Memorandum

Date: May 27, 2020

To: David Casper, Commissioner
Bruce Siebers, Commissioner
Kevin Coffey, Commissioner
Patrick Hennessey, Commissioner
John Sundelius, Commissioner
Brian Helminger, District Manager
Chad Giackino, Regulatory Compliance Manager

Copy: John Neumeier and John Sundelius, City of Kaukauna
Kent Taylor, Village of Little Chute
Michael Kawula, Darboy Sanitary District No. 1
Allyn Dannhoff, Village of Kimberly
Racquel Shampo-Giese, Village of Combined Locks
Dawn Bartel, HOVMSD
Mike Gerbitz, Donohue & Associates

From: Joe Holzwart, Donohue & Associates

Re: 2019 Annual Flow Summary
Heart of the Valley Metropolitan Sewerage District

The following memorandum documents the analysis and observations of the 2019 clear water (inflow and infiltration) flow component of the overall HOVMSD wastewater flow.

HOVMSD SUSTAINABILTY PROGRAM

HOVMSD has implemented a self-regulated sustainability program to maintain, monitor, and regulate flow to the WWTP. The goal of the sustainability program is to maintain or extend the longevity of the WWTP and interceptor hydraulic capacity by not increasing the existing level of clear water in the system and decreasing the clear water entering the system where possible.

Performance indicators provide a degree of insight to relative volume of clear water that is entering the system from the HOVMSD member communities and to the impacts of the clear water on the system. For the 2019 yearly evaluation, Donohue reviewed performance indicators from the following sources:

1. Observations at the HOVMSD wastewater treatment plant,
2. Analysis of the clear water components of flow through the Antecedent Moisture Model (AMM),
3. Analysis of the clear water components of flow identified in the Compliance Maintenance Annual Reports (CMAR) for each member community.

The following sections of the memorandum document the observations and analysis of the performance indicators listed above.

OBSERVATIONS AT HOVMSD WASTEWATER TREATMENT PLANT

The performance of the HOVMSD plant is ultimately the issue of greatest concern for the Wisconsin Department of Natural Resources (WDNR). If there are permit violations or steadily increasing secondary treatment diversion events and volumes, the WDNR may increase their oversight or impose/reinstate flow reduction mandates.

TABLE 1- PLANT PERFORMANCE

YEAR	PLANT FLOW (million gallons)	ANNUAL REPORTED PRECIPITATION (inches)	NUMBER OF SECONDARY TREATMENT DIVERSIONS	VOLUME OF DIVERTED FLOW (million gallons/year)
2010	2,391.17	32.25	3	16.618
2011	2,359.30	30.08	1	3.998
2012	1,844.61	17.89	0	0
2013	2,014.11	27.14	1	0.562
2014	2,079.44	29.34	2	3.549
2015	1,887.99	29.93	3	2.185
2016	2,020.67	27.71	0	0
2017	2,094.20	26.89	0	0
2018	2,127.69	31.01	5	2.062
2019	2,446.47	40.14	4	1.115

In 2019, the annual precipitation as recorded by the rain gauge located at the plant combined with NOAA data when the plant rain gauge was not active was 40.14 inches.

HOVMSD had four rainfall events that generated flows in excess of the plant capacity requiring the plant to utilize the secondary diversion facility to treat a total volume of 1.115 million gallons. Specific details of the plant's secondary treatment events are shown in the following table.

TABLE 2 - PLANT SECONDARY TREATMENT DIVERSION DETAILS			
DATE	PLANT FLOW (million gallons)	FOX ENERGY PUMPING (million gallons)	VOLUME OF DIVERTED FLOW (million gallons/event)
July 14, 2010	30.824	2.240	12.304
July 15, 2010	21.535	2.045	1.954
August 11, 2010	19.408	0.832	2.360
April 26, 2011	27.177	0.763	3.998
2012 - None			
April 10, 2013	22.526	2.221	0.562
April 14, 2014	21.435	0.050	1.718
May 12, 2014	21.958	1.505	1.831
June 15, 2015	15.934	3.277	0.800
September 8, 2015	15.346	2.453	0.027
December 14, 2015	30.390	1.877	1.358
2016 – None			
2017 – None			
May 4, 2018	23.269	0	0.750
June 18, 2018	13.728	2.400	0.382
August 28, 2018	20.056	3.607	0.392
September 4, 2018	21.826	1.865	0.418
October 10, 2018	18.291	3.390	0.120
March 14, 2019	23.969	1.998	0.474
April 23, 2019	12.194	3.171	0.172
May 27, 2019	17.216	0.957	0.084
September 11, 2019	21.155	2.611	0.385

It was observed in 2019 that the volume of blended flow per event was less than 0.5 million gallons for all four occurrences. To further evaluate this condition, the volume of blended flow for an event was divided by the overall plant flow for that same event. The results are shown on the following graph, and illustrate that the facility has consistently reduced the ratio of blended flow to total plant flow. This is evidence that the operations staff have been instrumental in reducing the volume of blended flow discharge to the Fox River.

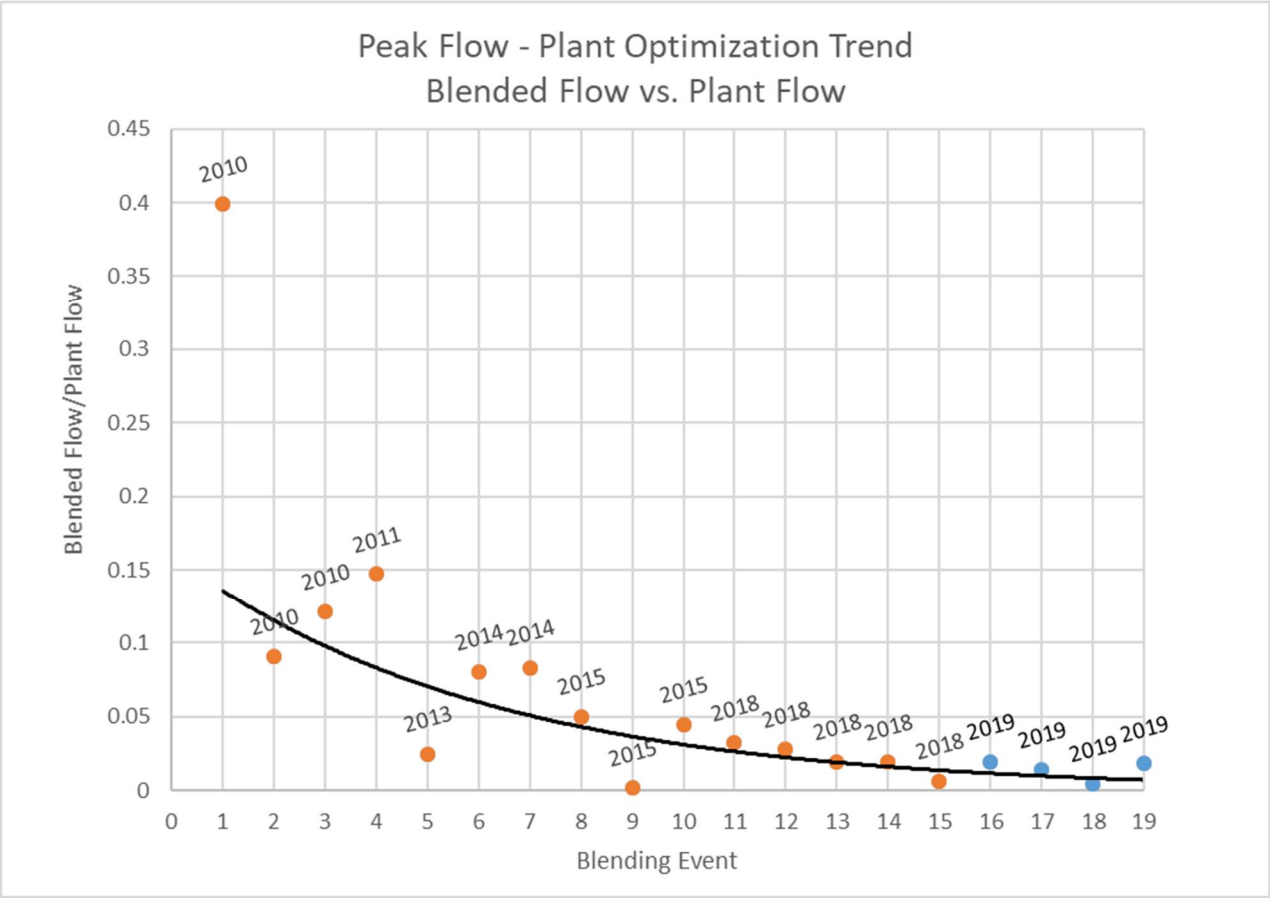


FIGURE 1 - PLANT OPTIMIZATION TREND

STORM EVENT IDENTIFICATION

The top ten rainfall events in 2019 were identified and are summarized in the table below. Although measured rainfall may only be a few hours for a specific event, the flow evaluation period may extend several days beyond the point of last rain drop. An evaluated event period begins at the start of event measured rainfall and ends when sewer flows return to pre-storm conditions or when a new rainfall that was not part of the event starts. The latter case is denoted as N/A in the rightmost column in the below table.

TABLE 3 - TOP RAINFALL EVENTS IN 2019

EVENT	RAIN DATES	RAINFALL DURATION	RAINFALL AVERAGE (inches)	* PLANT BYPASS OCCURRED ON	FLOW EVENT DATES	NO. OF DAYS AFTER RAINFALL FOR FLOW TO NORMALIZE
1	9/9 – 9/13 *	3.4 days	4.44	9/11	9/9 – 9/18	5
2	10/1 – 10/2	1.7 days	1.60		10/1 – 10/5	N/A
3	5/27 – 5/28 *	10 hours	1.60	5/27	5/27 – 6/1	N/A
4	7/19 – 7/20	1.8 days	1.50		7/19 – 7/25	5
5	8/5	6.3 hours	1.28	4/23	8/5 – 8/7	N/A
6	4/22 – 4/23	7.7 hours	0.89		7/25 – 8/1	N/A
7	8/7 – 8/8	10 hours	0.85		8/7 – 8/12	4
8	5/8	10 hours	0.76		5/8 – 5/13	5
9	5/18 – 5/19	15 hours	0.72		5/18 – 5/21	N/A
10	8/3	3.5 hours	0.72		8/3 – 8/5	N/A

Notes:
1- Rainfall data available from April 1, 2019 to October 30, 2019.
2- No rainfall data was available for 3/14 blending event.

