferguson Park	227 75th Street, Newport News	X	
211	Hampton U	54 Shore Drive, Hampton	X	
212	Hilton School	223 River Rd, Newport News	X	
213	Jefferson Ave	BHTP, Newport News	X	
214	Kingsmill	7851 Pocahontas Trl, Williamsburg	X	
215	Lee Hall PRS	17388 Warwick Blvd, Newport News		X
216	Lucas Creek PRS	750 Lucas Creek Road, Newport News	X	X
217	Langley Circle	4 Thornrose Ave, Hampton	X	
218	Morrison	1228 Gatewood Rd, Newport News	X	
219	Newmarket	6000 Orcutt Ave, Newport News	X	
220	Normandy Lane	116 Normandy Lane, Newport News	X	
221	Patrick Henry	215 G Avenue, Newport News	X	
222	Pine Chapel	42 Freeman Drive, Hampton	X	
223	Washington Street	217 Washington St, Hampton	X	
224	Woodland Road	11 McElheney Lane, Hampton	X	
225	Willard Ave	219 National Ave, Hampton	X	
226	Williamsburg	540 South England Street, Williamsburg	X	
227	Fort Eustis	1619 Taylor Ave, Newport News	X	

Table A-3. HRSD Pumping Facilities				
PS/PRS Number	Name	Address	Pumping Station	PRS
229	Colonial Williamsburg	1000 State Route 132, York Co	X	
230	Rolling Hills	414 Rolling Hills Dr, York Co	X	
231	Ford's Colony	430 Hempstead Road, Williamsburg	X	
232	Greensprings	3900 John Tyler Mem. Hwy, Williamsburg	X	

NORTH SHORE PUMP STATIONS		
NUMBER	NAME	LOCATION
201	25TH ST	NEWPORT NEWS
202	33RD ST	NEWPORT NEWS
203	BAY SHORE LN	HAMPTON
204	BLOXOMS CORNER	HAMPTON
205	BIG BETHEL PRS	HAMPTON
206	BRIDGE ST	HAMPTON
207	CENTER AVE	HAMPTON
208	CLAREMONT AVE	HAMPTON
209	COPELAND PARK	NEWPORT NEWS
210	FERGUSON PARK	NEWPORT NEWS
211	HAMPTON UNIVERSITY	HAMPTON
212	HILTON SCHOOL	NEWPORT NEWS
213	JEFFERSON AVE	NEWPORT NEWS
214	KINGSMILL	WILLIAMSBURG
215	LEE HALL PRS	NEWPORT NEWS
216	LUCAS CREEK PRS	NEWPORT NEWS
217	LANGLEY CIRCLE	HAMPTON
218	MORRISON	NEWPORT NEWS
219	NEWMARKET CREEK	NEWPORT NEWS
220	NORMANDY LN	NEWPORT NEWS
221	PATRICK HENRY	NEWPORT NEWS
223	WASHINGTON ST	HAMPTON
224	WOODLAND RD	HAMPTON
225	WILLARD AVE	HAMPTON
226	WILLIAMSBURG	WILLIAMSBURG
227	FORT EUSTIS	NEWPORT NEWS
229	COLONIAL WILLIAMSBURG	YORK COUNTY
230	ROLLING HILLS	YORK COUNTY
231	FORDS COLONY	WILLIAMSBURG
232	GREENSPRINGS	WILLIAMSBURG
233	LODGE ROAD	WILLIAMSBURG

Sewer System Map - North Shore

0 2.5 5 10 Miles

HAMPTON ROADS SANITATION DISTRICT

BROWN AND CALDWELL

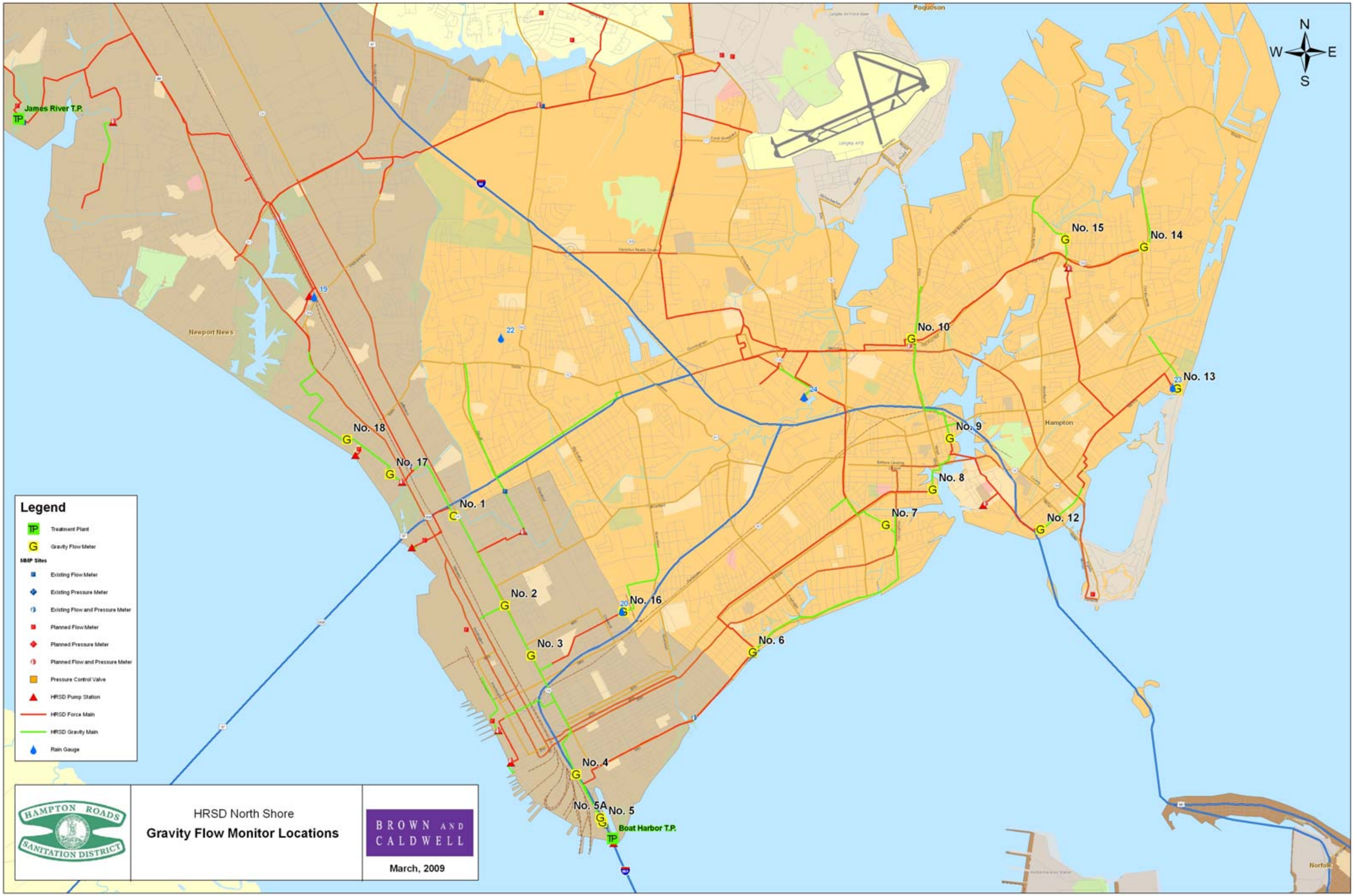
SOUTH SHORE PUMP STATIONS

NUMBER	NAME	LOCATION
101	ARCTIC AVENUE	VIRGINIA BEACH
102	ASHLAND CIRCLE	NORFOLK
103	BAINBRIDGE BLVD	NORFOLK
104	CEDAR LANE	PORTSMOUTH
105	CHESAPEAKE BLVD	NORFOLK
106	CITY PARK	NORFOLK
107	COLLEY AVE	NORFOLK
108	DOVERCOURT RD	NORFOLK
109	DOZIER'S CORNER	NORFOLK
110	FEREBEE AVE	CHESAPEAKE
111	GRANBY ST	NORFOLK
112	INDEPENDENCE BLVD PRS	VIRGINIA BEACH
113	LUXEMBOURG AVE	NORFOLK
114	MONROE PLACE	NORFOLK
115	NEWTOWN RD	NORFOLK
116	NORCHESTER ST	NORFOLK
117	NORTH SHORE RD	NORFOLK
118	NORVIEW AVE	NORFOLK
119	PARK AVE	CHESAPEAKE
120	PINE TREE PRS	VIRGINIA BEACH
121	PLUME ST	NORFOLK
122	POWHATAN AVE	NORFOLK
123	QUAIL AVENUE	CHESAPEAKE
124	RICHMOND CRESCENT	NORFOLK
125	SEAY AVE	NORFOLK
127	STATE ST	NORFOLK
128	STEAMBOAT CREEK	CHESAPEAKE
129	TAUSSIG BLVD	NORFOLK
130	VIRGINIA BEACH BLVD	NORFOLK
131	WASHINGTON PLANT	CHESAPEAKE
132	WILLOUGHBY AVE	NORFOLK
133	PROVIDENCE RD PRS	VIRGINIA BEACH
134	PUGHSVILLE PRS	SUFFOLK
135	SUFFOLK	SUFFOLK
137	BOWERS HILL PRS	CHESAPEAKE
138	DEEP CREEK PRS	CHESAPEAKE
139	QUAIL AVENUE PRS	CHESAPEAKE
140	ATLANTIC PRS	VIRGINIA BEACH
141	HANOVER AVE	NORFOLK
142	JAMESTOWN CRESCENT	NORFOLK
143	SHIPPS CORNER PRS	VIRGINIA BEACH
144	ELMHURST LN	PORTSMOUTH
145	RODMAN AVE	PORTSMOUTH
146	CAMDEN AVE	PORTSMOUTH
147	CHESTERFIELD BLVD	NORFOLK
148	INGLESIDE RD	NORFOLK
151	KEMPSVILLE PRS	VIRGINIA BEACH
152	TERMINAL PRS	NORFOLK
153	LASKIN RD PRS	VIRGINIA BEACH
154	ROUTE 337 PRS	CHESAPEAKE

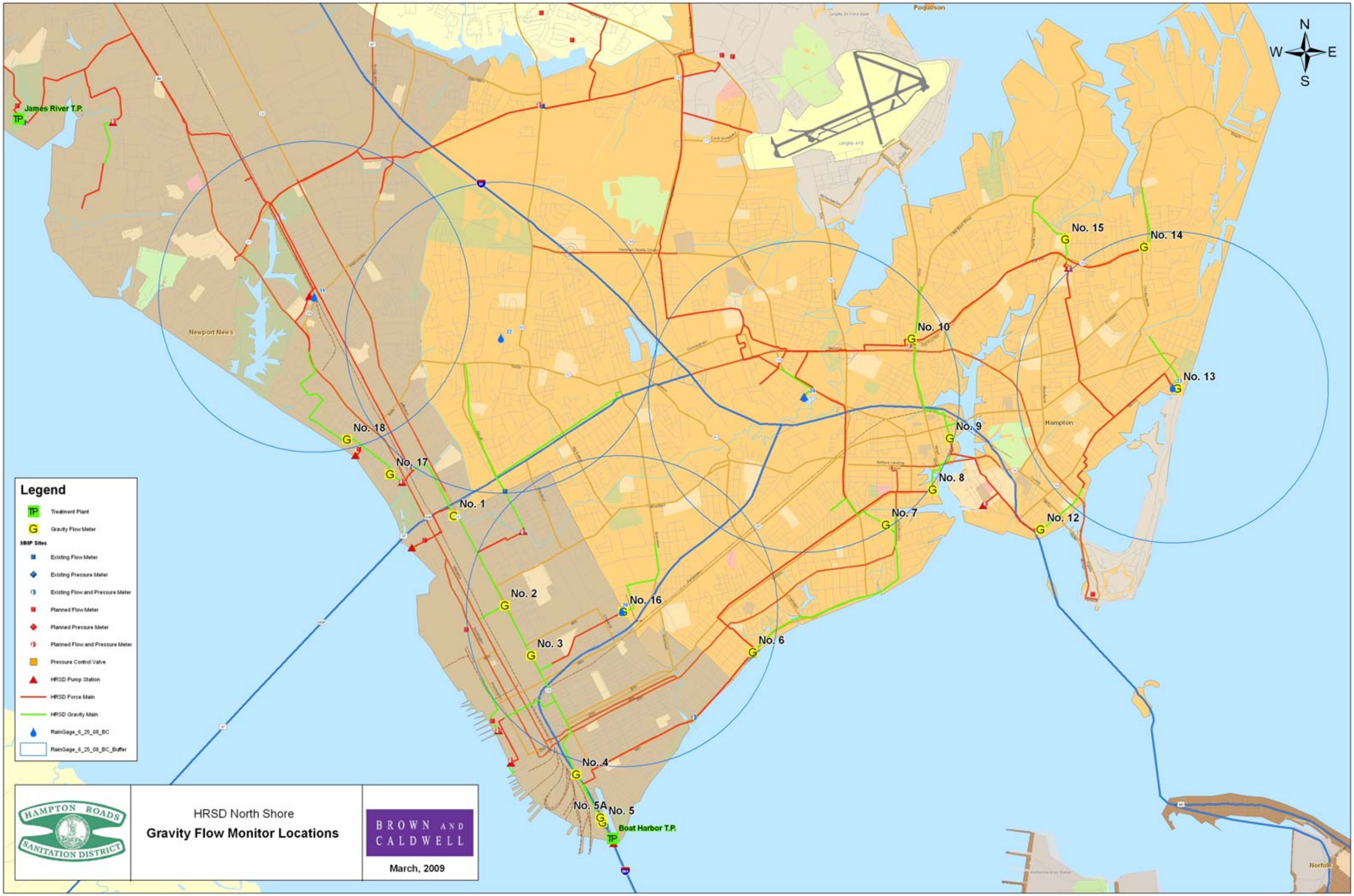
HAMPTON ROADS SANITATION DISTRICT

BROWN AND CALDWELL

Sewer System Map - South Shore



HRSD North Shore
Gravity Flow Monitor Locations
March, 2009
BROWN AND CALDWELL
HAMPTON ROADS SANITATION DISTRICT
Legend
TP Treatment Plant
G Gravity Flow Meter
MMP Sites
Existing Flow Meter
Existing Pressure Meter
Existing Flow and Pressure Meter
Planned Flow Meter
Planned Pressure Meter
Planned Flow and Pressure Meter
Pressure Control Valve
HRSD Pump Station
HRSD Force Main
HRSD Gravity Main
Rain Gauge
N
E
S
W
James River T.P.
Boat Harbor T.P.
Newport News
Hampton
Poquoson
Norfolk
No. 1
No. 2
No. 3
No. 4
No. 5
No. 5A
No. 6
No. 7
No. 8
No. 9
No. 10
No. 12
No. 13
No. 14
No. 15
No. 16
No. 17
No. 18
19
20
22
23
24

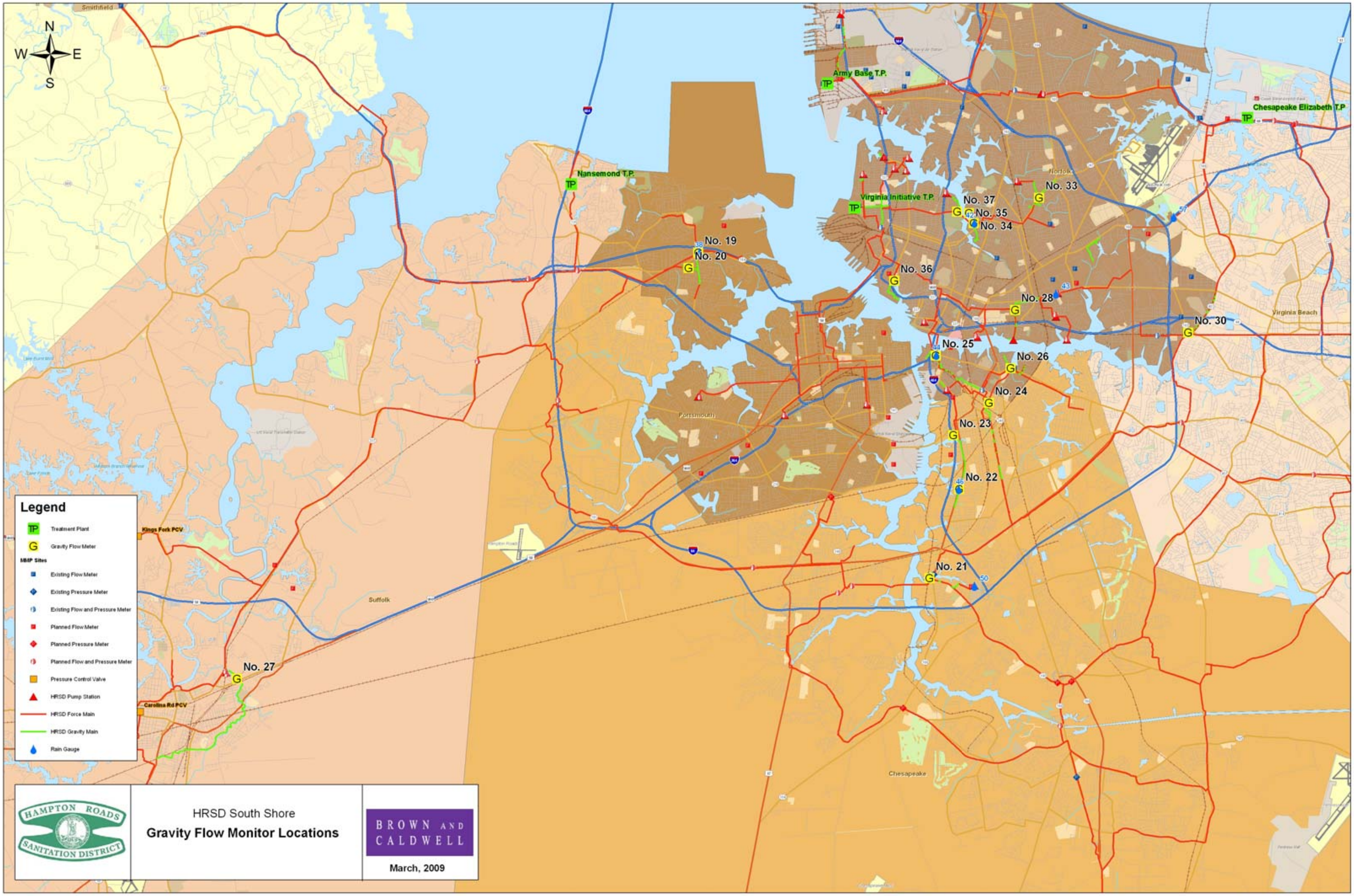


HRSD North Shore

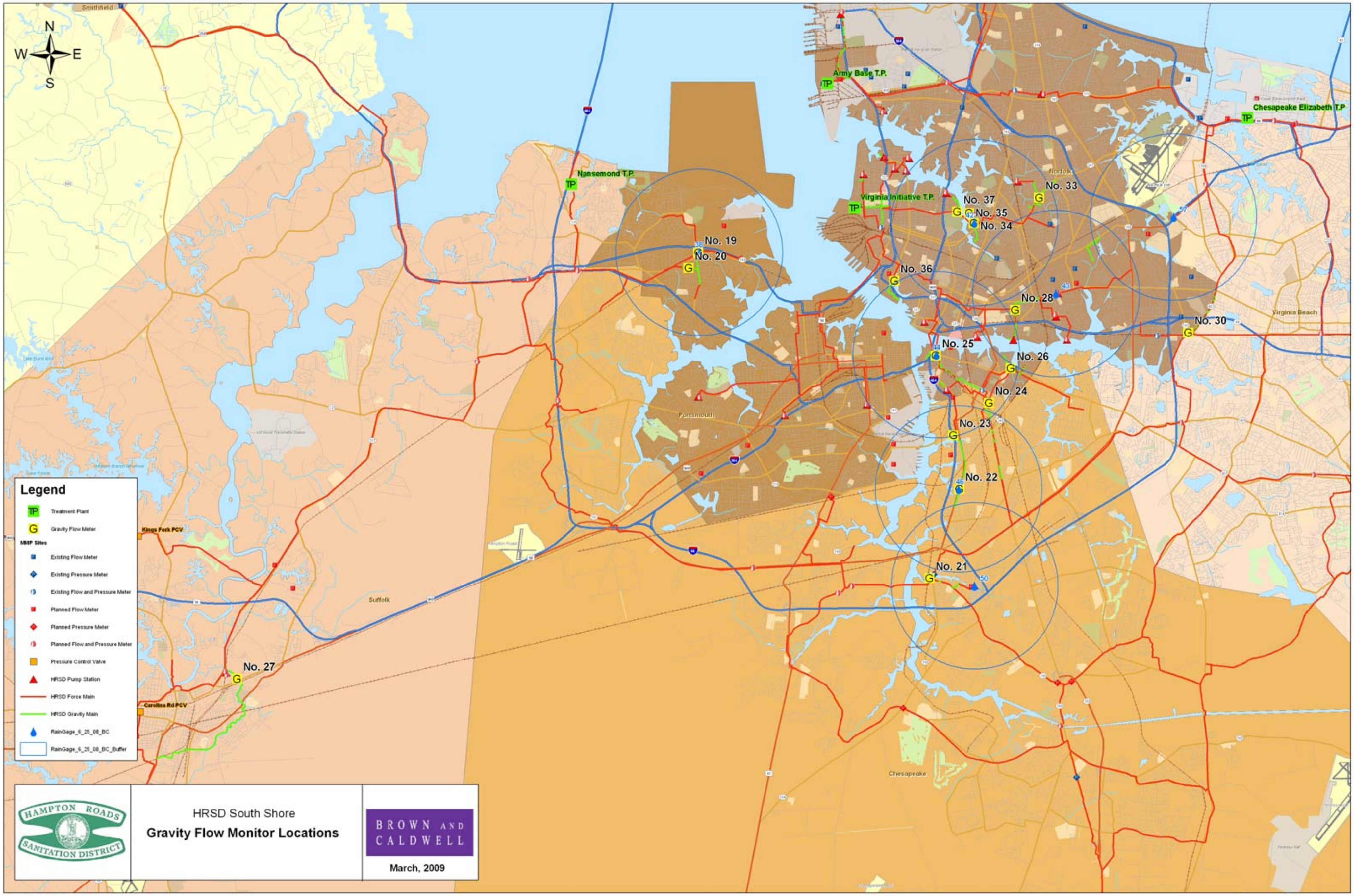
Gravity Flow Monitor Locations

BROWN AND CALDWELL

March, 2009



N
W
E
S
Smithfield
Nansemond T.P.
Army Base T.P.
Virginia Initiative T.P.
Chesapeake Elizabeth T.P
TP
Norfolk
Portsmouth
Suffolk
Chesapeake
Virginia Beach
No. 19
No. 20
No. 21
No. 22
No. 23
No. 24
No. 25
No. 26
No. 27
No. 28
No. 30
No. 33
No. 34
No. 35
No. 36
No. 37
Kings Fork PCV
Carolina Rd PCV
Legend
Treatment Plant
Gravity Flow Meter
MMP Sites
Existing Flow Meter
Existing Pressure Meter
Existing Flow and Pressure Meter
Planned Flow Meter
Planned Pressure Meter
Planned Flow and Pressure Meter
Pressure Control Valve
HRSD Pump Station
HRSD Force Main
HRSD Gravity Main
Rain Gauge
HAMPTON ROADS SANITATION DISTRICT
HRSD South Shore
Gravity Flow Monitor Locations
BROWN AND CALDWELL
March, 2009


N
W
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S
Smithfield
Nansemond T.P.
Army Base T.P.
Virginia Initiative T.P.
Chesapeake Elizabeth T.P.
Norfolk
Virginia Beach
Portsmouth
Suffolk
Chesapeake
No. 19
No. 20
No. 21
No. 22
No. 23
No. 24
No. 25
No. 26
No. 27
No. 28
No. 30
No. 33
No. 34
No. 35
No. 36
No. 37
Kings Fork PCV
Carolina Rd PCV
Legend
Treatment Plant
Gravity Flow Meter
MMP Sites
Existing Flow Meter
Existing Pressure Meter
Existing Flow and Pressure Meter
Planned Flow Meter
Planned Pressure Meter
Planned Flow and Pressure Meter
Pressure Control Valve
HRSD Pump Station
HRSD Force Main
HRSD Gravity Main
RainGage_6_25_08_BC
RainGage_6_25_08_BC_Buffer
HAMPTON ROADS SANITATION DISTRICT
HRSD South Shore
Gravity Flow Monitor Locations
BROWN AND CALDWELL
March, 2009

APPENDIX B: INSPECTION FORMS AND PROCEDURES

Sample Pumping Facility Asset Inspection Procedure

Manhole Inspection Form

CCTV Inspection Form

Sample Pumping Facility Asset Inspection Procedure

Most pumping facilities are designed in the wet well / dry well configuration style. Steps 1-15 will be performed on or in the upper level of the pump station. Steps 16-18 will be performed on the lower level (dry well) of the station, which is typically 20-40 feet below the upper level and connected by a spiral steel staircase. The dry well will contain centrifugal pumps as well as the piping, valves, and a sump pump.

Also, larger stations will have multiple levels but may not have the same layout as the duplex stations. The procedure described below should be adequate for performing a condition assessment on these larger stations.

NOTE: If immediate action is required for any pumping facility assets, record the needed action and notify HRSD Operations.

Please follow the steps below for a safe and reliable condition assessment:

<u>**Upper Level**</u>

1. **Photograph Station**

   Capture the doorway and station number that should be mounted on the door.

   Photograph potential issues and points of interest for documentation purposes.

2. **Pump Station Structure and Wet Well**

   Record any structural deficiencies in the structure such as spalling or settlement.

   Open Wet Well and determine condition. (Cleaning will likely be required. Note this on the form.)

   Check the Influent Valve of the wet well to be sure that it is clear of debris and is exercised regularly. Record a specific assessment for this valve.

   Fill the Condition Ranking field in the assessment form for Building, Wet Well and Influent Valve separately. Also complete the Field Observations field for Building and Wet. For the Influent Valve specify any observations/comments.

3. **Enter the station**
4. **Turn on HVAC**

***Warning* - If HVAC is not operational, DO NOT enter the dry well. The dry well constitutes a confined space if there is no ventilation. Appropriate measures should be taken if entry is necessary.**

5. **HVAC (FAN, LOUVER, and RECEIVER)**

   Check for operation of equipment and possible vibrations. Corrosion of the duct work running from the wet well to the exhaust system should be checked, particularly in the sections that run through the station building. Corrosion within the station is of particular concern since hazardous gasses from the wet well may gather in the station.

   Fill the Condition Ranking field in the assessment form for HVAC in general, and for (1) Exhaust Fan, (2) Scrubber Fan, (3) Wet Well Fan, (4) Intake Louvers, and (5) Air Receivers separately. Also complete the Field Observations field for HVAC. For items (1) through (5) above, specify any comments/observations.

6. **With the HVAC running, begin assessment of the remaining assets in the pump station.**
7. **Electrical Systems (ELECTEQT)**

   Check for foreign material in the control panel, dry or cracked cables, and loosened electrical connections. A general assessment of the electrical system should be recorded. Fill the general asset information fields in the assessment form.

Fill the Condition Ranking field in the assessment form for Electrical Systems. Also complete the Field Observations field for Electrical Systems. Note that the Transfer Switch assessment should be completed on the Transfer Switch form.

8. **Transfer Switch (SWITCH)**

   Fill the general asset information fields in the assessment form.

   Fill the Condition Ranking field and Field Observations field in the assessment form.

9. **Generator (GENERATR)**

   Fill the general asset information fields in the assessment form.

   Fill the Condition Ranking field and Field Observations field in the assessment form.

10. **Engine (ENGINE)**

    Fill the general asset information fields in the assessment form.

    Fill the Condition Ranking field and Field Observations field in the assessment form.

11. **Instrumentation (MISCEQPT)**

    This grouping is made up of bubbler panels and bubbler air compressors. Complete the general asset information fields in the assessment form.

    Fill the general asset information fields in the assessment form.

    Fill the Condition Ranking field in the assessment form for the system in general, and for the bubbler panel and air compressor separately. Also complete the Field Observations field for the system in general. For each component, specify any observations/comments if there is any.

12. **Air Compressor (COMPRESS)**

    Fill the general asset information fields in the assessment form.

    Fill the Condition Ranking field and Field Observations field in the assessment form.

13. **Tanks (TANKS)**

    Fill the general asset information fields in the assessment form.

    Fill the Condition Ranking field and Field Observations field in the assessment form.

14. **Manually start the station pumps and assess the Motors.**

15. **Motors and Controllers (MTRCONTR)**

    Each motor should be checked for abnormal noise, excessive heat, vibration and any other visual deficiencies. Use on-site run time logs to determine the approximate utilization.

    For each motor, fill the Condition Ranking and Utilization fields in the assessment form. Also fill the Field Observations field for each motor by using the field observation codes table.

