



Report for Sanitary Study/Investigation

Prepared for

**Villanova University
800 Lancaster Avenue
Villanova, Pennsylvania 19085
Radnor Township, Delaware County**

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EXECUTIVE SUMMARY

Purpose

Villanova University is proposing to develop an area on the south side of Lancaster Avenue, which will increase the sanitary flows from the campus. The University is located in Radnor Township, which would normally be the municipality to receive the additional flow. Since the capacity of Radnor's sewer system is in question, an alternative would be to redirect the flow and tie into Lower Merion Township's sewer system.

Currently the flow from the University's West Campus connects to Lower Merion's sewer system in the intersection of County Line Road and Ithan Avenue. The flow from Main Campus connects to Radnor's sewer system in Lancaster Avenue.

The purpose of this study/investigation was to obtain the actual sanitary flow information from the University's West Campus and Main Campus, and to determine the best routing for the proposed new flow.

Scope of Work

The study/investigation included the following tasks:

- A review of all available drawings pertaining to the existing sanitary sewer system obtained from the University, the Townships, PA One Call, and AEC's old project files.
- A survey to confirm existing site conditions, topography, and sanitary pipe invert elevations.
- The metering of six (6) sanitary manholes on campus by Goel Services.
- Meetings with Lower Merion Township, Radnor Township, and DEP.
- A study to determine the best routing for the sanitary flow from south of Lancaster project.

Introduction

The proposed development on the south side of Lancaster Avenue, known as the CICD Development, will consist of six (6) apartment style residence halls having a total of 1,138 beds; a performing arts center which will house a 400 seat theater, a 200 seat black box performance space and classrooms; and retail spaces total approximately 6,150 square feet. The sanitary discharge from this development could gravity flow into Radnor's sewer system.

Since the capacity of Radnor's system is questionable, Lower Merion was contacted to see if it was possible to connect into their system. The proposed connection would be to the system in County Line Road, their Mill Creek Line. Lower Merion is receptive to the idea of receiving the increase in flow into the Mill Creek system.

Investigation

West Campus

A site survey was completed to confirm existing conditions; and to determine the best path to reroute the sanitary piping. The survey included opening the existing sanitary manholes on West Campus and in Clairemont Road to confirm existing invert elevations; a partial topographical survey; and confirmation of existing on grade site conditions.

Villanova's West Campus consists of eight (8), apartment style residential halls having a total of 1,240 beds, a residence (Burns' Hall), an administration building (Picotte Hall at Dundale), and St Mary Hall, a residential and classroom building. St Mary Hall was not included in this investigation since it has a separate sanitary discharge that crosses Spring Mill Road and connects into Lower Merion's system in County Line Road.

The residence halls are not equipped with low-flow fixtures. Water consumption for toilets is 3.0 gpf; 3.5 gpm for shower heads; and 3.5 gpm for faucets.

There are two main sanitary lines that run from west to east for the eight (8) residential halls. The one line picks up the northern four buildings and the other one picks up the southern four buildings. The two lines connect at the sanitary manhole located by the guardhouse at the entrance to the West Campus. From this manhole, the flow is piped across Spring Mill Road, around the Law School, to County Line Road. See attached site plan 'Present Conditions'.

There are two existing pumping conditions. Picotte Hall at Dundale has a forced main discharge that ties into the northern sanitary line. Burns Hall has a forced main discharge that ties into the southern sanitary line.

Main Campus

A site survey was completed along Ithan Avenue to confirm existing conditions; to determine if the rerouting of the sanitary flow could be done by gravity or if it would need to be pumped; and to determine the best path to reroute the sanitary piping. The survey included opening the existing sanitary manholes to confirm existing invert elevations; a partial topographical survey; and confirmation of existing on grade site conditions.

Villanova's Main Campus consists of multiple academic buildings and residence halls. The residence halls on Main Campus are the traditional style dormitories consisting of a total of 1,344 beds. The buildings are equipped with a mixture of older and low-flow fixtures. Water consumption for the older fixtures is 3.0 gpf for toilets; 3.5 gpm for shower heads; and 3.5 gpm for faucets. Water consumption for the low-flow fixtures is 1.6 gpf for toilets; 1.75 gpm for shower heads; and 1.5 gpm for faucets.

There are three (3) main sanitary lines that flow from west to east through the campus to manholes on the east side of Ithan Avenue, which in turn connect into Radnor's system in Lancaster Avenue. See attached site plan 'Present Conditions'. There are two existing pumping conditions: Driscoll Hall, which is an academic building and Health Services Building, which consists of offices.

At one time, a portion of the campus gravity flowed to an 8" pipe that runs in a brick arch tunnel under the Amtrak railroad tracks just west of Ithan Avenue and north of the parking garage.

This pipe connects to Lower Merion's system in County Line and is currently abandoned. The invert of the manhole on the south side of the tracks is 405.19.

Our investigation determined that there are a number of existing utilities in Ithan Avenue, which prohibits the consideration of running a new sanitary pipe in Ithan Avenue under the Amtrak bridge. An alternative would be to reuse the existing pipe that is currently abandoned. Reuse of this pipe would allow for the two pumped conditions to be rerouted to a gravity flow. See attached site plan 'Proposed Conditions'.

Flow Monitoring

A total of six (6) manholes were monitored from February 24, 2015 through May 31, 2015. The monitoring was done by Goel Services with an ISCO 2150 Area Velocity Module. The 2150 Flow Module uses continuous wave Doppler technology to measure mean velocity. The sensor transmits a continuous ultrasonic wave, and then measures the frequency shift of returned echoes reflected by air bubbles or particles in the flow. Data information was measured every five (5) minutes. Flow monitoring reports showing the tabular data for each manhole were provided by Goel Services.

A location plan of the monitored manholes is included in the attachments. The plan is color coded to depict which buildings connect to which sanitary line. The manholes are identified as follows:

- Manhole 1 – West Campus
- Manhole 2 – County Line Road
- Manhole 3 – Ithan Avenue
- Manhole 4 – Ithan Avenue
- Manhole 5 – South of Jake Nevin
- Manhole 6 – South of Butler

The following is a summary of the **Peak Flows (gallons per day)** for month.

	February (5 days)	March (31 days)	April (30 days)	May (31 days)
Manhole 1	60,974	125,653	125,909	104,017
Manhole 2	87,902	95,935	92,838	78,869
Manhole 3	78,559	87,659	88,643	77,898
Manhole 4	107,575	70,542	80,525	82,577
Manhole 5	155,356	135,815	164,011	133,784**
Manhole 6	191,397	289,888	178,231*	148,299

The following is a summary of the **Average Flows (gallons per day)** for the month.

	February (5 days)	March (31 days)	April (30 days)	May (31 days)
Manhole 1	49,763	99,675	88,273	53,575
Manhole 2	66,863	77,488	80,922	56,548
Manhole 3	48,863	59,070	60,523	59,238
Manhole 4	79,175	48,954	53,616	63,661
Manhole 5	153,953	101,828	119,600	98,515**
Manhole 6	155,482	126,715	86,561*	99,207

The following is a summary of the **Maximum Flow (gallons per minute)** for the month.

	February (5 days)	March (31 days)	April (30 days)	May (31 days)
Manhole 1	125	190	137	173
Manhole 2	107	126	129	131
Manhole 3	150	185	139	193
Manhole 4	221	209	192	217
Manhole 5	227	226	231	242**
Manhole 6	240	582	312*	257

* Numbers are based on readings taken from April 13th through April 30th. Meter was not working April 1st through April 12th.

** Numbers are based on readings for complete days. Meter was not working properly on May 3rd and 4th, and was not working May 27th through May 31st.

Manholes 1 – West Campus, 3 – Ithan Avenue, and 5 – South of Nevin are the manholes that were identified for potential points for the rerouting of the sanitary lines. Additional detailed reports for these manholes are included in the attachments. The reports include the following:

- A table summarizing the ‘Gallons Per Day’ for the three manholes
- A graph of the ‘Gallons Per Day’ for each manhole
- A graph of the ‘Gallons Per Hour’ for the peak day for each manhole
- A graph of the ‘Average GPM Per Hour’ for the peak for each manhole

The above reports were completed for March, April and May. The following is a summary of the peak flows for the peak days.

	Peak Day	Peak Flow (GPM)	Time
Manhole 1	March 14	132.84	10:00 am
	April 20	133.77	9:00 am
	May 4	123.22	10:00 am
Manhole 3	March 24	10.90	4:00 pm
	April 20	109.49	8:00 am
	May 4	95.83	1:00 pm
Manhole 5	March 11	150.18	12:00 pm
	April 16	165.92	11:00 am
	May 5	155.47	10:00 am

The peak flows for all three manholes occur outside the normal peak hours of 6:00 am to 8:00 am and 4:00 pm to 6:00 pm for a municipality sewer system.

Flow Calculations

Based on the monitoring data, the **peak flow** for Manhole 1 – West Campus was 125,909 gallons a day in the month of April. Using this total and subtracting out the flow for the residence and the administration office, the flow for the dormitories would be 122,459. Using the flow for the dormitories and dividing it by the number of beds, the flow per unit would be 98.75. The breakdown of the flow can be interpolated as follows:

Use	Flow per Unit (gpd)	Unit	Flow Per Use (gpd)
Dormitory	98.75	1,240 Beds	122,459
Admin Office	0.1	24,000 sf	2,400
Residence (4)	262.5	EDU	1,050
Total Flow			125,909

Using the calculated flow per unit (gpd) above, the anticipated flow from the CICD Development would be as follows:

Use	Flow Per Unit (gpd)	Unit	Flow per Use (gpd)
Dormitory	98.75	1,138 Beds	112,378
100 Seat Restaurant	12	400 Patrons*	4,800
Convenience Store	0.1	2,500 sf	250
Performance Center	5	400 Seats**	2,000
Retail	0.1	6,150 sf	615
		Total Flow	120,043

*Assumes an average of 2 lunch and 2 dinner turnovers

**Largest performance spaced used for calculation

Based on the monitoring data, the **average flow** for Manhole 1 – West Campus was 80,423 gallons a day for the monitored period. Using the same logic as above, the breakdown of the flow can be interpolated as follows:

Use	Flow per Unit (gpd)	Unit	Flow Per Use (gpd)
Dormitory	62.1	1,240 Beds	76,973
Admin Office	0.1	24,000 sf	2,400
Residence (4)	262.5	EDU	1,050
Total Flow			80,423

Using the calculated flow per unit (gpd) above, the anticipated flow from the CICD Development would be as follows:

Use	Flow Per Unit (gpd)	Unit	Flow per Use (gpd)
Dormitory	62.1	1,138 Beds	70,670
100 Seat Restaurant	12	400 Patrons*	4,800
Convenience Store	0.1	2,500 sf	250
Performance Center	5	400 Seats**	2,000
Retail	0.1	6,150 sf	615
		Total Flow	78,335

*Assumes an average of 2 lunch and 2 dinner turnovers

**Largest performance spaced used for calculation

Proposed Routing

The flow from Manhole 5 (South of Nevin) will be rerouted (gravity) to tie into Lower Merion's sewer system in County Line Road. The maximum measured flow was 164,011 gallons per day.

The flow from the CICD Development will be routed (gravity) to tie into Radnor's sewer system in Lancaster Avenue. The maximum anticipated flow is 120,043 gallons per day.

Conclusion

Lower Merion's system in County Line Road will be increased by a maximum flow of 164,011 gallons per day. The average increase will be 107,268 gallons per day. The peak flow will occur in the middle of the day between 10:00 am and 4:00 pm.

Radnor's system in Lancaster Avenue will be decreased by a maximum flow of 43,968 (164,011 – 120,043) gallons per day. The decrease, based on maximum (peak) flow data, is approximately 27 percent. The maximum flow from the CICD development was calculated using the measured data from West Campus, which does not have low-flow fixtures. The decrease flow does not take into account that the CICD Development project will use low flow fixtures. The decrease in flow to the Radnor system could potentially be more.

Included as attachments, is water usage data for the monitored period and rainfall data for the monitored period for the past five years.

ATTACHMENTS

Plans

VILLANOVA UNIVERSITY CAMPUS AREAS PLAN

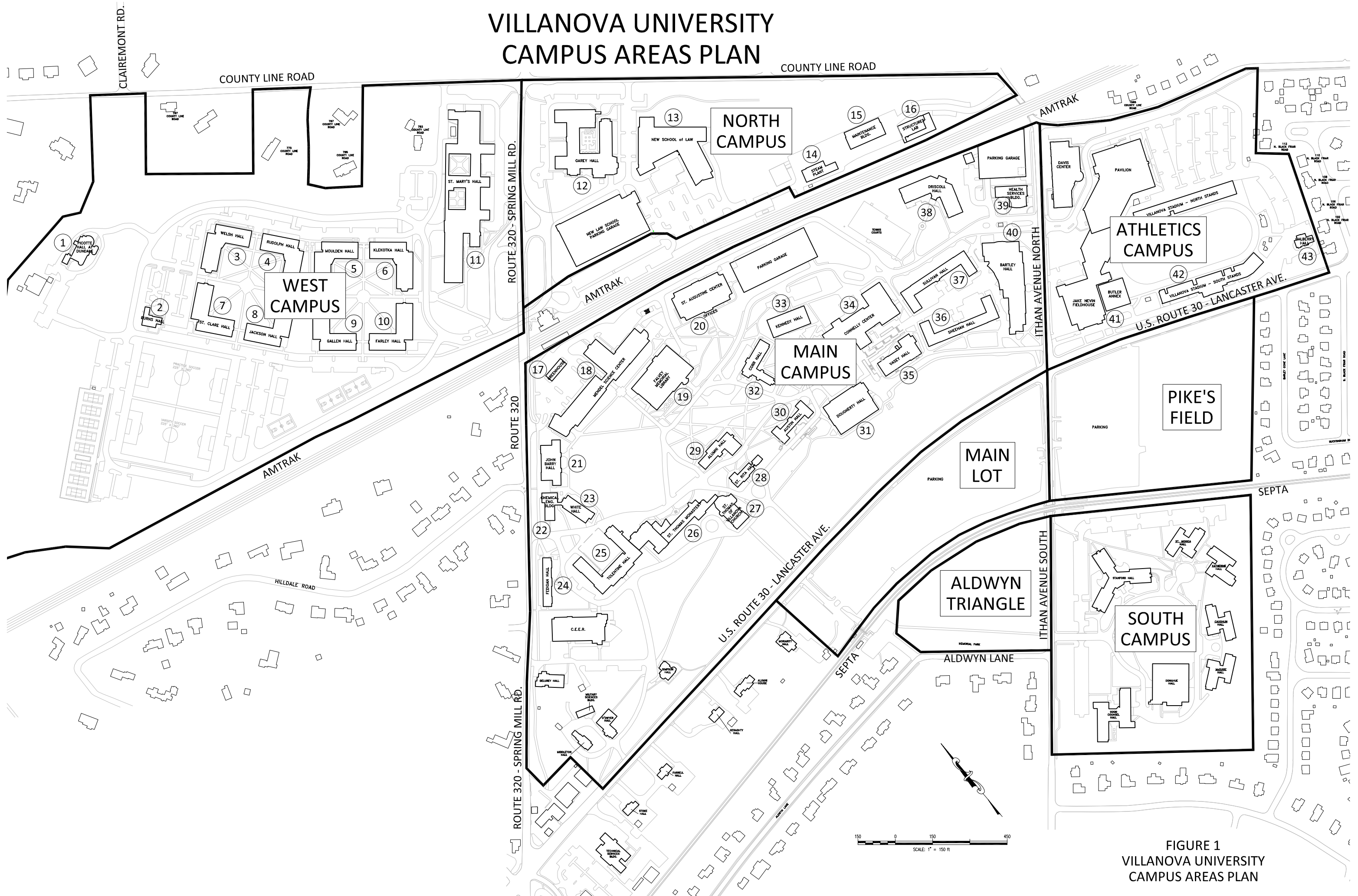
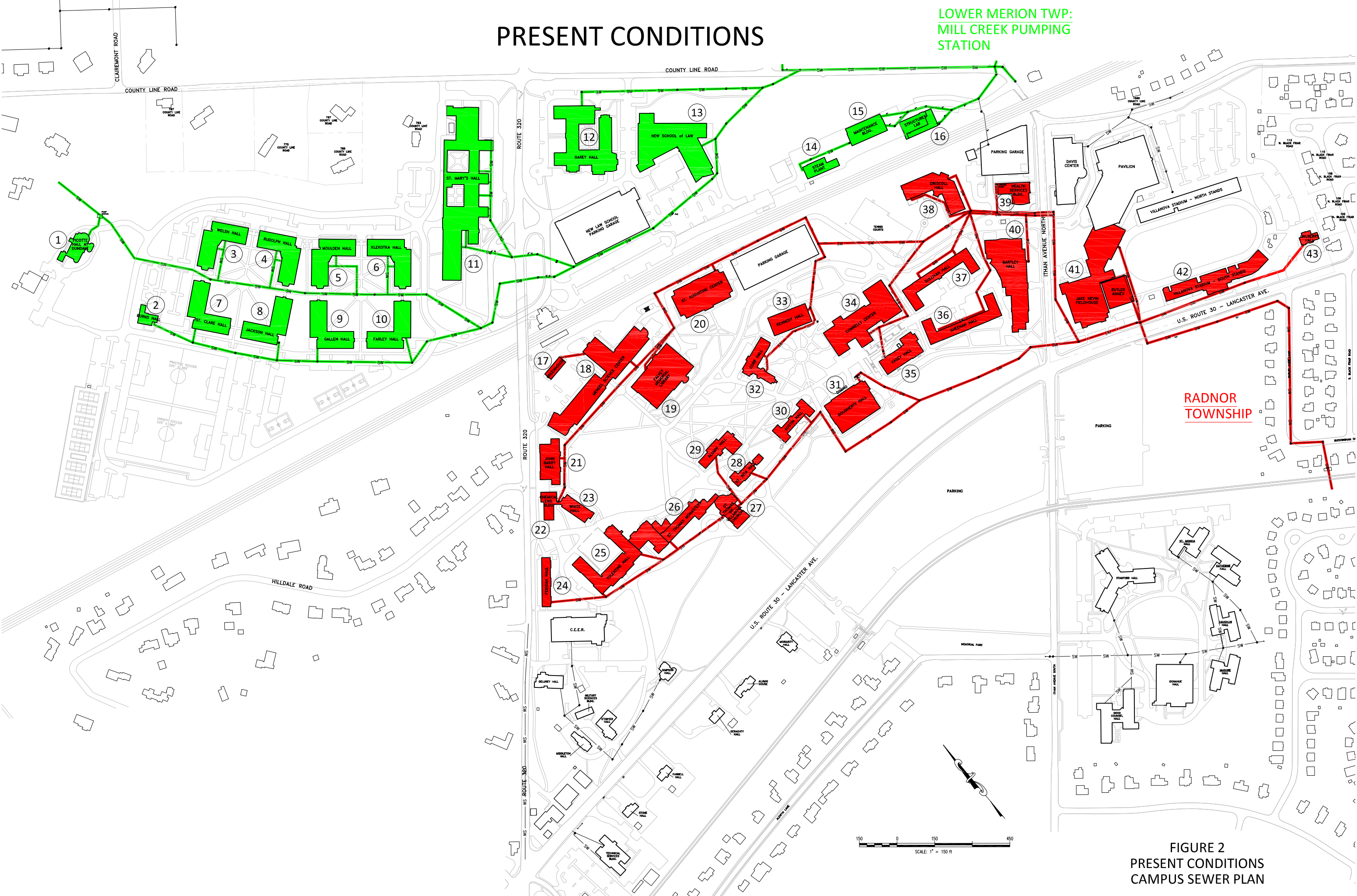


