

# Sewer System H&H Model Report

# **REVISION CONTROL**

REV. NO.	DATE ISSUED	PREPARED BY	DESCRIPTION OF CHANGES
1.	3/01/18	Greeley and Hansen / DELCORA	Appendix C – Revised and updated to address USEPA and PADEP comments

Appendix C Model Calibration and Validation Results (Revised and Updated March 1, 2018 to address USEPA and PADEP Comments received January 2, 2018)

# Appendix C

# H&H MODEL CALIBRATION AND VALIDATION RESULTS **APPENDIX C TABLE OF CONTENTS**

NO.       NO.         IN-02       3         EFF-02       6         CSO-02       9         IN-03       11         EFF-03       14         CSO-02       9         IN-03       17         No-05       19         EFF-03       14         CSO-03       17         No-05       19         EFF-05       22         CSO-05       25         IN-08       27         EFF-08       30         CSO-08       33         IN-10       35         IN-11       41         IN-12       41         IN-13       44         IN-14       41         IN-13       44         IN-14       53         IN-15       51         IN-16       53         IN-17       58         IN-18       61         IN-19-2       67         EFF-19       70         CSO-19       73         IN-25       75         IN-26       78         INT-PRIL       84         INT-Ridley 3       90<	Flow Meter No.	Page No.
EFF-02       6         CSO-02       9         IN-03       11         EFF-03       14         CSO-03       17         IN-05       19         EFF-06       22         CSO-05       25         IN-08       27         EFF-08       30         CSO-05       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       41         IN-13       44         IN-14       41         IN-15       51         IN-16       53         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-26       78         INT-2 <sup>nd</sup> St.       81         INT-Ridley 3       90         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-4       105	110.	
EFF-02       6         CSO-02       9         IN-03       11         EFF-03       14         CSO-03       17         IN-05       19         EFF-06       22         CSO-05       25         IN-08       27         EFF-08       30         CSO-05       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       41         IN-13       44         IN-14       41         IN-15       51         IN-16       53         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-26       78         INT-2 <sup>nd</sup> St.       81         INT-Ridley 3       90         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-4       105	IN-02	
IN-03       11         EFF-03       14         CSO-03       17         IN-05       19         EFF-05       22         CSO-05       25         IN-08       27         EFF-08       30         CSO-08       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         TS       73         IN-25       75         IN-26       78         INT-2 <sup>rd</sup> St       81         INT-Ridley 3       90         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-4       105		
IN-03       11         EFF-03       14         CSO-03       17         IN-05       19         EFF-05       22         CSO-05       25         IN-08       27         EFF-08       30         CSO-08       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         TS       73         IN-25       75         IN-26       78         INT-2 <sup>rd</sup> St       81         INT-Ridley 3       90         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-4       105	CSO-02	9
CSO-03       17         IN-05       19         EFF-05       22         CSO-05       25         IN-08       27         EFF-08       30         CSO-08       33         IN-10       35         IN-11       41         IN-13       41         IN-14       47         EFF-14       50         CSO-14       53         IN-17       55         IN-18       61         IN-19-1       64         IN-19-2       67         CSO-19       73         INT-26       78         INT-2 <sup>ad</sup> St.       81         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-4       105	IN-03	11
IN-05       19         EFF-05       22         CSO-05       25         IN-08       27         EFF-08       30         CSO-08       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         INT-2 <sup>rd</sup> St       81         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-3       102         SEP-4       105	EFF-03	14
EFF-05       22         CSO-05       25         IN-08       27         EFF-08       30         CSO-08       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         INT-25       75         INT-26d       78         INT-27d* St.       81         INT-Ridley 2       87         INT-WEI       93         SEP-1       96         SEP-3       102         SEP-4       105	CSO-03	17
CSO-05       25         IN-08       27         EFF-08       30         CSO-08       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-014       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-26       78         INT-2 <sup>rd</sup> St.       81         INT-BRI       84         INT-Ridley 2       87         INT-Ridley 3       90         SEP-1       96         SEP-2       99         SEP-4       105	IN-05	19
IN-08       27         EFF-08       30         CSO-08       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-26       78         INT-2 <sup>nd</sup> St.       81         INT-Ridley 2       87         INT-Ridley 3       90         SEP-1       96         SEP-4       105	EFF-05	
EFF-08       30         CSO-08       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-14       53         IN-16       53         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-25       75         IN-26       78         INT-DRI       84         INT-Ridley 2       87         INT-WEI       93         SEP-1       96         SEP-3       102         SEP-4       105	CSO-05	25
CSO-08       33         IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-014       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-26       78         INT-2 <sup>nd</sup> St.       81         INT-2 <sup>nd</sup> St.       81         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-4       105	IN-08	
IN-09       35         IN-10       38         IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-26       78         INT-2 <sup>nd</sup> St.       81         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-4       105	EFF-08	
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IN-11       41         IN-13       44         IN-14       47         EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-25       75         IN-26       78         INT-2 <sup>nd</sup> St       81         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-4       105	IN-09	
IN-13.       44         IN-14.       47         EFF-14.       50         CSO-14.       53         IN-16.       55         IN-17.       58         IN-18.       61         IN-19-1.       64         IN-19-2.       67         EFF-19.       70         CSO-19.       73         IN-25.       75         IN-26.       78         INT-2nd St.       81         INT-Ridley 2.       87         INT-Ridley 3.       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-4       105	IN-10	
IN-14       47         EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-25       75         IN-26       78         INT-DRI       84         INT-Ridley 2       87         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-4       102	IN-11	41
EFF-14       50         CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-26       75         IN-2nd St       81         INT-DRI       84         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	IN-13	
CSO-14       53         IN-16       55         IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-26       75         IN-26       78         INT-2 <sup>nd</sup> St       81         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	IN-14	47
IN-16.       55         IN-17.       58         IN-18.       61         IN-19-1.       64         IN-19-2.       67         EFF-19.       70         CSO-19.       73         IN-25.       75         IN-26.       78         INT-2 <sup>nd</sup> St.       81         INT-DRI       84         INT-Ridley 2.       87         INT-WEI.       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	EFF-14	
IN-17       58         IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-25       75         IN-26       78         INT-2 <sup>nd</sup> St       81         INT-DRI       84         INT-Ridley 2       87         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	CSO-14	53
IN-18       61         IN-19-1       64         IN-19-2       67         EFF-19       70         CSO-19       73         IN-25       75         IN-26       78         INT-2 <sup>nd</sup> St       81         INT-DRI       84         INT-Ridley 2       87         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	IN-16	
IN-19-1	IN-17	
IN-19-2	IN-18	61
EFF-19       70         CSO-19       73         IN-25       75         IN-26       78         INT-2 <sup>nd</sup> St       81         INT-DRI       84         INT-Ridley 2       87         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	IN-19-1	64
CSO-19       73         IN-25       75         IN-26       78         INT-2 <sup>nd</sup> St       81         INT-DRI       84         INT-Ridley 2       87         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	IN-19-2	67
IN-25       75         IN-26       78         INT-2 <sup>nd</sup> St       81         INT-DRI       84         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	EFF-19	70
IN-26	CSO-19	73
INT-2 <sup>nd</sup> St.       81         INT-DRI.       84         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	IN-25	75
INT-DRI       84         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	IN-26	78
INT-DRI       84         INT-Ridley 2       87         INT-Ridley 3       90         INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	INT-2 <sup>nd</sup> St	
INT-Ridley 3		
INT-WEI       93         SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	INT-Ridley 2	
SEP-1       96         SEP-2       99         SEP-3       102         SEP-4       105	INT-Ridley 3	
SEP-2       99         SEP-3       102         SEP-4       105		
SEP-3	SEP-1	96
SEP-4	SEP-2	
	SEP-3	
SIDE-1	SEP-4	
	SIDE-1	



DELCORA CSO Long Term Control Plan Update

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Flow Meter	Page
No.	No.
SIDE-2	111
RC MH-26	114
RC MH-30	117
RC MH-32	
CPS	
EPS-1	
NCPS	
CRPS	
CDPS	
CDPS to WRTP	
EDPS	
WRTP	
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# Statistical Evaluation: Nash-Sutcliffe Efficiencies

The Nash-Sutcliffe efficiency (NSE) was selected as an appropriate statistical measure of the goodness-of-fit for model calibration. It has been widely applied in hydrologic models (Moriasi et al., 2007) and thus can be used to assess the event volume predictions of the hydrologic component of the model. Although interpretation of NSE values may be subjective, model calibration is generally considered satisfactory for values greater than 0.5, with values greater than 0.75 being considered very good (Moriasi et al., 2007).

For this application the values were calculated as shown in following equation:

$$NSE = 1 - \left[ \frac{\sum_{i=1}^{n} (Y_{i}^{obs} - Y_{i}^{sim})^{2}}{\sum_{i=1}^{n} (Y_{i}^{obs} - Y^{mean})^{2}} \right]$$

where,

Y<sub>i</sub><sup>obs</sup>: the *i*<sup>th</sup> metered event volume Y<sub>i</sub><sup>sim</sup>: the *i*<sup>th</sup> modeled event volume Y<sup>mean</sup>: the mean metered volume *n*: the total number of events

NSE values were calculated for all flow meter calibration and the results are shown in **Figure C-1** for the wet weather events. According to the above mentioned criteria wet weather calibration of over 82% of meters are above good condition and over 76% of the meters are above very good condition.



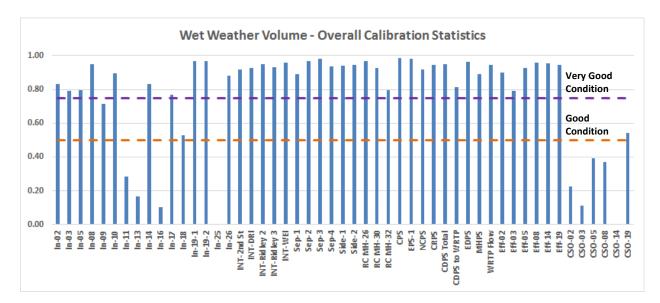
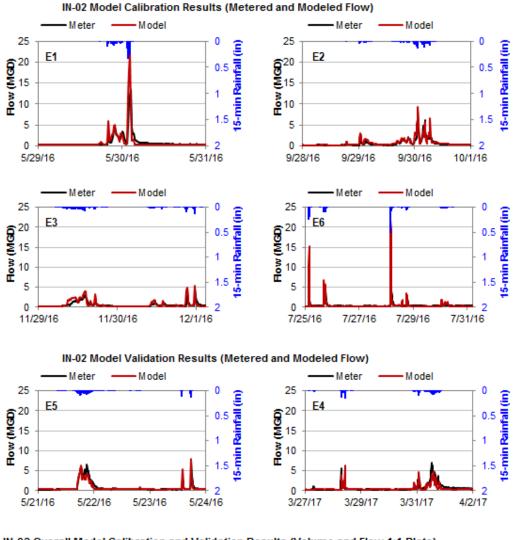


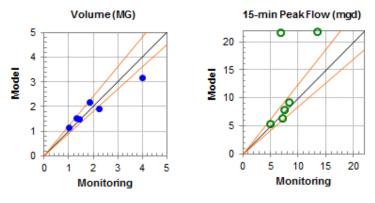
Figure C-1: Wet Weather Volume – Overall Calibration Statistics



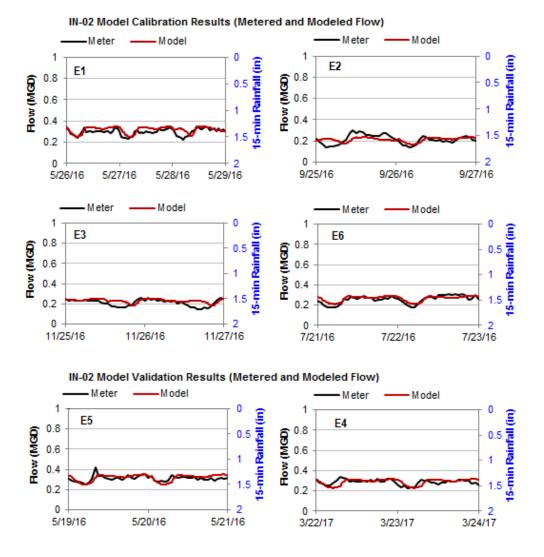


FLOW METER IN-02 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

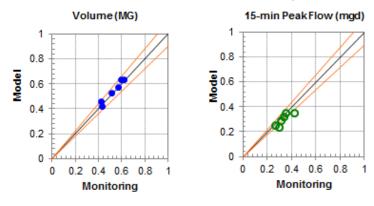
IN-02 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



# FLOW METER IN-02 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-02 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

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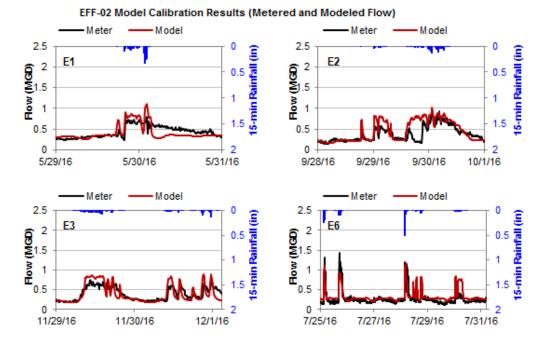
	IN-02 Model Dry Weather Calibration and Validation Summary											
Event		Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.35	0.35	-10% to +10%	1%	0.59	0.64	-10% to +10%	7%				
E2	0.30	0.24	-10% to +10%	-20%	0.43	0.43	-10% to +10%	0%				
E3	0.26	0.25	-10% to +10%	-4%	0.42	0.46	-10% to +10%	9%				
E4	0.34	0.32	-10% to +10%	-5%	0.57	0.58	-10% to +10%	1%				
E5	0.42	0.35	-10% to +10%	-17%	0.62	0.63	-10% to +10%	2%				
E6	0.31	0.29	-10% to +10%	-5%	0.51	0.53	-10% to +10%	4%				

	IN-02 Model Wet Weather Calibration and Validation Summary											
Event	ent Peak Flow (MGD)					Vo	olume (MG)					
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	13.38	21.82	-15% to +25%	63%	1.43	1.50	-10% to +20%	5%				
E2	8.31	9.29	-15% to +25%	12%	1.86	2.19	-10% to +20%	18%				
E3	5.00	5.46	-15% to +25%	9%	1.32	1.53	-10% to +20%	15%				
E4	7.05	6.37	-15% to +25%	-10%	4.00	3.17	-10% to +20%	-21%				
E5	7.54	7.97	-15% to +25%	6%	2.25	1.91	-10% to +20%	-15%				
E6	6.81	21.65	-15% to +25%	218%	1.01	1.18	-10% to +20%	17%				

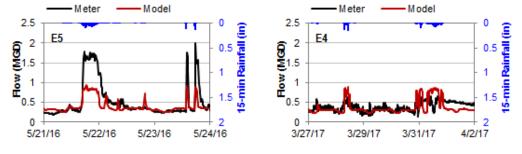
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for Events E1 and E6 is not consistent with the recorded rainfall intensity. These events are expected to have the highest peak flow. This is most likely a result of a malfunctioning flow meter. However, based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



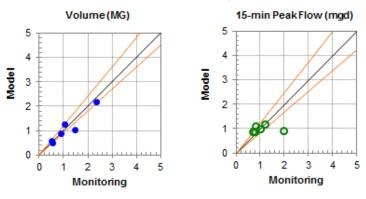
### FLOW METER EFF-02 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



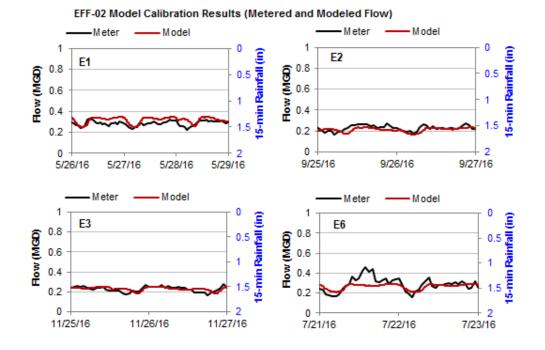




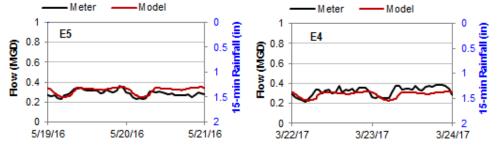
EFF-02 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



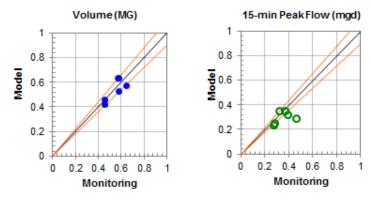
# FLOW METER EFF-02 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



EFF-02 Model Validation Results (Metered and Modeled Flow)



EFF-02 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



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	EFF-02 Model Dry Weather Calibration and Validation Summary											
Event		Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.32	0.35	-10% to +10%	10%	0.57	0.64	-10% to +10%	12%				
E2	0.27	0.24	-10% to +10%	-14%	0.46	0.43	-10% to +10%	-7%				
E3	0.28	0.25	-10% to +10%	-10%	0.45	0.46	-10% to +10%	2%				
E4	0.39	0.32	-10% to +10%	-18%	0.64	0.58	-10% to +10%	-10%				
E5	0.37	0.35	-10% to +10%	-4%	0.58	0.63	-10% to +10%	10%				
E6	0.46	0.29	-10% to +10%	-36%	0.58	0.53	-10% to +10%	-8%				

	EFF-02 Model Wet Weather Calibration and Validation Summary												
Event		Flow (MGD)			Vo	olume (MG)							
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved					
E1	0.80	1.12	-15% to +25%	39%	0.53	0.51	-10% to +20%	-3%					
E2	1.01	1.01	-15% to +25%	1%	1.03	1.27	-10% to +20%	23%					
E3	0.75	0.90	-15% to +25%	20%	0.90	0.88	-10% to +20%	-2%					
E4	0.71	0.88	-15% to +25%	24%	2.36	2.20	-10% to +20%	-6%					
E5	1.99	0.93	-15% to +25%	-53%	1.45	1.05	-10% to +20%	-27%					
E6	1.20	1.17	-15% to +25%	-2%	0.49	0.57	-10% to +20%	17%					

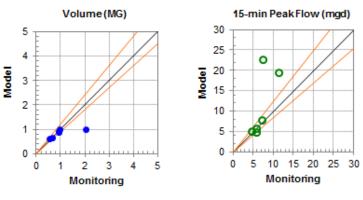
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. The EFF-02 meter is the effluent meter from Regulator 02. The calibration of Regulator 02 meters (which include the IN-02, EFF-02 and CSO-02 meters) are more focused on the influent IN-02 meter and the overflow CSO-02 meter when the total metered influent flow (IN-02) is not balanced with the total metered effluent flow (EFF-02 plus CSO-02). Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

#### CSO-02 Model Calibration Results (Metered and Modeled Flow) • Meter - Model • M eter Model 25 0 25 0 5-min Rainfall (in) 15-min Rainfall (in) (10) 15 10 10 10 E1 E2 (020 15 10 10 0.5 0.5 1 1 1.5 1.5 5 5 IÅ. 0 0 2 2 5/31/16 10/1/16 5/29/16 5/30/16 9/28/16 9/29/16 9/30/16 Meter Model Meter Model 25 0 25 0 5-min Rainfall (in) 5-min Rainfall (in) (00) 15 10 10 (00) 15 10 10 E3 E6 0.5 0.5 1 1 1.5 1.5 5 5 0 2 0 2 11/29/16 11/30/16 12/1/16 7/25/16 7/27/16 7/29/16 7/31/16 CSO-02 Model Validation Results (Metered and Modeled Flow) Meter Model Meter Model 25 0 25 0 Π E5 E4 0.5 0.5

#### FLOW METER CSO-02 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

15-min Rainfall (in) 5-min Rainfall (in) (00) 15 10 10 (00) 15 10 10 10 1 1 1.5 1.5 5 5 0 0 2 2 5/23/16 5/24/16 3/31/17 4/2/17 5/21/16 5/22/16 3/27/17 3/29/17

#### CSO-02 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



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	CSO-02 Model Wet Weather Calibration and Validation Summary											
Event		Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	11.40	19.39	-15% to +25%	70%	0.95	0.99	-10% to +20%	4%				
E2	7.16	7.90	-15% to +25%	10%	0.94	0.94	-10% to +20%	0%				
E3	4.69	5.11	-15% to +25%	9%	0.64	0.66	-10% to +20%	3%				
E4	5.79	4.82	-15% to +25%	-17%	2.02	0.99	-10% to +20%	-51%				
E5	5.82	5.67	-15% to +25%	-3%	0.91	0.88	-10% to +20%	-3%				
E6	7.49	22.64	-15% to +25%	202%	0.55	0.63	-10% to +20%	14%				

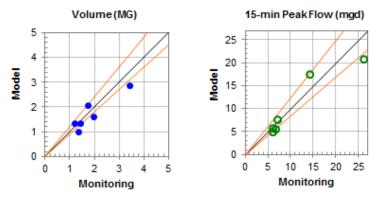
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the Events is not consistent with the recorded rainfall intensity. For instance, it is expected that Event E6 would have a high peak flow due to high rainfall intensity. This is most likely a result of a malfunctioning flow meter. However, based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



#### IN-03 Model Calibration Results (Metered and Modeled Flow) • M eter Model Meter Model 30 0 30 0 77 5-min Rainfall (in) 5-min Rainfall (in) E1 .25 E2 (00) 20 20 15 10 0.5 0.5 1 1 1.5 1.5 5 5 0 2 0 2 5/29/16 5/30/16 5/31/16 9/28/16 9/29/16 9/30/16 10/1/16 Meter Meter Model Model 30 0 30 0 5-min Rainfall (in) 5-min Rainfall (in) (00) 20 20 15 10 (00) 20 20 15 10 E3 E6 0.5 0.5 1 1 1.5 1.5 5 5 0 2 0 2 12/1/16 11/29/16 11/30/16 7/25/16 7/27/16 7/29/16 7/31/16 IN-03 Model Validation Results (Metered and Modeled Flow) Meter Model Meter Model 30 0 30 0 5-min Rainfall (in) 5-min Rainfall (in) (00) 20 20 15 10 25 E5 F4 (00 20 20 15 10 0.5 0.5 1 1 1.5 1.5 5 5 4/2/17 0 2 0 5/24/16 5/21/16 5/22/16 5/23/16 3/27/17 3/29/17 3/31/17

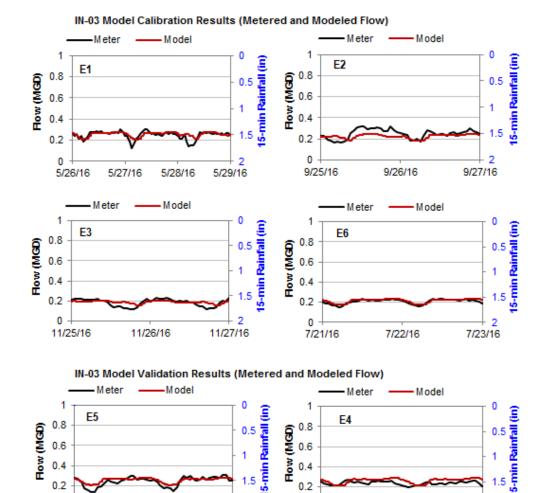
### FLOW METER IN-03 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events





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### FLOW METER IN-03 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events

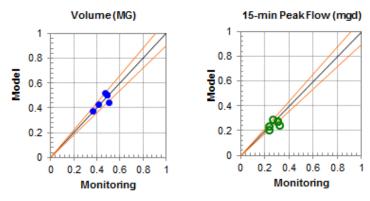


IN-03 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

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3/23/17



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DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

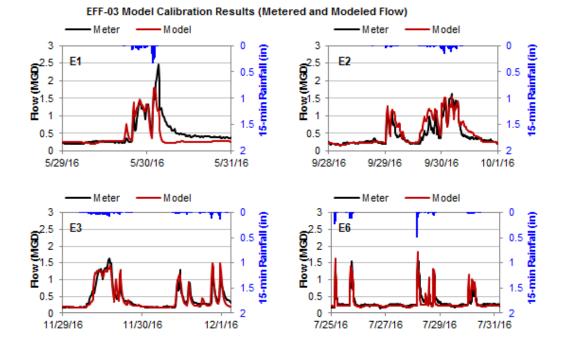
Appendix C

	IN-03 Model Dry Weather Calibration and Validation Summary											
Event		Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.31	0.28	-10% to +10%	-9%	0.48	0.51	-10% to +10%	5%				
E2	0.32	0.25	-10% to +10%	-23%	0.50	0.45	-10% to +10%	-10%				
E3	0.23	0.21	-10% to +10%	-12%	0.37	0.38	-10% to +10%	3%				
E4	0.27	0.29	-10% to +10%	8%	0.47	0.52	-10% to +10%	11%				
E5	0.31	0.28	-10% to +10%	-9%	0.48	0.51	-10% to +10%	5%				
E6	0.24	0.24	-10% to +10%	-1%	0.41	0.43	-10% to +10%	4%				

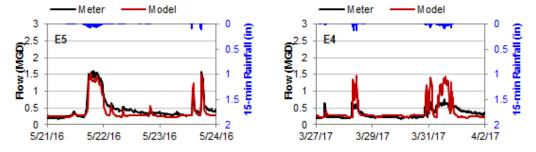
	IN-03 Model Wet Weather Calibration and Validation Summary											
Event		Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	14.09	17.46	-15% to +25%	24%	1.41	1.34	-10% to +20%	-6%				
E2	7.06	7.69	-15% to +25%	9%	1.73	2.07	-10% to +20%	20%				
E3	6.06	5.79	-15% to +25%	-4%	1.20	1.36	-10% to +20%	13%				
E4	6.01	5.07	-15% to +25%	-16%	3.43	2.87	-10% to +20%	-16%				
E5	6.71	5.50	-15% to +25%	-18%	1.96	1.60	-10% to +20%	-18%				
E6	26.00	20.94	-15% to +25%	-19%	1.36	1.02	-10% to +20%	-25%				

Note: All the six wet weather events are calibrated well within or close to the industry criteria.

