

# **2010 Biological and Water Quality Study of the Salt Creek Watershed**

**DuPage, Cook and Will Counties, Illinois**

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## **2010 Biological and Water Quality Study of Salt Creek and Tributaries**

**DuPage and Cook Counties, Illinois**

Final Report

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## FOREWORD

### *What is a Biological and Water Quality Survey?*

A biological and water quality survey, or “biosurvey”, is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. The latter is the case with this study in that Salt Creek represents a defined watershed of approximately 150 square miles in drainage area that has a complex mix of overlapping stressors and sources in a highly developed urban and suburban landscape. This assessment is a follow-up to a similar survey of Salt Creek performed in 2007 (MBI 2008) that was the first of this scope for the watershed. Previous surveys and assessments by Illinois EPA and DNR were done with less intense spatial detail. While the principal focus of a biosurvey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns, may also be assessed.

### *Scope of the Salt Creek Biological and Water Quality Assessment*

Standardized biological, chemical, and physical monitoring and assessment techniques were employed to meet three major objectives: 1) determine the extent to which biological assemblages are impaired (using Illinois EPA guidelines); 2) determine the categorical stressors and sources that are associated with those impairments; and, 3) add to the broader databases for the DuPage and Salt Creek watersheds to track and understand changes through time that occur as the result of abatement actions or other factors. The data presented herein were processed, evaluated, and synthesized as a biological and water quality assessment of aquatic life use support status. The assessment made herein is directly comparable to that accomplished in 2007, such that trends in status can be examined, and causes and sources of impairment can be confirmed, appended, or removed. This study contains a summary of major findings and recommendations for future monitoring, follow-up investigations, and any immediate actions that may be needed to resolve readily diagnosed impairments. It was not the role of this study to identify specific remedial actions on a site specific or watershed basis. However, the baseline data established by this study contributes to a process termed the Integrated Priority System (IPS; Miltner et al. 2010) that was developed to help determine and prioritize remedial projects.

## Biological and Water Quality Study of Salt Creek 2010

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### INTRODUCTION

A biological and water quality study of Salt Creek and its tributaries was conducted in 2010 to assess aquatic life condition status, identify proximate stressors, examine chemical/physical water quality and biological condition relative to publicly owned treatment works, and monitor for trends relative to the baseline survey conducted in 2007 (MBI 2008). Results from the 2007 survey were published in the Biological and Water Quality Study of the East and West Branches of the DuPage River and the Salt Creek Watersheds (MBI 2008). That report is hereafter referred to as the 2008 Bioassessment Report.

#### *Executive Summary*

Biological assemblages monitored in Salt Creek and its tributaries during 2010 were rated in poor to fair condition (in accordance with Illinois EPA methods) at most locations sampled, with the exception of macroinvertebrates in the Salt Creek mainstem downstream from the Graue Mill Dam. Macroinvertebrates were rated in good condition at 4 of the 6 locations resulting in partial support of Illinois EPA aquatic life goals (Figure 1). Compared to 2007, the condition of the fish assemblage in 2010 was essentially unchanged; however, the condition of the macroinvertebrate assemblage in 2010 was significantly better, averaging about 10 macroinvertebrate Index of Biotic Integrity (mIBI) points higher than in 2007 (mIBI mean = 27.6 in 2010 compared to 17.0 in 2007). Coincidentally, concentrations of ammonia-nitrogen, total Kjeldahl nitrogen (TKN), and 5-day carbonaceous biochemical oxygen demand (cBOD5) were lower on average in 2010 compared to 2007. The change in concentrations appears unrelated to loadings from municipal wastewater treatment plants (WWTP), as loadings between the time periods were similar. More likely, the change was the result of reduced loadings from nonpoint sources owing to different amounts of precipitation between the periods.<sup>1</sup> The important conclusion is that it shows that the biological assemblages in the watershed will respond to management actions.

Stormwater and associated pollutants, and poor habitat quality remain the major factors most limiting to the biological assemblages in the Salt Creek watershed, and are either directly or indirectly responsible for the uniform poor to fair condition. Dissolved oxygen (D.O.) concentrations measured during the 2010 survey became critically low due to the combined effects of stormwater, combined sewer overflows (CSOs), and impoundment by low-head

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<sup>1</sup> The likely scenario here is that 2009/10 was wetter than 2006/07, resulting in retention ponds being less stagnant, neither fostering as much algal growth nor remineralizing as much nitrogen, hence there were likely lower contributions of nitrogenous and oxygen demanding wastes to watershed receiving streams.

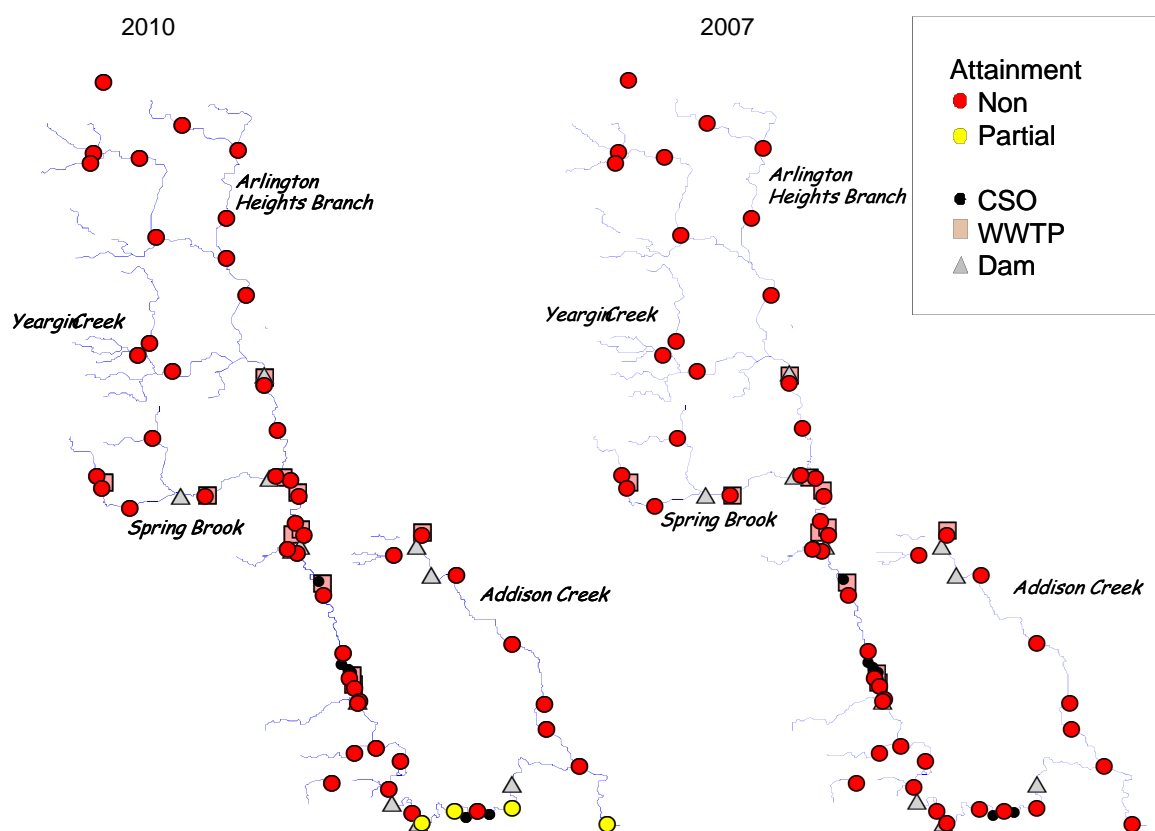


Figure 1. Attainment status of sites sampled in the Salt Creek watershed, 2010 (right) and 2007 (left). No sites were in full attainment based on Illinois EPA biological assessment methods in either year.

dams. Also, chloride concentrations in the headwaters, presumably due to loadings from deicing compounds, were elevated to the point of being limiting to biological communities.

Table 1. Status of aquatic life use support for stream segments sampled in the Salt Creek watershed, 2010.

SITE ID	River Mile	QHEI	fIBI	mIBI	Aquatic Life Use Support	MBI Cause(s)	IEPA Cause(s)	fIBI 2007	mIBI 2007
Arlington Heights Branch 95-840									
T*-IL_GL									
SC06	4.00	52	13	8	Not (Poor)	habitat, chloride, organic enrichment (ammonia, TKN), PAHs (sediment)			5
SC45	1.50	47	16	31	Not (Poor)				13
SC08	0.25	24	14		Not (Poor)				12
Baldwin Creek 95-845									
SC05	2.00	54	17	21	Not (Poor)			16	3
Salt Creek 95-850									
IL_GL									
SC03	41.06	74	17	27	Not (Poor)	D.O., PAHs (sediment),	chloride, habitat, D.O., TP, algae, Hg, PCBs	18	9
SC04	39.50	73	14	25	Not (Poor)		chloride, habitat, D.O., TP, algae, Hg, PCBs	15	13
SC07	36.00	68	19	28	Not (Poor)			20	8
SC15	32.00	72	20	21	Not (Poor)			20	40
IL_GL-10									
SC43	29.00	70	21	27	Not (Fair)		habitat, As, chloride, hexachlorobenzene, methoxychlor, pH, algae, Hg, PCBs	19	15
SC42	27.00	85	22	37	Not (Fair)			18	29
IL_GL-03									
SC41	25.00	79	19	36	Not (Poor)	PAHs (sediment), habitat, D.O.	habitat, DDT, heptachlor, D.O., PCBs, sediment, TSS, TP, Hg	14	43
SC40	24.50	38	17	29	Not (Poor)			15	29
SC34	23.50	51	20	21	Not (Poor)			21	28
SC35	23.00	52	20	24	Not (Poor)			19	20
SC23	22.50	66	19	27	Not (Poor)			22	24
SC39	20.50	73	22	33	Not (Fair)			23	36
SC38	18.00	72	15		Not (Poor)			16	24
SC37	17.50	67	16	40	Not (Poor)			16	25
SC51	17.00	68	14		Not (Poor)			13	25
SC57	16.50	67	15	35	Not (Poor)			14	27



Table 1. Status of aquatic life use support for stream segments sampled in the Salt Creek watershed, 2010.

SITE ID	River Mile	QHEI	fIBI	mIBI	Aquatic Life Use Support	MBI Cause(s)	IEPA Cause(s)	fIBI 2007	mIBI 2007
IL_GL-09									
SC55	13.50	56	15		Not (Poor)	habitat, D.O., PAHs (sediment)	aldrin, chloride, methoxychlor, habitat, D.O., sediment, TSS, pH, TP, Hg, PCBs	18	14
SC56	12.50	51	19		Not (Poor)			19	8
SC53	11.00	58	19	35	Not (Poor)			19	7
SC52	10.50	70	27	46	Not (Fair)			28	33
SC59	9.10	77	23	43	Not (Fair)			14	
SC49	8.00	68	17	35	Not (Poor)			24	32
SC60	7.20	42	21	56	Not (Fair)			14	
IL_GL19									
SC54	3.00	72	21	39	Not (Fair)	PAHs (sediment), habitat		22	39
SC29	0.50	40	24	50	Not (Fair)			22	8
Tributary to Salt Creek 95-851									
IL-x									
SC01	2.00	82	16	34	Not (Poor)			19	5
Tributary to Salt Creek 95-852									
-T- IL_GL									
SC02	0.25	56	3	32	Not (Poor)	habitat		23	10
Tributary to Salt Creek 95-853 <sup>2</sup>									
IL_GL									
SC03	0.50	74	17	27	Not (Poor)		chloride, habitat, D.O., TP, algae, Hg, PCBs	18	9
Tributary to Salt Creek 95-855									
T- IL_RGZX-									
SC11	5.00	43	16	28	Not (Poor)	habitat		19	15
Tributary to Salt Creek 95-856									
SC14	2.50	85	17	31	Not (Poor)			18	20
Yeargin Creek 95-857									
SC12	0.25	63	21	21	Not (Poor)			15	5

<sup>2</sup> Cross-listed as Salt Creek at river mile 42.06 to conform with IEPA segment definition.

Table 1. Status of aquatic life use support for stream segments sampled in the Salt Creek watershed, 2010.

SITE ID	River Mile	QHEI	fIBI	mIBI	Aquatic Life Use Support	MBI Cause(s)	IEPA Cause(s)	fIBI 2007	mIBI 2007
Ginger Creek 95-858									
T - IL_GL-09									
SC30	1.50	51	11	27	Not (Poor)	habitat		10	15
SC31									
Sugar Creek 95-859									
T- IL_GL-03									
SC33	0.25	54	12	24	Not (Poor)	habitat		20	12
Addison Creek 95-860									
IL_GLA-04									
SC24	10.50	53	9	13	Not (Poor)	PAHs (sediment), habitat	aldrin, copper, hexachlorobenzene, habitat, D.O., PCBs, sediment, TSS, TP, algae	10	3
SC26	8.00	50	3	26	Not (Poor)			4	9
IL_GLA-02									
SC27	5.00	60	13	28	Not (Poor)	habitat, organic enrichment (ammonia), PAHs (sediment)	aldrin, habitat, chloride, chromium, DDT, hexachlorobenzene, nickel, TP	18	21
SC48	2.50	46	11	17	Not (Poor)			16	5
SC28	1.50	42	13	14	Not (Poor)			21	5
Trib to Addison Creek 95-861									
T-IL_GLA-04-									
SC25	0.50	53	5	16	Not (Poor)	organic enrichment (ammonia), D.O., habitat		9	
Spring Brook 95-870									
IL_GLB-07									
SC21	6.50	52	15	23	Not (Poor)	chloride, habitat		12	
SC46	6.00	66	13	20	Not (Poor)			11	9
SC18	4.50	69	13	29	Not (Poor)			12	26

Table 1. Status of aquatic life use support for stream segments sampled in the Salt Creek watershed, 2010.

SITE ID	River Mile	QHEI	fIBI	mIBI	Aquatic Life Use Support	MBI Cause(s)	IEPA Cause(s)	fIBI 2007	mIBI 2007
IL_GLB-01									
SC47	2.50	61	23	18	Not (Poor)	TSS, chloride, organic enrichment (TKN)	habitat, DDT, endrin, hexachlorobenzene, D.O., sediment, TSS, TP, algae	22	10
SC16	0.25(1.6)	70	22	26	Not (Fair)			22	11
IL_RGZH									
SC17									
Oakbrook Creek 95-875									
T-IL_GL-09									
SC36	0.50	62	19	23	Not (Poor)	chloride		26	
SC32	0.25	58	21	20	Not (Poor)			25	10
Trib to Meacham Creek 95-881									
T-IL_GLBA									
SC20	0.25	29	15		Not (Poor)	habitat, organic enrichment (ammonia)		12	9
Westwood Creek 95-882									
T-IL_GL_03									
SC22	0.50	47	19	23	Not (Poor)	habitat, organic enrichment (TKN)		18	4

Narrative Ranges for Illinois fIBI and mIBI scores

fIBI		mIBI	
Restricted	0-21	Poor	0-21
Limited	21-30	Fair	21-40
Moderate	31-40	Good	41-70
High Value	41-50	Excellent	70-100
Unique	51-60		

\* A "T" attached to the segment code means that the reach was not assessed by the state, and that the code supplied is for the nearest state assessed segment to which the waterbody drains.

### STUDY AREA

The Salt Creek watershed (Figure 2) consists of approximately 152 square miles of highly urbanized land situated in western Cook and eastern DuPage Counties. The river has two major tributaries, Addison Creek and Spring Brook, with 6 minor tributaries. The mainstem of Salt Creek runs approximately 42.2 lineal miles and has a drop of 225 feet. Mean flow, measured at the USGS gage at Western Springs (station 05531500) between 2000 and 2009 was 189.8 cfs. Salt Creek flows into the Des Plaines River in Lyons, which is tributary to the Illinois River. There are 40 municipalities located within the watershed and 11 publicly owned treatment plants discharge treated effluent to Salt Creek. There are 6 outfalls for active combined sewer overflows (CSOs). Land use in the Salt Creek watershed by acres and percentage of total watershed area are shown in Table 2. Permanently protected open space is concentrated around the main stem of the Salt Creek with approximately 19.1 linear miles of the channel being contained within the Forest Preserve Districts of DuPage and Cook Counties.

*Table 2. Land uses types by area and percent for Salt Creek, and the East and West Branches of the DuPage River. Percentages are of total watershed area. Land use data is taken from Chicago Metropolitan Agency for Planning (CMAP) 2005 land use data.*

Land Use Category	Area (acres)	Area (percent)
Residential	48,657.50	49.9
Commercial and Services	10,824.80	11.1
Institutional	5,432.60	5.6
Industrial, Warehousing and Wholesale Trade	6,142.70	6.3
Transportation, Communication and Utilities	4,884.10	5.0
Total non-Residential Urban	27,284.2	28.0
Agricultural Land	311.70	0.3
Open Space	16,426.20	16.8
Forest, Grassland and Wetlands greater than 2.5 acres	3,220.90	3.3
Water	1,670.00	1.7
Totals	97,570.50	100.0

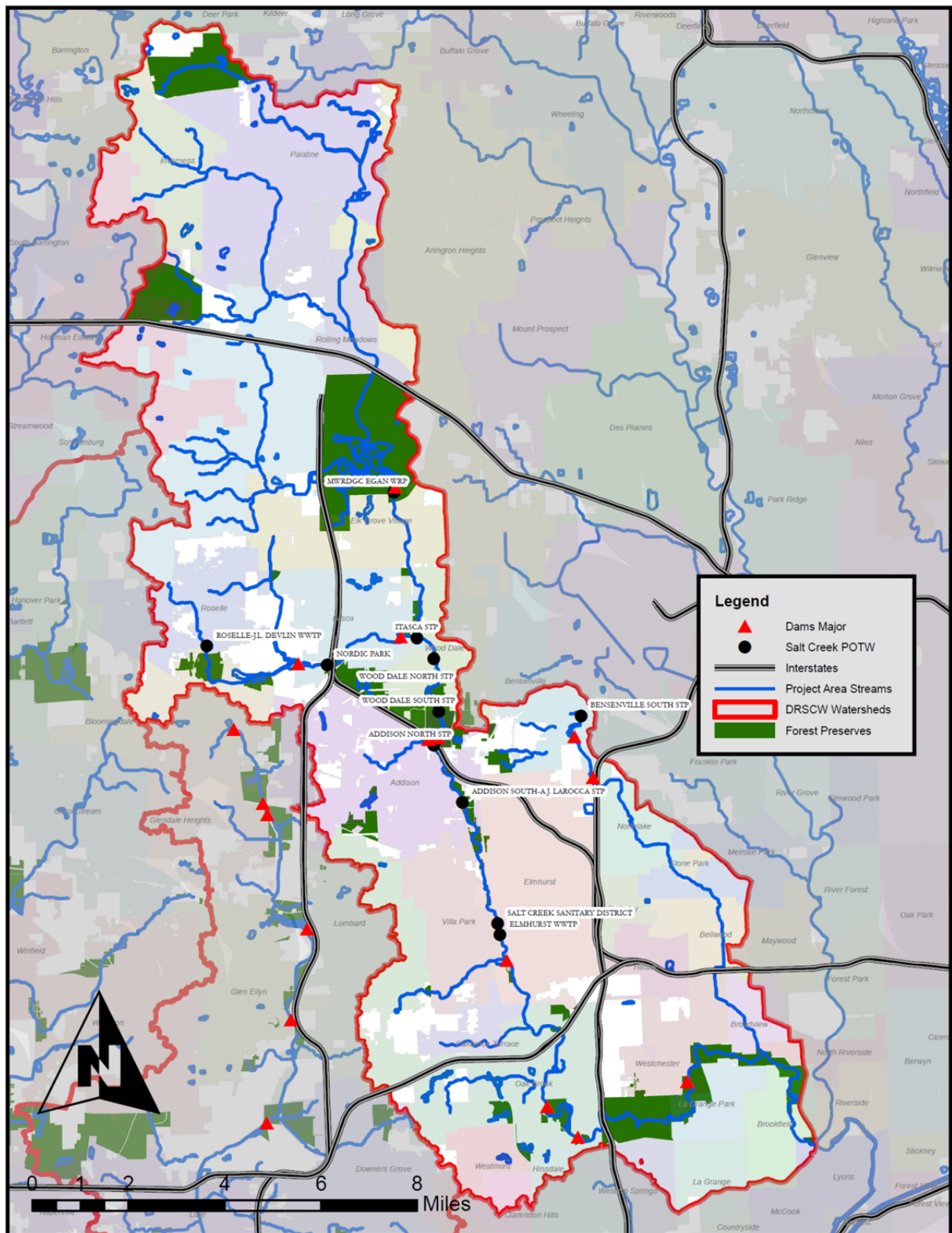


Figure 2. The 2010 Salt Creek study area showing major dischargers, dams, and distinctive geographic features of the watershed.

### ***Salt Creek Dam Descriptions***

The principal dams on Salt Creek are described as follows (ordered north to south):

**Busse Woods Reservoir South Dam:** The Busse Woods Reservoir South Dam is located on Salt Creek within the Busse Woods Forest Preserve, Elk Grove Village. The dam is owned and maintained by the Illinois Department of Natural Resources Office of Water Resources while the



*Figure 3. Busse Woods Reservoir South Dam. Looking north through the spillway.*

Forest Preserve is owned by The Forest Preserve District of Cook County. Access is best gained from Arlington Heights Road to picnic groves 26 and 27 or 32.

The dam was built for flood control and recreational purposes in 1977. The dam is of earthen construction and has a height of 23 feet and is 1381 feet long. The reservoir has a surface area of 415 acres.

**Itasca Country Club Dam:** Situated on Spring Brook 50 feet upstream of Prospect Avenue. Dam privately owned and maintained. No other information was available.



*Figure 4. Lake Kadajah Dam.*

**Lake Kadajah Dam:** Medinah Country Club, ½ mile upstream of Rohlwing Road/IL Route 53. This dam is maintained by the Medinah County Club and serves as part of the DuPage County Division of Stormwater Management Spring Creek Reservoir operation system.

**Oak Meadows Golf Course Dam:** The Oak Meadows Golf Course dam is located on Salt Creek within the Oak Meadows Golf Course. The golf course is maintained by the Forest Preserve District of DuPage County and is located east of Addison Road and north of I-290. The date of construction is unknown.





*Figure 5. Oak Meadow Dam in Addison.*

The dam was built by Elmhurst Country Club to provide a source of irrigation water for the golf course. The spillway is approximately 3 feet high and is 75 feet wide. The impoundment is approximately 4, 500 linear feet in length and covers approximately six acres.



*Figure 6. Westwood Creek Dam and pump station.*

**Westwood Creek Dam (Salt Creek Trib. WWTP dam):** The Westwood Creek dam is located on Westwood Creek, a tributary to Salt Creek in Addison. The dam is approximately 500 feet east of Addison Road and 200 feet southwest of I-290 and is maintained by the Village of Addison. Access to the dam is best gained from a driveway off of Addison Road, south of I-290. The dam was put on line in 1994 as part of an effort by the DuPage County Stormwater Management Division to reduce flooding in the area. Residential

areas to the west along Westwood Creek are protected during flood events by closing the gates of the dam and pumping Westwood Creek to Louis' Reservoir, a two stage 210 foot retention and detention area at the southwest corner of Lake Street and Villa Avenue.



**Redmond Reservoir Dam (George Street Reservoir):** Addison Creek in Bensenville. Operated by the Village of Bensenville. Constructed in 1999. Headwaters originate in Wood Dale and Bensenville. More information can be found at <http://dnr.state.il.us/OWR/Williamredmond.htm>.

**Mt Emblem Cemetery Pond:** Located in Bensenville at the southwest corner of Grand Avenue and County Line Road.

Figure 7. Redmond Reservoir Dam



**Graham Center Dam (Elmhurst Co. Forest Preserve Dam)** The dam is located on Salt Creek near Elmhurst. The dam is ¼ mile east of Route 83 and ¼ mile south of Monroe Street. Access is best granted from Monroe Street on the west side of Salt Creek. The dam was constructed in the early 1990's as a result of dredging on Salt Creek from Oak Brook north to this point. The structure was installed to allow for a step down between the dredged and undredged portions of the river and to prevent sedimentation of the dredged

Figure 8. Mt Emblem Cemetery Pond

portions. The structure was not intended to be a dam, but in low flow conditions acts as one.

The dam originally consisted of a single line of sheet metal piling. However, the creek began to erode the banks at the point of contact with the sheet metal piling. This was repaired by cutting a notch in the original sheet metal piling and installing another line of sheet metal piling further downstream.

**Old Oak Brook Dam:** The Old Oak Brook dam is located on Salt Creek, downstream of 31<sup>st</sup> Street in Oak Brook. The dam is maintained by the Village of Oak Brook and is approximately 85 years old. Access to the dam is best gained from Natoma Drive with permission of landowner (access point is on private land). The dam was originally built by Paul Butler in the 1920's to maintain an aesthetic pool on his property during low flow periods. The original structure of the Oak Brook Dam has undergone major rehabilitation over the last 20 years. There are two main spillway components:



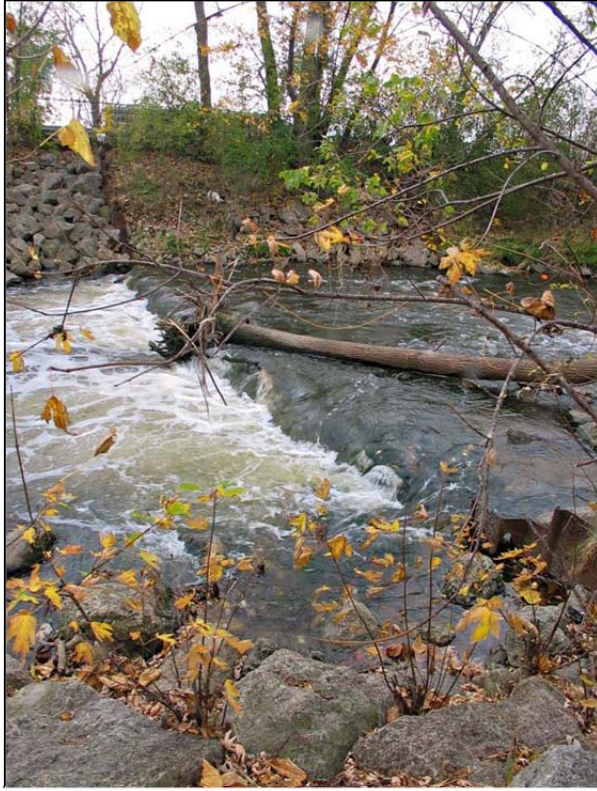


Figure 9. Graham Center Dam (Elmhurst Co. Forest Preserve Dam).

the fixed elevation spillway and a gated “emergency” spillway. The gated spillway section consists of two steel vertical slide gates. The dam was rehabilitated in 1992. The primary spillway is sixty-five feet wide, with about three feet of head at normal flow conditions, and consists of grouted stone with a concrete cap. The left and right training walls consist of grouted stone and reinforced concrete, overlain to a larger extent by concrete filled fabriform mats.

**Fullersburg Woods Dam:** The Fullersburg Woods Dam is located on Salt Creek associated with Graue Mill and within the Fullersburg Woods Forest Preserve. The dam is 300 feet upstream of York Road near the Village of Oak Brook. The dam is owned by the Forest Preserve District of DuPage County (FPDDC) and is 74 years old. Access to the dam is best granted from a trail and parking lot off of Spring Road. The adjacent

historic mill was originally constructed in 1852. The mill and dam were rebuilt by the Civilian



Figure 10. Old Oak Brook Dam Oak Brook.





**Figure11. Fullersburg Woods Dam**

Conservation Corps in the 1934. The dam is 123 feet across and 6.3 feet high. The impoundment created by the dam covers 16 acres and 3,900 linear feet.

### **Fox Lane Impoundment**

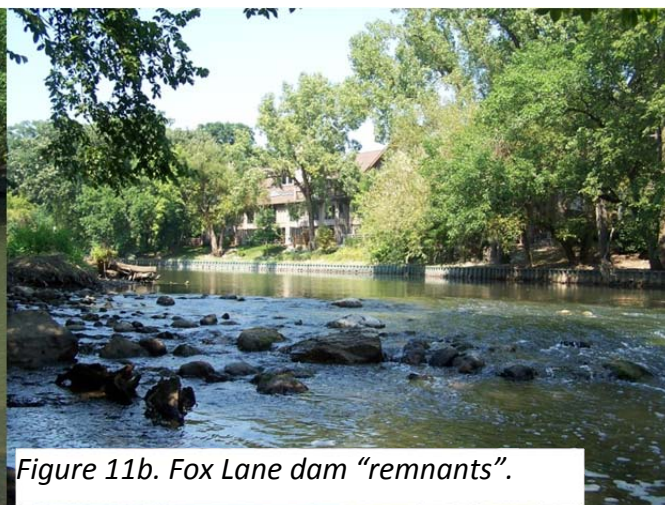
An approximately 5 acre impoundment occurs at river mile 10.00 was created by what seems to be the remnant foundation of an former dam (Figure 11a). The remnants currently function as a large riffle under low to average flow conditions (Figure 11b).

