June 2014

Village of Villa Park Comprehensive Plan Appendix – Chapter B

Prepared for the

Village of Villa Park, Illinois

Final Report

Prepared by

RJN Group, Inc.

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SECTION 1

PROJECT BACKGROUND AND OBJECTIVES

The Village of Villa Park (Village) has embarked on a capital improvement project to progressively enhance the quality and effectiveness of the village's infrastructure. Following the storms resulting from Hurricane Ike in 2008 and several other damaging flooding events, which resulted in widespread damage to private and public property, and combined sewer overflows (CSO) into Salt Creek, the Village has contracted RJN Group, Inc. (RJN) to conduct a study of the combined sewer system with the goal of alleviating flooding and reducing the stress on the combined sewer collection system.

SYSTEM OVERVIEW

The Village was incorporated in 1914, a result of farmers settling along the newly constructed electric railway. The railway was also largely responsible for the population boom of the 1920s and the subsequent urban development that followed. In this age of residential development, the sanitary sewage piping infrastructure that was developed was also allowed to take in the overland drainage that would accumulate after rain events. This is what is commonly referred to as a combined sewer collection system. Beginning in the post WWII era, any new development that ensued was constructed with separated sanitary and stormwater collection systems.

In the mid 1970s, the Village began the task of separating the combined sewer collection system to separately convey sanitary wastewater and stormwater drainage. The main driving force behind this separation was the passing of the Clean Water Act in 1972, as well as desire to decrease the volume of wastewater that needed to be treated.

The portion of the Village that is still currently being serviced, at least in part, by the combined sewer system is roughly bound by the Union Pacific – West Line Metra rail to the north, Madison Street to the south, Westmore Avenue to the west, and Robert Kingery Highway/IL-Route 83 to the east.

Within this service area, the lengths of remaining combined sewer as well as the lengths of sanitary sewer that has already been separated, by pipe size, is presented in Table 1-1.

TABLE 1-1

LENGTH OF SEWERS

Pipe Size (in)	Combined Sewer	Separated Sewer	Combined Overflow Sewer	**Total (LF)**
6		1,723		**1,723**
8	4,583	11,099		**15,682**
10	6,715	14,314		**21,029**
12	15,021	37,616		**52,637**
14		330		**330**
15	5,621	17,699		**23,320**
18	34	12,562	60	**12,656**
21	1,827	6,302		**8,129**
24	440	1,381	741	**2,562**
27	2,008	2,014	1,595	**5,617**
30	223	669	396	**1,288**
33	652	2,241		**2,893**
36	647	4,533	803	**5,983**
39		4,059		**4,059**
42	3,654	3,798	148	**7,600**
48	2,390		826	**3,215**
54			1,092	**1,092**
NULL		766		**766**
Total (LF)	**43,814**	**121,107**	**5,660**	**170,582**

Within this service area, there are four (4) separate basins into which the combined sewers feed. Subsequently, each is then tributary to a combined sewer overflow system. The details of the combined sewer overflow will be discussed in greater detail in the following section of the report.

Table 1-2 quantifies each basin by land area, number of parcels serviced in that basin, and the lengths of combined and separated sanitary sewers.

TABLE 1-2

QUANTIFICATION BY BASIN

	Basin				
	51	**52**	**53**	**54**	**TOTAL**
Combined Sewer (LF)	8,000	11,369	13,099	11,345	**43,814**
Separated Sewer (LF)	17,145	27,335	47,746	28,882	**121,108**
Area (acres)	159	245	468	346	**1,218**
Manholes	166	153	297	182	**798**
Parcels	430	951	1,428	1,122	**3,931**

Basin area delineations may also be seen in Exhibits 1-1 through 1-6.

In previous reports and exhibits, the four (4) discussed basin areas were also designated or referred to by other names and/or locations. As a point of reference, Table 1-3 outlines how these different basin labels correspond to one another.

TABLE 1-3

BASIN DESCRIPTIONS

Tributary Area	Outfall No.	Street Location	Basin ID	Primary Control Structure
Area 1	001	Riverside and Highland	54	CSO 12
Area 2	002	Wildwood	51	CSO 5
Area 3	003	St. Charles and Monterey	52	CSO 4
Area 4	004	Park Boulevard	53	CSO 13

Basis of Design and Separation

The ongoing goal of the Village is to continue with the separation of the combined sewer collection system. With a noticeable increase in storm frequency and intensity, the need to progress with this project is becoming more apparent.

During periods of dry weather, the flow from the combined sewer system is conveyed to Salt Creek Sanitary District (SCSD), located on the east side of IL Route 83 at the Illinois Prairie Path.

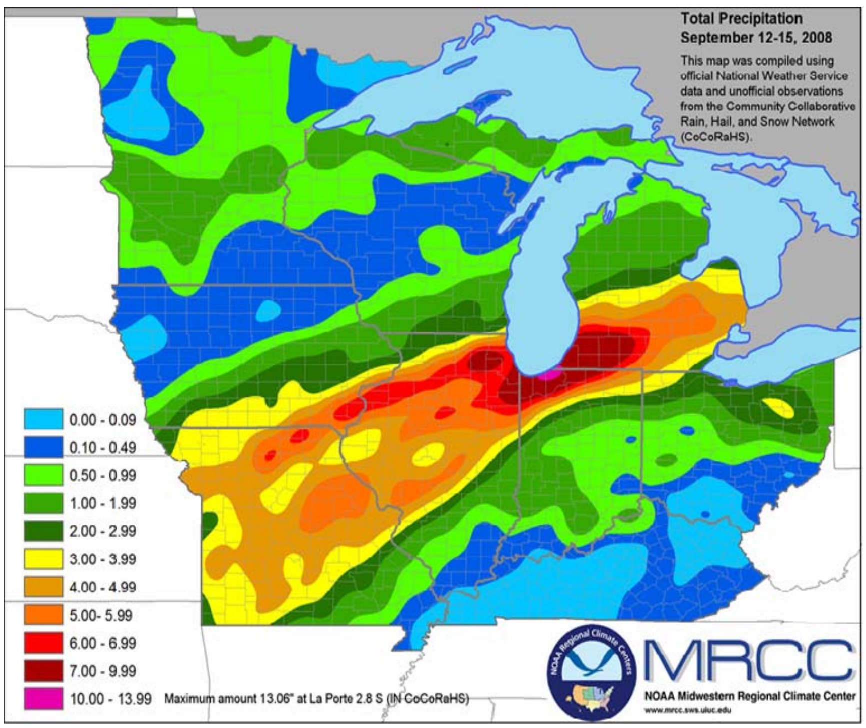
The Village's combined sewer overflow (CSO) system was designed to relieve the main combined sewer collection system during periods of large rain events, when the maximum pipe capacities were being reached. This flow is then conveyed to the Wet Weather Flow Treatment Facility (WWFTF), located on South Monterey Avenue, between Fairfield Avenue and the Illinois Prairie Path. Brought into operation in 1986, the WWFTF was designed to be able to treat a volume equal to the first flush plus ten (10) times the average dry weather flow (ADWF), resulting in a treatment capacity of 18 million gallons per day (MGD) of combined sewer flow.

Impacts of Hurricane Ike

In mid September of 2008, Hurricane Ike made landfall on United States soil around Galveston, Texas. The subsequent storm system continued up through the central portion of the United States. The state of Illinois was in the direct path of the storm system, which over the course of four (4) days, saturated the area with approximately eight (8) inches of rain, making it the third wettest September on record. Figure 1-1 shows the compiled rainfall data for the Midwest from the National Weather Service between September 12 and 15, 2008.

FIGURE 1-1

TOTAL PERCIPITATION – SEPTEMBER 12-15, 2008



Other Flooding Events

The month of July 2010 also brought flood related hardships to the residents of the Village. During this month, total monthly precipitation equaled 10.19 inches, according to the National Oceanic and Atmospheric Association (NOAA), which included 6.97 inches of rain on July 24. Most of the rainfall occurred during a six (6) hour period during the overnight and early morning hours. The total estimated costs incurred due to flood damage in July 2010 actually exceeded the costs of the September 2008 storms.

Most recently, the Village suffered from flood related damages following the April 18, 2013 storms. Rain gauges at the WWFTF and Salt Creek measured more than seven (7) inches of rain during this event, and a Village-owned rain gauge measured 9.3 inches. In all, April 2013 brought 10.20 inches of precipitation to the Village according to NOAA.

Estimated costs incurred by the Village due to the aforementioned storm related damages, and the number of private properties reporting flooding (sanitary backup, stormwater flooding, or a combination of the two) is summarized in Table 1-4. The Village costs include both emergency response costs and the cost of damage to public properties during these events.

TABLE 1-4

FLOOD RELATED QUANTITIES

Storm Event	# of Private Properties Affected	Village Costs Incurred
September 2008 (Hurricane Ike)	37	$103,505
July 2010	131	$152,000
April 2013	536	$96,422

Properties which reported both sanitary and stormwater flooding are only counted once in Table 1-4.

Primary Areas of Concern

Flooding data has been compiled for the above three (3) storms. Reported damaged areas have been highlighted and displayed in Exhibit 1-1, Exhibit 1-2, and Exhibit 1-3.

A composite display of the most recurrently affected areas, for stormwater flooding and sanitary sewer backup, in relation to the proposed capital improvement projects, are displayed in Exhibit 1-4 and Exhibit 1-5, respectively.

The areas of concern on Exhibits 1-4 and 1-5 were then overlaid to see if any areas were particularly prone to both sanitary backups and stormwater flooding. Based on these historically recurrent areas of damage, as displayed in Exhibit 1-6, RJN has evaluated which should be the target focus areas. These recommendations shall be discussed in further detail in the subsequent sections of this report.

Socioeconomic Factors

Areas of flooding concern were also cross referenced with public census data for the Village, which are shown on Exhibit 1-6. A relationship between an area's socioeconomic standing and a history of flooding is common, as areas which are less affluent tend to incur a disproportionate amount of financial hardship due to damage caused by flooding events.

A significant portion of the Village population reside in low-to-moderate income households. Any improvements that would significantly reduce the incidence of flooding and sewer backups will have a profound impact on Village residents, particularly those less affluent residents. This would be observed through decreased costs incurred to repair and replace personal property lost or damaged as a result of these storm events and potentially by decreasing the costs of insuring these homes against flood damage.

ONGOING EFFORTS

Capital Improvement Program

The Village currently has a proposed list of capital improvement projects relating to the improvement of failing and deteriorating infrastructure. Each project was initially evaluated and assigned a timeline. Projects were divided into two (2) categories, either to be completed within the next five (5) years, before 2018, or to be considered beyond the five (5) year window. The proposed capital improvement projects, along with their projected costs, are listed in Table 1-5. These proposed projects are also depicted in Exhibit 1-7.

As part of this study, RJN is further evaluating the proposed assigned timelines and adjusting the priority of these projects as necessary.

TABLE 1-5

CAPITAL IMPROVEMENT PROJECTS

Project Name	Within Combined Sewer Area?	Start	End	Projected Costs
Astor Court Improvement Project	Yes	> 2019	> 2019	$609,109
Maple Street Improvement Project	Yes	> 2019	> 2019	$1,103,256
Michigan Avenue Improvement Project - Park to Madison	Yes	2014	2016	$1,374,100
Michigan Avenue Improvement Project - Jackson to Madison	No	> 2019	> 2019	$1,092,591
Monterey Avenue Sewer Separation Project	Yes	> 2019	> 2019	$715,000
Myrtle Avenue Improvememt Project - Highland to Park	Yes	> 2019	> 2019	$687,403
Oak Street Improvement Project	Yes	> 2019	> 2019	$162,668
East Park Boulevard Improvement Project	Yes	2014	2016	$575,000
Pine Street Improvement Project	Yes	> 2019	> 2019	$893,017
Summit Avenue Improvement Project	Yes	> 2019	> 2019	$442,374
		Total Projected Cost		**$7,654,518**

Stormwater Management Program

The Village of Village Park is currently evaluating the possible implementation of a stormwater utility. If approved, the stormwater utility would collect revenue from all properties that place a demand on the stormwater collection system. This revenue would be generated by charging property owners a monthly fee, which would be calculated based on the individual property's impact to the storm sewer collection system. Revenue generated by the stormwater utility would be used towards operating, maintaining, and improving the stormwater system.

PROJECT APPROACH AND OBJECTIVES

This study is intended to provide an overview of the existing drainage infrastructure in the Village's combined sewer area and to provide recommendations to prevent and mitigate the impacts of future flooding and CSO events. The study analyzes the combined sewer system with respect to history of flooding events, hydraulic capacity, and ongoing Village improvements.

The work completed under this study generally includes:

- A skeletal hydraulic model of the combined sewer system to evaluate hydraulic capacity of the existing large-diameter sewers and predict occurrences of flooding and overflows
- Flow monitoring and analysis of the combined sewer system to evaluate the effectiveness of completed sewer separation projects and to calibrate the hydraulic model
- Detailed evaluation of past flooding and CSO reports to identify primary areas of concern
- Review of the Village's current capital improvement program (CIP) to reevaluate infrastructure improvements with respect to results of the data analysis and modeling

The findings and recommendations of this study are to be incorporated as the Stormwater Management Addendum to the Village's Comprehensive Plan. The complete Addendum may be further amended to include the findings of a pending comprehensive stormwater study of the drainage infrastructure throughout the entire Village, including fully separated sewer areas, contingent on its approval by the Village Council.

SECTION 2

ANALYSIS AND MODELING

In order to assess the incidence and causes of flooding and CSO events within the combined sewer area of Villa Park and to make recommendations for future improvements, a comprehensive analysis of the combined sewer collection system was conducted. This analysis included compilation of historical data, flow monitoring, and hydraulic modeling.

HISTORICAL DATA COLLECTION

Flooding Events

In order to gauge the severity of the flooding issues that the Village is subjected to, data was gathered for the three (3) most damaging events within the last six (6) years. Specifically, the storm damage was analyzed for the September 2008 (Hurricane Ike), the July 2010, and the April 2013 rain events. This data was obtained via flooding reports voluntarily provided by the Village residents. Data compiled was then quantified by the type of flooding that was reported, either stormwater, sanitary sewage backup, or a combination of the two. Table 2-1 displays the reported flooding data by storm.

TABLE 2-1

REPORTED FLOODING

Storm Event	# of Properties Reporting Sanitary Backup	# of Properties Reporting Stormwater Flooding
Sepember 13, 2008 (Hurricane Ike)	17	25
July 24, 2010	103	87
April 18, 2013	164	444

Table 2-1 includes individual reports by flooding type. ∴ if a home reported both sanitary and stormwater flooding, it will be accounted for in both columns

Priority Areas of Concern

Using the reported flood data from the three (3) above referenced storm events, composite exhibits were generated to visually depict how often individual parcels were affected. Based on the recurrence and clusters of affected parcels within close proximity to one another, RJN has outlined target areas of concern. These areas are depicted on Exhibit 1-4 for stormwater flooding and Exhibit 1-5 for sanitary and combined sewer backups.

Stormwater flooding incidents reported by Village residents during each of the three (3) recent major storm events were consolidated to identify clusters of properties where overland flooding has been most prevalent. Properties are symbolized by incidence of flooding reports, and the resulting twelve (12) areas of concern are delineated on Exhibit 1-4.

Based on the history of reported sanitary sewer backups within the combined sewer area, seven (7) areas of concern were identified. These areas displayed a significant cluster of homes serviced by the same set of combined sewers, which reported at least one sanitary sewer backup. These areas are delineated on Exhibit 1-5.

Having compiled areas of concern for both stormwater and sanitary flooding events, certain areas stood out as being highly prone to both sources of flooding. These are the areas which RJN feels should become priority areas for the Village when looking at infrastructure improvement projects. These overlapping areas are delineated on Exhibit 1-6.

The areas of concern were also viewed in relation to the currently proposed capital improvement projects listed in Table 1-5. Based on the overlap between these areas of concern and the locations of the proposed CIP, the projects on Astor Court, Maple, Oak, Pine, and Summit Streets are all potential candidates for escalated priority.

Income demographics in the areas impacted by these proposed projects are being investigated in greater detail to further establish a basis of need for these improvements. Any improvements to the sewer and drainage infrastructure in predominantly low-to-moderate income areas will engender tremendous social benefits, as residents in these areas are less able to afford escalated insurance premiums, costly private flood prevention, and sewer backup protection measures.

Combined Sewer Overflows

In December of 2011, the Village was approached by the Illinois Environmental Protection Agency (IEPA) in response to unmonitored and unreported CSO events spanning a period from September 2010 to August 2011. With an impending Long Term Control Plan (LTCP) requirement in the Village's NPDES permit renewal, reducing the frequency of CSO discharges to

Salt Creek has become more critical. Therefore, flow monitoring of the combined sewer areas was implemented in order to develop the hydraulic model of the existing system. With the information provided by the flow monitoring and modeling, modifications and improvements to the combined sewer collection system will be recommended to ensure that the Village remains compliant with IEPA regulations.

Drainage Areas

To be able to accurately model the system, the topography of the combined sewer area was analyzed to calculate the amount of overland flow that drains directly into the combined sewer collection system following rain events. This topographic analysis also quantified the amount of land area within the combined sewer service area that has been separated and is no longer contributing direct runoff to the combined collection system.

These quantities are presented in Table 2-2.

TABLE 2-2

LAND AREAS – COMBINED AND SEPARATED

Basin	Total Area (ac)	Combined Sewer Drainage Area (ac)	Separated Land Area (ac)	Percentage of Total Area - Combined	Percentage of Total Area - Separated	Total Rainfall Capture (R_T)
51	158.8	26.1	132.8	16.42%	83.58%	8.20%
52	245.1	56.3	188.8	22.97%	77.03%	19.20%
53	467.8	60.2	407.5	12.88%	87.12%	19.20%
54	345.8	54.4	291.4	15.72%	84.28%	29.60%
	1217.5	**197.0**	**1020.5**	**16.2%**	**83.8%**	**20.7%**

As Table 2-2 shows, within the four (4) basins that are still currently being serviced by the combined sewer collection system, the majority of the land area, approximately 83.8%, is no longer tributary to the combined system, but rather drains to the separated storm sewer collection system.

FLOW MONITORING

The flow monitoring portion of the project involved the installation of seven (7) flow meters and one (1) rain gauge within the combined sewer service area. Flow monitoring was performed for a period of sixty (60) days from September 26, 2013 to November 25, 2013.

Meter Locations

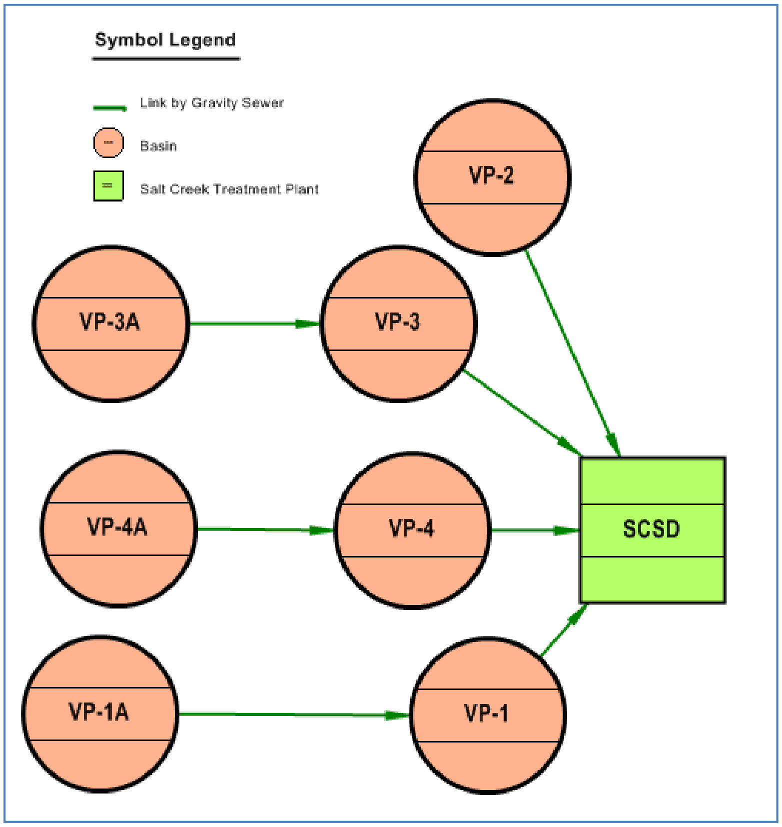
Prior to installing the flow meters, potential meter sites were investigated by RJN field crews and engineers, and the locations selected were those that would both maximize the tributary metered area and optimize data quality. The flow meter and rain gauge locations are summarized in Table 2-3 and shown on Exhibit 2-1 appended to the end of the report. Appendix A contains the site investigation and installation sheets for each of the meters and rain gauges, providing details regarding location, hydraulic conditions, and installation methods. The flow meter sites are shown schematically in Figure 2-1.

TABLE 2-3
METER SITE SUMMARY

Meter	Manhole	Parcel Count	Location	Pipe Material	Diameter (inches)
VP-1	54-8	446	403 MONTEREY	Brick	49
VP-1A	54-22	563	650 SUMMIT	Brick	44
VP-2	51-6	409	59 MONTEREY	Brick	37
VP-3	52-21	384	21 SUMMIT	Concrete	40
VP-3A	52-35	559	200 YALE	Vitrified Clay	30
VP-4	53-11	1151	519 Park	Brick	43
VP-4A	53-109	190	235 Park	PVC	18
VP-RG1	(Rain Guage)	-	S.Ardmore Ave.& W. Home Ave. (Villa Park Public Works Facility)	-	-
	Total:	**3702**			

FIGURE 2-1

FLOW SCHEMATIC



Meter Equipment, Calibration, and Maintenance

Upon installation, the meters were regularly tended to and calibrated throughout the monitoring period. Data was continually processed and analyzed by RJN data analysts to ensure quality and continuity of the data and to identify and remedy any potential maintenance concerns as they occurred.

The flow meters used for this project were ADS Environmental FlowShark 5000 area-velocity meters. The meters have three probes – a submerged pressure transducer at the invert of the pipe, a Doppler velocity sensor, and an ultrasonic depth sensor located at the crown of the pipe. The redundancy in depth measurements ensures that the meters collect accurate data during all flow conditions, including low flows and surcharged conditions.

The flow meters were installed with RU-33 telemetry units that allowed the data to be accessed and downloaded remotely. Therefore, meter data was downloaded daily and analyzed twice per week to assess whether they were functioning properly, and the probes were periodically assessed to ensure the accuracy of readings. In addition, the downloaded data was reviewed to check for missing data or a decline in data quality. When necessary, field crews would be sent to clean or replace a probe if the data indicated potential fouling.

Meters were calibrated a minimum of three (3) times; once on install, once on removal, and one other time throughout the duration of the monitoring period. Calibrations serve as a basis for fine adjustments to the level and velocity data, which are used to refine the final processed flow data. A calibration entails two (2) separate measurements of water depth from the invert of the pipe, two (2) peak velocity readings using a portable velocity meter (PVM), and a matrix of velocity measurements throughout the cross-section of the flow to obtain an average velocity. The number of cross-sectional velocity measurements depended on the size of the flow cross-section, which is determined by the size of the pipe and depth of the flow.

Additionally, silt depths were measured at each calibration. Measurements of silt – a general term for any kind of stationary deposit such as sand, gravel, silt, or sludge – are crucial for accurate flow calculation because the filled portion of the cross-sectional area covered with silt is not flowing and therefore must be subtracted out when calculating flow.

Flow Data Analysis

The flow and rainfall data was analyzed using RJN's proprietary RPM software to establish the average dry-weather flow (ADWF) baseline at each meter, observe seasonal variations in groundwater infiltration, and quantify the inflow and infiltration (I/I) response to wet-weather events.

Hydrographs of the entire flow monitoring period are contained in Appendix B.

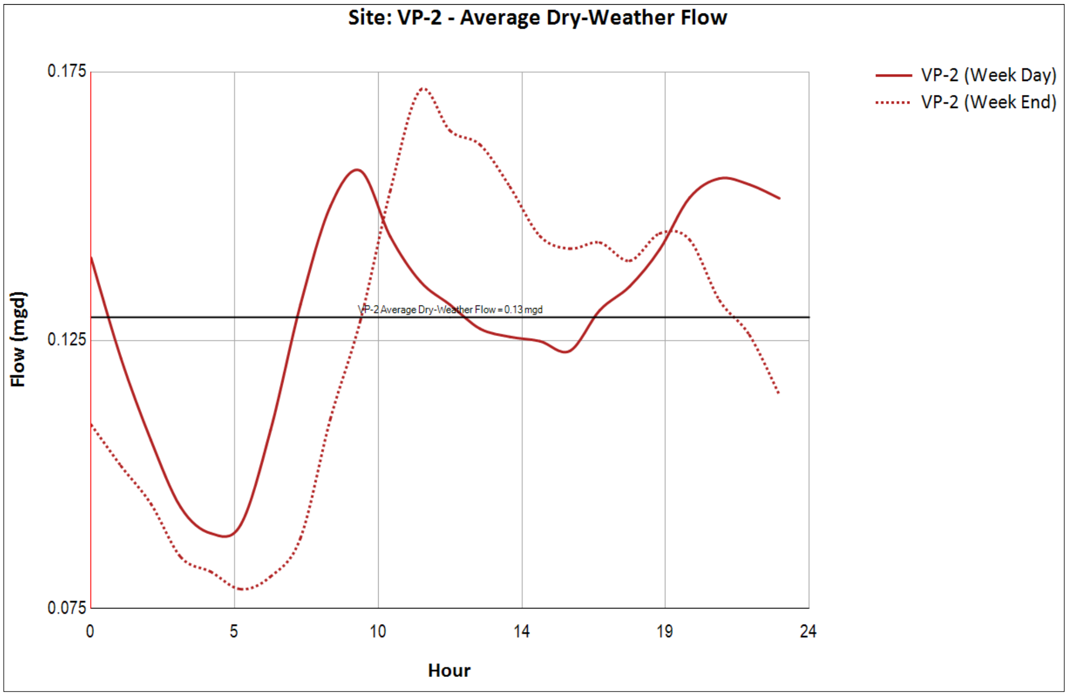
Dry-Weather Flow Analysis

Flow data collected during dry periods was analyzed to determine the average daily dry-weather flow (ADWF) for each meter. The dry-weather flow periods selected for computation of ADWF were all generally around October 23 through October 30 and November 14 through November 23. These periods provided the most continuous sample of rainless, low-groundwater conditions during the monitoring period.

Using the data from these periods, a composite diurnal dry-weather flow pattern was developed for each meter. Appendix C contains the diurnal flow curves for each meter, and an example is shown in Figure 2-2 below. The ADWF, diurnal low flow, and diurnal peak flow at each meter location are listed in Table 2-4. Also, provided in Table 2-4 are the diurnal peaking factors – the ratio of the diurnal peak flow to the average flow – and the low flow as a percentage of ADWF.

FIGURE 2-2

AVERAGE DRY-WEATHER FLOW (ADWF) DIURNAL PATTERN



Diurnal peaking factors for a basin in a residential area are normally in the range of 1.3 to 1.8. All basins were within or close to this range. Low flows, occurring during the late night and very early morning hours, are a good indicator of base infiltration in residential areas. All basins had relatively high low flow as a percentage of ADWF, indicating a high base infiltration. The typical range of low flow is around 15% to 30% of the ADWF.

TABLE 2-4
DRY-WEATHER FLOW SUMMARY

Meter/ Basin	Cumulative Parcel Count	Cumulative ADWF (mgd)	ADWF per Parcel (gpd)	Peak Hourly Flow (mgd)	Diurnal Peaking Factor	Daily Low Flow (mgd)	Percent of Daily Low Flow to ADWF
VP-1	1009	0.386	382	0.510	1.3	0.161	41.7%
VP-1A	563	0.098	175	0.150	1.5	0.037	37.6%
VP-2	409	0.129	316	0.172	1.3	0.079	60.8%
VP-3	943	0.220	233	0.287	1.3	0.089	40.3%
VP-3A	559	0.122	219	0.168	1.4	0.049	40.2%
VP-4	1341	0.196	146	0.395	2.0	0.091	46.5%
VP-4A	190	0.034	179	0.051	1.5	0.016	47.7%

While detailed pipe dimension and silt measurements were conducted at each of the sites throughout the flow monitoring period to maximize data accuracy, it should be noted that low flows in oversized pipes are difficult to monitor due to shallow flow cross-sections, low velocities, and the tendency for silt to accumulate and vary in depth. All seven meters in the Villa Park Study Area were in pipes that are oversized relative to their tributary ADWF and were therefore subject to larger margins of error than standard flow meter installations.

Rain Data

Rain events that occurred during the flow metering period are listed in Table 2-5. Table 2-5 generally includes only rain events that were used in the flow analysis and excludes events with very small rainfall totals. The recurrence intervals of the storm events ranged from less than 1 month to 2 years, and these events are represented graphically in Figure 2-3.