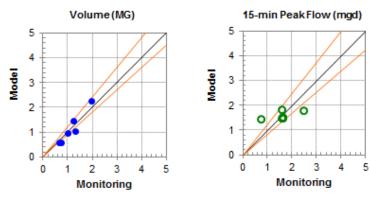
#### FLOW METER EFF-03 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



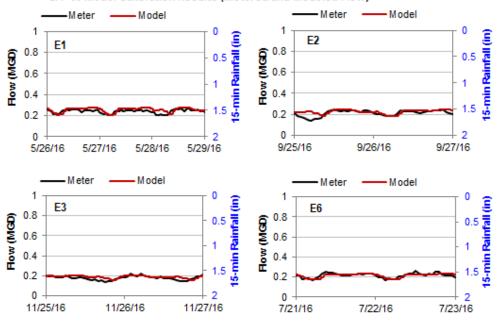
EFF-03 Model Validation Results (Metered and Modeled Flow)



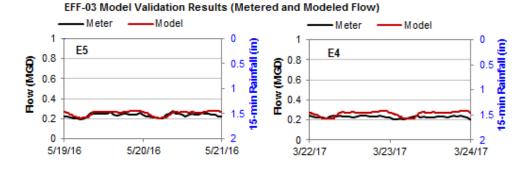
EFF-03 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



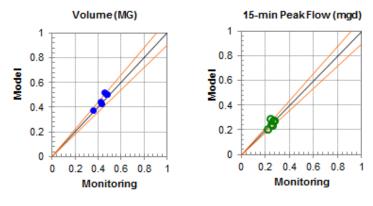
#### FLOW METER EFF-03 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



EFF-03 Model Calibration Results (Metered and Modeled Flow)



EFF-03 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

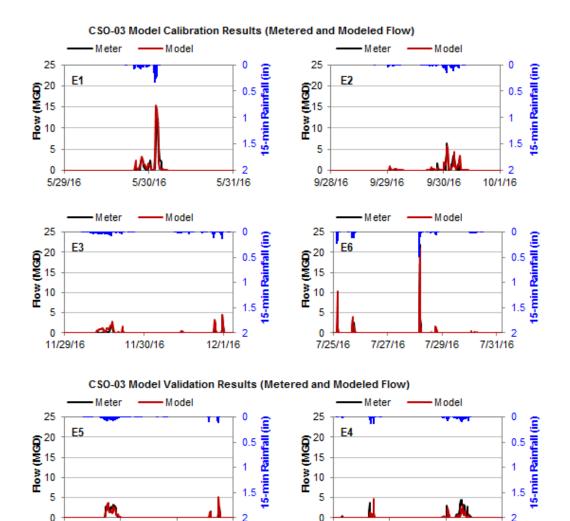
Appendix C

	EFF-03 Model Dry Weather Calibration and Validation Summary											
Event		Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.27	0.28	-10% to +10%	5%	0.48	0.51	-10% to +10%	6%				
E2	0.25	0.25	-10% to +10%	-1%	0.42	0.45	-10% to +10%	6%				
E3	0.22	0.21	-10% to +10%	-7%	0.36	0.38	-10% to +10%	6%				
E4	0.24	0.29	-10% to +10%	18%	0.46	0.52	-10% to +10%	15%				
E5	0.28	0.28	-10% to +10%	1%	0.47	0.51	-10% to +10%	8%				
E6	0.26	0.24	-10% to +10%	-9%	0.43	0.43	-10% to +10%	-1%				

	EFF-03 Model Wet Weather Calibration and Validation Summary										
Event		Peak Flow (MGD) Volume (MG)									
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	2.47	1.80	-15% to +25%	-27%	0.73	0.59	-10% to +20%	-19%			
E2	1.63	1.54	-15% to +25%	-6%	1.24	1.47	-10% to +20%	19%			
E3	1.63	1.49	-15% to +25%	-9%	0.99	0.96	-10% to +20%	-3%			
E4	0.75	1.47	-15% to +25%	96%	1.98	2.28	-10% to +20%	15%			
E5	1.60	1.51	-15% to +25%	-6%	1.31	1.06	-10% to +20%	-19%			
E6	1.57	1.84	-15% to +25%	17%	0.67	0.57	-10% to +20%	-15%			

**Note:** Four of the six wet weather events are calibrated well within the industry criteria. The EFF-03 meter is the effluent meter from Regulator 03. The calibration of Regulator 03 meters (which include the IN-03, EFF-03 and CSO-03 meters) are more focused on the influent IN-03 meter and the overflow CSO-03 meter when the total metered influent flow (IN-03) is not balanced with the total metered effluent flow (EFF-03 plus CSO-03). Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

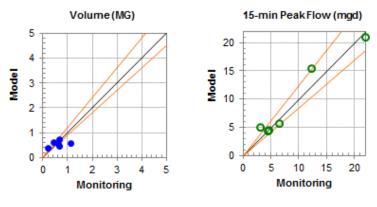




#### FLOW METER CSO-03 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

CSO-03 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

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3/27/17

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3/31/17

5/22/16

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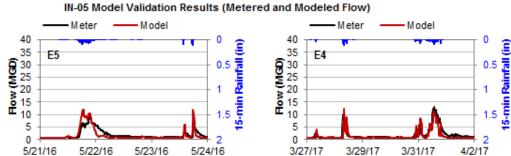
	CSO-03 Model Wet Weather Calibration and Validation Summary											
Event		Peak	Flow (MGD)	Vo	olume (MG)							
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	12.30	15.47	-15% to +25%	26%	0.64	0.75	-10% to +20%	17%				
E2	6.41	5.80	-15% to +25%	-9%	0.42	0.61	-10% to +20%	44%				
E3	4.48	4.39	-15% to +25%	-2%	0.19	0.39	-10% to +20%	112%				
E4	4.52	4.56	-15% to +25%	1%	1.13	0.58	-10% to +20%	-48%				
E5	3.13	5.03	-15% to +25%	61%	0.61	0.54	-10% to +20%	-11%				
E6	21.93	21.00	-15% to +25%	-4%	0.66	0.45	-10% to +20%	-31%				

**Note:** Four of the six wet weather event peak flows are calibrated well within the industry criteria. The overflow volume is more challenging to match, especially for the small overflow event like E3. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

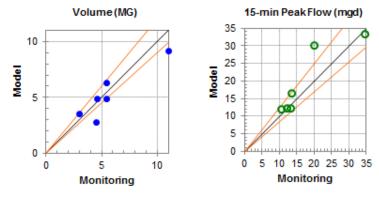


#### IN-05 Model Calibration Results (Metered and Modeled Flow) Meter - Model Meter Model 40 0 40 0 5-min Rainfall (in) 11 5-min Rainfall (in) 35 (00) 25 20 15 10 35 E1 E2 830 25 0.5 0.5 20 20 15 1 1 10 10 1.5 1.5 ιA 5 5 0 2 0 2 5/31/16 10/1/16 5/29/16 5/30/16 9/28/16 9/29/16 9/30/16 Model Meter Model Meter 40 0 0 40 5-min Rainfall (in) П 5-min Rainfall (in) 35 (00) 25 20 15 10 35 E6 E3 (00) 25 20 15 10 0.5 0.5 1 1 10 5 10 1.5 5 5 0 2 0 2 11/29/16 11/30/16 12/1/16 7/27/16 7/29/16 7/31/16 7/25/16

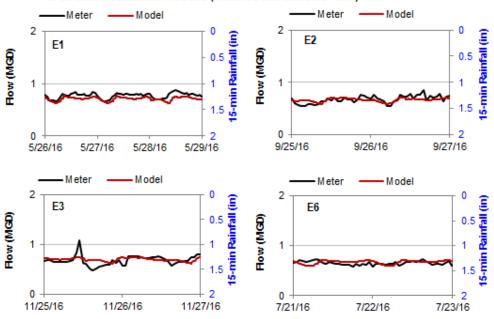
#### FLOW METER IN-05 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



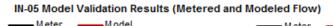
IN-05 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

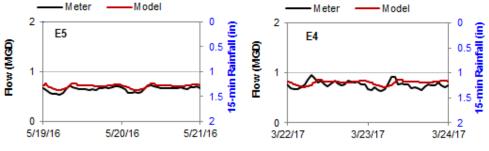


# FLOW METER IN-05 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events

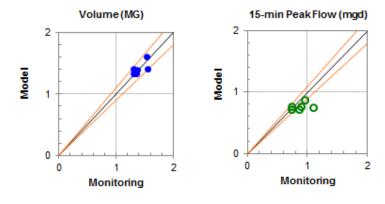


IN-05 Model Calibration Results (Metered and Modeled Flow)





IN-05 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

Appendix C

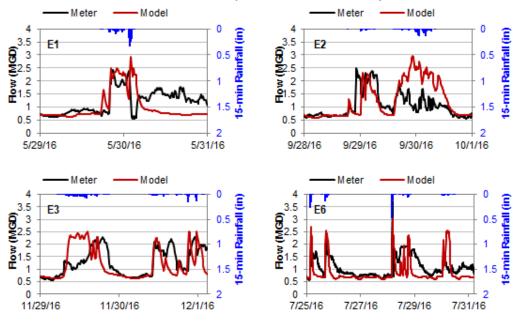
	IN-05 Model Dry Weather Calibration and Validation Summary											
Event		Peak Flow (MGD) Volume (MG)										
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.88	0.76	-10% to +10%	-14%	1.54	1.41	-10% to +10%	-8%				
E2	0.86	0.72	-10% to +10%	-16%	1.35	1.33	-10% to +10%	-2%				
E3	1.09	0.75	-10% to +10%	-31%	1.36	1.40	-10% to +10%	3%				
E4	0.95	0.87	-10% to +10%	-9%	1.53	1.61	-10% to +10%	5%				
E5	0.73	0.76	-10% to +10%	4%	1.31	1.42	-10% to +10%	8%				
E6	0.73	0.72	-10% to +10%	-1%	1.31	1.34	-10% to +10%	2%				

	IN-05 Model Wet Weather Calibration and Validation Summary												
Event		Peak	Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved					
E1	19.90	30.28	-15% to +25%	52%	3.00	3.57	-10% to +20%	19%					
E2	13.38	16.57	-15% to +25%	24%	5.39	6.32	-10% to +20%	17%					
E3	12.07	12.28	-15% to +25%	2%	4.57	4.93	-10% to +20%	8%					
E4	13.17	12.43	-15% to +25%	-6%	10.98	9.18	-10% to +20%	-16%					
E5	10.58	12.02	-15% to +25%	14%	5.42	4.89	-10% to +20%	-10%					
E6	34.58	33.54	-15% to +25%	-3%	4.50	2.79	-10% to +20%	-38%					

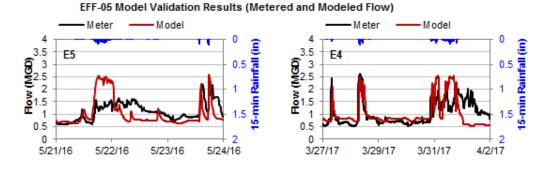
**Note:** Four of the six wet weather event peak flows are calibrated well within the industry criteria. Flow meter data recorded for some of the events is not consistent with the recorded rainfall intensity. For instance, it is expected that Event E1 would have a high peak flow due to high rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



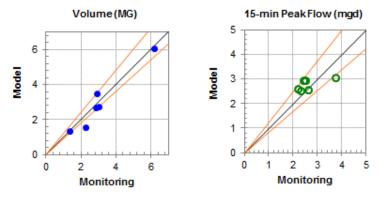
#### FLOW METER EFF-05 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



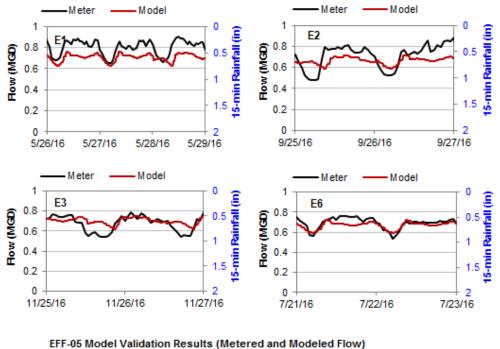
EFF-05 Model Calibration Results (Metered and Modeled Flow)



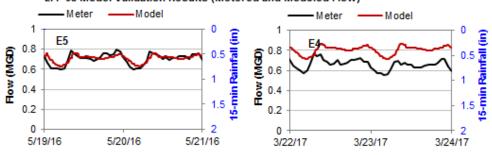
EFF-05 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



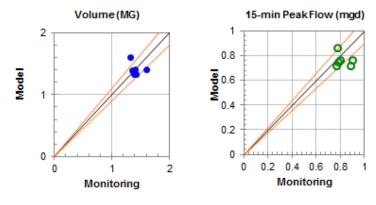
#### FLOW METER EFF-05 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



EFF-05 Model Calibration Results (Metered and Modeled Flow)



EFF-05 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

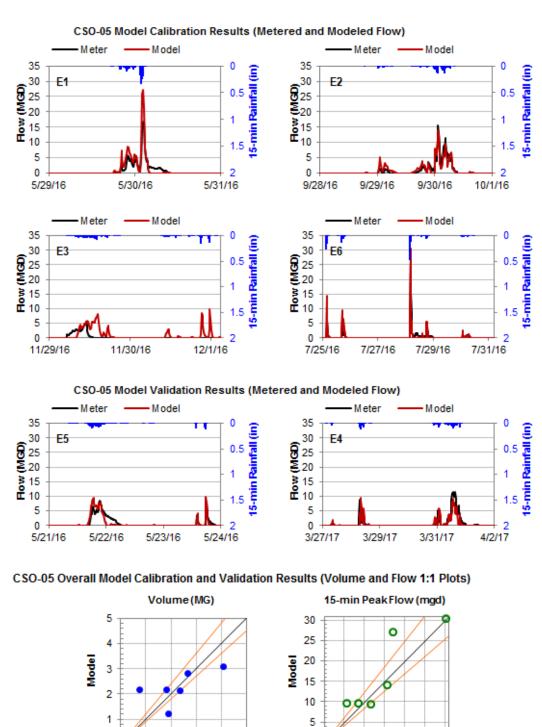
Appendix C

	EFF-05 Model Dry Weather Calibration and Validation Summary											
Event		Peak Flow (MGD) Volume (MG)										
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.90	0.76	-10% to +10%	-16%	1.59	1.41	-10% to +10%	-11%				
E2	0.88	0.72	-10% to +10%	-19%	1.42	1.33	-10% to +10%	-6%				
E3	0.78	0.75	-10% to +10%	-5%	1.35	1.40	-10% to +10%	4%				
E4	0.77	0.87	-10% to +10%	12%	1.32	1.61	-10% to +10%	22%				
E5	0.80	0.76	-10% to +10%	-4%	1.41	1.42	-10% to +10%	1%				
E6	0.77	0.72	-10% to +10%	-6%	1.38	1.34	-10% to +10%	-3%				

	EFF-05 Model Wet Weather Calibration and Validation Summary											
Event		Peak Flow (MGD) Volume (MG)										
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	2.44	2.93	-15% to +25%	20%	1.37	1.35	-10% to +20%	-1%				
E2	2.49	2.96	-15% to +25%	19%	2.89	3.49	-10% to +20%	21%				
E3	2.30	2.53	-15% to +25%	10%	2.88	2.72	-10% to +20%	-6%				
E4	2.61	2.55	-15% to +25%	-3%	6.20	6.07	-10% to +20%	-2%				
E5	2.20	2.58	-15% to +25%	18%	3.00	2.73	-10% to +20%	-9%				
E6	3.73	3.06	-15% to +25%	-18%	2.28	1.56	-10% to +20%	-32%				

**Note:** Five of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E2, E3) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.





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### FLOW METER CSO-05 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

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Monitoring

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	CSO-05 Model Wet Weather Calibration and Validation Summary											
Event		Peak	Flow (MGD)			Vo	olume (MG)					
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	16.91	27.24	-15% to +25%	61%	1.79	2.19	-10% to +20%	22%				
E2	15.44	14.14	-15% to +25%	-8%	2.64	2.84	-10% to +20%	8%				
E3	5.39	9.83	-15% to +25%	82%	0.72	2.18	-10% to +20%	202%				
E4	11.39	9.58	-15% to +25%	-16%	4.05	3.09	-10% to +20%	-24%				
E5	8.46	9.65	-15% to +25%	14%	2.35	2.15	-10% to +20%	-9%				
E6	30.25	30.66	-15% to +25%	1%	1.88	1.24	-10% to +20%	-34%				

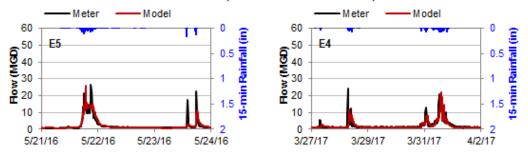
**Note:** Four of the six wet weather event peak flows are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E1, E2, E3) is not consistent with the recorded rainfall intensity. The overflow volume calibration is more challenging, especially for the small overflow event like E3. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



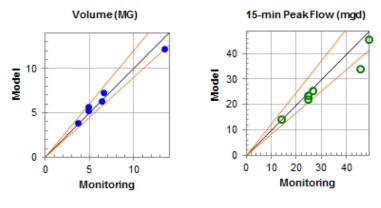
#### IN-08 Model Calibration Results (Metered and Modeled Flow) Meter Model Meter Model 60 0 60 0 5-min Rainfall (in) 77 15-min Rainfall (in) (00 40 40 30 20 (000 40 40 30 20 E1 E2 0.5 0.5 1 1 1.5 1.5 10 10 0 0 2 2 5/29/16 5/31/16 5/30/16 9/28/16 9/29/16 9/30/16 10/1/16 Meter Model Meter Model 60 60 0 0 5-min Rainfall (in) 5-min Rainfall (in) 11 E6 (00 40 40 30 20 E3 50 (00 40 30 20 0.5 0.5 1 1 1.5 1.5 10 10 2 0 0 2 11/29/16 11/30/16 12/1/16 7/27/16 7/29/16 7/31/16 7/25/16

#### FLOW METER IN-08 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

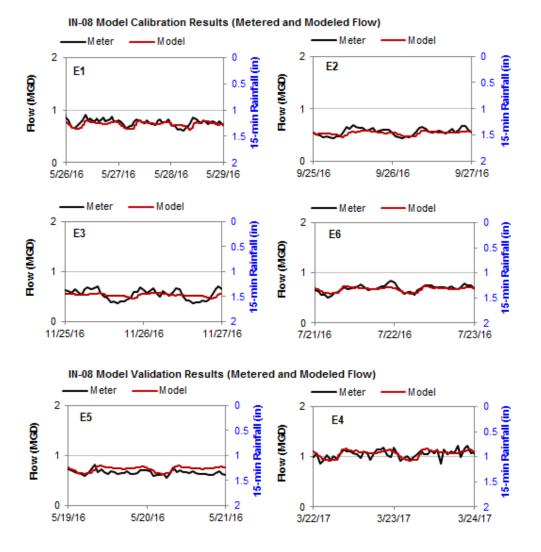




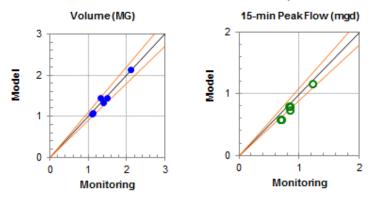
IN-08 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



### FLOW METER IN-08 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-08 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



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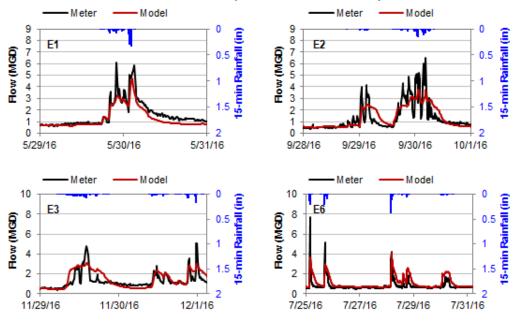
	IN-08 Model Dry Weather Calibration and Validation Summary											
Event		Peak Flow (MGD) Volume (MG)										
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.85	0.80	-10% to +10%	-6%	1.49	1.46	-10% to +10%	-2%				
E2	0.69	0.59	-10% to +10%	-15%	1.12	1.08	-10% to +10%	-4%				
E3	0.70	0.58	-10% to +10%	-17%	1.09	1.06	-10% to +10%	-3%				
E4	1.22	1.16	-10% to +10%	-5%	2.11	2.13	-10% to +10%	1%				
E5	0.82	0.80	-10% to +10%	-3%	1.32	1.46	-10% to +10%	11%				
E6	0.84	0.73	-10% to +10%	-13%	1.38	1.35	-10% to +10%	-2%				

	IN-08 Model Wet Weather Calibration and Validation Summary											
Event		Peak	Flow (MGD)		Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	48.94	45.65	-15% to +25%	-7%	4.81	5.25	-10% to +20%	9%				
E2	24.74	23.68	-15% to +25%	-4%	6.55	7.29	-10% to +20%	11%				
E3	14.08	14.45	-15% to +25%	3%	4.84	5.73	-10% to +20%	18%				
E4	24.42	22.15	-15% to +25%	-9%	13.46	12.23	-10% to +20%	-9%				
E5	26.44	25.62	-15% to +25%	-3%	6.39	6.34	-10% to +20%	-1%				
E6	45.55	33.93	-15% to +25%	-26%	3.65	3.91	-10% to +20%	7%				

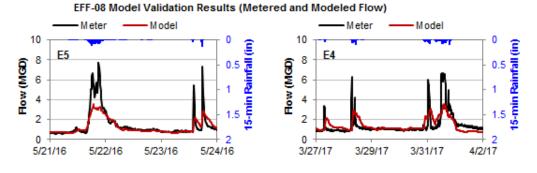
**Note:** All of the six wet weather events are calibrated well within the industry criteria except for the peak flow of E6. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



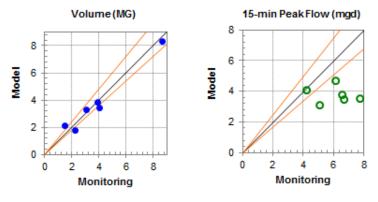
#### FLOW METER EFF-08 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



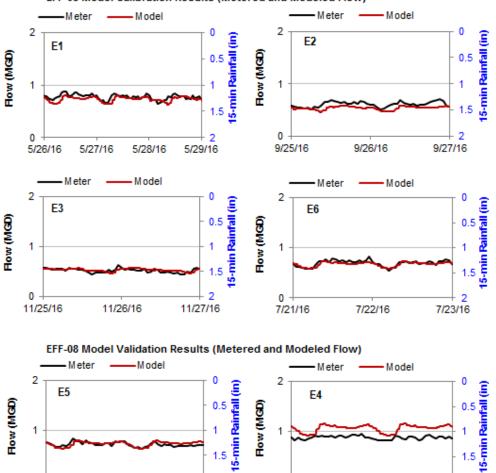
EFF-08 Model Calibration Results (Metered and Modeled Flow)



EFF-08 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



## FLOW METER EFF-08 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



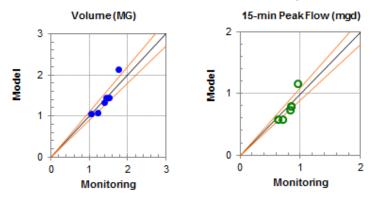
EFF-08 Model Calibration Results (Metered and Modeled Flow)



0

3/22/17

3/23/17



2

5/21/16

0

5/19/16

5/20/16

2

3/24/17

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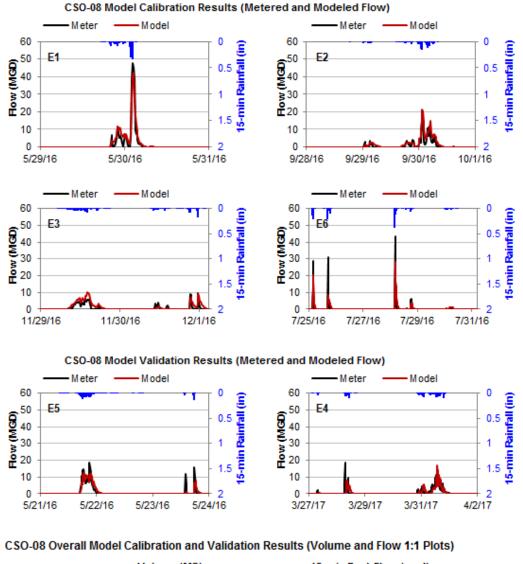
## Sewer System H&H Model Report

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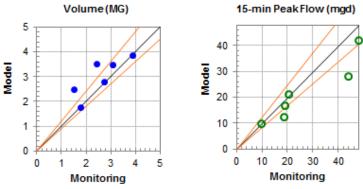
	EFF-08 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.85	0.80	-10% to +10%	-6%	1.52	1.46	-10% to +10%	-4%			
E2	0.70	0.59	-10% to +10%	-16%	1.22	1.08	-10% to +10%	-12%			
E3	0.63	0.58	-10% to +10%	-8%	1.05	1.06	-10% to +10%	2%			
E4	0.95	1.16	-10% to +10%	22%	1.76	2.13	-10% to +10%	21%			
E5	0.84	0.80	-10% to +10%	-6%	1.44	1.46	-10% to +10%	1%			
E6	0.83	0.73	-10% to +10%	-11%	1.39	1.35	-10% to +10%	-3%			

	EFF-08 Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	6.09	4.57	-15% to +25%	-25%	2.23	1.80	-10% to +20%	-19%			
E2	6.53	3.67	-15% to +25%	-44%	3.86	3.80	-10% to +20%	-2%			
E3	5.08	3.02	-15% to +25%	-40%	3.02	3.25	-10% to +20%	8%			
E4	6.65	3.35	-15% to +25%	-50%	8.66	8.25	-10% to +20%	-5%			
E5	7.71	3.20	-15% to +25%	-58%	3.99	3.41	-10% to +20%	-15%			
E6	4.18	4.39	-15% to +25%	5%	1.44	2.15	-10% to +20%	49%			

**Note:** Four of the six wet weather events are calibrated well within the industry criteria. The EFF-08 meter is the effluent meter from Regulator 08. The calibration of Regulator 08 meters (which include the IN-08, EFF-08 and CSO-08 meters) are more focused on the influent IN-08 meter and the overflow CSO-08 meter when the total metered influent flow (IN-08) is not balanced with the total metered effluent flow (EFF-08 plus CSO-08). Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



