Year of 2015 Chapter 94 Annual Report
Buckingham Township
Fieldstone WWTP
Bucks County

Prepared by:
Graham W. Orton
Buckingham Township
PO Box 413
Buckingham PA, 18912

Prepared for:
Buckingham Township
Fieldstone Wastewater treatment Plant
PO Box 413
Buckingham, PA 18912
Address of wastewater treatment facility:
4107 Crestview Way, Doylestown, PA 18902

Preparer

Signature
Graham W. Orton
Buckingham Township

Permittee

Signature
Graham W. Orton
Buckingham Township

Table of Contents

INTRODUCTION

The Fieldstone WWTP serves the Fieldstone (Formerly Windridge) development, Portions of Buttonwood, several connections on Church School Road and the Ridings of Buckingham Development. The service area is all in Buckingham Township and the Township is the sole owner/operator.

The Fieldstone Plant was originally built in 1986 and was expanded in 2000, with collection system extensions in 2005 & 2009. The plant consists of 4 sequential treatment lagoons and three nearby sprayfields. A sprayfield expansion will be constructed to allow the transfer of about 23,000 gpd of treated wastewater from the Township's Cold Spring System.

HYDRAULIC AND ORGANIC LOADINGS

Line graphs showing 5-year past and projected Hydraulic and Organic loading are inserted between pages 3 and 4.

The permitted capacities of the Fieldstone WWTP:
Annual Average (AA) Capacity = 61,200 gpd
Hydraulic Design Capacity is less than permitted = 56,300 gpd
Organic Design Capacity = 193.0 lb/day

Hydraulic Loading:

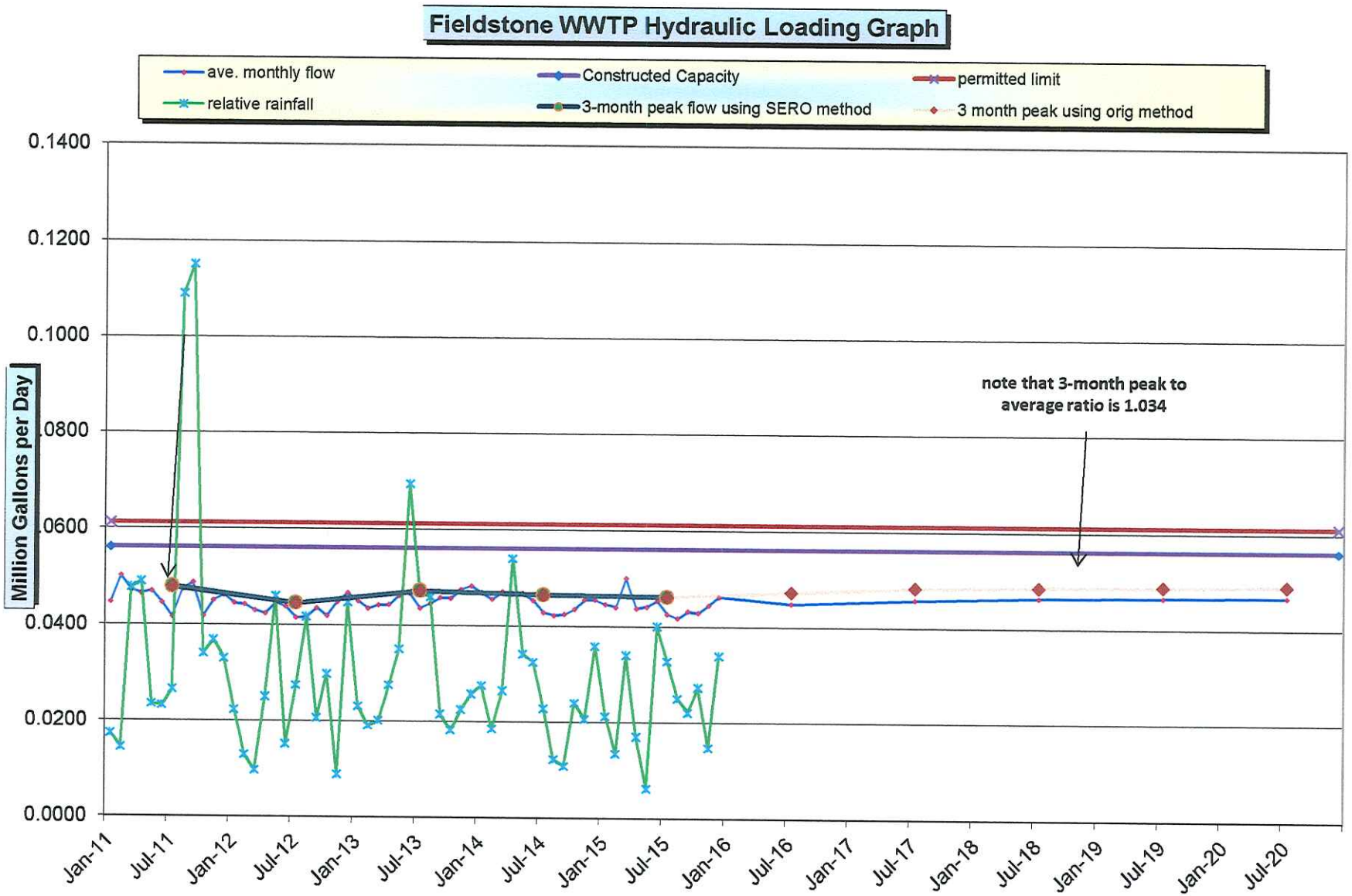
a. The calendar year's AA flow is less than the permitted and constructed AA capacity.