***Warning* - The dry well should never be entered without gas monitoring equipment. Leaking pumps can release wastewater into the dry well and contaminate the air supply. In this case, the HVAC may not be capable of adequately ventilating the dry well area.**

<u>Lower Level</u>

16. **Continue the assessment by following the stairs down into the dry well.**

17. **Pumps (PUMP)**

    Potential issues may include overly-tight or loose packings, vibrations, cavitation, bad bearings, shaft vibration or deflection, U-joint issues and excessive noise. Check pump mountings and pump base for loose mounts or cracking. Any possible issues should be recorded. Record assessments for each individual pump.

For each pump, fill the Condition Ranking and Utilization fields in the assessment form. Also fill the Field Observations fields for each pump by using the field observation codes table.

18. **Valves (VALVE)**

Individual components include (1) Suction Isolation Valves, (2) Discharge Isolation Valves, and (3) Check Valves for each pump in the station. Check for malfunctioning or leaking valves, and whether the valves are regularly exercised.

Shut down the pumps.

Listen for leaking check valves. Leaking valves can cause impeller and pump shaft damage.

Check for pipe strain (typically a result of misaligned pump to pipe connections).

Assessments should be recorded for each individual component as well as for the general system.

Fill the Condition Ranking field in the assessment form for Valves in general, and for each pump fill the Condition Ranking field of Suction Isolation, Discharge Isolation and Check Valves separately. Also fill the Field Observations field for Valves in general by using the field observation codes table. For each pump, specify any observations/comments about Suction Isolation, Discharge Isolation and Check Valves.

The condition assessment should now be complete. Exit the dry well, be sure the pumps are operating automatically, shut down the HVAC, turn off lights, and exit the station. Be sure that the wet well is shut and locked, and the gate, if present, is secure before leaving the pump station grounds.

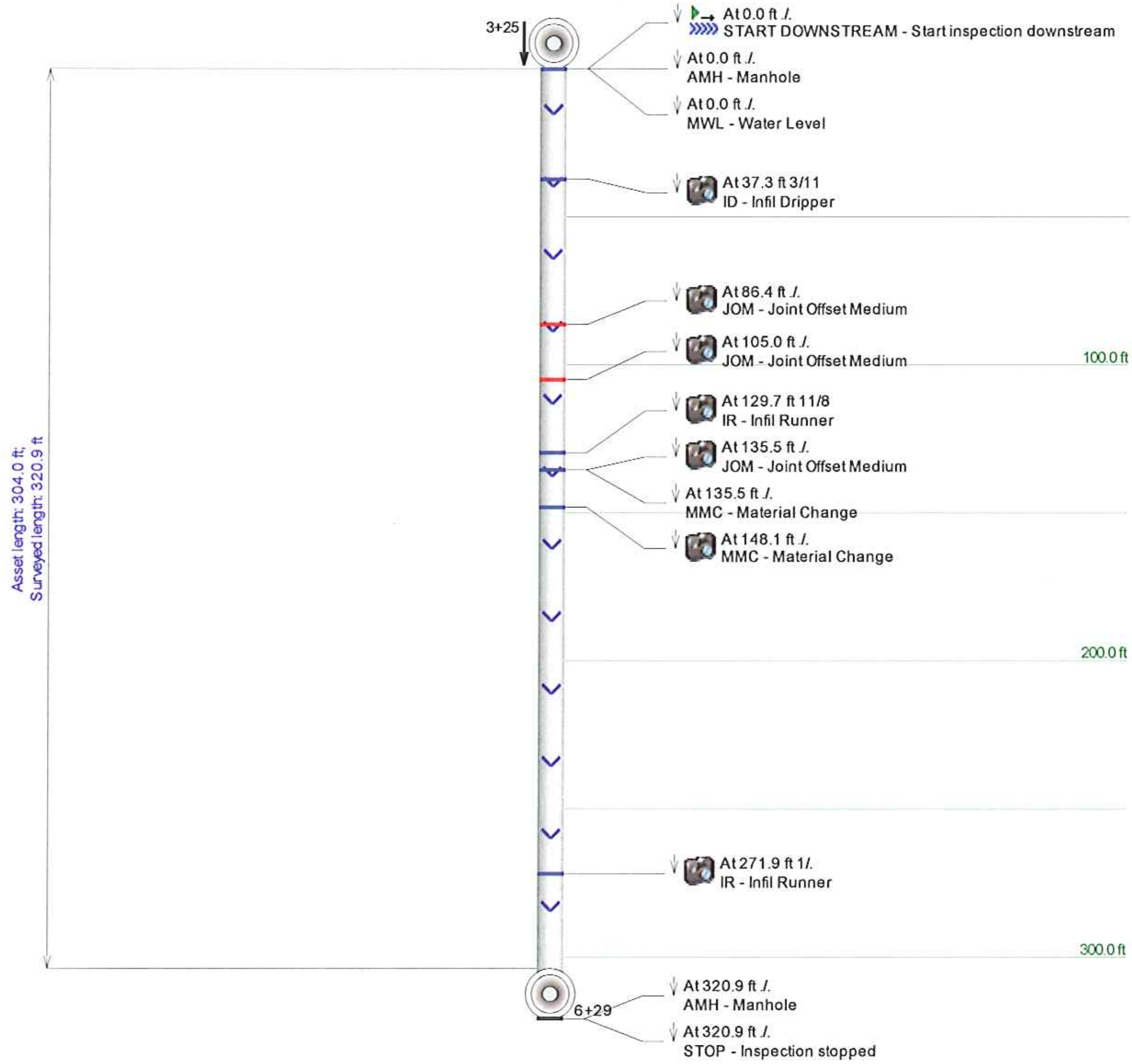
HRSD
1436 Air Rail Avenue
Va Beach, Virginia 23455
Fax 757-363-5839
Phone 757-460-2261

TV Inspection with Pipe-Run Graph

Project Name:	Asset ID:	City:	Address:
SG-207	3+25-6+29	Norfolk	Chesterfield Blvd

Date	Pipe Width:	Pipe Height:	Pipe Type:	Surface Condition:
7/19/2006		8	VCP	C

Direction:	Surveyed Footage:	Weather	Tape/Media #
Downstream	320.9	1	



HRSD
1436 Air Rail Avenue
Va Beach, Virginia 23455
Fax 757-363-5839
Phone 757-460-2261

Observation Report with Still Images

Main Asset ID:	Project Name:	Inspection Date:	Weather:	Operator:
3+25-6+29	SG-207	7/19/2006 10:29:27 AM	1	John Cobb

Upstream Node:	Downstream Node:	Main Length:
3+25	6+29	304.0

Comments:
SG-207

Observations

Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
0.0		START DOWNSTREAM	No	/		
0.0		AMH	No	/		3+25
0.0		MWL	No	/		
37.3		ID	No	3 / 11		

HRSD
1436 Air Rail Avenue
Va Beach, Virginia 23455
Fax 757-363-5839
Phone 757-460-2261

Observations

Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
86.4		JOM	No	/		

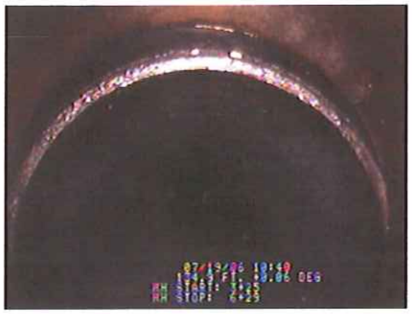
Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
105.0		JOM	No	/		

Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
129.7		IR	No	11 / 8		

HRSD
1436 Air Rail Avenue
Va Beach, Virginia 23455
Fax 757-363-5839
Phone 757-460-2261

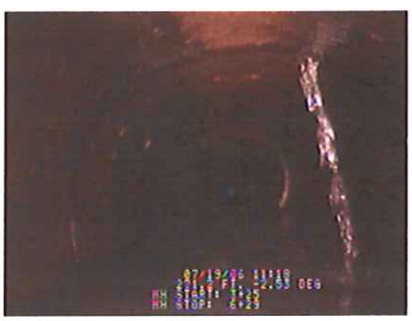
Observations

Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
135.5		JOM	No	/		



Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
135.5		MMC	No	/		pipe repair (pvc)
148.1		MMC	No	/		pipe changes to vc

Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
271.9		IR	No	1 /		



Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
320.9		AMH	No	/		6+29 Chesterfield Blvd pump station
320.9		STOP	No	/		

HRSD
1436 Air Rail Avenue
Va Beach, Virginia 23455
Fax 757-363-5839
Phone 757-460-2261

PACP Sewer Report

Surveyors Name	and Certificate Number	System Owner	Survey Customer	Drainage Area	Sheet No.
John Cobb	T-904-654	HRSD			1

P/O No.	Pipeline Segment Reference	Date	Time	Location (Street Name and Number)	Locality
	3+25-6+29	2006/07/19	10:29	Chesterfield Blvd	Norfolk

Further Location Details	Upstream Manhole Number	Rim to Invert	Grade to Invert	Rim to Grade
SG-207	3+25			

Downstream Manhole Number	Rim to Invert	Grade to Invert	Rim to Grade	Use of Sewer	Direction	Flow Control	Height
6+29				SS	D	L	8

Width	Shape	Material	Ln. Method	Pipe Joint Length	Total Length	Length Surveyed	Year Laid	Year Rehabilitated	Tape/Media Number
	C	VCP			304.0	320.9			SG-207

Purpose	Sewer Category	Pre-Cleaning	Cleaned	Weather	Location Code	Additional Information
F		J	2006/07/19	1	C	SG-207

	Structural					O&M					Overall Pipe	
Grade	Amount of Structural Defects	Structural Segment Grade	Structural Pipe Rating	Structural Quick Rating	Structural Pipe Rating Index	Amount of O&M Defects	O&M Segment Grade	O&M Pipe Rating	O&M Quick Rating	O&M Pipe Rating Index	Overall Pipe Rating	Overall Pipe Rating Index
1	3	3	3	1300	1	0	0	11	4231	3.666667	14	2.333333
2	0	0				0	0					
3	0	0				1	3					
4	0	0				2	8					
5	0	0				0	0					

HRSD
1436 Air Rail Avenue
Va Beach, Virginia 23455
Fax 757-363-5839
Phone 757-460-2261

Surveyors Name	System Owner	Date	Upstream Manhole Number	Pipeline Segment Ref	Sheet No.
John Cobb	HRSD	2006/07/19	3+25	3+25-6+29	2

Distance (Feet)	Video Ref.	Group/ Descripto Modifier/ Severity	Continuous Defect	S/M/L	Value Inches 1st	Value Inches 2nd	%	Joint	Circumferential Location at	Circumferential Location to	Image Ref.	Family	Rating	Remarks
0.0	3	AMH										O&M		3+25
0.0	15	MWL					10					O&M		
37.3	250	ID						J	3	11	2838a3b8-d80b -43d1-a26f-f192 97d9e09a.jpg	O&M	3	
86.4	428	JOM		M							61ada583-eb88 -418d-9c48-a3b daec10a.jpg	S	1	
105.0	525	JOM		M							b0053b5-2a3a-413b-84fd-e1ee 32c3123.jpg	S	1	
129.7	656	IR						J	11	8	beea802c-c1c6-4baa-ac94-6543 57c7c05b.jpg	O&M	4	
135.5	734	JOM		M							e997ecbd-5dbf-4b16-acd4-1913 6d5412.jpg	S	1	
135.5	769	MMC										O&M		pipe repair (pvc)
148.1	866	MMC									a88702f7-599-4 4d9-bbf7-f7eca 9121f5f.jpg	O&M		pipe changes to vc
271.9	2043	IR							1		80b05747-f0fd-4824-8192-18e c95aad77.jpg	O&M	4	
320.9	44	AMH										O&M		6+29 Chesterfield Blvd pump station

Manhole Information

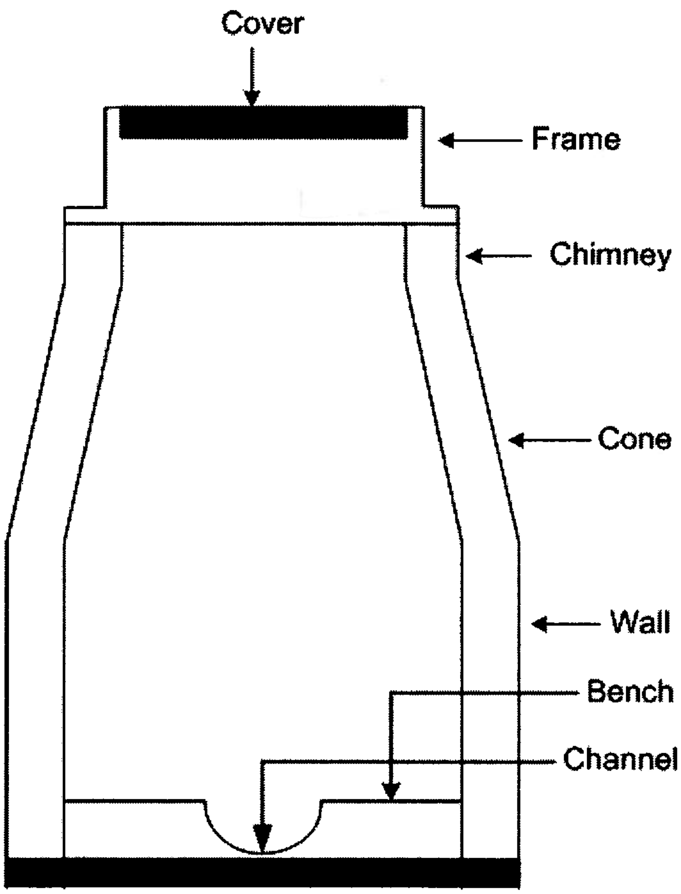
Manhole Number: SG-157-6+40 **Location:** Bainbridge Blvd @ Callow **City:** Chesapeake

Use Of Sewer: SS - Sanitary **Access Point Type:** AMH - Manhole **Year Laid:** 1950

MH Location Code: C - Light Highway **Futher Location Details:**

Year Rehabilitated: ☑ **Traffic Control** **Traffic Control Type:** Minor

Additional Information:



Structural MACP Grade: 3.27586206

O _M MACP Grade: 0

Status: SI - Surface Inspection **Date:** 8/6/2008

Surveyor's Name: John Cobb **Time:** 1:00

Certificate #: U-707-5293 **Weather:** 1 - Dry

Reason for Survey: F - Routine Assessment

Surface Type: Asphalt **Rim to Invert:**

Potential for Runoff: N - None

Cover
Diameter: 26
Material: CAS - Cast Iron
Condition: Sound
Fit: G - Good

Cone
Type: CC - Conical Centered
Material: BR - Brick
Depth:
Coating C - Cementitious

Frame
Material: CAS - Cast Iron
Condition: Corroded/Pitted
Diameter: 21.5in
Depth: 8in
Seal Cond: Loose/Not Attac
Seal Inflow: N - None

Wall
Diameter:
Material: BR - Brick
Depth: 82in
Coating: C - Cementitious

Bench
Bench Present ☑
Material: BR - Brick
Coating: C - Cementitious

Chimney
Material: BR - Brick
Diameter: 23in
Depth: 28in
Coating C - Cementitious
In Flow: N - None

Miscellaneous
# of Steps: 0
Steps Material
Evidence of Surcharge ☐

Channel
Installed ☑
Material: BR - Brick
Type: F - Formed
Exposure: P - Partially Ope

Manhole Number: SG-157-6+40 **Location:** Bainbridge Blvd @ **City:** Chesapeake

Use Of Sewer: SS - Sanitary **Access Point Type:** AMH - Manhole

Year Rehabilitated: **Year Laid:** 1950 **MH Location Code:** C - Light Highway

Futher Location Details:

Additional Information:

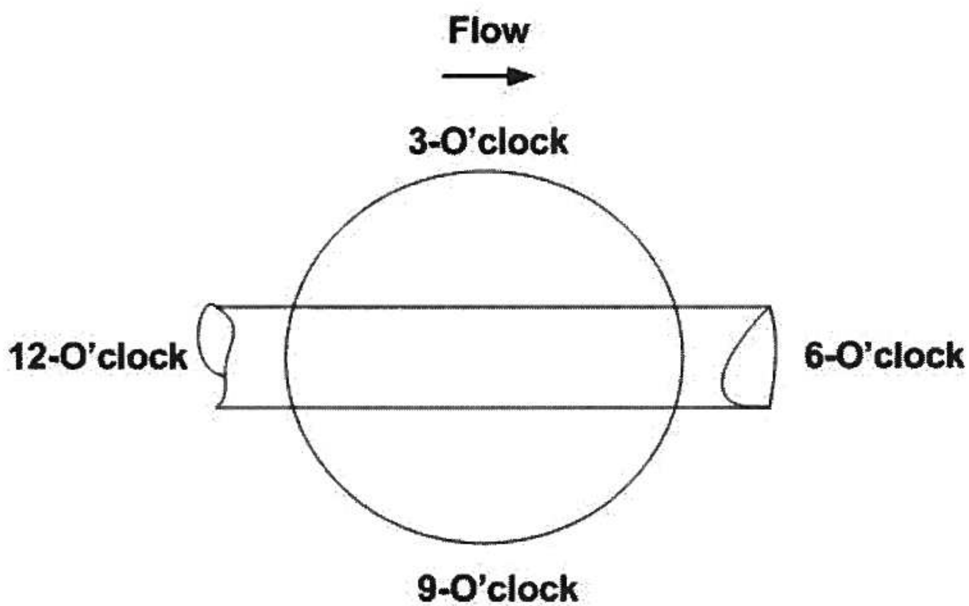
Surveyor's Name:	John Cobb	Certificate Number:	U-707-5293	Date:	8/6/2008
Time	1:00	Out Going Rim to Inver		Outgoing Grade to Invert:	
Rim to Grade	0	Reason for Survey:	outine Assessment	Pre-Cleaning:	N - No pre-cleaning
Date Cleaned		Weather:	1 - Dry	Manhole Surface Type:	Asphalt
Potential for Runoff:	N - None	Inspection Status:	SI - Surface Inspe	☐ Evidence of Surcharge	
Cover Shape	C - Circular	Cover Size:	26	Cover Width:	N/A
Cover Material:	CAS - Cast Iron	Cover Type:	Solid	Vent Hole Diameter:	
# of Vent Holes:	0	Cover Bearing Surface Diam	25.5in	Cover Bearing Surface Widt	N/A
Cover/Frame Fit:	G - Good	Cover Condition:	Sound	Adjustment Ring Type:	S - Solid
Adjustment Ring Conditio	Sound	Frame Material:	CAS - Cast Iron	Frame Condition:	Corroded/Pitted
Frame Bearing Surface Wi	1in	Frame Bearing Surface D	1.25in	Frame Clear Opening Diamet	21.5in
Frame Seal Condition:	Loose/Not Attach	Frame Offset Distance		Frame Seal Inflow:	N - None
Frame Depth:	8in	Chinmey Material:	BR - Brick	Chimney I/I:	N - None
Chimney Clear Opening:	23in	Chimney Depth:	28in	Chimney Interior Coating/	C - Cementitious
Chimney Exterior Coating	NA - Not Applica	Cone Type:	- Conical Centered	Cone Material:	BR - Brick
Cone Depth:		Interior Cone Coatin	C - Cementitious	Exterior Cone Coating/Lin	NA - Not Applicable
Wall Diameter:		Wall Material	BR - Brick	Wall Depth:	82in
Wall Interior Coating/Lin	C - Cementitious	Wall Exterior Coatin	NA - Not Applicable	☑ Bench Present	
Bench Material:	BR - Brick	Bench Coating/Line	C - Cementitious	☑ Channel Installed	
Channel Material:	BR - Brick	Channel Type:	F - Formed	Channel Exposure:	P - Partially Open
Manhole Steps #:	0	Steps Material:			

Manhole Defect Details   Manhole Number: SG-157-6+40

Date:	8/6/2008	Distance:		Video Ref.:		Image Ref.:	
Component:	Cone - Interior	Structural Defect:	MMM - Missing Mortar Medium				
Structural Grade:	3	Continuous:	☑	Length-Ft:	7		
O_M Defect:		O_M Grade:					
Continuous	☐	Length-Ft:	0 ft	Value -S/M/L:		Value Inches - 1:	
Value Inches - 2:		Value - %:		Joint	☑	Clock At/ From:	6
Clock To:	12	Remarks:	protective coating/liner deteriorated				
Date:	8/6/2008	Distance:		Video Ref.:		Image Ref.:	
Component:	Wall - Interior	Structural Defect:	MMM - Missing Mortar Medium				
Structural Grade:	3	Continuous:	☑	Length-Ft:	7		
O_M Defect:		O_M Grade:					
Continuous	☐	Length-Ft:	0 ft	Value -S/M/L:		Value Inches - 1:	
Value Inches - 2:		Value - %:		Joint	☑	Clock At/ From:	6
Clock To:	12	Remarks:	protective coating/liner deteriorated				
Date:	8/6/2008	Distance:		Video Ref.:		Image Ref.:	
Component:	Bench	Structural Defect:	SAM - Surface Aggregate Missing				
Structural Grade:	4	Continuous:	☑	Length-Ft:	4		
O_M Defect:		O_M Grade:					
Continuous	☐	Length-Ft:	0 ft	Value -S/M/L:		Value Inches - 1:	
Value Inches - 2:		Value - %:		Joint	☑	Clock At/ From:	6
Clock To:	12	Remarks:	protective coating/liner deteriorated/missing				

Pipe Connection Details   Manhole Number: SG-157-6+40

Date	Number	Position	Rim to Invert	In/Out	Material	Diameter	Seal	Type	Connects To
8/6/2008	1	6		Out	VCP - Vitrified Clay Pipe	18	C - Cracked	GR - Gravity	SG-157-9+40
8/6/2008	2	9		IN	XXX - Not Known	8	C - Cracked	GR - Gravity	City-plugged
8/6/2008	3	12		IN	VCP - Vitrified Clay Pipe	18	C - Cracked	GR - Gravity	SG-157-3+23
8/6/2008	4	3		IN	- Reinforced Plastic Pipe (T	8	C - Cracked	GR - Gravity	City
8/6/2008	5	3		IN	ZZZ - Other	8	C - Cracked	GR - Gravity	City-plugged



APPENDIX C: SANITARY SEWER SYSTEM DATA

Table C-1. Summary of Pump Station-Related SSOs						
Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
NORTH SHORE						
201	25th Street	1	2009-T-101749	14-Dec-08	1100	Blockage in line caused manhole beside pump station to overflow. Pumps at the station were operating normally.
203	Bay Shore	1	2004-T-0538	18-Sep-03	0	Hurricane Isabel. Widespread flooding and power outages.
204	Bloxoms Corner	1	2004-T-0539	18-Sep-03	0	Hurricane Isabel. PS lost both power feeds. Widespread flooding.
205	Big Bethel PRS	1	2005-T-100003	14-Oct-04	300	Personnel were repairing a valve at the pump station and had installed bypass pumping around the station. The coupling in the 12-inch suction hose came unhooked and caused the bypass hose to discharge into the storm drain.
206	Bridge Street	10	2003-T-1473	16-Feb-02	0	2.64" rain 2/15-2/17. High water alarm. No evidence of overflow.
			2003-T-1474	17-Feb-03	0	2.64" rain 2/15-2/17. High water alarm. No evidence of overflow.
			2004-T-0271	08-Aug-03	1900	1.52" in 90-min on 8/8. 4.89" Aug 4-8
			2004-T-0536	18-Sep-03	0	Hurricane Isabel. Widespread flooding.
			2005-T-0365	14-Aug-04	280340	TS Charley. 6.17" 8/12-8/16. 5.10" 8/14-8/15.
			2006-T-100347	08-Oct-05	4965	Heavy rainfall created excessive I/I. Estimated flow rate of 15 gpm discharging from tide gate.
			2006-T-100679	27-Jun-06	190400	Refer to SSOR 100678. Pump station was shut down in order to reduce flow at force main break on 3721 Victoria Blvd so that repairs could be made. PS has tidal gate which discharges overflow to river.
			2006-T-100680	28-Jun-06	2200	Mechanical problems with a by-pass pump caused the system to backup and by-pass at the Bridge St. Tide Gate for 1 hour and 50 minutes as 20 gpm.
			2007-T-100929	07-Oct-06	0	Heavy rainfall and flooding in area created excessive I/I.
			2007-T-100983	22-Nov-06	0	Heavy rains and high winds from coastal storm flooded the area, creating excessive I/I.

Table C-1. Summary of Pump Station-Related SSOs						
Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
207	Center Avenue	21	2003-T-1943	07-Apr-03	8250	2.29" of rain on 4/7. 3 manholes overflowed.
			2003-T-1963	09-Apr-03	30470	2.29" of rain on 4/7
			2003-T-2016	10-Apr-03	4420	2.29" of rain on 4/7 & 1.99" of rain on 4/9
			2004-T-0247	07-Aug-03	2200	2.07" of rain in 5 hrs on 8/7 (0.96" in 30-min); 5.01" Aug 5-7
			2004-T-0270	08-Aug-03	2790	6.29" Aug 5-8 (1.03" in 1-hr period before event)
			2004-T-0287	11-Aug-03	830	7.53" Aug 2-11; 0.72" in 90-min 8/11
			2004-T-0487	12-Sep-03	1365	2.45" of rain on 9/12.
			2004-T-0537	18-Sep-03	0	Hurricane Isabel. Widespread flooding.
			2004-T-0939	29-Oct-03	560	Upstream Gravity Line (NG-104). 2.90" of rain in 16-hr period prior to event.
			2004-T-1228	14-Dec-03	20250	Upstream Gravity Line (NG-104). 1.63" of rain on 12/14, 1.34" in 7 hours.
			2005-T-0034	07-Jul-04	5700	Upstream Gravity Line (NG-104). 1.82" on 7/7. 1.52" in 30 minutes.
			2005-T-0366	14-Aug-04	233675	Upstream Gravity Line (NG-104). TS Charley. 7.46" 8/12-8/16. 6.57" 8/14-8/15.
			2006-T-100349	08-Oct-05	5100	Upstream Gravity Line (NG-104). Heavy rainfall (6.05 inches recorded t nearest rain gauge) created excessive I/I. Manhole overflowed at an estimated rate of 50 gpm with 70 % (3570 gal) stormwater and 30 % (1530 gal) wastewater.
			2006-T-100348	08-Oct-05	8670	Heavy rainfall and localized flooding created excessive I/I. Manhole behind pump station overflowed at an estimated rate of 85 gpm. 70% (6069 gal) was stormwater and 30% (2601 gal) was wastewater.
			2006-T-100647	14-Jun-06	850	Area received several inches of rain from remnants of TS Alberto which created excessive I/I. Manhole located behind pump station overflowed due to system being overloaded.
			2006-T-100676	23-Jun-06	3600	Torrential rains created excessive I/I causing manhole at pump station to overflow.

Table C-1. Summary of Pump Station-Related SSOs

Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
			2007-T-100780	01-Sep-06	14235	Heavy rainfall from TS Ernesto created excessive I/I. Weather gauges located at HRSD pump stations recorded daily rainfall totals ranging from 7 to 9.8 inches with majority occurring within 8-hour period.
			2007-T-100930	07-Oct-06	59800	Heavy rainfall and flooding created excessive I/I. Typical dry weather flow at PS is 400 gpm. 2400 gpm flow rate was recorded during storm.
			2007-T-100964	12-Nov-06	16840	Area received large amount of rainfall which created excessive I/I.
			2007-T-100984	22-Nov-06	14370	Heavy rainfall and high winds from coastal storm created excessive I/I.
			2007-T-101068	25-Dec-06	2700	Pump station overflowed intermittently due to heavy rain and excessive I & I. Nearby rain gauge measured 1.26" of rain in 12 hour period.
208	Claremont Avenue	1	2006-T-100346	08-Oct-05	0	Heavy rainfall (6.05 inches recorded at nearest rain gauge) created excessive I/I. High water alarm at pump station alerted staff. May have been a spill with a 50/50 mix of stormwater and wastewater.
210	Ferguson Park	2	2004-T-0668	23-Sep-03	1000	Lost permanent power during heavy wind. Load did not transfer.
			2008-T-101439	03-Mar-08	250	City line had blockage. When the blockage was cleared, flow surged to pump station. The lead pump was not operating and the lag pump was operating but not pumping. This caused overflows at the manhole at the pump station site and the Leeward Marina restrooms.
211	Hampton University	1	2004-T-0667	23-Sep-03	3500	Possible line or valve failure. Section isolated. NS Ops to excavate.
212	Hilton School	2	2005-T-0362	14-Aug-04	930	TS Charley. 3.59" 8/14. 8.49" 8/1-8/16. Area flooding.
			2007-T-101084	05-Jan-07	120	Cast iron force main failed due to ground settling. Additional 30 gallons lost during pump and haul operation.

