MERI 2020 Summer Water Quality Report

2014-2020 7-year trends

On August 11 and 12, 2020, MERI staff conducted 2020 summer water quality sampling at the lower Hackensack River estuary. We visited 14 sampling sites (i.e. HR 1, HR 2, HR 3, HR 5, PHC 6, SMC 7, BC 8, MC 9, CKC 10, CKC 11, OPC 12, KM 13, and KM 14) and successfully collected samples from each site at low tide. The sampling map is shown in Figure 1. Water samples have been processed and analyzed based on NJDEP-certified standard procedures.

Based on 7-year summer water quality data (2014-2020), anions, cations, and most wet chemistry parameters (i.e. hardness, BOD, COD, nitrate, TSS, TDS, conductivity, salinity, chloride, sulfate, fluoride, nitrite, bromide, sodium, potassium, calcium, magnesium, and pH) show a decreasing trend during the summertime (Table 1). With increasing precipitation during the summer, it is reasonable to have lower salinity, pH, anions and cations in water. Also, from HR 1 to CKC 10, most total metals, including chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), and zinc (Zn) all have a decreasing trend (Table 2). However, from CKC 11 to KM 14, most total metals have an increasing trend. Total manganese has an increasing trend in almost all samples.

However, dissolved metals show different patterns during the summer season over these 7 years. Table 3 shows the dissolved metal trends over time. Dissolved Cu, Ni, and Zn have a decreasing trend in most sites. Dissolved Cd, Cr, Fe, Mn, Pb, and total Hg have an increasing trend at most sites. As shown in Table 4, the main concerns of water quality in the district of the Meadowlands come from the increasing level of temperature, fecal coliform, ammonium, turbidity and phosphate in the Hackensack tributaries (creeks) and the corresponding decreasing level of dissolved oxygen (DO). Because of the correlation between temperature and DO, with climate change, temperature is increasing over year which results in the decreasing level of DO in the water body. Especially during summertime, DO dropped below the critical level (4 mg/L) which threatens the lives of fishes and other organisms in the water. Furthermore, we found the increasing trend of phosphate in the creeks. Higher phosphate concentration could cause harmful algal bloom (HAB). HAB could make the water quality even worse. Therefore, it is necessary to take precautions by carefully monitoring water quality parameters for the estuary and reducing the potential pollution or emission of extra nutrients (phosphate, nitrate, etc.) into the creeks and rivers in the Meadowlands.

For HR1 (upstream), almost all metal concentrations are decreasing over time with decreasing TSS, COD, and turbidity. Fecal coliforms maintained the same level. However, we found increased levels of phosphate, temperature, and a decreased level of DO, which may cause HAB and threaten the fishes and other organisms in the lower Hackensack Estuary. For HR2, most metal concentrations also decrease over time with decreasing TSS, COD, and turbidity.

Phosphate concentration maintained the same range (1 to 2.5 mg/L). From 2018 to 2020, the fecal coliform level elevated with the increased ammonium concentration during the summer season. We also observed decreased DO concentrations in the past three years, which are below 4 mg/L at HR 2. For HR3, fecal coliform maintained a similar level from 2014 to 2018. However, the fecal coliform concentration of 2019 summer increased to 360 MPN/100ml at HR3. Moreover, the fecal coliform of 2020 summer is too numerous to count (TNTC). From 2015 to 2020, the ammonium concentration during the summer at HR 3 increased as well. Most metals, anions, cations, and TSS stayed at the same level and COD slightly decreased over time during the summer. The water quality at HR 4 and HR 5 maintained relatively the same level, except for the increased level of ammonium and turbidity.

Table 5, 6, 7, and Figure 2 show the 7-years average trends in the main river and creeks for all the parameters. For the main river, we have increasing trends for fecal coliform, temperature, phosphate, and ammonium. The total Cd and Hg also increases in the main stem of the river.

For the creeks, CKC 11 has the worst water quality among all the sites, including extremely low DO (0.39 mg/L), high concentrations of ammonium (10.2 mg-N/L), and TNTC fecal coliform. Among the creeks, the fecal coliform, turbidity, temperature, phosphate, Cr, Mn, and Hg have increasing trends. Most anions and cations, COD, TSS, TDS, and DO have decreasing trends.

