

Supplementary Materials

Table S1. Total violations across municipalities in Essex and Hudson County, New Jersey (2010-2020; NJ Drinking Water Watch, 2020).

Municipality	N Violations	N Nonmetal Violations	N Metal Violations	N Rule Violations
Bayonne City	6	3	0	3
Belleville Township	77	40	6	31
Bloomfield Township	44	11	7	26
Caldwell Borough	4	3	0	1
Cedar Grove	12	5	2	5
City of Orange	10	8	0	2
East Newark Borough	3	2	0	1
East Orange City	29	17	1	10
Essex Fells	12	9	0	1
Fairfield Borough	34	30	0	4
Glen Ridge	2	1	0	1
Guttenberg	7	4	2	0
Harrison Township	4	2	0	2
Hoboken Township	0	0	0	0
Irvington	1	1	0	0
Jersey City	1	1	0	0
Kearny Township	1	1	0	0
Livingston Township	39	33	0	3
Maplewood	1	1	0	0
Millburn Township	1	1	0	0
Montclair Township	3	2	0	2
Newark	32	15	6	8
North Bergen Township	7	4	2	0
North Caldwell	11	9	0	2

Nutley Township	15	4	0	11''
Roseland Township	21	15	1	5
Secaucus Township	7	4	2	0
South Orange Township	5	4	0	1
Union City	7	4	2	0
Verona Borough	29	18	2	9
Weehawken	7	4	2	0
West Caldwell	2	2	0	0
West New York	7	4	2	0
West Orange	1	1	0	0

Table S2. Most common violations across municipalities in Essex and Hudson County, New Jersey (2010-2020).

Municipality	N Lead Violations	N Chlorine Violations	N LCR Violations
Bayonne City	0	1	3
Belleville Township	4	17	11
Bloomfield Township	4	2	20
Caldwell Borough	0	3	0
Cedar Grove	0	3	3
City of Orange	0	2	1
East Newark Borough	0	2	1
East Orange City	0	1	7
Essex Fells	0	0	0
Fairfield Borough	0	29	0
Glen Ridge	0	0	0
Guttenberg	2	1	0
Harrison Township	0	2	1
Hoboken Township	0	0	0
Irvington	0	0	0
Jersey City	0	0	0
Kearny Township	0	0	0
Livingston Township	0	0	0
Maplewood	0	0	0
Millburn Township	0	0	0
Montclair Township	0	1	1
Newark	6	5	4
North Bergen Township	2	1	0
North Caldwell	0	6	1
Nutley Township	0	4	6

Roseland Township	1	11	0
Secaucus Township	2	1	0
South Orange Township	0	2	0
Union City	2	1	0
Verona Borough	0	6	3
Weehawken	2	1	0
West Caldwell	0	0	0
West New York	2	1	0
West Orange	0	0	0

Table S3. Minimum and maximum diversity percentages across Municipalities in Essex and Hudson County, New Jersey (2010-2020) in relation to historic redlining grades.

Municipality	Mean HOLC	Min. Diversity	Max Diversity
Bayonne City	3.33	25.42	27.34
Belleville Township	2.83	35.05	35.67
Bloomfield Township	2.25	34.76	36.70
Caldwell Borough	2.33	11.03	11.44
Cedar Grove	1.5	9.73	9.99
City of Orange	2.62	82.26	83.54
East Newark Borough	4	29.30	34.65
East Orange City	2.66	92.11	93.25
Essex Fells	1.5	3.36	3.63
Fairfield Borough	-	4.12	4.29
Glen Ridge	2	10.89	11.22
Guttenberg	3	26.03	27.86
Harrison Township	4	34.04	43.06
Hoboken Township	4	13.96	15.95
Irvington	2	90.63	91.96
Jersey City	3.55	58.57	64.03
Kearny Township	2.8	21.83	23.06
Livingston Township	2	21.91	22.85
Maplewood	2.89	38.33	40.60
Millburn Township	1.83	17.65	32.99
Montclair Township	2.55	33.99	34.90
Newark	3	68.45	70.47
North Bergen Township	2	27.00	28.75
North Caldwell	2	10.80	11.42
Nutley Township	2	15.03	15.47
Roseland Township	3	8.06	8.37