Table C-1. Summary of Pump Station-Related SSOs						
Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
214	Kingsmill	5	2003-T-0725	15-Oct-02	1800	Corroded emerg. pump connection. Spill from brewery's overflow pond.
			2003-T-2299	27-May-03	3000	Crew cut unmarked power line to Dominion Power Transformer
			2006-T-100674	23-Jun-06	21000	Heavy rains in area created excessive I/I. Pump station overflows into retention pond with sluice gate that enters tunnel under road and goes to ditch.
			2007-T-100706	01-Aug-06	2100	Pump at station burned up and caused power failure at station. Overflow from station entered stormwater pond where most of it was contained.
			2007-T-100932	07-Oct-06	0	Heavy rainfall and flooding created excessive I/I. Typical PS flow rate is 2500 gpm on dry day. Flow rate increased to 6800 gpm during the storm.
216	Lucas Creek PRS	1	2007-T-101196	07-May-07	700	Bubbler system at station malfunctioned causing wet well level to increase and overflow. Neighbor noticed problem and contacted HRSD.
217	Langley Circle	1	2005-T-0364	14-Aug-04	174315	TS Charley. 7.72" 8/12-8/16. 7.00" 8/14-8/15.
219	Newmarket	1	2006-T-100548	16-Mar-06	150	Drain hose inside of an 8" bypass pump set up at the pump station came apart.
221	Patrick Henry	6	2004-T-1502	07-Feb-04	300	Mechanical failure - suspected debris in bubbler control line.
			2005-T-100207	25-Feb-05	50	Bubbler system in pump station became clogged with sand. Pumps failed to operate when wet well level rose and minor spill occurred.
			2005-T-100290	18-Jun-05	50	Control panel in pump station failed which caused wet well level to rise.
			2006-T-100621	02-Jun-06	0	Metal coupling separated from rubber flex hose on 8" temporary by-pass pumping system discharging sewage to storm drain ditch.
			2006-T-100677	23-Jun-06	100	Torrential rainfall created excessive I/I causing manhole beside pump station to overflow into ditch.

Table C-1. Summary of Pump Station-Related SSOs						
Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
			2007-T-100784	01-Sep-06	0	Heavy rainfall from TS Ernesto created excessive I/I and flooding in the area. Weather gauges located at HRSD pump stations recorded daily rainfall totals ranging from 7 to 9.8 inches with majority occurring during 8-hour period.
226	Williamsburg	6	2005-T-0497	30-Aug-04	2600	WBTP generator failed. PCV controller locked up.
			2005-T-100087	10-Dec-04	60	Lightning struck the control valve in the force main leading to the plant. The valve froze in position at 40% open. The partially closed valve and the excessive I/I from the thunderstorm caused flow to back up and overflow the pump station wet well.
			2006-T-100513	09-Feb-06	4500	Failure of force main at the pump station. Leaking at approximately 25 gpm.
			2007-T-100785	01-Sep-06	4630	Heavy rainfall from TS Ernesto created excessive I/I. Weather gauge located at Williamsburg PS recorded 8.93 inches of rain for the day with majority occurring from 0500 to 1300.
			2007-T-101176	16-Apr-07	0	PLC failure stopped the working pump and did not start the lag pump. Small hole leaked sewerage onto floor and out door. Spill stopped at 1139 AM. Duration of problem was 5 minutes at rate of 5 gpm.
			2008-T-101585	19-Jun-08	50	There was a crack in a fitting for the bubbler line at the pump station which caused air to escape the bubbler system which monitors the wet well level. The bubbler failure gave a false reading to the controller so that it did not signal the pump to speed up as the wet well level rose. The wet well overflowed briefly.
231	Fords Colony	1	2008-T-101384	31-Dec-07	0	Station checker found 8-inch emergency pipe had blown off of its connection at pump station. An underground coupling failed which allowed the connection to come apart. The duration of the failure is unknown.

Table C-1. Summary of Pump Station-Related SSOs						
Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
232	Greensprings	2	2007-T-100910	06-Oct-06	70	Hose attached to drain valve on Godwin pump set up at station blew apart. Wastewater spilled onto ground for approximately seven minutes.
			2008-T-101345	29-Nov-07	1025	Crew set up bypass hose around station to conduct maintenance. The hose blew apart when 12" pump was started. Replaced hose but another section blew apart when re-tested.
SOUTH SHORE						
101	Arctic Avenue	1	2005-T-0247	03-Aug-04	675	TS Alex. 2.66" on 8/3. 1.32" in 90 minutes. 5th wettest July.
102	Ashland Circle	2	2003-T-1312	24-Jan-03	30	Operator error. Int. Tech left valve open briefly on emerg pump.
			2004-T-0530	18-Sep-03	75600	Hurricane Isabel. Power outage. Widespread flooding.
104	Cedar Lane	2	2005-T-0518	01-Sep-04	60	Sluice gate broke during PM.
			2005-T-100286	14-Jun-05	50	Bypass pumps had been set up in order to conduct wet well rehab at the station. The joint on the discharge piping was leaking. Pipe fittings broke loose while staff was attempting to stop leak.
105	Chesapeake Blvd	12	2003-T-1470	16-Feb-03	0	2.55" rain 2/15-2/17. Overflow qty unknown due to tidal flooding.
			2003-T-1472	17-Feb-03	375	2.55" rain 2/15-2/17. Presidents Day Storm.
			2003-T-2043	11-Apr-03	124750	4.88" of rain at Norfolk Airport April 7-11
			2004-T-1226	14-Dec-03	17830	1.73" of rainfall on 12/14. 1.49 inches in 8.5 hours.
			2005-T-0202	02-Aug-04	10865	TS Alex. 3.21" in 2 hours. Following 5th wettest July.
			2005-T-0213	03-Aug-04	167460	TS Alex. >4" on 8/2. 2.85" on 8/3. 1.93" in 90 minutes 8/3.
			2005-T-0360	14-Aug-04	662700	TS Charley. 5.16" 8/12-8/16. 9.77" 8/1-8/16.
			2005-T-0605	15-Sep-04	4020	Excessive I/I. 1.79" of rain for one hour prior to event.
			2006-T-100661	14-Jun-06	0	Pump station overflowed due to excessive I/I. Area received several inches of rain due to remnants of TS Alberto.

Table C-1. Summary of Pump Station-Related SSOs						
Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
			2007-T-100794	01-Sep-06	0	Heavy rainfall from TS Ernesto created excessive I/I & power outages in the area. Station experienced control problem with only two of three pumps operating in automatic position. Norfolk received record rainfall for day.
			2007-T-100989	22-Nov-06	3650	Heavy rains and high wind from coastal storm caused flooding and excessive I/I. Pump station overflowed at tide gate from 12:46 pm to 1:03 pm and then from 1:23 to 2:19 pm at estimated rate of 50 gpm.
			2007-T-101146	27-Feb-07	50	Contractor set up bypass piping around station. One of joints was leaking so it was opened to replace gasket causing wastewater to spill over berm.
106	City Park	1	2004-T-0533	18-Sep-03	0	Hurricane Isabel. Power outage. Tidal flooding.
109	Dozier's Corner	3	2004-T-0531	18-Sep-03	15000	Hurricane Isabel. Widespread flooding and power outages.
			2006-T-100660	14-Jun-06	0	Pump station overflowed due to excessive I/I. Area received several inches of rain due to remnants of TS Alberto.
			2007-T-100798	01-Sep-06	0	Heavy rainfall from TS Ernesto created excessive I/I and flooding in area. Rainfall gauges in city reported total rainfall amounts from 6.8 to 7.2 inches.
113	Luxembourg Avenue	2	2005-T-0215	03-Aug-04	0	TS Alex. 4.30" 8/1-8/3. Following 5th wettest July.
			2007-T-100799	01-Sep-06	0	Heavy rainfall from TS Ernesto created excessive I/I and power outages in area. Station had electrical control problem which resulted in only 2 of 3 pumps operating in automatic position. Station gauge recorded 8.27" rainfall for day.
116	Norchester Street	3	2005-T-0358	14-Aug-04	0	TS Charley. No overflow when on site. 3.36" 8/14. 9.77" 8/1-8/16.
			2007-T-101179	19-Apr-07	40000	20 inch cast iron force main on discharge side of PS had horizontal crack. Leaking started at estimated rate of 400 gpm for 75 minutes, decreased to 200 ppm for 35 minutes, then increased to 300 gpm for 110 minutes.

Table C-1. Summary of Pump Station-Related SSOs						
Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
			2007-T-101183	25-Apr-07	195	Gasket failure on 12" bypass pump discharge piping at the station. Lasted for two minutes.
119	Park Avenue	1	2005-T-0214	03-Aug-04	10300	TS Alex. >4" on 8/2. 2.85" on 8/3. 1.93" in 90 minutes 8/3.
123	Quail Avenue	1	2007-T-100801	01-Sep-06	0	Heavy rainfall from TS Ernesto created excessive I/I and flooding in area. Rain gauges in city recorded rainfall totals from 6.8 to 7.2 inches.
124	Richmond Crescent	4	2004-T-0534	18-Sep-03	0	Hurricane Isabel. Power outage. Tidal flooding in generator fuel tank.
			2004-T-0704	25-Sep-03	100	Leaking joint on PS site. Tightened bolts. Vaccon picked up spill.
			2005-T-0359	14-Aug-04	0	TS Charley. 3.36" 8/14. 9.77" 8/1-8/16. Area flooding.
			2007-T-100804	01-Sep-06	0	Norfolk received record amount of rainfall from TS Ernesto which created excessive I/I and flooded the area. Rainfall gauges throughout the city recorded rainfall totals from 7.3 to 8.9 inches for the day.
125	Seay Avenue	3	2003-T-0670	08-Oct-02	250	Debris or leak in bubbler control line. Overflow at cleanout.
			2005-T-0201	02-Aug-04	14300	TS Alex. 3.21" in 2 hours. Following 5th wettest July.
			2005-T-0356	14-Aug-04	150	TS Charley. Spill occurred during install of 6" portable pump.
127	State Street	4	2004-T-0529	19-Sep-03	450	Mechanical failure. Broken air line in bubbler system.
			2005-T-100227	14-Mar-05	22	Upstream Gravity Line (SG-096). Bubbler system on State Street Pump Station failed. The wet well gauge registered zero inches so the pumps did not come on when station wet well level rose. The system backed up and a nearby manhole overflowed.
			2006-T-100659	14-Jun-06	546	Upstream Gravity Line (SG-202). Manhole near pump station overflowed at estimated rate of 3 gpm due to excessive I/I. Area received several inches of rain due to remnants of TS Alberto. Manhole located at Pearl and Ligon Street.

Table C-1. Summary of Pump Station-Related SSOs						
Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
			2007-T-100802	01-Sep-06	0	Norfolk received record amount of rainfall from TS Ernesto which created excessive I/I and flooded area. Overflow discharged from manhole on Pearl and Ligon Streets. Rainfall totals from 7.3 to 8.9" recorded for day.
128	Steamboat Creek	1	2007-T-100803	01-Sep-06	0	Norfolk received record amount of rainfall from TS Ernesto which created excessive I/I and flooded the area. Rainfall gauges throughout the city recorded rainfall totals from 7.3 to 8.9 inches for the day.
131	Washington Plant	1	2005-T-0357	14-Aug-04	0	TS Charley. 2.76" on 8/14, 2.57" in 7 hours. Area flooding.
135	Suffolk	4	2003-T-1966	08-Apr-03	34400	1.98" of rain on 4/9.
			2004-T-0535	18-Sep-03	0	Hurricane Isabel. Widespread flooding.
			2004-T-1227	14-Dec-03	0	2.27" of rainfall on 12/14. 2.06" in 9 hours.
			2007-T-100987	22-Nov-06	0	Heavy rains and high winds from coastal storm created area flooding and excessive I/I. Pump failed at pump station during storm due to control problems.
137	Bowers Hill PRS	1	2008-T-101243	14-Aug-07	6000	Contractor had installed bypass piping at station in order to do construction work inside of station. Contractor hit 2" ball valve on the bypass piping.
142	Jamestown Crescent	1	2004-T-0532	19-Sep-03	2240	Hurricane Isabel. Power outage. Widespread flooding.
144	Elmhurst Lane	1	2008-T-101270	12-Sep-07	30	Crew was conducting routine wet well cleaning when metal clamp on hose on bypass pump blew off.
147	Chesterfield Blvd	1	2007-T-100795	01-Sep-06	0	Heavy rainfall from TS Ernesto created excessive I/I and flooding in the area. Weather gauges throughout the city recorded rainfall totals ranging from 7.3 to 8.9 inches.

Table C-2. Pump Station-Related SSOs Not Caused by Major Storm Events, Operator Error, Third Party Actions

Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
NORTH SHORE						
201	25th Street	1	2009-T-101749	14-Dec-08	1100	Blockage in line caused manhole beside pump station to overflow. Pumps at the station were operating normally.
206	Bridge Street	3	2003-T-1473	16-Feb-02	0	2.64" rain 2/15-2/17. High water alarm. No evidence of overflow.
			2003-T-1474	17-Feb-03	0	2.64" rain 2/15-2/17. High water alarm. No evidence of overflow.
			2004-T-0271	08-Aug-03	1900	1.52" in 90-min on 8/8. 4.89" Aug 4-8
207	Center Avenue	13	2003-T-1943	07-Apr-03	8250	2.29" of rain on 4/7. 3 manholes overflowed.
			2003-T-1963	09-Apr-03	30470	2.29" of rain on 4/7
			2003-T-2016	10-Apr-03	4420	2.29" of rain on 4/7 & 1.99" of rain on 4/9
			2004-T-0247	07-Aug-03	2200	2.07" of rain in 5 hrs on 8/7 (0.96" in 30-min); 5.01" Aug 5-7
			2004-T-0270	08-Aug-03	2790	6.29" Aug 5-8 (1.03" in 1-hr period before event)
			2004-T-0287	11-Aug-03	830	7.53" Aug 2-11; 0.72" in 90-min 8/11
			2004-T-0487	12-Sep-03	1365	2.45" of rain on 9/12.
			2004-T-0939	29-Oct-03	560	Upstream Gravity Line (NG-104). 2.90" of rain in 16-hr period prior to event.
			2004-T-1228	14-Dec-03	20250	Upstream Gravity Line (NG-104). 1.63" of rain on 12/14, 1.34" in 7 hours.
			2005-T-0034	07-Jul-04	5700	Upstream Gravity Line (NG-104). 1.82" on 7/7. 1.52" in 30 minutes.
			2006-T-100676	23-Jun-06	3600	Torrential rains created excessive I/I causing manhole at pump station to overflow.
			2007-T-100964	12-Nov-06	16840	Area received large amount of rainfall which created excessive I/I.
			2007-T-101068	25-Dec-06	2700	Pump station overflowed intermittently due to heavy rain and excessive I & I. Nearby rain gauge measured 1.26" of rain in 12 hour period.

Table C-2. Pump Station-Related SSOs Not Caused by Major Storm Events, Operator Error, Third Party Actions

Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
210	Ferguson Park	2	2004-T-0668	23-Sep-03	1000	Lost permanent power during heavy wind. Load did not transfer.
			2008-T-101439	03-Mar-08	250	City line had blockage. When the blockage was cleared, flow surged to pump station. The lead pump was not operating and the lag pump was operating but not pumping. This caused overflows at the manhole at the pump station site and the Leeward Marina restrooms.
211	Hampton University	1	2004-T-0667	23-Sep-03	3500	Possible line or valve failure. Section isolated. NS Ops to excavate.
212	Hilton School	1	2007-T-101084	05-Jan-07	120	Cast iron force main failed due to ground settling. Additional 30 gallons lost during pump and haul operation.
214	Kingsmill	3	2003-T-0725	15-Oct-02	1800	Corroded emerg. pump connection. Spill from brewery's overflow pond.
			2006-T-100674	23-Jun-06	21000	Heavy rains in area created excessive I/I. Pump station overflows into retention pond with sluice gate that enters tunnel under road and goes to ditch.
			2007-T-100706	01-Aug-06	2100	Pump at station burned up and caused power failure at station. Overflow from station entered stormwater pond where most of it was contained.
216	Lucas Creek PRS	1	2007-T-101196	07-May-07	700	Bubbler system at station malfunctioned causing wet well level to increase and overflow. Neighbor noticed problem and contacted HRSD.
221	Patrick Henry	4	2004-T-1502	07-Feb-04	300	Mechanical failure - suspected debris in bubbler control line.
			2005-T-100207	25-Feb-05	50	Bubbler system in pump station became clogged with sand. Pumps failed to operate when wet well level rose and minor spill occurred.
			2005-T-100290	18-Jun-05	50	Control panel in pump station failed which caused wet well level to rise.
			2006-T-100677	23-Jun-06	100	Torrential rainfall created excessive I/I causing manhole beside pump station to overflow into ditch.
226	Williamsburg	4	2005-T-0497	30-Aug-04	2600	WBTP generator failed. PCV controller locked up.
			2006-T-100513	09-Feb-06	4500	Failure of force main at the pump station. Leaking at approximately 25 gpm.

Table C-2. Pump Station-Related SSOs Not Caused by Major Storm Events, Operator Error, Third Party Actions

Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
			2007-T-101176	16-Apr-07	0	PLC failure stopped the working pump and did not start the lag pump. Small hole leaked sewerage onto floor and out door. Spill stopped at 1139 AM. Duration of problem was 5 minutes at rate of 5 gpm.
			2008-T-101585	19-Jun-08	50	There was a crack in a fitting for the bubbler line at the pump station which caused air to escape the bubbler system which monitors the wet well level. The bubbler failure gave a false reading to the controller so that it did not signal the pump to speed up as the wet well level rose. The wet well overflowed briefly.
231	Fords Colony	1	2008-T-101384	31-Dec-07	0	Station checker found 8-inch emergency pipe had blown off of its connection at pump station. An underground coupling failed which allowed the connection to come apart. The duration of the failure is unknown.
232	Greensprings	1	2007-T-100910	06-Oct-06	70	Hose attached to drain valve on Godwin pump set up at station blew apart. Wastewater spilled onto ground for approximately seven minutes.
			SOUTH SHORE			
104	Cedar Lane	1	2005-T-0518	01-Sep-04	60	Sluice gate broke during PM.
105	Chesapeake Blvd	5	2003-T-1470	16-Feb-03	0	2.55" rain 2/15-2/17. Overflow qty unknown due to tidal flooding.
			2003-T-1472	17-Feb-03	375	2.55" rain 2/15-2/17. Presidents Day Storm.
			2003-T-2043	11-Apr-03	124750	4.88" of rain at Norfolk Airport April 7-11
			2004-T-1226	14-Dec-03	17830	1.73" of rainfall on 12/14. 1.49 inches in 8.5 hours.
			2005-T-0605	15-Sep-04	4020	Excessive I/I. 1.79" of rain for one hour prior to event.
116	Norchester Street	1	2007-T-101179	19-Apr-07	40000	20 inch cast iron force main on discharge side of PS had horizontal crack. Leaking started at estimated rate of 400 gpm for 75 minutes, decreased to 200 ppm for 35 minutes, then increased to 300 gpm for 110 minutes.
124	Richmond Crescent	1	2004-T-0704	25-Sep-03	100	Leaking joint on PS site. Tightened bolts. Vaccon picked up spill.
125	Seay Avenue	1	2003-T-0670	08-Oct-02	250	Debris or leak in bubbler control line. Overflow at cleanout.

Table C-2. Pump Station-Related SSOs Not Caused by Major Storm Events, Operator Error, Third Party Actions

Pump Station Number	Pump Station Name	Total SSO Occurrences Between 2002 and 2008	SSORS Report Number	Date of SSO	Volume Not Recovered (gallons)	Reason for SSO
127	State Street	2	2004-T-0529	19-Sep-03	450	Mechanical failure. Broken air line in bubbler system.
			2005-T-100227	14-Mar-05	22	Upstream Gravity Line (SG-096). Bubbler system on State Street Pump Station failed. The wet well gauge registered zero inches so the pumps did not come on when station wet well level rose. The system backed up and a nearby manhole overflowed.
135	Suffolk	2	2003-T-1966	08-Apr-03	34400	1.98" of rain on 4/9.
			2004-T-1227	14-Dec-03	0	2.27" of rainfall on 12/14. 2.06" in 9 hours.

Table C-3. High Level Alarm Summary			
Pump Station Number	Pump Station Name	No. of Days with High Level Alarms	High Level Alarm Date
NORTH SHORE			
201	25th Street	0	N/A
202	33rd Street	0	N/A
203	Bay Shore	0	N/A
204	Bloxoms	0	N/A
206	Bridge Street	1	9/25/2008
207	Center Avenue	3	6/22/2008
			9/25/2008
			12/11/2008
208	Claremont	0	N/A
209	Copeland Park	0	N/A
210	Ferguson Park	1	12/11/2008
211	Hampton University	0	N/A
212	Hilton School	0	N/A
213	Jefferson Avenue	0	N/A
214	Kingsmill	0	N/A
216	Lucas Creek	0	N/A
217	Langley Circle	1	12/11/2008
218	Morrison	0	N/A
219	Newmarket	0	N/A
220	Normandy Lane	0	N/A
221	Patrick Henry	0	N/A
223	Washington Street	0	N/A
224	Woodland Road	0	N/A
225	Willard Avenue	0	N/A
226	Williamsburg	2	9/25/2008
			12/11/2008
227	Fort Eustis	2	12/11/2008
			12/12/2008
229	Colonial Williamsburg	0	N/A
230	Rolling Hills	0	N/A
231	Ford's Colony	7	4/21/2008
			4/22/2008
			5/11/2008
			9/8/2008
			9/25/2008
			11/30/2008
			12/11/2008
232	Greensprings	0	N/A
SOUTH SHORE			
101	Arctic Avenue	0	N/A

Table C-3. High Level Alarm Summary

Pump Station Number	Pump Station Name	No. of Days with High Level Alarms	High Level Alarm Date
102	Ashland Circle	0	N/A
103	Bainbridge Blvd	0	N/A
104	Cedar Lane	0	N/A
105	Chesapeake Blvd	0	N/A
106	City Park	0	N/A
107	Colley Avenue	8	4/22/2008
			5/7/2008
			5/14/2008
			7/3/2008
			7/15/2008
			7/17/2008
			7/31/2008
			8/18/2008
108	Dovercourt Road	0	N/A
109	Dozier's Corner	3	7/5/2008
			12/11/2008
			12/12/2008
110	Ferebee Avenue	0	N/A
111	Granby Street	1	6/12/2008
113	Luxembourg Avenue	0	N/A
114	Monroe Place	0	N/A
115	Newtown Road	1	8/21/2008
116	Norchester Street	3	6/4/2008
			11/13/2008
			12/11/2008
117	North Shore Road	4	4/12/2008
			5/28/2008
			9/11/2008
			9/29/2008
118	Norview Avenue	0	N/A
119	Park Avenue	0	N/A
121	Plume Street	0	N/A
122	Powhatan	0	N/A
123	Quail Avenue	0	N/A
124	Richmond Crescent	0	N/A
125	Seay Avenue	0	N/A
128	Steamboat Creek	0	N/A
129	Taussig Blvd	0	N/A
130	Virginia Beach Blvd	0	N/A
SOUTH SHORE			
127	State Street	10	5/11/2008

Table C-3. High Level Alarm Summary			
Pump Station Number	Pump Station Name	No. of Days with High Level Alarms	High Level Alarm Date
			7/15/2008
			7/17/2008
			8/18/2008
			8/22/2008
			9/9/2008
			9/11/2008
			11/18/2008
			12/4/2008
			12/7/2008
131	Washington Plant	0	N/A
132	Willoughby Avenue	0	N/A
135	Suffolk	5	4/29/2008
			9/18/2008
			10/28/2008
			12/11/2008
			12/12/2008
141	Hanover Avenue	6	5/22/2008
			5/25/2008
			5/31/2008
			6/5/2008
			9/5/2008
			9/11/2008
142	Jamestown Crescent	4	6/27/2008
			7/25/2008
			9/22/2008
			11/3/2008
144	Elmhurst Lane	1	5/6/2008
145	Rodman Avenue	2	7/23/2008
			12/11/2008
146	Camden Avenue	2	6/16/2008
			9/6/2008
147	Chesterfield Blvd	7	4/9/2008
			4/21/2008
			4/25/2008
			5/5/2008
			5/31/2008
			10/10/2008
			12/11/2008
148	Ingleside Road	0	N/A

Table C-4. Wet Well Pump Station Prioritization

Priority Group	Pump Station Number	Pump Station Name	Pump Station Size Based on Capacity	SSOs Not Related to Major Storm Events, Operator Error, Third Party Actions	Excessive Pump Run Time?	Number of Days with High Level Alarms	Total Score
			1 – Very Large 16 – Large 48 – Medium 65 – Small	1 – 4 or More SSOs 16 – 2 or 3 SSOs 48 – 1 SSO 65 – 0 SSOs	1– Yes 65 – No	1 – 5 or More Days 16 – 2 to 4 Days 48 – 1 Day 65 – 0 Days	Maximum score of 100
			30	40	10	20	Weight
Group 1	135	Suffolk	1	16	1	1	90.77
Group 1	226	Williamsburg	1	1	65	16	85.54
Group 1	127	State Street	1	16	65	1	80.92
Group 1	206	Bridge St	1	1	65	48	75.69
Group 1	221	Patrick Henry	16	1	1	65	73.38
Group 1	105	Chesapeake Blvd	1	1	65	65	70.46
Group 1	116	Norchester Street	48	16	1	16	64.46
Group 1	207	Center Ave	48	1	65	16	63.85
Group 1	214	Kingsmill	1	16	65	65	61.23
Group 1	145	Rodman Avenue	1	65	1	16	56.00
Group 1	146	Camden Avenue	1	65	1	16	56.00
Group 1	231	Ford's Colony	48	48	1	1	49.38
Group 1	217	Langley Circle	1	65	1	48	46.15
Group 1	107	Colley Avenue	16	65	65	1	43.85
Group 1	104	Cedar Lane	1	48	65	65	41.54
Group 1	227	Fort Eustis	16	65	65	16	39.23
Group 1	210	Ferguson Park	65	16	65	48	36.92
Group 1	115	Newtown Road	1	65	65	48	36.31
Group 1	216	Lucas Creek	16	48	65	65	34.62
Group 1	119	Park Avenue	16	65	1	65	34.00
Group 1	219	Newmarket	16	65	1	65	34.00
Group 1	225	Willard Ave	16	65	1	65	34.00
Group 2	101	Arctic Avenue	1	65	65	65	31.08
Group 2	108	Dovercourt Road	1	65	65	65	31.08
Group 2	121	Plume Street	1	65	65	65	31.08
Group 2	129	Taussig Blvd	1	65	65	65	31.08
Group 2	131	Washington Plant	1	65	65	65	31.08
Group 2	147	Chesterfield Blvd	65	65	1	1	31.08
Group 2	208	Claremont	1	65	65	65	31.08

