Memorandum

DONOHUE

DRAFT

Date: November 10, 2015

To: David Casper, Commissioner
Bruce Siebers, Commissioner
Kevin Coffey, Commissioner
Patrick Hennessey, Commissioner
John Sundelius, Commissioner
Glen Geurts, District Manager
John Johnson, Regulatory Compliance Manager

Copy: Ed Nevers, Donohue & Associates
Dawn Bartel, HOVMSD

From: Tammy Kuehlmann, Donohue & Associates

Re: 2014 Annual Flow Summary
Heart of the Valley Metropolitan Sewerage District

The following memorandum documents the analysis and observations of the 2014 clear water (inflow and infiltration, I/I) flow component of the overall HOVMSD wastewater flow.

BACKGROUND INFORMATION

As part of the 2004 HOVMSD Facilities Plan approval, WDNR required that individual member communities develop a plan to achieve community specific clear water reduction goals. HOVMSD was required to oversee the process and document the progress in an annual report to the WDNR.

Each member community spent two years (September 2004 – September 2006) developing Sanitary Sewer Evaluation Surveys (SSES). The surveys identified specific actions to achieve the communities' clear water reduction goals over a six to eight year period. Although some clear water reduction projects started sooner, the SSES plans were formally implemented beginning in 2007.

The analysis of the peak clear water reduction project effectiveness through mid-2011 indicated that member communities were having mixed success in achieving their clear water reduction goals. The analysis of the project effectiveness also indicated that the amount of clear water entering the sanitary system varied greatly with the presumed ground water levels and antecedent soil moisture conditions.

HOVMSD proposed to WDNR and was issued a Facility Plan Amendment that replaced the Clearwater Reduction Program and its reporting requirements with a Sustainability Program. The justification for the new program included:

- The original hydraulic analysis for the interceptor and WWTP was based on a small scale study with technology available in 2001. The current analysis methods were based on 6 years of rainfall and flow analysis using the AMM and MOUSE modeling programs and 54 years of historic rainfall and flow data.

- The model demonstrated that the return period for the interceptor flow exceeding the permitted capacity of the WWTP was 50 years (a two percent probability of being exceeded in any given year). Overflows are not possible in the interceptor system given the sealed and bolted manhole lids.
- The 2004 permitting and financial analysis was based on a criteria of zero overflows along the interceptor and at the WWTP up to a 100-year storm event.
- Based upon trending analysis HOVMSD achieved approximately seven percent of the Facilities Plan 30% Clearwater Reduction goal for the 100-year storm event at a cost of $15 million and was expecting to invest no less than an additional $13 million to reach the goal. The total flow reduction effort was expected to cost nearly four times the estimate in the 2004 facility plan, not including private property, accompanying municipal investments, or operation and maintenance costs.
- HOVMSD would implement 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 capacity by not increasing the existing level of I/I in the system and decreasing the I/I entering the system where possible. Components of the Sustainability Program include:

- Comprehensive CMOM Program for all member communities
- Annual report form the member communities to HOVMSD
- Flow monitoring of communities and data analysis of flow monitoring to verify collection system performance
- Ordinance revisions to reflect the above conditions
- Special Orders for member communities that fail to maintain their system
- Self-regulation and enforcement by HOVMSD

The *Concept of the Sustainability Plan* is shown in Figure 1.

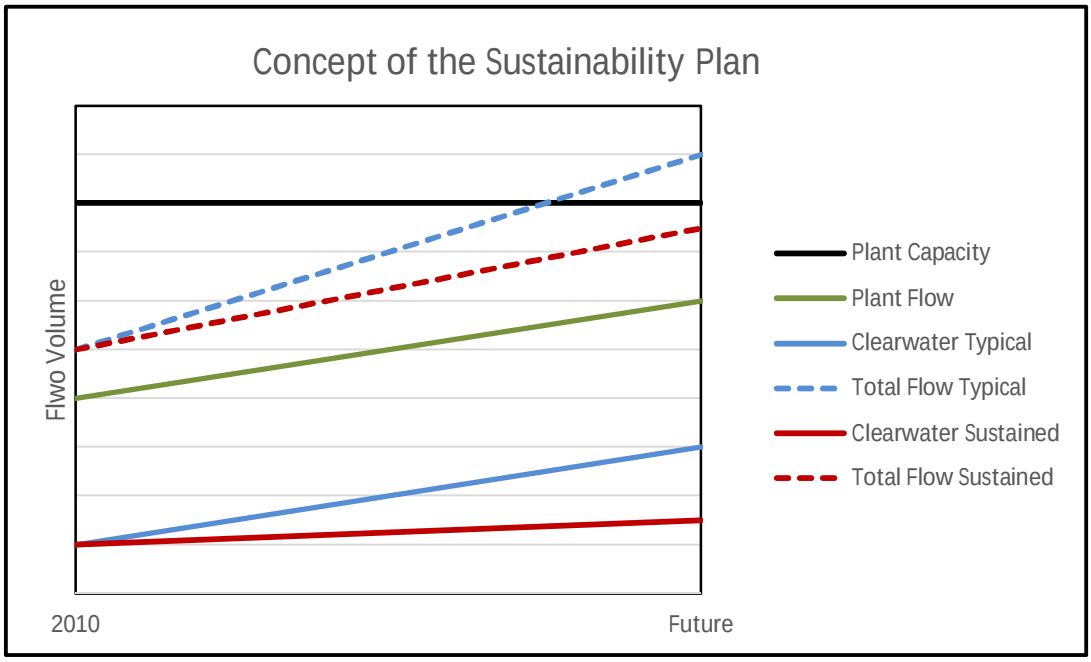


Figure 1. Concept of the Sustainability Plan

For the 2014 yearly evaluation, Donohue reviewed performance indicators from the following sources:

1. Observations at the HOVMSD plant
2. Analysis of the I/I components of flow through the antecedent moisture model (AMM)
3. Analysis of the I/I components of flow through the Compliance Maintenance Annual Report (CMAR) submitted to Wisconsin Department of Natural Resources (WDNR) by HOVMSD member communities
4. Observations by the member communities.

Performance indicators provide a degree of insight to relative volume of I/I that is entering the system from the HOVMSD member communities and the impacts of the I/I on the system.

OBSERVATIONS AT HOVMSD WASTEWATER TREATMENT PLANT

The performance at the HOVMSD plant is ultimately the issue of greatest concern for the WDNR. If there are permit violations or steadily increasing biological by-pass event quantities and volumes, the WDNR may increase their oversight as had been the case prior to the sustainability phase of the I/I reduction project.

PLANT PERFORMANCE				
YEAR	PLANT FLOW (million gallons)	ANNUAL REPORTED PRECIPITATION (inches)	NUMBER OF BIOLOGICAL BY-PASS EVENTS	TOTAL ANNUAL VOLUME OF BY-PASS FLOW (million gallons)
2010	2,390,000	32.25	3	14.258
2011	2,359.297	30.08	1	3.998
2012	1,844.606	17.89	0	0
2013	2,014.113	27.14	1	0.562
2014	2,079.438	29.34	2	3.549

PLANT BIOLOGICAL BY-PASS EVENT DETAILS			
DATE	PLANT FLOW (million gallons)	FOX ENERGY PUMPING (million gallons)	BIOLOGICAL BY-PASS FLOW (million gallons)
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
April 10, 2013	22.526	2.221	0.562
April 14, 2014	21.435	0.050	1.718
May 28, 2014	21.958	1.505	1.831

The number of biological by-pass events and volume in 2014 appears to be consistent with previous years relative to the total annual precipitation.

While 2014 had a similar amount of annual precipitation as 2011, the total plant flow was approximately 13.5% lower. In 2014, there was one additional by-pass event compared to 2011, but the total volume of the by-pass was approximately 12.6% less.

