BRENT SPENCE BRIDGE CORRIDOR
Moving the Economy, Creating Jobs

BRENT SPENCE BRIDGE CORRIDOR | TECHNICAL REPORT

Draft Corridor Drainage Study

November 1, 2017

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CHAPTER 1. EXECUTIVE SUMMARY

The Corridor Drainage Study was developed to identify Right of Way (ROW) needs for the proposed stormwater detention facilities to meet the *Draft Metropolitan Sewer District of Greater Cincinnati (MSD) Stormwater Regulations (June 2017)* for the Brent Spence Bridge Project. The study evaluated 3.0 miles of the I-75 corridor within Cincinnati, Ohio from Marshall Avenue to the Ohio River.

Ten detention facilities along the I-75 corridor were identified to meet the proposed Regulations. Four of these facilities are located on lands owned by the State of Ohio, one by the City of Cincinnati, and the remaining five have full or partial private ownership. The following map depicts the project corridor and the ten storage facility locations (Detailed maps are provided in **Appendix D**):

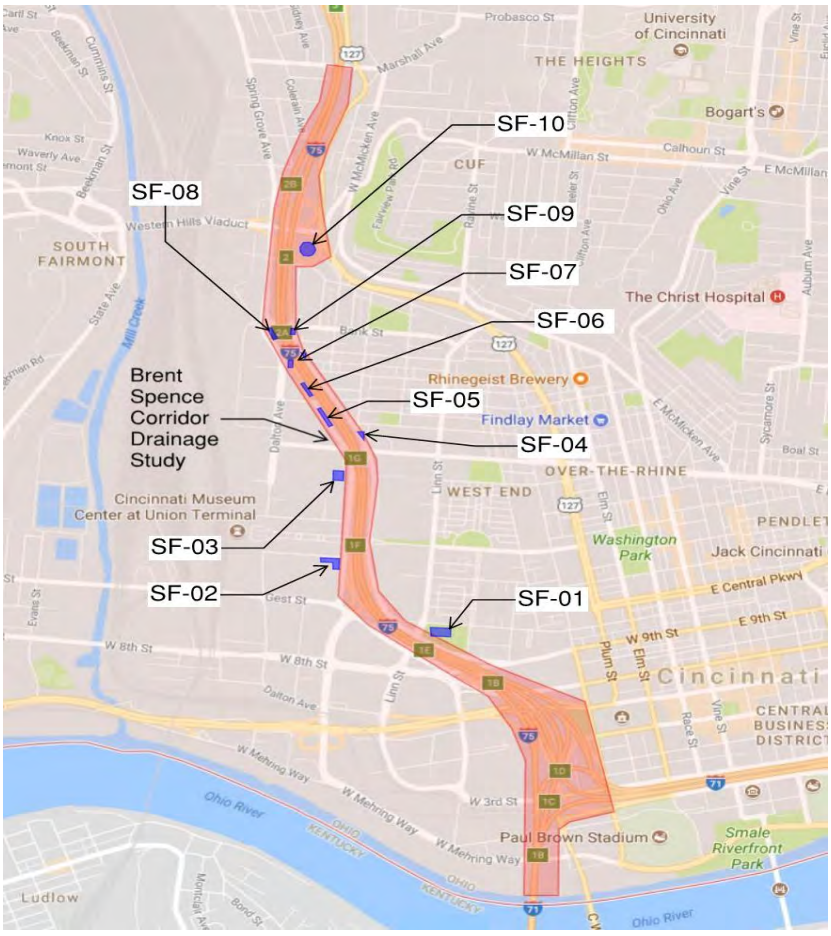


Figure 1-1: Corridor Drainage Overview Map

Eighteen existing outfalls were identified within the project corridor, two outfall to the Ohio River, and sixteen connect to the combined sewer which are tributary to eight combined sewer overflows (CSO's). To meet the MSD Stormwater Regulations, a combined 17.58 Ac-Ft of detention is needed to reduce flows to acceptable levels in each CSO. The following table identifies locations, size and cost for these facilities:

Table 1-1: Storage Facility Summary

PROPOSED STORAGE FACILITY	OUTFALL ID	LOCATION	OWNER	FACILITY SIZE (AC-FT)	OUTLET ELEVATION	CSO CONNECTION ELEVATION	STORAGE FACILITY COST
SF-01	BSB006	Linn Street - Queensgate Playfield	City	2.92	492.00	489.54	$3,179,880
SF-02	BSB007/ BSB008	1205 Western Ave./ 1017 Hopkins St./ 1225 Hopkins St.	Private	4.26	473.42	469.49	$4,639,140
SF-03	BSB009	Western Ave.	Private	0.81	483.00	481.00	$882,090
SF-04	BSB010/ BSB011	1634 Freeman Ave.	Private	0.61	487.00	480.79	$664,290
SF-05	BSB012 SOUTH	SB I-75 & Findley St.	ODOT	0.67	492.00	486.06	$729,630
SF-06	BSB012 NORTH	SB I-75 & Findley St.	ODOT	0.20	492.00	486.06	$217,800
SF-07	BSB013A/ BSB013B	1120 York St.	City/Private	0.83	489.29	487.72	$903,870
		1850 Dalton Ave.	Private		481.00	477.50	
SF-08	BSB014 WEST	2022 Western Ave.	ODOT	0.84	481.20	474.60	$914,760
SF-09	BSB014 EAST	2018 Winchell Ave.	City/Private	0.84	484.39	479.50	$914,760
SF-10	BSB015/ BSB016/ BSB017	Western Hills Viaduct SE Loop	ODOT	5.60	496.70	493.50	$1,219,680
			TOTAL STORAGE:	**17.58**		**STORAGE COST:**	**$14,265,900**

The first nine facilities are underground vaults located along I-75 or adjacent to the frontage roads. SF-10 is a graded detention basin located within the Western Hills Viaduct loop ramp. A geotechnical investigation is recommended at each site to determine subsurface soil conditions and groundwater levels to confirm design standards.

An estimated construction cost of $14.3 million was determined based of the following considerations: Vault construction cost were estimated at $25/cubic foot of storage. This was based on facility depths, and the need for temporary tiebacks during construction due to the proximity of adjacent parcels. The detention basin was estimated at $5/cubic foot. ROW and utility relocations are not included in this total.

CHAPTER 2. STORMWATER ANALYSIS

2.1 STORMWATER REGULATIONS

Local developers are currently subject to Section 303 of MSD Rules & Regulations on stormwater discharges to the combined sewer system. The primary purpose of the current regulation is to maintain capacity in the sewer system and help reduce sewer backups during large storm events. MSD has implemented a major public works initiative called "Project Groundwork" to move towards reducing overflows and sewer backups. To meet the goals of "Project Groundwork", MSD is currently revising the requirements for connections to the combined sewer. The revised regulation will require approval by the Hamilton County Board of County Commissioners. A draft version of the regulations are provided in **Appendix A**.

Separated storm sewers will follow Ohio EPA and ODOT L&D Volume 2 requirements for water quality with the use of best management practices (BMPs).

2.1.1 Current Section 303 Stormwater Regulations

The requirement is to detain the difference in runoff between a pre-developed site during a 10-year storm of one-hour duration (2.03 inches) and a post-development site during a 25-year storm of one-hour duration (2.42 inches). MSD also limits the pre-developed runoff rates used in calculations to a maximum of 0.91 cubic feet per second/acre.

2.1.2 Proposed Revisions MSD Stormwater Regulations

MSD is proposing a two-part stormwater detention requirement – "Surface and Basement Sewage Flooding Mitigation" and "Combined Sewer Overflow Mitigation" to replace its current Section 303 stormwater regulations. Transportation projects with complete road reconstruction or addition of impervious area will be subject to these regulations. Street resurfacing projects with no additional impervious area will not require detention.

Surface and Basement Sewage Flooding Mitigation:

A. For a 25-year storm and all more frequently recurring storm (i.e., 10-year, 5-year, 2-year, 1-year) post-development peak runoff rates are to be reduced to the pre-development peak runoff in a 2-year storm.
B. The 100-year storm post-development peak runoff rate reduced to the pre-development peak runoff in a 10-year storm.

Combined Sewer Overflow Mitigation:

Developer will be required to build a stormwater detention basin or other control structure that will capture the first 1.5 inches of rainfall and be released slowly to the combined sewer system over 72 hours. This requirement will be waived if the developer decreases the impervious surface of the area to be developed by 25%.

2.2 DATA COLLECTION

Mapping, construction plans and as-builts of the existing sewers were obtained from ODOT and MSD and inputted into a 3-D CADD file to create an existing drainage model. A drainage field survey was performed to verify and identify general location, size and depth of the existing combined sewers where existing information did not provide sufficient information to analyze.

2.3 PROJECT OUTFALLS

Eighteen existing Ohio Department of Transportation (ODOT) project outfalls were identified within the corridor. Two outfall's discharge directly to the Ohio River, while the remaining sixteen outfall's discharge to the MSD combined sewer system and are tributary to eight different combined sewer overflows systems. Refer to the *Existing Drainage System Map* in **Appendix B** which shows the existing sewer system, project outfalls, CSO boundaries, and existing drainage areas.

Table 2-1: Existing Project Outfalls

OUTFALL ID	LOCATION	TYPE	TRIBUTARY TO CSO #	OUTFALL SIZE (INCHES)
BSB001	BSB/HILLTOP READYMIX	Storm Sewer	-	18
BSB002	SMITH RD/HILLTOP READY MIX	Storm Sewer	-	54
BSB003	CENTRAL AVE/HILLTOP READY MIX	Combined Sewer	CSO 438	90
BSB005	6TH ST EXPWY/GEST ST	Combined Sewer	CSO 436	30
BSB005A	W 3RD STREET	Combined Sewer	CSO 436	24
BSB006	GEST STREET	Combined Sewer	CSO 430	78
BSB007	HOPKINS STREET	Combined Sewer	CSO 431	72
BSB008	HOPKINS STREET	Combined Sewer	CSO 431	72
BSB009	WADE WALK	Combined Sewer	CSO 431	30
BSB010	W. LIBERTY STREET	Combined Sewer	CSO 666	114
BSB011	WESTERN AVE.	Combined Sewer	CSO 666	30
BSB012	FINDLAY STREET	Combined Sewer	CSO 666	24
BSB013A	YORK ST/DALTON AVE.	Combined Sewer	CSO 666	30
BSB013B	YORK ST/DALTON AVE.	Combined Sewer	CSO 666	15
BSB014	BANK STREET	Combined Sewer	CSO 666	78
BSB015	HARRISSON AVENUE	Combined Sewer	CSO 004	54
BSB016	BUCK STREET	Combined Sewer	CSO 006	24
BSB017	ALFRED STREET	Combined Sewer	CSO 007	12

2.4 EXISTING PROJECT OUTFALL FLOW RATES

Existing flow rates were determined for each outfall using the TR-20 method within HydoCAD. Drainage areas were delineated based on the existing drainage network and surface contours. Runoff coefficients were developed based on pavement and non-pavement areas. Time of concentration values were developed from the 3-D drainage model in which rainfall intensities were derived. The following table provides the outfall flow rates and input data:

Table 2-2: Existing Project Outfall Flow Rates

OUTFALL ID	RECEIVING WATER BODY/CSO	EXISTING ODOT DRAINAGE AREA (ACRE)	EXISTING CUMULATIVE CURVE NUMBER	TC (MINUTES)	EXISTING FLOW RATES (CFS)	
					2-YR	10-YR
BSB001	OHIO RIVER	1.33	98.00	12	4.43	6.20
BSB002	OHIO RIVER	35.50	96.00	18	97.68	139.06
BSB003	CSO 438	13.85	91.00	19	30.45	46.18
BSB005	CSO 436	3.22	82.00	19	4.64	8.03
BSB005A	CSO 436	0.75	98.00	13	2.43	3.39
BSB006	CSO430	25.57	89.00	24	45.23	70.62
BSB007	CSO 431	2.44	89.00	26	4.09	6.41
BSB008	CSO 431	18.66	89.00	21	35.35	55.36
BSB009	CSO 431	3.91	86.00	18	7.10	11.57
BSB010	CSO 666	3.71	90.00	19	7.80	12.05
BSB011	CSO 666	0.84	85.00	17	1.52	2.52
BSB012	CSO 666	4.74	89.00	14	11.28	17.59
BSB013A	CSO 666	1.11	79.00	17	1.40	2.57
BSB013B	CSO 666	2.65	93.00	17	6.71	9.93
BSB014	CSO 666	12.98	89.00	17	28.04	43.82
BSB015	CSO 004	13.98	85.00	18	23.82	39.49
BSB016	CSO 006	12.12	84.00	20	18.66	31.42

2.5 PROPOSED PROJECT OUTFALL FLOWRATES

Proposed project outfall flow rates were determined by updating the drainage areas with the proposed Brent Spence Bridge Project roadway pavement sections. Overall, most drainage areas didn't increase in size greatly, but the runoff coefficient increased with the increase in impervious surfaces.

A preferred separation alternative was developed that separated Outfall's BSB005 and BSB005A from CSO 436, and reduced drainage areas to Outfall's BSB003 (CSO 438) and BSB006 (CSO 430). The proposed 78-inch separated trunk line would also combine the two existing separated outfalls BSB001 and BSB002 to create one outfall to the Ohio River. The proposed drainage system map is provided in **Appendix C**. The following table provides the outfall flow rates and input data for the proposed conditions:

Table 2-3: Proposed Project Outfall Flow Rates

OUTFALL ID	RECEIVING WATER BODY/CSO	DRAINAGE AREA (ACRE)	CUMULATIVE CURVE NUMBER	TC (MINUTES)	PROPOSED UNRESTRICTED FLOW RATE (CFS)	
					25-YR	100-YR
PBSB001	OHIO RIVER	70.71	96.00	25	264.52	325.65
BSB003	CSO 438	4.17	98.00	15	20.70	25.33
BSB006	CSO430	21.23	98.00	24	83.00	101.57
BSB007/008	CSO 431	26.59	98.00	26	99.11	121.08
BSB009	CSO 431	4.36	98.00	18	19.93	24.34
BSB010/011	CSO 666	3.92	98.00	19	17.40	21.25
BSB012	CSO 666	5.58	98.00	14	28.92	35.31
BSB013A/013B	CSO 666	4.31	98.00	17	20.42	24.95
BSB014	CSO 666	11.55	98.00	17	54.73	66.85
BSB015/016/017	CSO 004	27.92	98.00	25	106.62	130.25

2.6 PROPOSED STORAGE REQUIREMENTS

The following table provides the storage requirements needed to meet the MSD Stormwater Regulations:

Table 2-4: Proposed Storage Requirements

OUTFALL ID	RECEIVING WATER BODY/CSO	PROPOSED STORAGE REQUIREMENT (AC-FT)			PROPOSED RESTRICTED FLOW RATE (CFS)	
		1.5 INCH OVER 72 HOURS	25-YR POST TO 2-YR EX	100-YR POST TO 10-YR EX	25-YR	100-YR
PBSB001	OHIO RIVER	SEPARATED OUTFALL - NO STORAGE NEEDED				
BSB003	CSO 438	MEETS BOTH MSD REGULATIONS - NO STORAGE NEEDED				
BSB006	CSO430	1.04	2.50	2.92	43.98	54.92
BSB007/ BSB008	CSO 431	1.28	3.58	4.26	39.23	48.04
BSB009	CSO 431	0.27	0.69	0.81	6.89	8.00
BSB010/ BSB011	CSO 666	0.21	0.52	0.61	8.20	9.61
BSB012	CSO 666	0.24	0.73	0.87	10.16	12.72
BSB013A/ BSB013B	CSO 666	0.28	0.73	0.83	7.86	12.36
BSB014	CSO 666	0.62	1.43	1.68	26.20	30.69
BSB015/ BSB016/ BSB017	CSO 004	1.54	4.73	5.60	22.00	35.25

CHAPTER 3. IDENTIFIED ROW NEEDS

3.1 STORAGE FACILITY LOCATIONS

Ten facility locations have been identified to meet MSD Regulations. The following table summarizes the parcel ownership for each location and potential parcels to construct each facility:

Table 3-1: Proposed Facility Locations

PROPOSED STORAGE FACILITY	LOCATION	OWNER	PARCEL NUMBER
SF-01	Linn Street - Queensgate Playfield	City	City
SF-02	1205 Western Ave./ 1017 Hopkins St./ 1225 Hopkins St.	Private	143-0004-0388-00, 143-0004-0035-00, 143-0004-0044-00
SF-03	Western Ave.	Private	143-0006-0124-00
SF-04	1634 Freeman Ave.	Private	184-0002-0077-00, 184-0002-0078-00, 184-0002-0079-00, 184-0002-0212-00
SF-05	SB I-75 & Findley St.	ODOT	ODOT
SF-06	SB I-75 & Findley St.	ODOT	ODOT
SF-07	1120 York St.	City/Private	City/ 184-0005-0169-00
	1850 Dalton Ave.	Private	185-0006-0140-00
SF-08	2022 Western Ave.	ODOT	ODOT
SF-09	2018 Winchell Ave.	City	City
SF-10	Western Hills Viaduct SE Loop	ODOT	ODOT

APPENDIX A

Proposed Revisions MSD Stormwater Regulations

PROJECT GROUNDWORK
your pipeline to clean water

DRAFT Background

During rains, our combined sewer system can overflow, making Cincinnati among the top five locations in the U.S. for combined sewer overflows (CSOs). Rainfall can also lead to surface and basement sewage flooding when the capacity of the combined sewer system is exceeded leading to property damage and public health concerns which currently happens throughout the County service area.

The Metropolitan Sewer District of Greater Cincinnati (MSD) is under a federal court order (called a Consent Decree) to reduce the overflows and eliminate basement sewage flooding. MSD has implemented a major public works initiative called "Project Groundwork" to move towards reducing overflows and bring value to our communities through this multi-year and multi-billion-dollar investment.

This investment is one of the largest single investments in our County since the turn of the century and is an unfunded mandate from the federal government. This investment is primarily being funded from sewer user rates driving up the cost for sewer service to levels that may be unaffordable for many households in the future. To address these rising costs it is important that everyone does their share to manage rainwater on their property. If not managed properly, the rainwater runoff and sewage from your property can end up in your or your neighbor's basement or in our local streams and rivers.

Current MSD Stormwater Regulations

Local developers are currently subject to Section 303 of MSD Rules & Regulations on stormwater discharges to the combined sewer system.

For developments disturbing more than 10,000 square feet of land, the developer must construct a stormwater detention basin or other control that will minimize the impact of runoff from the development on the combined sewer system.

The requirement is to detain the difference in runoff between a pre-developed site during a 10-year storm of one hour duration (2.03 inches) and a post-development site during a 25-year storm of one hour duration (2.42 inches). MSD also limits the pre-developed runoff rates used in calculations to a maximum of 0.91 cubic feet per second/acre.

The primary purpose of the current regulation is to maintain capacity in the sewer system and help reduce sewer backups during large storms.

The regulation in its current form:

- Does not sufficiently reduce CSO volume
- Can lead to an increase in CSO volume during smaller storms
- Does not sufficiently reduce or eliminate surface or basement sewage flooding
- Does not promote a reduction in impervious surfaces (e.g., surfaces that are covered by parking lots, buildings and other structures that do not allow rain water to absorb into the ground)

The regulation can also result in large detention basins being constructed, even in situations where overall site runoff is not increased.

Proposed Revisions to MSD Stormwater Regulations

MSD is proposing a two-part stormwater detention requirement — "Surface and Basement Sewage Flooding Mitigation" and "Combined Sewer Overflow Mitigation" — to replace its current Section 303 stormwater regulations.

This proposed revision will require approval by the Hamilton County Board of County Commissioners.

Benefits

The proposed new requirements provide the following benefits:

- Help reduce CSO volume during smaller storms
- Helps reduce the magnitude of surface and basement sewage flooding
- Encourage reduction in impervious surfaces through waiver of stormwater management practice requirements
- Promote sustainable redevelopment of existing sites
- Offer potential cost savings for developers
- Consistent with the Hamilton County Stormwater District requirements for the separate sewer system
- Encourages the use of green infrastructure stormwater controls such as bioinfiltration basins, pervious pavement surfaces and bioswales. Ongoing MSD efforts to measure the effectiveness of such technologies have shown that, with proper operation and maintenance,

controls like these can reduce runoff to the combined sewer by 20-85% depending on scale and design thereby reducing CSOs and flooding

- National studies have shown increases in property values and rental or lease prices when property is associated with the use of green infrastructure stormwater controls

The proposed requirements reflect MSD's new focus on an integrated watershed planning approach and will help reduce costs to MSD's ratepayers associated with future CSO and flooding reductions.

MSD is also collaborating with the Hamilton County Stormwater District on a soon to be published Hamilton County stormwater design manual, which will provide technical guidance on the use of best management practices to comply with local and county regulations and enhance overall water quality. From MSD fact sheet. Confirm with MSD.

Under the proposed new regulation, the use of green infrastructure stormwater controls, like the large rain garden (bioinfiltration basin) above, can be incorporated more easily into a stormwater management plan.

Proposed New Requirements

Surface and Basement Sewage Flooding Mitigation

For development of sites greater than 10,000 square feet in size, the developer will be required to build a stormwater detention basin or other stormwater control to reduce stormwater peak flows to a more manageable rate that will not worsen flows in the combined sewer system.

The proposed regulation will require for large storms the peak stormwater runoff rate from the site will need to be reduced to a smaller rate more in-line with the peak flow capacity of the existing combined sewer system as described below:

A. For a 25-year storm and all more frequently recurring storms (i.e., 10-year, 5-year, 2-year, and 1-year) post-development peak runoff rates are to be reduced to the pre-development peak runoff in a 2-year storm.

B. The 100-year storm post-development peak runoff rate reduced to the pre-development peak runoff in a 10-year storm.

This requirement of managing rainwater from the redeveloped site will promote the use of more pervious "greenspace" areas while also contributing a fair share to the overall reduction in surface and basement sewage flooding.

Need More Information?
Contact:
MSD Engineering Customer Service Line at (513)557-3594 or
MSD.Communications@cincinnnati-oh.gov

Combined Sewer Overflow Mitigation

For development of sites greater than 10,000 square feet in size, the developer will be required to build a stormwater detention basin or other control that will capture the first 1.5-inches of rainfall.

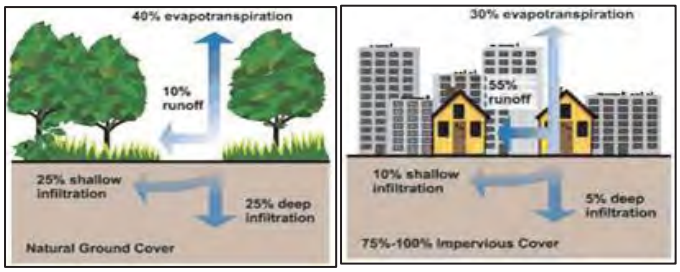
The stormwater will be released slowly to the combined sewer system over 72 hours, typically done by installing a smaller diameter outlet pipe. The rate of runoff from the site can be slowed even further through other methods such as bioswales, bioinfiltration basins, etc.

This proposed regulation will help reduce CSO volume by detaining the smaller, more typical rainstorms in our area. Over 90% of our rains are considered smaller rains (less than 1.5-inches). This regulation will also help to address surface and basement sewage flooding by capturing and slowing the rainfall during larger events.

Under current MSD regulations, stormwater from smaller rainstorms is not normally detained in detention basins (mainly due to the size of the outlet pipe) and is released to the combined sewer system where it contributes to CSOs.

The requirement will be waived if the developer decreases the impervious surface of the area to be developed by 25% (e.g., providing green space, installing rain gardens, etc).

This requirement incentivizes green solutions and also complies with MSDGC's federal consent decree, and Ohio EPA Phase II National Pollutant Discharge Elimination System (NPDES) water quality requirements.



Source: U.S. EPA Nonpoint Source Fact Sheet

Transportation Specific Requirements

The proposed requirements will also apply to all transportation improvements, with several specific conditions including:

- Street resurfacing will not require detention.
- Complete road reconstruction or addition of impervious area will be subject to these regulations.

Cost Savings for All Ratepayers

By implementing these regulations, MSDGC will be able to invest more capital into improving and maintaining assets within the County service area that would otherwise have gone to mitigating increases in overflows and surface and basement sewage flooding.

By everyone accepting responsibility for their stormwater flows and responsibility to manage rainwater on their site, MSDGC's rate dollars can be spent more wisely to improve the sewer system, provide additional capacity for economic growth, and to improve overall water quality faster for our ratepayers.

APPENDIX B

BRENT SPENCE BRIDGE PROJECT

PHASE 2 DRAINAGE
EXISTING DRAINAGE

EXISTING CSO BOUNDARY

OUTFALL ID	LOCATION	OUTFALLS TO	OUTFALL SIZE (INCHES)	PART OF CSO#	TOTAL CSO CONTRIBUTING AREAS (ACRES)	PROJECT DRAINAGE AREA TO OUTFALL (ACRES)		DRAINAGE AREA WITHIN R/W (ACRES)		TOTAL EXISTING PROJECT AREA GOING TO CSO (ACRES)	EXISTING FLOWS (CFS)			PROPOSED PROJECT DRAINAGE AREA TO OUTFALL (CFS)	PROPOSED CONDITION FLOWS (CFS)			CHANGE IN DRAINAGE AREA TO OUTFALL (CFS)	PERCENTAGE OF CHANGE IN FLOWS		
											10-YR	25-YR	50-YR		10-YR	25-YR	50-YR		10-YR	25-YR	50-YR
BSB001	BSB/HILLTOP READYMIX	OHIO RIVER	18	N/A	N/A	1.329	[blue outline]	1.329	[blue]	N/A	5.92	6.72	7.27	3.92	17.49	19.83	21.47	2.60	195.28%	195.28%	195.28%
BSB002	SMITH RD/HILLTOP READY MIX	OHIO RIVER	54±	N/A	N/A	44.611	[green outline]	33.858	[green]	N/A	128.68	147.73	160.95	48.42	152.36	174.92	190.57	3.81	18.40%	18.40%	18.40%
BSB003	CENTRAL AVE/HILLTOP READY MIX	OHIO RIVER	90	CSO 438	17.29	27.311	[red outline]	13.457	[red]	17.29	94.69	108.43	117.96	30.73	102.86	117.78	128.14	3.42	8.63%	8.63%	8.63%
BSB005	6TH ST EXPWY/GEST ST	MILL CREEK	30	CSO 436	63.25	3.536	[yellow outline]	3.245	[yellow]	5.509	10.20	11.69	12.72	3.43	8.95	10.25	11.15	-0.11	-12.29%	-12.29%	-12.29%
BSB005a	W 3RD STREET	MILL CREEK	24±			1.973	[salmon outline]	0.245	[pink]		8.46	9.61	10.41	1.62	6.93	7.87	8.53	-0.36	-18.13%	-18.13%	-18.13%
BSB006	GEST STREET	MILL CREEK	78	CSO 430	213.54	40.477	[purple outline]	29.104	[purple]	40.477	109.26	125.76	137.22	39.69	111.30	128.11	139.78	-0.79	1.86%	1.86%	1.86%
BSB007	HOPKINS STREET	MILL CREEK	72	CSO 431	302.73	5.585	[cyan outline]	2.438	[cyan]	34.704	13.62	15.71	17.16	5.89	13.78	15.89	17.36	0.31	1.16%	1.16%	1.16%
BSB008	HOPKINS STREET	MILL CREEK	72			21.536	[lavender outline]	18.660	[lavender]		61.25	70.32	76.62	24.45	73.19	84.03	91.54	2.91	19.49%	19.49%	19.49%
BSB009	WADE WALK	MILL CREEK	30			7.582	[peach outline]	3.906	[peach]		23.03	26.33	28.63	7.06	22.03	25.20	27.40	-0.52	-4.31%	-4.31%	-4.31%
BSB010	W. LIBERTY STREET	MILL CREEK	114	CSO 666	1032.70	6.285	[dark green outline]	3.714	[dark green]	45.889	19.48	22.31	24.28	6.78	21.55	24.68	26.85	0.49	10.60%	10.60%	10.60%
BSB011	WESTERN AVE.	MILL CREEK	30			1.920	[gold outline]	0.841	[gold]		5.57	6.36	6.90	1.70	4.92	5.61	6.10	-0.22	-11.68%	-11.68%	-11.68%
BSB012	FINDLAY STREET	MILL CREEK	24			7.660	[light blue outline]	4.744	[light blue]		28.29	32.16	34.86	7.84	29.69	33.75	36.59	0.18	4.96%	4.96%	4.96%
BSB013A	YORK ST/DALTON AVE.	MILL CREEK	30			3.069	[black outline]	1.040	[grey]		10.07	11.51	12.52	2.18	7.33	8.38	9.11	-0.89	-27.22%	-27.22%	-27.22%
BSB013B	YORK ST/DALTON AVE.	MILL CREEK	15			5.517	[magenta outline]	2.710	[magenta]		18.96	21.65	23.52	5.51	19.18	21.90	23.79	0.00	1.17%	1.17%	1.17%
BSB014	BANK STREET	MILL CREEK	78			21.439	[sea green outline]	13.047	[sea green]		71.21	81.31	88.32	22.01	79.67	90.96	98.81	0.57	11.87%	11.87%	11.87%
BSB015	HARRISSON AVENUE	MILL CREEK	54	CSO 004	64.48	15.121	[brown outline]	13.634	[tan]	15.121	42.25	48.35	52.58	15.24	46.29	52.97	57.61	0.12	9.56%	9.56%	9.56%
BSB016	BUCK STREET	MILL CREEK	24	CSO 006	-	16.330	[teal outline]	13.565	[teal]	-	42.13	48.31	52.60	16.21	46.81	53.68	58.45	-0.12	11.12%	11.12%	11.12%
BSB017	ALFRED STREET	MILL CREEK	12	CSO 007	-	6.752	[cream outline]	6.078	[cream]	-	21.28	24.29	26.37	6.87	21.95	25.05	27.20	0.12	3.15%	3.15%	3.15%

APPENDIX C

HORIZONTAL SCALE IN FEET
OHIO RIVER
PROPOSED OUTFALL P-BSB001
OUTFALL BSB001 OHIO RIVER REMOVED
OUTFALL BSB002 OHIO RIVER REMOVED
OUTFALL BSB004
OUTFALL BSB003 (CSO 438)
OUTFALL CSO 438
OUTFALL BSB005A (CSO 436)
OUTFALL BSB005 (CSO 436)
CSO 436
PROPOSED TRUNK LINE (OUTFALL - P-BSB001)
VAULT BSB006
CSO 430
CSO 431
CSO 666
CSO 004
CSO 006
CSO 007
OUTFALL BSB006 (CSO 430) MILL CREEK
OUTFALL BSB007 (CSO 431) MILL CREEK
VAULT BSB008
OUTFALL BSB008 (CSO 431) MILL CREEK
OUTFALL BSB009 (CSO 431) MILL CREEK
OUTFALL BSB010 (CSO 666) MILL CREEK
VAULT BSB010
OUTFALL BSB011 (CSO 666) MILL CREEK
VAULT BSB012 NORTH
VAULT BSB012 SOUTH
OUTFALL BSB012 (CSO 666) MILL CREEK
OUTFALL BSB013B (CSO 666) MILL CREEK
VAULT BSB013B
OUTFALL BSB013A (CSO 666) MILL CREEK
VAULT BSB013A
VAULT BSB014 WEST
VAULT BSB014 EAST
OUTFALL BSB014 (CSO 666) MILL CREEK
OUTFALL BSB015 (CSO 004) MILL CREEK
DETENTION BSB015
OUTFALL BSB016 (CSO 006) MILL CREEK
OUTFALL BSB017 (CSO 007) MILL CREEK
CLAY WADE BAILEY BR.
CENTRAL AVENUE
PLUM STREET
PAUL BROWN STADIUM
WESTERN AVENUE
WINCHELL AVENUE
DALTON AVENUE
PARKWAY
PROPOSED GRADE
EXISTING GRADE
PROPOSED TRUNK LINE
LEGEND

APPENDIX D

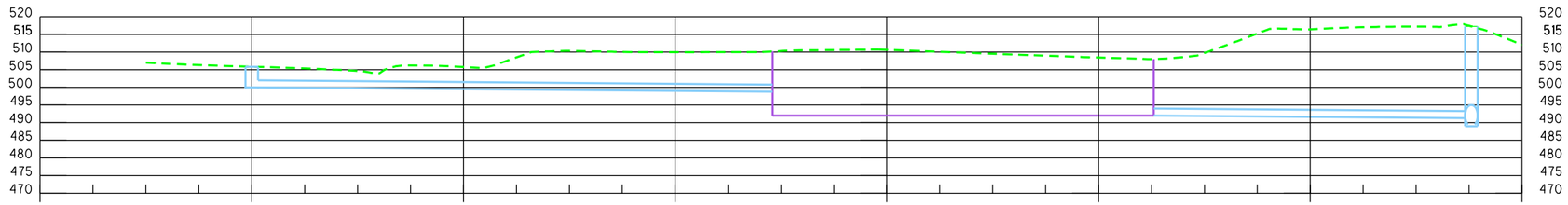
BRENT SPENCE BRIDGE PROJECT

PROPOSED DETENTION
OUTFALL BSB006

0 50
25 0
HORIZONTAL
SCALE IN FEET

OUTFALL
BSB006
(CSO 430)

VAULT
BSB006



VAULT BSB006
250' x 150' x 6'
5.17 AC-FT
Invert In: 498.00
Invert Out: 492.00
CSO 430 Connection: 489.54

BRENT SPENCE BRIDGE PROJECT

PROPOSED DETENTION
OUTFALL BSB007
OUTFALL BSB008

0 30 60
HORIZONTAL SCALE IN FEET

VAULT BSB008

OUTFALL BSB007 (CSO 431)

OUTFALL BSB008 (CSO 431)

WESTERN AVENUE

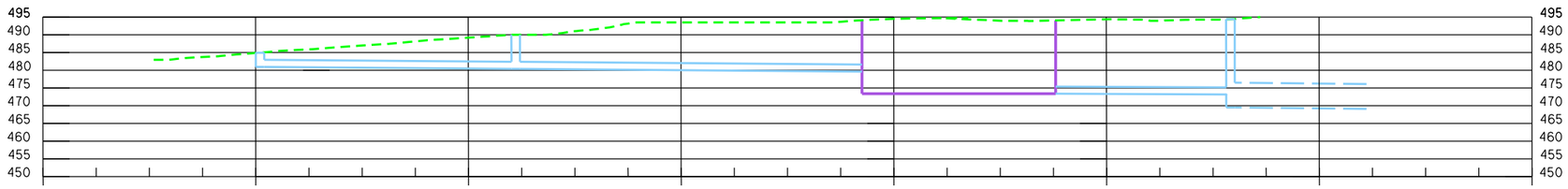
FREEMAN AVENUE

WINCHELL AVENUE

POT Sta. 79+16.52

POT Sta. 81+16.52

PC Sta. 83+68.47



VAULT BSB008
215' x 265' x 6'
4.02 AC-FT
Invert In: 479.62
Invert Out: 473.42
CSO 431 Connection: 469.49

BRENT SPENCE BRIDGE PROJECT

PROPOSED DETENTION OUTFALL BSB009

0 50 100 HORIZONTAL SCALE IN FEET

VAULT BSB009

OUTFALL BSB009 (CSO 666)

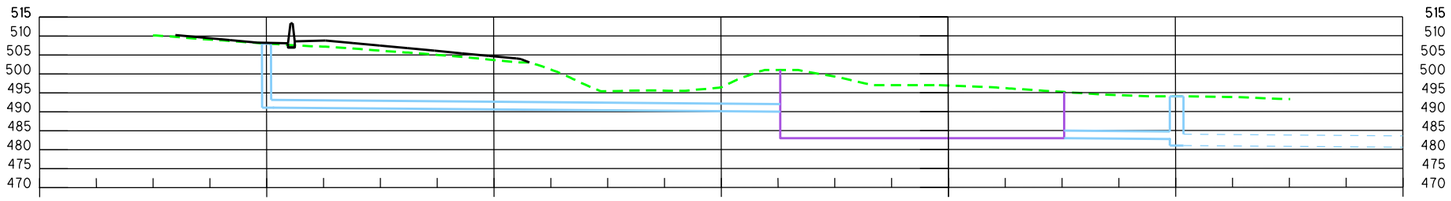
POT Sta. 79+16.52

POT Sta. 81+16.52

PC Sta. 83+68.41

RAMP F

CLARK ST

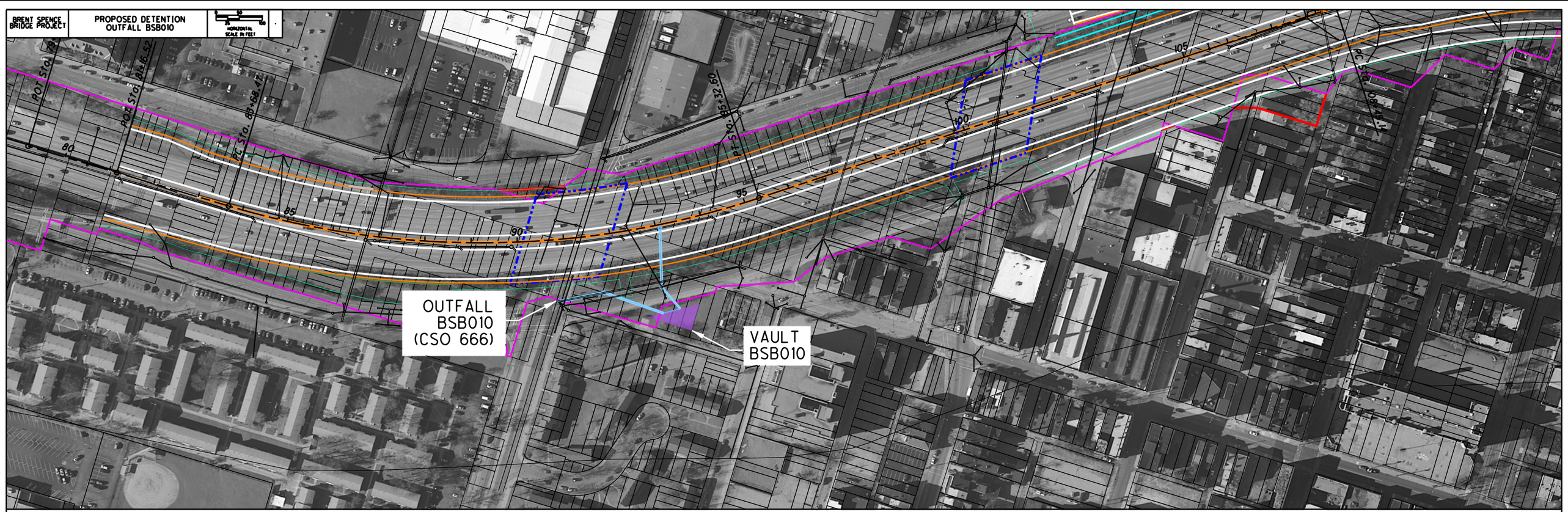


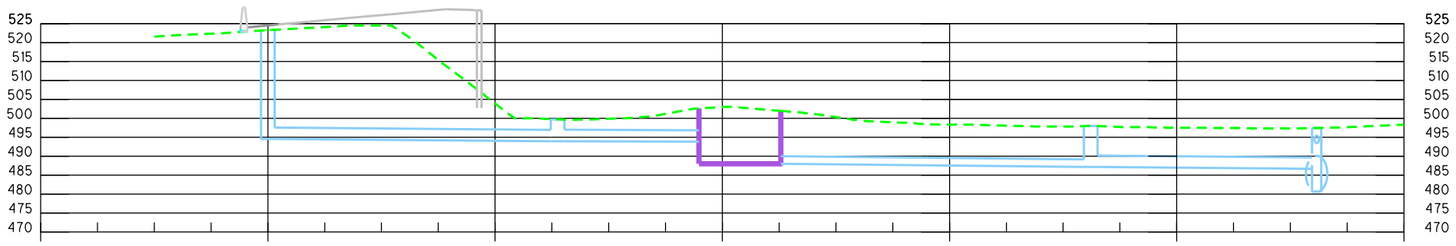
VAULT BSB009
106' x 120' x 7'
2.04 AC-FT
Invert In: 490.00
Invert Out: 483.00
CSO 431 Connection: 481.00

BRENT SPENCE BRIDGE PROJECT

PROPOSED DETENTION
OUTFALL BSB010

HORIZONTAL SCALE IN FEET



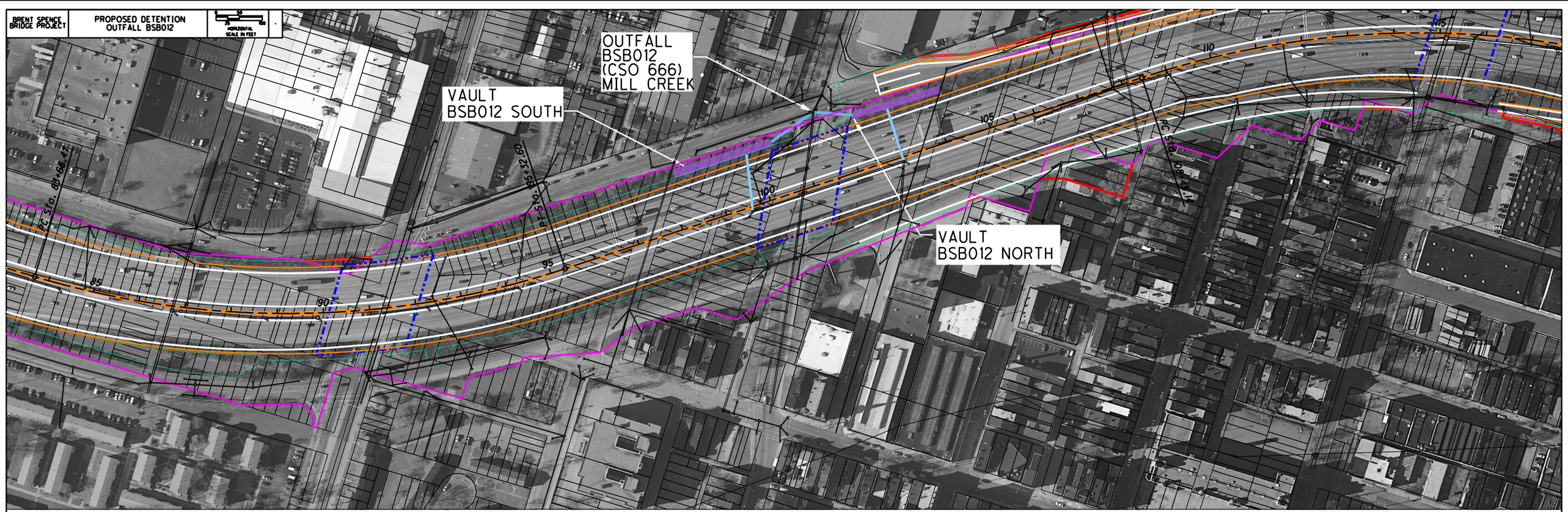


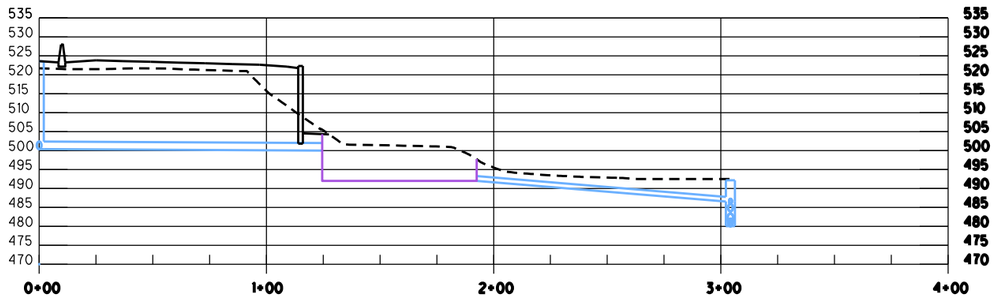
VAULT BSB010
100' x 60' x 7'
0.48 AC-FT
Invert In: 494.00
Invert Out: 487.00
CSO 666 Connection: 480.79

BRENT SPENCE BRIDGE PROJECT

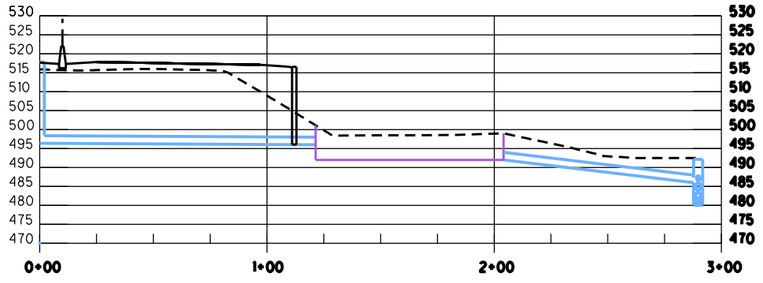
PROPOSED DETENTION
OUTFALL BSB012

0 30 60
HORIZONTAL SCALE IN FEET





VAULT BSB012 SOUTH
220' X 19' x 8'
0.77 AC-FT
Invert In: 500.00
Invert Out: 492.00
CSO 666 Connection: 480.06



VAULT BSB012 NORTH
195' x 16' x 4'
0.28 AC-FT
Invert In: 496.00
Invert Out: 492.00
CSO 666 Connection: 480.06

BRENT SPENCE BRIDGE PROJECT

PROPOSED DETENTION
OUTFALL BSB013A
OUTFALL BSB013B

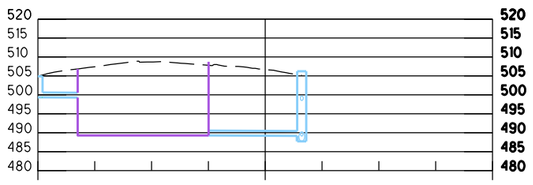
0 50 100
HORIZONTAL SCALE IN FEET

OUTFALL BSB013B (CSO 666) MILL CREEK

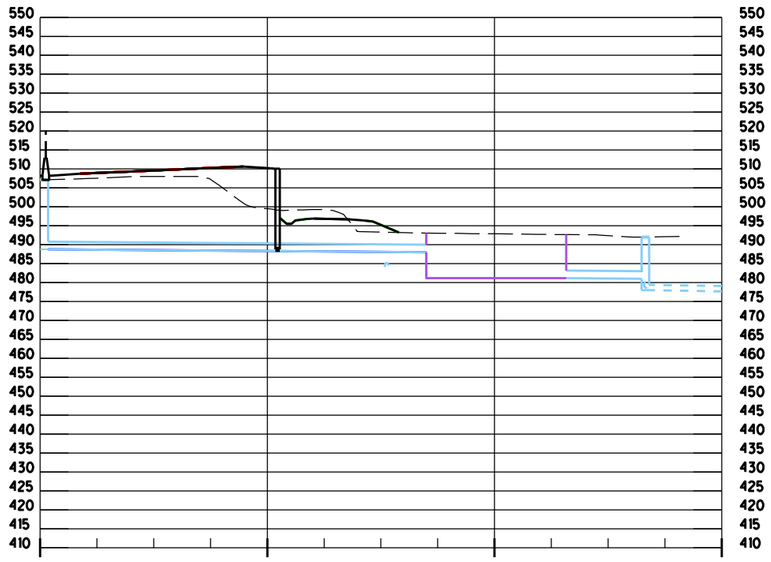
OUTFALL BSB013A (CSO 666) MILL CREEK

VAULT BSB013B

VAULT BSB013A



VAULT BSB013A
108′ x 80′ x 10′
0.99 AC-FT
Invert In: 499.29
Invert Out: 489.29
CSO 666 Connection: 487.72



VAULT BSB013B
106′ x 62′ x 7′
1.50 AC-FT
Invert In: 488.00
Invert Out: 481.00
CSO 666 Connection:

BRENT SPENCE BRIDGE PROJECT

PROPOSED DETENTION OUTFALL BSB014

HORIZONTAL SCALE IN FEET

OUTFALL BSB014 (CSO 666) MILL CREEK

VAULT BSB014 WEST

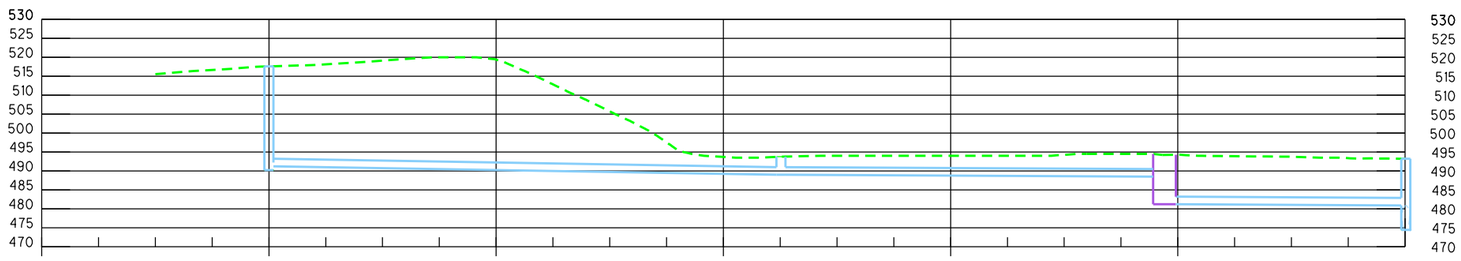
VAULT BSB014 EAST

DALTON AVENUE

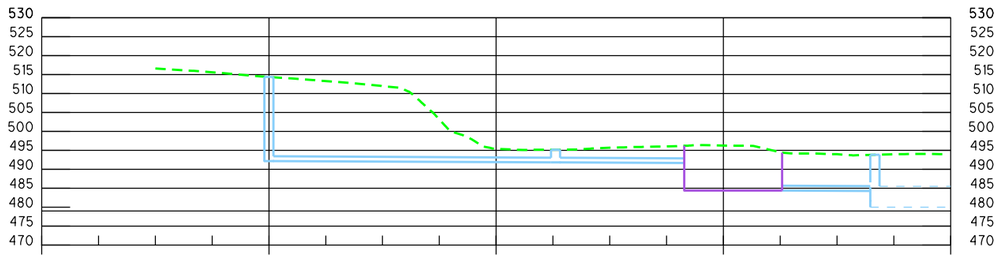
WINCHELL AVENUE

HARRISON AVE

WESTERN HILLS VIADUCT



VAULT BSB014 WEST
157' x 38' x 7.3'
1.00 AC-FT
Invert In: 488.50
Invert Out: 481.20
CSO 666 Connection: 474.60

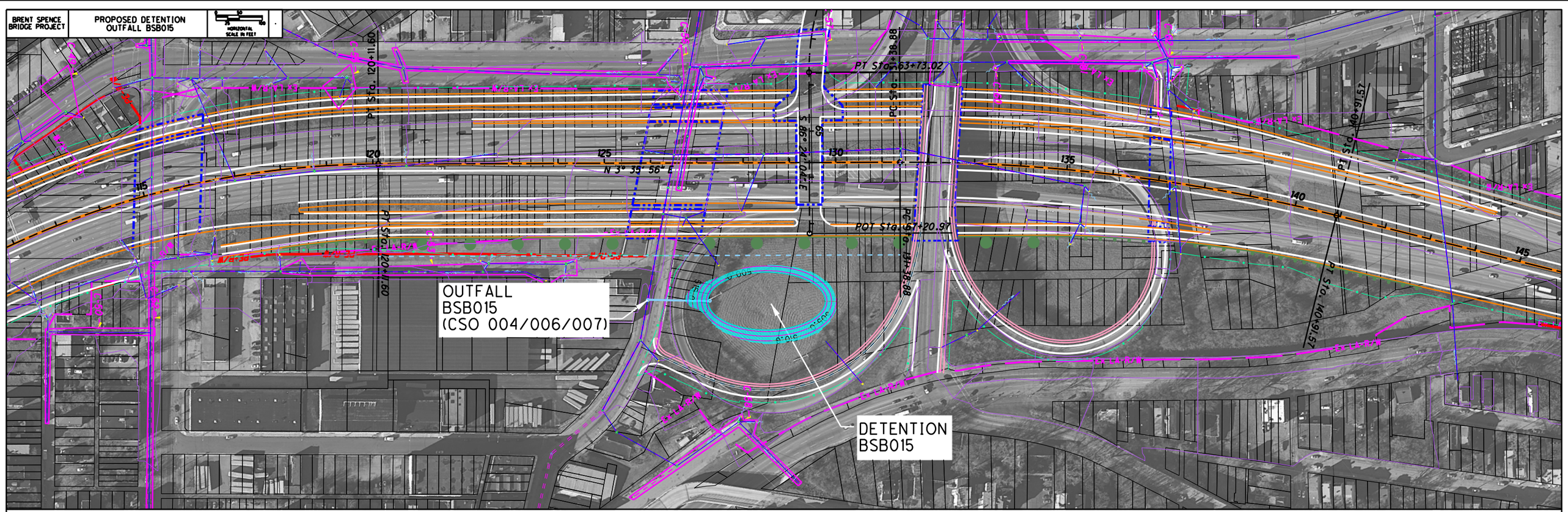


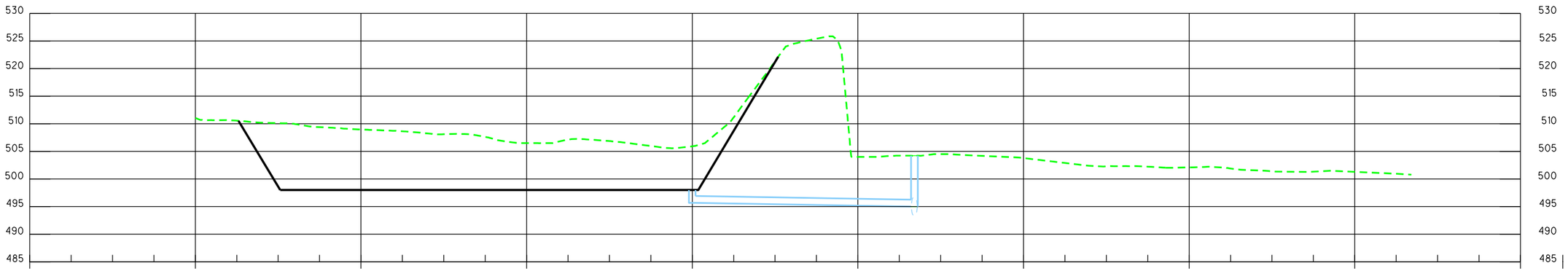
VAULT BSB014 EAST
108' x 58' x 7'
1.00 AC-FT
Invert In: 491.63
Invert Out: 484.39
CSO Connection: 479.50

BRENT SPENCE BRIDGE PROJECT

PROPOSED DETENTION OUTFALL BSB015

HORIZONTAL SCALE IN FEET





DETENTION BSB015
250' x 120' x 10'
5.63 AC-FT
Invert In: 506.70
Invert Out: 496.70
CSO 666 Connection: 493.50