**Possom Hollow Woods Dam:** in Westchester 3/4 miles east of Wolf Road, ¼ mile north of 31<sup>st</sup> Street. It is on FPDCC property and does not create a notable impoundment. No additional data collected at this time.





*Figure 11a. Impoundment at Fox Lane.*



*Figure 11b. Fox Lane dam "remnants".*



*Figure 12 Possum Hollow Woods Dam*

## METHODS

Sampling sites (Table 3) were determined systematically using a geometric design that was supplemented by an intensive pollution survey design. The geometric site process starts at the downstream terminus of the watershed as the first site, and then selecting subsequent “levels” at fixed intervals of one-half the drainage area of the preceding level. Thus the upstream drainage area of each succeeding level, as one moves upstream, decreases by one-half. This resulted in seven levels of drainage area, starting from 150 mi.<sup>2</sup> through drainage levels of 75, 38, 19, 9, 5 and finally 2 mi.<sup>2</sup>. Each level was then supplemented with sites that targeted stream segments of particular interest such as those that have outfalls of publicly owned treatment works (POTW), major stormwater sources, CSOs, and dams, and to fill in gaps left by the geometric design in the larger mainstem reaches for a total of 51 sites.

Each site was sampled for macroinvertebrates, fish habitat, and water quality. Water quality parameters at all sites (except WB12) included nutrients (nitrogen and phosphorus), indicators of organic enrichment (5-day biochemical oxygen demand, ammonia-nitrogen, total Kjeldahl nitrogen), indicators of ionic strength (chloride, conductivity, total dissolved solids), total suspended solids, dissolved oxygen (D.O.), and water temperature. Water column metals (Ca, Cd, Cu, Fe, Mg, Pb and Zn and hardness) were included at 29 locations. Additionally, sediment quality was sampled at 23 locations, and continuous D.O. monitoring was conducted at 8 locations. Sediments were analyzed for heavy metals, polycyclic aromatic hydrocarbons (PAHs), and pesticides.

The macroinvertebrate assemblage was sampled using the Illinois EPA multihabitat method (Illinois EPA 2005) at all sites. The Illinois EPA multi-habitat method involves the selection of a sampling reach that has instream and riparian habitat conditions typical of the assessment reach, has flow conditions that approximate typical summer base flows, has no highly influential tributary streams, contains one riffle/pool sequence or analog (i.e., run/bend meander or alternate point-bar sequence), if present, and is at least 300 feet in length. This method is applicable if conditions allow the sampler to collect macroinvertebrates (i.e., to take samples with a dip net) in all bottom-zone and bank-zone habitat types that occur in a sampling reach. The habitat types are defined explicitly in Appendix E of the project QAPP (MBI 2006b). Conditions must also allow the sampler to apply the 11-transect habitat-sampling method, as described Appendix E of the Quality Assurance Project Plan<sup>3</sup> or to estimate with reasonable accuracy via visual or tactile cues the amount of each of several bottom-zone and bank-zone habitat types. If conditions (e.g., inaccessibility, water turbidity, or excessive water depths) prohibit the sampler from estimating with reasonable accuracy the composition of the bottom zone or bank zone throughout the entire sampling reach, then the multi-habitat method is not applicable. In most cases, if more than one-half of the wetted stream channel cannot be seen, touched, or otherwise reliably characterized by the sampler, it is unlikely that reasonably accurate estimates of the bottom-zone and bank-zone habitat types are attainable, thus, the multi-habitat method is not applicable. The multihabitat samples were preserved in 10%

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<sup>3</sup> [http://www.drscw.org/reports/DuPage.QAPP\\_AppendixE.07.03.2006.pdf](http://www.drscw.org/reports/DuPage.QAPP_AppendixE.07.03.2006.pdf)

*Table 3. Sites sampled during the 2010 survey of the Salt Creek basin.*

Site ID	Stream Name	River Code	River Mile	Latitude	Longitude	Location
SC08	Arlington Heights Branch	95-840	0.25	42.06686	-88.01886	UST Central Rd./adj. Opera In Focus bldg.
SC45	Arlington Heights Branch	95-840	1.50	42.08414	-88.01910	UST Campbell St. @ Roger Florey Park
SC06	Arlington Heights Branch	95-840	4.00	42.11446	-88.01374	Adj. to Maple Park, Palatine, Ill.
SC05	Baldwin Creek	95-845	2.00	42.12519	-88.03947	UST foot bridge @ Carpenter Rd.
SC29	Salt Creek	95-850	0.50	41.81982	-87.83921	UST SR 171 bridge and confluence w/ DesPlaines R.
SC54	Salt Creek	95-850	3.00	41.84563	-87.85206	DST 17th Ave on Salt Creek F.P.
SC49	Salt Creek	95-850	8.00	41.82584	-87.90016	DST Wolf Rd. bridge
SC52	Salt Creek	95-850	10.50	41.82058	-87.92659	DST York Rd
SC53	Salt Creek	95-850	11.00	41.82541	-87.93156	DST Fullerton F.P. bridge/ entrance off Spring Rd
SC56	Salt Creek	95-850	12.50	41.83558	-87.94227	UST Oakbrook Rd/ DST GC bridge
SC55	Salt Creek	95-850	13.50	41.84745	-87.93652	DST 22nd St bridge
SC57	Salt Creek	95-850	16.50	41.87417	-87.95601	DST low head dam below Elmhurst WWTP
SC51	Salt Creek	95-850	17.00	41.87973	-87.95844	DST Elmhurst WWTP/ UST low head dam
SC38	Salt Creek	95-850	18.00	41.89501	-87.96365	UST Charles Rd
SC39	Salt Creek	95-850	20.50	41.92010	-87.97300	DST Fullerton Ave.
SC23	Salt Creek	95-850	22.50	41.93842	-87.98584	Behind ball field off Stone Ave.
SC35	Salt Creek	95-850	23.00	41.94617	-87.98266	UST second dam @ Oakwood G.C.
SC34	Salt Creek	95-850	23.50	41.95195	-87.98657	DST Elizabeth Drive
SC40	Salt Creek	95-850	24.50	41.96304	-87.98444	DST Irving Park Rd.
SC41	Salt Creek	95-850	25.00	41.97047	-87.98843	DST MWRDGC retention facility ramp
SC42	Salt Creek	95-850	27.00	41.99252	-87.99516	DST Devon Rd
SC43	Salt Creek	95-850	29.00	42.01216	-88.00114	DST Arlington Heights Ave at Elk Grove HS
SC15	Salt Creek	95-850	32.00	42.05099	-88.00951	DST Golf Rd. (SR 581)
SC07	Salt Creek	95-850	36.00	42.07630	-88.05254	At end of Plum Grove Rd.
SC04	Salt Creek	95-850	39.50	42.11063	-88.06004	Corner of Palatine Rd. and Quentin Rd.
SC01	Trib to Salt Creek	95-851	2.00	42.14373	-88.07698	UST service road culvert in Deer Grove F.P.
SC02	Trib to Salt Creek	95-852	0.25	42.11285	-88.08173	DST Inverway Dr. off Palatine Rd



*Table 3. Sites sampled during the 2010 survey of the Salt Creek basin.*

SC03	Trib to Salt Creek	95-853	0.50	42.10820	-88.08374	UST Plymouth St, culvert
SC11	Trib to Salt Creek	95-855	5.00	42.02996	-88.05499	UST Schaumburg Rd/ DST bike path
SC14	Trib to Salt Creek	95-856	2.50	42.01772	-88.04445	DST Meacham Rd
SC12	Yeargin Creek	95-857	0.25	42.02464	-88.06056	UST Palm Grove Rd.
SC31	Ginger Creek	95-858	0.55	41.83938	-87.95324	UST from Jorie Blvd
SC30	Ginger Creek	95-858	1.50	41.83829	-87.96922	DST Midwest Rd. below first pond
SC33	Sugar Creek	95-859	0.25	41.87320	-87.95736	DST Riverside/ DST SR 83
SC28	Addison Creek	95-860	1.50	41.86125	-87.86783	UST Gardner Ave.
SC48	Addison Creek	95-860	2.50	41.87237	-87.86882	DST/UST Van Buren St.
SC27	Addison Creek	95-860	5.00	41.89895	-87.88392	UST SR 45 @ PlayPen
SC26	Addison Creek	95-860	8.00	41.92870	-87.91064	Adj. to park on Rhodes Ave./ S. of Grand
SC24	Addison Creek	95-860	10.50	41.94642	-87.92636	UST Jefferson Rd
SC25	Trib to Addison Creek	95-861	0.50	41.93788	-87.93986	UST Forest View Rd.
SC16	Spring Brook of SC	95-870	0.25	41.97196	-87.99561	DST Prospect Ave.
SC47	Spring Brook of SC	95-870	2.50	41.96332	-88.02914	DST SR 53 (Rohlwing Rd)
SC18	Spring Brook of SC	95-870	4.50	41.95825	-87.06449	@ end of Lakeview Dr.
SC46	Spring Brook of SC	95-870	6.00	41.96670	-88.07754	DST Foster Ave.
SC21	Spring Brook of SC	95-870	6.50	41.97200	-88.08006	DST Walnut Ct.
SC17	Meacham Creek	95-871	0.35	41.96711	-88.04683	DST Irving Park Rd/Medinah Country Club
SC32	Oakbrook Creek	95-875	0.25	41.85364	-87.94862	16th St. @Citibank pkg. lot
SC36	Oakbrook Creek	95-875	0.50	41.85090	-87.95853	SR 83 & Hodges Rd behind Barnes and Nobles
SC20	Trib to Meacham Creek	95-881	0.25	41.98838	-88.05421	Behind Air-Liance Bldg. pkg . lot off Stevenson Ct.
SC22	Westwood Creek	95-882	0.50	41.94002	-87.99063	DST Rozanne Drive
SC13	Tributary to Salt Creek	NA	NA	42.015691	-88.054162	At end of University Lane

formalin. Laboratory procedures generally followed the Illinois EPA (2005) method. For the multi-habitat method this requires the production of a 300 organism subsample with a scan and pre-pick of large and/or rare taxa from a gridded tray. Taxonomic resolution was performed at the lowest practicable resolution for the common macroinvertebrate assemblage groups such as mayflies, stoneflies, caddisflies, midges, and crustaceans. This goes beyond the genus level requirement of Illinois EPA (2005); however, calculation of the macroinvertebrate IBI followed Illinois EPA methods in using genera as the lowest level of taxonomy for mBI scoring.

Methods for the collection of fish at wadeable sites was performed using a tow-barge or long-line pulsed D.C. electrofishing equipment utilizing a T&J 1736 DCV electrofishing unit described by MBI (2006b). A Wisconsin DNR battery powered backpack electrofishing unit was used as an alternative to the long line in the smallest streams and in accordance with the restrictions

described by Ohio EPA (1989). A three person crew carried out the sampling protocol for each type of wading equipment. Sampling effort was indexed to lineal distance and ranged from 150-200 meters in length. Non-wadeable sites were sampled with a raft-mounted pulsed D.C. electrofishing device. A Smith-Root 2.5 GPP unit was mounted on a 14' raft following the design of MBI (2007). Sampling effort for this method was 500 meters. A summary of the key aspects of each method appears the project QAPP (MBI 2006b). Sampling distance was measured with a GPS unit or laser range finder. Sampling locations were delineated using the GPS mechanism and indexed to latitude/longitude and UTM coordinates at the beginning, end, and mid-point of each site. The location of each sampling site was indexed by river mile (using river mile zero as the mouth of each stream). Sampling was conducted during a June 15-October 15 seasonal index period.

Samples from each site were processed by enumerating and recording weights by species and by life stage (y-o-y, juvenile, and adult). All captured fish were immediately placed in a live well, bucket, or live net for processing. Water was replaced and/or aerated regularly to maintain adequate D.O. levels in the water and to minimize mortality. Fish not retained for voucher or other purposes were released back into the water after they had been identified to species, examined for external anomalies, and weighed either individually or in batches. Weights were recorded at level 1-5 sites only. Larval fish were not included in the data and fish measuring less than 15-20 mm in length were generally excluded from the data as a matter of practice. The incidence of external anomalies was recorded following procedures outlined by Ohio EPA (1989, 2006a) and refinements made by Sanders et al. (1999). While the majority of captured fish were identified to species in the field, any uncertainty about the field identification required their preservation for later laboratory identification. Fish were preserved for future identification in borax buffered 10% formalin and labeled by date, river or stream, and geographic identifier (e.g., river mile and site number). Identification was made to the species level at a minimum and to the sub-specific level if necessary. A number of regional ichthyology keys were used and included the Fishes of Illinois (Smith 1979) and updates available through the Illinois Natural History Survey (INHS). Vouchers were deposited and verified at The Ohio State University Museum of Biodiversity (OSUMB).

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995; Ohio EPA 2006b) and as recently modified by MBI for specific attributes. Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the metrics used to determine the QHEI score which generally ranges from 20 to less than 100. The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments in the Midwestern U.S. have indicated that values greater than 60 are *generally* conducive to

the existence of warmwater faunas whereas scores less than 45 generally cannot support an assemblage consistent with baseline Clean Water Act goal expectations (e.g., the General Use in Illinois). Scores greater than 75 frequently typify habitat conditions which have the ability to support an exceptional fish assemblage.

#### *Data Management and Analysis*

MBI employed the data storage, retrieval, and calculation routines available in the Ohio ECOS system as described in the project QAPP (MBI 2006b). Fish and macroinvertebrate data were reduced to standard relative abundance and species/taxa richness and composition metrics. The Illinois Fish Index of Biotic Integrity (fIBI) was calculated with the fish data using programming supplied by Illinois EPA. The macroinvertebrate data were analyzed using the Illinois macroinvertebrate Index of Biotic Integrity (mIBI).

#### *Determination of Causal Associations*

Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine biological status (i.e., unimpaired or impaired, narrative ratings of quality) and assigning associated causes and sources of impairment utilizing the accompanying chemical/physical data and source information (e.g., point source loadings, land use). The identification of impairment in rivers and streams is straightforward - the numerical biological indices are the principal arbiter of aquatic life use attainment and impairment following the guidelines of Illinois EPA (2008). The rationale for using the biological results in the role as the principal arbiter within a weight of evidence framework has been extensively discussed elsewhere (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995).

Describing the causes and sources associated with observed biological impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures (Yoder and Rankin 1995; Yoder and DeShon 2003; Miltner *et al.* 2010). Thus the assignment of principal associated causes and sources of biological impairment in this report represents the association of impairments (based on response indicators) with stressor and exposure indicators using linkages to the biosurvey data based on previous experiences within the strata of analogous situations and impacts. The reliability of the identification of associated causes and sources is increased where many such prior associations have been observed. The process is similar to making a medical diagnosis in which a doctor relies on multiple lines of evidence concerning patient health. Such diagnoses are based on previous research which experimentally or statistically links symptoms and test results to specific diseases or pathologies. Thus a doctor relies on previous experiences in interpreting symptoms (*i.e.*, multiple lines from test results) to establish a diagnosis, potential causes and/or sources of the malady, a prognosis, and a strategy for alleviating the symptoms of the disease or condition. As in medical science, where the ultimate arbiter of success is the eventual recovery and well-being of the patient, the ultimate measure of success in water resource management is the restoration of lost or damaged ecosystem attributes including assemblage structure and function.



### *Hierarchy of Water Indicators*

A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. A tiered approach that links the results of administrative actions with true environmental measures was employed by our analyses. This integrated approach is outlined in Figure 13 and includes a hierarchical continuum from administrative to true environmental indicators. The six “levels” of indicators include:

- 1) actions taken by regulatory agencies (permitting, enforcement, grants);
- 2) responses by the regulated community (treatment works, pollution prevention);
- 3) changes in discharged quantities (pollutant loadings);
- 4) changes in ambient conditions (water quality, habitat);
- 5) changes in uptake and/or assimilation (tissue contamination, biomarkers, assimilative capacity); and, changes in health, ecology, or other effects (ecological condition, pathogens).

In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental “results” (level 6). An example is the aggregate effect of billions of dollars spent on water pollution control since the early 1970s that have been determined with quantifiable measures of environmental condition (Yoder et al. 2005). Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications. *Exposure* indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise the Illinois EPA biological endpoints. Other response indicators can include target assemblages, *i.e.*, rare, threatened, endangered, special status, and declining species or bacterial levels that serve as surrogates for the recreational uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* the roles which are most appropriate for each (Yoder and Rankin 1998).

### *Determining Causal Associations*

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure

# Completing the Cycle of WQ Management: Assessing and Guiding Management Actions with Integrated Environmental Assessment

## Indicator Levels

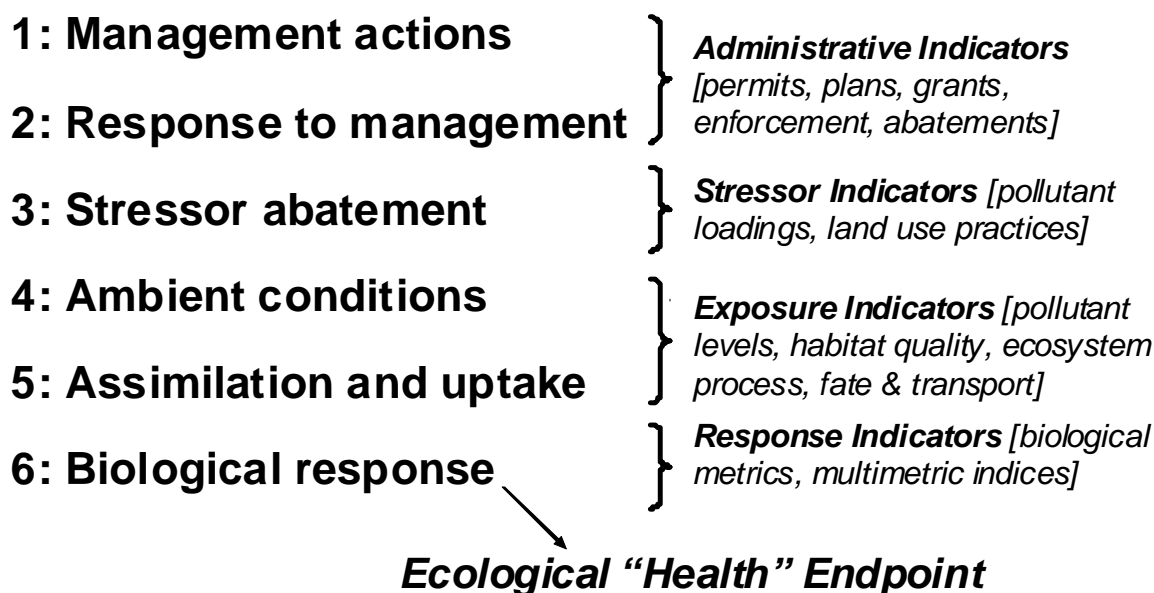


Figure 13. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995) and further enhanced by Karr and Yoder (2004).

indicators. The principal reporting venue for this process on a watershed or subbasin scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Illinois Water Resource Inventory (305[b] report), the Illinois Nonpoint Source Assessment, and other technical products.

### *Illinois Water Quality Standards: Designated Aquatic Life Uses*

The Illinois Water Quality Standards (WQS; IL Part 303.204-206) consist of designated uses and chemical criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad categories, aquatic life and non-aquatic life uses. Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each use. The system of use designations employed in the Illinois WQS constitutes a general approach in that one or two levels of protection are provided and extended to all water

bodies regardless of size or position in the landscape. In applications of state WQS to the management of water resource issues in rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality assessments. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all other uses.

Aquatic life use support for a water body in Illinois is determined by examining all available biological and water quality information. Where information exists for both fish and macroinvertebrate indicators, and both indicators demonstrate full support, the water body is considered in full support independent of the water chemistry results. Where information for both biological indicators exists, and one indicator suggests full support while the other shows moderate impairment, a use decision of full support can be made if the water chemistry data show no indication of impairment. Where one biological indicator is severely impaired, non-support is demonstrated. If information for only one biological indicator exists, water chemistry information is used to inform the use support decision in that a biological result of full support can be overridden if the water chemistry results clearly demonstrate impairment. However, in the Salt Creek survey biological data was available for each site.

### POLLUTANT LOADINGS BY PUBLICLY OWNED TREATMENT WORKS

Ten facilities with average daily design flows greater than 1 million gallons per day (MGD) discharge to Salt Creek and its tributaries. One facility, DuPage County Nordic, with average flows less than 1 MGD, but greater than 0.1 MGD discharges to Salt Creek via Spring Brook (Table 4). During stable, low summer flows, effluent can comprise up to 65 percent of the stream flow in the Salt Creek mainstem. However, during August of 2010, effluent was typically about 13 percent of the flow at the Western Springs USGS gauge. The percent stream flow composed of effluent obviously depends on the amount of precipitation over an antecedent period, especially the amount of precipitation during the winter and spring months. Effluent quality data from major dischargers in the Salt Creek watershed (Table 4) were evaluated against permit limits to gauge the relative performance of each plant, especially with respect to plant flows (the amount of effluent leaving the plant) relative to treatment capacity, and concentrations of several key effluent constituents: 5-day carbonaceous biochemical oxygen demand (cBOD5), total suspended solids (TSS) and ammonia-nitrogen (NH<sub>3</sub>-N). Detailed descriptions of each plant and effluent quality were provided in the 2008 report. Hence, the discussion for each plant herein is limited to effluent quality for the 2008-2010 period with trends in effluent quality analyzed over approximately the past decade.

*Table 4. Publicly owned sewage treatment plants that discharge to the Salt Creek watershed. DAF is design average flow, DMF is design maximum flow. Facility location coordinates are listed for reference.*

NPDES	Name	ADF	DMF	Receiving Stream	Long	Lat
IL0036340	MWRDGC Egan WRP	30	50	Salt Creek	-88.0008	42.0153
IL0026280	Itasca STP	2.6	10	Salt Creek	-87.9919	41.9714
IL0030813	Roselle-J.L. Devlin WWTP	2	4	Spring Brook	-88.0767	41.9692
IL0028398	DuPage County Nordic	0.5	1	Spring Brook	-88.0281	41.9633
IL0020061	Wood Dale North STP	1.97	3.93	Salt Creek	-87.985	41.965
IL0034274	Wood Dale South STP	1.13	2.33	Salt Creek	-87.9831	41.9492
IL0021849	Bensenville South STP	4.7	10	Addison Creek	-87.9258	41.9478
IL0033812	Addison North STP	5.3	7.6	Salt Creek	-87.9869	41.9472
IL0027367	Addison South-A.J. Larocca STP	3.2	8	Salt Creek	-87.9739	41.9253
IL0030953	Salt Creek Sanitary District	3.3	8	Salt Creek	-87.9597	41.8853
IL0028746	Elmhurst WWTP	8	20	Salt Creek	-87.9589	41.8819

Total daily effluent flows in millions of gallons per day (MGD) averaged 51.45 MGD for the period 2008-2010 (Figure 14). This was 10 percent higher than the preceding three year window, and likely a function of higher average monthly precipitation. Monthly precipitation during 2008-2010 was approximately 24 percent higher than in 2005-2007. The link between precipitation and effluent flow is directly related to combined storm and sanitary sewer collection system flows and is also a function of inflow and infiltration in the collection system. During rain events, excess flows are minimally treated per NPDES permit requirements and diverted to the receiving stream as overflows. The amount of diverted flows is largely a function of rainfall (Figure 16f). Average daily loadings of cBOD5, TSS and NH<sub>3</sub>-N over 2008-

2010 were 1036, 1321, and 164 lbs/day, respectively. Compared to 2005-2007 those represent an approximate 8 percent increase for cBOD5 and TSS, and a 5 percent decrease for NH3-N (Figure 15). The lower ammonia load in the face of increased flow is an indication that the treatment plants, as whole, have maintained high treatment efficiency over time.

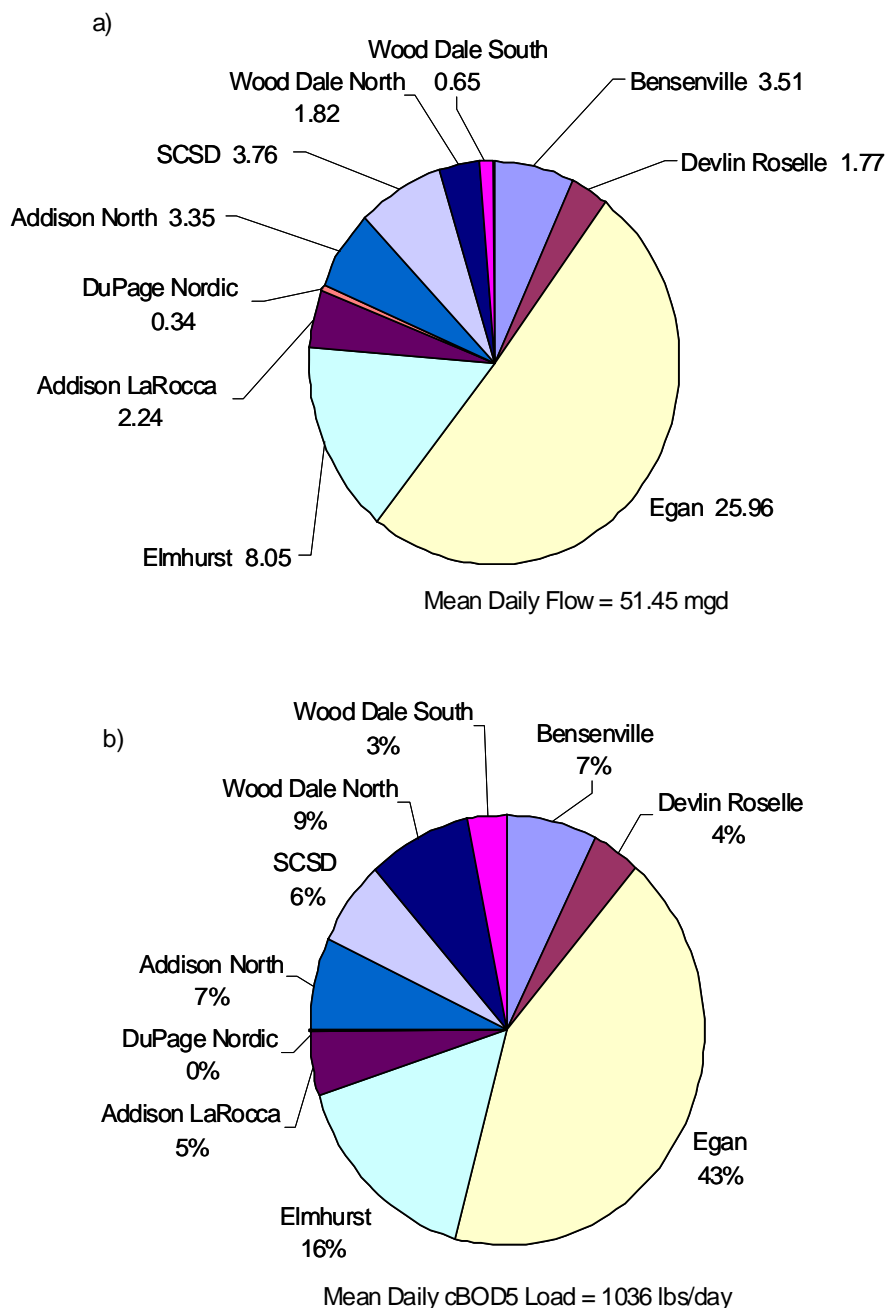


Figure 14. a) Mean daily effluent flows, 2008-2010, for dischargers in the Salt Creek watershed. Note that data for the DuPage Nordic plant were available only for 2008. b) Mean daily cBOD5 load apportioned by facility.