ANTECEDENT MOISTURE MODELING

The antecedent moisture model was developed using flow data from 2006-2008 with 50 years of rainfall, and temperature data. The model was used to:

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

Based on the WDNR's evaluation of the model and modeling results, WDNR allowed HOVMSD to terminate the 30% peak flow reduction mandate and replace it with a self monitoring, sustainability plan; savings the district tens of millions of dollars.

We are now using the model on an annual basis to evaluate the yearly, incremental change to the overall system performance.

The following member community scatter plots 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 or the combined measured flow for communities with multiple meter stations.
4. The diagonal, heavy dashed 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 I/I 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 represent more I/I 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 dashed, baseline represents I/I reduction progress compared to baseline year.
9. Tread lines below the dashed, baseline represent an increase in I/I in the sanitary sewer system compared to the baseline.
10. In an ideal, closed system where continual I/I reduction occurs, the annual tread lines would be increasing over the dashed baseline.
11. The heavy black, diagonal line is a combined result of all trend lines. A heavy line above the dashed line shows progress. A heavy line below the dashed line shows regression.
12. The goal of the sustainability plan is that the heavy line (a summary of the progress made since 2010) is at or above the dashed line.

Observations:

- While 2014 peak flows in general were increased, Kaukauna, Combined Locks, and Kimberly are sustaining or improving on the reductions in rain dependent I/I since the beginning of the program.
- Little Chute's peak I/I flows have fallen slightly behind the sustained goal.
- Darboy's peak I/I flows have increased since the beginning of the program.

To reduce the modeling impact of an individual storm event in any one given year, the community results were recalculated based on a three-year rolling average of storm events. A rolling average trend line also givens an indication of the progress made over the three year window as opposed to the entire program history.

Member community modeling results showing the *Annual Peak Flows* and *Three Year Rolling Averages of Peak Flows* are included in the appendix.

MEMBER COMMUNITY CMAR DATA

According to Technical Memorandum 8.2 dated August 14, 2013 and the District's Ordinance, communities are required to complete an annual report. As part of that, and as a WDNR requirement, the communities and the district prepare annual Compliance Maintenance Annual Reports (CMARs). 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)

CMARs from the communities were reviewed to determine the trend in the performance indicators. 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). Peaking factors, particularly the hourly peaking factors, in the summaries below differ from those reported in the yearly CMARs as they have been recalculated to match technical definitions in the WDNR CMAR guidance documents. A detailed list of CMAR flow data/peaking factor ratios is included in the appendix.

Observations of note:

- Compared to 2011 when the annual precipitation was similar to 2014, the annual average daily flow is lower for all communities except Darboy.
- In many cases, peaking factor ratios have remained the same or slightly increased.
- Peaking factor ratios can increase, in part, by significant reductions in the average annual daily flow.
- Since 2012, annual average daily flow reductions in Kaukauna alone can account for nearly the total flow reductions measured at HOVMSD WWTP. Other communities and HOVMSD have contributed to the overall flow reduction, but Kaukauna is worth mentioning given the percent of the total flow that comes of Kaukauna and the magnitude of the daily reductions.

CMAR summaries follow:

Kaukauna

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

[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.

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	3.27	1.50	6.17	4.19
2011	30.08	3.42	1.61	4.16	3.25
2012	17.89	2.48	1.37	6.47	3.51
2013	27.14	2.40	1.73	5.38	3.70
2014	29.34	2.64	1.55	6.88	4.13

Little Chute

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

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

Kimberly

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

[1]Kimberly has three lift stations. In 2013, one of the lift stations that serviced part of Kimberly mill was taken out of commission. In 2014, reported lift stations were reduced to two.

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

Combined Locks

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

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

Darboy

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

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

OBSERVATIONS BY MEMBER COMMUNITITES

Donohue & Associates met with officials from each member community on September 29 and 30, 2015, to review their assessment and observations of their sanitary sewer system.

In addition to the following observations, starting in 2015, HOVMSD receives annual reports from community members. The reports contain CMAR, and a listing of completed and planned sanitary sewer I/I reduction projects.

Kaukauna

- Kaukauna has five major lift stations of which one only pumps leachate from the landfill, and one collects a very small area at the ballfield/nature center. In the past, meter station 5S was a source of unmetered overflows. The meter station was structurally modified to eliminate the overflow (circa 2008). Occasionally, Kaukauna has mechanical pump issues at lift stations but the problems are the result of fat, oils, grease (FOG); not total flow. The FOG issues are being addressed.

- Basement backups were noted on the CMAR. Three recent backups were the result of a construction project. Other backups are the result of owner blockage issues (FOG, diapers/underwear).

- Manholes along the Fox River had surcharging in the past. This has not been an issue for the last several years.

- Many of the customer complaints have been the result of odor issues. There is one area in the system that has a long sewerage detention time and another area where the downstream sewer is flatter than the upstream sewer due to changes in topography.

- The city was conducting inspections for illicit connections in houses at the time of sale. These inspections have been stopped by legislation. Kaukauna Utility is still able to get into houses for inspections with water meter changes and cross connection control reviews but those inspections have far less frequency.

- Critical manholes identified in the SSES have not been inspected regularly. Kaukauna will consider those inspections in the future.

- Kaukauna could use HOVMSD assist in supporting communities to help change legislation for the illicit connection inspections. They would also like more detailed information regarding the peaking ratios, perhaps with monthly reports.

Kimberly

- Critical manholes identified in the SSES are still inspected regularly. Many of those manholes have been replaced. Kimberly doesn't have a specific plan for annual inspections of those manholes.

- Many main lines in high I/I areas have been replaced. Early projects did not include lateral replacements. Kimberly determined that the reductions in I/I were far less when the laterals were not replaced. They have been replacing all laterals with new projects and have been going back to completed projects to finish the lateral replacements. Forty to fifty laterals are replaced each year. In three years, all laterals on previous projects will be replaced.

- A recent project on Anne Street allowed Kimberly to eliminate a problem lift station.

- Basement backups were a historic problem along Kimberly Street. That portion of the sanitary system was completely replaced. There have not been backups in the area for the last 6 years.

- The Kimberly Mill was closed and completely separated from the sewer system in 2014. There may be some small sewers in the mill area that have not been identified. As redevelopment/decommissioning continues, those will be identified and removed.

- Kimberly does not submit sanitary sewer plans to HOVMSD for review as required by ordinance.

- The village is continually looking for better chimney seals. The previous type was not effective on old manholes. They are looking at a spray product that was used in the Town of Menasha.

- McMahon is still flow monitoring manholes throughout the village in advance of work projects.

- Clear water inspections can no longer be done with the sale of houses due to legislative changes. Kimberly was inspecting 40 to 60 houses each year at the time of sale. They found 5-10% of the houses contained illicit connections. Kimberly considered this an important tool in their ongoing efforts to remove I/I.

Combined Locks

- Several staff changes since the Sustainability Program started. Staff are not as familiar with the goals of the program.

- Critical manholes, identified in the SSES are monitored in spring and fall each year. They plan to include a few additional manholes near the mill.

- All sewers are televised on a 7-year rotation.

- Illicit sewer connection inspections at the point of sale is no longer allowed by legislative actions. The village can still inspect with the cross connection inspections but there is a 10-year rotation for every home. The village would like to work with banks to get information to the home owners prior to the sale of the house as part of their due diligence.

Darboy

- The utility inspects siphons every other week. Every year they fully inspect two of their six sanitary sewer basins. In a basin that was inspected in 2014, they found a major leak in a manhole on CTH KK that contributed an estimate 70,000 gallons a day of I/I. The leak was not noticed in 2011, but Darboy expects that it was the source of increasing I/I over the past few years. The manhole was repaired in 2014.