FIGURE 2-3
RAINFALL SUMMARY GRAPH

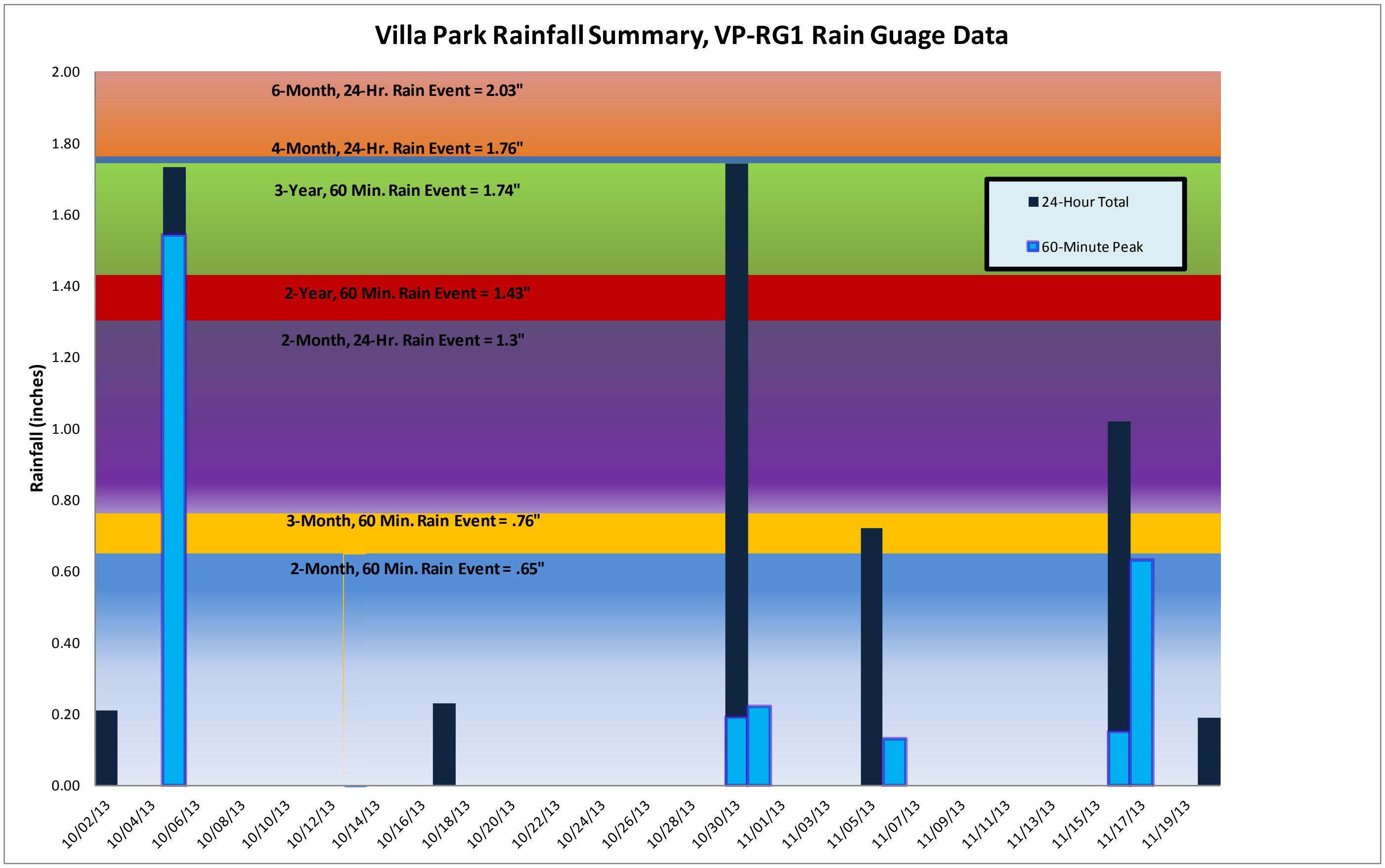


TABLE 2-5
RAINFALL SUMMARY

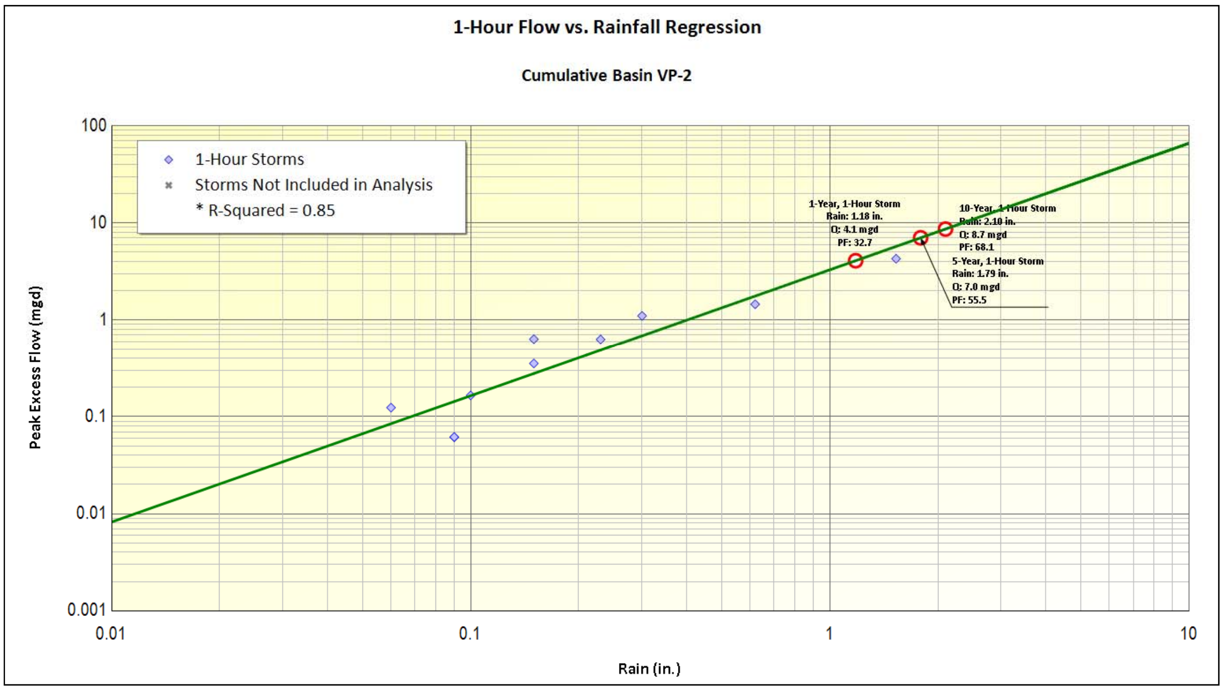
Date	VP-RG1 60-Minute Peak (inches)	Recurrence Interval for 60-Minute Peak	VP-RG1 24-Hour Total (inches)	Recurrence Interval for 24-Hour Total
5-Oct	1.54	2-Year	1.73	4-Month
30-Oct	0.19	1-Month	1.74	4-Month
31-Oct	0.22	1-Month	1.74	4-Month
6-Nov	0.13	<1-Month	0.72	1-Month
16-Nov	0.63	2-Month	1.02	2-Month

*** October 30 and October 31 rain events occurred within the same 24-hour rainfall period**

Wet-Weather Flow Analysis

All seven (7) of the flow meter basins exhibited large I/I responses during rain events. Peak flow data from storm events throughout the metering period was used to conduct a regression analysis to derive the logarithmic relationship between excess flow and rainfall. An example of the regression plot is shown in Figure 2-4, and results of the regression are presented in Table 2-6. The peaking factor (PF) is the ratio of the peak wet-weather flow to the ADWF. Appendix D contains graphs of the regression analyses for each meter.

FIGURE 2-4
REGRESSION ANALYSIS PLOT



Based on the regression analysis, it is clear that although the study area is largely separated, wet-weather flows remain much higher than those typical of a separated sanitary system and may exceed the sewer design capacities in large storm events.

TABLE 2-6
PROJECTED PEAK FLOWS

Meter Site	ADWF (mgd)	Pipe Capacity (mgd)	Peak Flow (mgd) 1-Year, 1-Hour Storm	Peak Flow (mgd) 5-Year, 1-Hour Storm	Peak Flow (mgd) 10-Year, 1-Hour Strom	Peaking Factor 1-Year, 1-Hour Storm	Peaking Factor 5-Year, 1-Hour Storm	Peaking Factor 10-Year, 1-Hour Strom
VP-1	0.386	24.11	17.37	31.88	40.29	45.0	82.6	104.4
VP-1A	0.098	18.09	4.76	8.54	10.69	48.4	86.7	108.6
VP-2	0.129	11.40	4.22	7.17	8.80	32.7	55.5	68.1
VP-3	0.220	16.19	6.65	10.44	12.42	30.3	47.5	56.5
VP-3A	0.122	6.98	4.96	7.84	9.36	40.6	64.2	76.6
VP-4	0.196	17.02	13.40	24.99	31.76	68.4	127.5	162.0
VP-4A	0.034	3.07	1.30	2.11	2.54	38.1	61.8	74.5

Meter Site	ADWF (mgd)	Pipe Capacity (mgd)	Peak Flow (mgd) 1-Year, 24-Hour Storm	Peak Flow (mgd) 5-Year, 24-Hour Storm	Peak Flow (mgd) 10-Year, 24-Hour Strom	Peaking Factor 1-Year, 24-Hour Storm	Peaking Factor 5-Year, 24-Hour Storm	Peaking Factor 10-Year, 24-Hour Strom
VP-1	0.386	24.11	3.66	6.94	8.99	9.5	18.0	23.3
VP-1A	0.098	18.09	0.81	1.30	1.57	8.3	13.2	16.0
VP-2	0.129	11.40	1.52	3.36	4.63	11.7	26.0	35.8
VP-3	0.220	16.19	1.62	2.64	3.23	7.4	12.0	14.7
VP-3A	0.122	6.98	0.92	1.41	1.68	7.5	11.5	13.7
VP-4	0.196	17.02	2.44	4.30	5.40	12.4	21.9	27.5
VP-4A	0.034	3.07	0.40	0.69	0.86	11.7	20.3	25.4

The October 5 event, which resulted in the highest peak rain intensity, resulted in minimal surcharging; however, the peak flows at sites VP-2 and VP-4A briefly reached full-pipe capacity. The peak levels and flows at each meter site from this event are shown in Table 2-7.

TABLE 2-7
OCTOBER 5, 2013 STORM EVENT

Meter Site	Pipe Diameter (in.)	Peak Level (in.)	Peak Flow (mgd)
VP-1	48	40.8	24.0
VP-1A	42	18.4	6.9
VP-2	36	34.6	6.5
VP-3	39	18.6	8.6
VP-3A	30	13.5	4.8
VP-4	42	20.9	14.3
VP-4A	18	21.2	1.5

HYDRAULIC MODELING

A skeletal hydraulic model of the combined sewer basins was developed to assess capacity in the combined sewer system. The model network is shown on Exhibit 2-1, as are the drainage basins currently tributary to the combined sewer system. The hydraulic model utilized XPSWMM software, and runoff was calculated using the proprietary XP runoff method.

The model was used largely to determine whether recent flooding events are the direct or partial result of limitations in combined sewer pipe capacity and to predict the incidence of flooding events and sewer backups in both existing conditions and following future separation projects.

The combined sewer model will also be incorporated into the hydraulic modeling conducted as part of the comprehensive stormwater management plan. This work includes analysis of both the combined sewer system and the separated storm sewer system and will provide Village-wide recommendations for Villa Park's immediate and long-term stormwater management needs.

Historical Storm Analysis

The historical storms of September 2008, July 2010, and April 2013 were modeled to determine whether capacity limitations in the combined sewer trunk lines contributed to flooding during these events.

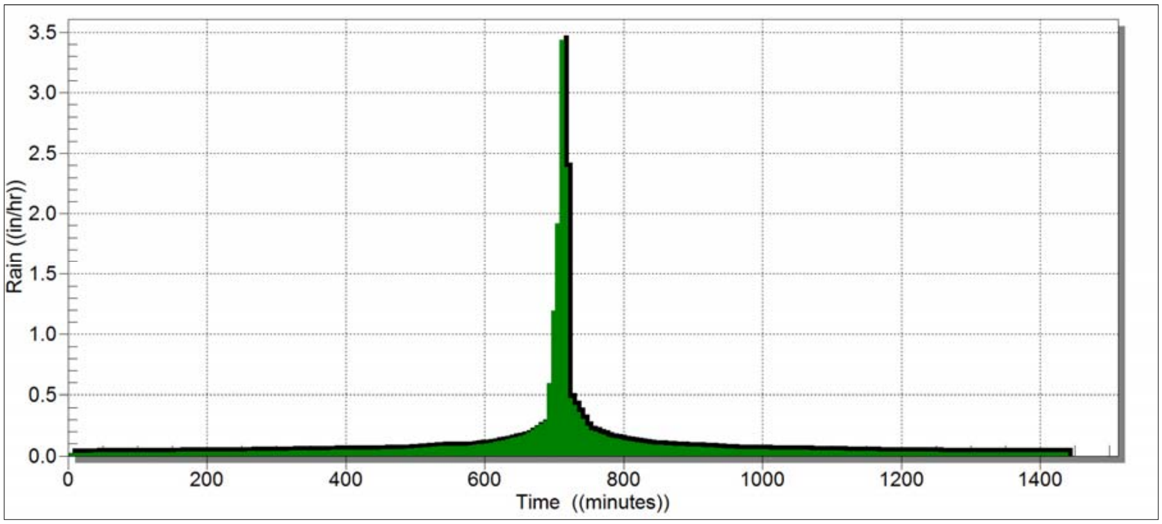
The results of this analysis are shown on Exhibits 2-2 through 2-4. Reported flooding incidents are overlaid with the results of the hydraulic model runs to show where flooding locations correlate to overloaded sewers in the model.

Design Storm Analysis

The combined sewer model was also simulated for design storms of various intensities to determine the impacts of rainfall on the combined sewer system under theoretical conditions. The design storms was a SCS Type II rainfall distribution scaled to intensities ranging from a 6-month to 100-year recurrence interval. An SCS Type II rainfall distribution is illustrated in Figure 2-5.

FIGURE 2-5

SCS TYPE II, 1-YEAR STORM



The results of the design storm analysis are shown on Exhibit 2-5. The level of protection on the highlighted structures indicates the smallest recurrence interval design storm that results in surcharging at the manhole.

Generally, surcharging is more prevalent further upstream in the system in areas where there are clusters of unseparated blocks. These areas are served by smaller diameter sewers and have the largest proportion of tributary area that remains combined. The larger diameter sewers further downstream in the system are less likely to surcharge. Sewers in these locations have a smaller proportion of unseparated tributary area and are closer to CSO control structures, which act as relief points by bypassing flow to CSO outfalls and the relief sewer system to the WWFTF.

It should be noted, however, that separated storm sewers in these locations would still be subject to restrictions caused by finite inlet capacities, as well as localized topography that may contribute to inadequate drainage. A comprehensive analysis of these areas with respect to the separated storm sewer system will need to be completed to determine the most effective way to drain these areas without flooding.

Future Condition Analysis

The model design storms were also simulated for future conditions to assess the impacts of further combined sewer separation on the frequency of flooding and sewer backups throughout the Village. This analysis was conducted using the RTK unit hydrograph method to simulated rainfall-derived inflow and infiltration (RDII) that would remain in the system following complete separation. The RTK parameters were established from the RDII observed at Meter VP-4A, a fully-separated meter basin. It was assumed for the analysis that this basin would provide a suitable representation of wet-weather flow conditions in the remaining combined sewer basins after inlet and catch basin connections were redirected from the system.

The results of this analysis indicate that the combined sewer system in a fully separated condition would not experience overflowing manholes and would surcharge in few locations, even during design storms of up to a 100-year recurrence interval. However, the system would continue to rely on the operation of the WWFTF and CSO outfalls during 1-year storms and larger in order to prevent surcharging and potential basement backups.

SECTION 3

Summary of Findings and Recommendations

The Village of Villa Park has experienced several high-intensity storm events in recent years which have incurred costly and widespread damages to public infrastructure, private property, and the natural environment. Overland flooding has occurred in numerous areas throughout the entire Village; as a result, a comprehensive addendum to the Village's stormwater management plan is currently under development, and a stormwater utility fee to fund major drainage infrastructure improvements is under consideration by the public and elected officials.

In addition, within the combined sewer areas of the Village, basement backups, combined sewer overflows (CSOs), and discharges of untreated flow to Salt Creek are recurrent issues. The findings and recommendations of this study specifically address improvements to the existing infrastructure in the combined sewer area of the Village. These recommendations are to be incorporated into the overall stormwater management plan as it develops.

Conclusions

The primary areas of concern both in regard to overland flooding and CSO events within the combined sewer areas of the Village are analyzed in Section 2 of this report.

Based on this analysis, many of the areas that are most at risk for flooding and CSO events are within areas still served by combined sewers. Of these, some are scheduled for separation within the time horizon of the Village's current capital improvement program (CIP), pending availability of funding. Other areas to potentially be added into the Village's shorter-term priorities were identified.

Analysis of hydraulic capacity within the main combined sewer system indicates that limitations in pipe capacity may be a contributing factor in flooding and CSO events. Generally, capacity limitations are most prevalent further upstream in the system in localized reaches with predominantly unseparated tributary areas.

While separation of these areas should help reduce the incidence of flooding, it cannot be assumed that separation alone will provide an easy solution. Flooding issues may also be the result of limited inlet capacities and local topography that are prohibitive of adequate drainage, and it is possible that additional means, such as detention or green infrastructure, may be needed to alleviate flooding.

Recommendations

Implementation of any recommendations regarding drainage infrastructure is contingent on the findings of the comprehensive stormwater management study, which is currently in progress. It is recommended that the modeling of the combined sewer area and following recommendations be further evaluated as part of the stormwater study and that the stormwater management addendum be updated to incorporate its recommendations.

Prioritization of CIP Projects

At the present time, two infrastructure improvement projects that include combined sewer separation are under design as part of the Village's capital improvement program (CIP). Several other projects have reached the planning and budgeting stage but are not yet scheduled for implementation. As part of this study, these projects were evaluated to determine whether any should be given more immediate priority based on their location within a combined sewer drainage basin and proximity or contribution to overland flooding and CSO events.

Based on this analysis, it is recommended that the following CIP projects be considered for acceleration of the proposed implementation timetables:

- Astor Court vicinity
- South Monterey
- Maple, Oak, Pine, near Summit Street

The hydraulic modeling analysis indicated that these areas were subject to localized flooding as a result of limited pipe capacity, and these areas reported a high incidence of flooding during previous storm events.

Other Sewer Separation Priorities

In addition to the CIP projects already in planning stages, the analysis sought other areas that may be considered for accelerated sewer separation prioritization. The primary location identified was the area west of Ardmore, north of St. Charles Road. Though not currently slated for any planned CIP projects, this area has several blocks of unseparated sewers and has incurred significant flood damage during recent large storm events. The hydraulic model also indicated a high likelihood for flooding throughout this area. Some other locations that may be considered for prioritized sewer separation are as follows:

- S. Wisconsin Ave. between Madison and Park
- S. Yale Ave. between Madison and Park
- Washington and Grant

Benefits of Continued Combined Sewer Separation

The drive for separation of the combined sewer collection system is supported by the multifaceted benefits resulting from such an investment. The benefits to the residential population of the Village would be most greatly seen in the decrease of personal expenditures incurred as a result of flooding damage. The loss of personal, often irreplaceable, property is often a significant burden on the affected homeowner. Also related would likely be the decrease of insurance premiums to be paid by the homeowner. With continued flooding events, and the subsequent increase in insurance claims, the costs incurred by the homeowner progressively increase. An investment by the Village to help alleviate these flooding events would significantly increase the quality of life of the residents by preventing them having to spend significant portions of their income and savings on flood related costs.

On a larger scale, the environmental benefits resulting in the separation of the combined sewer collection system would be equally significant. By continuing to separate the system, the potential for combined sewer overflows to our natural waterways is significantly decreased. With a general trend of increased rain storm frequency and intensity, the current combined sewer collection system is being progressively stressed to convey ever increasing amounts of flow. This results in more frequent discharges of untreated sewage into Salt Creek, resulting in a compromised environment for the native aquatic life. It is necessary to act in a proactive manner to decrease these overflows to a degree deemed acceptable and safe for the ecosystem present in Salt Creek.

Finally, the effort put into evaluating the current collection system will, as a secondary benefit, reveal potentially significant structural damage to the pipes currently in use. As separation occurs, the sewer pipe which was formerly used to convey both sanitary sewage and stormwater will, most likely, be reassigned to only convey sanitary flow, as new storm sewer pipe is installed. During these excavation projects, necessary point repairs and/or replacement of pipe sections can be performed to the existing pipe network. Making these repairs will then help prevent the infiltration of stormwater into the sanitary collection system via defects in the pipe.

Private Sector Remediation

In addition to sewer separation, the Village will need to remain diligent in disconnecting sources of stormwater inflow from the combined sewer system. Analysis of flows in a fully separated meter basin indicated a large rainfall derived inflow and infiltration (RDII) response during storm events, and modeling of the system with all storm inlet connections removed indicated a continued reliance on CSO outfalls for relief. While disconnecting the remaining storm inlets from the combined sewer system remains the highest priority for reducing wet-weather flows and CSO discharge events, it will be necessary to continue removing inflow sources, such as sump pumps and downspouts, largely by means of private property ordinances, as well as rehabilitation of the publically owned sewer mains.

Stormwater Study Recommendations

In conjunction with this study by RJN, the Village is also in the process of a comprehensive stormwater study to evaluate the drainage infrastructure throughout the entire Village, including the separated storm sewer system. Several recommendations related to the alleviation of stormwater flooding will be developed as a result of this study. The general plan of action is likely to include continued or accelerated separation of the combined sewer collection system, stormwater detention areas (both above ground and underground), green infrastructure improvements (both public and private), and upsizing or relief for existing storm sewers. Detailed, site specific recommendations may be incorporated into this Stormwater Management Addendum to be issued following this comprehensive analysis.

APPENDIX A – SITE SHEETS

Villa Park, IL

2013 Hydraulic Model

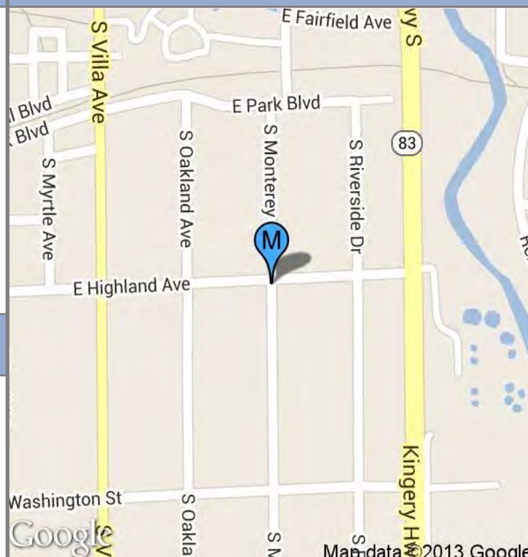
Site Name	
VP-1	

		Project No.	Site Code
Inspected By	SS/TR		
Inspected Date/Time	9/6/2013 12:25 PM	11-2577-01	U-2

System Information

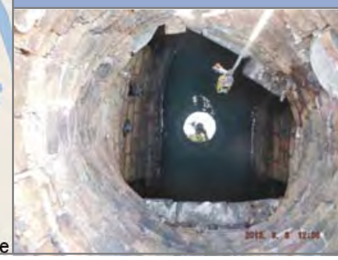
Target Pipe Dia. (in)	48.0
Municipality	Villa Park
District	
Assigned Rain Gauge	VP-RG1
Client Manhole #	54-8
U/S Connecting MH I.D	NO-MH-54
System Characteristics:	
Residential - ☐ Commercial - ☐ Industrial - ☐	
P/S Influence	No
WWTP Influence	No

Area Location Map



Area View Picture

Top View Picture



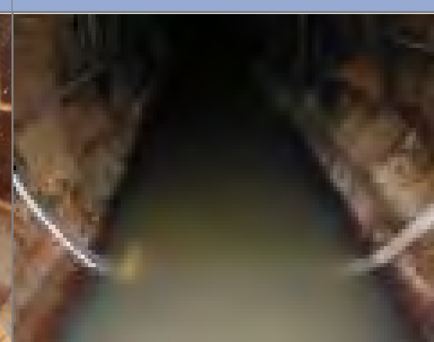
Access Notes

Location Information

Site Address	403 Monterey
Site Access	Roadway, Low Traffic
Longitude	-87.96495319
Latitude	41.88267495
MH Type	Brick
Manhole Depth (ft)	8.02
Manhole Width (ft)	3.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Investigation Photo

Installation Photo



Hydraulic Characteristics

Installation Notes

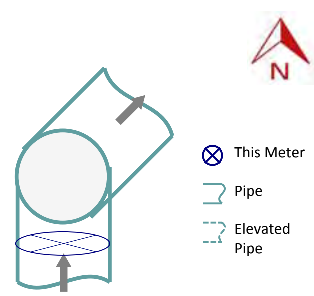
Site Information

Pipe Height (in)		47.50	
Pipe Width (in)		48.82	
Pipe Type		Brick	
Pipe Shape		Circular	
O2	20.9	**LEL %**	0.0
H2S	0.0	**CO**	0.0

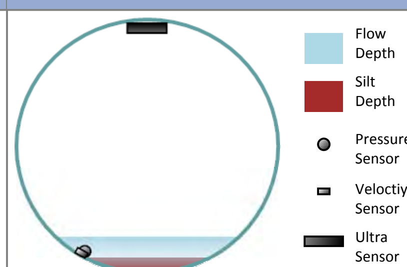
Hydraulic Information

Flow Depth (in)	6.88
Instant Velocity (fps)	0.30
Surcharge Evidence (ft)	N/A
Silt Type	Coarse
Silt Depth (in)	3.00
Needs Cleaning	No
Backwater	No
Flow Path	Less than 45 degree bend
Drop Inlet	No
Hydraulic Rating	Fair

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 7:00

Velocity Clock Position: 7:00

Installation Notes

Location in Pipe (ft)	1.5
Location from Manhole	Upstream
Sensors	
Antenna Surface	Asphalt
Signal Strength	100

Post Installation Notes

Meter Type	
Telemetry Type	Bat-Wing
Installation Date	9/25/2013

Approvals

Recommended by FSP	Client Approval
Yes	
9/16/2013	

rjngroup

The Choice for Collection System Solutions

Villa Park, IL

2013 Hydraulic Model

Site Name	
VP-1A	

		Project No.	Site Code
Inspected By	SS/TR		
Inspected Date/Time	9/6/2013 10:49 AM	11-2577-01	U-1

System Information

Target Pipe Dia. (in)	42.0
Municipality	Villa Park
District	
Assigned Rain Gauge	VP-RG1
Client Manhole #	54-8
U/S Connecting MH I.D	54-23
System Characteristics:	Residential - ☐ Commercial - ☐ Industrial - ☐
P/S Influence	No
WWTP Influence	No

Area Location Map

Area View Picture

Top View Picture

Access Notes

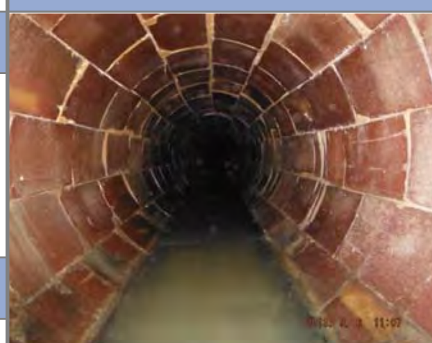
Location Information

Site Address	650 Summit
Site Access	Driveway
Longitude	-87.97393506
Latitude	41.87699023
MH Type	Brick
Manhole Depth (ft)	13.26
Manhole Width (ft)	3.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Site Information

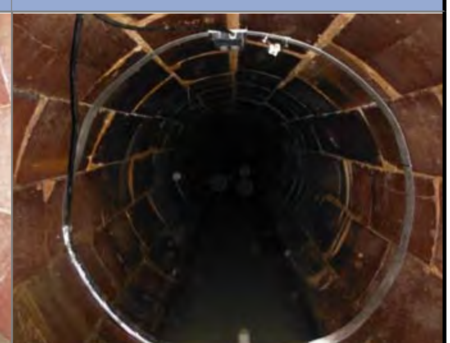
Pipe Height (in)	41.44		
Pipe Width (in)	43.82		
Pipe Type	Brick		
Pipe Shape	Circular		
O2 20.9		**LEL %**	0.0
H2S 0.0		**CO**	0.0

Investigation Photo



Hydraulic Characteristics

Installation Photo

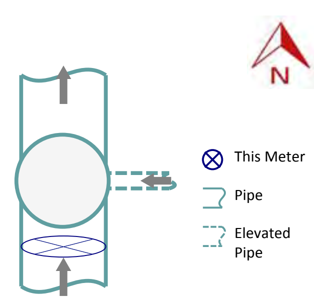


Installation Notes

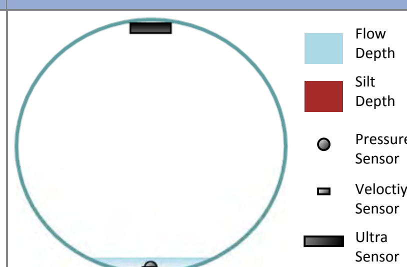
Hydraulic Information

Flow Depth (in)	2.50
Instant Velocity (fps)	0.50
Surcharge Evidence (ft)	N/A
Silt Type	Fine
Silt Depth (in)	0.10
Needs Cleaning	No
Backwater	No
Flow Path	Straight
Drop Inlet	No
Hydraulic Rating	Good

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Installation Notes

Location in Pipe (ft)	2.0
Location from Manhole	Upstream
Sensors	
Antenna Surface	Concrete
Signal Strength	100

Post Installation Notes

Meter Type	
Telemetry Type	Bat-Wing
Installation Date	9/24/2013

Approvals

Recommended by FSP	Client Approval
Yes	
9/16/2013	

rjngroup — The Choice for Collection System Solutions	Villa Park, IL 2013 Hydraulic Model	Site Name
		VP-2

		Project No.	Site Code
Inspected By	SS/TR		
Inspected Date/Time	9/10/2013 12:33 PM	11-2577-01	T