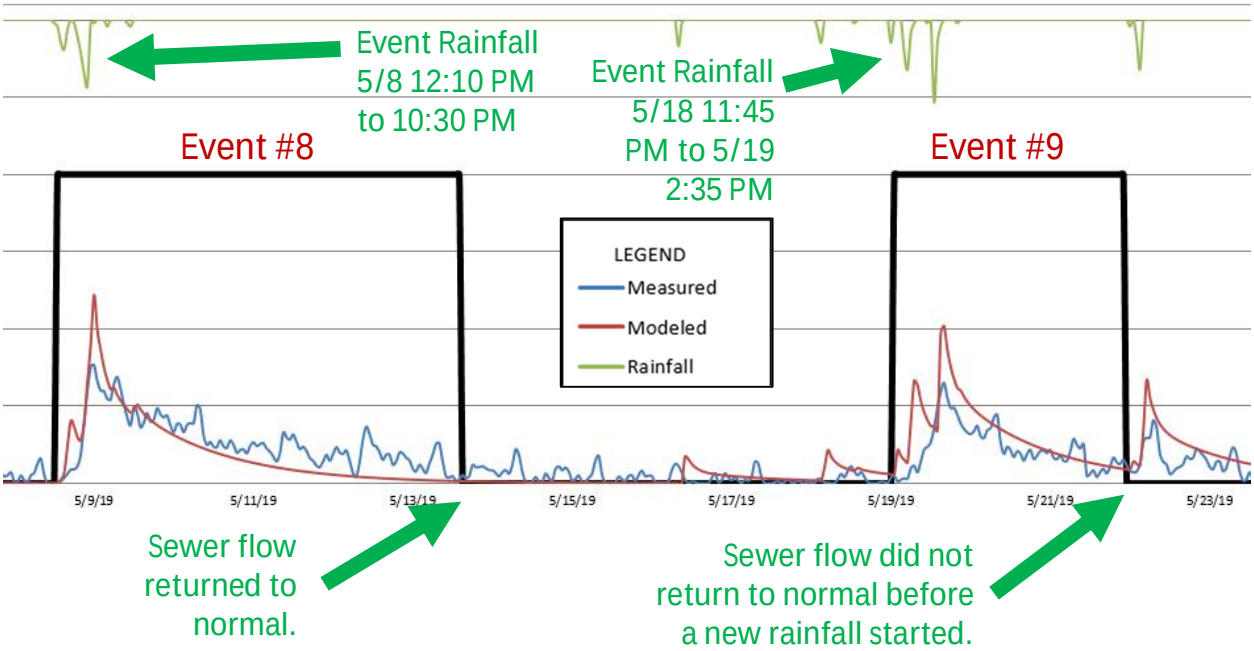


FIGURE 2 - COMBINED LOCKS MEASURED VS. MODELED FLOW – EVENT #8 AND EVENT #9

ANTECEDENT MOISTURE MODELING

Donohue previously used the antecedent moisture model with flow data from 2006-2008 and 50 years of rainfall and temperature data to:

- Calibrate the collection system performance,
- Predict the future plant flows and interceptor performance assuming there were no changes within the system to reduce clear water flow, and
- Extrapolate future plant flows and interceptor performance given completed efforts to reduce the clear water (inflow and infiltration) within the system.

The same model is now used on an annual basis to evaluate the yearly, incremental change in the overall system performance.

The member community scatter plots included at the end of the memorandum depict the AMM modeling results.

1. The results are presented as a comparison of the modeled flow versus the measured flow for given rainfall events.
2. The modeled flow is the flow that is predicted for a rainfall event based on the calibrated model.
3. The measured flow is the actual flow measured by a member community meter station for a rainfall event or the combined measured flow for a community with multiple meter stations.
4. The diagonal, heavy solid line represents the point at which the measured flow matches the modeled flow. This is the baseline (2006-2008 reference line) at the beginning of the program and the line to compare progress.
5. For points above the baseline, the modeled flow over-predicts the measured flow. Therefore, the sanitary sewer system is producing less flow than the model would have predicted for the given storm event. It is assumed that this represents clear water reduction progress.
6. For points below the baseline, an individual storm event produced a greater amount of flow than predicted. It is assumed that this represents more clear water in the system than at the point of original calibration.
7. A trend line is given for each year to summarize the analyzed storm events in that given year.
8. Trend line above the solid, baseline represents clear water reduction progress compared to baseline year.
9. Tread lines below the solid, baseline represent an increase in clear water in the sanitary sewer system compared to the baseline.
10. In an ideal, closed system where continual clear water reduction occurs, the annual tread lines would be increasing over the solid baseline.
11. Models adjusted for landfill leachate flows for Little Chute and Kaukauna communities.

The modeled flows represent the impact of peak flows. Communities continue to reduce the base flow component of their total flow by implementing projects such as repairs or replacement of cracked or damaged pipes, manholes, and connections in the sanitary sewer system. These sources of flow are true I/I sources but have a constant flow of water due to their location below groundwater or in/alongside the river. As a result, they appear to be part of the ‘base’ flow for the communities.

Member community modeling results for the ten storm events showing the *Annual Peak Flows* and *Three Year Rolling Averages of Peak Flows* are included at the end of this memorandum.

Observations of note are as follows:

- Little Chute only had four flow events that could be evaluated, compared to ten for the other four communities. The Little Chute flow meter was producing erroneous results during the other six flow events. Figure 3 below shows the Little Chute recorded flow for 2019, with the erroneous zone clearly visible.
- Kimberly was the only community to have their 2019 annual peak trend line and three year rolling average trend line above the reference line.
- Kaukauna, Combined Locks, Little Chute, and Darboy all have their 2019 annual peak trend lines and three year rolling average trend lines below the reference line.
- All communities except Darboy had their 2019 annual peak trend lines show an improvement over 2018.
- Kaukauna and Darboy had their 2019 three year rolling averages deteriorate from 2018.
- Little Chute had their 2019 three year rolling average remain unchanged from 2018.
- Combined Locks and Kimberly had their 2019 three year rolling average improve from 2018.
- Event #2 (10/1 – 10/2) was consistently the worst event (in terms of the measured flow being greater than the modeled flow) for all communities where Event #2 was recorded.
- Larger flow events generally perform worse in terms of clear water entering the system than smaller flow events. These large flow events tend to drag the trend lines down towards and below the reference line. In dryer years (i.e. 2016), few (if any) large flow events occurred. This results in the trend lines for those years looking significantly better than years that have large flow events.

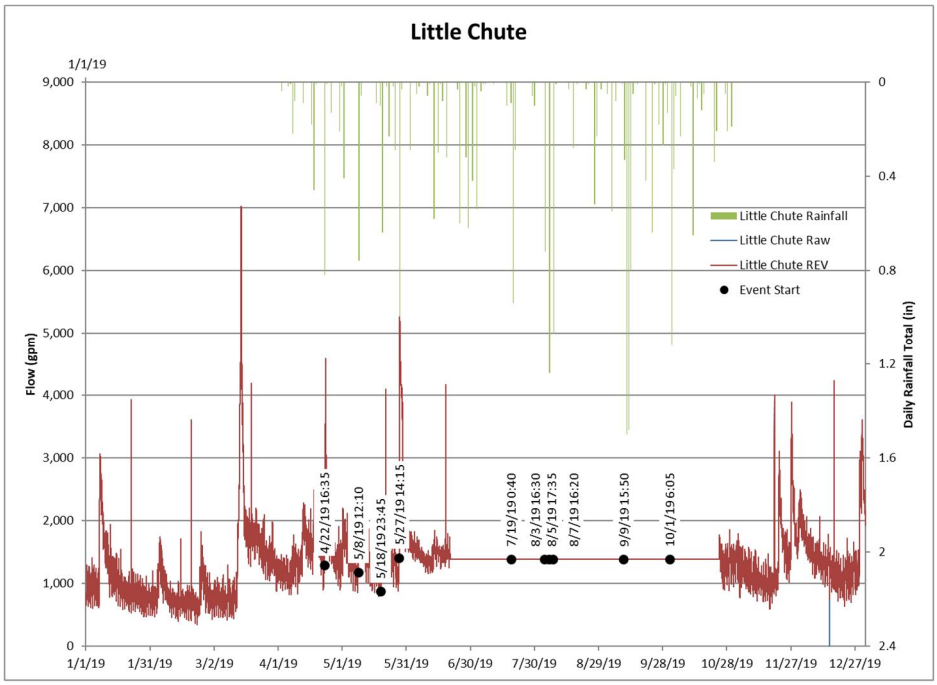


FIGURE 3 – 2019 LITTLE CHUTE FLOW METER DATA

MEMBER COMMUNITY CMAR DATA

WDNR requires that member communities and the district prepare annual CMARs and submit them to the WDNR by October of each year. The CMAR has sanitary sewer condition performance indicators that include:

- lift station failures
- sewer pipe failures
- sanitary sewer overflows
- basement backups
- number of complaints
- peaking factor ratio (peak monthly to annual daily average)
- peaking factor ratio (peak hourly to annual daily average)

Annual reported precipitation is provided by HOVMSD based on one regional recording station. Individual community rainfall gages are not used for the annual total precipitation values as they are not in service during frost/freezing susceptible times (late fall to early spring). A summary of the previous performance indicators and CMAR flow data/peaking factor ratios for each community are summarized in the following tables.

CMARs from the communities were reviewed to determine the trend in the performance indicators. CMAR summaries are given on the following pages. Observations of note are as follows:

- Little Chute flow data from June through October was not included in the CMAR analysis due to erroneous data being recorded by the Little Chute flow meter during those months.
- The only 2019 sewer failure (in Little Chute) was caused by a contractor pushing a broken hydrant into a sanitary sewer pipe.
- The only 2019 basement backup (and associated complaint) caused by public infrastructure occurred in Kaukauna. A private lateral was blocked by roots in the city sewer main. This sewer was replaced in 2019 as part of planned rehabilitation work.
- The Kimberly lift station had a power outage occur on July 20, 2019. A backup generator activated and prevented sewage backups. This event triggered a review of the lift station. Following the review, Kimberly decided to replace the lift station control panel and pumps within the spring of 2020.
- The average daily flow for 2019 increased for all communities over the previous year.
- The average daily flows were the highest in the last 10 years (since 2010) for Little Chute and Combined Locks.
- The highest monthly peak flow occurred in March for Darboy, April for Combined Locks, May for Little Chute and Kimberly, and September for Kaukauna.
- Peak hourly flows decreased in 2019 while average daily flows increased, resulting in the lower peaking factor ratios across all categories for all communities.