- All manholes have internal chimney seals that are installed by Great Lakes. Darboy previously used a spray-on product but that had very little success.

- Illicit connection inspections will continue with the change of water meters and utility cross connection inspections, but cannot happen at the time of sale. Darboy plans to make a note of that in their annual CMAR to bring attention to the issue with WDNR.

Little Chute

- Staff mentioned that information from HOVMSD is not always provided when asked.

- All recent basement backups have been related to the actions of the homeowners.

- Inspections for illicit connections in houses are completed with water meter changes and prior to a sanitary sewer project in the area. Every house is inspected approximately once in ten years. The village was not conducting time of sale inspections, therefore recent legislative changes do not have an impact on the frequency of inspections.

- Sewers are televised prior to projects. Since 2005, laterals are televised to the house or as close as possible.

- Critical manholes are inspected on a weekly or monthly basis depending on their location. Additional inspection are conducted during specific high flow events.

- When storm sewers are televised, the village specifically looks for sanitary sewer cross connections.

- Internal chimney seals are install on all manholes. A Cretex product is preferred. Spray liners, used in the past, are not effective on older concrete.

- Village would like to have access to the instantaneous (15-minute interval) readings at the meter stations.

Heart of the Valley Metropolitan Sewerage District

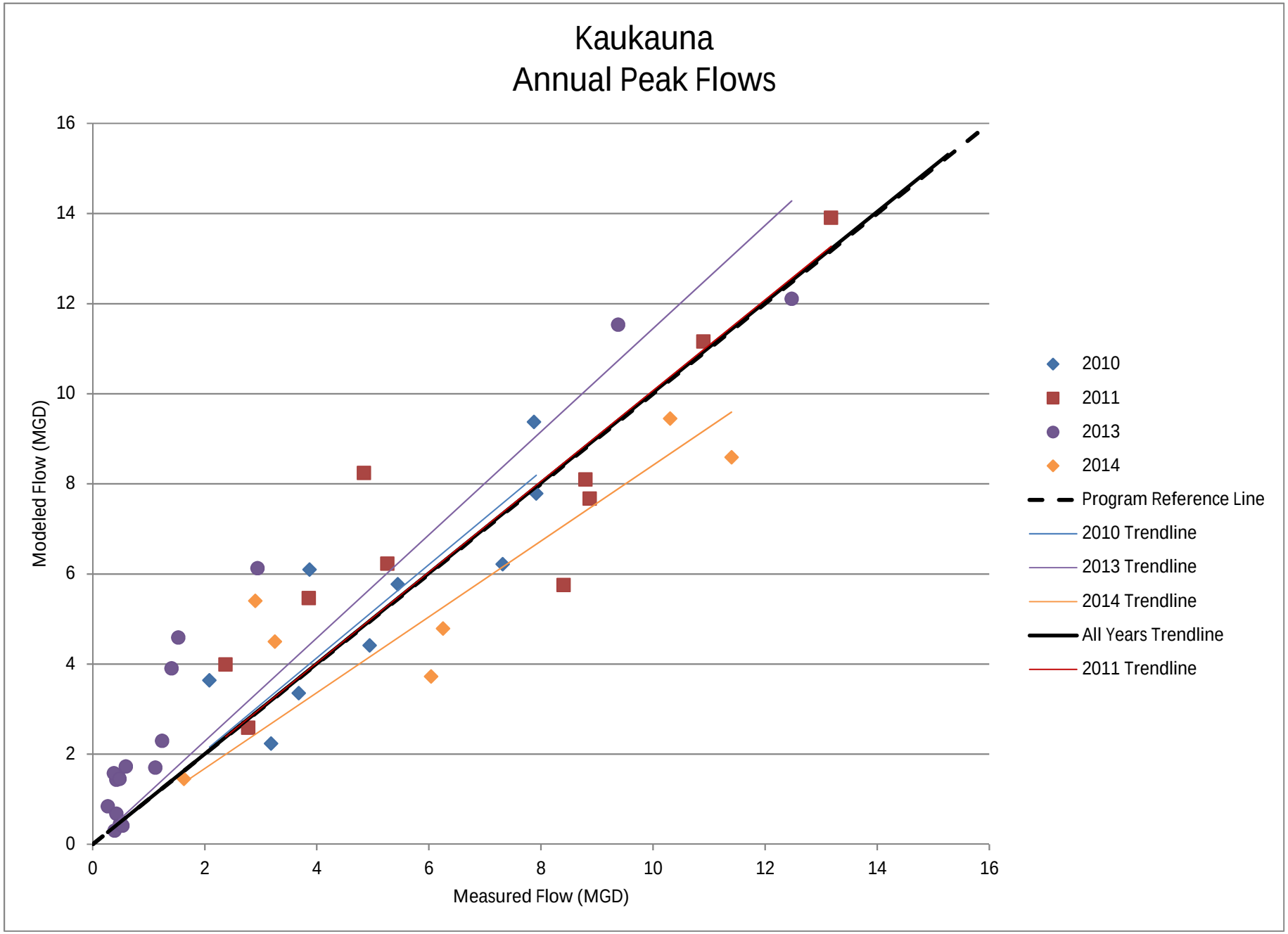
Member Community Compliance Maintenace Annual Report: Peaking Factor Ratios