Secaucus Township	3.5	22.92	29.59
South Orange Township	-	34.80	35.73
Union City	3.4	34.60	36.73
Verona Borough	2	7.01	7.16
Weehawken	2.5	20.62	24.20
West Caldwell	2	5.88	5.98
West New York	3.33	30.15	33.22
West Orange	1.83	38.60	40.17

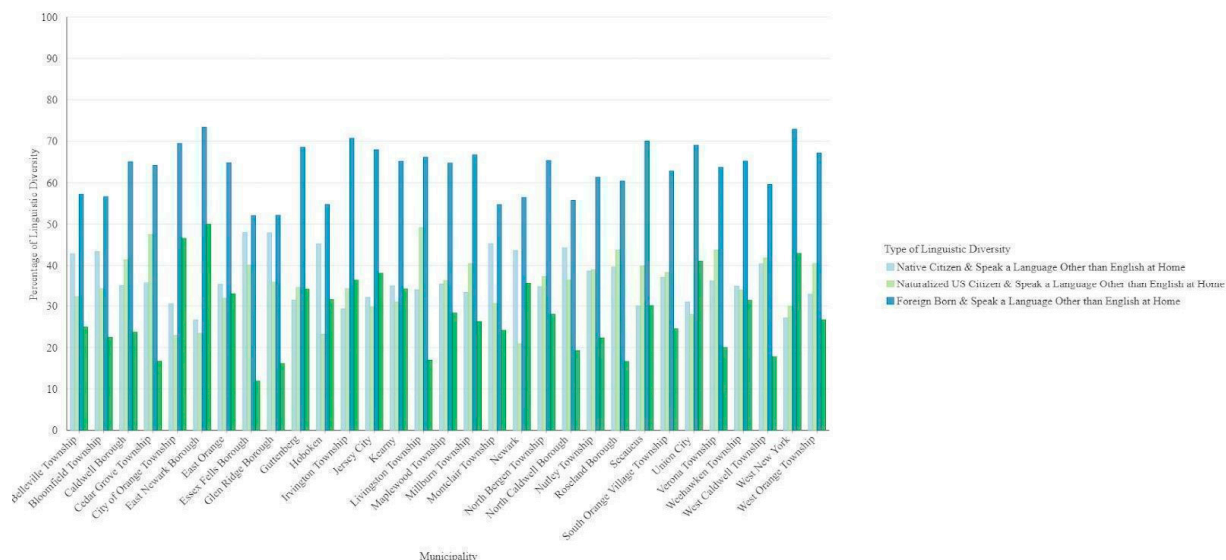


Figure S1. Geographic variation in linguistic diversity among non-US, foreign-born, naturalized citizens (Census, 2020) in the municipalities in Essex and Hudson County, New Jersey (2010-2020).

Table S4. Metal violations among linguistically diverse residents in the municipalities of Essex and Hudson County, New Jersey (2010-2020).

Violations	Speak eEnglish very well				Speak English less than very well			
	Z	P	No Violation (means±SD%)	One or more violations (means±SD%)	Z	P	No Violation (means±SD%)	One or more violations (means±SD%)
Lead	-1.91	0.06	64.54±10.82	58.87±10.78	1.91	0.06	35.46±10.82	41.14±10.78
IronManganese	0.91	0.36	64.22±10.97	67.33±3.46	-0.91	0.36	35.78±10.97	32.67±3.46
Mercury			64.30±10.86				35.70±10.86	
Chromium			64.30±10.86				35.70±10.86	
Cadmium			64.30±10.86				35.70±10.86	
Barium			64.30±10.86				35.70±10.86	
Arsenic	0.98	0.33	64.27±10.87	73.00±0.00	-0.98	0.33	35.73±10.87	27.00±0.00
Silver			64.30±10.86				35.70±10.86	
Manganese			64.30±10.86				35.70±10.86	

