

Appendix A. Figures and tables from the Explanatory, Confounding, and Auxiliary Variables Technical Memorandum.



Figure 1a. Moores Run watershed, Baltimore City drainage area revisions.

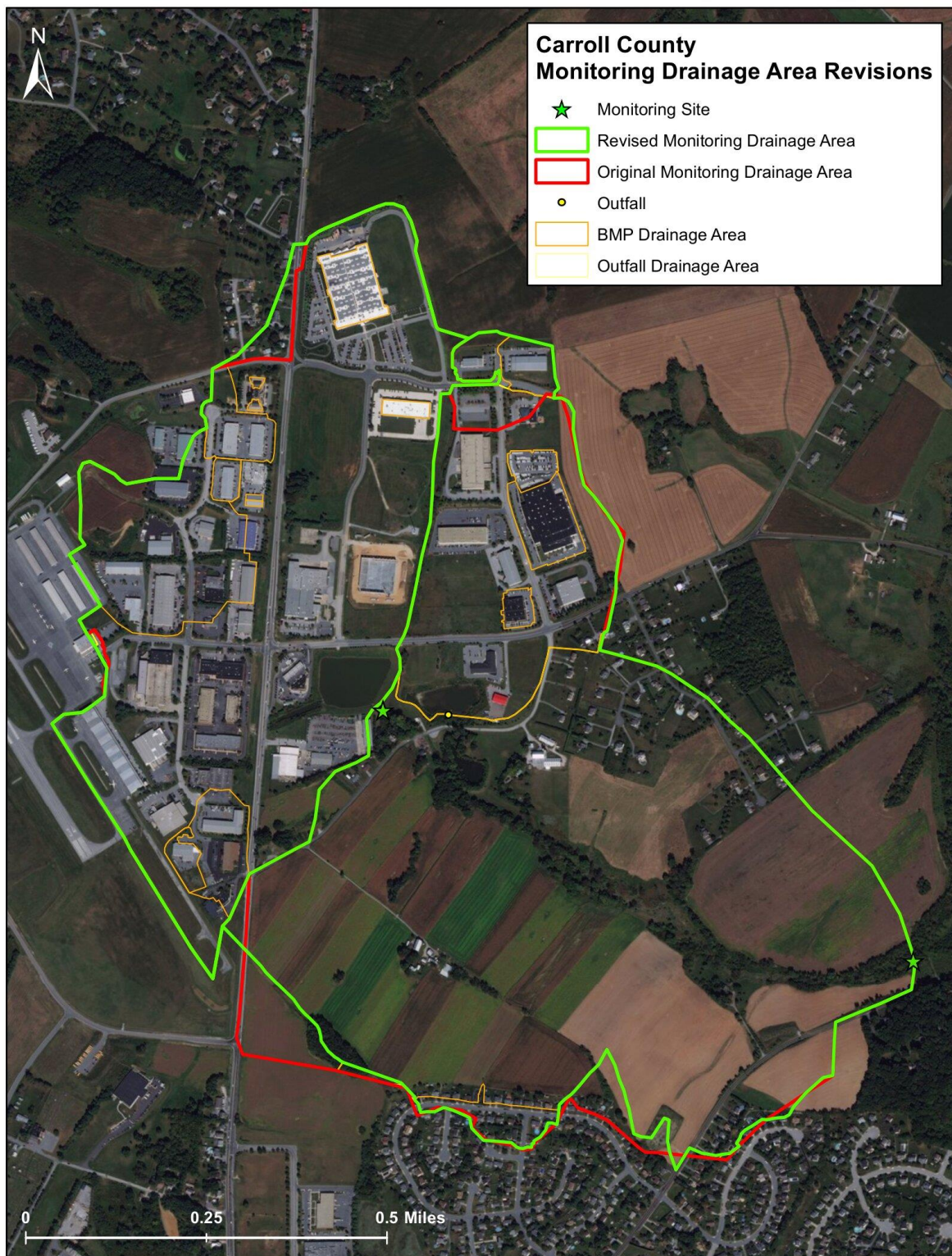


Figure 1b. Airpark Business Center watershed, Carroll County drainage area revisions.

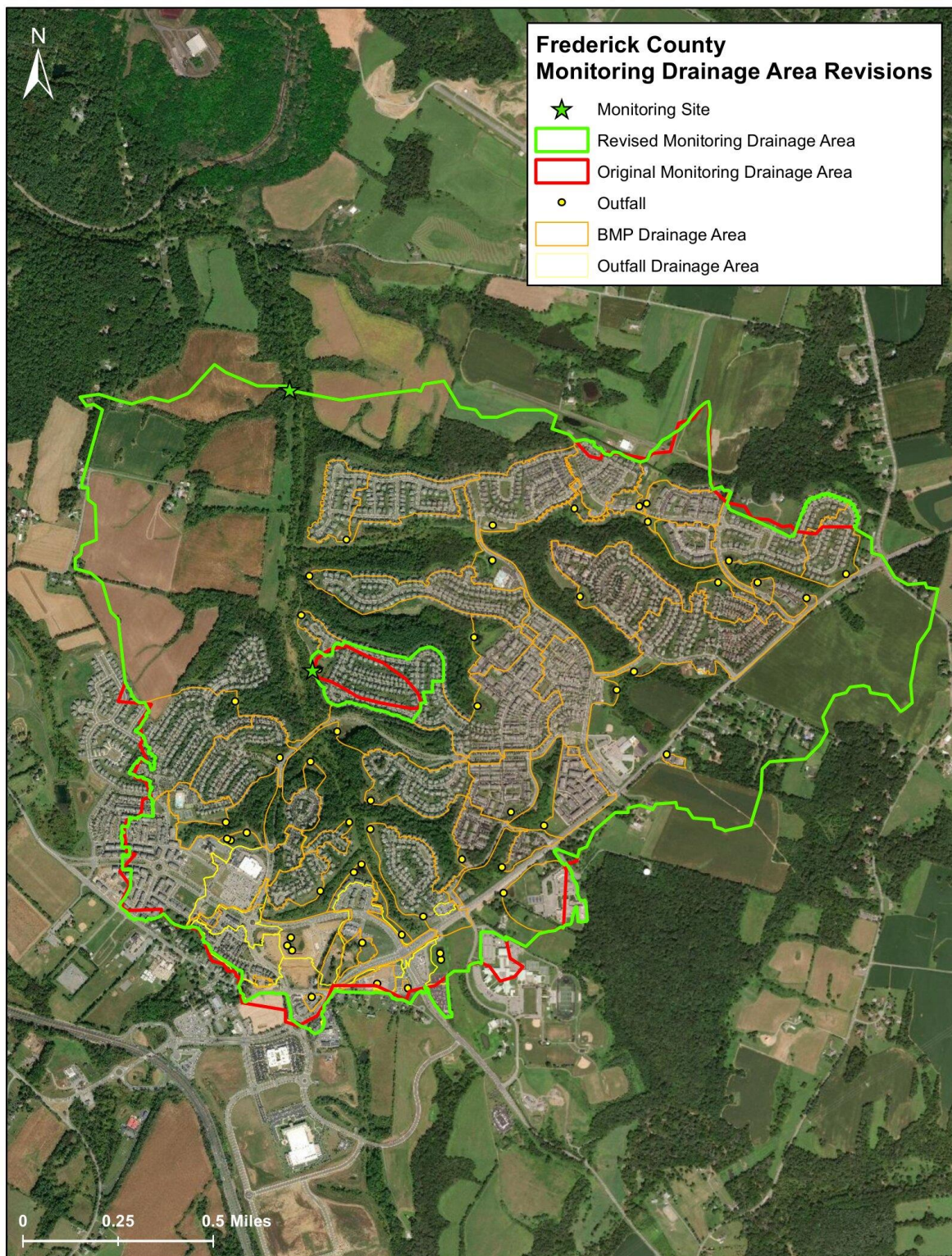


Figure 1c. Urbana watershed, Frederick County drainage area revisions.

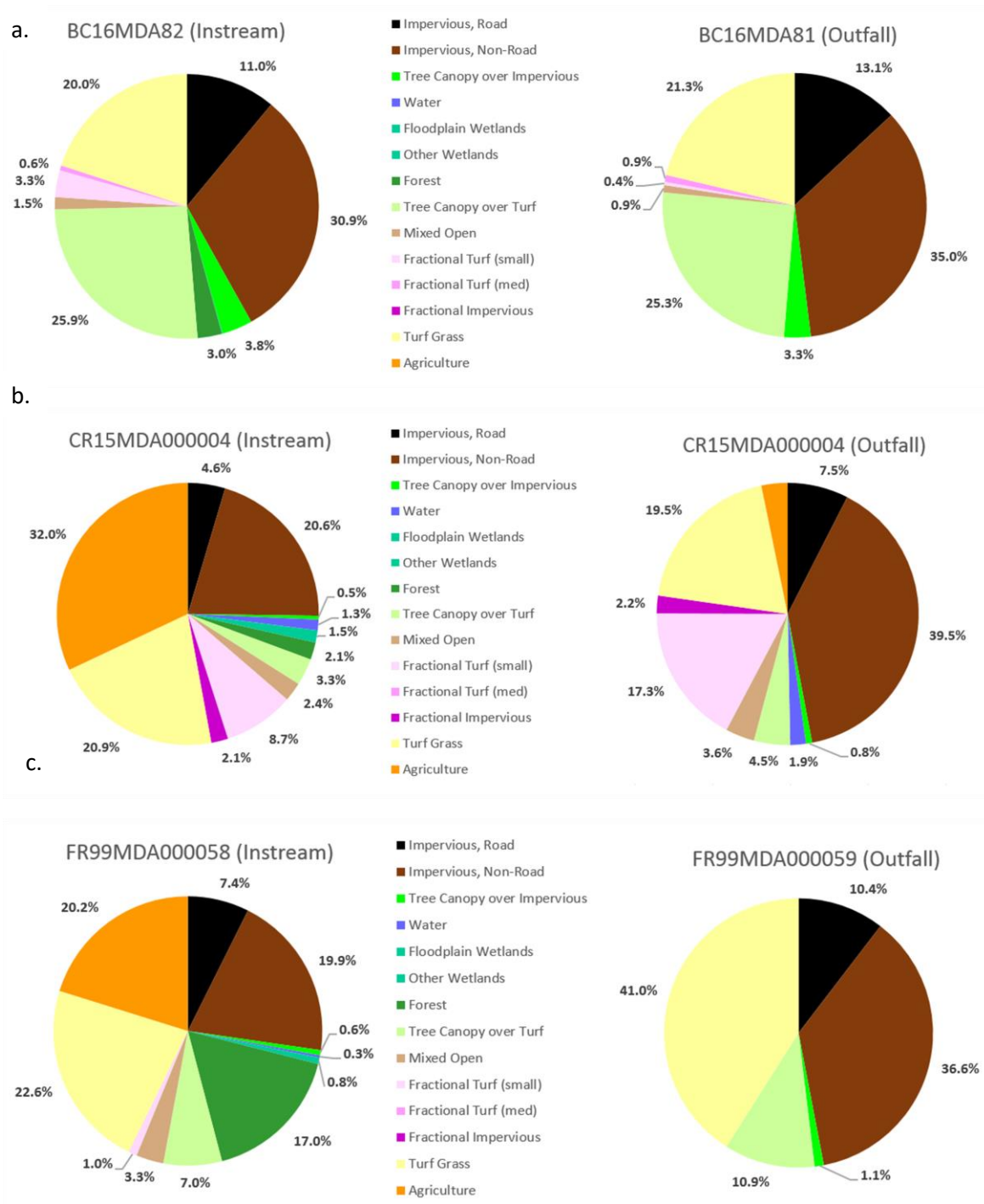


Figure 2a-2c. Monitoring area 2013 land use distribution for (a) BACI, (b) CACO, and (c) FRCO. Data source: Chesapeake Conservancy Conservation Innovation Center; <https://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-use-data-project/>.

Table 1. Number of New Development (NEWD), Redevelopment (REDE), Conversion (CONV), and Restoration (REST) BMPs in each monitoring area.

Jurisdiction	Site	Identifier	# NEWD	# REDE	# CONV	# REST
Baltimore City	Outfall	BC16MS000181	0	0	0	0
	Instream	BC16MS000182	5	5	1	0
Carroll County	Outfall	CR15MSI000003	12	0	1	0
	Instream	CR15MSI000004	18	0	1	1
Frederick County	Outfall	FR02MSI000059	1	0	0	0
	Instream	FR99MSI000058	54	7	0	0

Table 2. Baltimore City instream (BC16MS000182) BMP summary.

Year	Total Impervious Acres in Monitoring Drainage Area	Impervious Acres Treated by Ponds	Impervious Acres Treated by Other BMPs	Impervious Acres Treated by Combined Dry ED Pond + Sand Filter	% Monitoring Area Impervious Acres Treated
1982	1020.82	3.05	0.00	0.00	0.30%
1993	1021.89	4.12	0.00	0.00	0.40%
2003	1022.27	4.12	0.37	0.00	0.44%
2009	1023.01	4.12	1.11	0.00	0.51%
2013	1025.78	4.12	3.89	0.00	0.78%
2014	1025.78	4.12	4.06	0.00	0.80%
2015	1025.78	1.07	4.06	3.05	0.80%
2016	1025.78	1.07	5.44	3.05	0.93%

Table 3. Carroll County outfall (CR15MDA000003) BMP summary.

Year	Total Impervious Acres in Monitoring Drainage Area from MDE Digitization	Impervious Acres Treated by 1970's Era Wet Pond ¹	Impervious Acres Treated by Modern ED Wet Pond ¹	Impervious Acres Treated by Other BMPs	Nested Impervious Acres Treated	% Monitoring Area Impervious Acres Treated ²
2005	73.0	49.6	0.0	0.0	23.3	100.0% (31.9%)
2006	73.8	46.6	0.0	0.0	27.2	100.0% (36.9%)
2007	80.9	53.7	0.0	0.0	27.2	100.0% (33.6%)
2008	80.9	0.0	52.8	0.0	28.1	100.0%
2009	80.9	0.0	51.5	0.0	29.5	100.0%
2011	84.0	0.0	54.5	0.0	29.5	100.0%
2013	95.4	0.0	61.4	0.0	33.9	100.0%
2014	95.4	0.0	61.5	0.0	33.9	100.0%
2015	95.6	0.0	61.7	0.0	33.9	100.0%
2017	95.8	0.0	61.7	0.0	34.2	100.0%
2018	102.2	0.0	68.0	0.0	34.2	100.0%

1: The wet pond at the outfall captures everything in the monitoring area and the impervious acres treated should always be 100%. The impervious acres treated by the wet pond were adjusted so that the % monitoring area impervious acres treated was 100%. The pond was originally constructed in 1979 and was retrofitted to a modern ED wet pond in 2008. One possibility for the % monitoring area not equaling 100% before adjustment is that the BMPs implemented after the original pond was installed treated some of the existing impervious cover, whereas our analysis treated the BMPs as implemented for separate new developments. Another explanation could be that the BMPs were built before the development they were designed to treat and that their treated impervious acres were therefore reported in years prior to the actual impervious cover delineated from new development.

2: Numbers in parentheses represent percent captured by Modern BMPs (i.e., does not include 1979 Wet Pond)

Table 4. Carroll County instream (CR15MDA000004) BMP summary.

Year	Total Impervious Acres in Monitoring Drainage Area from MDE Digitization	Impervious Acres Treated by 1970's Era Wet Pond ¹	Impervious Acres Treated by Modern ED Wet Pond ¹	Impervious Acres Treated by Shallow Marsh	Impervious Acres Treated by Other BMPs	Nested Impervious Acres Treated	% Monitoring Area Impervious Acres Treated ²
2005	102.3	49.6	0.0	0.0	0.0	23.3	71.3% (22.8%)
2006	106.9	46.6	0.0	0.0	0.0	27.2	69.0% (25.4%)
2007	117.4	53.7	0.0	29.5	0.0	35.6	101.2% (55.5%)
2008	117.3	0.0	52.8	29.5	0.0	36.5	101.2%
2009	120.8	0.0	51.5	29.5	0.0	38.7	99.0%
2010	120.8	0.0	51.5	29.5	0.0	40.1	100.2%
2011	123.6	0.0	54.5	29.5	0.0	40.1	100.4%
2013	137.5	0.0	61.4	29.5	0.0	44.5	98.5%
2014	137.5	0.0	61.5	29.5	0.0	44.5	98.5%
2015	137.7	0.0	61.7	29.5	0.0	44.5	98.5%
2017	138.0	0.0	61.7	29.5	0.0	44.8	98.5%
2018	144.8	0.0	68.0	29.5	1.7	44.8	99.5%

1: The impervious acres treated by the wet pond were adjusted to match the changes made in the Carroll Co outfall (CR15MDA000003) calculations.

2: Numbers in parentheses represent percent captured by Modern BMPs (i.e., does not include 1979 Wet Pond).

Table 5. Frederick County outfall (FR02MDA000059) BMP summary.

Year	Total Impervious Acres in Monitoring Drainage Area from MDE Digitization	Impervious Acres Treated by Dry ED Pond ¹	Impervious Acres Treated by Other BMPs	% Monitoring Area Impervious Acres Treated
2005	13.1	13.1	0.0	100.0%

1: The dry ED pond at the outfall captures everything in the monitoring area and the impervious acres treated should always be 100%. The impervious acres treated by the pond were adjusted from 11.9 acres in the MS4 data to 13.1 acres so that the % monitoring area impervious acres treated was 100%.

Table 6. Frederick County instream (FR99MDA000058) BMP summary.

Year	Total Impervious Acres in Monitoring Drainage Area from MDE Digitization	Impervious Acres Treated by Dry ED Ponds ¹	Impervious Acres Treated by Micropool ED Ponds	Impervious Acres Treated by Wet ED Ponds	Impervious Acres Treated by Shallow Marsh	Impervious Acres Treated by Other BMPs	Impervious Acres Treated by Combined Dry ED Pond + Sand Filter	% Monitoring Area Impervious Acres Treated
2005	246.9	51.6	0.0	18.8	0.0	0.0	0.0	28.5%
2006	246.9	60.4	0.0	18.8	0.0	0.0	0.0	32.1%
2008	330.0	62.3	0.0	73.8	0.0	0.0	0.0	41.2%
2009	372.6	62.3	0.0	82.9	0.0	1.3	0.0	39.3%
2010	372.6	62.3	0.0	87.6	0.0	13.1	8.9	46.1%
2011	390.4	62.3	0.0	104.9	22.3	18.9	10.4	56.0%
2012	390.4	62.3	0.0	104.9	22.3	23.1	10.4	57.1%
2013	395.7	102.0	0.0	114.5	22.3	23.1	23.2	72.0%
2014	397.9	102.0	0.0	114.5	22.3	23.3	23.2	71.7%
2015	404.8	102.0	0.0	114.5	22.3	26.6	23.2	71.3%
2017	409.3	102.0	0.0	114.5	22.3	26.7	23.2	70.5%
2018	409.8	102.0	15.9	114.5	22.3	26.7	23.2	74.3%

1: 1.2 treated acres were added to the dry ED ponds starting in 2005 to account for the change made in the Frederick Co outfall calculations (FR02MDA000059) calculations above in Table 5.

Table 7. Monitoring area 2013 land use distribution. Data source: Chesapeake Conservancy Conservation Innovation Center; <https://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-use-data-project>.

Land Use	BC16MS000I82 (Instream)	BC16MS000I81 (Outfall)	CR15MDA000004 (Instream)	CR15MDA000003 (Outfall)	FR99MDA000058 (Instream)	FR02MDA000059 (Outfall)
Impervious, Road	247.9	14.8	25.5	15.6	116.9	3.1
Impervious, Non-Road	693.4	39.6	114.5	81.9	315.4	11.0
Tree Canopy over Impervious	84.4	3.7	2.6	1.6	10.0	0.3
Water	0.0	0.0	7.3	4.0	4.6	0.0
Floodplain Wetlands	0.0	0.0	8.4	0.0	0.0	0.0
Other Wetlands	1.6	0.0	0.0	0.0	11.9	0.0
Forest	67.1	0.0	11.8	0.0	268.7	0.0
Tree Canopy over Turf	583.2	28.6	18.5	9.3	111.3	3.3
Mixed Open	33.4	1.0	13.1	7.4	52.3	0.0
Fractional Turf (small)	73.6	0.4	48.4	35.9	16.2	0.0
Fractional Turf (medium)	13.6	1.0	0.0	0.0	0.0	0.0
Fractional Impervious ¹	0.0	0.0	11.5	4.5	0.0	0.0
Turf Grass	449.4	24.1	115.9	40.5	357.5	12.3
Agriculture	0.0	0.0	177.7	6.7	319.9	0.0
Total Acres	2247.6	113.2	555.2	207.3	1584.6	30.1
Total Impervious Acres ²	1025.8	58.1	146.1	100.4	442.3	14.5
Percentage Impervious	45.6%	51.3%	26.3%	48.4%	27.9%	48.1%

¹Fractional impervious consists of 30% impervious cover.

²Total impervious acres includes the acres of impervious, road; impervious, non-road; tree canopy over impervious; and 30% of the fractional impervious acres.