System Information

Target Pipe Dia. (in)	36.0
Municipality	Villa Park
District	
Assigned Rain Gauge	VP-RG1
Client Manhole #	54-8
U/S Connecting MH I.D	51-222
System Characteristics:	
Residential - ☐ Commercial - ☐ Industrial - ☐	
P/S Influence	No
WWTP Influence	No

Area Location Map

Area View Picture

Top View Picture

Access Notes

Location Information

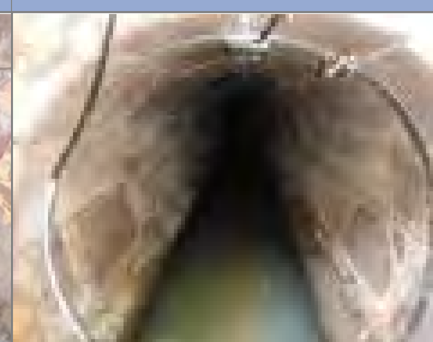
Site Address	59 Monterey
Site Access	Roadway, Low Traffic
Longitude	-87.96458605
Latitude	41.88820667
MH Type	Brick
Manhole Depth (ft)	4.60
Manhole Width (ft)	3.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Site Information

Pipe Height (in)	35.94		
Pipe Width (in)	36.88		
Pipe Type	Brick		
Pipe Shape	Circular		
O2 20.9		**LEL %**	0.0
H2S 0.0		**CO**	0.0

Investigation Photo

Installation Photo



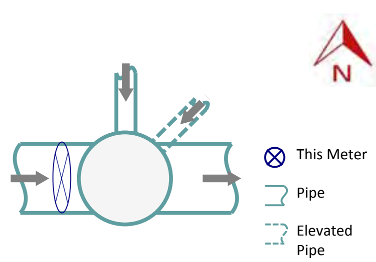
Hydraulic Characteristics

Installation Notes

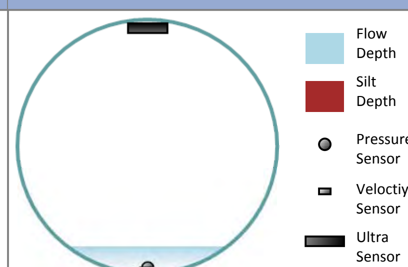
Hydraulic Information

Flow Depth (in)	3.94
Instant Velocity (fps)	0.50
Surcharge Evidence (ft)	N/A
Silt Type	Fine
Silt Depth (in)	0.20
Needs Cleaning	No
Backwater	No
Flow Path	Straight
Drop Inlet	No
Hydraulic Rating	Fair

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Installation Notes

Location in Pipe (ft)	0.5
Location from Manhole	Upstream
Sensors	
Antenna Surface	Asphalt
Signal Strength	75

Post Installation Notes

Meter Type	
Telemetry Type	Bat-Wing
Installation Date	9/25/2013

Approvals

Recommended by FSP	Client Approval
Yes 9/16/2013	

rjngroup — The Choice for Collection System Solutions	**Villa Park, IL** 2013 Hydraulic Model	**Site Name** VP-3

Inspected By	SS/TR	**Project No.**	**Site Code**
Inspected Date/Time	9/10/2013 9:26 AM	11-2577-01	T

System Information

Target Pipe Dia. (in)	40.0
Municipality	Villa Park
District	
Assigned Rain Gauge	VP-RG1
Client Manhole #	54-8
U/S Connecting MH I.D	52-22
System Characteristics:	Residential - ☐ Commercial - ☐ Industrial - ☐
P/S Influence	No
WWTP Influence	No

Area Location Map

Area View Picture

Top View Picture

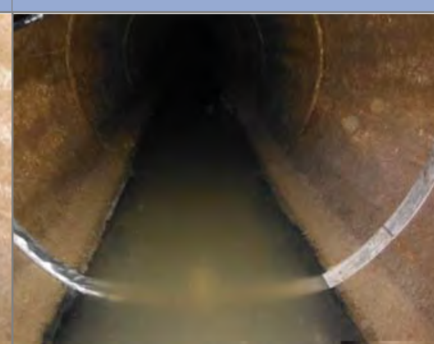
Access Notes

Location Information

Site Address	21 Summit
Site Access	Roadway, Low Traffic
Longitude	-87.97378376
Latitude	41.89074894
MH Type	Concrete Block
Manhole Depth (ft)	13.68
Manhole Width (ft)	3.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Investigation Photo

Installation Photo



Hydraulic Characteristics

Installation Notes

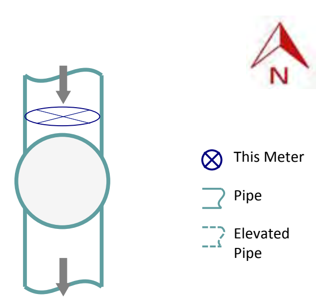
Site Information

Pipe Height (in)	39.00		
Pipe Width (in)	39.44		
Pipe Type	Concrete		
Pipe Shape	Circular		
O2 20.2		**LEL %**	0.0
H2S 0.0		**CO**	0.0

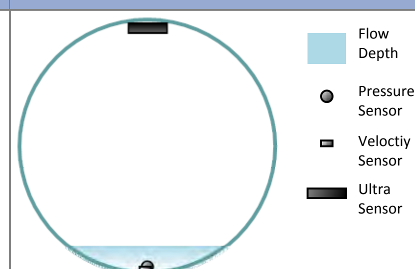
Hydraulic Information

Flow Depth (in)	4.00
Instant Velocity (fps)	0.95
Surcharge Evidence (ft)	N/A
Silt Type	None
Silt Depth (in)	N/A
Needs Cleaning	No
Backwater	No
Flow Path	Straight
Drop Inlet	No
Hydraulic Rating	Good

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Installation Notes

Location in Pipe (ft)	1.0
Location from Manhole	Upstream
Sensors	
Antenna Surface	Asphalt
Signal Strength	100

Post Installation Notes

Meter Type	
Telemetry Type	Bat-Wing
Installation Date	9/25/2013

Approvals

Recommended by FSP	**Client Approval**
Yes 9/16/2013	

rjngroup The Choice for Collection System Solutions	**Villa Park, IL** 2013 Hydraulic Model	**Site Name** VP-3A

Inspected By	SS/TR	**Project No.**	**Site Code**
Inspected Date/Time	9/10/2013 10:29 AM	11-2577-01	D-1

System Information

Target Pipe Dia. (in)	30.0
Municipality	Villa Park
District	
Assigned Rain Gauge	VP-RG1
Client Manhole #	54-8
U/S Connecting MH I.D	52-36
System Characteristics:	Residential - ☐ Commercial - ☐ Industrial - ☐
P/S Influence	No
WWTP Influence	No

Area Location Map

Area View Picture

Top View Picture

Access Notes

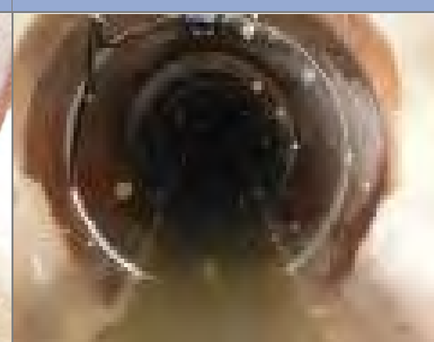
Location Information

Site Address	200 Yale
Site Access	Roadway, Low Traffic
Longitude	-87.98229822
Latitude	41.89253152
MH Type	Precast Concrete
Manhole Depth (ft)	14.04
Manhole Width (ft)	5.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Investigation Photo

Hydraulic Characteristics

Installation Photo



Installation Notes

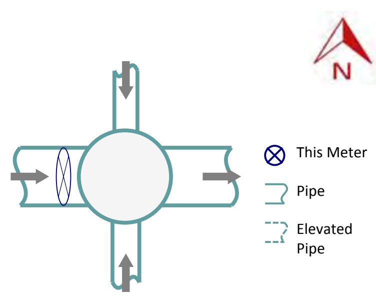
Site Information

Pipe Height (in)	30.00
Pipe Width (in)	30.44
Pipe Type	Vitrified Clay
Pipe Shape	Circular
O2	**LEL %**
H2S	**CO**

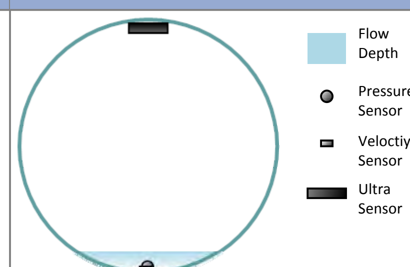
Hydraulic Information

Flow Depth (in)	2.50
Instant Velocity (fps)	0.90
Surcharge Evidence (ft)	N/A
Silt Type	None
Silt Depth (in)	N/A
Needs Cleaning	No
Backwater	No
Flow Path	Straight
Drop Inlet	No
Hydraulic Rating	Good

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Installation Notes

Location in Pipe (ft)	
Location from Manhole	Upstream
Sensors	
Antenna Surface	Asphalt
Signal Strength	75

Post Installation Notes

Meter Type	
Telemetry Type	Bat-Wing
Installation Date	

Approvals

Recommended by FSP	**Client Approval**
Yes 9/16/2013	

rjngroup The Choice for Collection System Solutions	**Villa Park, IL** 2013 Hydraulic Model	**Site Name** VP-4

Inspected By	SS/TR	**Project No.**	**Site Code**
Inspected Date/Time	9/6/2013 2:26 PM	11-2577-01	U-2

System Information

Target Pipe Dia. (in)	42.0
Municipality	Villa Park
District	
Assigned Rain Gauge	VP-RG1
Client Manhole #	54-8
U/S Connecting MH I.D	53-12
System Characteristics:	

Residential - ☐ Commercial - ☐ Industrial - ☐

P/S Influence	No
WWTP Influence	No

Location Information

Site Address	519 Park
Site Access	Parkway
Longitude	-87.96618710
Latitude	41.88570713
MH Type	Brick
Manhole Depth (ft)	7.74
Manhole Width (ft)	3.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Site Information

Pipe Height (in)	41.00		
Pipe Width (in)	43.12		
Pipe Type	Brick		
Pipe Shape	Circular		
O2 20.1		**LEL %**	0.0
H2S 0.0		**CO**	0.0

Hydraulic Information

Flow Depth (in)	2.75
Instant Velocity (fps)	1.75
Surcharge Evidence (ft)	N/A
Silt Type	None
Silt Depth (in)	N/A
Needs Cleaning	No
Backwater	No
Flow Path	Less than 45 degree bend
Drop Inlet	No
Hydraulic Rating	Fair

Installation Notes

Location in Pipe (ft)	1.0
Location from Manhole	Upstream
Sensors	
Antenna Surface	Non-Paved
Signal Strength	100

Post Installation Notes

Meter Type	
Telemetry Type	ADS
Installation Date	9/23/2013

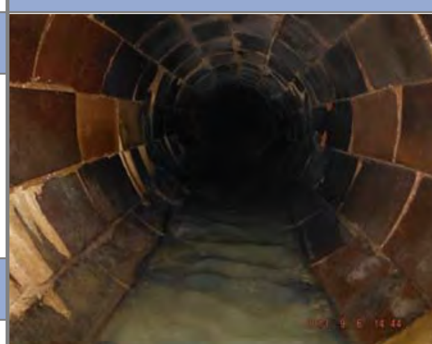
Area Location Map

Area View Picture

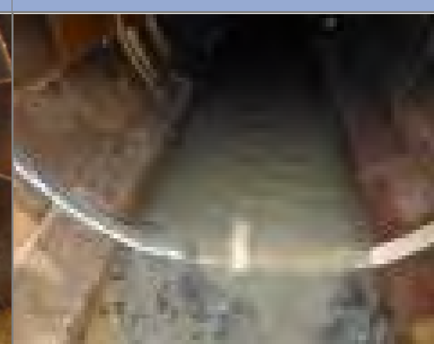
Top View Picture

Access Notes

Investigation Photo

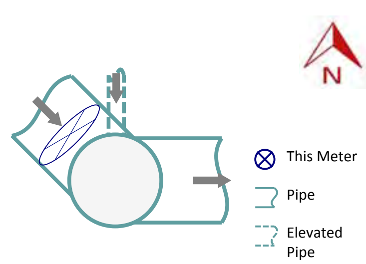


Installation Photo

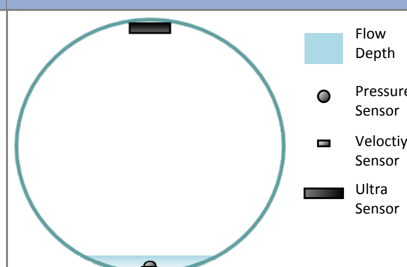


Hydraulic Characteristics	bumpy invert causing hydraulic bumps	**Installation Notes**

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Approvals

Recommended by FSP	**Client Approval**
Yes 9/16/2013	

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The Choice for Collection System Solutions

Villa Park, IL

2013 Hydraulic Model

Site Name	
VP-4A	

Inspected By	SS/TR	**Project No.**	**Site Code**
Inspected Date/Time	9/10/2013 11:23 AM	11-2577-01	D-1

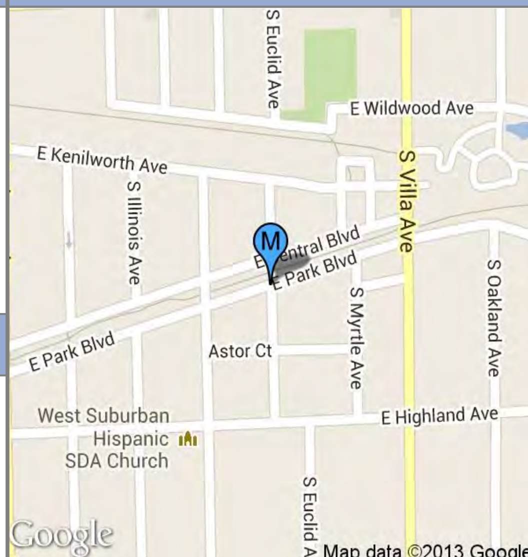
System Information

Target Pipe Dia. (in)	18.0
Municipality	Villa Park
District	
Assigned Rain Gauge	VP-RG1
Client Manhole #	54-8
U/S Connecting MH I.D	53-110
System Characteristics:	

Residential - ☐ Commercial - ☐ Industrial - ☐

P/S Influence	No
WWTP Influence	No

Area Location Map



Area View Picture

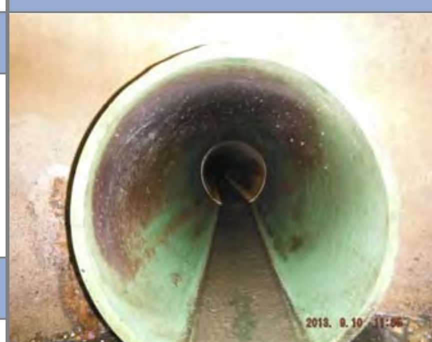
Top View Picture

Access Notes

Location Information

Site Address	235 Park
Site Access	Roadway, Low Traffic
Longitude	-87.97247738
Latitude	41.88490132
MH Type	Precast Concrete
Manhole Depth (ft)	10.70
Manhole Width (ft)	5.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Investigation Photo



Installation Photo

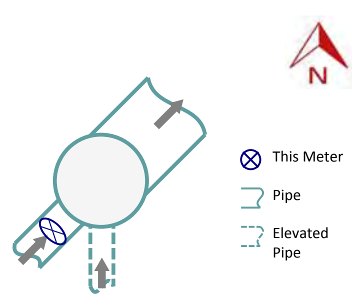
Hydraulic Characteristics

Installation Notes

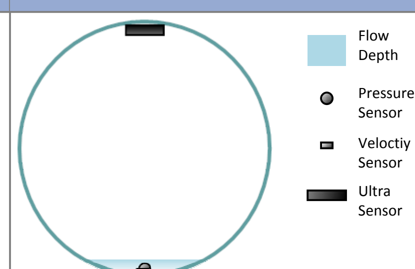
Site Information

Pipe Height (in)	17.38		
Pipe Width (in)	17.15		
Pipe Type	Polyvinyl Chloride		
Pipe Shape	Circular		
O2	20.9	**LEL %**	0.0
H2S	0.0	**CO**	0.0

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Hydraulic Information

Flow Depth (in)	1.00
Instant Velocity (fps)	1.75
Surcharge Evidence (ft)	5.20
Silt Type	None
Silt Depth (in)	N/A
Needs Cleaning	No
Backwater	No
Flow Path	Straight
Drop Inlet	Yes
Hydraulic Rating	Fair

Installation Notes

Location in Pipe (ft)	1.0
Location from Manhole	Upstream
Sensors	
Antenna Surface	Asphalt
Signal Strength	75

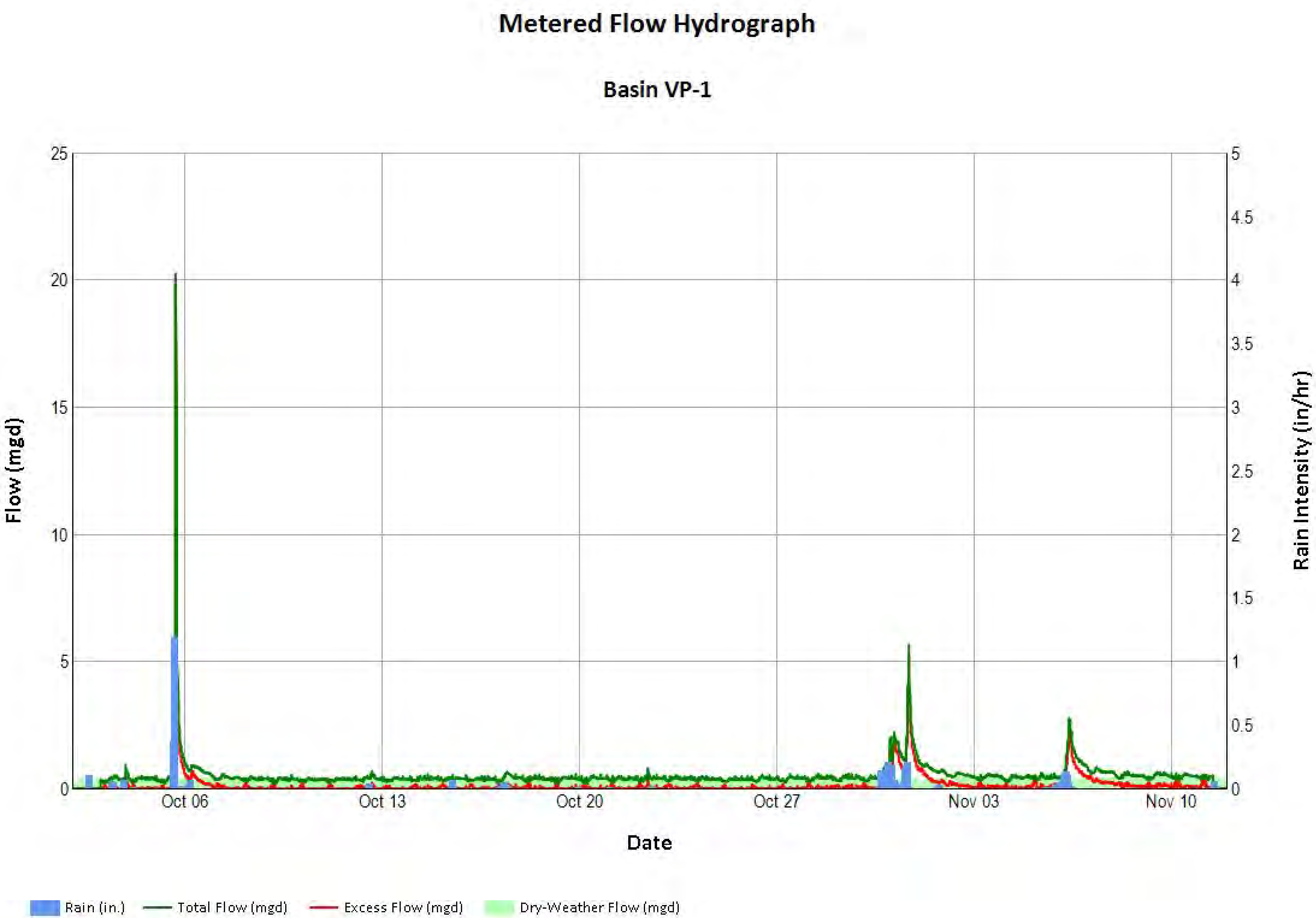
Post Installation Notes

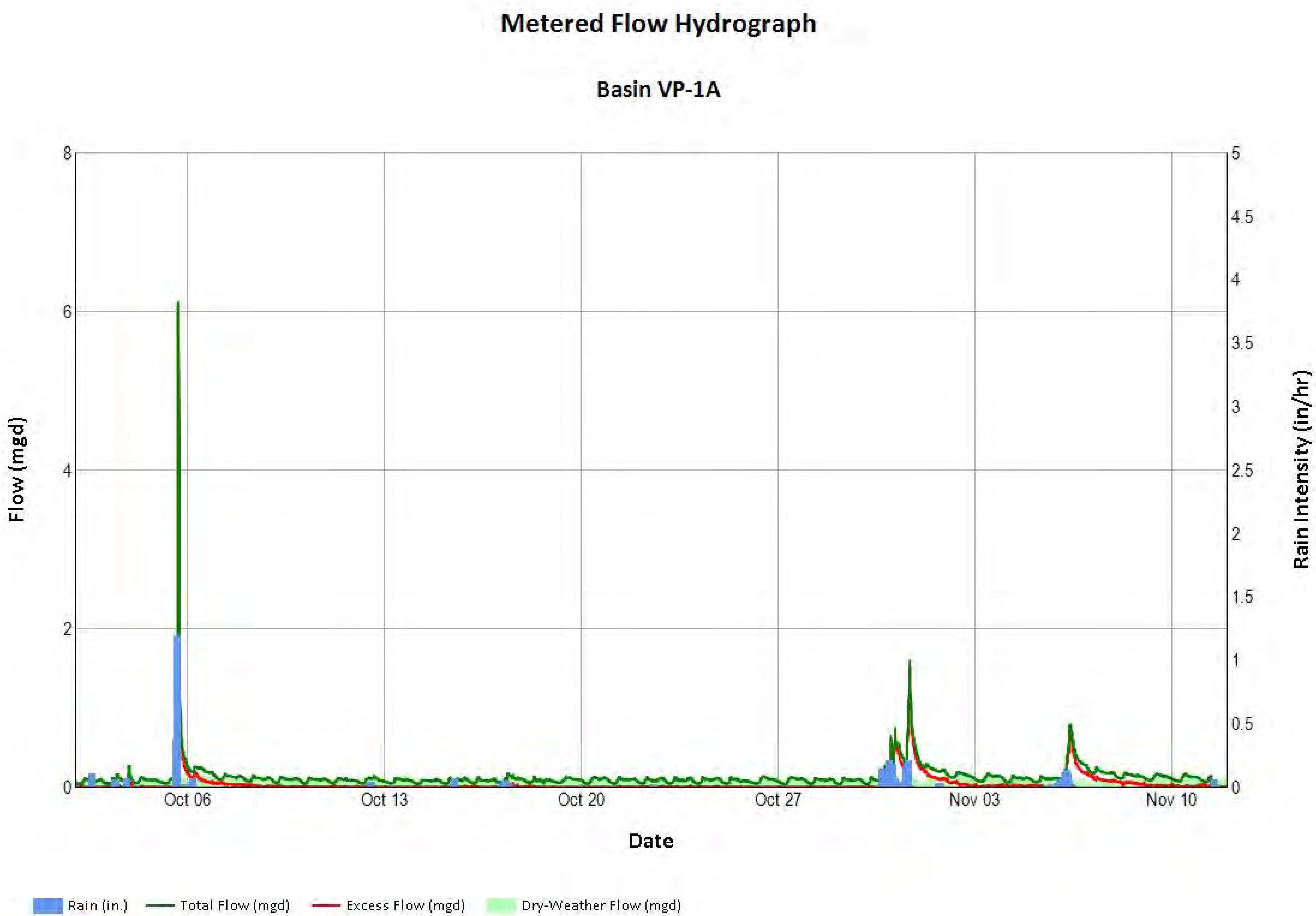
Meter Type	
Telemetry Type	Bat-Wing
Installation Date	9/24/2013

Approvals

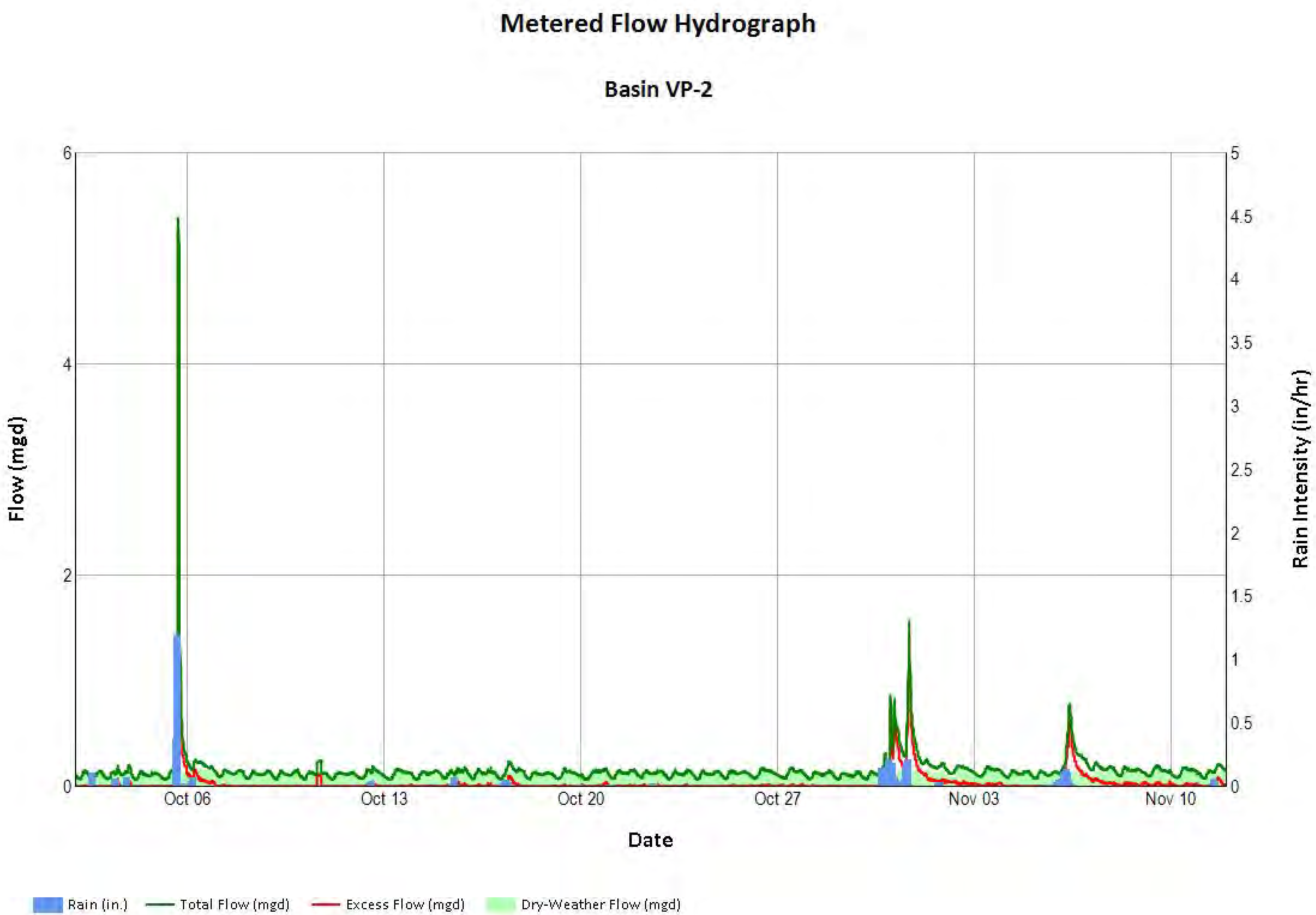
Recommended by FSP	**Client Approval**
Yes	
9/16/2013	

APPENDIX B - HYDROGRAPHS


Metered Flow Hydrograph
Basin VP-1
Flow (mgd)
Rain Intensity (in/hr)
Date
25
20
15
10
5
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct 06
Oct 13
Oct 20
Oct 27
Nov 03
Nov 10
Rain (in.)
Total Flow (mgd)
Excess Flow (mgd)
Dry-Weather Flow (mgd)