Table C-4. Wet Well Pump Station Prioritization

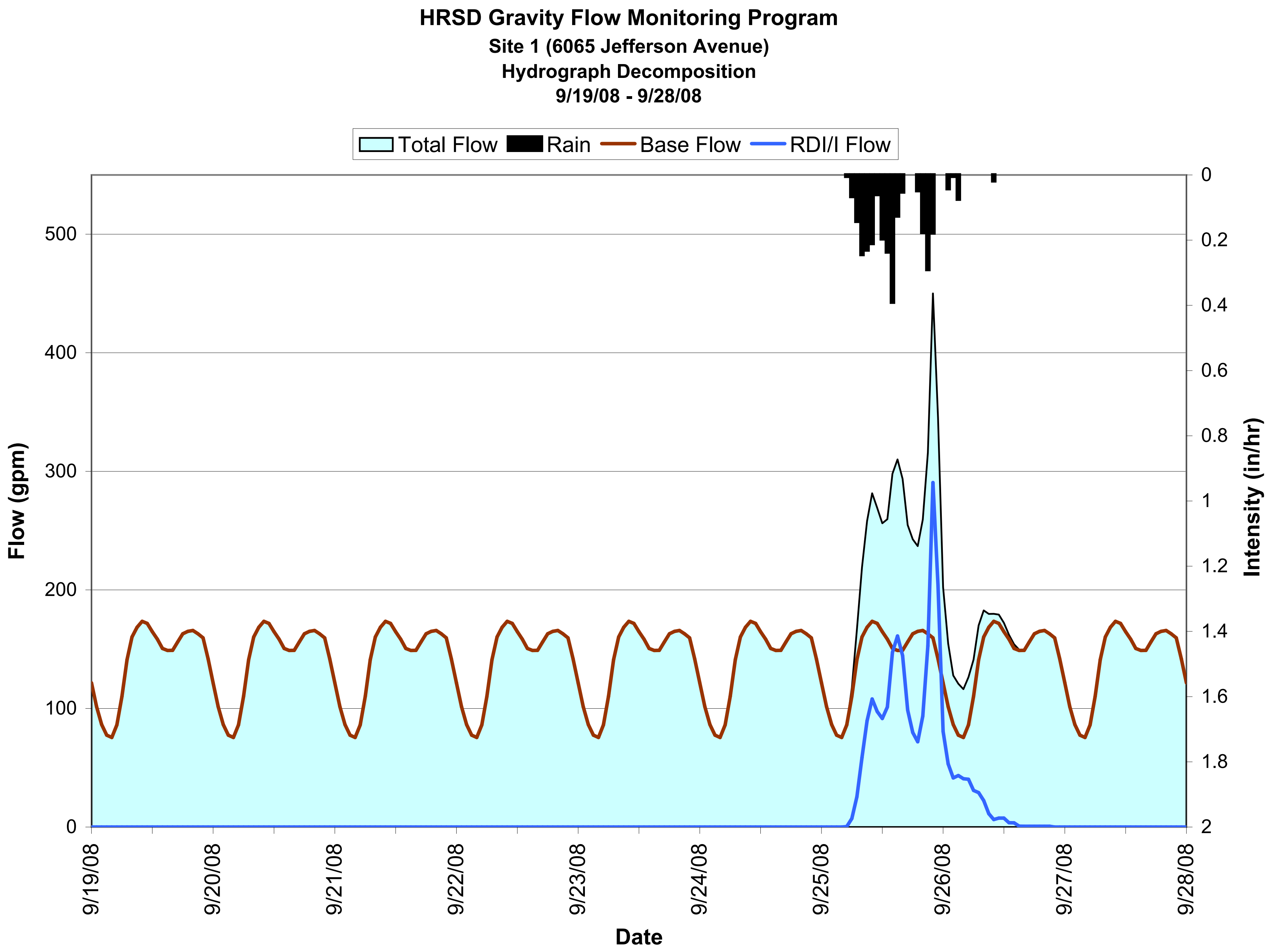
Priority Group	Pump Station Number	Pump Station Name	Pump Station Size Based on Capacity	SSOs Not Related to Major Storm Events, Operator Error, Third Party Actions	Excessive Pump Run Time?	Number of Days with High Level Alarms	Total Score
			1 – Very Large 16 – Large 48 – Medium 65 – Small	1 – 4 or More SSOs 16 – 2 or 3 SSOs 48 – 1 SSO 65 – 0 SSOs	1– Yes 65 – No	1 – 5 or More Days 16 – 2 to 4 Days 48 – 1 Day 65 – 0 Days	Maximum score of 100
			30	40	10	20	Weight
Group 2	232	Greensprings	48	48	1	65	29.69
Group 2	144	Elmhurst Lane	16	65	65	48	29.38
Group 2	109	Dozier's Corner	65	65	1	16	26.46
Group 2	117	North Shore Road	48	65	65	16	24.46
Group 2	113	Luxembourg Avenue	16	65	65	65	24.15
Group 2	130	Virginia Beach Blvd	16	65	65	65	24.15
Group 2	202	33rd Street	16	65	65	65	24.15
Group 2	203	Bay Shore	16	65	65	65	24.15
Group 2	209	Copeland Park	16	65	65	65	24.15
Group 2	223	Washington Street	16	65	65	65	24.15
Group 2	229	Colonial Williamsburg	16	65	65	65	24.15
Group 2	230	Rolling Hills	16	65	65	65	24.15
Group 2	141	Hanover Avenue	65	65	65	1	21.23
Group 2	201	25th Street	48	48	65	65	19.85
Group 2	218	Morrison	48	65	1	65	19.23
Group 3	142	Jamestown Crescent	65	65	65	16	16.62
Group 3	124	Richmond Crescent	65	48	65	65	12.00
Group 3	125	Seay Avenue	65	48	65	65	12.00
Group 3	211	Hampton U	65	48	65	65	12.00
Group 3	212	Hilton School	65	48	65	65	12.00
Group 3	102	Ashland Circle	65	65	1	65	11.38
Group 3	103	Bainbridge Blvd	48	65	65	65	9.38
Group 3	110	Ferebee Avenue	48	65	65	65	9.38
Group 3	122	Powhatan Avenue	48	65	65	65	9.38
Group 3	123	Quail Avenue	48	65	65	65	9.38
Group 3	128	Steamboat Creek	48	65	65	65	9.38
Group 3	132	Willoughby Avenue	48	65	65	65	9.38
Group 3	213	Jefferson Ave	48	65	65	65	9.38

Table C-4. Wet Well Pump Station Prioritization

Priority Group	Pump Station Number	Pump Station Name	Pump Station Size Based on Capacity	SSOs Not Related to Major Storm Events, Operator Error, Third Party Actions	Excessive Pump Run Time?	Number of Days with High Level Alarms	Total Score
			1 – Very Large 16 – Large 48 – Medium 65 – Small	1 – 4 or More SSOs 16 – 2 or 3 SSOs 48 – 1 SSO 65 – 0 SSOs	1– Yes 65 – No	1 – 5 or More Days 16 – 2 to 4 Days 48 – 1 Day 65 – 0 Days	Maximum score of 100
			30	40	10	20	Weight
Group 3	220	Normandy Lane	48	65	65	65	9.38
Group 3	224	Woodland Road	48	65	65	65	9.38
Group 3	111	Granby Street	65	65	65	48	6.77
Group 3	106	City Park	65	65	65	65	1.54
Group 3	114	Monroe Place	65	65	65	65	1.54
Group 3	118	Norview Avenue	65	65	65	65	1.54
Group 3	148	Ingleside Road	65	65	65	65	1.54
Group 3	204	Bloxoms Corner	65	65	65	65	1.54

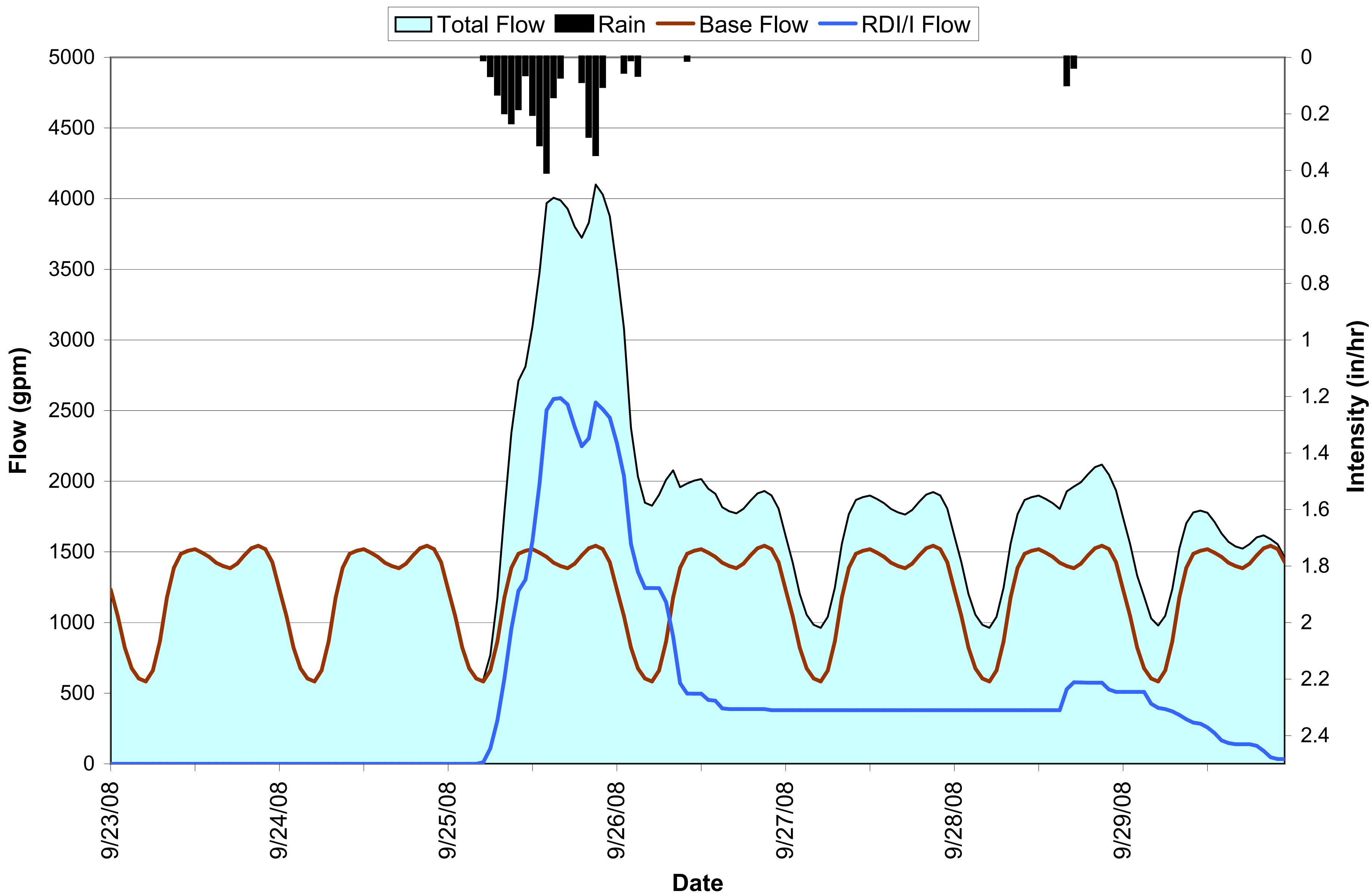
Table C-5. PRS Prioritization

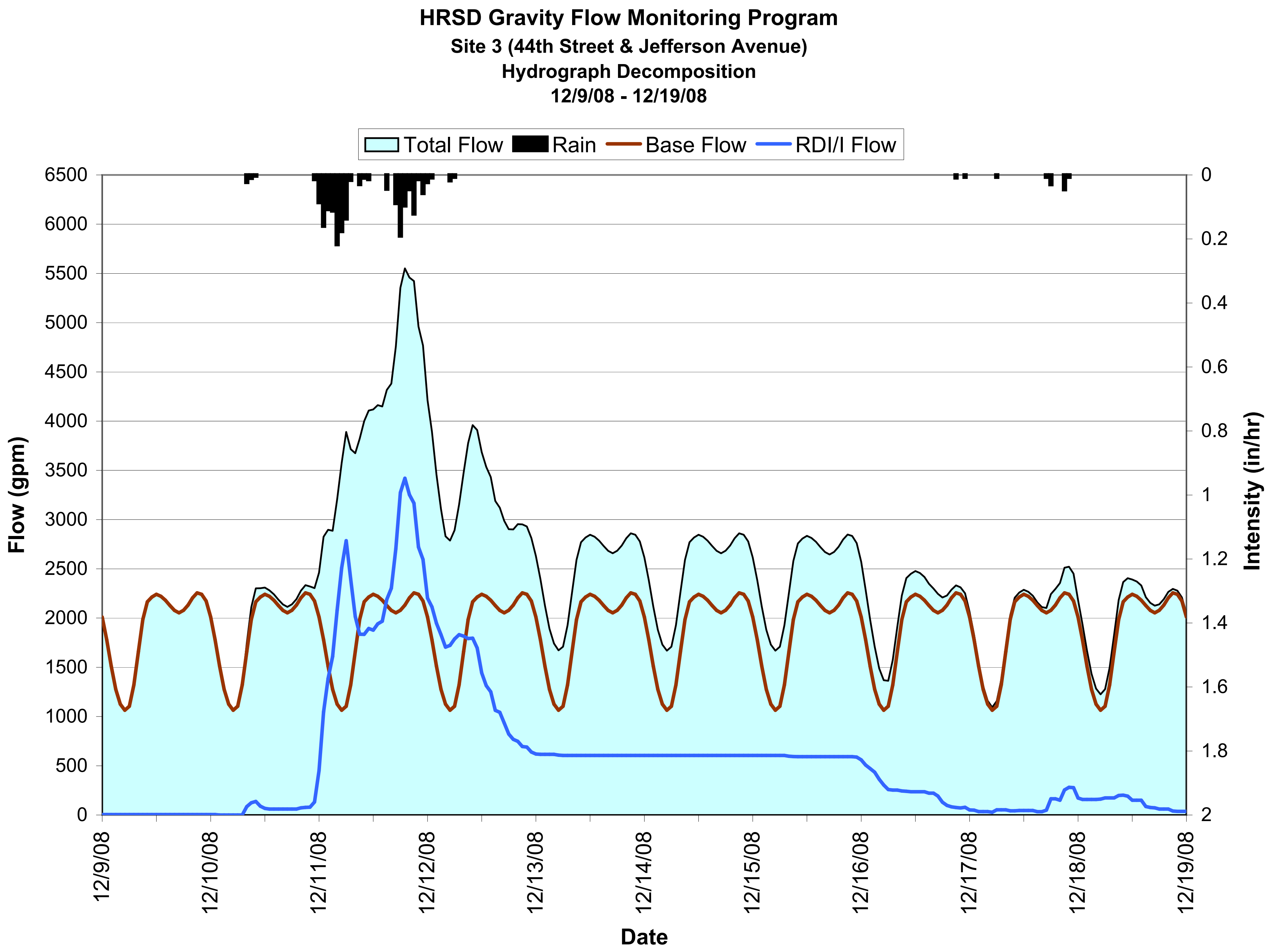
Priority Group	Pump Station Number	Pump Station Name	Pump Station Size Based on Capacity	Pump Station Age	Total Score
			1 – Very Large 5 – Large 10 – Medium 15 – Small	1 – Greater than 35 Years Old 5 – 30 to 35 Years Old 10 – 20 to 29 Years Old 15 – Less than 20 Years Old	Maximum score of 100
			40	60	Weight
Group 1	112	Independence Blvd PRS	5	1	89.33
Group 1	133	Providence Road PRS	1	5	84.00
Group 1	140	Atlantic Avenue PRS	1	5	84.00
Group 1	205	Big Bethel PRS	10	1	76.00
Group 1	143	Shipps Corner PRS	1	10	64.00
Group 2	120	Pine Tree PRS	15	1	62.67
Group 2	134	Pughsville Road PRS	10	5	60.00
Group 2	215	Lee Hall PRS	15	5	46.67
Group 2	151	Kempsville Road PRS	1	15	44.00
Group 2	139	Quail Avenue PRS	10	10	40.00
Group 3	152	Terminal Blvd PRS	5	15	33.33
Group 3	153	Laskin Road PRS	5	15	33.33
Group 3	137	Bowers Hill PRS	15	10	26.67
Group 3	138	Deep Creek PRS	15	10	26.67
Group 3	154	Route 337 PRS	10	15	20.00



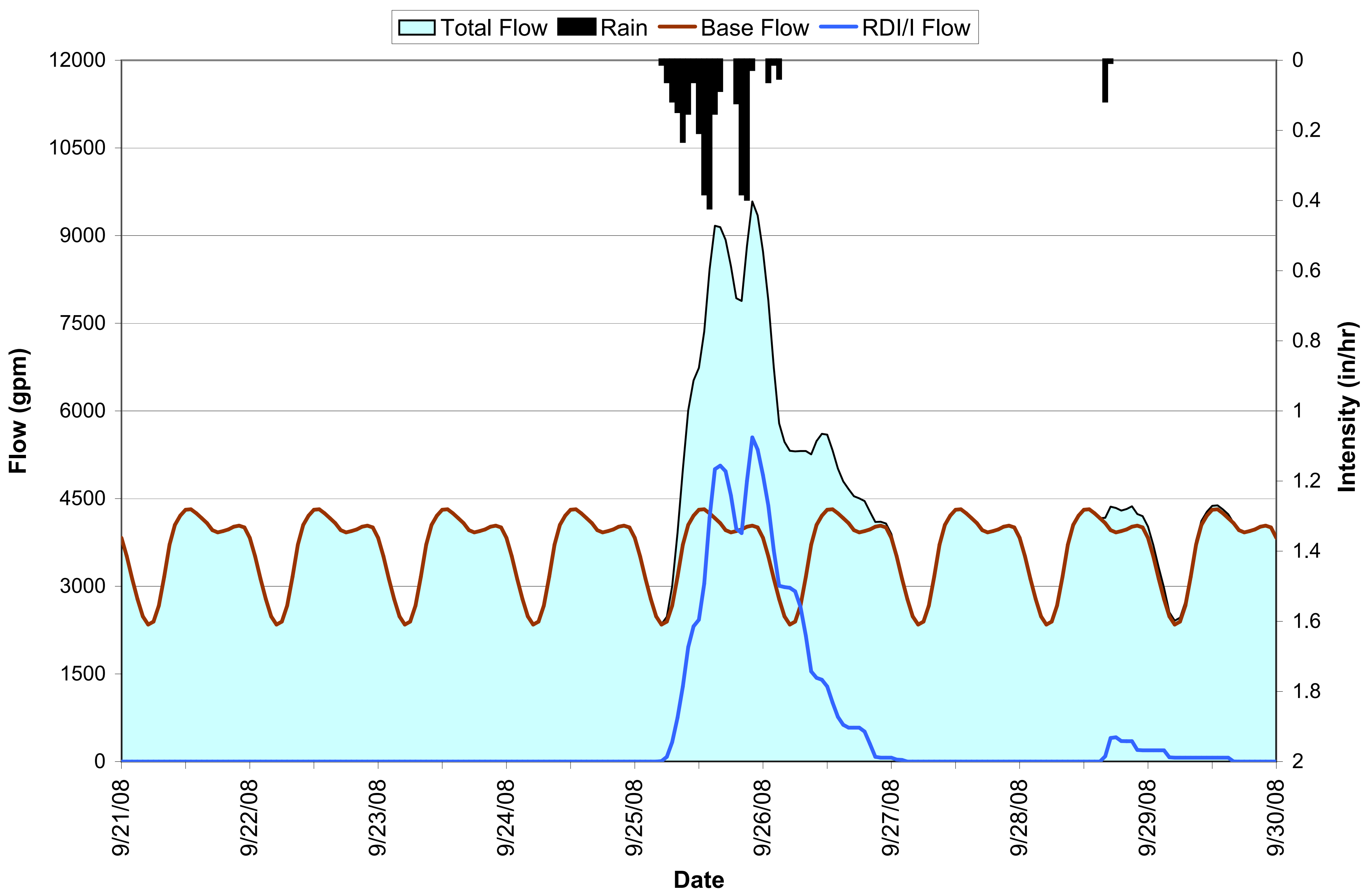
HRSD Gravity Flow Monitoring Program
Site 1 (6065 Jefferson Avenue)
Hydrograph Decomposition
9/19/08 - 9/28/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
500
400
300
200
100
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
9/19/08
9/20/08
9/21/08
9/22/08
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
Date

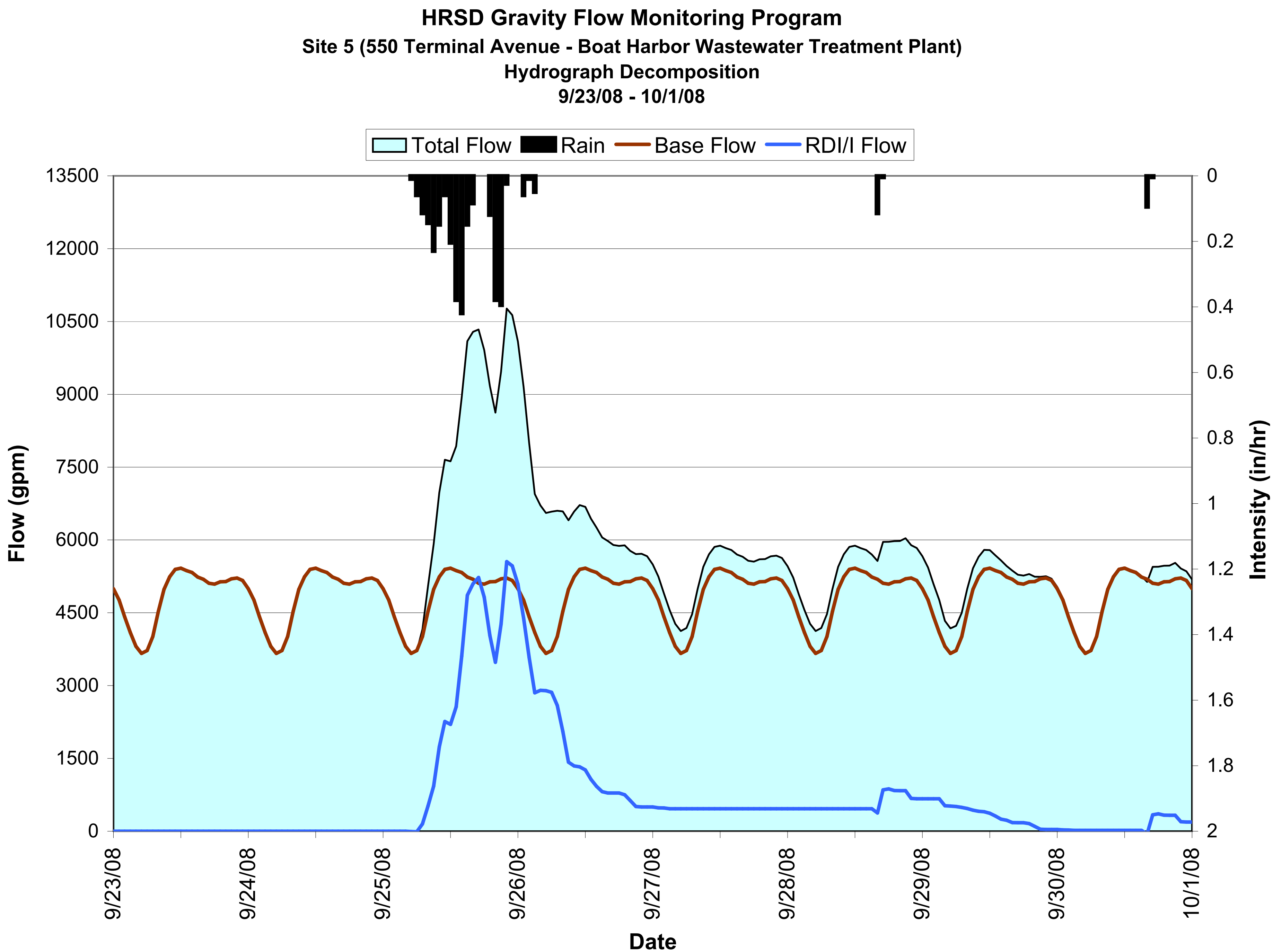
HRSD Gravity Flow Monitoring Program
Site 2 (Temple Lane & Jefferson Avenue)
Hydrograph Decomposition
9/23/08 - 9/29/08




HRSD Gravity Flow Monitoring Program
Site 3 (44th Street & Jefferson Avenue)
Hydrograph Decomposition
12/9/08 - 12/19/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
12/9/08
12/10/08
12/11/08
12/12/08
12/13/08
12/14/08
12/15/08
12/16/08
12/17/08
12/18/08
12/19/08
Date

HRSD Gravity Flow Monitoring Program
Site 4 (2316 Terminal Avenue)
Hydrograph Decomposition
9/21/08 - 9/30/08





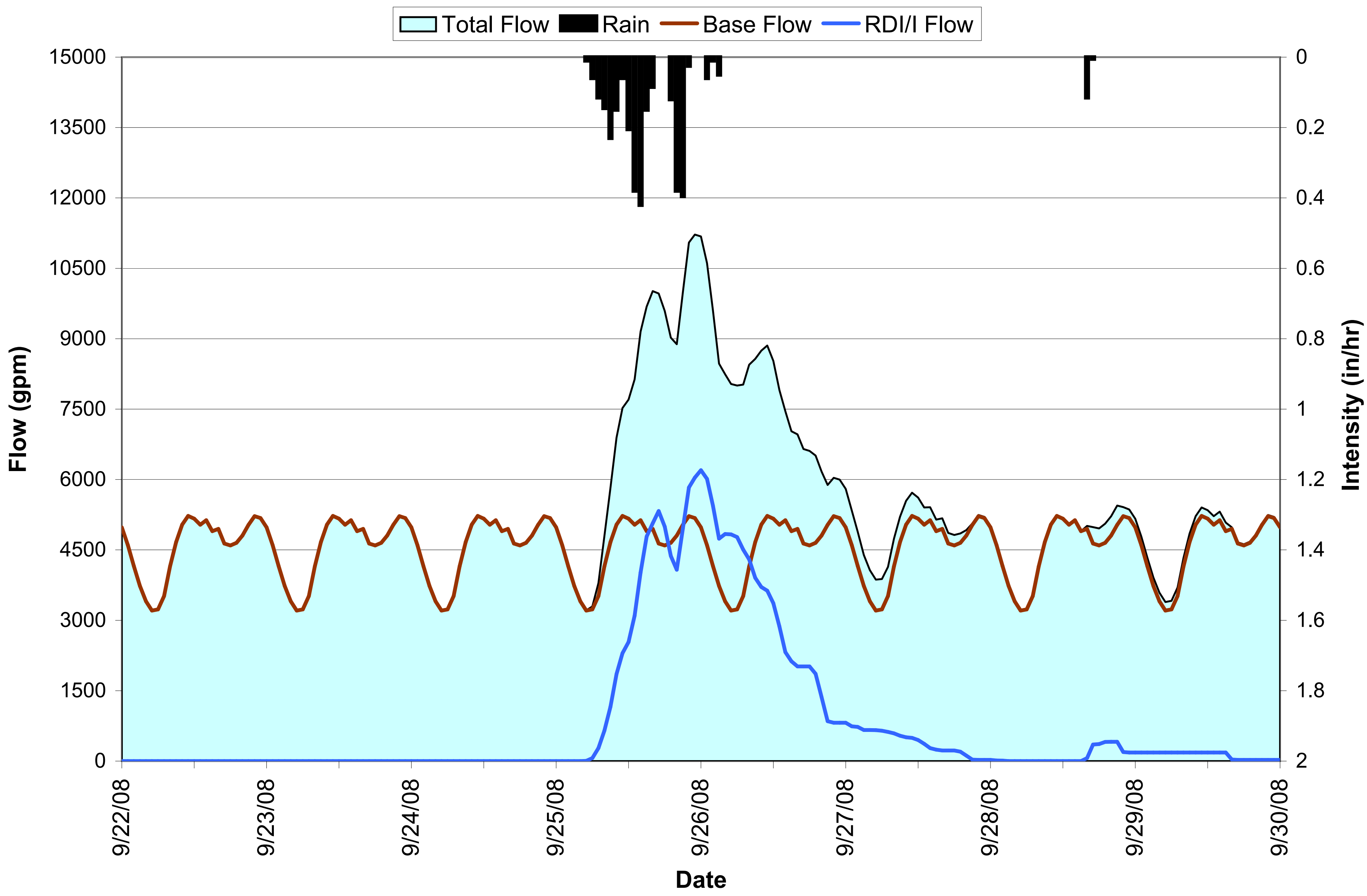
HRSD Gravity Flow Monitoring Program
Site 5 (550 Terminal Avenue - Boat Harbor Wastewater Treatment Plant)
Hydrograph Decomposition
9/23/08 - 10/1/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
13500
12000
10500
9000
7500
6000
4500
3000
1500
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08
10/1/08
Date

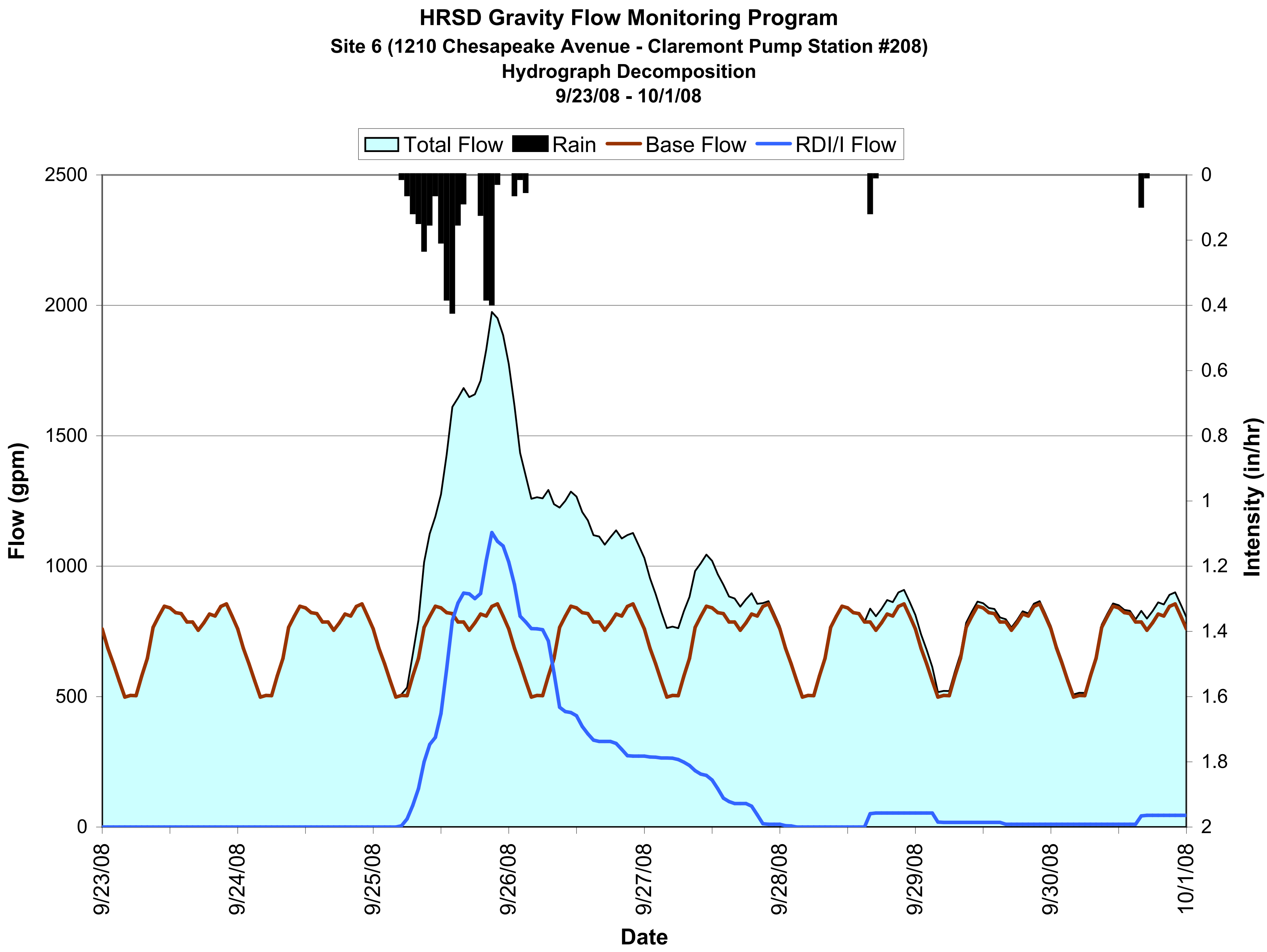
HRSD Gravity Flow Monitoring Program

Site 5A (550 Terminal Avenue - Boat Harbor Wastewater Treatment Plant)