#### FLOW METER CSO-08 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



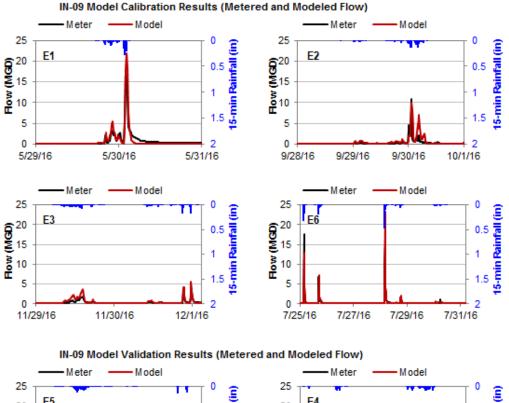
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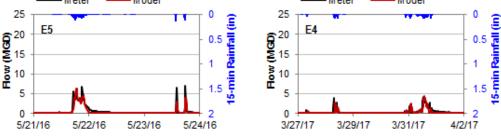
	CSO-08 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	47.82	42.26	-15% to +25%	-12%	3.08	3.47	-10% to +20%	13%		
E2	20.55	21.32	-15% to +25%	4%	2.42	3.54	-10% to +20%	46%		
E3	9.50	9.79	-15% to +25%	3%	1.52	2.48	-10% to +20%	63%		
E4	18.72	16.78	-15% to +25%	-10%	3.87	3.87	-10% to +20%	0%		
E5	18.35	12.44	-15% to +25%	-32%	2.73	2.81	-10% to +20%	3%		
E6	43.63	28.23	-15% to +25%	-35%	1.78	1.77	-10% to +20%	0%		

**Note:** Four of the six wet weather events are calibrated well within the industry criteria. This is the CSO meter from Regulator 08, the calibration of Regulator 08 meters (including Influent meter, effluent meter and CSO meter) are more focused on matching the peak flow and flow volume of the influent and CSO meter. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

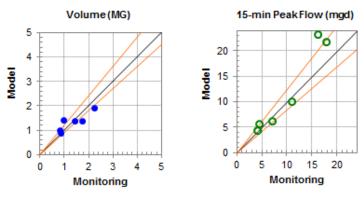


## FLOW METER IN-09 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

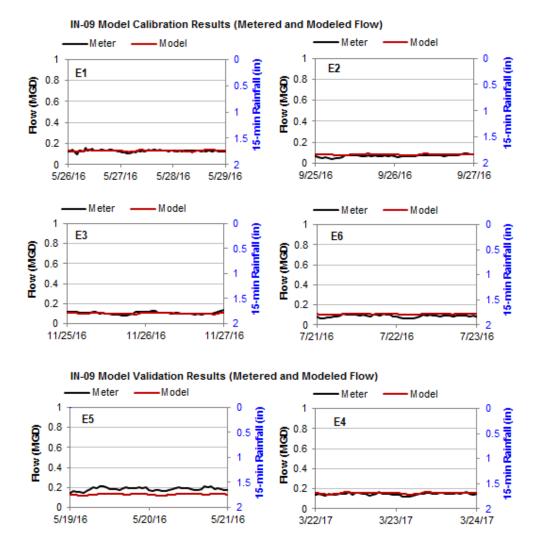




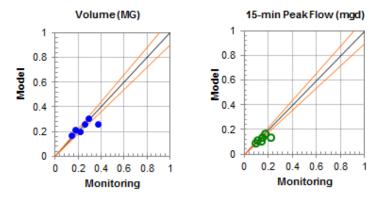
#### IN-09 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



#### FLOW METER IN-09 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-09 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



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## Sewer System H&H Model Report

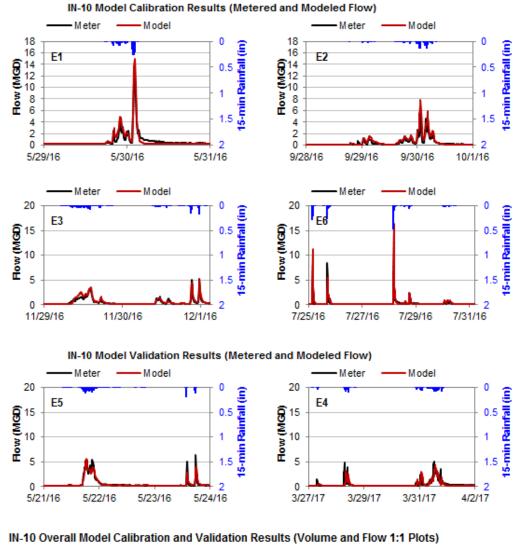
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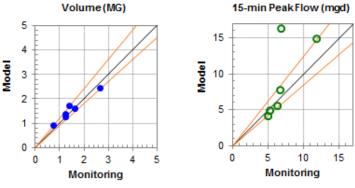
	IN-09 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.15	0.14	-10% to +10%	-3%	0.26	0.26	-10% to +10%	2%			
E2	0.09	0.09	-10% to +10%	-4%	0.14	0.17	-10% to +10%	19%			
E3	0.14	0.11	-10% to +10%	-20%	0.21	0.20	-10% to +10%	-4%			
E4	0.17	0.17	-10% to +10%	-2%	0.29	0.31	-10% to +10%	6%			
E5	0.21	0.14	-10% to +10%	-35%	0.37	0.26	-10% to +10%	-29%			
E6	0.11	0.11	-10% to +10%	6%	0.17	0.21	-10% to +10%	22%			

	IN-09 Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	17.88	21.83	-15% to +25%	22%	1.42	1.39	-10% to +20%	-2%			
E2	10.87	10.06	-15% to +25%	-7%	0.96	1.41	-10% to +20%	47%			
E3	4.41	5.62	-15% to +25%	28%	0.79	1.01	-10% to +20%	27%			
E4	4.10	4.49	-15% to +25%	10%	2.24	1.91	-10% to +20%	-15%			
E5	7.10	6.25	-15% to +25%	-12%	1.74	1.41	-10% to +20%	-19%			
E6	16.13	23.34	-15% to +25%	45%	0.85	0.88	-10% to +20%	3%			

**Note:** Four of the six wet weather events are calibrated well within or close to the industry criteria. Flow meter data recorded for some of the events (E3, E5, and E6) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

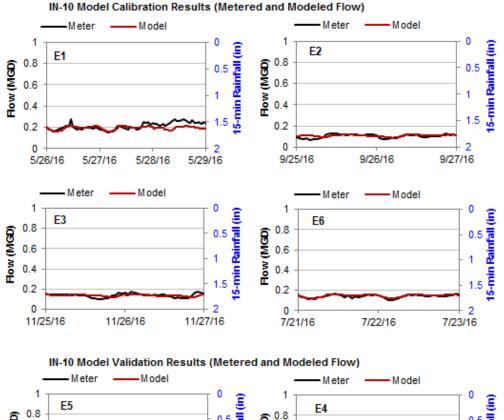
## FLOW METER IN-10 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events





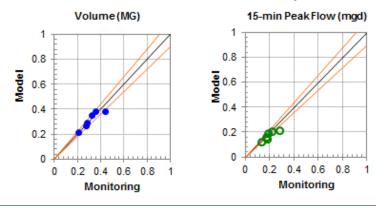


#### FLOW METER IN-10 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



0 0.5 1 1.5 1.5 (COW) 0.6 MOM 0.4 How (MGD) Rainfall 0.5 0.6 1 0.4 5-min 1.5 0.2 0.2 0 2 0 2 5/19/16 5/20/16 5/21/16 3/24/17 3/22/17 3/23/17

IN-10 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



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	IN-10 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.28	0.21	-10% to +10%	-24%	0.44	0.39	-10% to +10%	-12%			
E2	0.13	0.12	-10% to +10%	-10%	0.21	0.22	-10% to +10%	3%			
E3	0.18	0.15	-10% to +10%	-16%	0.27	0.27	-10% to +10%	-1%			
E4	0.19	0.19	-10% to +10%	1%	0.32	0.35	-10% to +10%	8%			
E5	0.22	0.21	-10% to +10%	-2%	0.35	0.39	-10% to +10%	10%			
E6	0.17	0.16	-10% to +10%	-6%	0.28	0.29	-10% to +10%	5%			

	IN-10 Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	11.83	14.96	-15% to +25%	26%	1.25	1.28	-10% to +20%	3%			
E2	6.70	7.85	-15% to +25%	17%	1.38	1.72	-10% to +20%	24%			
E3	5.31	4.99	-15% to +25%	-6%	1.23	1.37	-10% to +20%	11%			
E4	5.04	4.22	-15% to +25%	-16%	2.67	2.46	-10% to +20%	-8%			
E5	6.31	5.56	-15% to +25%	-12%	1.61	1.60	-10% to +20%	-1%			
E6	6.82	16.42	-15% to +25%	141%	0.72	0.94	-10% to +20%	30%			

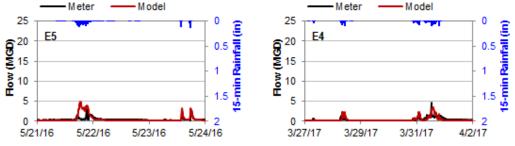
**Note:** Five of the six wet weather events are calibrated well within or close to the industry criteria. Flow meter data recorded for some of the events (E6) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



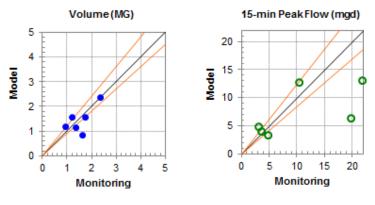
#### IN-11 Model Calibration Results (Metered and Modeled Flow) Meter Model Meter Model 25 0 25 0 5-min Rainfall (in) 77 5-min Rainfall (in) (00) 15 Mon 10 E1 E2 (10) 15 10) 10 0.5 0.5 1 1 1.5 1.5 5 5 0 0 2 2 5/31/16 9/28/16 9/29/16 10/1/16 5/29/16 5/30/16 9/30/16 Meter Model Meter Model 25 0 0 25 5-min Rainfall (in) -min Rainfall (in) E6 (00) 15 10 10 (00) 15 10 10 E3 0.5 0.5 1 1 1.5 1.5 5 5 0 2 0 2 12/1/16 11/29/16 11/30/16 7/25/16 7/27/16 7/29/16 7/31/16

## FLOW METER IN-11 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

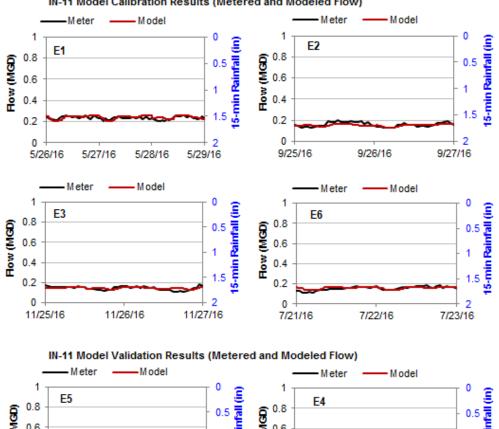




IN-11 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



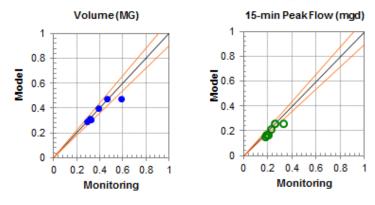
## FLOW METER IN-11 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-11 Model Calibration Results (Metered and Modeled Flow)

0 1.5 1.5 1.5 1.5 5-min Rainfall (in) (CDW) 0.6 MOM 0.4 How (MGD) 0.6 1 0.4 1.5 0.2 0.2 0 2 0 2 5/19/16 5/20/16 5/21/16 3/22/17 3/24/17 3/23/17

IN-11 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

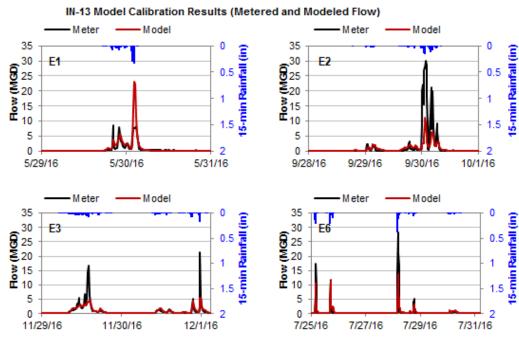
## Sewer System H&H Model Report

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	IN-11 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vc	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.26	0.26	-10% to +10%	1%	0.46	0.48	-10% to +10%	3%			
E2	0.20	0.17	-10% to +10%	-17%	0.32	0.31	-10% to +10%	-4%			
E3	0.18	0.16	-10% to +10%	-13%	0.29	0.29	-10% to +10%	1%			
E4	0.23	0.22	-10% to +10%	-5%	0.39	0.40	-10% to +10%	2%			
E5	0.32	0.26	-10% to +10%	-20%	0.59	0.48	-10% to +10%	-18%			
E6	0.19	0.17	-10% to +10%	-8%	0.31	0.32	-10% to +10%	2%			

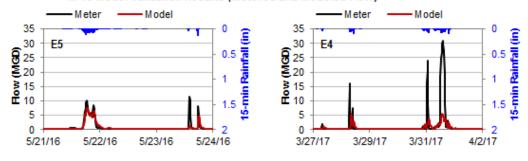
	IN-11 Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	21.79	13.12	-15% to +25%	-40%	1.34	1.14	-10% to +20%	-15%			
E2	19.64	6.48	-15% to +25%	-67%	1.71	1.56	-10% to +20%	-9%			
E3	3.59	4.11	-15% to +25%	14%	0.94	1.19	-10% to +20%	27%			
E4	4.74	3.44	-15% to +25%	-27%	2.34	2.37	-10% to +20%	1%			
E5	3.06	4.84	-15% to +25%	58%	1.19	1.58	-10% to +20%	33%			
E6	10.30	12.79	-15% to +25%	24%	1.62	0.86	-10% to +20%	-47%			

**Note:** Only two of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E1, E2, E5) is not consistent with the recorded rainfall intensity. The calibration goal is to balance the over-prediction and under-prediction event numbers cross all the events. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

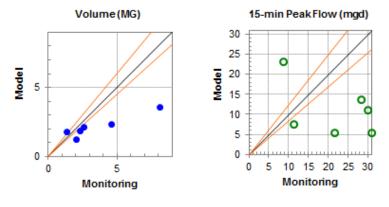


#### FLOW METER IN-13 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

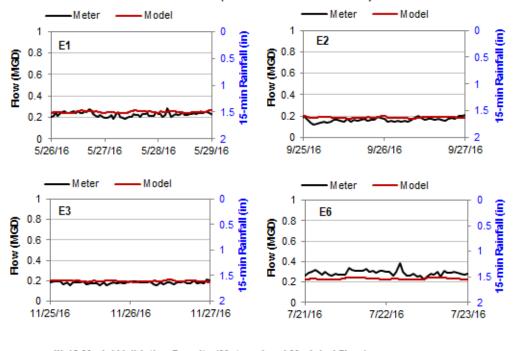
IN-13 Model Validation Results (Metered and Modeled Flow)



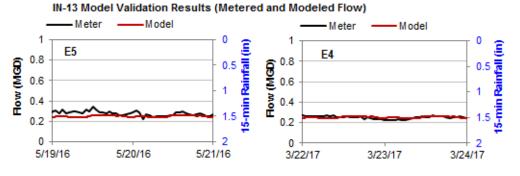
IN-13 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

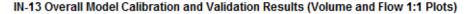


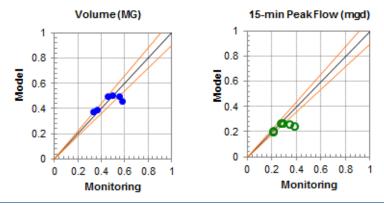
#### FLOW METER IN-13 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-13 Model Calibration Results (Metered and Modeled Flow)







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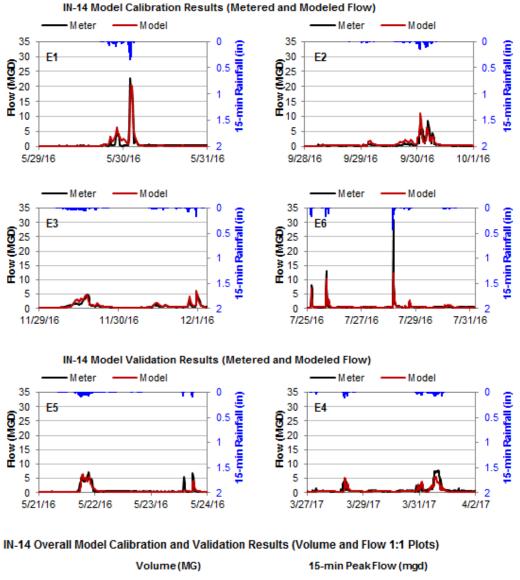
Appendix C

	IN-13 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.29	0.27	-10% to +10%	-5%	0.45	0.50	-10% to +10%	11%			
E2	0.21	0.20	-10% to +10%	-5%	0.33	0.37	-10% to +10%	13%			
E3	0.21	0.21	-10% to +10%	0%	0.36	0.39	-10% to +10%	9%			
E4	0.27	0.27	-10% to +10%	-2%	0.50	0.51	-10% to +10%	1%			
E5	0.34	0.26	-10% to +10%	-23%	0.56	0.50	-10% to +10%	-10%			
E6	0.38	0.24	-10% to +10%	-37%	0.58	0.46	-10% to +10%	-20%			

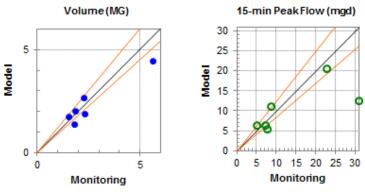
	IN-13 Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	8.54	23.16	-15% to +25%	171%	1.35	1.80	-10% to +20%	34%			
E2	29.87	11.05	-15% to +25%	-63%	4.59	2.37	-10% to +20%	-48%			
E3	21.47	5.53	-15% to +25%	-74%	2.28	1.91	-10% to +20%	-16%			
E4	30.86	5.54	-15% to +25%	-82%	8.12	3.57	-10% to +20%	-56%			
E5	11.35	7.59	-15% to +25%	-33%	2.53	2.15	-10% to +20%	-15%			
E6	28.28	13.85	-15% to +25%	-51%	1.98	1.26	-10% to +20%	-36%			

**Note:** This flow meter is hard to calibrate because flow meter data recorded for most of the events is not consistent with the recorded rainfall intensity. The calibration goal is to calibrate the meter to those wet weather response in line with the rainfall data.

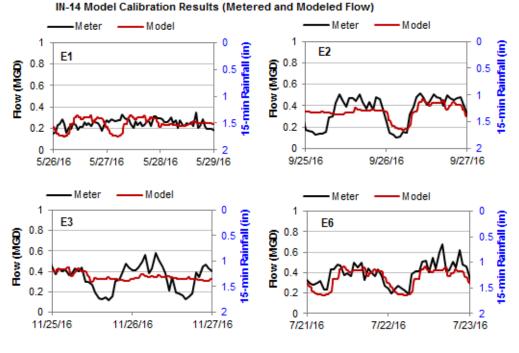




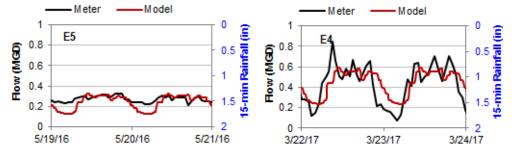
#### FLOW METER IN-14 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



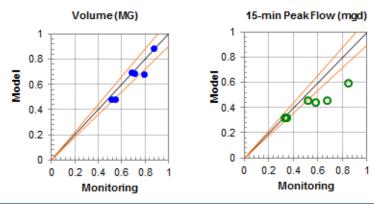
#### FLOW METER IN-14 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-14 Model Validation Results (Metered and Modeled Flow)



IN-14 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

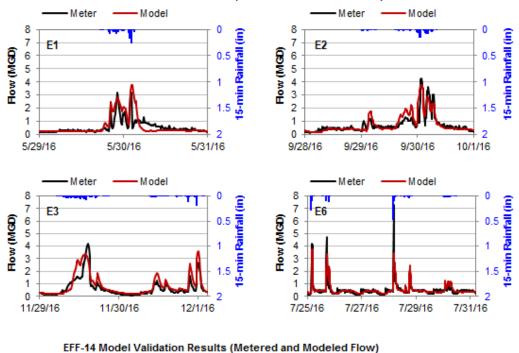
Appendix C

	IN-14 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.35	0.32	-10% to +10%	-6%	0.51	0.48	-10% to +10%	-6%			
E2	0.52	0.46	-10% to +10%	-11%	0.71	0.69	-10% to +10%	-3%			
E3	0.58	0.44	-10% to +10%	-24%	0.68	0.70	-10% to +10%	2%			
E4	0.84	0.59	-10% to +10%	-30%	0.87	0.89	-10% to +10%	2%			
E5	0.33	0.32	-10% to +10%	0%	0.54	0.48	-10% to +10%	-11%			
E6	0.67	0.46	-10% to +10%	-32%	0.79	0.68	-10% to +10%	-13%			

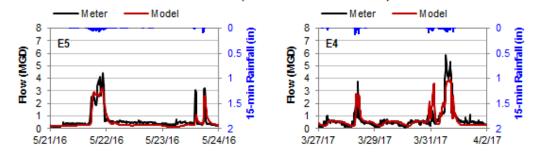
	IN-14	dation	Summary					
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	22.85	20.54	-15% to +25%	-10%	1.54	1.74	-10% to +20%	13%
E2	8.60	11.12	-15% to +25%	29%	2.25	2.67	-10% to +20%	19%
E3	4.98	6.34	-15% to +25%	27%	1.84	2.05	-10% to +20%	11%
E4	7.74	5.54	-15% to +25%	-28%	5.62	4.46	-10% to +20%	-21%
E5	7.13	6.48	-15% to +25%	-9%	2.29	1.88	-10% to +20%	-18%
E6	30.94	12.50	-15% to +25%	-60%	1.81	1.39	-10% to +20%	-23%

**Note:** Four of the six wet weather events are calibrated well within or close to the industry criteria. Flow meter data recorded for some of the events (E6) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

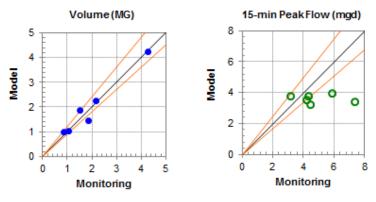
## FLOW METER EFF-14 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



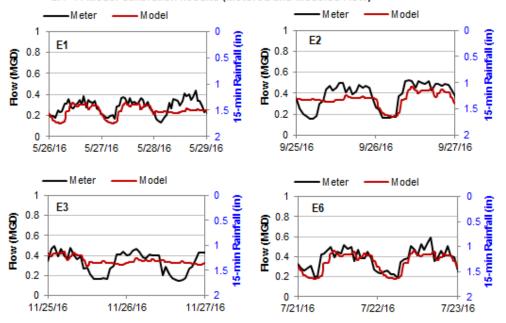
EFF-14 Model Calibration Results (Metered and Modeled Flow)



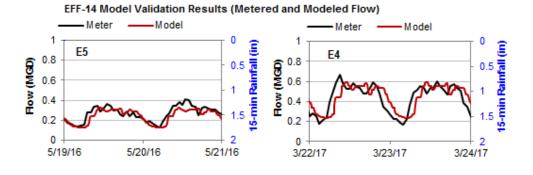




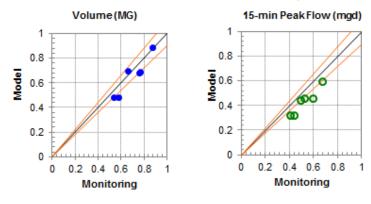
## FLOW METER EFF-14 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



EFF-14 Model Calibration Results (Metered and Modeled Flow)







DELCORA CSO Long Term Control Plan Update

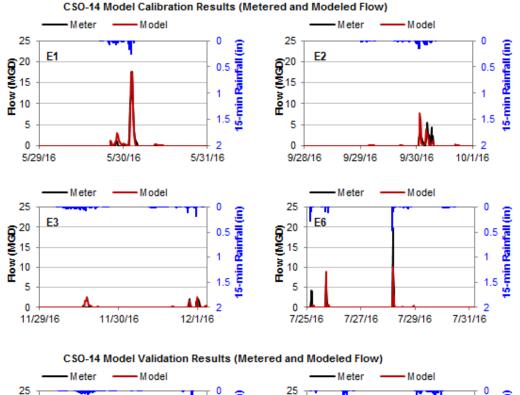
## Sewer System H&H Model Report

Appendix C

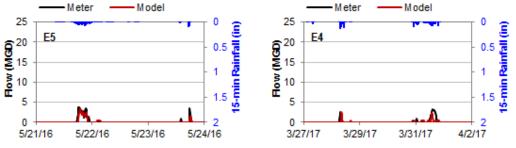
	EFF-14	Mode	l Dry Weather	Calibratio	n and Valio	dation S	Summary	
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	0.44	0.32	-10% to +10%	-26%	0.58	0.48	-10% to +10%	-17%
E2	0.53	0.46	-10% to +10%	-12%	0.76	0.69	-10% to +10%	-10%
E3	0.49	0.44	-10% to +10%	-11%	0.66	0.70	-10% to +10%	6%
E4	0.67	0.59	-10% to +10%	-11%	0.87	0.89	-10% to +10%	2%
E5	0.41	0.32	-10% to +10%	-21%	0.54	0.48	-10% to +10%	-9%
E6	0.59	0.46	-10% to +10%	-23%	0.76	0.68	-10% to +10%	-10%

EFF-14 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)		
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved	
E1	3.17	3.78	-15% to +25%	19%	0.85	1.00	-10% to +20%	17%	
E2	4.29	3.77	-15% to +25%	-12%	2.14	2.27	-10% to +20%	6%	
E3	4.20	3.56	-15% to +25%	-15%	1.50	1.89	-10% to +20%	26%	
E4	5.84	3.99	-15% to +25%	-32%	4.25	4.25	-10% to +20%	0%	
E5	4.47 3.25 -15% to +25% -27%				1.84	1.46	-10% to +20%	-21%	
E6	7.32	3.42	-15% to +25%	-53%	1.05	1.05	-10% to +20%	0%	

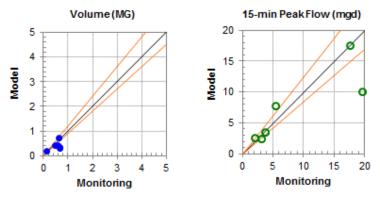
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. The EFF-14 meter is the effluent meter from Regulator 14. The calibration of Regulator 14 meters (which include the IN-14, EFF-14 and CSO-14 meters) are more focused on the influent IN-14 meter and the overflow CSO-14 meter when the total metered influent flow (IN-14) is not balanced with the total metered effluent flow (EFF-14 plus CSO-14). Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