FIGURE 1
VILLANOVA UNIVERSITY
CAMPUS AREAS PLAN

PRESENT CONDITIONS

LOWER MERION TWP:
MILL CREEK PUMPING
STATION



RADNOR
TOWNSHIP

FIGURE 2
PRESENT CONDITIONS
CAMPUS SEWER PLAN

PROPOSED CONDITIONS

LOWER MERION TWP:
MILL CREEK PUMPING
STATION (+164,011 GPD)

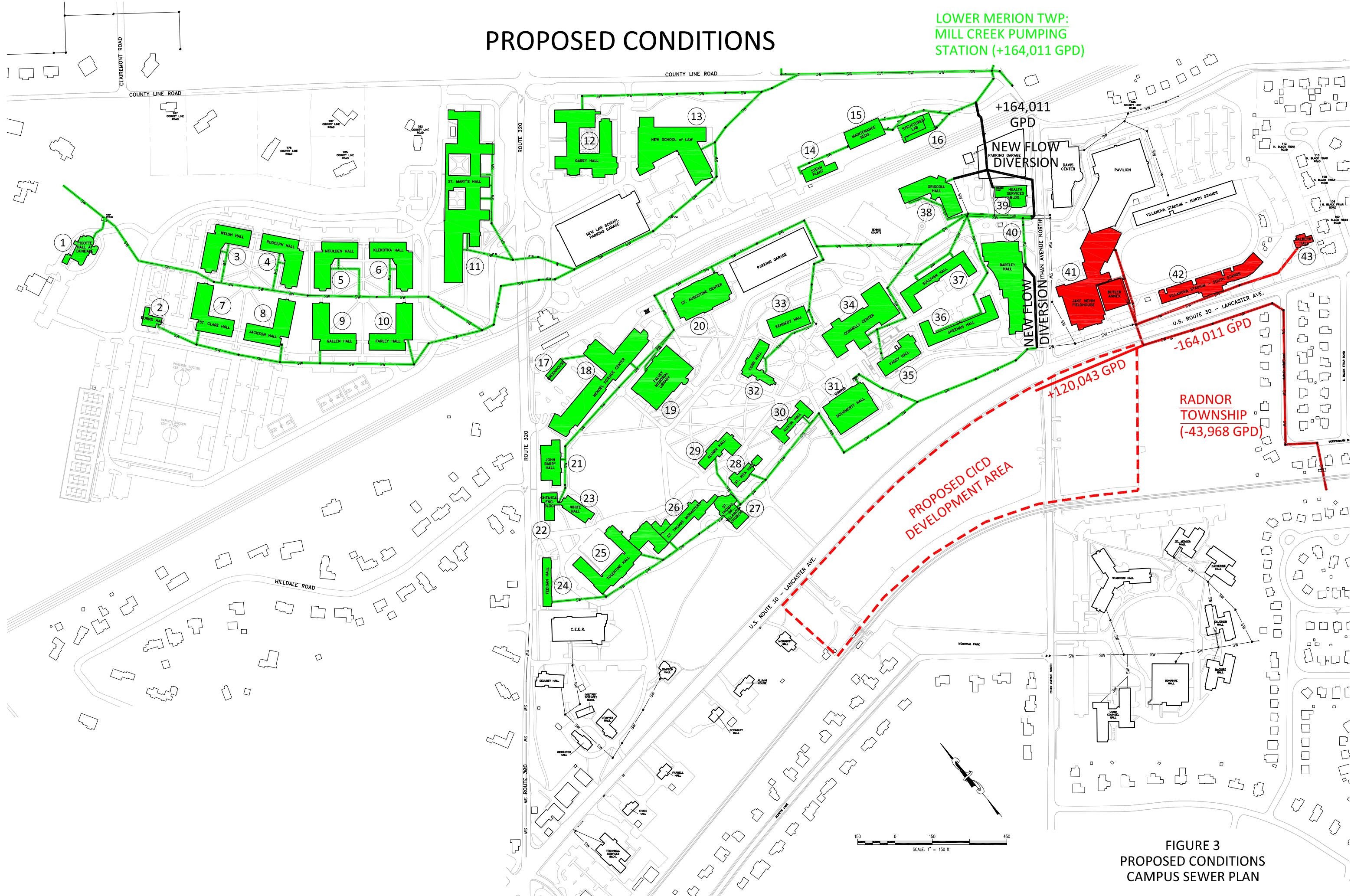


FIGURE 3
PROPOSED CONDITIONS
CAMPUS SEWER PLAN

MANHOLE MONITORING PLAN

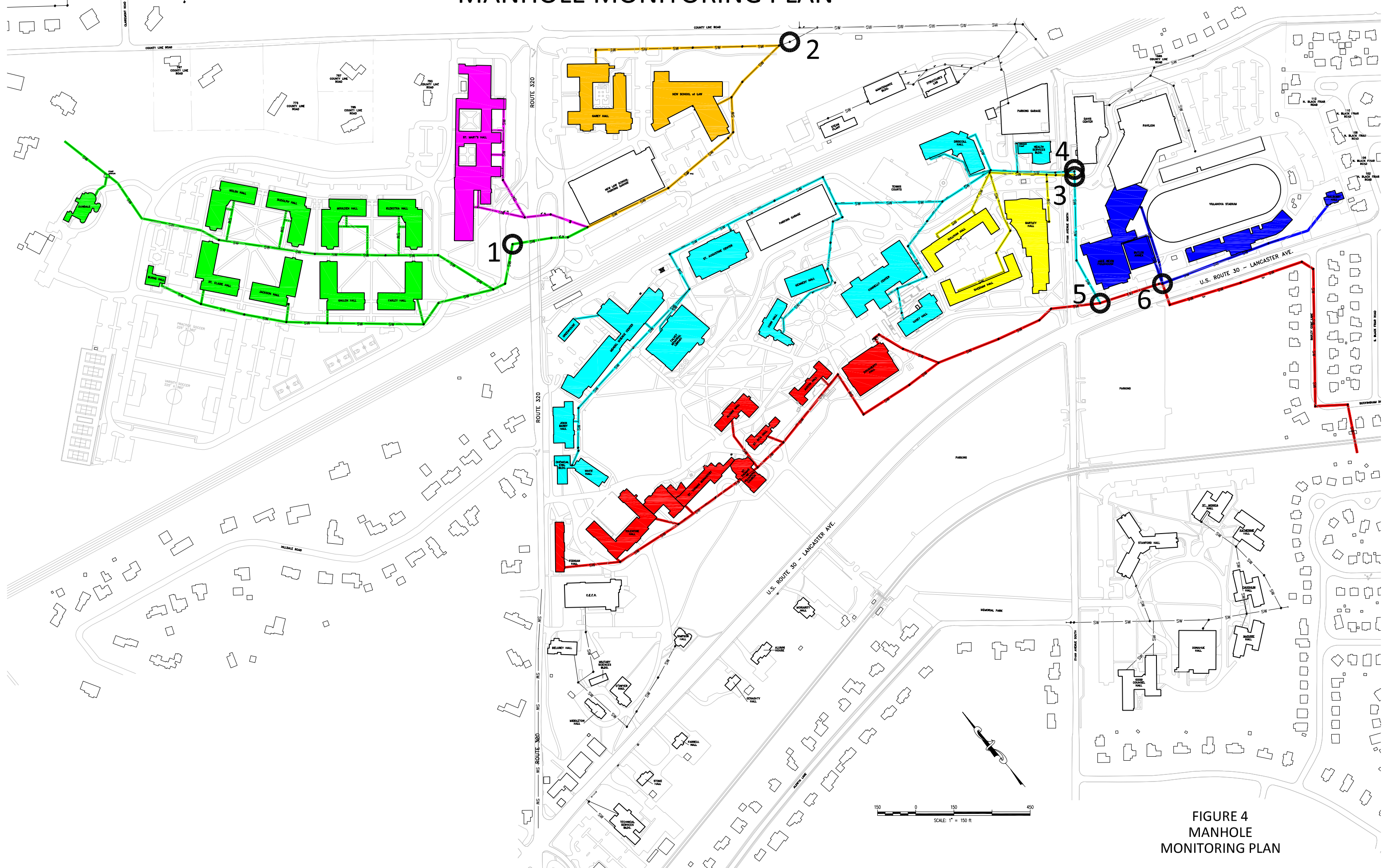


FIGURE 4
MANHOLE
MONITORING PLAN

Monitoring Reports

**Villanova University
Sanitary Study/Investigation
Monitoring Summary**

	Manhole #1 - West Campus		
	March	April	May
Total Gallons for the Month	3,089,914	2,648,205	1,660,817
Maximum Gallons per Day	125,653	125,909	104,017
Minimum Gallons per Day	35,119	38,553	12,900
Average Gallons per Day	99,675	88,273	53,575
Average Gallons per Day Over the 3 Months	80,423		

	Manhole #3 - Ithan Avenue		
	March	April	May
Total Gallons for the Month	1,831,198	1,815,694	1,836,367
Maximum Gallons per Day	87,659	88,643	77,898
Minimum Gallons per Day	20,412	26,564	41,349
Average Gallons per Day	59,070	60,523	59,238
Average Gallons per Day Over the 3 Months	59,601		

	Manhole #5 - South of Nevin		
	March	April	May
Total Gallons for the Month	3,156,647	3,588,006	2,265,853
Maximum Gallons per Day	135,815	164,011	133,784
Minimum Gallons per Day	54,113	52,774	75,590
Average Gallons per Day	101,828	119,600	98,515
Average Gallons per Day Over the 3 Months	107,268		

Denotes Peak Flow for the Period

Villanova University
Sanitary Study/Investigation
March - Gallons Per Day

		Special Events	Manhole #1 West Campus	Manhole #3 Ithan Avenue	Manhole #5 South of Nevin
March 1, 2015	S		35,119	20,412	65,582
March 2, 2015	M	Spring Break	46,004	27,355	85,824
March 3, 2015	T	Spring Break	70,962	29,583	78,487
March 4, 2015	W	Spring Break	78,957	44,467	8,638
March 5, 2015	T	Spring Break	114,459	35,334	19,283
March 6, 2015	F	Spring Break	92,939	31,364	54,113
March 7, 2015	S		103,115	33,213	57,834
March 8, 2015	S		103,788	46,659	82,523
March 9, 2015	M		110,366	74,980	126,063
March 10, 2015	T		104,345	77,029	135,290
March 11, 2015	W		117,361	79,777	135,815
March 12, 2015	T		110,847	72,765	128,363
March 13, 2015	F		118,536	57,467	111,761
March 14, 2015	S		125,653	47,409	107,792
March 15, 2015	S		114,467	49,520	98,732
March 16, 2015	M		119,259	73,821	126,309
March 17, 2015	T		113,468	76,298	134,637
March 18, 2015	W		110,961	78,495	128,672
March 19, 2015	T		113,833	75,942	91,525
March 20, 2015	F		113,609	63,549	110,665
March 21, 2015	S		95,294	44,735	102,049
March 22, 2015	S		100,598	46,234	97,084
March 23, 2015	M		90,204	81,711	125,671
March 24, 2015	T		96,973	87,659	122,833
March 25, 2015	W		99,862	82,260	126,741
March 26, 2015	T		97,665	76,332	125,618
March 27, 2015	F		111,266	67,087	118,868
March 28, 2015	S		98,570	48,550	98,012
March 29, 2015	S		93,378	50,624	95,366
March 30, 2015	M		90,528	74,937	126,284
March 31, 2015	T		97,528	75,631	130,213
Total			3,089,914	1,831,198	3,156,647
Average Flow			99,675	59,070	101,828