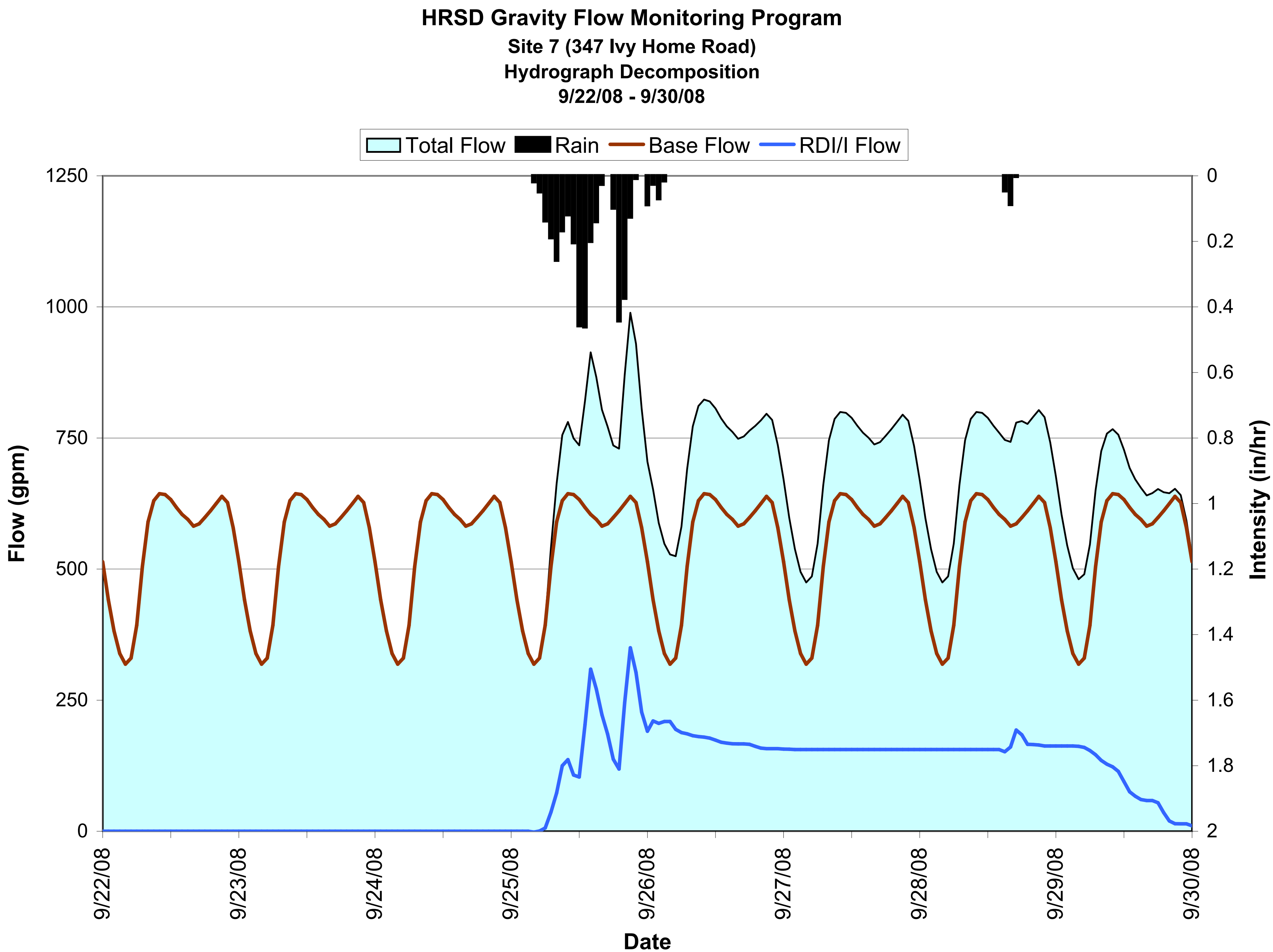
Hydrograph Decomposition

9/22/08 - 9/30/08





HRSD Gravity Flow Monitoring Program
Site 6 (1210 Chesapeake Avenue - Claremont Pump Station #208)
Hydrograph Decomposition
9/23/08 - 10/1/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
Intensity (in/hr)
Date
2500
2000
1500
1000
500
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08
10/1/08



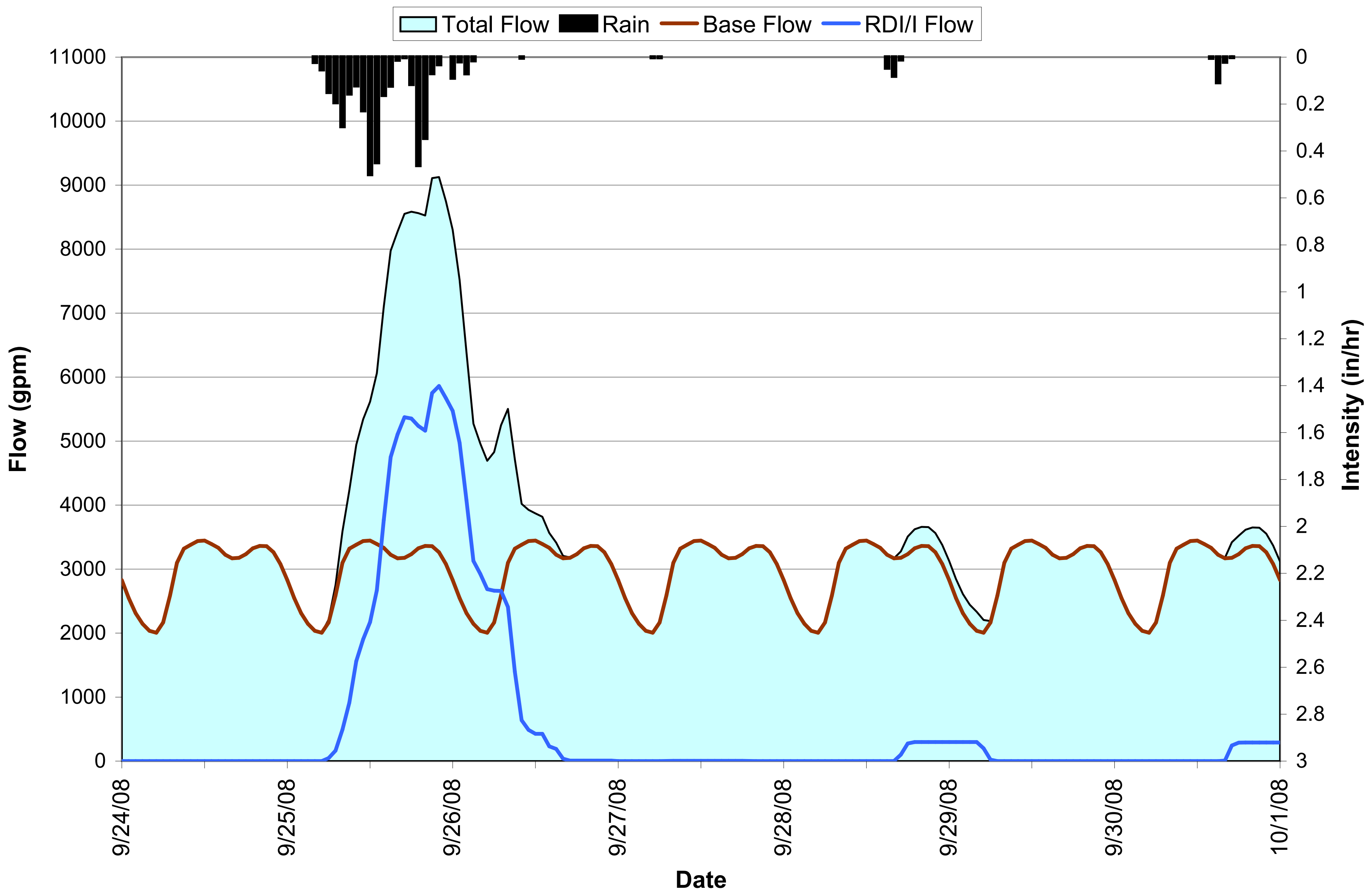
HRSD Gravity Flow Monitoring Program
Site 7 (347 Ivy Home Road)
Hydrograph Decomposition
9/22/08 - 9/30/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
1250
1000
750
500
250
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
9/22/08
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08
Date

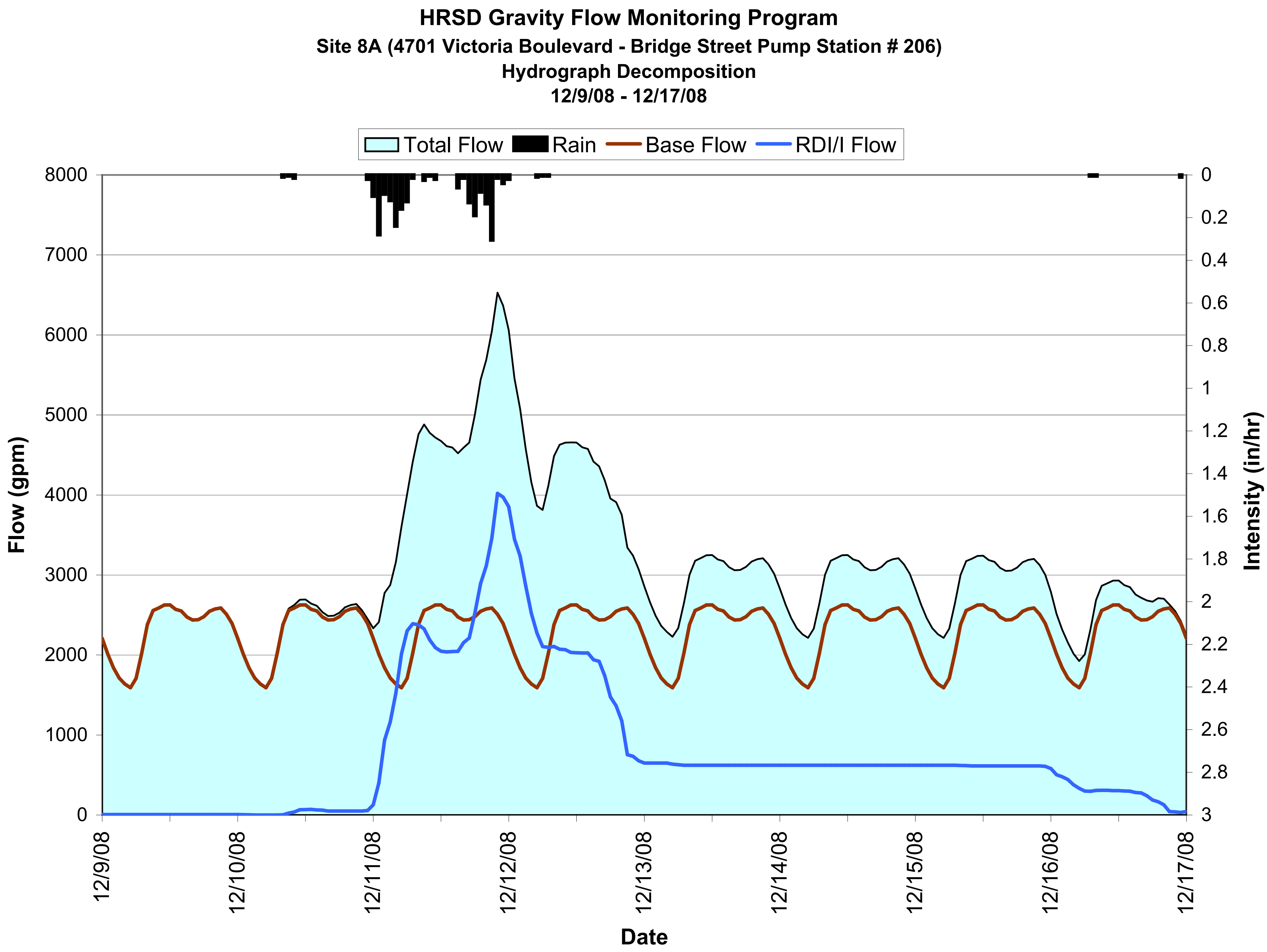
HRSD Gravity Flow Monitoring Program

Site 8 (4701 Victoria Boulevard - Bridge Street Pump Station # 206)

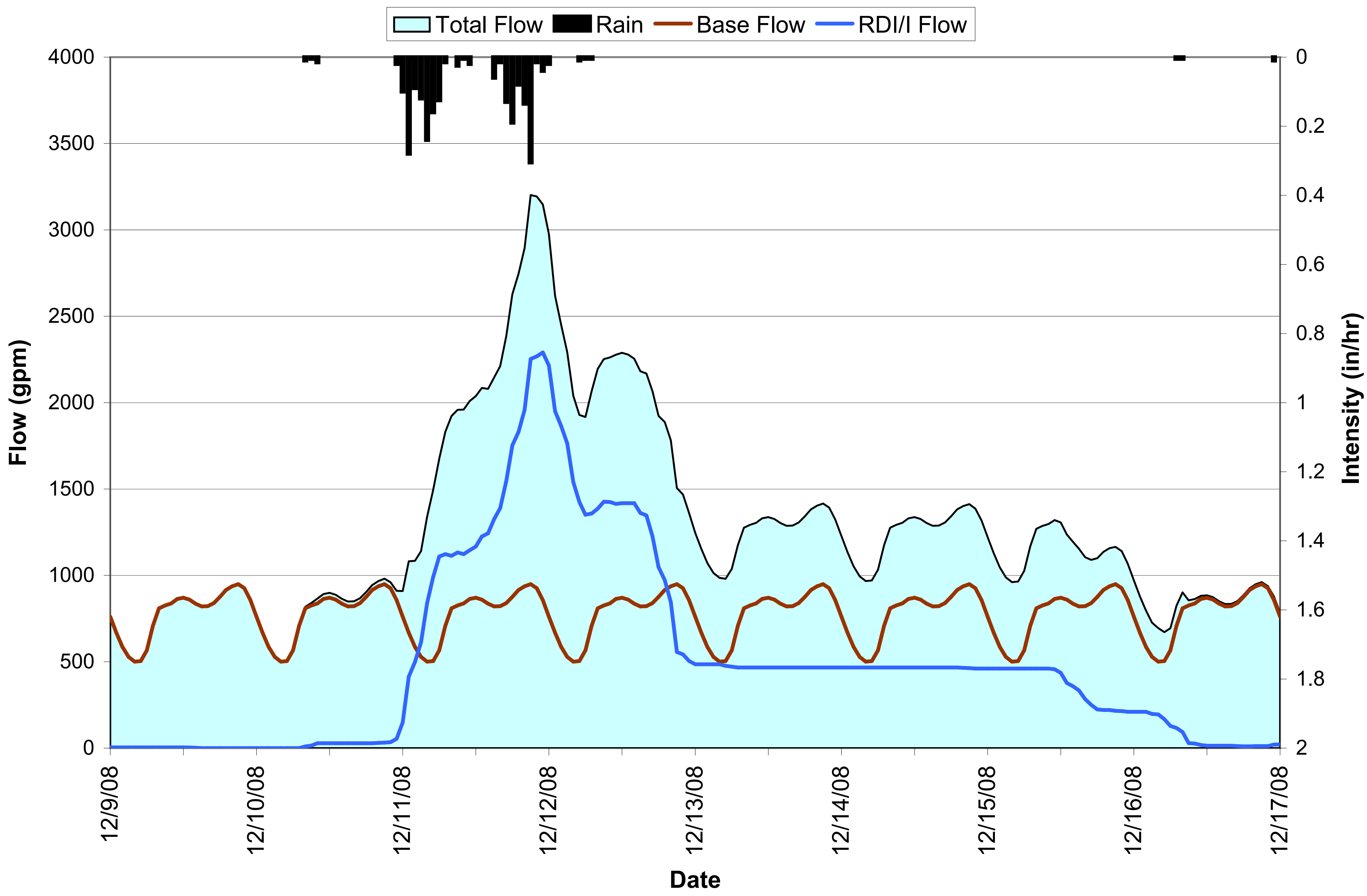
Hydrograph Decomposition

9/24/08 - 10/1/08

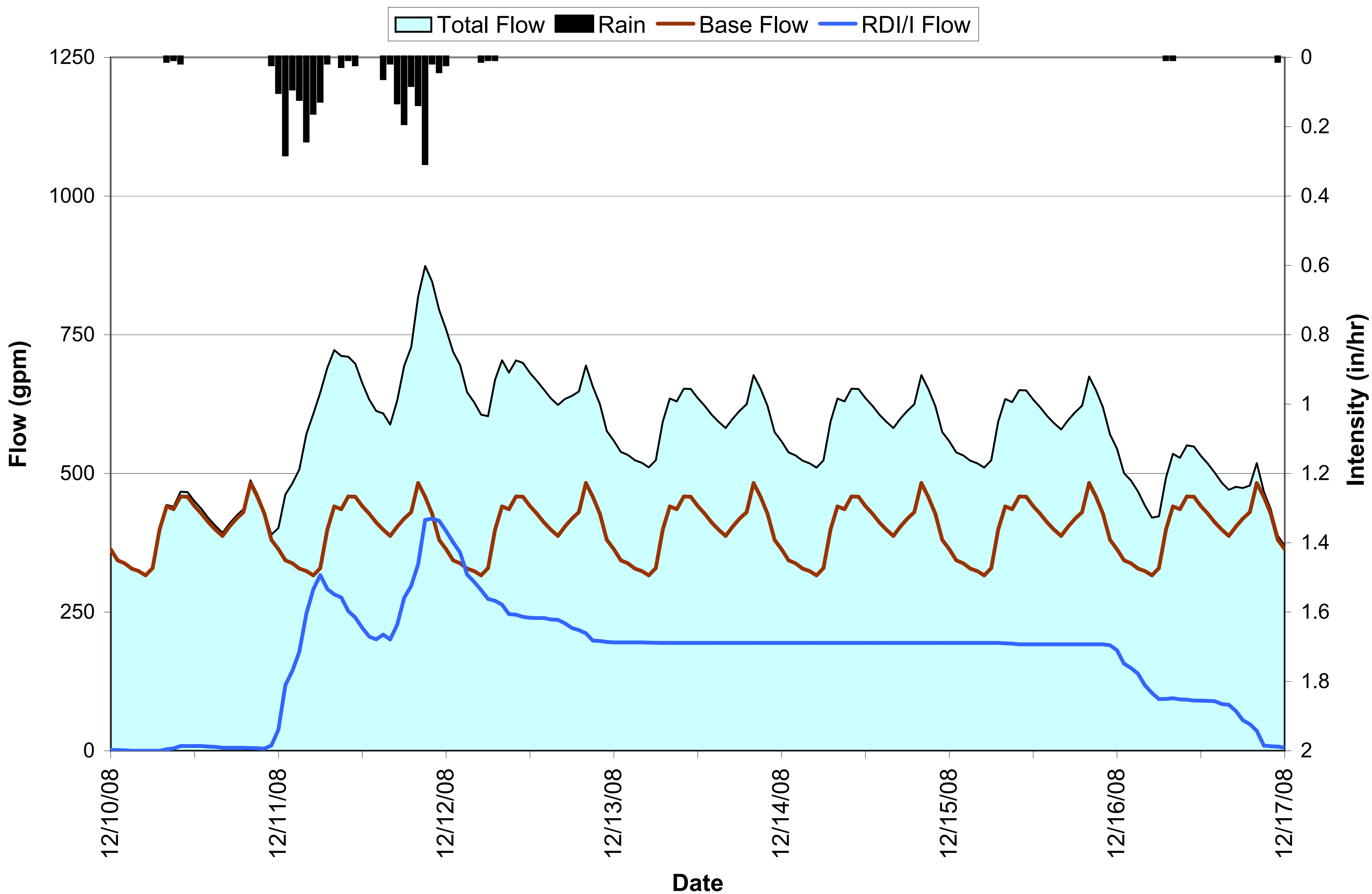


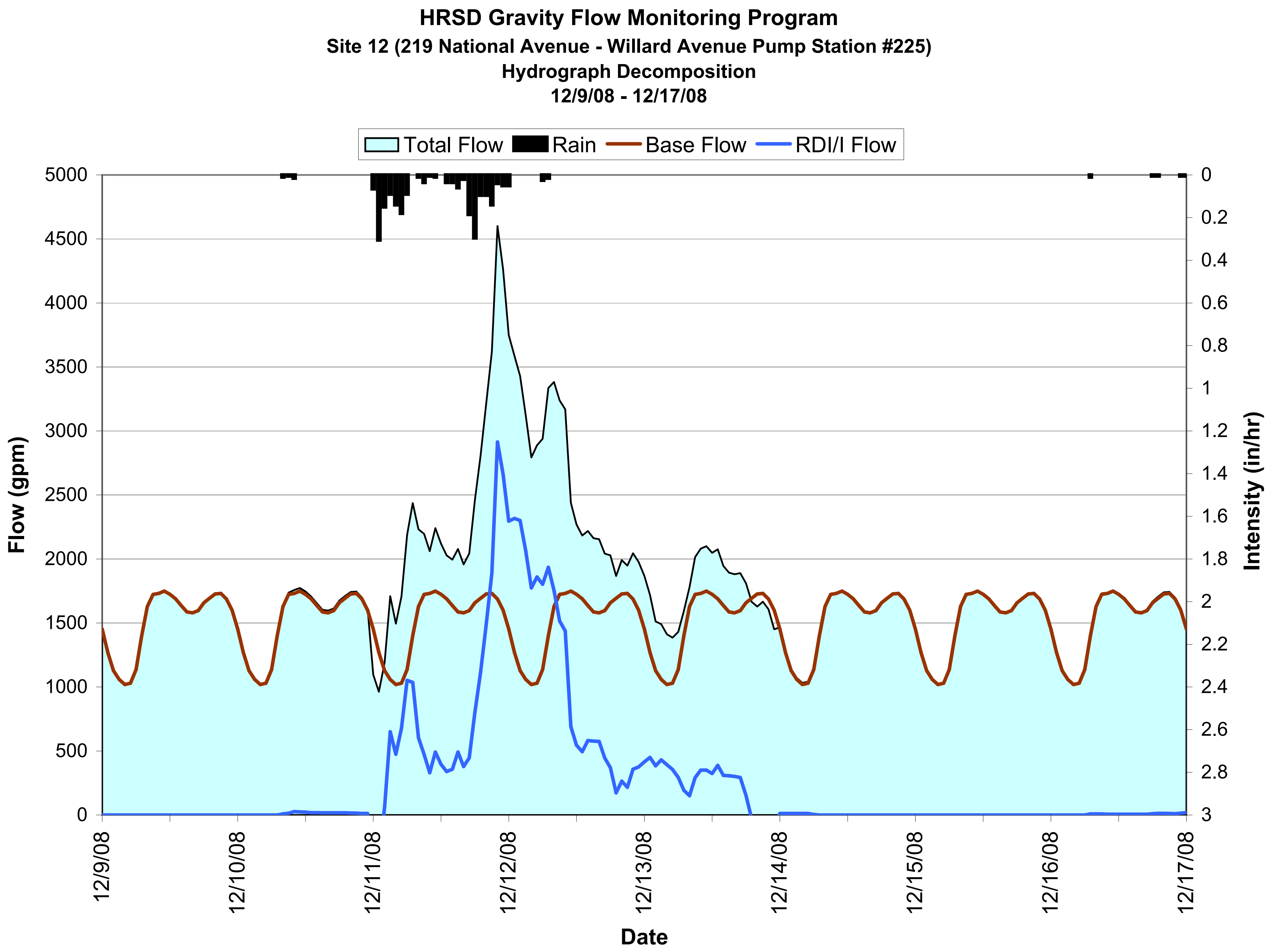

HRSD Gravity Flow Monitoring Program
Site 8A (4701 Victoria Boulevard - Bridge Street Pump Station # 206)
Hydrograph Decomposition
12/9/08 - 12/17/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
8000
7000
6000
5000
4000
3000
2000
1000
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
12/9/08
12/10/08
12/11/08
12/12/08
12/13/08
12/14/08
12/15/08
12/16/08
12/17/08
Date

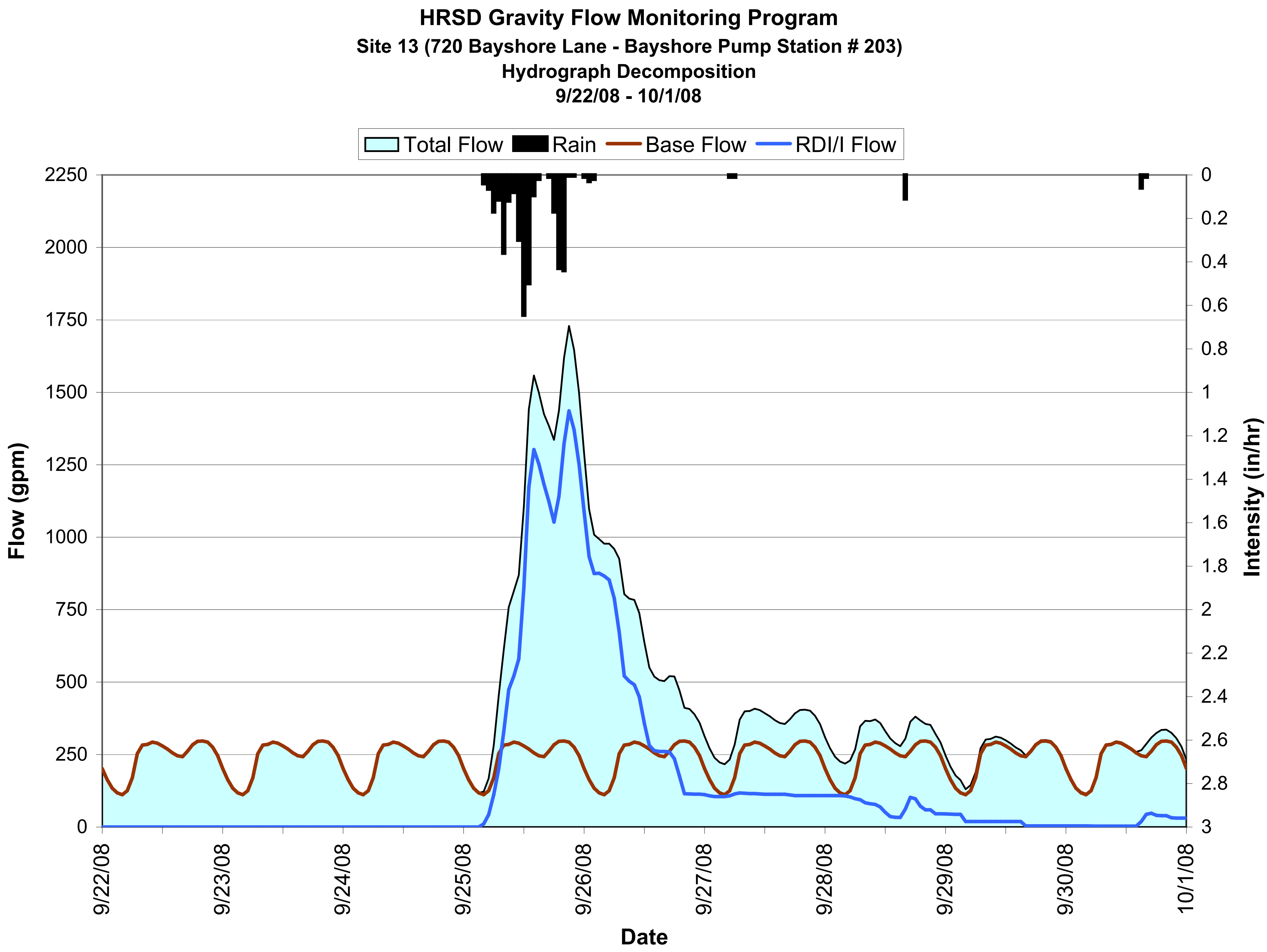
HRSD Gravity Flow Monitoring Program
Site 9 (217 Washington Street - Washington Street Pump Station # 223)
Hydrograph Decomposition
12/9/08 - 12/17/08