Iron			64.30±10.86				35.70±10.86	
Nickel			64.30±10.86				35.70±10.86	
Thallium Total			64.30±10.86				35.70±10.86	
Beryllium Total			64.30±10.86				35.70±10.86	
Zinc			64.30±10.86				35.70±10.86	

Table S5. Metal violations among BIPOC residents including residents who speak a language other than English at home in the municipalities of Essex and Hudson County, New Jersey (2010-2020).

Violations	Foreign Born				Not a US Citizen			
	<i>Z</i>	<i>P</i>	No Violation (means±SD%)	One or more violations (means±SD%)	<i>Z</i>	<i>P</i>	No Violation (means±SD%)	One or more violations (means±SD%)
Lead	-1.38	0.16	63.36±8.08	61.48±6.74	1.36	0.17	27.82±11.37	31.1±7.611
IronManganese	-1.11	0.27	63.31±8.08	61.73±5.70	-1.09	0.28	28.05±11.29	24.22±9.18
Mercury	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Chromium	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Cadmium	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Barium	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Arsenic	-0.68	0.49	63.29±8.03	59.80±0.00	-0.49	0.62	27.98±23.10	0.17±0.00
Silver	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Manganese	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Iron	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Nickel	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Thallium Total	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Beryllium Total	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00
Zinc	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.24	00.00±00.00

Table S6. Nonmetal violations among linguistically diverse residents in the municipalities of Essex and Hudson County, New Jersey (2010-2020).

Violations	Speak english very well				Speak english less than very well			
	Z	P	No Violation (means±SD%)	One or more violations (means±SD%)	Z	P	No Violation (means±SD%)	One or more violations (means±SD%)
<i>E.coli</i>	0.38	0.71	64.27±10.93	64.94±9.15	-0.39	0.70	35.73±10.93	35.04±9.13
TTHM	0.64	0.52	64.21±10.92	66.02±9.58	-0.64	0.52	35.79±10.92	33.98±9.58
Nitrate	0.20	0.84	64.29±10.89	64.93±10.04	-0.20	0.84	35.71±10.89	35.07±10.04
Fluoride			64.30±10.86				35.70±10.86	
Selenium			64.30±10.86				35.70±10.86	
PFNA			64.30±10.86				35.70±10.86	
1,2,3 Trichloropropane	0.09	0.92	64.29±10.90	65.20±5.09	-0.09	0.92	35.71±10.90	34.80±5.09
1,2-Dibromo-3-Chloropropane	0.09	0.92	64.29±10.90	65.20±5.09	-0.09	0.92	35.71±10.90	34.80±5.09
Ethylene Dibromide	0.09	0.92	64.29±10.90	65.20±5.09	-0.09	0.92	35.71±10.90	34.80±5.09
TDS			64.30±10.86				35.70±10.86	
Trichloroethylene			64.30±10.86				35.70±10.86	
Sodium			64.30±10.86				35.70±10.86	
pH			64.30±10.86				35.70±10.86	
1-1 Dichloroethylene			64.30±10.86				35.70±10.86	
Tetrachloroethylene			64.30±10.86				35.70±10.86	
Cryptosporidium	-1.93	0.05	64.45±10.86	57.92±9.33	1.94	0.05	35.53±10.86	42.08±9.33
Color			64.30±10.86				35.70±10.86	
Cyanide	-1.45	0.15	64.34±10.84	48.60±0.00	1.45	0.15	35.66±10.84	51.40±0.00
Turbidity	-2.41	0.02	64.45±10.82	54.44±9.53	2.42	0.02	35.52±10.82	45.57±8.53
Antimony Total			64.30±10.86				35.70±10.86	
Copper Free			64.30±10.86				35.70±10.86	
Combined Uranium			64.30±10.86				35.70±10.86	
Inorganics	0.20	0.84	64.29±10.87	65.30±10.75	-0.20	0.84	35.71±10.87	34.70±10.75
Asbestos	0.77	0.44	64.28±10.87	71.50±0.00	-0.77	0.44	35.72±10.87	28.50±0.00