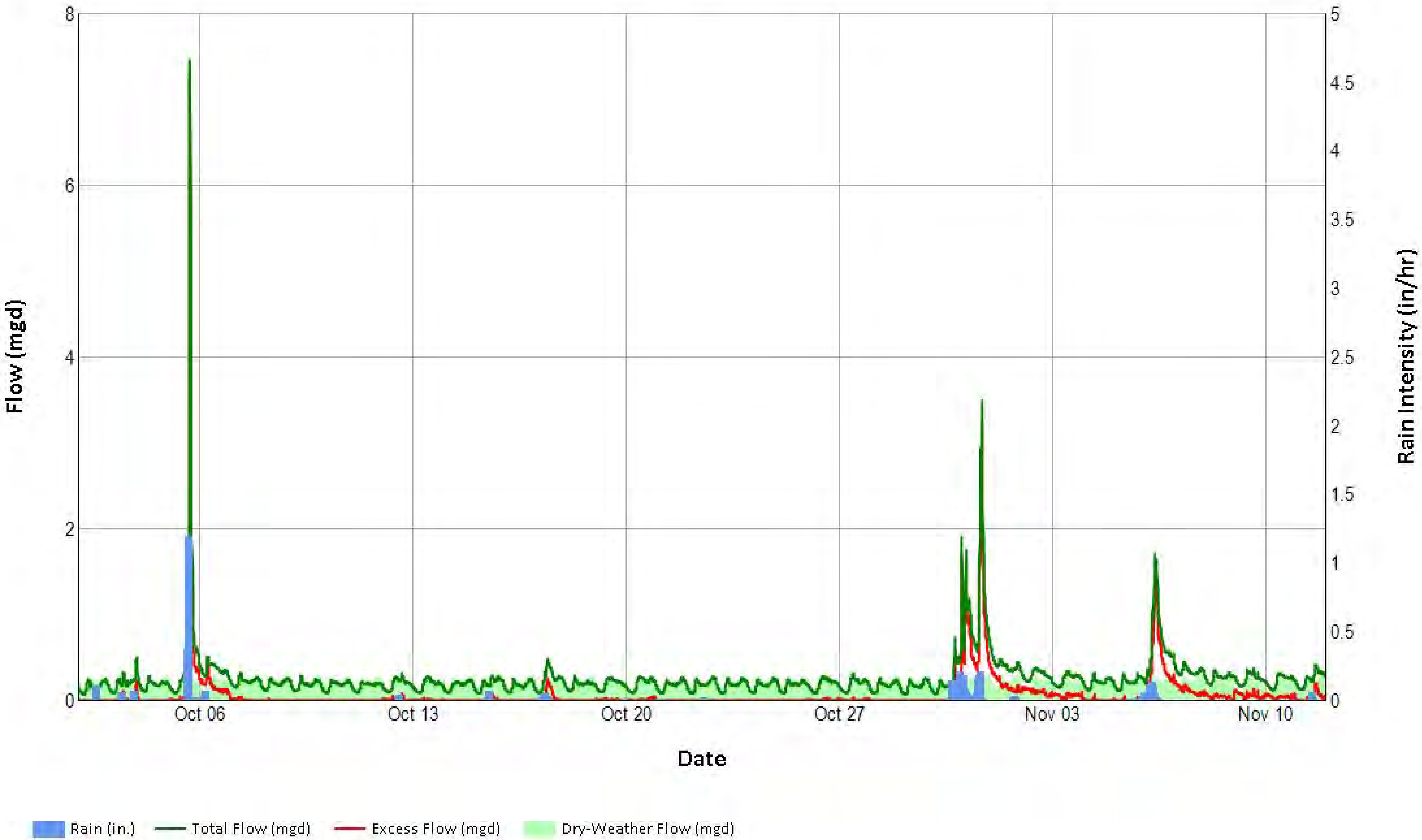


Metered Flow Hydrograph
Basin VP-1A
Flow (mgd)
Rain Intensity (in/hr)
Date
8
6
4
2
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct 06
Oct 13
Oct 20
Oct 27
Nov 03
Nov 10
Rain (in.)
Total Flow (mgd)
Excess Flow (mgd)
Dry-Weather Flow (mgd)


Metered Flow Hydrograph
Basin VP-2
Flow (mgd)
Rain Intensity (in/hr)
6
4
2
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct 06
Oct 13
Oct 20
Oct 27
Nov 03
Nov 10
Date
Rain (in.)
Total Flow (mgd)
Excess Flow (mgd)
Dry-Weather Flow (mgd)

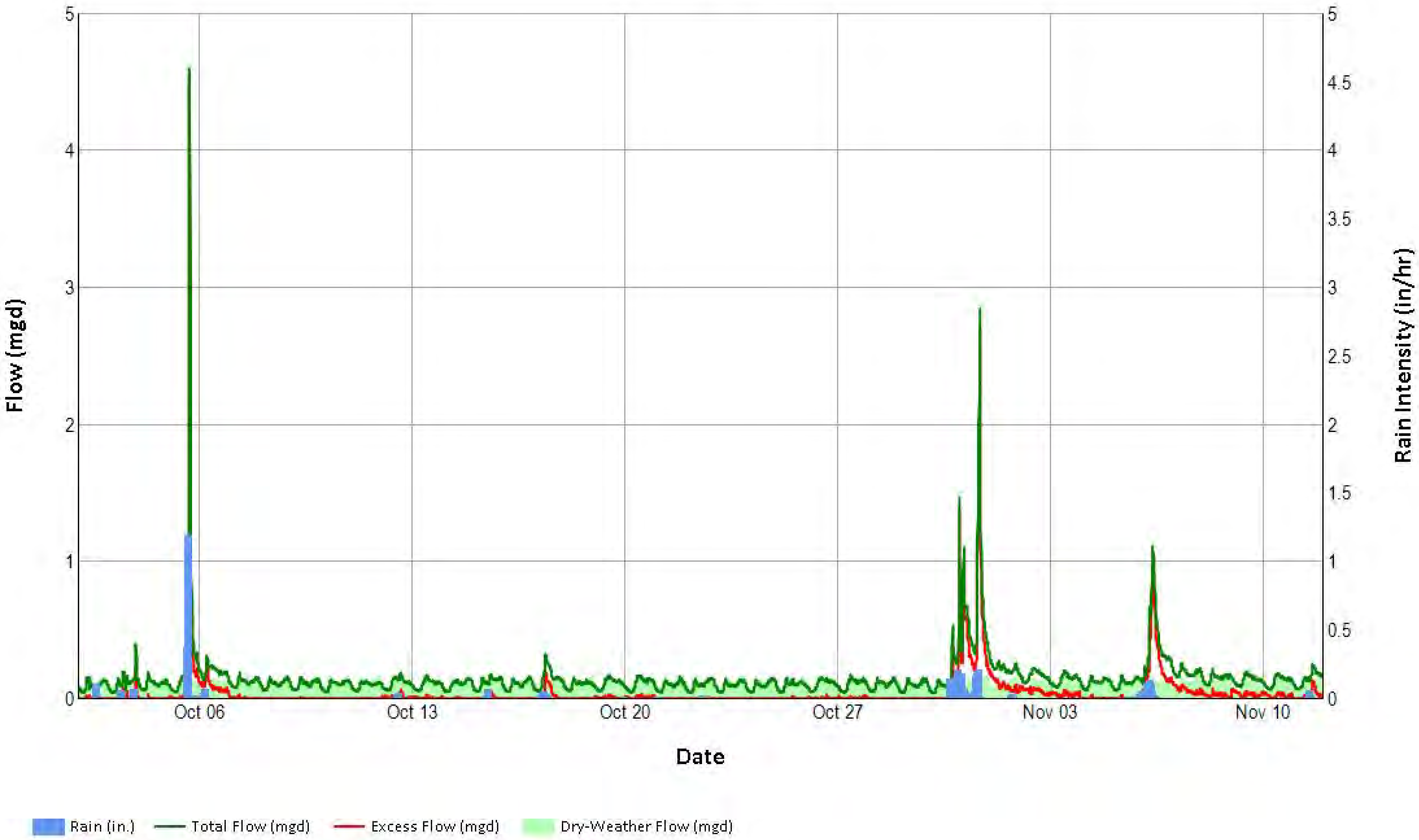
Metered Flow Hydrograph

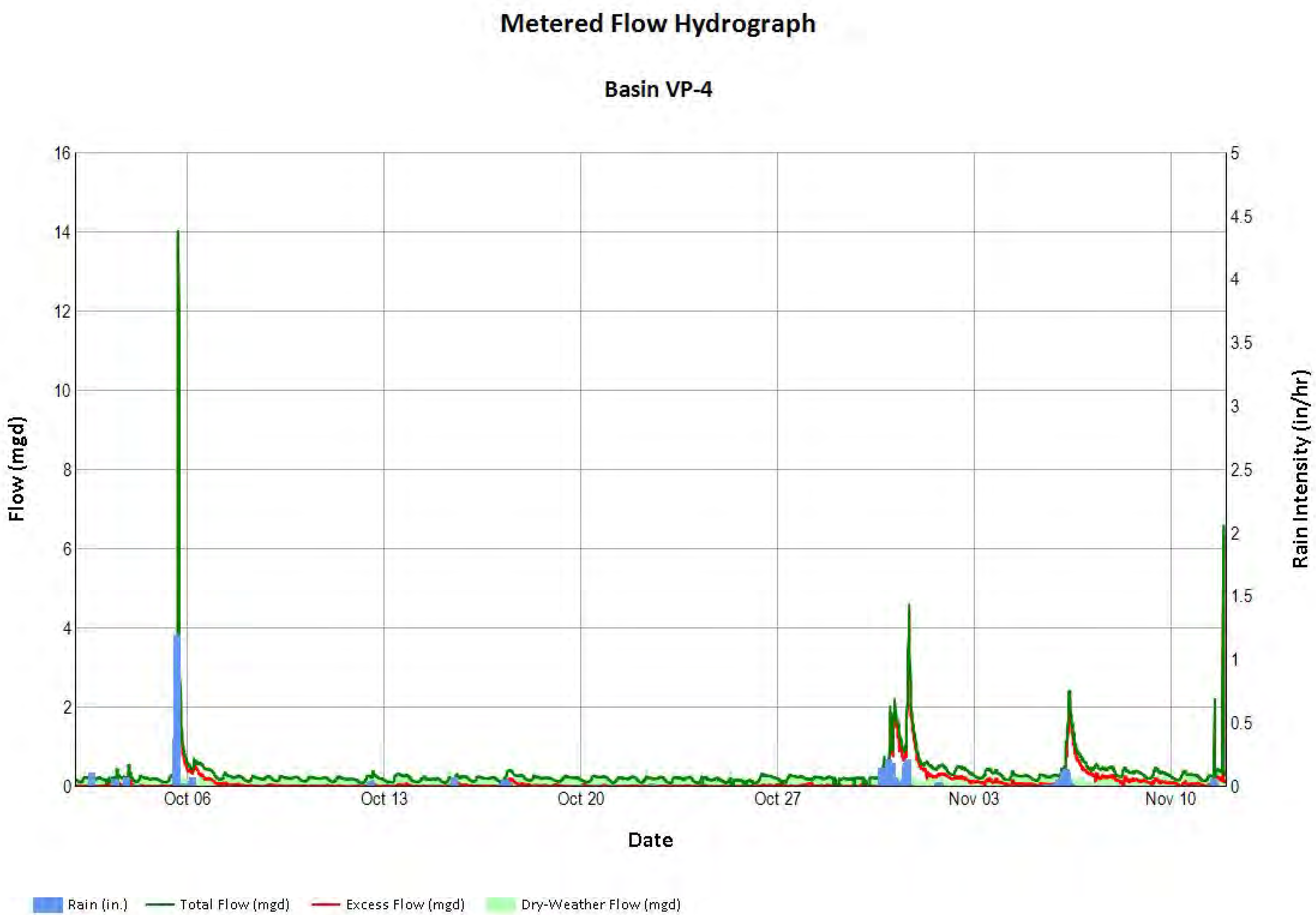
Basin VP-3

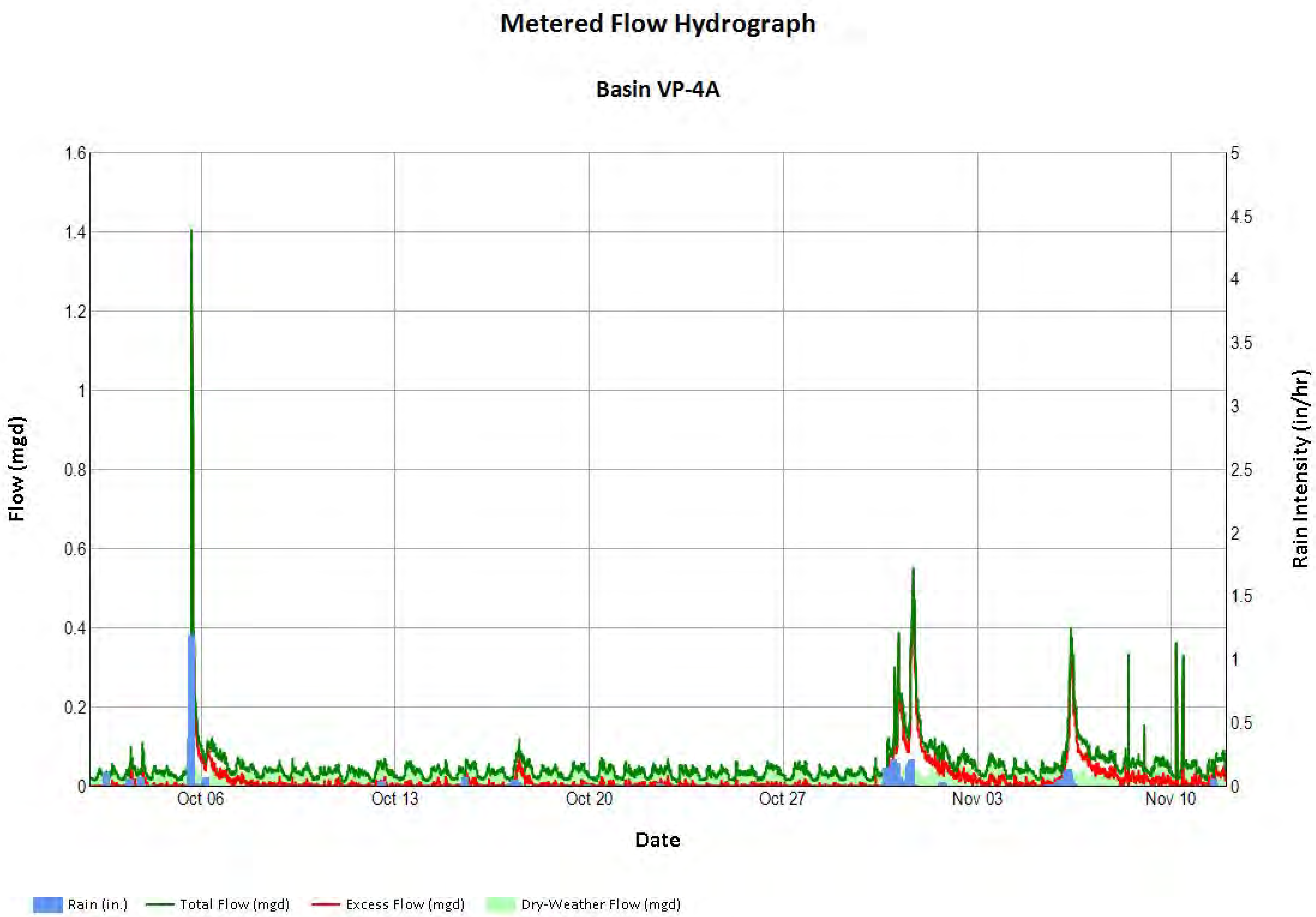


Metered Flow Hydrograph

Basin VP-3A



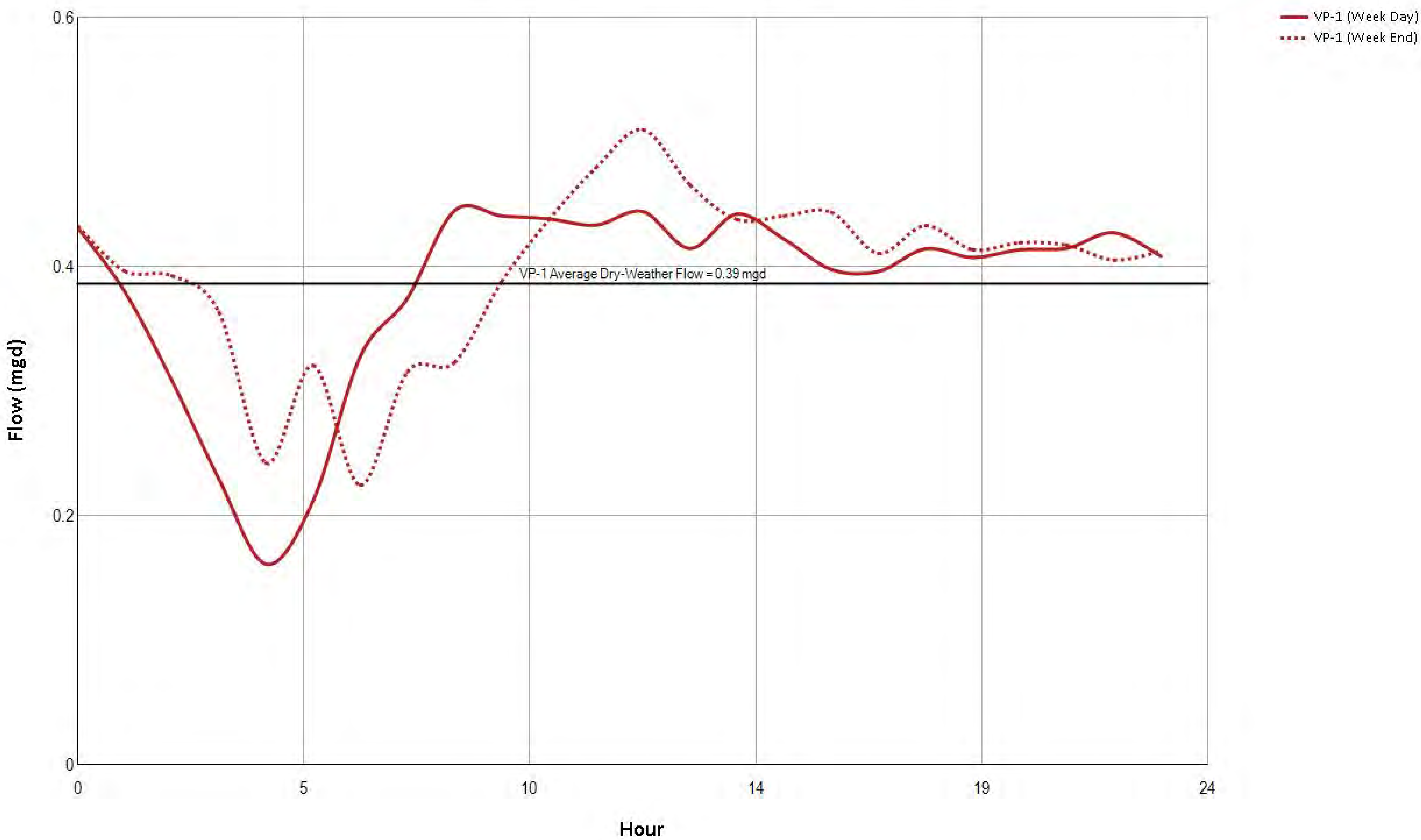

Metered Flow Hydrograph
Basin VP-4
Flow (mgd)
Rain Intensity (in/hr)
Date
16
14
12
10
8
6
4
2
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct 06
Oct 13
Oct 20
Oct 27
Nov 03
Nov 10
Rain (in.)
Total Flow (mgd)
Excess Flow (mgd)
Dry-Weather Flow (mgd)

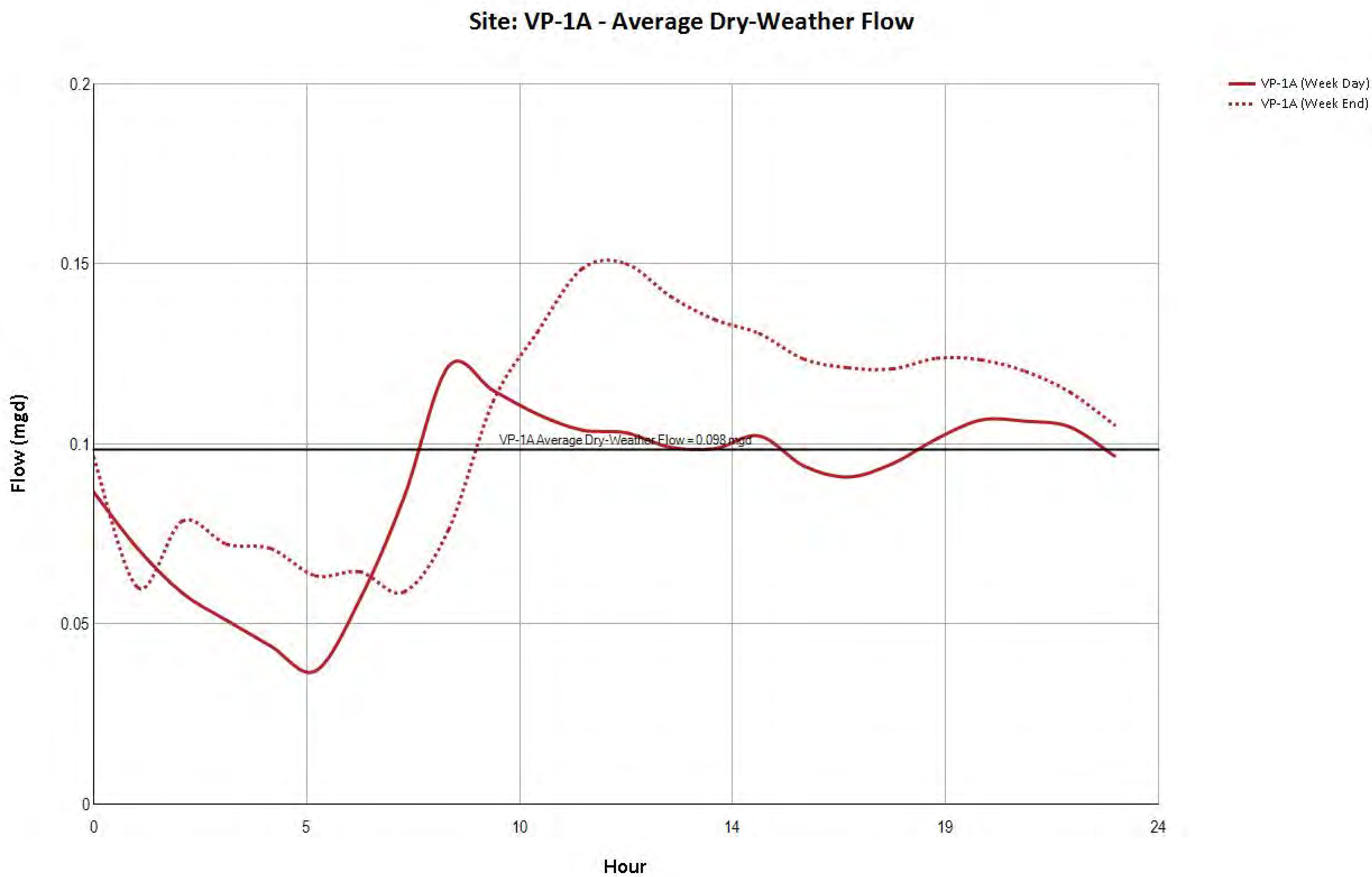


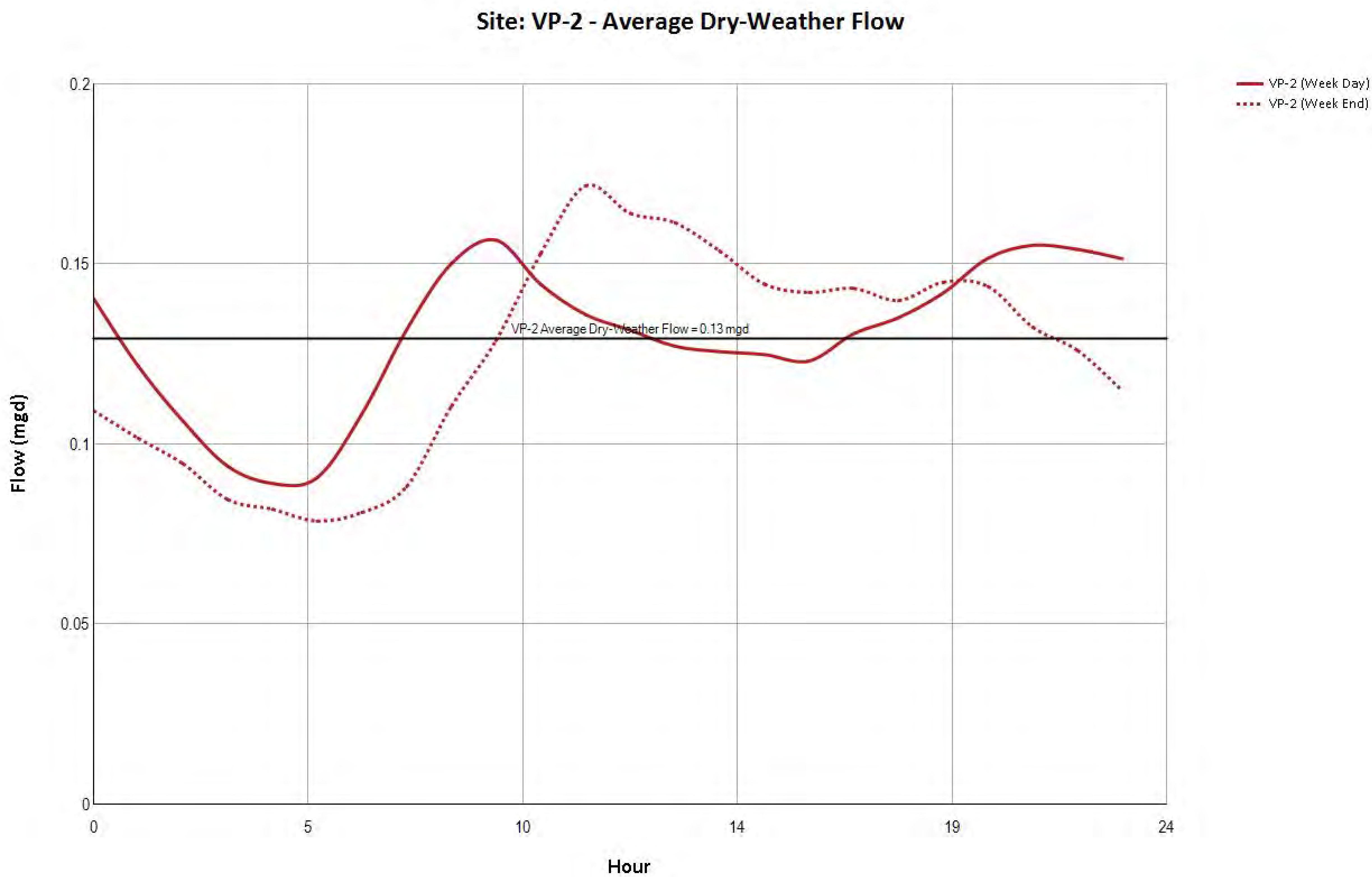
Metered Flow Hydrograph
Basin VP-4A
Flow (mgd)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Rain Intensity (in/hr)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct 06
Oct 13
Oct 20
Oct 27
Nov 03
Nov 10
Date
Rain (in.)
Total Flow (mgd)
Excess Flow (mgd)
Dry-Weather Flow (mgd)