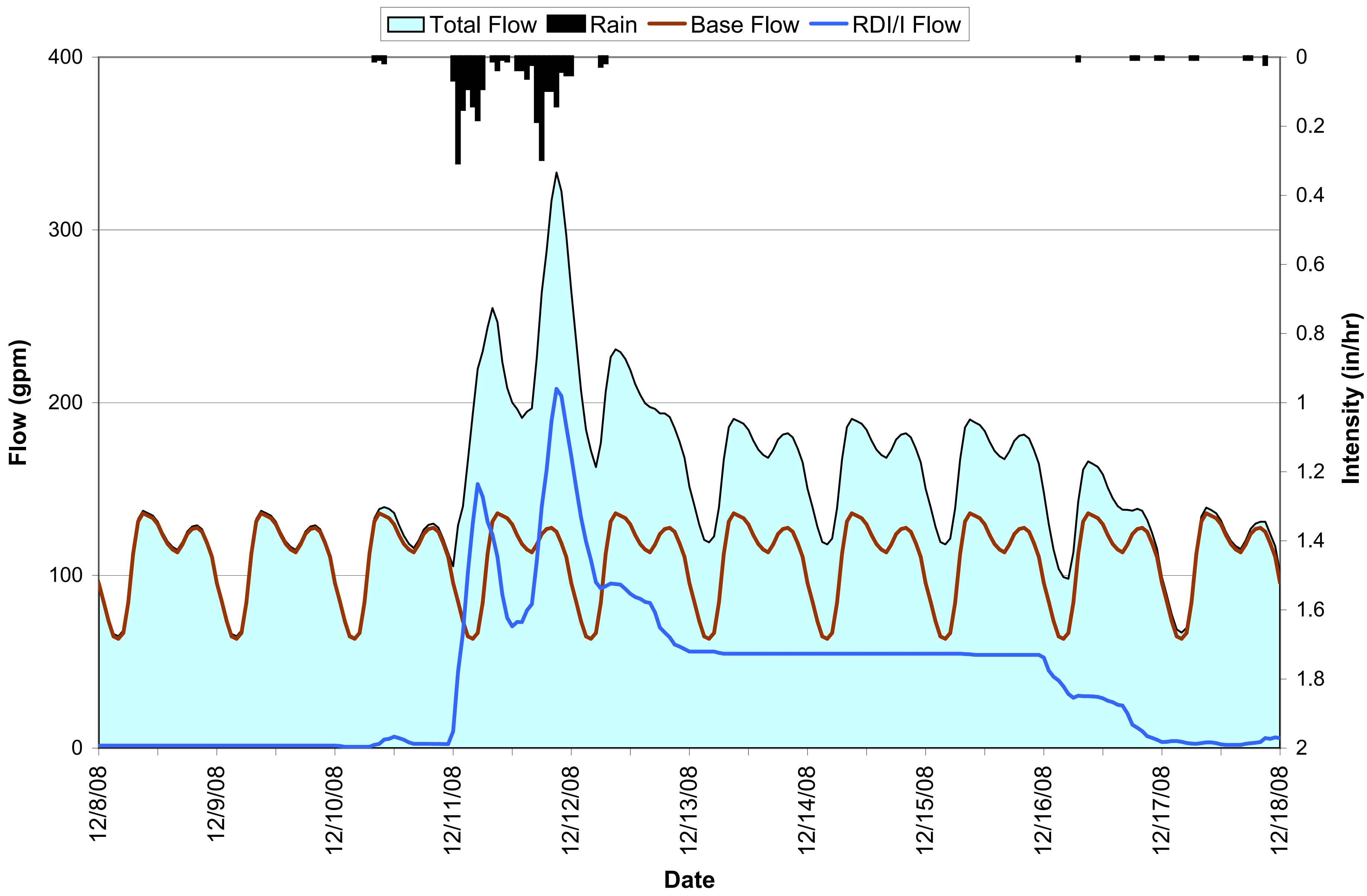
HRSD Gravity Flow Monitoring Program
Site 10 (7 Thornrose Avenue - Langley Circle Pump Station # 217)
Hydrograph Decomposition
12/10/08 - 12/17/08



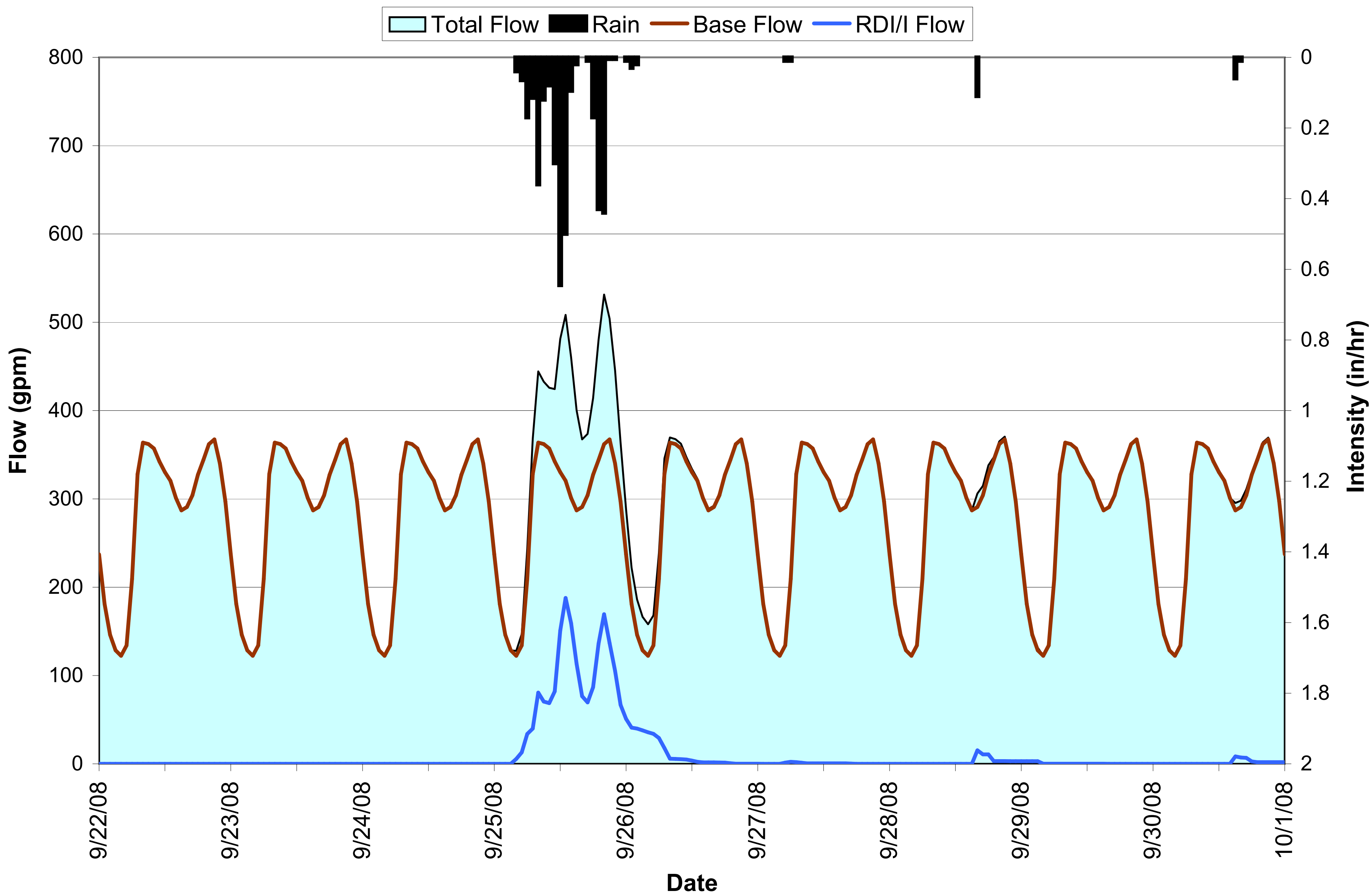

HRSD Gravity Flow Monitoring Program
Site 12 (219 National Avenue - Willard Avenue Pump Station #225)
Hydrograph Decomposition
12/9/08 - 12/17/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
12/9/08
12/10/08
12/11/08
12/12/08
12/13/08
12/14/08
12/15/08
12/16/08
12/17/08
Date

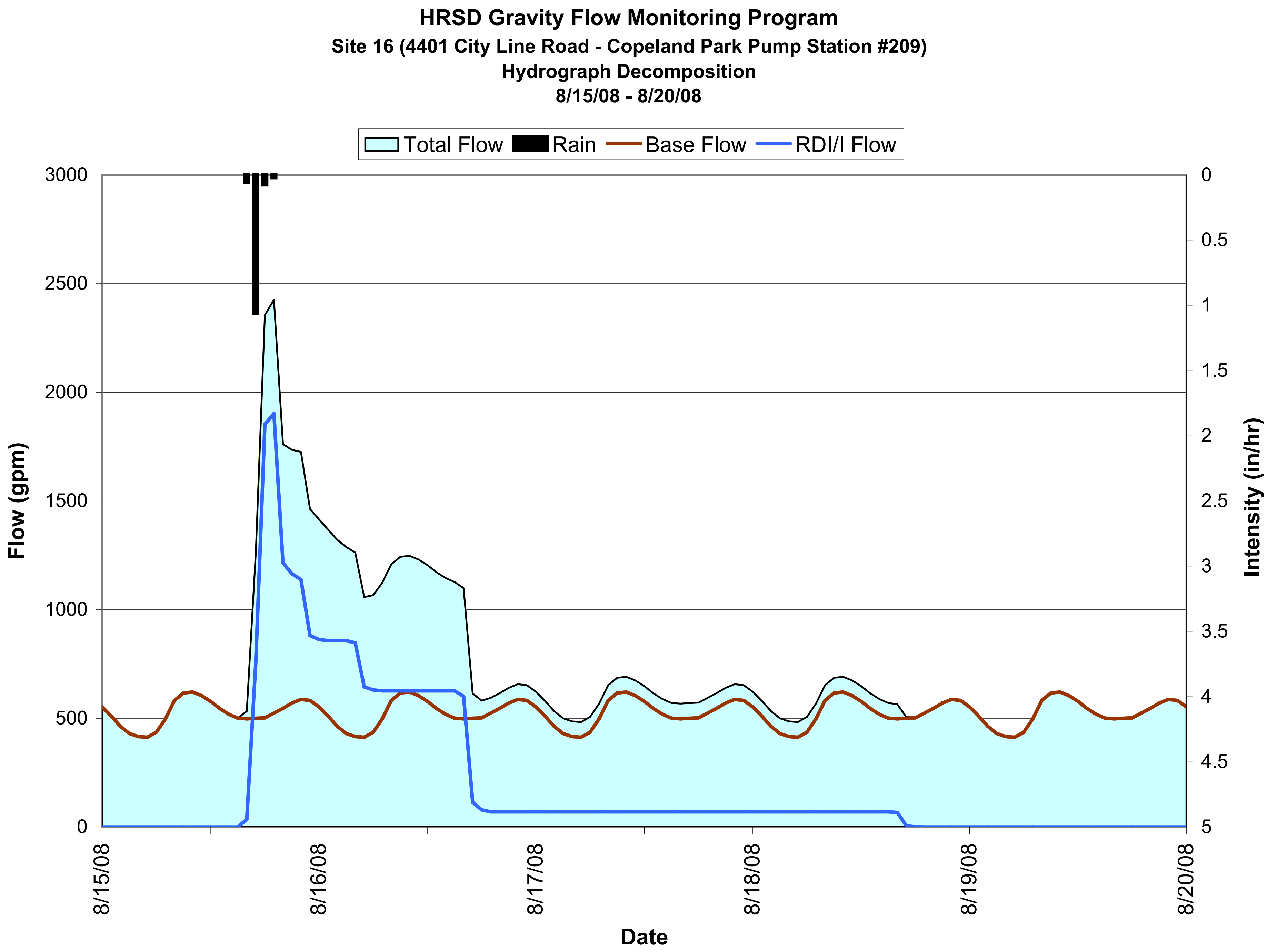

HRSD Gravity Flow Monitoring Program
Site 13 (720 Bayshore Lane - Bayshore Pump Station # 203)
Hydrograph Decomposition
9/22/08 - 10/1/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
2250
2000
1750
1500
1250
1000
750
500
250
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
9/22/08
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08
10/1/08
Date

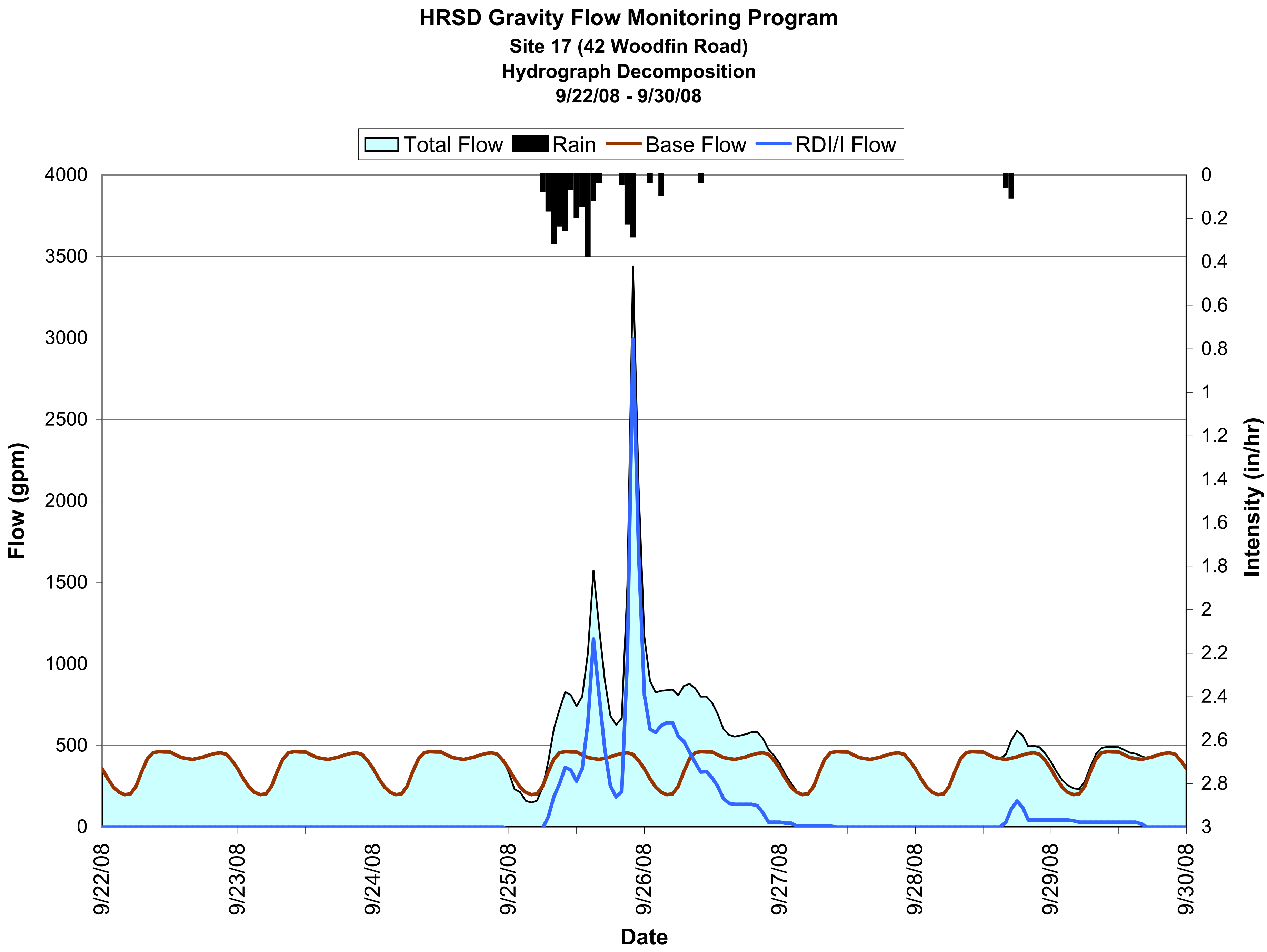
HRSD Gravity Flow Monitoring Program
Site 14 Isco (Bloxoms Corner Pump Station # 204)
Hydrograph Decomposition
12/8/08 - 12/18/08

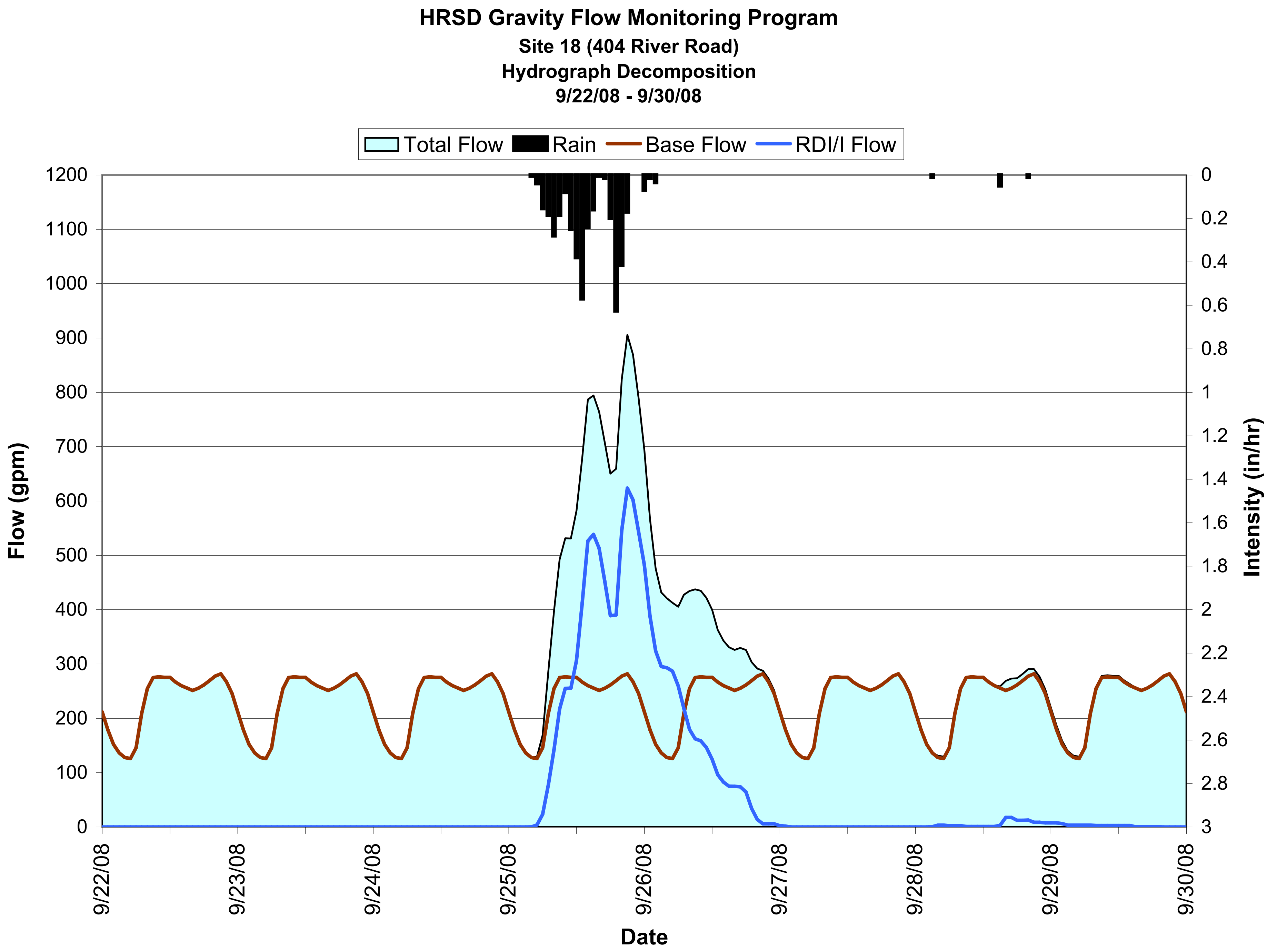


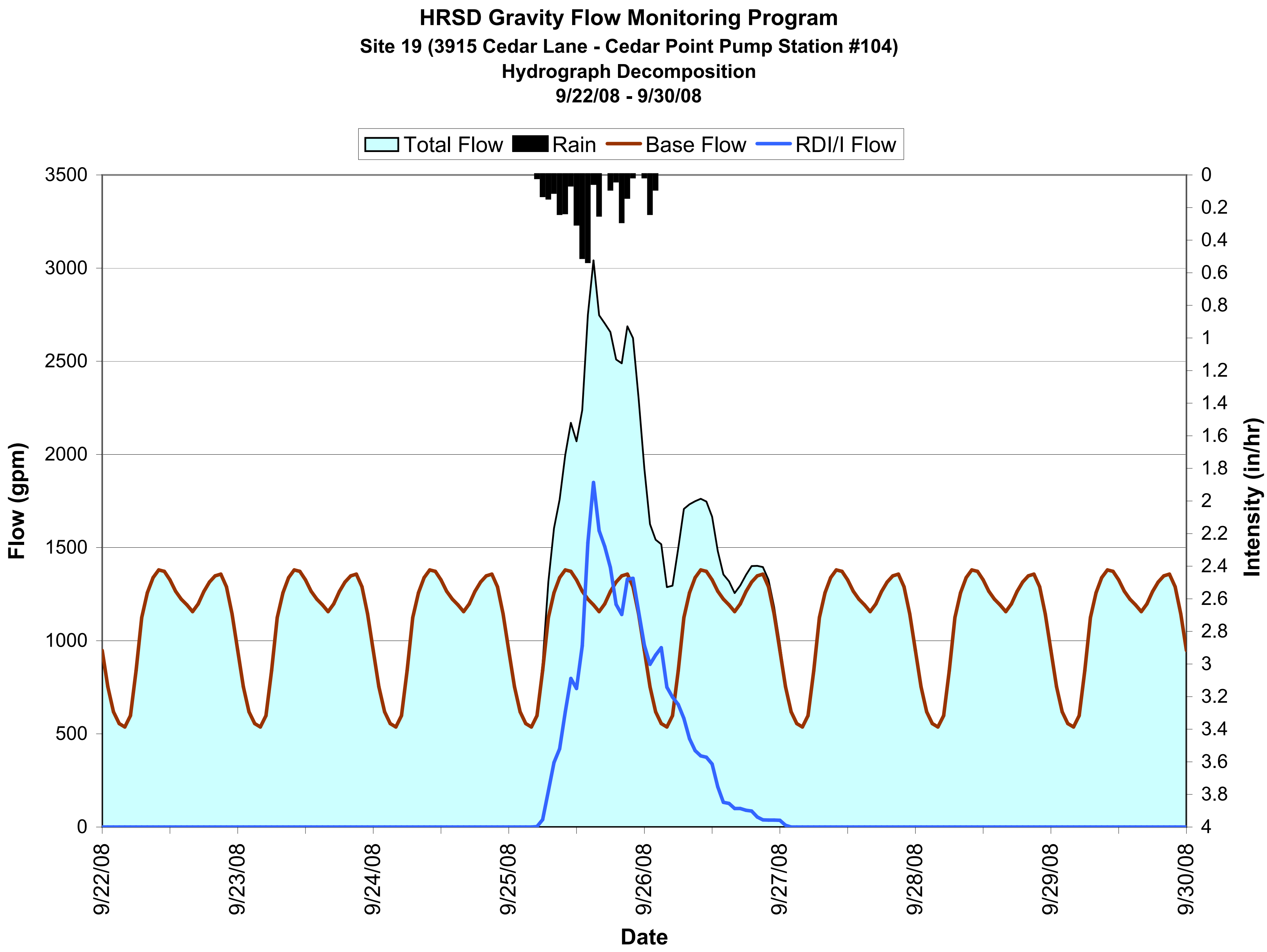
HRSD Gravity Flow Monitoring Program
Site 15 (704 LeMaster Avenue - Philips Elementary School)
Hydrograph Decomposition
9/22/08 - 10/1/08



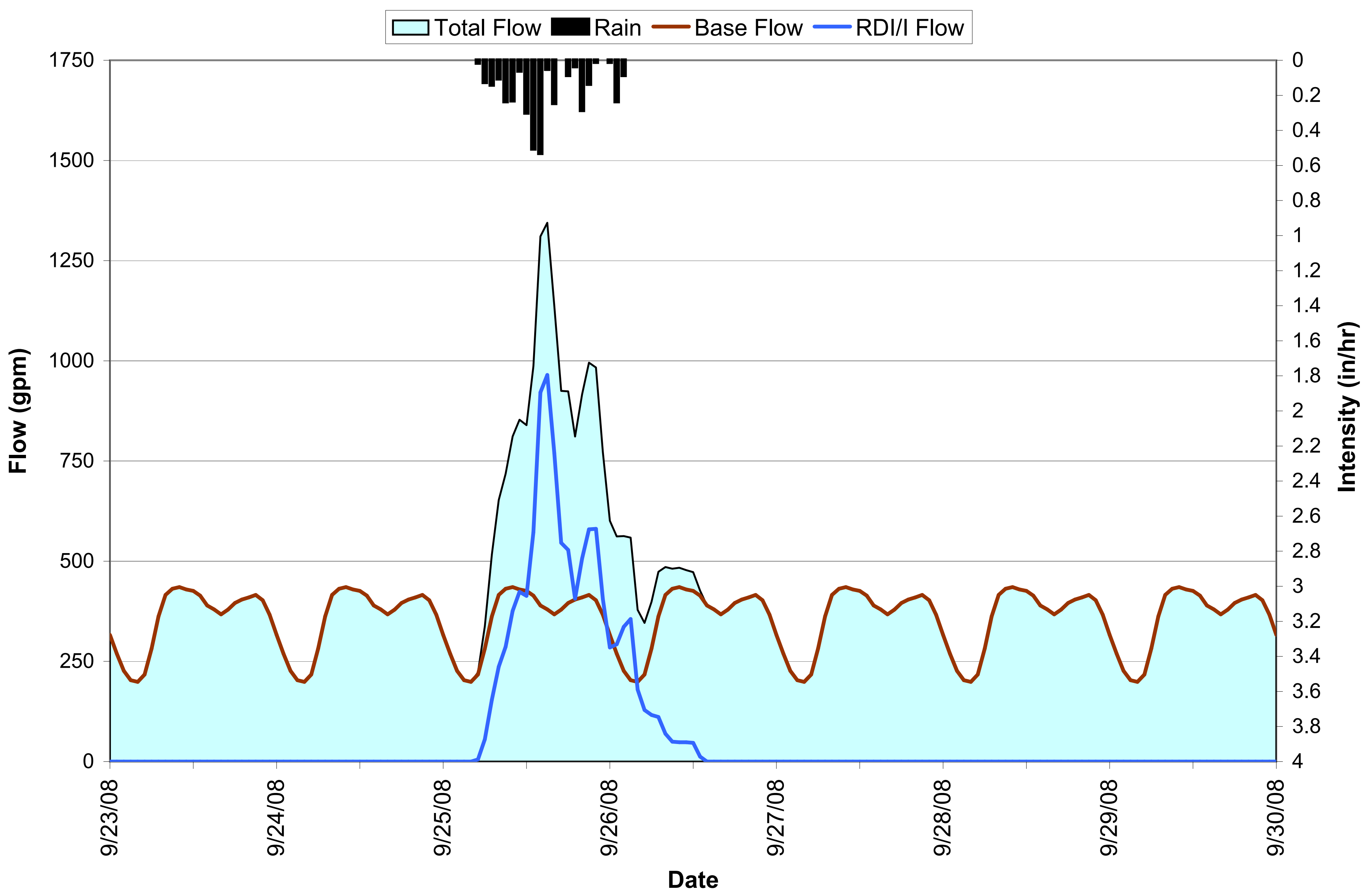

HRSD Gravity Flow Monitoring Program
Site 16 (4401 City Line Road - Copeland Park Pump Station #209)
Hydrograph Decomposition
8/15/08 - 8/20/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
Intensity (in/hr)
Date
3000
2500
2000
1500
1000
500
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
8/15/08
8/16/08
8/17/08
8/18/08
8/19/08
8/20/08