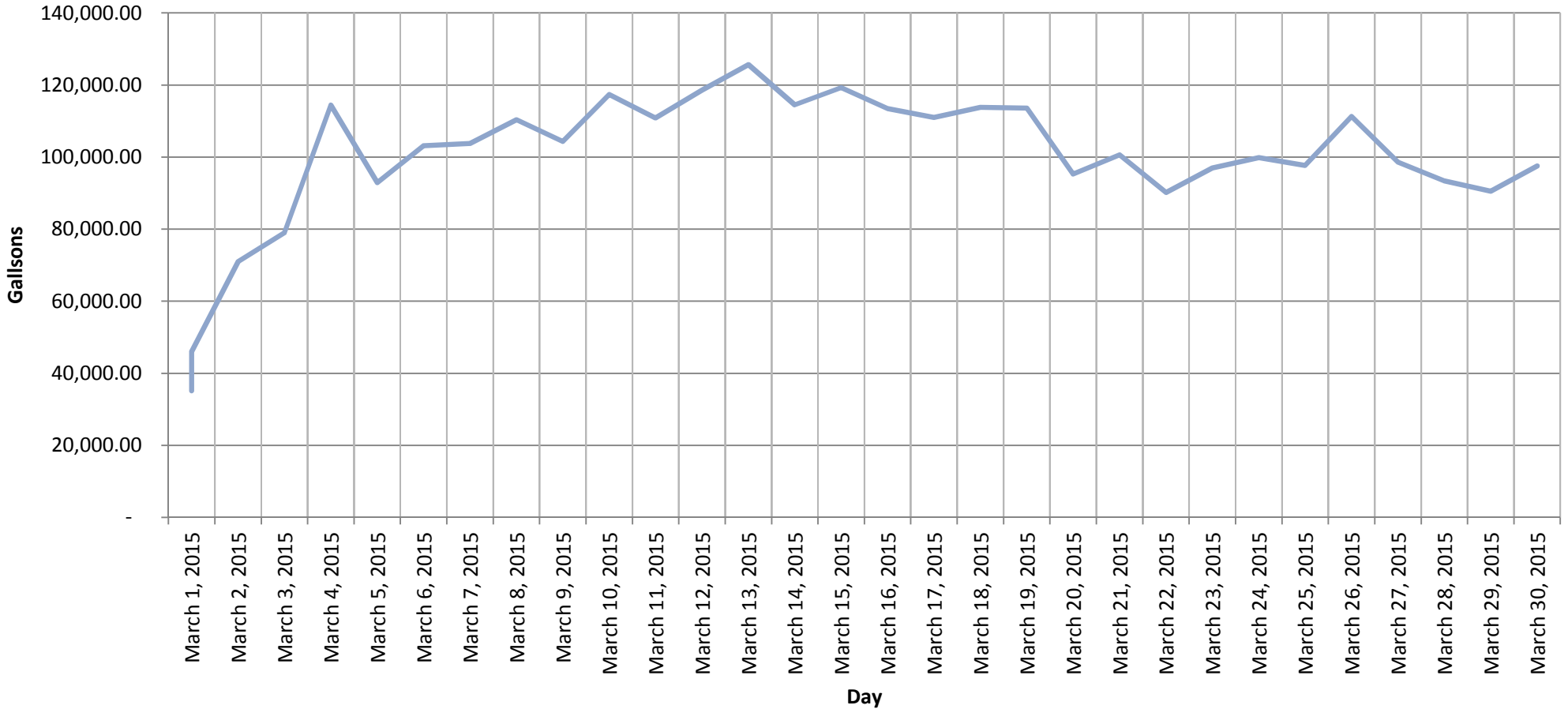
Denotes Peak Flow for the Month

Manhole #1 - West Campus

March 2015

Gallons Per Day

Average Gallons Per Day = 99,675
Peak Gallons = 125,653 on March 14th

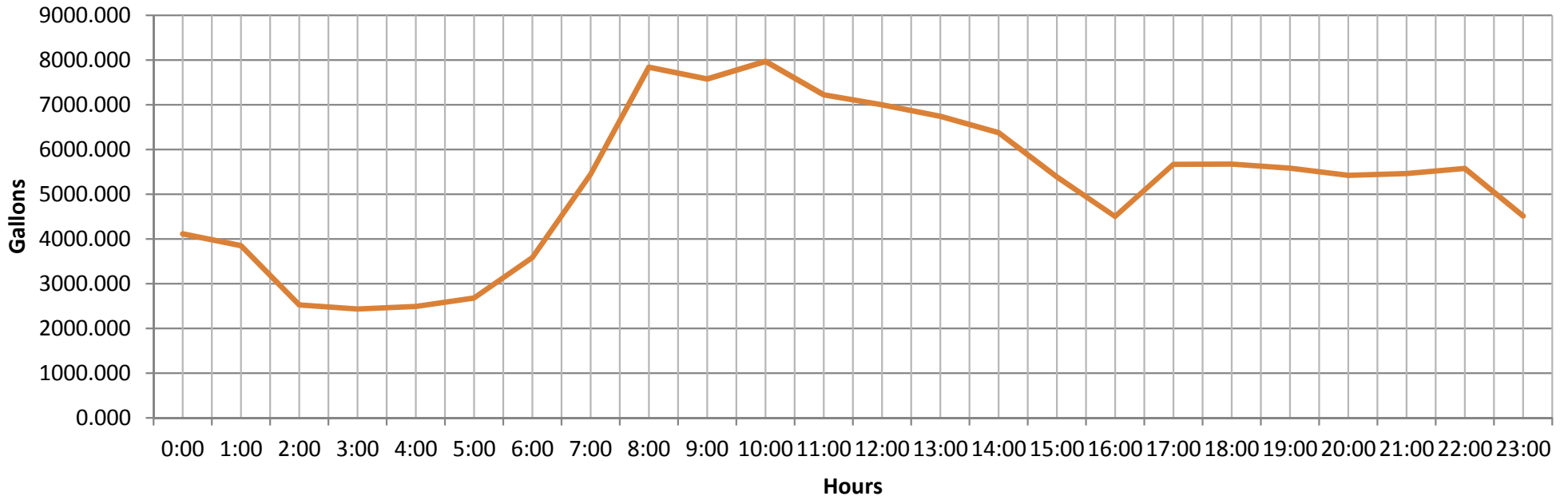


Manhole #1 - West Campus

March 14, 2015

Gallons Per Hour

Peak Gallons = 7,970 @ 10:00am

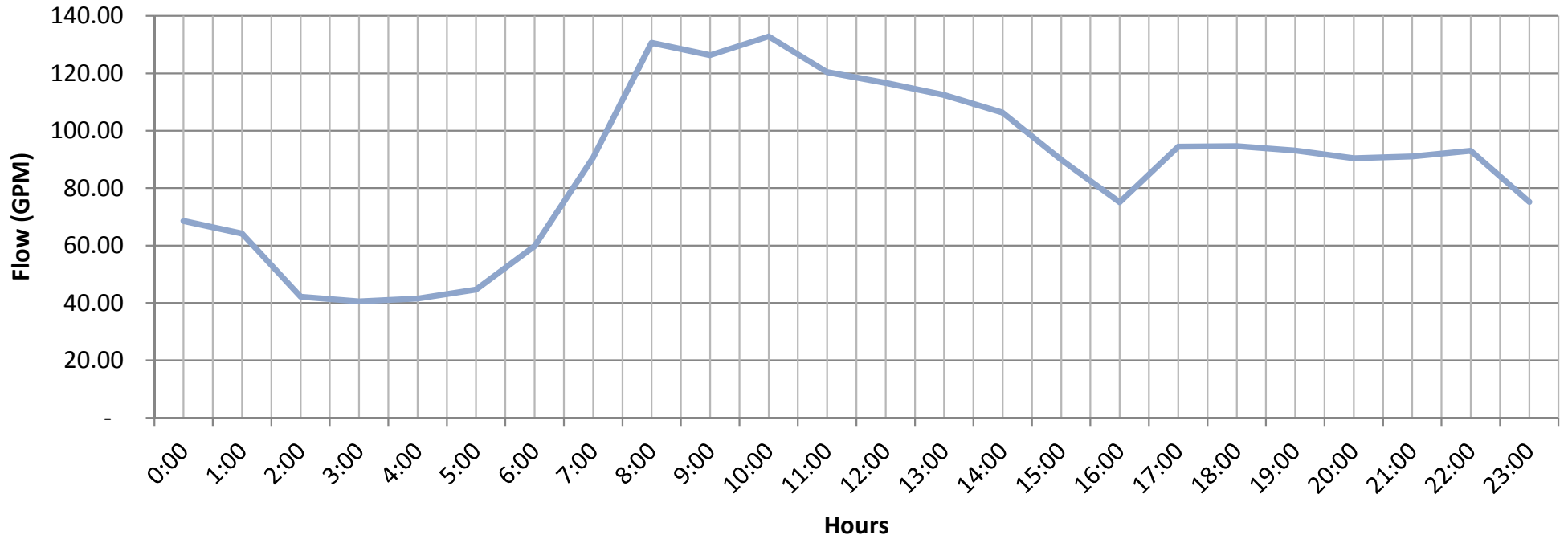


Manhole #1 - West Campus

March 14, 2015

Average GPM Per Hour

Peak Flow (GPM) = 132.84 @ 10:00am

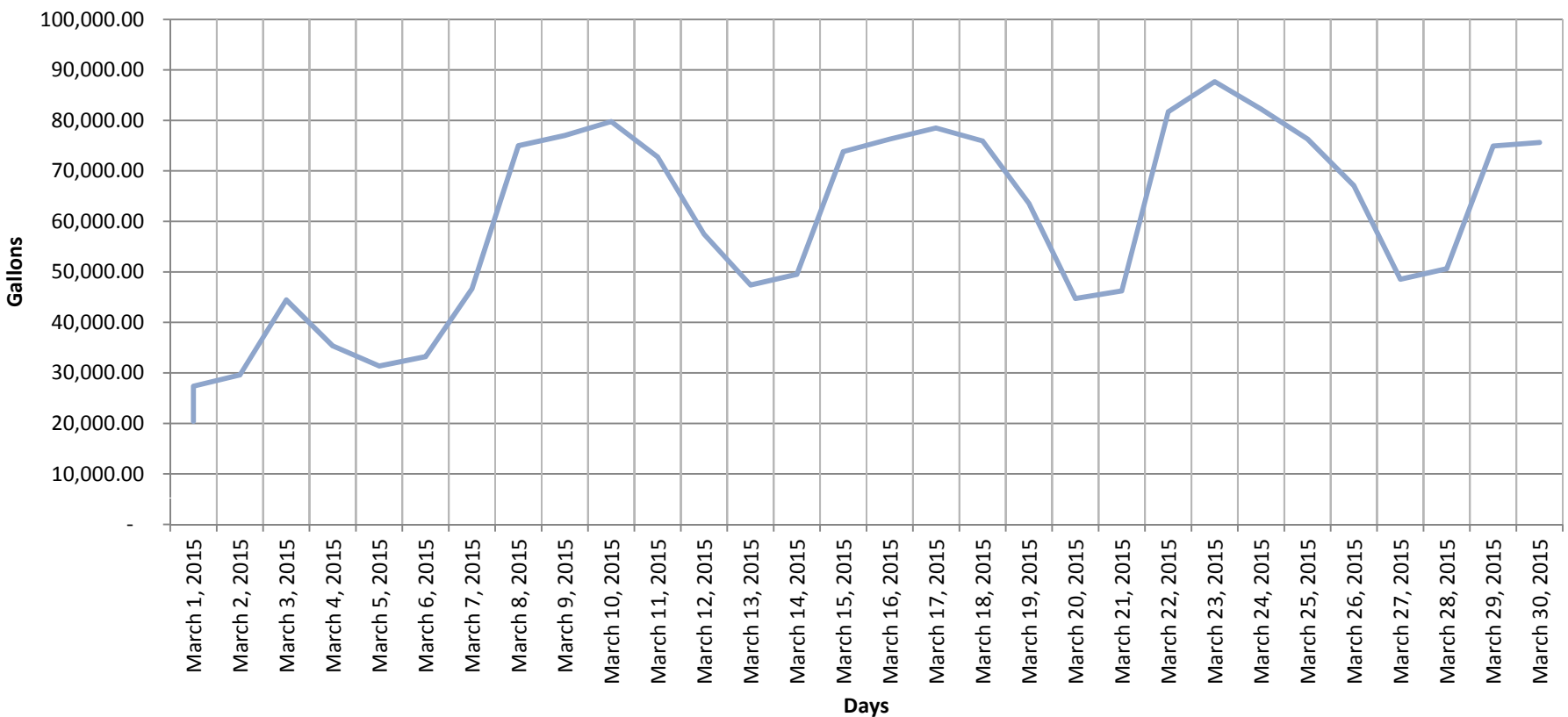


Manhole #3 - Ithan Avenue

March 2015

Gallons Per Day

Average Gallons Per Day = 59,070
Peak Gallons = 87,658 on March 24th

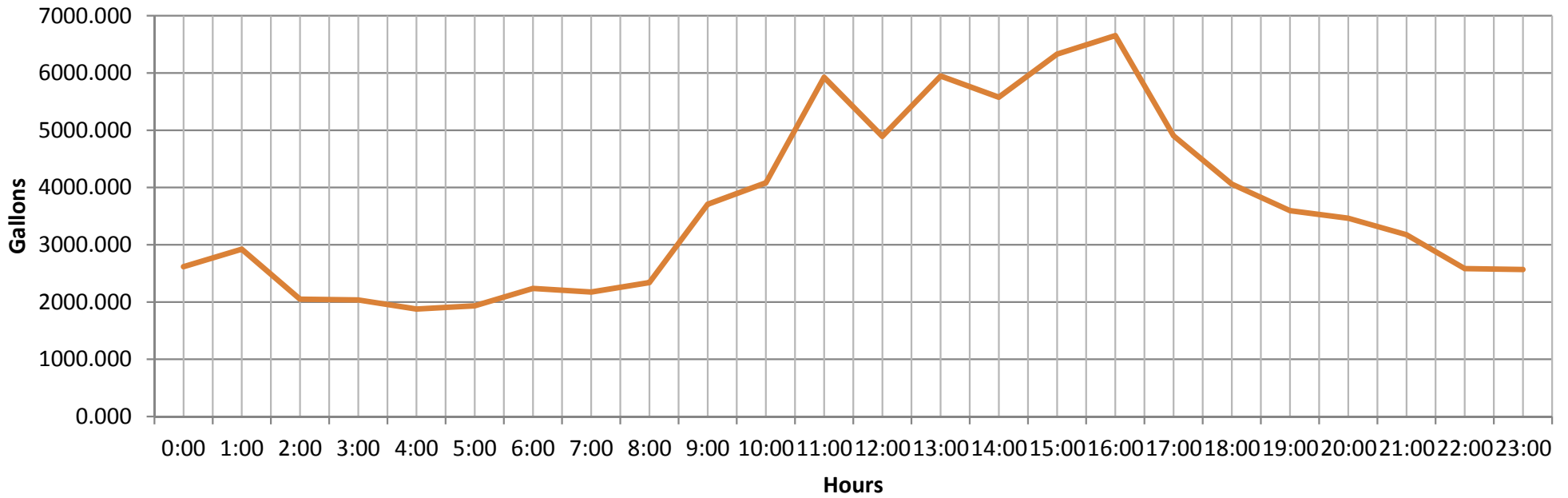


Manhole #3 - Ithan Avenue

March 24, 2015

Gallons Per Hour

Peak Gallons = 6,654 @ 4:00pm

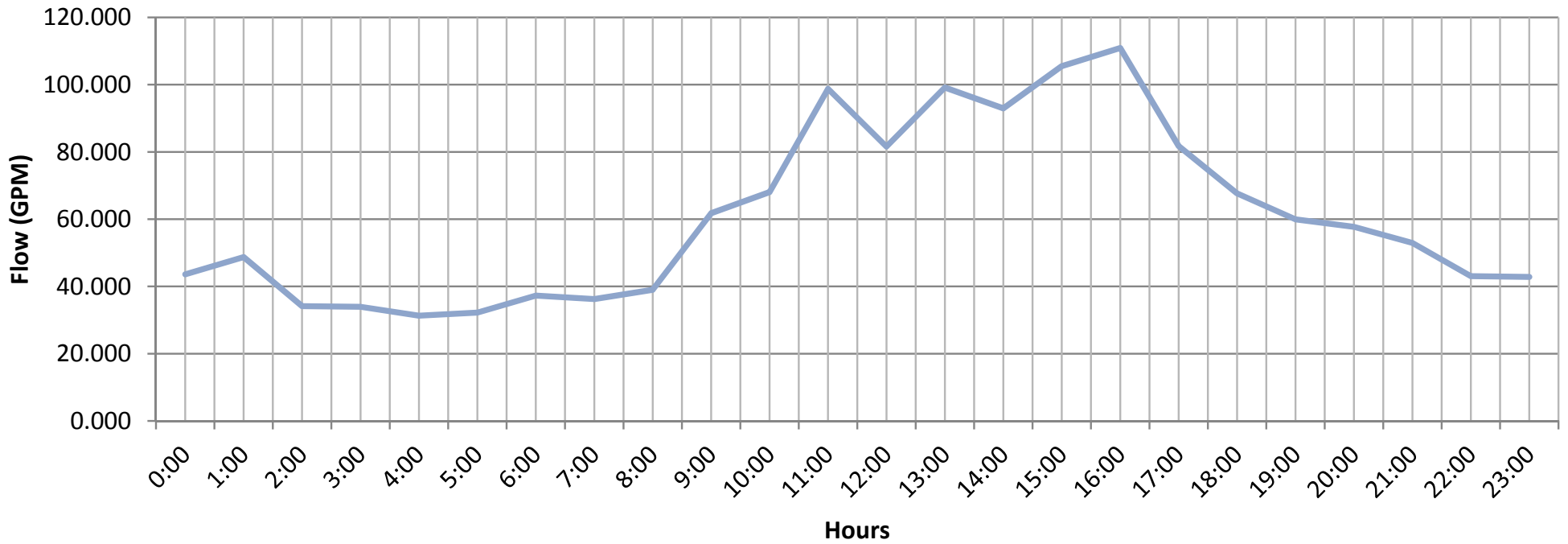


Manhole #3 - Ithan Avenue

March 24, 2015

Average GPM Per Hour

Peak Flow (GPM) = 110.904 @ 4:00pm



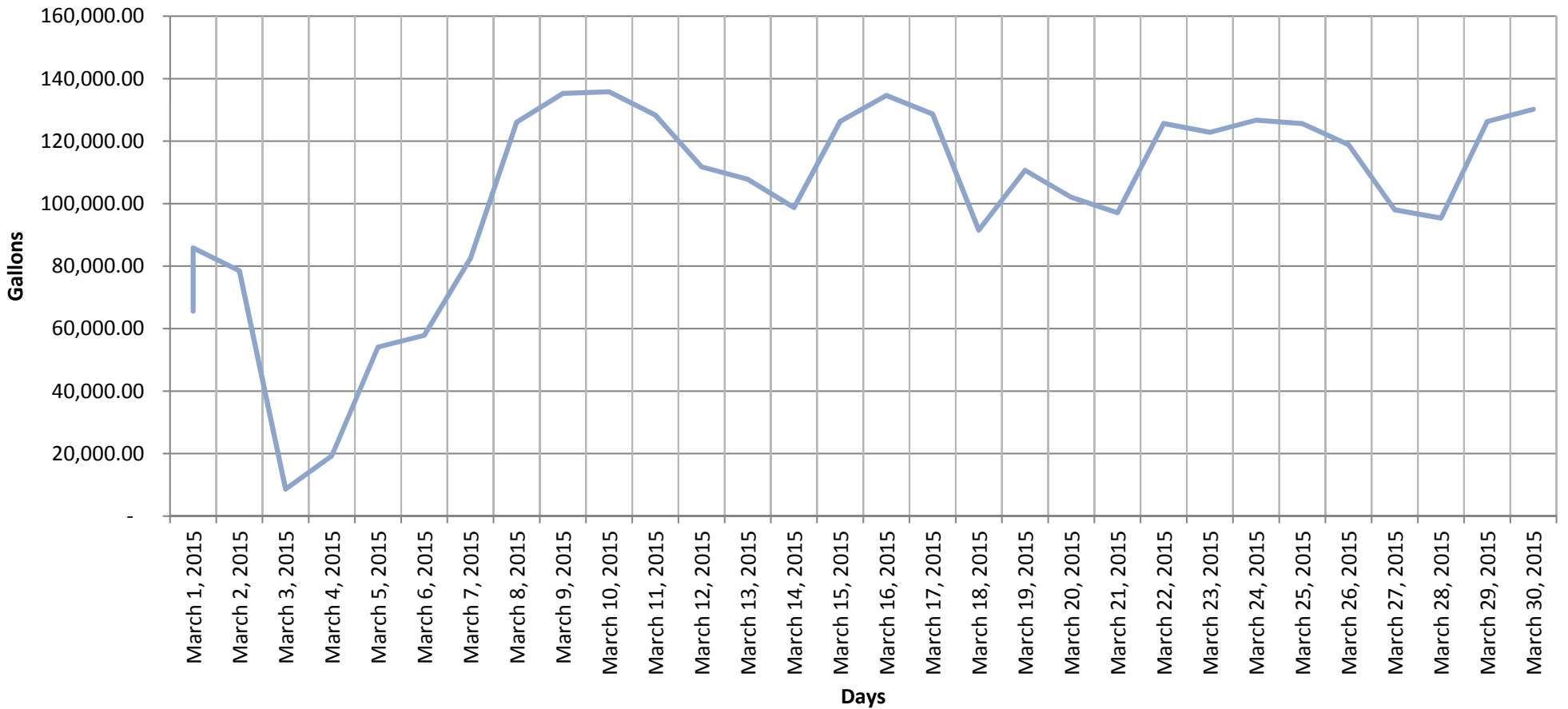
Manhole #5 - South of Jake Nevin

March 2015

Gallons Per Day

Average Gallons Per Day = 101,828

Peak Gallons =

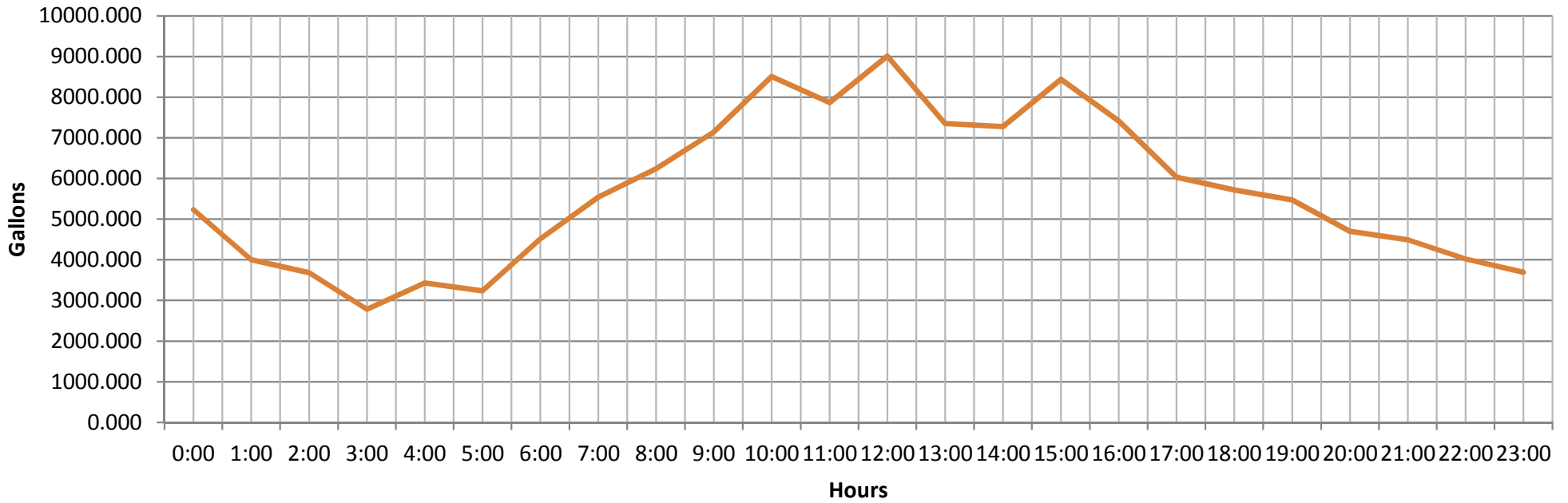


Manhole #5 - South of Jake Nevin

March 11, 2015

Gallons Per Hour

Peak Gallons = 9,010 @ 12 Noon

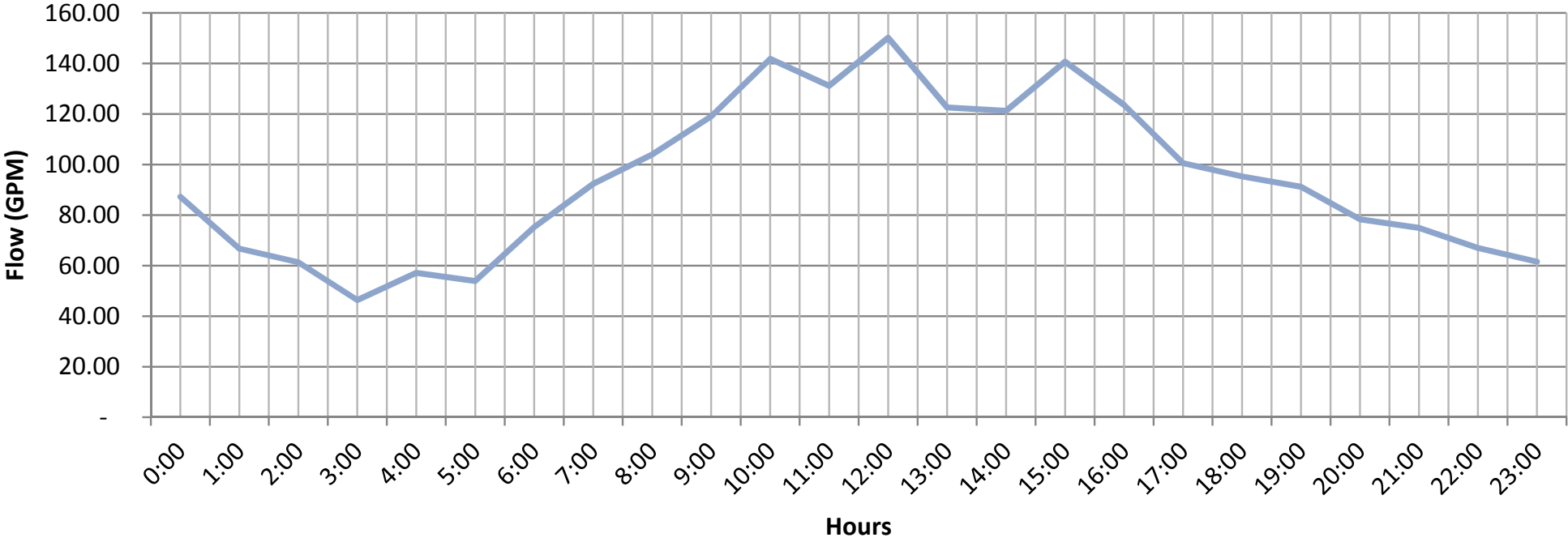


Manhole #5 - South of Jake Nevin

March 11, 2015

Average GPM Per Hour

Peak Flow (GPM) = 150.18 @ 12 Noon



**Villanova University
Sanitary Study/Investigation
April - Gallons Per Day**

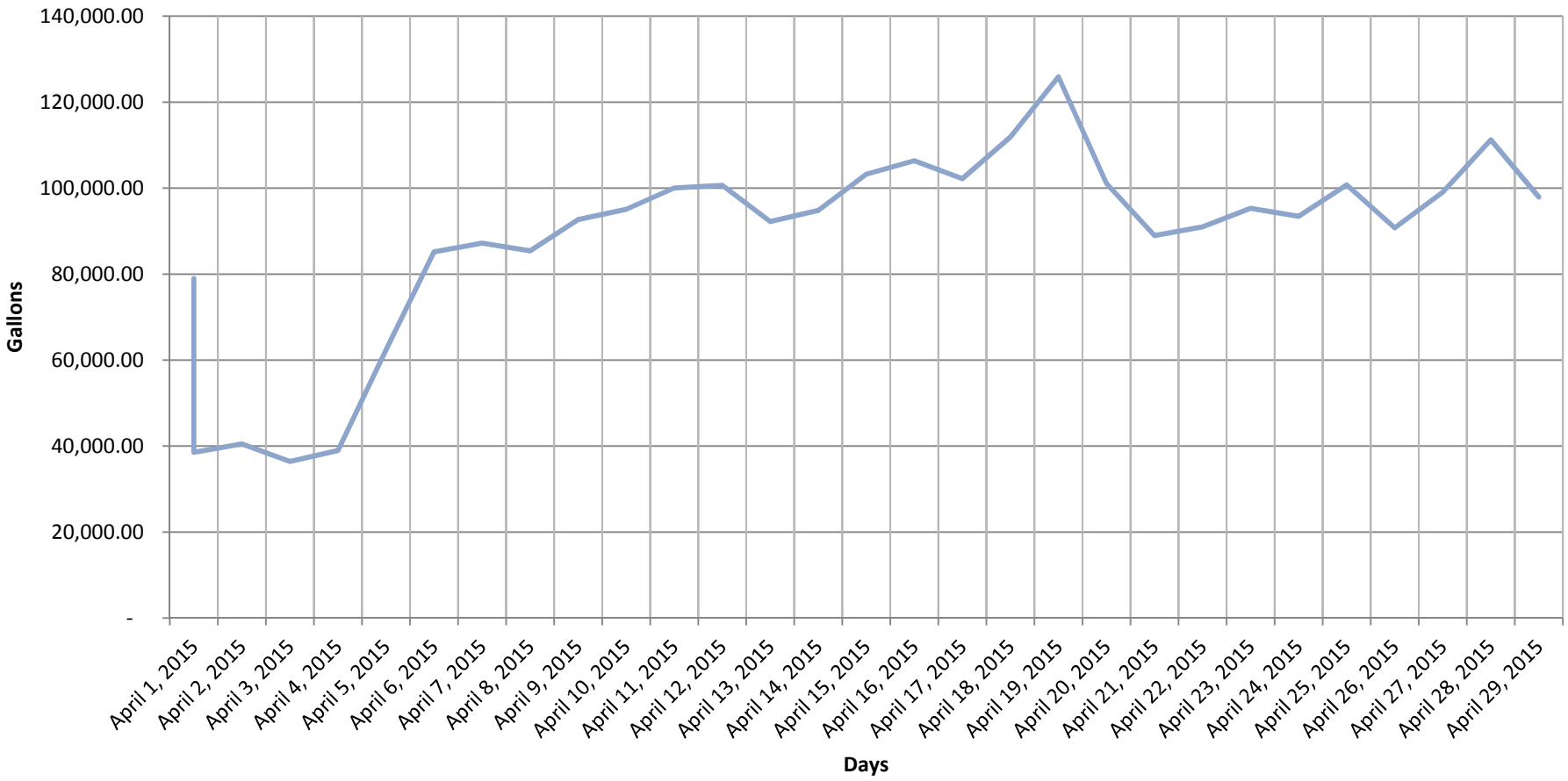