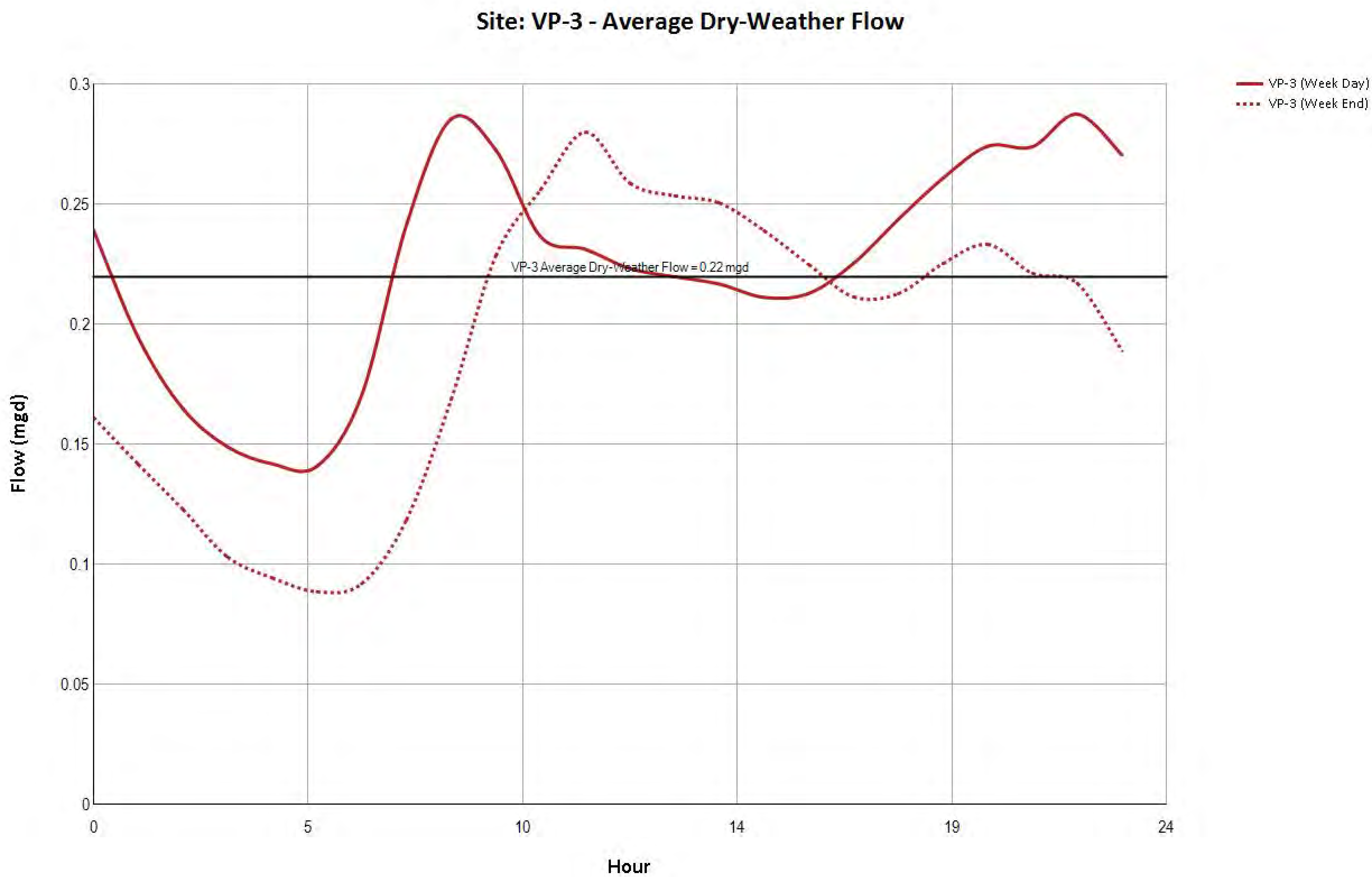
APPENDIX C – AVERAGE DRY-WEATHER FLOW

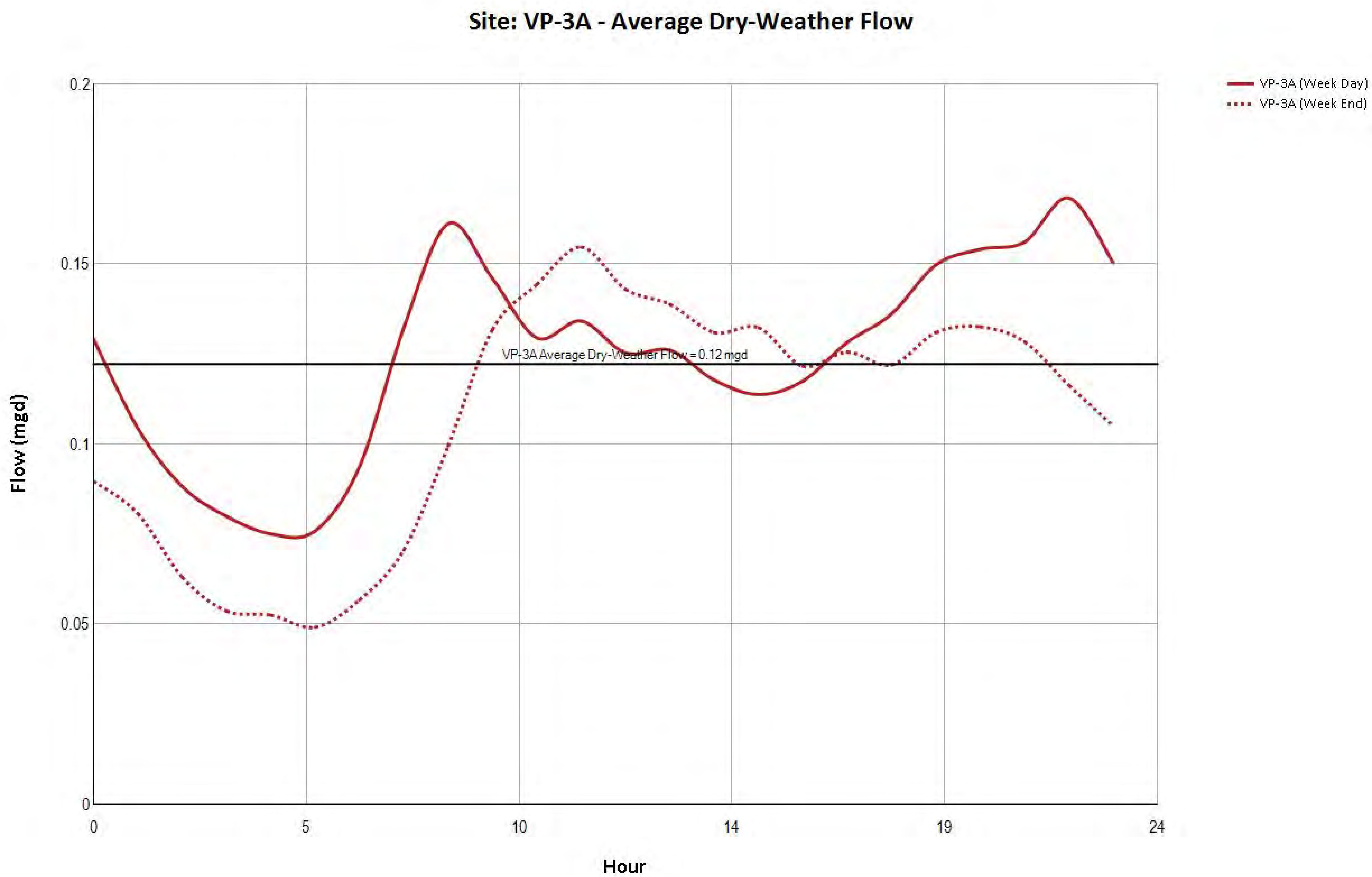
Site: VP-1 - Average Dry-Weather Flow




Site: VP-1A - Average Dry-Weather Flow
VP-1A (Week Day)
VP-1A (Week End)
VP-1A Average Dry-Weather Flow = 0.098 mgd
Flow (mgd)
Hour
0.2
0.15
0.1
0.05
0
0
5
10
14
19
24

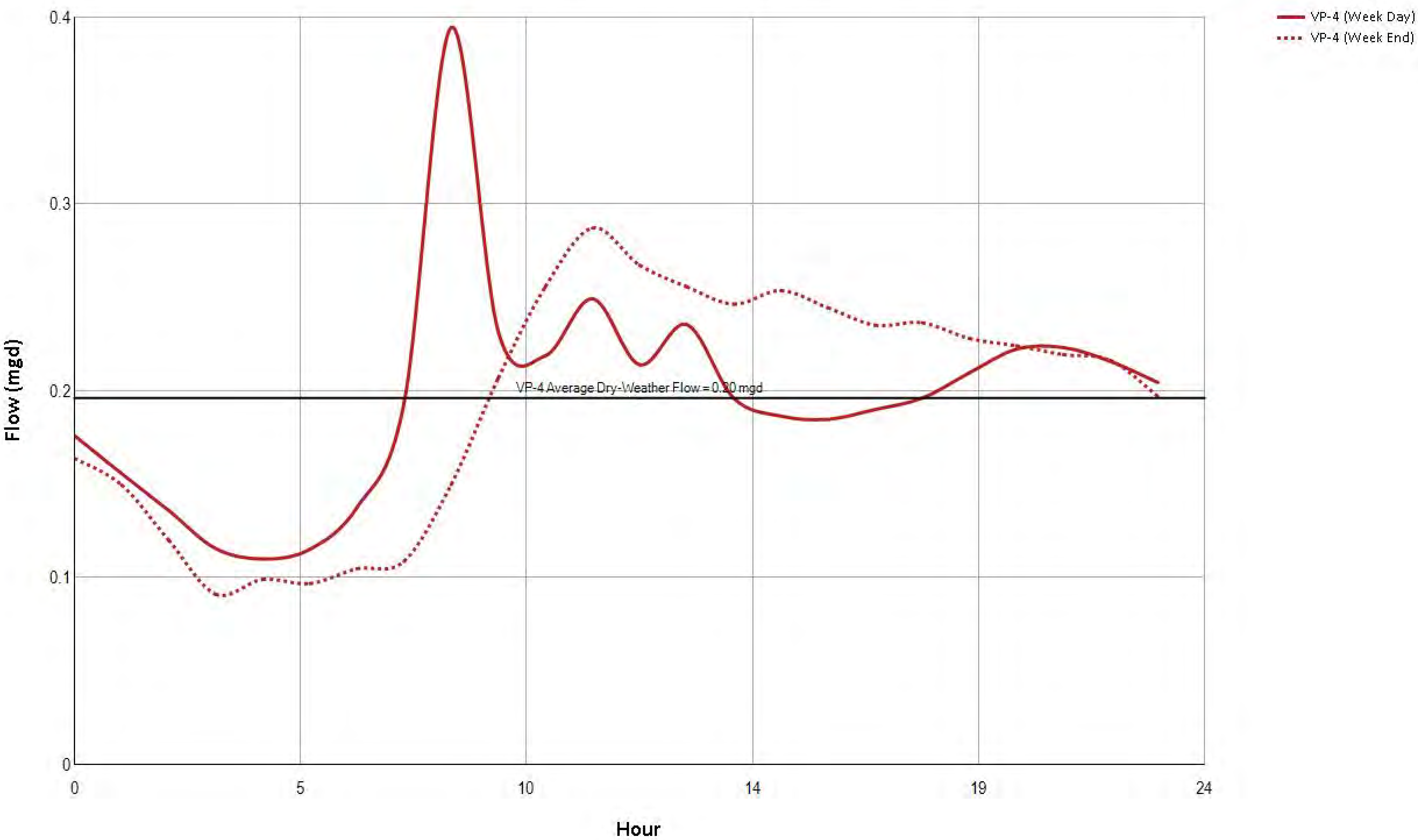

Site: VP-2 - Average Dry-Weather Flow
VP-2 (Week Day)
VP-2 (Week End)
VP-2 Average Dry-Weather Flow = 0.13 mgd
Flow (mgd)
0.2
0.15
0.1
0.05
0
0
5
10
14
19
24
Hour

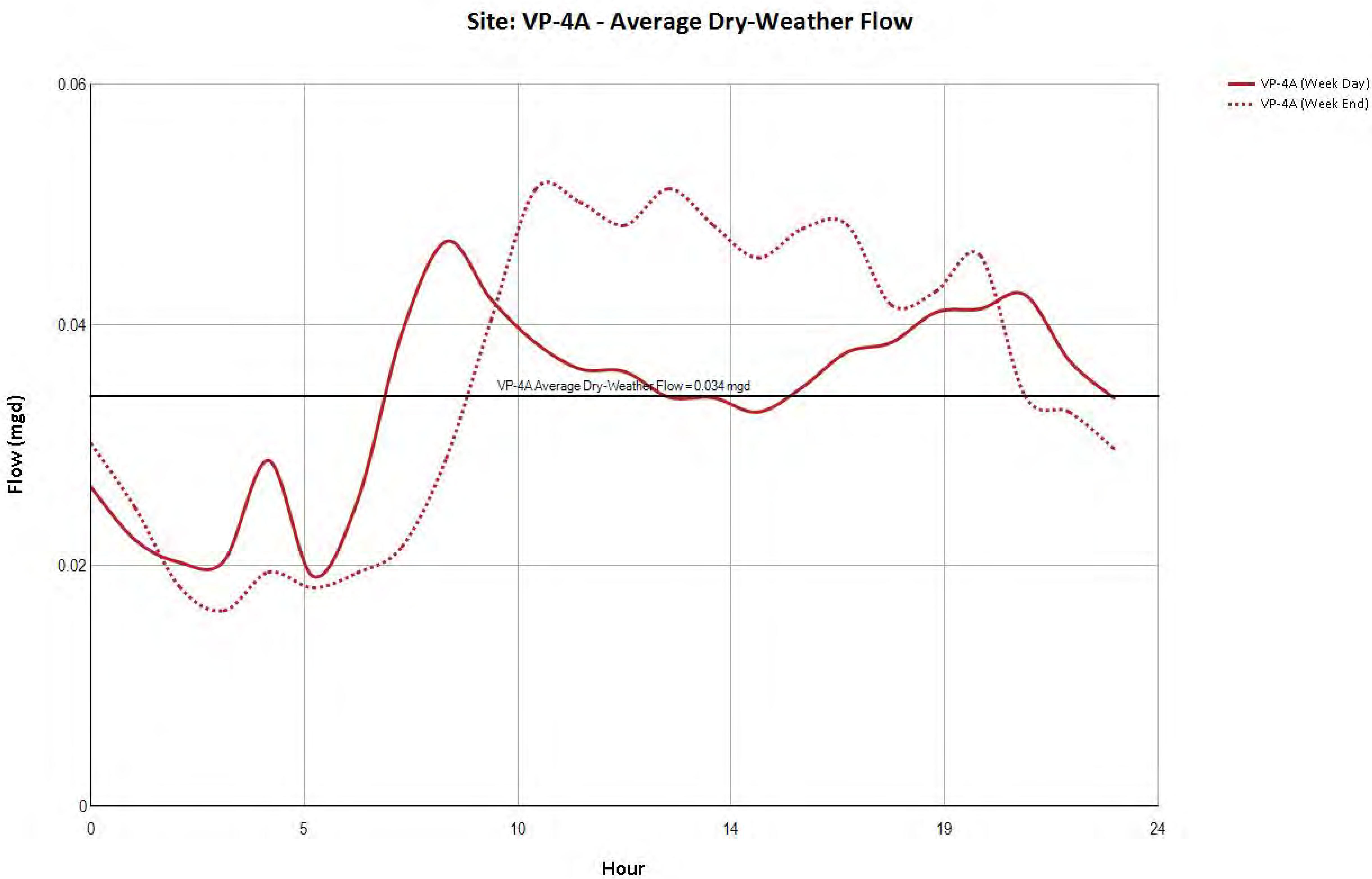

Site: VP-3 - Average Dry-Weather Flow
VP-3 (Week Day)
VP-3 (Week End)
VP-3 Average Dry-Weather Flow = 0.22 mgd
Flow (mgd)
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5
10
14
19
24
Hour



Site: VP-3A - Average Dry-Weather Flow
VP-3A (Week Day)
VP-3A (Week End)
VP-3A Average Dry-Weather Flow = 0.12 mgd
Flow (mgd)
0.2
0.15
0.1
0.05
0
0
5
10
14
19
24
Hour

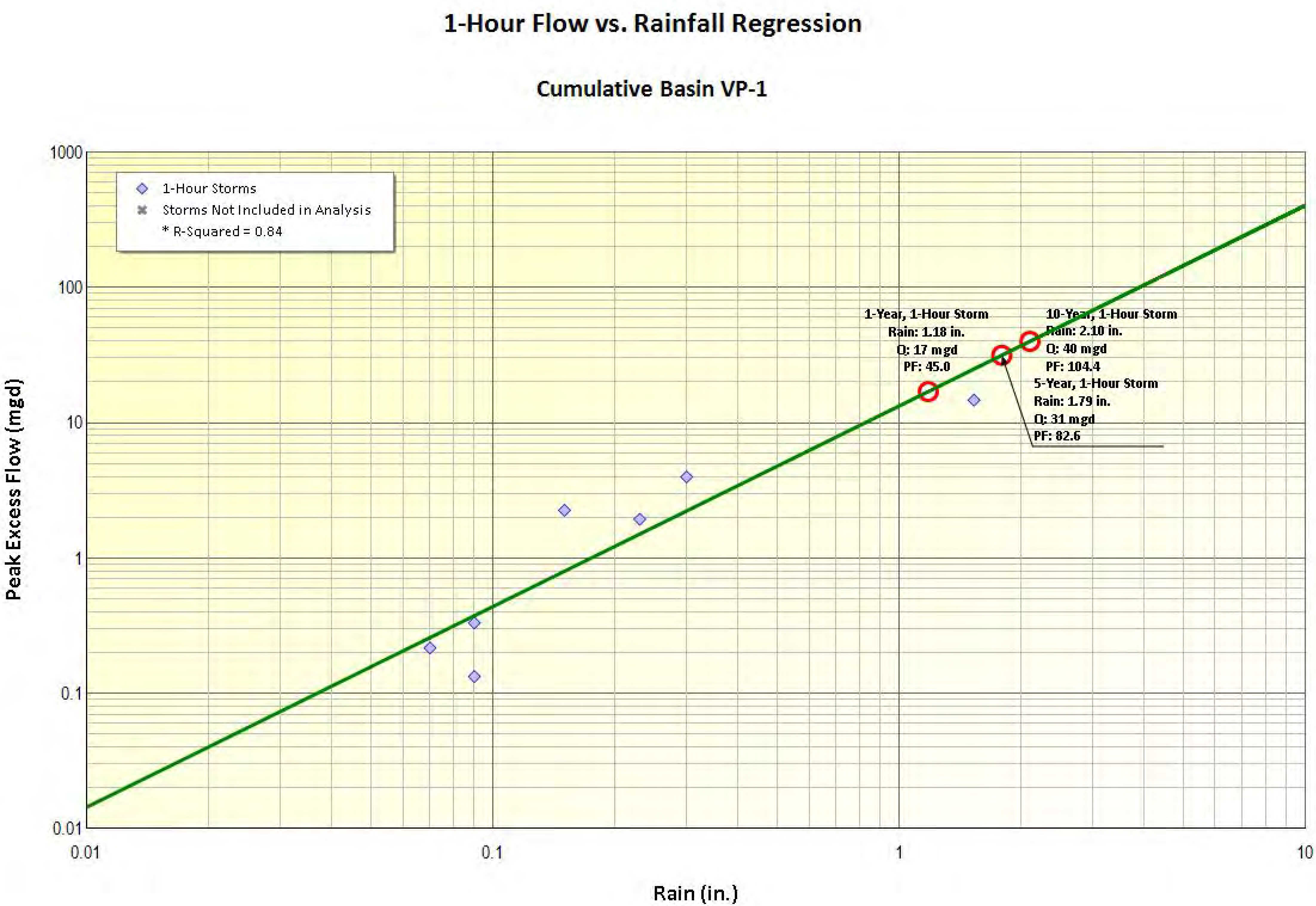
Site: VP-4 - Average Dry-Weather Flow





Site: VP-4A - Average Dry-Weather Flow
VP-4A (Week Day)
VP-4A (Week End)
VP-4A Average Dry-Weather Flow = 0.034 mgd
Flow (mgd)
0.06
0.04
0.02
0
0
5
10
14
19
24
Hour

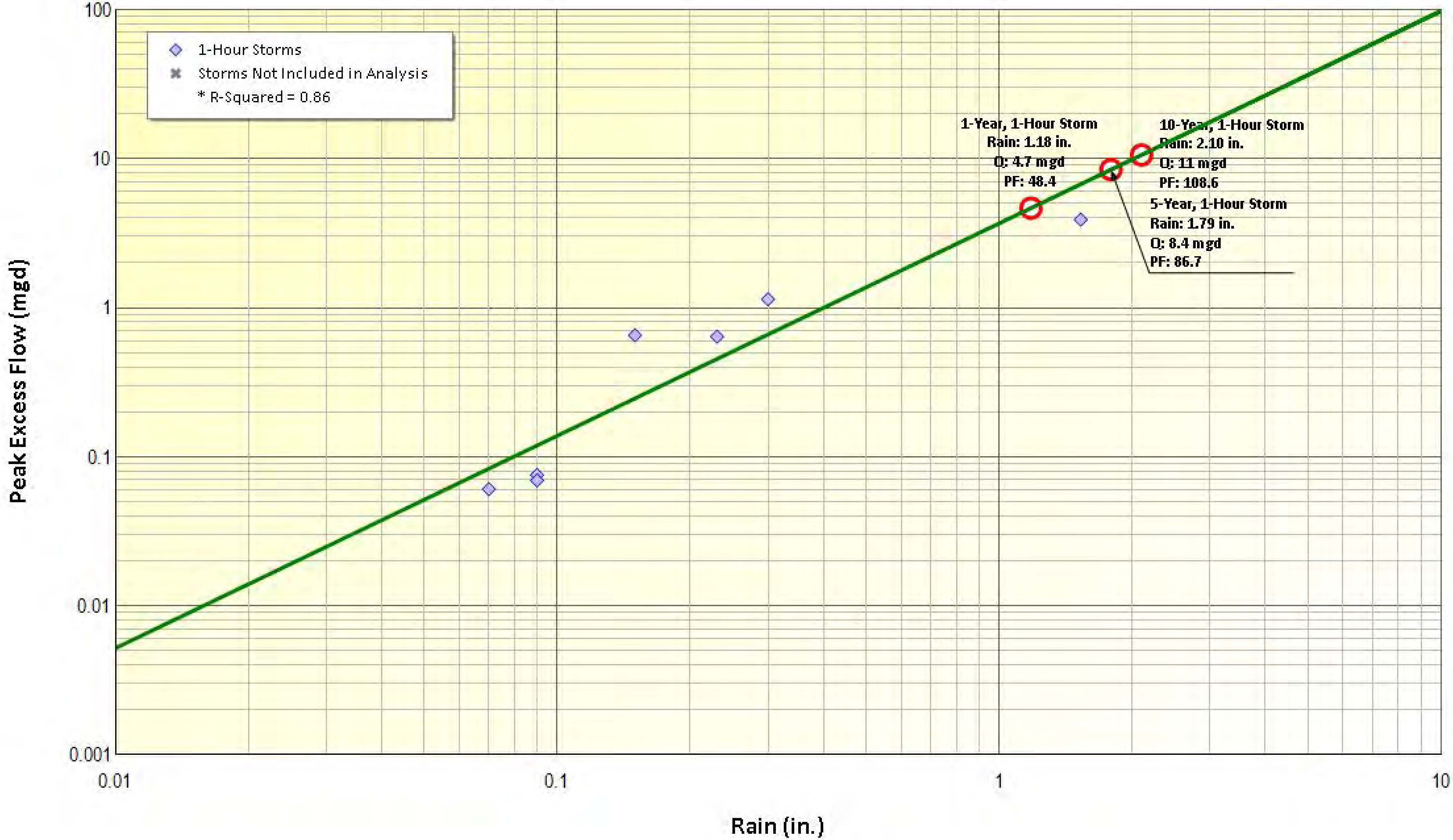
APPENDIX D – REGRESSION ANALYSIS

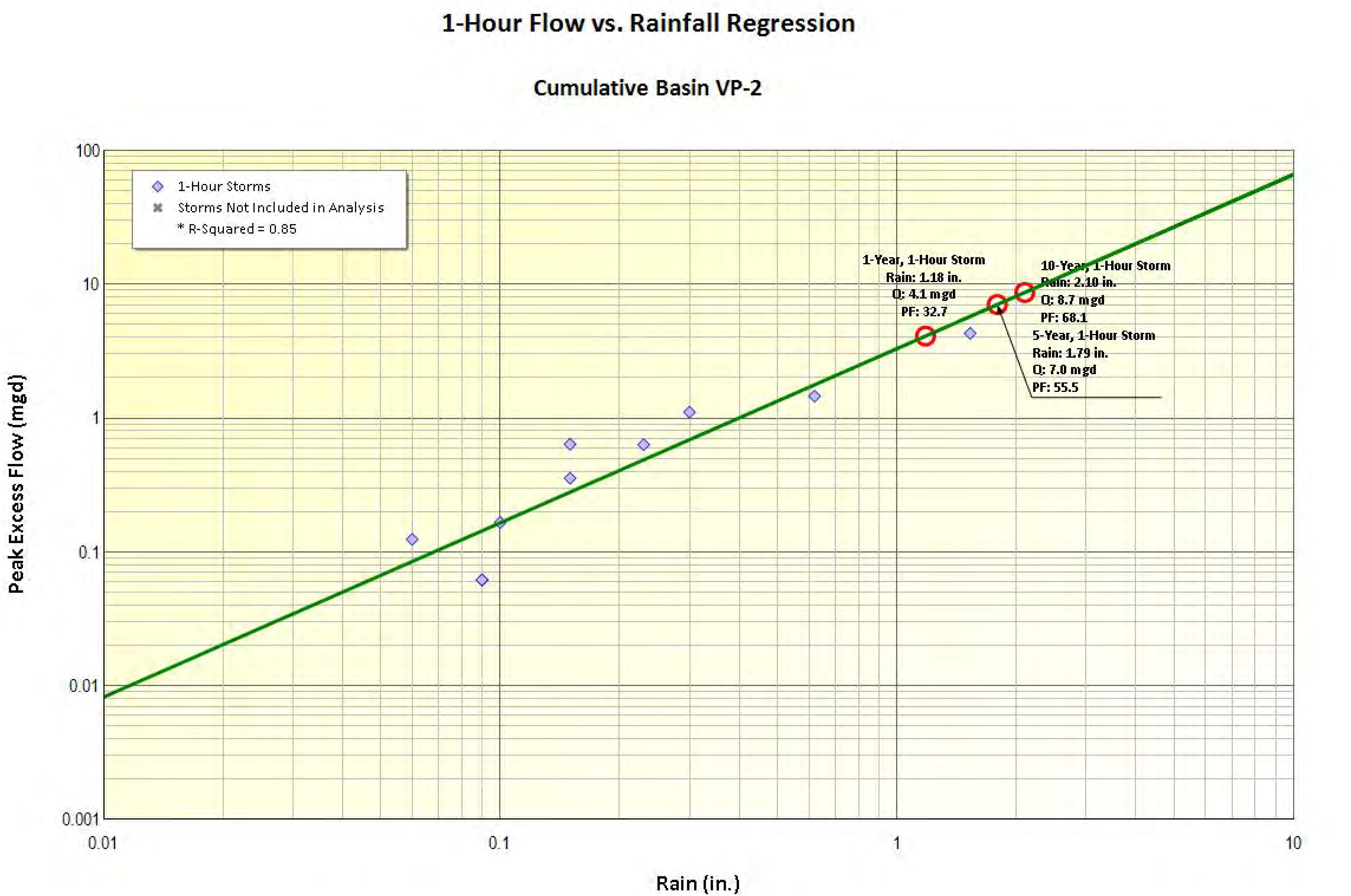


1-Hour Flow vs. Rainfall Regression
Cumulative Basin VP-1
1-Hour Storms
Storms Not Included in Analysis
* R-Squared = 0.84
1-Year, 1-Hour Storm
Rain: 1.18 in.
Q: 17 mgd
PF: 45.0
10-Year, 1-Hour Storm
Rain: 2.10 in.
Q: 40 mgd
PF: 104.4
5-Year, 1-Hour Storm
Rain: 1.79 in.
Q: 31 mgd
PF: 82.6
Peak Excess Flow (mgd)
Rain (in.)
1000
100
10
1
0.1
0.01
0.01
0.1
1
10

1-Hour Flow vs. Rainfall Regression

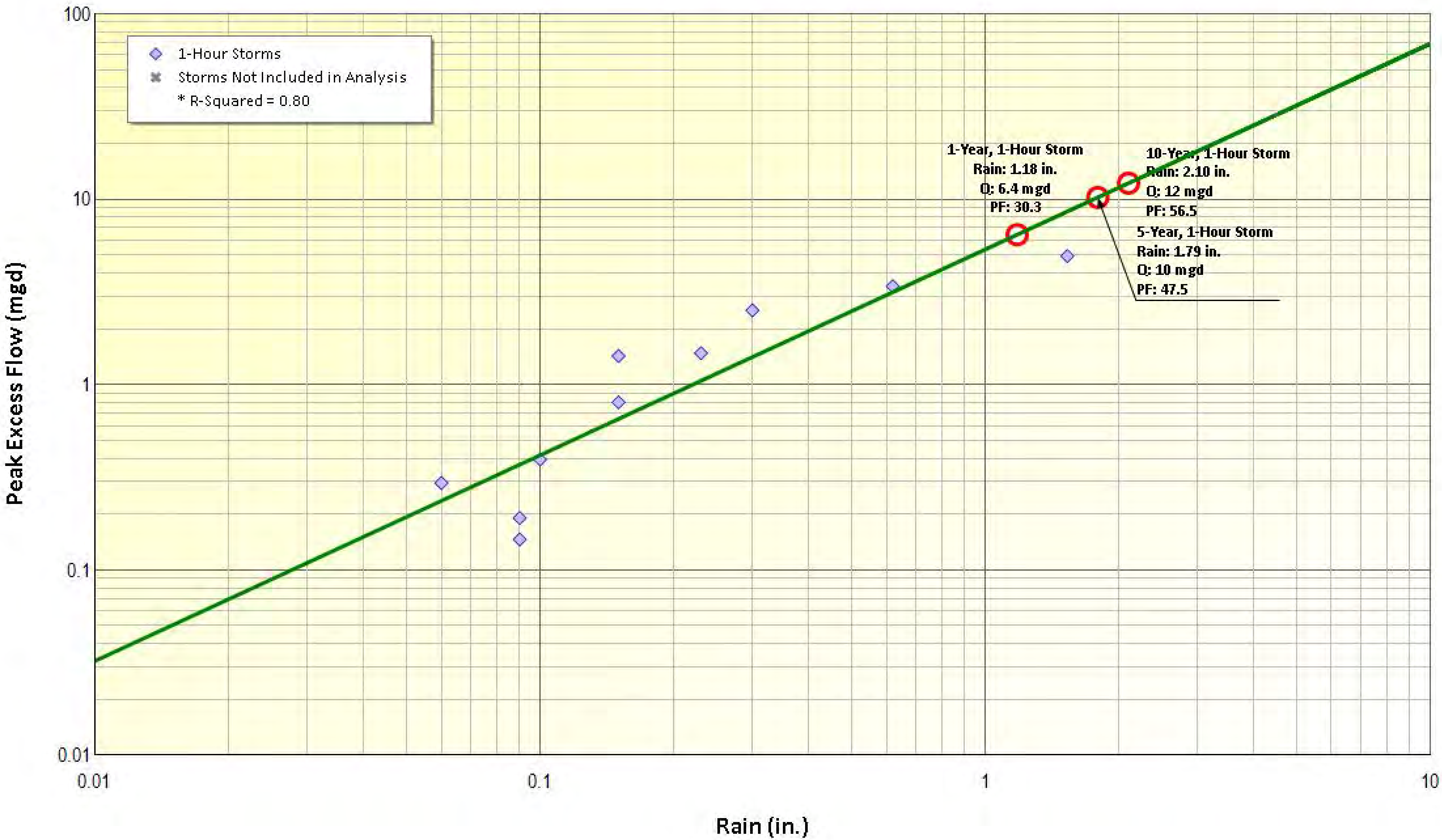
Cumulative Basin VP-1A




1-Hour Flow vs. Rainfall Regression
Cumulative Basin VP-2
1-Hour Storms
Storms Not Included in Analysis
* R-Squared = 0.85
1-Year, 1-Hour Storm
Rain: 1.18 in.
Q: 4.1 mgd
PF: 32.7
10-Year, 1-Hour Storm
Rain: 2.10 in.
Q: 8.7 mgd
PF: 68.1
5-Year, 1-Hour Storm
Rain: 1.79 in.
Q: 7.0 mgd
PF: 55.5
Peak Excess Flow (mgd)
Rain (in.)
100
10
1
0.1
0.01
0.001
0.01
0.1
1
10

