WATERSHED ANALYSIS OF THE MYSTIC RIVER AND NEPONSET RIVER WATERSHEDS

TASK 4D TECHNICAL REPORT
NEPONSET RIVER WATERSHED ENVIRONMENTAL JUSTICE ANALYSIS

NOVEMBER 13, 2023

Prepared for:

U.S. EPA Region 1

Prepared by:

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1 INTRODUCTION

The Neponset River Watershed is highly residential, drains into Boston Harbor, and faces multiple water quality impairments including pathogens and nutrients (phosphorus and nitrogen) from human activity and urban development. Twenty-four waterbody segments have Total Maximum Daily Loads (TMDLs) for fecal bacteria, with illicit sewer connections, failing septic systems, and stormwater carrying fecal matter from domestic and wild animals identified as the primary sources (MassDEP, 2012, 2002) with an additional eighteen segments listed as requiring a TMDL (MassDEP, 2023). Stormwater runoff also carries excess nutrients into waterbodies which can cause algal blooms and macrophyte growth that contribute to anoxic bottom waters that do not support aquatic life, reduce water clarity, degrade waterbodies' aesthetic quality, and impair designated uses such as fishing, swimming, and boating. This is evidenced in the nearby Charles River and Mystic River Watersheds, where stormwater is the primary source of these pollutants (U.S. EPA, 2022; USEPA, 2020a). Within the Neponset River Watershed, there are twenty-three segments on the 303(d) list with evidence of nutrient pollution and eutrophication based on impairments for either nutrients, dissolved oxygen, turbidity, aquatic plants (macrophytes), or algae (MassDEP, 2023). On August 24, 2020, the U.S. Environmental Protection Agency (EPA) received a residual designation petition from the Conservation Law Foundation for the Neponset River Watershed. The petition requests that EPA use its residual designation authority (RDA) to permit stormwater discharges from commercial, industrial, institutional, and multi-family residential (CIIM) properties of one acre or greater in the watershed under the National Pollutant Discharge Elimination System (NPDES) program to meet water quality standards (WQS) in the Neponset River and its tributaries.

Several communities in areas with environmental justice (EJ) concerns are located within the Neponset 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 in response to the RDA petition. This report builds on the methodology and results of watershed-wide analyses of parcel-level stormwater total phosphorus (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. Additionally, 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. Lastly, the potential opportunity area for installing stormwater control measures (SCMs) is quantified for the watershed and a specific municipality is discussed as an example. While the permitting process primarily focuses on nutrient load reductions, it's worth noting that these SCMs can also contribute to the reduction of bacteria loads, which is a significant pollutant of concern in this watershed. This dual impact on nutrient and bacteria load reductions will be an important consideration in the RD decision-making process.

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 Neponset 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 Neponset 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 Neponset River Watershed, there are 38 census tracts identified as having environmental justice concerns based on the criteria specified in Section 2, out of the 88 total census tracts in the watershed. Figure 3-1 shows that these areas are concentrated in the lower, more urbanized, portions of the watershed (e.g., Boston, Quincy) with pockets in Norwood and Stoughton; this figure also shows the overlap of the different criteria. The census tracts in areas with environmental justice concerns are within five of the fourteen 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 94% of all tracts in areas with environmental justice concerns, 44% of tracts in areas with environmental justice concerns are Disadvantaged, and 17% meet the Low Median Household Income threshold. Sixteen 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 Neponset River Watershed that were identified as having environmental justice concerns as shown in Table 3-2. Most of these tracts have a mix of French Creole, Portuguese Creole, Spanish Creole, or Vietnamese; Quincy has a large contingent of Chinese speakers.

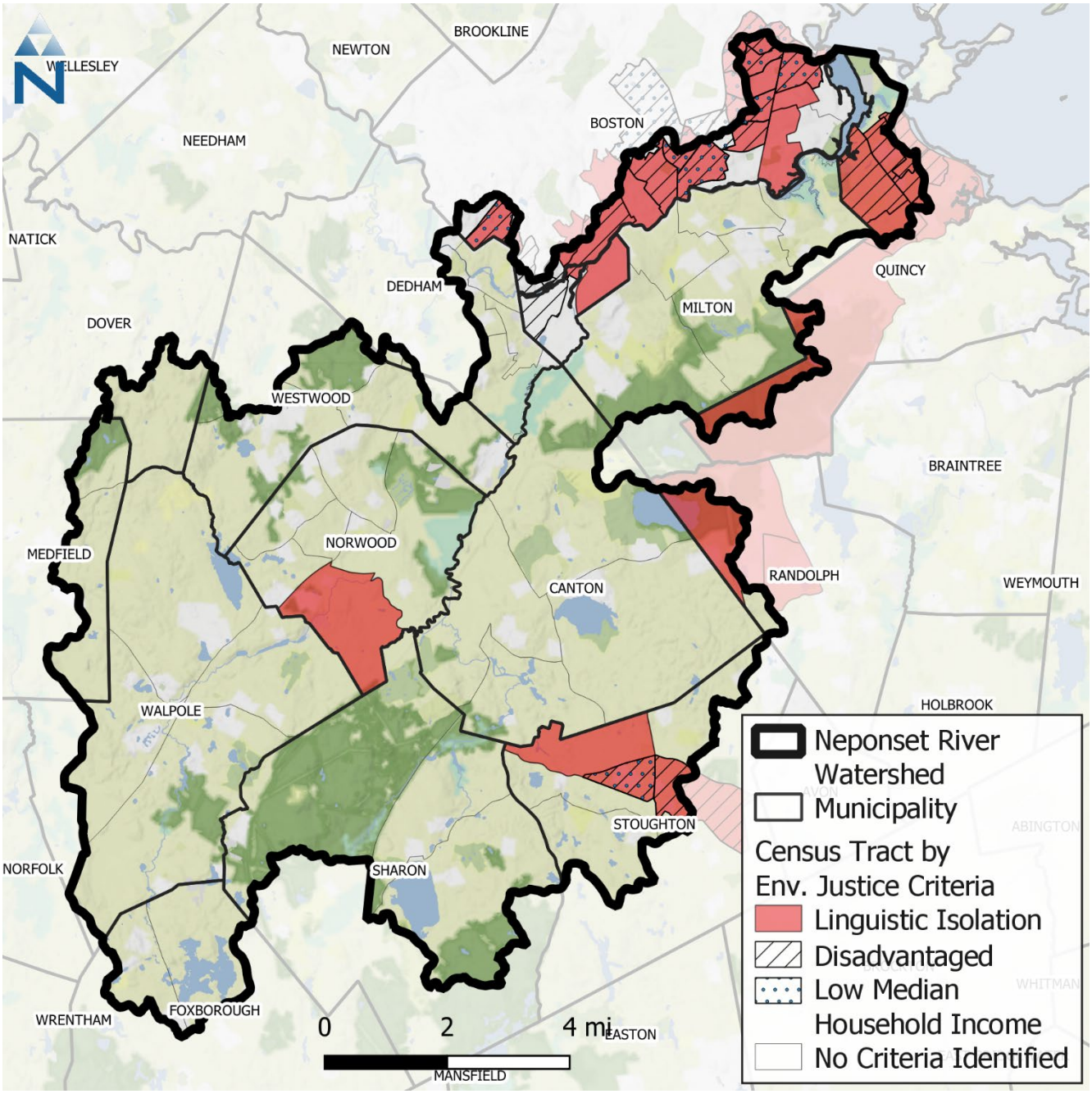

Figure 3-1. Map of census tracts in areas with environmental justice concerns by criteria.

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

Municipality	Any Criteria		Linguistic Isolation		Low Median Household Income		Disadvantaged		All Criteria	
	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage
BOSTON	3,971.4	41.5%	3,417.7	35.7%	1,347.2	14.1%	2,581.4	26.9%	1,210.7	12.6%
NORWOOD	1,433.5	15.0%	1,433.5	15.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
QUINCY	1,876.8	19.6%	1,876.8	19.6%	0.0	0.0%	1,011.0	10.6%	0.0	0.0%
RANDOLPH	761.6	8.0%	761.6	8.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
STOUGHTON	1,535.6	16.0%	1,535.6	16.0%	302.4	3.2%	616.4	6.4%	302.4	3.2%
Environmental Justice Total	**9,579.0**	**100.0%**	**9,025.3**	**94.2%**	**1,649.6**	**17.2%**	**4208.827**	**43.9%**	**1,513.1**	**15.8%**

* 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 in the Neponset River Watershed

Municipality	> 5% of Tracts with Environmental Justice Concerns are Linguistic Isolation	Arabic	Chinese	French Creole	Portuguese Creole	Spanish Creole	Vietnamese
BOSTON	Yes	--	--	6.0%	--	6.5%	4.4%
NORWOOD	Yes	1.2%	--	--	4.2%	3.3%	--
QUINCY	Yes	--	19.4%	--	--	0.5%	1.2%
RANDOLPH	Yes	--	--	5.8%	1.2%	--	3.5%
STOUGHTON	Yes	--	--	1.6%	3.9%	1.1%	--

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 1992-2022. The total watershed baseline TP load from unattenuated stormwater for this period is 34,367 lb/yr.

A total of 25,516 parcels were identified as being within census tracts in areas with environmental justice concerns. The parcels are predominately Multifamily and Single Family Residential, which represent 83% of all parcels in areas with environmental justice concerns by count but only 23% by land area. Public Open Land and Right-of-Way make up the majority of parcel area (55%). Private commercial, industrial, and institutional make up 6% 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 38% of the total parcel area; forty percent of impervious cover is within these private parcels. In terms of nutrient loading, private parcels contribute 47% and 46% of the total TP and TN, respectively. Loading from IC within private parcels amounts to 93% of the total TP and 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 in areas with environmental justice concerns by Use Group and Private/Public designation for TP and TN, respectively.

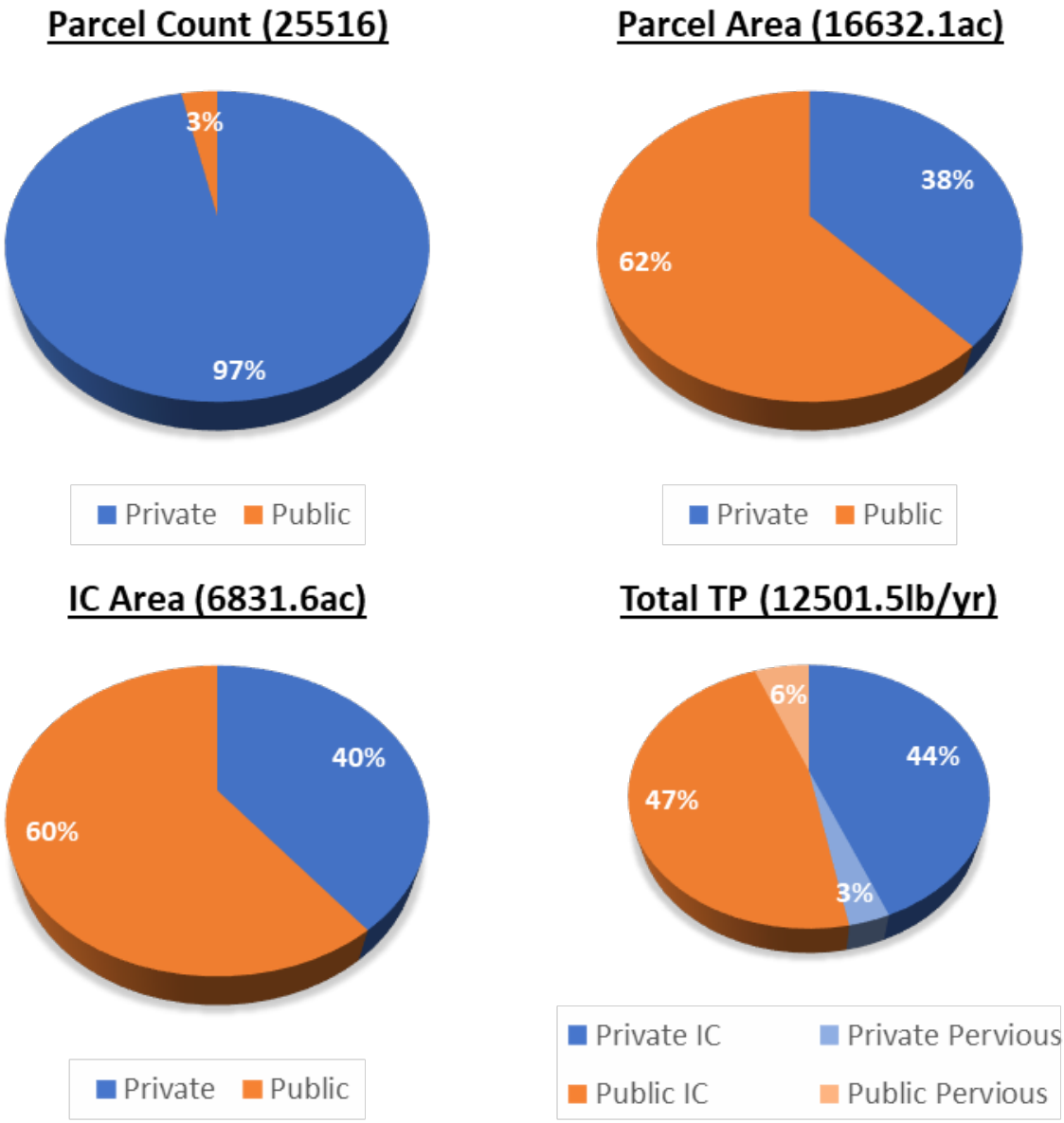

Figure 3-2. Private/Public summaries for all parcels in areas with environmental justice concerns within the Neponset River Watershed.