		Special Events	Manhole #1 West Campus	Manhole #3 Ithan Avenue	Manhole #5 South of Nevin
April 1, 2015	W		78,964	62,554	116,829
April 2, 2015	T	Easter Break	38,553	43,754	81,645
April 3, 2015	F	Easter Break	40,491	30,578	66,550
April 4, 2015	S	Easter Break	36,434	29,474	55,777
April 5, 2015	S	Easter Break	38,980	26,564	52,774
April 6, 2015	M	Easter Break	62,372	29,198	81,682
April 7, 2015	T		85,172	64,055	116,249
April 8, 2015	W		87,216	67,844	122,847
April 9, 2015	T		85,402	70,802	136,180
April 10, 2015	F		92,689	64,030	143,202
April 11, 2015	S		95,074	45,663	116,368
April 12, 2015	S		100,035	51,713	109,124
April 13, 2015	M	Greek Week	100,645	80,584	144,779
April 14, 2015	T	Greek Week	92,231	86,723	149,545
April 15, 2015	W	Greek Week	94,816	83,714	155,438
April 16, 2015	T	Greek Week	103,235	82,632	164,011
April 17, 2015	F	Greek Week	106,368	68,793	145,216
April 18, 2015	S		102,184	62,897	121,717
April 19, 2015	S		111,903	60,323	121,669
April 20, 2015	M		125,909	88,643	136,862
April 21, 2015	T		101,092	80,547	127,730
April 22, 2015	W		88,969	66,040	138,894
April 23, 2015	T		90,997	62,604	141,387
April 24, 2015	F		95,299	52,884	119,702
April 25, 2015	S		93,437	38,159	112,531
April 26, 2015	S		100,744	41,148	111,773
April 27, 2015	M		90,778	64,353	118,741
April 28, 2015	T		99,048	65,550	127,221
April 29, 2015	W		111,247	72,259	128,762
April 30, 2015	T		97,921	71,612	122,801
Total			2,648,205	1,815,694	3,588,006
Average Flow			88,273	60,523	119,600