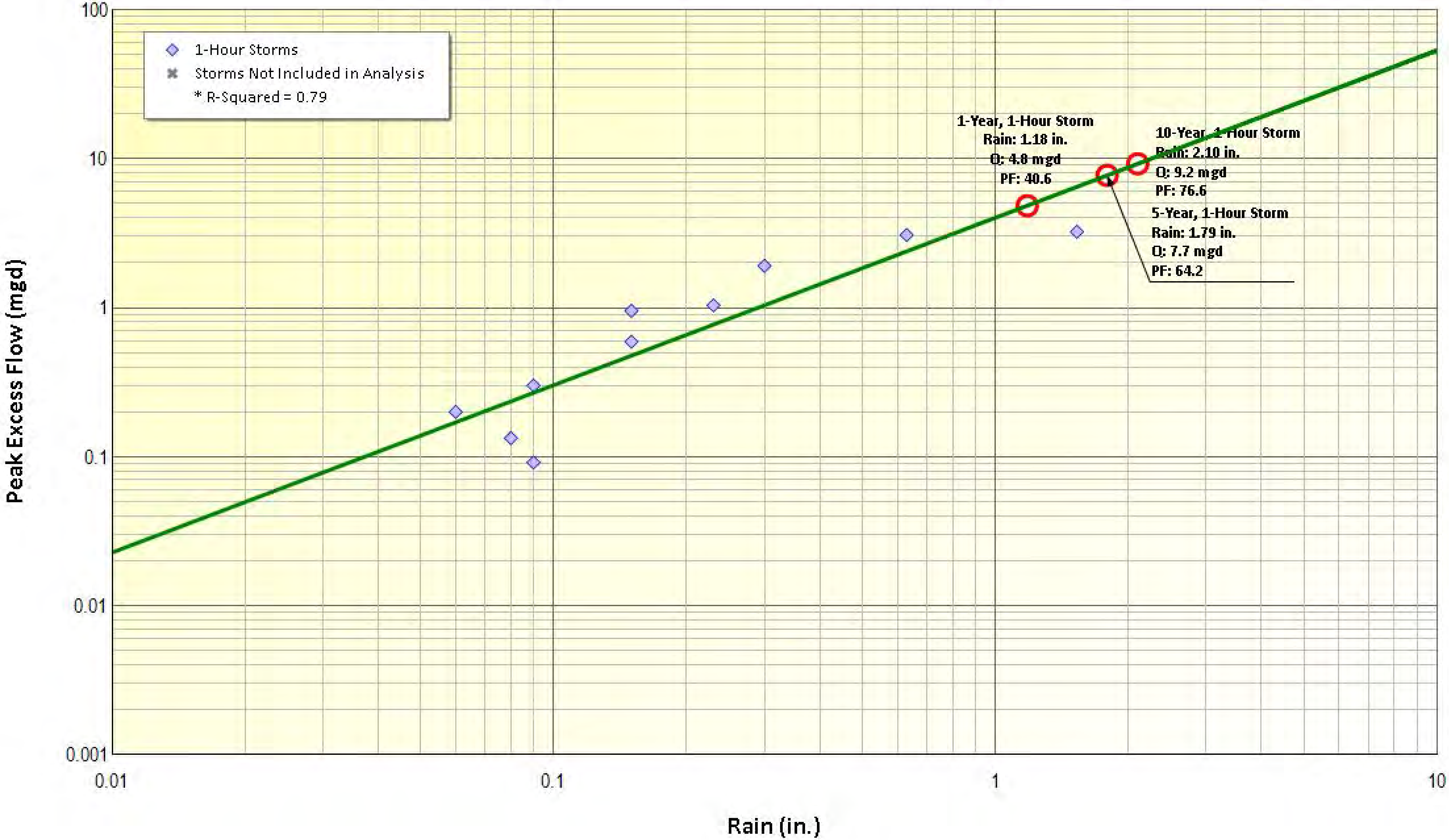
1-Hour Flow vs. Rainfall Regression

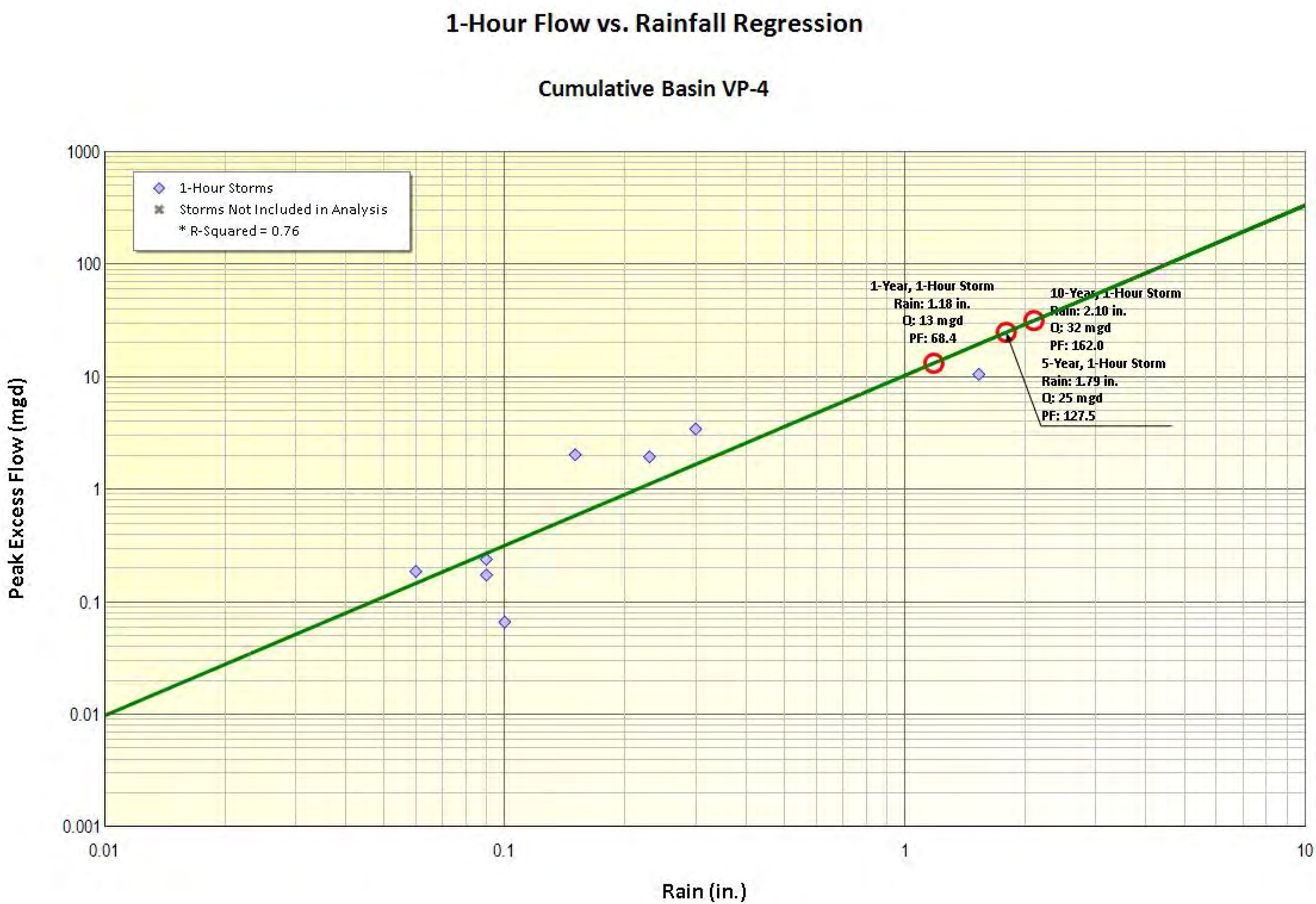
Cumulative Basin VP-3



1-Hour Flow vs. Rainfall Regression

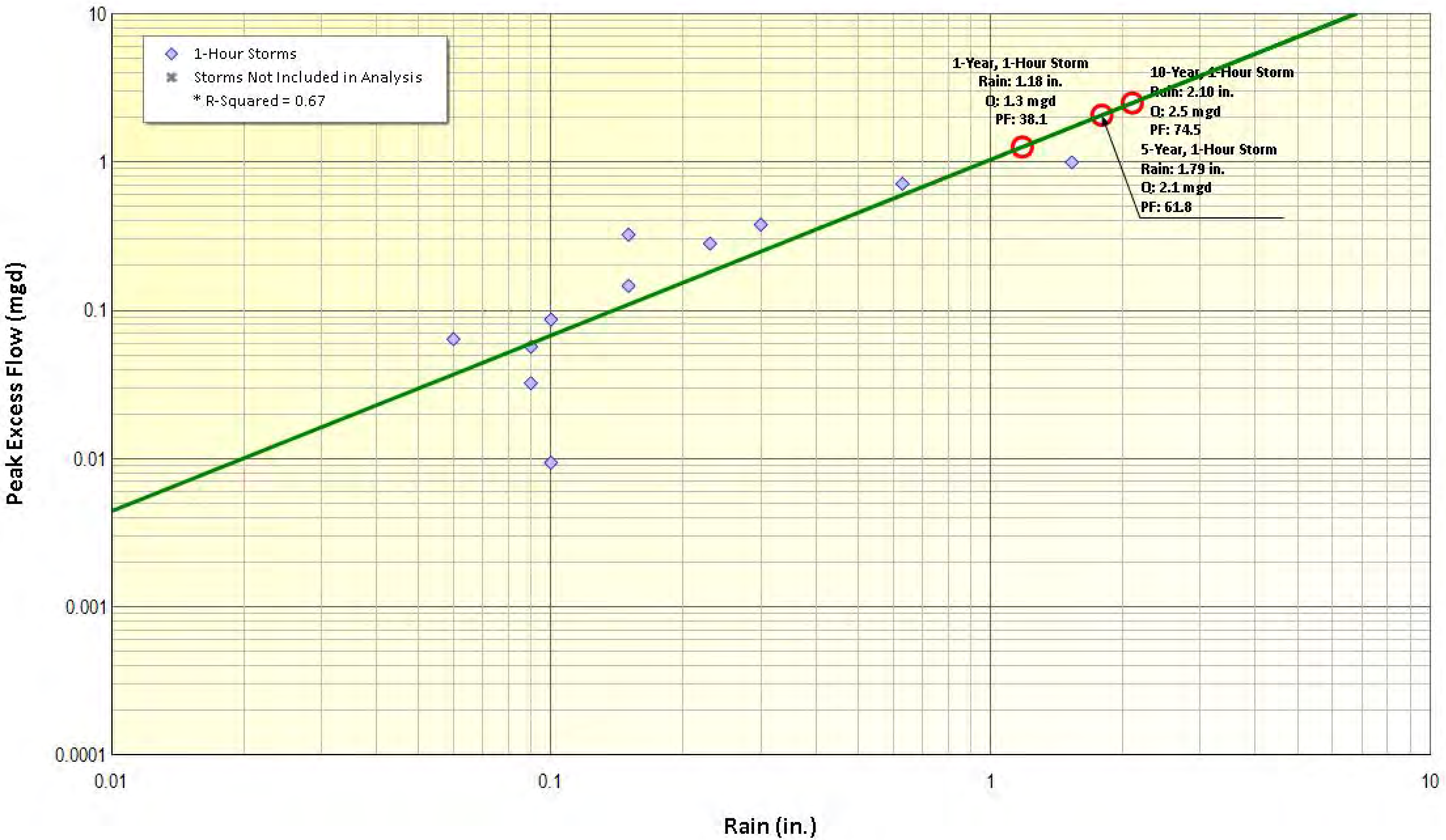
Cumulative Basin VP-3A




1-Hour Flow vs. Rainfall Regression
Cumulative Basin VP-4
1-Hour Storms
Storms Not Included in Analysis
* R-Squared = 0.76
1-Year, 1-Hour Storm
Rain: 1.18 in.
Q: 13 mgd
PF: 68.4
10-Year, 1-Hour Storm
Rain: 2.10 in.
Q: 32 mgd
PF: 162.0
5-Year, 1-Hour Storm
Rain: 1.79 in.
Q: 25 mgd
PF: 127.5
Peak Excess Flow (mgd)
Rain (in.)
1000
100
10
1
0.1
0.01
0.001
0.01
0.1
1
10