## FLOW METER CSO-14 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



CSO-14 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

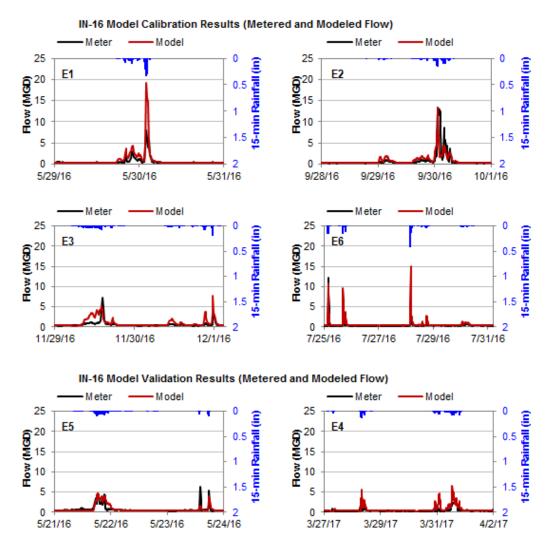


Appendix C

CSO-14 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)		
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved	
E1	17.57	17.55	-15% to +25%	0%	0.63	0.75	-10% to +20%	19%	
E2	5.47	7.82	-15% to +25%	43%	0.45	0.43	-10% to +20%	-4%	
E3	2.03	2.59	-15% to +25%	27%	0.10	0.21	-10% to +20%	100%	
E4	3.16	2.50	-15% to +25%	-21%	0.65	0.33	-10% to +20%	-49%	
E5	3.76	3.49	-15% to +25%	-7%	0.57	0.42	-10% to +20%	-25%	
E6	19.66	10.03	-15% to +25%	-49%	0.67	0.36	-10% to +20%	-46%	

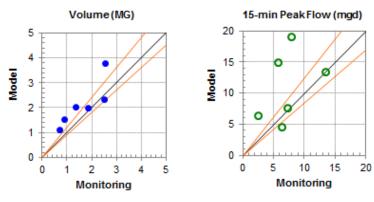
**Note:** Four of the six wet weather event volumes are calibrated well within or close to the industry criteria. This is the CSO meter from Regulator 14, the calibration of Regulator 14 meters (including Influent meter, effluent meter and CSO meter) are more focused on matching the peak flow and flow volume of the influent and CSO meters. The CSO meter flow volume is challenging to calibrate especially for the small overflow events like E3. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



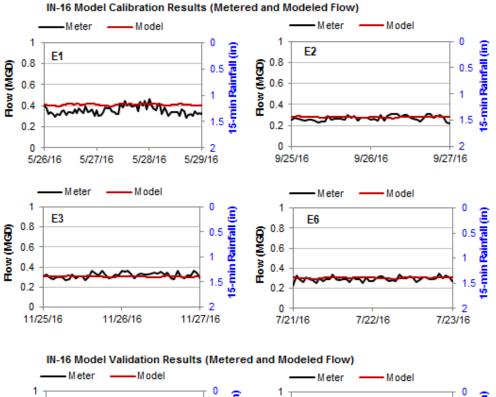


## FLOW METER IN-16 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

IN-16 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

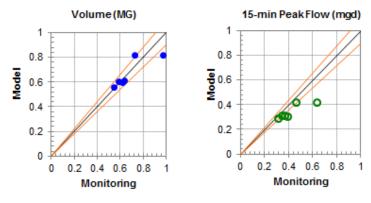


## FLOW METER IN-16 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



0 (u) 1.5 **1** 1.5 **1** 5-min Rainfall (in) E5 E4 0.8 How (MGD) 0.8 How (MGD) 0.5 0.6 0.6 0.4 0.4 1.5 0.2 0.2 0 2 0 2 5/19/16 5/20/16 5/21/16 3/22/17 3/23/17 3/24/17





DELCORA CSO Long Term Control Plan Update

## Sewer System H&H Model Report

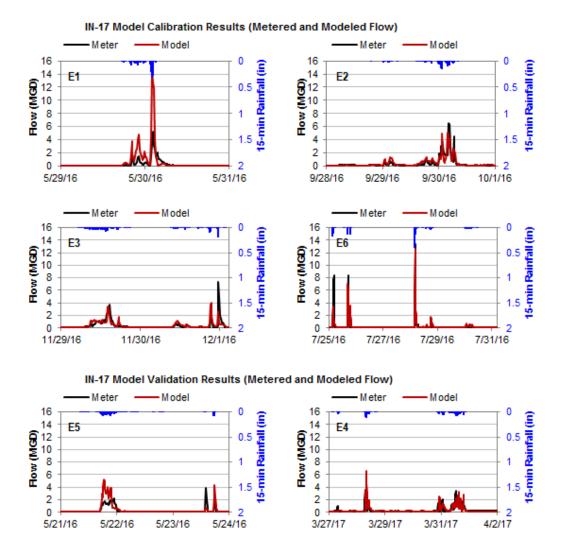
Appendix C

	IN-16 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.46	0.42	-10% to +10%	-9%	0.72	0.82	-10% to +10%	13%			
E2	0.31	0.29	-10% to +10%	-7%	0.54	0.56	-10% to +10%	4%			
E3	0.37	0.31	-10% to +10%	-14%	0.63	0.61	-10% to +10%	-4%			
E4	0.39	0.31	-10% to +10%	-20%	0.62	0.60	-10% to +10%	-3%			
E5	0.64	0.42	-10% to +10%	-34%	0.97	0.82	-10% to +10%	-16%			
E6	0.35	0.31	-10% to +10%	-9%	0.59	0.61	-10% to +10%	4%			

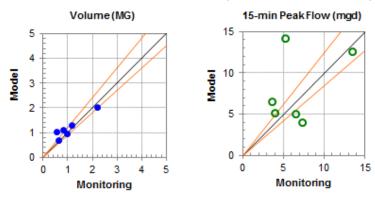
	IN-16 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	7.94	19.10	-15% to +25%	141%	0.88	1.56	-10% to +20%	77%		
E2	13.37	13.45	-15% to +25%	1%	2.48	2.35	-10% to +20%	-5%		
E3	7.23	7.64	-15% to +25%	6%	1.35	2.05	-10% to +20%	52%		
E4	2.48	6.49	-15% to +25%	161%	2.54	3.80	-10% to +20%	50%		
E5	6.35	4.62	-15% to +25%	-27%	1.83	2.02	-10% to +20%	10%		
E6	5.72	15.05	-15% to +25%	163%	0.68	1.14	-10% to +20%	66%		

**Note:** Only two of the six wet weather event volumes are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E1, E4, E5, and E6) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

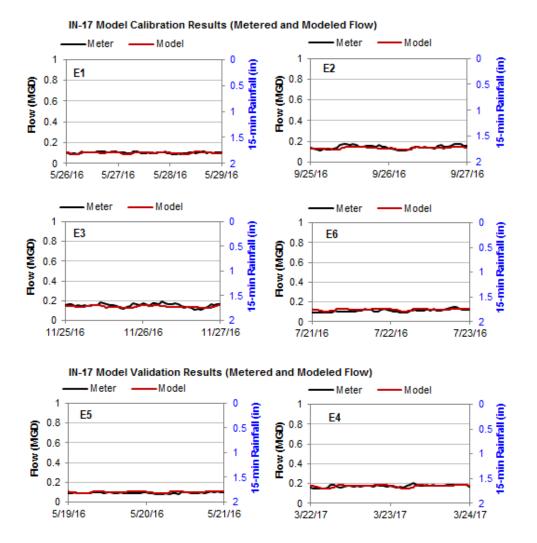
## FLOW METER IN-17 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



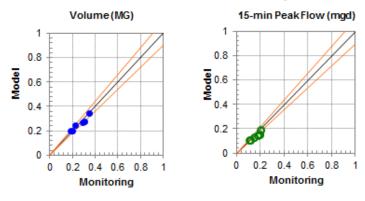




#### FLOW METER IN-17 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events







DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

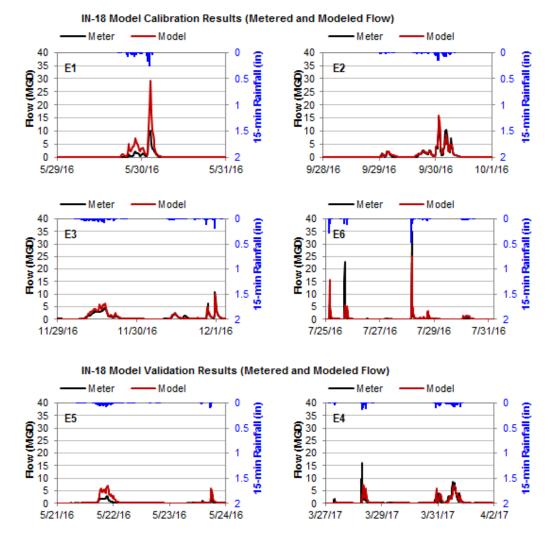
Appendix C

	IN-17 Model Dry Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	0.12	0.11	-10% to +10%	-6%	0.20	0.20	-10% to +10%	0%		
E2	0.18	0.15	-10% to +10%	-15%	0.29	0.27	-10% to +10%	-7%		
E3	0.19	0.15	-10% to +10%	-19%	0.31	0.28	-10% to +10%	-9%		
E4	0.20	0.19	-10% to +10%	-6%	0.35	0.35	-10% to +10%	0%		
E5	0.11	0.11	-10% to +10%	1%	0.19	0.20	-10% to +10%	9%		
E6	0.15	0.13	-10% to +10%	-11%	0.22	0.24	-10% to +10%	9%		

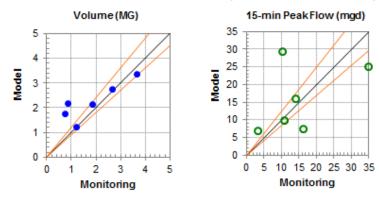
	IN-17 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	5.19	14.26	-15% to +25%	175%	0.53	1.06	-10% to +20%	101%		
E2	6.54	5.11	-15% to +25%	-22%	1.15	1.30	-10% to +20%	13%		
E3	7.31	4.01	-15% to +25%	-45%	0.95	0.99	-10% to +20%	4%		
E4	3.64 6.57 -15% to +25% 819				2.19	2.05	-10% to +20%	-6%		
E5	3.95	5.17	-15% to +25%	31%	0.79	1.10	-10% to +20%	39%		
E6	13.38	12.67	-15% to +25%	-5%	0.61	0.72	-10% to +20%	18%		

**Note:** Only two of the six wet weather event volumes are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E1, E4) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

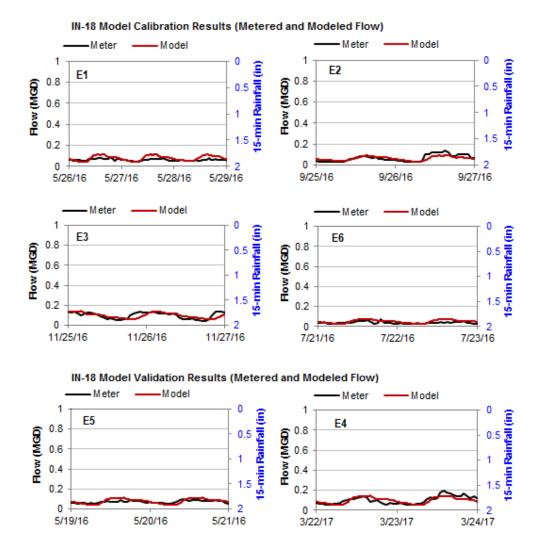
#### FLOW METER IN-18 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



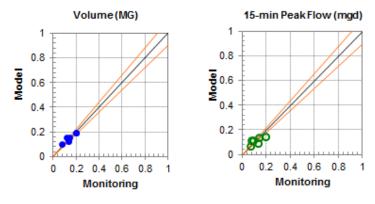
IN-18 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



## FLOW METER IN-18 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-18 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

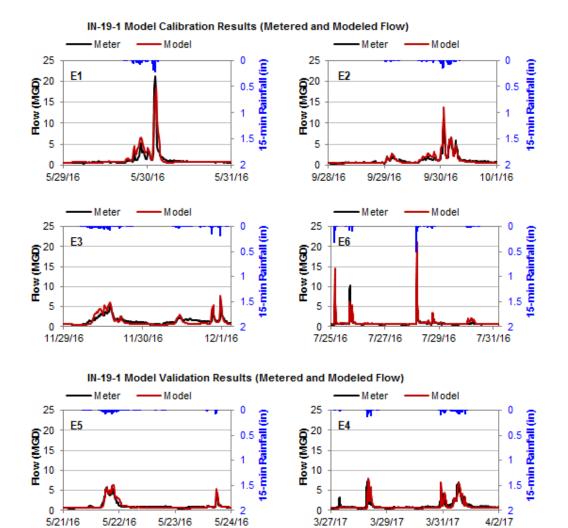
## Sewer System H&H Model Report

Appendix C

	IN-18 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.08	0.11	-10% to +10%	40%	0.12	0.16	-10% to +10%	32%			
E2	0.14	0.09	-10% to +10%	-32%	0.13	0.13	-10% to +10%	-5%			
E3	0.14	0.14	-10% to +10%	1%	0.20	0.19	-10% to +10%	-1%			
E4	0.20	0.14	-10% to +10%	-27%	0.20	0.20	-10% to +10%	-3%			
E5	0.09	0.11	-10% to +10%	20%	0.14	0.16	-10% to +10%	9%			
E6	0.07	0.07	-10% to +10%	2%	0.08	0.10	-10% to +10%	33%			

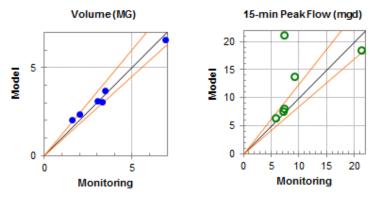
	IN-18 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	10.33	29.33	-15% to +25%	184%	0.83	2.19	-10% to +20%	162%		
E2	14.07	16.01	-15% to +25%	14%	2.64	2.78	-10% to +20%	5%		
E3	10.70	10.00	-15% to +25%	-7%	1.84	2.14	-10% to +20%	16%		
E4	16.28	7.62	-15% to +25%	-53%	3.63	3.39	-10% to +20%	-7%		
E5	3.15 6.92 -15% to +25% 119%				0.75	1.78	-10% to +20%	138%		
E6	34.92	25.11	-15% to +25%	-28%	1.19	1.22	-10% to +20%	2%		

**Note:** Only two of the six wet weather event volumes are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E1, E4, E5, and E6) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

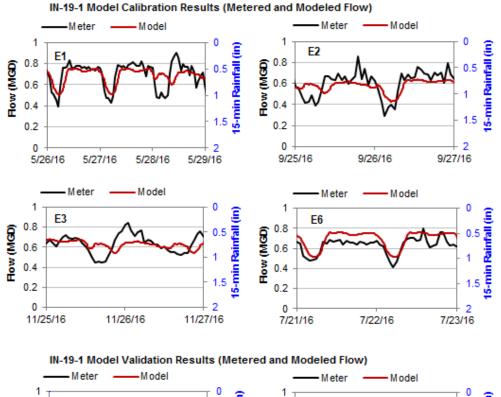


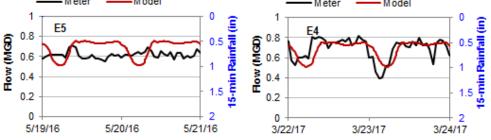
## FLOW METER IN-19-1 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

IN-19-1 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

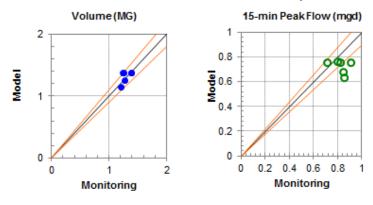


## FLOW METER IN-19-1 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events





IN-19-1 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

## Sewer System H&H Model Report

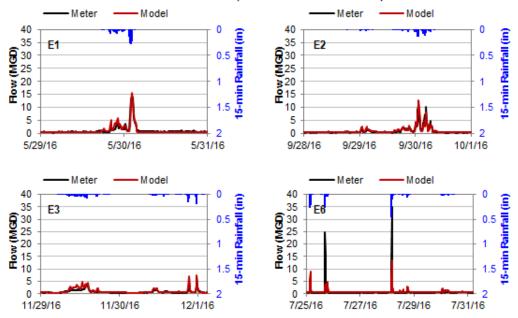
Appendix C

	IN-19-1 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.91	0.76	-10% to +10%	-17%	1.38	1.37	-10% to +10%	-1%			
E2	0.85	0.64	-10% to +10%	-25%	1.20	1.16	-10% to +10%	-4%			
E3	0.84	0.68	-10% to +10%	-20%	1.27	1.25	-10% to +10%	-2%			
E4	0.82	0.76	-10% to +10%	-8%	1.38	1.37	-10% to +10%	0%			
E5	0.72	0.76	-10% to +10%	6%	1.24	1.38	-10% to +10%	11%			
E6	0.79	0.76	-10% to +10%	-4%	1.26	1.39	-10% to +10%	10%			

	IN-19-1 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	21.30	18.54	-15% to +25%	-13%	2.01	2.36	-10% to +20%	17%		
E2	9.15	13.77	-15% to +25%	50%	3.42	3.71	-10% to +20%	9%		
E3	7.04	7.66	-15% to +25%	9%	3.28	3.09	-10% to +20%	-6%		
E4	7.33	8.01	-15% to +25%	9%	6.87	6.61	-10% to +20%	-4%		
E5	5.73	6.40	-15% to +25%	12%	3.00	3.11	-10% to +20%	4%		
E6	7.26	21.13	-15% to +25%	191%	1.56	2.04	-10% to +20%	30%		

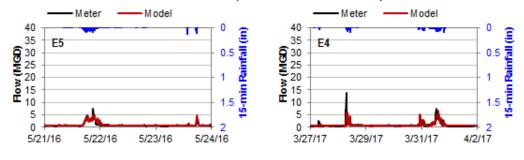
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E2 and E6) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

## FLOW METER IN-19-2 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

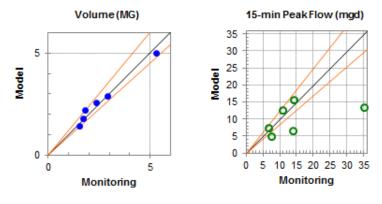


IN-19-2 Model Calibration Results (Metered and Modeled Flow)



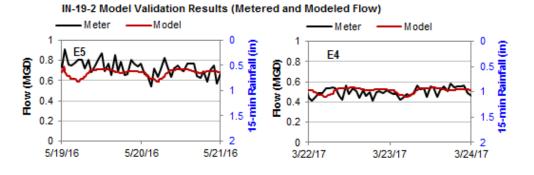


IN-19-2 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

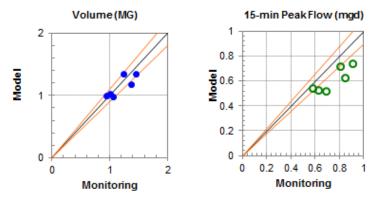


#### IN-19-2 Model Calibration Results (Metered and Modeled Flow) -Meter Model Meter Model 1 1 0 0 5-min Rainfall (in) 5-min Rainfall (in) E2 E1 (000 0.8 0.6 0.4 0.8 How (MGD) 0.5 0 6 0.6 0.4 1.5 1.5 0.2 0.2 0 0 2 2 9/25/16 9/27/16 9/26/16 5/27/16 5/29/16 5/26/16 5/28/16 Meter Model Meter Model 0 1 0 1 5-min Rainfall (in) 5-min Rainfall (in) E3 E6 0.8 0.8 How (MGD) 0.5 How (MGD) 0.5 0.6 0.6 0.4 0.4 5 1 0.2 0.2 0 2 0 2 11/25/16 11/26/16 11/27/16 7/23/16 7/21/16 7/22/16

## FLOW METER IN-19-2 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-19-2 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

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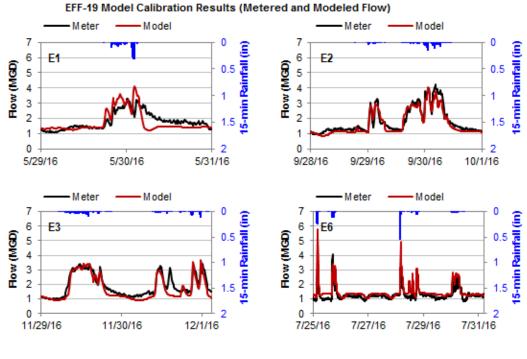
	IN-19-2	Mode	l Dry Weather	Calibratio	n and Valio	dation S	Summary	
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Monitored Model Criteria Achieved Monitored Model Criteria						
E1	0.81	0.72	-10% to +10%	-11%	1.24	1.35	-10% to +10%	9%
E2	0.69	0.52	-10% to +10%	-24%	1.06	0.98	-10% to +10%	-7%
E3	0.63	0.53	-10% to +10%	-16%	0.95	1.00	-10% to +10%	5%
E4	0.58	0.54	-10% to +10%	-6%	1.00	1.03	-10% to +10%	3%
E5	0.91	0.74	-10% to +10%	-18%	1.45	1.35	-10% to +10%	-7%
E6	0.85	0.63	-10% to +10%	-25%	1.37	1.19	-10% to +10%	-13%

	IN-19-2	Mode	l Wet Weather	Calibratio	on and Vali	dation	Summary	
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	14.15	15.72	-15% to +25%	11%	1.69	1.80	-10% to +20%	6%
E2	10.79	12.67	-15% to +25%	18%	2.90	2.91	-10% to +20%	0%
E3	6.61	7.58	-15% to +25%	15%	1.80	2.22	-10% to +20%	23%
E4	13.88	6.56	-15% to +25%	-53%	5.29	4.99	-10% to +20%	-6%
E5	7.59	4.90	-15% to +25%	-35%	2.37	2.60	-10% to +20%	10%
E6	35.07	13.51	-15% to +25%	-61%	1.51	1.44	-10% to +20%	-4%

**Note:** Four of the six wet weather events are calibrated well within or close to the industry criteria. Flow meter data recorded for some of the events (E4, E5 and E6) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

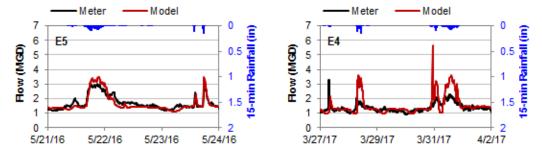


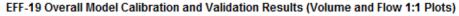
Appendix C

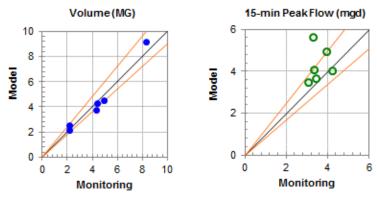


## FLOW METER EFF-19 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

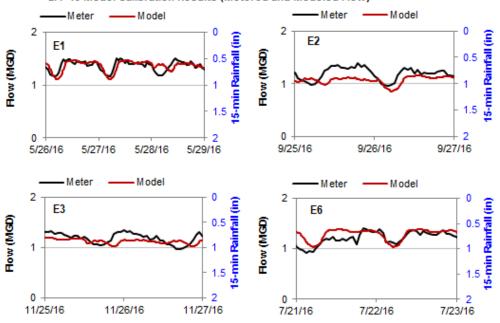
EFF-19 Model Validation Results (Metered and Modeled Flow)



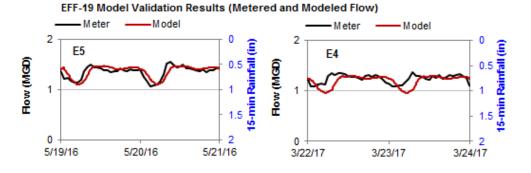




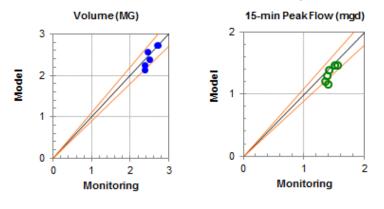
#### LOW METER EFF-19 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



EFF-19 Model Calibration Results (Metered and Modeled Flow)



EFF-19 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



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# Sewer System H&H Model Report

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	EFF-19 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	1.51	1.47	-10% to +10%	-2%	2.72	2.73	-10% to +10%	0%			
E2	1.40	1.16	-10% to +10%	-17%	2.38	2.14	-10% to +10%	-10%			
E3	1.34	1.21	-10% to +10%	-10%	2.37	2.25	-10% to +10%	-5%			
E4	1.38	1.30	-10% to +10%	-6%	2.49	2.40	-10% to +10%	-4%			
E5	1.55	1.47	-10% to +10%	-5%	2.70	2.73	-10% to +10%	1%			
E6	1.41	1.39	-10% to +10%	-1%	2.44	2.58	-10% to +10%	6%			

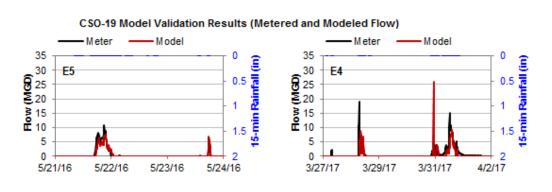
	EFF-19	Mode	l Wet Weather	Calibratio	on and Vali	dation	Summary	
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	3.33	4.09	-15% to +25%	23%	2.18	2.13	-10% to +20%	-2%
E2	4.22	4.05	-15% to +25%	-4%	4.90	4.55	-10% to +20%	-7%
E3	3.43	3.69	-15% to +25%	8%	4.33	3.79	-10% to +20%	-12%
E4	3.28	5.63	-15% to +25%	72%	8.28	9.18	-10% to +20%	11%
E5	3.05	3.51	-15% to +25%	15%	4.41	4.31	-10% to +20%	-2%
E6	3.93	4.96	-15% to +25%	26%	2.12	2.54	-10% to +20%	20%

**Note:** Five of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E4) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



#### CSO-19 Model Calibration Results (Metered and Modeled Flow) Meter Model Meter Model 0 0.5 1.5 1.5 1.5 35 0 35 0 5-min Rainfall (in) (00) 20 20 15 10 30 E1 E2 (00 25 20 20 15 10 0.5 1 10 10 1.5 5 5 0 2 0 2 5/29/16 5/30/16 5/31/16 9/28/16 9/29/16 9/30/16 10/1/16 Meter Model Meter Model 35 0 (ii) 1.5 **1** 1.5 **1** 0 35 0 5-min Rainfall (in) 30 30 E3 E6 (0)25 20 20 15 10 (00 25 20 15 10 10 0.5 1

FLOW METER CSO-19 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



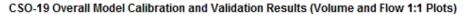
5

0

7/25/16

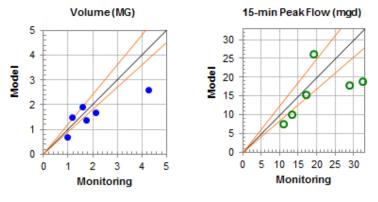
7/27/16

7/29/16



2

12/1/16



5 0

11/29/16

11/30/16

1.5

2

7/31/16

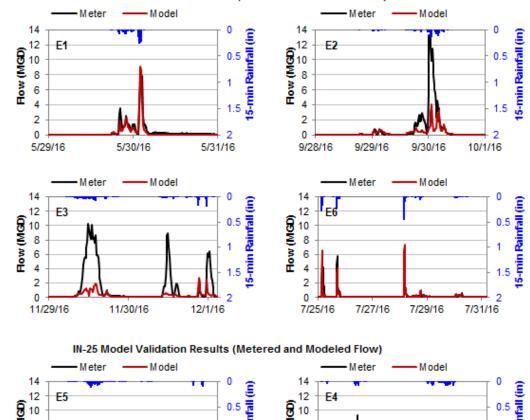
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	CSO-19	Mode	l Wet Weather	Calibratio	on and Vali	dation	Summary		
Event		Peak	Flow (MGD)			Vo	olume (MG)		
	Monitored	Nonitored Model Criteria Achieved Monitored Model Criteria							
E1	28.77	17.93	-15% to +25%	-38%	2.13	1.70	-10% to +20%	-20%	
E2	17.03	15.36	-15% to +25%	-10%	1.56	1.91	-10% to +20%	22%	
E3	13.23	10.18	-15% to +25%	-23%	1.16	1.51	-10% to +20%	30%	
E4	19.16	26.11	-15% to +25%	36%	4.26	2.63	-10% to +20%	-38%	
E5	10.84	7.63	-15% to +25%	-30%	1.72	1.40	-10% to +20%	-19%	
E6	32.37	19.04	-15% to +25%	-41%	0.98	0.70	-10% to +20%	-28%	

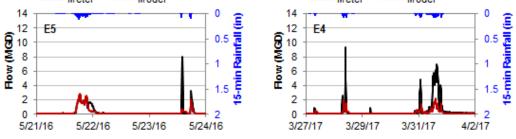
**Note:** Three of the six wet weather events are calibrated well within or close to the industry criteria. Flow meter data recorded for some of the events (E1 and E6) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall Regulator 19 flow meters, the model calibration is adequate for purposes of long term control planning.