In conclusion, the salinity/conductivity during summertime is decreasing, therefore, most anions, cations, total metals, COD, BOD, TSS, TDS are decreasing during the summer. Moreover, the temperature, fecal coliform, ammonium, and phosphate are increasing during this period, and the DO is decreasing, which could threaten the organisms in the waterbody. The increasing level of phosphate also increased the risk of HAB. HAB has been found in KM 13 for several years, which makes water samples from KM 13 very difficult to filtrate. With climate change, the local water quality has been affected accordingly.

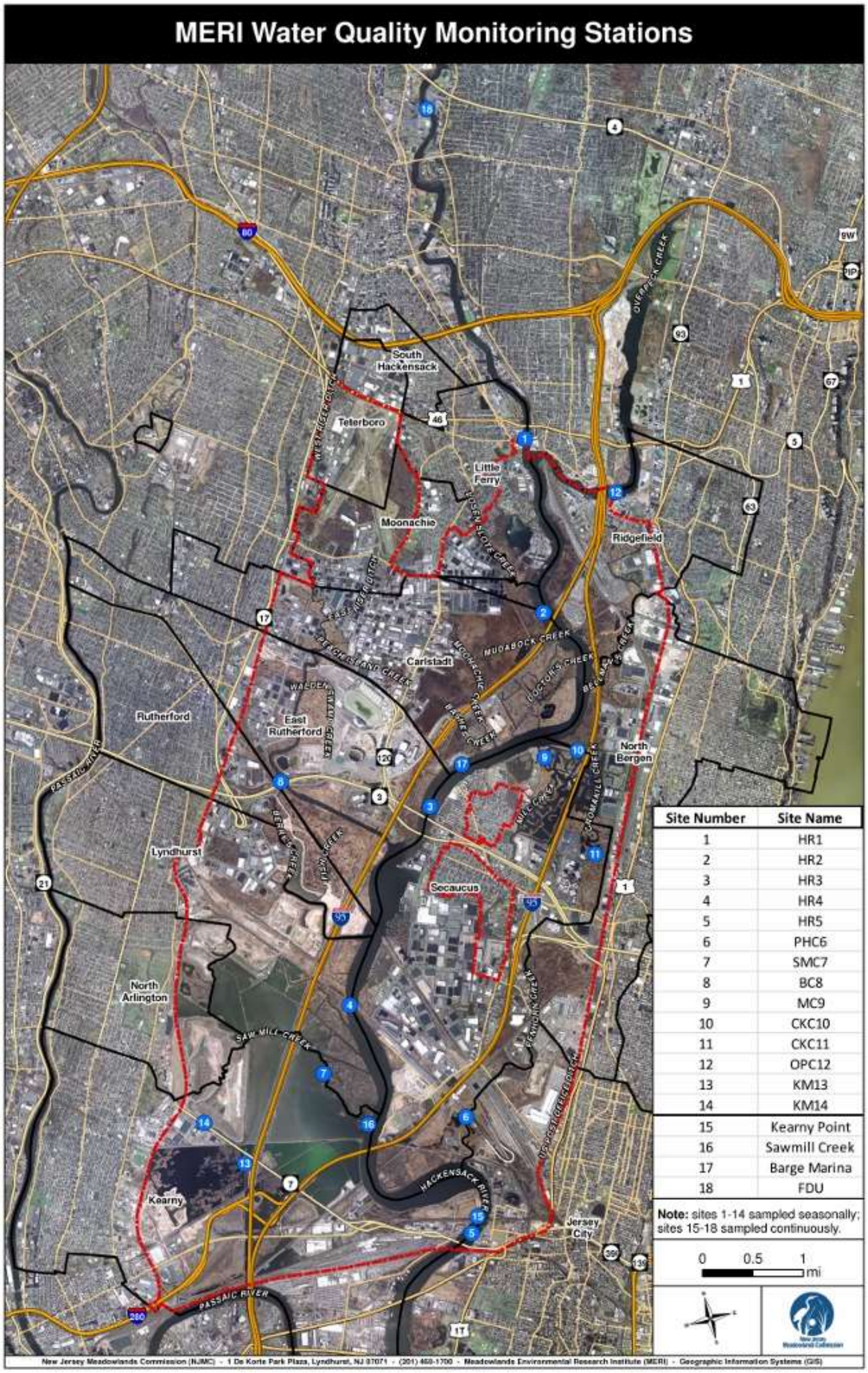

Figure 1. Map of sampling locations.