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

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 (%)	Total Avg.
Private	Agriculture	43	0.17	18.18	0.11	13.54	74.44	0.31	24.08	0.52	24.60	0.20	0.57
	Commercial	1,109	4.35	876.52	5.27	644.74	73.56	0.58	1,176.70	27.36	1,204.06	9.63	1.09
	Industrial	138	0.54	358.73	2.16	200.70	55.95	1.45	360.65	18.02	378.67	3.03	2.74
	MultiFamily Res.	8,709	34.13	1,664.99	10.01	885.99	53.21	0.10	2,081.75	79.72	2,161.47	17.29	0.25
	Open Land	1,719	6.74	949.17	5.71	101.16	10.66	0.06	196.71	72.02	268.73	2.15	0.16
	Private Inst.	387	1.52	374.58	2.25	119.47	31.89	0.31	214.51	23.32	237.83	1.90	0.61
	Public Inst.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Right-of-Way	5	0.02	0.92	0.01	0.55	60.21	0.11	0.83	0.02	0.84	0.01	0.17
	Single Family Res.	12,560	49.22	2,141.63	12.88	733.06	34.23	0.06	1,442.74	164.97	1,607.71	12.86	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	**24,670**	**96.7**	**6,384.73**	**38.4**	**2,699.20**	**42.3**	--	**5,497.95**	**385.96**	**5,883.91**	**47.1**	--
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	2	0.01	2.80	0.02	2.34	83.63	1.17	4.21	0.08	4.29	0.03	2.15
	Industrial	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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	40	0.16	3,430.15	20.62	36.25	1.06	0.91	64.90	458.85	523.76	4.19	13.09
	Private Inst.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Public Inst.	740	2.90	1,022.69	6.15	237.90	23.26	0.32	416.48	88.19	504.68	4.04	0.68
	Right-of-Way	59	0.23	5,684.17	34.18	3,854.79	67.82	65.34	5,391.44	190.81	5,582.26	44.65	94.61
	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	5	0.02	107.59	0.65	1.15	1.07	0.23	1.79	0.79	2.58	0.02	0.52
	Subtotal	**846**	**3.3**	**10,247.40**	**61.6**	**4,132.42**	**40.3**	--	**5,878.83**	**738.73**	**6,617.56**	**52.9**	--
Environmental Justice Total		**25,516**	**100**	**16,632.12**	**100**	**6,831.62**	**41.1**	--	**11,376.79**	**1,124.68**	**12,501.47**	**100**	--
Watershed Total		**79,527**	**32%**	**74,944.34**	**22%**	**15,592.28**	**44%**	--	**27,742.02**	**6,625.28**	**34,367.30**	**36%**	--

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

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

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 (%)	Total Avg.
Private	Agriculture	43	0.17	18.18	0.11	13.54	74.44	0.31	202.07	4.14	206.21	0.23	4.80
	Commercial	1,109	4.35	876.52	5.27	644.74	73.56	0.58	9,758.88	209.45	9,968.33	10.94	8.99
	Industrial	138	0.54	358.73	2.16	200.70	55.95	1.45	3,049.15	142.86	3,192.01	3.50	23.13
	MultiFamily Res.	8,709	34.13	1,664.99	10.01	885.99	53.21	0.10	12,580.42	595.21	13,175.63	14.47	1.51
	Open Land	1,719	6.74	949.17	5.71	101.16	10.66	0.06	1,325.82	545.98	1,871.80	2.06	1.09
	Private Inst.	387	1.52	374.58	2.25	119.47	31.89	0.31	1,809.25	188.72	1,997.97	2.19	5.16
	Public Inst.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Right-of-Way	5	0.02	0.92	0.01	0.55	60.21	0.11	5.99	0.09	6.07	0.01	1.21
	Single Family Res.	12,560	49.22	2,141.63	12.88	733.06	34.23	0.06	10,424.97	1,239.53	11,664.51	12.81	0.93
	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	**24,670**	**96.7**	**6,384.73**	**38.4**	**2,699.20**	**42.3**	--	**39,156.56**	**2,925.98**	**42,082.54**	**46.2**	--
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	2	0.01	2.80	0.02	2.34	83.63	1.17	35.67	0.62	36.29	0.04	18.15
	Industrial	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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	40	0.16	3,430.15	20.62	36.25	1.06	0.91	547.84	3,085.36	3,633.20	3.99	90.83
	Private Inst.	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Public Inst.	740	2.90	1,022.69	6.15	237.90	23.26	0.32	3,462.54	735.40	4,197.94	4.61	5.67
	Right-of-Way	59	0.23	5,684.17	34.18	3,854.79	67.82	65.34	39,701.63	1,411.62	41,113.25	45.14	696.83
	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	5	0.02	107.59	0.65	1.15	1.07	0.23	14.08	6.02	20.10	0.02	4.02
	Subtotal	**846**	**3.3**	**10,247.40**	**61.6**	**4,132.42**	**40.3**	--	**43,761.75**	**5,239.03**	**49,000.78**	**53.8**	--
Environmental Justice Total		**25,516**	**100**	**16,632.12**	**100**	**6,831.62**	**41.1**	--	**82,918.32**	**8,165.01**	**91,083.32**	**100**	--
Watershed Total		**79,527**	**32%**	**74,944.34**	**22%**	**15,592.28**	**44%**	--	**206,227.6**	**47,457.9**	**253,685.5**	**36%**	--

* 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 41% of all parcels in areas with environmental justice concerns (Table 3-5). The majority of CIIM parcels in areas with environmental justice concerns are multifamily residential parcels. 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 parcels within the watershed ("Watershed Total"). For example, CIIM parcels in areas with environmental justice concerns represent 60% of all private CIIM parcels, 13% of all parcels, 12% of the total IC area, 14% of the total TP and 13% of the total TN load from all IC in the watershed.

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

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	Parcel Total Avg.	IC	Pervious	Parcel Total Avg.
Commercial	1,109	876.52	644.74	73.56	0.58	1,176.70	27.36	1.09	9,758.88	209.45	8.99
Industrial	138	358.73	200.70	55.95	1.45	360.65	18.02	2.74	3,049.15	142.86	23.13
MultiFamily Residential	8,709	1,664.99	885.99	53.21	0.10	2,081.75	79.72	0.25	12,580.42	595.21	1.51
Private Institutional	387	374.58	119.47	31.89	0.31	214.51	23.32	0.61	1,809.25	188.72	5.16
Subtotal	**10,343**	**3,274.82**	**1,850.89**	**56.52**	--	**3,833.60**	**148.42**	--	**27,197.71**	**1,136.24**	--
Environmental Justice Total (%)	**40.5**	**19.7**	**27.1**	**--**	--	**33.7**	**13.2**	--	**32.8**	**13.9**	--
All Private CIIM (%)	**60.4**	**22.6**	**34.3**	**--**	--	**36.0**	**14.8**	--	**34.0**	**15.3**	--
Watershed Total (%)	**13.0**	**4.4**	**11.9**	--	--	**13.8**	**2.2**	--	**13.2**	**2.4**	--

* 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 ≥ 1 ac, the number of parcels regulated is relatively small, but accounts for more than half of the private CIIM total load from parcels in areas with environmental justice concerns. As the IC threshold decreases, the number of parcels regulated sharply increases.

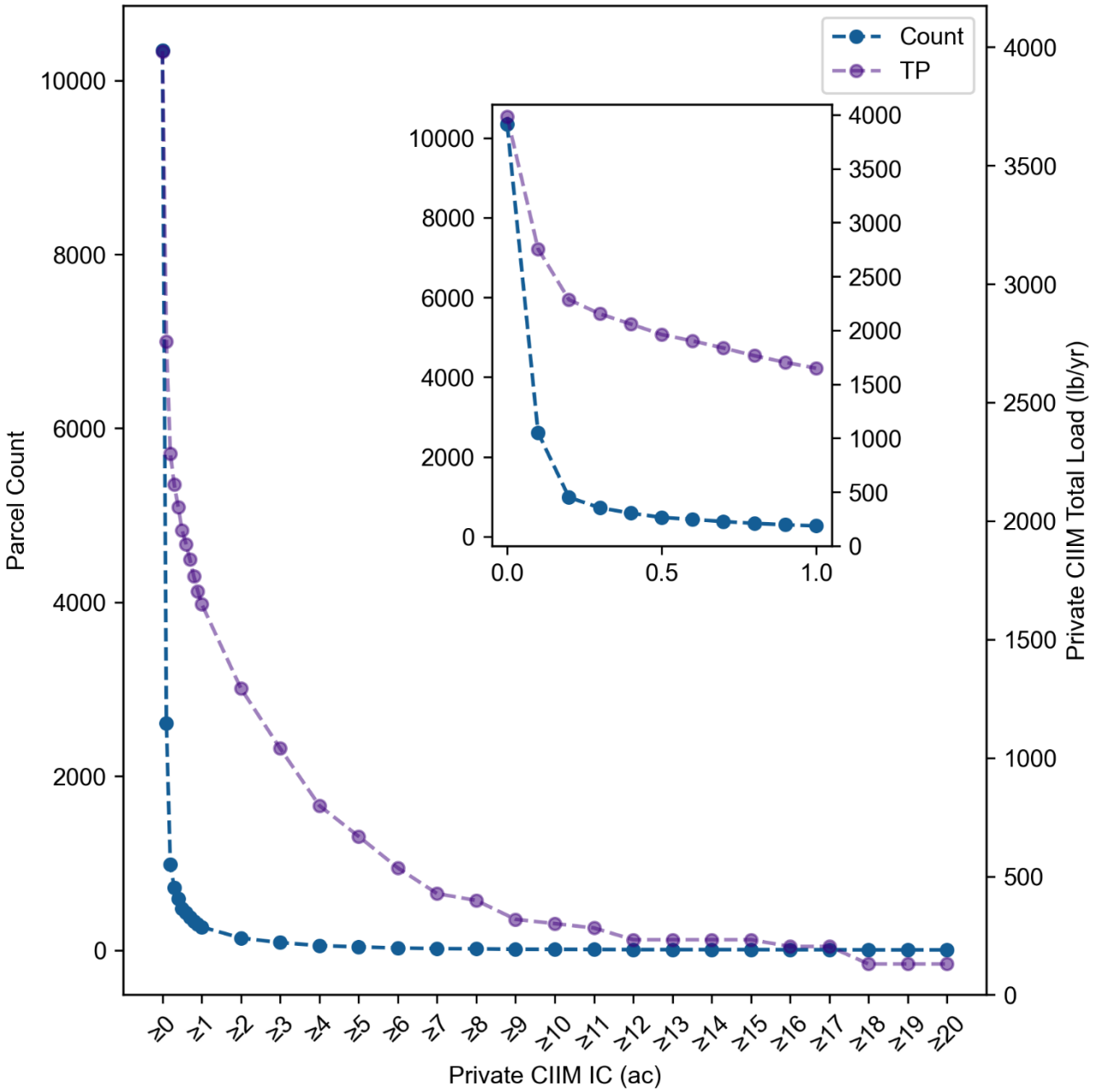

Figure 3-3. Count and total TP load for private CIIM parcels in areas with environmental justice concerns by parcel IC area in the Neponset River Watershed. Note that a threshold of ≥ 0ac IC includes all private CIIM parcels in areas with environmental justice concerns.

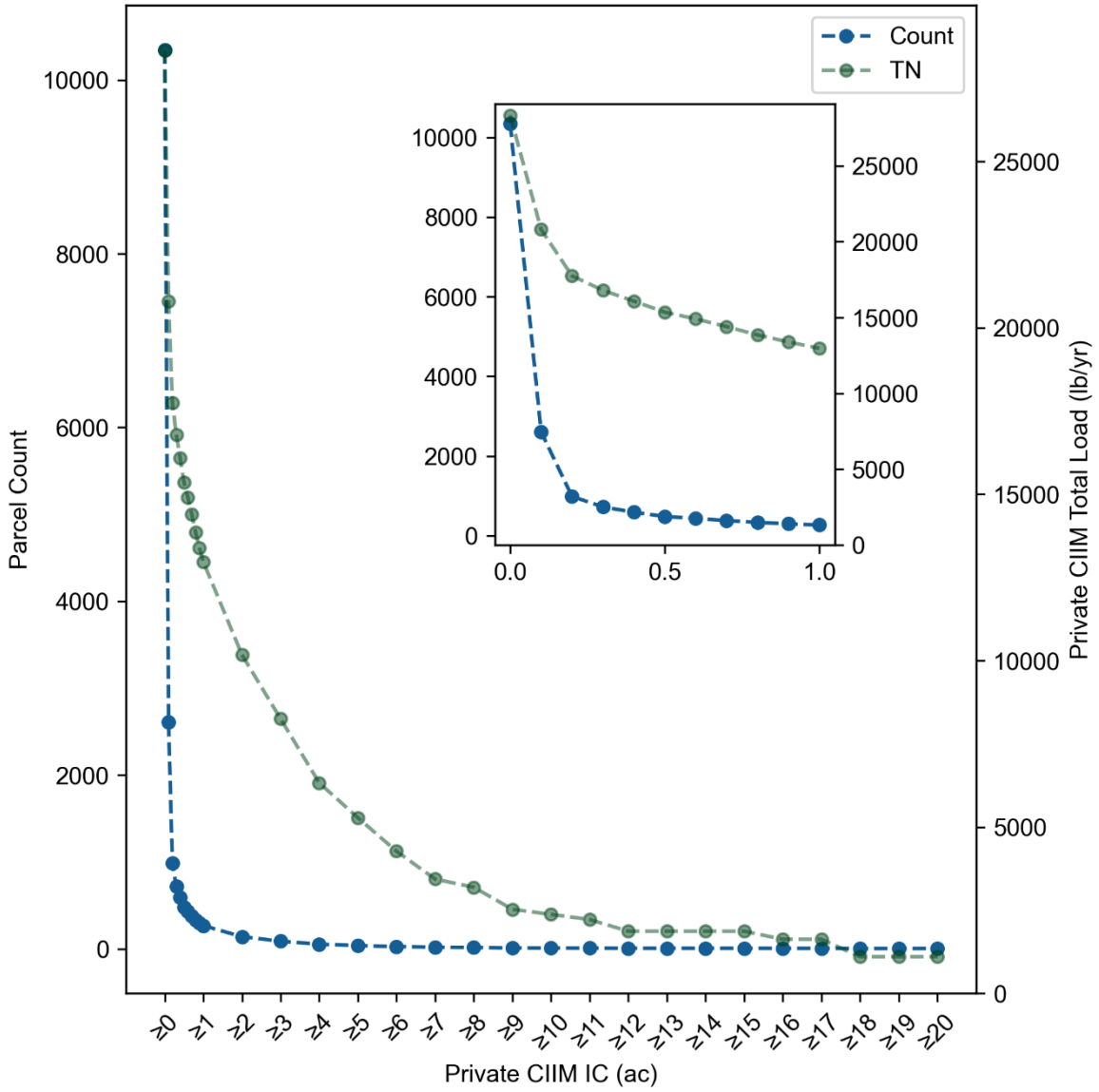

Figure 3-4. Count and total TN load for private CIIM parcels in areas with environmental justice concerns by parcel IC area in the Neponset River Watershed. Note that a threshold of ≥ 0ac IC includes all private CIIM parcels in areas with environmental justice concerns.

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), 814 parcels in areas with environmental justice concerns would have to install additional stormwater controls. These parcels are 3% of the total parcels in areas with environmental justice concerns, 34% of all private CIIM parcels meeting the IC threshold, 5% of all private CIIM parcels, and 1% of all parcels within the watershed. While parcels in areas with environmental justice concerns make up 60% of all private CIIM parcels, using an IC threshold greater than 0.25 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). For a given IC threshold, the percentage of CIIM parcels in areas with environmental justice concerns is relatively consistent - between 23% and 34% - for the IC thresholds evaluated here.