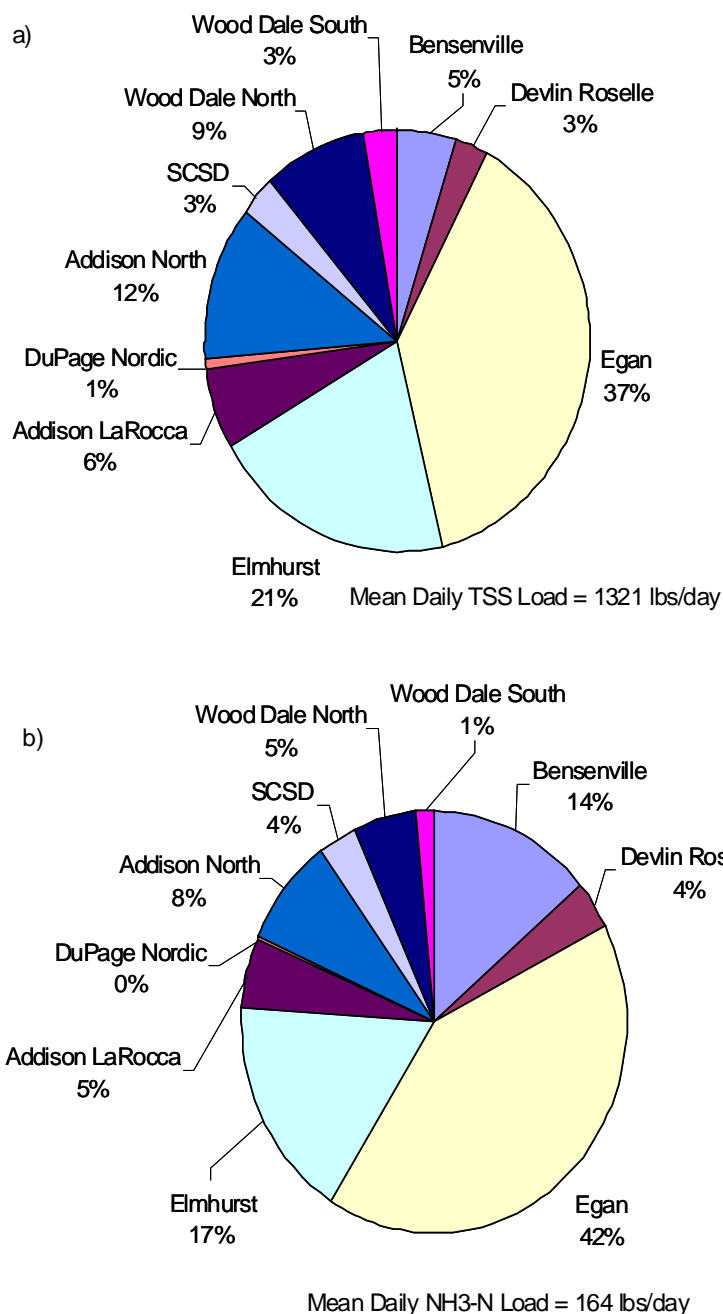


Figure 15. a) Mean daily total suspended solids load, and b) mean daily ammonia nitrogen load, 2008-2010, apportioned by facility. Note that data for the DuPage Nordic plant were available only for 2008. Note that NH<sub>3</sub>-N load from Bensenville is proportionately larger relative to its load of cBOD<sub>5</sub> and TSS due to its higher daily maximum limits for NH<sub>3</sub>-N (9.3 mg/l) compared to the maximum limit of 3.0 mg/l for most other plants in the watershed.

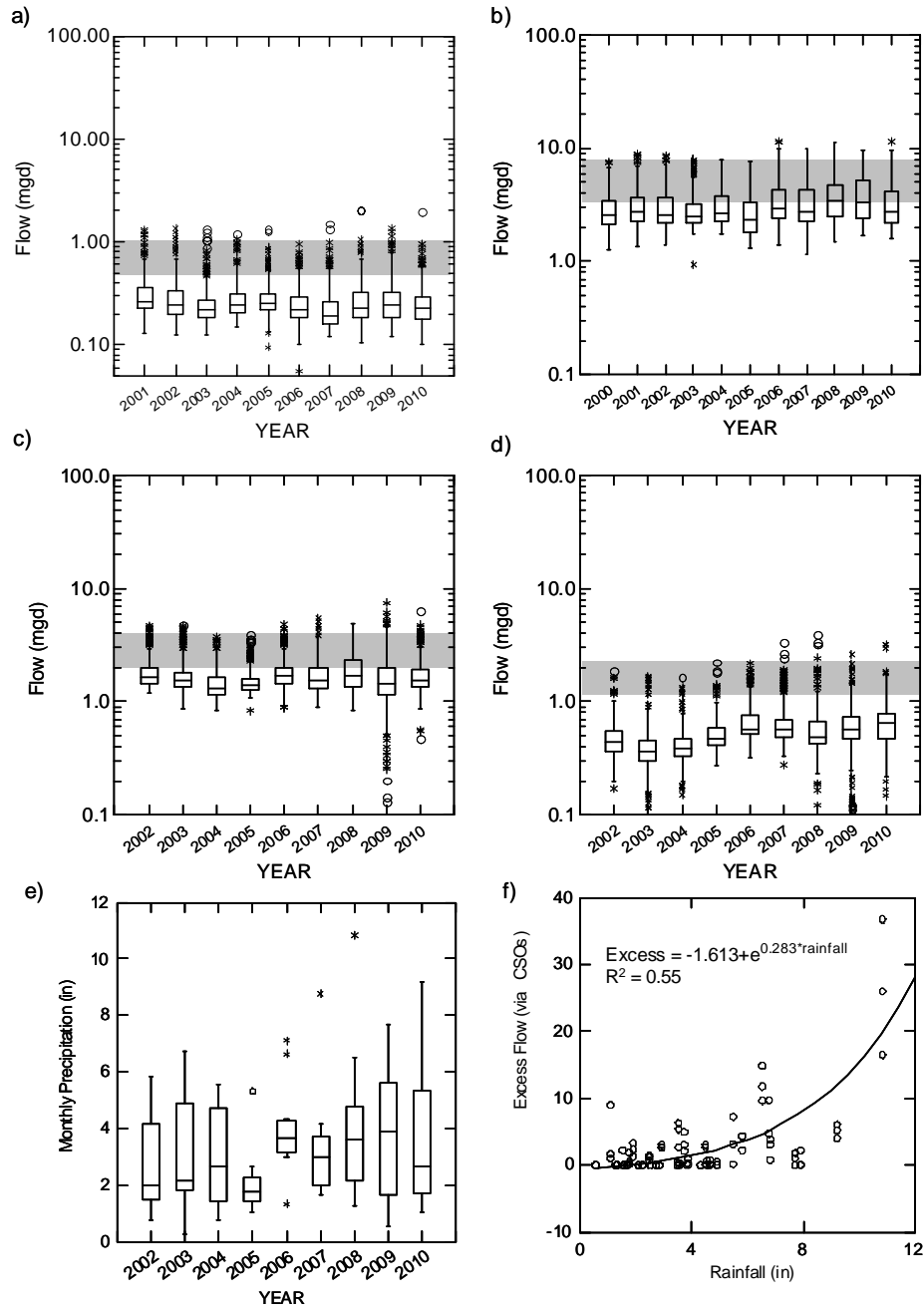


Figure 16. Distributions of daily plant flows by year for a) DuPage Nordic, b) Salt Creek Sanitary District, c) Wood Dale North, and d) Wood Dale South. e) Distributions of monthly precipitation by year (can we note that the distribution of rain for the 2006-2007 look anomalous for the decade reviewed) , and f) reported excess plant flows (from a representative sample) as a function of rainfall. The linear trend line is from non-linear regression. The shaded region in the flow plots bounds the average daily design flow, and the maximum hydraulic capacity.

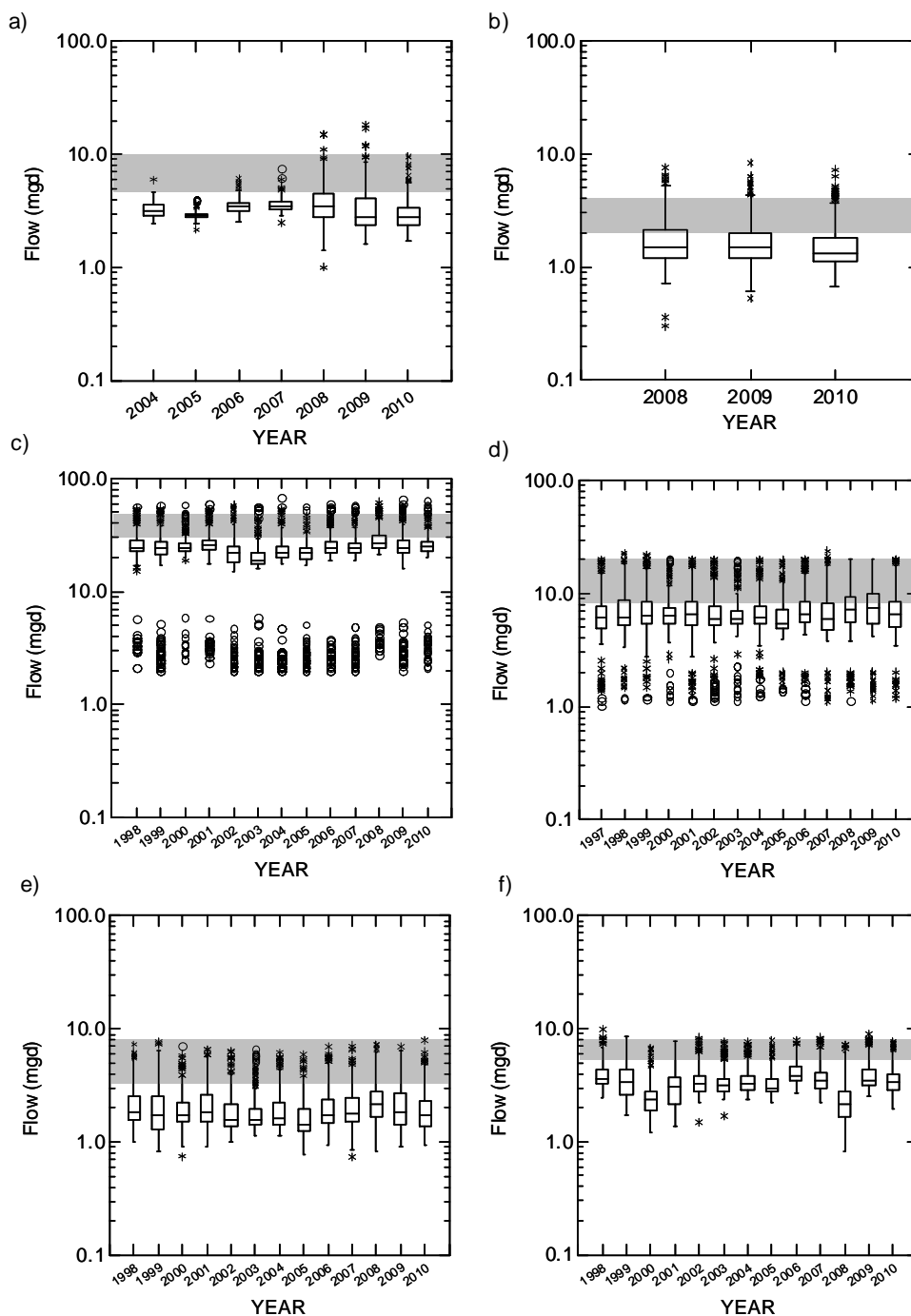
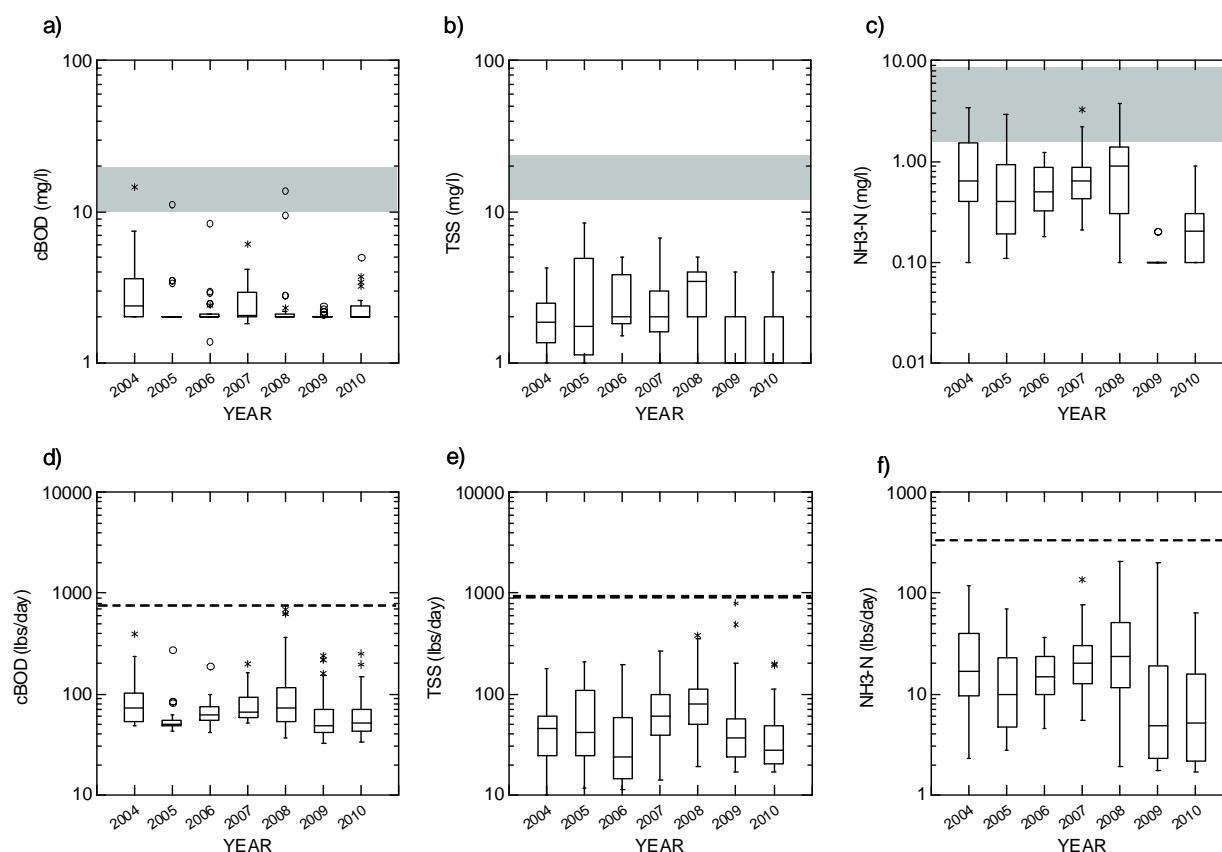


Figure 17. Distributions of daily plant flows by year for a) Bensenville, b) Devlin, c) Egan, d) Elmhurst, e) Addison LaRocca, and f) Addison North. The shaded region in the flow plots bounds the average daily design flow, and the maximum hydraulic capacity.



**BENSENVILLE SOUTH STP** [IL0021849] The primary discharge is outfall 001. The 10-year recurrent 7-day low flow (Q7,10) of the receiving stream, Addison Creek, is 0 cfs. The design average flow (DAF) for the treatment facility is 4.7 MGD and the design maximum flow (DMF) for the facility is 10 MGD. Treatment consists of screening, grit removal, primary treatment trickling filtration, activated sludge, sedimentation, tertiary filtration, disinfection and sludge handling facilities. Effluent flows averaged well below the plant's design average capacity, but showed increased variance in the last three years compared to previous years (Figure 17a). Concentrations and loads of cBOD5, TSS and NH3-N did not exceed permit limits, and showed no obvious trend, with the possible exception of lower NH3-N loads in 2009 and 2010 compared to previous years (Figure 18).



*Figure 18. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the Bensenville WWTP. The shaded region in the concentrations plots show the applicable permit limits for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the load plots shows the 30 day average load limit. Where limits vary by season, the most stringent limit is used.*

**ROSELLE- J.L. DEVLIN WWTP [IL0030813]** Treatment consists of screening, primary clarifiers, activated sludge, sedimentation, filtration, disinfection, sludge handling facilities, and excess flow treatment. The design average flow (DAF) for the facility is 2.0 MGD and the design maximum flow (DMF) for the facility is 4.0 MGD. The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream, Springbrook Creek, is 0 cfs. Effluent flows (Figure 17b) were stable over the three years reported (2008-2010), and averaged well-below the daily design average. However, plant flows exceeded the maximum design capacity in approximately 5 percent of reported cases. Concentrations and loads of cBOD5, TSS and NH3-N (Figure 19) were also stable over the reporting period, and were consistently less than applicable limits.

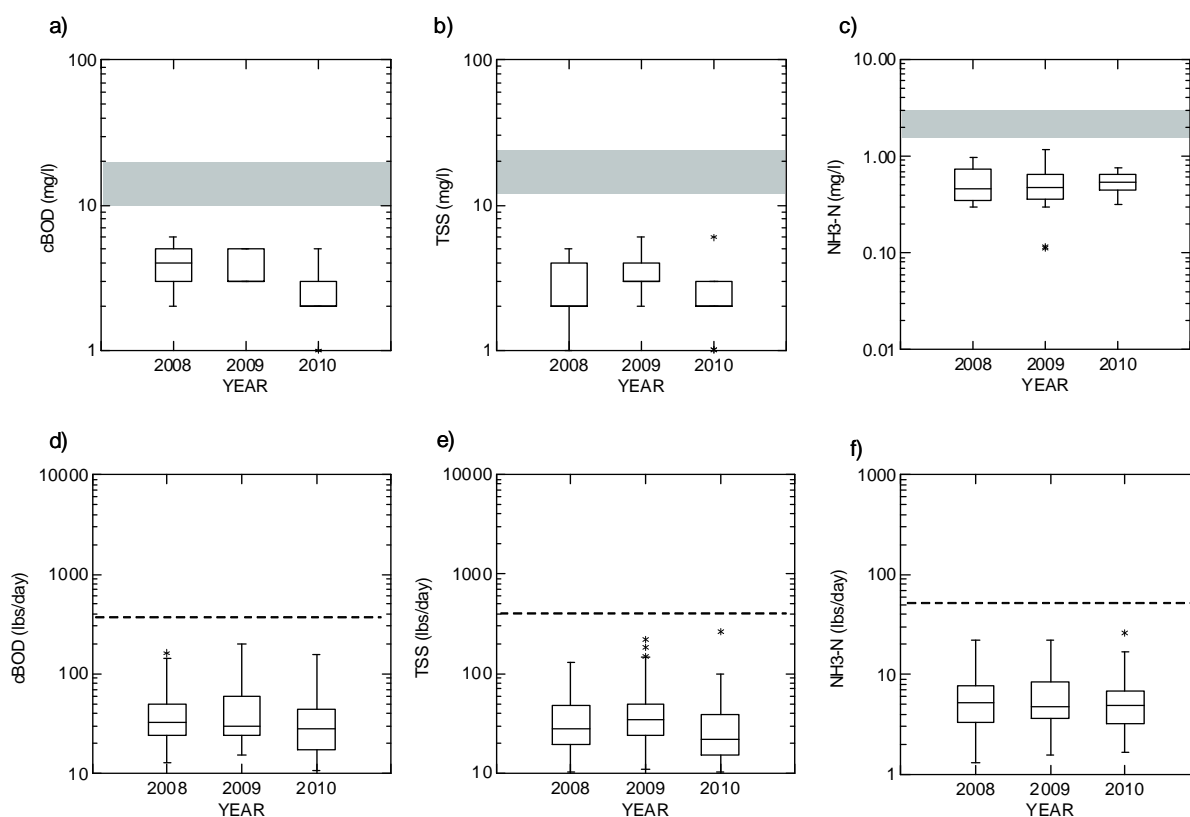
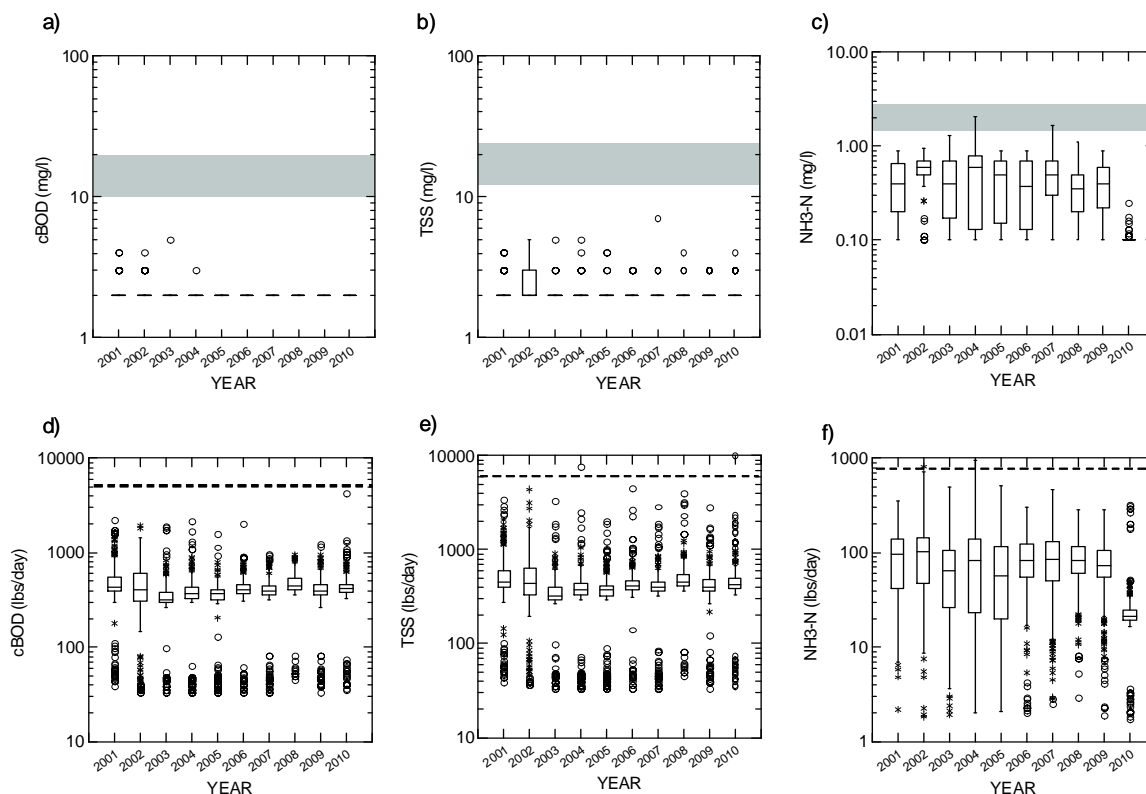


Figure 19. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the Roselle J. L. Devlin WWTP. The shaded region in the concentrations plots show the applicable permit limits for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the load plots shows the 30 day average load limit. Where limits vary by season, the most stringent limit is used.

**MWRDGC EGAN WRP** [IL0036340] The design average flow (DAF) for this treatment facility is 30 MGD and the design maximum flow (DMF) for the facility is 50 MGD. Treatment consists of screening, grit removal, settling tanks, aeration tanks, tertiary filtration, anaerobic digestion, gravity belt thickeners, and excess flow facilities. Excess flow is permitted only when the main treatment facility is receiving its maximum practical flow. Excess flows, when they occur, are required to be monitored. Monthly average limits for the excess discharges are 30 mg/l for cBOD5 and TSS, 400 colonies/100 ml of fecal coliform, 0.75 mg/l for residual chlorine (used as a



*Figure 20. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the MWRDGC John E. Egan WRP. The shaded region in the concentrations plots show the applicable permit limits for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the load plots shows the 30 day average load limit. Where limits vary by season, the most stringent limit is used.*

disinfectant). The 10-year recurrent 7-day low flow (Q7/10) of Salt Creek at the discharge point is 0 cubic feet per second (cfs). Treatment efficiency at the plant appears high, given that effluent concentrations of cBOD5 and TSS (Figure 20a and b) are generally at or below detection limits. Effluent concentrations of NH3-N are typically less than 1.0 mg/l, and have been consistent in terms of magnitude and variability over the period of record, with the exception of significantly lower concentrations and loads during 2010.

**CITY OF ELMHURST STP [IL0028746]** The Elmhurst Sewage Treatment Plant has an average design flow of 8.0 MGD and a design maximum flow of 20 MGD. Flows from the plant edged higher over the last three years, with seventy-fifth percentile flows exceeding the design daily average (Figure 17d); however, concentrations of cBOD5, TSS and NH3-N have trended downward over the last decade, and noticeably for the last three years (Figure 21 a-c), apparently to maintain consistent loadings (Figure 21 d-f) in the face of increasing flows.