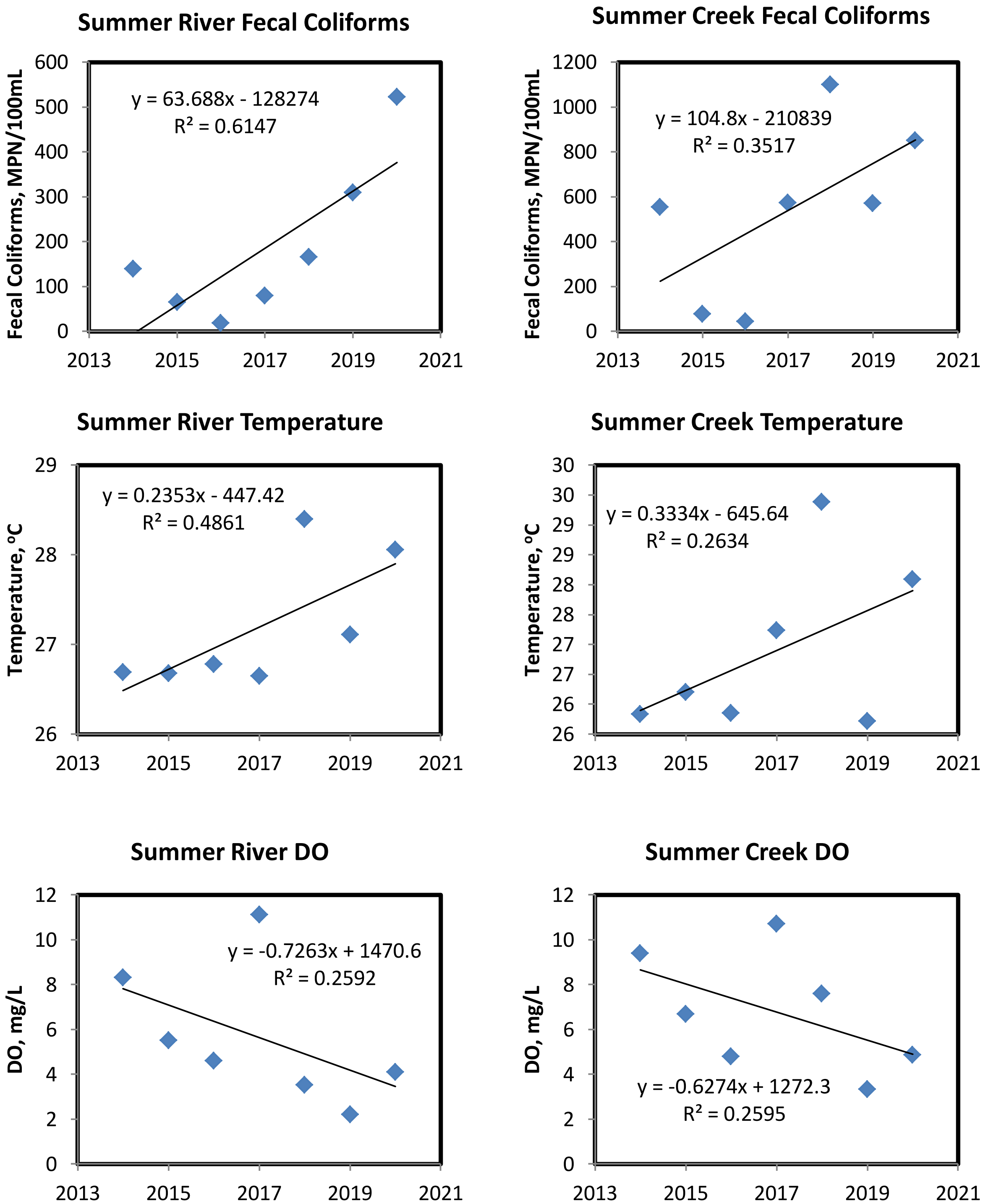

Figure 1. The 2014-2020 average summer water quality trends of temperature, DO, and fecal coliform for the main lower Hackensack River (HR1, HR2, HR3, HR4, HR5, SMC7, and CKC 10) or creeks (PHC 6, BC 8, MC 9, CKC 11, OPC 12, KM 13, and KM 14).