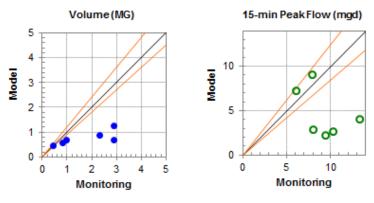
## FLOW METER IN-25 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



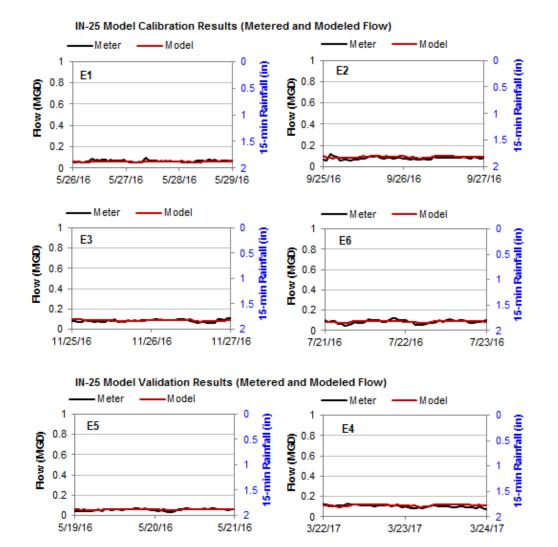
IN-25 Model Calibration Results (Metered and Modeled Flow)



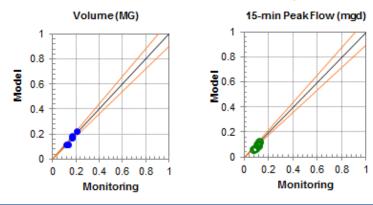
#### IN-25 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



## FLOW METER IN-25 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



IN-25 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



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# Sewer System H&H Model Report

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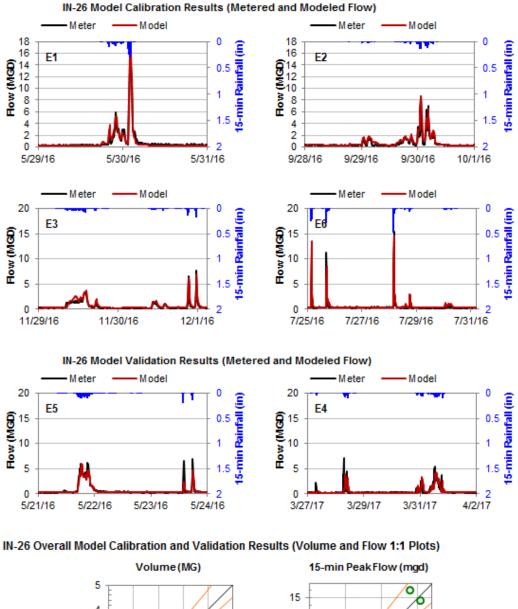
	IN-25 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	onitored Model Criteria Achieved Monitored Model Crit									
E1	0.09	0.07	-10% to +10%	-27%	0.13	0.12	-10% to +10%	-10%			
E2	0.12	0.11	-10% to +10%	-9%	0.16	0.19	-10% to +10%	15%			
E3	0.11	0.10	-10% to +10%	-9%	0.17	0.17	-10% to +10%	4%			
E4	0.13	0.12	-10% to +10%	-3%	0.21	0.22	-10% to +10%	9%			
E5	0.07	0.06	-10% to +10%	-14%	0.11	0.12	-10% to +10%	4%			
E6	0.12	0.09	-10% to +10%	-19%	0.17	0.17	-10% to +10%	2%			

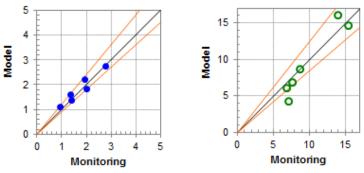
	IN-25	Mode	l Wet Weather	Calibratio	on and Vali	dation	Summary	
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	7.88	9.09	-15% to +25%	15%	0.82	0.60	-10% to +20%	-28%
E2	13.30	4.04	-15% to +25%	-70%	2.30	0.91	-10% to +20%	-61%
E3	10.24	2.68	-15% to +25%	-74%	2.89	0.71	-10% to +20%	-75%
E4	9.39	2.21	-15% to +25%	-76%	2.90	1.29	-10% to +20%	-56%
E5	8.02	2.87	-15% to +25%	-64%	0.97	0.72	-10% to +20%	-26%
E6	6.04	7.32	-15% to +25%	21%	0.42	0.47	-10% to +20%	12%

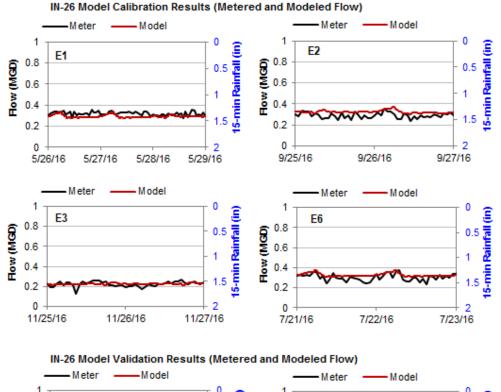
**Note:** Only two of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E2, E3, E4, and E5) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



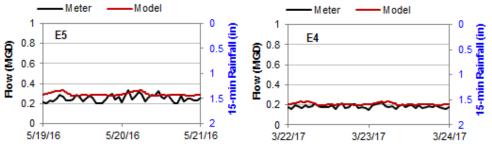
# FLOW METER IN-26 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



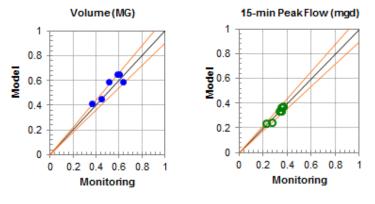




#### FLOW METER IN-26 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events







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# Sewer System H&H Model Report

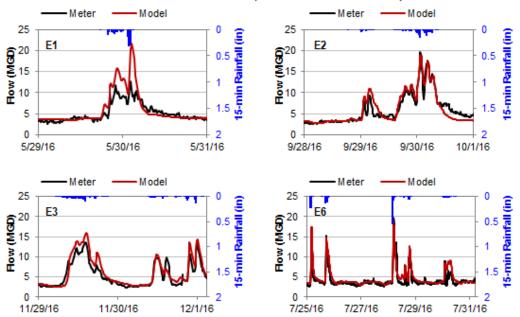
Appendix C

	IN-26 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	onitored Model Criteria Achieved Monitored Model Crite									
E1	0.35	0.34	-10% to +10%	-5%	0.64	0.59	-10% to +10%	-7%			
E2	0.35	0.37	-10% to +10%	4%	0.58	0.65	-10% to +10%	12%			
E3	0.27	0.24	-10% to +10%	-11%	0.45	0.45	-10% to +10%	1%			
E4	0.23	0.24	-10% to +10%	4%	0.37	0.42	-10% to +10%	13%			
E5	0.34	0.34	-10% to +10%	0%	0.51	0.59	-10% to +10%	16%			
E6	0.37	0.37	-10% to +10%	1%	0.60	0.65	-10% to +10%	8%			

	IN-26 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	13.97	16.12	-15% to +25%	15%	1.40	1.38	-10% to +20%	-1%		
E2	8.60	8.69	-15% to +25%	1%	1.92	2.24	-10% to +20%	17%		
E3	7.66	6.92	-15% to +25%	-10%	1.35	1.61	-10% to +20%	19%		
E4	7.06	4.37	-15% to +25%	-38%	2.78	2.78	-10% to +20%	0%		
E5	6.84	6.07	-15% to +25%	-11%	2.01	1.83	-10% to +20%	-9%		
E6	15.36	14.64	-15% to +25%	-5%	0.92	1.14	-10% to +20%	24%		

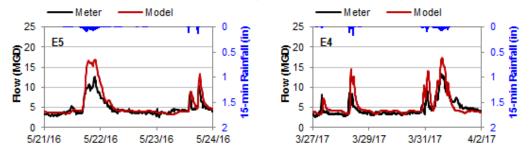
**Note:** All the six wet weather events are calibrated well within the industry criteria except flow peak for E4 because flow meter data recorded for E4 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

## FLOW METER INT-2ND ST MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

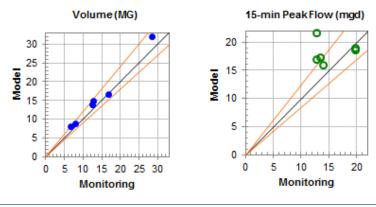


INT-2nd St Model Calibration Results (Metered and Modeled Flow)

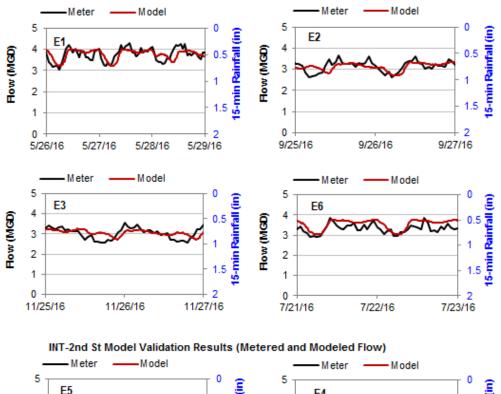




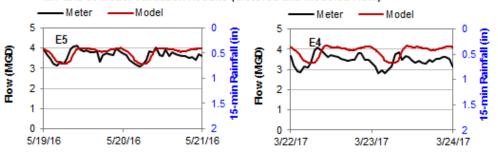
INT-2nd St Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

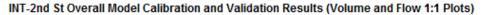


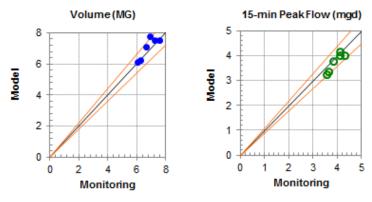
## FLOW METER INT-2ND ST MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



INT-2nd St Model Calibration Results (Metered and Modeled Flow)







DELCORA CSO Long Term Control Plan Update

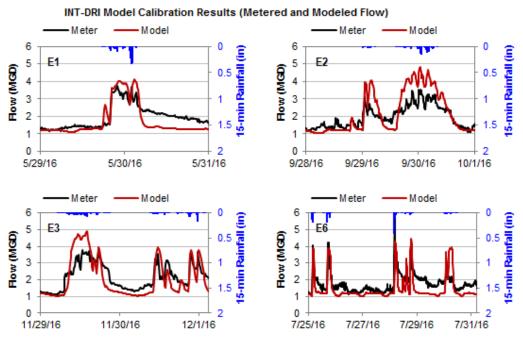
# Sewer System H&H Model Report

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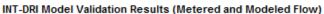
I	NT-2nd St	Mode	l Dry Weather	n and Valio	lation S	Summary		
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	4.32	4.01	-10% to +10%	-7%	7.58	7.51	-10% to +10%	-1%
E2	3.64	3.35	-10% to +10%	-8%	6.29	6.25	-10% to +10%	-1%
E3	3.56	3.26	-10% to +10%	-8%	6.05	6.10	-10% to +10%	1%
E4	4.11	4.18	-10% to +10%	2%	6.89	7.79	-10% to +10%	13%
E5	4.10	4.01	-10% to +10%	-2%	7.26	7.52	-10% to +10%	4%
E6	3.85	3.78	-10% to +10%	-2%	6.65	7.08	-10% to +10%	7%

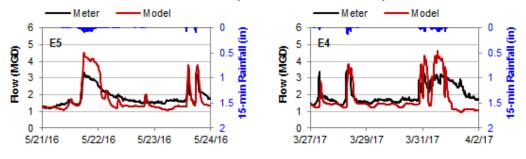
I	NT-2nd St	Mode	l Wet Weather	on and Vali	dation	Summary		
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	12.71	21.71	-15% to +25%	71%	6.63	8.13	-10% to +20%	23%
E2	19.69	19.00	-15% to +25%	-3%	16.80	16.79	-10% to +20%	0%
E3	13.92	16.04	-15% to +25%	15%	12.44	13.88	-10% to +20%	12%
E4	13.36	17.30	-15% to +25%	30%	28.36	32.16	-10% to +20%	13%
E5	12.76	16.98	-15% to +25%	33%	12.74	15.01	-10% to +20%	18%
E6	19.67	18.72	-15% to +25%	-5%	7.79	8.80	-10% to +20%	13%

**Note:** Four of the six wet weather events are calibrated well within or close to the industry criteria. Flow meter data recorded for some events (E1, E4, E5) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

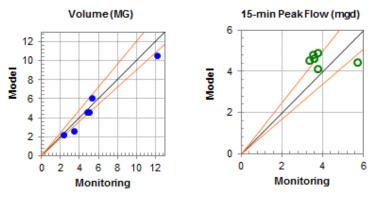


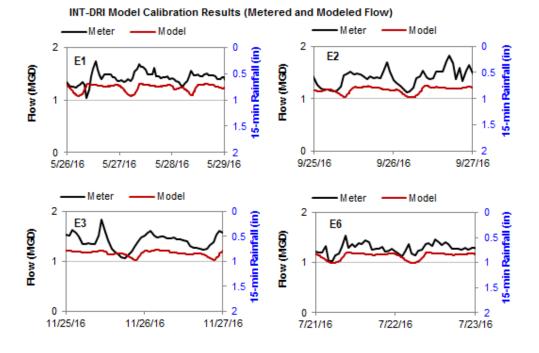
FLOW METER INT-DRI MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events





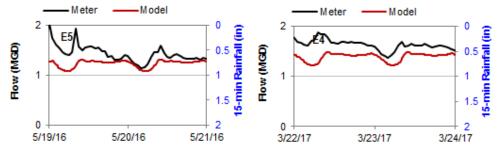
INT-DRI Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



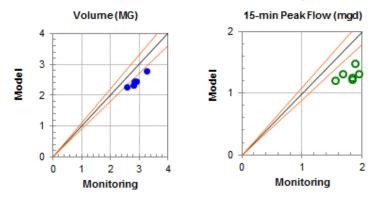


#### FLOW METER INT-DRI MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events

INT-DRI Model Validation Results (Metered and Modeled Flow)



INT-DRI Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

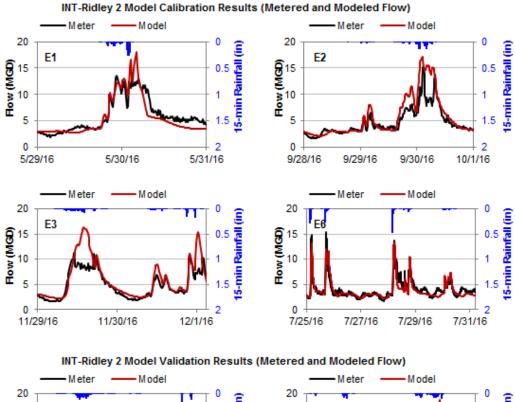
# Sewer System H&H Model Report

Appendix C

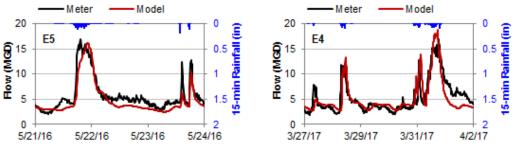
	INT-DRI Model Dry Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	1.68	1.31	-10% to +10%	-22%	2.90	2.47	-10% to +10%	-15%		
E2	1.83	1.25	-10% to +10%	-32%	2.80	2.34	-10% to +10%	-17%		
E3	1.83	1.23	-10% to +10%	-33%	2.81	2.33	-10% to +10%	-17%		
E4	1.88	1.49	-10% to +10%	-21%	3.26	2.78	-10% to +10%	-15%		
E5	1.94	1.31	-10% to +10%	-32%	2.84	2.47	-10% to +10%	-13%		
E6	1.55	1.21	-10% to +10%	-22%	2.57	2.27	-10% to +10%	-12%		

	INT-DRI	INT-DRI Model Wet Weather Calibration and Validation Summary									
Event		Flow (MGD)			Vo	olume (MG)					
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	3.75	4.13	-15% to +25%	10%	2.35	2.26	-10% to +20%	-4%			
E2	3.51	4.79	-15% to +25%	37%	5.27	6.10	-10% to +20%	16%			
E3	3.76	4.92	-15% to +25%	31%	5.00	4.63	-10% to +20%	-7%			
E4	3.57	4.62	-15% to +25%	30%	12.18	10.51	-10% to +20%	-14%			
E5	3.32	4.53	-15% to +25%	36%	4.78	4.62	-10% to +20%	-3%			
E6	5.70	4.45	-15% to +25%	-22%	3.40	2.64	-10% to +20%	-22%			

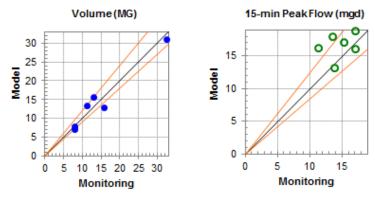
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E2, E3, E4, and E5) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



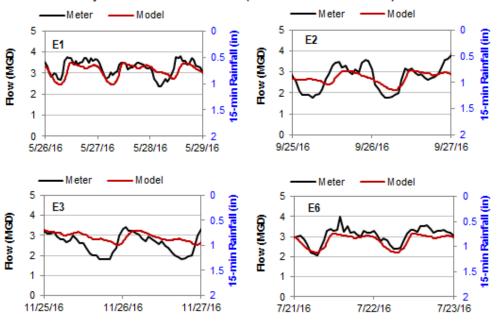
#### FLOW METER INT-RIDLEY 2 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



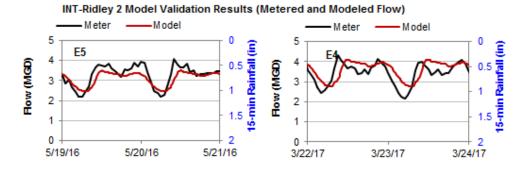
INT-Ridley 2 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



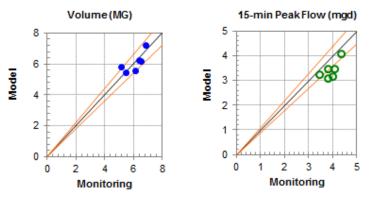
#### FLOW METER INT-RIDLEY 2 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



INT-Ridley 2 Model Calibration Results (Metered and Modeled Flow)







DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

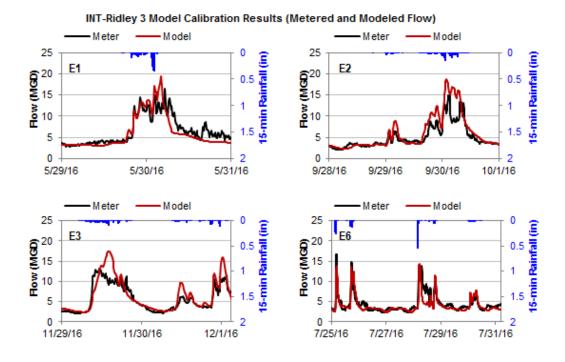
Appendix C

IN	INT-Ridley 2 Model Dry Weather Calibration and Validation Summary								
Event		Peak	Flow (MGD)			Vo	olume (MG)		
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved	
E1	3.81	3.49	-10% to +10%	-8%	6.38	6.23	-10% to +10%	-2%	
E2	3.78	3.08	-10% to +10%	-18%	5.45	5.43	-10% to +10%	0%	
E3	3.43	3.26	-10% to +10%	-5%	5.15	5.82	-10% to +10%	13%	
E4	4.32	4.10	-10% to +10%	-5%	6.84	7.20	-10% to +10%	5%	
E5	4.07	3.49	-10% to +10%	-14%	6.54	6.20	-10% to +10%	-5%	
E6	4.00	3.16	-10% to +10%	-21%	6.12	5.60	-10% to +10%	-8%	

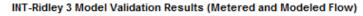
IN	INT-Ridley 2 Model Wet Weather Calibration and Validation Summary							
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	13.52	17.98	-15% to +25%	33%	7.96	7.95	-10% to +20%	0%
E2	15.19	17.15	-15% to +25%	13%	13.05	15.68	-10% to +20%	20%
E3	11.34	16.32	-15% to +25%	44%	11.24	13.57	-10% to +20%	21%
E4	17.00	18.81	-15% to +25%	11%	32.32	31.09	-10% to +20%	-4%
E5	17.00	16.14	-15% to +25%	-5%	15.68	12.99	-10% to +20%	-17%
E6	13.72	13.29	-15% to +25%	-3%	7.98	7.27	-10% to +20%	-9%

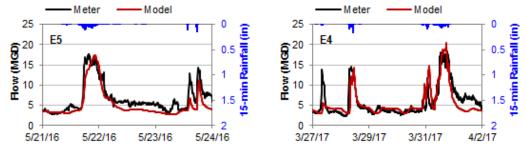
**Note:** Four of the six wet weather events are calibrated well within or close to the industry criteria. Flow meter data recorded for some of the events (E1 and E3) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



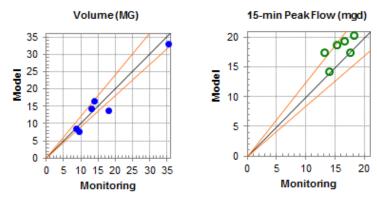


## FLOW METER INT-RIDLEY 3 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

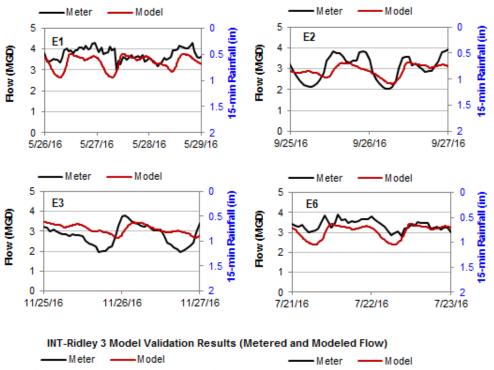




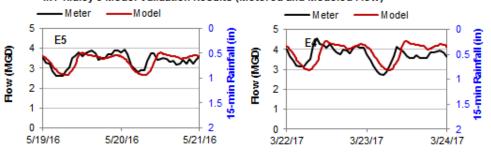
INT-Ridley 3 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

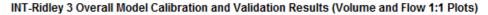


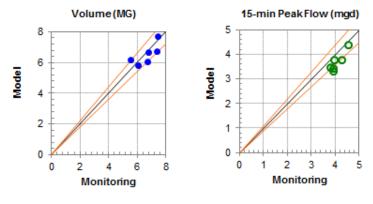
#### FLOW METER INT-RIDLEY 3 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



INT-Ridley 3 Model Calibration Results (Metered and Modeled Flow)







DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

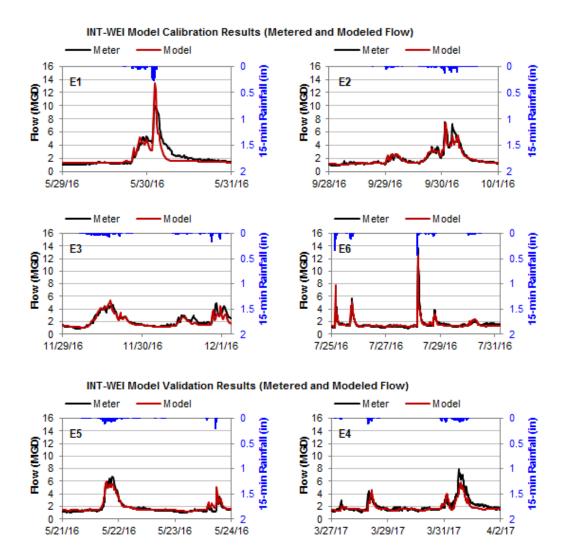
Appendix C

IN	INT-Ridley 3 Model Dry Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	4.28	3.78	-10% to +10%	-12%	7.39	6.74	-10% to +10%	-9%		
E2	3.92	3.31	-10% to +10%	-16%	6.07	5.84	-10% to +10%	-4%		
E3	3.78	3.48	-10% to +10%	-8%	5.56	6.22	-10% to +10%	12%		
E4	4.55	4.41	-10% to +10%	-3%	7.42	7.74	-10% to +10%	4%		
E5	3.95	3.77	-10% to +10%	-5%	6.78	6.70	-10% to +10%	-1%		
E6	3.90	3.43	-10% to +10%	-12%	6.73	6.07	-10% to +10%	-10%		

IN.	INT-Ridley 3 Model Wet Weather Calibration and Validation Summary								
Event		Peak	Flow (MGD)			Vo	olume (MG)		
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved	
E1	16.50	19.45	-15% to +25%	18%	8.57	8.49	-10% to +20%	-1%	
E2	15.23	18.76	-15% to +25%	23%	13.85	16.70	-10% to +20%	21%	
E3	13.11	17.45	-15% to +25%	33%	13.01	14.42	-10% to +20%	11%	
E4	18.23	20.42	-15% to +25%	12%	35.43	33.21	-10% to +20%	-6%	
E5	17.50	17.44	-15% to +25%	0%	18.03	13.98	-10% to +20%	-22%	
E6	13.88	14.34	-15% to +25%	3%	9.31	7.80	-10% to +20%	-16%	

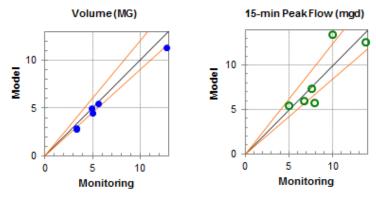
Note: All of the six wet weather events are calibrated well within or close to the industry criteria.