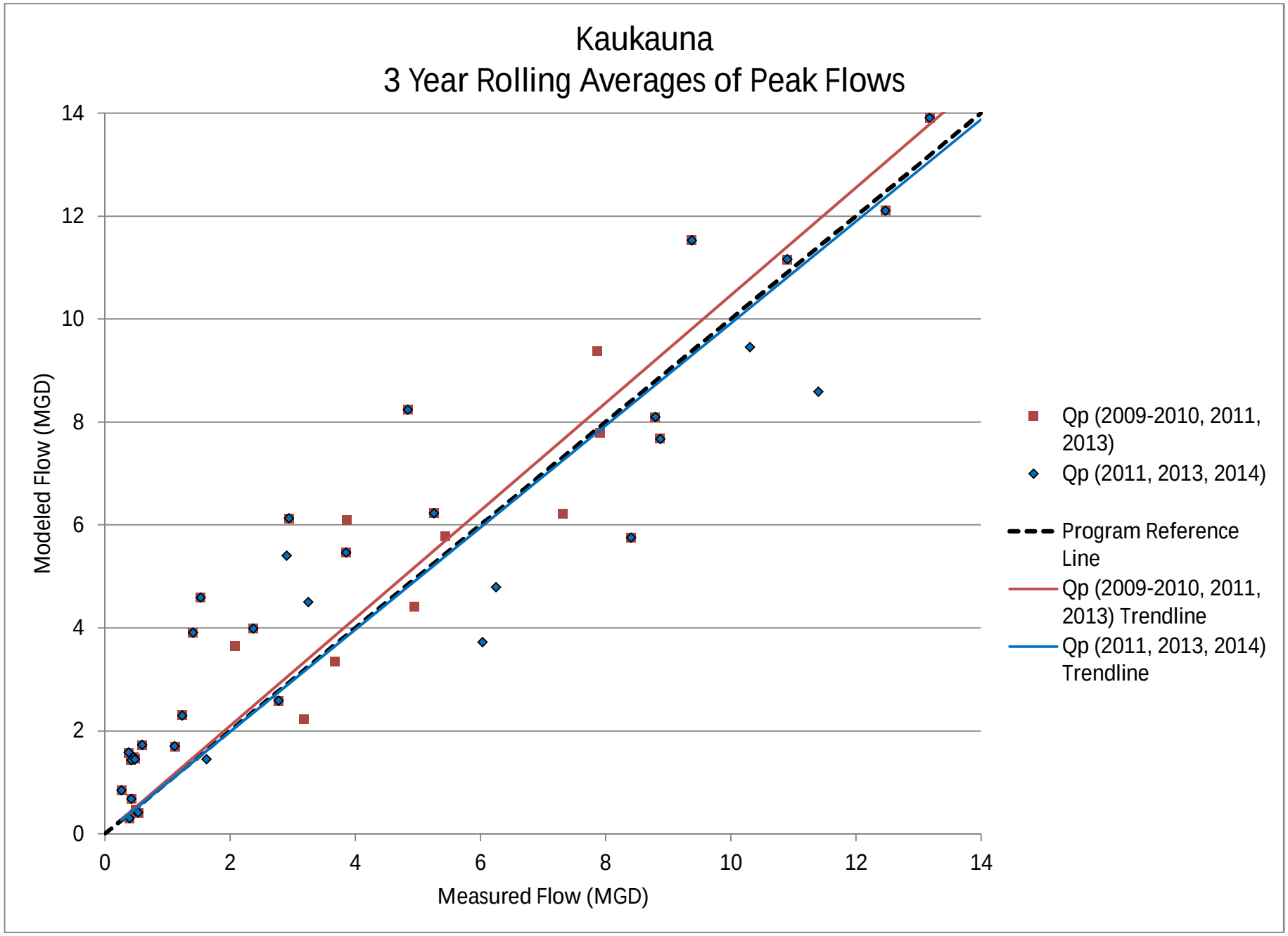
January 2010- December 2014

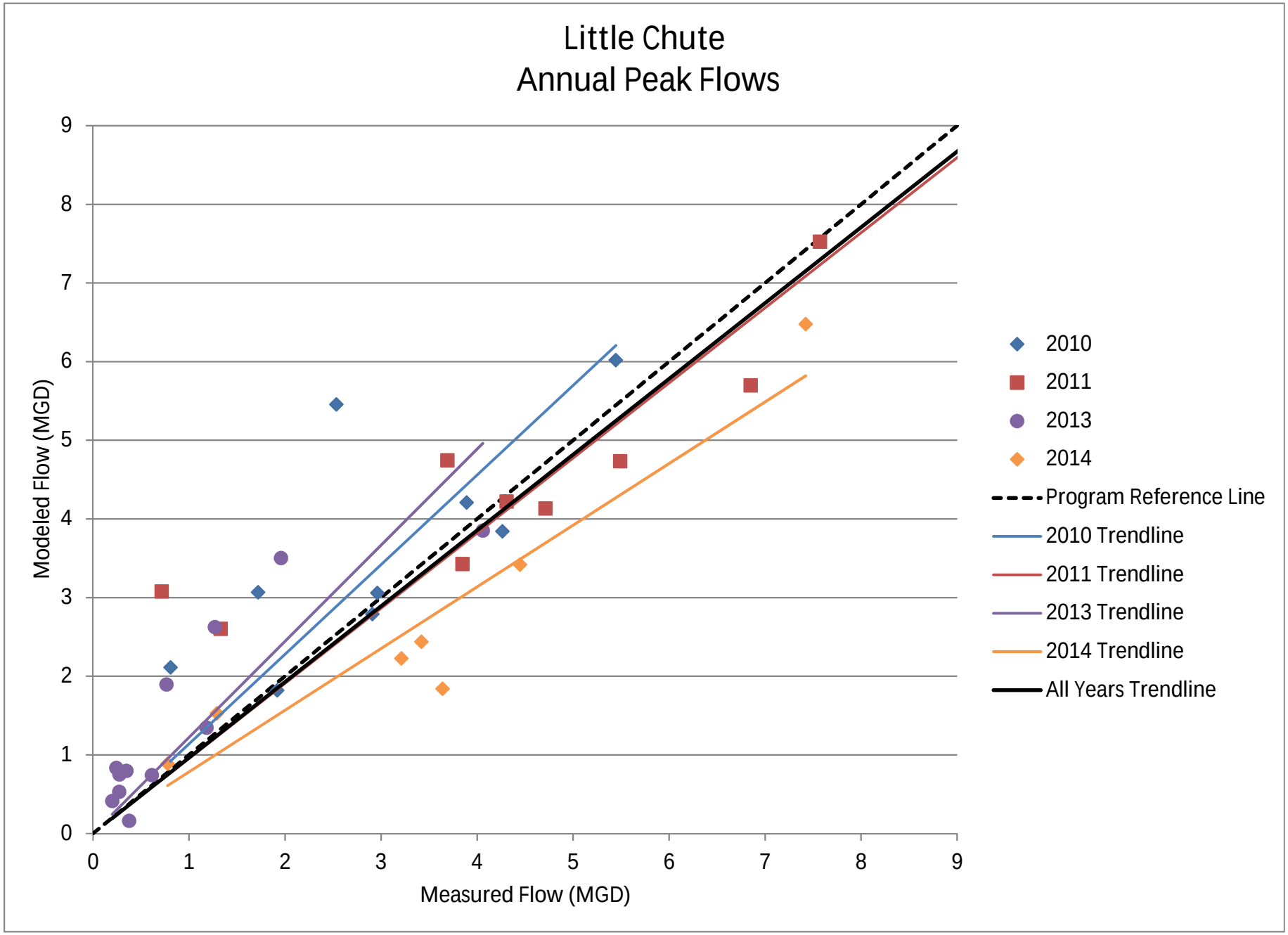
Metric	Kaukauna					Kimberly					Little Chute					Combined Locks					Darboy				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014*	2010	2011	2012	2013	2014*
Average daily flow in MGD	3.27	3.42	2.48	2.40	2.64	0.98	0.84	0.68	0.68	0.75	1.46	1.49	1.16	1.39	1.45	0.38	0.38	0.30	0.34	0.36	0.95	0.96	0.94	1.02	1.06
Peak monthly flow in MGD	4.92	5.50	3.39	4.16	4.08	1.68	2.01	1.04	1.37	1.32	2.42	3.05	1.73	2.43	2.42	0.68	0.80	0.47	0.63	0.63	1.13	1.26	1.04	1.27	1.35
Month of peak monthly flow in MGD	July	April	March	April	April	July	April	March	April	April	July	April	March	April	April	July	April	March	April	April	July	April	March	April	April
Peak hourly flow in MGD	20.20	14.22	16.03	12.94	18.16	10.90	7.05	5.11	4.52	6.99	13.86	8.42	6.02	6.66	8.73	4.13	2.51	2.33	2.15	2.73	3.43	2.61	3.10	2.82	3.18
Peaking factor ratio Peak Monthly:Annual Daily Avg	1.50	1.61	1.37	1.73	1.55	1.71	2.39	1.53	2.00	1.76	1.66	2.05	1.50	1.75	1.67	1.78	2.13	1.56	1.83	1.75	1.19	1.31	1.11	1.25	1.27
Peaking factor ratio Peak Hourly:Annual Daily Avg	6.17	4.16	6.47	5.38	6.88	11.07	8.36	7.56	6.62	9.32	9.49	5.65	5.20	4.80	6.01	10.77	6.65	7.74	6.26	7.64	3.60	2.71	3.29	2.76	2.99
Top 10 peak hourly flow in MGD: 1	20.20	14.22	16.03	12.94	18.16	10.90	7.05	5.11	4.52	6.99	13.86	8.42	6.02	6.66	8.73	4.13	2.51	2.33	2.15	2.73	3.43	2.61	3.10	2.82	3.18
2	18.90	12.50	10.74	12.93	15.95	10.02	4.62	4.83	4.07	6.77	12.20	6.42	5.91	5.62	8.13	3.19	1.77	2.01	1.92	2.58	3.34	2.58	2.78	2.67	2.80
3	18.04	12.30	9.66	9.98	14.62	9.71	4.47	4.46	3.91	6.22	11.10	6.07	5.44	5.49	7.12	3.18	1.59	1.64	1.51	2.44	3.24	2.52	2.72	2.51	2.75
4	17.76	11.40	8.67	9.40	10.70	8.04	4.32	4.07	3.78	5.18	8.66	6.01	4.45	5.44	6.25	3.17	1.58	1.37	1.37	2.44	2.82	2.26	2.38	2.45	2.41
5	10.78	10.19	7.38	8.45	10.66	7.66	4.14	3.17	3.15	4.93	7.39	5.61	3.92	4.98	5.34	2.79	1.54	1.17	1.24	1.78	2.82	2.18	2.10	2.44	2.37
6	10.64	10.19	7.26	7.33	7.99	6.06	4.10	2.81	2.75	3.89	5.25	5.51	3.63	4.27	5.11	1.96	1.53	1.16	1.22	1.77	2.76	2.16	2.06	2.33	2.27
7	10.58	10.18	7.02	7.22	7.92	5.33	4.05	2.77	2.64	3.84	5.01	5.49	3.43	4.00	4.96	1.85	1.49	1.14	1.21	1.54	2.70	2.14	2.03	2.26	2.18
8	10.43	10.04	6.76	7.01	7.67	5.27	3.98	2.66	2.58	3.70	4.75	5.10	3.41	3.83	4.59	1.65	1.41	1.11	1.14	1.32	2.37	2.12	1.98	2.21	2.17
9	10.01	9.98	6.76	6.90	7.67	5.22	3.63	2.44	2.35	2.95	4.67	5.04	3.34	3.77	3.99	1.61	1.30	1.08	1.04	1.29	2.35	2.08	1.96	2.17	2.15
10	9.77	9.95	6.75	6.87	7.57	5.07	3.37	2.44	2.26	2.93	4.67	5.00	3.32	3.69	3.87	1.59	1.27	0.99	1.00	1.24	2.09	2.05	1.96	2.15	2.09
Peaking factor ratio Ave Top 10 Peak Hourly:Annual Daily Avg	4.19	3.25	3.51	3.70	4.13	7.45	5.19	5.14	4.69	6.32	5.31	3.94	3.71	3.44	4.00	6.55	4.24	4.65	4.03	5.34	2.93	2.36	2.45	2.35	2.29