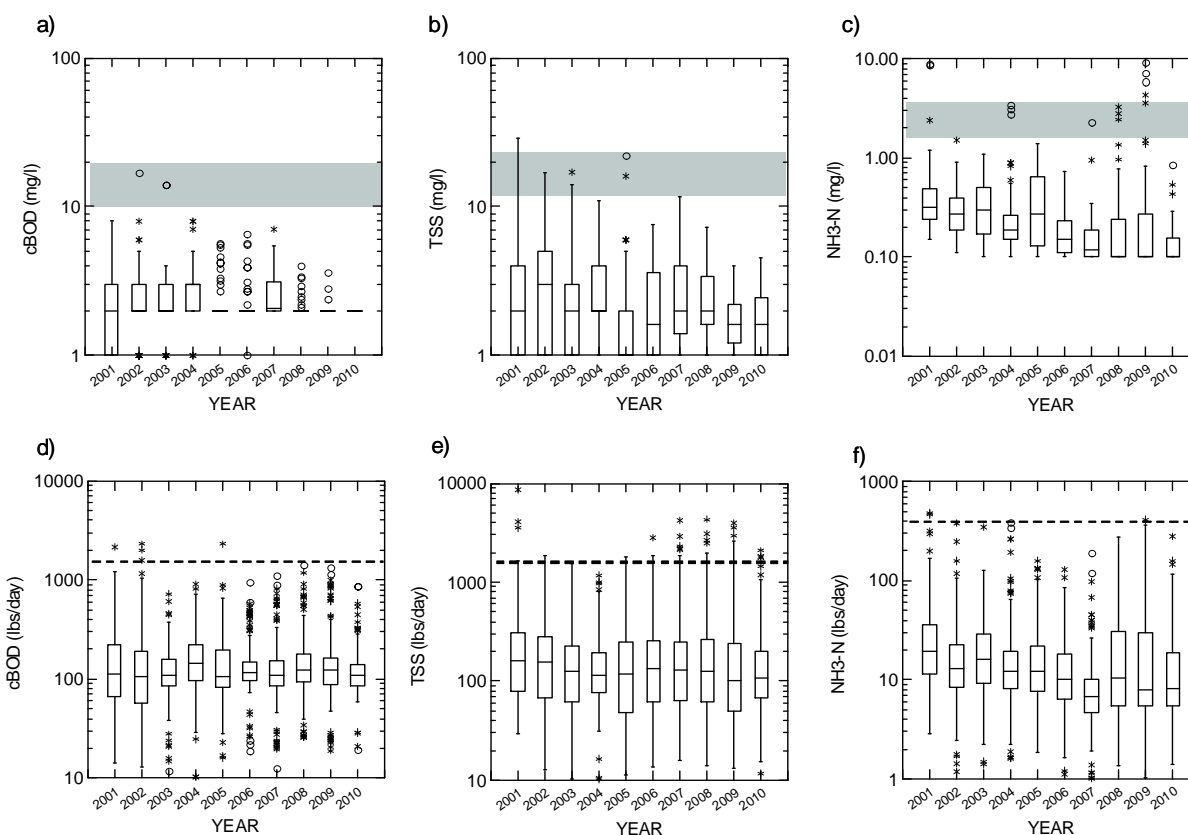
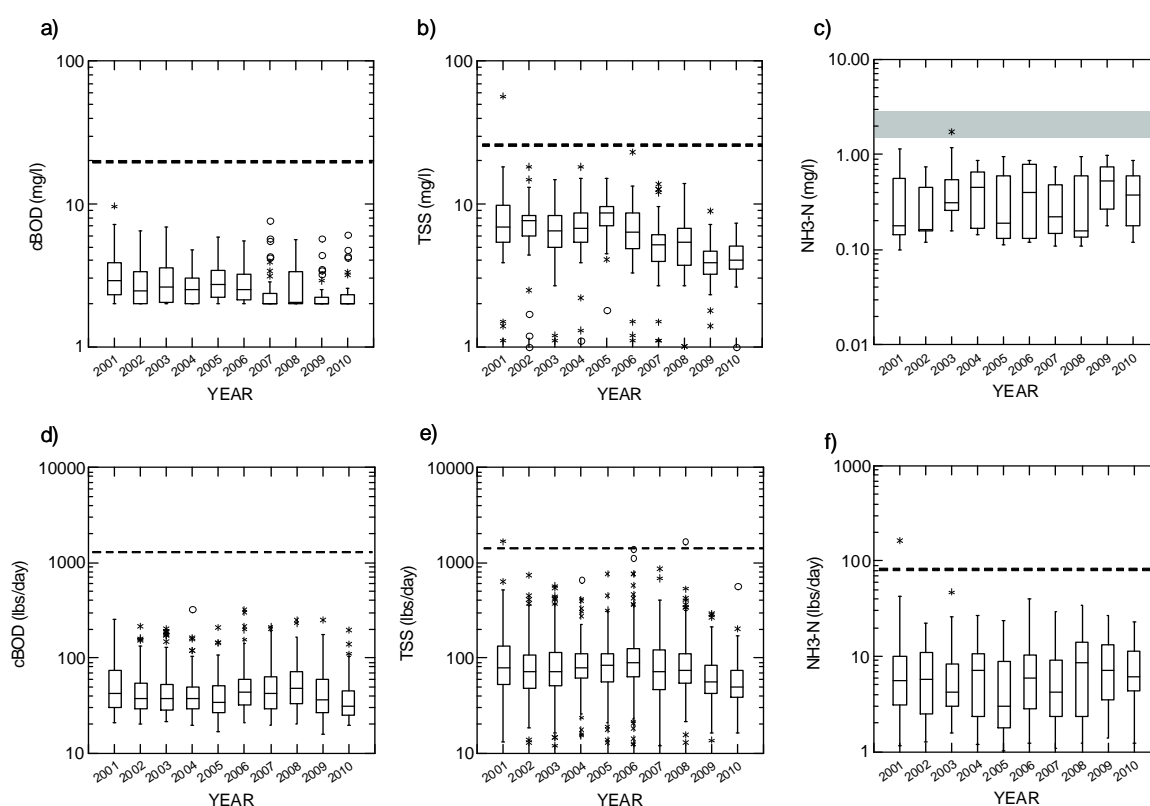


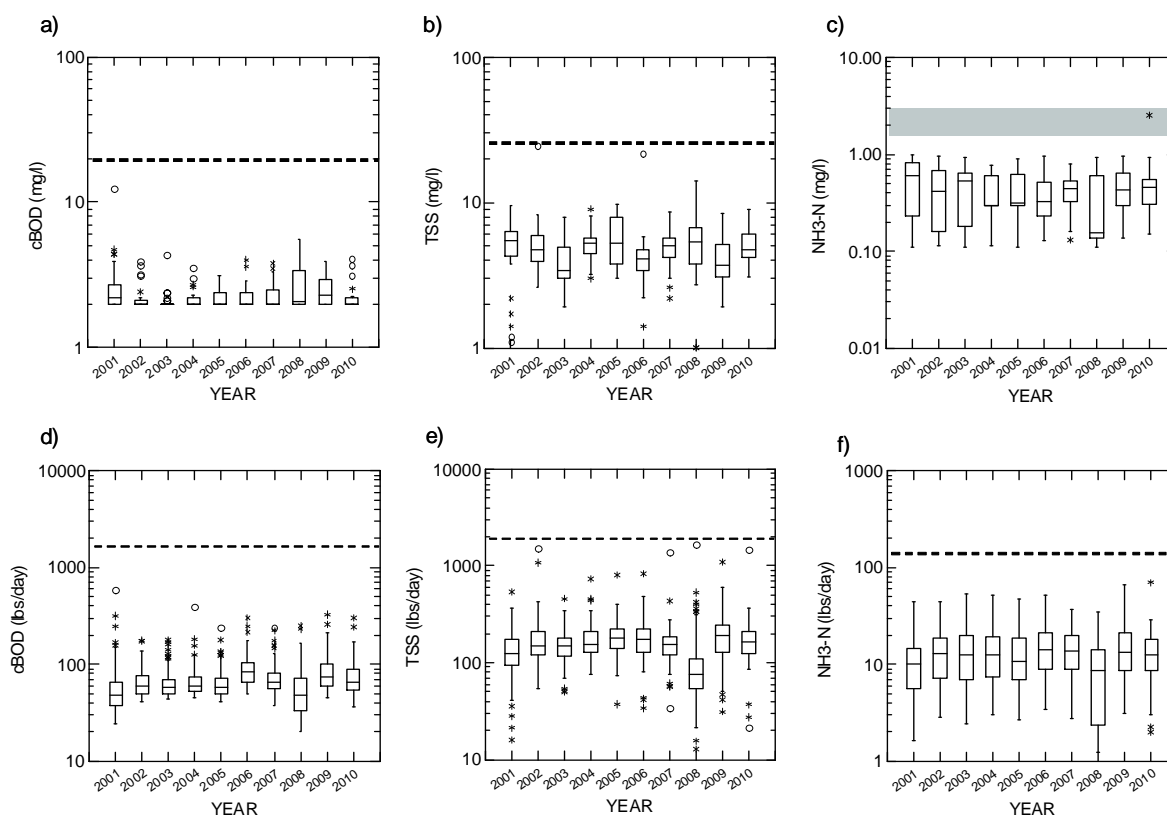
Figure 21. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the City of Elmhurst STP. The shaded region in the concentrations plots show the applicable permit limits for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the load plots shows the 30 day average load limit. Where limits vary by season, the most stringent limit is used.

**ADDISON SOUTH (A. J. Larocca) STP** [IL0027367] The design average flow (DAF) for the treatment facility is 3.2 MGD and the design maximum flow (DMF) for the facility is 8.0 MGD. Treatment consists of screening, grit removal primary settling, activated sludge, secondary settling chlorination and dechlorination. Sludge is stabilized with anaerobic digestion. Addison South is authorized to treat and discharge excess flow as follows through a combined sewer outfall (CSO) subject to secondary treatment standards as outlined in 40 CFR 133.102. Effluent flows from the plant were consistent in terms of magnitude and variability over the last decade, and have remained within treatment capacity (Figure 17e). Concentrations and loads of cBOD5, TSS and NH3-N (Figure 22) have also been stable and consistently within applicable permit limits for the last decade.



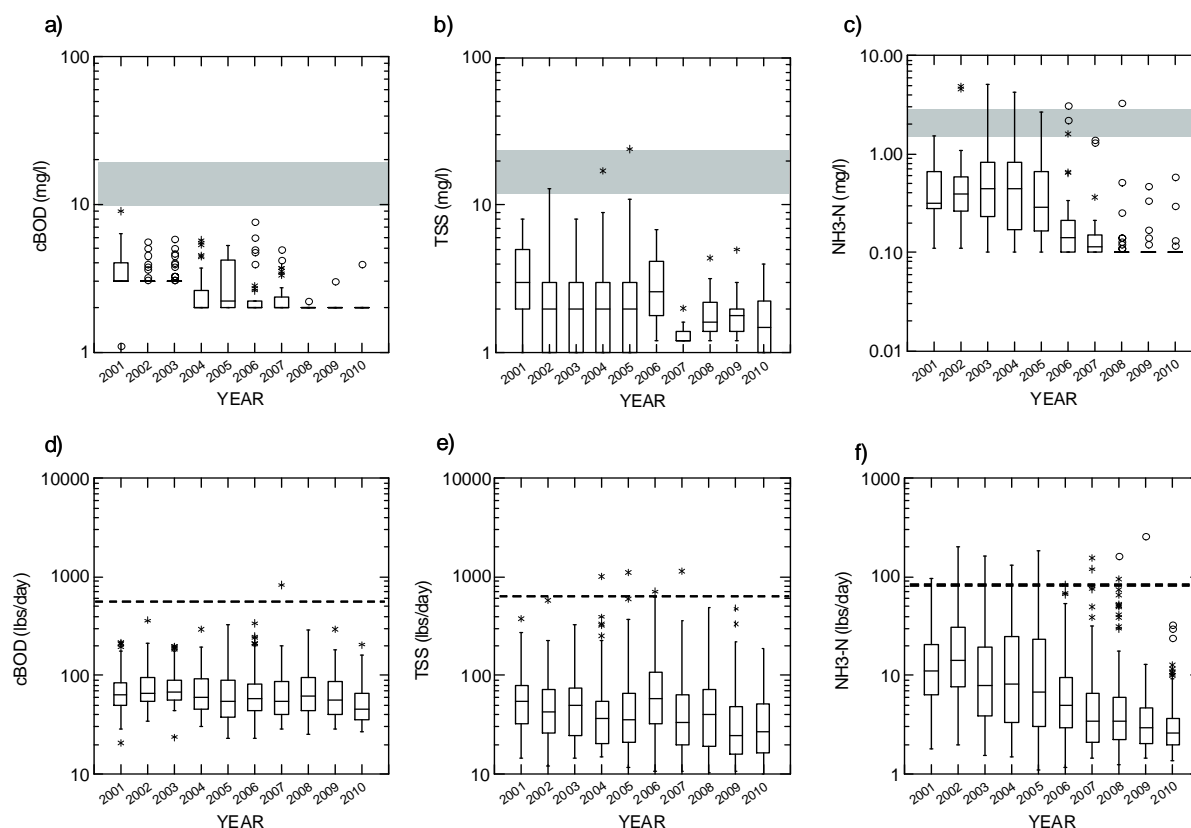
*Figure 22. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the A.J. LaRocca Wastewater Treatment Facility. The shaded region in NH3-N concentration plots show the applicable permit limit for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the cBOD5 and TSS concentration plots, and the each of the load plots shows the 30 day average limit. Where limits vary by season, the most stringent limit is used.*

**ADDISON NORTH STP [IL0033812]** The design average flow (DAF) for the treatment facility is 5.3 MGD and the design maximum flow (DMF) for the facility is 7.6 MGD. Treatment consists of screening, 2 stage activated sludge treatment clarification, excess flow treatment and effluent disinfection. Sludge is both aerobically and an aerobically digested, belt pressed and applied to agricultural land. Effluent flows from the plant were consistent in terms of magnitude and variability over the last decade, and have remained within treatment capacity (Figure 17e). Concentrations and loads of cBOD5, TSS and NH3-N (Figure 23) have also been stable and consistently within applicable permit limits for the last decade.



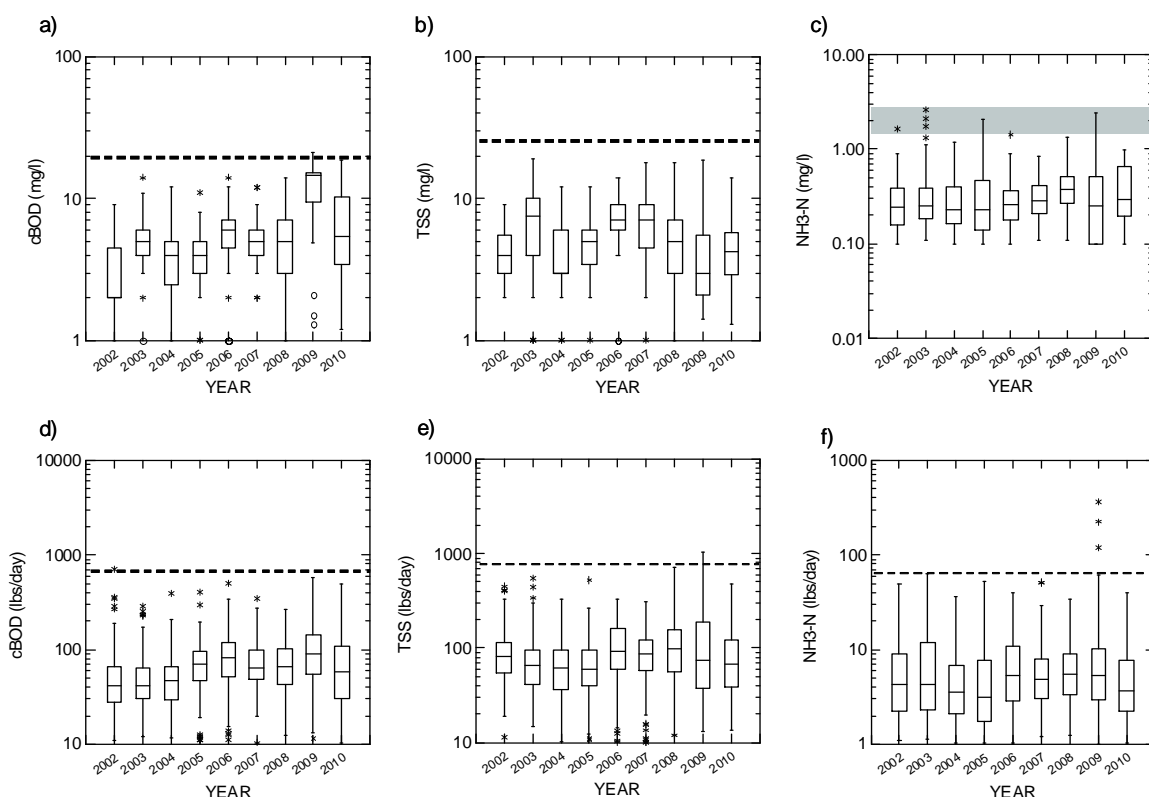
*Figure 23. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the Village of Addison North STP. The shaded region in NH3-N concentration plots show the applicable permit limit for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the cBOD5 and TSS concentration plots, and the each of the load plots shows the 30 day average limit. Where limits vary by season, the most stringent limit is used.*

**SALT CREEK SANITARY DISTRICT STP [IL0030953]** The 10-year recurrent 7-day low flow (Q7/10) of the receiving stream is 32 cfs (21MGD). The design average flow for this treatment facility is 3.3 MGD and design maximum flow for the facility is 8.0 MGD. Treatment consists of screening, pre-aeration, primary clarification, aeration, final clarification, filtration, chlorination, dechlorination, anaerobic digestion and sludge dewatering/application. Plant flows have trended up the last three years, such that seventy-fifth percentile flows were at or above the daily design average (Figure 16b). Also, flows in excess of maximum hydraulic capacity occurred in approximately 4 percent of the reported cases. Conversely, treatment efficiency appears to have improved, as evidenced by concentrations of cBOD5, TSS and NH3-N (Figure 24 a-c), likely reflecting the need to maintain consistent loads of cBOD5 and TSS (Figure 24 d and e) in the face of increasing flows. The effort has apparently allowed the plant to get out in front of NH3-N loads (Figure 24 f).



*Figure 24. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the Salt Creek Sanitary District STP. The shaded region in the concentrations plots show the applicable permit limits for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the load plots shows the 30 day average load limit. Where limits vary by season, the most stringent limit is used.*

**WOOD DALE NORTH STP [IL0020061]** The design average flow (DAF) for the treatment facility is 1.97 MGD and the design maximum flow (DMF) for the facility is 3.93 MGD. Plant flows from the North plant have remained similar in terms of central tendency over the last decade (Figure 16c); however, flows were more variable in 2008-2010, especially in 2009, compared to the antecedent period. Concentrations and loads of cBOD5, TSS and NH3-N (Figure 25) have been consistently within applicable limits, with the exception of 2009, likely a consequence of episodic high flows to the plant.



*Figure 25. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the City of Wood Dale - North STP. The shaded region in NH3-N concentration plots show the applicable permit limit for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the cBOD5 and TSS concentration plots, and the each of the load plots shows the 30 day average limit. Where limits vary by season, the most stringent limit is used.*



**WOOD DALE SOUTH STP [IL0034274]** The design average flow (DAF) for the treatment facility is 1.13 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 2.33 MGD. Plant effluent flows have been consistent in terms of magnitude, variability and central tendency over the last decade (Figure 16d). Concentrations and loads of cBOD5 have trended up over the last several years (Figure 26 a and d), but concentrations and loads of TSS and NH3-N have remained similar and within limits over the reporting period.

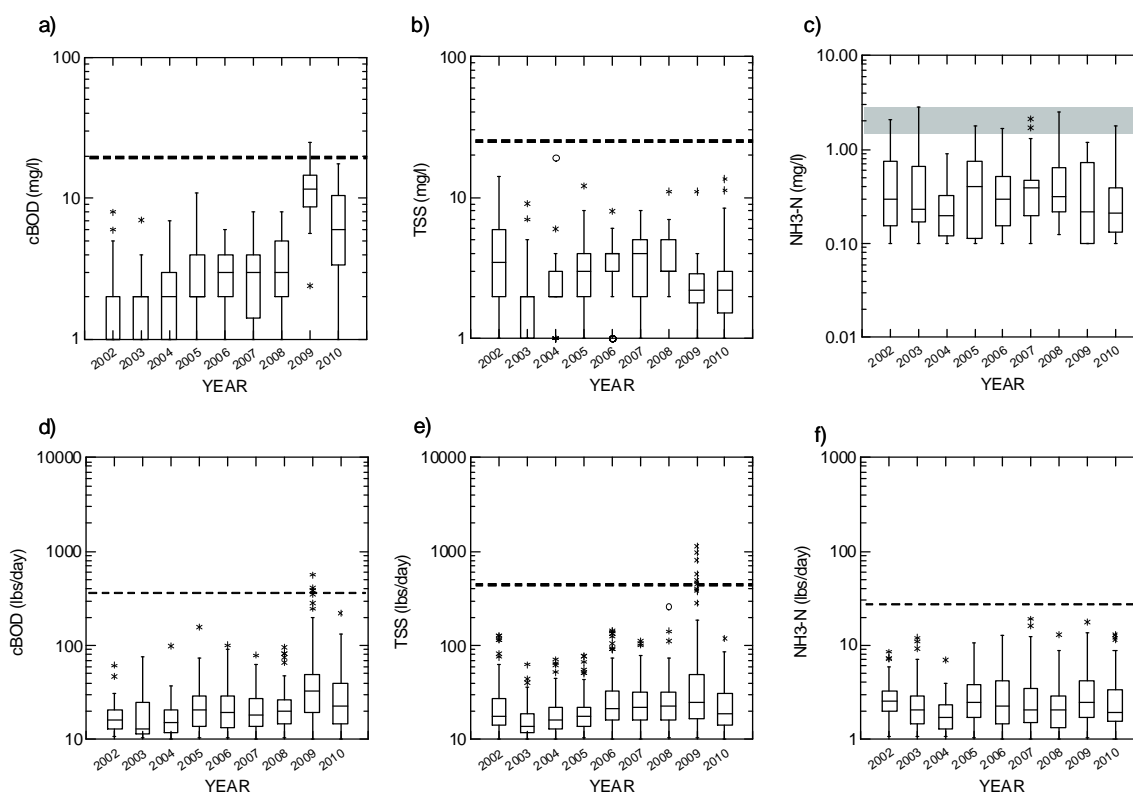
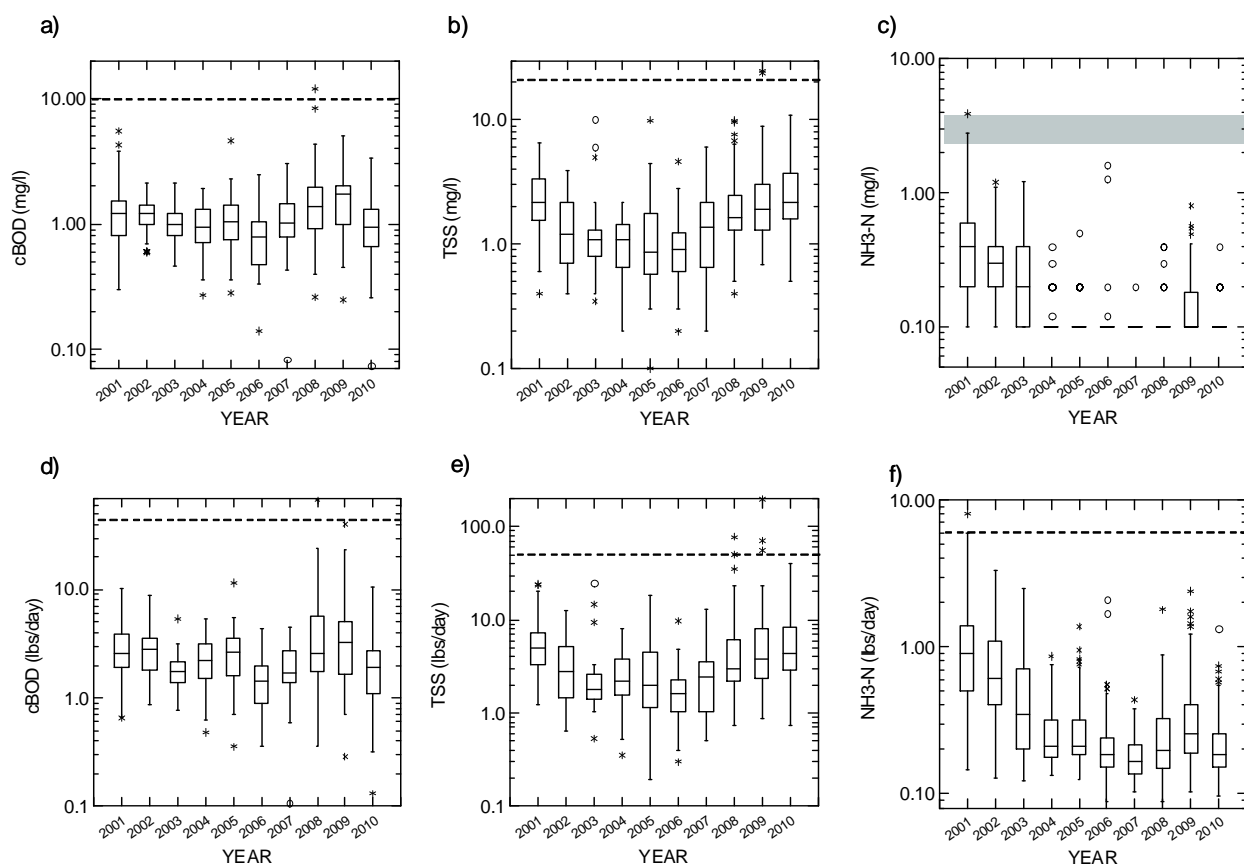


Figure 26. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH3-N plotted by year for the Wood Dale - South STP. The shaded region in NH3-N concentration plots show the applicable permit limit for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the cBOD5 and TSS concentration plots, and the each of the load plots shows the 30 day average limit. Where limits vary by season, the most stringent limit is used.

**DCDEC NORDIC PARK STP [IL0028398]** The design average flow (DAF) for the treatment facility is 0.50 MGD and the design maximum flow (DMF) for the facility is 1.00 MGD. Plant effluent flows have been consistent in terms of magnitude, variability and central tendency over the last decade (Figure 16a). Concentrations and loads of cBOD5 average slightly higher were more variable in 2008 and 2009 relative to the period of record; however, levels in 2010 were similar to the baseline record. Concentrations and loads of TSS appear to have tracked annual precipitation (see Figure 16 e). NH<sub>3</sub>-N concentrations and loads have remained steady over the last several years. Concentrations and loads of cBOD5, TSS and NH<sub>3</sub>-N were within limits over the reporting period (Figure 27).



*Figure 27. Distributions of effluent concentrations (a, b, and c) and loads (d, e, and f) of cBOD5, TSS and NH<sub>3</sub>-N plotted by year for the Nordic Park STP. The shaded region in NH<sub>3</sub>-N concentration plots show the applicable permit limit for the monthly average (the lower bounds) and the daily maximum (upper bounds). The dashed-line in the cBOD5 and TSS concentration plots, and the each of the load plots shows the 30 day average limit. Where limits vary by season, the most stringent limit is used.*

## WATER CHEMISTRY

### *Salt Creek*

Salt Creek drains a highly urbanized landscape with a high population density. Pollutants associated with urbanized landscapes, especially heavy metals, hydrocarbons, and road de-icing compounds enter the streams via stormwater flows. Because heavy metals and hydrocarbons are typically adsorbed to sediment particles those pollutants accumulate in the bottom sediments. However, de-icing compounds, being soluble, persist mainly in the water column. The water quality “footprint” resulting from de-icing compounds is most obvious in the small tributaries and especially in the headwater network upstream from the confluence with Spring Brook (Figure 28). Concentrations of chlorides measured in the headwaters of Salt Creek were elevated to the point that if one were to attempt drinking the water the taste would be “salty”. Chloride concentrations that elevated are anomalous for freshwater systems and are beyond the tolerance of most macroinvertebrates. Concentrations of suspended solids (Figure 29) were also high, a likely function of the urbanized character of the watershed, algae discharged from stormwater retention ponds, and possibly the dispersive effect of monovalent ions on clayey silts.

Given the high population density in the watershed, treated municipal effluent comprises a significant fraction of the total flow in Salt Creek and strongly influences water quality, especially with respect to nitrogen and phosphorus. Phosphorus concentrations in the headwaters were typical of developed urban landscapes, but were not necessarily excessive. However, starting at the first major treatment plant, concentrations became highly elevated, with little or no assimilation occurring along the run-of-river (Figure 29). Nitrate concentrations followed an essentially identical pattern, going from background concentrations (e.g., <1 mg/l) to highly elevated (e.g., >3 mg/l). Total Kjeldahl nitrogen (TKN) also increased downstream from where the treatment discharges began (Figure 29). TKN can signal organic enrichment, however as a by-product of treated domestic sewage, it can also represent refractory organic nitrogen. Carbonaceous biological oxygen demand did not increase significantly in relation to the plant effluents (Figure 29), suggesting that refractory nitrogenous compounds were a significant fraction of the TKN measured in the middle reaches (river miles 15 to 25) that received most of the municipal discharges. Ammonia-nitrogen concentrations were also influenced by the treatment plants (Figure 29); however, the cluster of combined sewer overflows that discharges to the reach immediately upstream from the Graham Center dam appeared to raise the mean concentration above that which is chronically toxic to sensitive aquatic organisms.

D.O. concentrations were measured in Salt Creek with automated sensors at eight locations during 2010 (Figures 30, 32, 34, 36-40) and at three locations in 2009 (Figures 31, 33, and 35). Episodically low D.O. concentrations were recorded during July 2010 at seven of the eight locations, but especially downstream from the confluence with the Arlington Branch and the Busse Woods Dam where protracted periods of hypoxia were noted in late July and through most of September 2010 (Figure 30). Chronically low D.O. levels were also recorded immediately downstream of the Busse Woods Dam through most of the summer of 2009.

These may be caused by periods of low flow over the spillway (figure 3 shows the location of the data logger relative to the spillway). An extended period of low D.O. concentrations in July 2010 was also noted at Wolf Road (Figure 34). A high flow event in late July 2010 (see Figure 41) appeared to both temporarily restore D.O. levels, as well as causing depletion depending on the juxtaposition of the sensor in relation to CSOs and dams. For example, D.O. levels measured at Fullersburg Woods exhibited a noticeable decline starting August 4 and did not recover through August 9 (when the instrument was retrieved; Figures 37 and 41). The Fullersburg Woods station is located downstream from five CSOs where Salt Creek is impounded by a low-head dam.

Violations of daily minimum WQS as well as rolling average D.O. criteria were routine at six of the eight monitoring locations. The York Road site had consistently the highest D.O. (Figure 40) followed by the location at JFK Boulevard where D.O. concentrations were generally good.