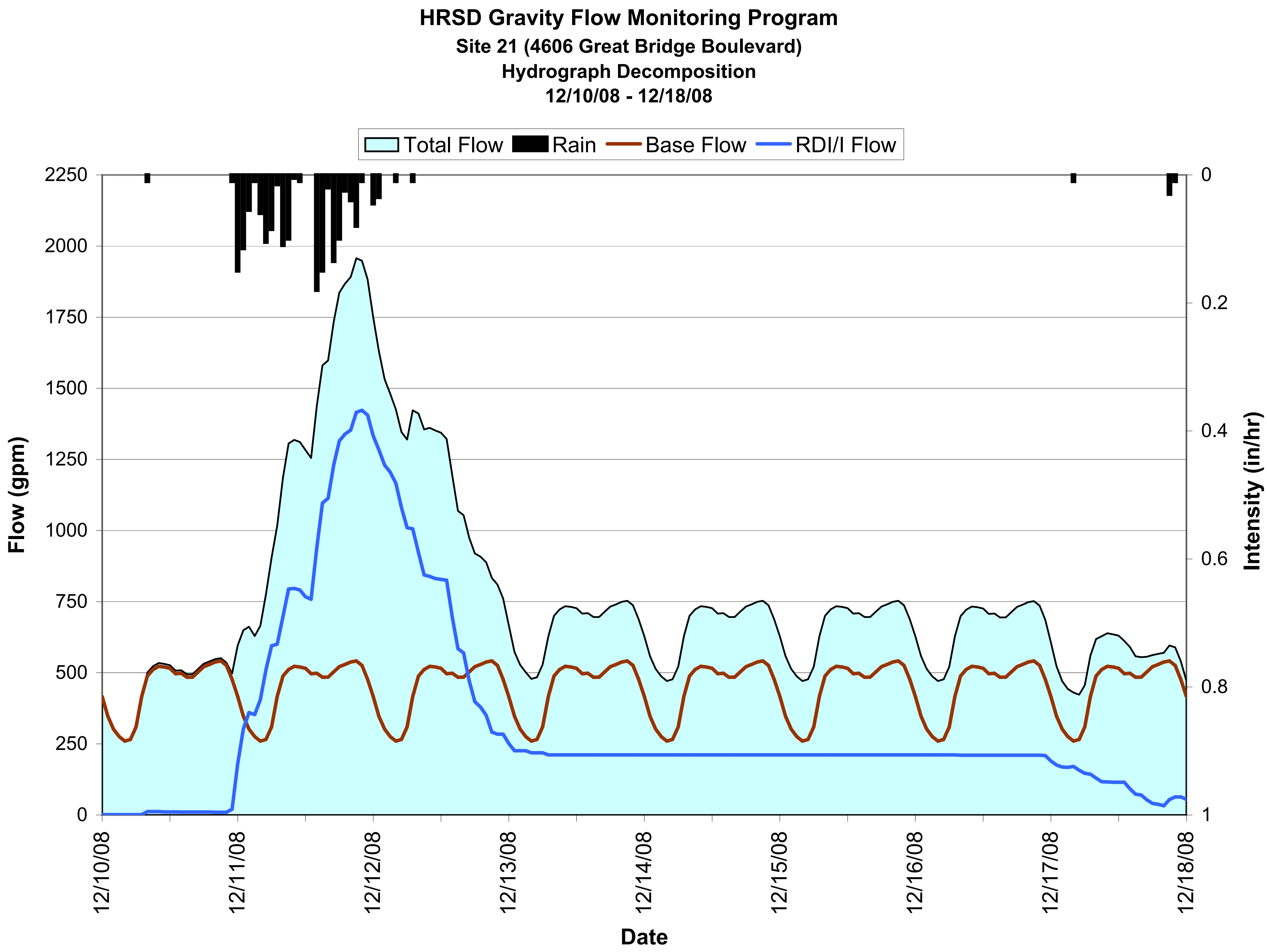

HRSD Gravity Flow Monitoring Program
Site 17 (42 Woodfin Road)
Hydrograph Decomposition
9/22/08 - 9/30/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
4000
3500
3000
2500
2000
1500
1000
500
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
9/22/08
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08
Date


HRSD Gravity Flow Monitoring Program
Site 18 (404 River Road)
Hydrograph Decomposition
9/22/08 - 9/30/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
Intensity (in/hr)
Date
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
9/22/08
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08

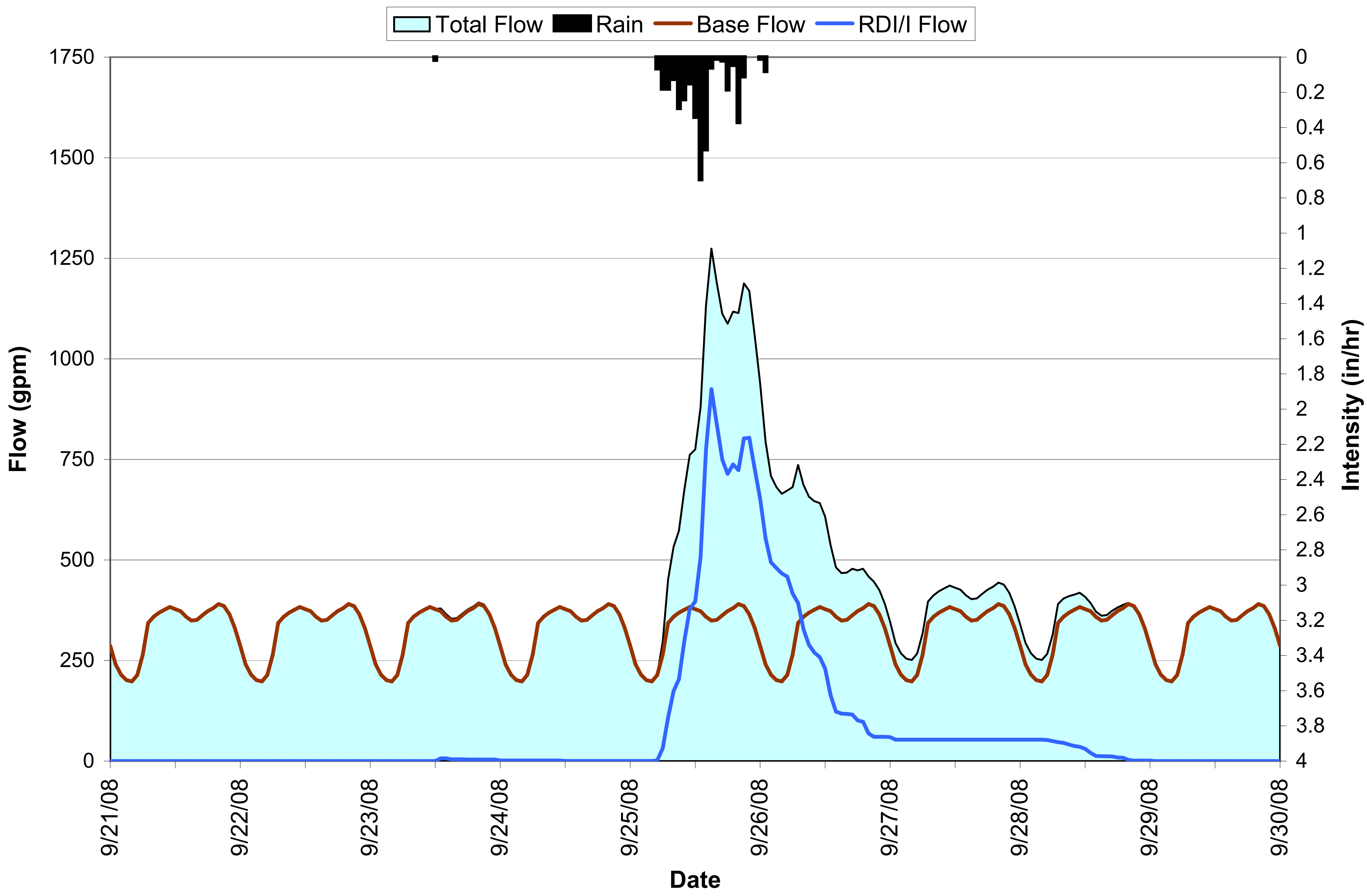

HRSD Gravity Flow Monitoring Program
Site 19 (3915 Cedar Lane - Cedar Point Pump Station #104)
Hydrograph Decomposition
9/22/08 - 9/30/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
3500
3000
2500
2000
1500
1000
500
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
9/22/08
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08
Date

HRSD Gravity Flow Monitoring Program
Site 20 (5209 Peake Lane - Intersection of Peake Lane and Pine Lane)
Hydrograph Decomposition
9/23/08 - 9/30/08




HRSD Gravity Flow Monitoring Program
Site 21 (4606 Great Bridge Boulevard)
Hydrograph Decomposition
12/10/08 - 12/18/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
2250
2000
1750
1500
1250
1000
750
500
250
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
12/10/08
12/11/08
12/12/08
12/13/08
12/14/08
12/15/08
12/16/08
12/17/08
12/18/08
Date

HRSD Gravity Flow Monitoring Program
Site 22B (Ferebee Avenue Pump Station #110)
Hydrograph Decomposition
9/21/08 - 9/30/08

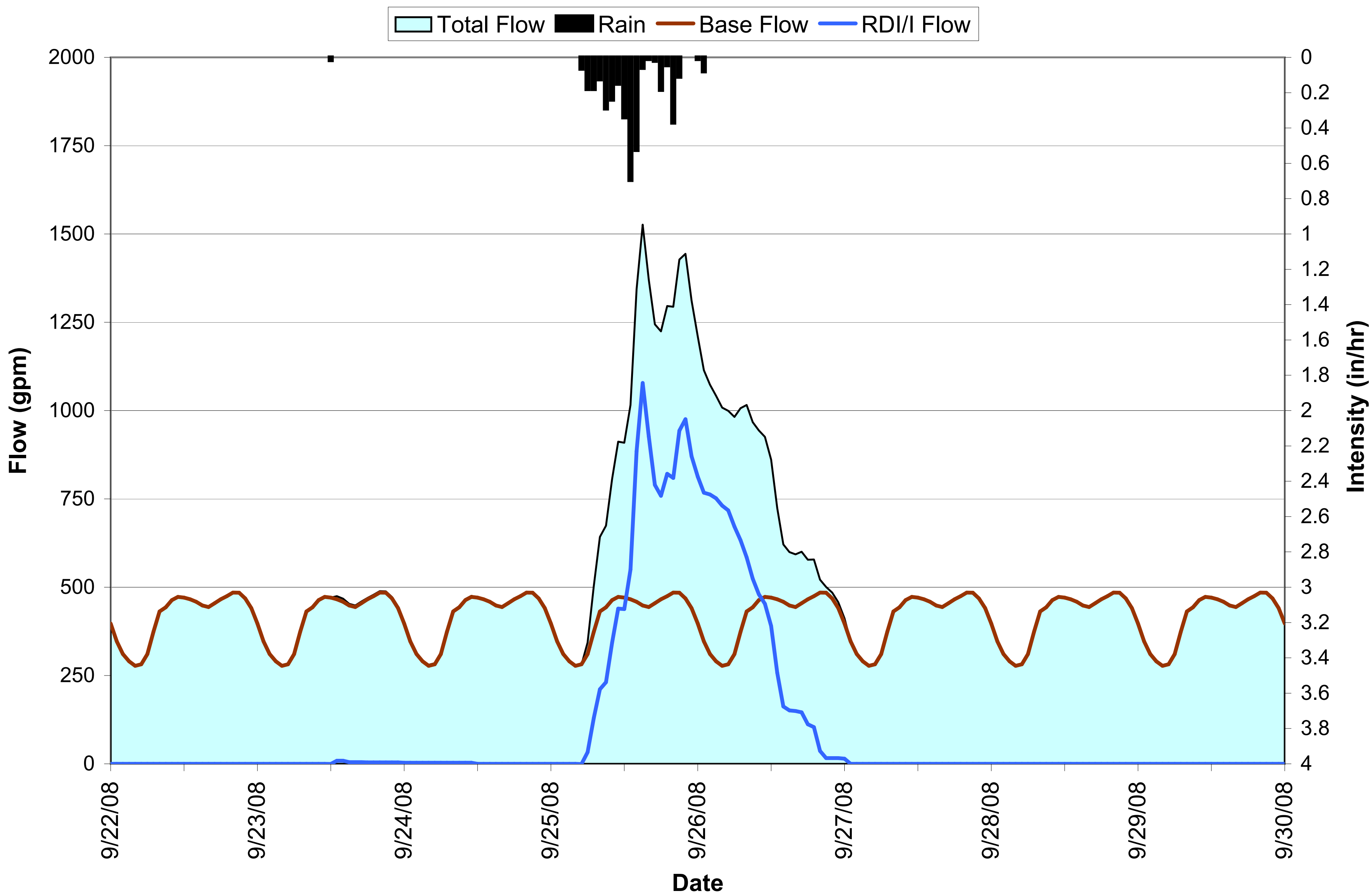


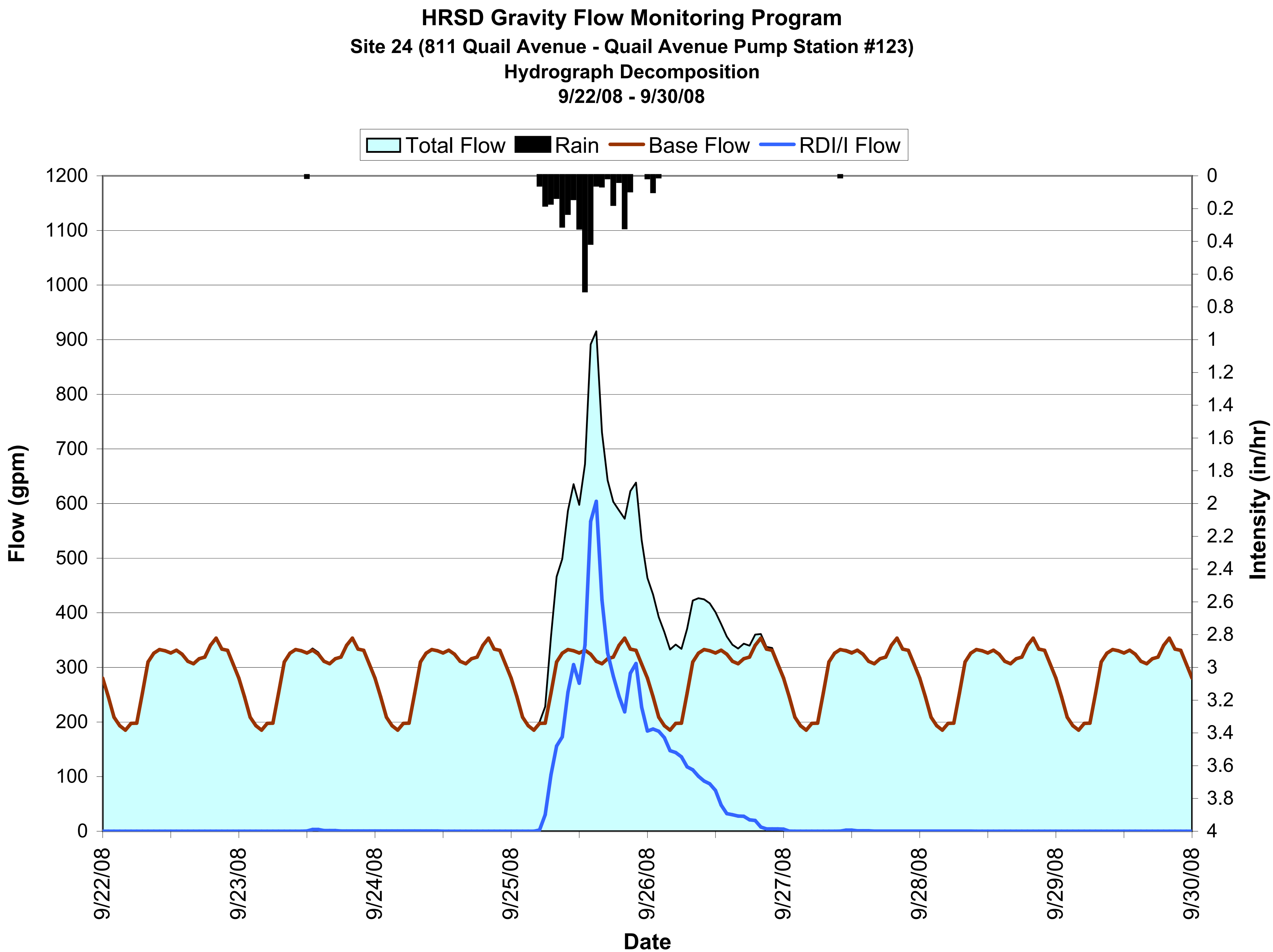
HRSD Gravity Flow Monitoring Program

Site 23 (503 Park Avenue - Park Avenue Pump Station #119)

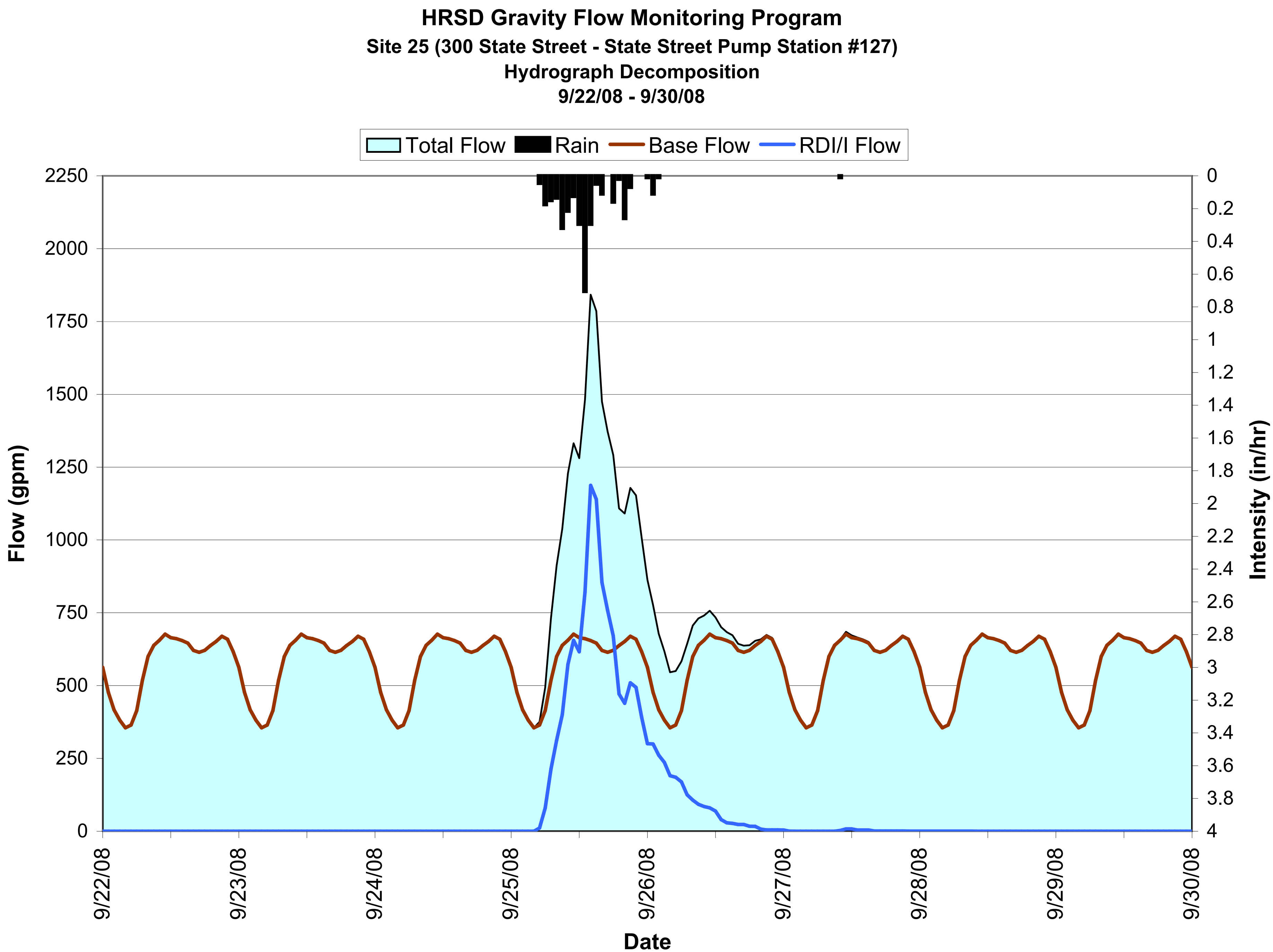
Hydrograph Decomposition

9/22/08 - 9/30/08





HRSD Gravity Flow Monitoring Program
Site 24 (811 Quail Avenue - Quail Avenue Pump Station #123)
Hydrograph Decomposition
9/22/08 - 9/30/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
Intensity (in/hr)
Date
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
9/22/08
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08



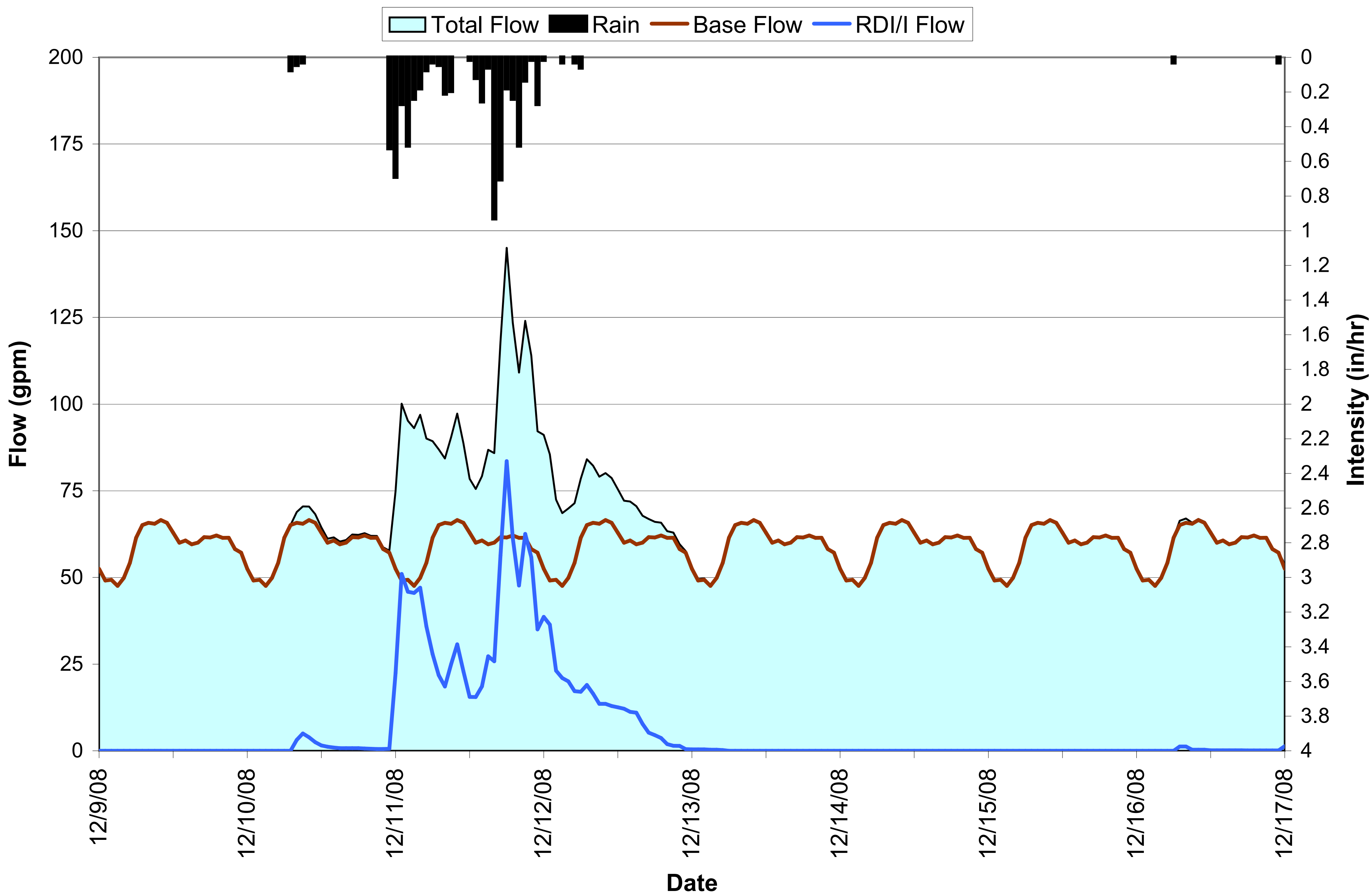
HRSD Gravity Flow Monitoring Program
Site 25 (300 State Street - State Street Pump Station #127)
Hydrograph Decomposition
9/22/08 - 9/30/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
2250
2000
1750
1500
1250
1000
750
500
250
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
9/22/08
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08
Date

HRSD Gravity Flow Monitoring Program

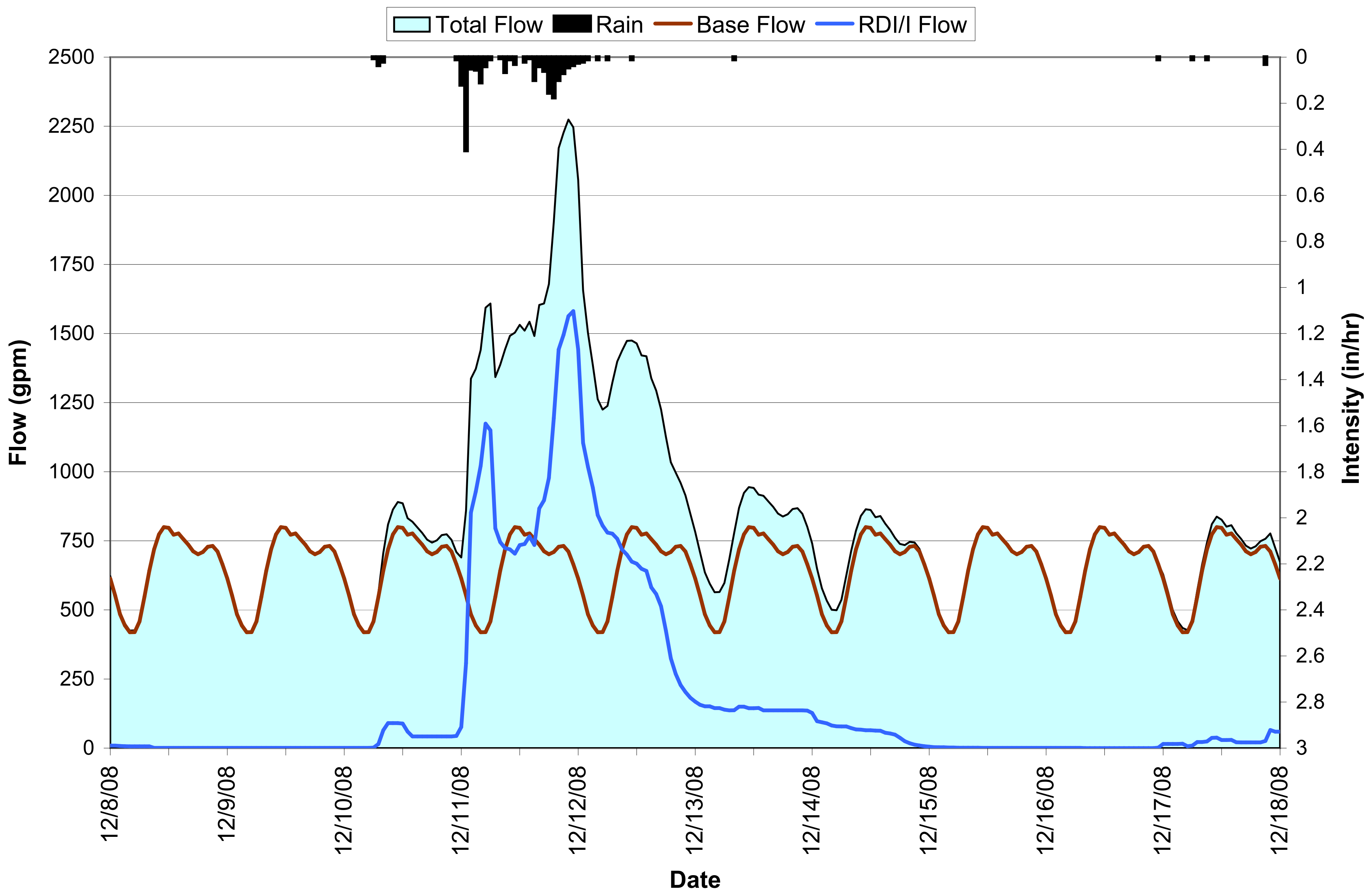
Site 26 (1900 East Indian River Road - Steamboat Creek Pump Station #128)