1-Hour Flow vs. Rainfall Regression

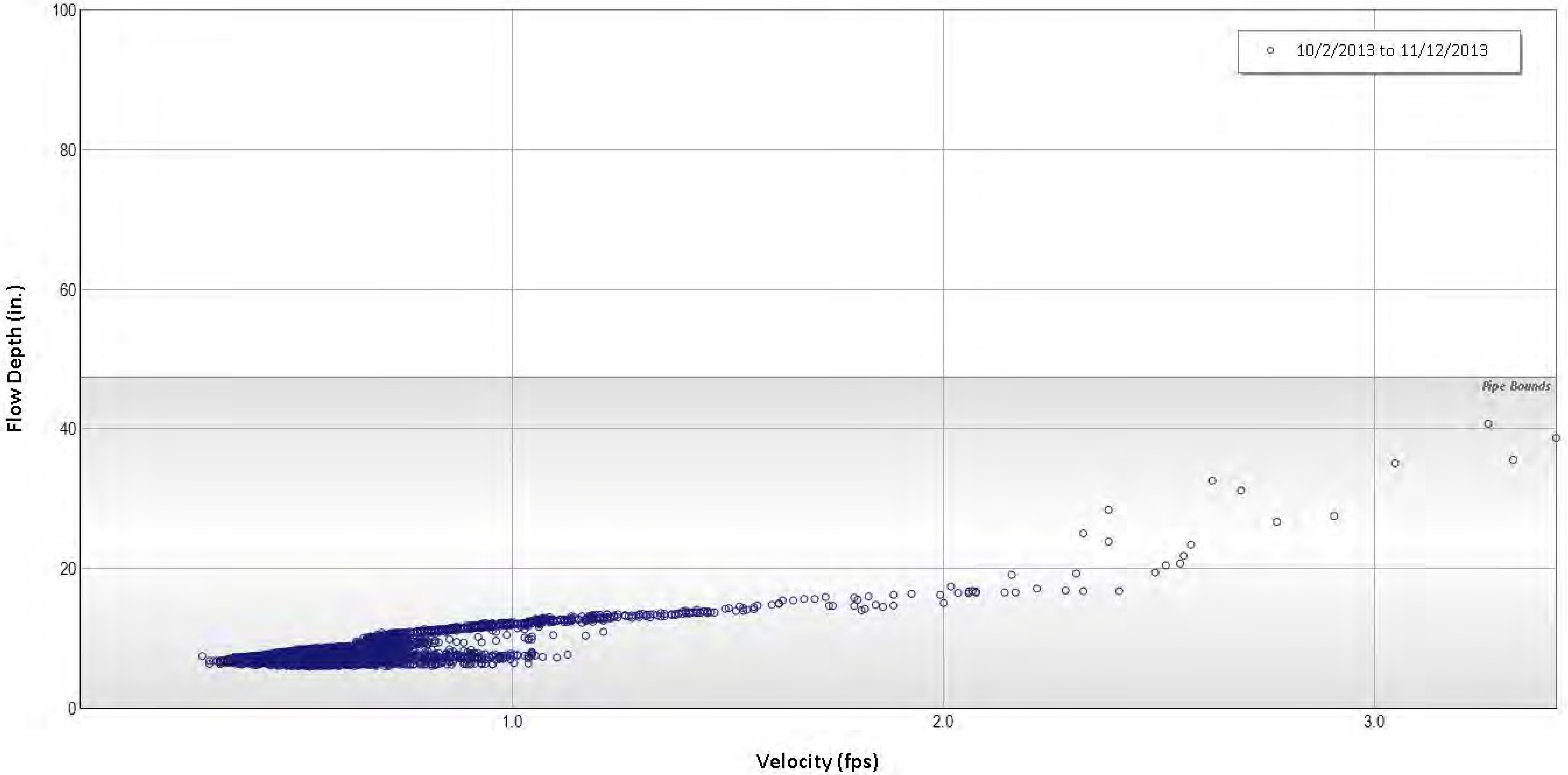
Cumulative Basin VP-4A



APPENDIX E – SCATTERGRAPHS

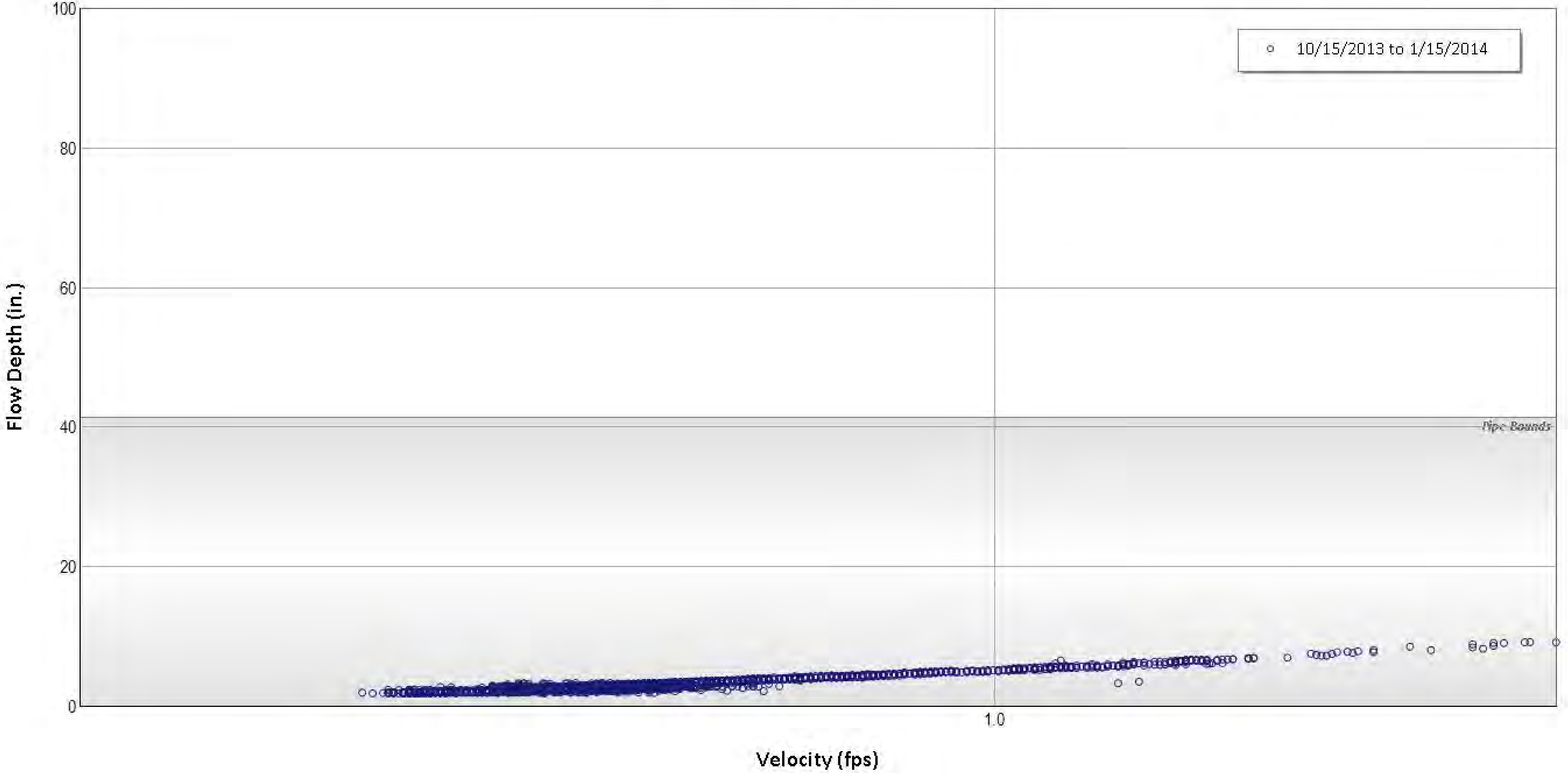
Scattergraph

Meter Site: VP-1



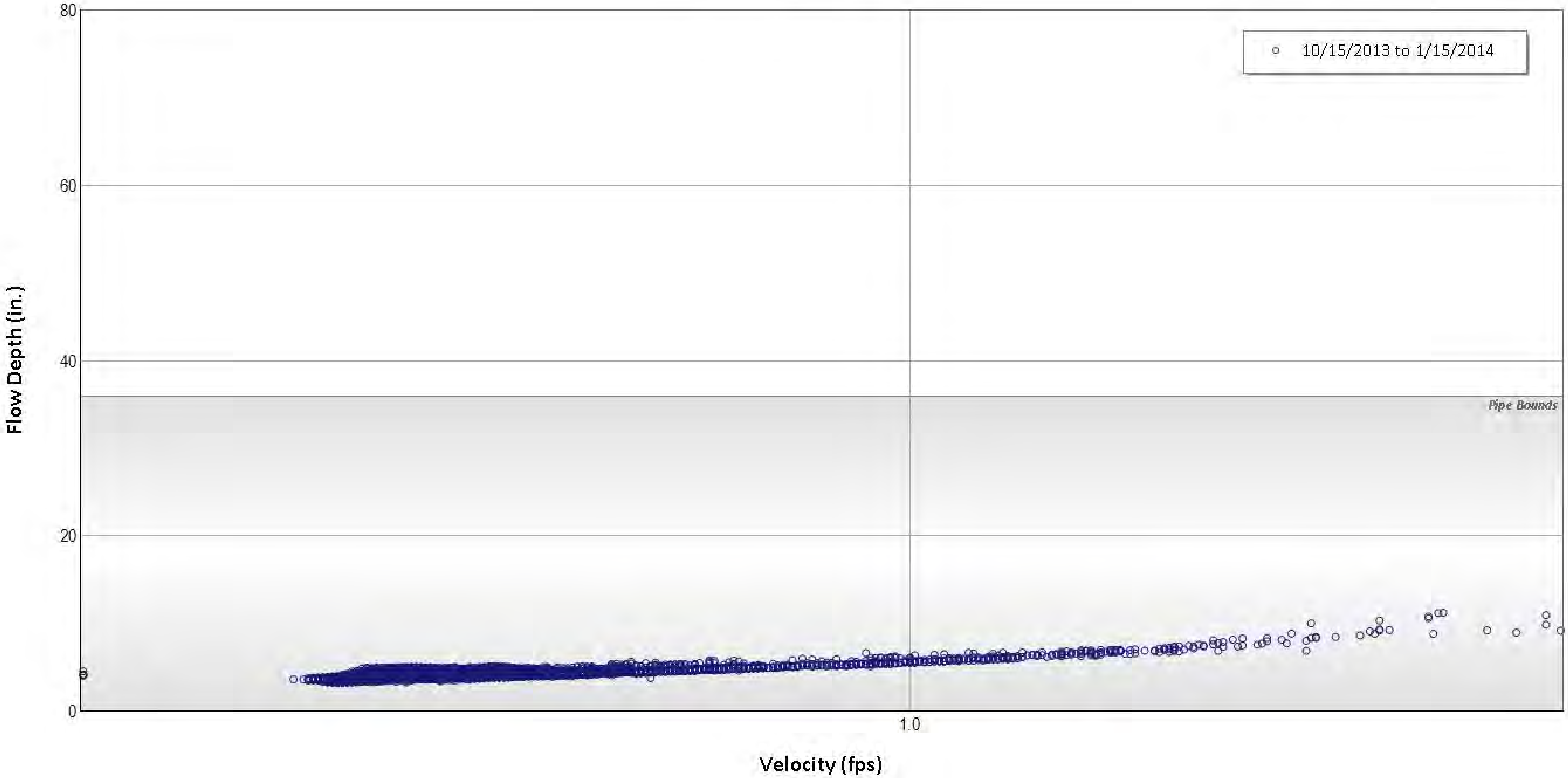
Scattergraph

Meter Site: VP-1A



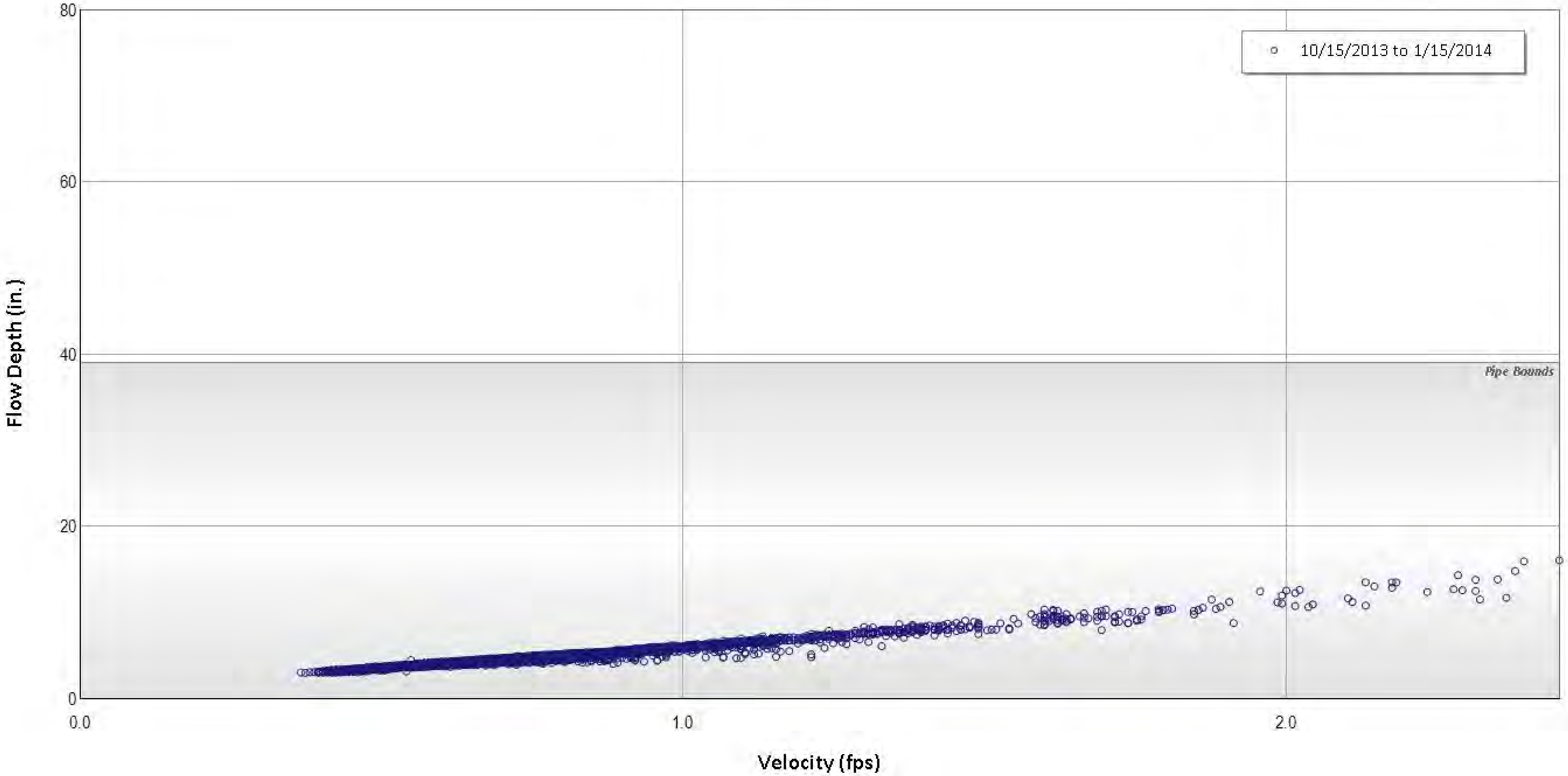
Scattergraph

Meter Site: VP-2



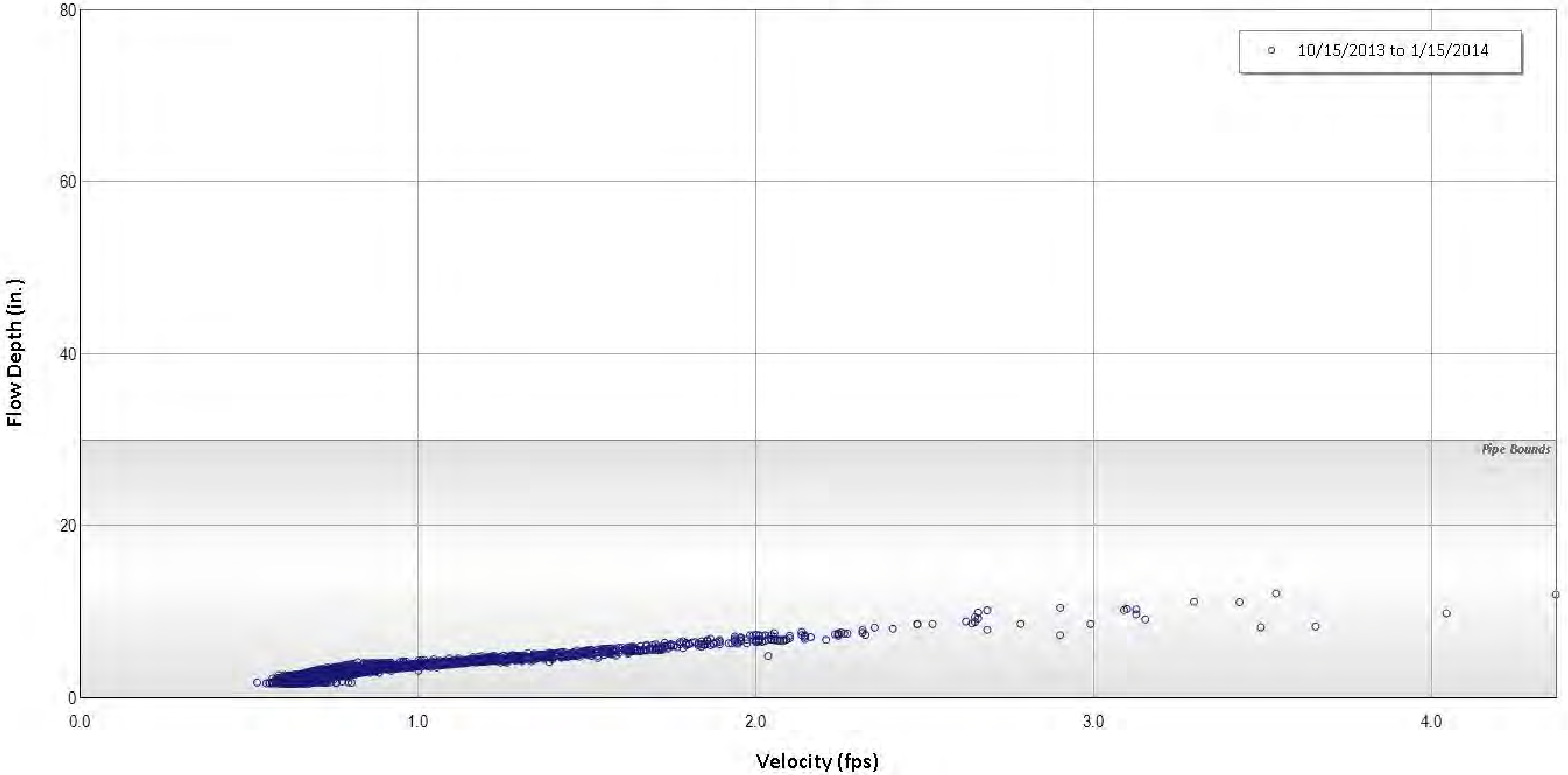
Scattergraph

Meter Site: VP-3



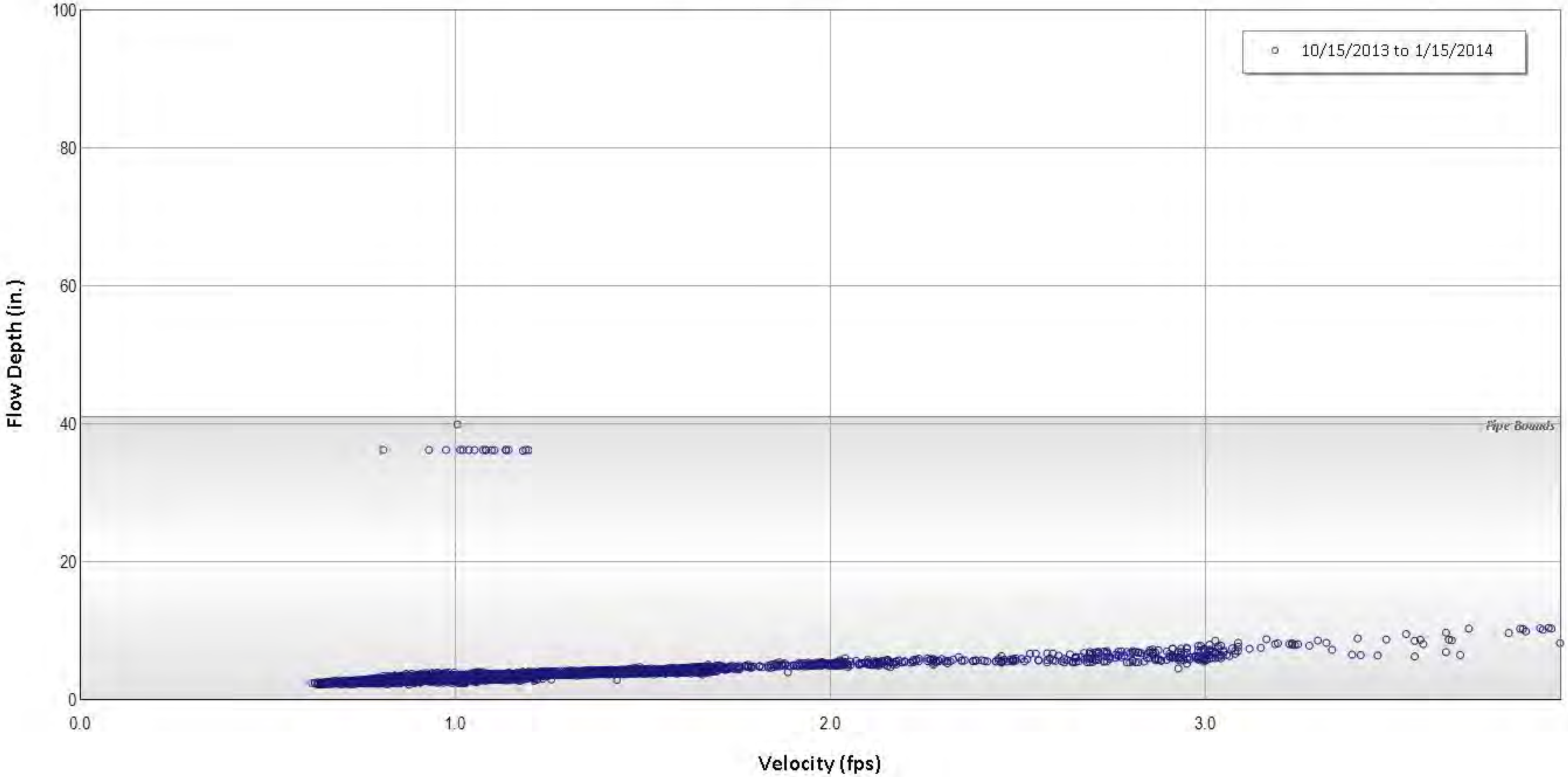
Scattergraph

Meter Site: VP-3A



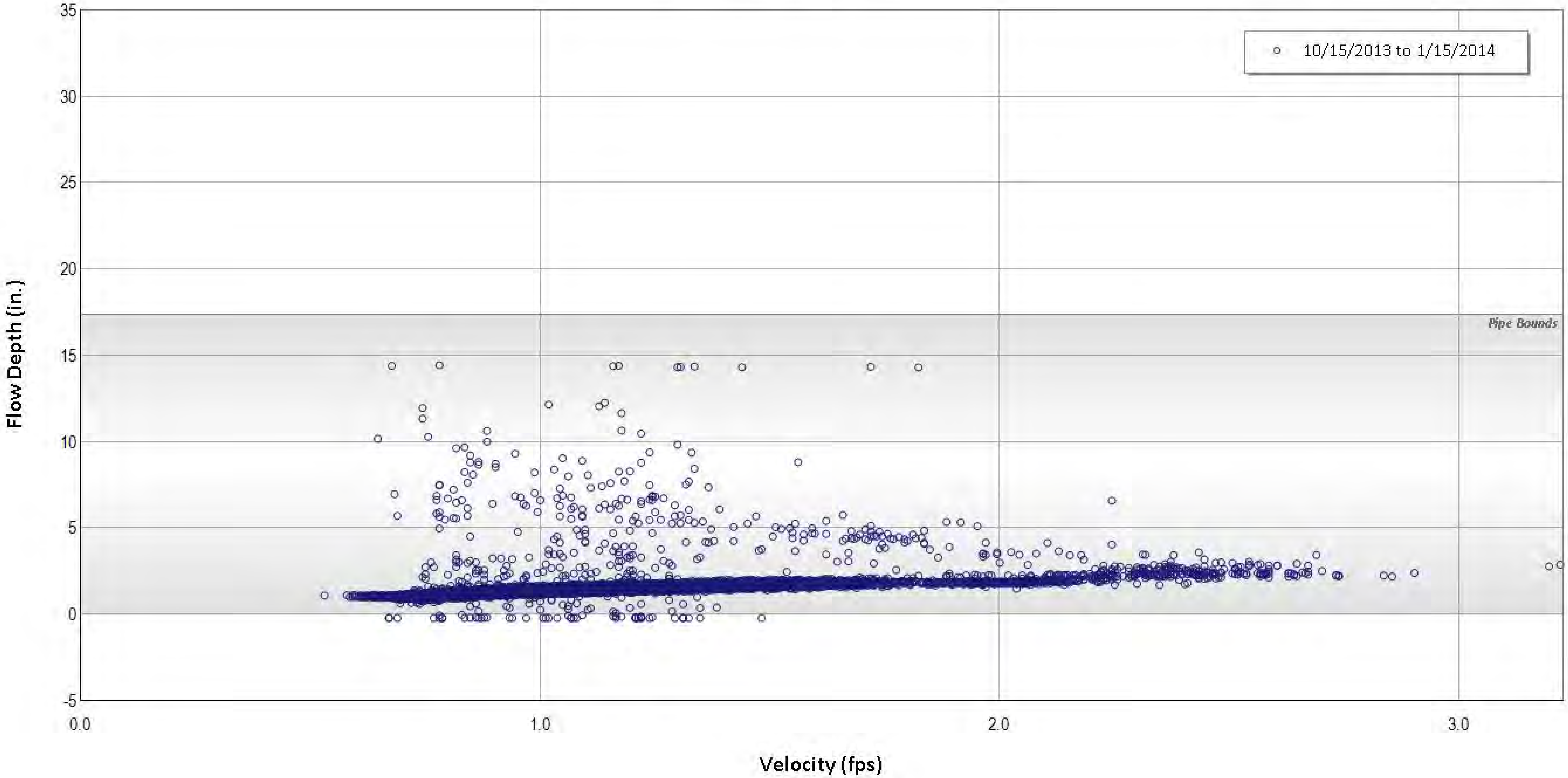
Scattergraph

Meter Site: VP-4

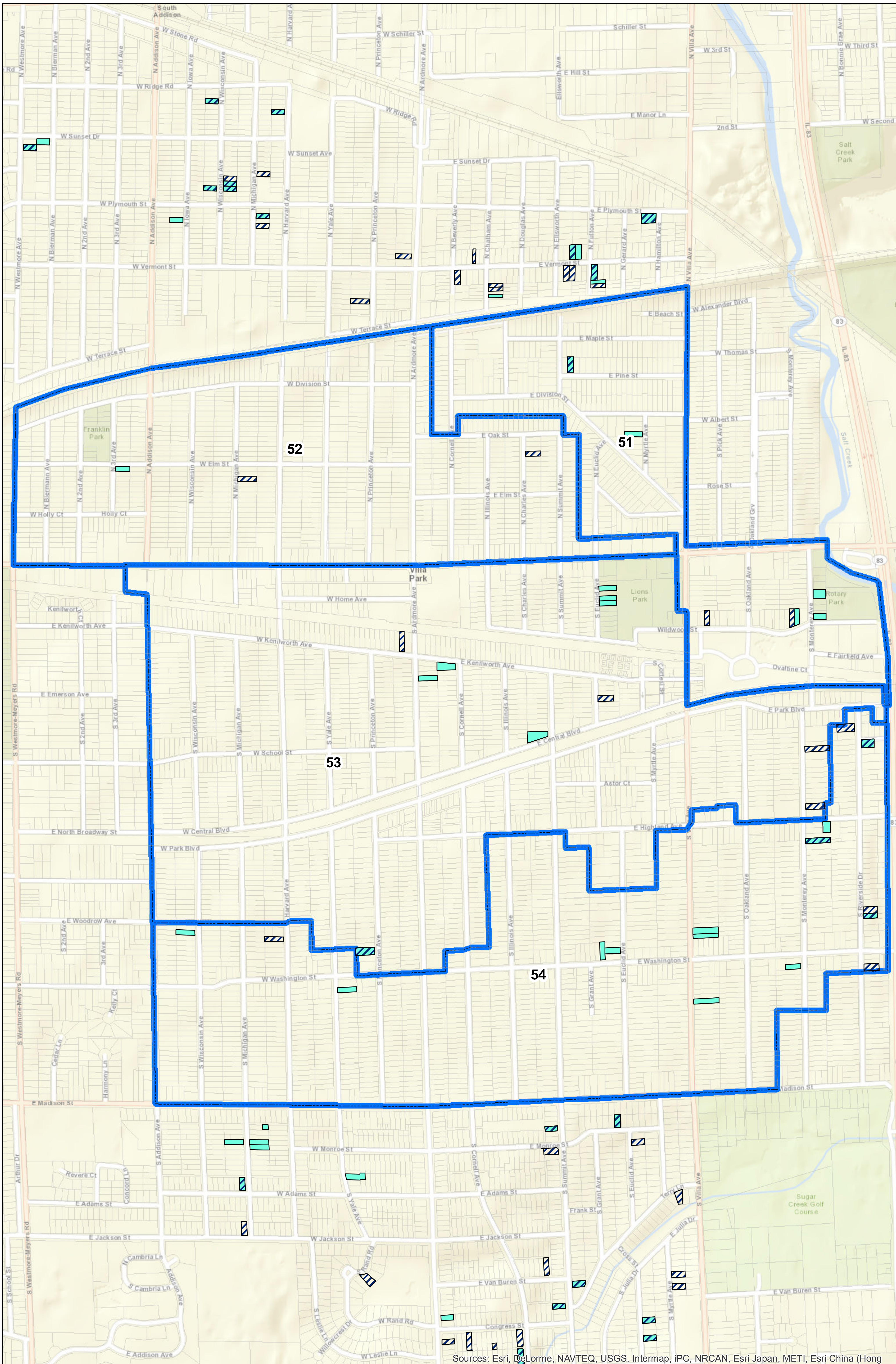


Scattergraph

Meter Site: VP-4A



APPENDIX F – EXHIBITS



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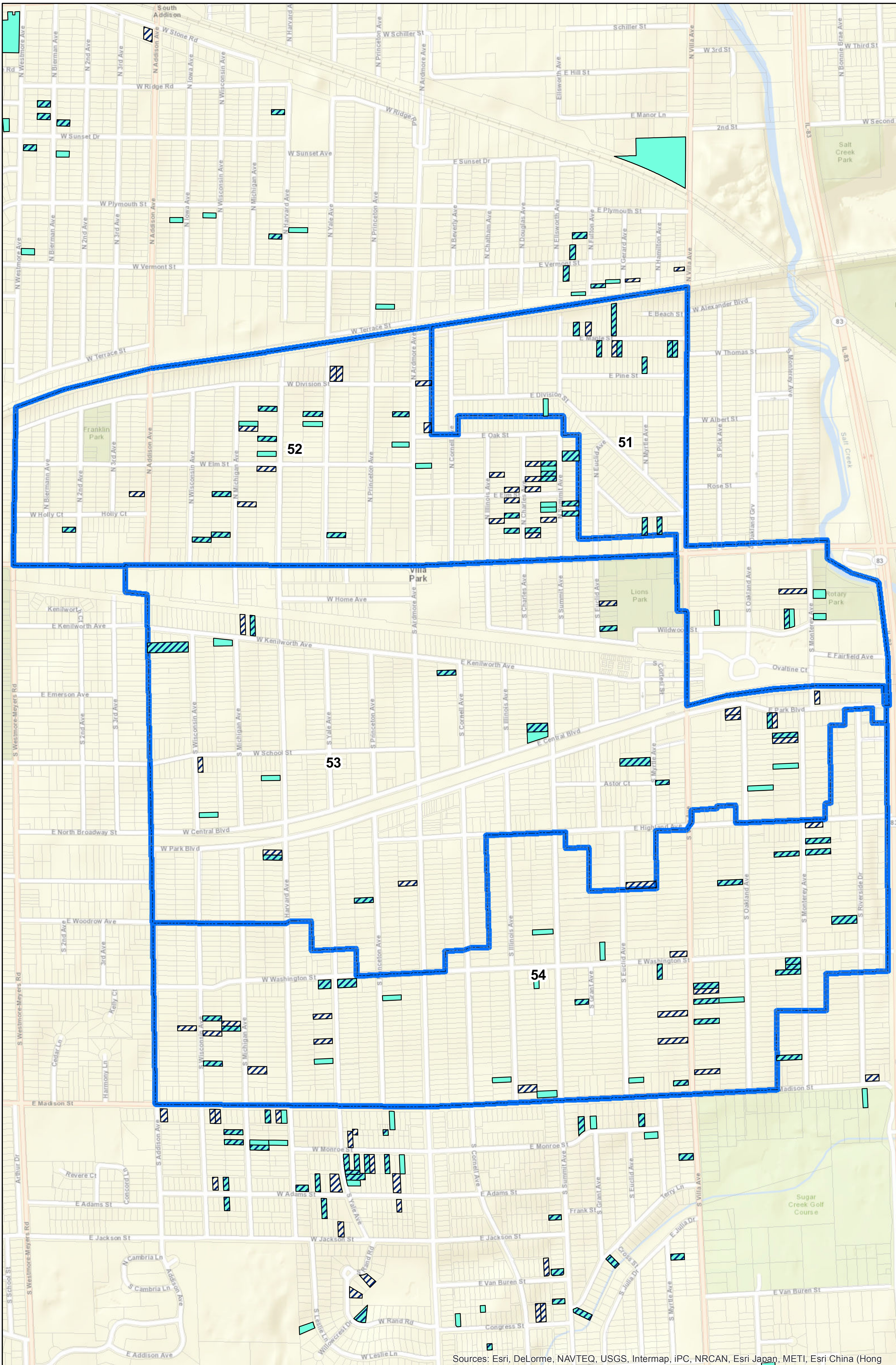
The Choice for Collection System Solutions

Combined Sewer Basins | September 13, 2008 Sanitary Backups | September 13, 2008 Flooding

Village of Villa Park
11.2577.01
Exhibit 1-1: September 2008 Storm Event
January 2014

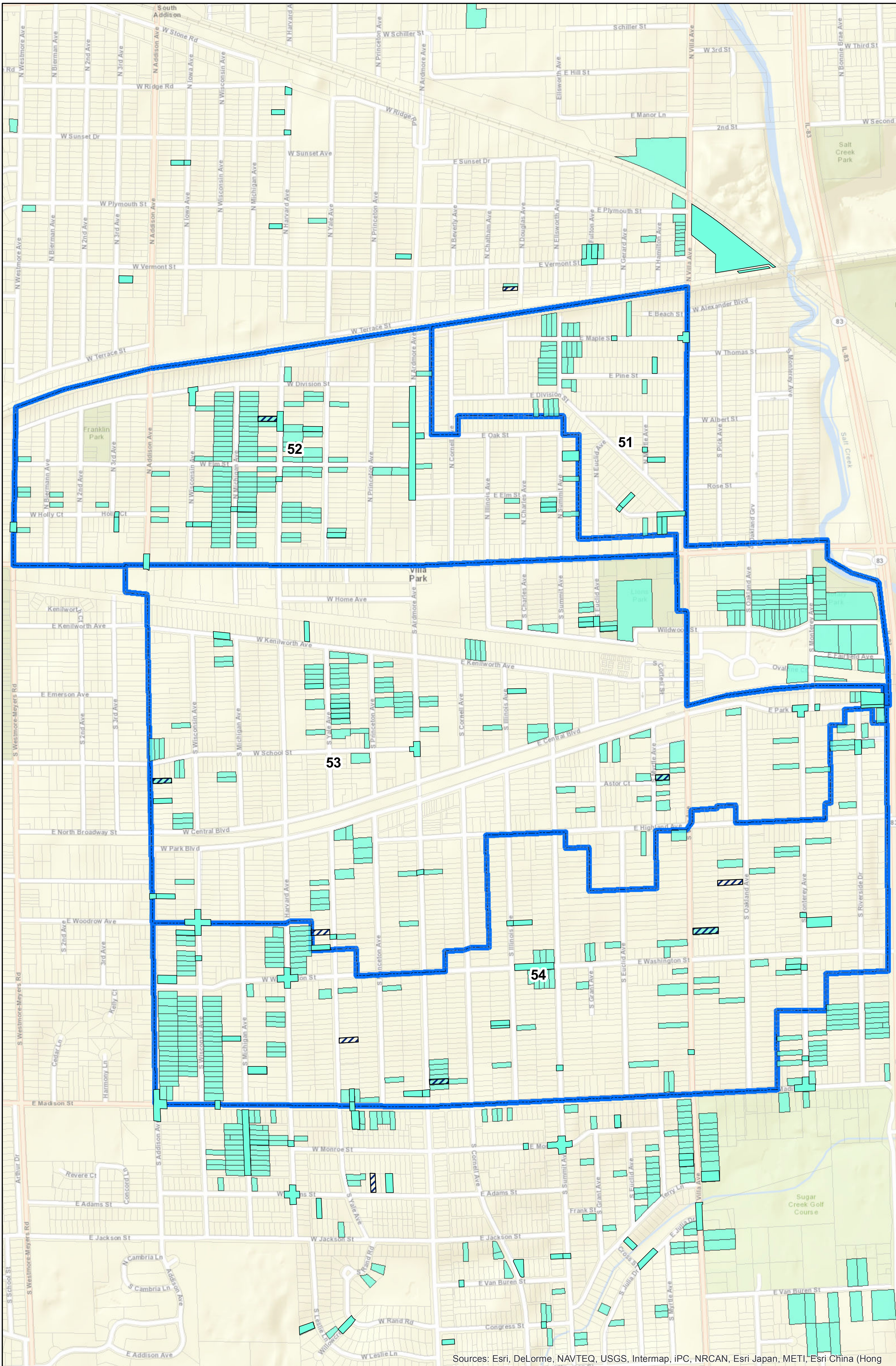


rjngroup
The Choice for Collection System Solutions

Combined Sewer Basins | July 26, 2010 Sanitary Backups | July 26, 2010 Flooding

N E S W

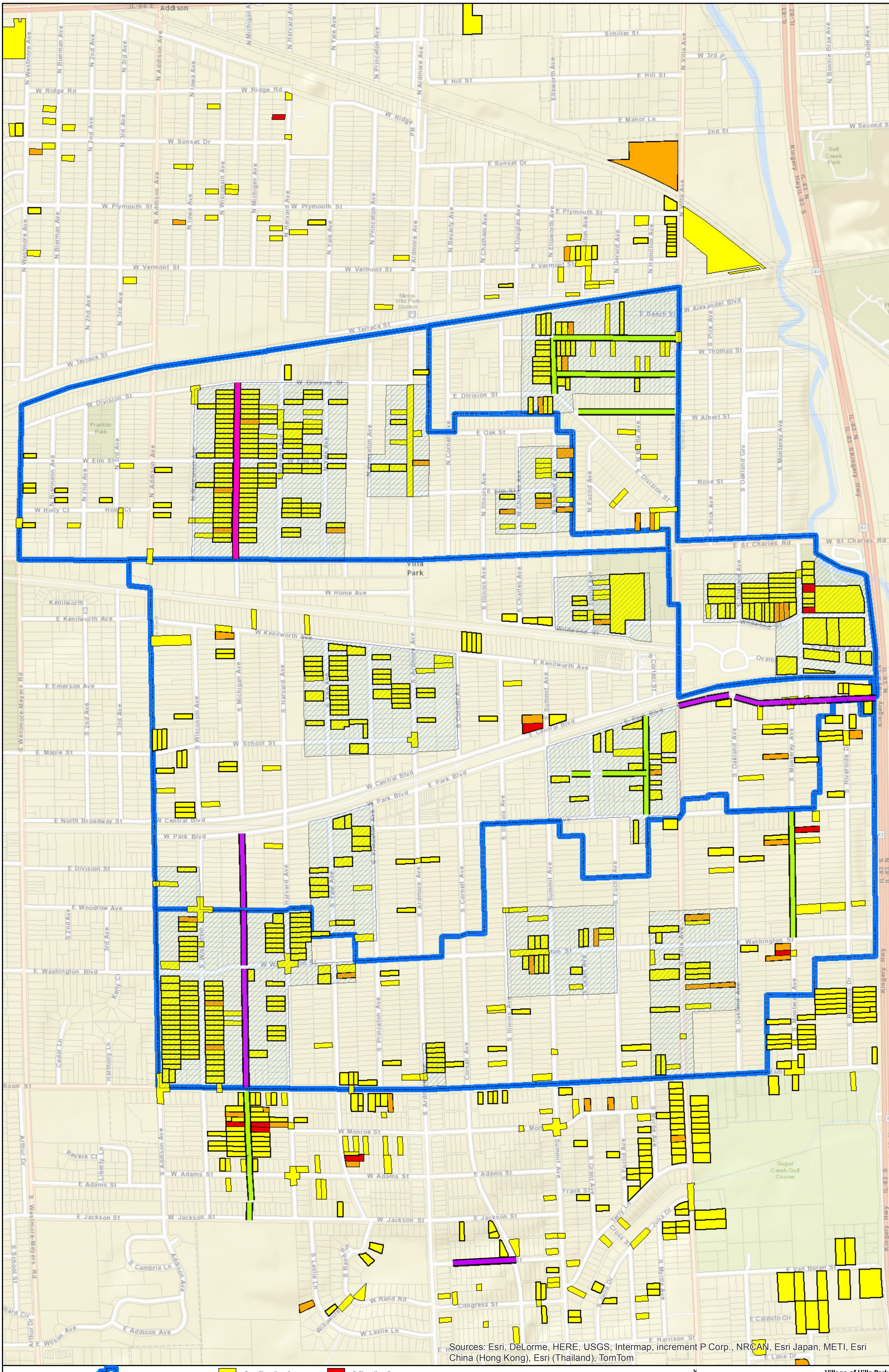
Village of Villa Park
11.2577.01
Exhibit 1-2: July 2010 Storm Event
January 2014



rjngroup
The Choice for Collection System Solutions

Combined Sewer Basins
April 18, 2013 Flooding
April 18, 2013 Sanitary Backups

Village of Villa Park
11.2577.01
Exhibit 1-3: April 2013 Storm Event
January 2014



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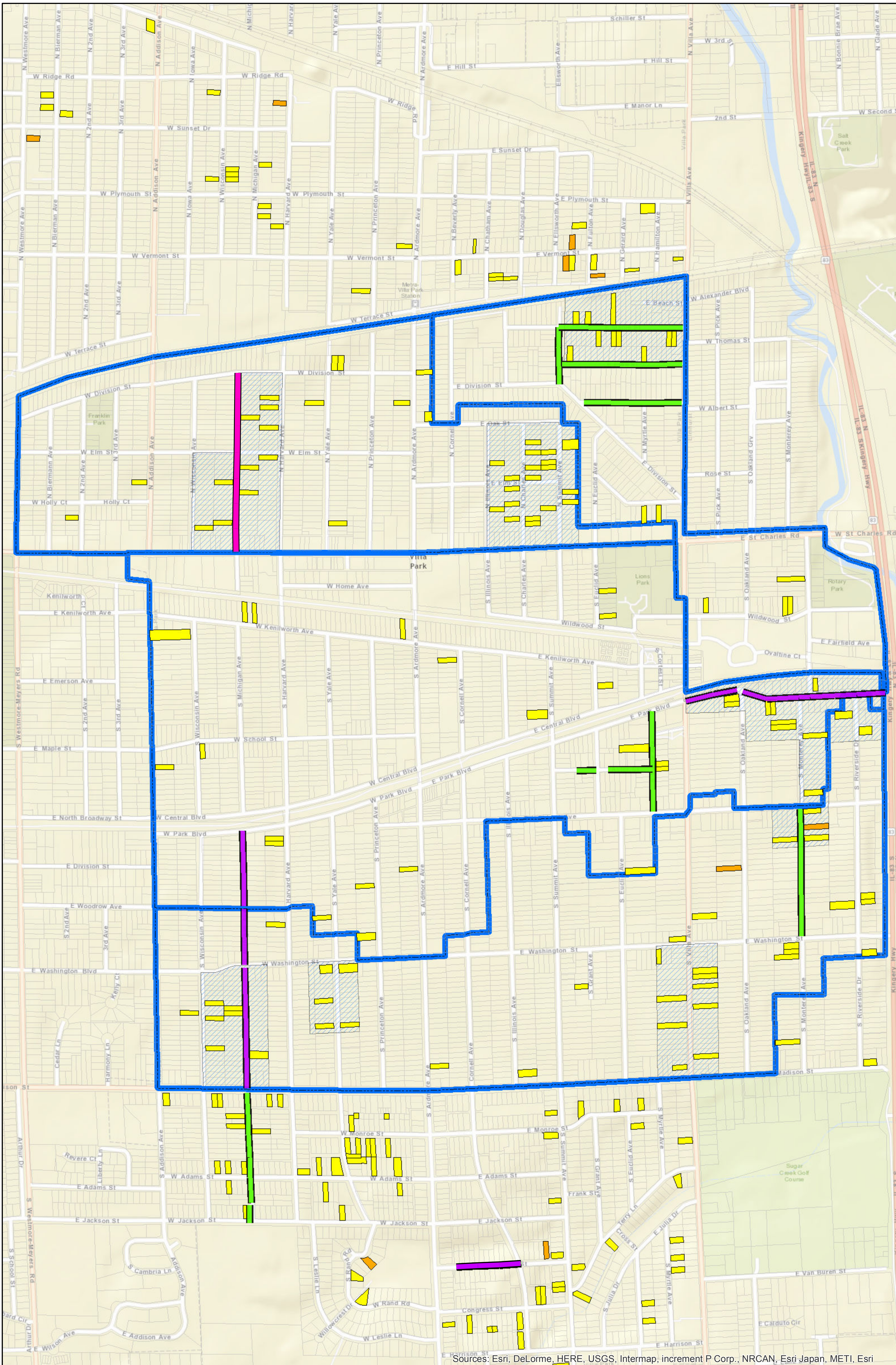
The Choice for Collection System Solutions