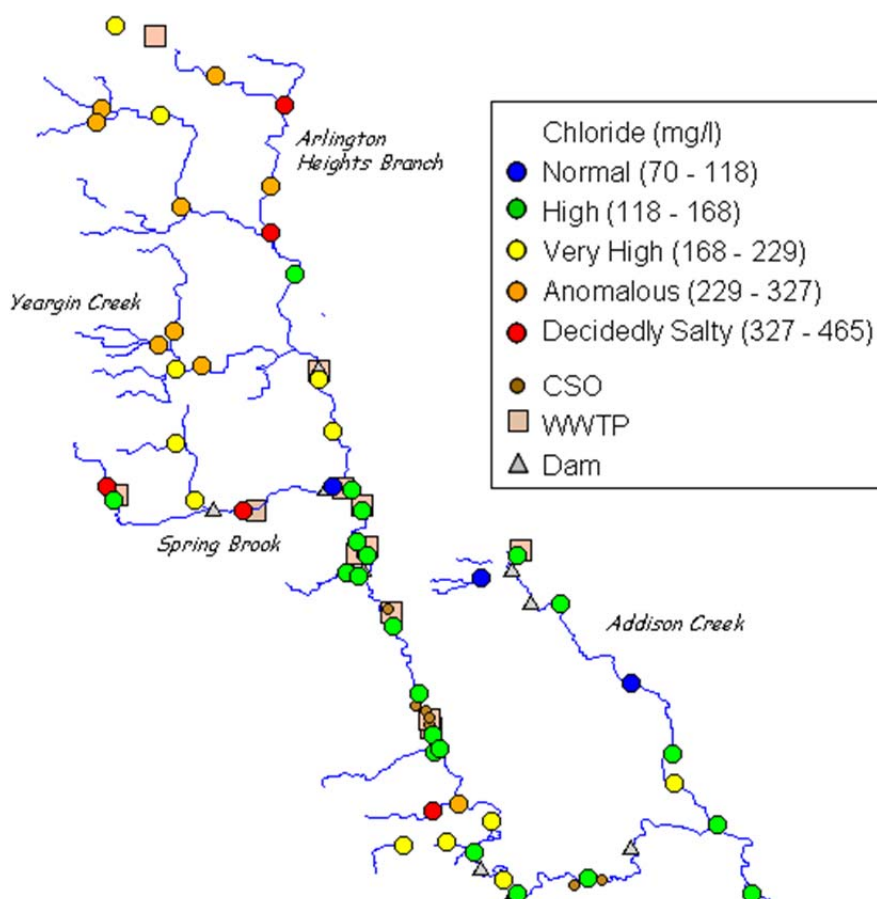


Figure 28. Mean chloride concentrations at locations sampled in the Salt Creek watershed, 2010, in relation to dams, combined sewer overflows (CSO) and municipal wastewater treatment plants (WWTP).

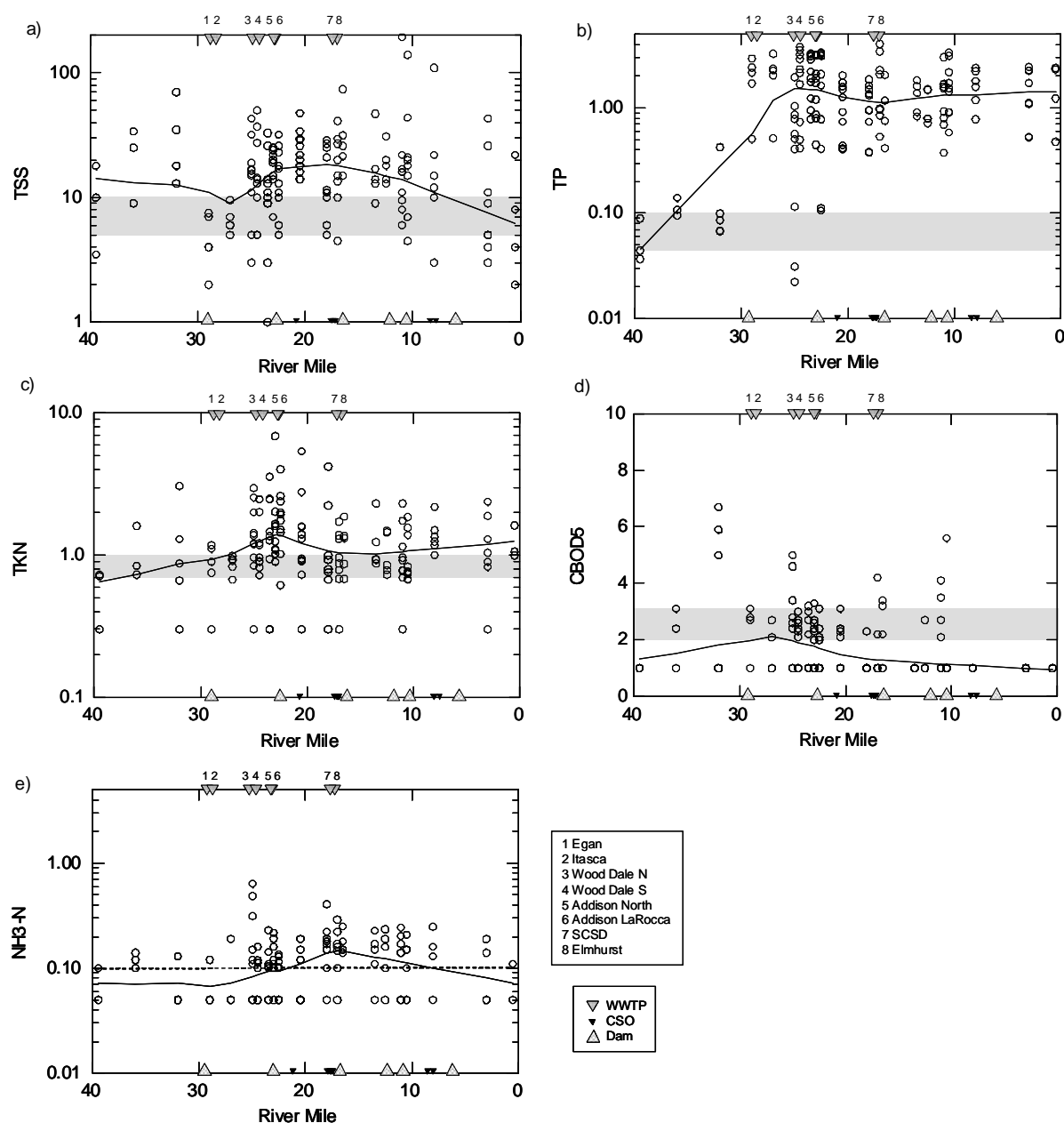


Figure 29. Concentrations of water quality constituents measured in samples collected from Salt Creek 2010: a) total suspended solids (TSS), b) total phosphorus (TP), c) total Kjeldahl nitrogen (TKN), d) 5-day biochemical oxygen demand (CBOD<sub>5</sub>), and e) ammonia nitrogen (NH<sub>3</sub>-N). All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of combined sewer overflows (CSO) and low-head dams are arrayed along the x-axes. The solid line drawn through the data points follows the local central tendency. The dashed line in the ammonia nitrogen plot corresponds to the concentration where chronic toxicity affects sensitive species. The shaded region in the other plots shows the range where concentrations become elevated above concentrations typical for unpolluted streams.

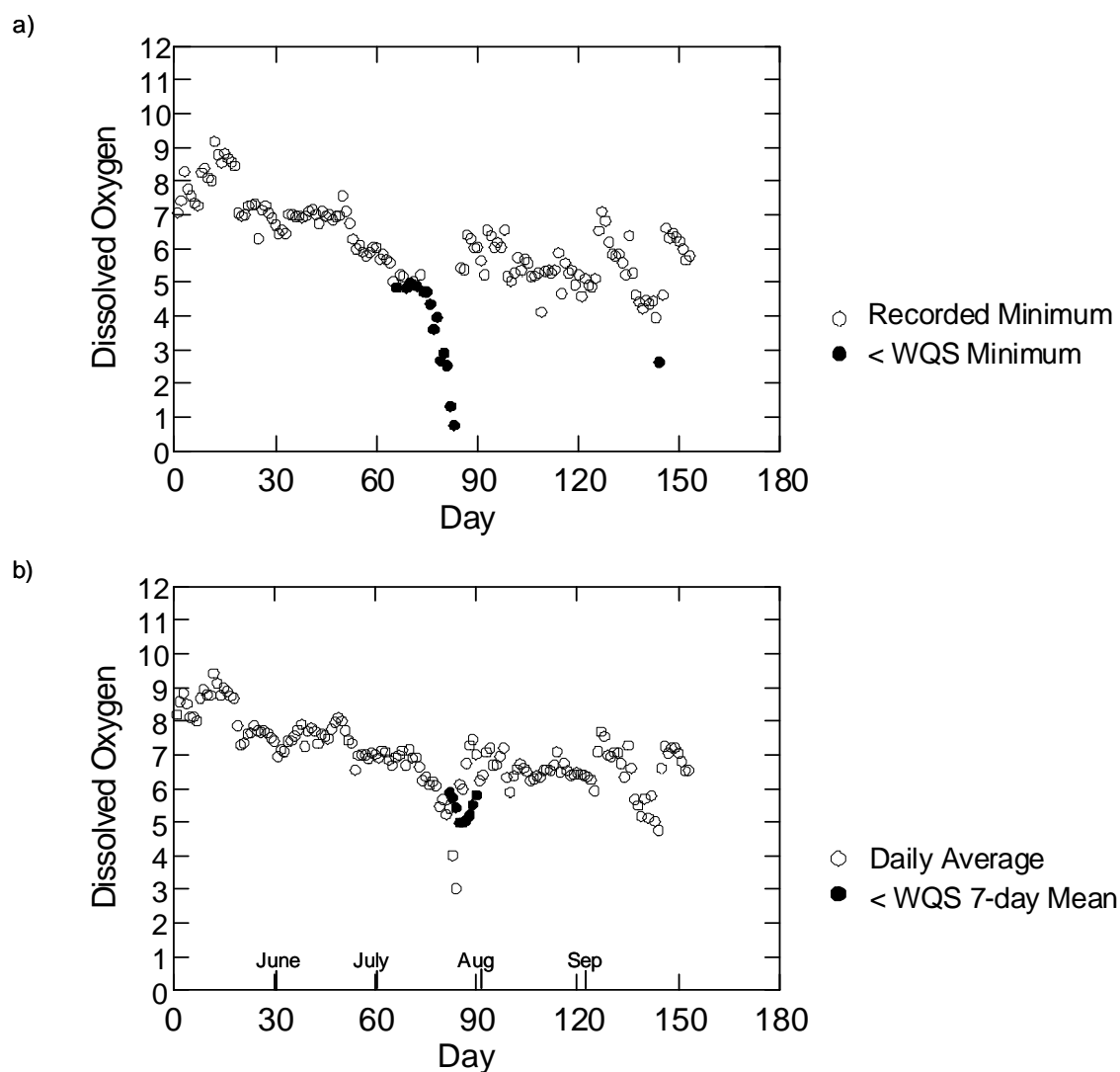


Figure 30. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at JFK Boulevard during 2010. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid fill. b) Daily average concentrations (open points) and 7-day rolling average concentrations less than the applicable water quality standard (filled points).

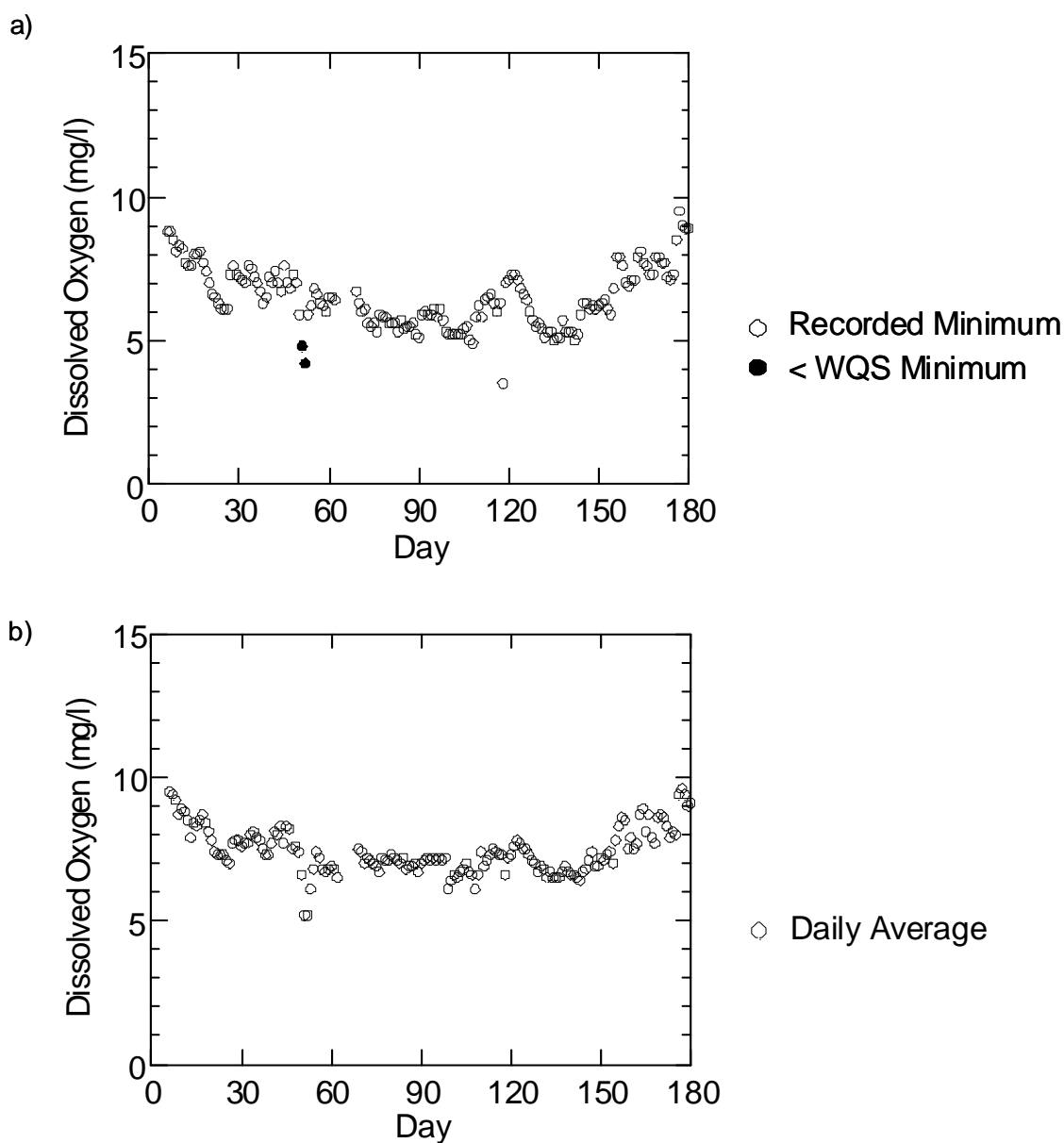


Figure 31. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at JFK Boulevard during 2009. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid fill. b) Daily average concentrations (open points) and 7-day rolling average concentrations less than the applicable water quality standard (filled points).



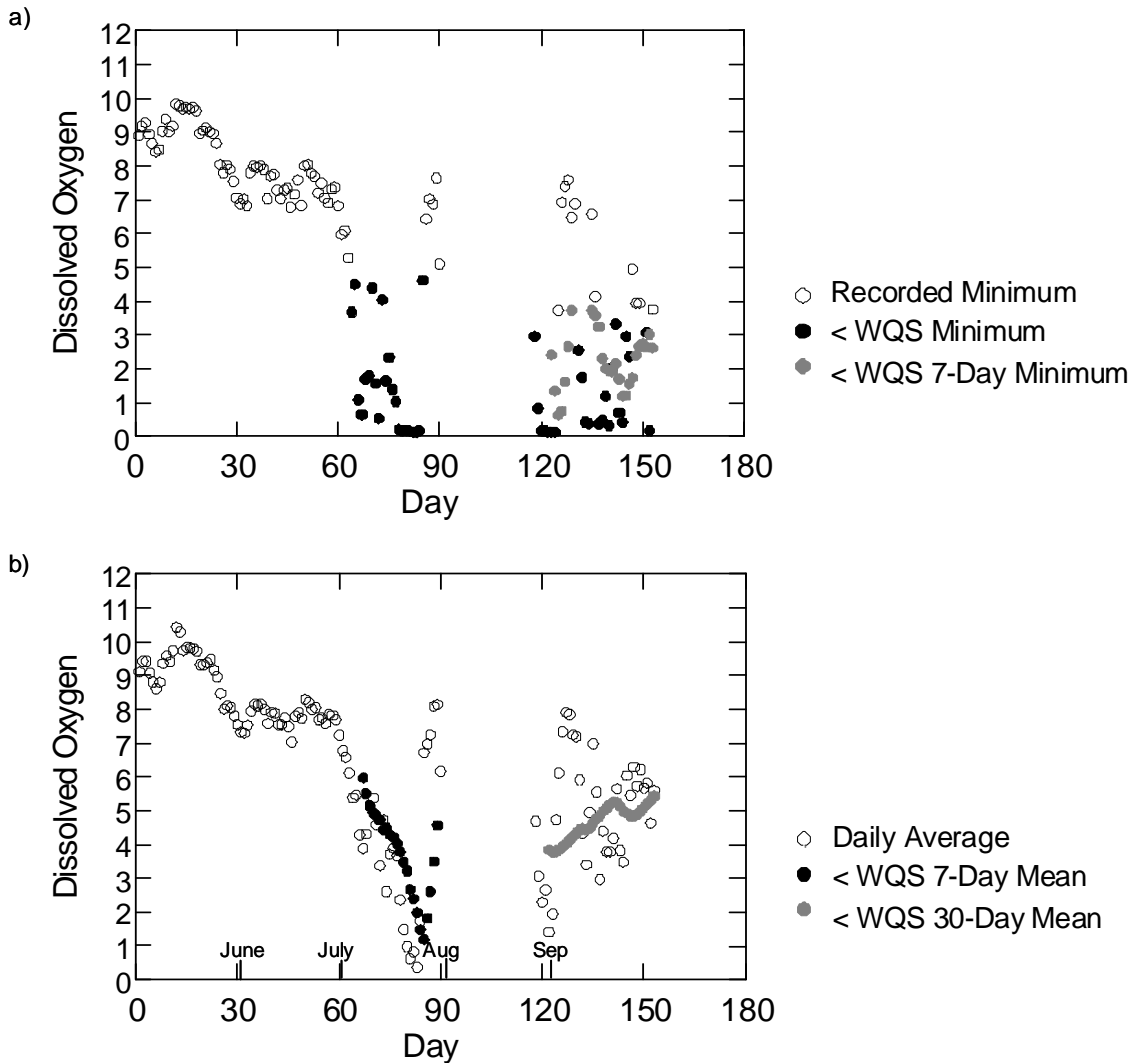


Figure 32. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at Busse Woods Dam, 2010. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid black fill, and 7-day rolling average minimum values less than the applicable water quality standard are plotted as gray-shaded points. b) Daily average concentrations (open points), and 7-day rolling average and 30-day rolling average concentrations less than water quality standards are plotted as solid black points and gray-shaded points, respectively

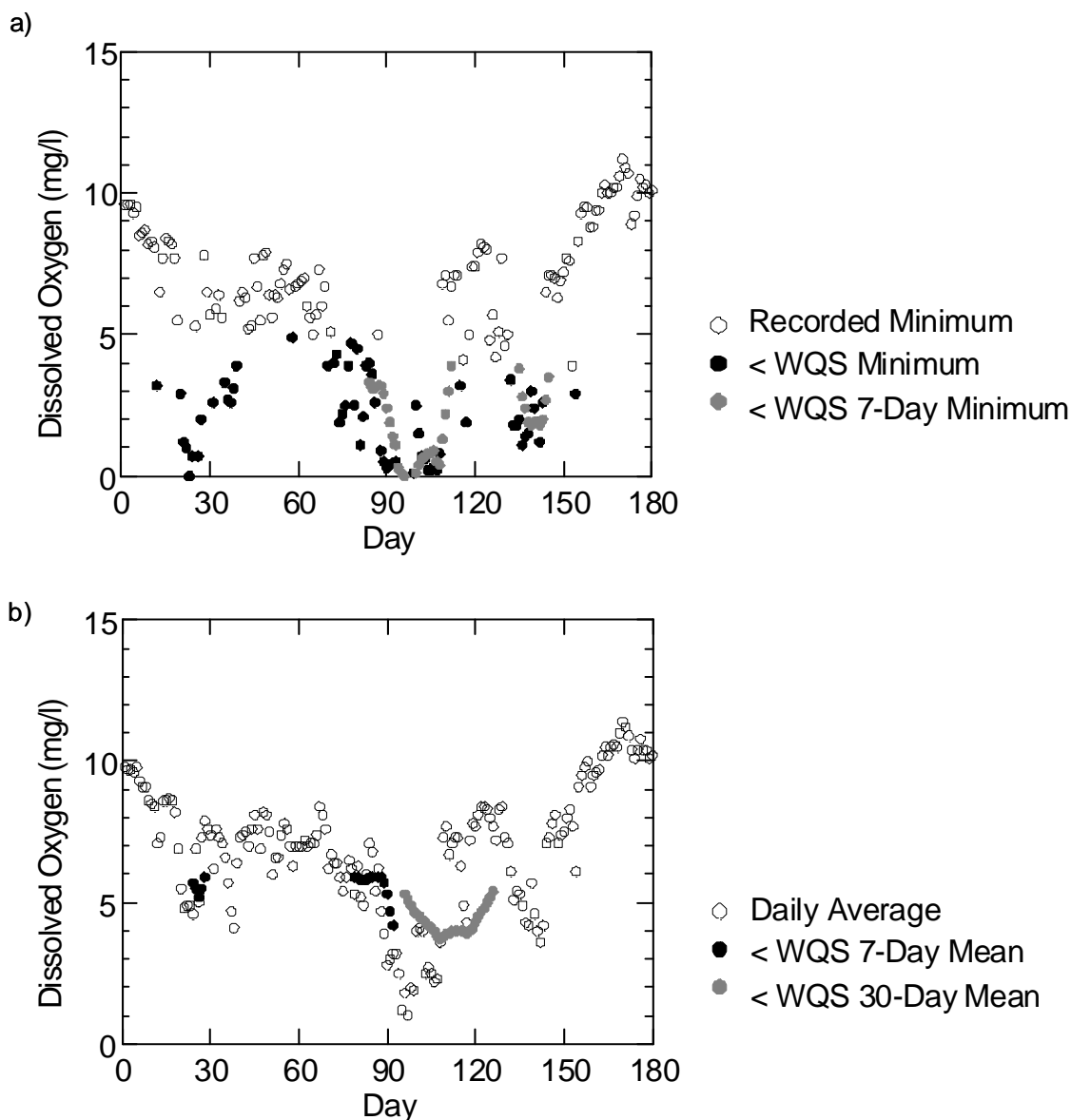


Figure 33. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at Busse Woods Dam, 2009. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid black fill, and 7-day rolling average minimum values less than the applicable water quality standard are plotted as gray-shaded points. b) Daily average concentrations (open points), and 7-day rolling average and 30-day rolling average concentrations less than water quality standards are plotted as solid black points and gray-shaded points, respectively.

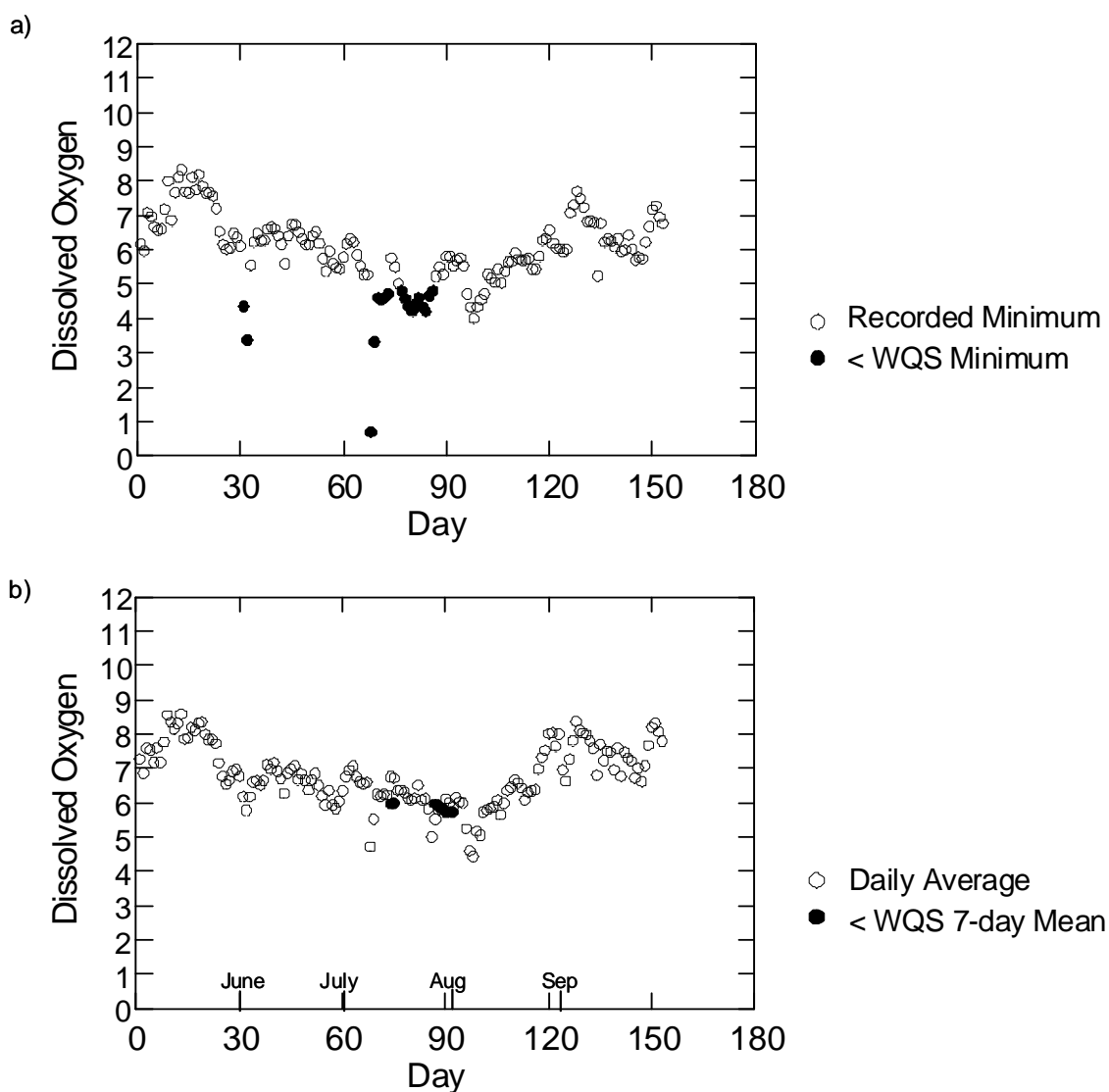


Figure 34. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at Wolf Road, 2010. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid fill. b) Daily average concentrations (open points) and 7-day rolling average concentrations less than the applicable water quality standard (filled points).

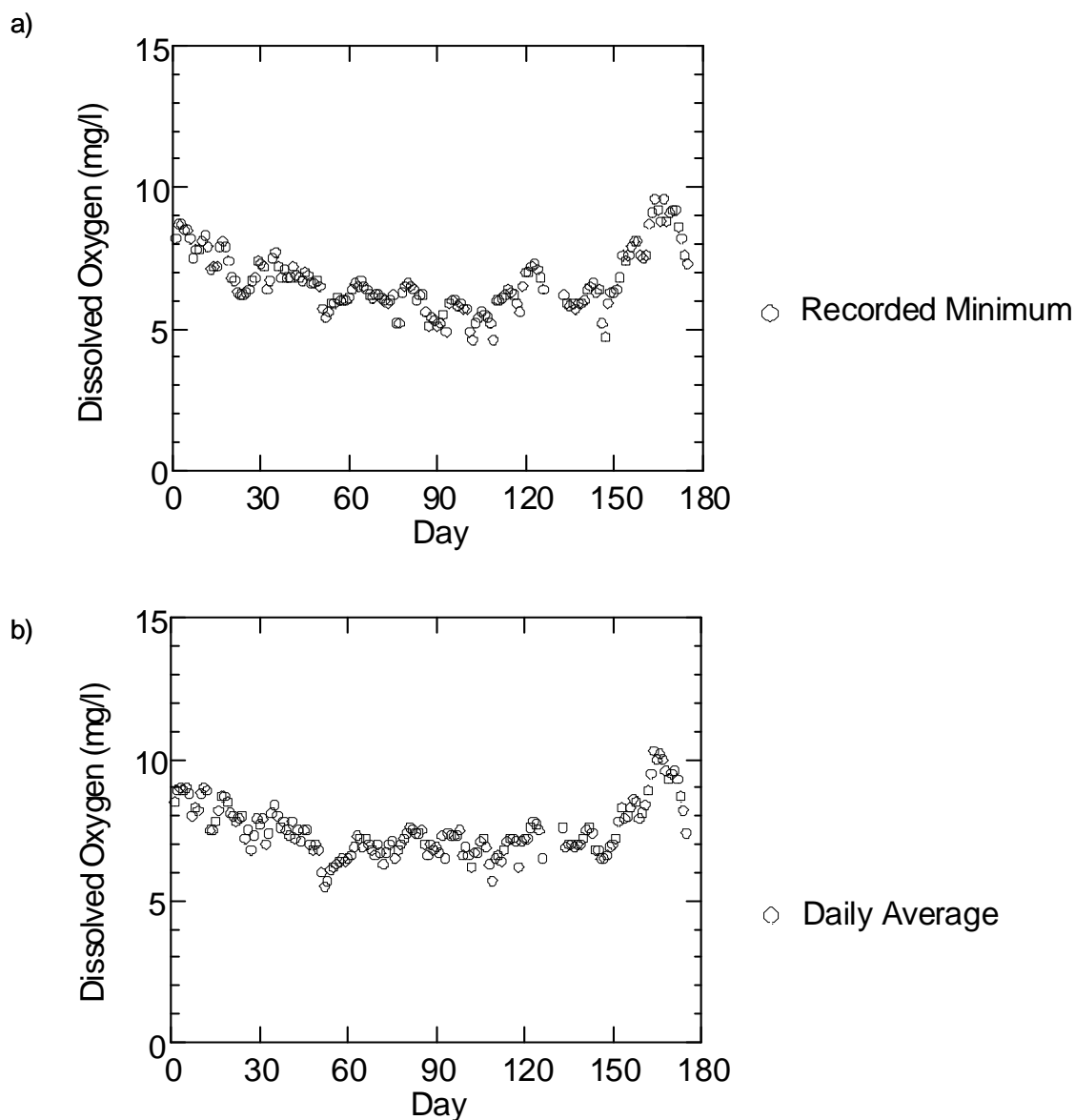


Figure 35. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at Wolf Road, 2009. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid fill. b) Daily average concentrations (open points) and 7-day rolling average concentrations less than the applicable water quality standard (filled points).