Table 1. The 2014-2020 summer water quality trends for wet chemistry parameters, major anions and cations. (Green, decreasing trends; Blue, no visible difference; Red, increasing trends; Yellow, data not available for trends, concentration is out of range.)

Site	Hardness	BOD	COD	NO_3^-	TSS	TDS	Conductivity	Salinity	Cl^-	SO_4^{2-}	F^-	NO_2^-	Br-	Na^+	K^+	Ca^{2+}	Mg^{2+}	pH
	mg/l						mS/cm	‰	Mg/L									
HR 1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↔
HR 2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↔
HR 3	↓	↔	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↔	↓	↑
HR 4	↓	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↔	↓	↓
HR 5	↓	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	ND	↓	↓	↓	↑	↓	↓
PH 6	↓	↔	↓	↓	↓	↓	↓	↓	↓	↓	↓	ND	↓	↓	↓	↓	↓	↓
SM 7	↓	↔	↓	↓	↓	↓	↔	↔	↓	↓	↓	ND	↓	↓	↓	↓	↓	↓
BC 8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↑
MC 9	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
CKC 10	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↔	↓	↓
CKC 11	↔	↑	↑	↑	↓	↓	↓	↓	↓	↓	↓	ND	↓	↓	↓	↑	↓	↓
OPC 12	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↔	↔	↔	↔	↔
K13	↓	↔	↓	↓	↑	↓	↓	↓	↓	↓	↓	ND	↓	↓	↓	↓	↓	↔
K14	↓	↓	↓	↓	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

Table 2. The 2014-2020 summer water quality trends for total metals. (Green, decreasing trends; Blue, no visible difference; Red, increasing trends.)

	Total Metals, µg/L							
Site	**Cadmium**	**Chromium**	**Copper**	**Iron**	**Lead**	**Manganese**	**Nickel**	**Zinc**
HR 1	↑	↓	↓	↓	↓	↔	↓	↓
HR 2	↓	↓	↓	↓	↓	↔	↓	↓
HR 3	↓	↓	↓	↓	↓	↑	↓	↓
HR 4	↓	↔	↓	↔	↓	↑	↓	↓
HR 5	↓	↓	↓	↓	↓	↑	↓	↓
PH 6	↓	↓	↓	↑	↓	↔	↓	↓
SM 7	↓	↓	↓	↓	↓	↑	↓	↓
BC 8	↓	↓	↓	↓	↓	↑	↓	↓
MC 9	↓	↓	↓	↓	↓	↑	↓	↓
CKC 10	↑	↓	↓	↓	↓	↑	↓	↓
CKC 11	↓	↓	↑	↓	↑	↑	↓	↓
OPC 12	↑	↑	↑	↔	↑	↑	↓	↓
K13	↑	↑	↑	↓	↑	↑	↓	↓
K14	↑	↑	↓	↑	↑	↑	↑	↑

Table 3. The 2014-2020 summer water quality trends for dissolved metals. (Green, decreasing trends; Blue, no visible difference; Red, increasing trends.)

	Dissolved Metals, ug/L								**Hg, ng/l**
Site	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Zn**	**Hg, ng/l**
HR 1	↓	↑	↓	↔	↔	↔	↑	↓	↑
HR 2	↑	↓	↓	↑	↑	↓	↑	↓	↓
HR 3	↑	↑	↓	↑	↑	↓	↑	↑	↑
HR 4	↔	↑	↓	↑	↑	↓	↓	↓	↑
HR 5	↓	↑	↓	↑	↑	↓	↓	↓	↑
PH 6	↑	↑	↑	↑	↑	↓	↑	↓	↓
SM 7	↑	↑	↓	↑	↑	↓	↓	↓	↑
BC 8	↔	↑	↓	↑	↑	↓	↑	↓	↓
MC 9	↑	↑	↓	↑	↑	↓	↑	↓	↑
CKC 10	↑	↔	↓	↑	↑	↓	↓	↓	↑
CKC 11	↓	↑	↑	↓	↑	↑	↑	↓	↓
OPC 12	↑	↓	↑	↑	↑	↓	↑	↓	↑
K13	↑	↓	↓	↓	↓	↓	↑	↓	↑
K14	↔	↑	↑	↑	↓	↓	↑	↓	↑