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

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	395	768.55	563.93	73.38	1,025.52	24.32	1,049.84	8,557.94	188.11	8,746.04
Industrial	102	334.66	196.87	58.83	353.83	16.52	370.35	2,991.66	130.87	3,122.53
MultiFamily Residential	227	507.88	243.39	47.92	564.80	24.37	589.17	3,450.31	198.71	3,649.02
Private Institutional	90	281.21	100.71	35.81	180.72	15.84	196.56	1,526.43	130.63	1,657.05
Subtotal	**814**	**1,892.30**	**1,104.90**	**58.39**	**2,124.87**	**81.04**	**2,205.91**	**16,526.33**	**648.31**	**17,174.64**
Environmental Justice Total (%)	**3.2**	**11.4**	**16.2**	--	**18.7**	**7.2**	**17.6**	**19.9**	**7.9**	**18.9**
Threshold Private CIIM (%)	**33.5**	**17.3**	**26.4**	--	**26.9**	**10.8**	**25.5**	**26.4**	**11.5**	**25.2**
All Private CIIM (%)	**4.8**	**13.0**	**20.5**	--	**20.0**	**8.1**	**19.0**	**20.7**	**8.7**	**19.7**
Watershed Total (%)	**1.0**	**2.5**	**7.1**	--	**7.7**	**1.2**	**6.4**	**8.0**	**1.4**	**6.8**

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

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

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	232	695.31	505.72	72.73	919.17	22.90	942.07	7,682.14	177.55	7,859.69
Industrial	81	320.43	189.25	59.06	340.20	16.13	356.32	2,876.79	127.83	3,004.62
MultiFamily Residential	118	443.15	204.66	46.18	473.88	21.53	495.41	2,897.90	177.69	3,075.58
Private Institutional	50	245.40	86.16	35.11	154.53	13.07	167.60	1,305.03	107.58	1,412.60
Subtotal	**481**	**1,704.28**	**985.79**	**57.84**	**1,887.78**	**73.63**	**1,961.41**	**14,761.85**	**590.65**	**15,352.50**
Environmental Justice Total (%)	**1.9**	**10.2**	**14.4**	--	**16.6**	**6.5**	**15.7**	**17.8**	**7.2**	**16.9**
Threshold Private CIIM (%)	**30.1**	**16.8**	**25.3**	--	**25.8**	**10.7**	**24.5**	**25.4**	**11.3**	**24.2**
All Private CIIM (%)	**2.8**	**11.7**	**18.3**	--	**17.7**	**7.4**	**16.8**	**18.5**	**7.9**	**17.6**
Watershed Total (%)	**0.6**	**2.3**	**6.3**	--	**6.8**	**1.1**	**5.7**	**7.2**	**1.2**	**6.1**

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

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

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	172	647.47	469.15	72.46	853.41	21.59	875.01	7,126.11	167.50	7,293.61
Industrial	67	305.53	180.05	58.93	323.64	15.47	339.11	2,736.70	123.50	2,860.19
MultiFamily Residential	80	400.44	181.36	45.29	419.57	19.56	439.13	2,564.47	161.13	2,725.59
Private Institutional	38	223.39	78.35	35.07	140.52	10.98	151.50	1,186.72	93.37	1,280.09
Subtotal	**357**	**1,576.84**	**908.92**	**57.64**	**1,737.15**	**67.60**	**1,804.75**	**13,613.99**	**545.49**	**14,159.49**
Environmental Justice Total (%)	**1.4**	**9.5**	**13.3**	--	**15.3**	**6.0**	**14.4**	**16.4**	**6.7**	**15.5**
Threshold Private CIIM (%)	**28.9**	**16.5**	**24.8**	--	**25.2**	**10.4**	**23.9**	**24.8**	**11.0**	**23.6**
All Private CIIM (%)	**2.1**	**10.9**	**16.9**	--	**16.3**	**6.8**	**15.5**	**17.0**	**7.3**	**16.2**
Watershed Total (%)	**0.4**	**2.1**	**5.8**	--	**6.3**	**1.0**	**5.3**	**6.6**	**1.1**	**5.6**

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

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

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	598.66	433.33	72.38	789.00	20.73	809.74	6,586.19	160.85	6,747.04
Industrial	49	281.13	165.09	58.72	296.72	13.97	310.69	2,509.00	111.47	2,620.47
MultiFamily Residential	55	352.52	159.93	45.37	369.77	17.20	386.98	2,260.66	142.51	2,403.18
Private Institutional	32	216.05	73.22	33.89	131.30	10.57	141.87	1,108.66	90.10	1,198.76
Subtotal	**267**	**1,448.36**	**831.58**	**57.41**	**1,586.80**	**62.48**	**1,649.28**	**12,464.51**	**504.93**	**12,969.44**
Environmental Justice Total (%)	**1.0**	**8.7**	**12.2**	--	**13.9**	**5.6**	**13.2**	**15.0**	**6.2**	**14.2**
Threshold Private CIIM (%)	**26.8**	**16.0**	**24.0**	--	**24.4**	**10.1**	**23.2**	**24.0**	**10.7**	**22.9**
All Private CIIM (%)	**1.6**	**10.0**	**15.4**	--	**14.9**	**6.2**	**14.2**	**15.6**	**6.8**	**14.8**
Watershed Total (%)	**0.3**	**1.9**	**5.3**	--	**5.7**	**0.9**	**4.8**	**6.0**	**1.1**	**5.1**

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

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

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	68	477.50	343.14	71.86	625.50	17.52	643.02	5,217.27	135.38	5,352.65
Industrial	29	241.75	136.25	56.36	245.33	12.95	258.28	2,076.35	102.43	2,178.78
MultiFamily Residential	29	260.68	124.43	47.73	286.31	12.14	298.46	1,753.36	104.32	1,857.68
Private Institutional	13	144.83	48.26	33.32	86.91	6.01	92.92	735.53	50.69	786.22
Subtotal	**139**	**1,124.77**	**652.07**	**57.97**	**1,244.06**	**48.62**	**1,292.68**	**9,782.50**	**392.83**	**10,175.33**
Environmental Justice Total (%)	**0.5**	**6.8**	**9.5**	--	**10.9**	**4.3**	**10.3**	**11.8**	**4.8**	**11.2**
Threshold Private CIIM (%)	**25.6**	**15.5**	**23.1**	--	**23.6**	**10.3**	**22.5**	**23.2**	**10.7**	**22.2**
All Private CIIM (%)	**0.8**	**7.7**	**12.1**	--	**11.7**	**4.9**	**11.1**	**12.2**	**5.3**	**11.6**
Watershed Total (%)	**0.2**	**1.5**	**4.2**	--	**4.5**	**0.7**	**3.8**	**4.7**	**0.8**	**4.0**

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

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

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	19	254.27	184.76	72.66	339.16	8.69	347.85	2,805.61	67.63	2,873.24
Industrial	7	151.54	72.40	47.78	130.45	10.05	140.50	1,104.39	79.00	1,183.39
MultiFamily Residential	8	139.83	59.18	42.32	133.31	8.17	141.48	819.43	73.12	892.55
Private Institutional	3	74.90	19.89	26.55	35.81	3.15	38.96	303.09	26.92	330.00
Subtotal	**37**	**620.54**	**336.23**	**54.18**	**638.73**	**30.06**	**668.79**	**5,032.52**	**246.67**	**5,279.19**
Environmental Justice Total (%)	**0.1**	**3.7**	**4.9**	--	**5.6**	**2.7**	**5.3**	**6.1**	**3.0**	**5.8**
Threshold Private CIIM (%)	**23.0**	**15.9**	**20.6**	--	**21.1**	**12.7**	**20.5**	**20.7**	**12.5**	**20.0**
All Private CIIM (%)	**0.2**	**4.3**	**6.2**	--	**6.0**	**3.0**	**5.7**	**6.3**	**3.3**	**6.0**
Watershed Total (%)	**0.0**	**0.8**	**2.2**	--	**2.3**	**0.5**	**1.9**	**2.4**	**0.5**	**2.1**

* 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 install stormwater controls. This figure assumes that runoff from IC within a parcel would be treated by SCMs sized to achieve a 60% reduction[2]. 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 Neponset River Watershed, this appears to lie between parcels with ≥0.25 ac and ≥0.75 ac of IC. As an example, if 0.5 ac IC is chosen as a threshold, approximately 1,600 private CIIM parcels would need to be permitted, nearly 500 of those parcels are in areas with environmental justice concerns, and the potential reduction in the watershed TP load would be 13%. Appendix B presents similar plots by individual parcel use group.

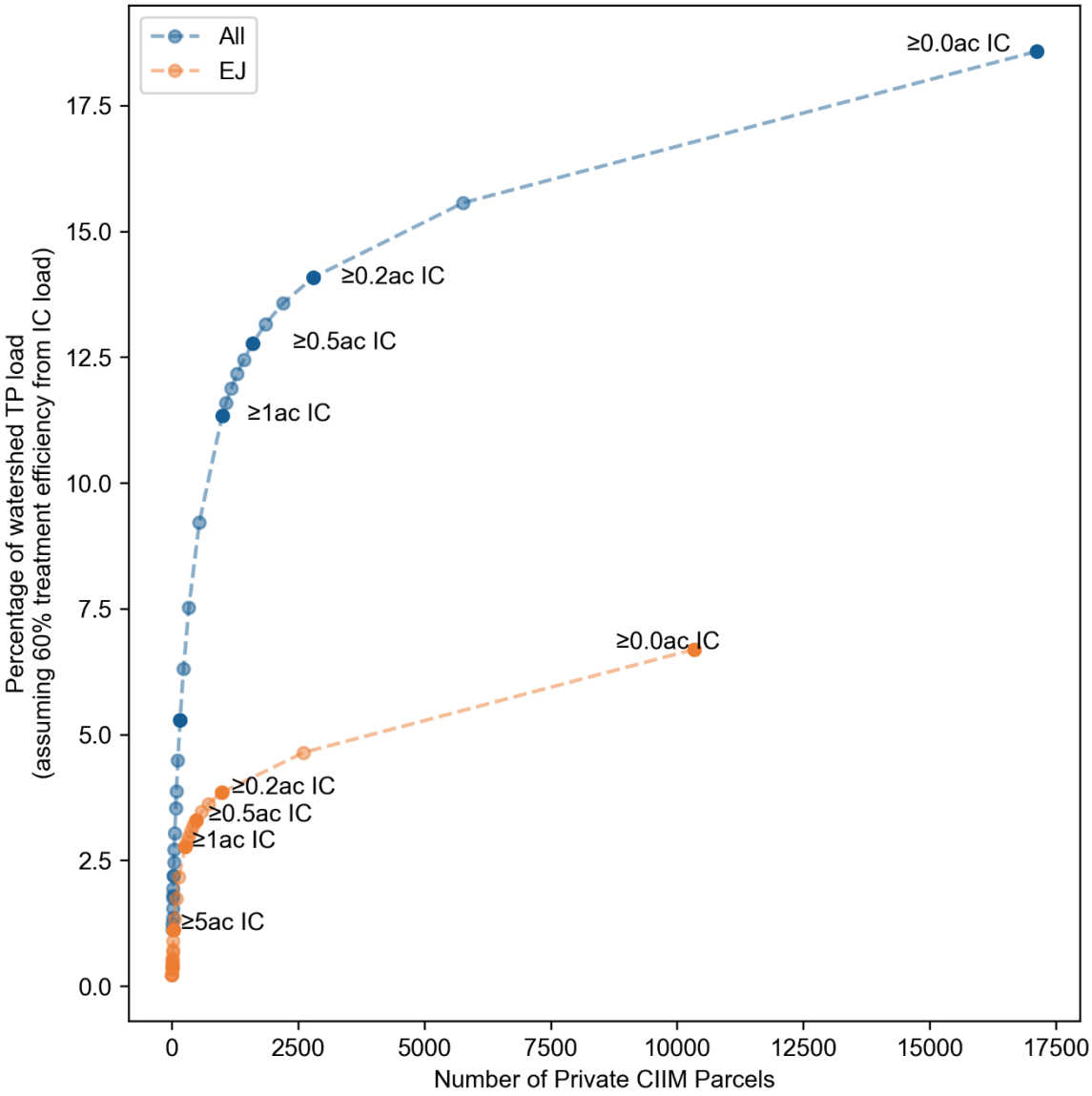

Figure 3-5. Percentage of watershed TP load that can be captured from IC runoff, assuming a 60% treatment efficiency, and the corresponding number of private CIIM parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

[2] In the absence of a specific TP reduction requirement, 60% was used as a starting point in this analysis to align with MA MS4 permitting.

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 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 4A and 4B (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 Neponset 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 (99%) have moderate to moderately low vulnerability. Other studies have found that urban flooding risk (as opposed to the SFHAs evaluated by MAPC) is a major concern in several communities in the watershed that have significant areas with environmental justice concerns. For example, a recent community resilience building workshop with Stoughton residents found that urban flooding is the top climate-related hazard of concern and that retrofits of the stormwater management system are a high priority for future action to address these hazards of concerns (BETA Group Inc., 2020). Similar studies in Quincy (Tighe & Bond, 2019) and Dedham (VBH and Kim Lundgren Associates, 2019) reported similar results.