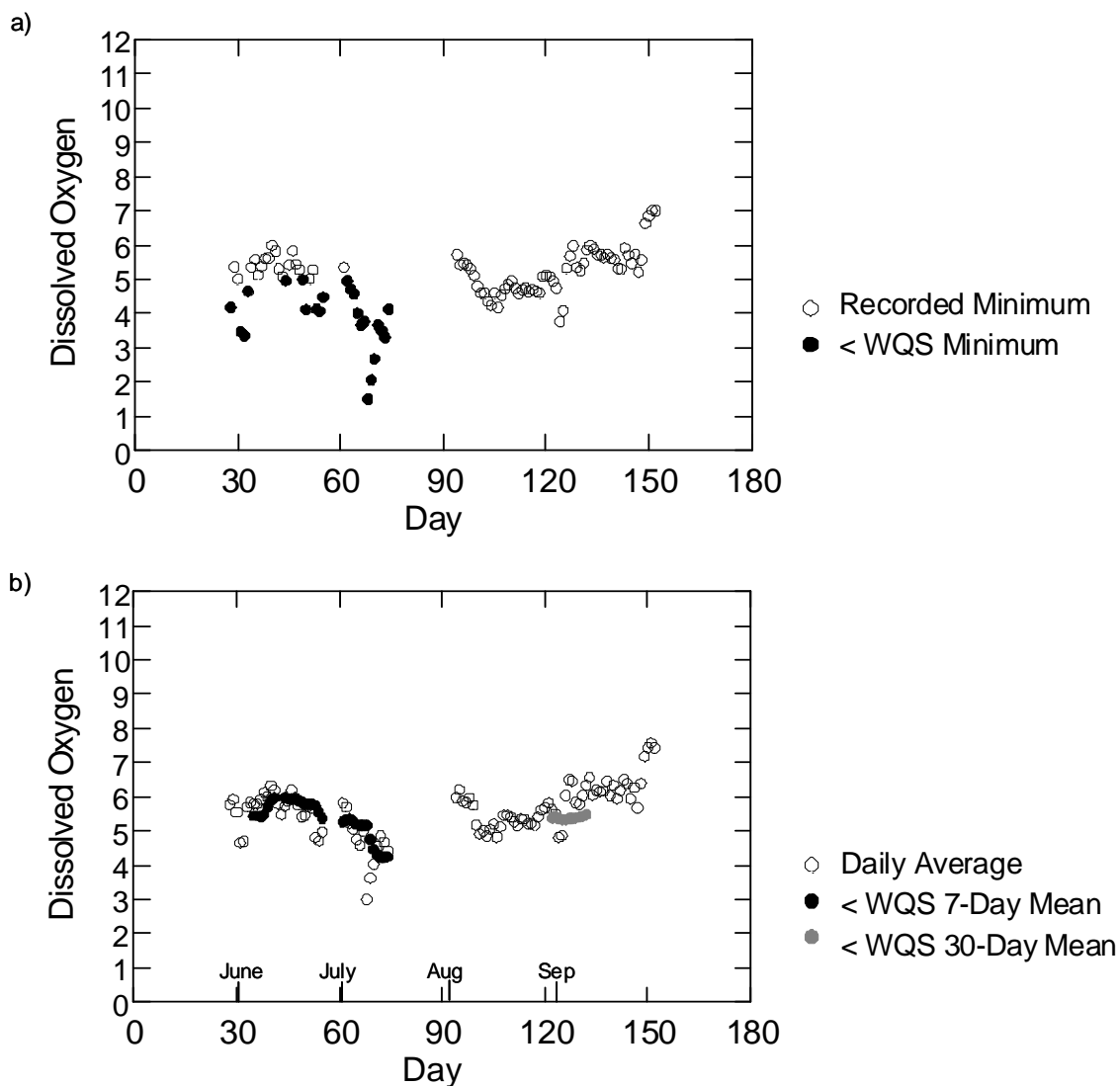


Figure 36. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at Butterfield Road, 2010. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid black fill. b) Daily average concentrations (open points), and 7-day rolling average and 30-day rolling average concentrations less than water quality standards are plotted as solid black points and gray-shaded points, respectively.

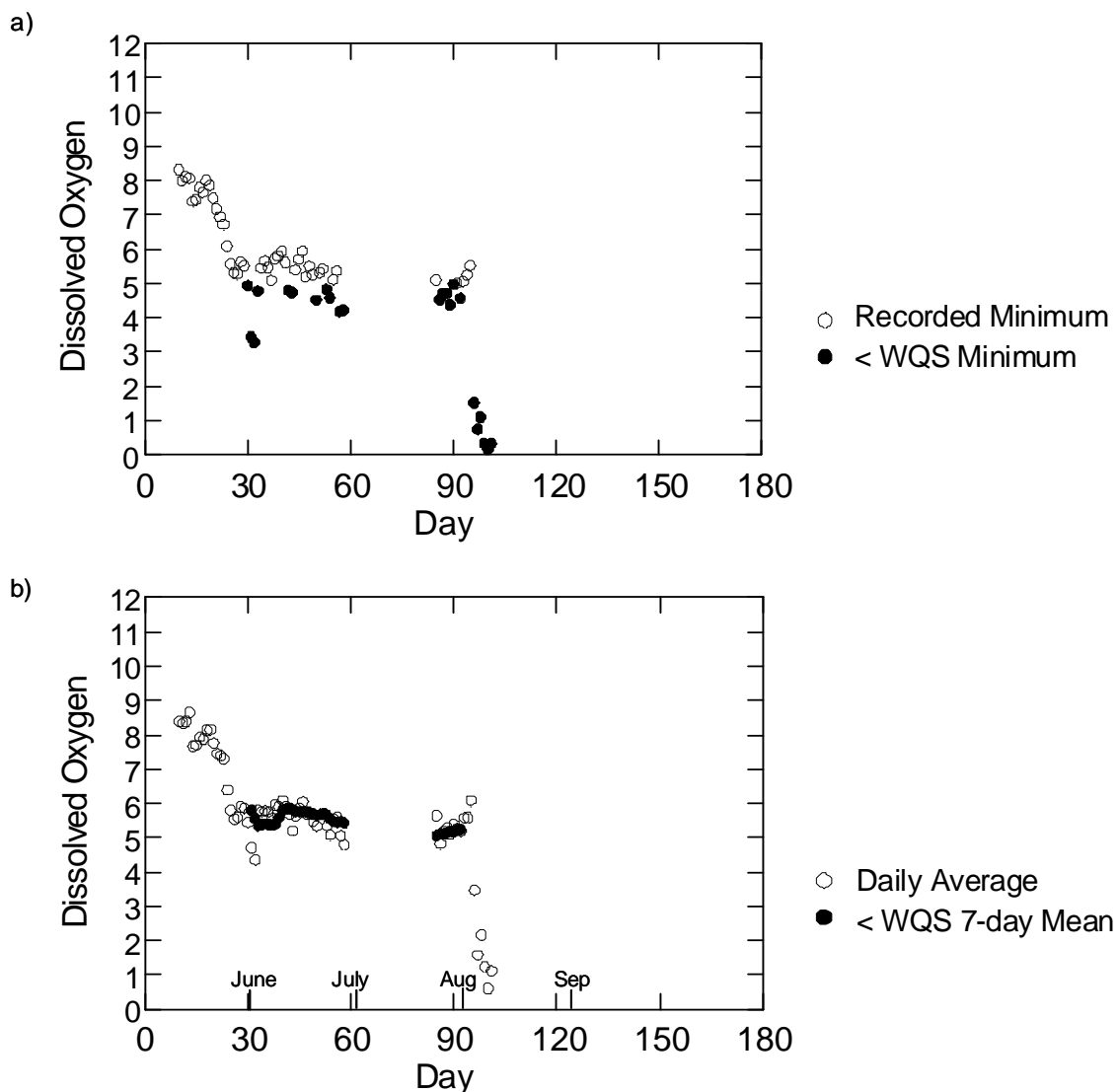


Figure 37. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at Fullersburg Woods, 2010. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid fill. b) Daily average concentrations (open points) and 7-day rolling average concentrations less than the applicable water quality standard (filled points).

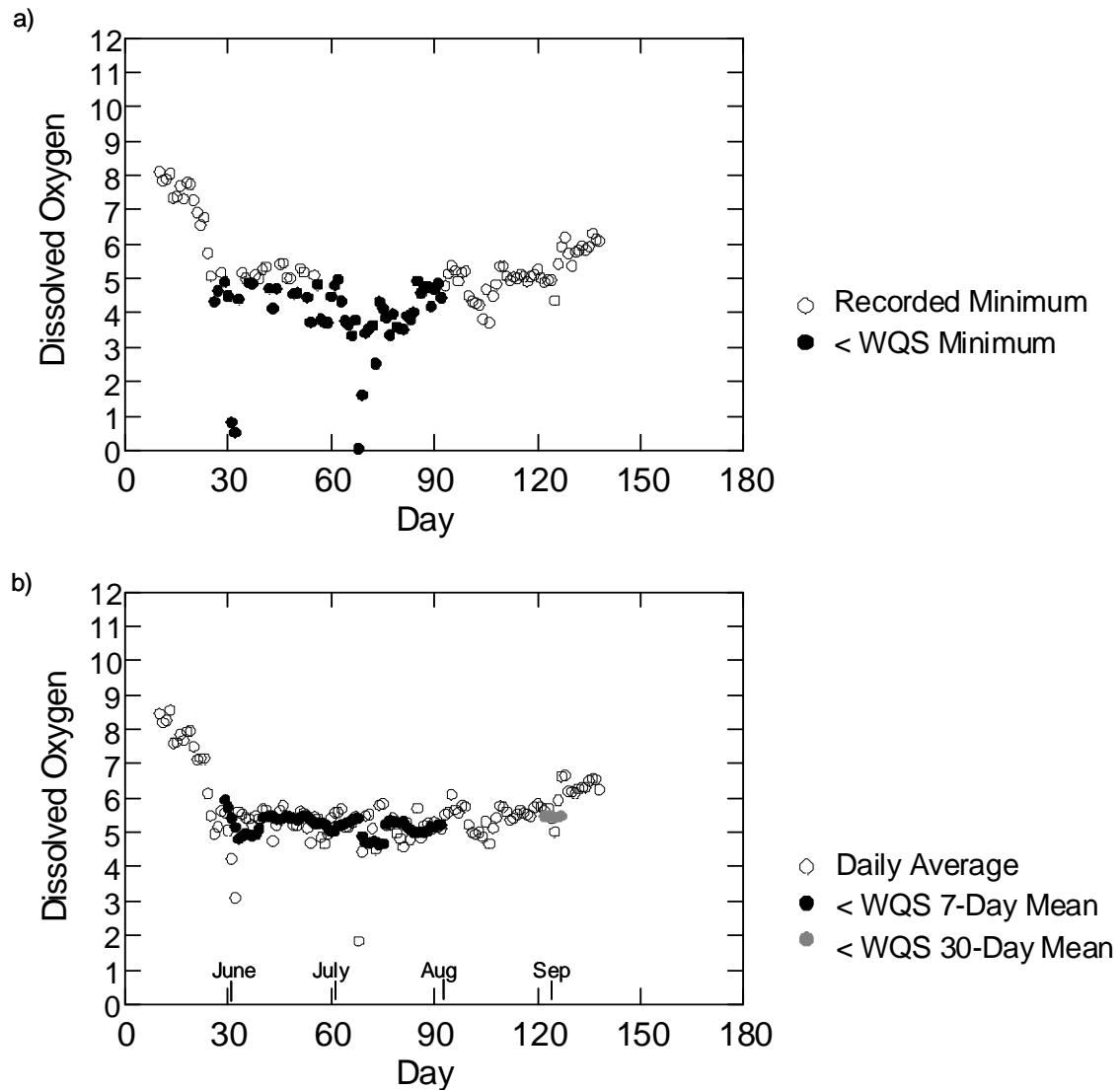


Figure 38. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at Graue Mill Dam, 2010. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid black fill. b) Daily average concentrations (open points), and 7-day rolling average and 30-day rolling average concentrations less than water quality standards are plotted as solid black points and gray-shaded points, respectively.



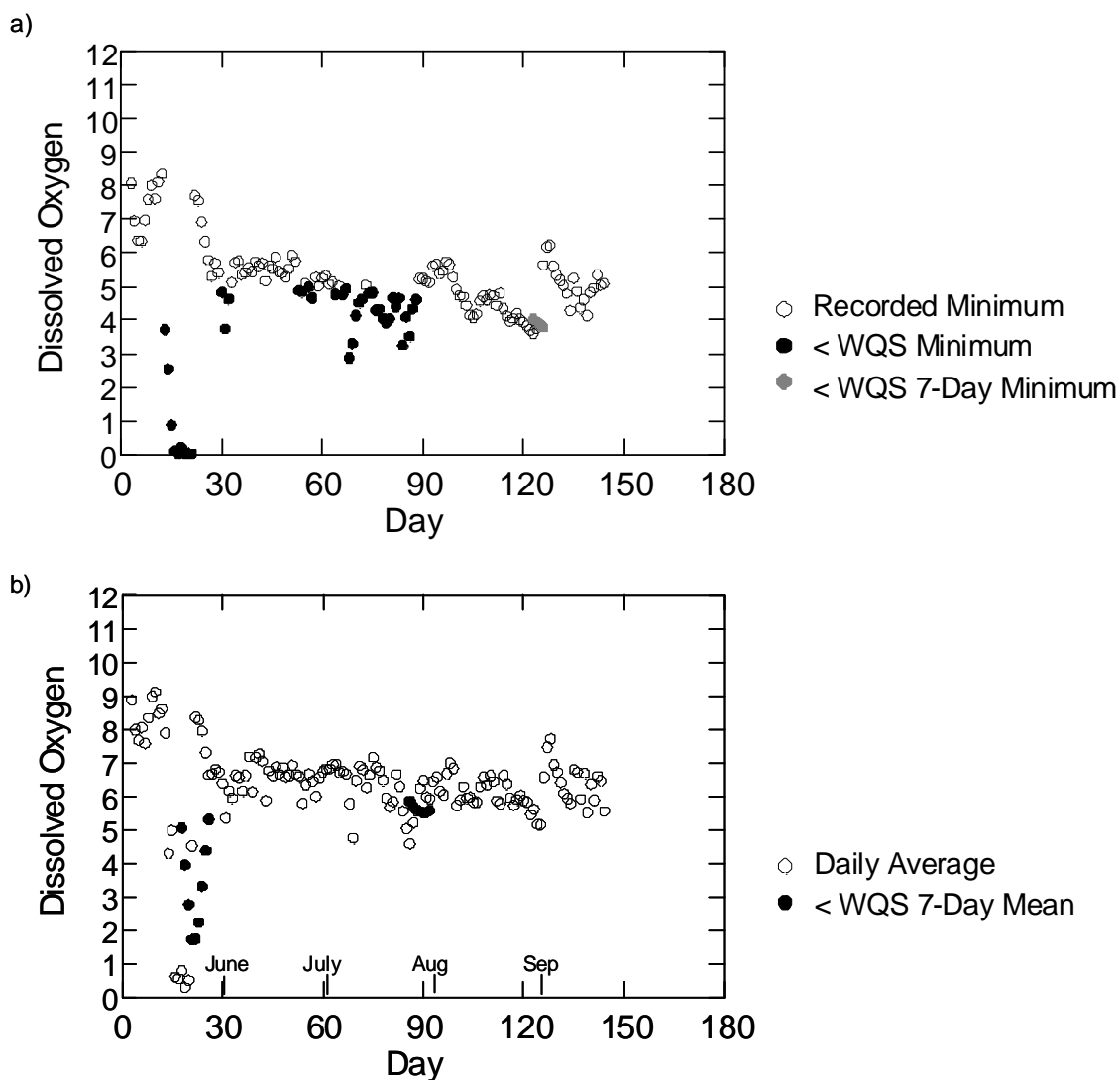


Figure 39. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at Oak Meadows, 2010. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid black fill, and 7-day rolling average minimum values less than the applicable water quality standard are plotted as gray-shaded points. b) Daily average concentrations (open points), and 7-day rolling average concentrations less than water quality standards are plotted as solid black points.

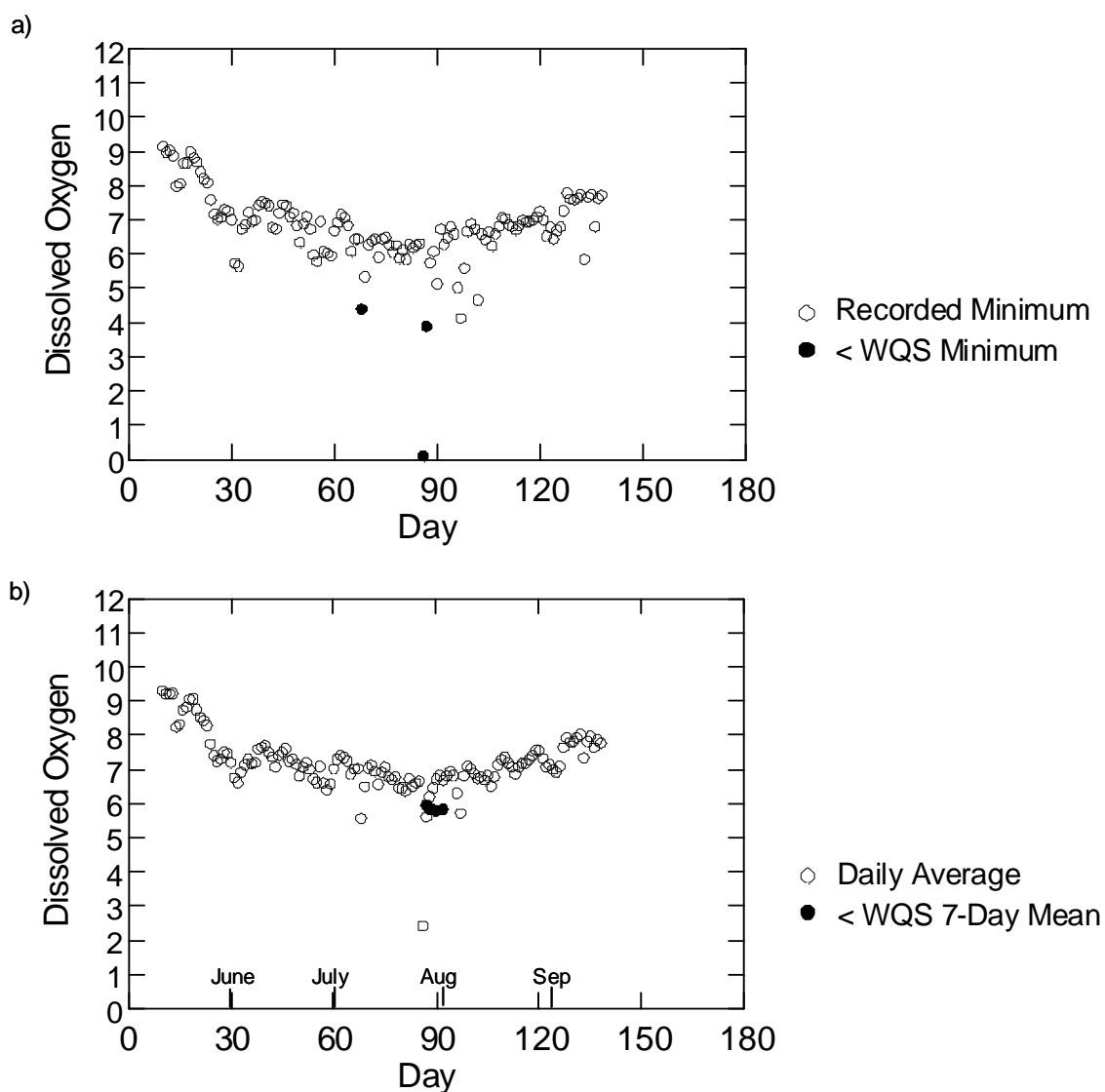


Figure 40. Statistical summaries of dissolved oxygen concentrations measured by an automated sensor deployed at York Road, 2010. a) Minimum daily concentration. Values less than the applicable seasonal water quality standard for minimum at any time are noted with a solid fill. b) Daily average concentrations (open points) and 7-day rolling average concentrations less than the applicable water quality standard (filled points).

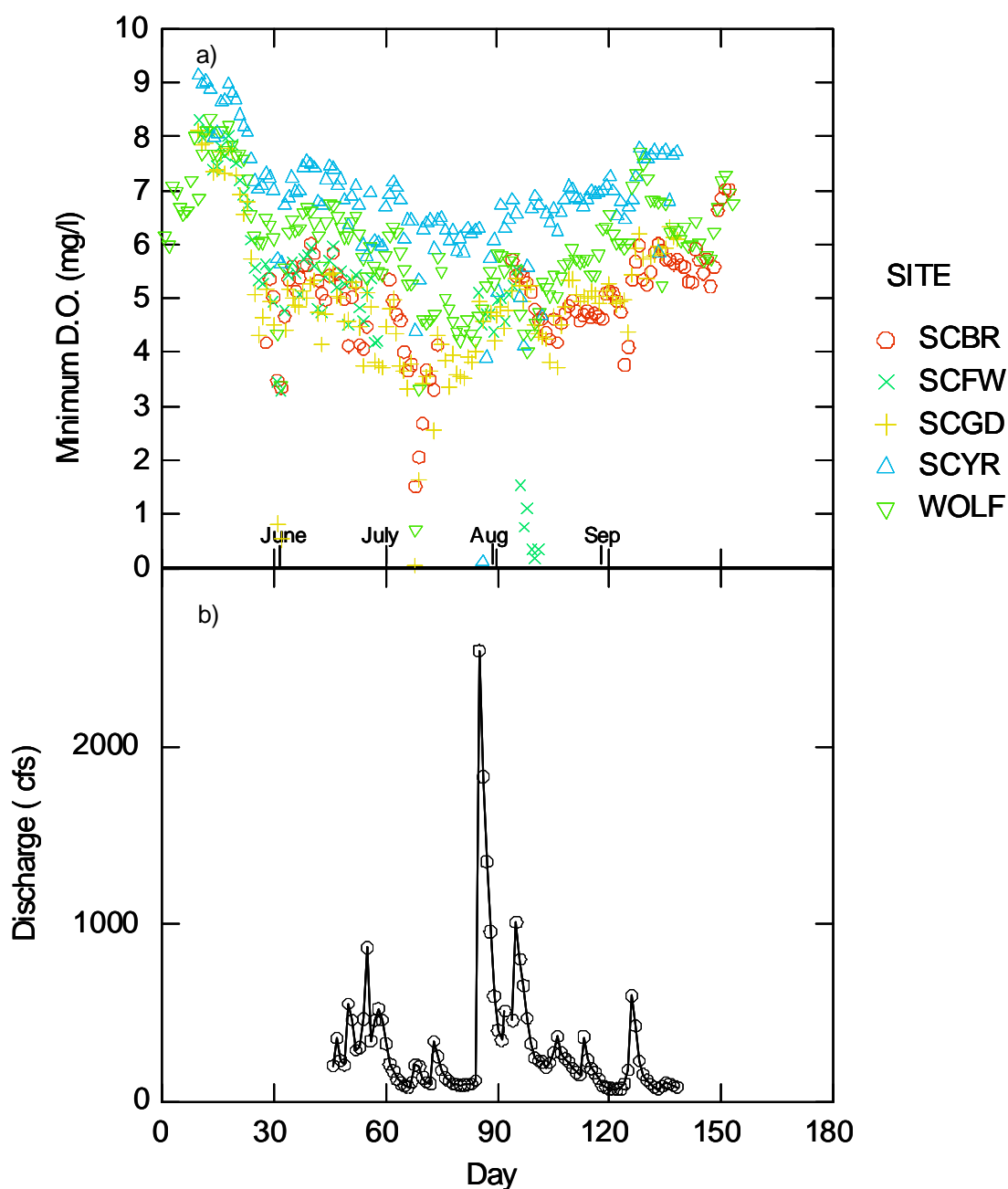
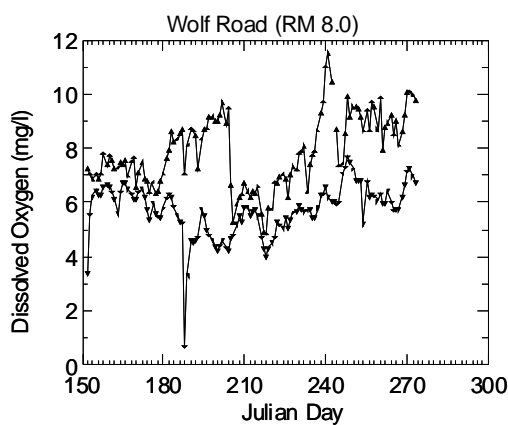
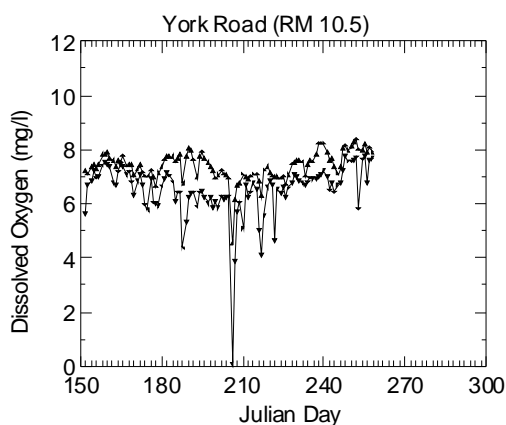
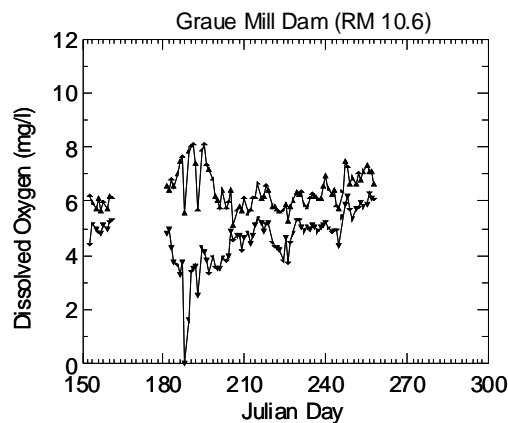
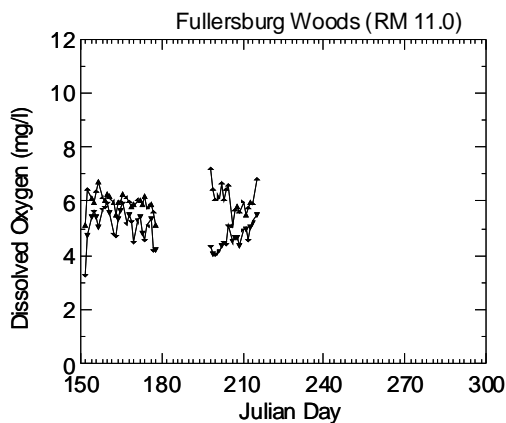
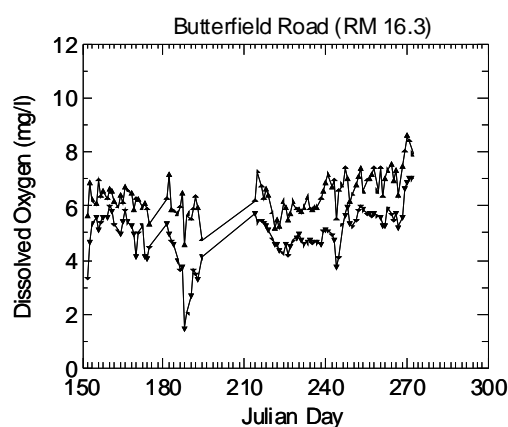
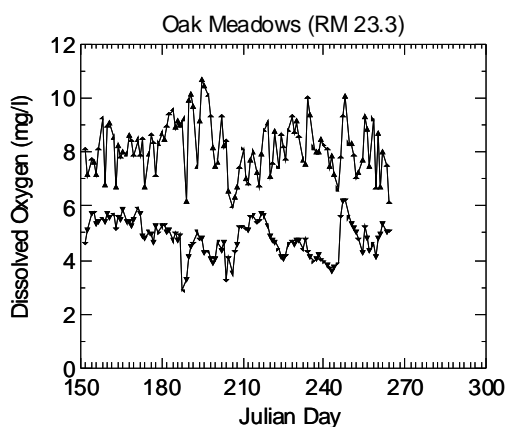
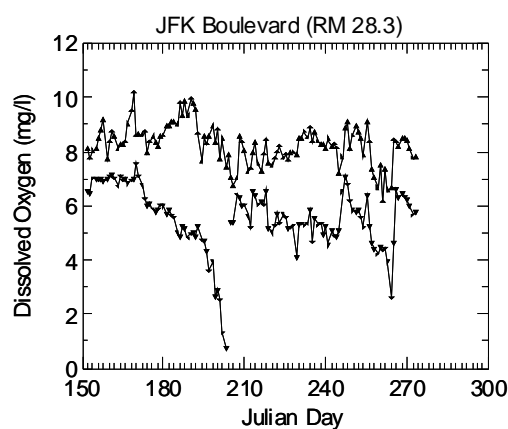
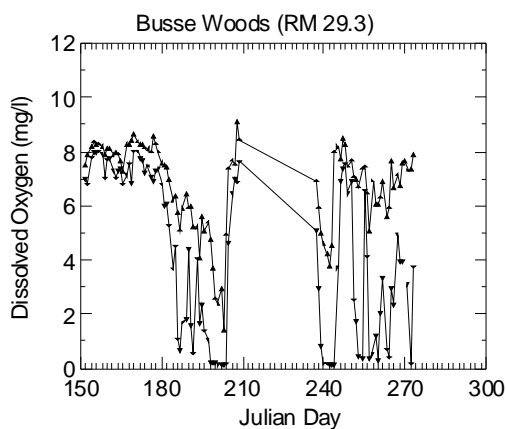


Figure 41. a) Minimum daily dissolved oxygen concentrations measured in Salt Creek at Butterfield Road (SCBR), Fullersburg Woods (SCFW), Graue Mill dam (SCGD), York Road (SCYR), and Wolf Road (WOLF). b) Flow hydrograph for the period June 15<sup>th</sup> – September 15<sup>th</sup>, 2010.