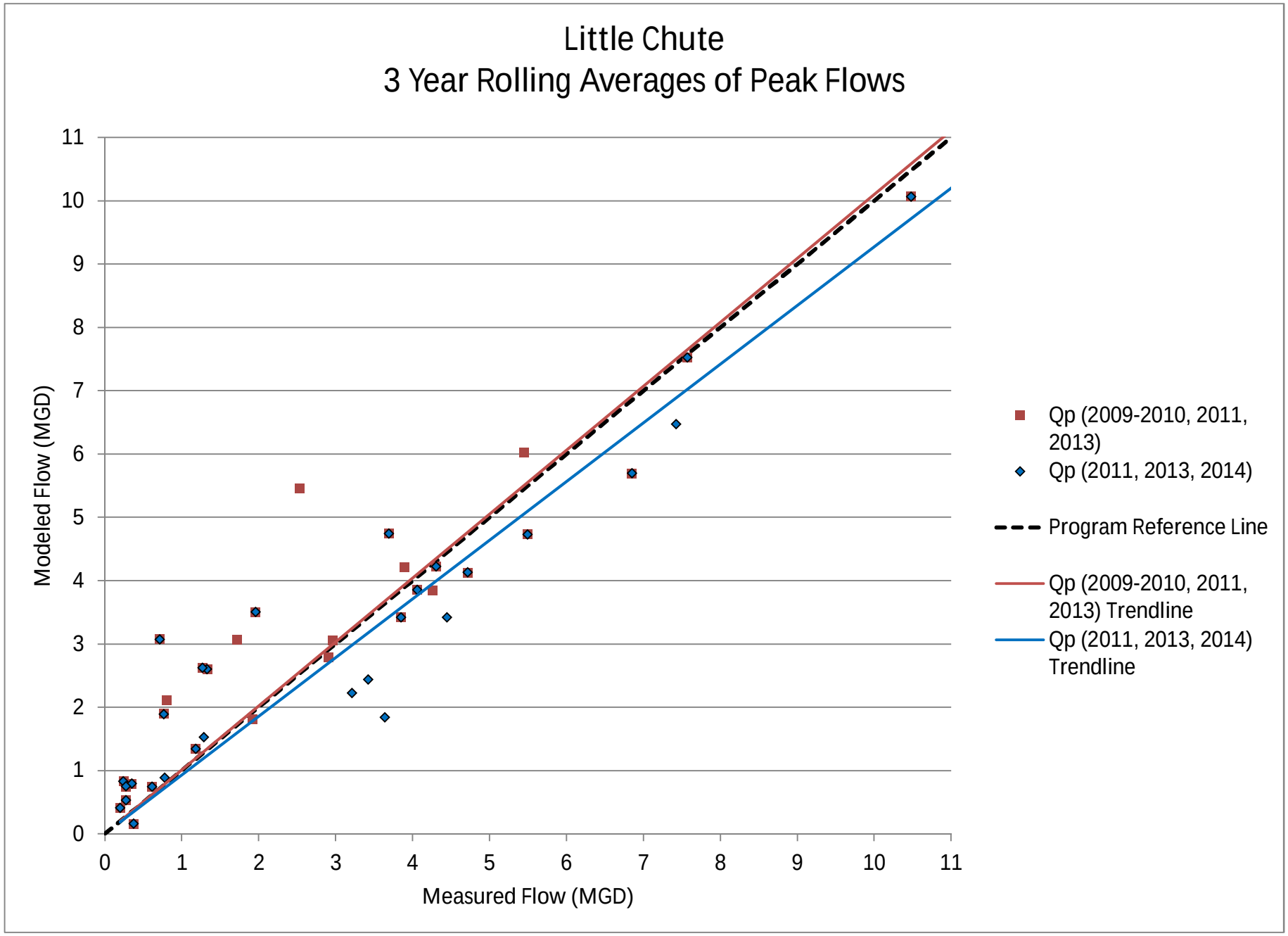
Peak monthly flow is the highest average rate for any given calendar month
Peak hourly flow is the highest average rate for any four consecutive 15-minute reporting intervals