Combined Sewer Basins
Areas Of Concern
One Flooding Report
2 Flooding Reports
3 Flooding Events
Capital Improvement Area 2014-2016
Capital Improvement Area 2019
Completed in 2014

N W E S

Village of Villa Park
11.2577.01
Exhibit 1-4: Reported Incidence of Flooding
June 2014

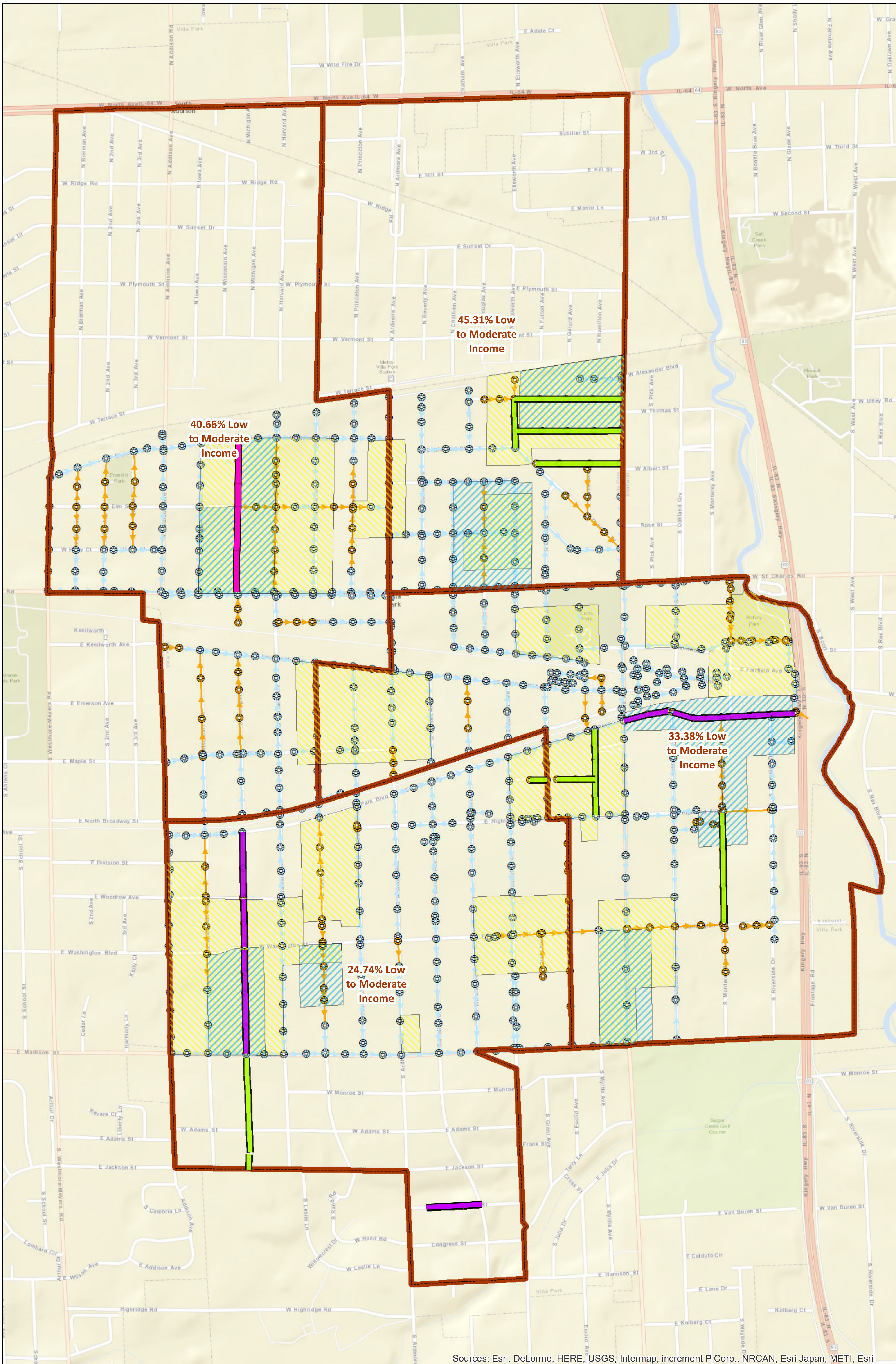


rjngroup
The Choice for Collection System Solutions

- Combined Sewer Basins
- AreasOfConcern
- One Backup Report
- More than One Backup Report
- Capital Improvement Area 2014-2016
- Capital Improvement Area 2019
- Completed in 2014

N W E S

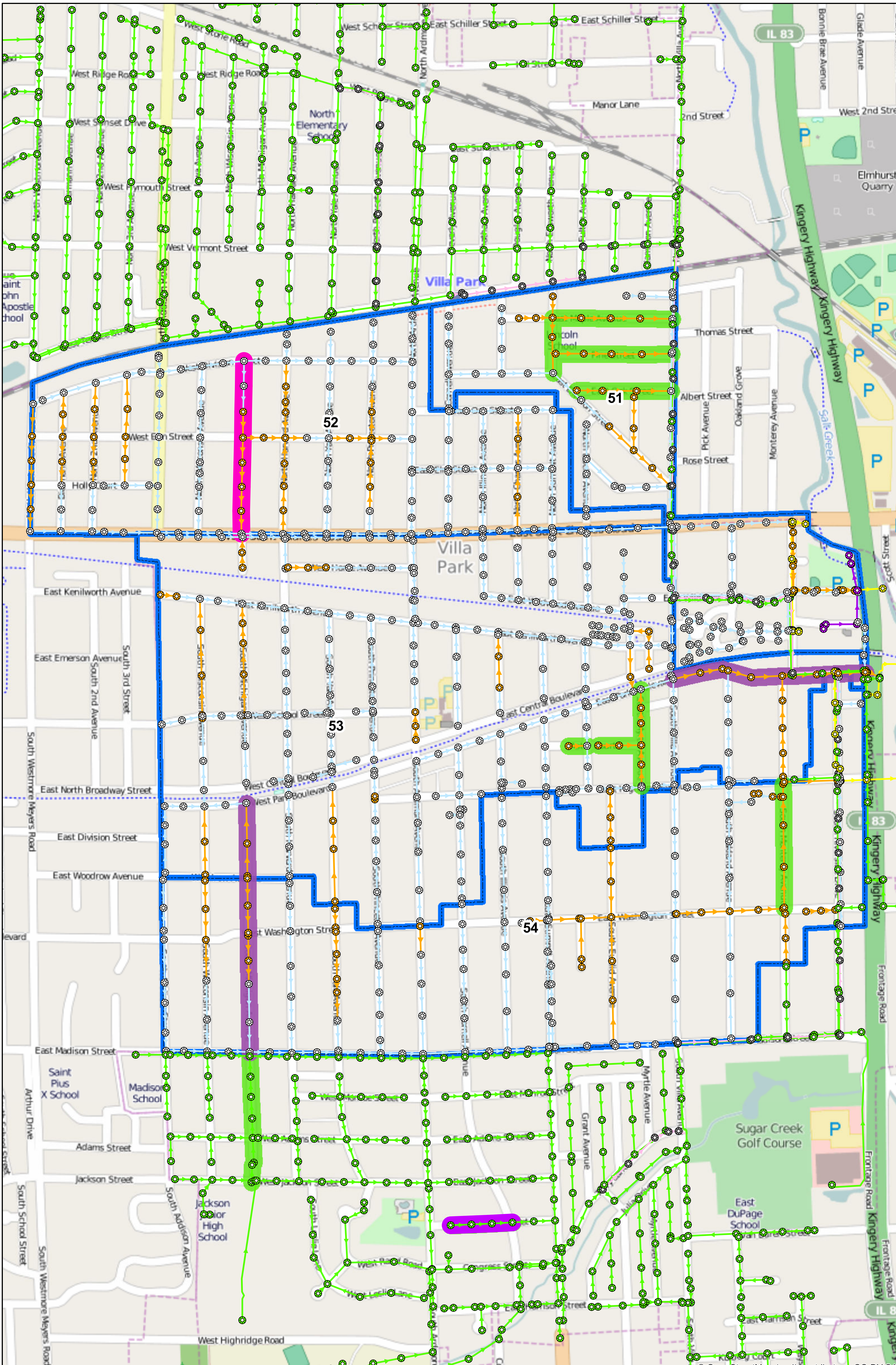
Village of Villa Park
11.2577.01
Exhibit 1-5: Reported Incidence of Sewer Backups
June 2014



rjngroup
The Choice for Collection System Solutions

- Census Tracts
- Areas Of Concern (Sanitary)
- Areas Of Concern (Storm)
- Areas Of Concern (Both)
- Sewer Capital Improvement Area 2014-2016
- Sewer Capital Improvement Area 2019
- Completed in 2014

Village of Villa Park
11.2577.01
Exhibit 1-6: Areas of Concern & Priority Consideration
June 2014



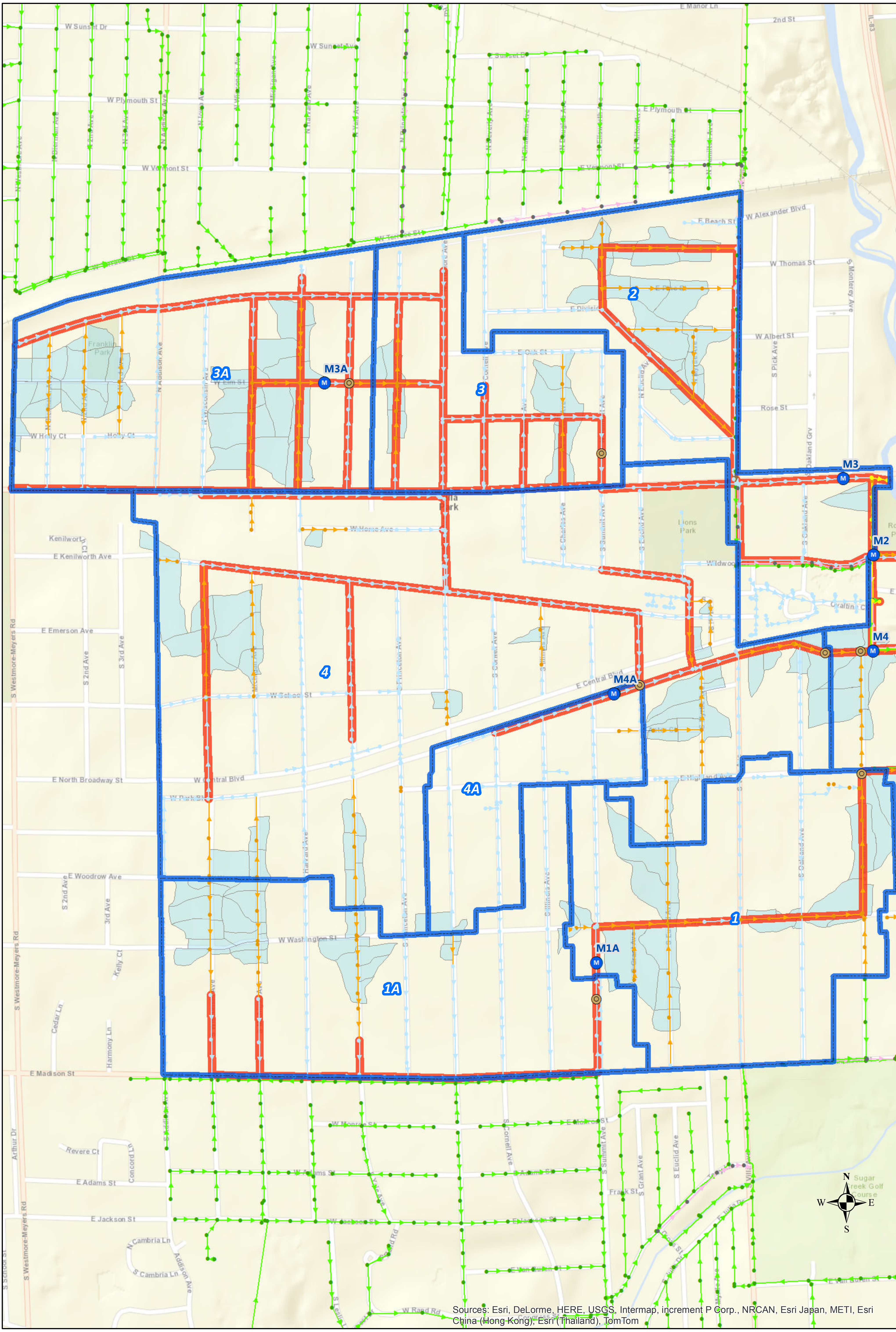
Combined Sewer Basins

Capital Improvement Area > 2019

Capital Improvement Area 2014-2016

Completed in 2014

Village of Villa Park
11.2577.01
Exhibit 1-7: Capital Improvement Projects
June 2014



Combined
Combined Overflow
Sanitary
Sanitary Overflow
Seperated
WWFTF Outflow
Model Sanitary Sewer
Flow Meter Basin Boundary
Flow Meter Site
Drainage Area Tributary to Basin:

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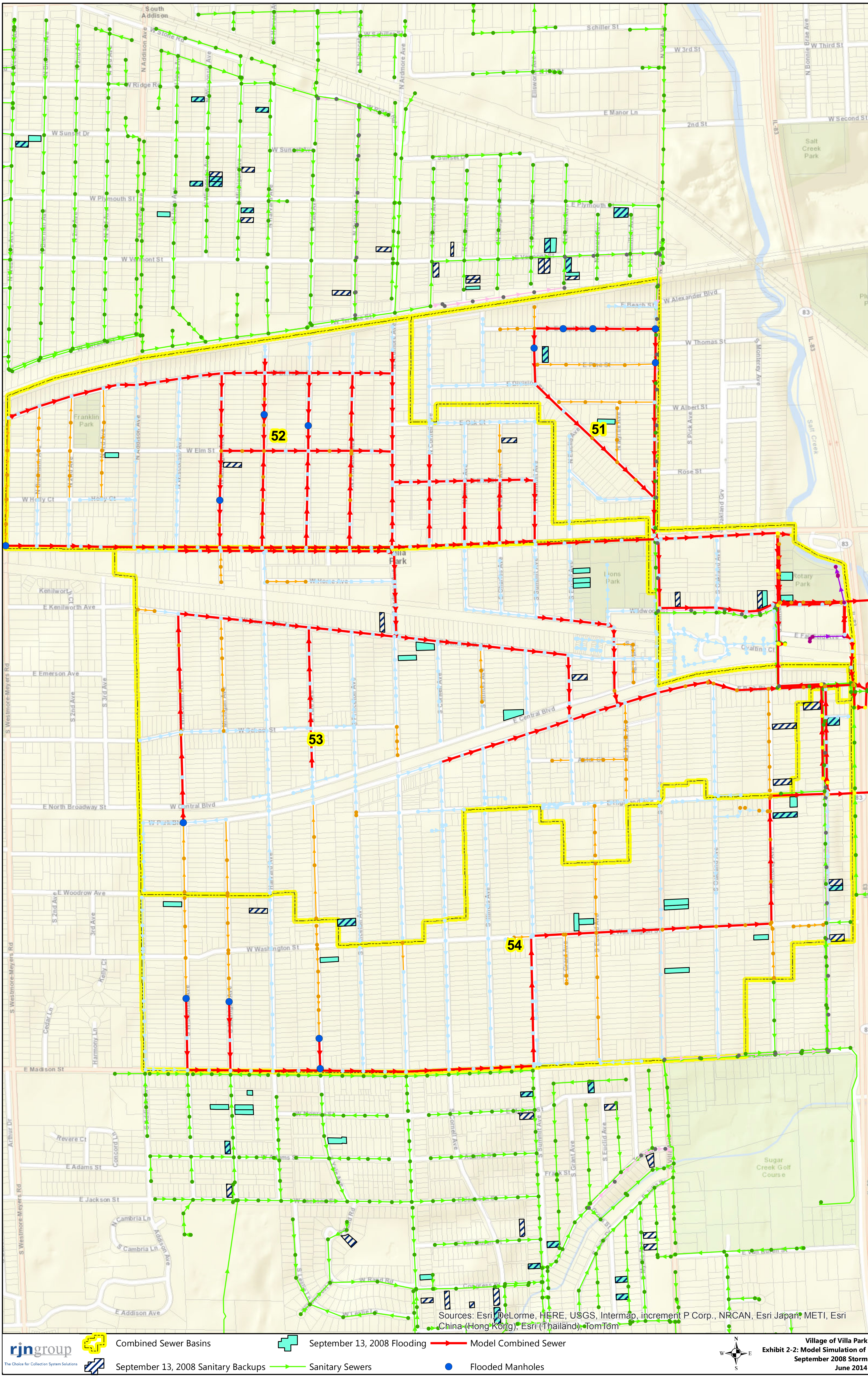
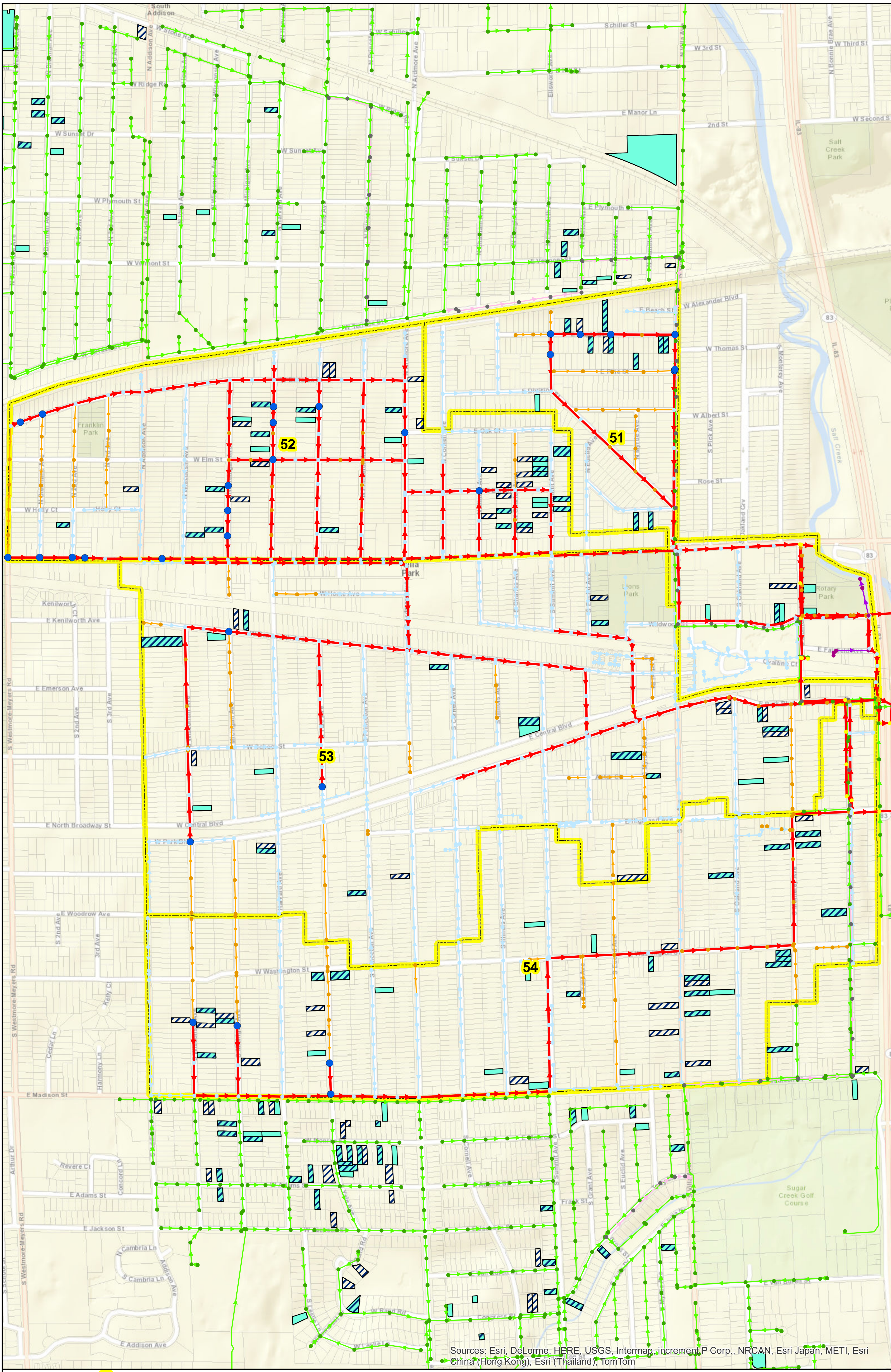
Exhibit 2-1: Meter Basins and Model Routes
June 2014



Village of Villa Park
Exhibit 2-2: Model Simulation of September 2008 Storm
June 2014



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Legend		
Combined Sewer Basins	July 24, 2010 Flooding	Model Combined Sewer
July 24, 2010 Sanitary Backups	Sanitary Sewers	Flooded Manholes

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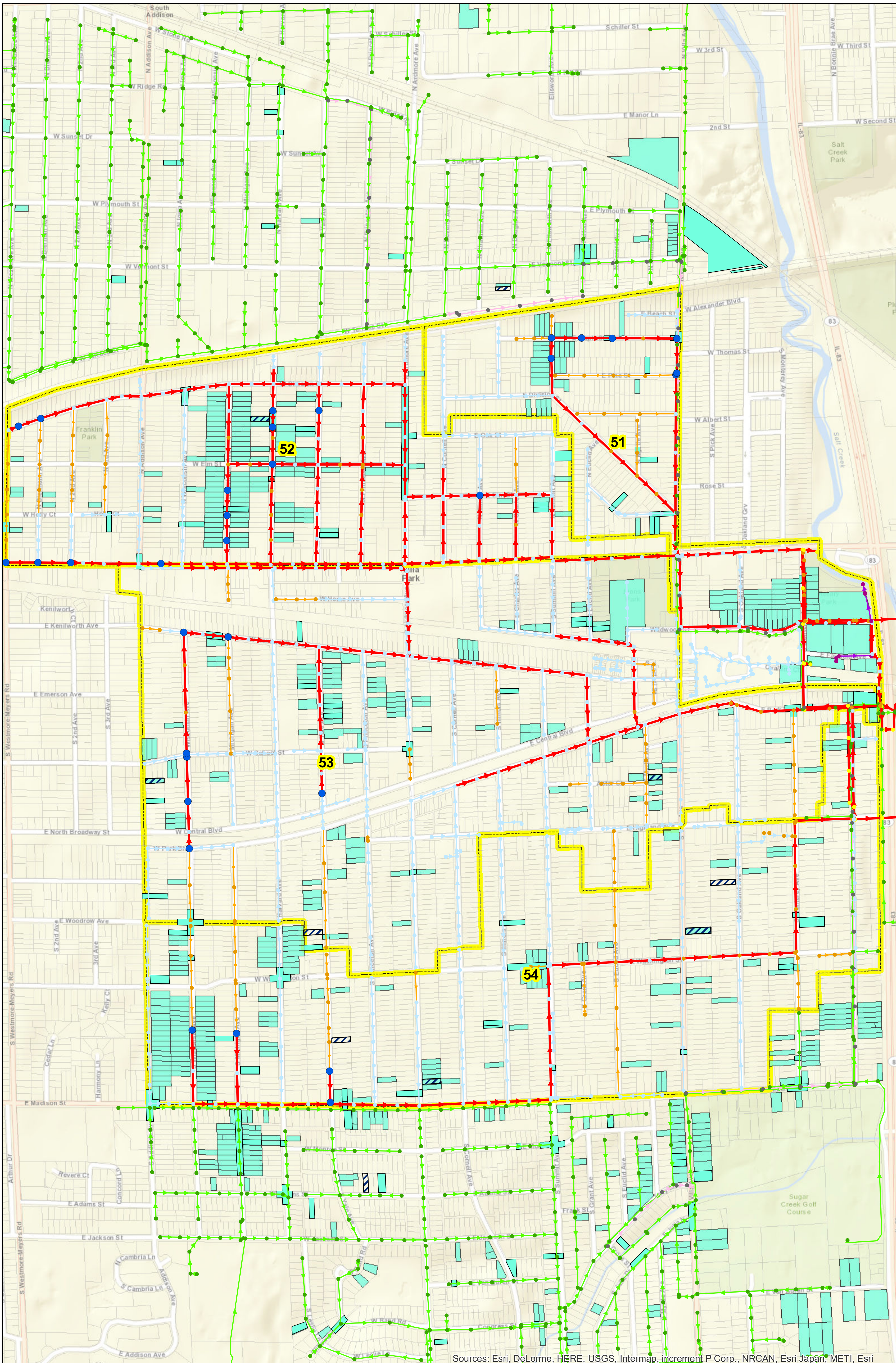
Exhibit 2-3: Model Simulation of July 2010 Storm
June 2014



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Combined Sewer Basins
April 18, 2013 Flooding
April 18, 2013 Sanitary Backups
Sanitary Sewers
Model Combined Sewer
Flooded Manholes

N W E S

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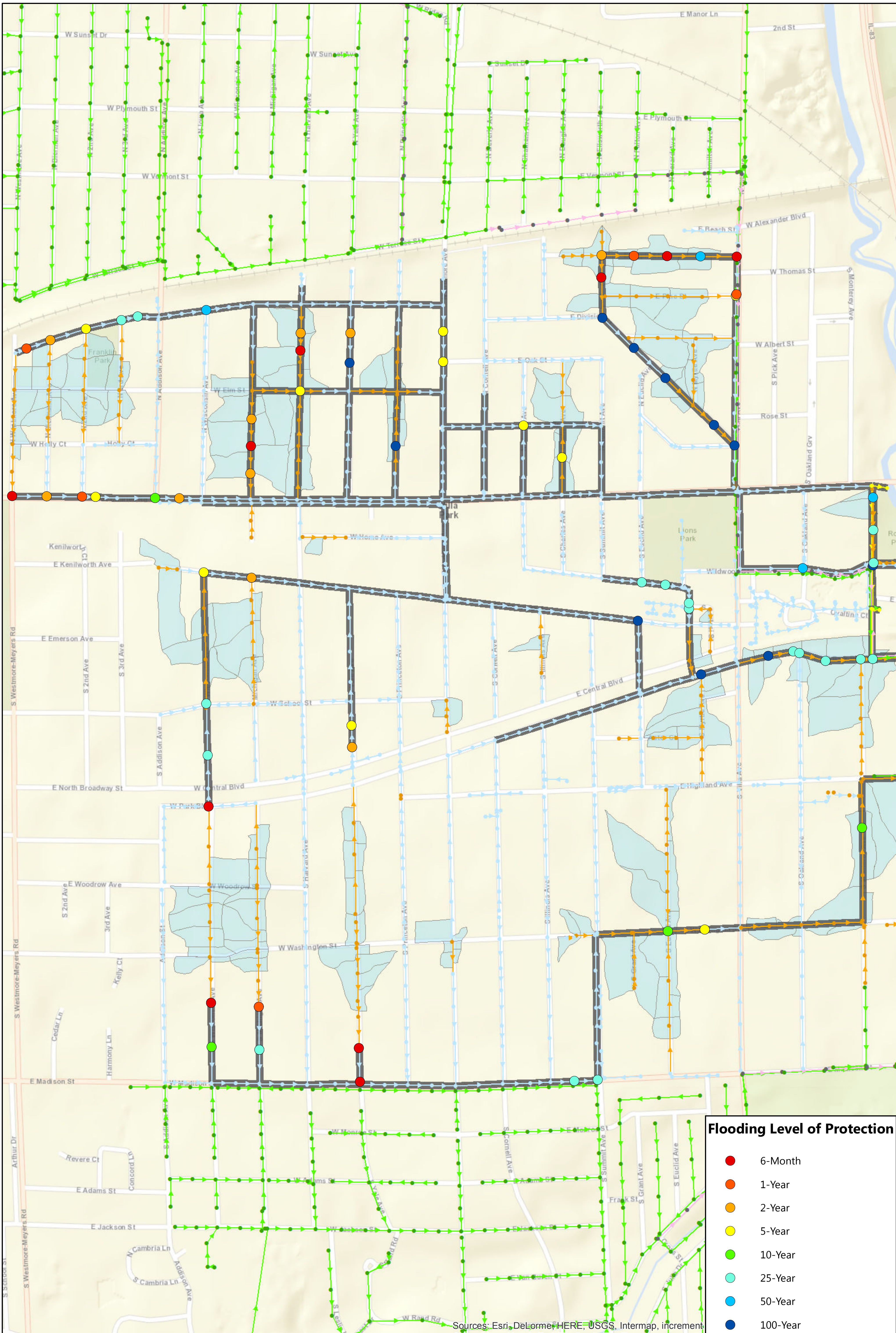
Exhibit 2-4: Model Simulation of April 2013 Storm
June 2014



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Combined
Combined Overflow
Sanitary
Sanitary Overflow
Seperated
WWFTF Outflow
Model Sanitary Sewer 2013
Drainage Area Tributary to Basin:

Village of Villa Park
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Exhibit 2-5: Design Storm Model Simulation
June 2014