Figure 42 (on the following page). Daily maximum and minimum (diel) dissolved oxygen concentrations in the Salt Creek mainstem, 2010, recorded by automated data sensors and plotted by Julian Day (June 1<sup>st</sup> = Julian Day152, July 1<sup>st</sup> = 182, August 1<sup>st</sup> = 213, September 1<sup>st</sup> = 244). Plots are arranged by from left to right by descending river mile (i.e., upstream to downstream).



### *Water Chemistry - Tributaries*

The Arlington Branch, Spring Brook, an unnamed tributary (IL\_RGZH-T) that includes Yeargin Creek and the headwaters of Salt Creek upstream from the confluence with Arlington Branch had anomalously high chloride concentrations (Figure 28) i.e., concentrations that are toxic to sensitive macroinvertebrates and some fish species (Meador and Carlyle 2007). Presumably, the source of the chloride is road de-icing compounds. Concentrations of ammonia (Figure 43) and TKN (Figure 44) tended to be elevated throughout the system, with ammonia-nitrogen concentrations in the headwaters of Spring Brook, Addison Creek and the Arlington Branch at chronically toxic levels. Despite the apparent organic load evidenced by the high TKN values, biochemical oxygen demand was generally not elevated (Figure 45).

### *Water Chemistry Trends*

Relative to the baseline survey conducted in 2007, median concentrations of ammonia nitrogen, total Kjeldahl nitrogen (TKN), 5-day biochemical oxygen (cBOD5) and total suspended solids (TSS) in the Salt Creek mainstem were all lower in 2010 (Figure 46). These parameters are generally indicative of organic enrichment. Concentrations of chloride ions, and total phosphorus, however, increased in 2010 relative to 2007. Chloride is a conservative parameter in that it is not subject to biochemical assimilation or degradation, as is phosphorus at the concentrations present in the mainstem. As such, their concentrations are influenced by loadings and dilution. Flows measured at the Western Springs gauge on Salt Creek were much lower during the late-summer, early-fall sampling period in 2010 compared to 2007. The decrease in organic enrichment parameters is likely also related to flows, in that the 2007 survey identified stormwater ponds as a primary source. High magnitude precipitation events in the early-mid summer of 2010 may have flushed the ponds, but that is highly speculative. In any event, concentrations in tributaries followed the same trend as observed for the mainstem, with the exception of total phosphorus. Concentrations of parameters related to organic enrichment were lower in 2010 compared 2007, especially for ammonia nitrogen, TKN, and cBOD5, though TSS concentrations were similar between years (Figure 47). Also mirroring the results from the mainstem, chloride concentrations measured in the tributaries were also higher in 2010 compared to 2007. Twice as much snowfall was recorded in the Chicago area for 2009-2010 (54.2 inches) compared to 2006-2007 (35.6 inches). Tributary phosphorus concentrations were, however, similar between time periods.

### *Water Chemistry - Organics*

Water samples were collected at 14 sites in the Salt Creek watershed during 2010 for an organic scan of 91 compounds including organochlorine pesticides, polycyclic aromatic hydrocarbons (PAHs), and hydrocarbons commonly employed in manufacturing such as benzene and toluene. Detections, where they occurred, were mostly for compounds related to byproducts of drinking water chlorination (e.g., chloroform, bromodichloromethane) (Table 5). PAHs were detected at three locations. No detections of organochlorine pesticides were observed. No detections were above water quality standards for the protection of aquatic life.

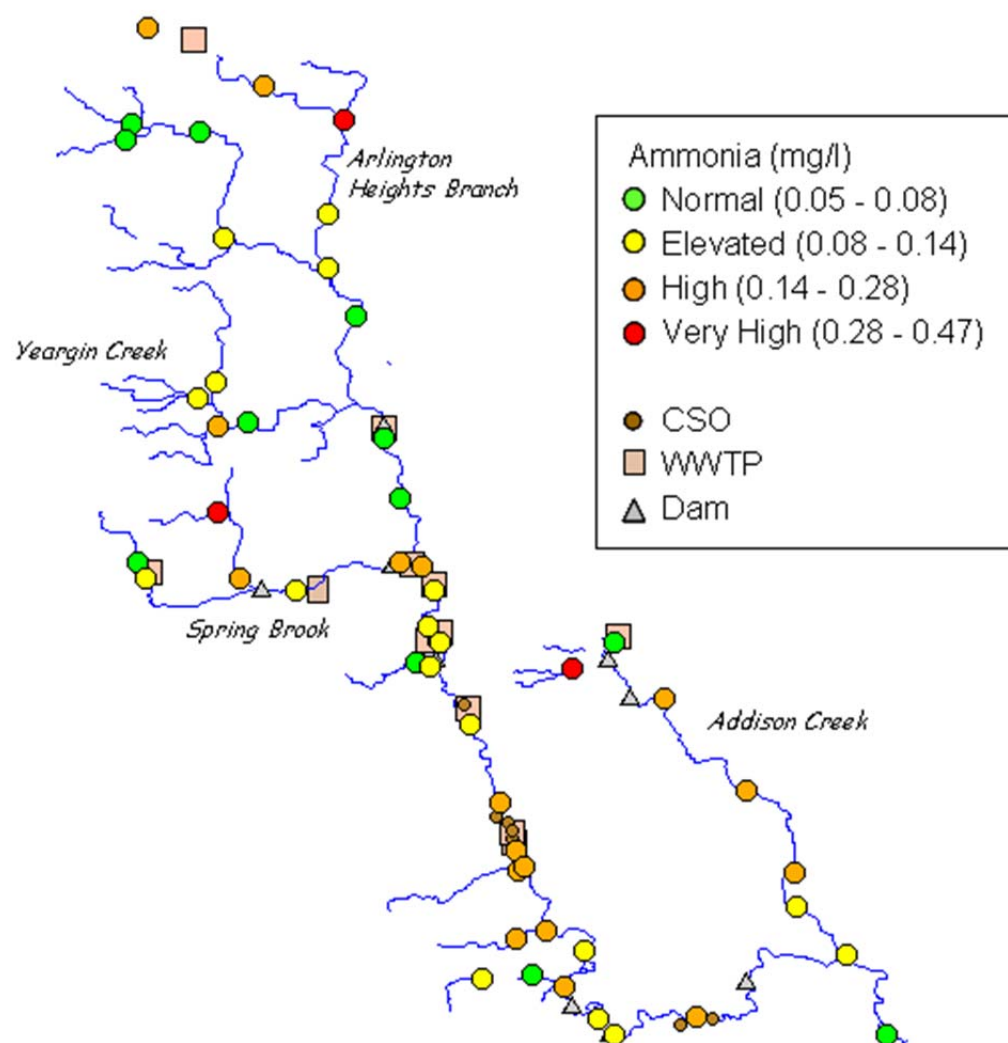


Figure 43. Mean ammonia nitrogen concentrations measured in water quality samples collected from the Salt Creek watershed, 2010, in relation to dams, combined sewer overflows (CSO) and municipal wastewater treatment plants (WWTP).

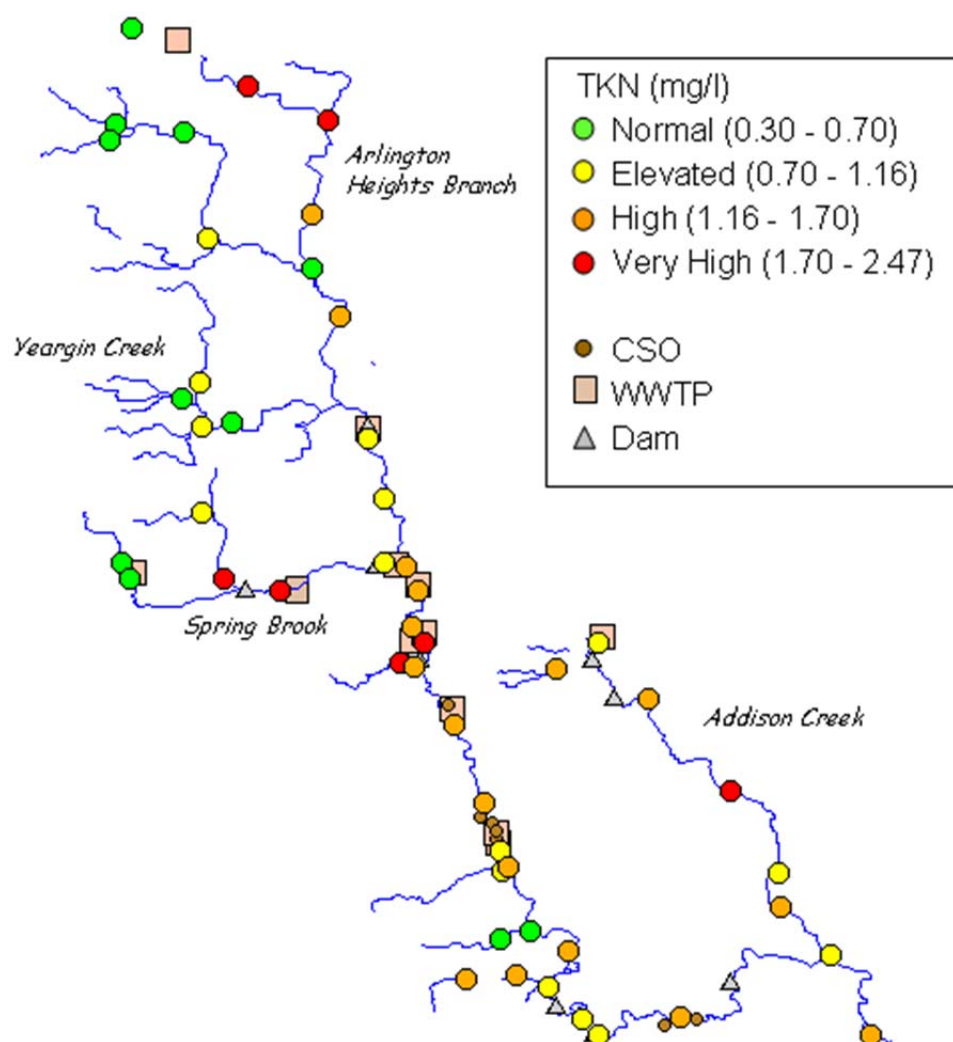


Figure 44. Mean total Kjeldahl nitrogen concentrations measured in water quality samples collected from the Salt Creek watershed, 2010, in relation to dams, combined sewer overflows (CSO) and municipal wastewater treatment plants (WWTP).



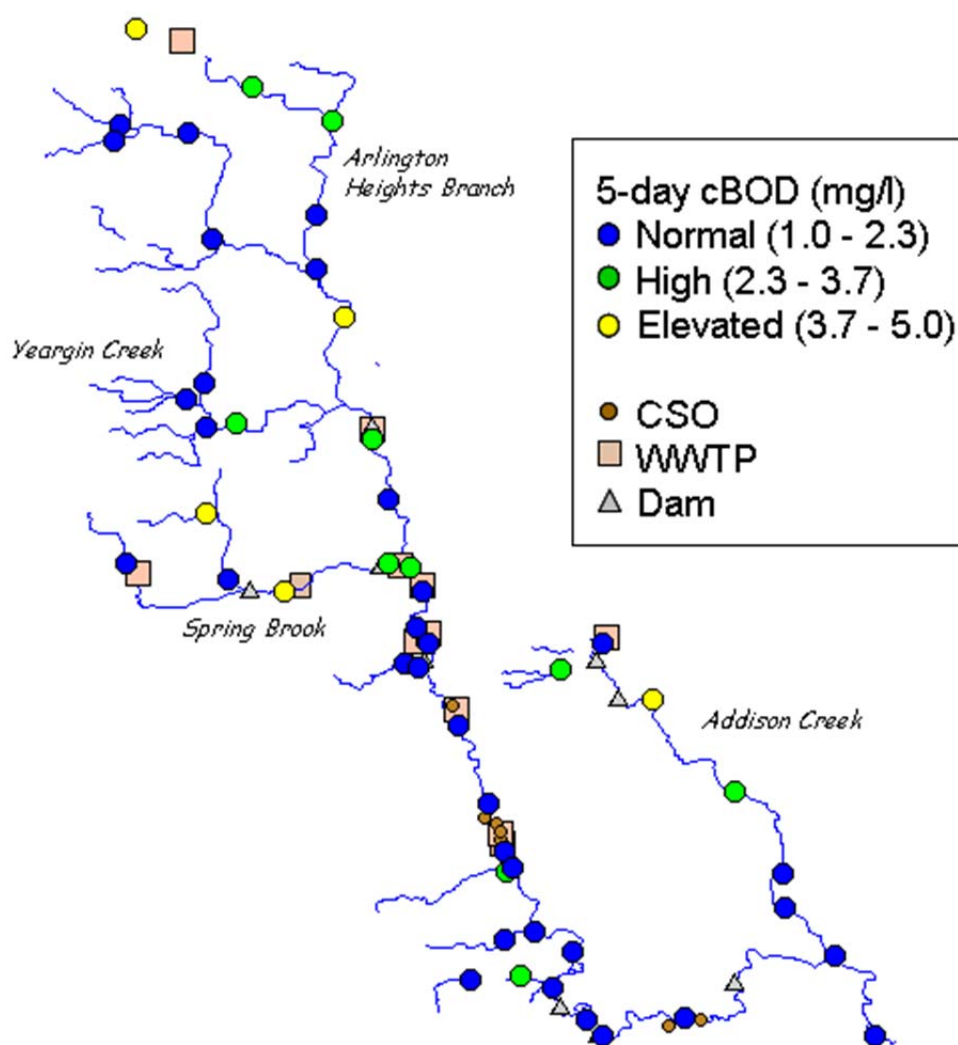


Figure 45. Mean 5-day biochemical oxygen demand measured in water quality samples collected from the Salt Creek watershed, 2010, in relation to dams, combined sewer overflows (CSO) and municipal wastewater treatment plants (WWTP).

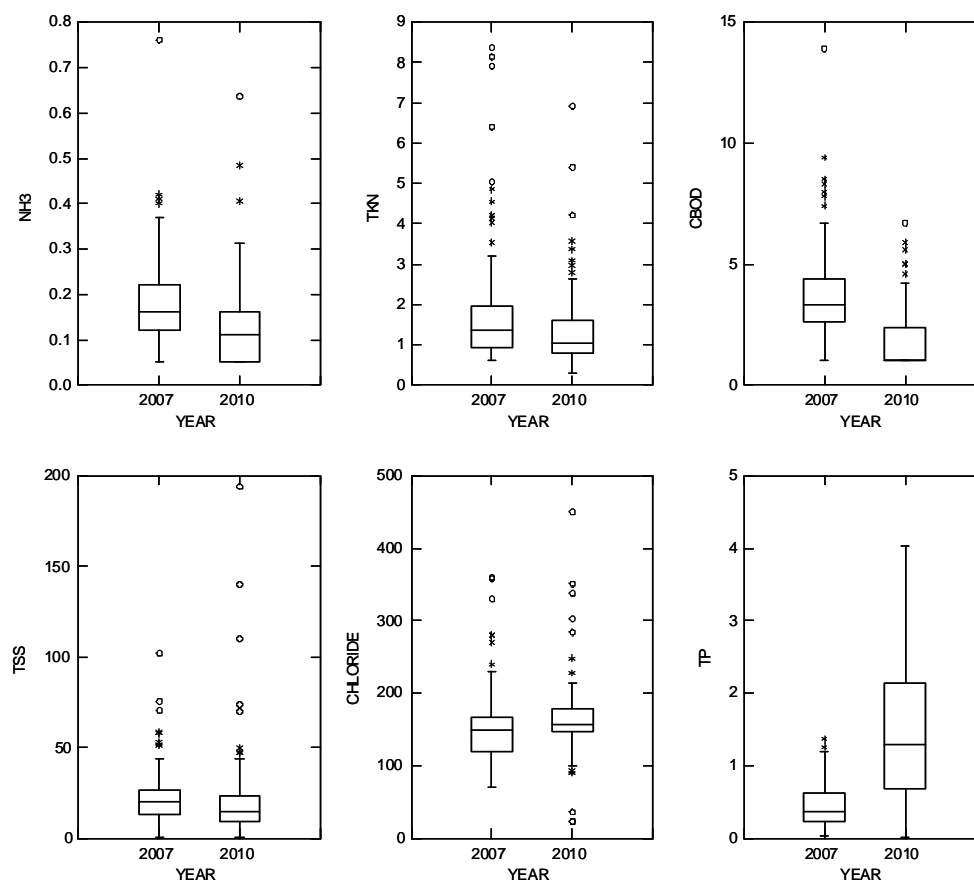


Figure 46. Distributions of water chemistry parameters measured in 2007 and 2010 in the Salt Creek mainstem.

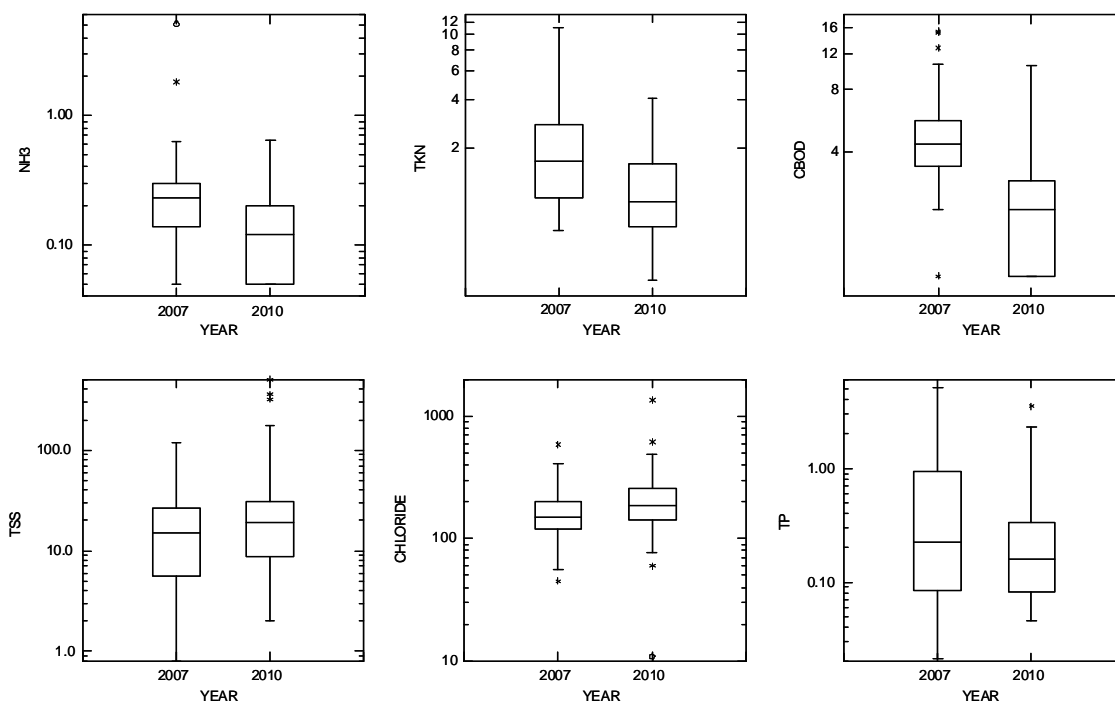


Figure 47. Distributions of water chemistry parameters measured in 2007 and 2010 in tributaries to Salt Creek.

Table 5. Number of detections of organic compounds in water column samples collected from the 14 sites in the Salt Creek watershed, 2010.

Site	Number of Detections		Name	Rivcode	RM
	Chlorination By-Products	PAHs			
SC45	0	0	Arlington Heights Branch	95-840	1.5
SC43	3	0	Salt Creek	95-850	29.0
SC41	3	0	Salt Creek	95-850	25.0
SC40	3	0	Salt Creek	95-850	24.5
SC34	2	0	Salt Creek	95-850	23.5
SC35	0	1	Salt Creek	95-850	23.0
SC23	2	0	Salt Creek	95-850	22.5
SC39	2	3	Salt Creek	95-850	20.5
SC38	2	0	Salt Creek	95-850	18.0
SC49	0	1	Salt Creek	95-850	8.0
SC29	0	0	Salt Creek	95-850	0.5
SC21	0	0	Spring Brook of SC	95-870	6.5
SC46	2	0	Spring Brook of SC	95-870	6.0
SC22	2	0	Westwood Creek	95-882	0.5

### Sediment Chemistry

Sediment samples were collected from 27 sites in the Salt Creek watershed during the 2010 survey, and analyzed for heavy metals and a variety of organic compounds including PAHs, organochlorine pesticides, polychlorinated biphenyls (PCBs), and organics commonly employed in industry (e.g., acetone, toluene). Metals and PAHs were routinely detected at all locations, though concentrations of metals rarely exceed levels likely to adversely impact aquatic life (Figure 48). Concentrations of PAHs, however, frequently exceeded levels likely to affect aquatic life (Figure 48). Sources of metals in the urban environment include buildings, especially galvanized roofs, and automobiles. PAHs are the by-product of incomplete gasoline combustion, and tend to build-up on road surfaces. Blacktop sealant is another potential source of PAHs. Organochlorine pesticides were not detected in any of the samples, and volatile organic compounds like toluene, a commonly used industrial organic solvent and component of gasoline, were detected at only several sites. Compared to 2007, the number of detections of metals exceeding probable effects levels (*sensu* McDonald et al. 2000) was less in 2010, whereas the number of PAH detections above probable effects levels was similar between time periods.

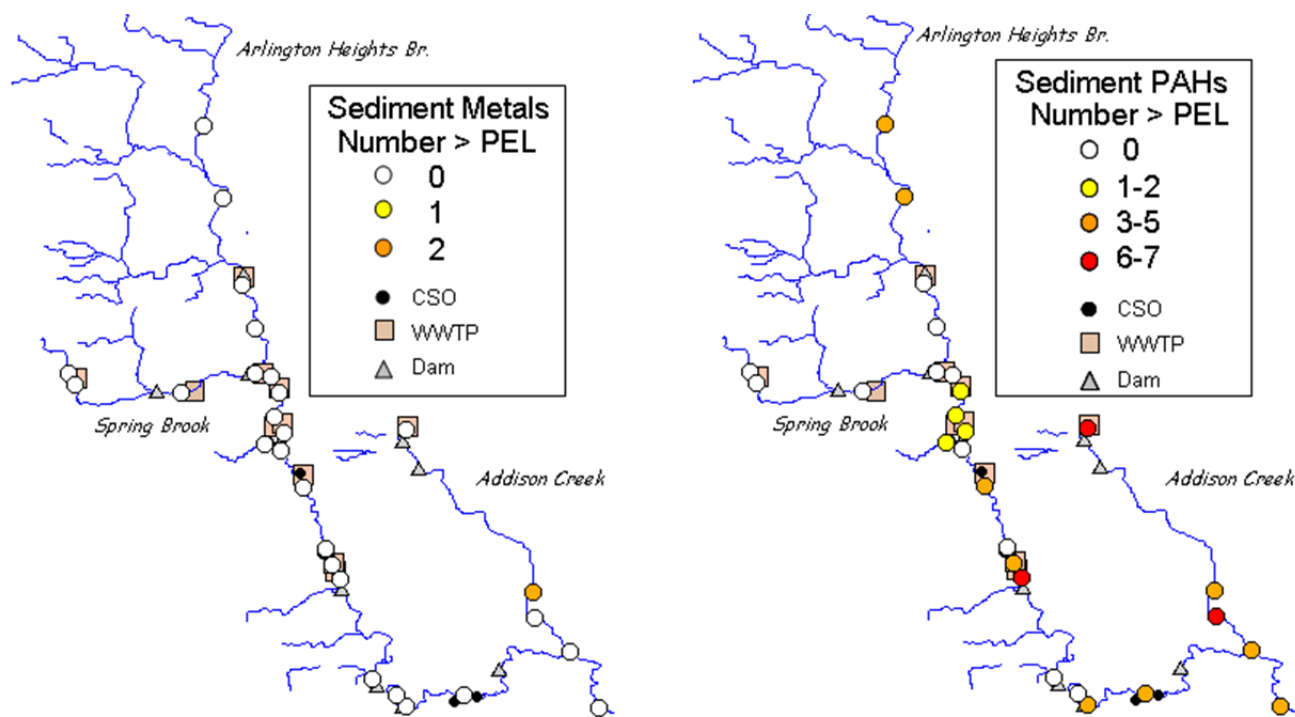


Figure 48. Number of metals and PAH compounds present at concentrations in sediments likely to adversely affect aquatic life (i.e., Probable Effects Levels [PEL] of McDonald et al. 2000).

## PHYSICAL HABITAT QUALITY FOR AQUATIC LIFE

### *Salt Creek Mainstem*

Physical habitat quality was evaluated using the Qualitative Habitat Evaluation Index (QHEI) at 24 sites along the Salt Creek mainstem. Most of the sites possessed the types and amounts of habitat features necessary to support aquatic life consistent with beneficial uses (Figure 49 a), with QHEI scores averaging  $63.7(\pm 12.7 \text{ SD})$ . Perhaps more telling, 19 of the sites possessed none of the attributes that characterized stream channels highly modified either directly or indirectly by anthropogenic modifications, and only one site, the most upstream site (SC04, RM 39.5), possessed more than one highly modified attribute. Highly modified attributes (Figure 50 and Table 6) are especially deleterious to aquatic life, and an accumulation of two or more at a given site typically precludes a balanced aquatic assemblage. Additionally, the total number of all modified attributes relative to the total number of natural attributes at any given site generally did not overwhelm the ability of the site to support aquatic life, except in the pools behind low-head dams (Figure 49 b and Table 6). Lastly, QHEI scores obtained in 2010 were similar to those obtained during 2006/07 survey; however, substrate scores in the lower 8 miles of the creek were less in 2010, owing to (qualitatively) higher amounts of silt and embedding fines. Whether this is a transient condition, a trend, or the result of observer bias is unknown.