Table 4. The 2014-2020 summer water quality trends for fecal coliform, ammonium, turbidity, temperature, phosphate, and dissolved oxygen (DO). (Green, decreasing trends; Blue, no visible difference; Red, increasing trends; Yellow, concentration is out of range.)

Site	Fecal Coliforms	NH_4^+	Turbidity	Temperature	Phosphate	DO
	MPN/100ml	mgN/L	NTU	°C	mg/L	mg/L
HR 1	↓	↓	↓	↑	↑	↓
HR 2	↑	↑	↓	↑	↓	↓
HR 3	↑	↓	↓	↑	↑	↓
HR 4	↑	↑	↑	↑	↓	↓
HR 5	↑	↑	↑	↑	↓	↓
PH 6	↑	↓	↔	↔	↑	↓
SM 7	↑	↑	↑	↑	↓	↓
BC 8	↑	↑	↓	↑	↓	↔
MC 9	↔	↑	↑	↑	↓	↓
CKC 10	↑	↑	↓	↑	↓	↓
CKC 11	High	↑	↑	↑	↑	↓
OPC 12	↑	↑	↓	↑	↑	↓
K13	↑	↓	↑	↑	↑	↓
K14	↑	↓	↑	↑	↓	↓

Table 5. The 2014-2020 average summer water quality trends of wet chemistry parameters for the main lower Hackensack River or its tributaries. (Green, decreasing trends; Blue, no visible difference; Red, increasing trends.)

Site		Main River	Creeks
Hardness	mg/L	↓	↓
Fecal Coliforms	MPN/100ml	↑	↑
BOD	mg/L	↓	↔
COD	mg/L	↓	↓
TSS	mg/L	↓	↓
TDS	mg/L	↓	↓
Turbidity	NTU	↓	↑
Temperature	°C	↑	↑
Conductivity	mS/cm	↓	↓
Salinity	ppt	↓	↓
pH	SU	↓	↓
DO	mg/L	↓	↓
Phosphate	mg/L	↑	↑
NH 4	mgN/L	↑	↓

Table 6. The 2014-2020 average summer water quality trends of metals for the main lower Hackensack River or its tributaries. (Green, decreasing trends; Blue, no visible difference; Red, increasing trends.)

	Sites	Rivers	Creeks
Total Metal	Cd, ug/l	↑	↓
	Cr, ug/l	↓	↑
	Cu, ug/l	↓	↓
	Fe, ug/l	↓	↔
	Mn, ug/l	↓	↑
	Ni, ug/l	↑	↑
	Pb, ug/l	↓	↓
	Zn, ug/l	↓	↓
Dissolved Metals	Cd, ug/l	↑	↑
	Cr, ug/l	↑	↑
	Cu, ug/l	↓	↔
	Fe, ug/l	↑	↑
	Mn, ug/l	↑	↑
	Ni, ug/l	↓	↓
	Pb, ug/l	↓	↑
	Zn, ug/l	↓	↓
Hg, ng/l	Hg, ng/l	↑	↑

Table 7. The 2014-2020 average summer water quality trends of anions and cations for the main lower Hackensack River or its tributaries. (Green, decreasing trends; Blue, no visible difference; Red, increasing trends.)

	Site	Rivers	Creeks
Phosphate	mg/L	↑	↑
NH 4	mgN/L	↑	↓
Nitrate	mg/L	↓	↓
Nitrite	mg/L	↓	↓
Chloride	mg/L	↓	↓
Sulfate	mg/L	↓	↓
Fluoride	mg/L	↓	↓
Bromide	mg/L	↓	↓
Sodium	mg/L	↓	↓
Potassium	mg/L	↓	↓
Calcium	mg/L	↓	↓
Magnesium	mg/L	↓	↓