b. There were no 3 consecutive month periods where the 3-month average flow exceeded the hydraulic design capacity of the WWTP.

c. No CAP or CMP is required

d. A High Flow Maintenance Plan (HFMP) has not been prepared for the Fieldstone WWTP. This is a lagoon treatment plant which is not affected by short duration rain events. Very wet winters can cause the plant to enter the freeboard storage designed and constructed as a safety feature. The plant never entered freeboard until January-February of 2014. We now have 5 good historical years' data from the replaced influent meter

e. Table 1 below, in the DEP recommended format, provides tabular data. We are now showing the SERO-method plot on the graphs.


Fieldstone WWTP Hydraulic Loading Graph
ave. monthly flow
Constructed Capacity
permitted limit
relative rainfall
3-month peak flow using SERO method
3 month peak using orig method
Million Gallons per Day
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
note that 3-month peak to average ratio is 1.034
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20

Fieldstone WWTP Organic Loading Graph

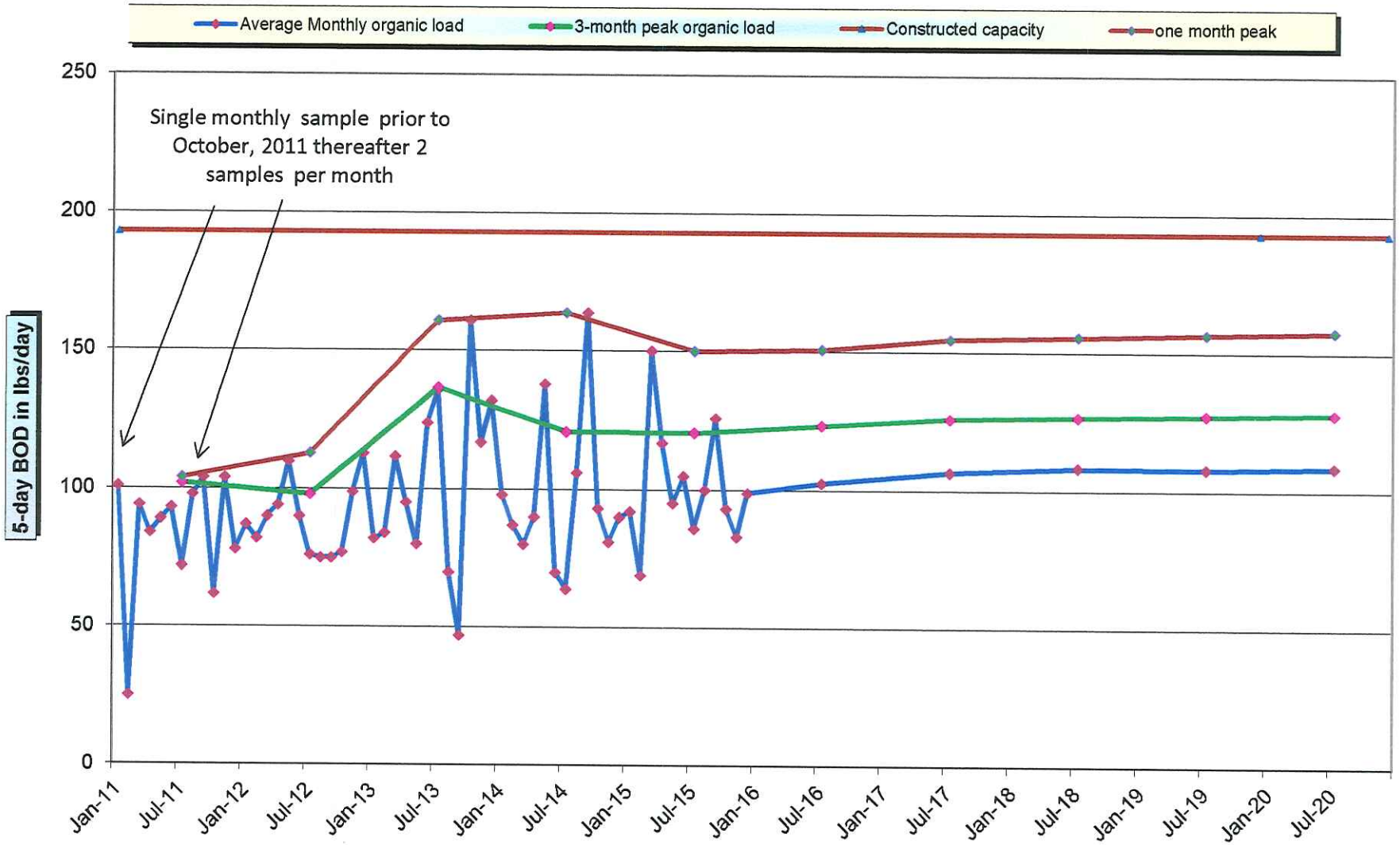


Table 1						
	Hydraulic Loading (metered) (MGD)					Rainfall (inches)
Month	**2011**	**2012**	**2013**	**2014**	**2015**	**2015**
January	0.0447	0.0446	0.0452	0.0470	0.0447	3.28
February	0.0500	0.0443	0.0436	0.0456	0.0441	2.07
March	0.0472	0.0431	0.0443	0.0471	0.0500	5.26
April	0.0465	0.0425	0.0444	0.0469	0.0439	2.62
May	0.0470	0.0446	0.0463	0.0468	0.0442	0.96
June	0.0446	0.0439	0.0468	0.0454	0.0455	6.18
July	0.0417	0.0417	0.0437	0.0430	0.0428	5.06
August	0.0475	0.0418	0.0447	0.0424	0.0419	3.87
September	0.0487	0.0436	0.0459	0.0426	0.0434	3.41
October	0.0419	0.0420	0.0458	0.0437	0.0430	4.21
November	0.0452	0.0449	0.0476	0.0456	0.0446	2.27
December	0.0463	0.0468	0.0483	0.0456	0.0464	5.23
Annual Average (AA)	**0.0459**	**0.0436**	**0.0455**	**0.0451**	**0.0445**	
3 Month Max. Average	**0.0479**	**0.0446**	**0.0472**	**0.0466**	**0.0463**	
Ratio (3 Month Max to AA ratio)	**1.04**	**1.02**	**1.04**	**1.03**	**1.04**	
5-Year Average Hydraulic Ratio = 1.034						

Organic loading of the Fieldstone WWTP:

f. Organic loadings at the Fieldstone WWTP pre 2012 are derived from a single grab sample per month through September of 2011 and two grab samples per month thereafter through 2015. The loading is coming from 100% domestic connections and, over a statistically significant (no less than three) number of samples, the loading average should not vary by more than 20 to 30% but we added another sample event per month to get into a more comfortable statistical zone for shorter terms which has resulted in a more flat curve. 2011-15 organic loading data are generally calculated using the flow on the day the sample was collected except for a few times two day averages had to be used.

g. A minimum of three consecutive month grab samples are likely to generate statistically significant values but a single grab sample will not. The single peak month has not exceeded the WWTP's design organic loading.

h. Grabbed samples are usually taken during expected peak BOD_5 concentration hours. A lagoon treatment plant works on the principal of very long retention times and very low MLSS concentrations. It is, therefore, able to assimilate and treat wide organic loading variations that might occur. We have sampled twice per month since October of

2011 to improve the probability that anomalous peaks and valleys are evened out.

i. There is no existing or projected organic overload condition.

A discussion of the influent organic sampling protocol that details:

j. Sampling frequency, recommended as follows:

Recommended Sampling Frequency for Influent BOD_5	
Annual Average Capacity	**Minimum Sampling Frequency**
> 1.0 MGD	Once per week
0.050 to 1.0 MGD	Twice per month
<0.050 MGD	Once per month

k. Type of sample taken – see above – grab samples tested for BOD_5.

l. The influent BOD_5 sample is taken from the PS #10 forcemain. This station takes the flow from 83+% of the connections.

m. There is no hauled in septage to this plant

n. Influent loadings were calculated using the month's average flow and the single monthly sample prior to September 2011. We calculate loading based on the day of sampling's flow most of the time. Table 2 below, shows the calendar year's organic loading sampling data:

o.