TABLE 4 - PREVIOUS 5-YEAR COMPARISON
AVERAGE DAILY FLOW IN MGD

	Kaukauna	Kimberly	Little Chute	Combined Locks	Darboy
2015	2.25	0.65	1.25	0.31	0.92
2016	2.41	0.76	1.36	0.32	0.82
2017	2.66	0.77	1.57	0.35	0.94
2018	2.85	0.84	1.56	0.35	0.92
2019	3.38	0.92	1.92	0.43	0.98

Kaukauna

TABLE 5 - KAUKAUNA CMAR PERFORMANCE INDICATOR SUMMARY

YEAR	NUMBER OF LIFT STATION FAILURES[1]	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	0	1	0	27
2011	0	1	2	26
2012	0	0	3	32
2013	0	0	2	30
2014	0	0	0	27
2015	0	0	0	17
2016	0	0	0	0
2017	1	0	0	0
2018	1	0	0	0
2019	0	0	1	1

[1]Kaukauna has five major (traditional) and two minor lift stations. One of the minor lift stations is a semi-public station at the softball fields/1000 Islands Park. The second minor lift station is manually operated to pump leachate from an old landfill. HOV is notified each time the landfill lift station is operated.

One complaint filed in 2019 was found to be related to a City sanitary sewer issue. A private lateral at 1710 Florence Street was blocked by roots in the city sewer main. This sewer was replaced in 2019 as part of planned rehabilitation work.

TABLE 6 - KAUKAUNA CMAR PEAKING FACTOR RATIOS

YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	3.07	1.60	6.58	4.47
2011	30.08	3.53	1.55	4.02	3.14
2012	17.89	2.36	1.44	6.79	3.69
2013	27.14	2.35	1.77	5.51	3.79
2014	29.34	2.60	1.57	6.99	4.19
2015	29.93	2.25	1.60	8.93	4.94
2016	23.59	2.41	1.61	5.19	3.34
2017	25.34	2.66	1.32	3.72	3.33
2018	27.37	2.85	1.37	7.88	5.32
2019	40.14	3.38	1.23	6.17	4.00

Kaukauna experienced its highest recorded hourly flow of 20.86 MGD on September 11, 2019. Kaukauna experienced its second highest recorded hourly flow of 17.99 MGD on March 14, 2019.

Little Chute

TABLE 7 - LITTLE CHUTE CMAR PERFORMANCE INDICATOR SUMMARY				
YEAR	NUMBER OF LIFT STATION FAILURES	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	NA	0	2	2
2011	NA	0	0	0
2012	NA	0	2	2
2013	NA	0	0	0
2014	NA	0	0	0
2015	NA	0	0	0
2016	NA	0	0	0
2017	NA	0	0	0
2018	NA	0	0	0
2019	NA	1	0	0

The sewer pipe failure was caused by a contractor pushing a broken hydrant into a sanitary sewer pipe.

TABLE 8 - LITTLE CHUTE CMAR PEAKING FACTOR RATIOS					
YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	1.46	1.66	9.49	5.31
2011	30.08	1.49	2.05	5.65	3.94
2012	17.89	1.16	1.50	5.20	3.71
2013	27.14	1.39	1.75	4.80	3.44
2014	29.34	1.45	1.67	6.01	4.00
2015	29.93	1.25	1.54	9.33	4.27
2016	25.22	1.36	1.65	4.68	3.08
2017	27.91	1.57	1.50	3.30	2.95
2018	27.54	1.56	1.77	6.79	4.58
2019	40.14	1.92	1.20	5.22	3.28

Little Chute experienced its highest recorded hourly flow of 10.02 MGD on March 14, 2019. Little Chute experienced its second highest recorded hourly flow of 7.47 MGD on May 27, 2019.

Kimberly

TABLE 9 - KIMBERLY CMAR PERFORMANCE INDICATOR SUMMARY

YEAR	NUMBER OF LIFT STATION FAILURES[1]	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	1	1
2016	0	0	0	0
2017	0	0	0	0
2018	0	1	3	1
2019	0	0	0	0

[1]Kimberly had three lift stations in 2009 when the system was originally modeled. In 2019, Kimberly has one remaining lift station.

No complaints related to a failure in the City sewer system were filed in 2019. The Kimberly lift station had a power outage occur on July 20, 2019. A backup generator activated and prevented sewage backups. This event triggered a review of the lift station. Following the review, Kimberly decided to replace the lift station control panel and pumps within the spring of 2020.

TABLE 10 - KIMBERLY CMAR PEAKING FACTOR RATIOS

YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	0.98	1.71	11.07	7.45
2011	30.08	0.84	2.39	8.36	5.19
2012	17.89	0.68	1.53	7.56	5.14
2013	27.14	0.68	2.00	6.62	4.69
2014	29.34	0.75	1.76	9.32	6.32
2015	29.93	0.65	1.46	14.25	5.96
2016	24.51	0.76	1.64	5.43	3.69
2017	27.59	0.77	1.56	6.83	4.56
2018	25.78	0.84	1.63	11.91	7.08
2019	40.14	0.92	1.21	7.73	5.67

Kimberly experienced its highest recorded hourly flow of 7.08 MGD on March 14, 2019. Kimberly experienced its second highest recorded hourly flow of 6.40 MGD on May 27, 2019.

Combined Locks

TABLE 11 - COMBINED LOCKS CMAR PERFORMANCE INDICATOR SUMMARY				
YEAR	NUMBER OF LIFT STATION FAILURES	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	NA	0	2	2
2011	NA	0	0	1
2012	NA	0	0	0
2013	NA	0	0	1
2014	NA	0	0	0
2015	NA	0	0	0
2016	NA	0	0	0
2017	NA	0	0	0
2018	NA	0	0	0
2019	NA	0	0	0

No complaints related to a failure in the Village sewer system were filed in 2019.

TABLE 12 - COMBINED LOCKS CMAR PEAKING FACTOR RATIOS					
YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	0.38	1.78	10.77	6.55
2011	30.08	0.38	2.13	6.65	4.24
2012	17.89	0.30	1.56	7.74	4.65
2013	27.14	0.34	1.83	6.26	4.03
2014	29.34	0.36	1.75	7.64	5.34
2015	29.93	0.31	1.79	12.04	5.72
2016	24.51	0.32	1.81	5.53	3.81
2017	27.59	0.35	1.51	6.61	4.20
2018	28.37	0.35	1.54	9.94	6.57
2019	40.14	0.43	1.29	6.14	4.36

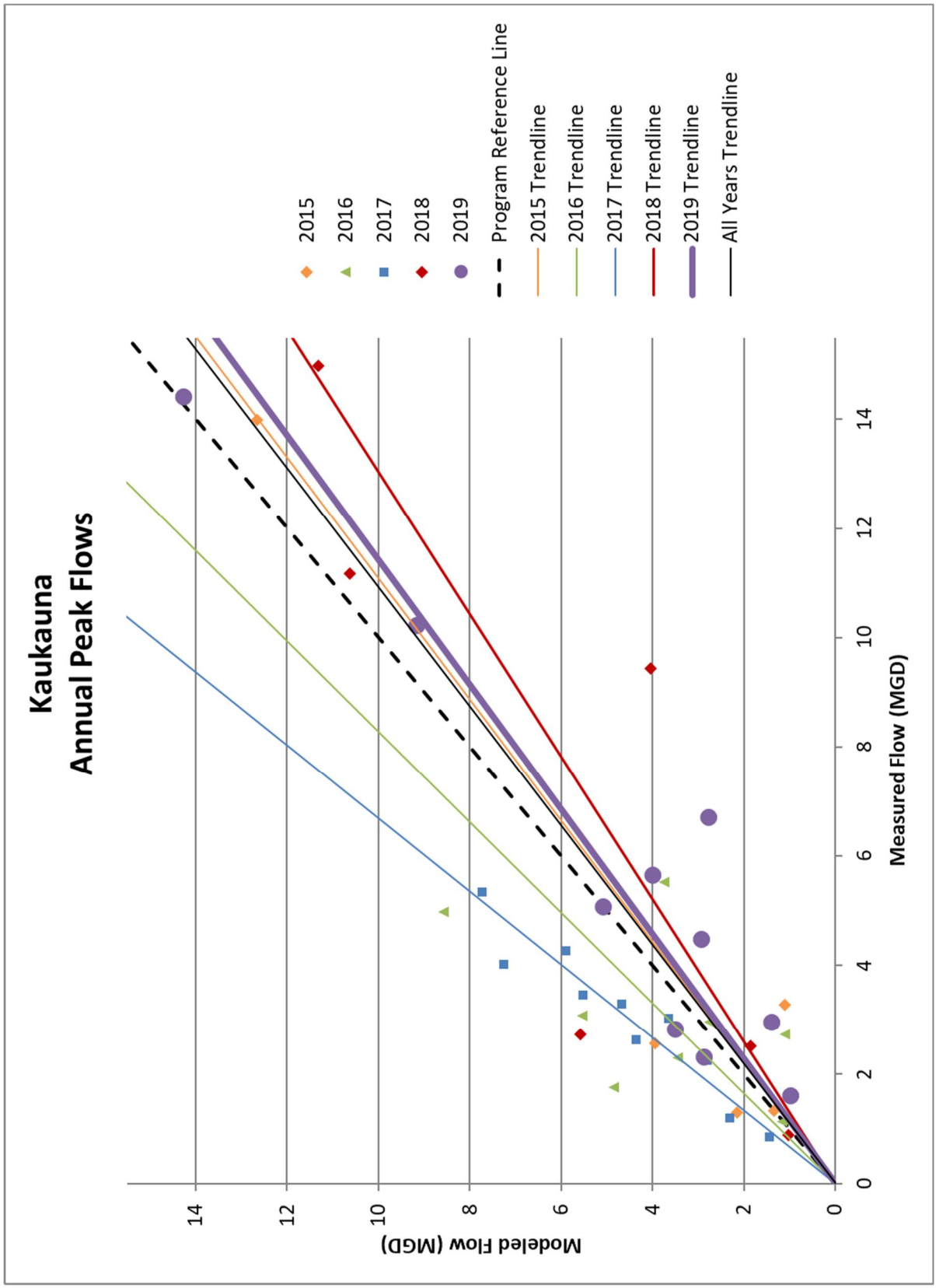
Combined Locks experienced its highest recorded hourly flow of 2.67 MGD on September 11, 2019. Combined Locks experienced its second highest recorded hourly flow of 2.57 MGD on March 14, 2019.