In response to climate change-induced changes in precipitation patterns, the Neponset River Watershed may experience a 22% increase in flooded areas, on average, for a 2070 10-year storm event (Neponset River Watershed Association, 2023). Implementation of additional stormwater controls on CIIM parcels within

and upstream from areas with environmental justice concerns 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 in the Neponset River Watershed with environmental justice concerns based on vulnerability to riverine and storm surge flooding from a 100-year event*

Vulnerability	Parcels in areas with environmental justice concerns	
	Parcels	Percentage
Extremely high	0	0%
Moderately high	0	0%
Moderate	7,650	30%
Moderately low	17,613	69%
Extremely low	0	0%
No Data	253	1%
Total	25,516	100%

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

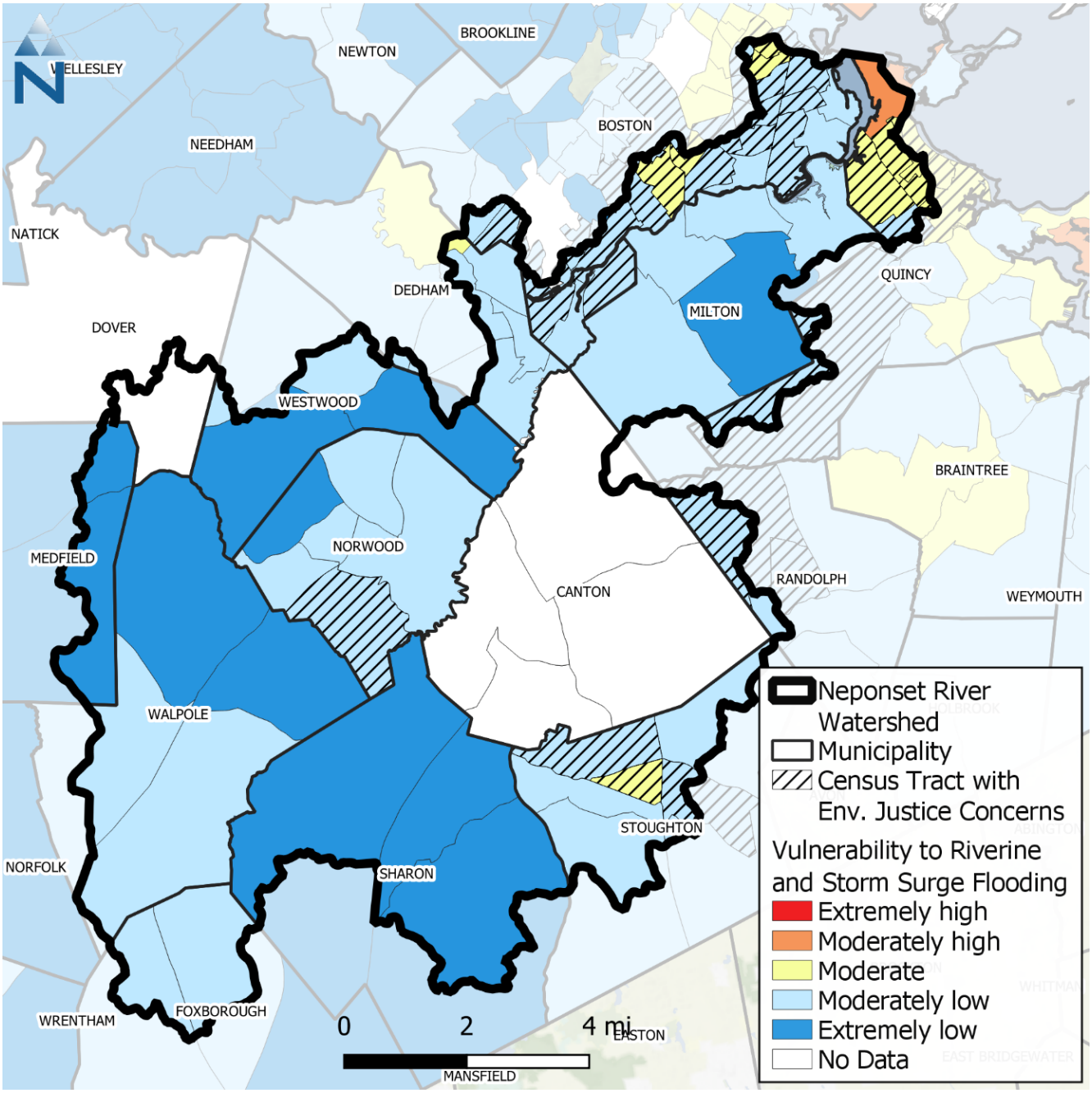

Figure 3-6. Overlay of areas with environmental justice concerns and vulnerability to riverine and storm surge flooding from a 100-year event.

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 Neponset River Watershed are highly urbanized (e.g., within Boston) and have moderately high or moderate vulnerability to extreme heat (85% 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 in the Neponset River Watershed with environmental justice concerns based on vulnerability to extreme heat*

Vulnerability	Parcels in areas with environmental justice concerns	
	Parcels	Percentage
Extremely high	0	0%
Moderately high	3,041	12%
Moderate	18,752	73%
Moderately low	3,470	14%
Extremely low	0	0%
No Data	253	1%
Total	25,516	100%

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

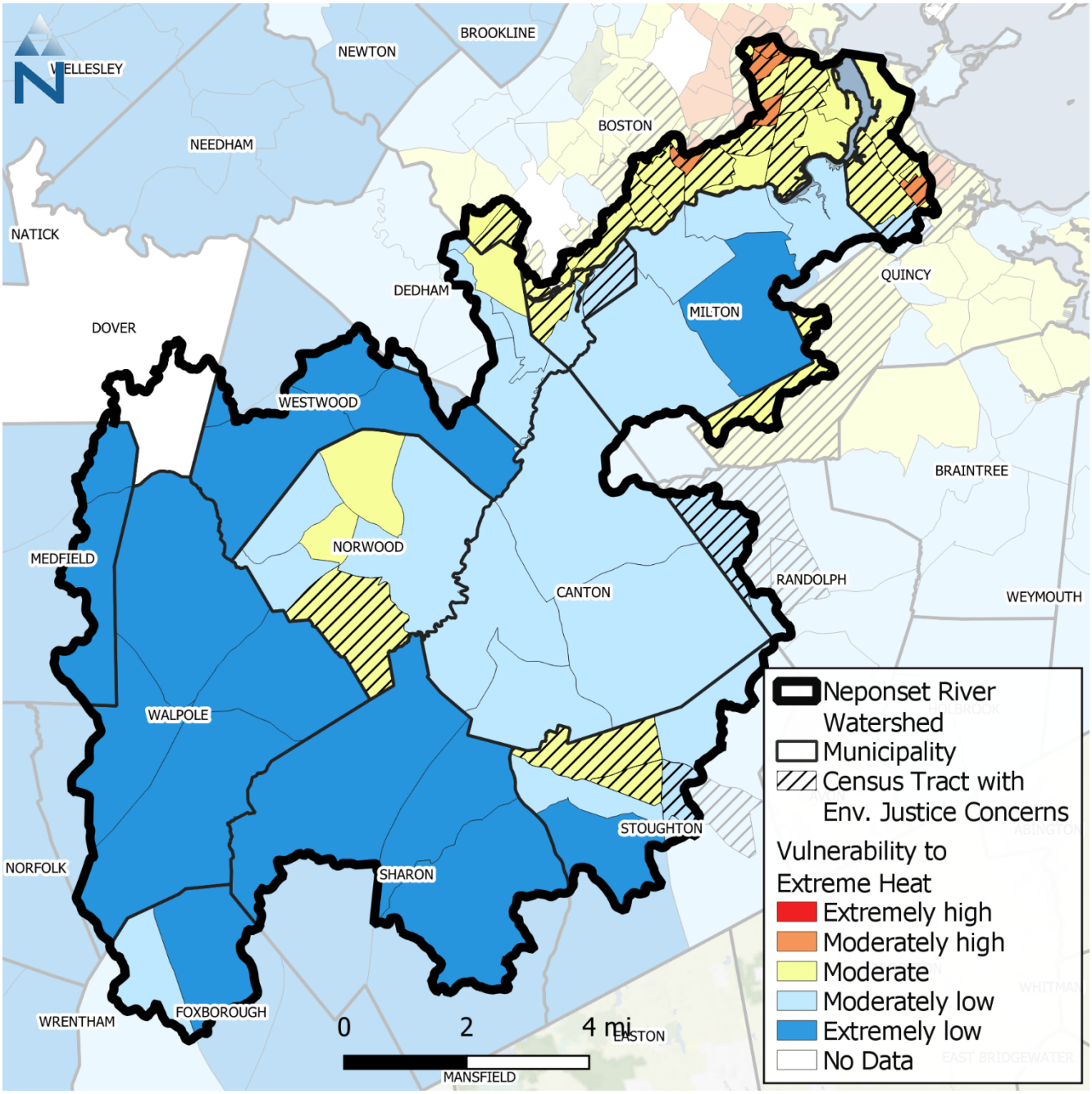

Figure 3-7. Overlay of areas with environmental justice concerns and vulnerability to extreme heat.

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 almost all (99.5%) of these do not overlap with a mapped aquifer (Table 3-15), there are areas of overlap with high and medium-yield aquifers in Norwood and Stoughton (Figure 3-8). Moreover, Dedham relies on local groundwater for its drinking water supply, and protection of these aquifers is critical to the long term resilience of its water system (VBH and Kim Lundgren Associates, 2019).

While there is limited overlap between areas with environmental justice concerns and supply aquifers in most of the Neponset River Watershed, there are large aquifers within the watershed and protecting groundwater quality remains important for several reasons. First, some watershed residents (e.g., in Dedham) rely on groundwater aquifers for current drinking water supply. Second, local groundwater aquifers may need to be more heavily tapped in the future to augment surface water supplies. Third, 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. Fourth, flows of high-quality groundwater are also critical to protecting and restoring river and ecosystem health. The Neponset 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 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 Neponset River as it flows through their neighborhoods. These actions will also help enable the future use of additional 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%
MED	99	0.4%
HIGH	40	0.2%
No Data	25,377	99.5%
Total	25,516	100%

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

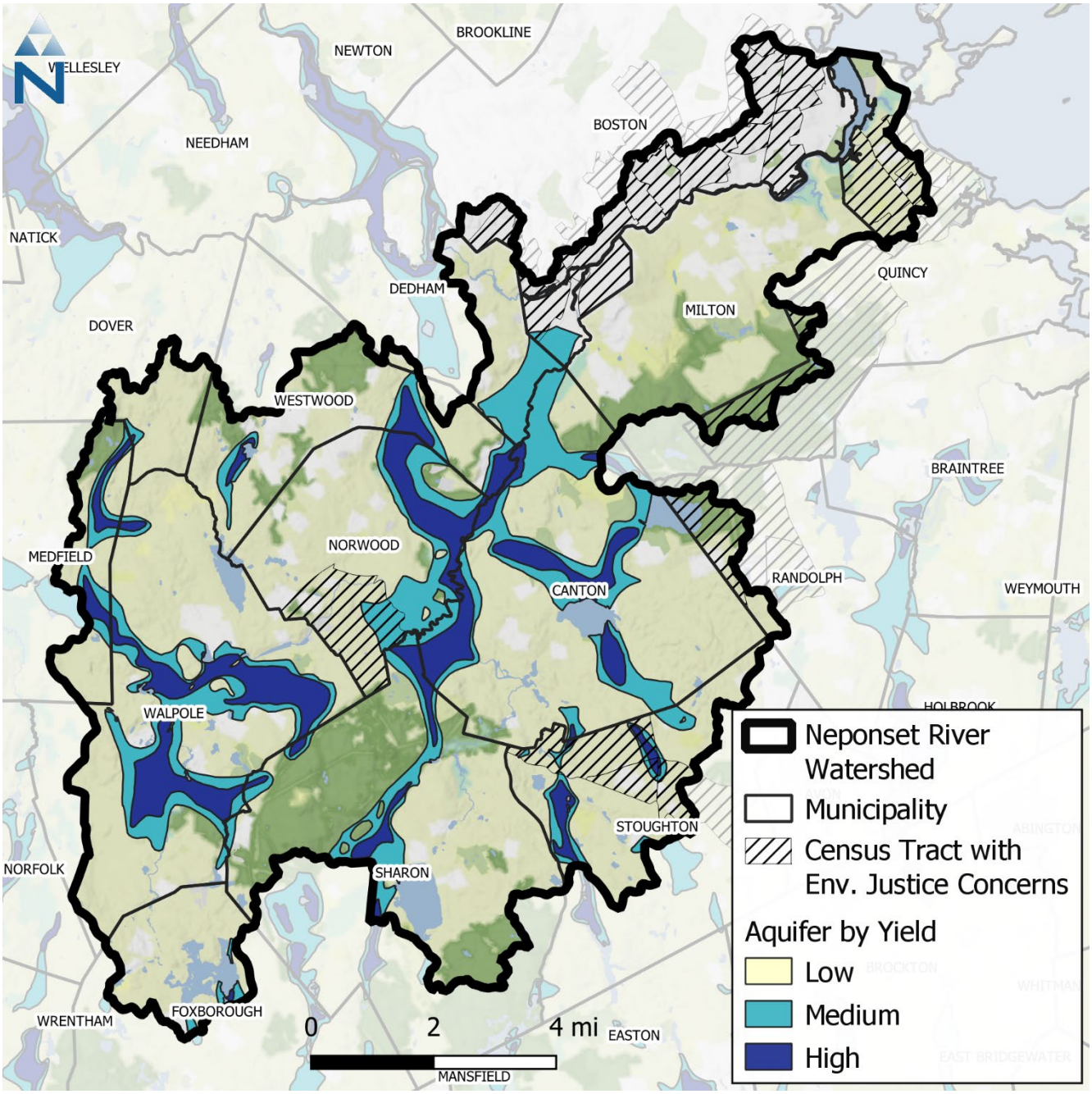

Figure 3-8. Overlay of areas with environmental justice concerns and aquifers by groundwater yield.

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 number of buildings within developed areas, rooftop disconnection (e.g., rain barrels, cisterns) makes up 12% of the SCM opportunities. Subsurface infiltration practices, such as infiltration trenches, are also good opportunities that could be implemented on impervious areas (9% 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	--	--	4,634.1	48.38%
Rooftop Disconnection	Impervious	--	1,177.3	12.29%
Subsurface Infiltration Practice	Impervious	A	385.0	4.02%
Subsurface Infiltration Practice	Impervious	B	76.3	0.80%
Subsurface Infiltration Practice	Impervious	C	384.1	4.01%
Porous Pavement with Underdrain	Impervious	D	18.0	0.19%
		Impervious Subtotal	2,040.8	21.30%
Surface Infiltration Practice	Pervious	A	888.4	9.27%
Surface Infiltration Practice	Pervious	B	400.8	4.18%
Surface Infiltration Practice	Pervious	C	617.2	6.44%
Biofiltration with Underdrain	Pervious	D	128.6	1.34%
		Pervious Subtotal	2,035.1	21.24%
Water/Wetland	--	--	869.3	9.07%
		Total	**9,579.3**	**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 Neponset 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 Norwood is shown in Figure 3-10 as an example. The southern portion of Norwood was identified as having environmental justice concerns and moderate vulnerability to extreme heat. Additionally, Norwood has a significant aquifer area that may be an important water source. When commercial and industrial properties are refurbished or redeveloped, there may 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.

SCMs in the residential areas of Norwood 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.