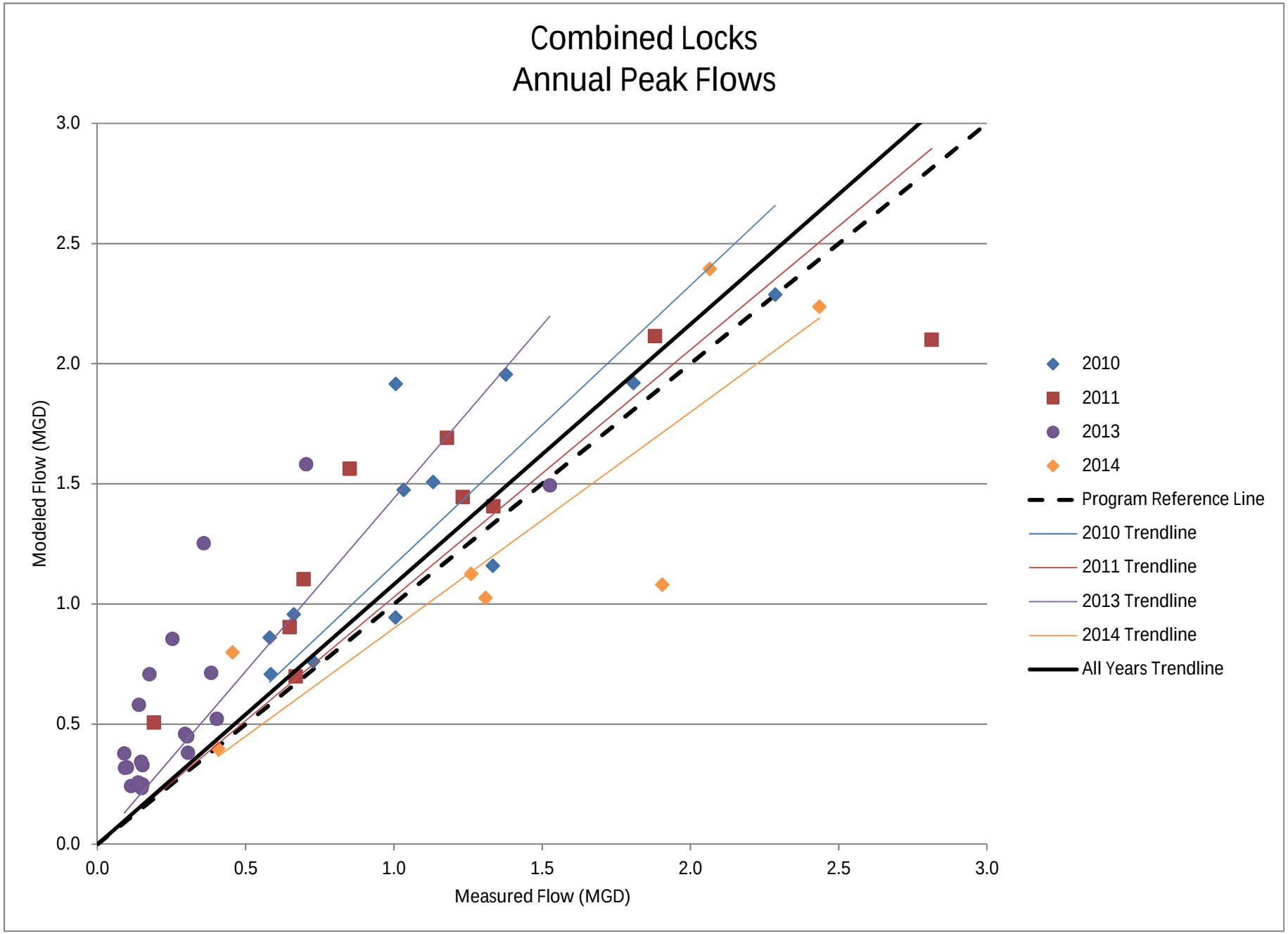
*Note: Data from 7/9/14 9:00 to 7/15/14 16:45 at Combined Locks and Darboy meter stations was omitted from analysis. Interceptor maintenance caused surcharging at meter station.
Data on the table represents the highest monthly and peak hourly flows rates outside of the maintenance time period.

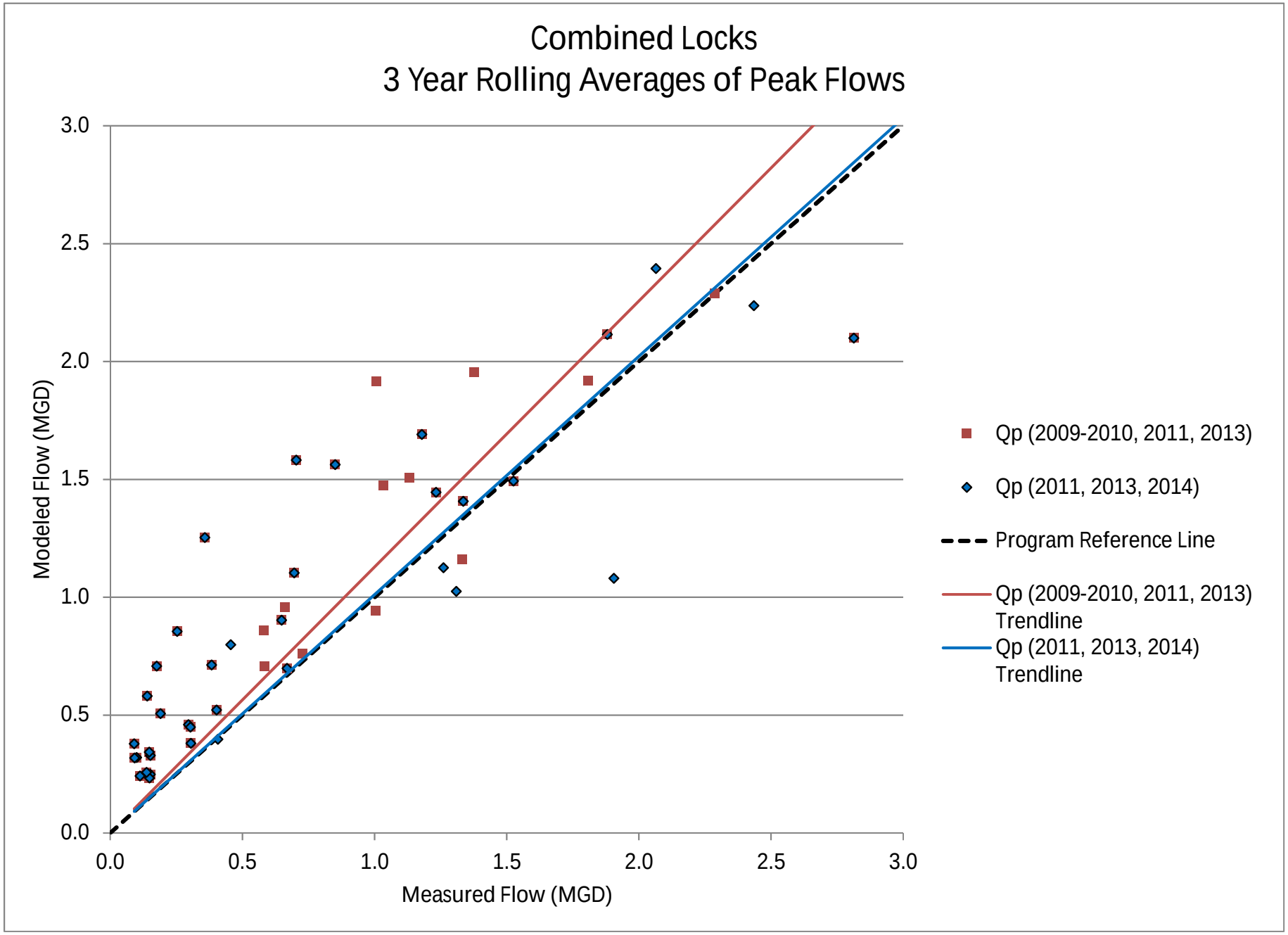

Kaukauna
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
2
4
6
8
10
12
14
16
2010
2011
2013
2014
Program Reference Line
2010 Trendline
2013 Trendline
2014 Trendline
All Years Trendline
2011 Trendline