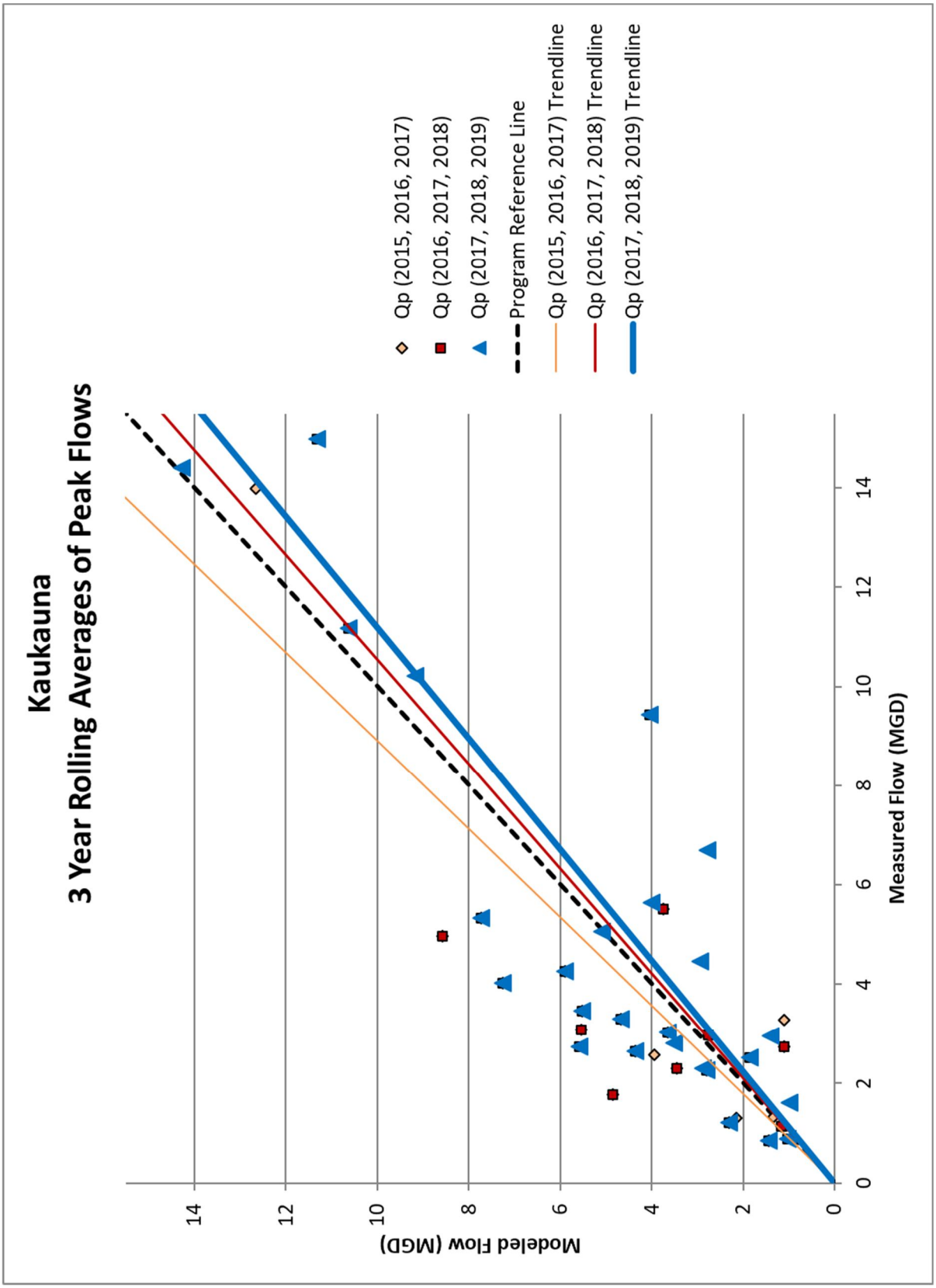
Darboy

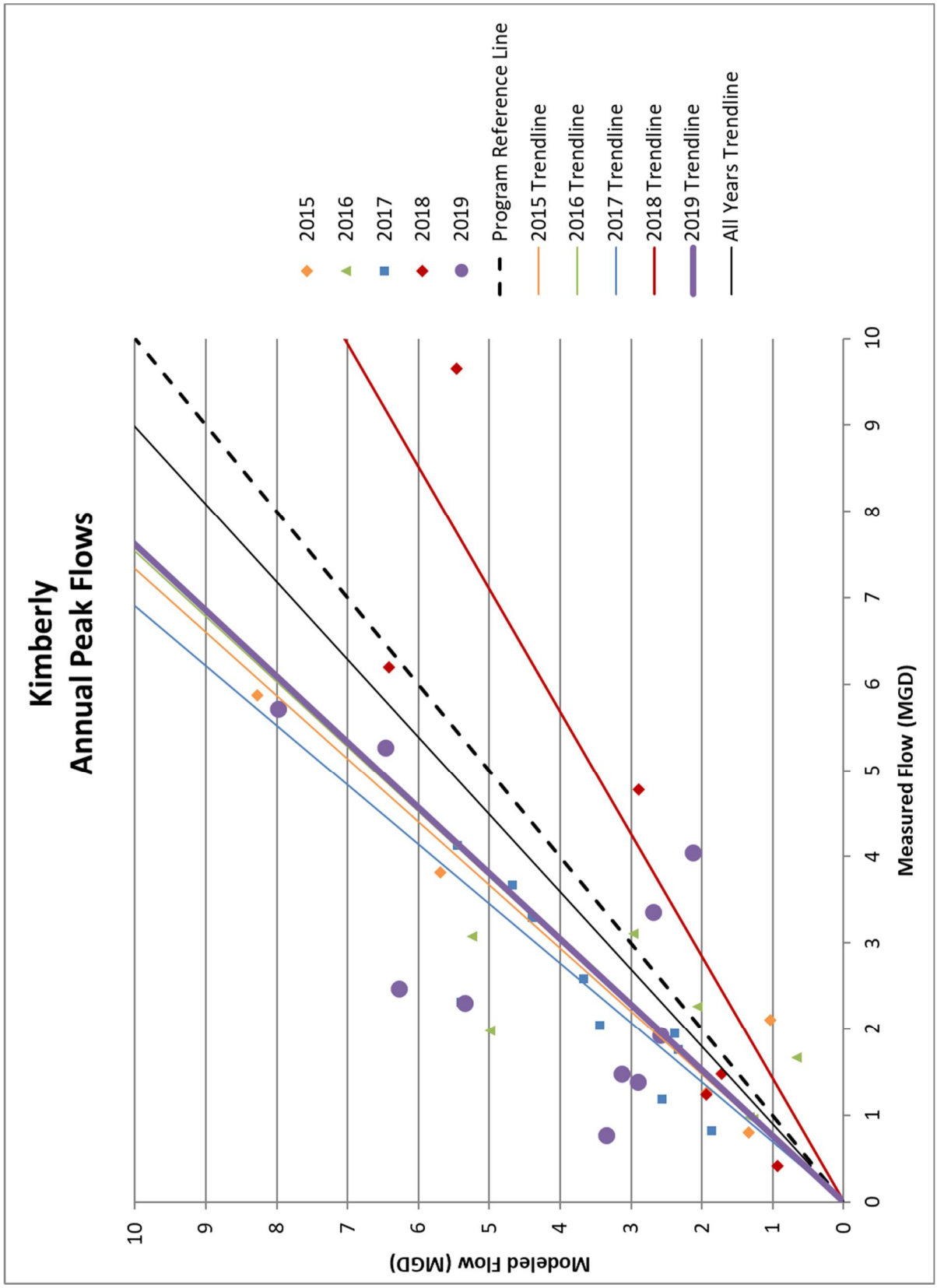
TABLE 13 - DARBOY CMAR PERFORMANCE INDICATOR SUMMARY				
YEAR	NUMBER OF LIFT STATION FAILURES	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	NA	0	0	0
2011	NA	0	0	0
2012	NA	4	0	4
2013	NA	0	0	0
2014	NA	0	0	0
2015	NA	0	0	0
2016	NA	0	0	0
2017	NA	0	0	0
2018	NA	0	0	0
2019	NA	0	0	0

TABLE 14 - DARBOY CMAR PEAKING FACTOR RATIOS					
YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	0.95	1.19	3.60	2.93
2011	30.08	0.96	1.31	2.71	2.36
2012	17.89	0.94	1.11	3.29	2.45
2013	27.14	1.02	1.25	2.76	2.35
2014	29.34	1.06	1.27	2.99	2.29
2015	29.93	0.92	1.14	4.27	2.62
2016	24.64	0.82	1.43	2.82	2.50
2017	26.72	0.94	1.18	2.61	2.13
2018	28.37	0.92	1.17	3.93	2.81
2019	40.14	0.98	1.12	3.59	2.54

Darboy experienced its highest recorded hourly flow of 3.51 MGD on March 14, 2019. Darboy experienced its second highest recorded hourly flow of 2.96 MGD on May 27, 2019.


Kaukauna
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
2
4
6
8
10
12
14
2015
2016
2017
2018
2019
Program Reference Line
2015 Trendline
2016 Trendline
2017 Trendline
2018 Trendline
2019 Trendline
All Years Trendline


Kaukauna
3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
2
4
6
8
10
12
14
Qp (2015, 2016, 2017)
Qp (2016, 2017, 2018)
Qp (2017, 2018, 2019)
Program Reference Line
Qp (2015, 2016, 2017) Trendline
Qp (2016, 2017, 2018) Trendline
Qp (2017, 2018, 2019) Trendline