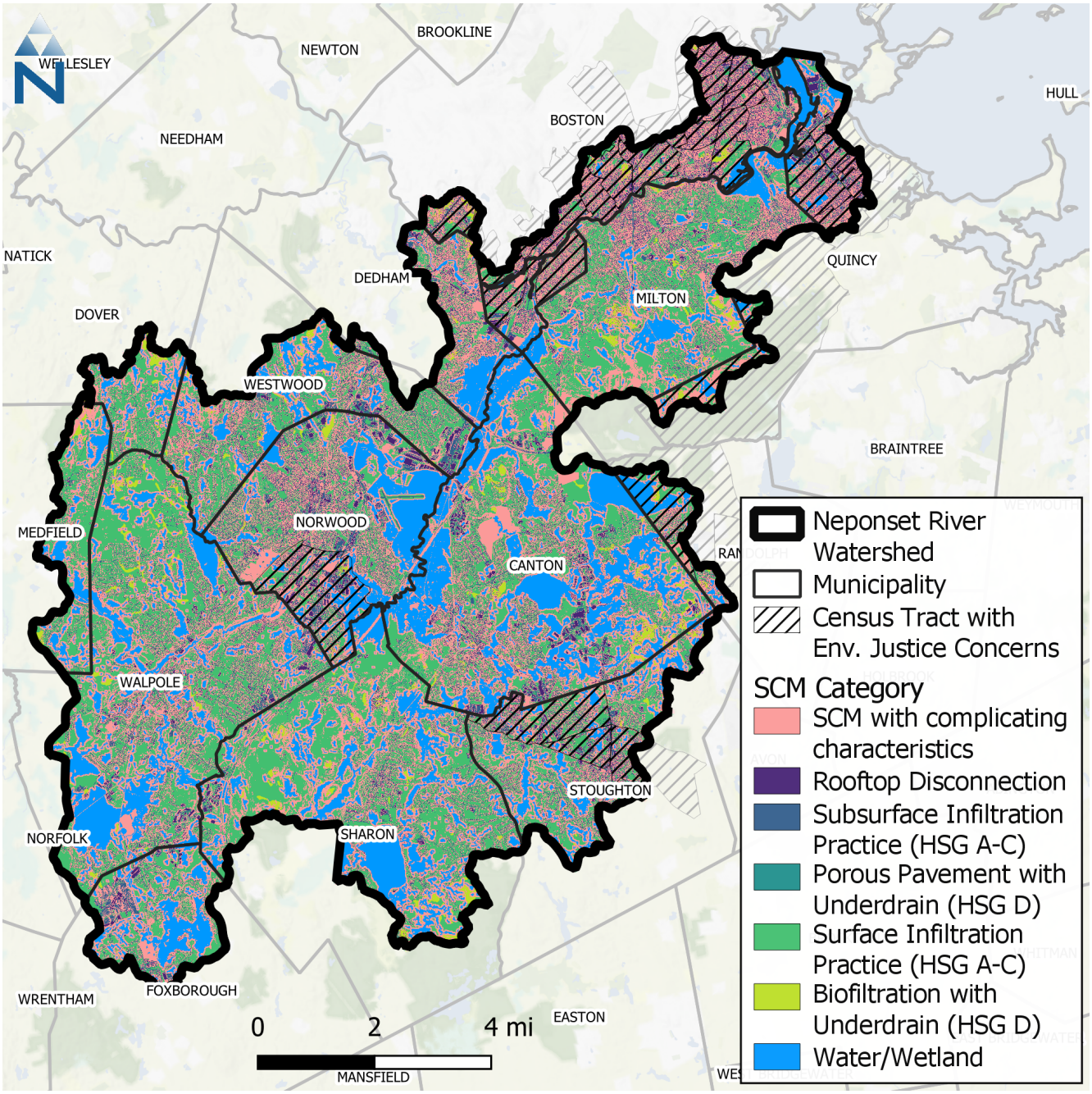

Figure 3-9. Overlay of areas with environmental justice concerns and potential SCM types.

Communities in the lower Neponset River Watershed are vulnerable both to coastal and inland stormwater flooding. For example, several neighborhoods in Quincy (Tighe & Bond, 2019) and Boston (Wasser, 2021) within the Neponset River Watershed have experienced extensive local flooding damage following intense storms due to a combination of coastal inundation flooding in neighborhoods adjacent to tidally-influenced waters and flooding caused by excessive stormwater runoff. Installation of additional SCMs at CIIM properties in these vulnerable neighborhoods should help reduce flood risks, especially during high tide periods in areas that are also subject to coastal flooding.

Similar opportunities exist to implement SCMs further upstream in communities like Dedham (VBH and Kim Lundgren Associates, 2019) and Stoughton (BETA Group Inc., 2020), which identified upgrades to stormwater infrastructure including green infrastructure as high priorities for short term actions to build community resilience to flooding risks. As communities in the Neponset River Watershed act to plan and implement upgrades to public stormwater and flood control systems in response to flooding risks, there may be opportunities to coordinate installation of SCMs at CIIM properties to leverage public and private stormwater control investments that will collectively yield greater flood protection benefits.

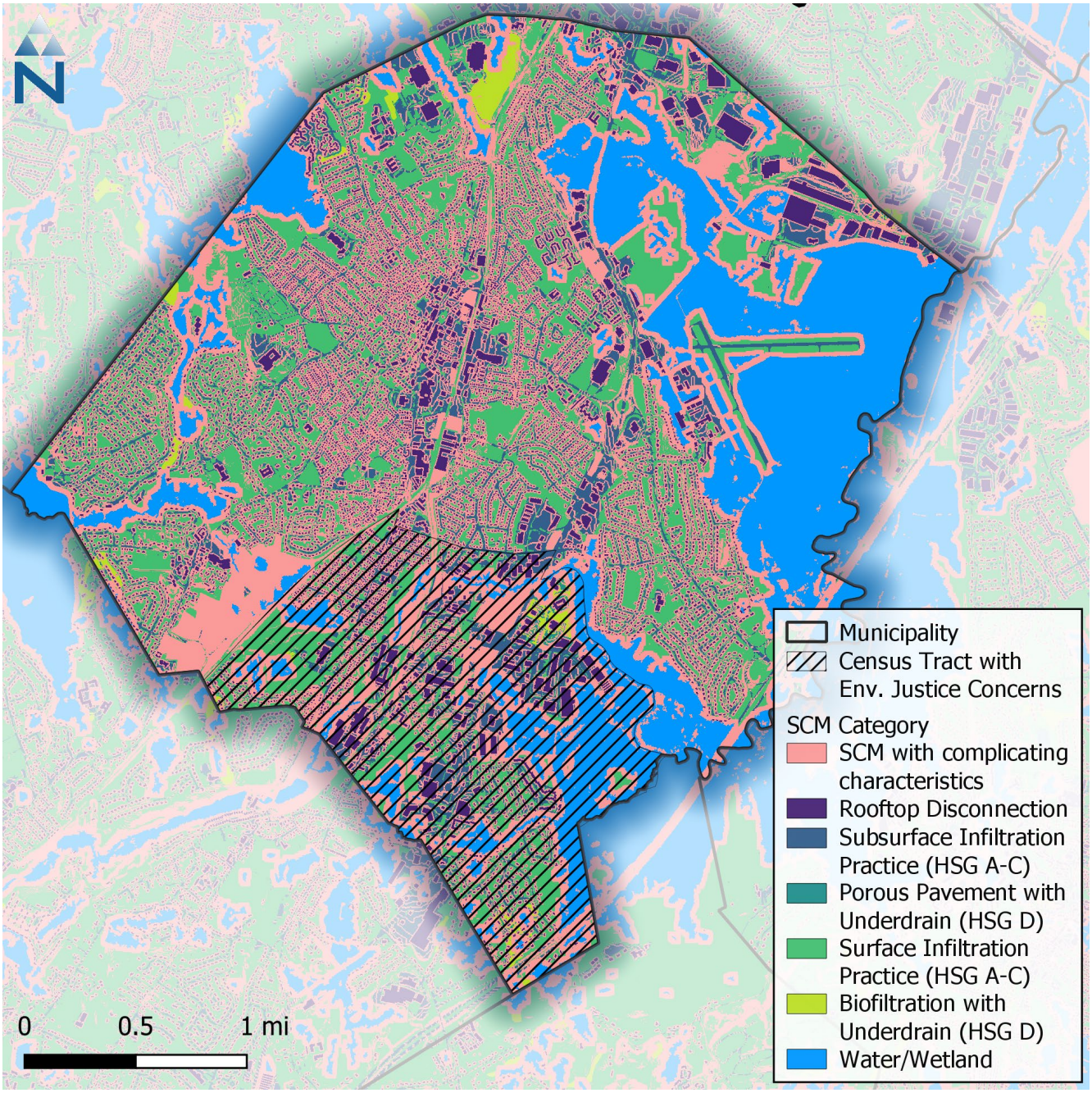

Figure 3-10. Example SCM detail map for Norwood.

4 CONCLUSIONS

This report builds on the methodology and results of watershed-wide analyses of parcel-level stormwater TP and TN loading in the Neponset River Watershed (Paradigm Environmental, 2023a) by identifying and further evaluating parcels within areas with environmental justice concerns. Collectively, the insights gathered from these reports can serve as a foundation for EPA Region 1 to make informed decisions regarding the management of stormwater runoff from specific private properties. These decisions are aimed at achieving water quality objectives, not only by addressing nutrient load reductions for permitting requirements but also by enhancing water quality with a co-benefit of reducing bacteria loads through the chosen SCMs. Findings from these analyses include:

1. Thirty-eight census tracts were identified as areas with environmental justice concerns based on linguistic isolation, low median household income, or other disadvantages. Hotspots areas that meet all environmental justice criteria represent 16% of the areas with environmental justice concerns.
2. Within the watershed, 32% of parcels are in areas with environmental justice concerns; these parcels represent 44% of the watershed IC area and 36% of the total TP load.
3. Private properties contribute nearly three-quarters (70%) of the watershed's total TP load, with 17% 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 (81% of load from private properties and 57% of the watershed total load).
5. Private commercial, industrial, institutional, and multi-family residential (CIIM) properties make up 22% of all parcels, but have relatively high percentages of IC and therefore contribute a large proportion of the watershed TP load (34%)
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. Nearly two-thirds (60%) 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 Neponset River Watershed with environmental justice concerns should prove particularly effective in yielding additional community benefits while reducing key pollutant loadings. As discussed in this report, approximately one third of the parcels in the watershed are in areas with environmental justice concerns. These parcels represent nearly half of all impervious surfaces and over one-third of the total phosphorus pollutant loads. 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 Neponset 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 Neponset River Watershed, 60% of CIIM parcels that could be subject to a residual designation stormwater permit are concentrated within the 32% of the watershed area 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 residents of areas with environmental justice concerns. As the discussion in Section 3.4.4 of SCM opportunities in Norwood 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 Neponset River Watershed with environmental justice concerns that may be regulated. For example, if an IC threshold of 1 ac is used for permitting, 55 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 Neponset 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, flood control, and climate resilience planning of other property owners and municipal governments. Many communities in the Neponset River Watershed are planning and implementing projects to revitalize areas of their communities[3], incorporate green infrastructure elements in street and sidewalk projects[4], 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

[3] See, for example, Quincy's Urban Revitalization Plan for the Wollaston Urban Revitalization District, Accessed at: https://cms7files1.revize.com/quincyma/Planning/Projects/WURD/1%20WURD%20Plan.pdf.

[4] See, for example, Boston's new policy to require incorporation of green infrastructure elements in small-scale public sidewalk and roadway improvement projects. Accessed at: https://www.boston.gov/news/new-environmental-standards-city-infrastructure-announced.

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 unattenuated stormwater runoff from private parcels within the Neponset River Watershed contributes the majority of the pollutant load. Without additional controls on stormwater runoff and pollutant loads from these parcels, making meaningful improvements to water quality could be difficult. A portion of those reductions may need 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 additional stormwater controls are needed to address water quality impairments in the Neponset River Watershed. Implementation of these controls associated with any new RDA permits 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 Neponset 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)	17,117	10,343	60.4%	11,640.62	10,639.67	19%
≥0.25	2,430	814	33.5%	8,649.50	7,900.09	14%
≥0.5	1,597	481	30.1%	8,005.42	7,315.68	13%
≥0.75	1,235	357	28.9%	7,538.68	6,889.90	12%
≥1	995	267	26.8%	7,113.46	6,494.29	11%
≥2	544	139	25.6%	5,749.45	5,279.48	9%
≥5	161	37	23.0%	3,261.91	3,024.93	5%

* Percentage calculated as IC load times a 60% treatment efficiency divided by the watershed total TP load of 34,367lb/yr.

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APPENDIX A

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

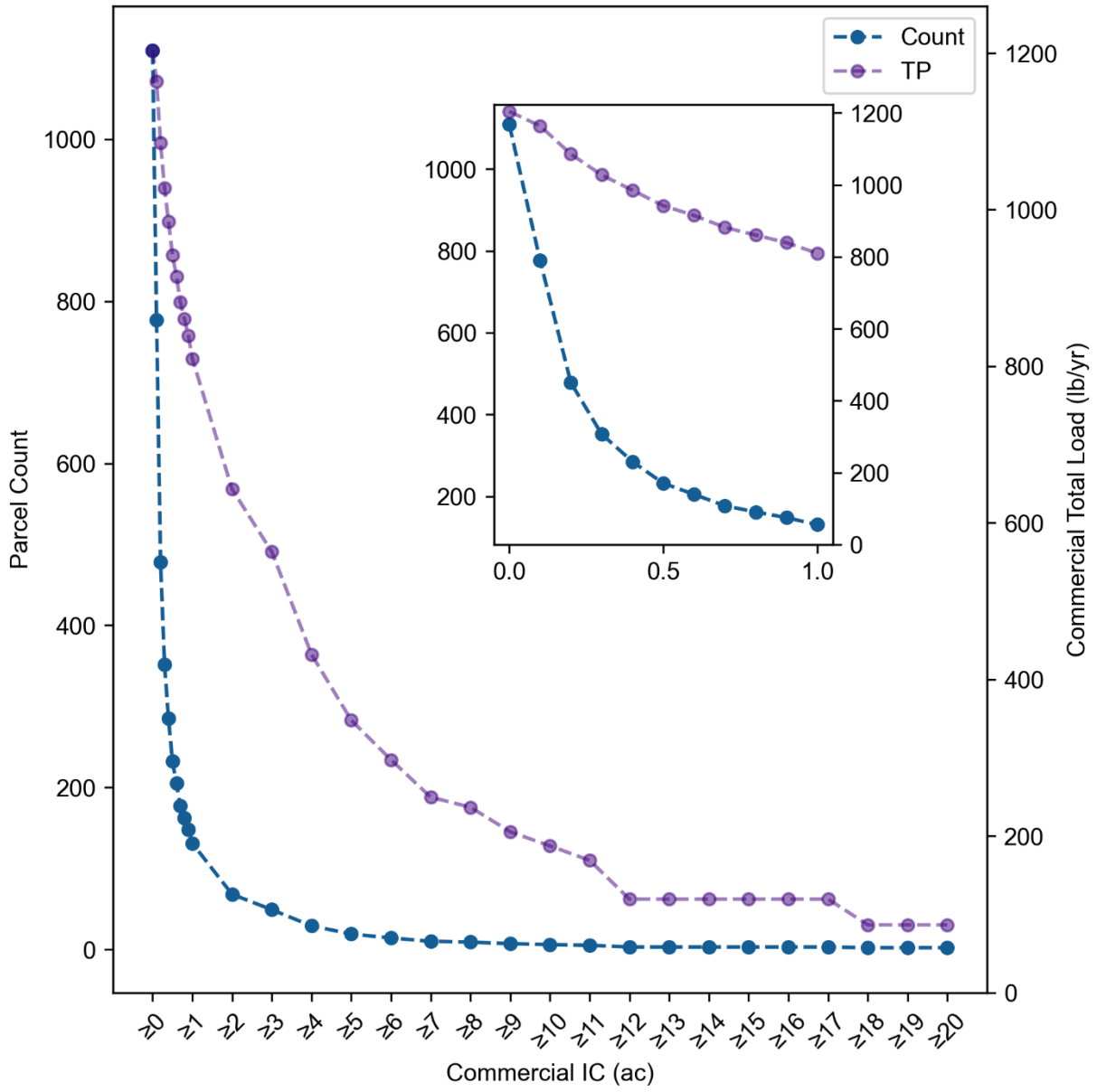

Figure A-1. Count and total TP load for private commercial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private commercial parcels in areas with environmental justice concerns.