Table 2				
Organic Loading Sampling Data				
	A	B	C = A x B x 8.34	
Date of sample	**BOD5 (mg/l)**	**Flow (MGD) on the sample day**	**Daily BOD5 (lbs/day)**	**Monthly Average (lbs/day)**
1/9/2015	192	0.0446	71	
1/12/2015	319	0.0421	112	**92**
2/5/2015	217	0.0430	78	
2/12/2015	166	0.0428	59	**69**
3/5/15	274	0.0523	120	
03/11/11	320	0.0675	180	**150**
04/02/15	300	0.0449	112	
04/16/15	352	0.0416	122	**117**
05/07/15	251	0.0468	98	
05/21/15	271	0.0405	92	**95**
06/04/15	361	0.0453	136	
06/11/15	186	0.0479	74	**105**
07/09/15	254	0.0444	94	
07/23/15	223	0.0415	77	**86**

Table 2 (cont.)				
Organic Loading Sampling Data				
	A	**B**	**C = A x B x 8.34**	
Date of sample	**BOD5 (mg/l)**	**Flow (MGD) on the sample day**	**Daily BOD5 (lbs/day)**	**Monthly Average (lbs/day)**
08/06/15	370	0.0395	122	
08/13/15	222	0.0417	77	**100**
09/03/15	386	0.0446	131	
09/17/15	353	0.0410	121	**126**
10/08/15	326	0.0420	114	
10/15/15	212	0.0399	71	**93**
11/5/15	259	0.0421	91	
11/12/15	234	0.0377	74	**83**
12/03/15	306	0.0449	115	
12/10/15	241	0.0410	82	**99**
Year 2015				**101**

Table 3 below shows the Fieldstone WWTP's historic 5-year organic loading data:

Table 3					
Organic Loading (lbs/day)					
Month	**2011**	**2012**	**2013**	**2014**	**2015**
January	101	87	82	98	92
February	25	82	84	87	69
March	94	90	112	80	150
April	84	94	95	90	117
May	89	110	80	138	95
June	93	90	124	70	105
July	72	76	136	64	86
August	98	75	70	106	100
September	104	75	47	164	126
October	62	77	161	93	93
November	104	99	117	81	83
December	78	113	132	90	99
Annual Average	**84**	**89**	**103**	**97**	**101**
Ratio (Max Month to Annual Average Ratio)*	**1.24**	**1.27**	**1.56**	**1.69**	**1.49**
5-Year Average Organic Ratio = 1.45					

*While the hydraulic loading "peaking factor" is determined using the 3-Month-Max to AA ratio, the organic loading "peaking factor" is determined using the Maximum Month (i.e., the single highest monthly average in the calendar year) to AA ratio.

5-YEAR HYDRAULIC AND ORGANIC LOADING PROJECTIONS

The Fieldstone WWTP influent meter has been giving accurate information since mid 2010:

b. The Department has requested that flow projections be determined using a "5-year adjusted annual average flow," rather than a 5-year average or current calendar year AA flow.

c. Average annual organic loading is calculated as DEP requests and peak one month projections are graphed with a comparison to using the 2015 3-month peak data as a base method. Neither method predicts an overload.

d. To project organic loading, we use 0.17 pounds of BOD_5 per person per day and use 4 people per new EDU which is higher than the census data of 2.7 people per EDU.

e. Neither a 5-year hydraulic nor organic loading is projected to the Fieldstone WWTP.

f. Table 4 lists the organic projections we calculated using the SERO-recommended method.

Table 4
Organic Loading Projections

Year	Annual Average BOD_5 Loading Projections[1] (lbs/day)	Maximum Monthly BOD_5 Loading Projections[2] (lbs/day)
2016	104	151
2017	107	146
2018	108	157
2019	108	157
2020	109	158

[1]AA projections = (Current report year's AA loadings) + (loadings from proposed EDUs)
[2] Max Month projections = (AA projection) x (5-year Average Organic Ratio)

Calculating the Five-Year Adjusted Annual Average For Chapter 94 Flow Projections

A. Determine the new flow in million gallons per day (MGD), which corresponds to the new EDUs connected for each calendar year:

Table 5			
Year	**# of EDUs connected**	**gpd/EDU**	**New Flow (MGD)**
2011	4	250	0.00100
2012	1	250	0.00025
2013	2	250	0.00050
2014	0	250	0.00000
2015	0	250	0.00000

B. adjust each calendar year by adding the flows from new connections to the annual average flow for each of the previous calendar years.