Kimberly
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
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6
7
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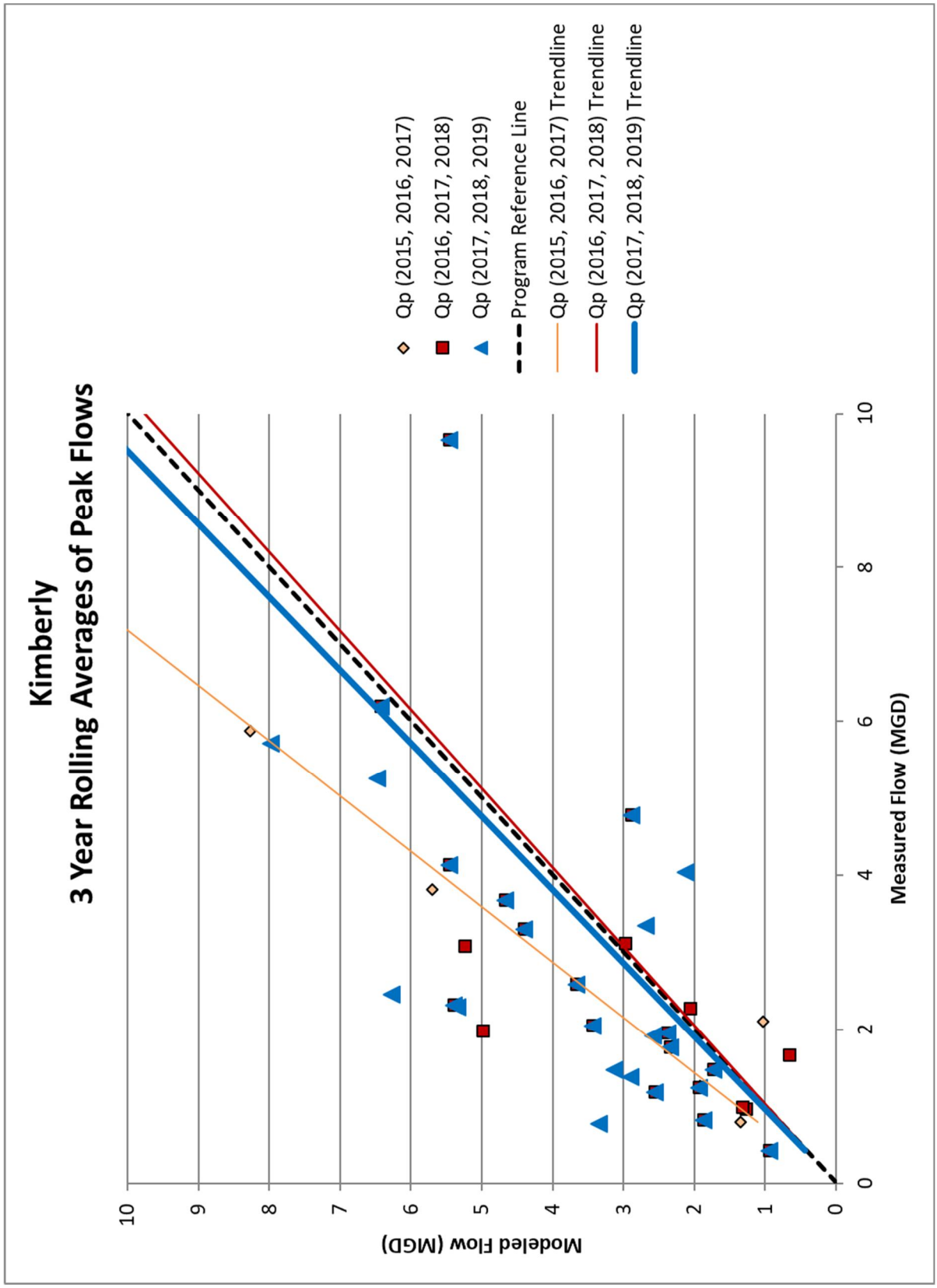
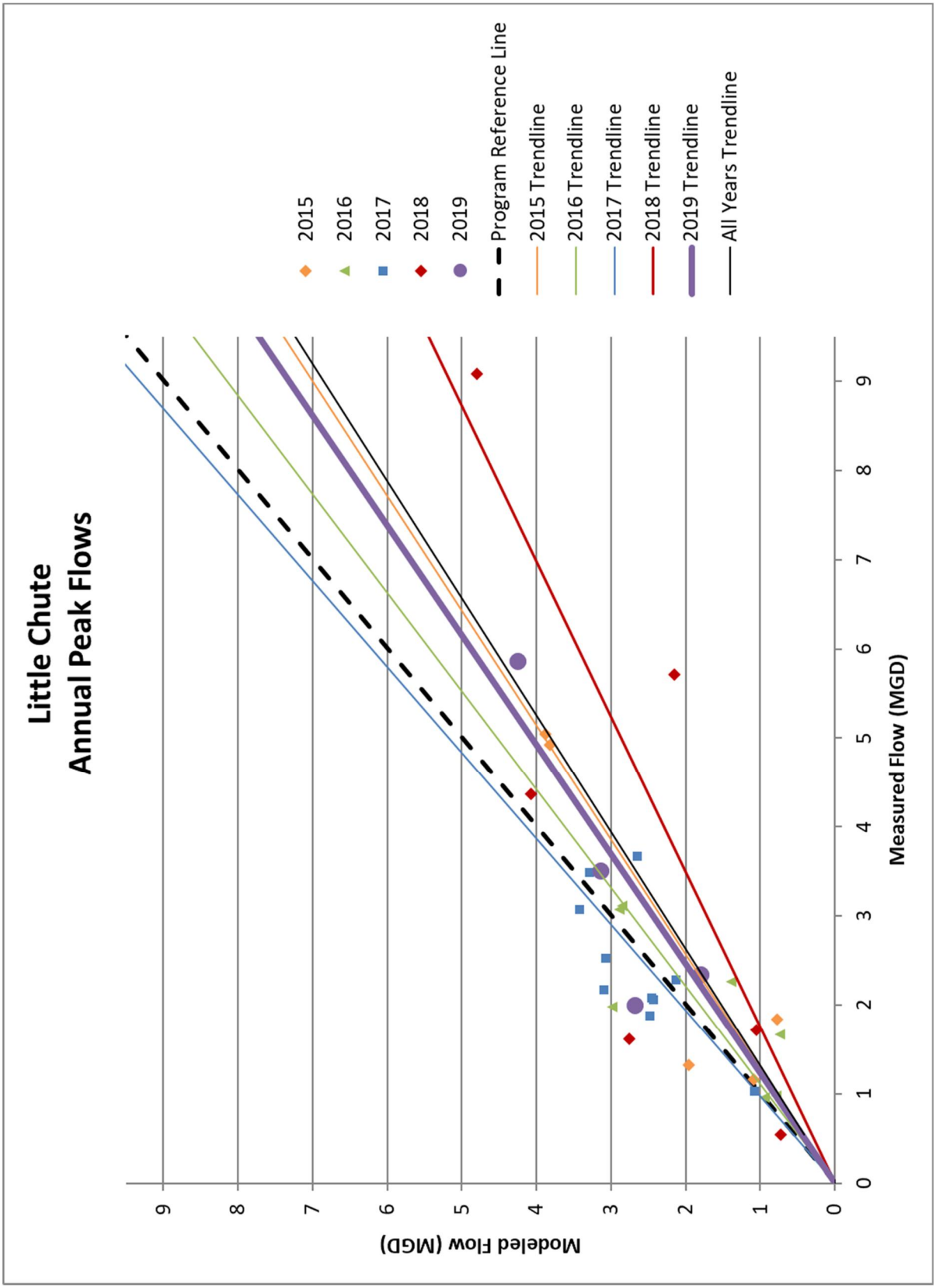
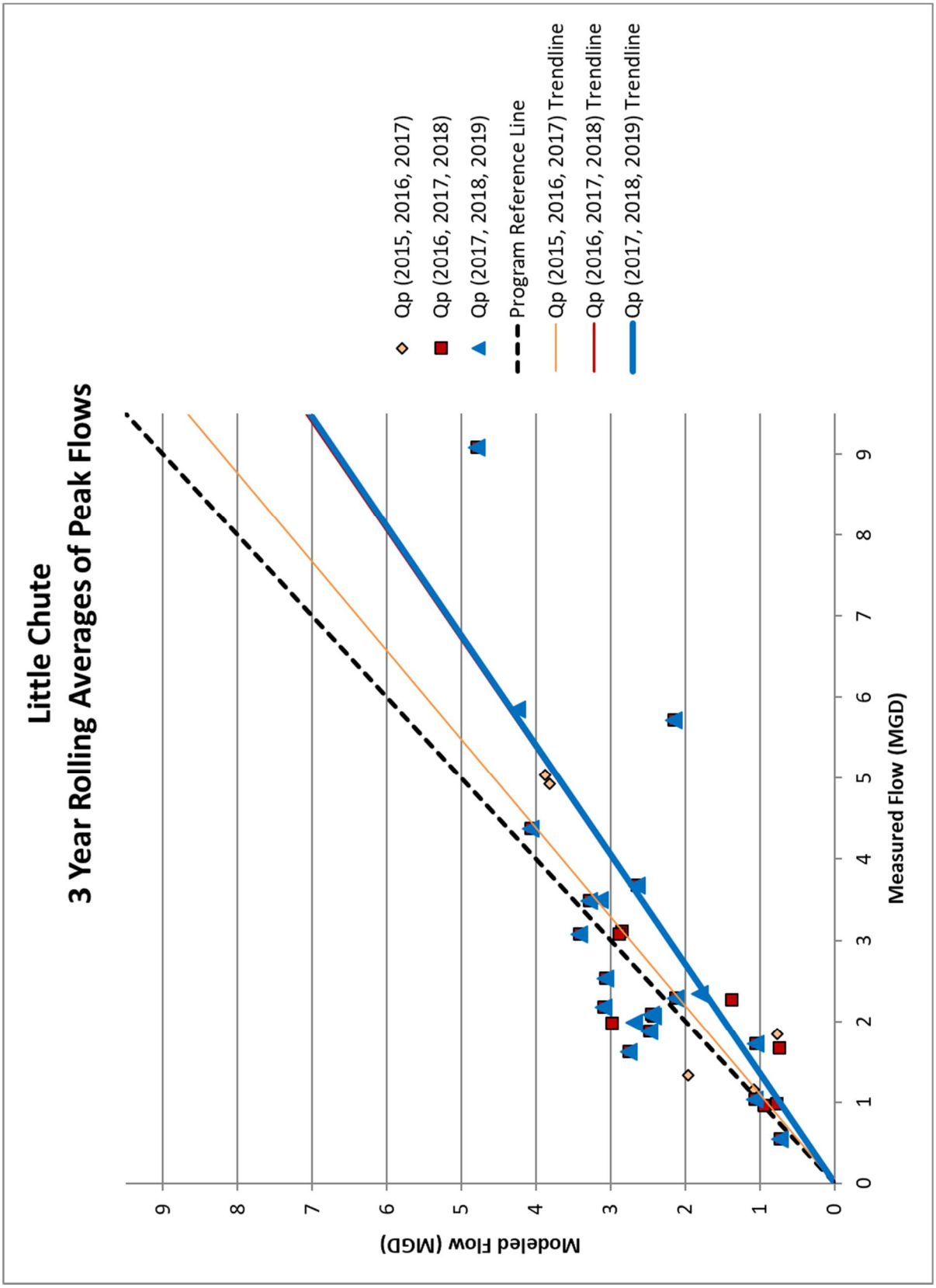
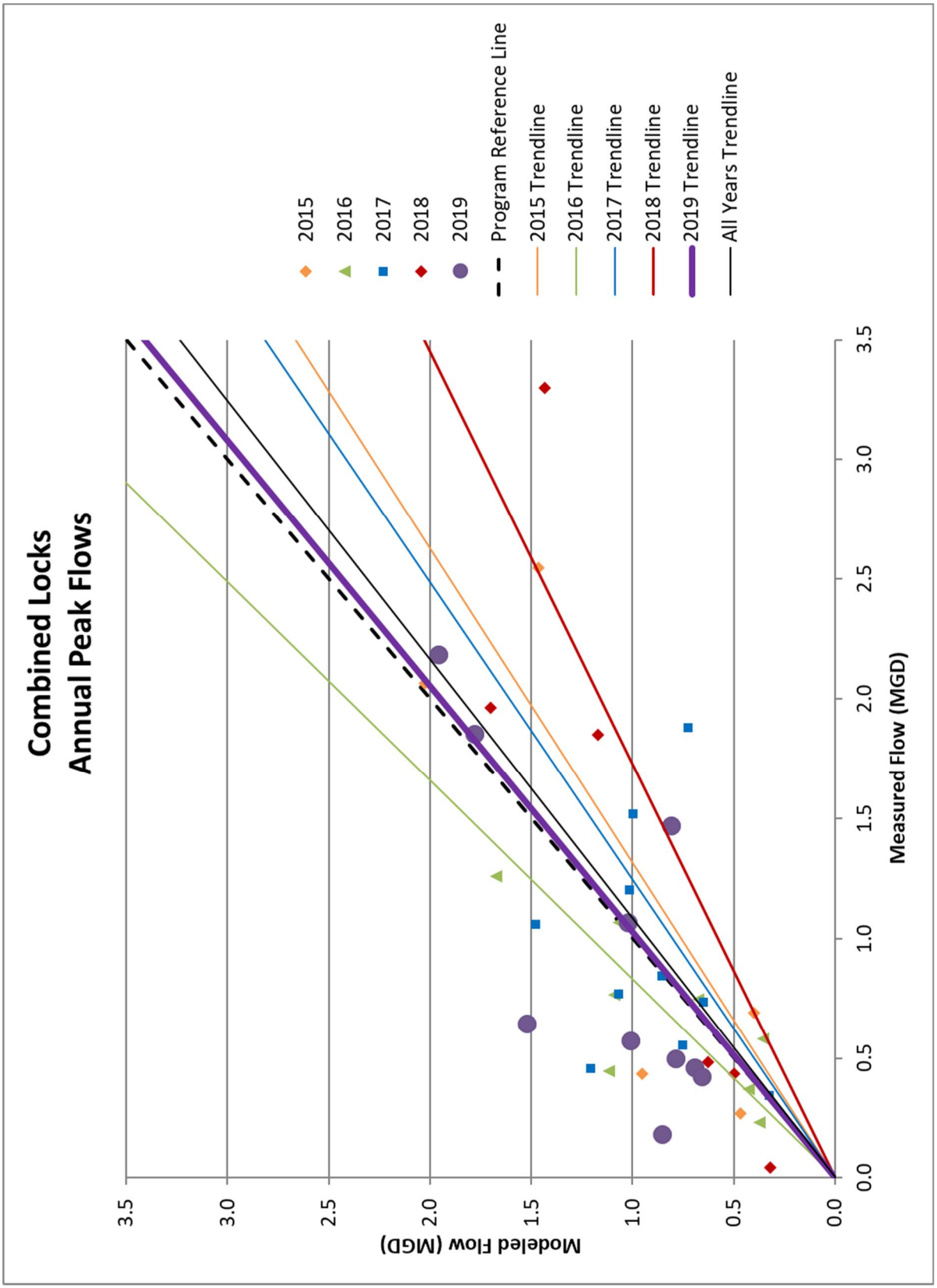
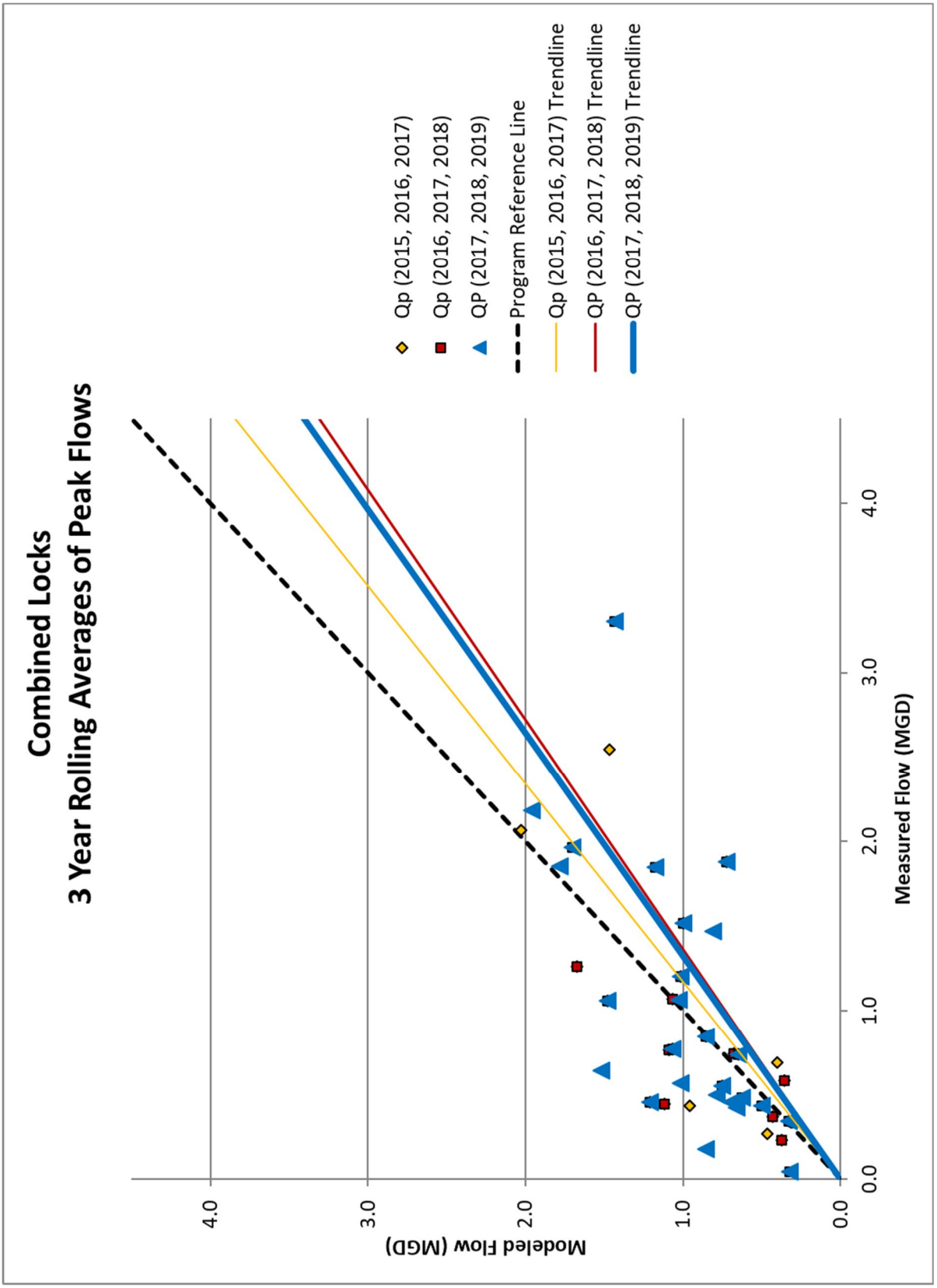
9
10
2015
2016
2017
2018
2019
Program Reference Line
2015 Trendline
2016 Trendline
2017 Trendline
2018 Trendline
2019 Trendline
All Years Trendline