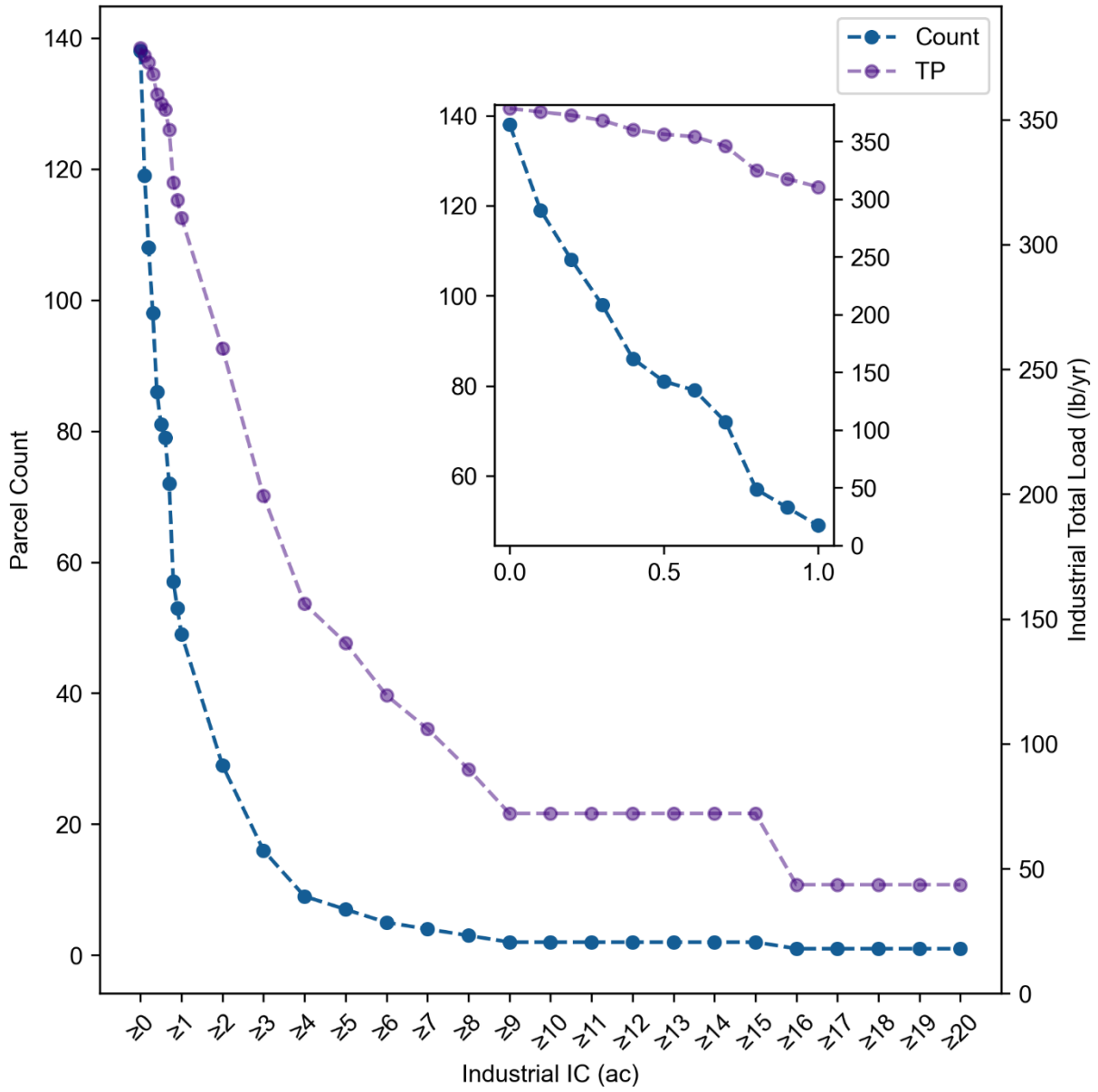

Figure A-2. Count and total TP load for private industrial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private industrial parcels in areas with environmental justice concerns.

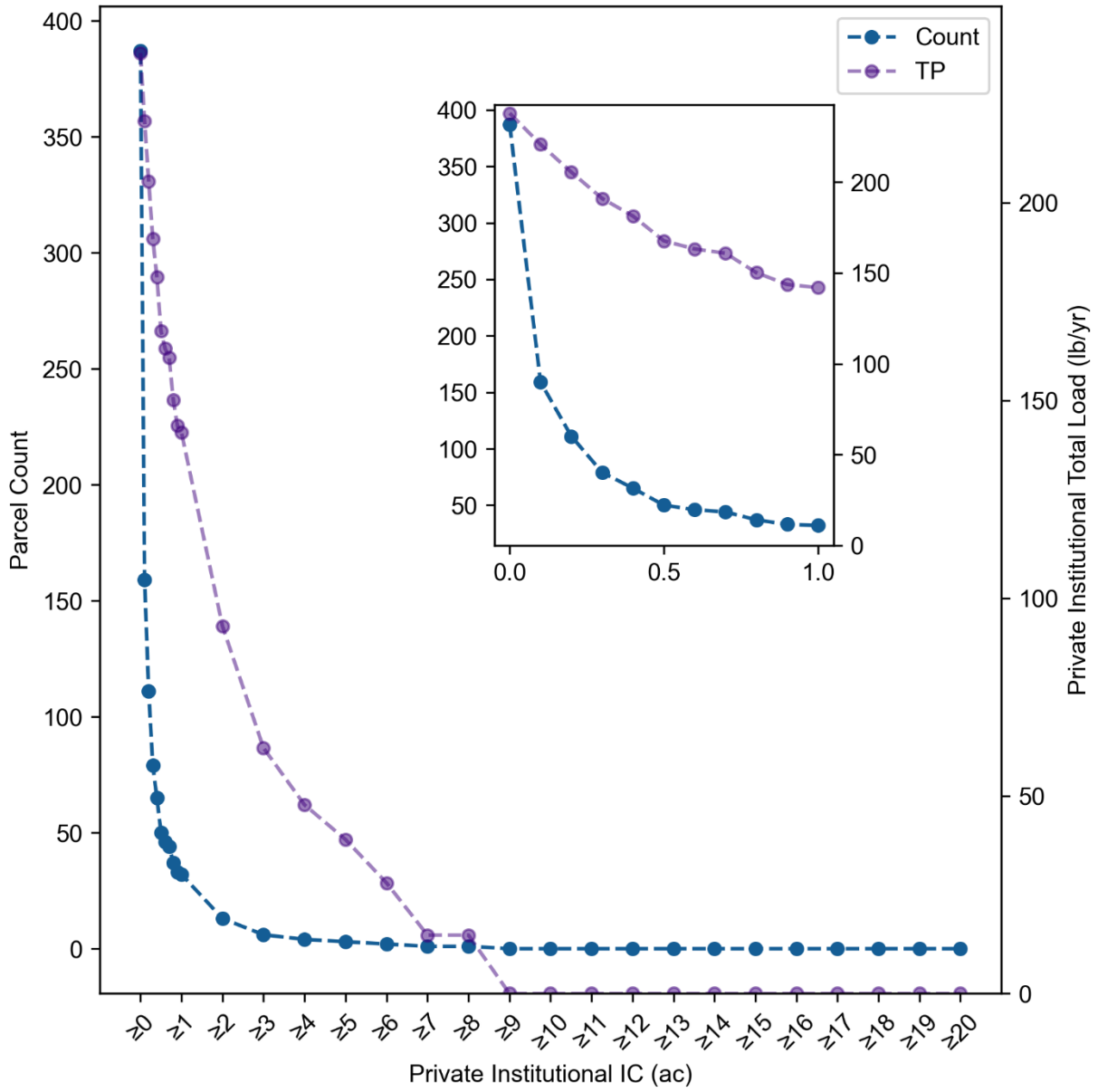

Figure A-3. Count and total TP load for private institutional parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private institutional parcels in areas with environmental justice concerns.

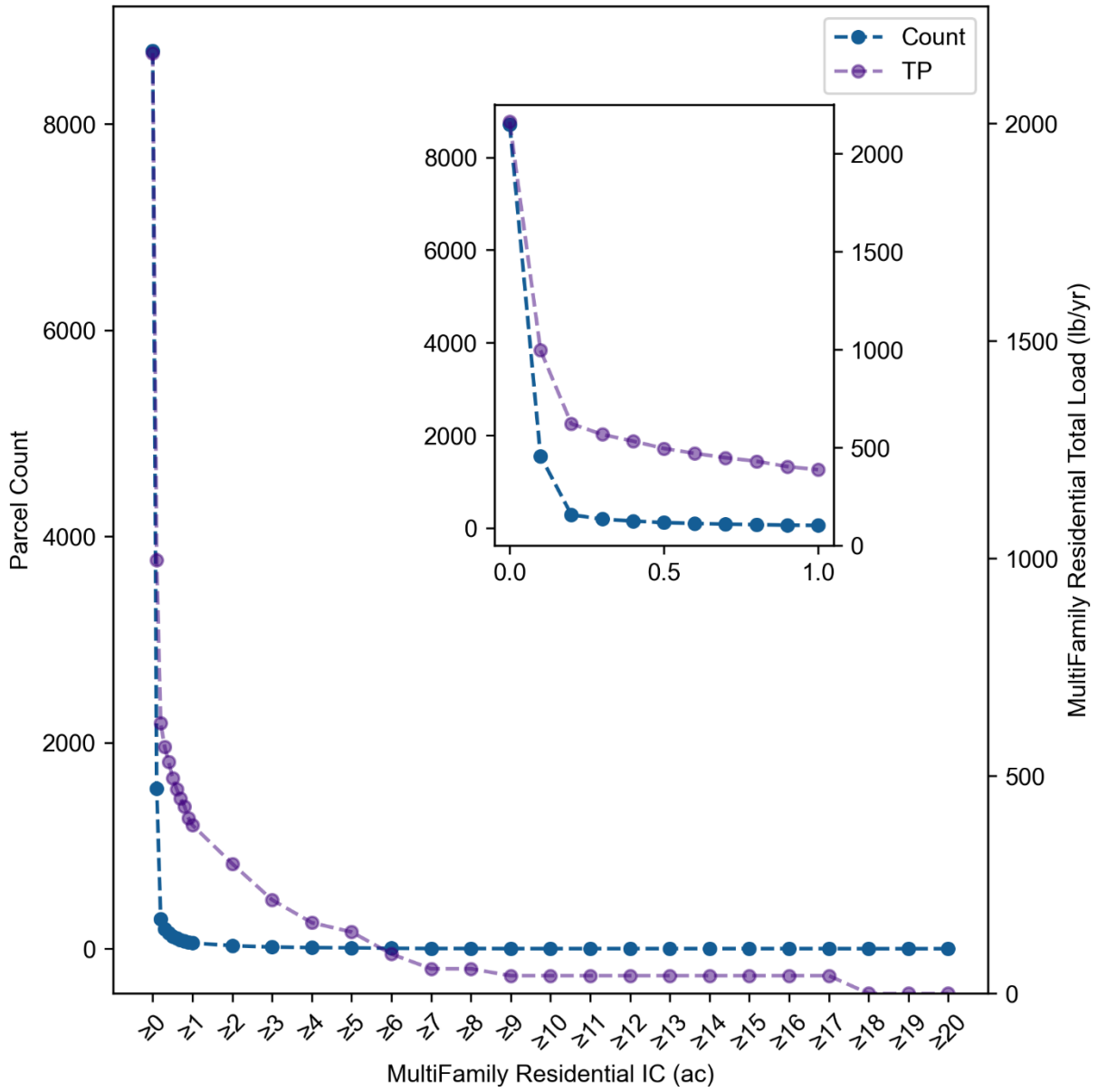

Figure A-4. Count and total TP load for private multi-family residential parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private multi-family residential parcels in areas with environmental justice concerns.