Denotes Peak Flow for the Month

Manhole #1 - West Campus April 2015 Gallons Per Day

Average Gallons Per Day = 88,273
Peak Gallons = 125,909 on April 20th

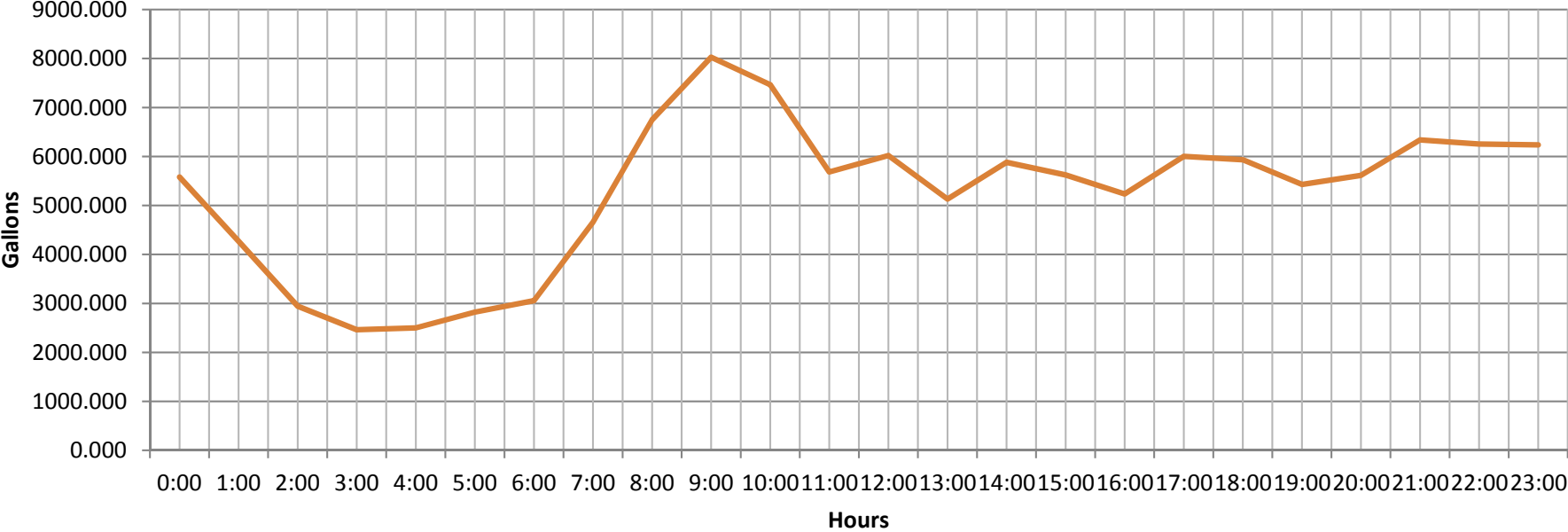


Manhole #1 - West Campus

April 20, 2015

Gallons Per Hour

Peak Gallons = 8,026 @ 9:00am

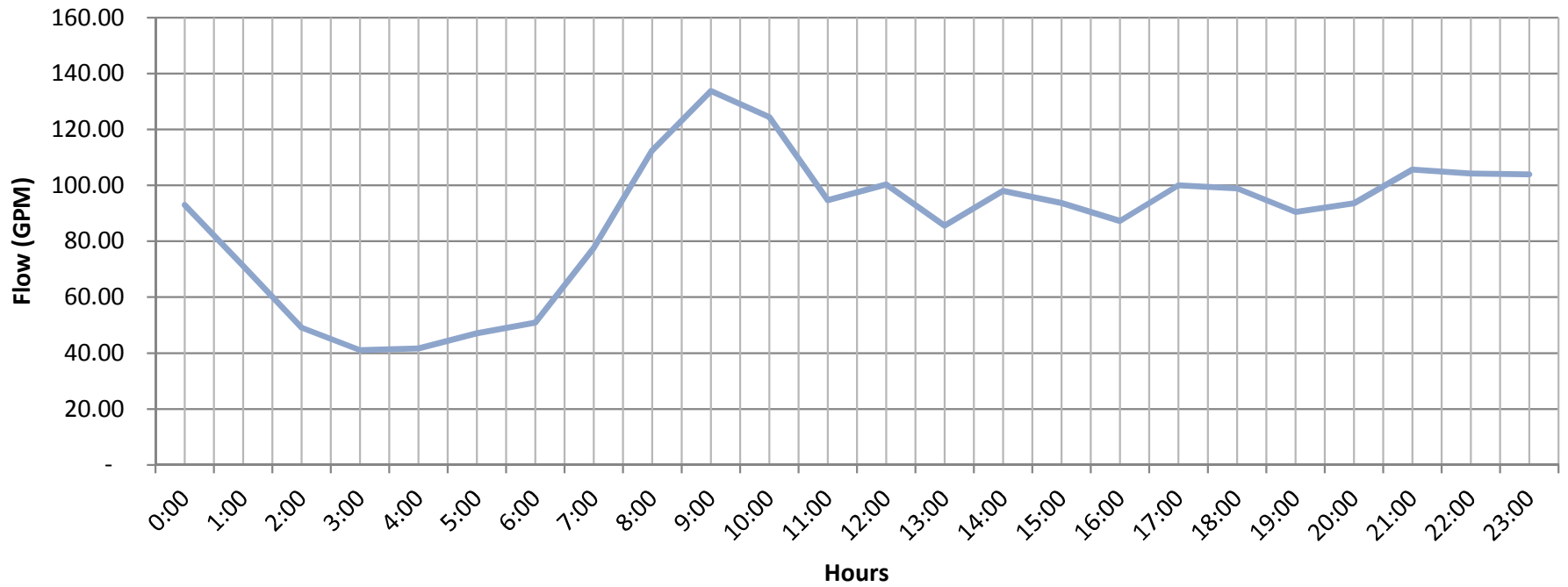


Manhole #1 - West Campus

April 20, 2015

Average GPM Per Hour

Peak Flow (GPM) = 133.77 @ 9:00am

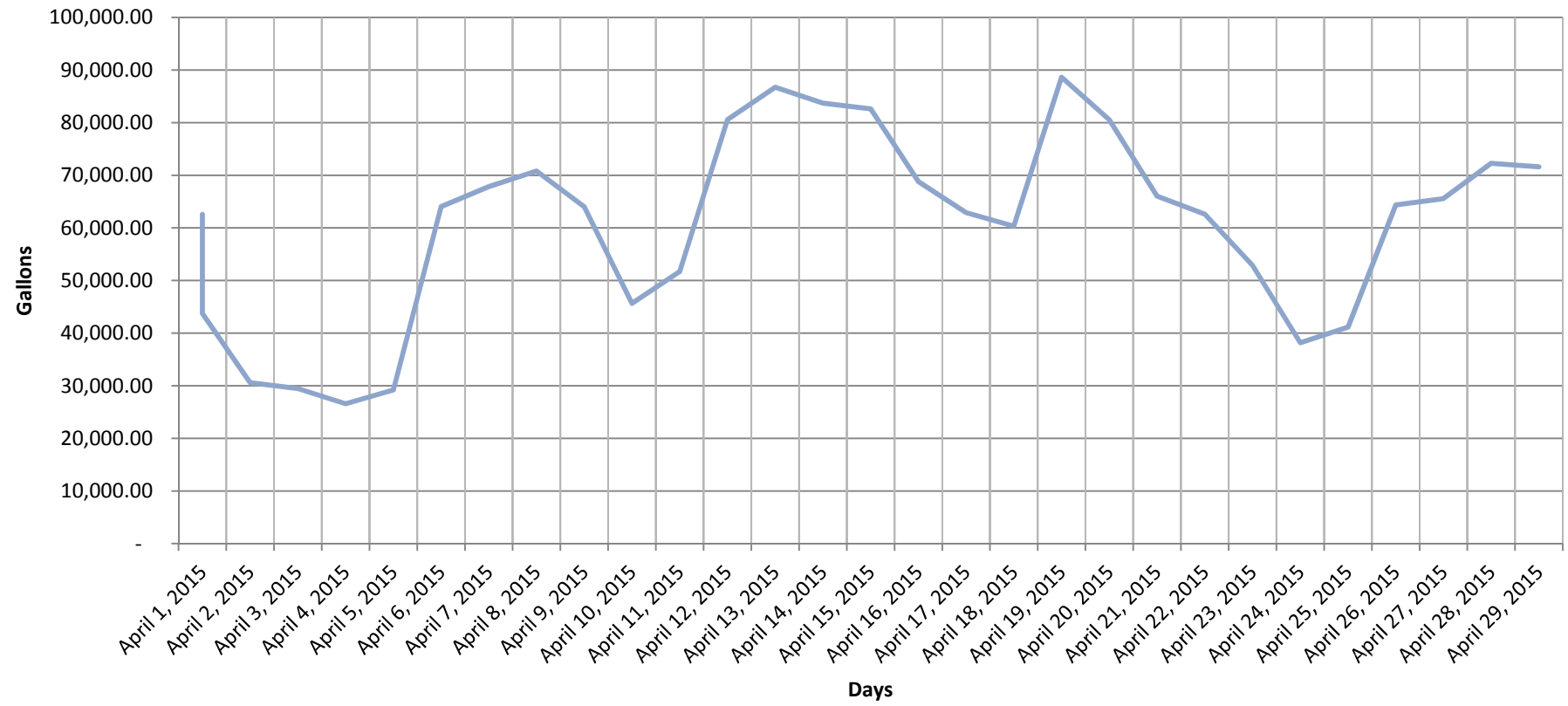


Manhole #3 - Ithan Avenue

April 2015

Gallons Per Day

Average Gallons Per Day = 60,523
Peak Gallons = 88,643 on April 20, 2015

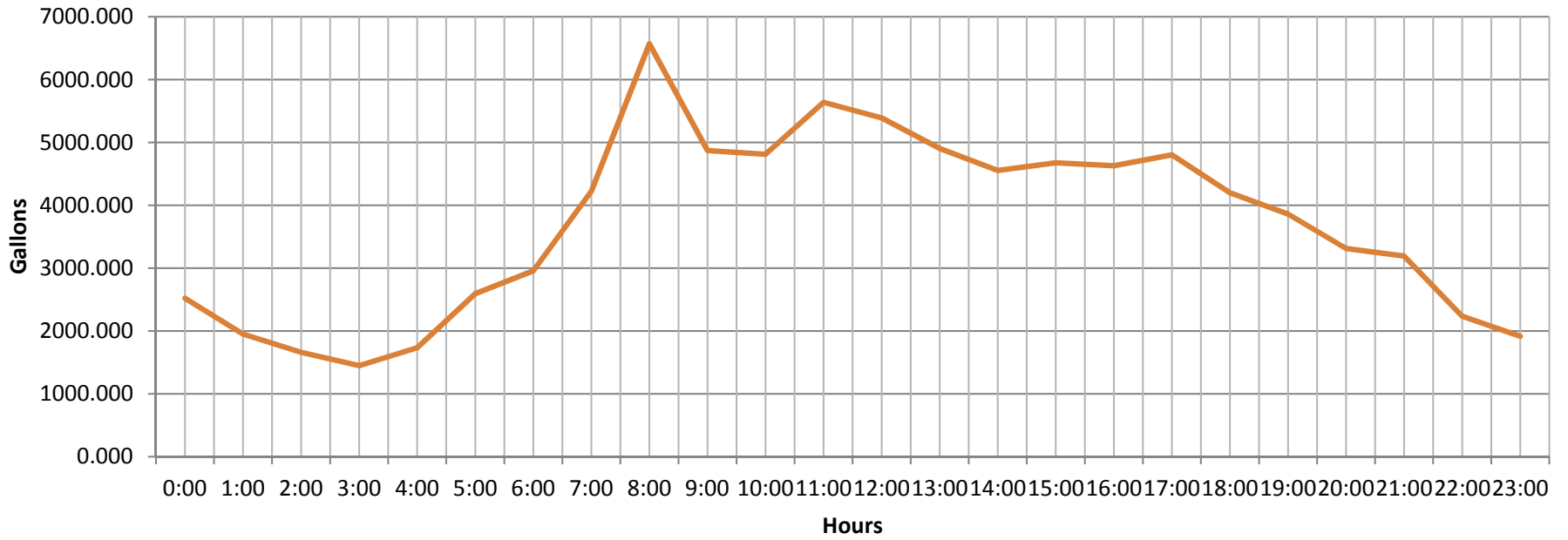


Manhole #3 - Ithan Avenue

April 20, 2015

Gallons Per Hour

Peak Gallons = 6,570 @ 8:00am

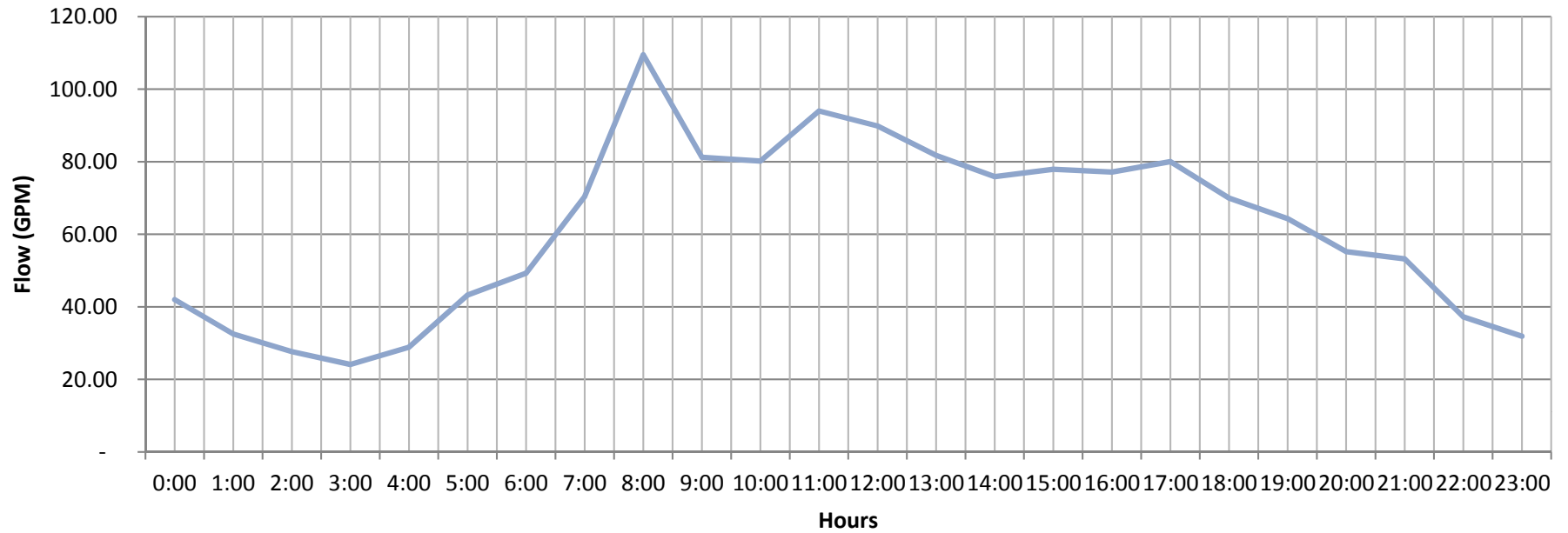


Manhole #3 - Ithan Avenue

April 20, 2015

Average GPM Per Hour

Peak Flow (GPM) = 109.49 @ 8:00am



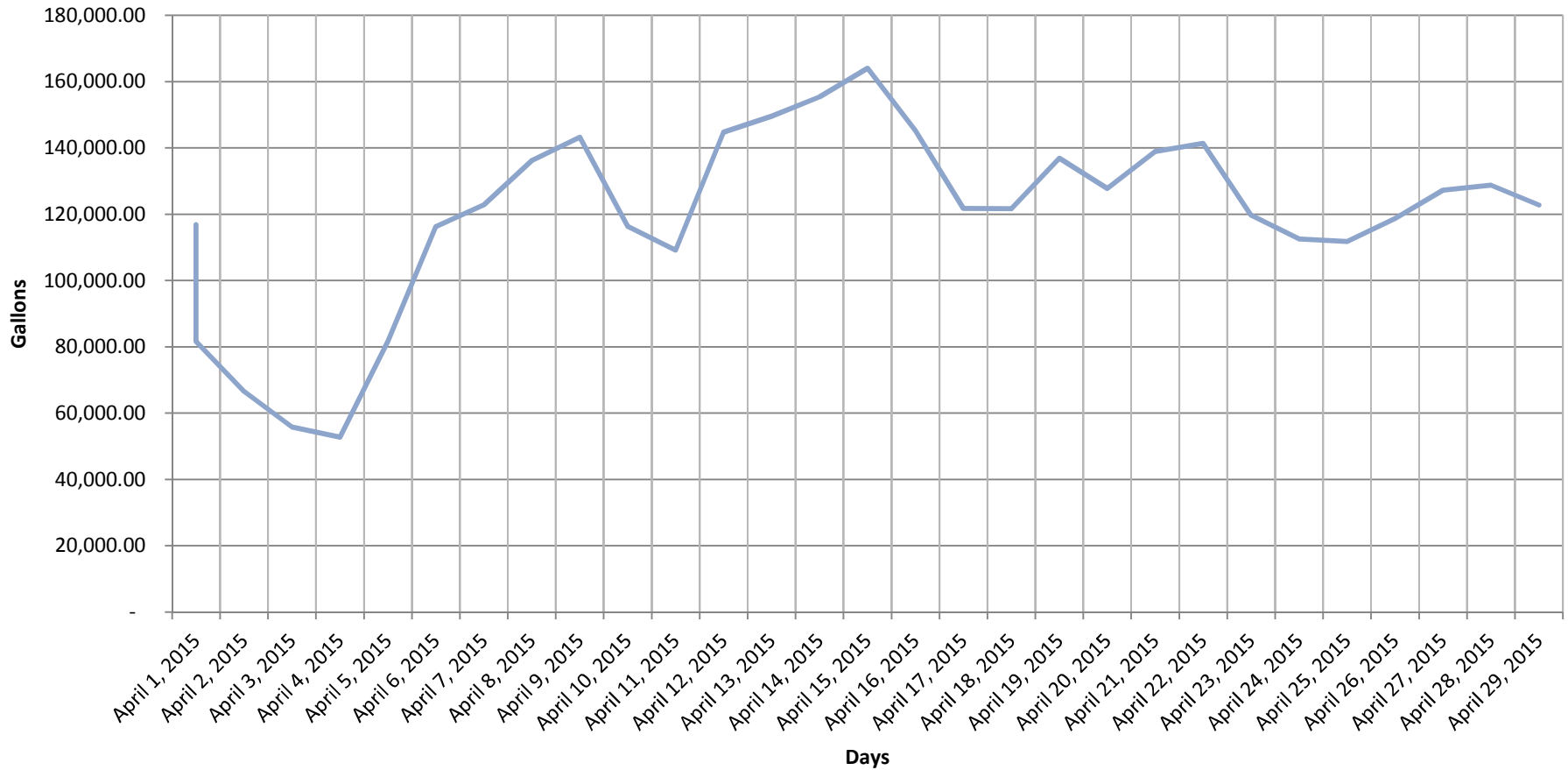
Manhole #5 - South of Jake Nevin

April 2015

Gallons Per Day

Average Gallons Per Day = 119,600

Peak Gallons = 164,011 on April 16

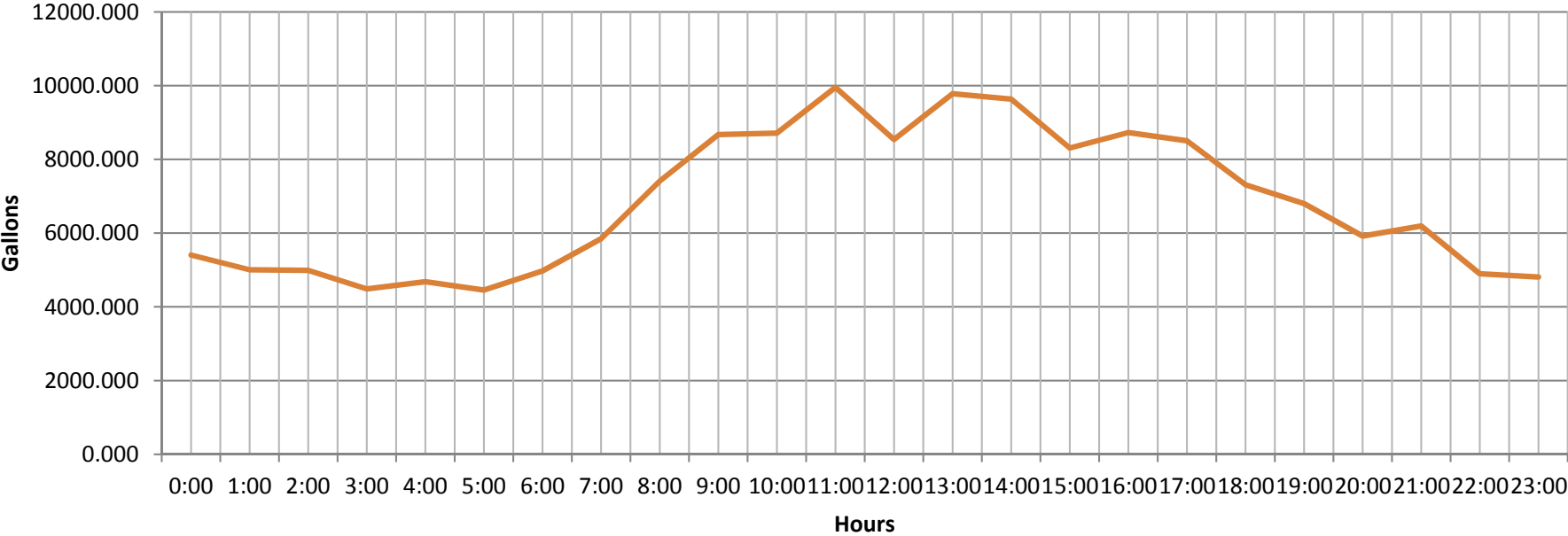


Manhole #5 - South of Jake Nevin

April 16, 2015

Gallons Per Hour

Peak Gallons = 9,955 @ 11:00am

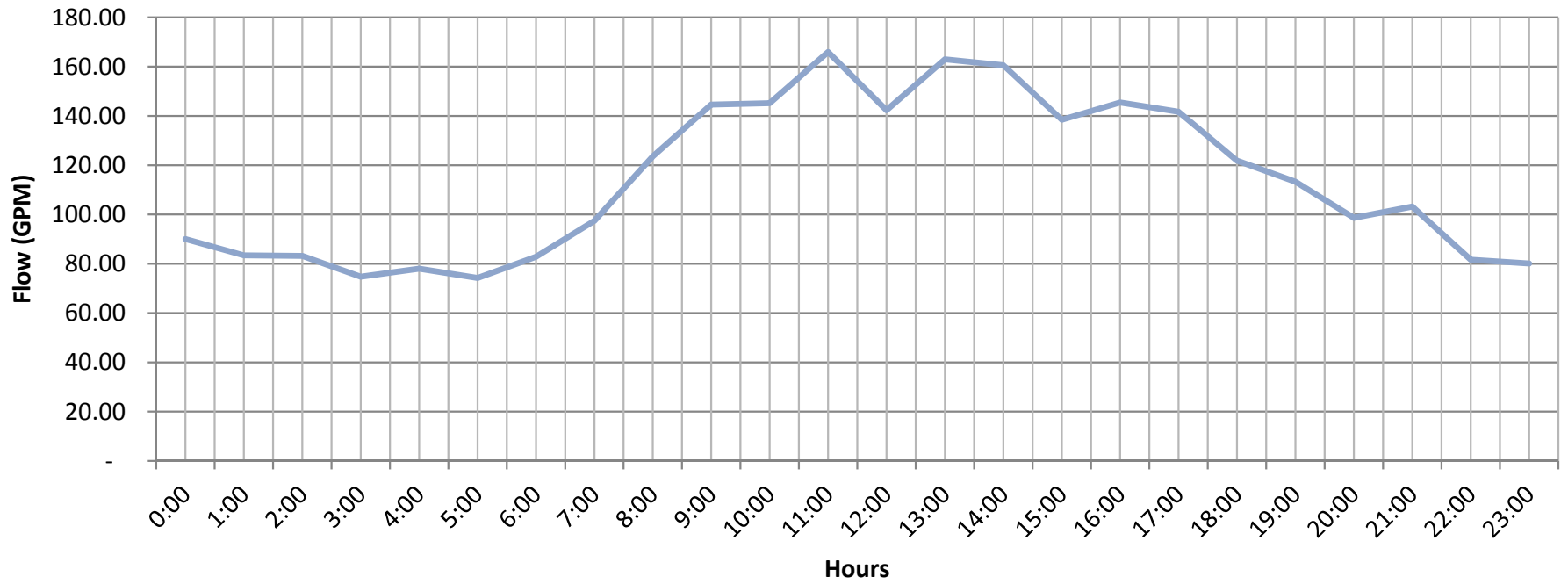


Manhole #5 - South of Jake Nevin

April 16, 2015

Average GPM Per Hour

Peak Flow (GPM) = 165.92 @ 11:00am



**Villanova University
Sanitary Study/Investigation
May - Gallons Per Day**

		Special Events	Manhole #1 West Campus	Manhole #3 Ithan Avenue	Manhole #5 South of Nevin
May 1, 2015	F	Last Day of Classes	92,715	68,286	101,233
May 2, 2015	S		98,355	55,068	92,684
May 3, 2015	S		97,511	58,171	61,927*
May 4, 2015	M		104,017	77,898	111,882*
May 5, 2015	T		97,295	71,417	133,784
May 6, 2015	W		87,925	61,623	120,353
May 7, 2015	T		88,504	62,340	116,566
May 8, 2015	F		78,016	68,815	120,295
May 9, 2015	S	Last Day of Finals	60,923	53,994	81,074
May 10, 2015	S		42,178	62,772	79,776
May 11, 2015	M		48,610	69,399	103,025
May 12, 2015	T		44,623	72,499	94,474
May 13, 2015	W		43,901	74,487	97,813
May 14, 2015	T		47,176	63,645	98,027
May 15, 2015	F	Graduation	60,558	68,402	106,502
May 16, 2015	S	Graduation	56,192	71,759	119,138
May 17, 2015	S	Dorms Empty	46,338	53,895	99,416
May 18, 2015	M		18,659	61,421	97,900
May 19, 2015	T	Contract Cleaners	31,992	59,696	87,394
May 20, 2015	W	Contract Cleaners	40,201	50,636	91,098
May 21, 2015	T	Contract Cleaners	45,310	52,673	93,514
May 22, 2015	F	Contract Cleaners	28,211	56,303	88,660
May 23, 2015	F	Contract Cleaners	12,900	54,240	75,590
May 24, 2015	S	Contract Cleaners	15,533	56,662	76,384
May 25, 2015	S	Contract Cleaners	19,381	55,368	91,153
May 26, 2015	M	Contract Cleaners	18,979	53,576	34,147*
May 27, 2015	T	Conferences	32,064	48,393	0
May 28, 2015	W	Conferences	45,618	46,090	0
May 29, 2015	T	Conferences	48,287	43,358	0
May 30, 2015	F	Conferences	49,185	41,349	0
May 31, 2015	S	Conferences	59,660	42,132	0
Total			1,660,817	1,836,367	2,265,853
Average Flow			53,575	59,238	95,147