Table 6							
Year	**AA Flow in MGD**	**All projects connected (provide flows approved in planning modules or exemptions in MGD—include any connected projects that did not require planning)**					**Adjusted AA Flow**
		2011	2012	2013	2014	20145	
2011	.0459		0.00025	0.00050	0.00000	0.00000	0.0467
2012	.0467			0.00050	0.00000	0.00000	0.0472
2013	.0472				0.00000	0.00000	0.0472
2014	.0472					0.00000	0.0472
2015	.0472						0.0472
Total	**0.2342**					**Total**	**0.2355**
5 Yr Avg	**0.0468**					**5 Yr Adj Avg**	**0.0471**

C. our original method and the SERO method produce essentially the same projection (at least in the 2015 report).

Table 7 – using the SERO method and 250 gpd/EDU					
Result is slightly higher than shown on the graph since the Fieldstone EDU is 225 gpd					
Year	Previous Year's Annual Average Flow[1]	New EDUs	Increased Flow[2] (MGD)	Projected Annual Average Flow[3] (MGD)	Projected Max Month Flow[4] (MGD)
2016	0.0471	4	0.00100	0.0481	0.0497
2017	0.0481	4	0.00100	0.0491	0.0508
2018	0.0491	1	0.00025	0.0494	0.0510
2019	0.0494	1	0.00025	0.0496	0.0513
2020	0.0496	1	0.00025	0.0499	0.0515

[1] The first year's projection (2016 in this example) was calculated in table 6 to get the 5-year adjusted average.
[2] Increased Flow = (New EDUs x 250 gpd/EDU)/1,000,000
[3] Projected Annual Average Flow = Previous Year's AA Flow + Increased flow
[4] Projected Max Month = Projected Annual Avg. Flow x 5-year average hydraulic ratio.

D. Considerations on projection figures:

Since there are no future connections (other than emergencies for failed on-lot systems) foreseen after 2017 (Buttonwood reservations all connected), the Fieldstone WWTP will "flat line" after 2017. I & I is not a problem in this system with a 3-month peak multiplier of 1.034. We did observe an unusual spike in flow during hurricanes Lee and Irene but that was atypical and probably related to things happening that will hopefully never happen again.

As part of the Cold Spring WWTP CAP, the Township has proposed an expansion of the Fieldstone treated effluent facilities (irrigation only) so that Cold Spring treated wastewater may be transferred to the Fieldstone system. Permitting and design are nearly complete.

SEWER EXTENSIONS

a. There were no sewer extensions in 2015.
b. There were no sewer extensions approved or exempted in the past year in accordance with the PA Sewage Facilities Act (35 P.S. §§ 750.1—750.20) and Chapter 71 (relating to administration of the sewage facilities program), but not yet constructed;
c. There are no known proposed projects in the Fieldstone WWTP drainage area that require public sewers but are in the preliminary planning stages.

PROGRAM FOR SANITARY SEWER MONITORING, MAINTENANCE, AND REPAIR

a. Monitoring – none except manholes are spot checked
b. Maintenance -none
c. Repair – a leak at PS 10
d. Rehabilitation - none
e. Routine and special activities - none
f. Personnel and equipment used – one certified wastewater operator inspects
g. Sampling frequency - none
h. Quality assurance - none
i. Data analyses – none except at pump stations
j. Infiltration/inflow (I/I) monitoring - none
k. Maintenance and control of combined sewer regulators during the past year: not applicable

The sewer system is relatively new – about one third constructed in the late 1980's and 2/3 constructed from 1999 though 2009. I & I is not a problem and an inspection program is not warranted at this time.

CONDITION OF THE SEWER SYSTEM

l. Bypassing - none
m. Combined sewer overflows – not applicable
n. Sanitary sewer overflows - none
o. Excessive infiltration - none
p. Other system problems - none

Discussion of available existing and future capacity.

q. The age of the sewer system is 7 to 28 years
r. 100% PVC pipe is used
s. All sewer capacities were analyzed for peaking during the design and permitting stages.
t. No repairs or rehabilitations are needed

Discuss any portions of the sewer system in which surcharging occurs:

u. There is no system surcharging
v. There were no SSO's during the report year
w. Dry weather flows are monitored at the two pumping stations which convey 100% of the flow to the Fieldstone WWTP. Although neither pump station has a meter, the existing hour meters provide a fairly reasonable indication of wet and dry weather flow. This data is entered onto a spreadsheet and graphed against rainfall in each monitoring period (graphs are attached).
x. Wet weather capacity analysis consists of looking at the same graph mentioned above. All sewers were designed with very high peak-conveyance capacity and there is very little I & I in this system.