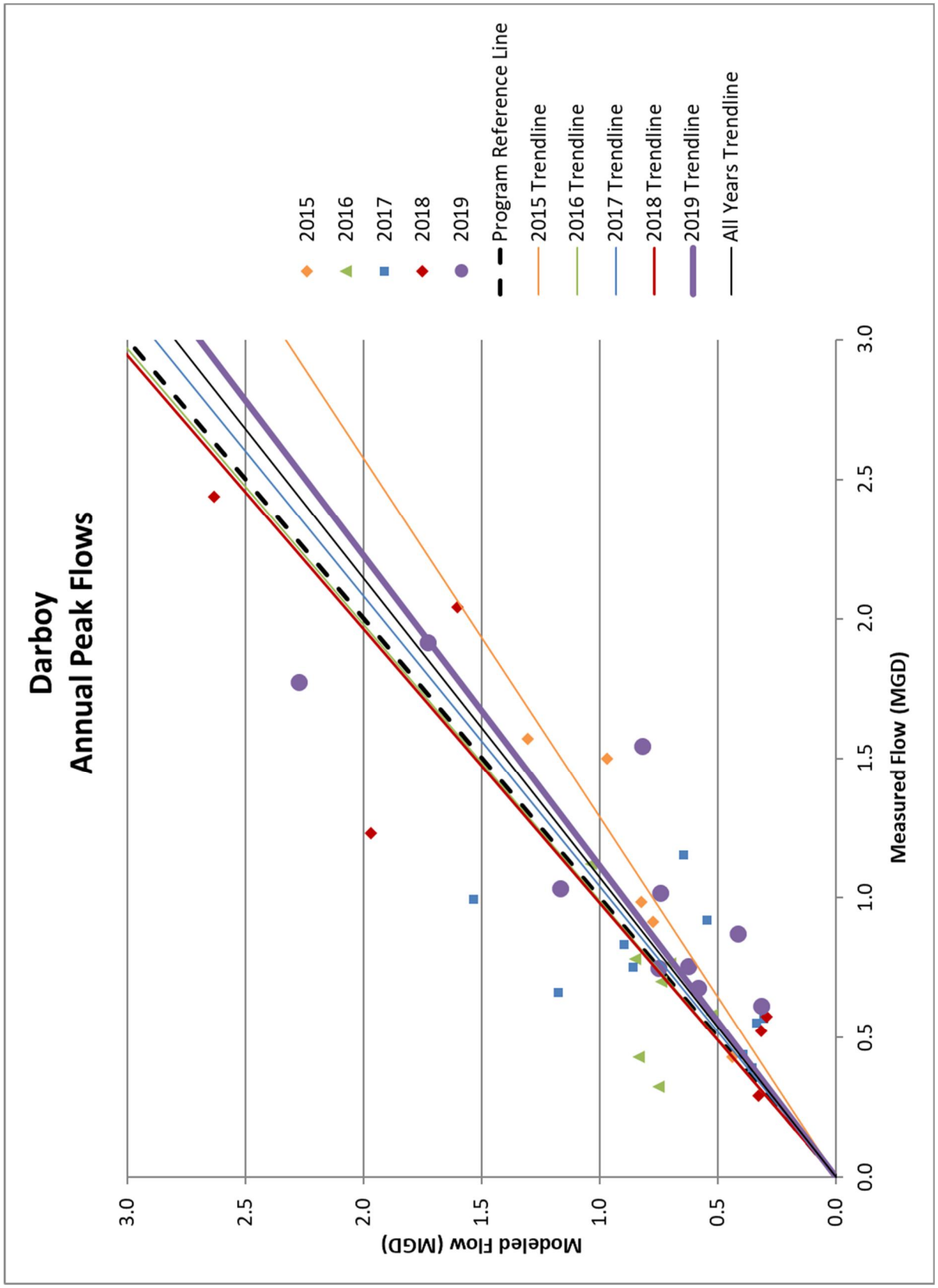

Kimberly
3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
10
0
2
4
6
8
10
Qp (2015, 2016, 2017)
Qp (2016, 2017, 2018)
Qp (2017, 2018, 2019)
Program Reference Line
Qp (2015, 2016, 2017) Trendline
Qp (2016, 2017, 2018) Trendline
Qp (2017, 2018, 2019) Trendline