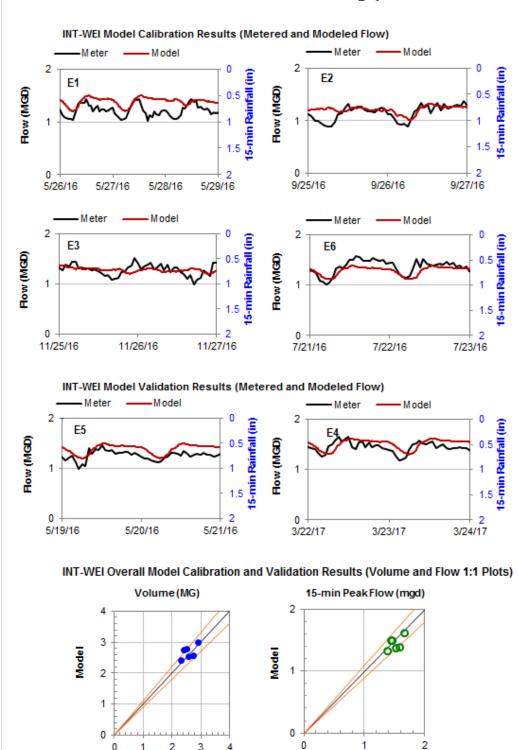




#### FLOW METER INT-WEI MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

INT-WEI Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)





## FLOW METER INT-WEI MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



0

1

2

Monitoring

3

4

1

Monitoring

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# Sewer System H&H Model Report

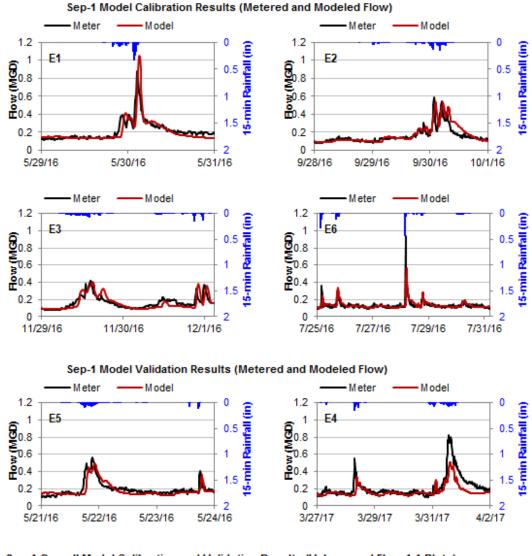
Appendix C

	INT-WEI	INT-WEI Model Dry Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	1.44	1.50	-10% to +10%	5%	2.41	2.77	-10% to +10%	15%			
E2	1.37	1.33	-10% to +10%	-3%	2.31	2.42	-10% to +10%	5%			
E3	1.51	1.37	-10% to +10%	-9%	2.56	2.56	-10% to +10%	0%			
E4	1.66	1.62	-10% to +10%	-2%	2.90	3.02	-10% to +10%	4%			
E5	1.46	1.50	-10% to +10%	3%	2.52	2.78	-10% to +10%	10%			
E6	1.58	1.39	-10% to +10%	-12%	2.73	2.58	-10% to +10%	-6%			

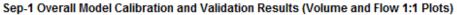
	INT-WEI	INT-WEI Model Wet Weather Calibration and Validation Summary								
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	9.99	13.44	-15% to +25%	35%	3.27	2.84	-10% to +20%	-13%		
E2	7.54	7.44	-15% to +25%	-1%	5.64	5.46	-10% to +20%	-3%		
E3	4.93	5.44	-15% to +25%	10%	5.00	4.55	-10% to +20%	-9%		
E4	7.91	5.83	-15% to +25%	-26%	12.77	11.34	-10% to +20%	-11%		
E5	6.73	6.03	-15% to +25%	-10%	4.91	5.05	-10% to +20%	3%		
E6	13.69	12.65	-15% to +25%	-8%	3.31	2.91	-10% to +20%	-12%		

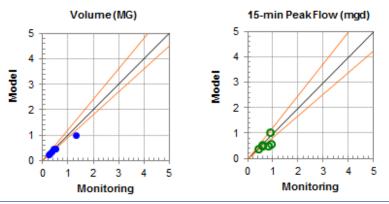
Note: All the six wet weather events are calibrated well within or close to the industry criteria.



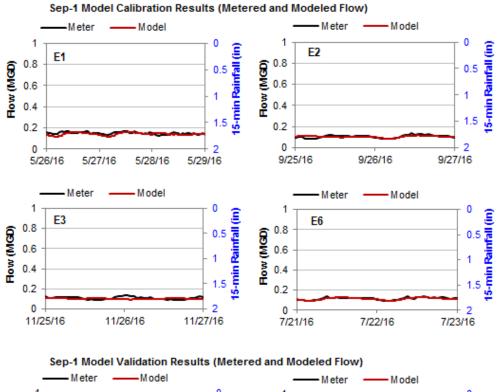


#### FLOW METER SEP-1 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



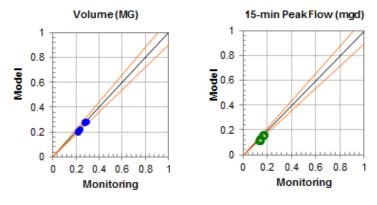


#### FLOW METER SEP-1 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



1 0 0 1 5-min Rainfall (in) Ξ E5 E4 0.8 0.5 July 1 0.8 How (MGD) How (MGD) 0.5 0.6 0.6 1 0.4 0.4 5-min 1.5 1.5 0.2 0.2 0 2 0 2 5/21/16 5/19/16 5/20/16 3/22/17 3/23/17 3/24/17





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# Sewer System H&H Model Report

Appendix C

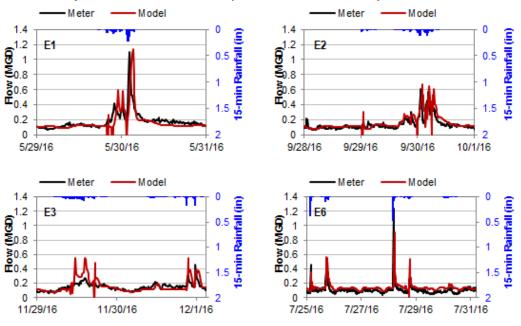
	Sep-1 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.17	0.16	-10% to +10%	-7%	0.29	0.28	-10% to +10%	-4%			
E2	0.14	0.12	-10% to +10%	-18%	0.22	0.21	-10% to +10%	-3%			
E3	0.13	0.11	-10% to +10%	-16%	0.22	0.20	-10% to +10%	-6%			
E4	0.16	0.16	-10% to +10%	-4%	0.28	0.28	-10% to +10%	1%			
E5	0.17	0.16	-10% to +10%	-4%	0.27	0.28	-10% to +10%	4%			
E6	0.14	0.13	-10% to +10%	-7%	0.23	0.22	-10% to +10%	-3%			

Sep-1 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)		
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved	
E1	0.88	1.05	-15% to +25%	19%	0.27	0.27	-10% to +20%	2%	
E2	0.58	0.53	-15% to +25%	-8%	0.43	0.47	-10% to +20%	10%	
E3	0.42	0.40	-15% to +25%	-5%	0.37	0.36	-10% to +20%	-3%	
E4	0.82	0.51	-15% to +25%	-38%	1.30	1.01	-10% to +20%	-22%	
E5	0.56	0.49	-15% to +25%	-11%	0.51	0.47	-10% to +20%	-9%	
E6	0.94	0.57	-15% to +25%	-40%	0.25	0.25	-10% to +20%	-2%	

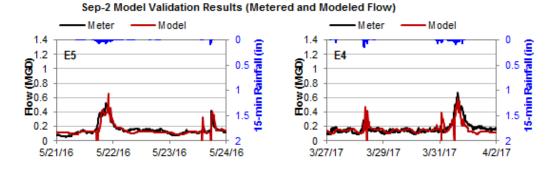
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E4) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



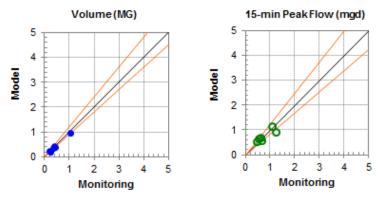


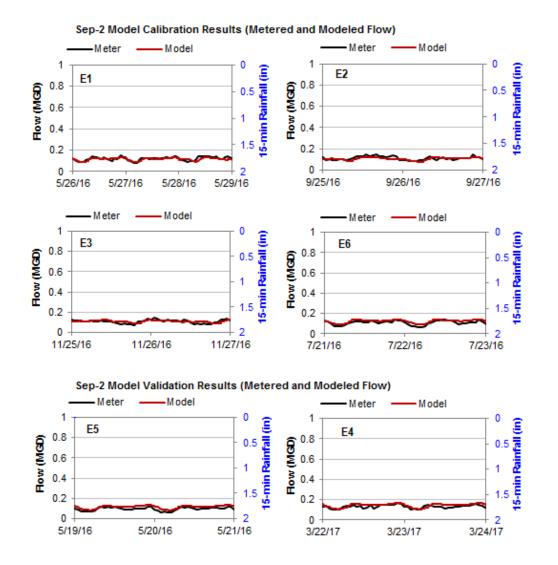


Sep-2 Model Calibration Results (Metered and Modeled Flow)



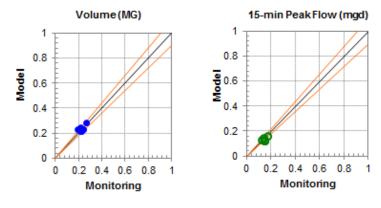
Sep-2 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)





#### FLOW METER SEP-2 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events





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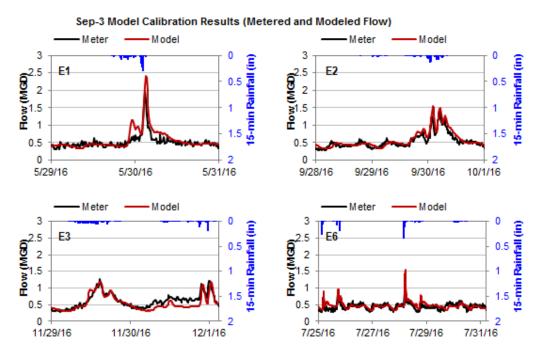
Appendix C

	Sep-2 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.15	0.13	-10% to +10%	-8%	0.24	0.23	-10% to +10%	-4%			
E2	0.15	0.12	-10% to +10%	-14%	0.23	0.22	-10% to +10%	-5%			
E3	0.15	0.13	-10% to +10%	-15%	0.22	0.22	-10% to +10%	2%			
E4	0.17	0.17	-10% to +10%	-3%	0.26	0.28	-10% to +10%	9%			
E5	0.12	0.13	-10% to +10%	10%	0.19	0.23	-10% to +10%	20%			
E6	0.14	0.14	-10% to +10%	2%	0.22	0.25	-10% to +10%	14%			

	Sep-2 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	1.10	1.15	-15% to +25%	5%	0.24	0.22	-10% to +20%	-7%		
E2	0.61	0.66	-15% to +25%	7%	0.38	0.44	-10% to +20%	14%		
E3	0.46	0.57	-15% to +25%	22%	0.34	0.36	-10% to +20%	5%		
E4	0.67	0.59	-15% to +25%	-11%	1.04	0.95	-10% to +20%	-8%		
E5	0.53	0.65	-15% to +25%	22%	0.42	0.38	-10% to +20%	-9%		
E6	1.24	0.92	-15% to +25%	-26%	0.20	0.26	-10% to +20%	26%		

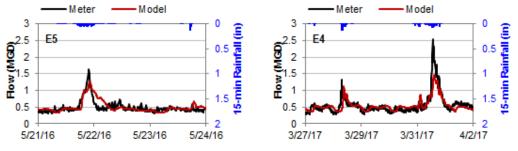
**Note:** All the six wet weather events are calibrated well within the industry criteria except E6 because the flow meter data recorded for E6 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



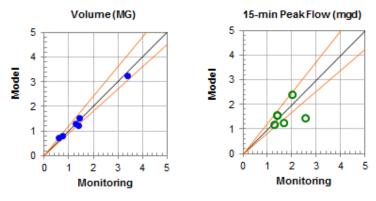


#### FLOW METER SEP-3 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



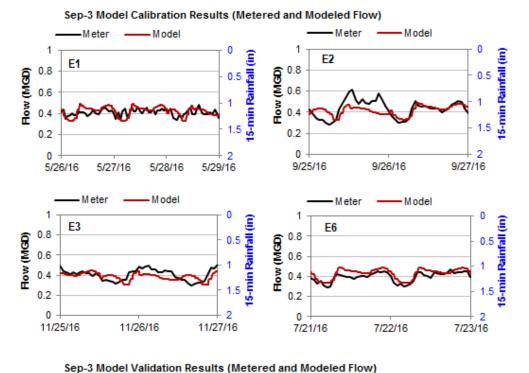


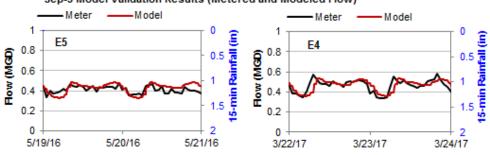
Sep-3 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



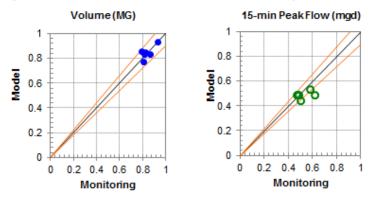
# Appendix C

#### FLOW METER SEP-3 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events





Sep-3 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



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# Sewer System H&H Model Report

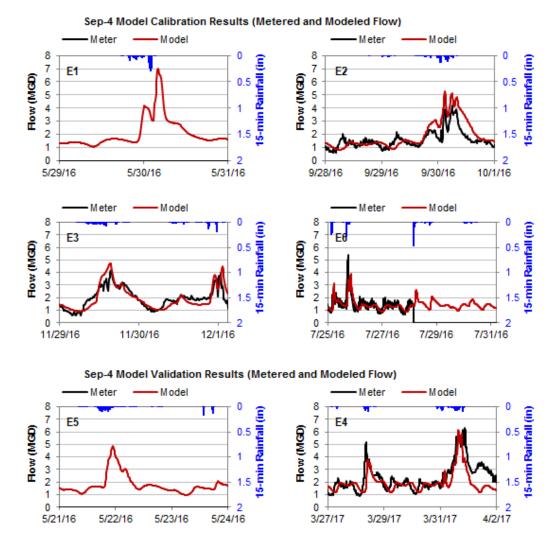
Appendix C

	Sep-3 Model Dry Weather Calibration and Validation Summary										
Event		Peak	(Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.48	0.49	-10% to +10%	1%	0.82	0.84	-10% to +10%	2%			
E2	0.61	0.49	-10% to +10%	-21%	0.87	0.84	-10% to +10%	-3%			
E3	0.50	0.45	-10% to +10%	-11%	0.81	0.77	-10% to +10%	-4%			
E4	0.58	0.53	-10% to +10%	-8%	0.93	0.93	-10% to +10%	1%			
E5	0.48	0.49	-10% to +10%	2%	0.82	0.85	-10% to +10%	4%			
E6	0.47	0.49	-10% to +10%	6%	0.79	0.86	-10% to +10%	9%			

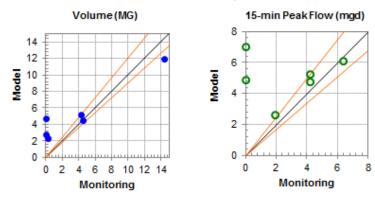
	Sep-3 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	1.99	2.41	-15% to +25%	21%	0.59	0.73	-10% to +20%	24%		
E2	1.40	1.56	-15% to +25%	11%	1.43	1.56	-10% to +20%	9%		
E3	1.26	1.19	-15% to +25%	-6%	1.40	1.24	-10% to +20%	-12%		
E4	2.55	1.47	-15% to +25%	-42%	3.39	3.26	-10% to +20%	-4%		
E5	1.64	1.25	-15% to +25%	-24%	1.27	1.29	-10% to +20%	2%		
E6	1.40	1.55	-15% to +25%	11%	0.72	0.83	-10% to +20%	15%		

**Note:** All the six wet weather events are calibrated well within or close to the industry criteria except peak flow for Event E4 because the flow meter data recorded for E4 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

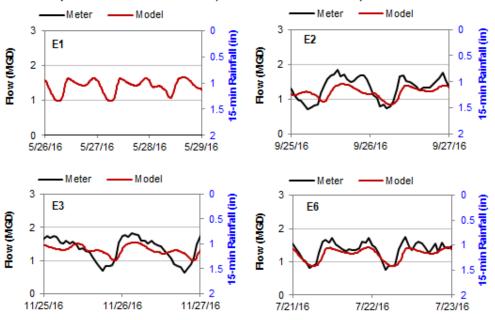
# FLOW METER SEP-4 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



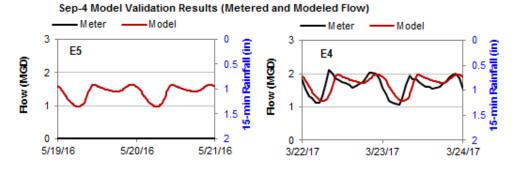
Sep-4 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



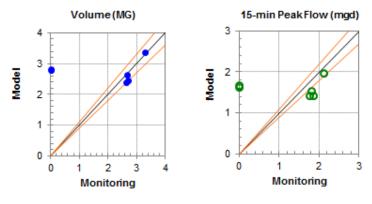
## FLOW METER SEP-4 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



Sep-4 Model Calibration Results (Metered and Modeled Flow)



Sep-4 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

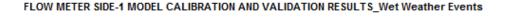
Appendix C

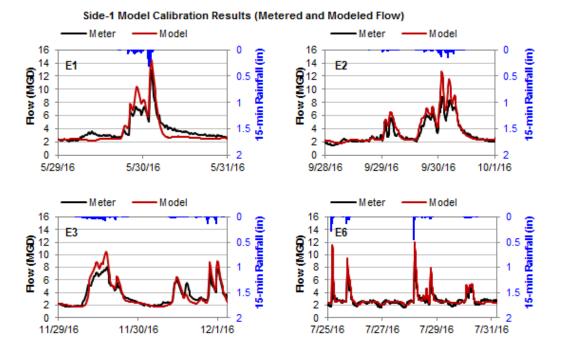
	Sep-4 Model Dry Weather Calibration and Validation Summary										
Event		Peak	(Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.00	1.67	-10% to +10%	See Note Below	0.00	2.82	-10% to +10%	See Note Below			
E2	1.84	1.43	-10% to +10%	-22%	2.65	2.40	-10% to +10%	-9%			
E3	1.82	1.55	-10% to +10%	-15%	2.66	2.62	-10% to +10%	-2%			
E4	2.12	1.98	-10% to +10%	-7%	3.29	3.38	-10% to +10%	3%			
E5	0.00	1.63	-10% to +10%	See Note Below	0.00	2.79	-10% to +10%	See Note Below			
E6	1.75	1.43	-10% to +10%	-19%	2.70	2.45	-10% to +10%	-9%			

	Sep-4	Mode	l Wet Weather	Calibratio	n and Valio	lation S	ummary	
Event		Pea	k Flow (MGD)			V	olume (MG)	
	Monitored Model Criteria Achieved Monitored Mode						Criteria	Achieved
E1	0.00	7.04	-15% to +25%	See Note Below!	0.00	2.77	-10% to +20%	See Note Below
E2	4.19	5.28	-15% to +25%	26%	4.27	5.24	-10% to +20%	23%
E3	4.17	4.77	-15% to +25%	14%	4.45	4.49	-10% to +20%	1%
E4	6.33	6.13	-15% to +25%	-3%	14.38	11.95	-10% to +20%	-17%
E5	0.00	4.91	-15% to +25%	See Note Below	0.00	4.68	-10% to +20%	See Note Below
E6	1.88	2.62	-15% to +25%	See Note Below	0.27	2.32	-10% to +20%	See Note Below

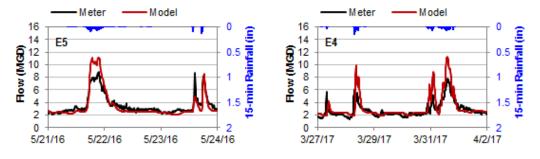
**Note:** Flow meter was included after the first quarter of flow monitoring; therefore no data was available for Events E1 and E5. Also, meter data was not available for part of E6.

Three of the four available wet weather events are calibrated well within the industry criteria. Flow meter data recorded for E6 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

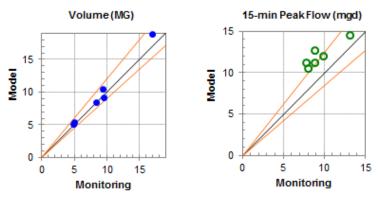




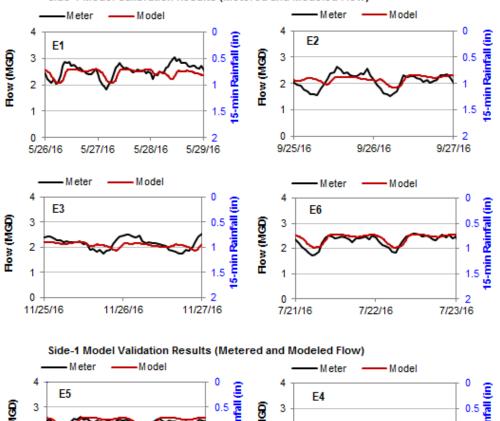
Side-1 Model Validation Results (Metered and Modeled Flow)



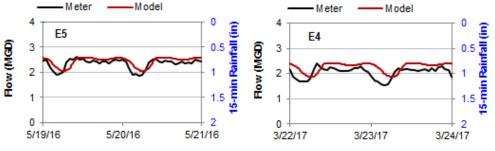
Side-1 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



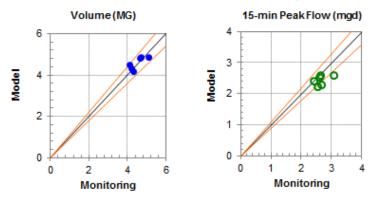
## FLOW METER SIDE-1 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



Side-1 Model Calibration Results (Metered and Modeled Flow)



Side-1 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

Appendix C

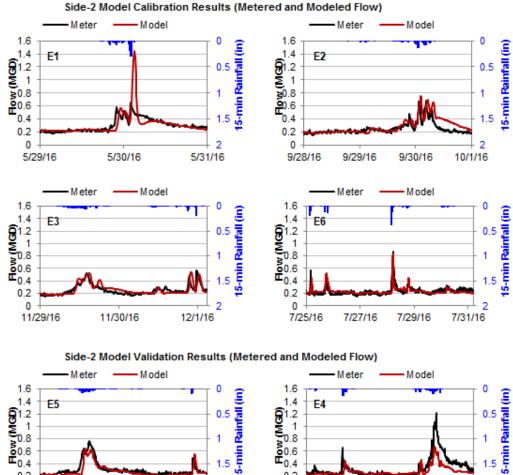
	Side-1 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	3.05	2.59	-10% to +10%	-15%	5.11	4.87	-10% to +10%	-5%			
E2	2.66	2.31	-10% to +10%	-13%	4.20	4.33	-10% to +10%	3%			
E3	2.53	2.22	-10% to +10%	-12%	4.31	4.18	-10% to +10%	-3%			
E4	2.42	2.41	-10% to +10%	0%	4.09	4.52	-10% to +10%	11%			
E5	2.62	2.59	-10% to +10%	-1%	4.69	4.88	-10% to +10%	4%			
E6	2.61	2.55	-10% to +10%	-2%	4.62	4.81	-10% to +10%	4%			

	Side-1 Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	13.05	14.57	-15% to +25%	12%	4.90	5.07	-10% to +20%	3%			
E2	8.85	12.75	-15% to +25%	44%	9.30	10.43	-10% to +20%	12%			
E3	8.03	10.54	-15% to +25%	31%	8.35	8.49	-10% to +20%	2%			
E4	7.73	11.25	-15% to +25%	45%	16.90	18.97	-10% to +20%	12%			
E5	8.84	11.19	-15% to +25%	27%	9.43	9.22	-10% to +20%	-2%			
E6	9.88	12.03	-15% to +25%	22%	5.02	5.43	-10% to +20%	8%			

**Note:** All the six wet weather events are calibrated well within or close to the industry criteria except peak flows for Event E2 and E4 because the flow meter data recorded for the events is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

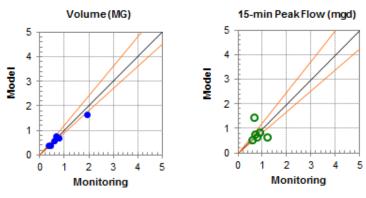


# FLOW METER SIDE-2 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



1.4 (0)1.2 1 0.8 0.6 0.4 5-min Rainfall 1.5 1 0.2 0 2 2 4/2/17 5/21/16 5/22/16 5/23/16 5/24/16 3/27/17 3/29/17 3/31/17

Side-2 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



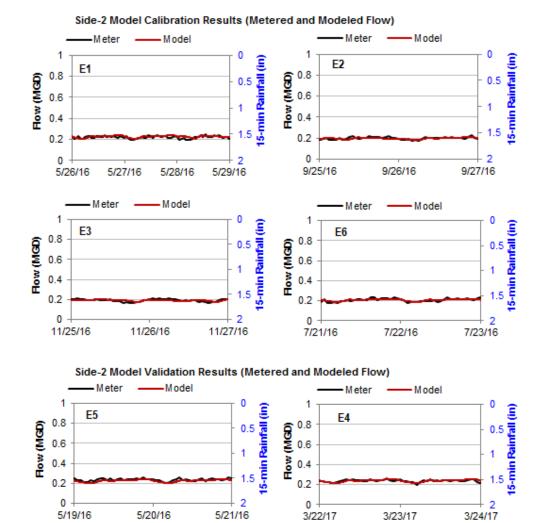
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0.2