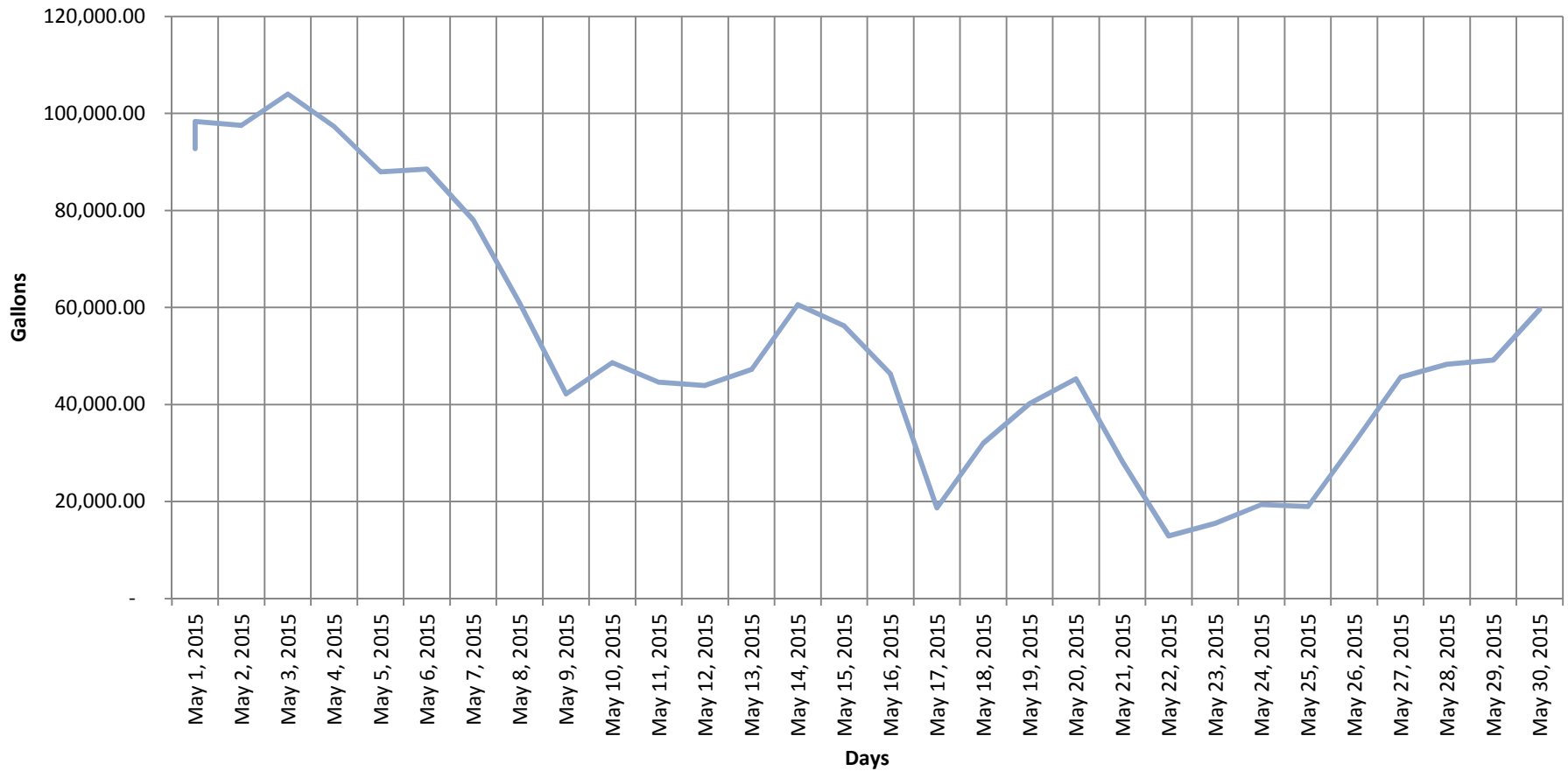
Denotes Peak Flow for the Month

61,927*

Denotes Partial Readings

Manhole #1 - West Campus May 2015 Gallons Per Day

Average Gallons Per Day = 53,575
Peak Gallons = 104,017 on May 4, 2015

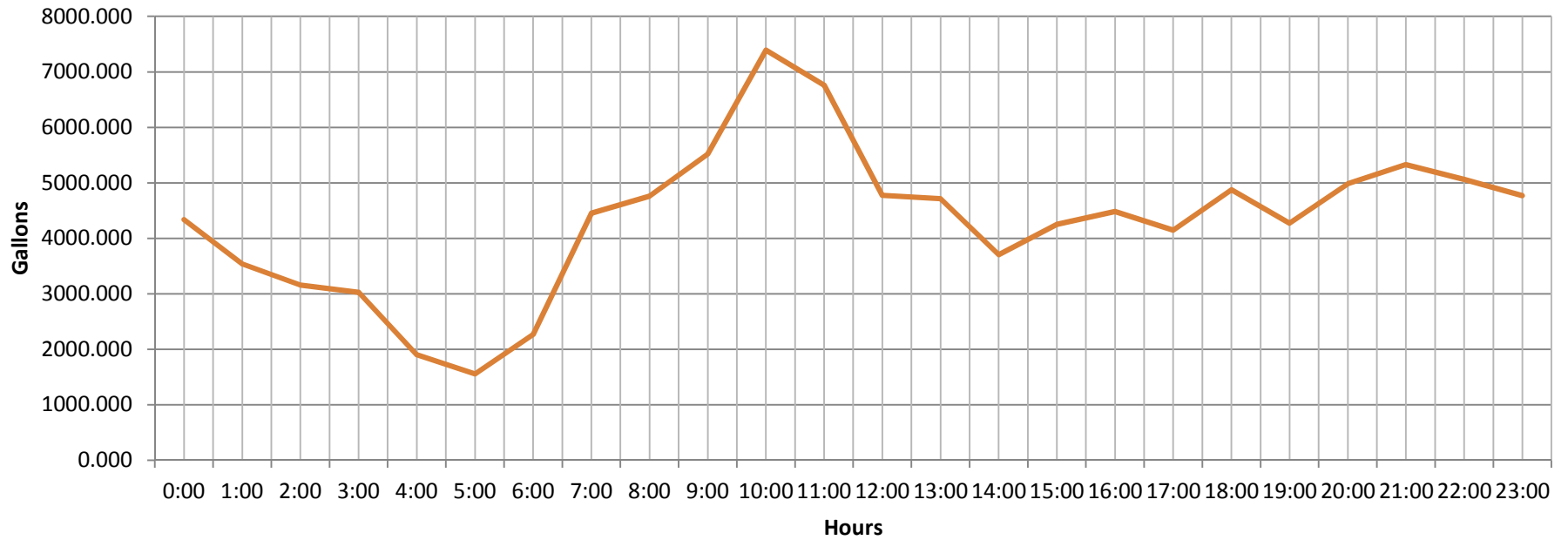


Manhole #1 - West Campus

May 4, 2015

Gallons Per Hour

Peak Gallons = 7373.44 @ 10:00am

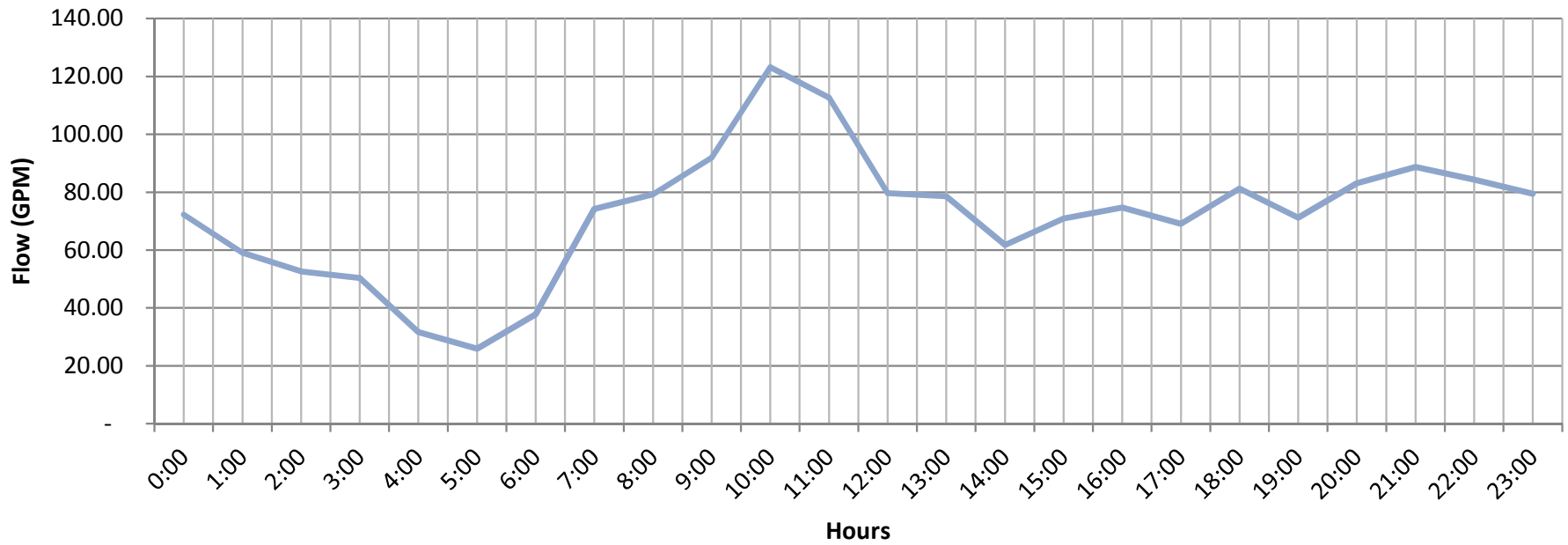


Manhole #1 - West Campus

May 4, 2015

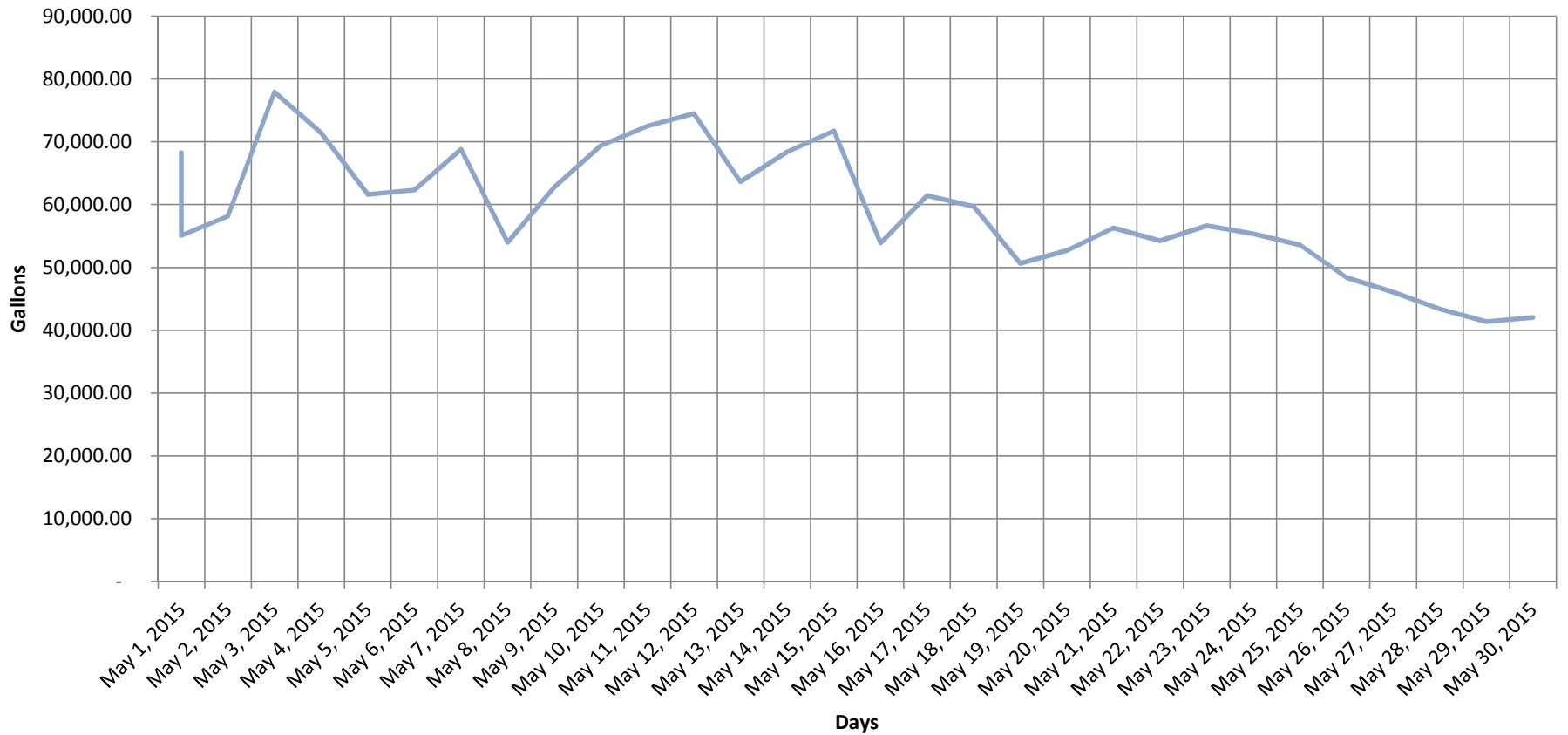
Average GPM Per Hour

Peak Flow (GPM) = 123.22 @ 10:00am



Manhole #3 - Ithan Avenue May 2015 Gallons Per Day

Average Gallons Per Day = 59,238
Peak Gallons = 77,898 on May 4, 2015

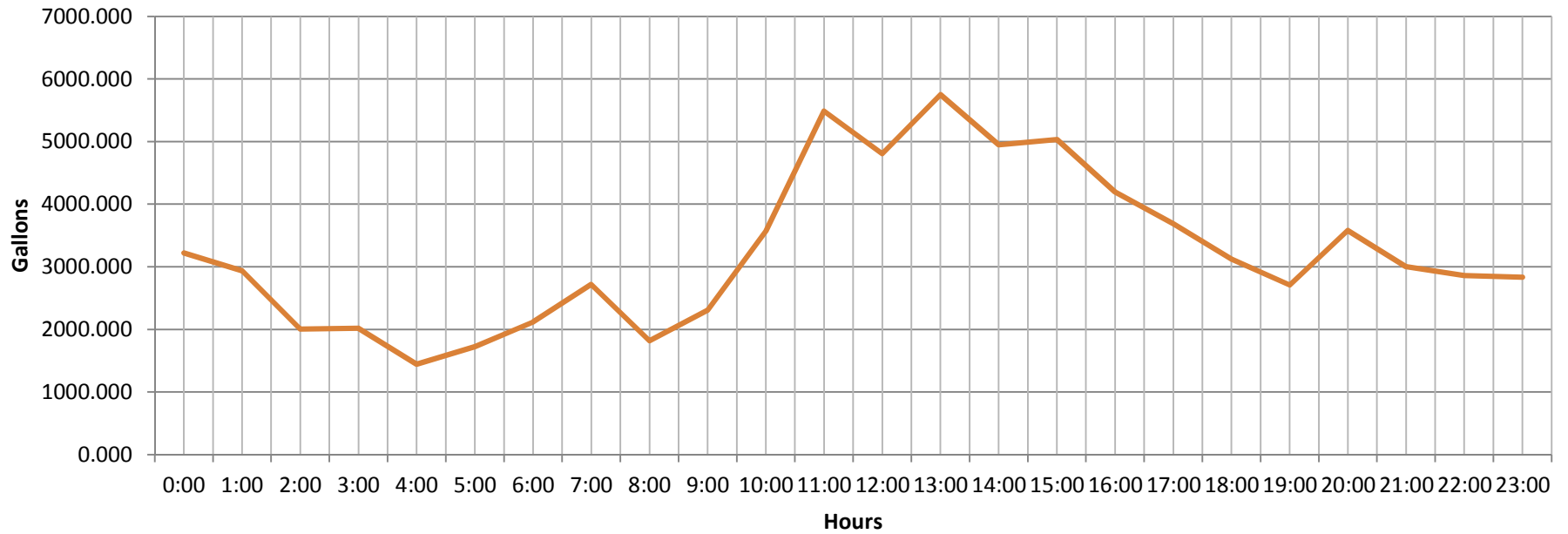


Manhole #3 - Ithan Avenue

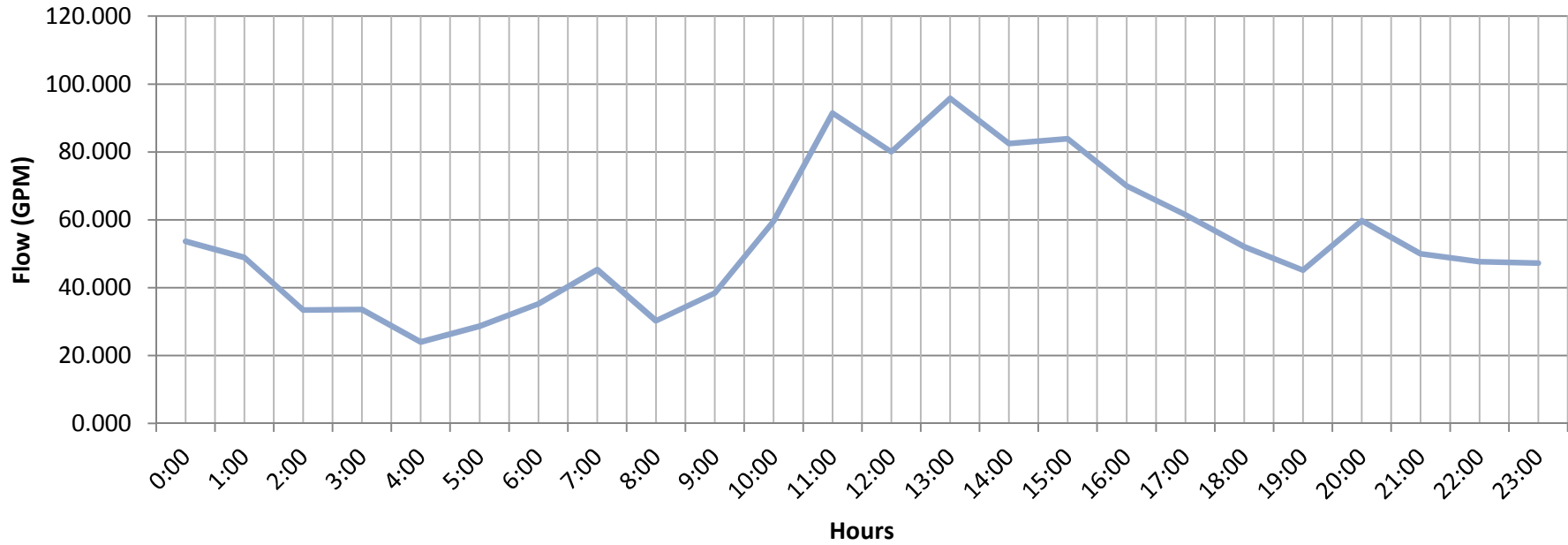
May 4, 2015