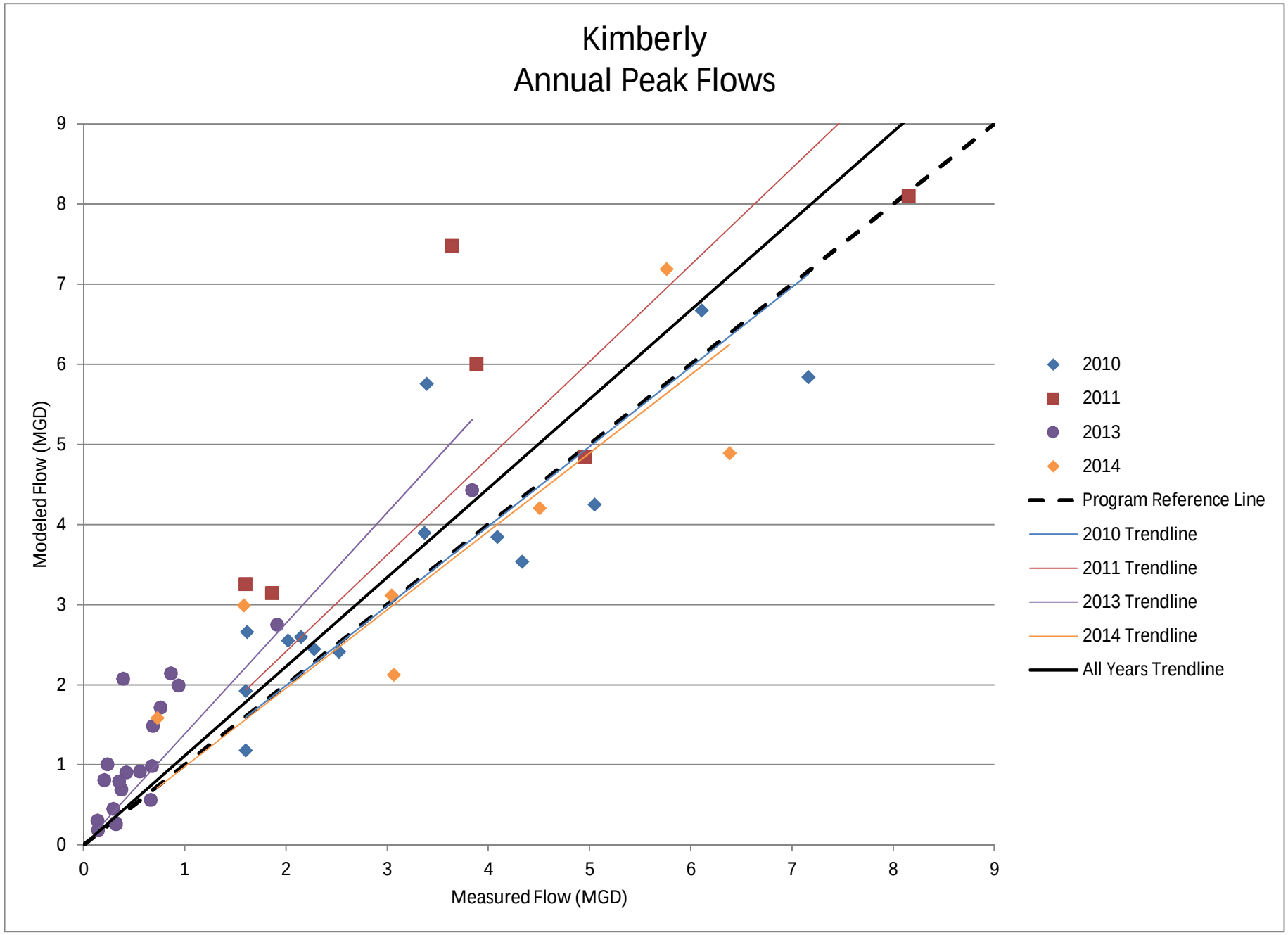

Kaukauna
3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
2
4
6
8
10
12
14
Qp (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Program Reference Line
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline

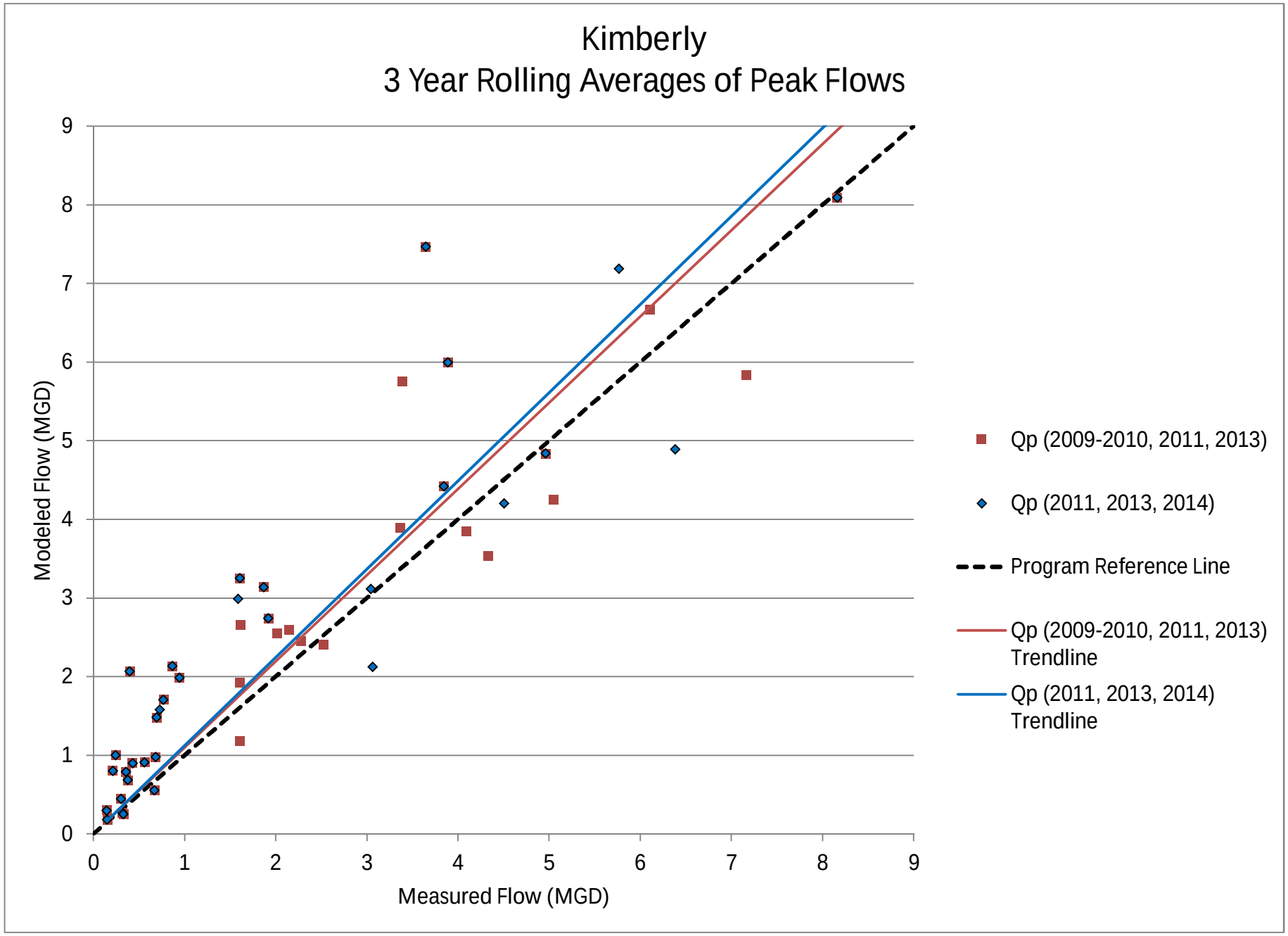

Little Chute
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
2010
2011
2013
2014
Program Reference Line
2010 Trendline
2011 Trendline
2013 Trendline
2014 Trendline
All Years Trendline