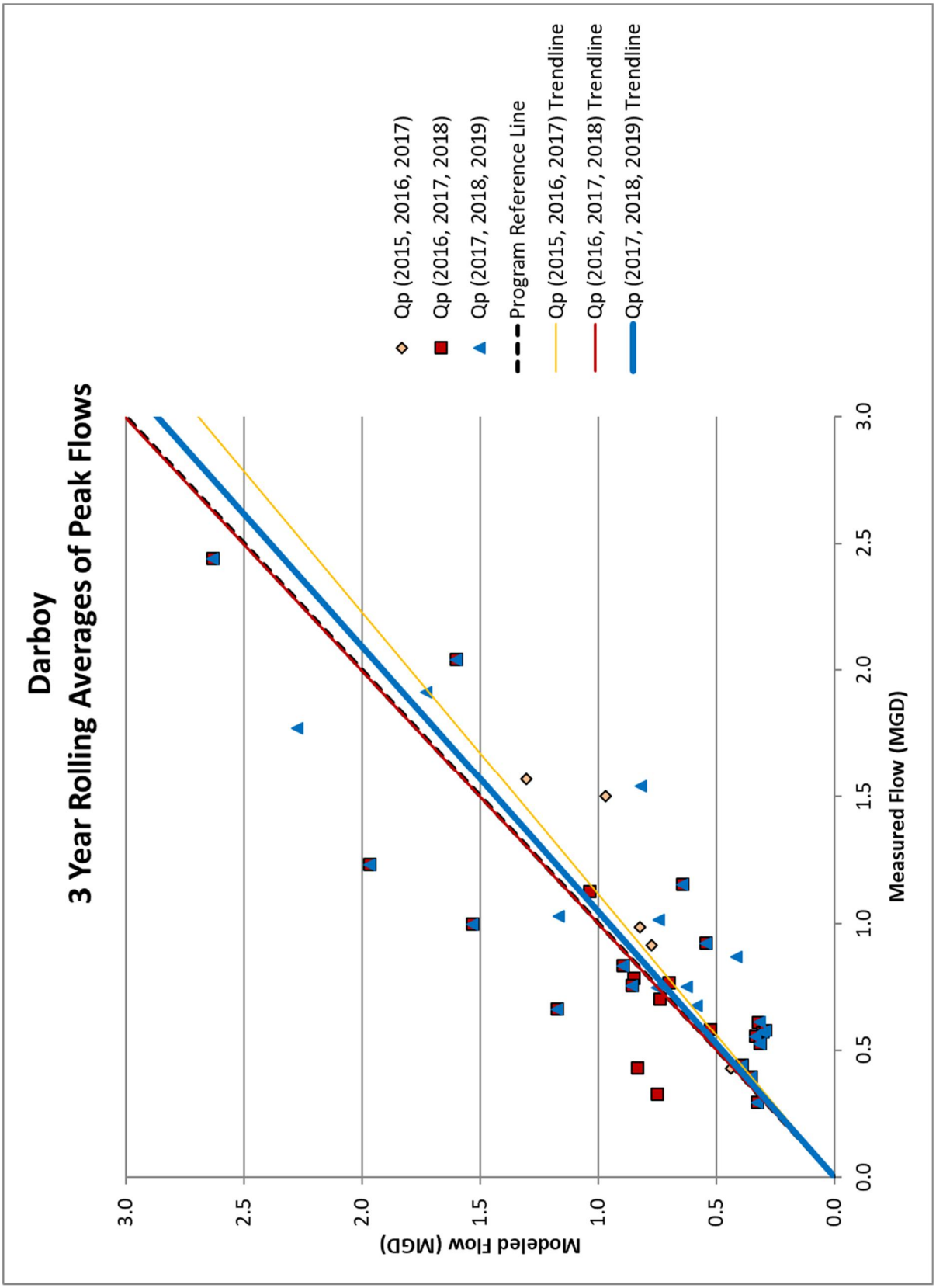

Little Chute
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
2015
2016
2017
2018
2019
Program Reference Line
2015 Trendline
2016 Trendline
2017 Trendline
2018 Trendline
2019 Trendline
All Years Trendline


Little Chute
3 Year Rolling Averages of Peak Flows
Qp (2015, 2016, 2017)
Qp (2016, 2017, 2018)
Qp (2017, 2018, 2019)
Program Reference Line
Qp (2015, 2016, 2017) Trendline
Qp (2016, 2017, 2018) Trendline
Qp (2017, 2018, 2019) Trendline
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9


Combined Locks
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
2015
2016
2017
2018
2019
Program Reference Line
2015 Trendline
2016 Trendline
2017 Trendline
2018 Trendline
2019 Trendline
All Years Trendline


Combined Locks
3 Year Rolling Averages of Peak Flows
Qp (2015, 2016, 2017)
Qp (2016, 2017, 2018)
QP (2017, 2018, 2019)
Program Reference Line
Qp (2015, 2016, 2017) Trendline
QP (2016, 2017, 2018) Trendline
QP (2017, 2018, 2019) Trendline
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
1.0
2.0
3.0
4.0


Darboy
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
2015
2016
2017
2018
2019
Program Reference Line
2015 Trendline
2016 Trendline
2017 Trendline
2018 Trendline
2019 Trendline
All Years Trendline


Darboy
3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Qp (2015, 2016, 2017)
Qp (2016, 2017, 2018)
Qp (2017, 2018, 2019)
Program Reference Line
Qp (2015, 2016, 2017) Trendline
Qp (2016, 2017, 2018) Trendline
Qp (2017, 2018, 2019) Trendline

Heart of the Valley Metropolitan Sewerage District

Member Community Compliance Maintenance Annual Report: Peaking Factor Ratios

January 2010 - December 2019

Metric	Kaukauna										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019 [9]	
Average daily flow in MGD	3.07	3.53	2.36	2.35	2.60	2.25	2.41	2.66	2.85	3.38	
Peak monthly flow in MGD	4.92	5.50	3.39	4.16	4.08	3.59	3.90	3.50	3.89	4.15	
Month of peak monthly flow in MGD	July	April	March	April	April	December	March	June	May	September	
Peak hourly flow in MGD	20.20	14.22	16.03	12.94	18.16	20.12	12.52	9.90	22.43	20.86	
Peaking factor ratio Peak Monthly:Annual Daily Avg	1.60	1.55	1.44	1.77	1.57	1.60	1.61	1.32	1.37	1.23	
Peaking factor ratio Peak Hourly:Annual Daily Avg	6.58	4.02	6.80	5.51	6.99	8.93	5.19	3.72	7.88	6.17	
Top 10 peak hourly flow in MGD: 1	20.20	14.22	16.03	12.94	18.16	20.22	12.52	9.90	22.43	20.86	9/11
2	18.90	12.50	10.74	12.93	15.95	20.12	11.37	9.33	21.12	17.99	3/14
3	18.04	12.30	9.66	9.98	14.62	17.42	8.33	9.20	17.57	16.27	5/27
4	17.76	11.40	8.67	9.40	10.70	8.31	7.65	9.16	17.34	14.05	
5	10.78	10.19	7.38	8.45	10.66	8.28	7.34	8.89	15.33	11.89	
6	10.64	10.19	7.26	7.33	7.99	8.01	6.90	8.62	14.15	11.63	
7	10.58	10.18	7.02	7.22	7.92	7.71	6.75	8.55	11.53	11.56	
8	10.43	10.04	6.76	7.01	7.67	7.64	6.68	8.51	11.10	11.44	
9	10.01	9.98	6.76	6.90	7.67	6.76	6.57	8.30	10.71	9.83	
10	9.77	9.95	6.75	6.87	7.57	6.68	6.50	8.24	10.29	9.77	
Peaking factor ratio Ave Top 10 Peak Hourly:Annual Daily Avg	4.47	3.14	3.69	3.79	4.19	4.94	3.34	3.33	5.32	4.00	

Peak monthly flow is the highest average rate for any given calendar month
Peak hourly flow is the highest average rate for any four consecutive 15-minute reporting intervals

9 Data omitted from 9/30/19 7:00 to 23:45 because it is not available.

Heart of the Valley Metropolitan Sewerage District

Member Community Compliance Maintenance Annual Report: Peaking Factor Ratios

January 2010- December 2019

Metric	Kimberly										
	2010	2011	2012	2013	2014	2015 [1]	2016	2017	2018 [2]	2019 [8,9]	
Average daily flow in MGD	0.98	0.84	0.68	0.68	0.75	0.65	0.76	0.77	0.84	0.92	
Peak monthly flow in MGD	1.68	2.01	1.04	1.37	1.32	0.95	1.25	1.20	1.36	1.11	
Month of peak monthly flow in MGD	July	April	March	April	April	December	March	April	April	May	
Peak hourly flow in MGD	10.90	7.05	5.11	4.52	6.99	9.32	4.14	5.26	9.95	7.08	
Peaking factor ratio Peak Monthly:Annual Daily Avg	1.71	2.39	1.53	2.00	1.76	1.46	1.64	1.56	1.63	1.21	
Peaking factor ratio Peak Hourly:Annual Daily Avg	11.07	8.36	7.56	6.62	9.32	14.25	5.43	6.83	11.91	7.73	
Top 10 peak hourly flow in MGD: 1	10.90	7.05	5.11	4.52	6.99	9.32	4.14	5.26	9.95	7.08	3/14
2	10.02	4.62	4.83	4.07	6.77	6.55	3.82	4.48	9.67	6.40	5/27
3	9.71	4.47	4.46	3.91	6.22	4.47	3.11	3.88	6.84	6.12	9/11
4	8.04	4.32	4.07	3.78	5.18	2.97	2.91	3.85	6.66	5.82	
5	7.66	4.14	3.17	3.15	4.93	2.86	2.69	3.24	5.42	5.61	
6	6.06	4.10	2.81	2.75	3.89	2.68	2.47	3.10	5.28	4.61	
7	5.33	4.05	2.77	2.64	3.84	2.62	2.35	2.95	4.02	4.13	
8	5.27	3.98	2.66	2.58	3.70	2.55	2.31	2.94	3.92	4.11	
9	5.22	3.63	2.44	2.35	2.95	2.51	2.23	2.86	3.79	4.10	4/23
10	5.07	3.37	2.44	2.26	2.93	2.49	2.14	2.58	3.61	3.95	
Peaking factor ratio Ave Top 10 Peak Hourly:Annual Daily	7.45	5.19	5.14	4.69	6.32	5.96	3.69	4.56	7.08	5.67	