SEWAGE PUMPING STATIONS

y. "Maximum pump rate" is the permitted hydraulic design capacity of the station, which excludes the capacity of the backup pump.

z. "Present maximum flows" are estimated - peak instantaneous flow data is not available for each pump station. The stations were designed to handle peaks as dictated by DEP design criteria with only one pump in service. The second pump is redundant but may also operate in tandem ("lag") with the lead pump if the lead pump is partly blocked or in extreme high flow conditions. Because of the desire to keep the 2-hour fill time for the station, the lag pump is set to start at a point far below where it would need to come on to pump extra in order to keep the station from potentially overflowing. Partly blocked pumps evidence themselves when pumping hours are analyzed and are immediately serviced. If both pumps at a pump station fail, the station is designed to hold at least two hours of flow with no pumping. A phone alarm notifies the operators of high wet well level – set a few inches above the station's normal HWL. If both pumps at a pump station fail, the Township's pump stations are all listed with Sanders Power Equipment who can supply the correct temporary pump within an hour or two from notification of the need. Gary's Septic and Norbill Disposal are on-call to provide transient emergency pumping and hauling if the station is completely out of service. Response time has been adequate to avoid station overflows in nearly every imaginable situation. Both pump stations are scheduled to get generators and meters – PS 10 in 2016 and PS 11 in 2017-18.

Table 8

Pump Stations

Pump Station Name	Number of Pumps	Permitted Capacities		Present Flows (2015 peak 57,007 PS 10 & 6,930 PS 11)		Projected Flows
		AA Permitted Capacity (gpd)	Hydraulic Design Capacity (*w/o backup pump*) (gpm)	Annual Average Flows (gpd)	Peak 2011 or 2012 3-Day Flow (gpm)	5-Year Projected Maximum[1] Flow (gpd)
PS No. 10	2	50,850	135	40,488	43	65,430
PS No. 11	2	9,470	63	4,695	5	6,930

[1] 11 new projected 263 gpd connections were added to the peak 2011 (highest ever seen) flow of 62,540 gpd for PS 10. No new connections will be made to PS 11.

INDUSTRIAL WASTES

There are no industrial wastes or significant users

CORRECTIVE ACTION PLAN

A Corrective Action Plan is not needed. Any decision made to address I & I will look to data gathered over several years since a repeat of the two major 2011 storms, back to back, is highly unlikely. Of the 2 pump stations contributing to the Fieldstone WWTP, the largest one (#10) experienced its 2011 peak loading during Hurricane Lee:

PS #10 – 15% higher in 2011 than the next peak of 57,007 gpd (in 2015)

CALIBRATION REPORTS

Calibration of the Fieldstone Influent meter was completed in November of 2015 and the report is attached after page 13

TRIBUTARY MUNICIPALITY REPORTS

Not applicable

ATTACHMENTS

Meter Calibration report

Pump Station graphs showing 5-year history. Since so few new EDU's are projected, the graphs do not show any loading projections to better display the five-year history.

ESSEX SERVICE CORPORATION
82 DOE RUN DRIVE
HOLLAND, PA 18966
T/A TREATMENT INSTRUMENTATION SPECIALIST

FIELD SERVICE REPO November 24-25,28 2015

Township of Buckingham
P.O. Box 413
Buckingham, PA 18912

Attention: Graham Orton

Trip required for verification of calibration of influent flow meter located at Fieldstone Spray.

Influent Flow Meter

1. Endress & Hauser Model 50W1H
2. SN# D6004516000
3. K-Factor 1.2732

Calibration 0 -400 gpm. Primary Element 4" TubeForward - Normal, 0 Return Off, System dampening 5 seconds, Integration 16.7 MS, Low cutoff 15 gpm, Empty pipe detection ON, Failsafe Low.

Unit checked and calibrated at the following:

As found settings:	Adjusted settings:
0% in - out = 4.01 Madc	None
50% in - out = 12.02 Madc	None
100% in - out = 20.01 Madc	None

Note: All units checked and calibrated in accordance with manufacturers' specifications as set forth in their instruction manuals.

Next calibration due December 2016.

If you have any questions or comments please feel free to call.

ESSEX SERVICE CORPORATION

William K. Weissman

ESSEX SERVICE CORPORATION
82 DOE RUN DRIVE
HOLLAND, PA 18966
T/A TREATMENT INSTRUMENTATION SPECIALIST

FIELD SERVICE REPO November 24-25,28 2015

Township of Buckingham
P.O. Box 413
Buckingham, PA 18912

Attention: Graham Orton

Trip required for verification of calibration of effluent flow meter located at Fieldstone Spray.

Effluent Flow Meter

1. Sparling model Mainline; Serial No. GO5426.

    a. Calibration 0 - 500 gpm. Primary Element 4" Tube.

Unit checked and calibrated at the following:

As found settings:	Adjusted settings:
0% in - out = 4.01 Madc	None
50% in - out = 12.02 Madc	None
100% in - out = 20.01 Madc	None

Note: All units checked and calibrated in accordance with manufacturers' specifications as set forth in their instruction manuals.

Next calibration due December 2016.

If you have any questions or comments please feel free to call.

