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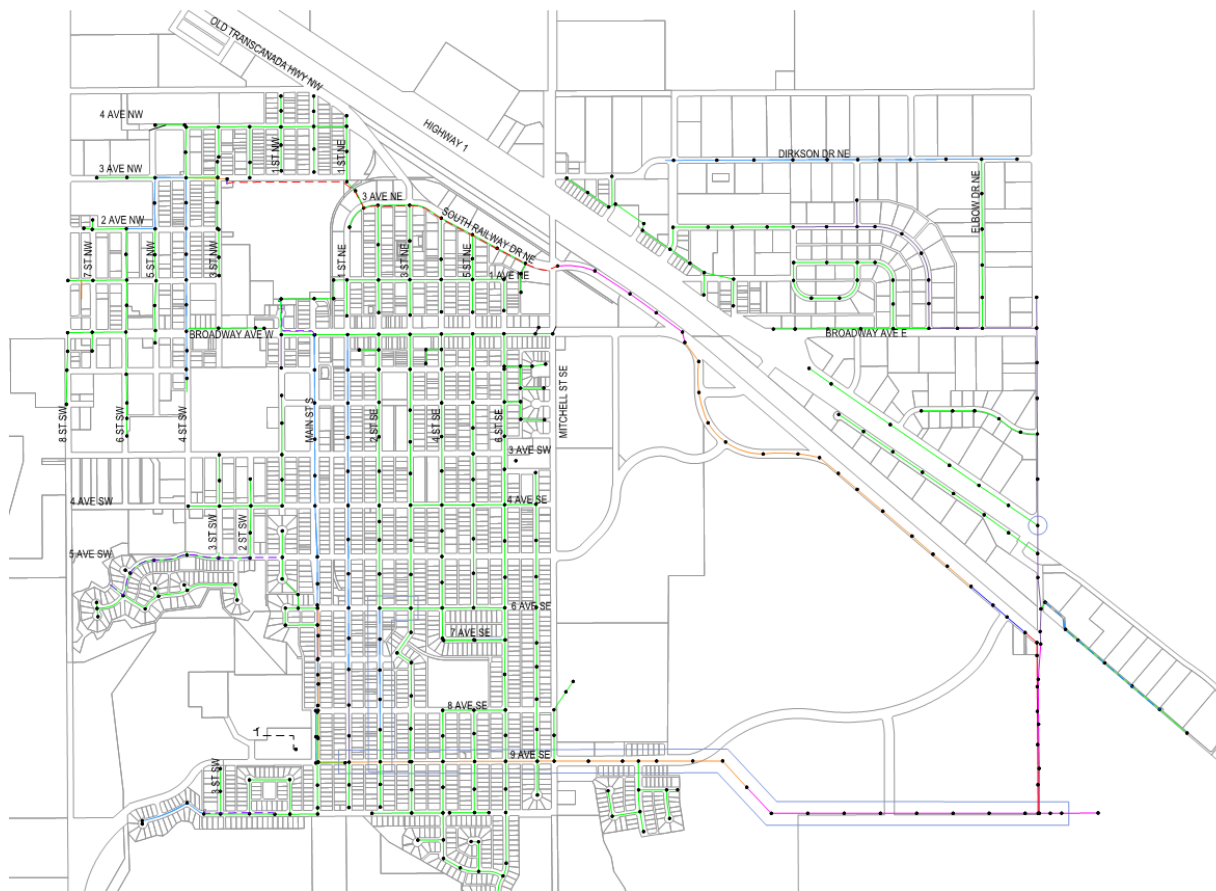
Town of Redcliff – Inflow-Infiltration Management Strategy Sanitary Sewer System Level of Service Discussion December 8, 2014



Study Overview to Date

- Hydrodynamic (MIKE URBAN) model developed of existing sanitary sewer system
- Sewer flow monitoring conducted
- Smoke testing and CCTV inspection conducted
- Sanitary model calibrated with flow monitoring data
- Inflow-infiltration rates observed reviewed
- System assessments undertaken for several scenarios
- Upgrades developed for each scenario

FIGURE 2



LEGEND

SANITARY TRUNK:

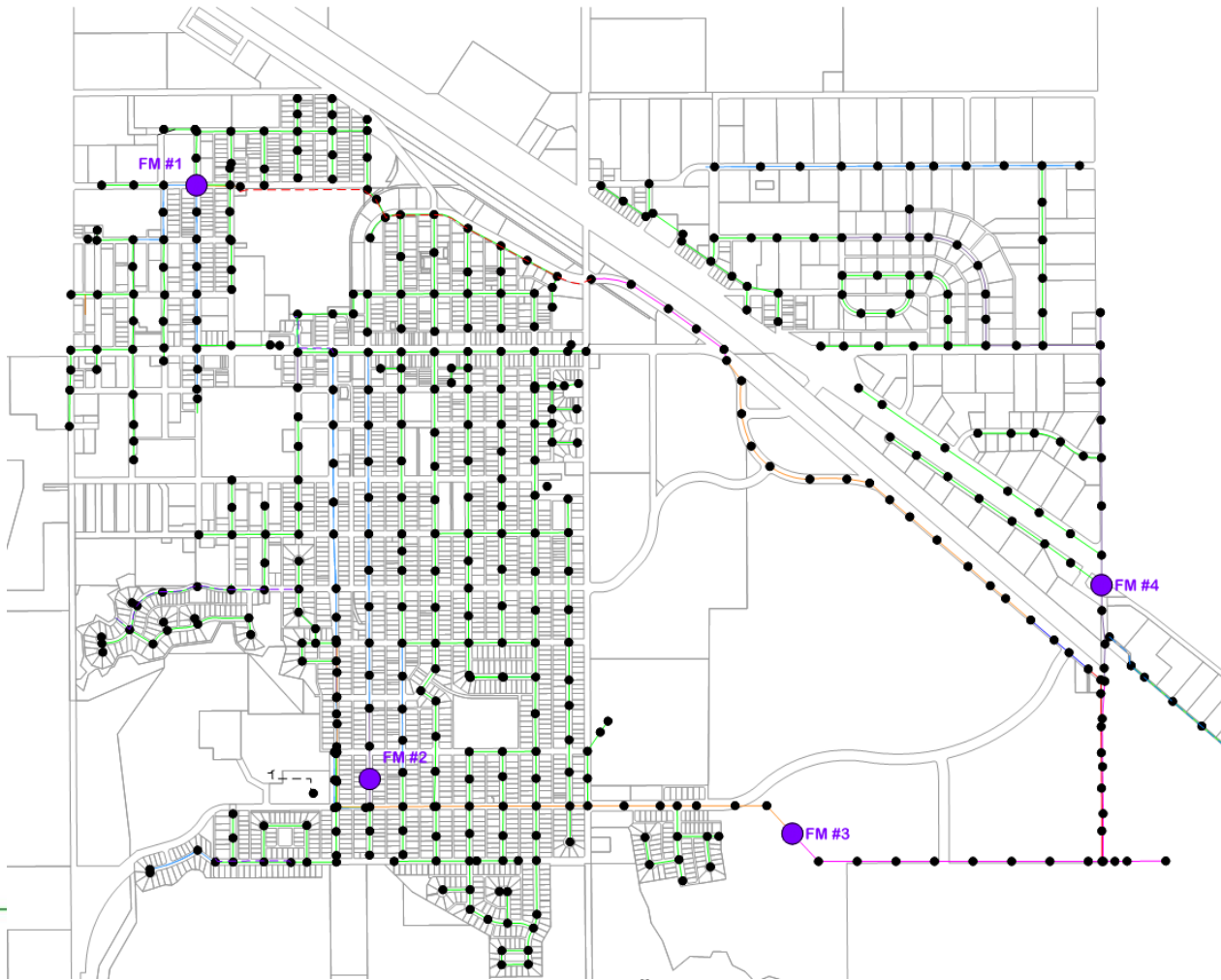
- 100mm —
- 150mm —
- 200mm —
- 250mm —
- 300mm —
- 375mm —
- 450mm —
- 525mm —
- 700mm —

SANITARY FORCEMAIN:

- 50mm - - -
- 75mm - - -
- 100mm - - -
- 150mm - - -
- 250mm - - -



TOWN OF REDCLIFF
SANITARY I-I INVESTIGATION

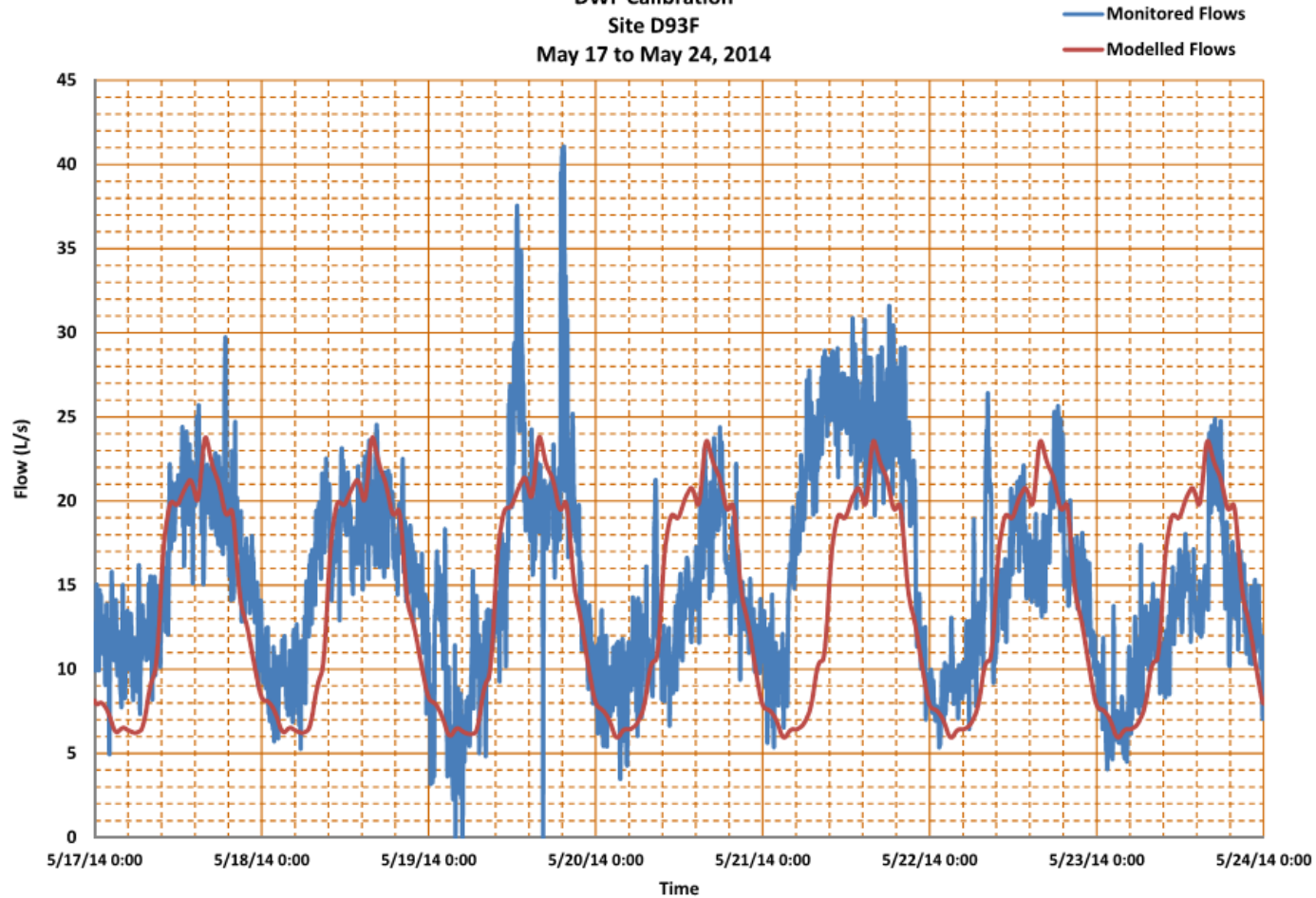


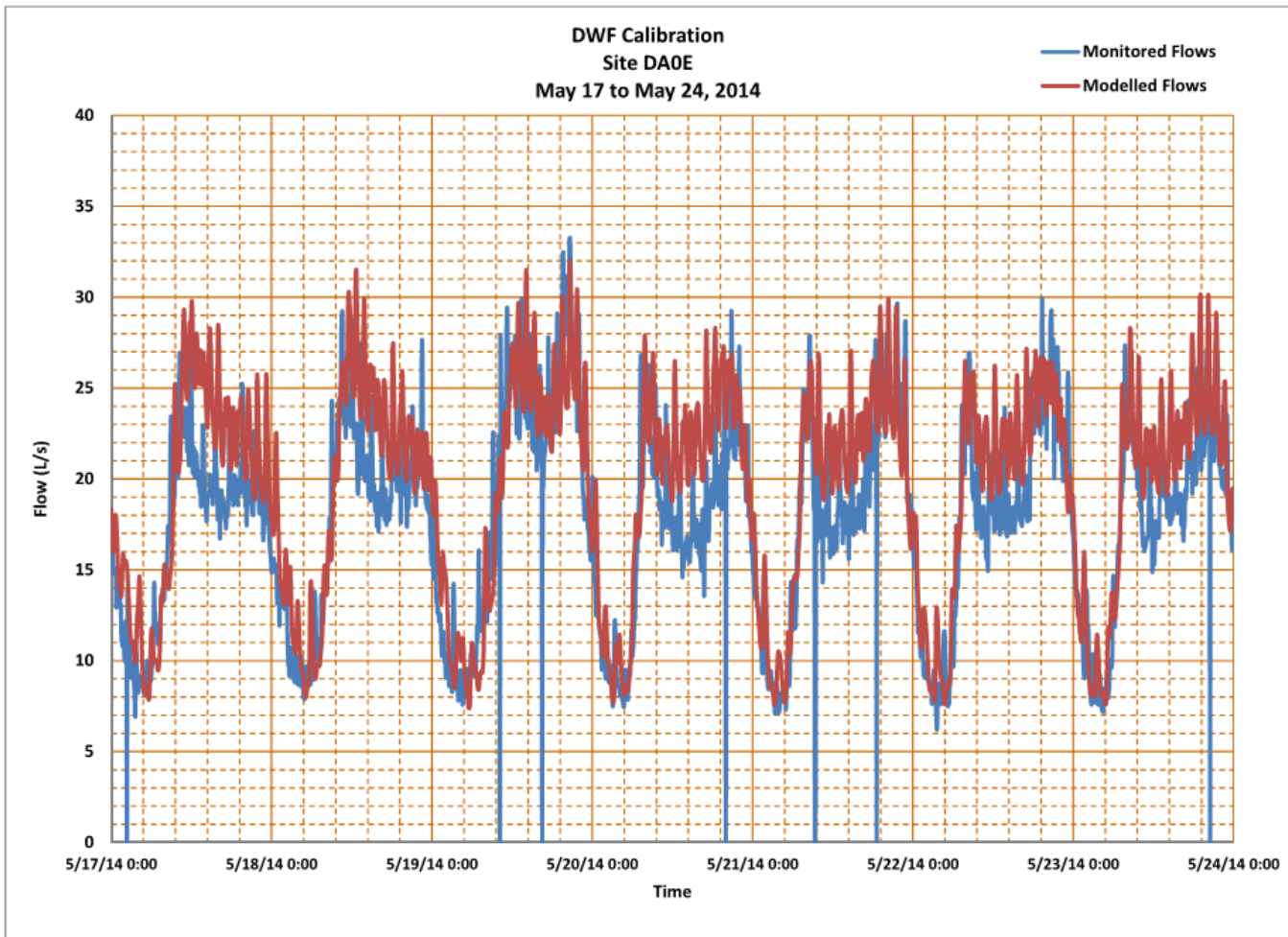


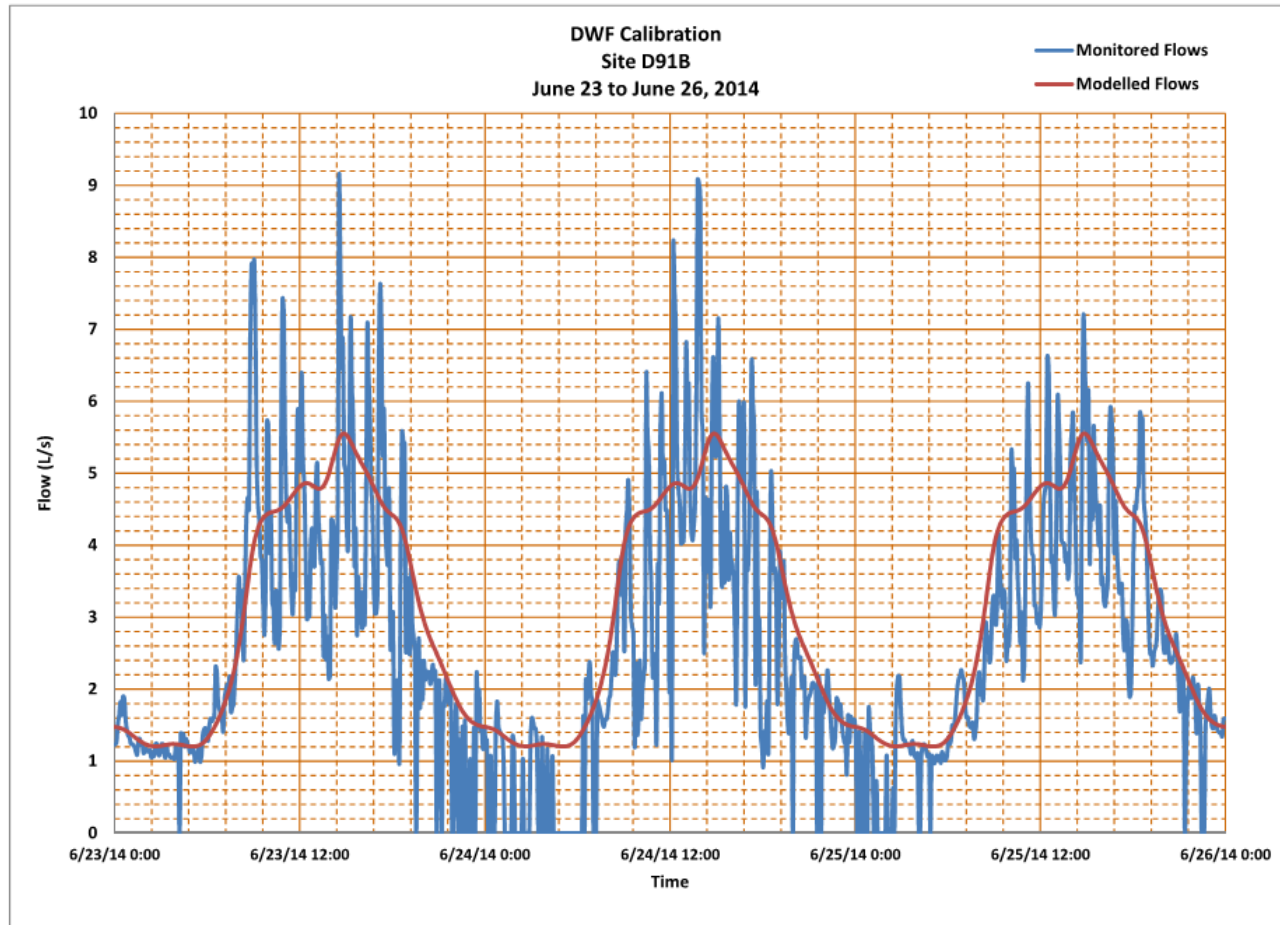
Modelling Process

- Compile existing sanitary system in model
- Fill in missing data
- Compile flow monitoring data
- Calibrate model for dry and wet weather

DWF Calibration
Site D93F
May 17 to May 24, 2014

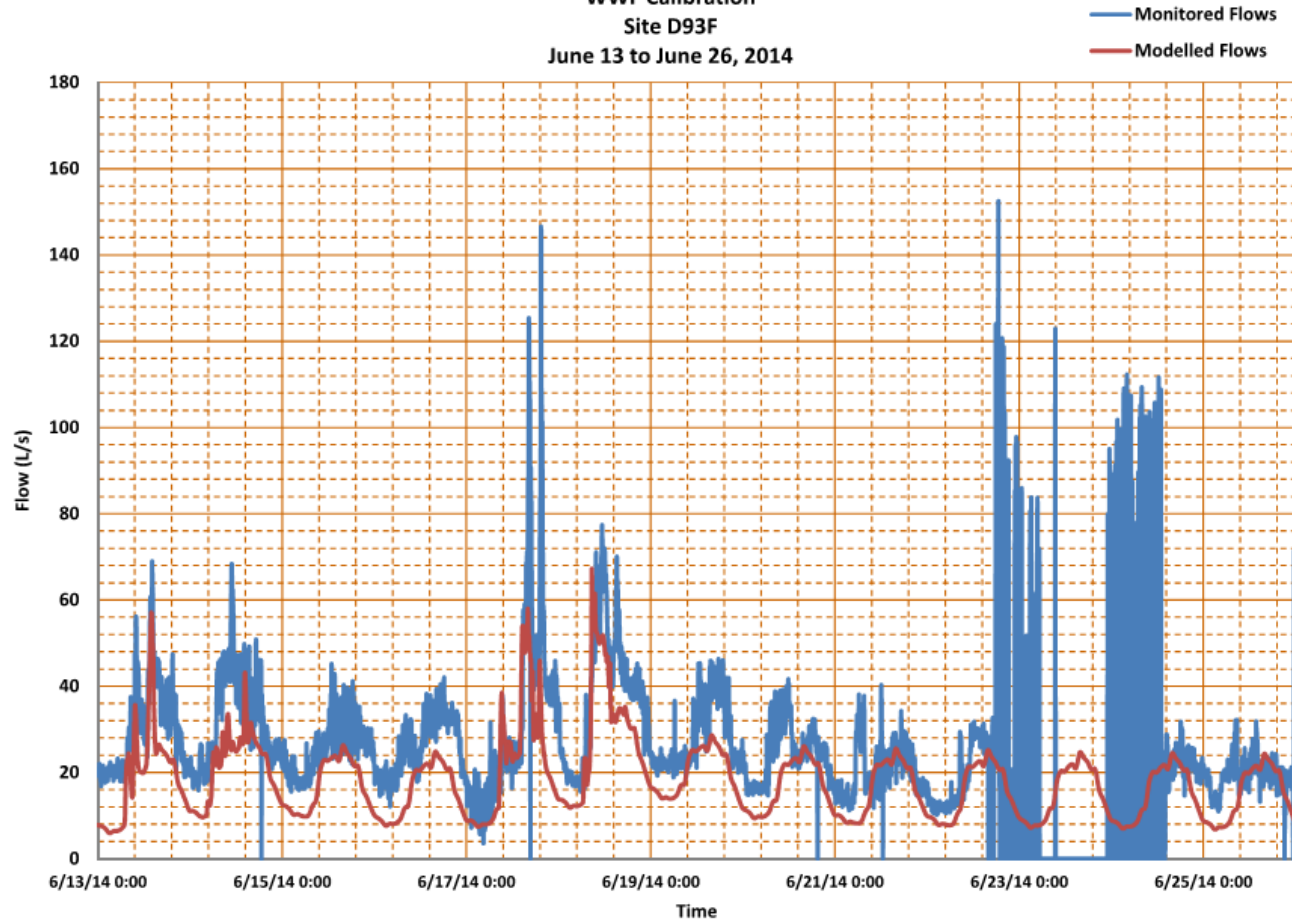


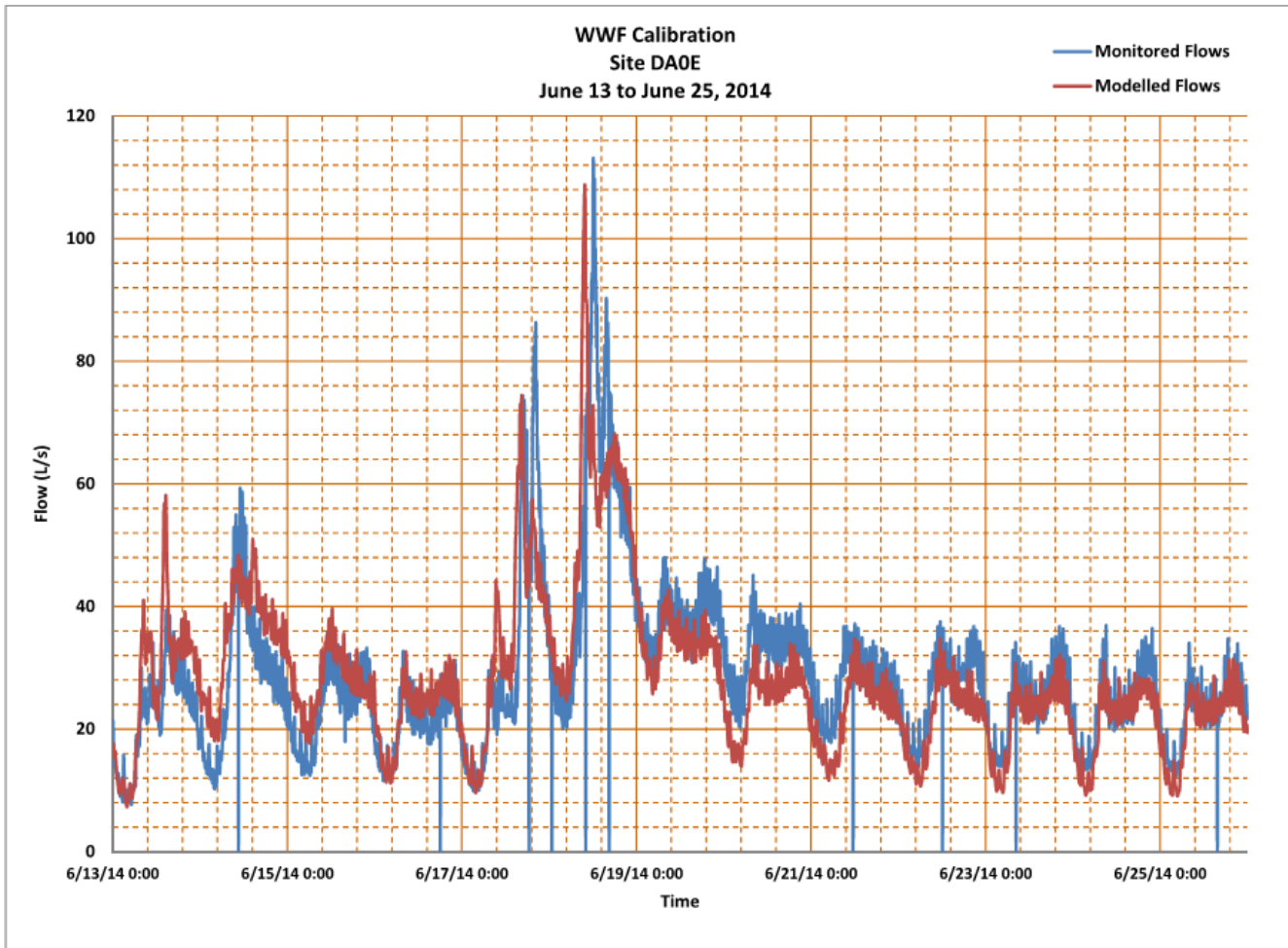






WWF Calibration
Site D93F
June 13 to June 26, 2014







Flow Monitoring Observations

- No major backup events were flow monitored in 2014
- Northwest exhibited significant wet weather response (very peaky, suggesting inflow)
- South trunk also showed fairly significant response (pattern a very classic mix of inflow and infiltration)

Redcliff Inflow - Infiltration Study - Estimated I-I Rates Based On Flow Monitoring Data

FM Site	DWF		WWF		Difference (L/s)	WWF/DWF Ratio	Upstream Area	I-I Rate	Length of Sewer
	Peak Flow	Date	Peak Flow	Date			(ha)	(L/s/ha)	(m)
D93F	30.00	May 17, 2014	146.48	June 17, 2014	116.48	4.88	70.34	1.66	8,297
DA0E	33.00	May 19, 2014	113.07	June 18, 2014	80.07	3.43	166.79	0.48	24,876
D91B	9.00	June 24, 2014	14.60	June 27, 2014	5.60	1.62	135.73	0.04	7,795

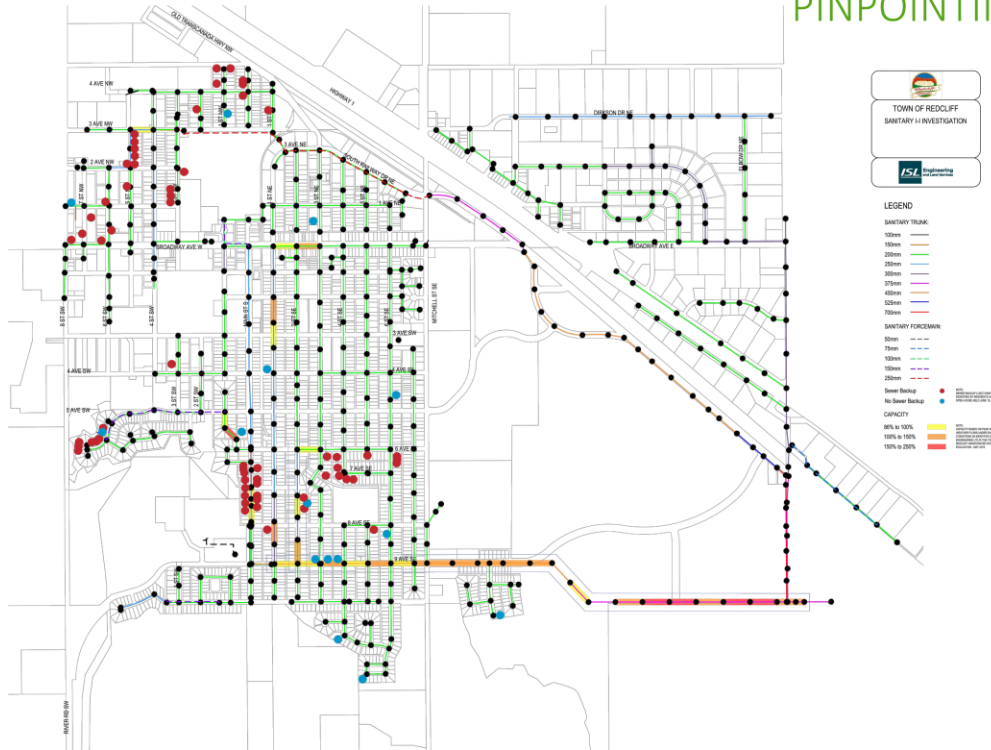


Drainage Surveys

- Initial survey at open house on lots with sewer backup
- Mailed out surveys requesting information on:
 - Lots with sewer backup
 - Presence of inflow-infiltration contributors such as:
 - Roof leaders
 - Sump pumps
 - Weeping tiles
 - Etc. as well as their discharge location (sanitary is bad)

What is Redcliff doing about I-I?

PINPOINTING THE SOURCES



HELP US LOCATE POSSIBLE I-I SOURCES

Use a **RED** sticker to mark where you live if you have experienced a sewer backup in your home, business, or on your property.

Use a **BLUE** sticker to mark where you live if you have not experienced a sewer backup on your property.



Drainage Survey Results

Total Survey Responses	209
Via Online Survey	76
Via Paper Copy Survey	133

Total Lots with Sewer Backup	62
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Total Lots with Each Form of Drainage Infrastructure	
Roof Leaders	96
Rain Barrel	30
Weeping Tile	77
Sump Pumps	44
Basement Drain	164
Backup Prevention Valve	62

Total Lots with Roof Leaders to Each Destination	
Storm Sewer	5
Sanitary Sewer	0
Onto My Property and/or the Street	94
Not Sure	24

Total Lots with Weeping Tile to Each Destination	
Storm Sewer	8
Sanitary Sewer	23
Onto My Property and/or the Street	7
Not Sure	74

Total Lots with Sump Pump to Each Destination	
Storm Sewer	1
Sanitary Sewer	29
Onto My Property and/or the Street	6
Not Sure	16

Total Lots with Basement Drain to Each Destination	
Storm Sewer	18
Sanitary Sewer	91
Onto My Property and/or the Street	0
Not Sure	55



FIGURE 1





FIGURE 2

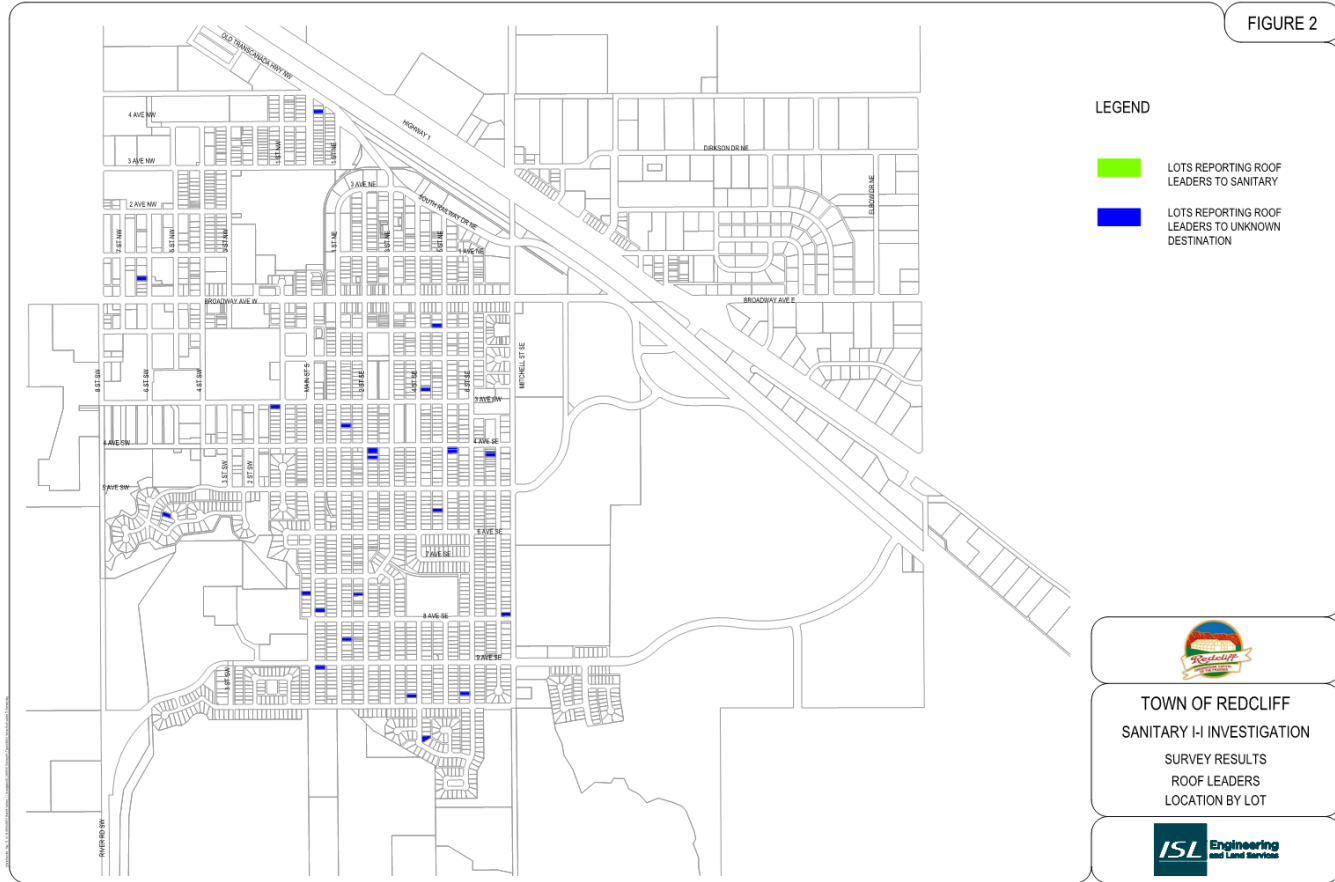


FIGURE 3

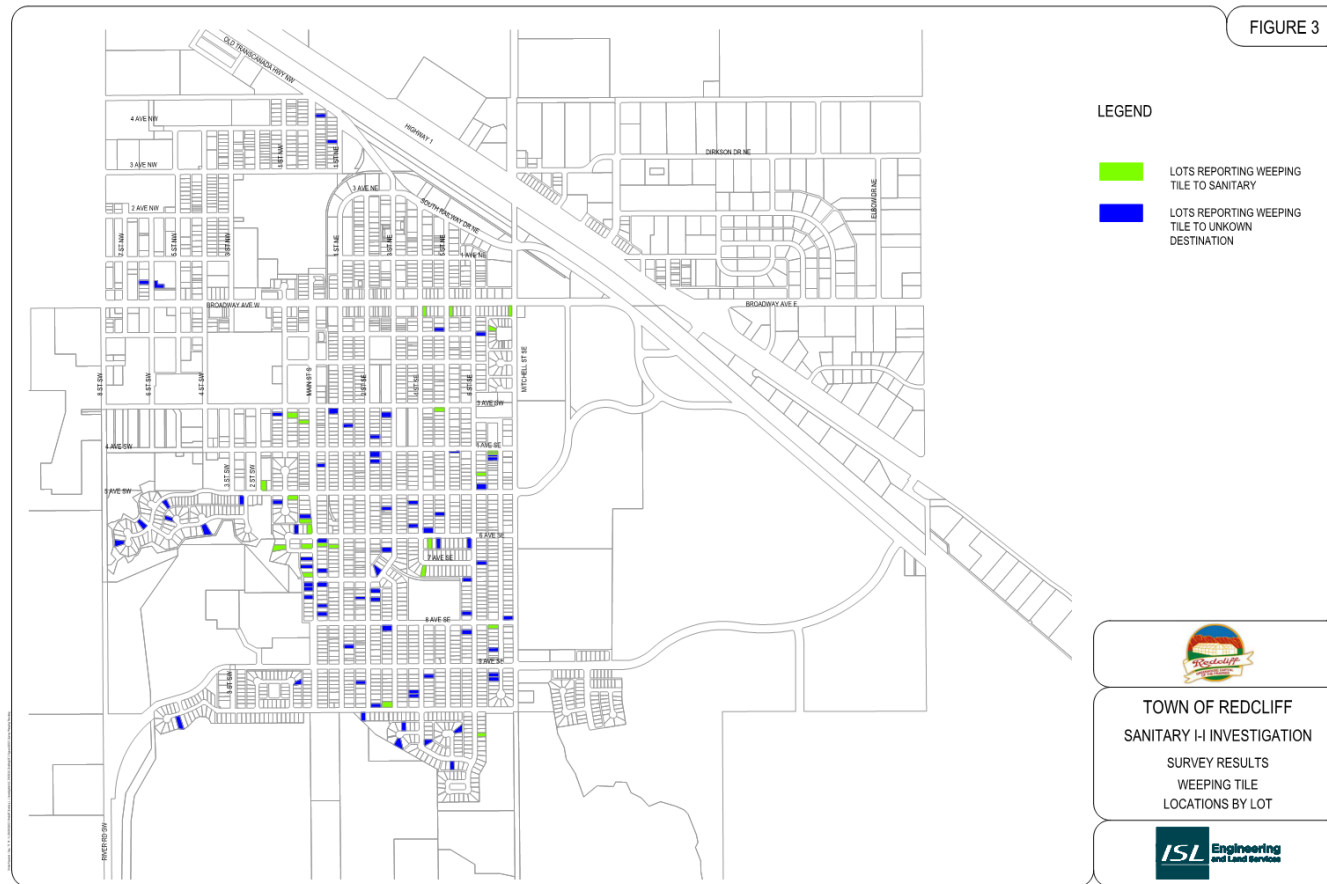




FIGURE 4

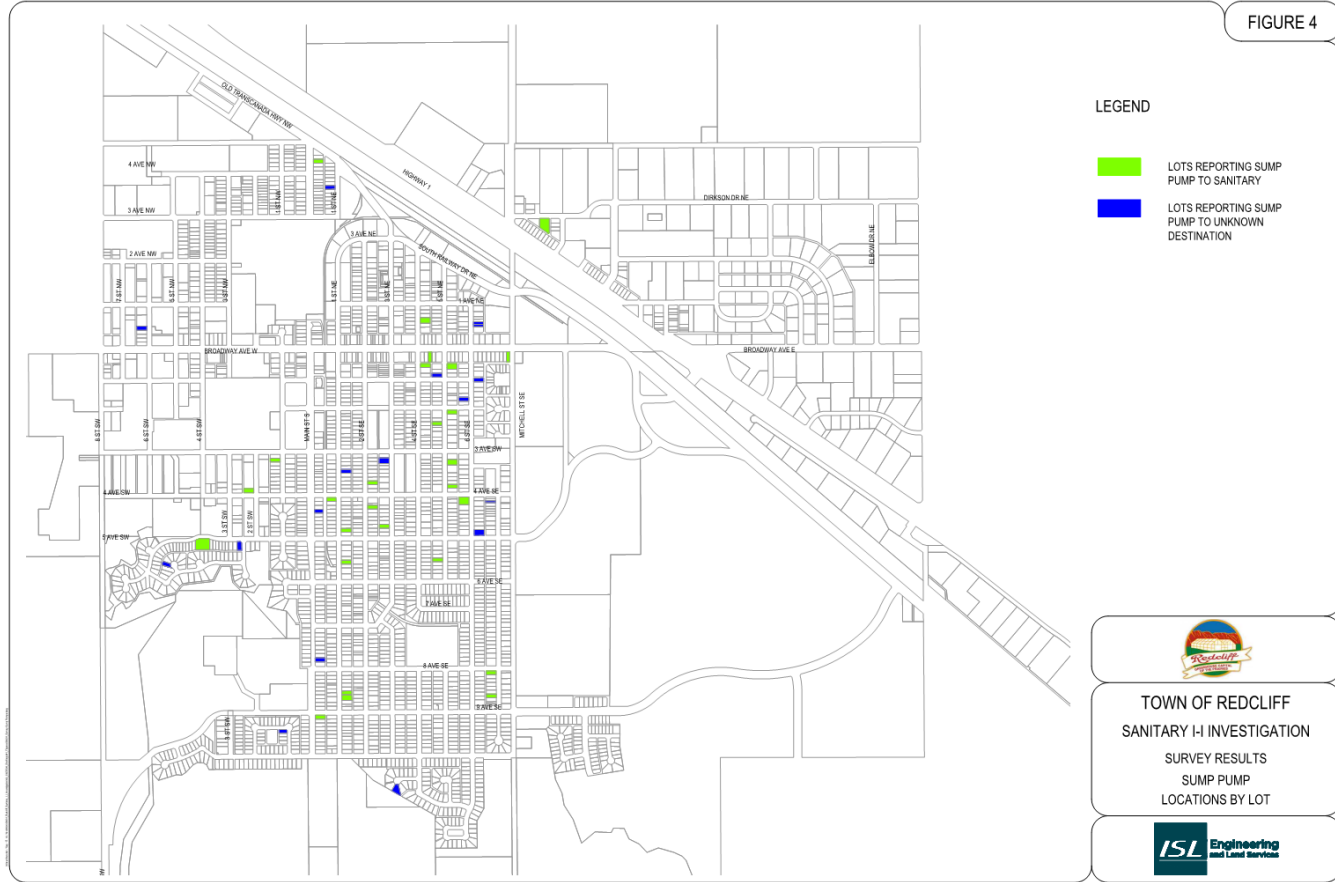




FIGURE 5

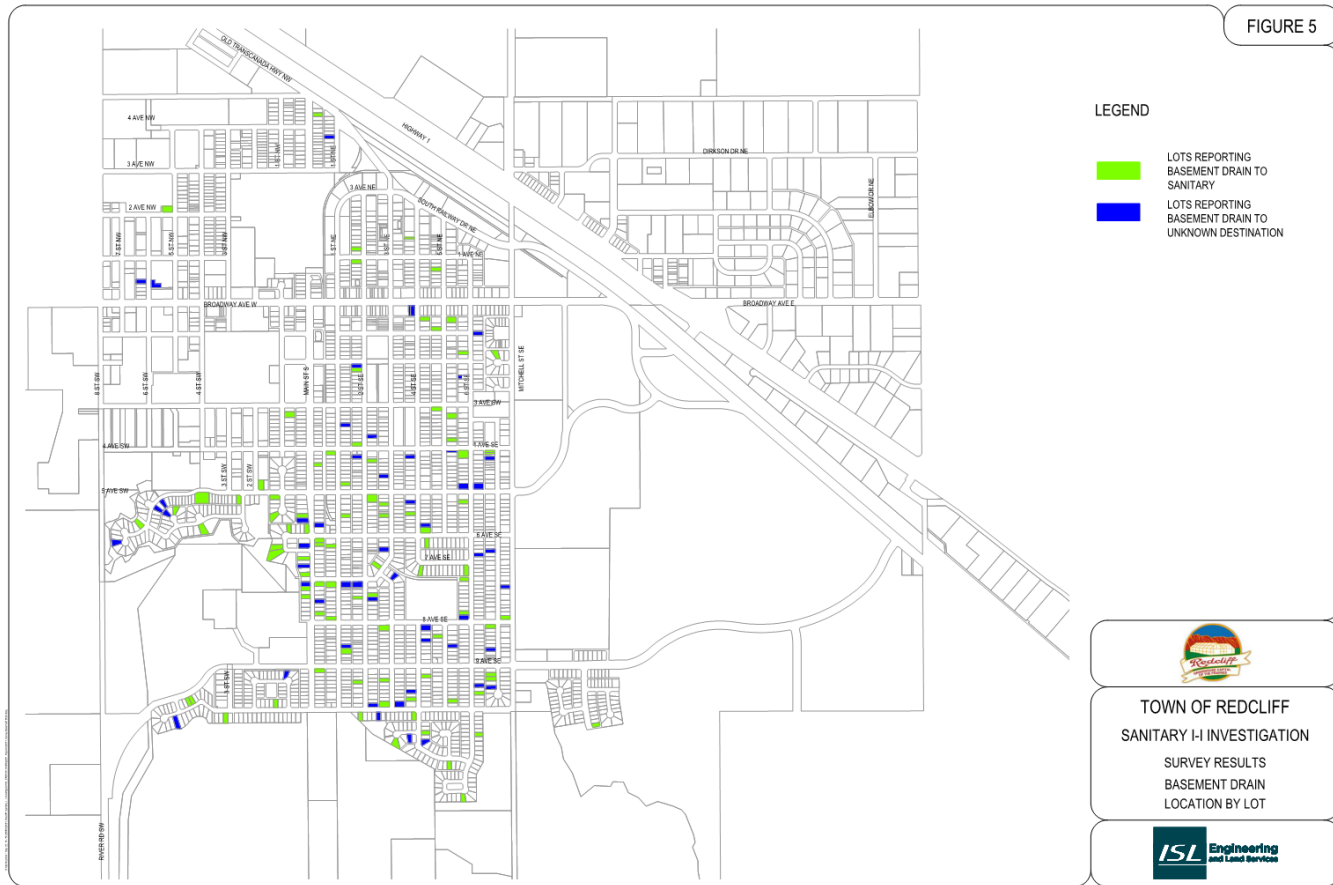


FIGURE 7



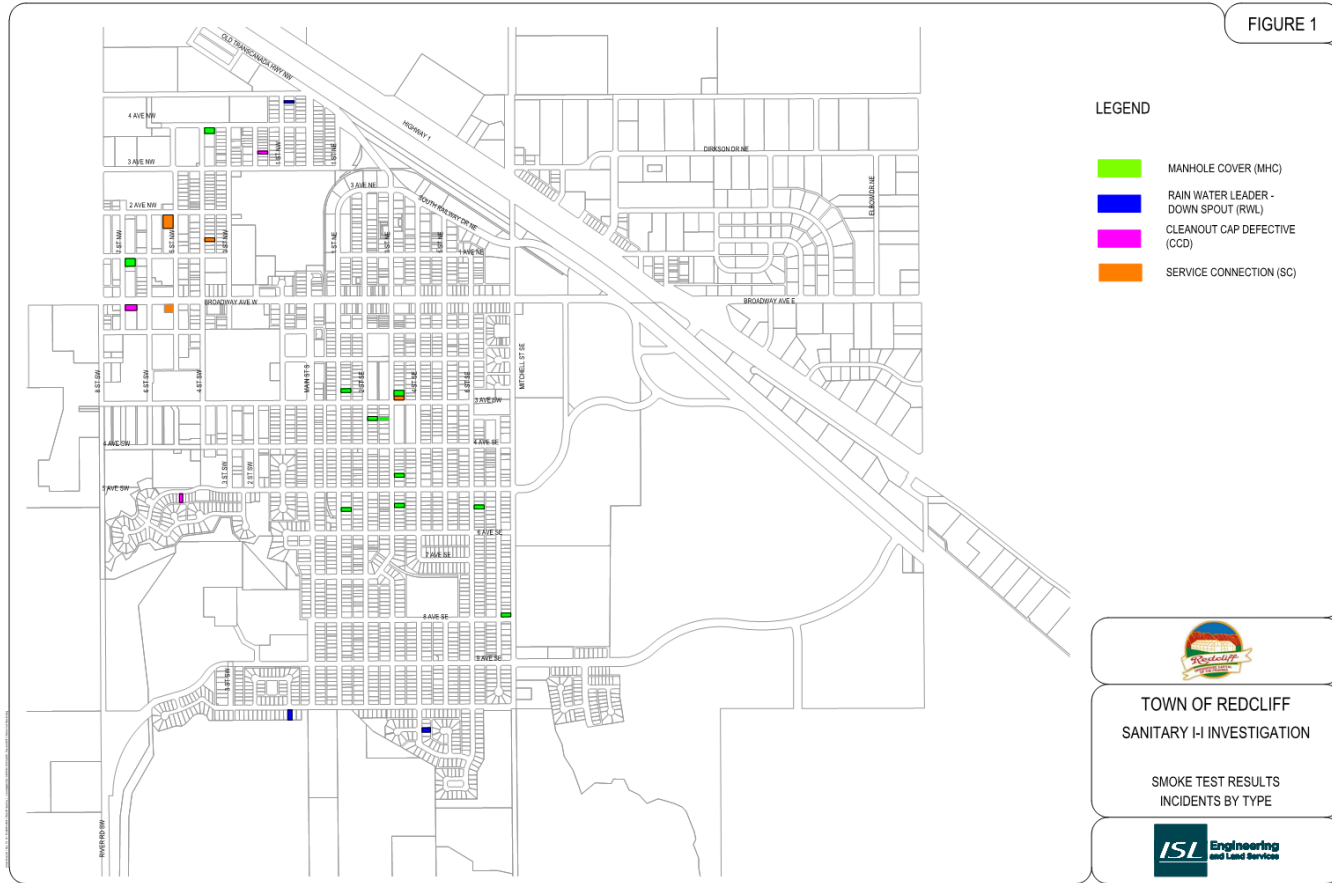


Smoke Testing

- Smoke testing was conducted in August 2014
- Involved filling sequential sections of the sewer system with non-toxic smoke
- Smoke observation locations were noted (logic is where smoke comes out, water gets in)
- Items observed included roof drains, cleanout caps, manholes, etc.



FIGURE 1



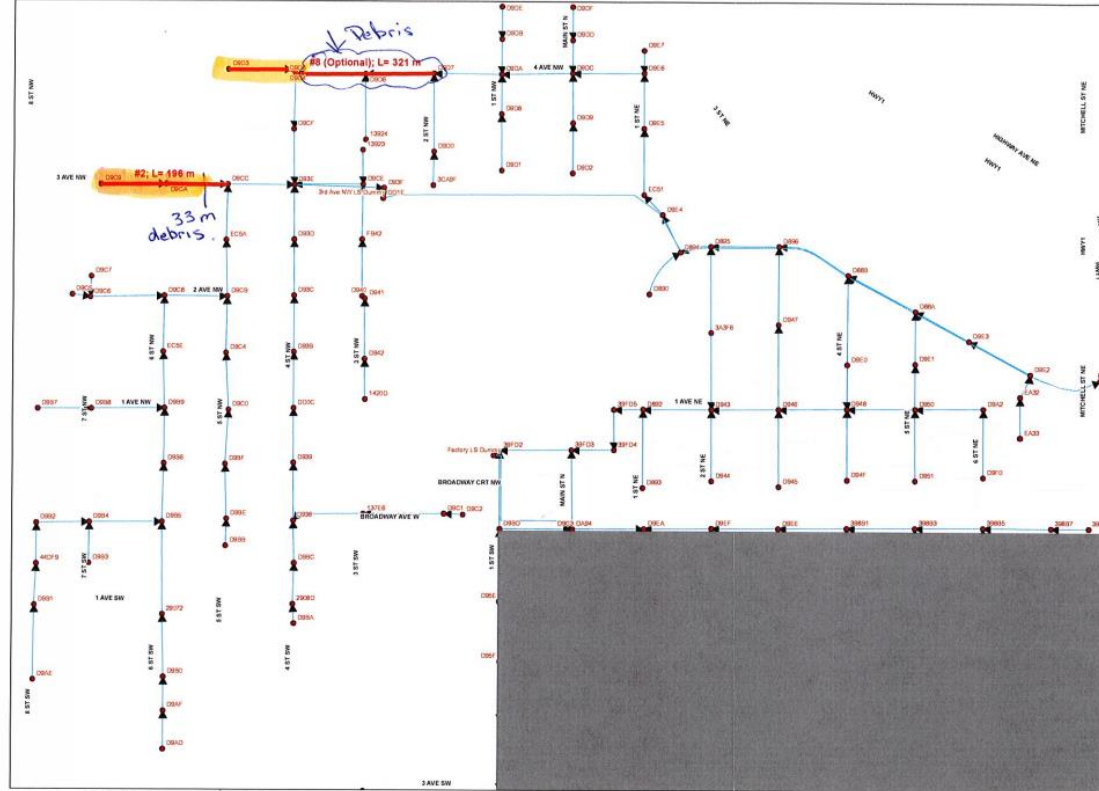


CCTV Inspection

- Portions of the sanitary sewer system were previously CCTV inspected in 2012
- Additional sections were inspected in 2014
- Looking for pipe condition issues, high inflows, debris accumulation, etc.
- Some issues with pipe condition were noted (joint displacement, service connection issues), as well as some higher flow areas (NW), and debris accumulation



TOWN OF REDCLIFF: PROPOSED CCTV INSPECTION LOCATIONS - NORTHWEST TRUNK



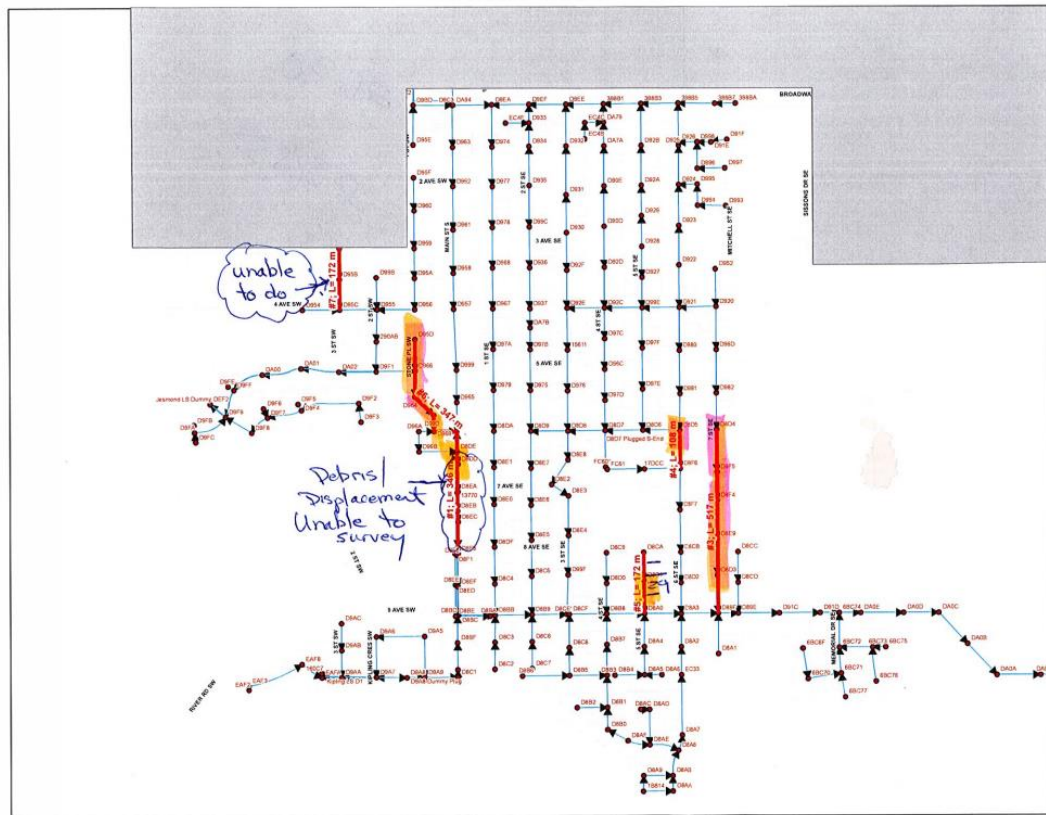
Legend

- Sewers To Be CCTV'ed
- Sanitary Manhole
- ▶ Sanitary Pipe

Length of Sewer To Be CCTV'ed = 518m

NW SAN Sewer Length = 9,640m

TOWN OF REDCLIFF: PROPOSED CCTV INSPECTION LOCATIONS - DOWNTOWN TRUNK



Legend

- Sewers To Be CCTV'ed
- Sanitary Manhole
- Sanitary Pipe

Length of Sewer To Be CCTV'ed = 1,665m

DT SAN Sewer Length = 24,210m
(excluding trunk east of MH DA0E)





Assessment Scenarios

- Constant inflow-infiltration rate of 0.28L/s/ha (standard for new development per Alberta Environment)
- 1:50 year, 4th quartile 24 hour Huff rainfall distribution (used by City of Calgary – represents a typical distribution for heavy sanitary response)
- July, 2013 Thunderstorm (derived from Environment Canada radar imagery and Seven Persons rain gauge using geostatistical methods)



Assessment Scenario Inflow-Infiltration Rates

Site Name / Area	Average Peak Runoff Rate (L/s/ha)	
	July 6 2013 Thunderstorm	50yr 24hr Huff Q4 Design Storm
#D93F (NW Area)	10.07	1.55
#DA0E (South Area)	4.60	1.06
#D91B & Non-FM'ed (NE Area)	0.75	0.11

Redcliff Inflow - Infiltration Study - Estimated I-I Rates Based On 50yr 24hr Huff Q4 Storm

FM Site	DWF		WWF Modelled Peak Flow	Difference (L/s)	WWF/DWF Ratio	Upstream Area (ha)	I-I Rate (L/s/ha)
	Peak Flow	Date					
D93F	30.00	May 17, 2014	59.70	29.70	1.99	70.34	0.42
DA0E	33.00	May 19, 2014	163.30	130.30	4.95	166.79	0.78
D91B	9.00	June 24, 2014	20.00	11.00	2.22	135.73	0.08

Redcliff Inflow - Infiltration Study - Estimated I-I Rates Based On July 6 2013 Thunderstorm

FM Site	DWF		WWF Modelled Peak Flow	Difference (L/s)	WWF/DWF Ratio	Upstream Area (ha)	I-I Rate (L/s/ha)
	Peak Flow	Date					
D93F	30.00	May 17, 2014	114.00	84.00	3.80	70.34	1.19
DA0E	33.00	May 19, 2014	200.80	167.80	6.08	166.79	1.01
D91B	9.00	June 24, 2014	39.50	30.50	4.39	135.73	0.22

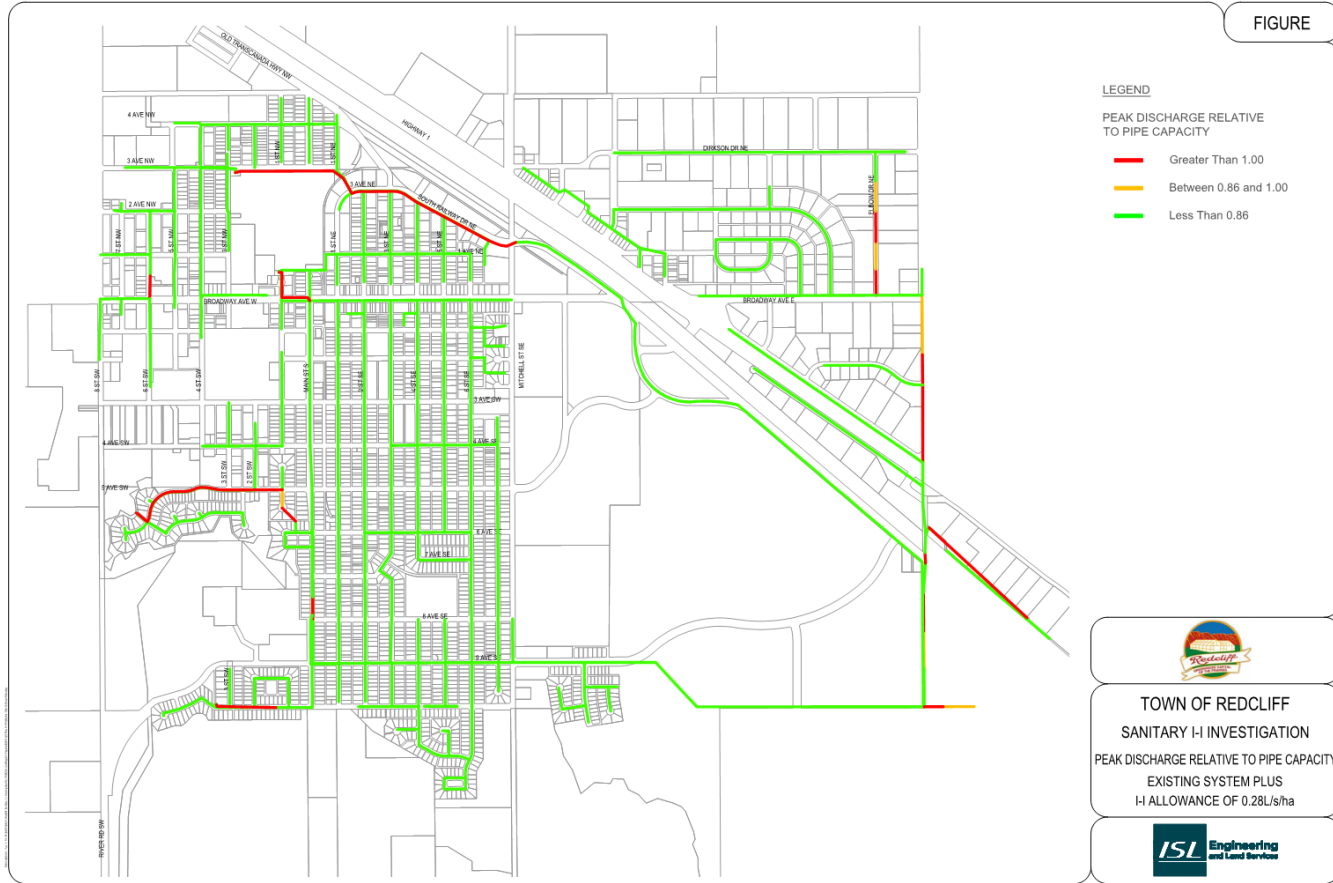


FIGURE





FIGURE

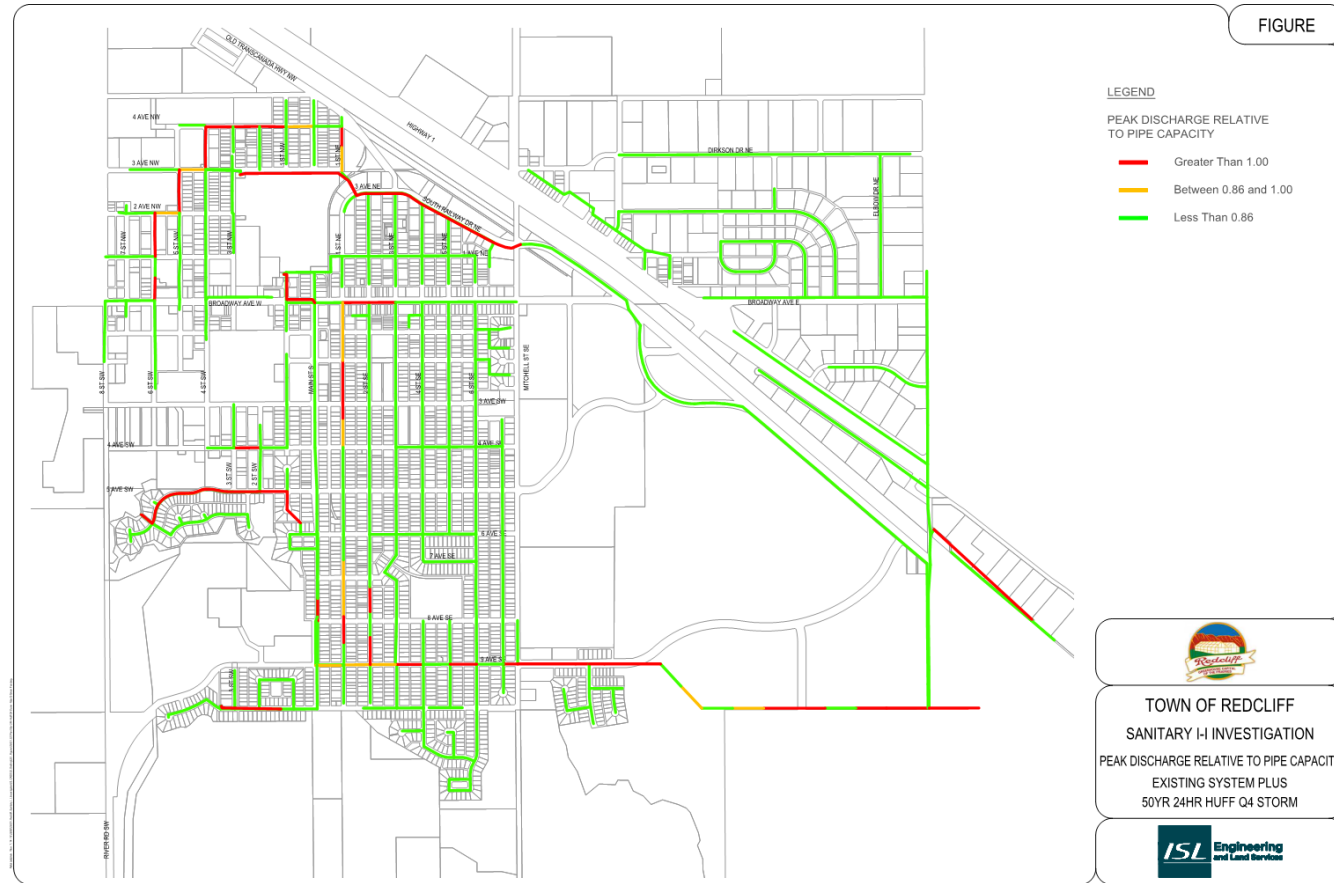


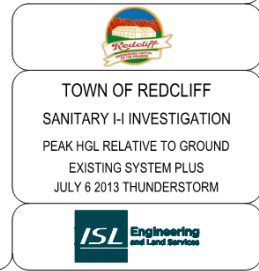
FIGURE





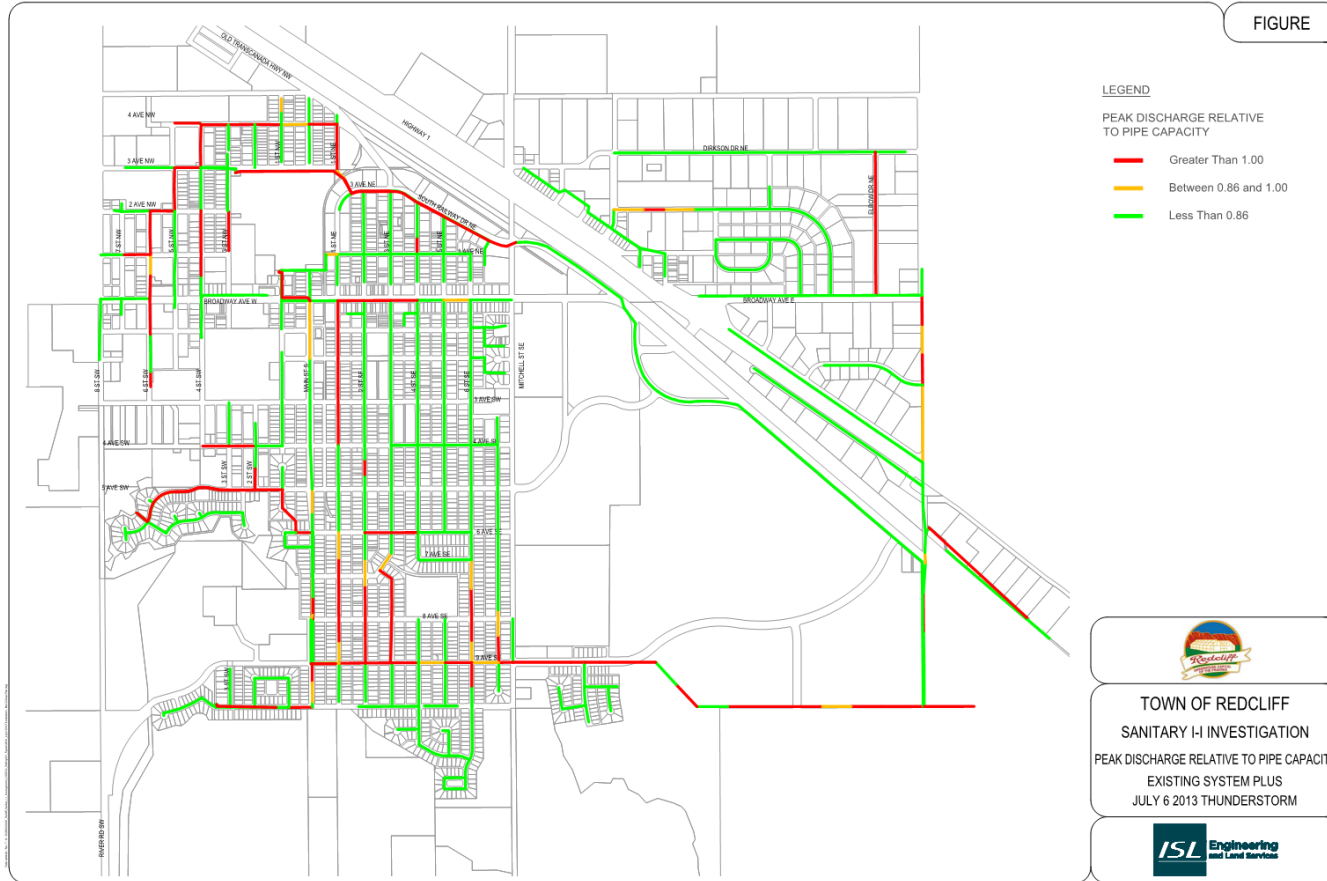
FIGURE







FIGURE





Pipe Diameter (mm)	0.4500												0.3750																		
Ground Level (m)		740.33	739.48	738.63	737.87	737.40	737.15	737.29		736.52	735.62	734.84	733.76	733.60	729.99	728.78	728.91	727.55	726.57	726.01	724.98		724.11	722.92							
Invert Level (m)		736.42	736.11	735.91	735.49	734.52	734.28	733.94		733.57	733.17	732.66	731.14	729.72	727.35	726.17	725.56	724.86	723.49	722.95	722.38		721.42	719.86							
Pipe Slope (%)	0.12	0.29	0.15	0.39	0.18	0.20	0.28	0.30	0.29	0.30	1.26	1.09	1.92	0.95	0.48	0.49	1.12	0.45	0.46	0.73	0.73075	1.26									
50yr Huff Q4 Storm Max Flow (cms)	0.1228	0.1301	0.1336		0.1566		0.1577		0.1629	0.1633	0.1632	0.1631	0.1630	0.1448	0.1325		0.1326				0.1928	0.1927									
July 6 2013 Thunderstorm Max Flow (cms)		0.1478							0.2002	0.2008	0.2007			0.1969	0.1880	0.1832	0.1817	0.1744	0.1743	0.1575	0.1568	0.1522	0.1514	0.1463	0.1454	0.1442	0.1441	0.1437	0.1432	0.1431	0.1954
H of 0.28L/s/ha Max Flow (cms)		0.0628					0.0737		0.0757	0.0758		0.0759	0.0758	0.0757	0.0756	0.0757	0.0756	0.0755	0.0754	0.0755	0.0751	0.0752								0.1690	

5/18/2014 9:24:00 PM



Assessment Scenario Upgrade Summary

- Upgrades were developed for each scenario
 - 0.28L/s/ha scenario – no upgrades
 - Huff storm
 - South trunk upgrades
 - NW upgrades including lift station pumps
 - Minor upgrades in Town core
 - July, 2013 Thunderstorm
 - Similar to Huff storm plus:
 - Extended south trunk upgrades
 - Significant Town core upgrades
 - Major NW upgrades including new lift station and entire receiving sewer

LEGEND

SANITARY TRUNK:

Existing Sewer	—
Proposed Twin 200mm	—
Proposed Twin 250mm	—
Proposed Twin 300mm	—
Proposed Twin 375mm	—

SANITARY FORCEMAIN:

Existing Forcemain	---
Proposed Twin 250mm	---

PROPOSED LIFT STATIONS:

New Set of Pumps -
Maximum Capacity of 115L/s



New Set of Pumps -
Maximum Capacity of 80L/s



TOWN OF REDCLIFF

SANITARY I-I INVESTIGATION

CONCEPTUAL UPGRADES (SEWER TO MH FIXED)

EXISTING SYSTEM PLUS

50YR 24HR HUFF Q4 STORM



LEGEND

SANITARY TRUNK:

Existing Sewer	—
Proposed Twin 200mm	—
Proposed Twin 250mm	—
Proposed Twin 300mm	—
Proposed Twin 375mm	—

SANITARY FORCEMAIN:

Existing Forcemain	---
Proposed Twin 250mm	---

PROPOSED LIFT STATIONS:

New Set of Pumps - Maximum Capacity of 115L/s	★
New Set of Pumps - Maximum Capacity of 80L/s	★
Proposed Surcharge Suppression Lagoon	■



TOWN OF REDCLIFF
SANITARY I-I INVESTIGATION
 CONCEPTUAL UPGRADES WITH SS LAGOON
 EXISTING SYSTEM PLUS
 50YR 24HR HUFF Q4 STORM



FIGURE

LEGEND

SANITARY TRUNK:

Existing Sewer	—
Proposed Twin 200mm	—
Proposed Twin 250mm	—
Proposed Twin 300mm	—
Proposed Twin 375mm	—
Proposed Twin 450mm	—
Proposed Twin 525mm	—
Proposed Twin 675mm	—

SANITARY FORCEMAIN:

Existing Forcemain	—
Proposed Twin 250mm	—
Proposed Twin 525mm	—

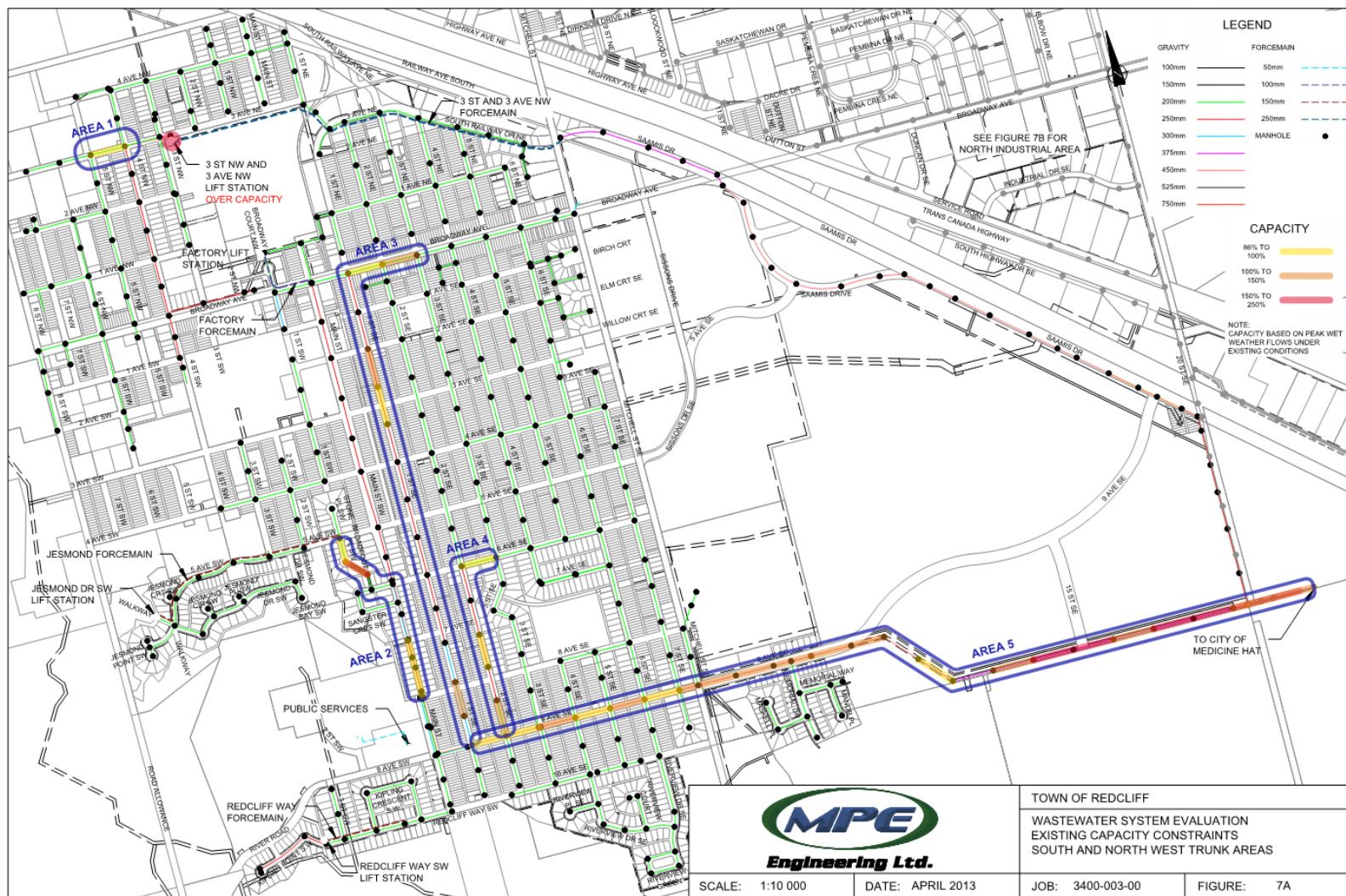
PROPOSED LIFT STATIONS:

New Lift Station - Maximum Capacity of 560L/s	★
New Set of Pumps - Maximum Capacity of 80L/s	★



TOWN OF REDCLIFF
 SANITARY I-I INVESTIGATION
 CONCEPTUAL UPGRADES (SEWER TO MH FIXED)
 EXISTING SYSTEM PLUS
 JULY 6, 2013 THUNDERSTORM







Upgrade Cost Comparison

Town of Redcliff Sanitary Upgrades - Cost Estimate Summary		
Proposed Sanitary Upgrades	Scenario (Existing System)	
	50-yr 24-hr 4th Quartile Huff Storm	July 6, 2013 Thunderstorm
Trunk Sewers	\$2,010,000	\$7,750,000
Forcemains	\$790,000	\$1,580,000
Lift Stations / Pumps	\$1,740,000	\$8,120,000
Pavement Rehabilitation	\$3,880,000	\$11,190,000
Total Cost	\$8,420,000	\$28,640,000

Note:

These estimates do not include the cost of upgrading the Medicine Hat sewer to provide adequate capacity to convey the Town's existing and future sanitary flows to Medicine Hat's WWTP.

Estimated Cost of Surcharge Suppression Lagoon	\$600,000
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- Previous study had existing conveyance upgrades at ~\$11.0M



Outfall Line to Medicine Hat

- Line from SE Redcliff to Medicine Hat has ~165-170 L/s capacity
- Capacity is exceeded under existing conditions (notwithstanding future growth)
- Could twin dedicated line to Medicine Hat (~2,500m), but after that upgrades are unclear
 - Possible off-site levy charges
 - Possible upgrades to gravity sewer to Brier Park Lift Station
 - Possible upgrades to Brier Park Lift Station
 - Possible upgrades from Brier Park Lift Station to WWTP



Outfall Line to Medicine Hat

- Information from City has been unclear to date
- Reference was made to a long term trunk upgrade that either upgrades existing alignment or goes around to north (City was talking \$10.0M+ for this upgrade) – it is not in their 25 year plan
- Continuing efforts to get a cost from the City to take additional flows
- Depending on this information, other upgrades may be considered to optimize capital spending (e.g. Redcliff starts treating wastewater from growth areas with independent discharge upstream of Medicine Hat)



Next Steps

- Town to confirm desired level of service
- Existing system conceptual designs / costs to be developed
- Future system upgrade conceptual designs/costs to be developed
- Further engagement with City of Medicine Hat to review options to deal with downstream capacity issues
- Inflow-infiltration reduction measures to be recommended
- Report to be prepared



Questions and Discussion