Peak monthly flow is the highest average rate for any given calendar month
Peak hourly flow is the highest average rate for any four consecutive 15-minute reporting intervals

1 Data from 6/9/15 17:30 to 6/11/15 14:00 at the Kimberly meter station was omitted from analysis.
2 Kimberly data omitted from 7/20/18 00:45 to 7/27/18 7:45 because suspect it erroneous
8 Kimberly data omitted from 9/19/19 3:00 to 9/22/19 22:30 because suspect it erroneous
9 Data omitted from 9/30/19 7:00 to 23:45 because it is not available.

Heart of the Valley Metropolitan Sewerage District

Member Community Compliance Maintenance Annual Report: Peaking Factor Ratios

January 2010- December 2019

Metric	Little Chute										
	2010	2011	2012	2013	2014	2015	2016	2017	2018 [1]	2019 [7,9]	
Average daily flow in MGD	1.46	1.49	1.16	1.39	1.45	1.25	1.36	1.57	1.56	1.92	
Peak monthly flow in MGD	2.42	3.05	1.73	2.43	2.42	1.93	2.25	2.37	2.76	2.30	
Month of peak monthly flow in MGD	July	April	March	April	April	December	March	April	April	May	
Peak hourly flow in MGD	13.86	8.42	6.02	6.66	8.73	11.66	6.37	5.20	10.60	10.02	
Peaking factor ratio Peak Monthly:Annual Daily Avg	1.66	2.05	1.50	1.75	1.67	1.54	1.65	1.50	1.77	1.20	
Peaking factor ratio Peak Hourly:Annual Daily Avg	9.49	5.65	5.20	4.80	6.01	9.33	4.68	3.30	6.79	5.22	
Top 10 peak hourly flow in MGD: 1	13.86	8.42	6.02	6.66	8.73	11.66	6.37	5.20	10.60	10.02	3/14
2	12.20	6.42	5.91	5.62	8.13	6.63	5.57	5.19	10.18	7.47	5/27
3	11.10	6.07	5.44	5.49	7.12	6.19	4.83	5.00	8.93	7.40	
4	8.66	6.01	4.45	5.44	6.25	5.61	3.86	4.88	7.09	6.66	
5	7.39	5.61	3.92	4.98	5.34	4.49	3.85	4.71	7.04	5.85	
6	5.25	5.51	3.63	4.27	5.11	4.07	3.84	4.64	5.81	5.46	
7	5.01	5.49	3.43	4.00	4.96	4.04	3.54	4.31	5.60	5.13	
8	4.75	5.10	3.41	3.83	4.59	3.61	3.43	4.26	5.58	5.09	4/23
9	4.67	5.04	3.34	3.77	3.99	3.53	3.35	4.22	5.52	4.91	
10	4.67	5.00	3.32	3.69	3.87	3.47	3.30	3.99	5.14	4.90	
Peaking factor ratio Ave Top 10 Peak Hourly:Annual Daily	5.31	3.94	3.71	3.44	4.00	4.27	3.08	2.95	4.58	3.28	

Peak monthly flow is the highest average rate for any given calendar month
Peak hourly flow is the highest average rate for any four consecutive 15-minute reporting intervals

1 Little Chute data omitted from 2/23/18 15:45 to 4/10/18 10:00 because suspect it erroneous
7 Little Chute data omitted from 6/03/19 7:45 to 10/25/19 12:00 because suspect it erroneous
9 Data omitted from 9/30/19 7:00 to 23:45 because it is not available.

Heart of the Valley Metropolitan Sewerage District

Member Community Compliance Maintenance Annual Report: Peaking Factor Ratios

January 2010- December 2019

Metric	Combined Locks										
	2010	2011	2012	2013	2014 [1]	2015	2016 [2]	2017	2018 [3]	2019 [9]	
Average daily flow in MGD	0.38	0.38	0.30	0.34	0.36	0.31	0.32	0.35	0.35	0.43	
Peak monthly flow in MGD	0.68	0.80	0.47	0.63	0.63	0.56	0.57	0.53	0.54	0.56	
Month of peak monthly flow in MGD	July	April	March	April	April	December	March	April	April	April	
Peak hourly flow in MGD	4.13	2.51	2.33	2.15	2.73	3.75	1.75	2.31	3.46	2.67	
Peaking factor ratio Peak Monthly:Annual Daily Avg	1.78	2.13	1.56	1.83	1.75	1.79	1.81	1.51	1.54	1.29	
Peaking factor ratio Peak Hourly:Annual Daily Avg	10.77	6.65	7.74	6.26	7.64	12.04	5.53	6.61	9.94	6.14	
Top 10 peak hourly flow in MGD: 1	4.13	2.51	2.33	2.15	2.73	3.75	1.75	2.31	3.46	2.67	9/11
2	3.19	1.77	2.01	1.92	2.58	2.90	1.57	1.79	3.44	2.57	3/14
3	3.18	1.59	1.64	1.51	2.44	2.58	1.33	1.64	2.98	2.34	5/27
4	3.17	1.58	1.37	1.37	2.44	1.36	1.15	1.63	2.26	2.13	
5	2.79	1.54	1.17	1.24	1.78	1.32	1.11	1.35	2.22	1.72	
6	1.96	1.53	1.16	1.22	1.77	1.28	1.05	1.33	2.18	1.70	
7	1.85	1.49	1.14	1.21	1.54	1.26	1.04	1.23	1.75	1.49	4/23
8	1.65	1.41	1.11	1.14	1.32	1.14	1.04	1.19	1.60	1.44	
9	1.61	1.30	1.08	1.04	1.29	1.11	1.01	1.13	1.50	1.44	
10	1.59	1.27	0.99	1.00	1.24	1.10	0.99	1.07	1.49	1.43	
Peaking factor ratio Ave Top 10 Peak Hourly:Annual Daily	6.55	4.24	4.65	4.03	5.34	5.72	3.81	4.20	6.57	4.36	

Peak monthly flow is the highest average rate for any given calendar month
Peak hourly flow is the highest average rate for any four consecutive 15-minute reporting intervals

1 Data from 7/9/14 9:00 to 7/15/14 16:45 at Combined Locks and Darboy meter stations was omitted from analysis. Interceptor maintenance caused surcharging at meter station.
2 No Combined Locks data available until 1/15/16
3 Data from 5/4/18 6:30 am to 5/4/18 9:30 am at Combined Locks and Darboy meter stations was omitted from analysis. Interceptor maintenance caused surcharging at meter station.
9 Data omitted from 9/30/19 7:00 to 23:45 because it is not available.

Heart of the Valley Metropolitan Sewerage District

Member Community Compliance Maintenance Annual Report: Peaking Factor Ratios

January 2010- December 2019

Metric	Darboy										
	2010	2011	2012	2013	2014 [1]	2015	2016 [2]	2017	2018 [3]	2019 [9]	
Average daily flow in MGD	0.95	0.96	0.94	1.02	1.06	0.92	0.82	0.94	0.92	0.98	
Peak monthly flow in MGD	1.13	1.26	1.04	1.27	1.35	1.05	1.18	1.11	1.08	1.09	
Month of peak monthly flow in MGD	July	April	March	April	April	December	March	March	April	March	
Peak hourly flow in MGD	3.43	2.61	3.10	2.82	3.18	3.93	2.32	2.46	3.63	3.51	
Peaking factor ratio Peak Monthly:Annual Daily Avg	1.19	1.31	1.11	1.25	1.27	1.14	1.43	1.18	1.17	1.12	
Peaking factor ratio Peak Hourly:Annual Daily Avg	3.60	2.71	3.29	2.76	2.99	4.27	2.82	2.61	3.93	3.59	
Top 10 peak hourly flow in MGD: 1	3.43	2.61	3.10	2.82	3.18	3.93	2.32	2.46	3.63	3.51	3/14
2	3.34	2.58	2.78	2.67	2.80	2.76	2.29	2.08	3.56	2.96	5/27
3	3.24	2.52	2.72	2.51	2.75	2.45	2.14	2.00	2.96	2.61	
4	2.82	2.26	2.38	2.45	2.41	2.28	2.08	1.98	2.92	2.55	9/11
5	2.82	2.18	2.10	2.44	2.37	2.22	2.06	1.95	2.43	2.29	
6	2.76	2.16	2.06	2.33	2.27	2.18	2.02	1.95	2.18	2.25	
7	2.70	2.14	2.03	2.26	2.18	2.15	1.94	1.91	2.08	2.24	
8	2.37	2.12	1.98	2.21	2.17	2.14	1.92	1.91	2.08	2.18	
9	2.35	2.08	1.96	2.17	2.15	2.01	1.92	1.91	2.06	2.13	
10	2.09	2.05	1.96	2.15	2.09	1.99	1.91	1.90	2.05	2.12	
Peaking factor ratio Ave Top 10 Peak Hourly:Annual Daily	2.93	2.36	2.45	2.35	2.29	2.62	2.50	2.13	2.81	2.54	

Peak monthly flow is the highest average rate for any given calendar month
Peak hourly flow is the highest average rate for any four consecutive 15-minute reporting intervals

1 Data from 7/9/14 9:00 to 7/15/14 16:45 at Combined Locks and Darboy meter stations was omitted from analysis. Interceptor maintenance caused surcharging at meter station.
2 Darboy data omitted until 2/9/16 because suspect it erroneous
3 Data from 5/4/18 6:30 am to 5/4/18 9:30 am at Combined Locks and Darboy meter stations was omitted from analysis. Interceptor maintenance caused surcharging at meter station.
9 Data omitted from 9/30/19 7:00 to 23:45 because it is not available.