ESSEX SERVICE CORPORATION

William K. Weissman

ESSEX SERVICE CORPORATION
82 DOE RUN DRIVE
HOLLAND, PA 18966
T/A TREATMENT INSTRUMENTATION SPECIALIST

FIELD SERVICE REPORT November 24-25,28 2015

Township of Buckingham
P.O. Box 413
Buckingham, PA 18912

Attention: Graham Orton

Trip required for verification of calibration of effluent flow meter located at Fieldstone Ridings Spray.

Effluent Flow Meter

1. Sparling model Mainline; Serial No. GO5447.

    a. Calibration 0 - 750 gpm. Primary Element 6" Tube.

Unit checked and calibrated at the following:

As found settings:	Adjusted settings:
0% in - out = 4.01 Madc	None
50% in - out = 12.01 Madc	None
100% in - out = 19.99 Madc	None

Note: All units checked and calibrated in accordance with manufacturers' specifications as set forth in their instruction manuals.

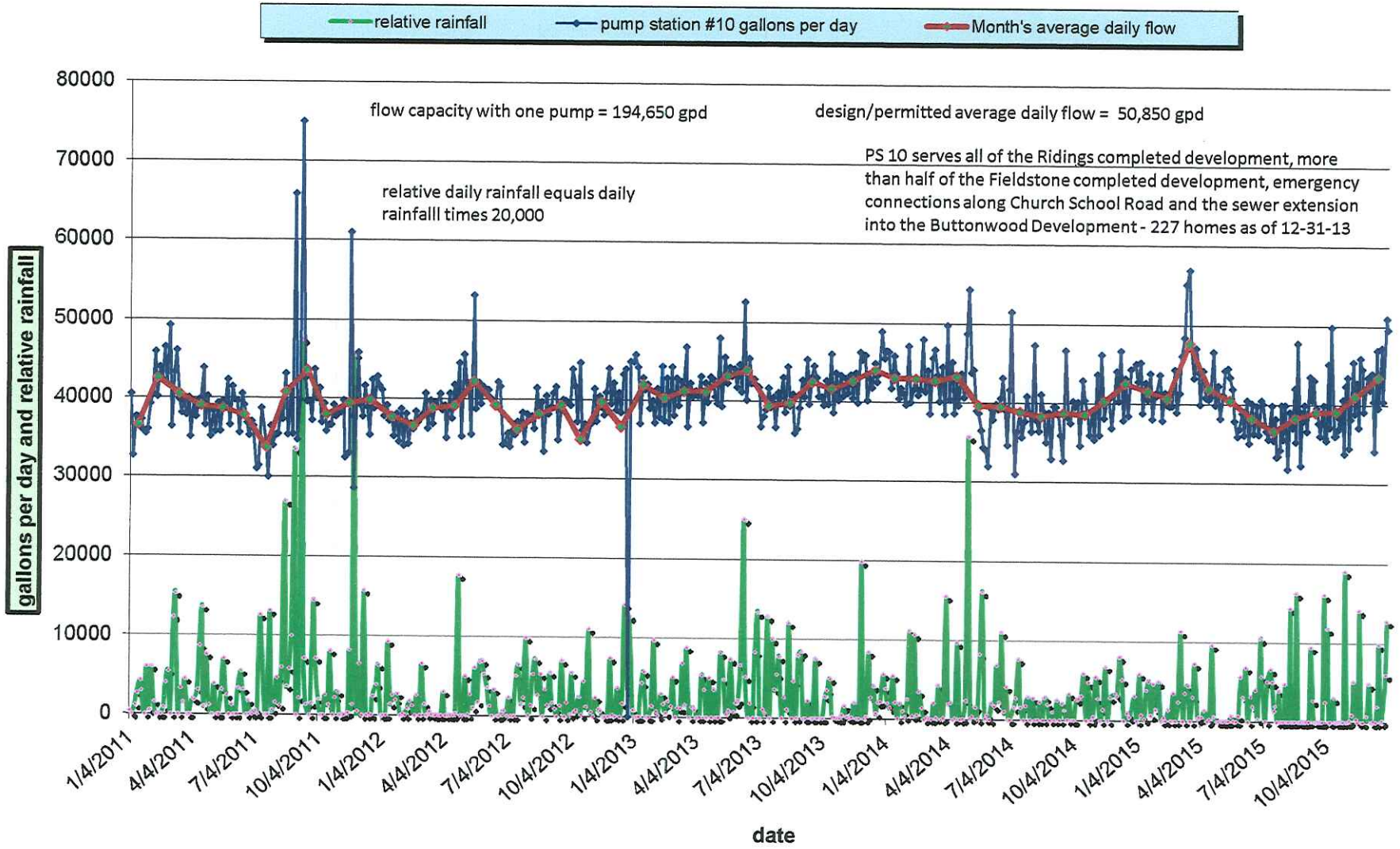
Next calibration due December, 2016.