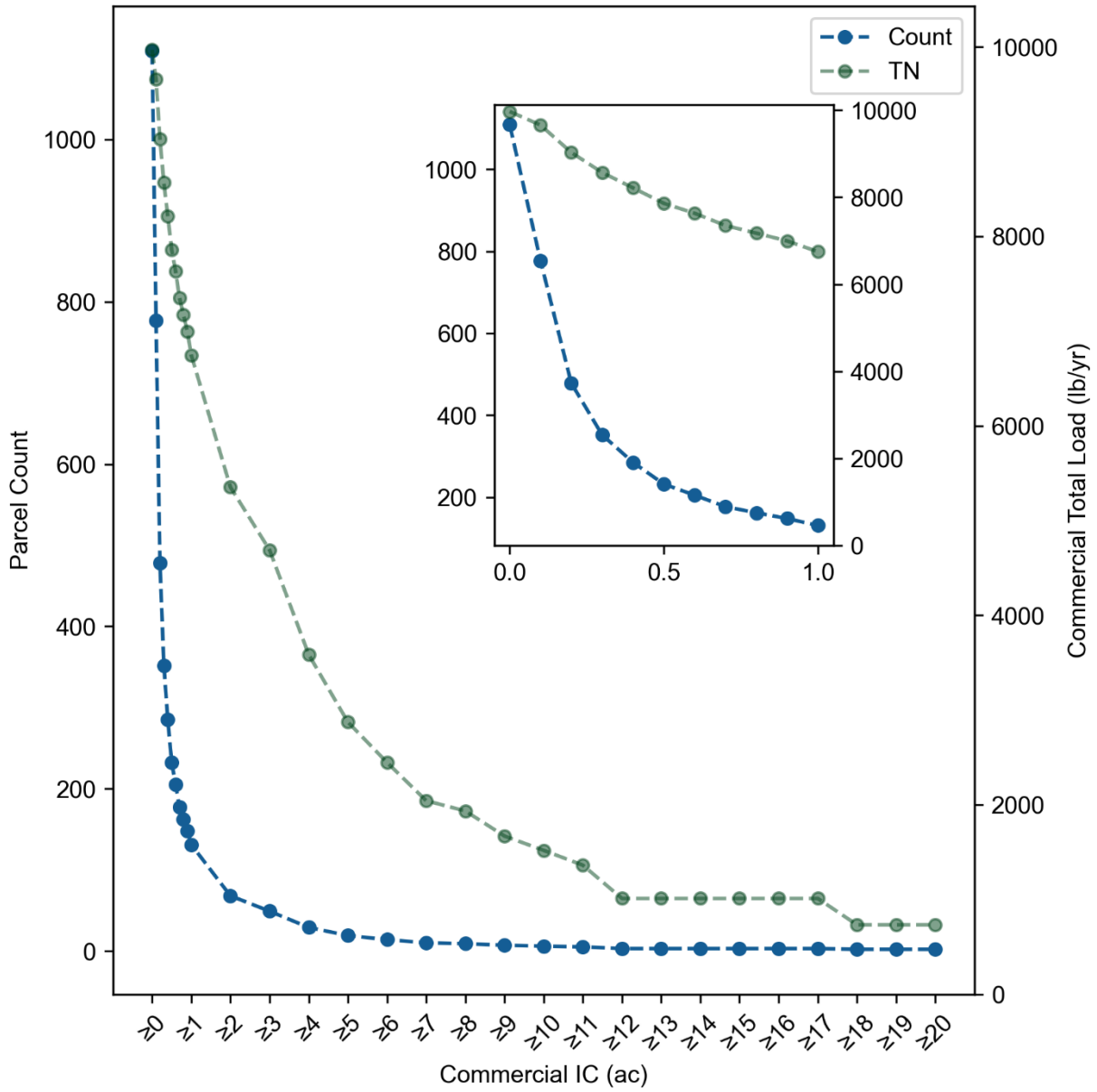

Figure A-5. Count and total TN load for private commercial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private commercial parcels in areas with environmental justice concerns.

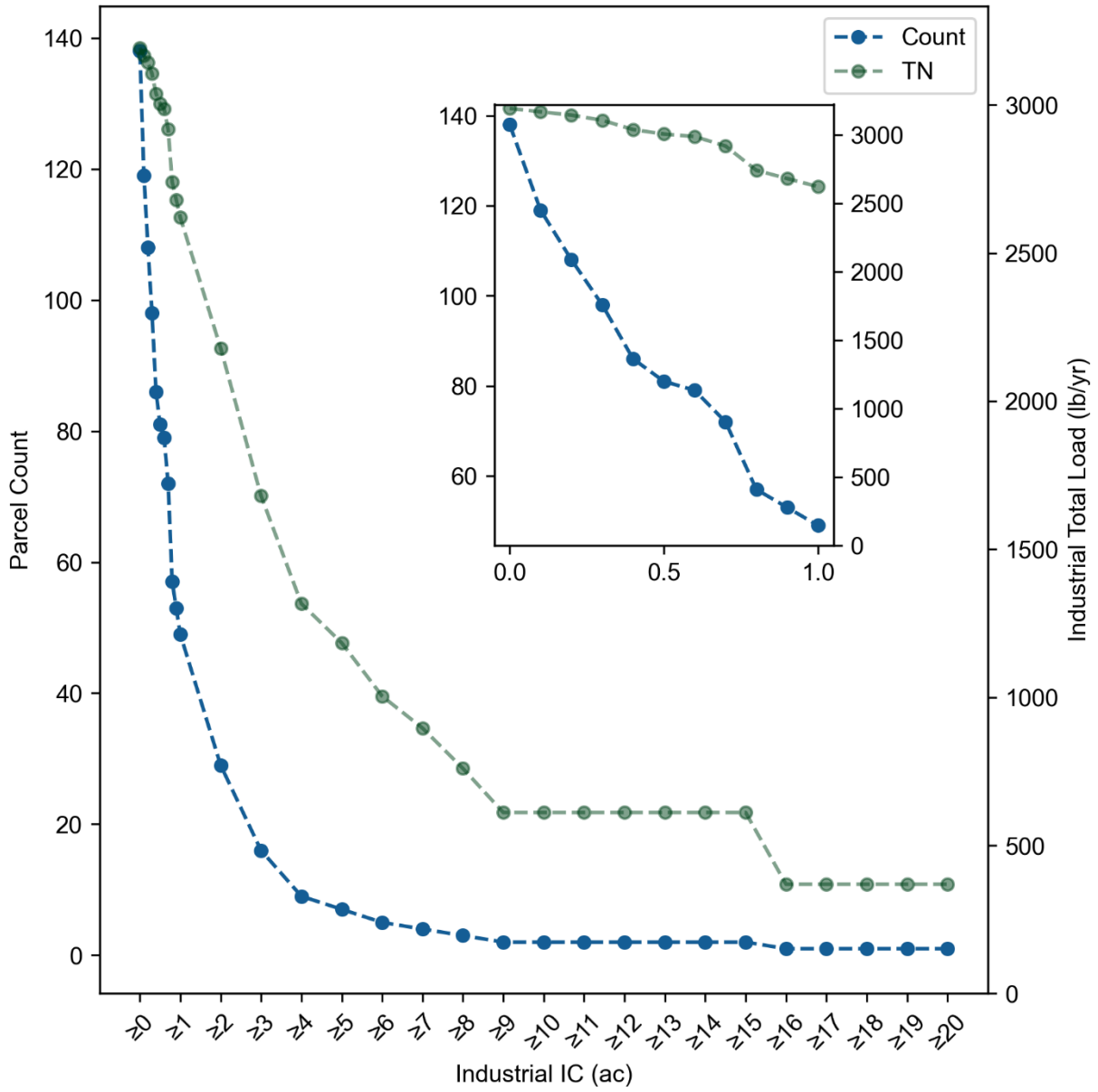

Figure A-6. Count and total TN load for private industrial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private industrial parcels in areas with environmental justice concerns.

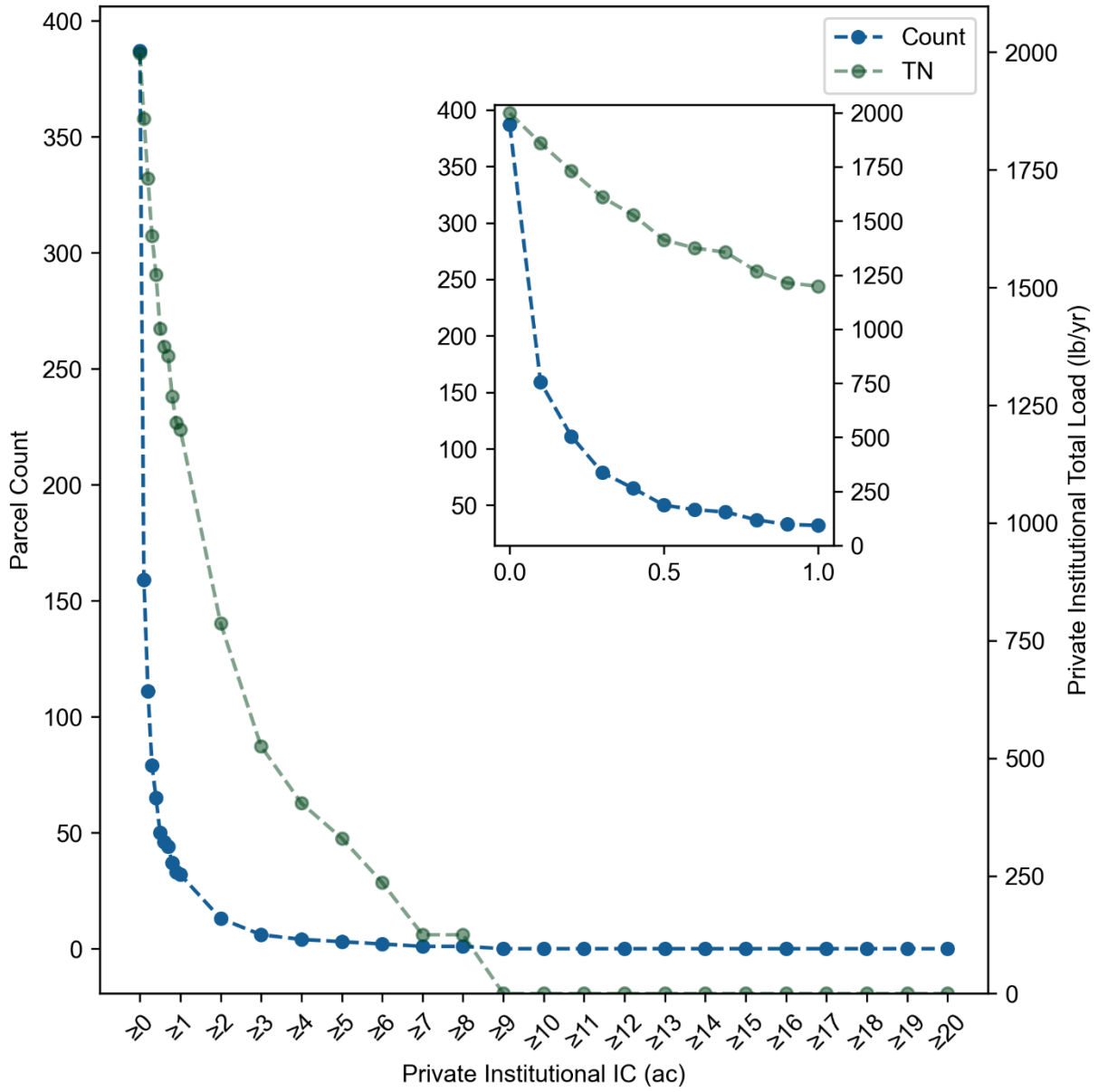

Figure A-7. Count and total TN load for private institutional parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private institutional parcels in areas with environmental justice concerns.

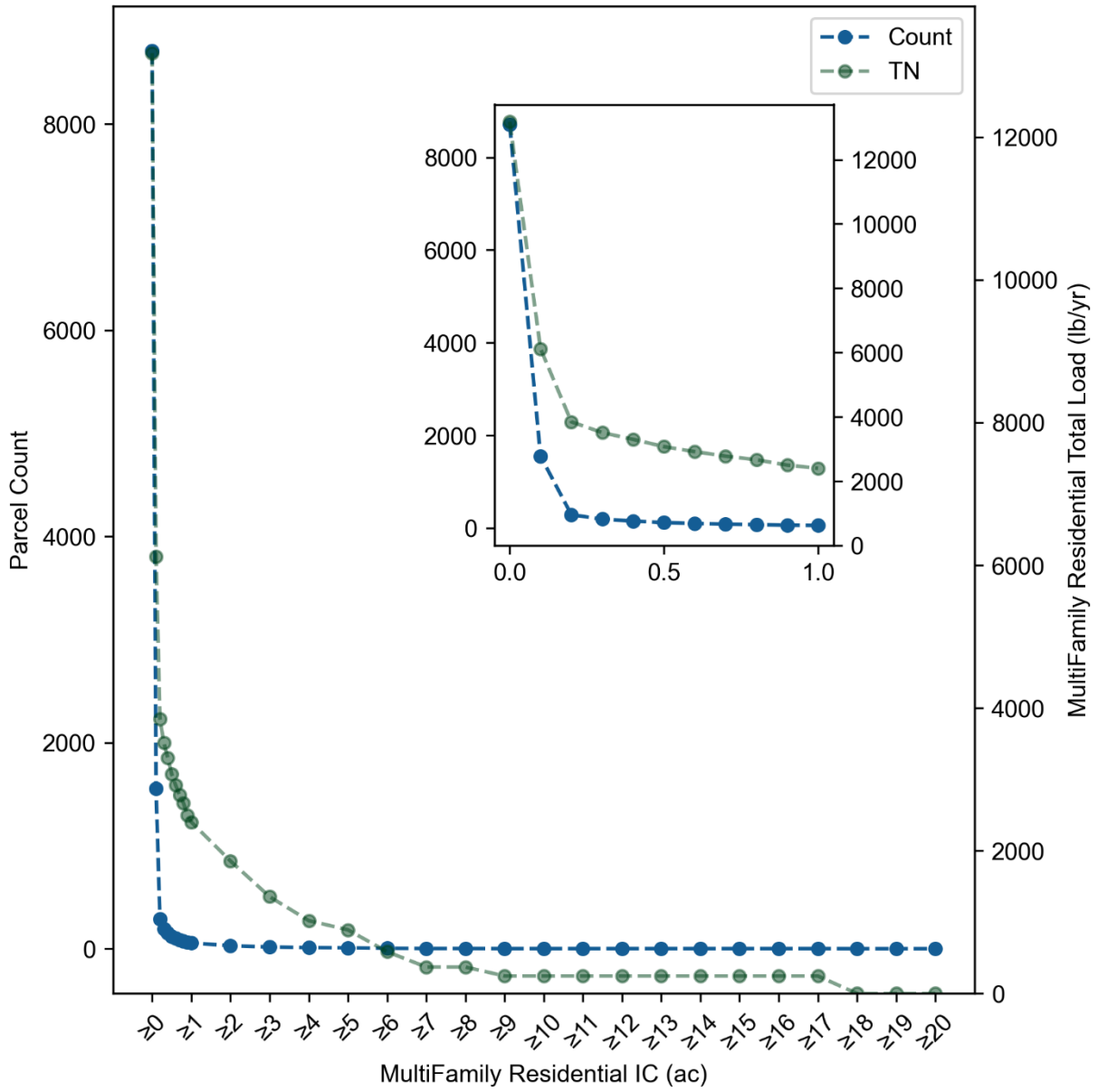

Figure A-8. Count and total TN load for private multi-family residential parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private multi-family residential parcels in areas with environmental justice concerns.