Fecal Coliform			64.30±10.86				35.70±10.86	
Stage 2 TTHM HAA5	0.02	0.98	64.28±10.89	64.58±10.58	-0.02	0.98	35.72±10.89	35.42±10.58
Total THMS HAA5	0.98	0.32	64.26±10.88	70.85±4.31	-0.98	0.32	35.74±10.88	29.15±4.31
Chlorine	1.70	0.09	63.89±10.64	67.18±12.07	-1.70	0.09	36.11±10.64	32.82±12.07
Total Haloacetic (Acids) HAA5			64.30±10.86				35.70±10.86	
Coliform			64.30±10.86				35.70±10.86	

Table S7. Nonmetal violations among BIPOC residents including residents who speak a language other than English at home in the municipalities of Essex and Hudson County, New Jersey (2010-2020).

Violations	Foreign Born				Not a US Citizen			
	Z	P	No Violation (means±SD%)	One or more violations (means±SD%)	Z	P	No Violation (means±SD%)	One or more violations (means±SD%)
<i>E.coli</i>	0.32	0.75	63.23±8.11	64.55±5.21	-0.06	0.95	27.95±11.25	28.43±11.64
TTHM	-3.79	0.0001	63.54±8.09	58.12±4.08	-1.64	0.10	28.16±11.37	24.23±7.90
Nitrate	-1.17	0.24	63.31±8.08	61.24±4.03	-0.83	0.41	28.03±11.26	24.43±10.28
Fluoride	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Selenium	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
PFNA	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
1,2,3 Trichloropropane	-2.16	0.03	63.41±7.85	46.6±14.05	-2.72	0.01	28.11±11.15	8.77±4.55
1,2-Dibromo-3-Chloropropane	-2.16	0.03	63.41±7.85	46.6±14.05	-2.72	0.01	28.11±11.15	8.77±4.55
Ethylene Dibromide	-2.16	0.03	63.41±7.85	46.6±14.05	-2.72	0.01	28.11±11.15	8.77±4.55
TDS	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Trichloroethylene	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Sodium	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Ph	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
1-1 Dichloroethylene	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Tetrachloroethylene	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Cryptosporidium	1.77	0.08	63.16±8.08	67.47±4.11	1.49	0.14	27.84±11.30	32.61±7.97
Color	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Cyanide	-1.29	0.20	63.30±54.80	70.01±0.00	1.00	0.31	27.94±11.25	37.80±0.00
Turbidity	0.53	0.60	63.24±8.07	65.37±4.62	1.78	0.07	27.84±11.28	34.56±6.59
Antimony Total	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Copper Free	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Combined Uranium	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00

Inorganics	1.38	0.17	63.24±8.03	70.05±3.61	0.95	0.34	27.93±11.27	33.70±2.40
Asbestos	-0.09	0.92	63.28±8.04	63.70±0.00	0.45	0.65	27.96±11.26	31.30±0.00
Fecal Coliform	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Stage 2 TTHM HAA5	-0.67	0.51	63.31±8.11	62.69±6.45	0.40	0.69	27.94±11.35	28.35±9.14
Total THMS HAA5	-1.50	0.13	63.31±8.03	56.10±4.95	-1.72	0.09	28.03±11.23	14.75±6.72
Chlorine	-1.60	0.11	63.49±8.02	61.75±7.98	-0.70	0.49	28.07±11.03	27.21±12.77
Total Haloacetic (Acids) HAA5	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00
Coliform	—	—	63.28±8.03	00.00±00.00	—	—	27.96±11.25	00.00±00.00

Table S8. Rule violations among linguistically diverse residents in the municipalities of Essex and Hudson County, New Jersey (2010-2020).