Hydrograph Decomposition

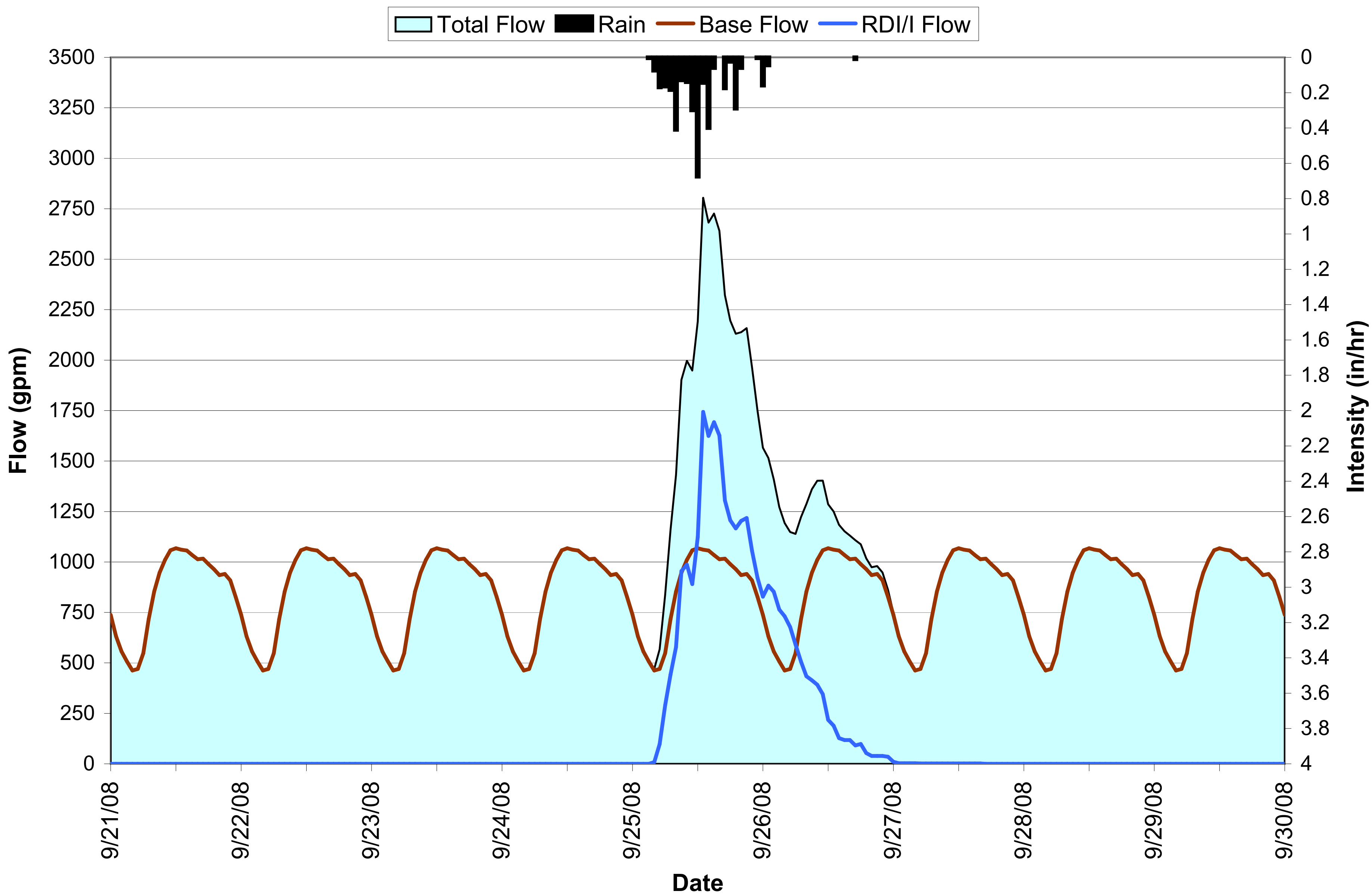
12/9/08 - 12/17/08

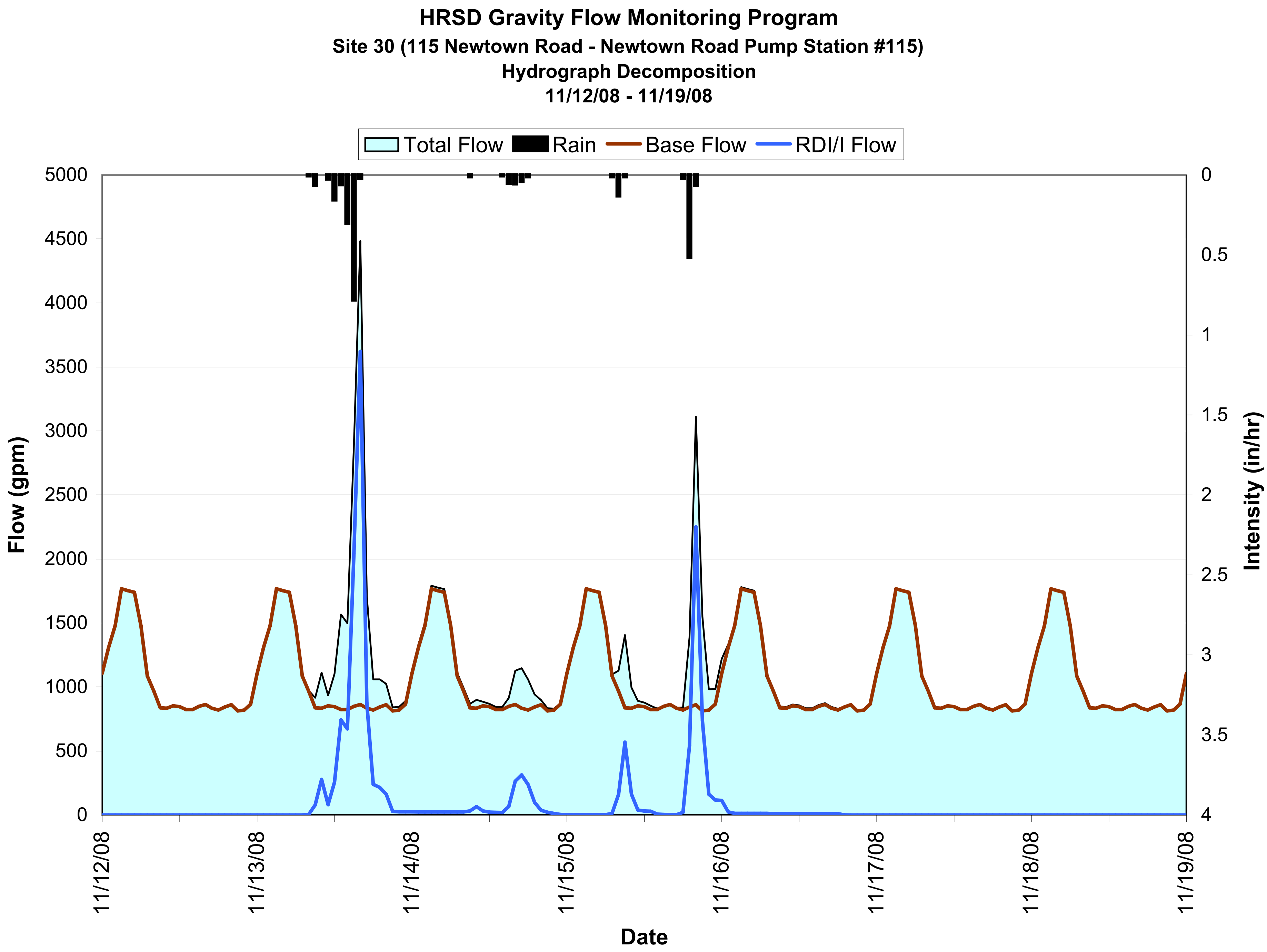


HRSD Gravity Flow Monitoring Program
Site 27 (905 Portsmouth Boulevard)
Hydrograph Decomposition
12/8/08 - 12/18/08

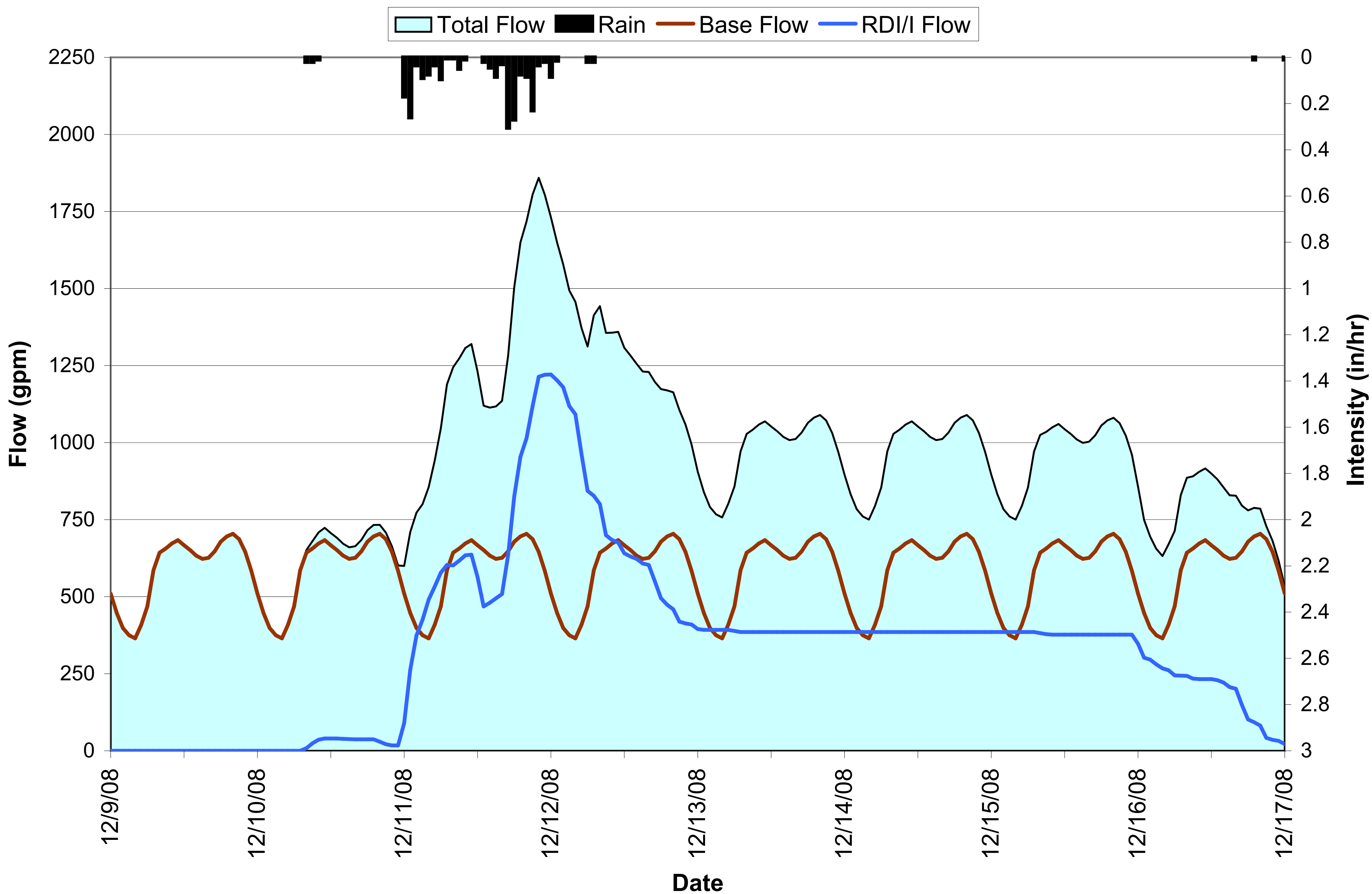


HRSD Gravity Flow Monitoring Program
Site 28 (935 Norchester Avenue - Norchester Pump Station #116)
Hydrograph Decomposition
9/21/08 - 9/30/08

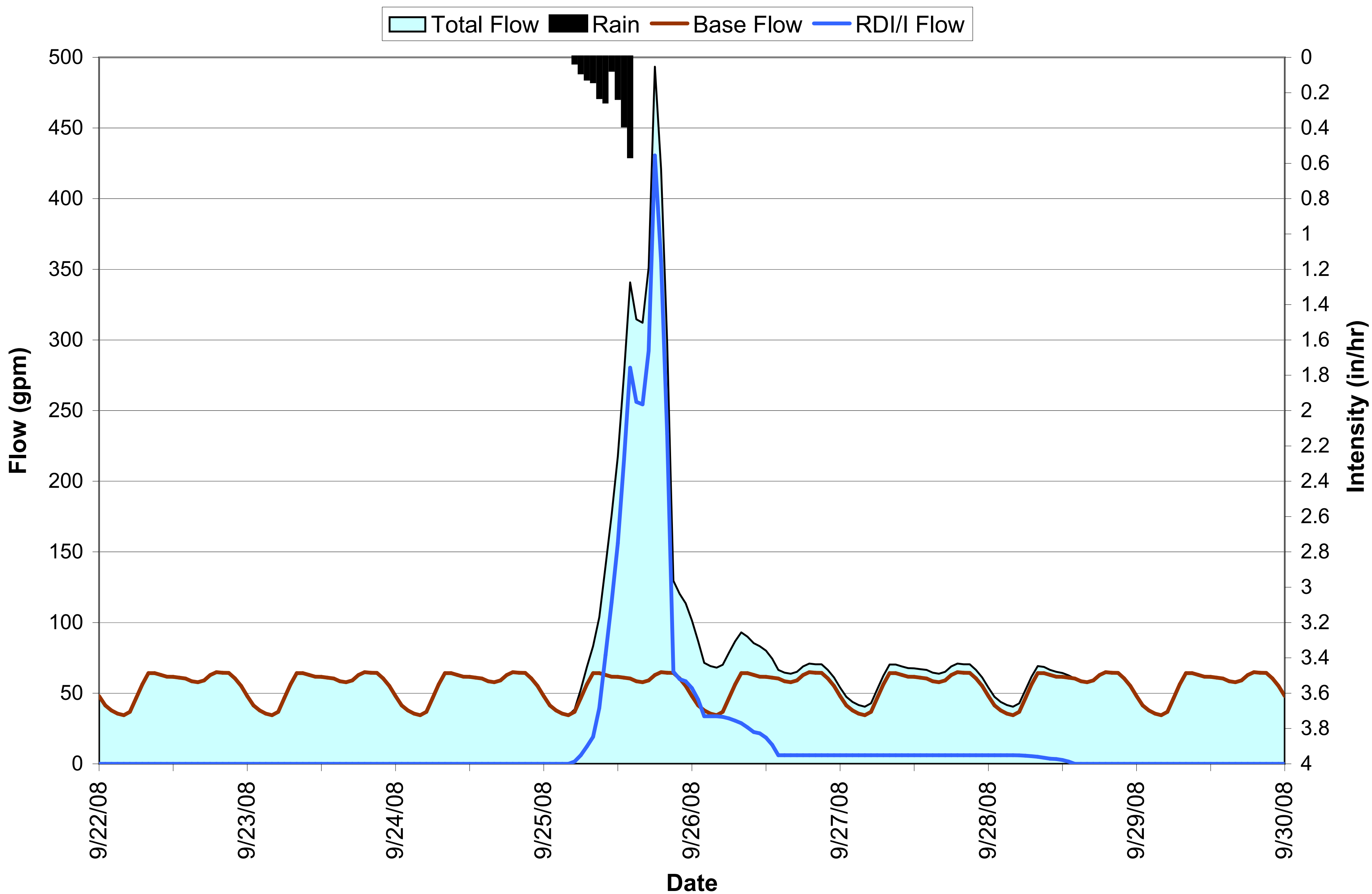


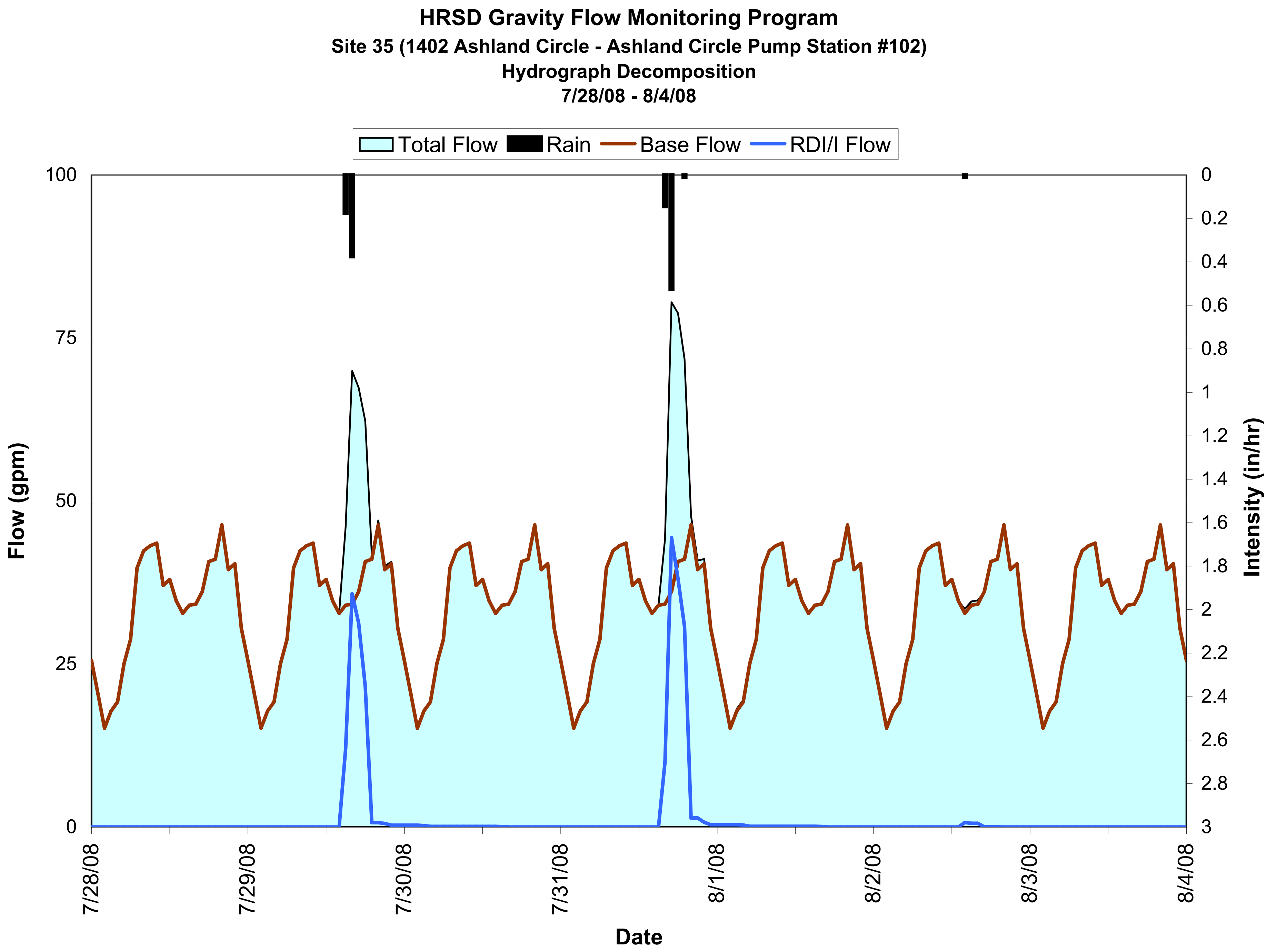

HRSD Gravity Flow Monitoring Program
Site 30 (115 Newtown Road - Newtown Road Pump Station #115)
Hydrograph Decomposition
11/12/08 - 11/19/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Intensity (in/hr)
0
0.5
1
1.5
2
2.5
3
3.5
4
11/12/08
11/13/08
11/14/08
11/15/08
11/16/08
11/17/08
11/18/08
11/19/08
Date

HRSD Gravity Flow Monitoring Program
Site 33 (5739 Chesapeake Boulevard - Chesapeake Boulevard Pump Station #105)
Hydrograph Decomposition
12/9/08 - 12/17/08

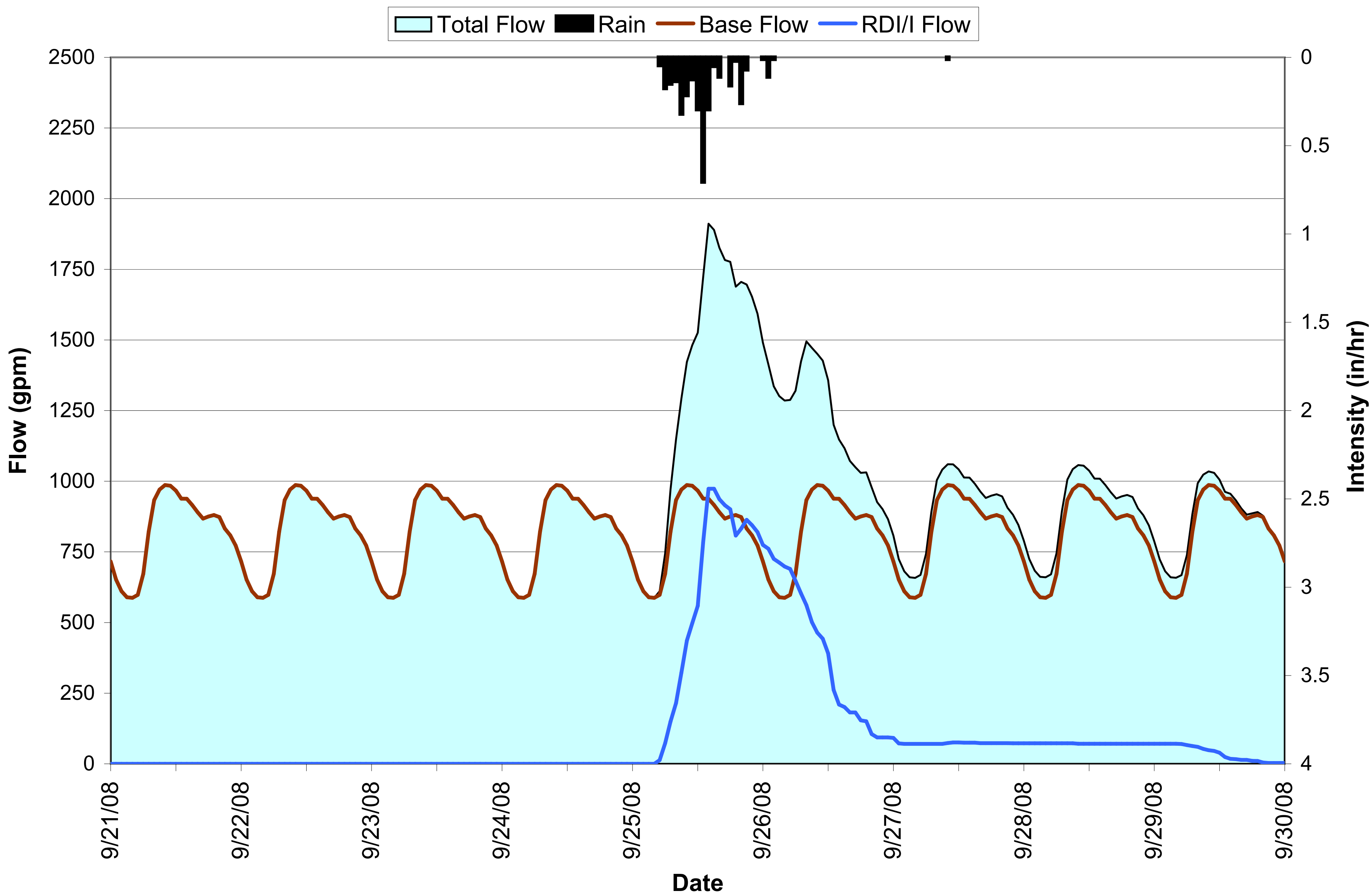


HRSD Gravity Flow Monitoring Program
Site 34 Flodar(3030 Luxembourg Avenue - Luxembourg Pump Station #113)
Hydrograph Decomposition
9/22/08 - 9/30/08




HRSD Gravity Flow Monitoring Program
Site 35 (1402 Ashland Circle - Ashland Circle Pump Station #102)
Hydrograph Decomposition
7/28/08 - 8/4/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
Intensity (in/hr)
Date
100
75
50
25
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
7/28/08
7/29/08
7/30/08
7/31/08
8/1/08
8/2/08
8/3/08
8/4/08

HRSD Gravity Flow Monitoring Program
Site 36 (715 Fairfax Avenue - Colley Avenue Pump Station #107)
Hydrograph Decomposition
9/21/08 - 9/30/08



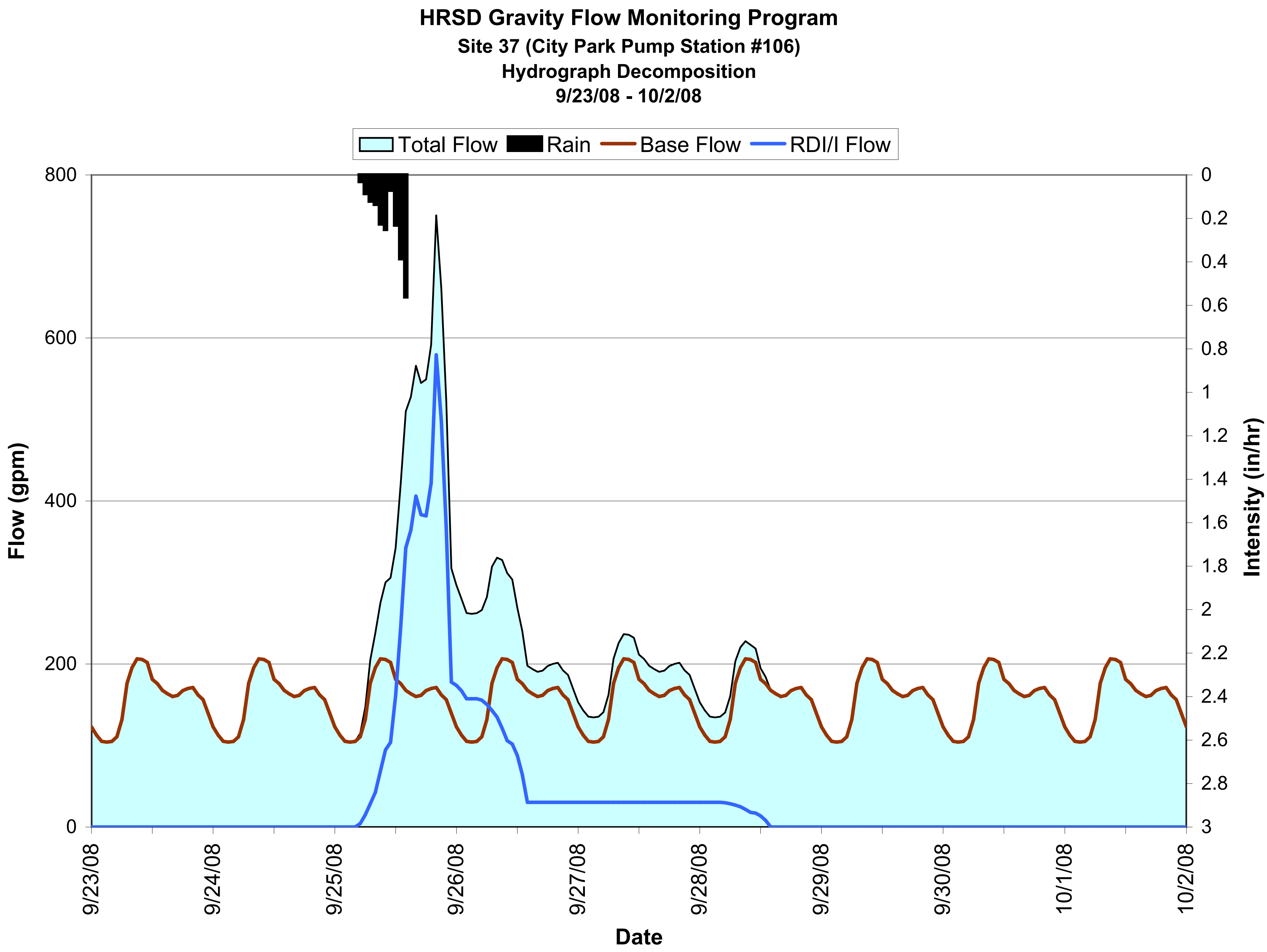

HRSD Gravity Flow Monitoring Program
Site 37 (City Park Pump Station #106)
Hydrograph Decomposition
9/23/08 - 10/2/08
Total Flow
Rain
Base Flow
RDI/I Flow
Flow (gpm)
800
600
400
200
0
Intensity (in/hr)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
9/23/08
9/24/08
9/25/08
9/26/08
9/27/08
9/28/08
9/29/08
9/30/08
10/1/08
10/2/08
Date

Table C-6. I/I Hydrograph Rain Events				
Site Number	Associated Rain Gauge	Rain Event	24-hour Total Accumulation (inches)	Recurrence Interval
1	22	9/25/08	2.82	1 year
2	20	9/25/08	3.05	1 year
3	20	12/11/08	1.91	< 1 year
4	20	9/25/08	3.05	1 year
5	20	9/25/08	3.05	1 year
5A	20	9/25/08	3.05	1 year
6	20	9/25/08	3.05	1 year
7	24	9/25/08	3.87	2 year
8	24	9/25/08	3.87	2 year
8A	24	12/11/08	2.16	< 1 year
9	24	12/11/08	2.16	< 1 year
10	24	12/11/08	2.16	< 1 year
12	23	12/11/08	2.15	< 1 year
13	23	9/25/08	3.63	2 year
14	23	12/11/08	2.15	< 1 year
15	23	9/25/08	3.63	2 year
16	20	8/15/08	1.21	< 1 year
17	22	9/25/08	2.82	1 year
18	19	9/25/08	4.08	2 year
19	38	9/25/08	3.42	1 year
20	38	9/25/08	3.42	1 year
21	50	12/11/08	1.57	< 1 year
22B	46	9/25/08	3.68	2 year
23	46	9/25/08	3.68	2 year
24	46	9/25/08	3.68	2 year
25	44	9/25/08	3.26	1 year
26	44	12/11/08	2.13	< 1 year
27	36	12/11/08	1.72	< 1 year
28	43	9/25/08	3.62	2 year

Table C-6. I/I Hydrograph Rain Events				
Site Number	Associated Rain Gauge	Rain Event	24-hour Total Accumulation (inches)	Recurrence Interval
30	57	11/13/08	2.33	< 1 year
33	42	12/11/08	2.11	< 1 year
34	42	9/25/08	2.09	< 1 year
35	42	7/31/08	0.68	< 1 year
36	44	9/25/08	3.26	1 year
37	42	9/25/08	2.09	< 1 year

Hampton Roads Sanitation District
1436 Air Rail Ave
Virginia Beach, VA 23455