Gallons Per Hour

Peak Gallons = 5,750 @ 1:00pm



Manhole #3 - Ithan Avenue
May 4, 2015
Average GPM Per Hour
Peak Flow (GPM) = 95.826 @ 1:00pm

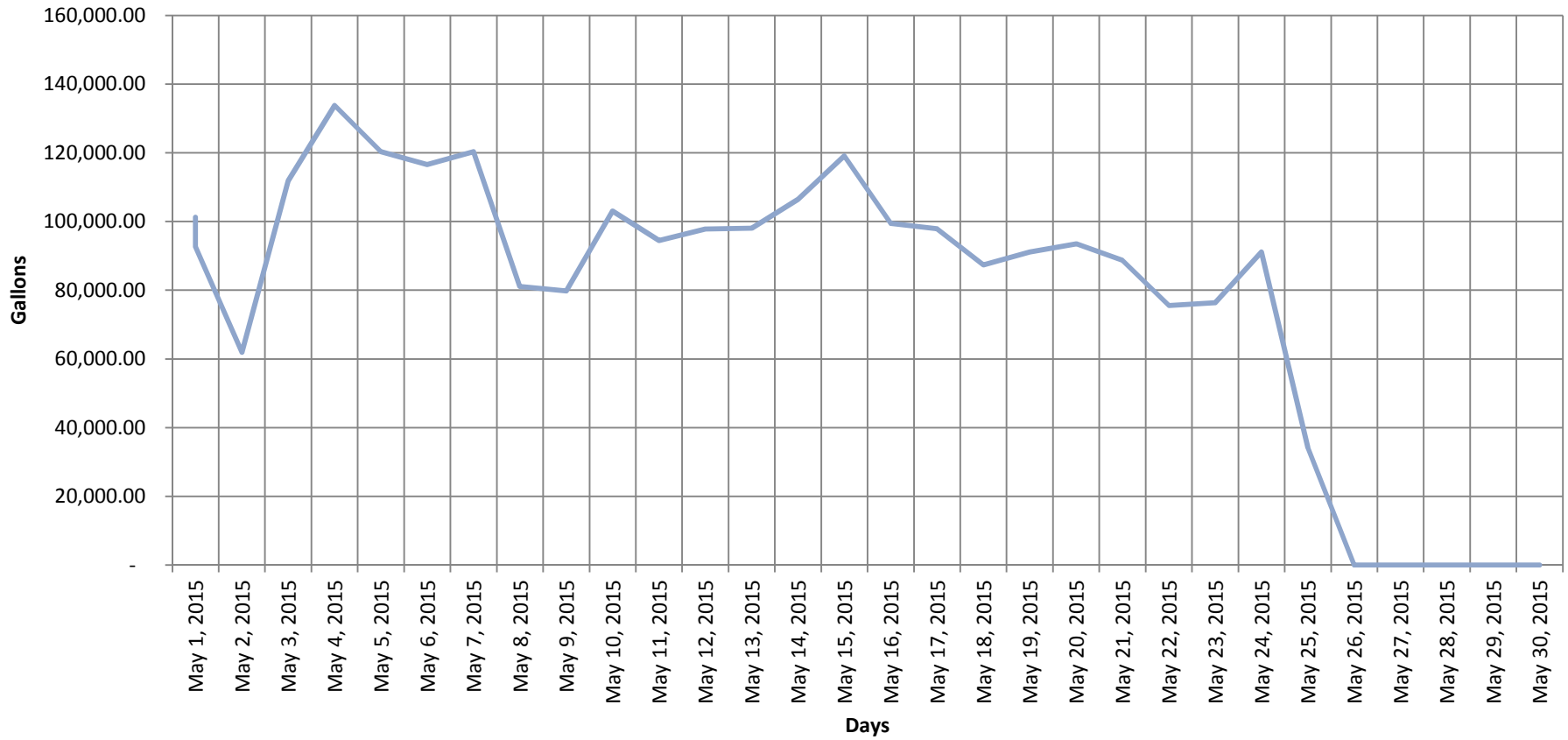


Manhole #5 - South of Jake Nevin

May 2015

Gallons Per Day

Average Gallons Per Day = 79,800
Peak Gallons = 133,784 on May 5, 2015

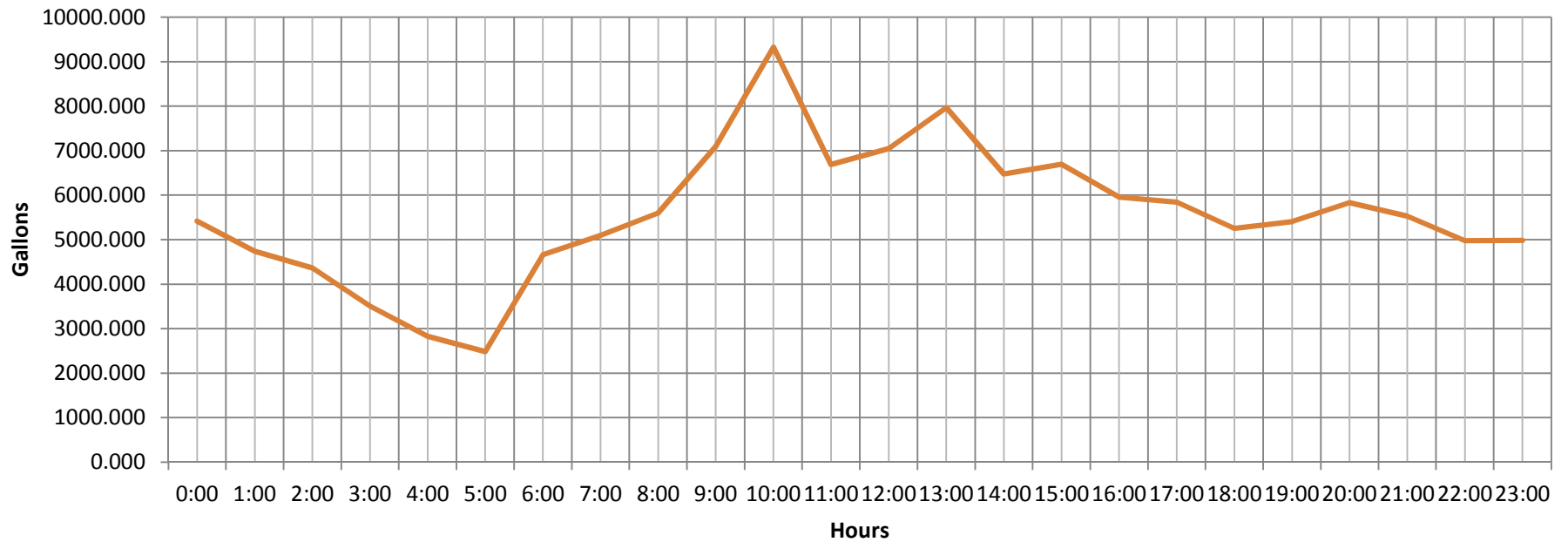


Manhole #5 - South of Jake Nevin

May 5, 2015

Gallons Per Hour

Peak Gallons = 9,328 @ 10:00am

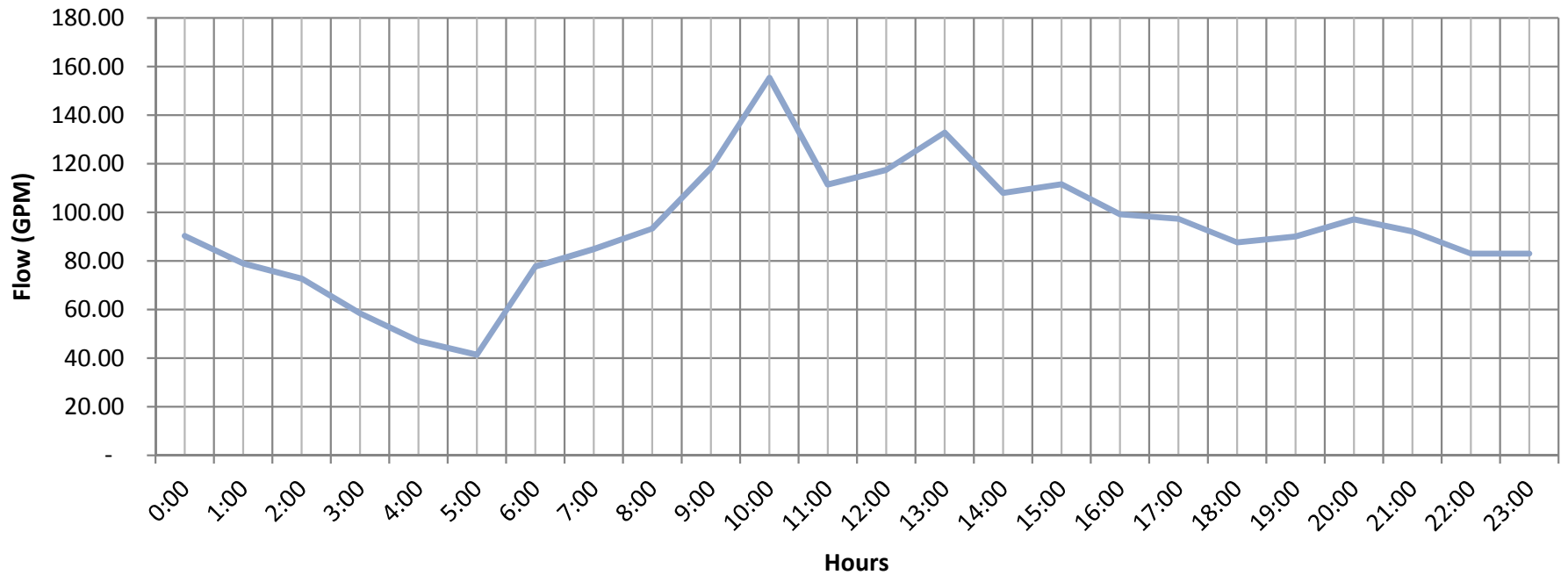


Manhole #5 - South of Jake Nevin

May 5, 2015

Average GPM Per Hour

Peak Flow (GPM) = 155.47 @ 10:00am



Water Usage Data

Villanova University - AQUA Bills

Account Number: 000177916 0177916

Service To: Villanova University - **West Campus (Includes Residential Halls and St Mary Hall)**