APPENDIX B

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

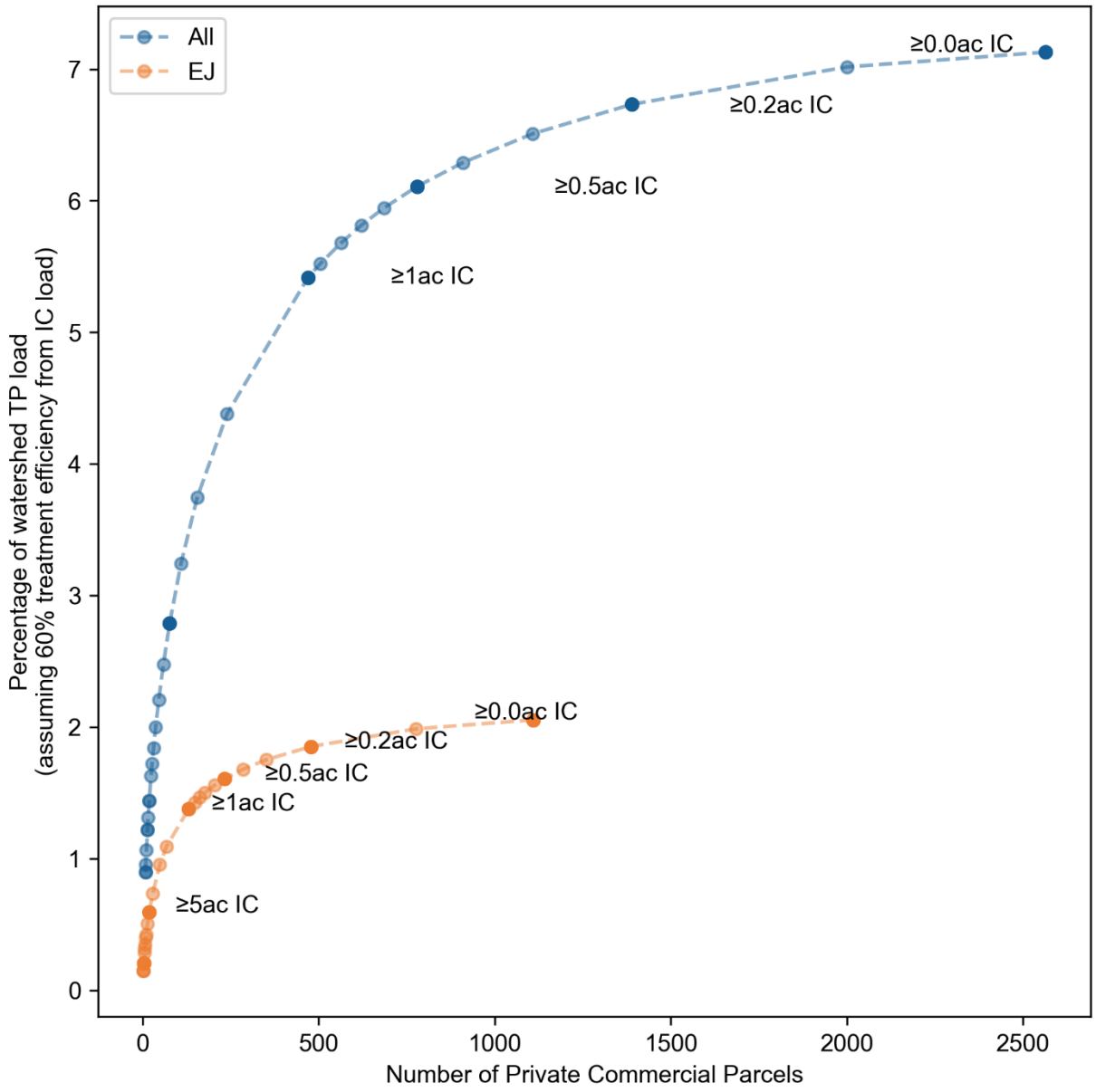

Figure B-1. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private commercial parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

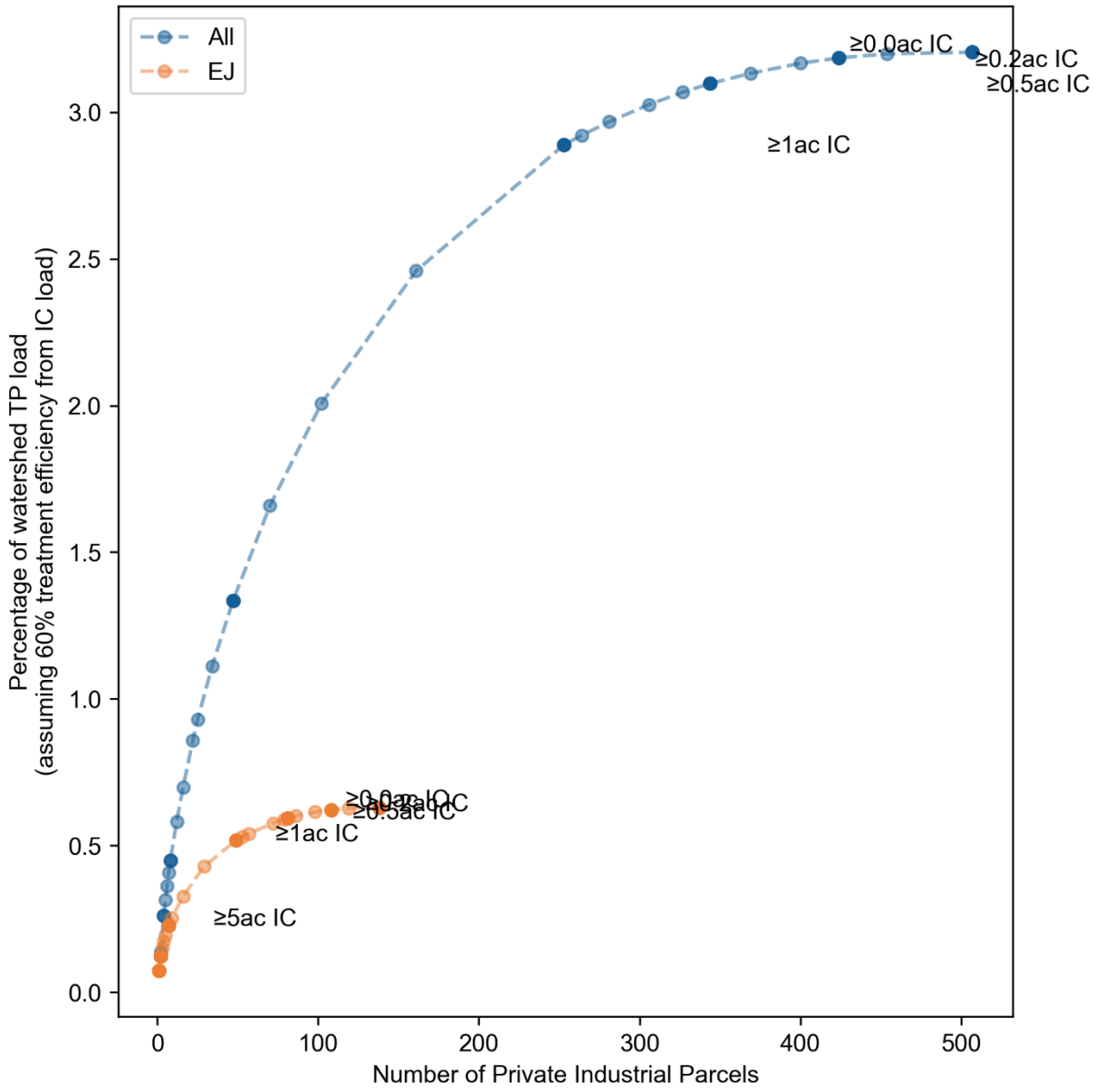

Figure B-2. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private industrial parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

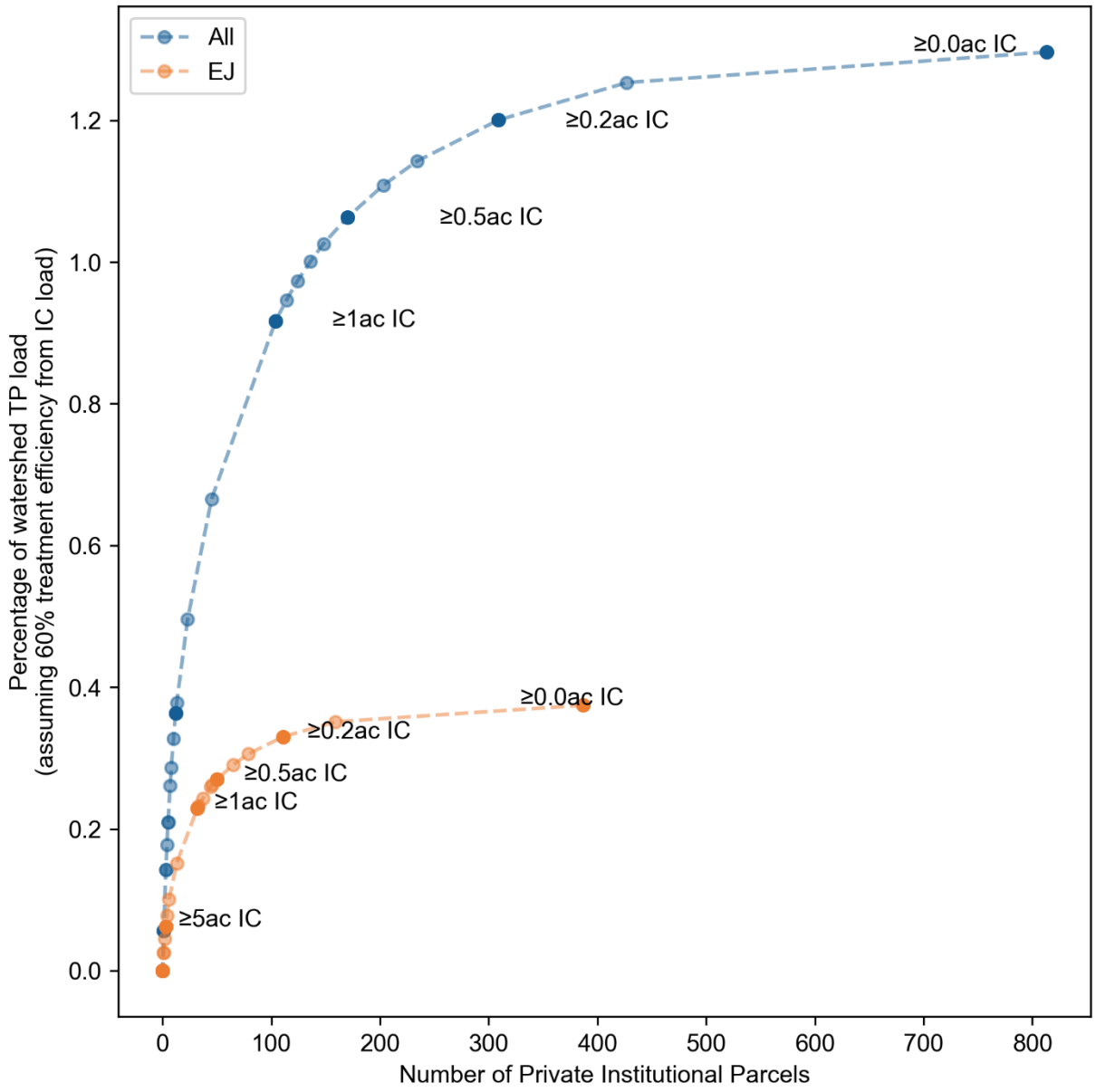

Figure B-3. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private institutional parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

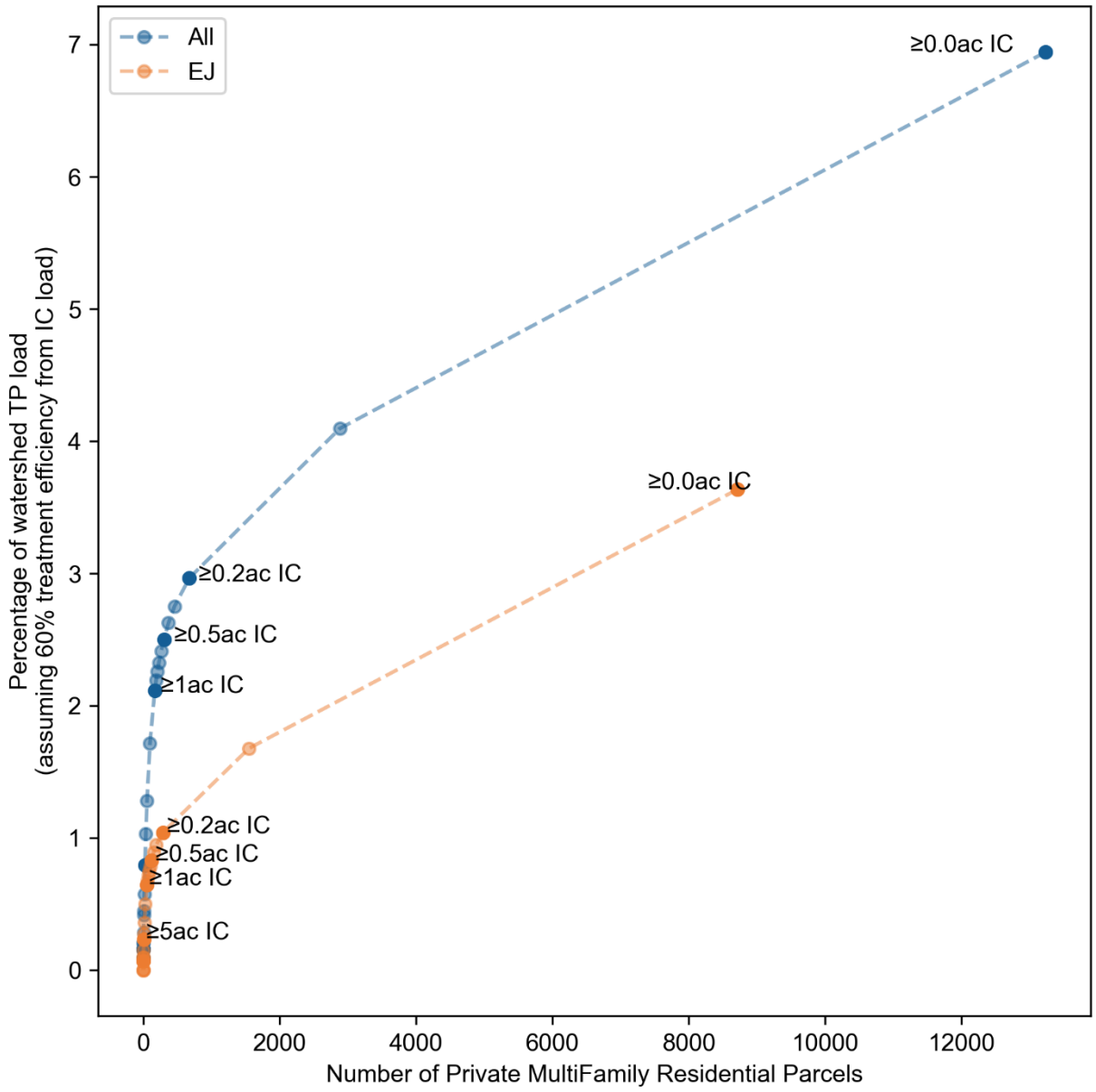

Figure B-4. Percentage of watershed TP load that can be captured from IC runoff, assuming a 62% treatment efficiency, and the corresponding number of private multifamily residential parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.