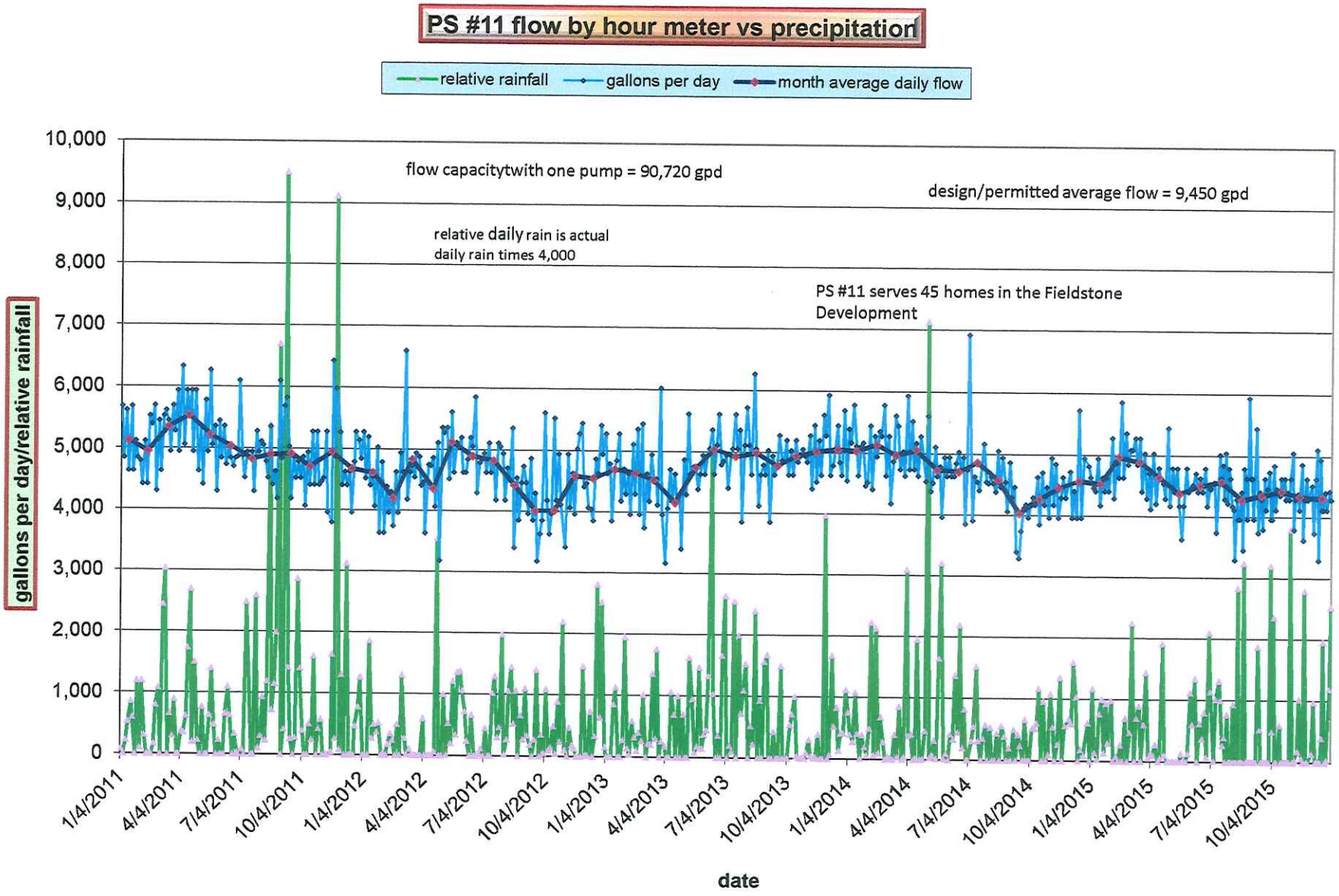
If you have any questions or comments please feel free to call.

ESSEX SERVICE CORPORATION

William K. Weissman

Pump Station #10 Flow by hour meter vs Precipitation




PS #11 flow by hour meter vs precipitation
relative rainfall
gallons per day
month average daily flow
flow capacitytwith one pump = 90,720 gpd
design/permitted average flow = 9,450 gpd
relative daily rain is actual daily rain times 4,000
PS #11 serves 45 homes in the Fieldstone Development
gallons per day/relative rainfall
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1/4/2011
4/4/2011
7/4/2011
10/4/2011
1/4/2012
4/4/2012
7/4/2012
10/4/2012
1/4/2013
4/4/2013
7/4/2013
10/4/2013
1/4/2014
4/4/2014
7/4/2014
10/4/2014
1/4/2015
4/4/2015
7/4/2015
10/4/2015
date