Meter: 56564264 (Old) - 14029057 (New)

Size: 6"

Billing Period	Days	Usage	Units	Ave Daily Usage
02/10/15 - 03/11/15	29	2,567,600	Gallons	88,537
03-11-15 - 04/13/15	33	2,009,500	Gallons	60,893
04/13/15 - 05/12/15	29	3,134,700	Gallons	108,093
05/12/15 - 06/11/15	30	2,227,100	Gallons	74,236

Account Number: 000349452 0349452

Service To: Villanova University - **Main**

Meter: 11019676

Size: 10"

Billing Period	Days	Usage	Units	Ave Daily Usage
03/03/15 - 04/07/15	32	5,061,000	Gallons	158,156
04/07/15 - 05/06/15	29	5,389,000	Gallons	185,827
05/06/15 - 06/05/15	30	5,016,000	Gallons	167,200

Villanova University - AQUA vs Monitored

Account Number: 000177916 0177916

Service To: Villanova University - **West Campus (Includes Residential Halls and St Mary Hall)**

Meter: 56564264 (Old) - 14029057 (New)

Size: 6"

AQUA				Monitored (Manhole #1)			
Billing Period	Days	Usage	Ave Daily Usage	Dates	Days	Flow	Ave Daily Flow
02/10/15 - 03/11/15	29	2,567,600	88,537	2/24/15 - 03/11/15	15	1,168,454	77,897
03/11/15 - 04/13/15	33	2,009,500	60,893	03/11/15 - 04/13/15	33	3,059,650	92,717
04/13/15 - 05/12/15	29	3,134,700	108,093	04/13/15 - 05/12/15	29	2,676,740	92,301
05/12/15 - 06/11/15	30	2,227,100	74,236	05/12/15 - 05/31/15	19.5	698,952	35,844

Account Number: 000349452 0349452

Service To: Villanova University - **Main**

Meter: 11019676

Size: 10"

AQUA				Monitored (Manhole #5)			
Billing Period	Days	Usage	Ave Daily Usage	Dates	Days	Flow	Ave Daily Flow
03/06/15 - 04/07/15	32	5,061,000	158,156	03/06/2015 - 04/07/15	32	3,465,108	108,285
04/07/15 - 05/06/15	29	5,389,000	185,827	04/07/15 - 05/06/15	29	3,646,274	125,734
05/06/15 - 06/05/15	30	5,016,000	167,200	05/06/15 - 05/31/15	20	1,914,064	95,703

Rainfall Data

Rainfall Data
Weather History for KLOM (Wings Field)
Source: wunderground.com

March

Date	Precip	Date	Precip	Date	Precip	Date	Precip	Date	Precip	Date	Precip
2015-3-1	0.33	2014-3-1	0	2013-3-1	0	2012-3-1	0.09	2011-3-1	0.01	2010-3-1	0
2015-3-2	0	2014-3-2	0.06	2013-3-2	0	2012-3-2	0.01	2011-3-2	0	2010-3-2	0
2015-3-3	0.37	2014-3-3	0	2013-3-3	0	2012-3-3	0.07	2011-3-3	0	2010-3-3	0.02
2015-3-4	0.45	2014-3-4	0	2013-3-4	0	2012-3-4	0	2011-3-4	0	2010-3-4	0
2015-3-5	0.42	2014-3-5	0	2013-3-5	0	2012-3-5	0	2011-3-5	0	2010-3-5	0
2015-3-6	0	2014-3-6	0	2013-3-6	0	2012-3-6	0	2011-3-6	2	2010-3-6	0
2015-3-7	0	2014-3-7	0			2012-3-7	0	2011-3-7	0.04	2010-3-7	0
2015-3-8	0	2014-3-8	0	2013-3-8	0.01	2012-3-8	0	2011-3-8	0	2010-3-8	0
2015-3-9	0	2014-3-9	0.03	2013-3-9	0	2012-3-9	0.04	2011-3-9	0	2010-3-9	0
2015-3-10	0.51	2014-3-10	0	2013-3-10	0	2012-3-10	0	2011-3-10	0.95	2010-3-10	0.11
2015-3-11	0.04	2014-3-11	0	2013-3-11	0	2012-3-11	0	2011-3-11	0.21	2010-3-11	0
2015-3-12	0	2014-3-12	0.31	2013-3-12	0.61	2012-3-12	0	2011-3-12	0	2010-3-12	0.14
2015-3-13	0	2014-3-13	0	2013-3-13	0	2012-3-13	0.07	2011-3-13	0	2010-3-13	1.06
2015-3-14	0.69	2014-3-14	0	2013-3-14	0	2012-3-14	0	2011-3-14	0	2010-3-14	0.35
2015-3-15	0	2014-3-15	0	2013-3-15	0	2012-3-15	0	2011-3-15	0	2010-3-15	0.15
2015-3-16	0	2014-3-16	0	2013-3-16	0.08	2012-3-16	0.01	2011-3-16	0.5	2010-3-16	0.01
2015-3-17	0	2014-3-17	0	2013-3-17	0	2012-3-17	0	2011-3-17	0	2010-3-17	0
2015-3-18	0	2014-3-18	0	2013-3-18	0.29	2012-3-18	0	2011-3-18	0	2010-3-18	0
2015-3-19	0	2014-3-19	0.45	2013-3-19	0.15	2012-3-19	0	2011-3-19	0	2010-3-19	0
2015-3-20	0.26	2014-3-20	0	2013-3-20	0	2012-3-20	0	2011-3-20	0	2010-3-20	0
2015-3-21	0	2014-3-21	0	2013-3-21	0	2012-3-21	0	2011-3-21	0.45	2010-3-21	0
2015-3-22	0	2014-3-22	0	2013-3-22	0	2012-3-22	0	2011-3-22	0	2010-3-22	0.36
2015-3-23	0	2014-3-23	0	2013-3-23	0	2012-3-23	0	2011-3-23	0.28	2010-3-23	0.01
2015-3-24	0	2014-3-24	0	2013-3-24	0	2012-3-24	0	2011-3-24	0.01	2010-3-24	0
2015-3-25	0.08	2014-3-25	0.01	2013-3-25	0.24	2012-3-25	0.01	2011-3-25	0	2010-3-25	0
2015-3-26	0.31	2014-3-26	0	2013-3-26	0	2012-3-26	0	2011-3-26	0	2010-3-26	0.15
2015-3-27	0.31	2014-3-27	0	2013-3-27	0	2012-3-27	0	2011-3-27	0	2010-3-27	0
2015-3-28	0	2014-3-28	0.03	2013-3-28	0	2012-3-28	0	2011-3-28	0	2010-3-28	0.19
2015-3-29	0	2014-3-29	0.85	2013-3-29	0	2012-3-29	0	2011-3-29	0	2010-3-29	0.9
2015-3-30	0	2014-3-30	0.71	2013-3-30	0	2012-3-30	0	2011-3-30	0	2010-3-30	1.36
2015-3-31	0.05	2014-3-31	0.01	2013-3-31	0.04	2012-3-31	0.32	2011-3-31	0.1	2010-3-31	0.04
Total	3.82		2.46		1.42		0.62		4.55		4.85

Rainfall Data
Weather History for KLOM (Wings Field)
Source: wunderground.com

April

Date	Precip	Date	Precip	Date	Precip	Date	Precip	Date	Precip	Date	Precip
2015-4-1	0	2014-4-1	0	2013-4-1	0.01	2012-4-1	0	2011-4-1	0.2	2010-4-1	0
2015-4-2	0	2014-4-2	0.06	2013-4-2	0	2012-4-2	0.06	2011-4-2	0	2010-4-2	0
2015-4-3	0.04	2014-4-3	0.11	2013-4-3	0	2012-4-3	0	2011-4-3	0	2010-4-3	0
2015-4-4	0.01	2014-4-4	0.07	2013-4-4	0	2012-4-4	0.01	2011-4-4	0	2010-4-4	0
2015-4-5	0	2014-4-5	0.01	2013-4-5	0	2012-4-5	0	2011-4-5	0.4	2010-4-5	0
2015-4-6	0	2014-4-6	0	2013-4-6	0	2012-4-6	0	2011-4-6	0	2010-4-6	0
2015-4-7	0.01	2014-4-7	0.17	2013-4-7	0	2012-4-7	0	2011-4-7	0	2010-4-7	0
2015-4-8	0.03	2014-4-8	0.03	2013-4-8	0	2012-4-8	0	2011-4-8	0.4	2010-4-8	0
2015-4-9	0.02	2014-4-9	0	2013-4-9	0	2012-4-9	0	2011-4-9	0.06	2010-4-9	0.27
2015-4-10	0.03	2014-4-10	0	2013-4-10	0.48	2012-4-10	0	2011-4-10	0	2010-4-10	0
2015-4-11	0	2014-4-11	0	2013-4-11	0	2012-4-11	0	2011-4-11	0	2010-4-11	0
2015-4-12	0	2014-4-12	0	2013-4-12	0.48	2012-4-12	0	2011-4-12	0.43	2010-4-12	0
2015-4-13	0	2014-4-13	0	2013-4-13	0.01	2012-4-13	0	2011-4-13	0.09	2010-4-13	0.11
2015-4-14	0.03	2014-4-14	0	2013-4-14	0	2012-4-14	0	2011-4-14	0	2010-4-14	0
2015-4-15	0	2014-4-15	1.12	2013-4-15	0	2012-4-15	0	2011-4-15	0	2010-4-15	0
2015-4-16	0	2014-4-16	0	2013-4-16	0	2012-4-16	0	2011-4-16	0.99	2010-4-16	0.05
2015-4-17	0.07	2014-4-17	0	2013-4-17	0	2012-4-17	0	2011-4-17	0.06	2010-4-17	0.02
2015-4-18	0	2014-4-18	0	2013-4-18	0	2012-4-18	0.02	2011-4-18	0	2010-4-18	0
2015-4-19	0.01	2014-4-19	0	2013-4-19	0.47	2012-4-19	0.01	2011-4-19	0.07	2010-4-19	0
2015-4-20	1.42	2014-4-20	0	2013-4-20	0.09	2012-4-20	0	2011-4-20	0	2010-4-20	0
2015-4-21	0.35	2014-4-21	0	2013-4-21	0	2012-4-21	0.32	2011-4-21	0	2010-4-21	0.02
2015-4-22	0.1	2014-4-22	0.07	2013-4-22	0	2012-4-22	1.25	2011-4-22	0	2010-4-22	0
2015-4-23	0	2014-4-23	0	2013-4-23	0	2012-4-23	0.16	2011-4-23	0.28	2010-4-23	0
2015-4-24	0	2014-4-24	0	2013-4-24	0	2012-4-24	0	2011-4-24	0.14	2010-4-24	0
2015-4-25	0	2014-4-25	0.15	2013-4-25	0	2012-4-25	0	2011-4-25	0.01	2010-4-25	0.52
2015-4-26	0	2014-4-26	0.17	2013-4-26	0	2012-4-26	0	2011-4-26	0	2010-4-26	0.41
2015-4-27	0	2014-4-27	0	2013-4-27	0	2012-4-27	0	2011-4-27	0.05	2010-4-27	0.04
2015-4-28	0	2014-4-28	0	2013-4-28	0	2012-4-28	0	2011-4-28	0.17	2010-4-28	0
2015-4-29	0	2014-4-29	0.16	2013-4-29	0.26	2012-4-29	0	2011-4-29	0	2010-4-29	0
2015-4-30	0	2014-4-30	2.55	2013-4-30	0.02	2012-4-30	0	2011-4-30	0	2010-4-30	0
Total	2.12		4.67		1.82		1.83		3.35		1.44

Rainfall Data
Weather History for KLOM (Wings Field)
Source: wunderground.com

May

Date	Precip	Date	Precip	Date	Precip	Date	Precip	Date	Precip	Date	Precip
2015-5-1	0	2014-5-1	0.04	2013-5-1	0	2012-5-1	0.29	2011-5-1	0	2010-5-1	0
2015-5-2	0			2013-5-2	0	2012-5-2	0.08	2011-5-2	0	2010-5-2	0
2015-5-3	0			2013-5-3	0	2012-5-3	0.14	2011-5-3	0	2010-5-3	0.64
2015-5-4	0			2013-5-4	0	2012-5-4	0.28	2011-5-4	0.39	2010-5-4	0
2015-5-5	0			2013-5-5	0	2012-5-5	0	2011-5-5	0	2010-5-5	0
2015-5-6	0	2014-5-6	0	2013-5-6	0	2012-5-6	0	2011-5-6	0	2010-5-6	0
2015-5-7	0	2014-5-7	0	2013-5-7	0.1	2012-5-7	0	2011-5-7	0	2010-5-7	0
2015-5-8	0	2014-5-8	0	2013-5-8	0.37	2012-5-8	0.04	2011-5-8	0	2010-5-8	0
2015-5-9	0	2014-5-9	0	2013-5-9	0.04	2012-5-9	0.38	2011-5-9	0	2010-5-9	0
2015-5-10	0	2014-5-10	0.32	2013-5-10	0.41	2012-5-10	0.09	2011-5-10	0	2010-5-10	0
2015-5-11	0	2014-5-11	0	2013-5-11	0.42	2012-5-11	0	2011-5-11	0	2010-5-11	0.02
2015-5-12	0	2014-5-12	0	2013-5-12	0	2012-5-12	0	2011-5-12	0	2010-5-12	0.46
2015-5-13	0	2014-5-13	0	2013-5-13	0	2012-5-13	0	2011-5-13	0	2010-5-13	0
2015-5-14	0	2014-5-14	0	2013-5-14	0	2012-5-14	0.09	2011-5-14	0.06	2010-5-14	0
2015-5-15	0	2014-5-15	0	2013-5-15	0	2012-5-15	0.74	2011-5-15	0.54	2010-5-15	0
2015-5-16	0.06	2014-5-16	2.21	2013-5-16	0.04	2012-5-16	0.86	2011-5-16	0	2010-5-16	0
2015-5-17	0	2014-5-17	0	2013-5-17	0	2012-5-17	0	2011-5-17	0.18	2010-5-17	0
2015-5-18	0	2014-5-18	0			2012-5-18	0	2011-5-18	0.13	2010-5-18	0.98
2015-5-19	0.01	2014-5-19	0			2012-5-19	0	2011-5-19	0.78	2010-5-19	0
2015-5-20	0	2014-5-20	0.01			2012-5-20	0	2011-5-20	0.56	2010-5-20	0
2015-5-21	0.01	2014-5-21	0.02	2013-5-21	0	2012-5-21	0.11	2011-5-21	0	2010-5-21	0
2015-5-22	0	2014-5-22	0.54	2013-5-22	0	2012-5-22	0.03	2011-5-22	0	2010-5-22	0.28
2015-5-23	0	2014-5-23	0.01	2013-5-23	0.68	2012-5-23	0.08	2011-5-23	0.29	2010-5-23	0.03
2015-5-24	0	2014-5-24	0	2013-5-24	0.11	2012-5-24	0.39	2011-5-24	0	2010-5-24	0.02
2015-5-25	0	2014-5-25	0	2013-5-25	0	2012-5-25	0	2011-5-25	0	2010-5-25	0
2015-5-26	0	2014-5-26	0	2013-5-26	0	2012-5-26	0	2011-5-26	0	2010-5-26	0
2015-5-27	0.19	2014-5-27	0.64	2013-5-27	0	2012-5-27	0.37	2011-5-27	0	2010-5-27	0
2015-5-28	0.02	2014-5-28	0.81	2013-5-28	0.24	2012-5-28	0	2011-5-28	0	2010-5-28	0.03
2015-5-29	0	2014-5-29	0	2013-5-29	0	2012-5-29	0.22	2011-5-29	0	2010-5-29	0.02
2015-5-30	0	2014-5-30	0	2013-5-30	0	2012-5-30	0.03	2011-5-30	0	2010-5-30	0.19
2015-5-31	0	2014-5-31	0	2013-5-31	0	2012-5-31	0	2011-5-31	0	2010-5-31	0
Total	0.29		4.6		2.41		4.22		2.93		2.67