Violations	Speak english very well				Speak english less than very well			
	Z	P	No Violation (means±SD%)	One or more violations (means±SD%)	Z	P	No Violation (means±SD%)	One or more violations (means±SD%)
LCR	-0.52	0.60	64.38±11.01	63.14±8.71	0.52	0.60	35.62±11.01	36.86±8.71
Consumer Confidence Rule	2.01	0.04	63.91±10.97	67.50±9.47	-2.01	0.04	36.09±10.97	32.50±9.47
State Rule	-0.17	0.86	64.31±10.88	63.20±10.39	0.17	0.86	35.69±10.88	36.80±10.39
Revised Total Coliform Rule	0.74	0.46	64.24±10.88	68.15±9.44	-0.74	0.46	35.76±10.88	31.85±9.44
WQP Initial	1.21	0.23	64.26±10.87	72.05±0.64	-1.21	0.23	35.74±10.87	27.95±0.64
Public Notice	0.32	0.75	64.29±10.87	68.00±0.00	-0.32	0.75	35.71±10.87	32.00±0.00
DBP Stage 1			64.30±10.86				35.70±10.86	
VOCs State			64.30±10.86				35.70±10.86	
RAD_M&R Historical			64.30±10.86				35.70±10.86	
VOC Phase 1			64.30±10.86				35.70±10.86	
Filter Backwash Rule			64.30±10.86				35.70±10.86	
VOCS Federal	-1.48	0.14	64.42±10.88	59.07±8.80	1.48	0.14	35.58±10.88	40.93±8.80
IESWTR	-2.62	0.009	47.83±10.80	47.83±0.86	2.62	0.009	35.57±10.80	52.17±0.86

Table S9. Rule violations among BIPOC residents including residents who speak a language other than English at home in the municipalities of Essex and Hudson County, New Jersey (2010-2020).

Violations	Foreign Born				Not a US Citizen			
	Z	P	No Violation (means±SD)	One or more violations (means±SD%)	Z	P	No Violation (means±SD)	One or more violations (means±SD%)
LCR	-1.34	0.18	63.35±8.11	62.33±6.88	-0.01	0.99	27.95±11.26	28.11±11.21
Consumer Confidence Rule	-3.99	<.0001	63.80±7.89	58.88±7.91	-3.65	0.0003	28.67±11.16	22.02±10.30

State Rule	-1.43	0.15	63.32±8.05	59.60±5.17	-0.27	0.79	27.99±11.27	26.1±9.73
Revised Total Coliform Rule	-0.85	0.40	63.32±8.00	60.28±9.82	-0.12	0.90	27.98±11.26	26.75±11.58
WQP Initial	-1.20	0.23	63.30±8.04	58.75±0.63	-0.17	0.86	27.97±11.27	26.4±1.84
Public Notice	-1.25	0.21	63.30±8.04	58.50±1.41	-1.18	0.24	28.01±11.24	18.60±11.17
DBP Stage 1	—	—	63.28±8.03	0.00±0.00	—	—	27.96±11.25	0.00±0.00
VOCs State	—	—	63.28±8.03	0.00±0.00	—	—	27.96±11.25	0.00±0.00
RAD_M&R Historical	—	—	63.28±8.03	0.00±0.00	—	—	27.96±11.25	0.00±0.00
VOC Phase 1	—	—	63.28±8.03	0.00±0.00	—	—	27.96±11.25	0.00±0.00
Filter Backwash Rule	—	—	63.28±8.03	0.00±0.00	—	—	27.96±11.25	0.00±0.00
VOCS Federal	1.14	0.25	63.20±8.07	66.34±5.47	0.04	0.96	27.98±11.21	0.54±0.30
IESWTR	-2.33	0.02	63.35±8.01	53.73±1.01	0.72	0.47	27.93±11.26	31.93±9.73