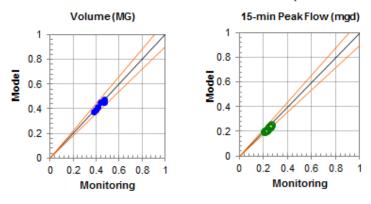
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.5

#### FLOW METER SIDE-2 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



Side-2 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

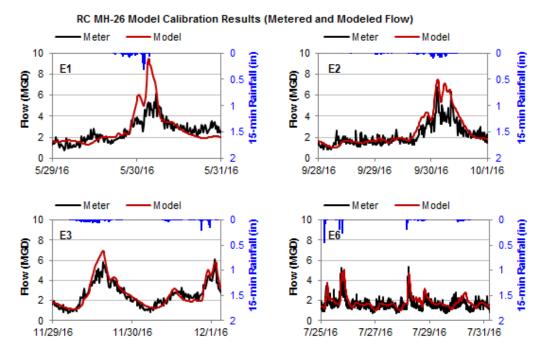
Appendix C

	Side-2 Model Dry Weather Calibration and Validation Summary										
Event		Peak	(Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.25	0.24	-10% to +10%	-4%	0.44	0.45	-10% to +10%	2%			
E2	0.23	0.21	-10% to +10%	-8%	0.40	0.39	-10% to +10%	-1%			
E3	0.21	0.20	-10% to +10%	-4%	0.38	0.38	-10% to +10%	0%			
E4	0.26	0.25	-10% to +10%	-5%	0.47	0.47	-10% to +10%	0%			
E5	0.26	0.24	-10% to +10%	-7%	0.47	0.45	-10% to +10%	-5%			
E6	0.23	0.22	-10% to +10%	-7%	0.41	0.41	-10% to +10%	-1%			

	Side-2 Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	0.65	1.44	-15% to +25%	120%	0.36	0.38	-10% to +20%	5%			
E2	0.68	0.75	-15% to +25%	10%	0.67	0.76	-10% to +20%	15%			
E3	0.56	0.54	-15% to +25%	-3%	0.58	0.59	-10% to +20%	2%			
E4	1.21	0.67	-15% to +25%	-45%	1.94	1.66	-10% to +20%	-14%			
E5	0.76	0.65	-15% to +25%	-14%	0.78	0.71	-10% to +20%	-8%			
E6	0.87	0.85	-15% to +25%	-3%	0.42	0.41	-10% to +20%	-4%			

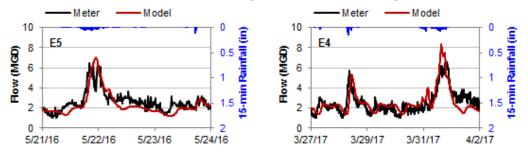
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. Flow meter data recorded for some of the events (E1 and E4) is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



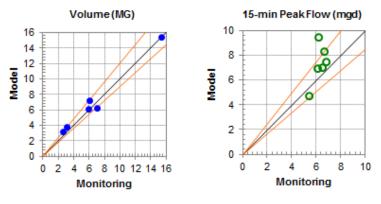


#### FLOW METER RC MH-26 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



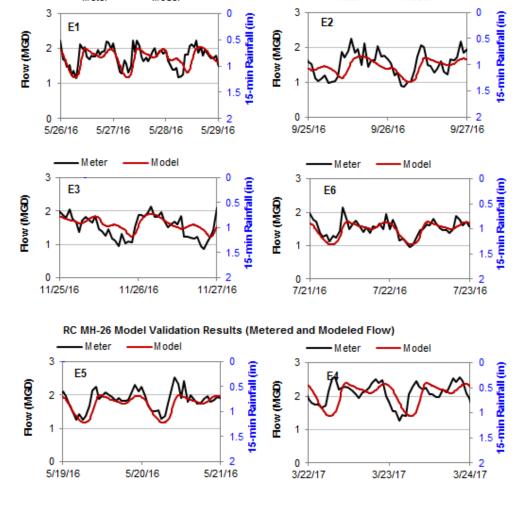




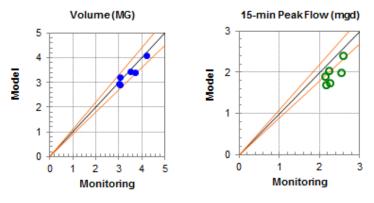


# RC MH-26 Model Calibration Results (Metered and Modeled Flow) Meter Model Model Model

FLOW METER RC MH-26 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



RC MH-26 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

Appendix C

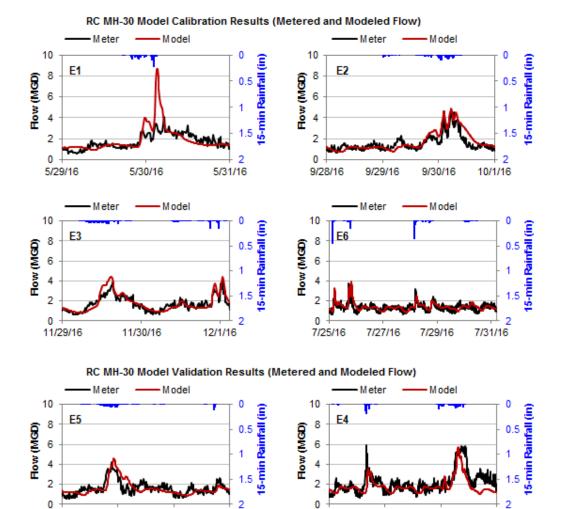
I	RC MH-26 Model Dry Weather Calibration and Validation Summary								
Event		Peak	Flow (MGD)			Vo	olume (MG)		
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved	
E1	2.23	2.04	-10% to +10%	-8%	3.49	3.44	-10% to +10%	-1%	
E2	2.25	1.74	-10% to +10%	-23%	3.04	2.90	-10% to +10%	-5%	
E3	2.14	1.91	-10% to +10%	-11%	3.04	3.21	-10% to +10%	6%	
E4	2.58	2.40	-10% to +10%	-7%	4.20	4.09	-10% to +10%	-3%	
E5	2.53	2.00	-10% to +10%	-21%	3.70	3.41	-10% to +10%	-8%	
E6	2.15	1.71	-10% to +10%	-21%	3.02	2.94	-10% to +10%	-3%	

I	RC MH-26 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	6.14	9.50	-15% to +25%	55%	3.08	3.89	-10% to +20%	26%		
E2	6.76	7.46	-15% to +25%	10%	5.99	7.22	-10% to +20%	21%		
E3	6.07	6.93	-15% to +25%	14%	5.85	6.18	-10% to +20%	6%		
E4	6.64	8.33	-15% to +25%	25%	15.34	15.43	-10% to +20%	1%		
E5	6.48	7.02	-15% to +25%	8%	7.01	6.25	-10% to +20%	-11%		
E6	5.39	4.72	-15% to +25%	-12%	2.64	3.24	-10% to +20%	23%		

**Note:** All the six wet weather events are calibrated well within the industry criteria except Event E1. Flow meter data recorded for E1 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

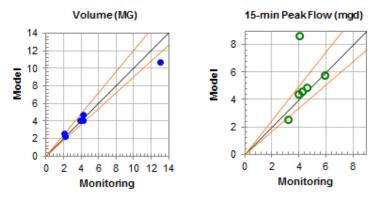


## FLOW METER RC MH-30 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



RC MH-30 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

5/24/16



3/27/17

3/29/17

3/31/17

4/2/17

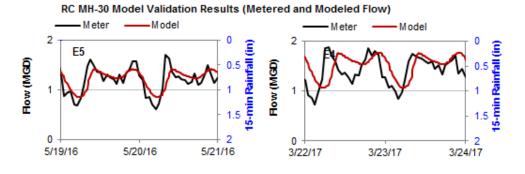
5/21/16

5/22/16

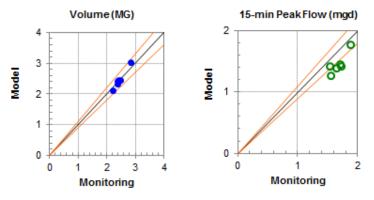
5/23/16

#### RC MH-30 Model Calibration Results (Metered and Modeled Flow) Meter Model Meter Model 2 2 0 15-min Rainfall (in) 3 E2 5-min Rainfall How (MGD) How (MGD) 0.5 1 1.5 1.5 0 2 0 2 9/25/16 9/27/16 5/29/16 9/26/16 5/26/16 5/27/16 5/28/16 Meter Model Model Meter 2 2 0 (5-min Rainfall (in) 5-min Rainfall (in) E3 E6 How (MGD) How (MGD) 0.5 1 1 1 1.5 0 2 0 2 11/25/16 11/26/16 11/27/16 7/21/16 7/22/16 7/23/16

FLOW METER RC MH-30 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



RC MH-30 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

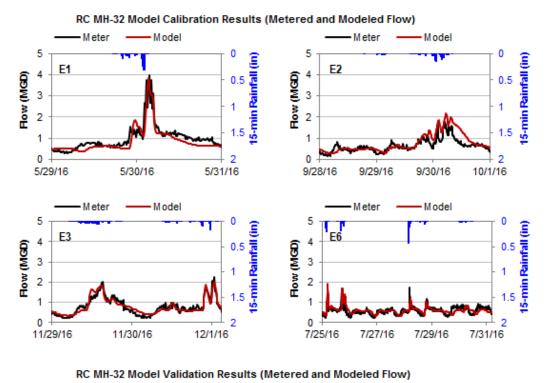
Appendix C

I	RC MH-30 Model Dry Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	1.71	1.46	-10% to +10%	-15%	2.41	2.44	-10% to +10%	2%		
E2	1.54	1.28	-10% to +10%	-17%	2.23	2.13	-10% to +10%	-4%		
E3	1.65	1.39	-10% to +10%	-16%	2.38	2.34	-10% to +10%	-2%		
E4	1.88	1.77	-10% to +10%	-6%	2.84	3.03	-10% to +10%	7%		
E5	1.71	1.42	-10% to +10%	-17%	2.38	2.43	-10% to +10%	2%		
E6	1.53	1.43	-10% to +10%	-7%	2.48	2.45	-10% to +10%	-1%		

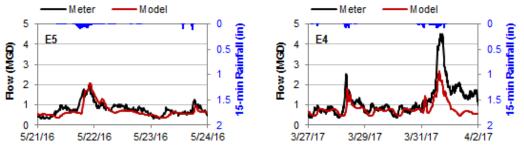
I	RC MH-30 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	4.04	8.67	-15% to +25%	114%	2.11	2.59	-10% to +20%	23%		
E2	4.57	4.88	-15% to +25%	7%	4.17	4.73	-10% to +20%	13%		
E3	3.97	4.44	-15% to +25%	12%	3.91	4.05	-10% to +20%	4%		
E4	5.94	5.77	-15% to +25%	-3%	13.02	10.72	-10% to +20%	-18%		
E5	4.24	4.63	-15% to +25%	9%	4.24	4.13	-10% to +20%	-3%		
E6	3.23	2.55	-15% to +25%	-21%	2.15	2.27	-10% to +20%	6%		

**Note:** All the six wet weather events are calibrated well within or close to the industry criteria except peak flow for Event E1. Flow meter data recorded for E1 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

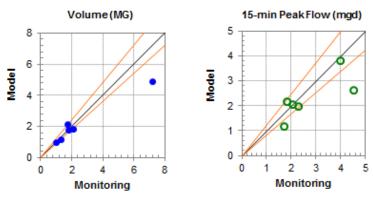




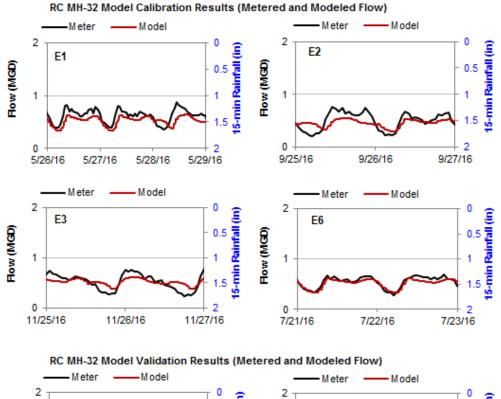
FLOW METER RC MH-32 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



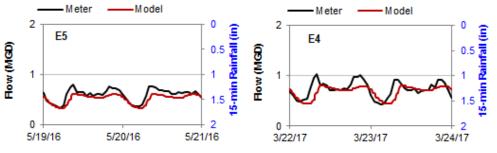
RC MH-32 Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



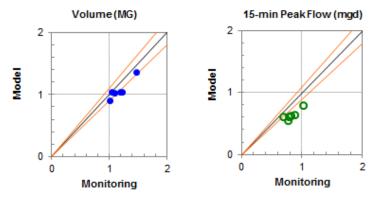
Appendix C



#### FLOW METER RC MH-32 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events







DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

Appendix C

I	RC MH-32 Model Dry Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored Model Criteria Achieved				Monitored	Model	Criteria	Achieved		
E1	0.88	0.64	-10% to +10%	-28%	1.22	1.05	-10% to +10%	-14%		
E2	0.76	0.55	-10% to +10%	-28%	1.00	0.91	-10% to +10%	-9%		
E3	0.77	0.62	-10% to +10%	-20%	1.04	1.04	-10% to +10%	0%		
E4	1.02	0.80	-10% to +10%	-22%	1.47	1.36	-10% to +10%	-8%		
E5	0.81	0.62	-10% to +10%	-23%	1.19	1.04	-10% to +10%	-13%		
E6	0.69	0.61	-10% to +10%	-11%	1.09	1.03	-10% to +10%	-5%		

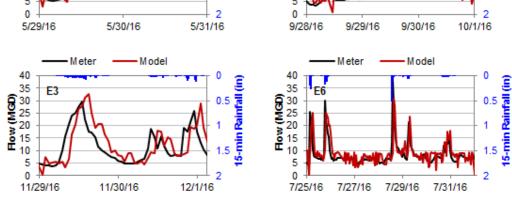
	RC MH-32 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	3.98	3.83	-15% to +25%	-4%	1.27	1.19	-10% to +20%	-7%		
E2	1.80	2.20	-15% to +25%	22%	1.75	2.13	-10% to +20%	22%		
E3	2.27	1.99	-15% to +25%	-12%	1.78	1.79	-10% to +20%	0%		
E4	4.52	2.65	-15% to +25%	-41%	7.18	4.89	-10% to +20%	-32%		
E5	2.04	2.08	-15% to +25%	2%	2.07	1.85	-10% to +20%	-11%		
E6	1.72	1.19	-15% to +25%	-30%	0.98	0.98	-10% to +20%	0%		

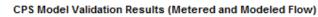
**Note:** All the six wet weather events are calibrated well within or close to the industry criteria except Event E4. Flow meter data recorded for E4 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.

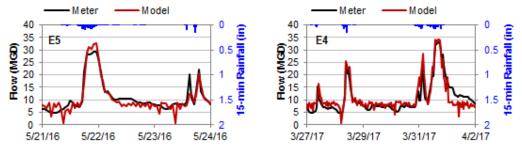


#### CPS Model Calibration Results (Metered and Modeled Flow) Meter Model Meter Model 40 0 40 0 5-min Rainfall (in) 5-min Rainfall (in) 35 35 E1 E2 (00) 25 20 20 15 (00) 25 20 20 15 0.5 0.5 1 1 10 10 1.5 1 5 5 5 0 2 0 2 5/29/16 5/30/16 5/31/16 9/28/16 9/29/16 9/30/16 10/1/16 Meter Model Meter Model 40 35 40 0 0 min Rainfall (in) 35 (00) 25 20 15 10 E3 E6 (00) 25 20 20 15 10 0.5 0.5 1 10 10 5

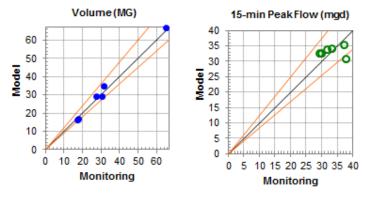
FLOW METER CPS MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events







CPS Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



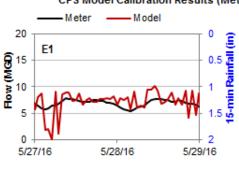


Model

0

2 7/23/16

## FLOW METER CPS MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



11/26/16

Model

Meter

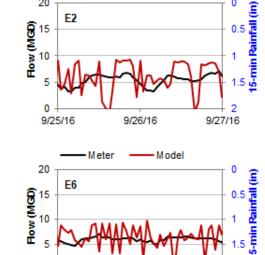
20

5

0

11/25/16

E3



7/22/16

CPS Model Calibration Results (Metered and Modeled Flow) Meter

0 (u) 1.5 U

0

2

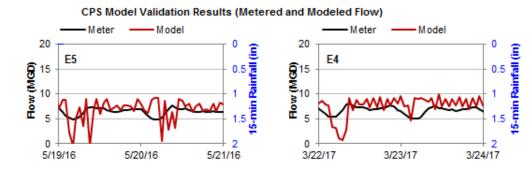
11/27/16

20

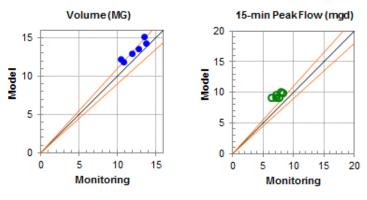
0

7/21/16

E2



CPS Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



DELCORA CSO Long Term Control Plan Update

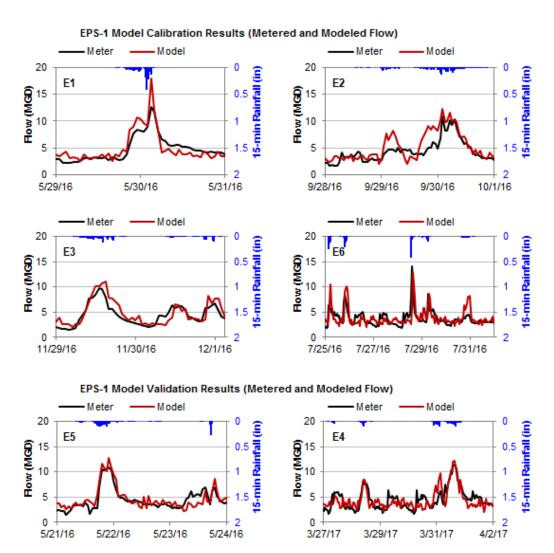
# Sewer System H&H Model Report

Appendix C

	CPS Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	7.93	10.12	-10% to +10%	28%	13.69	14.37	-10% to +10%	5%			
E2	7.16	9.19	-10% to +10%	28%	10.80	11.93	-10% to +10%	10%			
E3	6.41	9.17	-10% to +10%	43%	10.42	12.30	-10% to +10%	18%			
E4	8.12	9.96	-10% to +10%	23%	13.45	15.24	-10% to +10%	13%			
E5	7.62	9.23	-10% to +10%	21%	12.79	13.56	-10% to +10%	6%			
E6	7.11	9.69	-10% to +10%	36%	11.93	12.99	-10% to +10%	9%			

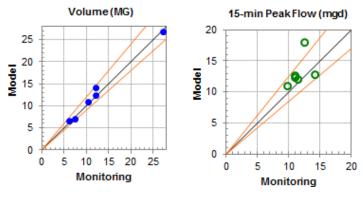
	CPS Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vc	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	31.54	33.89	-15% to +25%	7%	17.67	17.16	-10% to +20%	-3%			
E2	37.19	35.56	-15% to +25%	-4%	31.53	35.06	-10% to +20%	11%			
E3	29.85	32.57	-15% to +25%	9%	27.12	29.09	-10% to +20%	7%			
E4	33.24	34.24	-15% to +25%	3%	64.77	66.78	-10% to +20%	3%			
E5	29.39	32.86	-15% to +25%	12%	30.35	29.10	-10% to +20%	-4%			
E6	37.62	30.86	-15% to +25%	-18%	16.98	16.47	-10% to +20%	-3%			

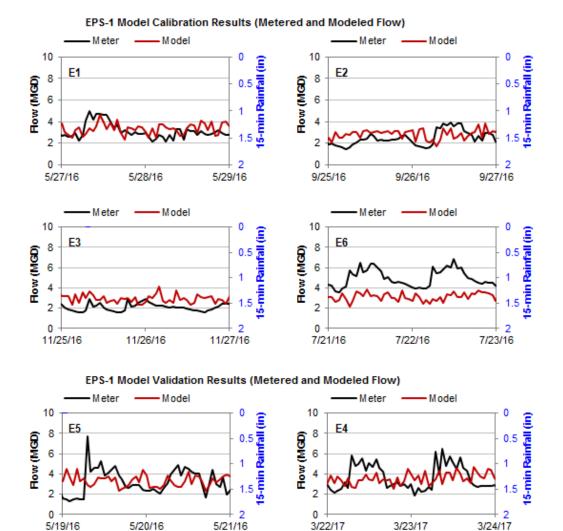
Note: All the six wet weather events are calibrated well within the industry criteria.



#### FLOW METER EPS-1 MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

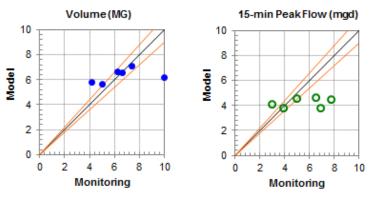






#### FLOW METER EPS-1 MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events





DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

Appendix C

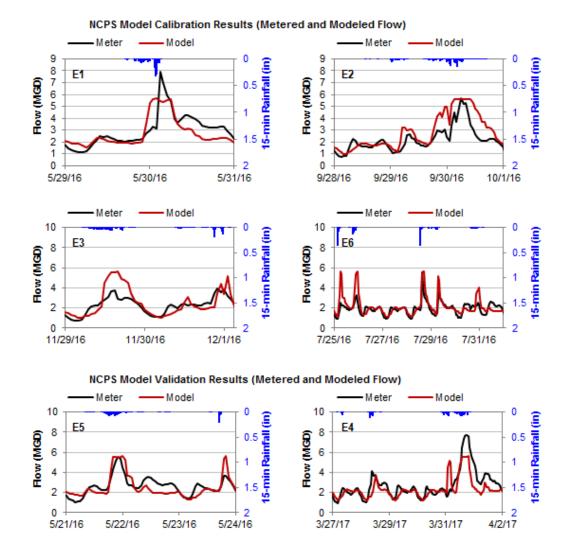
	EPS-1 Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vc	olume (MG)				
	Monitored	Model	Criteria	Monitored	Model	Criteria	Achieved				
E1	4.95	4.61	-10% to +10%	-7%	6.25	6.65	-10% to +10%	7%			
E2	3.88	3.81	-10% to +10%	-2%	4.96	5.69	-10% to +10%	15%			
E3	2.90	4.11	-10% to +10%	42%	4.15	5.83	-10% to +10%	40%			
E4	6.51	4.67	-10% to +10%	-28%	7.34	7.14	-10% to +10%	-3%			
E5	7.72	4.50	-10% to +10%	-42%	6.57	6.62	-10% to +10%	1%			
E6	6.83	3.86	-10% to +10%	-43%	9.97	6.23	-10% to +10%	-38%			

	EPS-1 Model Wet Weather Calibration and Validation Summary									
Event		Peak	Flow (MGD)			Vo	olume (MG)			
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved		
E1	12.57	18.03	-15% to +25%	43%	6.19	6.60	-10% to +20%	6%		
E2	10.94	12.32	-15% to +25%	13%	11.99	14.22	-10% to +20%	19%		
E3	9.79	11.08	-15% to +25%	13%	10.30	10.88	-10% to +20%	6%		
E4	11.50	12.12	-15% to +25%	5%	27.24	26.82	-10% to +20%	-2%		
E5	10.92	12.74	-15% to +25%	17%	12.06	12.37	-10% to +20%	3%		
E6	14.11	12.83	-15% to +25%	-9%	7.32	7.02	-10% to +20%	-4%		

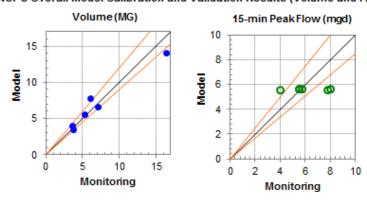
**Note:** All the six wet weather events are calibrated well within the industry criteria except peak flow for Event E1. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



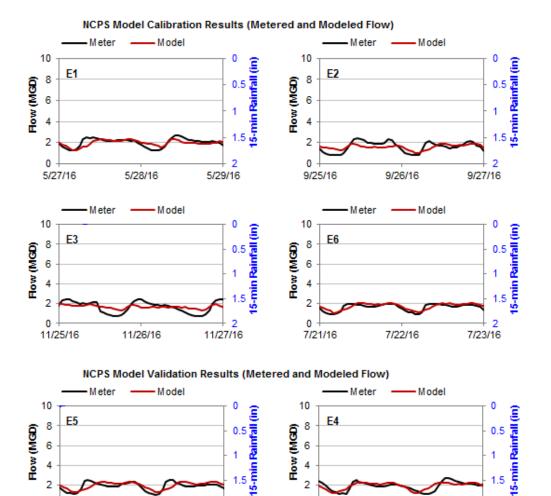
#### FLOW METER NCPS MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



NCPS Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)



#### FLOW METER NCPS MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events

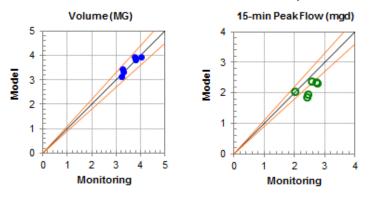


NCPS Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

0

3/22/17

3/23/17



2

5/21/16

0

5/19/16

5/20/16

2

3/24/17

DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

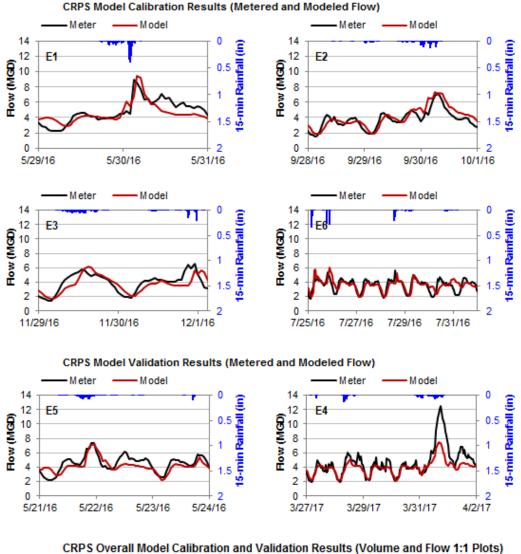
Appendix C

	NCPS Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vc	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	2.72	2.36	-10% to +10%	-13%	4.02	3.93	-10% to +10%	-2%			
E2	2.41	1.86	-10% to +10%	-23%	3.22	3.14	-10% to +10%	-2%			
E3	2.45	1.94	-10% to +10%	-21%	3.31	3.33	-10% to +10%	1%			
E4	2.74	2.31	-10% to +10%	-16%	3.78	3.84	-10% to +10%	2%			
E5	2.55	2.38	-10% to +10%	-7%	3.77	3.95	-10% to +10%	5%			
E6	1.99	2.05	-10% to +10%	3%	3.25	3.44	-10% to +10%	6%			