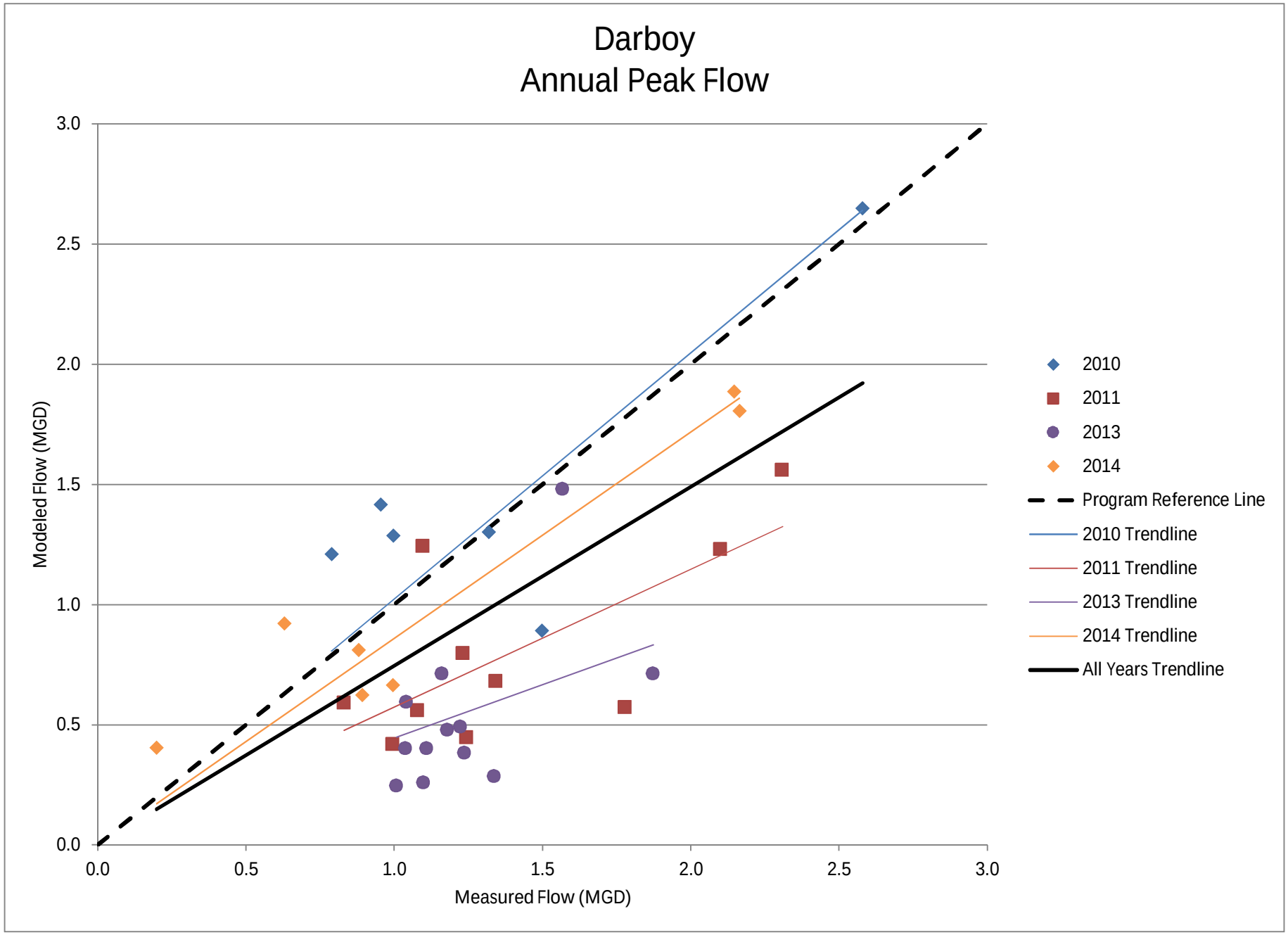

Little Chute
3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
10
11
Qp (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Program Reference Line
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline

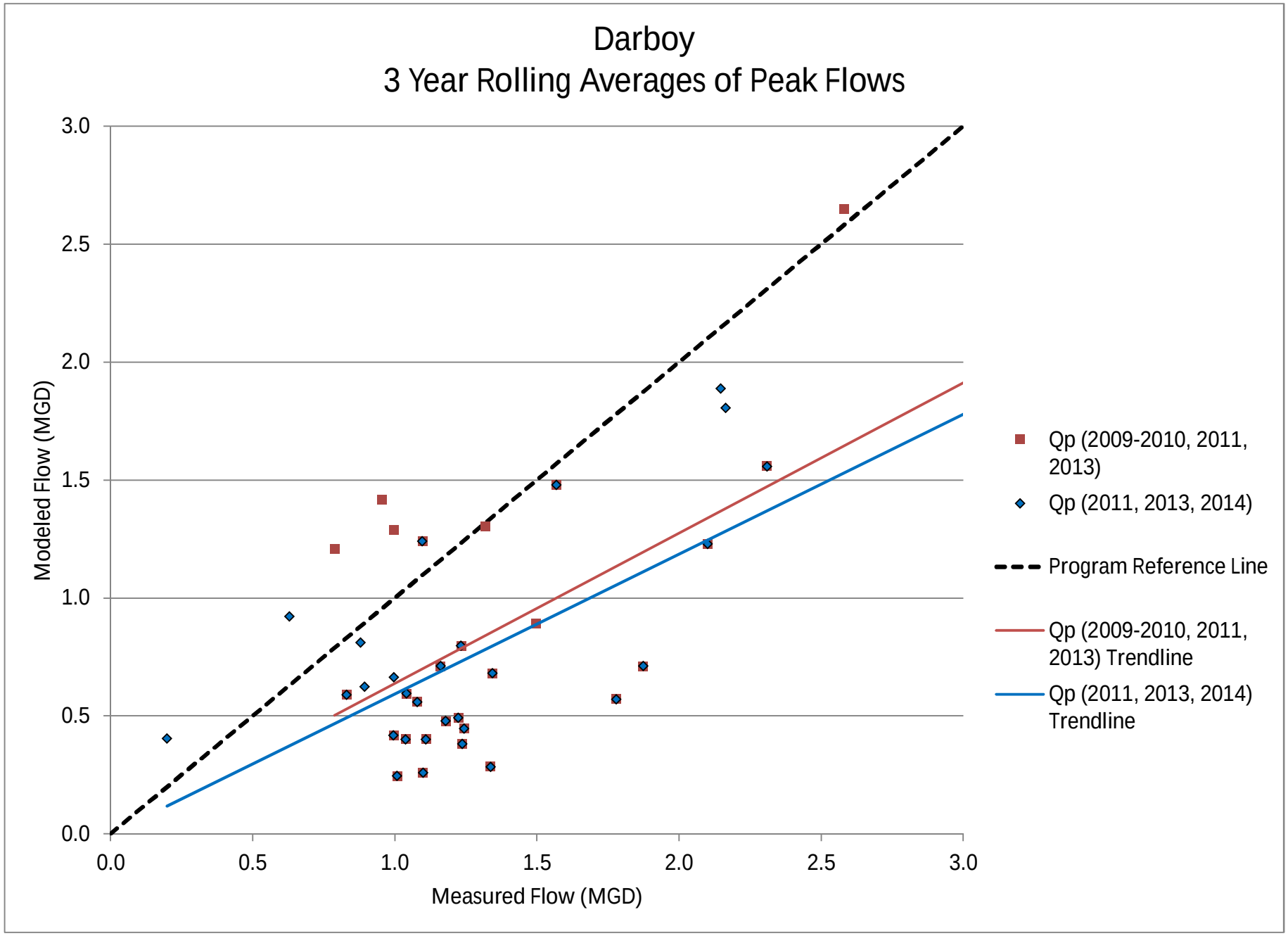

Combined Locks
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
2010
2011
2013
2014
Program Reference Line
2010 Trendline
2011 Trendline
2013 Trendline
2014 Trendline
All Years Trendline


Combined Locks
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 (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Program Reference Line
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline


Kimberly
Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
2010
2011
2013
2014
Program Reference Line
2010 Trendline
2011 Trendline
2013 Trendline
2014 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
Qp (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Program Reference Line
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline


Darboy
Annual Peak Flow
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
2010
2011
2013
2014
Program Reference Line
2010 Trendline
2011 Trendline
2013 Trendline
2014 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 (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Program Reference Line
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline