WATERSHED ANALYSIS OF THE MYSTIC RIVER AND NEPONSET RIVER WATERSHEDS

TASK 3D TECHNICAL REPORT
MYSTIC RIVER WATERSHED ENVIRONMENTAL JUSTICE ANALYSIS

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Prepared for:

U.S. EPA Region 1

Prepared by:

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1 INTRODUCTION

The highly developed Mystic River Watershed drains into Boston Harbor and faces multiple water quality impairments primarily from nutrients (phosphorus and nitrogen) and pathogens from human activity and urban development. These impairments are evidenced by algal blooms and macrophyte growth which contribute to anoxic bottom waters that do not support aquatic life, reduce water clarity, degrade the aesthetic quality of the river, and impair designated uses such as fishing, swimming, and boating. The Mystic River Alternative TMDL was published in January 2020 and provides an adaptive approach to managing phosphorus nutrient pollution to improve water quality and attain water quality standards (USEPA, 2020). The alternative TMDL identifies stormwater runoff as the main source of nutrient loads within the watershed that, when calculated under existing conditions, requires a 62-67% reduction of stormwater total phosphorus (TP) loadings. On August 24, 2020, the U.S. Environmental Protection Agency (EPA) received a residual designation petition from the Conservation Law Foundation and the Charles River Watershed Association for the Mystic River Watershed. The petition requests that EPA uses its residual designation authority (RDA) to regulate discharges of stormwater from commercial, industrial, institutional, and multi-family residential (CIIM) properties of one acre or greater under the National Pollutant Discharge Elimination System (NPDES) program to meet water quality standards (WQS) in Boston Harbor.

Several communities in areas with environmental justice (EJ) concerns are located within the Mystic River Watershed. These communities need further evaluation to better understand the effects of increased stormwater control requirements based on EPA Region 1's potential permitting decisions. This report builds on the methodology and results of watershed-wide analyses of parcel-level stormwater TP and total nitrogen (TN) loading (Paradigm Environmental, 2023a) by further evaluating parcels within areas with environmental justice concerns. Key information presented in this report includes a description of the factors used to define areas with environmental justice concerns, an analysis of census tracts in areas with environmental justice concerns, and an analysis of the parcels, particularly CIIM parcels, within areas with environmental justice concerns. The approximate TP and TN loads from parcels in areas with environmental justice concerns are quantified based on varying thresholds of impervious cover (IC) area; these loads and the number of parcels impacted are put in the context of the broader watershed to support decision-making on additional stormwater permitting. Lastly, the potential effects of permitting decisions on areas with environmental justice concerns are visualized through GIS overlay analysis and the potential co-benefits of increased stormwater controls in these areas (e.g., reducing flood vulnerability, urban heat islands, and increasing groundwater recharge) are briefly described.

2 APPLICABLE ENVIRONMENTAL JUSTICE FACTORS

For the analyses presented in this report, areas with environmental justice concerns were defined by three different factors as identified by EPA Region 1 for this analysis based on data from the Climate and Economic Justice Screening Tool (CEJST). CEJST, available at https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5[1], is a national tool that was developed to help federal agencies locate and identify environmentally and economically disadvantaged communities. CEJST uses census tracts, which are a small unit of geography defined by the U.S. Census Bureau, giving users access to high-resolution information. The tool uses datasets, primarily from the 2010 census, as indicators of burdens. The burdens are organized into categories.

The three criteria used to identify areas with environmental justice concerns within the Mystic River Watershed for this analysis, as identified by US EPA Region 1, are:

- *Low Median Household Income*: Any census tract with greater than or equal to the 80th percentile for low median household income as a percent of area median income,
- *Linguistic Isolation*: Any census tract with greater than or equal to the 80th percentile for households in linguistic isolation,
- *Disadvantaged:* Any census tract defined as "Disadvantaged" in CEJST.

2.1 Definitions

Definitions of specific terms used in CEJST, and for the selected criteria, are given below. These, and additional information, can be found at https://screeningtool.geoplatform.gov/en/methodology#3/33.47/-97.5 or the provided link.

Burden categories: there are several different burden categories, including, climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

Census tracts: are small units of geography. Census tract boundaries for statistical areas are determined by the U.S. Census Bureau once every ten years. The tool utilizes the census tract boundaries from 2010. This was chosen because many of the data sources in the tool currently use the 2010 census boundaries.

Disadvantaged: A community is highlighted as disadvantaged on the CEJST map if it is in a census tract that is: (1) at or above the threshold for one or more environmental, climate, or other burdens, and (2) at or above the threshold for an associated socioeconomic burden. In addition, a census tract that is surrounded by disadvantaged communities and is at or above the 50% percentile for low-income is also considered disadvantaged.

Linguistic Isolation: is defined as "the share of households where no one over age 14 speaks English very well." https://screeningtool.geoplatform.gov/en/methodology#ling-iso

Low Median Household Income: is defined as the percentage of a census tract's population in households where household income is at or below 200% of the Federal poverty level, not including students enrolled in higher education. https://screeningtool.geoplatform.gov/en/methodology#low-income

[1] Additional information on CEJST can be found at: https://screeningtool.geoplatform.gov/en/downloads#3/33.84/-76.34 (see links to the Technical Support Document and Instructions to Federal Agencies On the Use of CEJST).

3 ENVIRONMENTAL JUSTICE DATA ANALYSES

The census tracts in areas with environmental justice concerns meeting the criteria specified in Section 2 were mapped and the area within the Mystic River Watershed was evaluated. The breakdown of parcel types and loads within these areas is shown in Section 3.2 and the CIIM subset is shown in Section 3.3. Spatial analyses of areas with environmental justice concerns with other datasets is shown in Section 3.4.

3.1 Watershed Overview

Within the Mystic River Watershed, there are 65 census tracts identified as having environmental justice concerns based on the criteria specified in Section 2, out of the 150 total census tracts in the watershed. Figure 3-1 shows that these areas are concentrated in the lower, more urbanized, portions of the watershed; this figure also shows the overlap of the different criteria. The census tracts in areas with environmental justice concerns are within thirteen of the twenty-one municipalities in the watershed. Table 3-1 provides the breakdown of the areas with environmental justice concerns by criteria for each municipality. Linguistic isolation is the predominant factor covering 96% of all tracts in areas with environmental justice concerns, 55% of tracts in areas with environmental justice concerns are Disadvantaged, and 22% meet the Low Median Household Income threshold. Nineteen percent of the tracts in areas with environmental justice concerns meet all three of the criteria.

For municipalities where Linguistic Isolation makes up more than 5% of the tracts in areas with environmental justice concerns, the other languages spoken were evaluated using data available at: https://mass-eoeea.maps.arcgis.com/apps/MapSeries/index.html?appid=535e4419dc0545be980545a0eeaf9b53. The data from this tool is based on the Census Bureau's 2015 American Community Survey and represents the percentage of a census tract's population that does not speak English well. This information was aggregated by municipality for tracts within the Mystic River Watershed that were identified as having environmental justice concerns as shown in Table 3-2. Spanish Creole is the dominate language for these populations in many of these tracts, with Portuguese Creole, French Creole, and Chinese also being common.

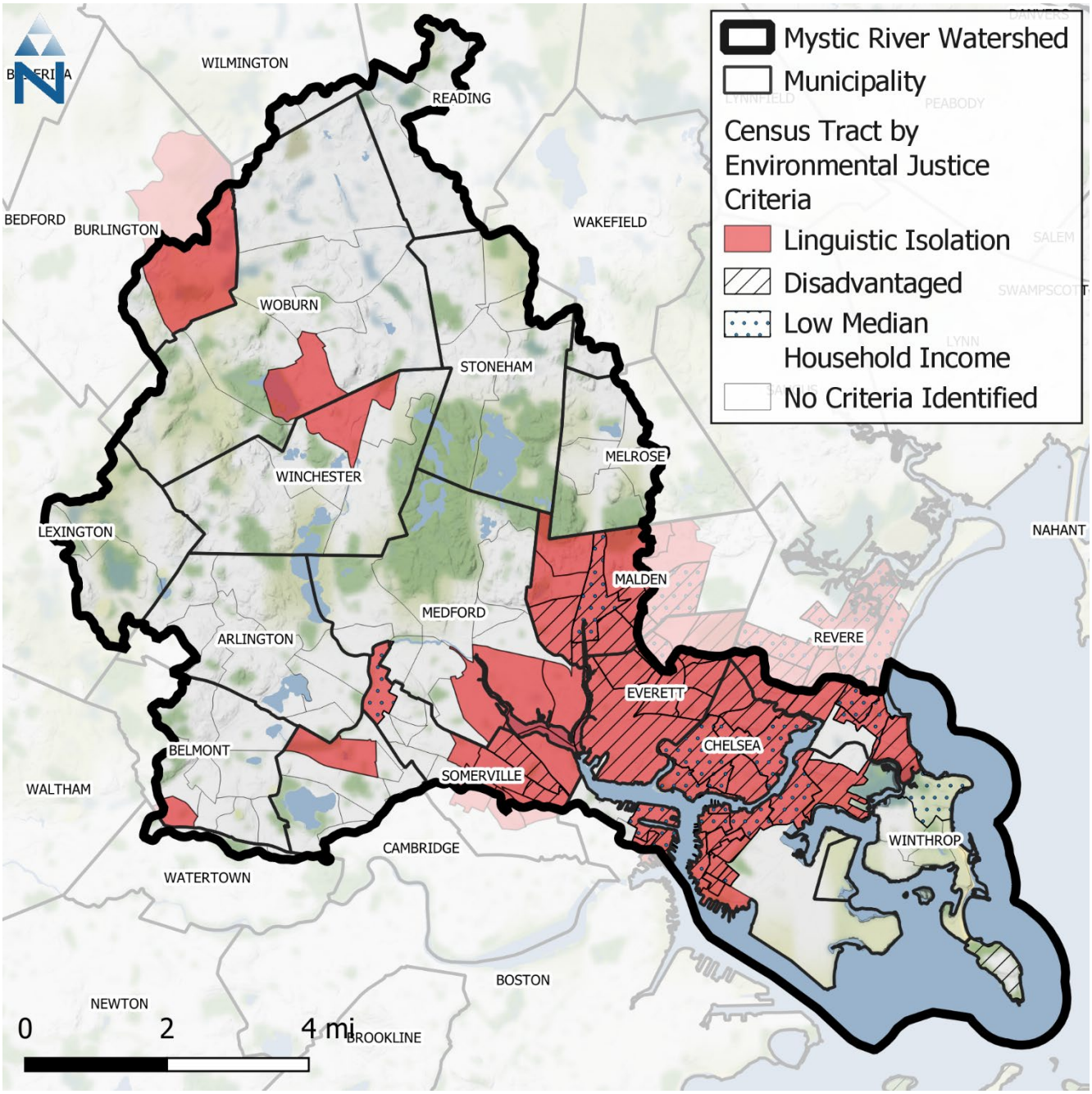

Figure 3-1. Map of census tracts in areas with environmental justice concerns by criteria.

Table 3-1. Summary of tracts in areas with environmental justice concerns by municipality and environmental justice criteria*

Municipality	Any Criteria[1]		Linguistic Isolation		Low Median Household Income		Disadvantaged		All Criteria[2]	
	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage
BELMONT	108.3	0.9%	108.3	0.9%	0.0	0.0%	0.0	0.0%	0.0	0.0%
BOSTON	1,622.4	13.0%	1,419.7	11.4%	795.0	6.4%	1,518.2	12.2%	795.0	6.4%
BURLINGTON	1,010.6	8.1%	1,010.6	8.1%	0.0	0.0%	0.0	0.0%	0.0	0.0%
CAMBRIDGE	319.7	2.6%	319.7	2.6%	0.0	0.0%	0.0	0.0%	0.0	0.0%
CHELSEA	1,414.5	11.3%	1,414.5	11.3%	892.4	7.1%	1,414.5	11.3%	892.4	7.1%
EVERETT	1,750.9	14.0%	1,750.9	14.0%	28.4	0.2%	1,750.9	14.0%	28.4	0.2%
MALDEN	1,766.4	14.1%	1,766.4	14.1%	333.5	2.7%	965.4	7.7%	333.5	2.7%
MEDFORD	1,212.5	9.7%	1,212.5	9.7%	0.0	0.0%	0.0	0.0%	0.0	0.0%
REVERE	874.7	7.0%	874.7	7.0%	256.3	2.1%	874.1	7.0%	255.7	2.0%
SOMERVILLE	1,189.2	9.5%	1,189.2	9.5%	198.4	1.6%	317.2	2.5%	0.0	0.0%
WINCHESTER	432.4	3.5%	432.4	3.5%	0.0	0.0%	0.0	0.0%	0.0	0.0%
WINTHROP	281.1	2.3%	0.0	0.0%	281.1	2.3%	0.0	0.0%	0.0	0.0%
WOBURN	510.5	4.1%	510.5	4.1%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Environmental Justice Total	**12,493.3**	**100.0%**	**12,009.5**	**96.1%**	**2,785.2**	**22.3%**	**6,840.2**	**54.8%**	**2,305.0**	**18.5%**

* A darker color gradient represents increasing value within a column.
[1]Any Criteria: at least one of the environmental justice criteria is met within a census tract.
[2]All Criteria: all three environmental justice criteria are met within a census tract.

Table 3-2. Top three languages for populations (%) in census tracts in areas with environmental justice concerns that do not speak English well by municipality

Municipality	> 5% of tracts in areas with environmental justice concerns are Linguistic Isolation	African Languages	Arabic	Chinese	French Creole	Italian	Other Indic	Portuguese Creole	Spanish Creole
BELMONT	No	--	--	--	--	--	--	--	--
BOSTON	Yes	--	2.1%	1.9%	--	--	--	--	34.5%
BURLINGTON	Yes	--	--	1.3%	1.2%	--	--	--	1.6%
CAMBRIDGE	No	--	--	--	--	--	--	--	--
CHELSEA	Yes	0.7%	--	--	--	--	--	1.6%	36.8%
EVERETT	Yes	--	--	--	4.8%	--	--	8.5%	10.3%
MALDEN	Yes	--	--	11.4%	2.5%	--	--	--	2.6%
MEDFORD	Yes	--	--	--	2.6%	2.3%	--	2.9%	--
REVERE	Yes	--	4.3%	--	--	--	--	2.0%	14.2%
SOMERVILLE	Yes	--	--	--	--	--	1.5%	4.3%	4.8%
WINCHESTER	No	--	--	--	--	--	--	--	--
WINTHROP	No	--	--	--	--	--	--	--	--
WOBURN	No	--	--	--	--	--	--	--	--

3.2 Parcel Analysis

Pollutant load and other attributes for parcels in areas with environmental justice concerns are presented in this section based on the analysis conducted for the entire watershed (Paradigm Environmental, 2023a). Parcels in areas with environmental justice concerns are defined as any parcel within or overlapping a census tract with environmental justice concerns. For these parcels, the annual average TP and TN loads from private and public properties based on the parcel Use Group are quantified over the 2007-2016 period used in the Mystic River Watershed Alternative TMDL (USEPA, 2020a). The total watershed baseline TP load from unattenuated stormwater for this period is 40,660 lb/yr; a watershed-wide 62-67% required reduction in TP load (25,209 lb/yr) is specified in the Alternative TMDL. A 62% reduction in stormwater total phosphorus loads was used in this analysis to represent the estimated load reduction required under baseline conditions (USEPA 2020) and for consistency with the watershed-wide analysis (Paradigm Environmental, 2023a). These values and analyses exclude parcels within combined sewer areas (i.e., areas where stormwater is assumed to be treated already).

A total of 36,119 parcels were identified as being within census tracts in areas with environmental justice concerns after excluding combined sewer areas. The parcels are predominately Multifamily and Single Family Residential, which represent 82% of all parcels in areas with environmental justice concerns by count but only 22% by land area. Private commercial, industrial, and institutional make up 9% of parcels in areas with environmental justice concerns. Figure 3-2 illustrates the distribution of summary attributes by Public/Private designation for all parcels in areas with environmental justice concerns. Private parcels account for 97% of parcels and 52% of the total parcel area. Fifty-nine percent of total parcel area is impervious cover. In terms of nutrient loading, private parcels contribute 60% of the total TP and TN. Loading from IC within private parcels amounts to 96% of the total TP and 95% of the total TN load from private parcels. Table 3-3 and Table 3-4 provide additional details on the parcel count, parcel area, IC area and load by source (i.e., impervious or pervious) for all parcels not in Combined Sewer Areas (non-CSA parcels) in areas with environmental justice concerns by Use Group and Private/Public designation for TP and TN, respectively.

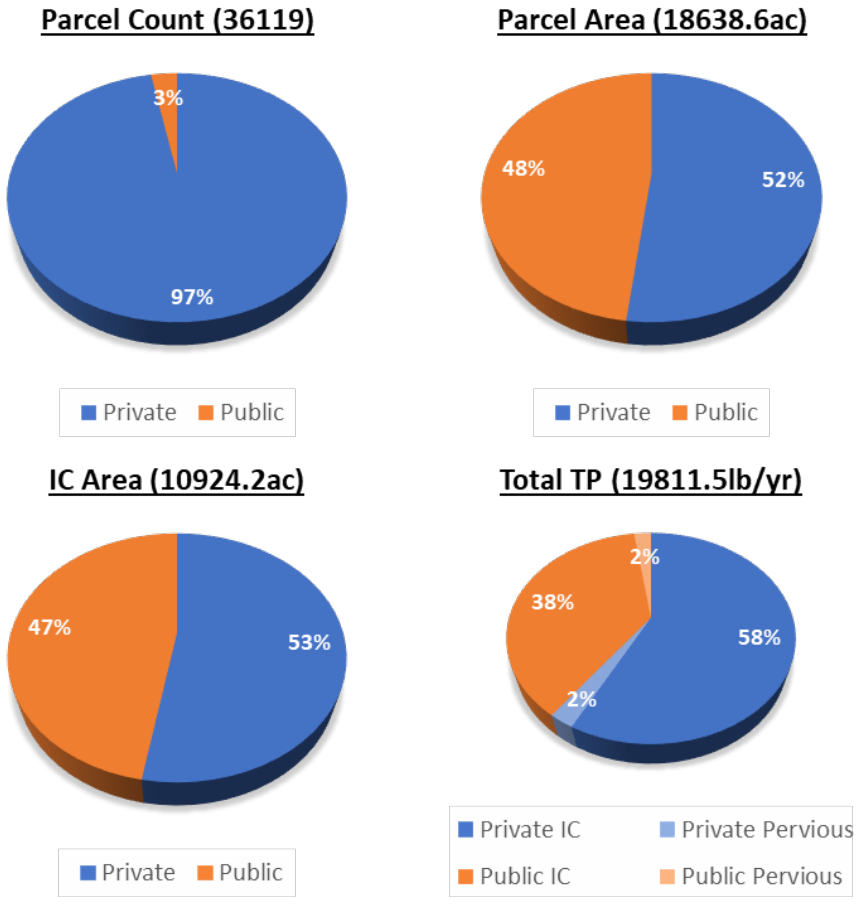

Figure 3-2. Private/Public summaries for all parcels in areas with environmental justice concerns within the Mystic River Watershed.

Table 3-3. Summary of attributes for all non-CSA parcels in the Mystic River Watershed in areas with environmental justice concerns by Use Group and Public/Private designation with TP*

Public/ Private	Use Group	Count	Count (%)	Total Area (ac)	Total Area (%)	IC Area			TP Load (lb/yr)				
						Acre	% IC of Total Area	Parcel Avg. (ac)	IC	Pervious	Total	Total (%)	Parcel Total Avg.
Private	Agriculture	28	0.08	9.89	0.05	5.46	55.18	0.19	9.77	0.26	10.03	0.05	0.36
	Commercial	2,561	7.09	3,948.25	21.18	2,375.55	60.17	0.93	4,283.77	184.57	4,468.34	22.55	1.74
	Industrial	330	0.91	814.58	4.37	642.84	78.92	1.95	1,153.60	26.05	1,179.65	5.95	3.57
	MultiFamily Res.	17,985	49.79	2,551.67	13.69	1,704.45	66.80	0.09	3,997.86	105.45	4,103.31	20.71	0.23
	Open Land	2,226	6.16	545.29	2.93	186.26	34.16	0.08	321.60	49.71	371.30	1.87	0.17
	Private Inst.	329	0.91	215.97	1.16	121.91	56.45	0.37	219.57	12.14	231.71	1.17	0.70
	Right-of-Way	17	0.05	3.51	0.02	1.43	40.86	0.08	2.16	0.31	2.47	0.01	0.15
	Single Family Res.	11,563	32.01	1,595.22	8.56	723.84	45.38	0.06	1,428.50	93.35	1,521.85	7.68	0.13
	Water	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**35,039**	**97.0**	**9,684.38**	**52.0**	**5,761.75**	**59.5**	--	**11,416.82**	**471.85**	**11,888.67**	**60.0**	--
Public	Agriculture	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Commercial	3	0.01	5.64	0.03	4.32	76.64	1.44	7.78	0.26	8.04	0.04	2.68
	Industrial	2	0.01	1.38	0.01	1.15	83.72	0.58	2.07	0.04	2.12	0.01	1.06
	MultiFamily Res.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Land	35	0.10	548.77	2.94	3.77	0.69	0.11	6.34	103.52	109.86	0.55	3.14
	Public Inst.	863	2.39	2,296.33	12.32	716.47	31.20	0.83	1,256.14	191.65	1,447.79	7.31	1.68
	Right-of-Way	154	0.43	5,683.41	30.49	4,433.62	78.01	28.79	6,193.62	152.49	6,346.10	32.03	41.21
	Single Family Res.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Water	23	0.06	418.72	2.25	3.07	0.73	0.13	4.51	4.41	8.92	0.05	0.39
	Subtotal	**1,080**	**3.0**	**8,954.24**	**48.0**	**5,162.40**	**57.7**	--	**7,470.45**	**452.38**	**7,922.83**	**40.0**	--
EJ Total		**36,119**	**100**	**18,638.62**	**100**	**10,924.15**	**58.6**	--	**18,887.27**	**924.23**	**19,811.50**	**100**	--
Watershed Total		**108,810**	**33%**	**48,234.72**	**39%**	**20,720.21**	**53%**		**37,625.48**	**3,034.80**	**40,660.29**	**49%**	

* A darker color gradient represents increasing value within a column.

Table 3-4. Summary of attributes for all non-CSA parcels in the Mystic River Watershed in areas with environmental justice concerns by Use Group and Public/Private designation with TN*

Public/ Private	Use Group	Count	Count (%)	Total Area (ac)	Total Area (%)	IC Area			TN Load (lb/yr)				
						Acre	% IC of Total Area	Parcel Avg. (ac)	IC	Pervious	Total	Total (%)	Parcel Total Avg.
Private	Agriculture	28	0.08	9.89	0.05	5.46	55.18	0.19	82.26	2.51	84.77	0.06	3.03
	Commercial	2,561	7.09	3,948.25	21.18	2,375.55	60.17	0.93	35,825.47	1,907.85	37,733.33	25.40	14.73
	Industrial	330	0.91	814.58	4.37	642.84	78.92	1.95	9,756.12	247.80	10,003.93	6.73	30.31
	MultiFamily Res.	17,985	49.79	2,551.67	13.69	1,704.45	66.80	0.09	24,277.95	831.17	25,109.12	16.90	1.40
	Open Land	2,226	6.16	545.29	2.93	186.26	34.16	0.08	2,411.87	438.53	2,850.40	1.92	1.28
	Private Inst.	329	0.91	215.97	1.16	121.91	56.45	0.37	1,839.35	104.33	1,943.68	1.31	5.91
	Right-of-Way	17	0.05	3.51	0.02	1.43	40.86	0.08	16.65	2.56	19.21	0.01	1.13
	Single Family Res.	11,563	32.01	1,595.22	8.56	723.84	45.38	0.06	10,290.42	709.92	11,000.34	7.41	0.95
	Water	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**35,039**	**97.0**	**9,684.38**	**52.0**	**5,761.75**	**59.5**	--	**84,500.11**	**4,244.66**	**88,744.77**	**59.7**	--
Public	Agriculture	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Commercial	3	0.01	5.64	0.03	4.32	76.64	1.44	65.84	2.87	68.72	0.05	22.91
	Industrial	2	0.01	1.38	0.01	1.15	83.72	0.58	17.54	0.33	17.87	0.01	8.93
	MultiFamily Res.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Land	35	0.10	548.77	2.94	3.77	0.69	0.11	51.86	615.20	667.06	0.45	19.06
	Public Inst.	863	2.39	2,296.33	12.32	716.47	31.20	0.83	10,493.62	1,606.81	12,100.43	8.15	14.02
	Right-of-Way	154	0.43	5,683.41	30.49	4,433.62	78.01	28.79	45,635.06	1,236.35	46,871.41	31.55	304.36
	Single Family Res.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Water	23	0.06	418.72	2.25	3.07	0.73	0.13	34.09	39.57	73.66	0.05	3.20
	Subtotal	**1,080**	**3.0**	**8,954.24**	**48.0**	**5,162.40**	**57.7**	--	**56,298.01**	**3,501.13**	**59,799.14**	**40.3**	--
EJ Total		**36,119**	**100**	**18,638.62**	**100**	**10,924.15**	**58.6**	--	**140,798.12**	**7,745.80**	**148,543.92**	**100**	--
Watershed Total		**108,810**	**33%**	**48,234.72**	**39%**	**20,720.21**	**53%**		**277,941.67**	**22,702.28**	**300,643.95**	**49%**	

* A darker color gradient represents increasing value within a column.

3.3 Commercial, Industrial, Institutional, and Multi-Family Parcels

Private Commercial, Industrial, Institutional, and Multi-Family parcels make up 59% of all parcels in areas with environmental justice concerns in the Mystic River Watershed (Table 3-5). The vast majority of CIIM parcels in areas with environmental justice concerns are multifamily residential parcels (50%). On average, however, these parcels have the lowest IC area and total TP and TN loads. Industrial parcels have the highest average IC and load values, followed by Commercial and Institutional. The totals shown in Table 3-5 represent i) the CIIM parcels in areas with environmental justice concerns as a percentage of all parcels in areas with environmental justice concerns ("Environmental Justice Total"), ii) the CIIM parcels in areas with environmental justice concerns as a percentage of all private CIIM parcels ("All Private CIIM"), and iii) the CIIM parcels in areas with environmental justice concerns as a percentage of all non-CSA parcels within the watershed ("Watershed Total"). For example, CIIM parcels in areas with environmental justice concerns represent 52% of all private CIIM parcels and 20% of all parcels in the watershed but makeup 23% of the total IC area and 26% of the total TP and TN load from all IC.

Table 3-5. Summary of private commercial, industrial, institutional, and multifamily parcel attributes in areas with environmental justice concerns*

Use Group	Count	Total Area (ac)	IC Area			TP Load (lb/yr)			TN Load (lb/yr)		
			Acre	% IC of Total Area	Parcel Avg. (ac)	IC	Pervious	Total Avg.	IC	Pervious	Total Avg.
Commercial	2,561	3,948.25	2,375.55	60.17	0.93	4,283.77	184.57	1.74	35,825.47	1,907.85	14.73
Industrial	330	814.58	642.84	78.92	1.95	1,153.60	26.05	3.57	9,756.12	247.80	30.31
MultiFamily Residential	17,985	2,551.67	1,704.45	66.80	0.09	3,997.86	105.45	0.23	24,277.95	831.17	1.40
Private Institutional	329	215.97	121.91	56.45	0.37	219.57	12.14	0.70	1,839.35	104.33	5.91
Subtotal	**21,205**	**7,530.47**	**4,844.76**	**64.34**	--	**9,654.79**	**328.22**	--	**71,698.90**	**3,091.15**	--
Environmental Justice Total (%)	**58.7**	**40.4**	**44.3**	**--**	--	**51.1**	**35.5**	--	**50.9**	**39.9**	--
All Private CIIM (%)	**51.6**	**50.0**	**52.2**	**--**	--	**51.7**	**46.6**	--	**52.3**	**51.5**	--
Watershed Total (%)	**19.5**	**15.6**	**23.4**	--	--	**25.7**	**10.8**	--	**25.8**	**13.6**	--

* A darker color gradient represents increasing value within a column.

3.3.1 *Analysis of CIIM Parcels by IC Area*

The relationship between the number of parcels, the amount of IC area within a parcel, and the total load was evaluated for private CIIM parcels in areas with environmental justice concerns by varying thresholds of IC area as shown in Figure 3-3 and Figure 3-4 (Appendix A presents similar plots by individual parcel use group). These plots show that while the IC threshold is > 0.1 ac, the number of parcels identified is relatively small, but accounts for approximately 60% of the private CIIM total load from parcels in areas with environmental justice concerns. As the IC threshold decreases, the number of parcels identified sharply increases. An IC threshold of ≥ 0.1 ac exhibits a large increase in the number of parcels identified because more multifamily residential parcels are included (these parcels have an average IC area of 0.1 ac, as shown in Table 3-5).

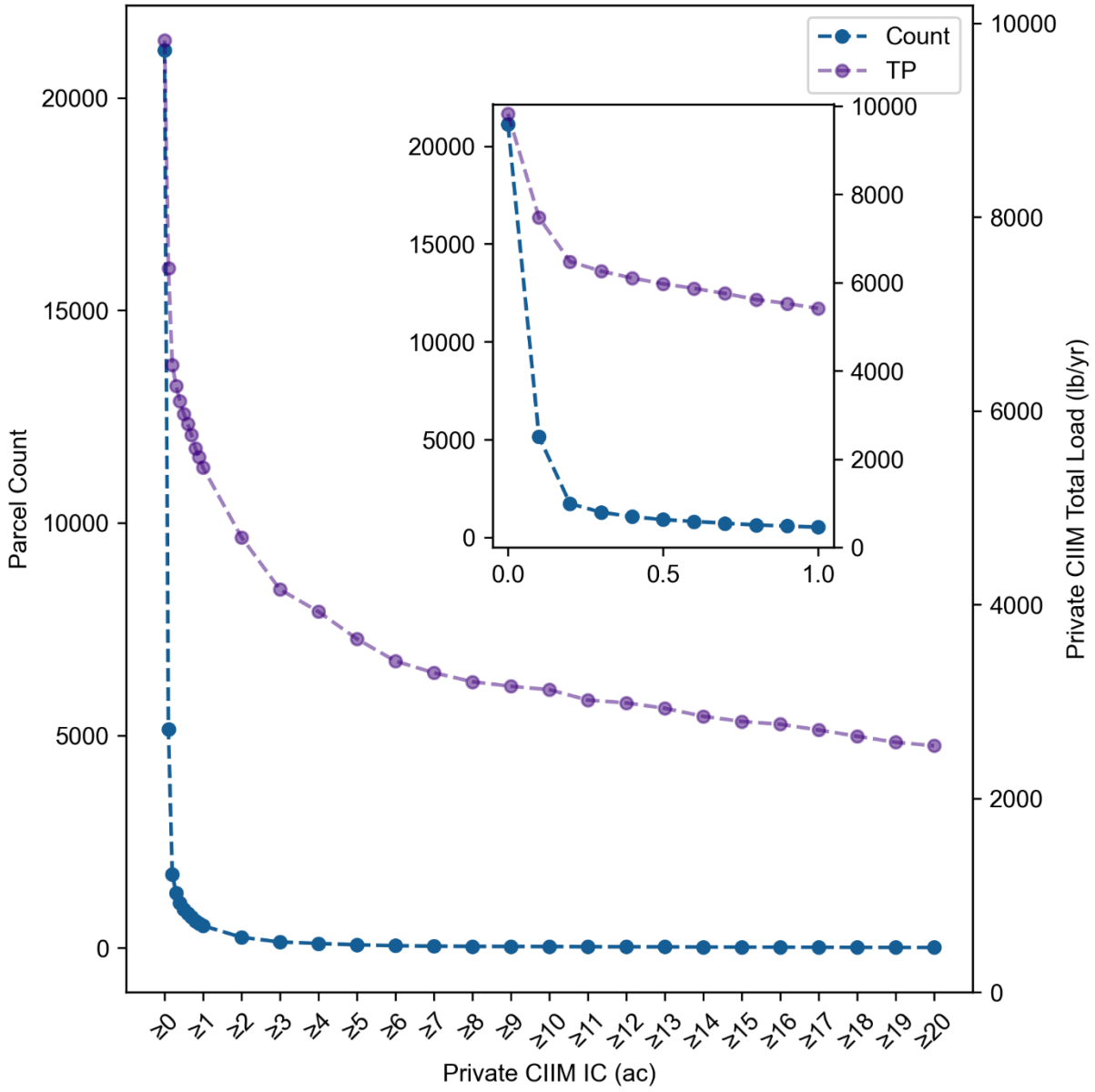

Figure 3-3. Count and total TP load for private CIIM parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private CIIM parcels in areas with environmental justice concerns.

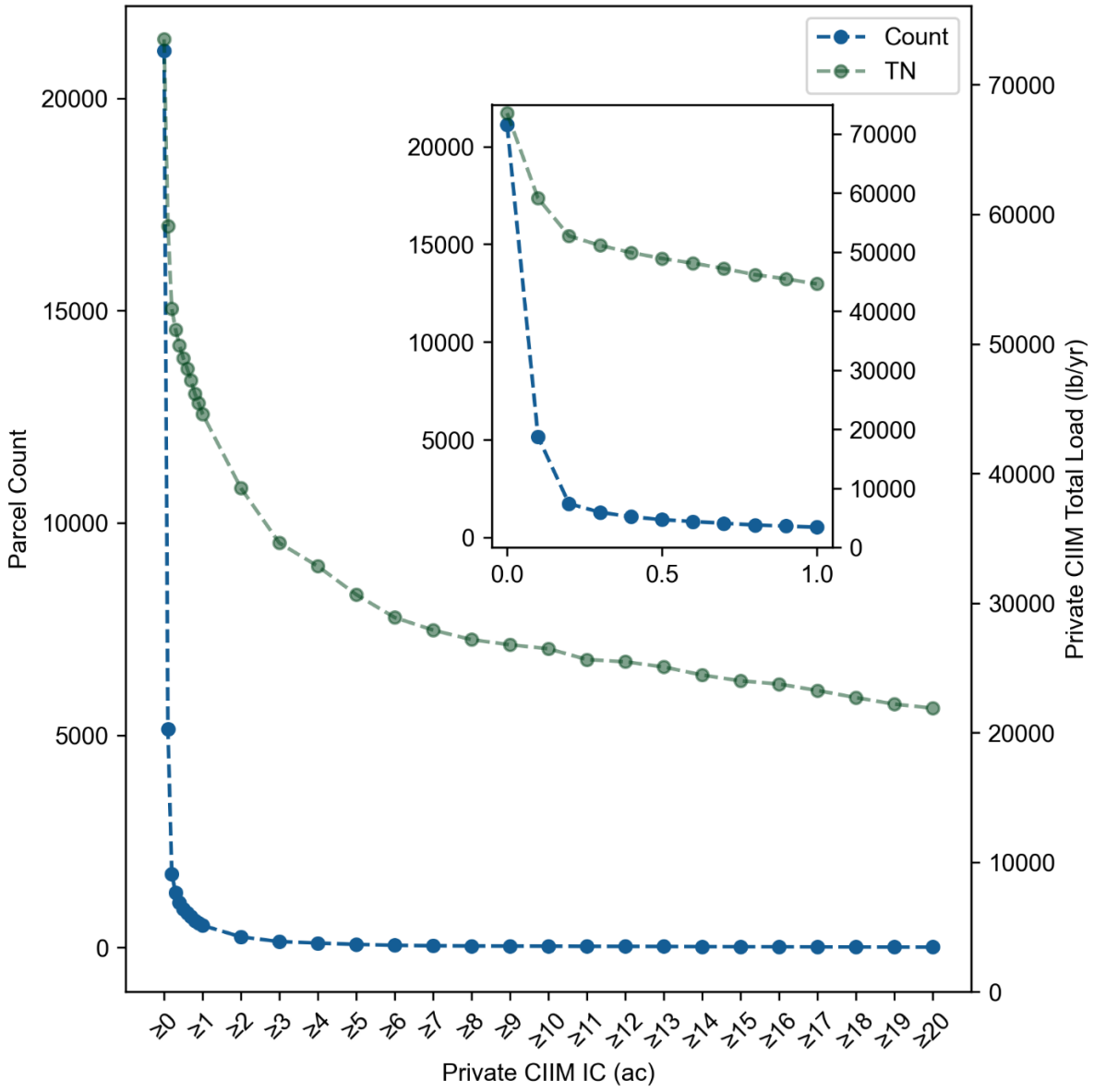

Figure 3-4. Count and total TN load for private CIIM parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private CIIM parcels in areas with environmental justice concerns.

The parcel count, load, and IC relationship was further analyzed for IC thresholds of 0.25 ac, 0.5 ac, 0.75 ac, 1 ac, 2 ac, and 5 ac as shown in Table 3-6 to Table 3-11. These tables provide key summary information on the number of parcels in areas with environmental justice concerns impacted by a given IC threshold. For example, with an IC threshold of 0.25 ac (Table 3-6), 1,503 parcels in areas with environmental justice concerns would have to install additional stormwater controls. These parcels are 4% of the total parcels in areas with environmental justice concerns, 45% of all private CIIM parcels meeting the IC threshold, 3.7% of all private CIIM parcels, and 1.4% of all parcels within the Mystic River Watershed. While parcels in areas with environmental justice concerns make up nearly 52% of all private CIIM parcels, using an IC threshold greater than 0.1 ac helps lower the percentage of impacted parcels in areas with environmental justice concerns, primarily by excluding multifamily residential parcels (the average parcel IC area for multifamily residential parcels is 0.1 ac). The percentage of parcels in areas with environmental justice concerns is relatively consistent - between 41% and 46% - for the IC thresholds evaluated here.

Table 3-6. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 0.25ac in the Mystic River Watershed*

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)			TN Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total	IC	Pervious	Total
Commercial	770	3,731.82	2,209.39	59.20	3,967.90	176.96	4,144.86	33,354.20	1,844.16	35,198.36
Industrial	257	801.42	634.52	79.17	1,138.66	25.64	1,164.30	9,630.02	244.20	9,874.23
MultiFamily Residential	354	713.23	421.77	59.14	963.63	41.46	1,005.08	6,033.32	339.44	6,372.75
Private Institutional	122	162.13	103.14	63.61	185.74	7.39	193.13	1,555.91	65.56	1,621.47
Subtotal	**1,503**	**5,408.61**	**3,368.82**	**62.29**	**6,255.92**	**251.45**	**6,507.37**	**50,573.45**	**2,493.36**	**53,066.81**
Environmental Justice Total (%)	**4.2**	**29.0**	**30.8**	--	**33.1**	**27.2**	**32.8**	**35.9**	**32.2**	**35.7**
Threshold Private CIIM (%)	**45.3**	**53.2**	**54.3**	--	**53.9**	**49.3**	**53.7**	**54.4**	**54.7**	**54.4**
All Private CIIM (%)	**3.7**	**35.9**	**36.3**	--	**33.5**	**35.7**	**33.6**	**36.9**	**41.5**	**37.1**
Watershed Total (%)	**1.4**	**11.2**	**16.3**	--	**16.6**	**8.3**	**16.0**	**18.2**	**11.0**	**17.7**

* A darker color gradient represents increasing value within a column.

Table 3-7. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 0.5ac in the Mystic River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)			TN Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total	IC	Pervious	Total
Commercial	460	3,609.21	2,101.68	58.23	3,773.42	175.47	3,948.89	31,731.34	1,832.25	33,563.58
Industrial	210	781.60	617.51	79.01	1,108.07	25.28	1,133.35	9,371.08	241.38	9,612.46
MultiFamily Residential	196	646.72	367.08	56.76	837.40	39.83	877.22	5,254.93	326.58	5,581.51
Private Institutional	69	130.90	84.53	64.58	152.12	5.71	157.82	1,273.66	50.35	1,324.00
Subtotal	**935**	**5,168.42**	**3,170.80**	**61.35**	**5,871.01**	**246.28**	**6,117.29**	**47,631.01**	**2,450.55**	**50,081.56**
Environmental Justice Total (%)	**2.6**	**27.7**	**29.0**	--	**31.1**	**26.6**	**30.9**	**33.8**	**31.6**	**33.7**
Threshold Private CIIM (%)	**45.9**	**54.1**	**55.1**	--	**54.7**	**50.1**	**54.5**	**55.1**	**55.6**	**55.2**
All Private CIIM (%)	**2.3**	**34.3**	**34.2**	--	**31.4**	**35.0**	**31.6**	**34.8**	**40.8**	**35.0**
Watershed Total (%)	**0.9**	**10.7**	**15.3**	--	**15.6**	**8.1**	**15.0**	**17.1**	**10.8**	**16.7**

* A darker color gradient represents increasing value within a column.

Table 3-8. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 0.75ac in the Mystic River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)			TN Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total	IC	Pervious	Total
Commercial	344	3,517.76	2,029.62	57.70	3,642.89	171.95	3,814.85	30,646.02	1,800.60	32,446.63
Industrial	170	735.86	592.59	80.53	1,063.43	21.18	1,084.61	8,993.86	203.26	9,197.12
MultiFamily Residential	133	596.30	327.81	54.97	747.10	38.56	785.66	4,693.55	316.46	5,010.01
Private Institutional	45	109.53	69.37	63.33	124.60	4.64	129.24	1,045.96	42.08	1,088.03
Subtotal	**692**	**4,959.45**	**3,019.39**	**60.88**	**5,578.03**	**236.34**	**5,814.36**	**45,379.39**	**2,362.40**	**47,741.78**
Environmental Justice Total (%)	**1.9**	**26.6**	**27.6**	--	**29.5**	**25.6**	**29.3**	**32.2**	**30.5**	**32.1**
Threshold Private CIIM (%)	**44.9**	**54.5**	**55.5**	--	**55.0**	**50.1**	**54.8**	**55.5**	**55.6**	**55.5**
All Private CIIM (%)	**1.7**	**32.9**	**32.5**	--	**29.9**	**33.6**	**30.0**	**33.1**	**39.3**	**33.4**
Watershed Total (%)	**0.6**	**10.3**	**14.6**	--	**14.8**	**7.8**	**14.3**	**16.3**	**10.4**	**15.9**

* A darker color gradient represents increasing value within a column.

Table 3-9. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 1ac in the Mystic River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)			TN Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total	IC	Pervious	Total
Commercial	263	3,432.06	1,959.66	57.10	3,517.00	169.89	3,686.90	29,608.31	1,784.52	31,392.84
Industrial	134	695.14	560.72	80.66	1,006.16	19.76	1,025.92	8,509.21	189.31	8,698.53
MultiFamily Residential	100	555.35	298.88	53.82	679.44	37.45	716.89	4,280.50	307.96	4,588.46
Private Institutional	36	98.93	61.80	62.47	110.99	4.25	115.25	930.76	38.26	969.03
Subtotal	**533**	**4,781.48**	**2,881.06**	**60.25**	**5,313.60**	**231.35**	**5,544.95**	**43,328.79**	**2,320.06**	**45,648.85**
Environmental Justice Total (%)	**1.5**	**25.7**	**26.4**	--	**28.1**	**25.0**	**28.0**	**30.8**	**30.0**	**30.7**
Threshold Private CIIM (%)	**43.7**	**55.0**	**55.8**	--	**55.3**	**50.8**	**55.1**	**55.8**	**56.4**	**55.8**
All Private CIIM (%)	**1.3**	**31.7**	**31.1**	--	**28.4**	**32.9**	**28.6**	**31.6**	**38.6**	**31.9**
Watershed Total (%)	**0.5**	**9.9**	**13.9**	--	**14.1**	**7.6**	**13.6**	**15.6**	**10.2**	**15.2**

* A darker color gradient represents increasing value within a column.

Table 3-10. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 2ac in the Mystic River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)			TN Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total	IC	Pervious	Total
Commercial	131	3,209.56	1,778.60	55.42	3,192.01	165.72	3,357.72	26,906.56	1,747.48	28,654.04
Industrial	58	560.66	449.18	80.12	806.11	16.71	822.83	6,817.90	161.33	6,979.24
MultiFamily Residential	57	472.64	239.06	50.58	544.18	34.02	578.21	3,429.29	281.60	3,710.89
Private Institutional	12	59.11	30.26	51.19	54.42	2.94	57.36	460.77	26.33	487.10
Subtotal	**258**	**4,301.97**	**2,497.10**	**58.05**	**4,596.73**	**219.39**	**4,816.12**	**37,614.52**	**2,216.75**	**39,831.26**
Environmental Justice Total (%)	**0.7**	**23.1**	**22.9**	--	**24.3**	**23.7**	**24.3**	**26.7**	**28.6**	**26.8**
Threshold Private CIIM (%)	**41.1**	**58.1**	**57.7**	--	**57.2**	**55.4**	**57.2**	**57.7**	**60.6**	**57.9**
All Private CIIM (%)	**0.6**	**28.6**	**26.9**	--	**24.6**	**31.2**	**24.8**	**27.4**	**36.9**	**27.8**
Watershed Total (%)	**0.2**	**8.9**	**12.1**	--	**12.2**	**7.2**	**11.8**	**13.5**	**9.8**	**13.2**

* A darker color gradient represents increasing value within a column.

Table 3-11. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 5ac in the Mystic River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)			TN Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total	IC	Pervious	Total
Commercial	46	2,859.05	1,523.53	53.29	2,730.37	148.00	2,878.37	23,076.00	1,595.19	24,671.18
Industrial	17	403.07	321.88	79.86	578.01	13.36	591.37	4,890.35	132.94	5,023.30
MultiFamily Residential	13	234.22	105.99	45.25	248.64	20.24	268.87	1,514.79	156.20	1,670.99
Private Institutional	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Subtotal	**76**	**3,496.34**	**1,951.39**	**55.81**	**3,557.02**	**181.60**	**3,738.62**	**29,481.14**	**1,884.32**	**31,365.46**
Environmental Justice Total (%)	**0.2**	**18.8**	**17.9**	--	**18.8**	**19.6**	**18.9**	**20.9**	**24.3**	**21.1**
Threshold Private CIIM (%)	**45.2**	**68.8**	**66.9**	--	**66.4**	**65.4**	**66.3**	**67.0**	**70.2**	**67.2**
All Private CIIM (%)	**0.2**	**23.2**	**21.0**	--	**19.0**	**25.8**	**19.3**	**21.5**	**31.4**	**21.9**
Watershed Total (%)	**0.1**	**7.2**	**9.4**	--	**9.5**	**6.0**	**9.2**	**10.6**	**8.3**	**10.4**

* A darker color gradient represents increasing value within a column.

Figure 3-5 further illustrates the tradeoff between pollutant reduction and the number of private CIIM parcels with IC area ranging from ≥20 ac to ≥0 ac (i.e., all private CIIM parcels and private CIIM parcels in areas with environmental justice concerns) that would have to manage stormwater. This figure assumes that runoff from IC within a parcel would be treated by stormwater controls sized to achieve the required load reduction target of 62%. The "knee" of the curve, where the slope begins to flatten, indicates the IC threshold where the fewest number of parcels can provide the greatest benefit in terms of TP reduction. For the Mystic River Watershed, this appears to lie between parcels with ≥0.2 ac and ≥0.75 ac of IC. As an example, if 0.25 ac IC is chosen as a threshold, approximately 3,300 private CIIM parcels would need to be permitted, 1,503 of those parcels are in areas with environmental justice concerns, and the potential reduction in the watershed TP load would be 18%. Appendix B presents similar plots by individual parcel use group.

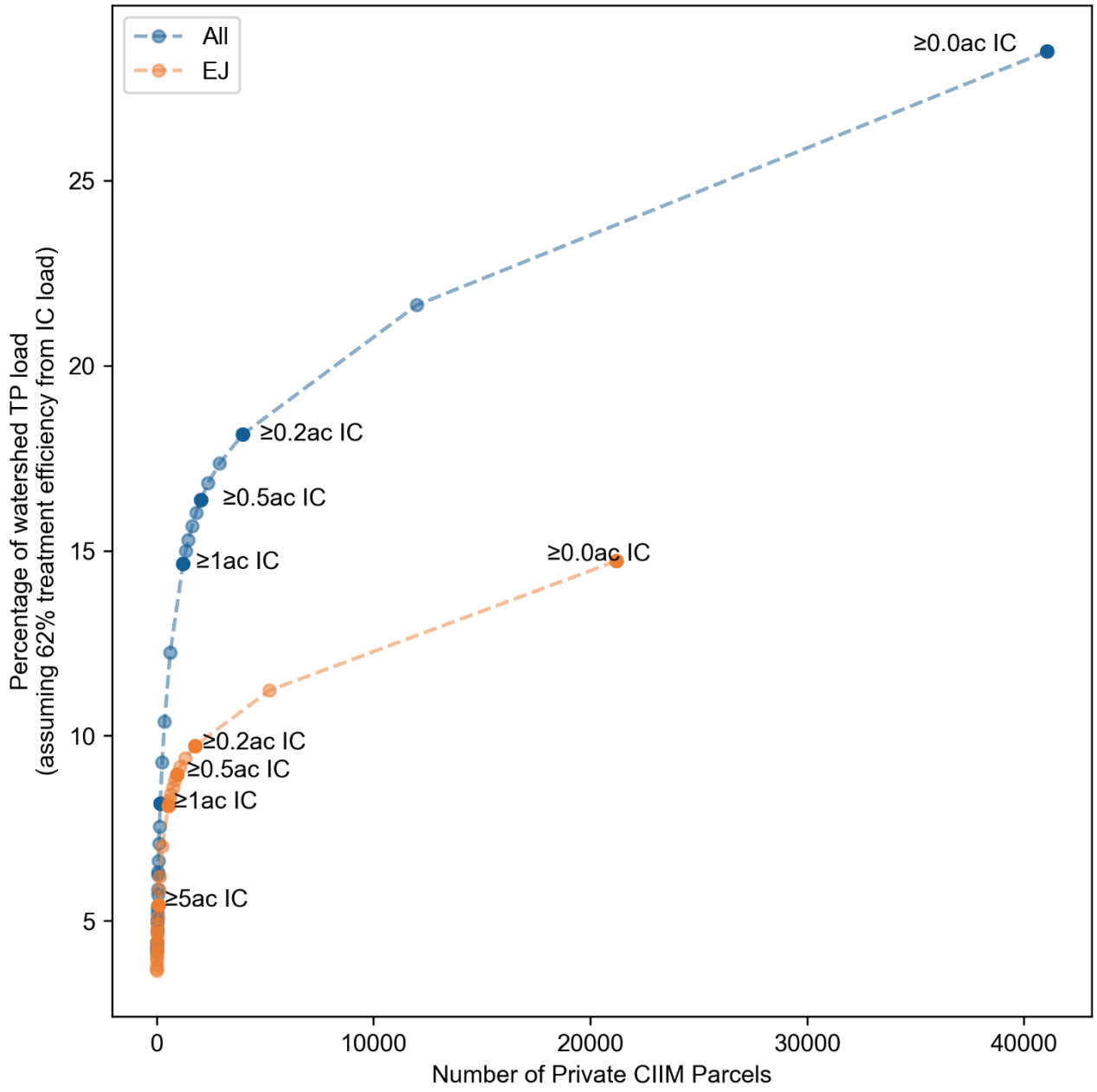

Figure 3-5. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private CIIM parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

3.4 Analysis of Additional Effects in Areas with Environmental Justice Concerns

GIS overlay analysis of parcels in areas with environmental justice concerns with other spatial datasets was performed to illustrate how increased stormwater control could potentially yield additional benefits to help address environmental issues such as vulnerability to flooding, vulnerability to extreme heat exposure, and aquifer protection in areas with environmental justice concerns. The last overlay analysis presents potential areas where stormwater control measures (SCMs) could be implemented. The sources for spatial datasets used in this section are shown in Table 3-12.

Table 3-12. Datasets used in environmental justice overlay analysis

Name	Description	Source	Source Link	Date
Flooding	Categorical vulnerability to riverine and storm surge flooding from a 100-year event	Boston Metropolitan Area Planning Council (MAPC)	https://climate-vulnerability.mapc.org/assets/data/MAPC-climate-vulnerability-dataset.zip	Dec., 2019
Heat	Categorical vulnerability to extreme heat			
Aquifer	Aquifer location and groundwater yield	MassGIS	https://www.mass.gov/info-details/massgis-data-aquifers	July, 2007
SCM Siting	Planning-level siting analysis of stormwater control measures	Task 3A and 3B (Paradigm Environmental, 2023b)		

3.4.1 *Flooding Risk*

Flooding vulnerability for census tracts within the Boston metropolitan area was developed by MAPC based on several measures of sensitivity, exposure, and adaptive capacity as part of the Metro Common × 2050 project. Full details on this project can be found at https://climate-vulnerability.mapc.org. The flood exposure portion of their analysis is based on the Federal Emergency Management Agency's (FEMA) Special Flood Hazard Areas (SFHAs) that indicate where riverine flooding and storm surge have a more than 1% chance of occurring each year (i.e., the 100-year floodplain.) They calculated the exposure metric as the fraction of housing units in each census tract that lies within a SFHA (see Flingai and Spence, 2019 for technical documentation). The flood exposure, sensitivity, and adaptive capacity were used by MAPC to create a categorical variable for vulnerability from extremely low to extremely high. Note that the analyses carried out by MAPC include socioeconomic and demographic factors similar to those used by CEJST.

The distribution of parcels in areas with environmental justice concerns by vulnerability to flooding is shown in Table 3-13 and mapped in Figure 3-6. The lower portions of the Mystic River Watershed have the highest vulnerability to flooding and correspond to many of the areas with environmental justice concerns. The majority of parcels in areas with environmental justice concerns (82%) have moderate to extremely low vulnerability. However, there are hotspots of moderately high and extremely high vulnerability (16%), especially in Chelsea, Boston, Revere, and Winthrop.

In response to climate change-induced changes in precipitation patterns, urban flooding risk is expected to increase substantially in the Mystic River Watershed in the future (Resilient Mystic Collaborative, 2023). Implementation of additional stormwater controls on CIIM parcels within and upstream from areas with environmental justice concerns in the Mystic River Watershed should reduce stormwater runoff volumes from IC areas, thereby reducing the frequency and magnitude of localized flooding events. Stormwater controls that enable parcels to absorb and infiltrate stormwater runoff help prevent water from overwhelming drainage networks and pooling in streets, basements, and low-lying areas (Atkins, 2015).

Table 3-13. Distribution of parcels in areas with environmental justice concerns based on vulnerability to riverine and storm surge flooding from a 100-year event*

Vulnerability	Flooding	
	Parcels in areas with environmental justice concerns	Percentage
Extremely high	2,642	6%
Moderately high	4,137	10%
Moderate	15,098	36%
Moderately low	17,009	41%
Extremely low	2,011	5%
No Data	805	2%
Total	41,702	100%

* A darker color gradient represents increasing value within a column.

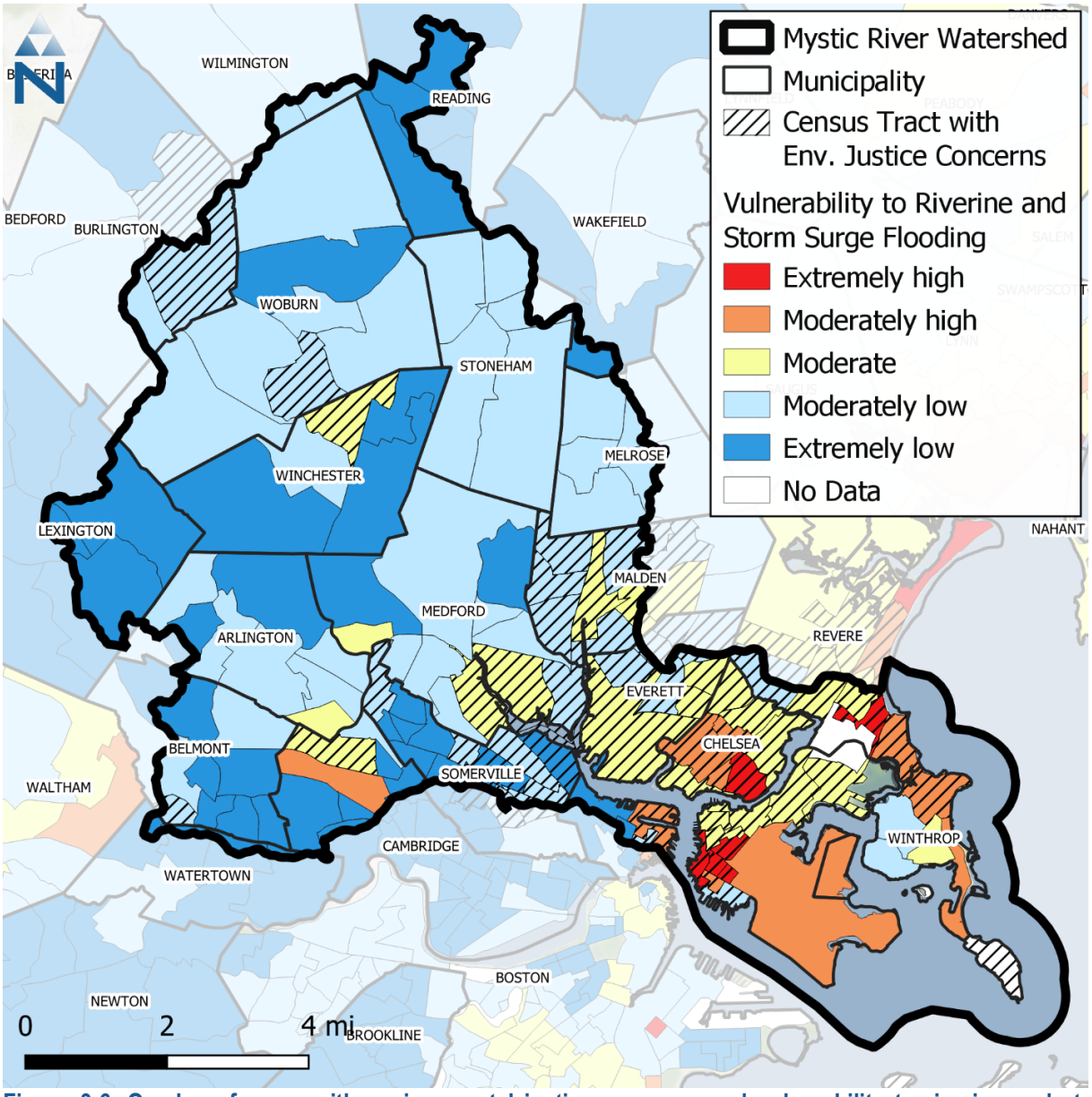

Figure 3-6. Overlay of areas with environmental justice concerns and vulnerability to riverine and storm surge flooding from a 100-year event.

3.4.2 *Heat Exposure*

Vulnerability to extreme heat exposure was also calculated by MAPC and is based on the difference in land surface temperature during a clear, hot day (influenced by dark and impervious surfaces) and the regional air temperature measured at Logan International Airport. This is an estimate of the degree to which surface properties influence local temperature; areas where the local temperature is greater than the regional temperature are referred to as heat islands. MAPC's heat exposure metric is the average heat island temperature increase for housing units in a given census tract and was combined with other sensitivity and adaptive capacity measures to create vulnerability. Additional details are available in Flingai and Spence (2019).

The distribution of parcels in areas with environmental justice concerns by vulnerability to extreme heat is shown in Table 3-14 and mapped in Figure 3-7. Many areas with environmental justice concerns within the Mystic River Watershed are highly urbanized (e.g., within Chelsea, Everett) and have extremely high or moderately high vulnerability to extreme heat (41% of parcels in areas with environmental justice concerns). The most developed areas of the watershed have dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat, and few green spaces with trees and vegetation that reduce urban heat effects by shading buildings and pavement, deflecting radiation from the sun, and releasing moisture into the air. Urban heating problems are expected to grow worse in the most urbanized areas of Boston due to climate change effects (Resilient Mystic Collaborative, 2023). Installing green roofs and planting new trees and other vegetation as part of stormwater controls provides an effective approach for reducing discharges of polluted stormwater while helping to address urban heating effects. Increased implementation of green stormwater control measures on CIIM parcels in areas with environmental justice concerns should help reduce heat buildup in these areas and provide more vegetated, shaded areas that cool air temperatures and provide places where people can find relief from intense heat events (USEPA, 2020b).

Table 3-14. Distribution of parcels in areas with environmental justice concerns based on vulnerability to extreme heat*

Vulnerability	Extreme Heat	
	Parcels in areas with environmental justice concerns	Percentage
Extremely high	3,274	8%
Moderately high	13,929	33%
Moderate	18,284	44%
Moderately low	5,410	13%
Extremely low	0	0%
No Data	805	2%
Total	41,702	100%

* A darker color gradient represents increasing value within a column.

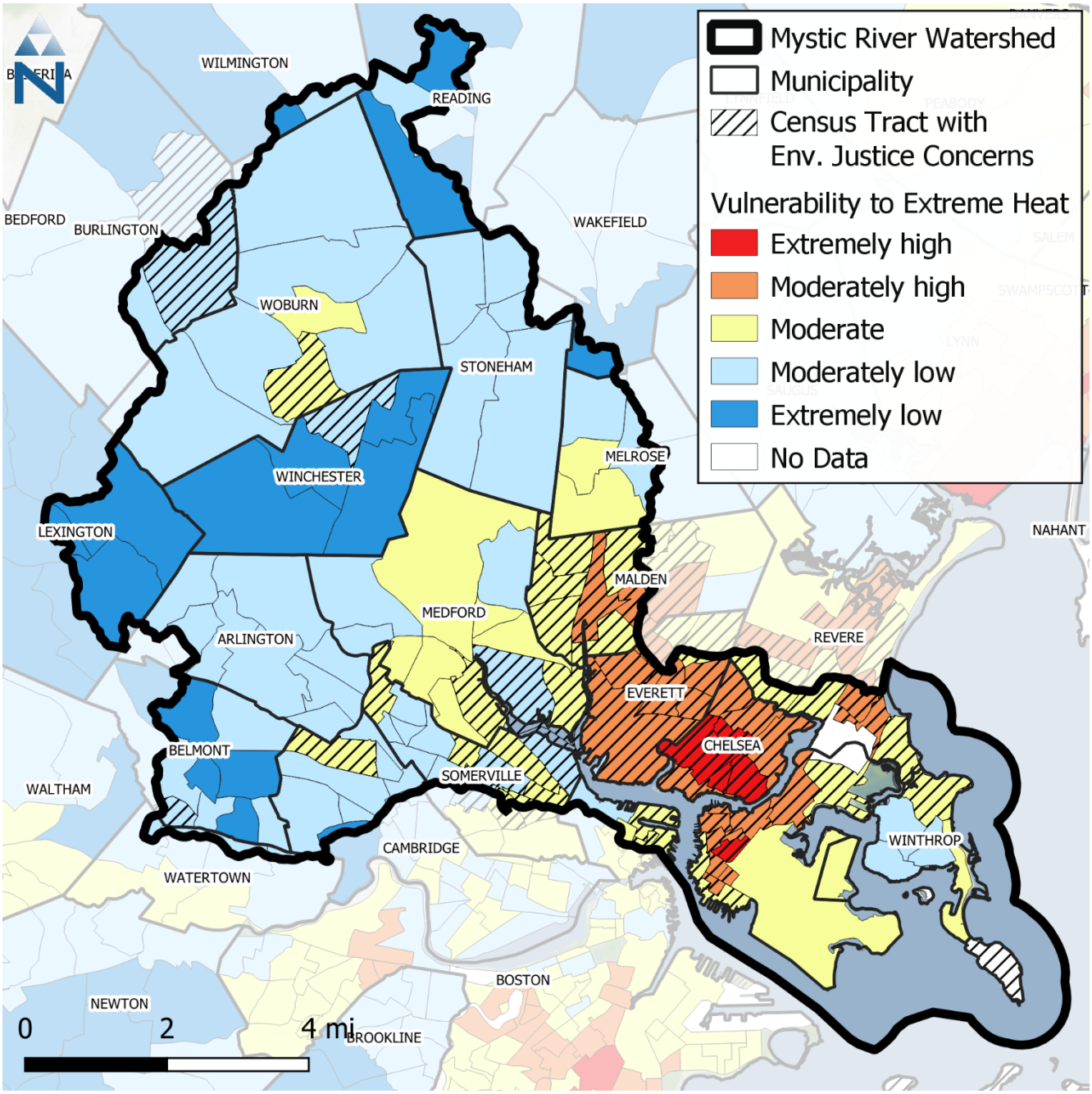

Figure 3-7. Overlay of areas with environmental justice concerns and vulnerability to extreme heat.

3.4.3 *Aquifer Protection*

Parcels in areas with environmental justice concerns were overlaid with the MassGIS aquifer yield dataset to highlight areas that could potentially benefit from increased groundwater recharge. While the majority (91%) of these do not overlap with a mapped aquifer (Table 3-15), there are significant areas of overlap with high and medium-yield aquifers in Malden, Winchester, and Woburn (Figure 3-8). Moreover, many of the aquifer recharge areas upstream of areas with environmental justice concerns in the lower Mystic River Watershed are connected to groundwater aquifers under these areas.

While residents in the Mystic River Watershed currently rely principally on surface water supplies for their drinking water, protecting groundwater quality remains important for several reasons. First, local groundwater aquifers may need to be tapped in the future to augment surface water supplies. Second, local groundwater aquifers provide a redundant local source of water that may need to be tapped if regional surface water supplies are disrupted by disasters or other unexpected events. Third, flows of high-quality groundwater are also critical to protecting and restoring river and ecosystem health. The Mystic River and its tributary streams rely on the slow release of groundwater from local aquifers to maintain flows and supply aquatic ecosystems, especially during periods of the year when precipitation runoff is lower. Stormwater projects implemented on CIIM parcels in the Mystic River Watershed will increase the quantity of water that infiltrates to groundwater aquifers and can help improve the quality of infiltrated water by filtering out pollutants in stormwater before they reach the aquifers.

In the Boston area, overall annual groundwater recharge is expected to decrease by about 18% by the end of the century in response to climate change-induced variations in precipitation patterns (GBRAG, 2022). Stormwater management actions on CIIM parcels that increase infiltration of higher-quality water will indirectly benefit residents of areas with environmental justice concerns by increasing river and stream flows and improving water and habitat quality in the Mystic River as it flows through their neighborhoods. These actions will also help enable the future use of local groundwater sources to augment potable water supplies if necessary.

Table 3-15. Distribution of overlap between parcels in areas with environmental justice concerns and aquifers by groundwater yield*

Aquifer Yield	Parcels in areas with environmental justice concerns	
	Count	Percentage
Low	0	0.0%
Medium	3,077	7.4%
High	890	2.1%
No Data	37,735	90.5%
Total	41,702	100%

* A darker color gradient represents increasing value within a column.

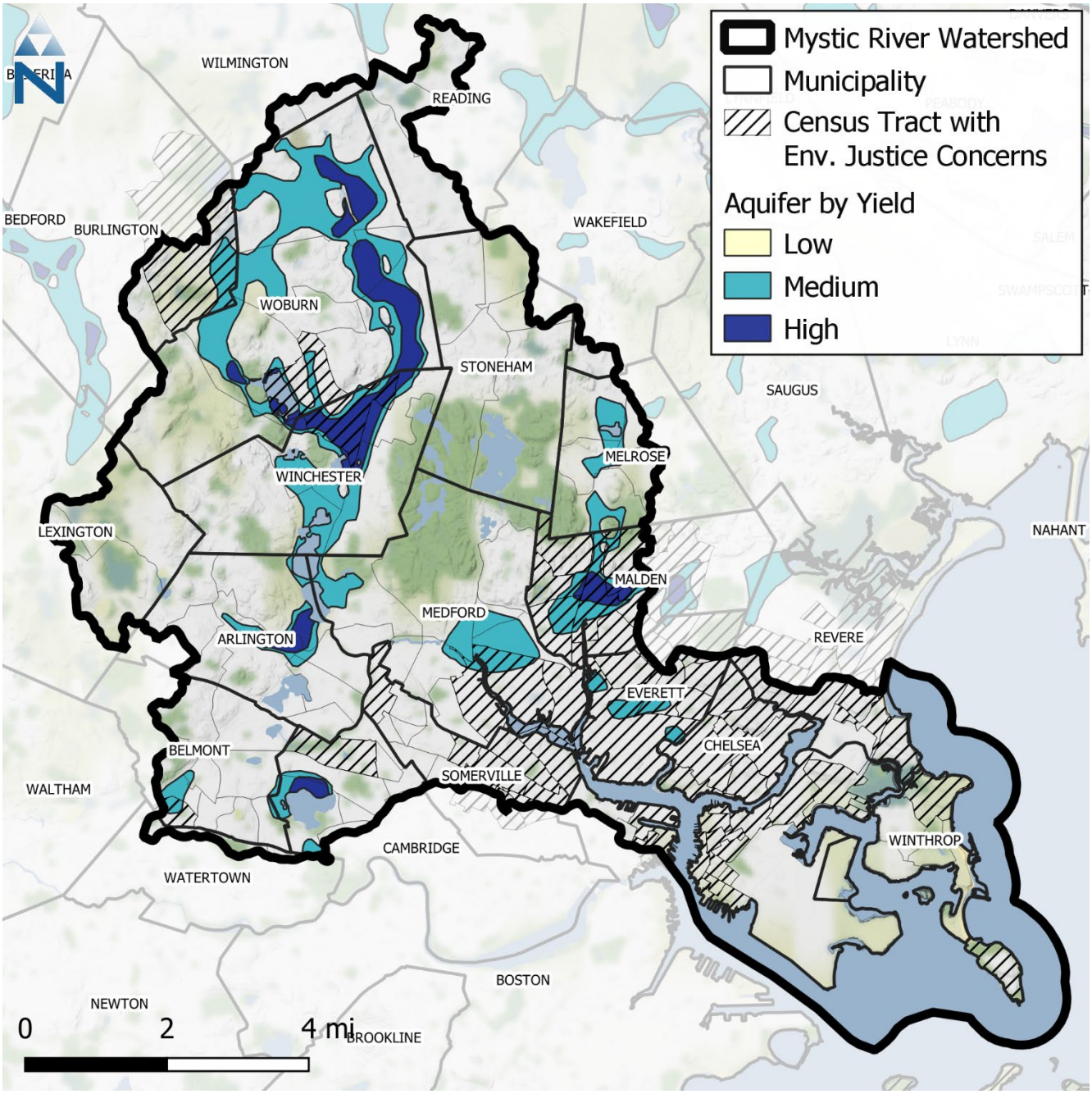

Figure 3-8. Overlay of areas with environmental justice concerns and aquifers by groundwater yield.

3.4.4 *Stormwater Control Opportunities*

To quantify where and what type of SCMs could be implemented in areas with environmental justice concerns, results of the SCM siting analysis previously completed were overlaid with the areas with environmental justice concerns (see Paradigm Environmental [2023b] for full details on the SCM siting analysis). The SCM siting analysis provides planning-level locations for broad classes of SCMs as shown in Table 3-16. The spatial distribution of these SCM classes is shown in Figure 3-9. Given the large amount of roof area, rooftop disconnection (e.g., rain barrels, cisterns) makes up 16% of the SCM opportunities. Subsurface infiltration practices, such as infiltration trenches, are also good opportunities that could be implemented on impervious areas (12% of SCM opportunities). Because the SCM siting analysis is intended for large-scale planning, it does not take local factors like drainage areas or stormwater drainage network into account. It does, however, provide insight into the types of feasible SCMs that could be implemented and is a useful aid toward more site-specific planning.

Table 3-16. Distribution of potential SCM areas within census tracts in areas with environmental justice concerns*

Stormwater Management Category	Land Cover	HSG	Area (ac)	Area (%)
SCM with Complicating Characteristics	--	--	6,865.3	55.0%
Rooftop Disconnection	Impervious	--	1,985.1	15.9%
Subsurface Infiltration Practice	Impervious	A	267.4	2.1%
Subsurface Infiltration Practice	Impervious	B	66.8	0.5%
Subsurface Infiltration Practice	Impervious	C	1,152.7	9.2%
Porous Pavement with Underdrain	Impervious	D	51.3	0.4%
		Impervious Subtotal	3,523.4	28.2%
Surface Infiltration Practice	Pervious	A	364.1	2.9%
Surface Infiltration Practice	Pervious	B	181.1	1.4%
Surface Infiltration Practice	Pervious	C	757.5	6.1%
Biofiltration with Underdrain	Pervious	D	78.5	0.6%
		Pervious Subtotal	1,381.1	11.1%
Water/Wetland	--	--	723.4	5.8%
		Total	**12,493.3**	**100%**

* A darker color gradient represents increasing value within a column.

As discussed in this section, the installation of SCMs as part of RDA permitting within the Mystic River Watershed can have benefits beyond water quality improvement for communities in areas with environmental justice concerns. A more detailed view of SCM opportunities in Everett is shown in Figure 3-10 as an example. All areas in Everett were identified as having environmental justice concerns, with the majority of the municipality within the watershed having moderate vulnerability to severe flooding and moderately high vulnerability to extreme heat. Additionally, Everett has medium yield aquifers that may be important water sources. As many coastal areas in Everett are heavily developed with industrial and commercial properties, there may be limited opportunities to site additional SCMs due to factors such as site contamination or underground storage tanks. Where these factors are not a concern however, there are likely some opportunities to install additional SCMs that route rooftop and parking area stormwater to bioretention and infiltration cells or incorporate permeable pavements and infiltration cells when parking areas are resurfaced. When commercial and industrial properties are refurbished or redeveloped, there may also be opportunities to install green infrastructure solutions that provide greened areas where stormwater is captured for infiltration, or rainwater capture cisterns that can provide water for landscape irrigation. Reducing stormwater flow to the storm drain system should help reduce local flooding potential in low lying, heavily developed areas. Incorporating green infrastructure solutions to rooftops or parking areas in commercial and industrial areas can also yield additional benefits in the form of increased green space, shading, and groundwater replenishment.

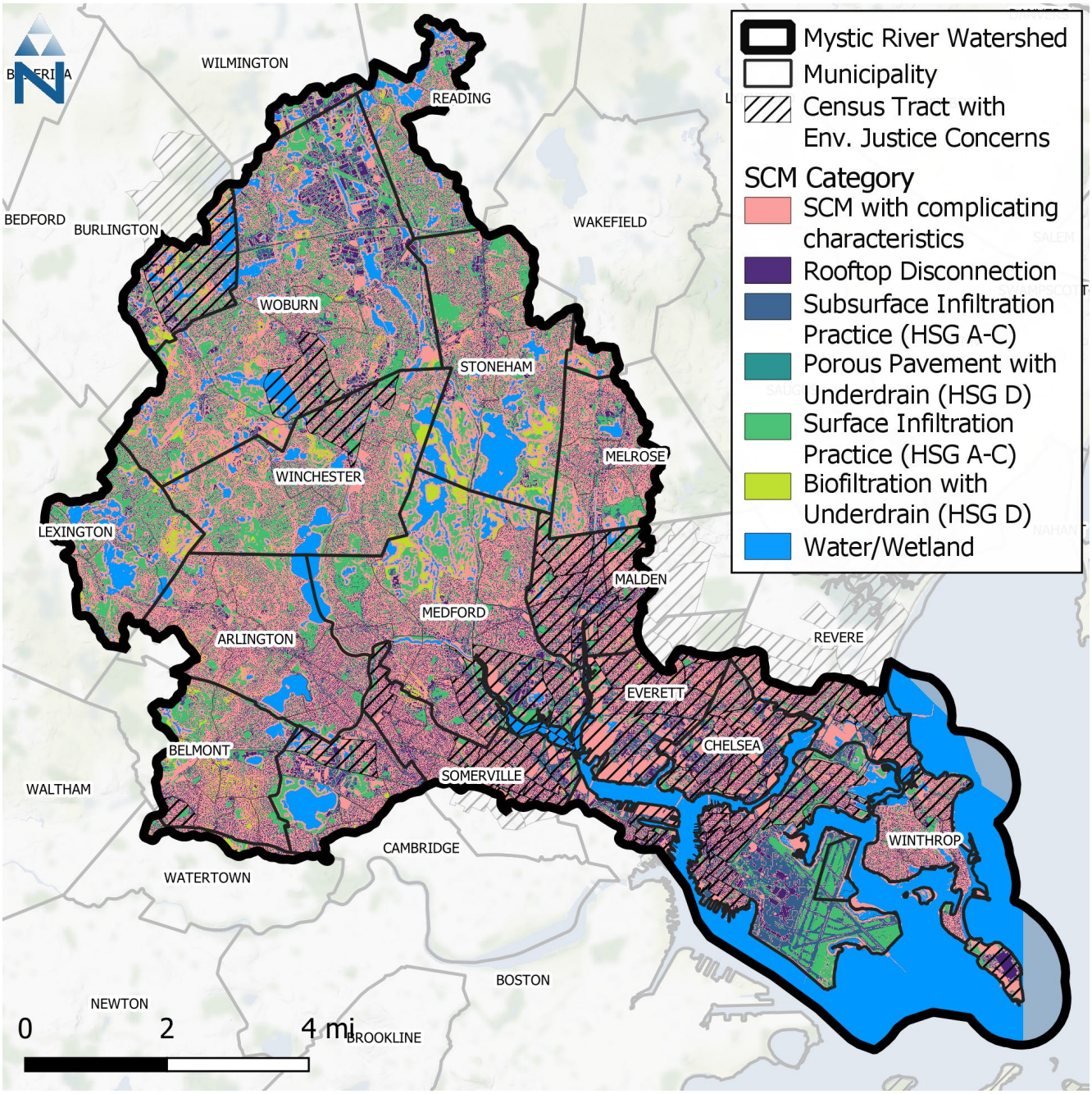

Figure 3-9. Overlay of areas with environmental justice concerns and potential SCM types.

SCMs in the residential areas of Everett could be more straight forward to install than those in industrial areas. For example, rooftop disconnection linked with the installation of bioretention and infiltration cells should reduce the burden on the stormwater network during storms to help reduce local flooding. Rooftop disconnection linked with the use of rain barrels and cisterns can also yield other benefits by making water available for irrigation, which can reduce the demand on potable water sources Opportunities for surface SCMs such as vegetated swales and bioretention cells can also increase recharge to aquifers, reduce the volume of runoff entering the stormwater drainage system, and allow for vegetation. Where possible, opportunities to convert impervious surfaces to permeable, vegetated spaces will help reduce urban heat island effects and lower communities' vulnerability to extreme heat.

There should also be opportunities to coordinate the installation of additional SCMs at CIIM properties with additional street improvement/reconstruction projects like the recent Ferry Street-Elm Street Reconstruction Project, which improved street/sidewalks conditions and traffic flow while incorporating green infrastructure elements and improved SCMs in the street corridors.[2] Similarly, Everett has recently embarked on a number of urban redevelopment projects in previously industrial areas such as the Lower Broadway District Urban Renewal Plan.[3] There should be opportunities to incorporate sound, multi-benefit stormwater management planning in these redevelopment projects, and a permit may provide an incentive for such multi-benefit project planning to occur.

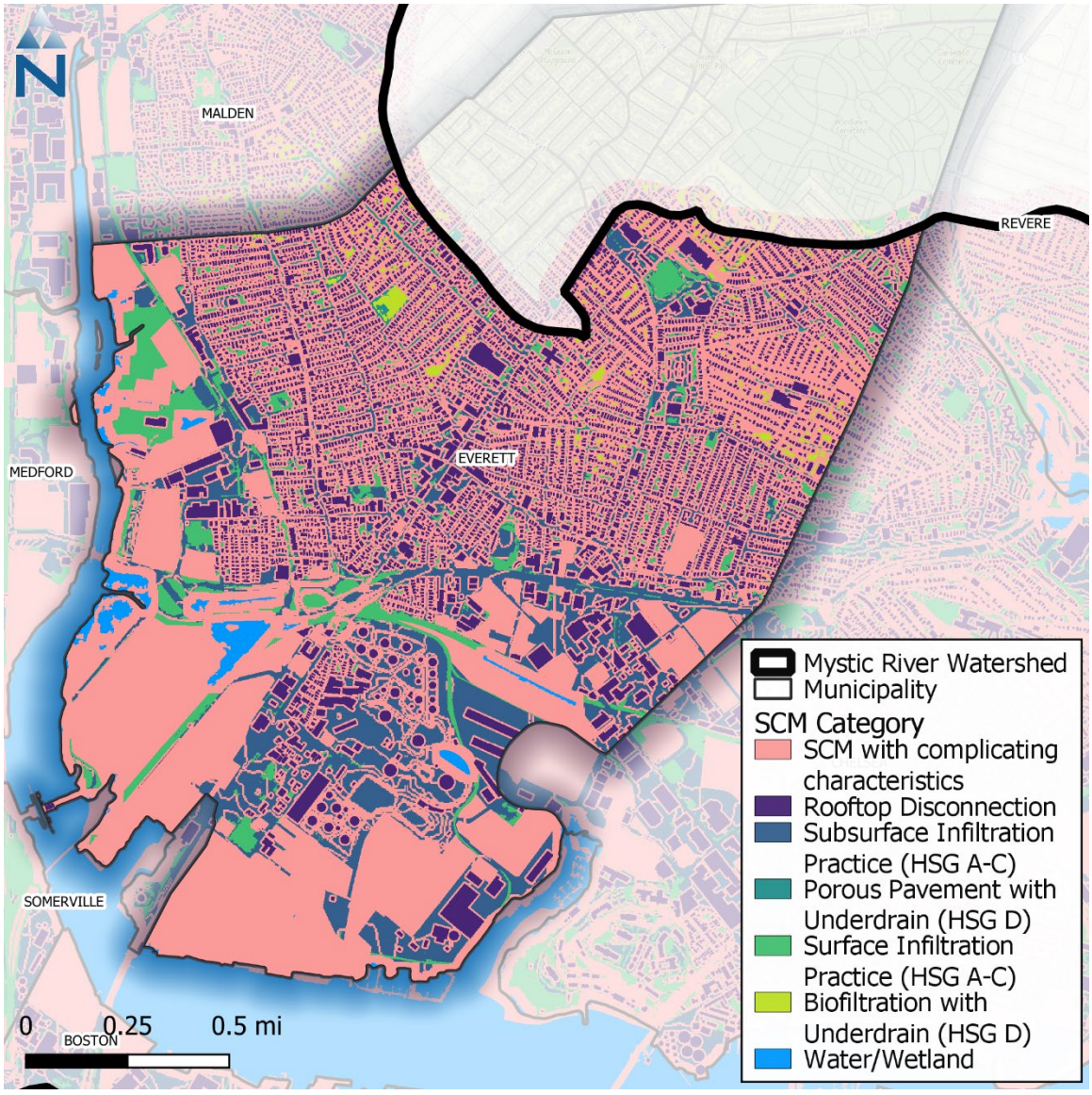

Figure 3-10. Example SCM detail map for Everett. Note that all census tracts in Everett within the Mystic River Watershed are in areas with environmental justice concerns; the environmental justice overlay was removed for clarity.

[2] Ferry Street-Elm Street Reconstruction Project. City of Everett Department of Public Works. Accessed at: https://cityofeverett.com/city-hall/departments/public-works/ferry-street-elm-street-reconstruction-project/.
[3] Lower Broadway District Urban Renewal Plan, Amendment #2. Prepared by Fort Point Associated, Inc. 2021. Accessed at: https://cityofeverett.com/wp-content/uploads/2021/10/Lower-Broadway-District-URP-Amendment-2-07202021.pdf.

4 CONCLUSIONS

This report builds on the methodology and results of watershed-wide analyses of parcel-level stormwater TP and TN loading in the Mystic River Watershed (Paradigm Environmental, 2023a) by identifying and further evaluating parcels within areas with environmental justice concerns. Taken together, findings from these reports may be used by EPA Region 1 to support decisions regarding the control of stormwater runoff from certain private properties to meet watershed Alternative TMDL goals and WQS. Findings from these analyses include:

1. Sixty-five census tracts were identified as areas with environmental justice concerns based on linguistic isolation, low median household income, or disadvantaged. Hotspots areas that meet all environmental justice criteria represent 19% of the areas with environmental justice concerns.
2. Within the watershed, 33% of parcels are in areas with environmental justice concerns but these parcels represent 53% of the watershed IC area and 49% of the total TP load.
3. Private properties contribute nearly three-quarters (72%) of the watershed's total TP load, with 29% of the total coming from private parcels in areas with environmental justice concerns.
4. The majority of TP from private properties is generated from impervious cover (94% of load from private properties and 68% of the watershed total load).
5. Private commercial, industrial, institutional, and multi-family residential (CIIM) properties make up 37.7% of all parcels, but have relatively high percentages of IC and therefore contribute a large proportion of the watershed TP load (48%).
6. Selecting private CIIM parcels based on their IC area (which is proportional to the amount of TP generated) can minimize the number of parcels installing stormwater controls, while providing the greatest TP reduction benefit (Table 4-1).
7. More than half (52%) of all private CIIM parcels are in areas with environmental justice concerns. However, the majority of these parcels are multifamily residential and are largely avoided with IC thresholds greater than 1.0 ac (the average multi-family residential parcel IC area is 0.1 ac).

Installation of additional SCMs in areas of the Mystic River Watershed with environmental justice concerns should prove particularly effective in reducing key pollutant loadings while yielding additional community benefits. As discussed in this report, while about one third of the parcels in the watershed are in areas with environmental justice concerns, more than half of all impervious surfaces and nearly half of the total phosphorus pollutant loads are associated with these areas. Additionally, depending on permitting decisions by EPA R1, more than half of the CIIM parcels that could be subject to a residual designation stormwater permit are concentrated within the third of the watershed comprised of areas with environmental justice concerns. As a result, these areas are particularly important contributors to stormwater-related problems. These areas are also particularly vulnerable to the impacts of polluted stormwater runoff, which adversely affects the quality of urban streams and rivers, harms aquatic ecosystems, and reduces recreational and swimming opportunities for area residents. Moreover, areas of the Mystic River Watershed with environmental justice concerns also experience disproportionately high urban flooding risk, concentrated heat island effects, and limited available green spaces. There are significant opportunities to improve water quality, reduce flooding and urban heating risks, and expand urban green spaces through implementation of additional stormwater controls in these communities.

In the Mystic River Watershed, more than half of CIIM parcels that could be subject to a residual designation stormwater permit are concentrated within the one third of the watershed comprised of areas with environmental justice concerns. Implementation of additional SCMs by CIIM property managers in these areas should prove effective in addressing the stormwater-related impacts and risks experienced by local residents of areas with environmental justice concerns.

As the discussion in Section 3.4.4 of SCM opportunities in the City of Everett suggests, different types of SCMs are likely to be implemented by different property types. Existing commercial, industrial, and large institutional properties can implement SCMs that disconnect rooftop and parking lot stormwater runoff to the storm drain system and instead reroute stormwater to bioretention and infiltration cells that filter the water before slowly recharging groundwater aquifers. Commercial and industrial property managers may also be able to install green rooftops or other green infrastructure elements when buildings are periodically renovated or redeveloped. Similarly, pervious pavement, green swales, and additional stormwater retention cells can be installed when parking areas are refurbished.

If a residual designation permit is to apply to multi-family residential properties, it will be unlikely to create new stormwater control requirements for smaller residential properties. However, there are some large residential properties located in areas of the Mystic River Watershed with environmental justice concerns that may be regulated. For example, if an IC threshold of 1 ac is used for permitting, 100 multi-family residential parcels in areas with environmental justice concerns would be included (Table 3-9). A variety of effective SCM options are available to these properties, some of which can be retrofitted to the existing building and associated impervious surface areas, and others which can be implemented when buildings and impervious areas are refurbished. Many of the same types of SCMs discussed above for use by commercial, industrial, and institutional property managers are also appropriate for use in multi-family residential parcels. These include rooftop disconnection and bioretention/infiltration cells that have been widely demonstrated effective in reducing stormwater flows to local streams and rivers.

Many residential and institutional properties have a greater amount of existing surrounding green spaces as compared with commercial and industrial land uses. Additional SCM options are available to utilize and refurbish even small green spaces around residential and institutional properties to improve their ability to collect and absorb polluted stormwater before it recharges groundwater, and reduce flows to storm drains. At locations near existing streams and rivers, SCM projects incorporating treatment wetlands have proven highly effective in reducing pollutant loads while creating additional green space and aquatic habitat. Residential and institutional parcel managers may have a wider range of SCM options available to help them meet their permit obligations while generating additional local benefits.

The types of green infrastructure approaches available to CIIM property managers can yield a range of additional benefits, including contributing to flood risk reduction by reducing rapid stormwater flow to over-burdened storm drain systems and increasing tree canopy and green spaces, which helps reduce urban heat island effects. Similar projects installed in other highly urbanized areas have successfully created additional neighborhood amenities and recreational spaces that are highly valued in areas with little existing green space or parklands. SCM projects that increase retention and filtering of stormwater before it is infiltrated to groundwater or slowly released to surface waters have proven effective in ensuring flows of clean water to adjacent surface wetlands and streams. Stormwater recharge SCMs also help ensure that clean groundwater resources are protected, which may become more important in the future if surface sources of water supply become less reliable and as populations grow. The SCMs to be implemented in the Mystic River watershed will likely vary substantially in size and type. While the benefits of implementing individual, often small-scale distributed SCMs to the community as a whole may seem difficult to detect, their implementation in many locations within a community overtime can yield substantial cumulative benefits.

There are also opportunities to coordinate planning and implementation of SCMs by newly-regulated CIIM properties with the stormwater management planning of other property owners and municipal governments. Many communities in the Mystic River watershed are planning and implementing projects to revitalize areas of their communities, refurbish and improve transportation corridors, and reduce flooding, urban heating, and other climate-related risks. These initiatives present opportunities for CIIM properties to collaborate with their neighbors and with government agencies to devise SCM solutions that efficiently address stormwater runoff and complement other project objectives, while leveraging investments in stormwater projects to extract maximum benefits. Through cooperative project planning, there may also be opportunities

to address stormwater runoff from several CIIM properties through investment in larger scale SCM projects that more efficiently control stormwater pollution and potentially yield greater collateral benefits than can be realized solely through smaller-scale SCM controls at each CIIM parcel.

The findings from the watershed-wide report indicate that the Alternative TMDL goals for TP and other WQS in the Mystic River cannot be met without additional reduction of stormwater runoff and pollutant loads from private parcels. A portion of those reductions will have to come from parcels within areas with environmental justice concerns. These areas are disproportionately impacted by polluted stormwater and disproportionately vulnerable to associated risks including urban flooding, heat island effects, and threats to groundwater quality. It is clear that substantial additional stormwater controls are needed to address water quality impairments in the Mystic River Watershed. Implementation of these controls presents a tremendous opportunity for the watershed communities to move toward restoration of polluted urban waters while creating a wide range of additional community benefits. While this report presents an initial broad-scale evaluation of areas with environmental justice concerns within the Mystic River Watershed, engaging these communities in outreach and further planning efforts will be essential to understanding their unique needs and ensuring the best localized and watershed-wide outcomes from any residual designation permitting decisions.

Table 4-1. Summary of private CIIM parcels installing stormwater controls based on parcel IC area, the count and percentage of parcels in areas with environmental justice concerns, and the potential reduction achieved in watershed total TP load

IC Threshold (ac)	Parcel Count	Parcels in areas with environmental justice concerns		Total TP Load (lb/yr)	IC TP Load (lb/yr)	Total TP Treated (%)*
		Count	%			
≥0 (All)	41,065	21,205	52%	19,388.86	18,684.76	28%
≥0.25	3,316	1,503	45%	12,113.48	11,603.15	18%
≥0.5	2,039	935	46%	11,231.54	10,740.23	16%
≥0.75	1,540	692	45%	10,612.77	10,140.61	15%
≥1	1,220	533	44%	10,061.45	9,605.77	15%
≥2	628	258	41%	8,426.72	8,030.58	12%
≥5	168	76	45%	5,638.10	5,360.56	8%

* Percentage calculated as IC load times a 62% treatment efficiency divided by the watershed total TP load of 40,660lb/yr.

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APPENDIX A

See the accompanying Excel workbook for the data used to create these plots.

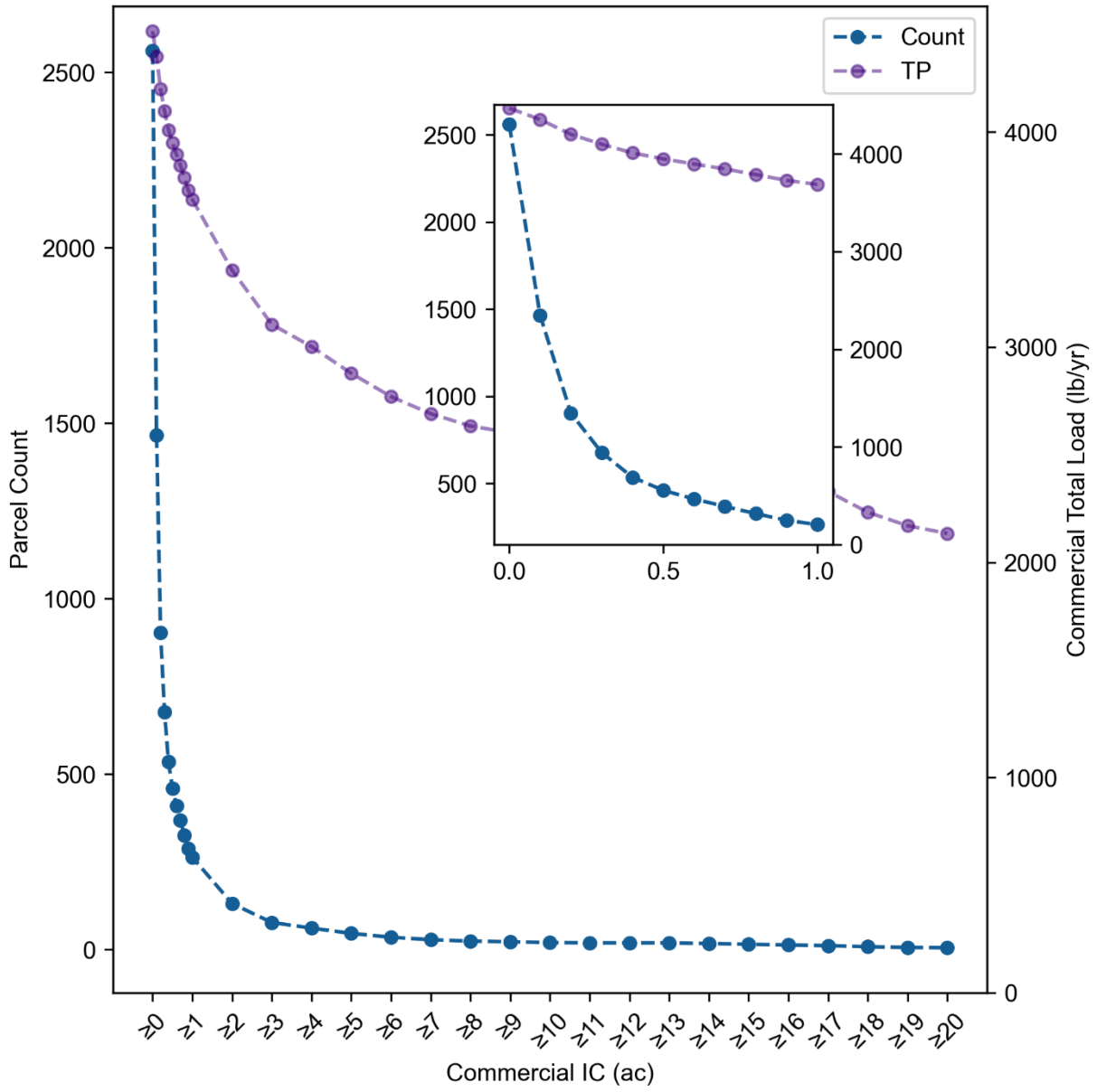

Figure A-1. Count and total TP load for private commercial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private commercial parcels in areas with environmental justice concerns.

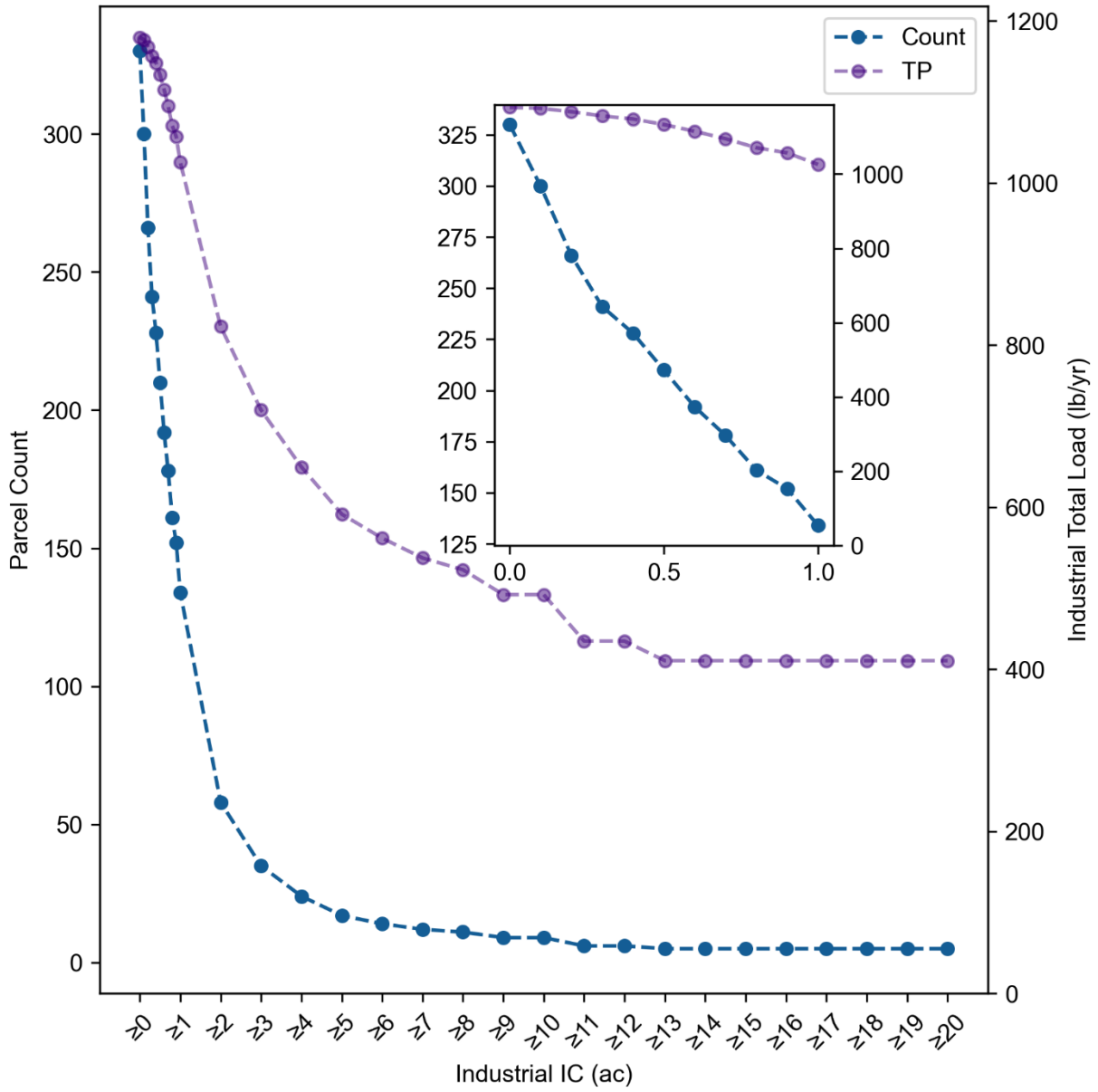

Figure A-2. Count and total TP load for private industrial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private industrial parcels in areas with environmental justice concerns.

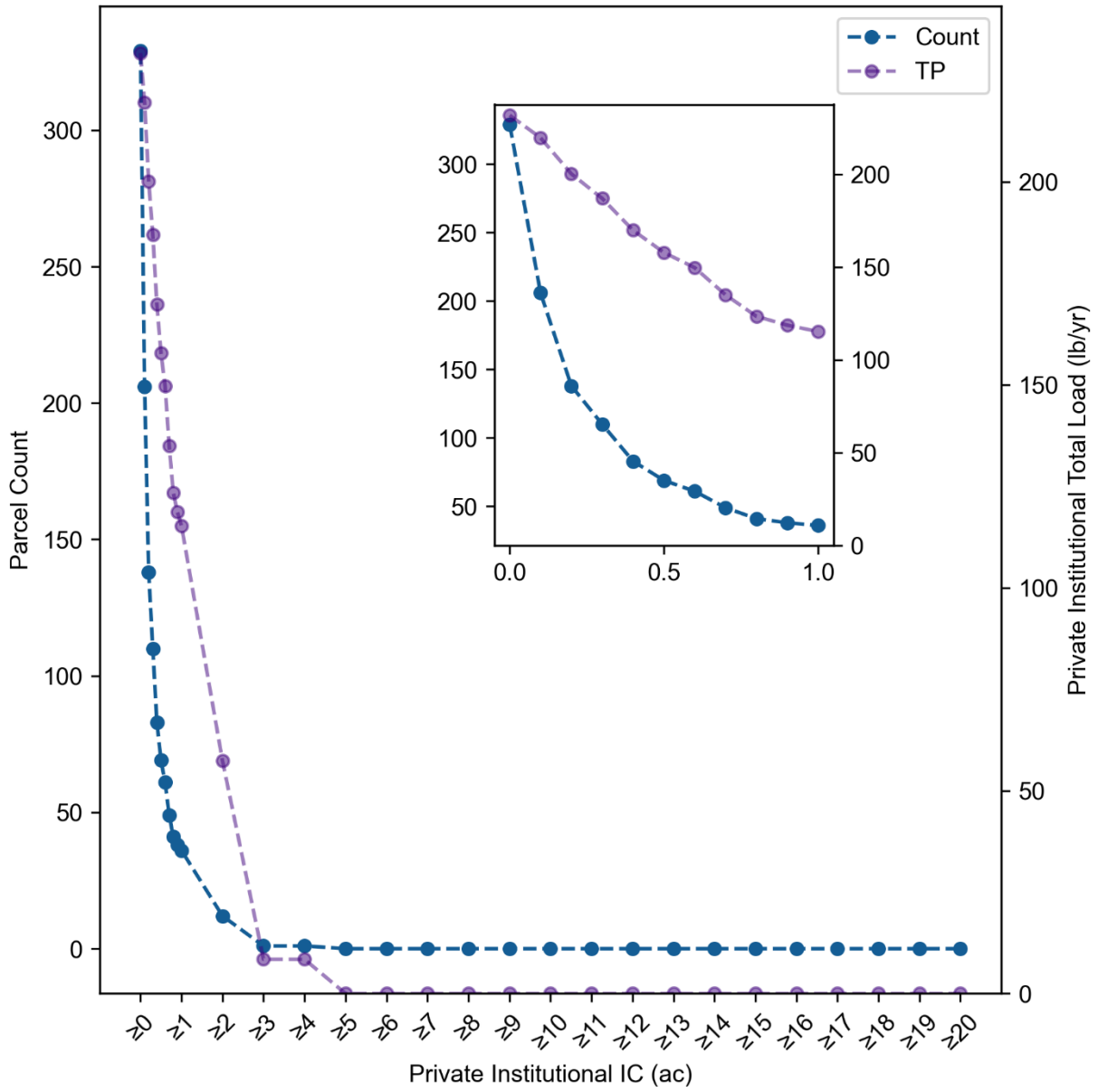

Figure A-3. Count and total TP load for private institutional parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private institutional parcels in areas with environmental justice concerns.

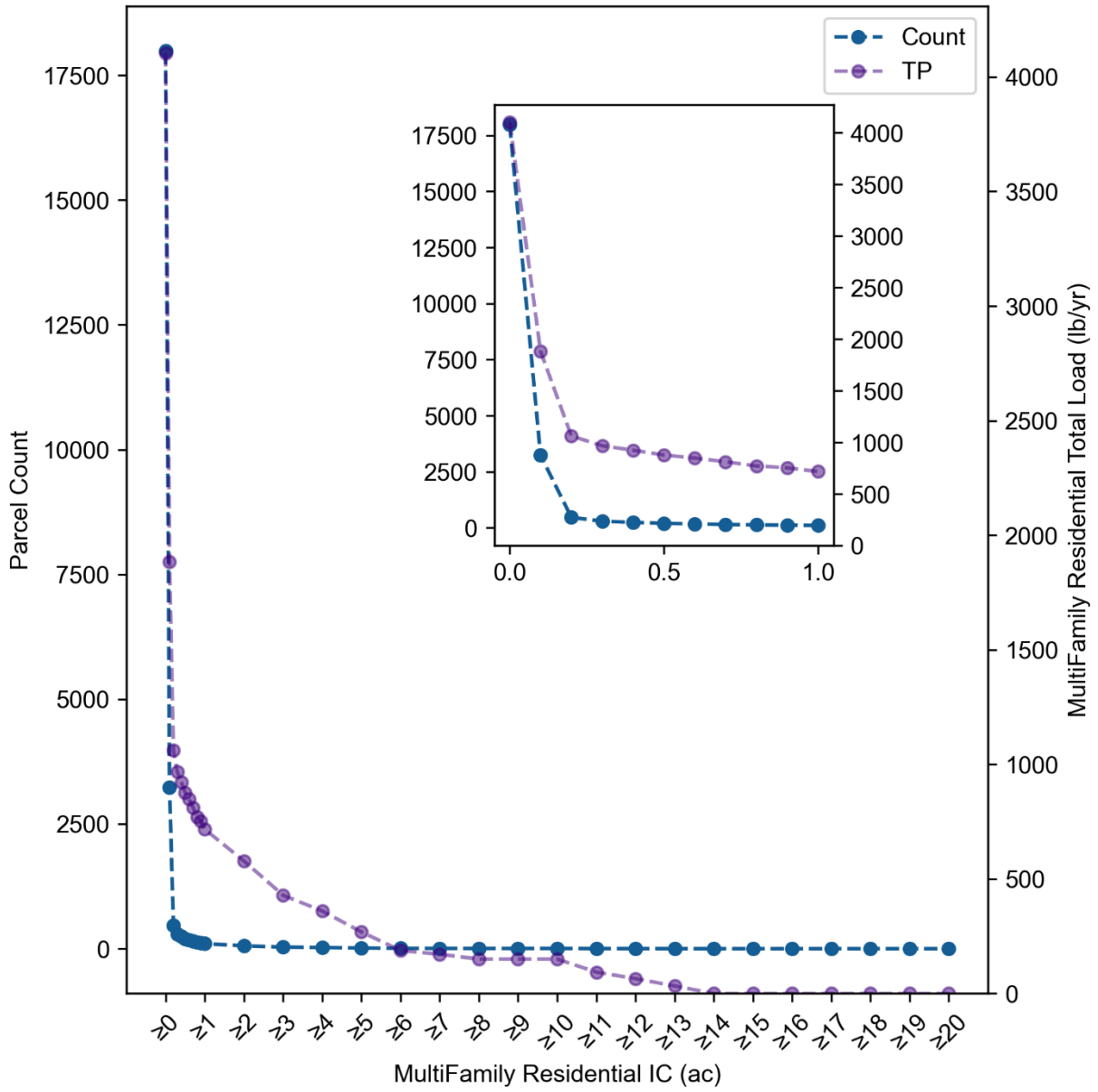

Figure A-4. Count and total TP load for private multi-family residential parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private multi-family residential parcels in areas with environmental justice concerns.

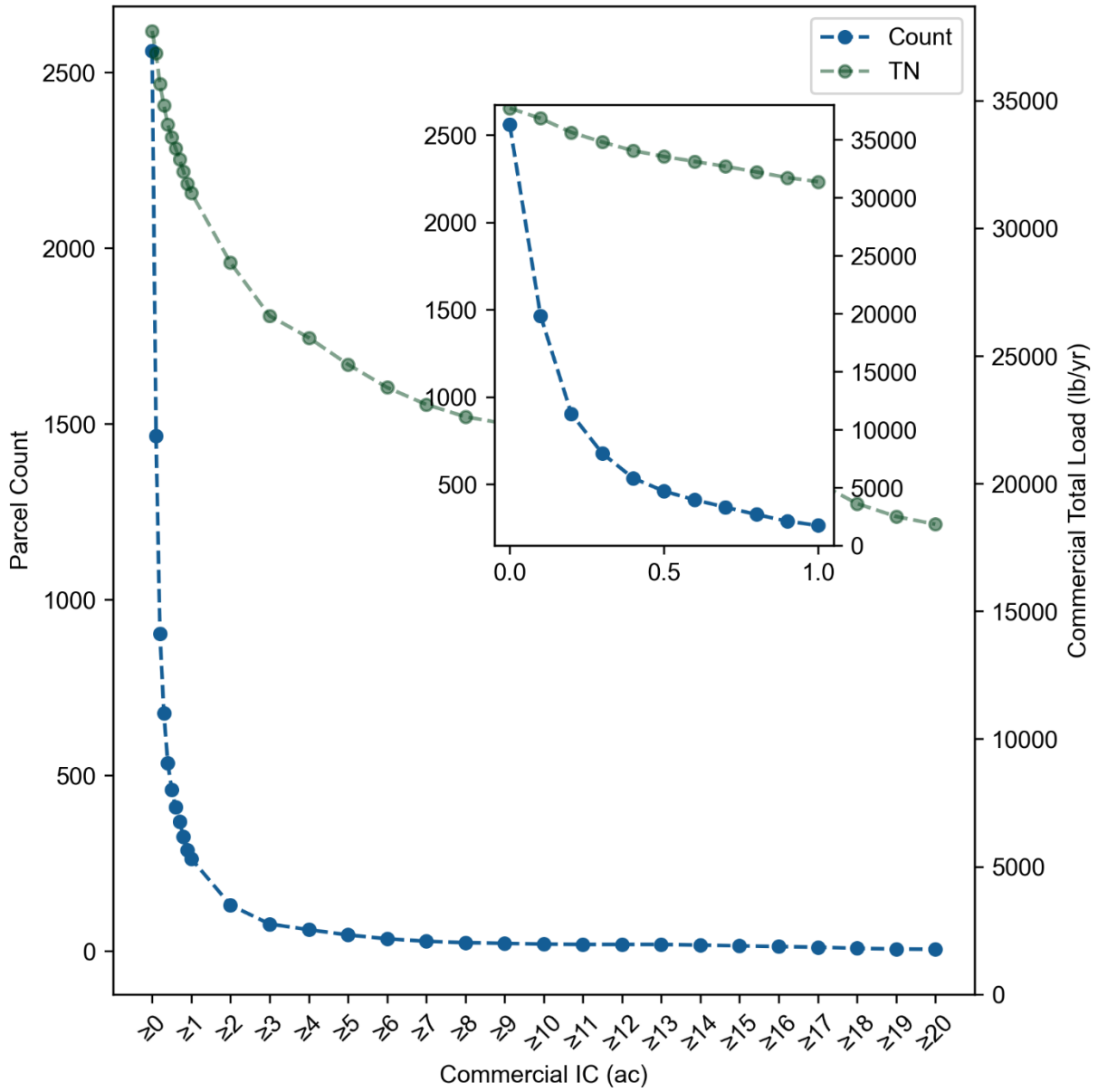

Figure A-5. Count and total TN load for private commercial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private commercial parcels in areas with environmental justice concerns.

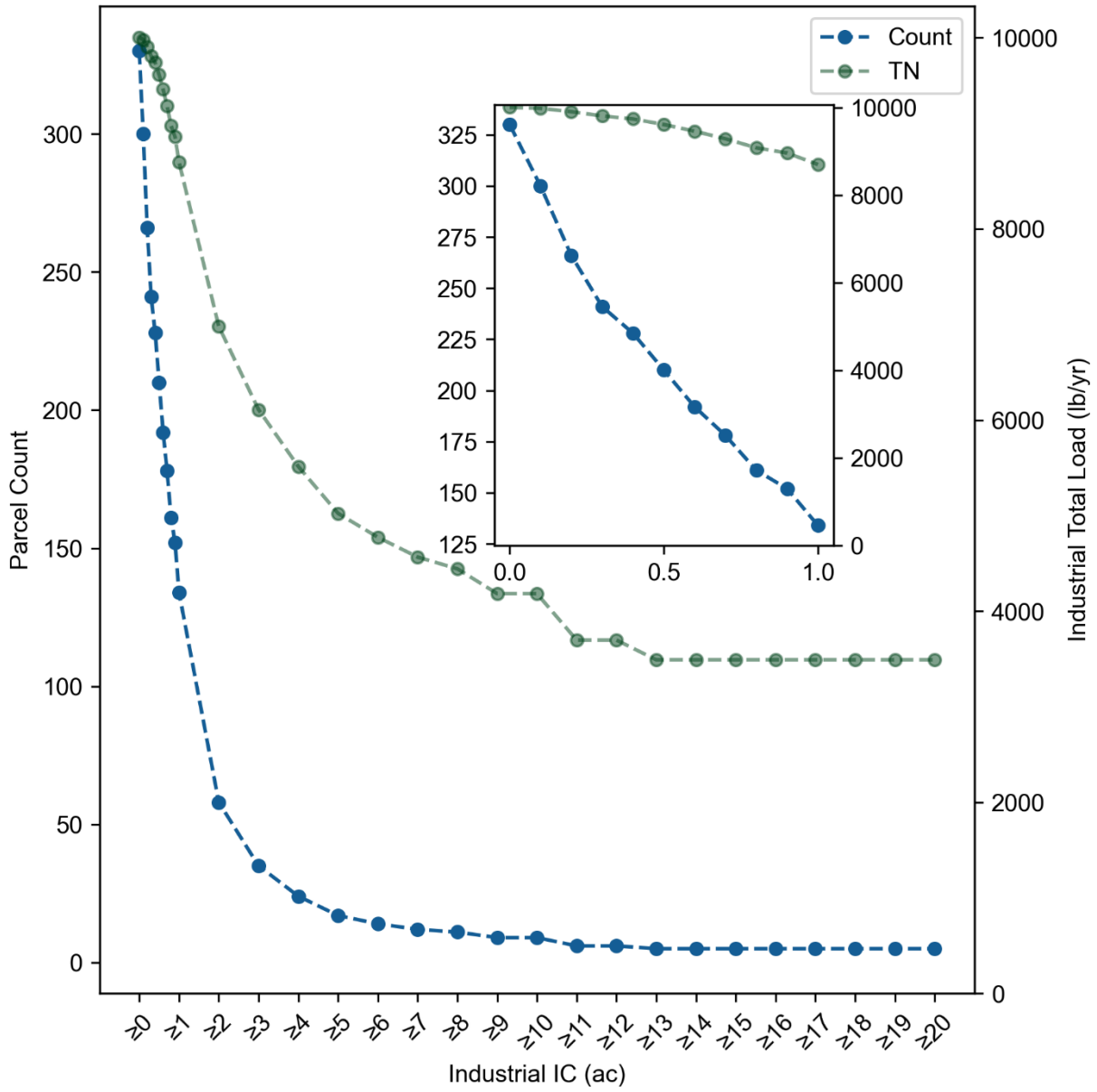

Figure A-6. Count and total TN load for private industrial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private industrial parcels in areas with environmental justice concerns.

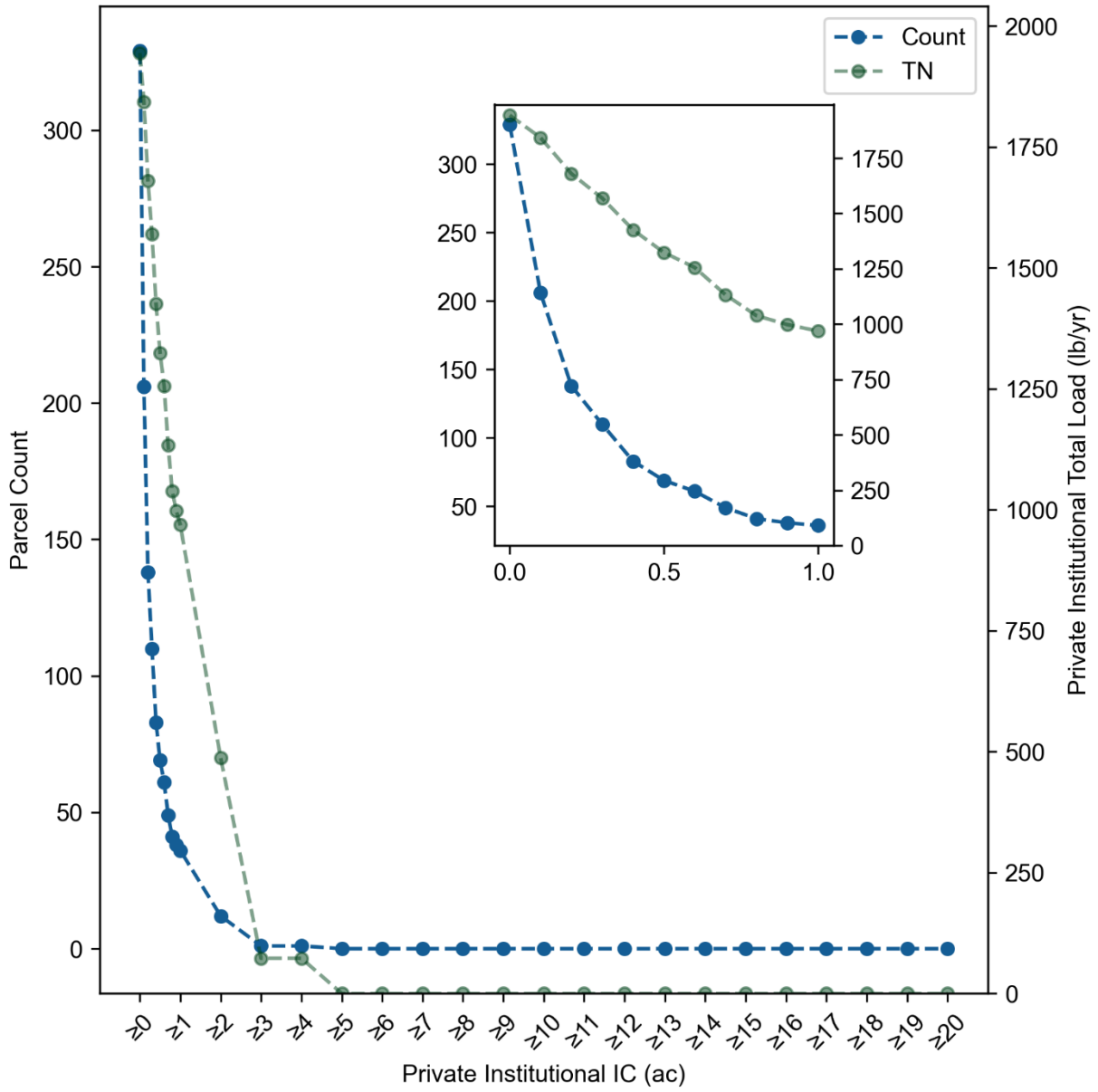

Figure A-7. Count and total TN load for private institutional parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private institutional parcels in areas with environmental justice concerns.

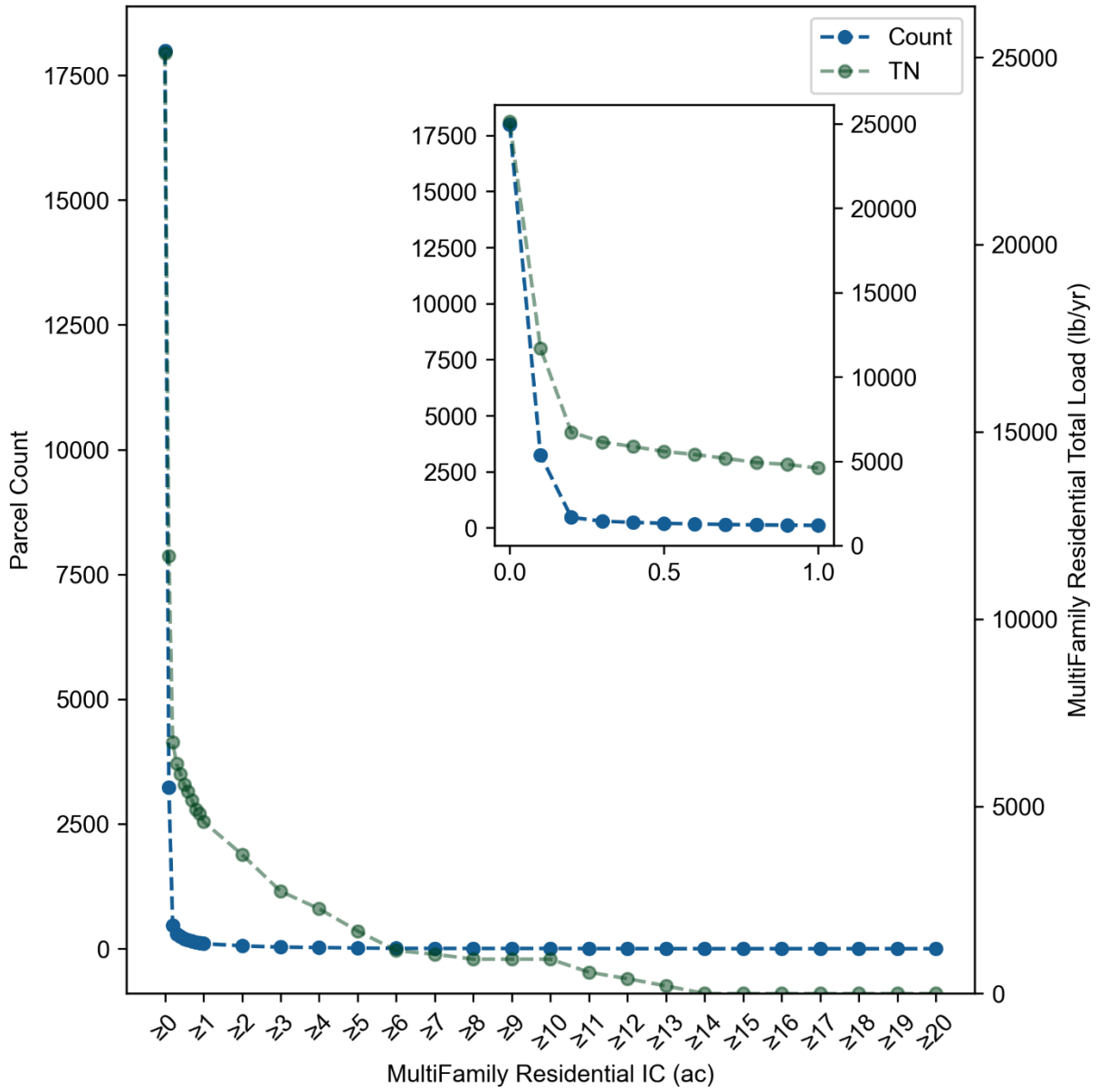

Figure A-8. Count and total TN load for private multi-family residential parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private multi-family residential parcels in areas with environmental justice concerns.

APPENDIX B

See the accompanying Excel workbook for the data used to create these plots.

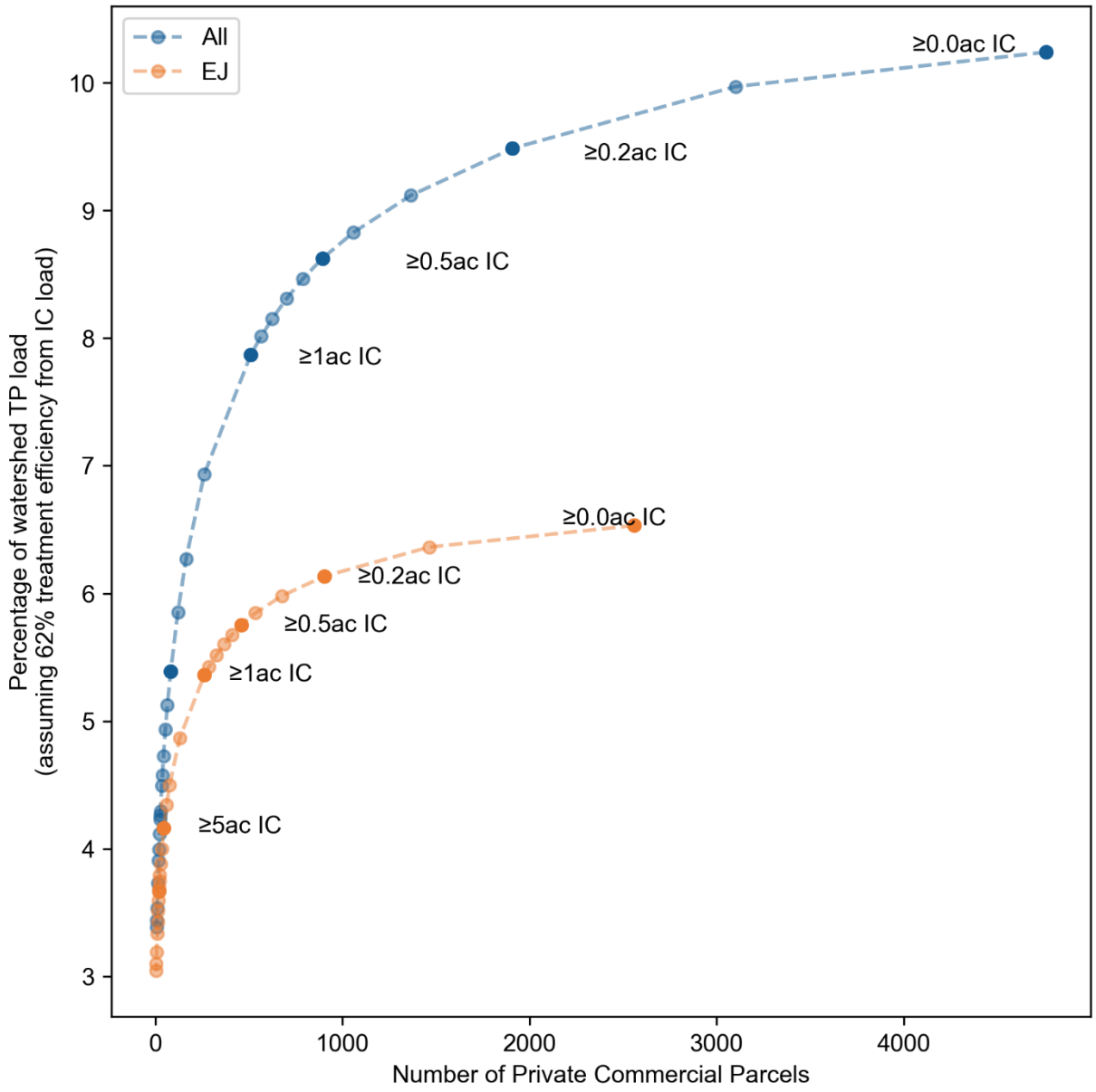

Figure B-1. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private commercial parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

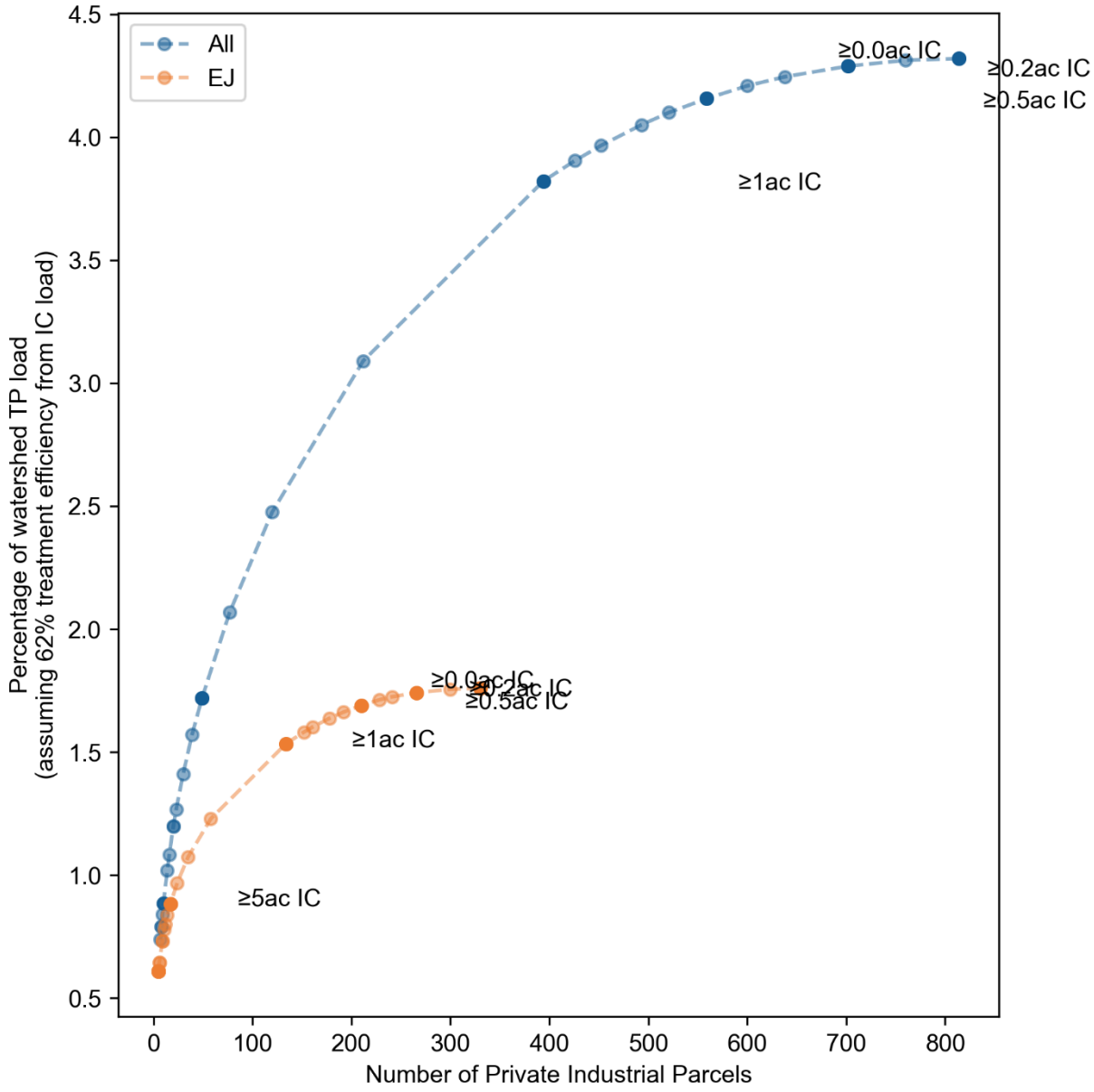

Figure B-2. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private industrial parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

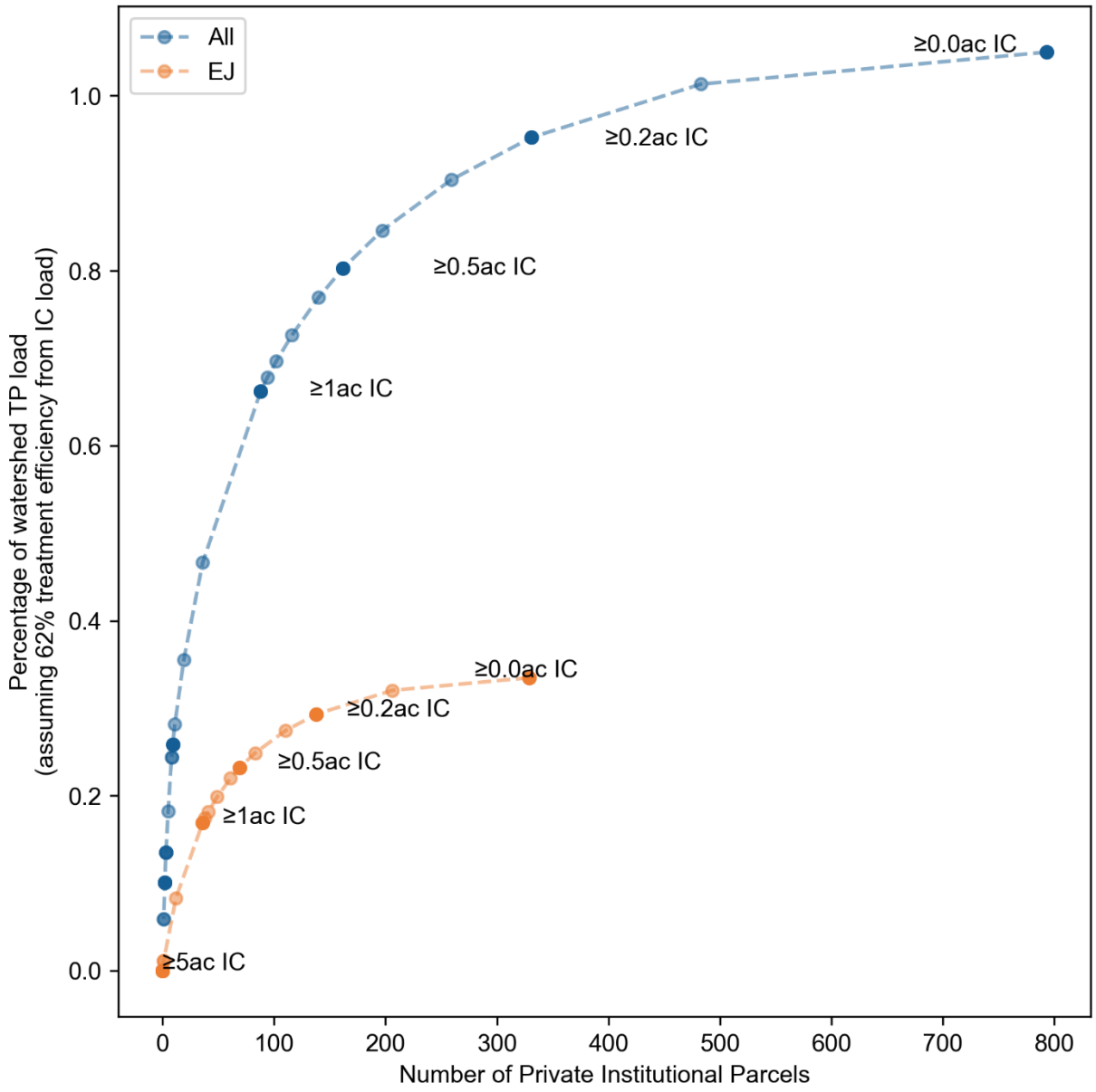

Figure B-3. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private institutional parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

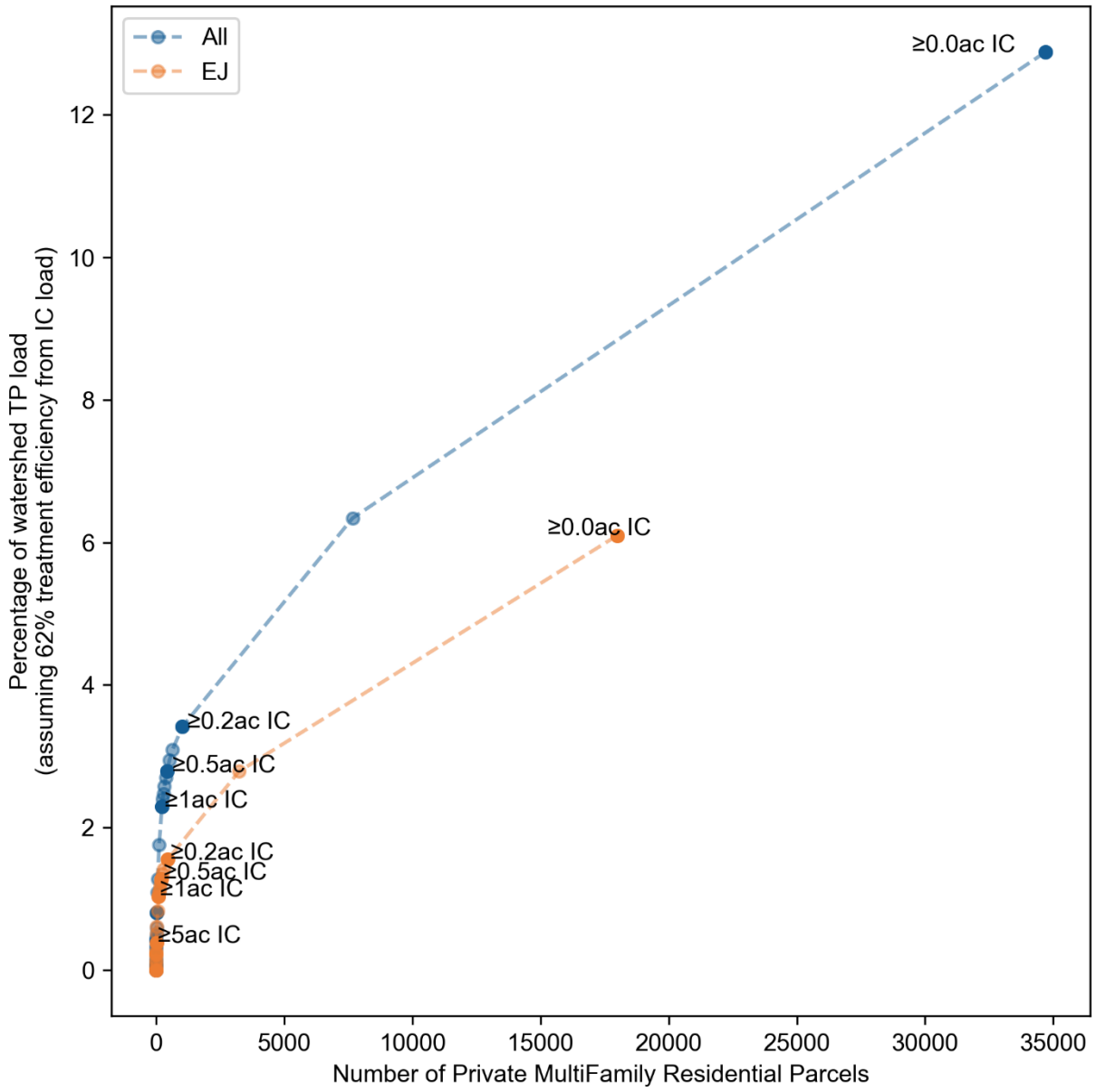

Figure B-4. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private multifamily residential parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.