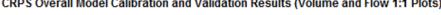
	NCPS Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vo	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	7.95	5.65	-15% to +25%	-29%	3.67	3.51	-10% to +20%	-4%			
E2	5.71	5.63	-15% to +25%	-1%	6.02	7.83	-10% to +20%	30%			
E3	3.95	5.62	-15% to +25%	42%	5.29	5.61	-10% to +20%	6%			
E4	7.75	5.61	-15% to +25%	-28%	16.38	14.07	-10% to +20%	-14%			
E5	5.51	5.66	-15% to +25%	3%	7.07	6.64	-10% to +20%	-6%			
E6	5.51	5.67	-15% to +25%	3%	3.53	4.03	-10% to +20%	14%			

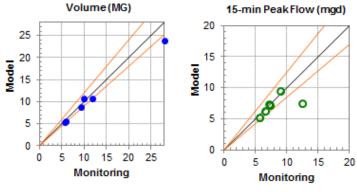
**Note:** Four of the six wet weather events are calibrated well within the industry criteria. The underpredicted peak flow for E1 and E4 is probably due to the pump capacity limit put in the model based on received pump curves. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



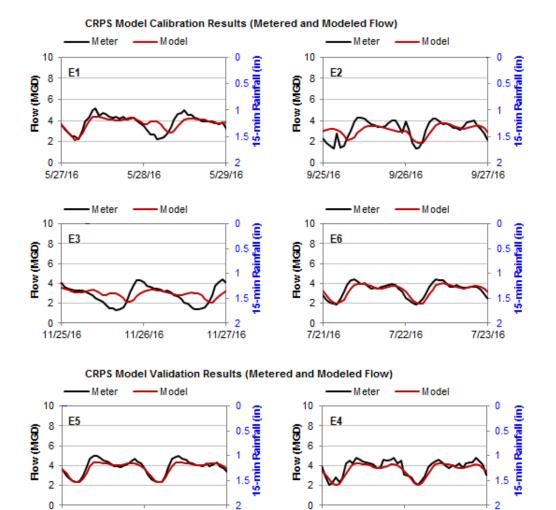


#### FLOW METER CRPS MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



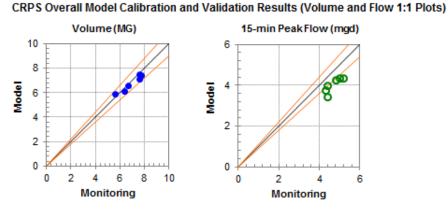


#### FLOW METER CRPS MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



3/22/17

3/23/17



5/21/16

5/19/16

5/20/16

3/24/17

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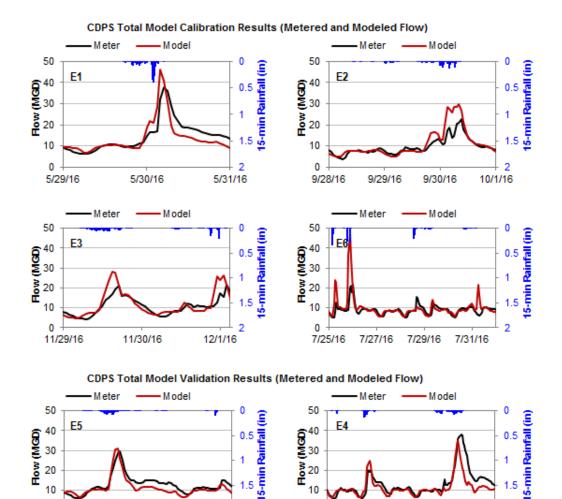
# Sewer System H&H Model Report

Appendix C

	CRPS Model Dry Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vc	olume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved			
E1	5.18	4.36	-10% to +10%	-16%	7.58	7.49	-10% to +10%	-1%			
E2	4.30	3.75	-10% to +10%	-13%	6.36	6.13	-10% to +10%	-4%			
E3	4.38	3.44	-10% to +10%	-21%	5.64	5.87	-10% to +10%	4%			
E4	4.81	4.26	-10% to +10%	-12%	7.59	7.10	-10% to +10%	-6%			
E5	4.97	4.36	-10% to +10%	-12%	7.71	7.45	-10% to +10%	-3%			
E6	4.42	3.99	-10% to +10%	-10%	6.71	6.56	-10% to +10%	-2%			

	CRPS Model Wet Weather Calibration and Validation Summary										
Event		Peak	Flow (MGD)			Vc	olume (MG)				
	Monitored	Model	Criteria	Achieved							
E1	8.96	9.48	-15% to +25%	6%	5.67	5.45	-10% to +20%	-4%			
E2	7.22	7.29	-15% to +25%	1%	10.03	10.80	-10% to +20%	8%			
E3	6.54	6.21	-15% to +25%	-5%	9.27	8.75	-10% to +20%	-6%			
E4	12.48	7.48	-15% to +25%	-40%	27.92	23.89	-10% to +20%	-14%			
E5	7.40	7.17	-15% to +25%	-3%	11.95	10.82	-10% to +20%	-9%			
E6	5.64	5.18	-15% to +25%	-8%	5.84	5.64	-10% to +20%	-3%			

**Note:** All the six wet weather events are calibrated well within the industry criteria except peak flow for Event E4. Flow meter data recorded for E4 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



## FLOW METER CDPS TOTAL MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

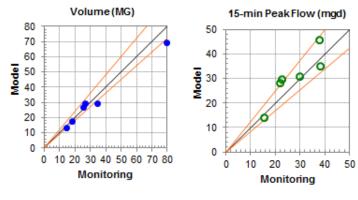
CDPS Total Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

0

3/27/17

3/29/17

3/31/17



2

5/24/16

5/23/16

0

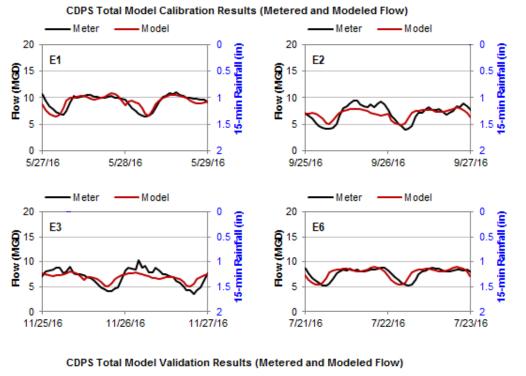
5/21/16

5/22/16

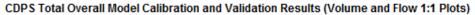
2

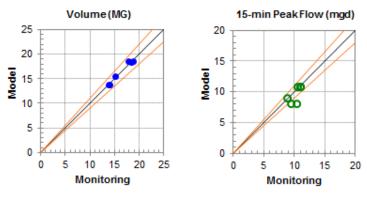
4/2/17

#### FLOW METER CDPS TOTAL MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



Meter - Model Meter Model 20 0 (ii) 1.5 - 00 1.5 -0 20 0 5-min Rainfall (in) E5 E4 (00) 10 10 5 (015 MOW) 10 5 0.5 5 5 1.5 0 2 0 2 5/19/16 5/20/16 5/21/16 3/22/17 3/23/17 3/24/17





DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

Appendix C

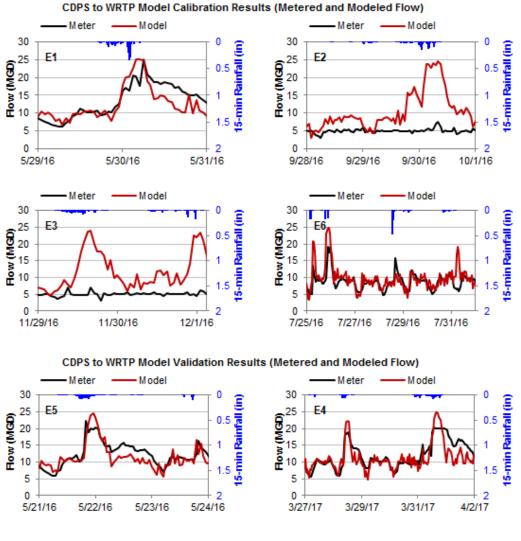
C	DPS Total	Mode	l Dry Weather	Calibratio	n and Vali	dation S	Summary	
Event		Peak	Flow (MGD)			Vo	olume (MG)	
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	10.96	10.82	-10% to +10%	-1%	18.43	18.45	-10% to +10%	0%
E2	9.44	8.14	-10% to +10%	-14%	14.04	13.87	-10% to +10%	-1%
E3	10.39	8.04	-10% to +10%	-23%	13.84	13.76	-10% to +10%	-1%
E4	10.97	10.82	-10% to +10%	-1%	18.70	18.50	-10% to +10%	-1%
E5	10.52	10.82	-10% to +10%	3%	17.77	18.50	-10% to +10%	4%
E6	8.81	9.06	-10% to +10%	3%	15.18	15.50	-10% to +10%	2%

С	CDPS Total Model Wet Weather Calibration and Validation Summary								
Event		Peak	Flow (MGD)			Vo	lume (MG)		
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved	
E1	37.59	46.03	-15% to +25%	22%	18.12	17.80	-10% to +20%	-2%	
E2	22.62	29.77	-15% to +25%	32%	26.28	29.53	-10% to +20%	12%	
E3	21.62	28.12	-15% to +25%	30%	25.07	27.13	-10% to +20%	8%	
E4	38.01	35.13	-15% to +25%	-8%	79.48	69.36	-10% to +20%	-13%	
E5	29.79	31.11	-15% to +25%	4%	34.43	29.65	-10% to +20%	-14%	
E6	15.30	14.01	-15% to +25%	-8%	14.43	13.30	-10% to +20%	-8%	

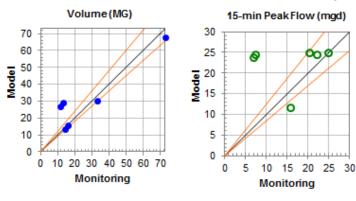
Note: All the six wet weather events are calibrated well within or close to the industry criteria.



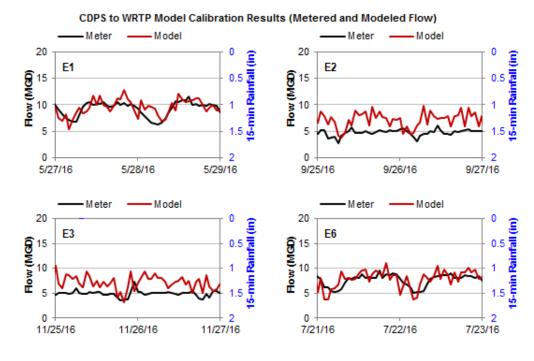
# FLOW METER CDPS TO WRTP MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



CDPS to WRTP Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

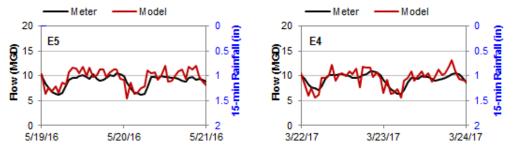




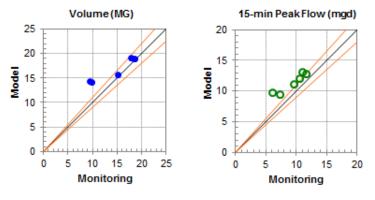


## FLOW METER CDPS TO WRTP MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events

CDPS to WRTP Model Validation Results (Metered and Modeled Flow)







DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

Appendix C

CDPS to WRTP Model Dry Weather Calibration and Validation Summary								
Event		Flow (MGD)		Volume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	11.51	12.85	-10% to +10%	12%	18.39	19.01	-10% to +10%	3%
E2	6.00	9.79	-10% to +10%	63%	9.45	14.29	-10% to +10%	51%
E3	7.22	9.46	-10% to +10%	31%	9.83	14.19	-10% to +10%	44%
E4	10.89	13.14	-10% to +10%	21%	18.50	18.96	-10% to +10%	2%
E5	10.44	12.10	-10% to +10%	16%	17.76	19.21	-10% to +10%	8%
E6	9.56	11.13	-10% to +10%	16%	15.20	15.76	-10% to +10%	4%

CDPS to WRTP Model Wet Weather Calibration and Validation Summary								
Event		Flow (MGD)		Volume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	24.93	24.93	-15% to +25%	0%	15.92	15.55	-10% to +20%	-2%
E2	7.41	24.61	-15% to +25%	232%	12.92	29.02	-10% to +20%	125%
E3	6.95	23.88	-15% to +25%	243%	11.69	26.99	-10% to +20%	131%
E4	20.25	24.89	-15% to +25%	23%	72.78	68.00	-10% to +20%	-7%
E5	22.24	24.53	-15% to +25%	10%	33.04	30.02	-10% to +20%	-9%
E6	15.80	11.79	-15% to +25%	-25%	14.31	13.26	-10% to +20%	-7%

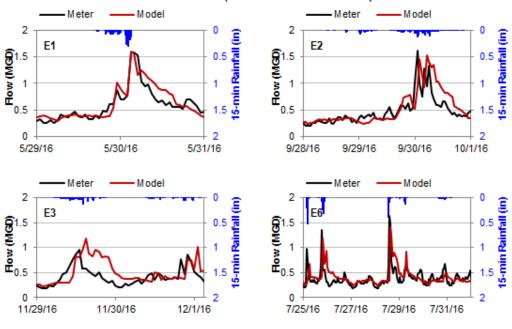
**Note:** During Rainfall Events E2 and E3, CDPS flow to the WRTP was capped due to the aeration replacement project at WRTP.

All the remaining four wet weather events are calibrated well within the industry criteria.

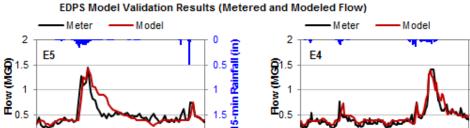


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#### FLOW METER EDPS MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events



EDPS Model Calibration Results (Metered and Modeled Flow)



2

5/24/16

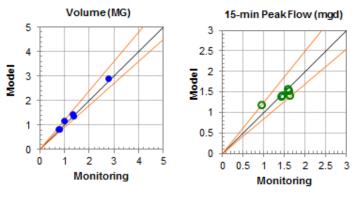
EDPS Overall Model Calibration and Validation Results (Volume and Flow 1:1 Plots)

0

3/27/17

3/29/17

3/31/17



0

5/21/16

5/22/16

5/23/16

0

0.5

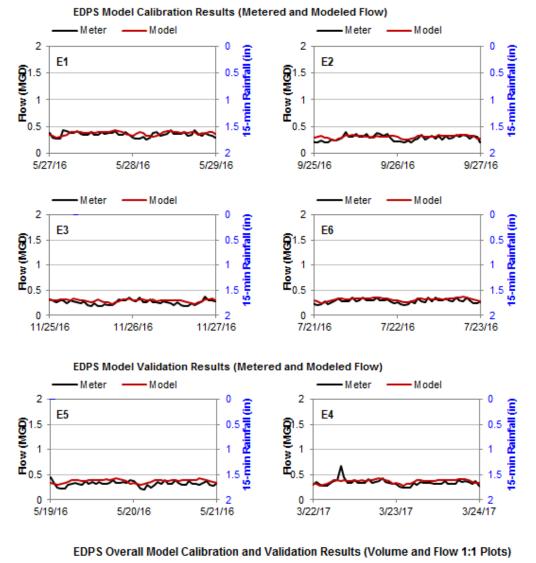
15

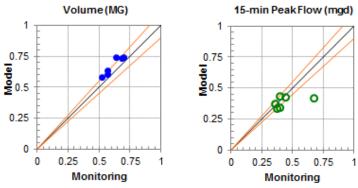
2

4/2/17

5-min Rainfall (in)

# FLOW METER EDPS MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events





DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

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	EDPS Model Dry Weather Calibration and Validation Summary											
Event	Peak Flow (MGD)					Vc	olume (MG)					
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.44	0.43	-10% to +10%	-2%	0.70	0.74	-10% to +10%	6%				
E2	0.39	0.35	-10% to +10%	-12%	0.57	0.61	-10% to +10%	7%				
E3	0.37	0.34	-10% to +10%	-8%	0.52	0.58	-10% to +10%	12%				
E4	0.67	0.42	-10% to +10%	-37%	0.68	0.74	-10% to +10%	8%				
E5	0.40	0.43	-10% to +10%	10%	0.64	0.74	-10% to +10%	17%				
E6	0.36	0.37	-10% to +10%	5%	0.57	0.64	-10% to +10%	12%				

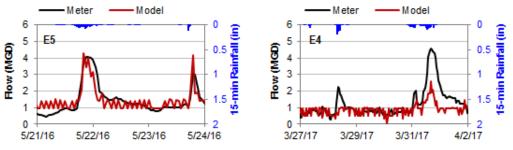
	EDPS Model Wet Weather Calibration and Validation Summary											
Event		Peak F	low (MGD)	Volume (MG)								
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	1.59	1.59	-15% to +25%	0%	0.77	0.83	-10% to +20%	8%				
E2	1.61	1.53	-15% to +25%	-5%	1.32	1.44	-10% to +20%	9%				
E3	0.95	1.19	-15% to +25%	25%	0.98	1.20	-10% to +20%	23%				
E4	1.41	1.40	-15% to +25%	-1%	2.76	2.92	-10% to +20%	6%				
E5	1.44	1.42	-15% to +25%	-2%	1.35	1.39	-10% to +20%	3%				
E6	1.63	1.42	-15% to +25%	-13%	0.77	0.85	-10% to +20%	11%				

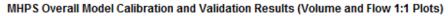
Note: All the six wet weather events are calibrated well within or close to the industry criteria.

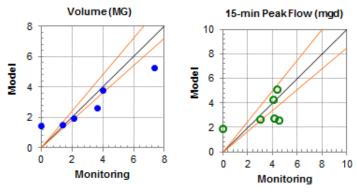


#### MHPS Model Calibration Results (Metered and Modeled Flow) Model Meter Meter Model 6 6 0 0 17 5-min Rainfall (in) 5-min Rainfall (in) E1 5 F2 5 How (MGD) How (MGD) 0.5 0.5 4 4 3 3 1 1 2 2 1 1 .5 1 1 0 0 2 2 5/29/16 5/30/16 5/31/16 9/28/16 9/29/16 9/30/16 10/1/16 Meter Model Meter Model 0 (u) 1.5 **1** 1.5 **1** 6 6 0 0 П 5-min Rainfall (in) 5 E3 5 E6 How (MGD) How (MGD) 0.5 4 4 3 3 1 2 2 1.5 1 1 Π" 2 0 2 0 11/29/16 11/30/16 12/1/16 7/25/16 7/27/16 7/29/16 7/31/16 MHPS Model Validation Results (Metered and Modeled Flow)

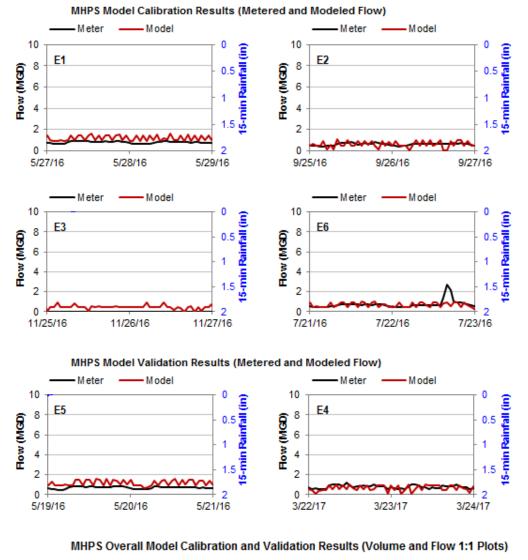
#### FLOW METER MHPS MODEL CALIBRATION AND VALIDATION RESULTS\_Wet Weather Events

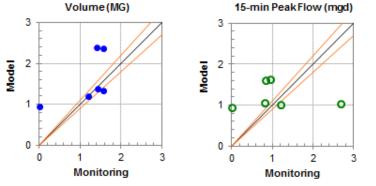






# FLOW METER MHPS MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events





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# Sewer System H&H Model Report

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	MHPS Model Dry Weather Calibration and Validation Summary											
Event		Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	0.94	1.63	-10% to +10%	73%	1.58	2.36	-10% to +10%	50%				
E2	0.81	1.06	-10% to +10%	32%	1.20	1.20	-10% to +10%	1%				
E3	0.00	0.95	-10% to +10%	See Note Below	0.00	0.93	-10% to +10%	See Note Below				
E4	1.20	1.02	-10% to +10%	-15%	1.58	1.33	-10% to +10%	-16%				
E5	0.83	1.60	-10% to +10%	93%	1.40	2.38	-10% to +10%	70%				
E6	2.68	1.04	-10% to +10%	-61%	1.43	1.38	-10% to +10%	-4%				

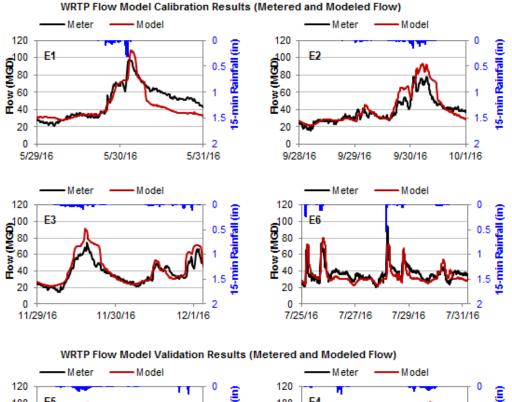
	MHPS Model Wet Weather Calibration and Validation Summary											
Event		Flow (MGD)			Vo	olume (MG)						
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved				
E1	4.39	5.09	-15% to +25%	16%	2.11	1.95	-10% to +20%	-8%				
E2	4.12	2.73	-15% to +25%	-34%	3.62	2.65	-10% to +20%	-27%				
E3	0.00	1.91	-15% to +25%	See Note Below	0.00	1.46	-10% to +20%	See Note Below				
E4	4.54	2.61	-15% to +25%	-43%	7.36	5.28	-10% to +20%	-28%				
E5	4.05	4.27	-15% to +25%	5%	4.00	3.81	-10% to +20%	-5%				
E6	2.99	2.70	-15% to +25%	-10%	1.39	1.50	-10% to +20%	8%				

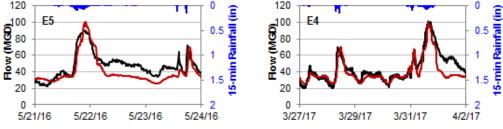
**Note:** Flow meter data not available for Event E3. Three of the remaining five wet weather events are calibrated well within the industry criteria. Flow meter data recorded for E2 and E4 is not consistent with the recorded rainfall intensity. Based on the calibration results of the overall model, the model calibration is adequate for purposes of long term control planning.



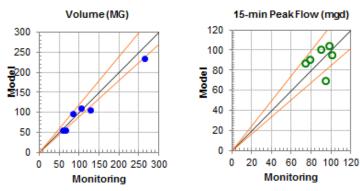
Appendix C



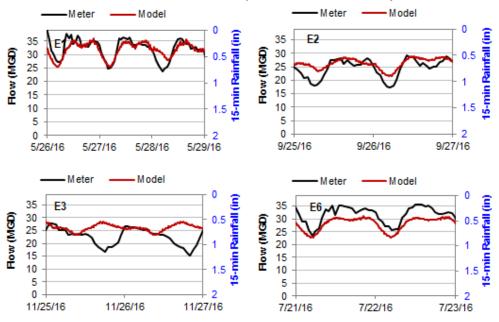




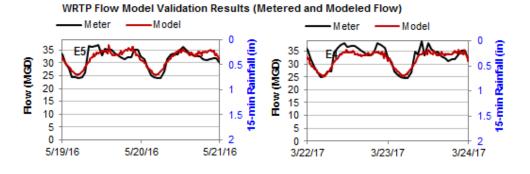




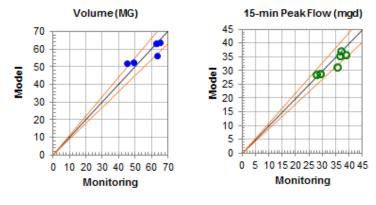
## FLOW METER WRTP FLOW MODEL CALIBRATION AND VALIDATION RESULTS\_Dry Weather Events



WRTP Flow Model Calibration Results (Metered and Modeled Flow)







DELCORA CSO Long Term Control Plan Update

# Sewer System H&H Model Report

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WRTP Flow Model Dry Weather Calibration and Validation Summary								
Event		Flow (MGD)		Volume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	36.45	38.89	-10% to +10%	7%	62.91	63.52	-10% to +10%	1%
E2	29.28	29.03	-10% to +10%	-1%	49.02	52.61	-10% to +10%	7%
E3	27.68	28.79	-10% to +10%	4%	45.05	52.52	-10% to +10%	17%
E4	38.76	36.21	-10% to +10%	-7%	65.29	63.80	-10% to +10%	-2%
E5	36.88	36.10	-10% to +10%	-2%	62.75	63.47	-10% to +10%	1%
E6	35.61	31.18	-10% to +10%	-12%	63.12	56.27	-10% to +10%	-11%

WRTP Flow Model Wet Weather Calibration and Validation Summary								
Event		Flow (MGD)		Volume (MG)				
	Monitored	Model	Criteria	Achieved	Monitored	Model	Criteria	Achieved
E1	97.94	108.55	-15% to +25%	11%	59.32	56.46	-10% to +20%	-5%
E2	78.26	93.19	-15% to +25%	19%	104.19	113.52	-10% to +20%	9%
E3	74.21	91.44	-15% to +25%	23%	85.10	95.25	-10% to +20%	12%
E4	100.93	101.13	-15% to +25%	0%	263.84	235.90	-10% to +20%	-11%
E5	89.95	100.49	-15% to +25%	12%	127.56	106.30	-10% to +20%	-17%
E6	94.40	72.14	-15% to +25%	-24%	66.96	57.10	-10% to +20%	-15%

Note: All the six wet weather events are calibrated well within or close to the industry criteria.