### *Salt Creek Tributaries*

Habitat quality measured in tributaries to Salt Creek varied considerably from site-to-site, and by tributary. Where habitat quality varies widely over a reach or within a catchment, the reach average quality tends to be a better predictor of aquatic life than the local habitat quality. The headwaters of Salt Creek upstream from Busse Woods including the Arlington Heights Branch has specific locations where the habitat quality is excellent (Figure 51); however, within the context of the subcatchment, habitat quality overall is stressed by modifications and disturbance (Figure 50). Similarly, Spring Brook generally has good habitat quality, but four of the six sites within the watershed had at least one highly modified habitat attribute, notably little or no sinuosity, a remnant of historic channelization. Westwood, Sugar, Oakbrook and Ginger Creeks all are noted for low sinuosity, again, a function of historic channelization. Addison Creek is, overall, the most modified tributary in the Salt Creek watershed with QHEI scores averaging less than 60, and one or more highly modified attribute found at each site.

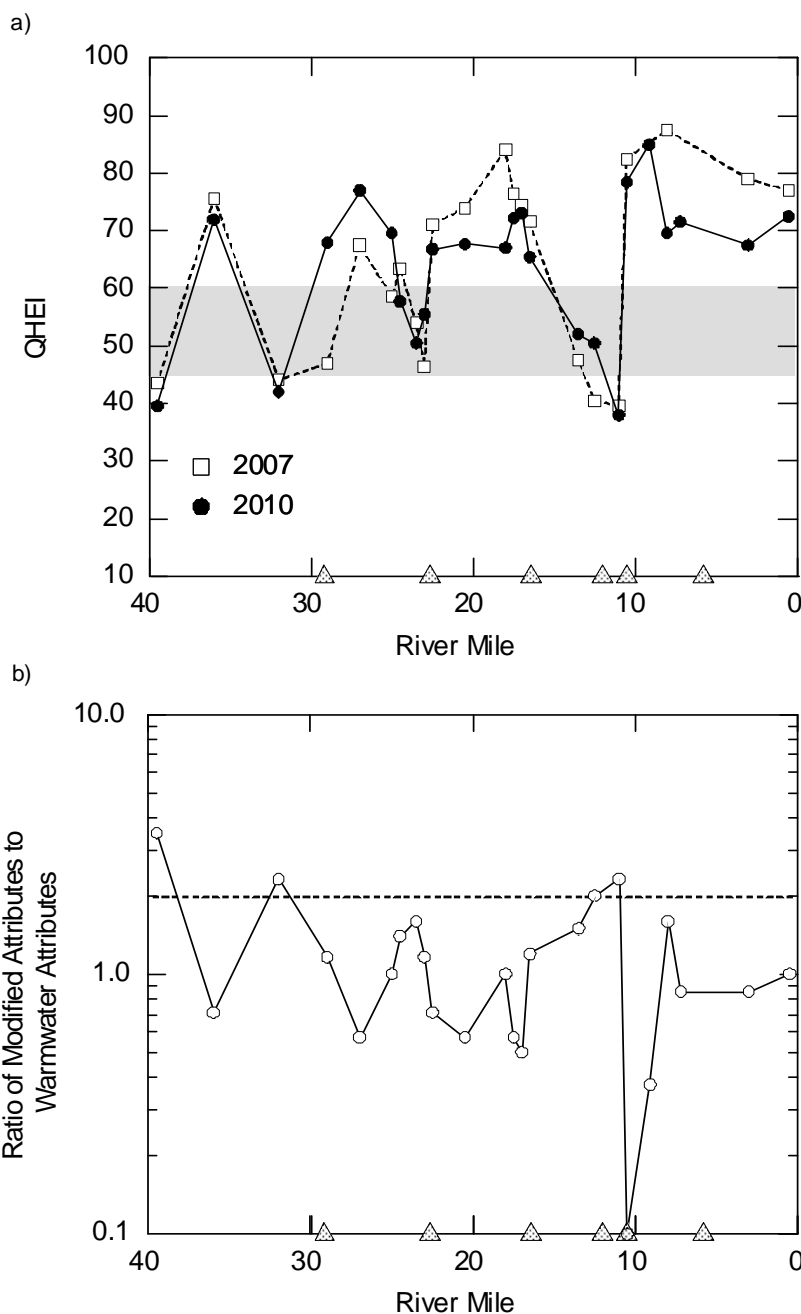


Figure 49. a) Qualitative Habitat Evaluation Index (QHEI) scores for Salt Creek plotted by river mile. The shaded region depicts the range of QHEI scores where habitat quality is marginal and limiting to aquatic life. QHEI scores less than 45 are typical of highly modified channels. b) The ratio of modified habitat attributes to warmwater (i.e., natural) attributes noted at sampling locations in Salt Creek. Where the number of modified features are twice that of natural features, the habitat has essentially no ability to support aquatic life consistent with beneficial aquatic life uses. The triangles arrayed along the x-axis in both plots show the locations of low-head dams.

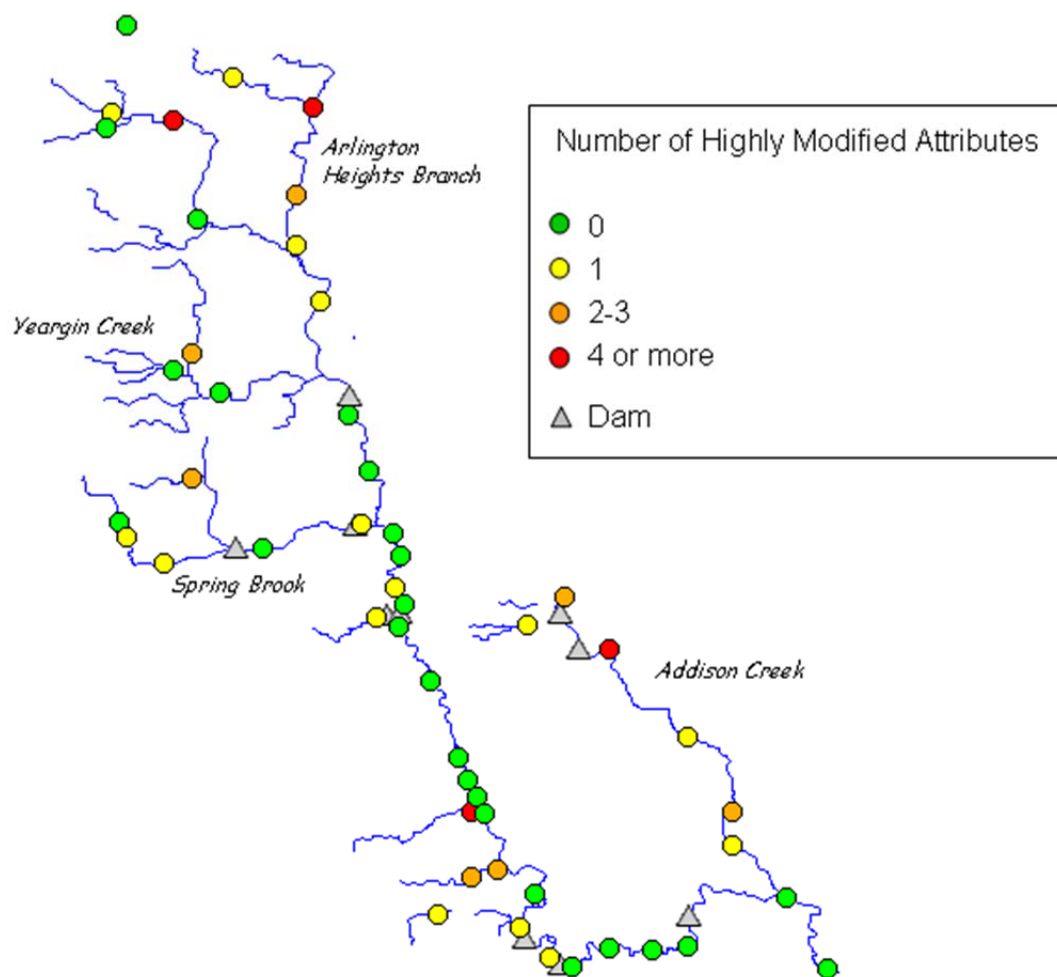


Figure 50. The number of habitat attributes typical of highly modified or disturbed stream channels that are deleterious to aquatic life.

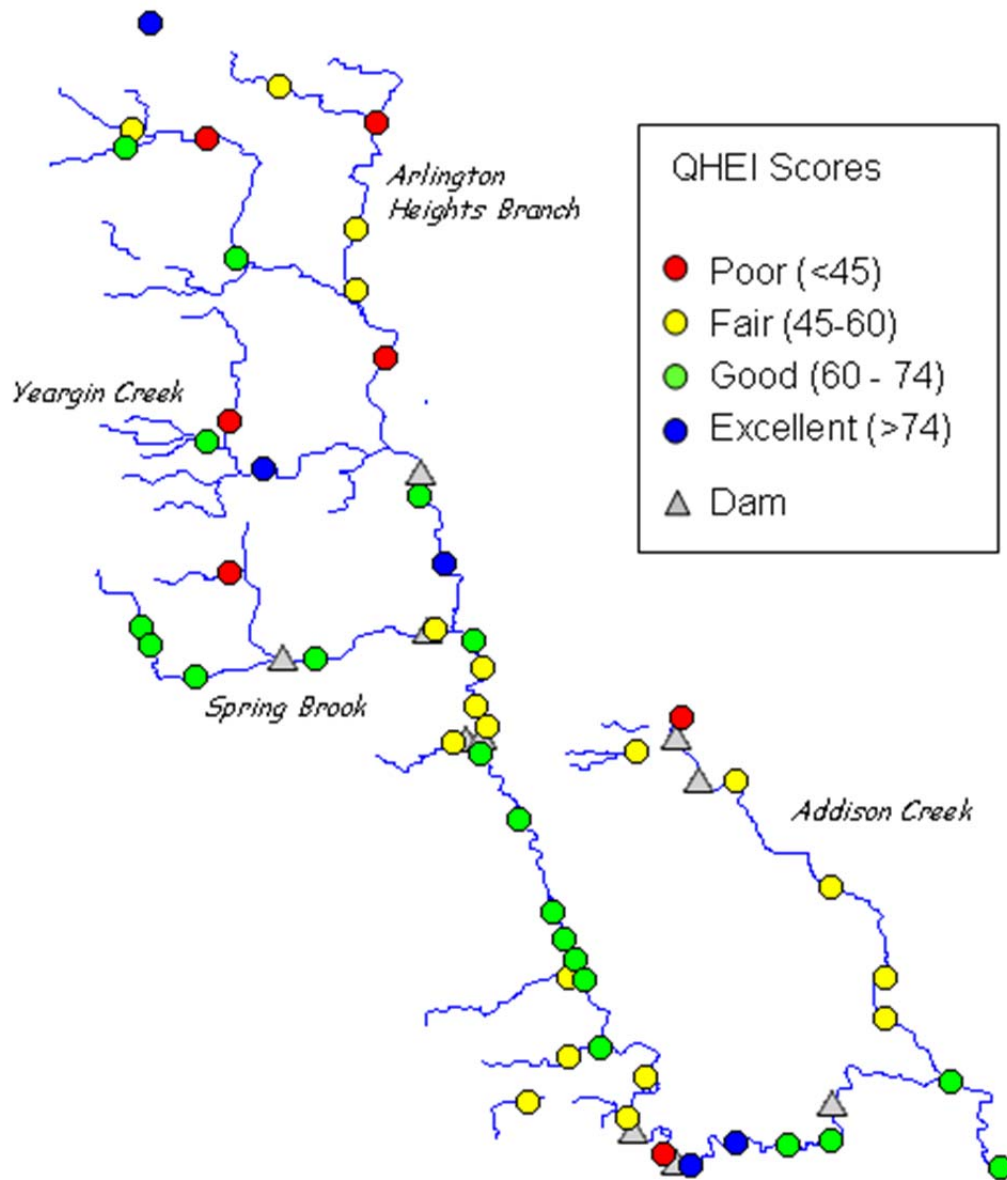


Figure 51. QHEI scores measured in the Salt Creek watershed, 2010.



Table 6. QHEI scores and metric values for sites sampled in the Salt Creek study area during 2010.

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes										MWH Attributes										Total MLI MWH Attributes	((MWH HLI+0)/(MWH+1)) Ratio	((MWH MLI+1)/(MWH+1)) Ratio					
			Key QHEI Components										High Influence					Moderate Influence												
			No Channelization or Recovery	Bulwark/Cobble/Gravel Substrates	Silt Free Substrates	Good Substrates	Modeling High Sinuosity	Extensive Moderate Cover	Fast Current/Eccles	Low Normal Channel Embedment	Max Depth > 40 cm	Low Normal Channel Embedment	Channelized or No Recovery	Silt/Clay Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (MD, HW)	Total H.L. MWH Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin				Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current
(95840) Arlington Heights Branch Salt Creek																														
Year: 2010																														
4.00	24.00	14.40																												
1.50	47.00	9.50																												
0.25	52.00	7.10																												
(95845) Baldwin Creek																														
Year: 2010																														
2.00	53.50	18.60																												
(95850) Salt Creek																														
Year: 2010																														
39.50	39.50	23.50																												
36.00	72.00	19.30																												
32.00	42.00	12.90																												
29.00	68.00	10.20																												
27.00	77.00	9.28																												
25.00	69.50	7.34																												
24.50	57.75	3.63																												
23.50	50.50	6.55																												
23.00	55.50	6.16																												
22.50	66.75	5.70																												
20.50	67.75	4.95																												
18.00	67.00	4.60																												
17.50	72.25	4.40																												
17.00	73.00	4.30																												
16.50	65.50	4.20																												
13.50	52.00	2.00																												
12.50	50.50	2.10																												
11.00	38.00	2.20																												
10.50	78.50	2.20																												
9.10	85.00	2.20																												
8.00	69.50	2.20																												

Table 6. continued.

[illegible]

Table 6. continued.

		WWH Attributes										MWH Attributes												
												High Influence					Moderate Influence							

# BIOLOGICAL COMMUNITIES – FISH ASSEMBLAGE

Fish assemblages sampled in Salt Creek were in poor to fair condition throughout the mainstem. The site immediately downstream from the Graue Mill Dam performed the best, where the fish community scored an fIBI of 27, likely owing to the ameliorative effect from reaeration imparted by the dam, as the sample site was inside the dam's aeration plume. The Graue Mill Dam is a barrier to several fish species, notably johnny darters and hornyhead chubs, two species that should be found throughout most of the mainstem. fIBI scores in 2010 followed the same longitudinal pattern along the length of the mainstem as that observed in 2007, with no statistical difference between years (Figure 52). Moreover, fIBI scores throughout the Salt Creek watershed sampled in 2010 were similar to those from 2007, with no statistical difference between years or within size strata (Figure 53). Scores in tributaries throughout the watershed in 2010 were typically in the poor to fair range, with the exception of the headwaters of Addison Creek where scores were very poor (Figure 54).

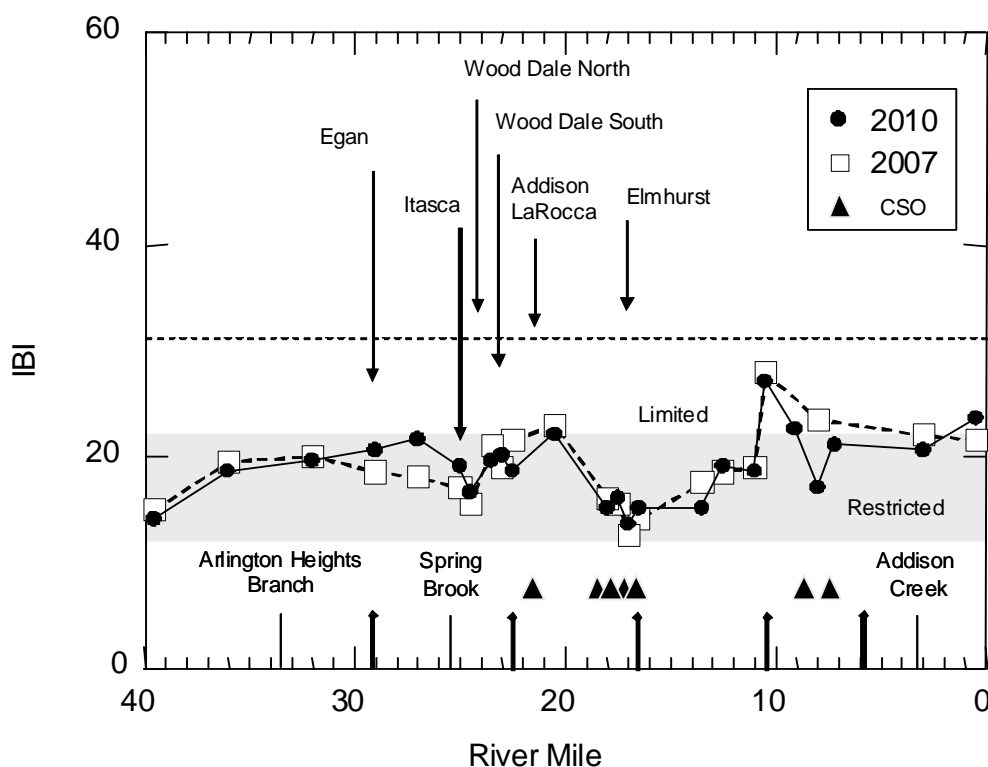


Figure 52. Fish Index of Biotic Integrity scores for samples collected from Salt Creek in 2010 and 2007 in relation to the locations of NPDES permitted facilities, combined sewer overflow (CSO) outfalls, dams and principal tributaries. The locations of dams are arrayed along the x-axis and noted as diamond tipped bars. The shaded area indicates the range for a restricted fish assemblage as defined by Illinois EPA.

Fish assemblages in the Salt Creek basin are clearly limited by stormwater pollutants, episodically low dissolved oxygen concentrations, and poor and fragmented habitat. Episodically low dissolved oxygen concentrations are driven by organic enrichment. The source of the organic enrichment is both direct, from CSOs and stormwater runoff, as well as indirect from algae cooked-up in stormwater ponds and behind low head dams. Low dissolved oxygen concentrations, apart from being directly lethal or stressful, apparently also result in denitrification of nitrate to nitrite. Thirty-five percent of the variation in nitrite concentrations measured in the Salt Creek watershed can be explained by a linear combination of dissolved oxygen concentrations, nitrate concentrations, and QHEI scores. Nitrite is highly toxic to aquatic organisms.

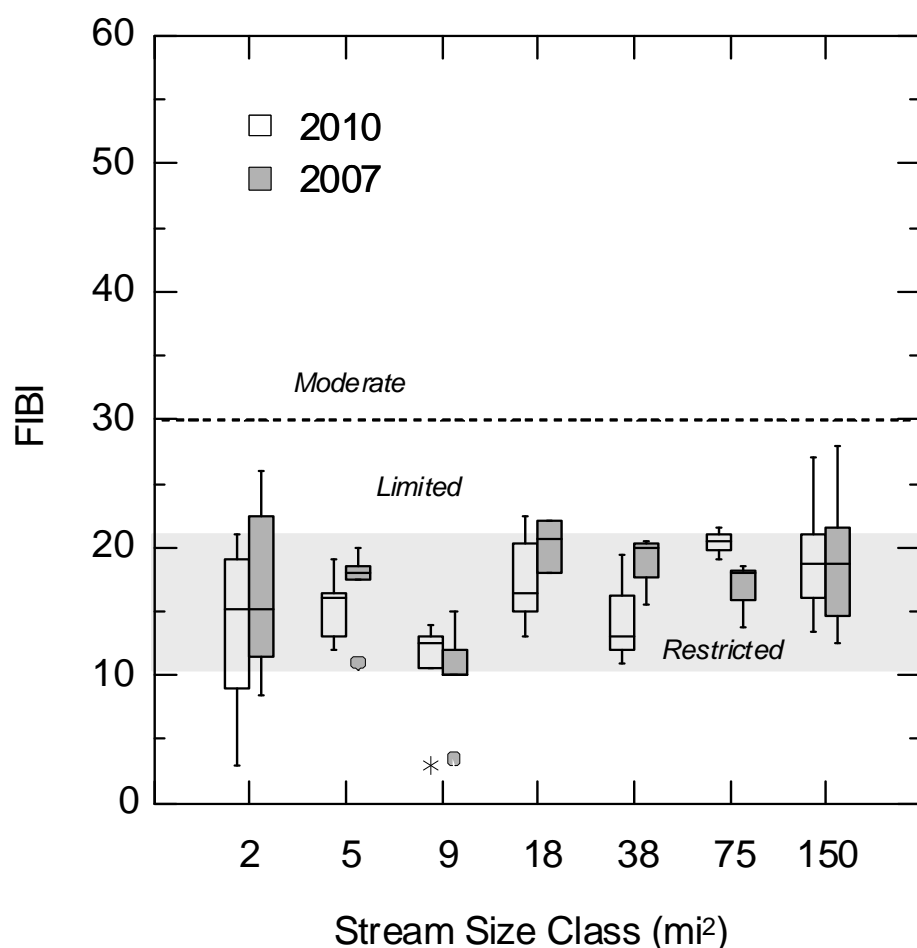


Figure 53. Distributions of fish IBI scores within stream size class, 2010 and 2007. No statistical difference exists between years within size strata. The shaded area indicates the range for a restricted fish assemblage as defined by Illinois EPA.

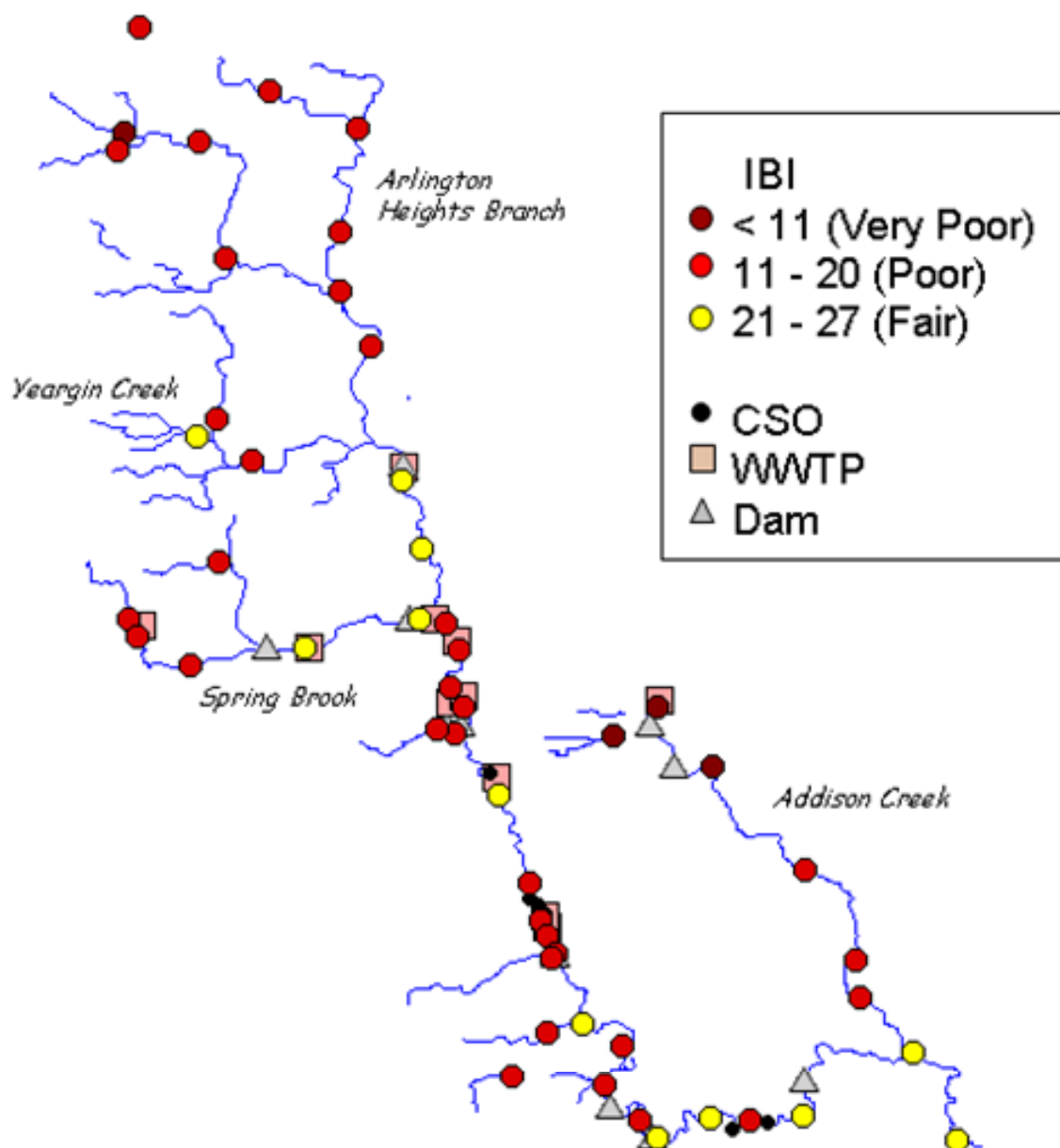


Figure 54. IBI scores plotted by narrative range for fish communities sampled from the Salt Creek watershed, 2010.

## BIOLOGICAL COMMUNITIES – MACROINVERTEBRATE ASSEMBLAGE

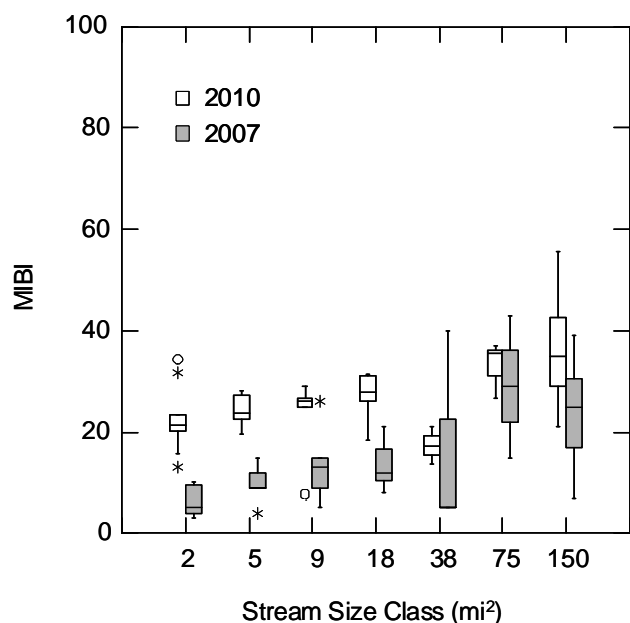
### *Salt Creek*

Macroinvertebrate communities sampled from the mainstem of Salt Creek were rated as Fair upstream from the Graue Mill Dam, and rated good at four of six sites sampled downstream from the dam, and Fair at the other two. Longitudinally, scores decreased downstream from Spring Brook relative to those upstream. The confluence with Spring Brook marks the reach where several WWTPs discharge in short succession. Otherwise, no clear longitudinal pattern was evident (see Figures 56 and 57).

Macroinvertebrate Index of Biotic Integrity (mIBI) scores computed from samples collected at similar locations in 2010 and 2007 were higher in 2010 compared to 2007 (two sample t-test,  $p < 0.039$ ). The mean mIBI score in 2010 was 32.6 compared 25.3 in 2007. The higher scores in 2010 appear coincidental with lower concentrations of organic enrichment parameters. Whether that relationship is direct is unknown, but it comports with findings from 2007. Unlike 2007, mIBI scores in 2010 were not as strongly correlated with water quality parameters. The highest correlations (albeit weak) were with typical urban parameters like chlorides and conductivity and other parameters were counterintuitive. However, mIBI scores from 2010, like 2007, remained strongly correlated with habitat quality (Table 7). This may well be an indication of a shift in the stressor gradient towards non-chemical parameters.

The tendency for higher scores in 2010 compared to 2007 was evident across all drainage area strata (Figure 55), but was especially evident in the smaller size classes  $< 20 \text{ mi}^2$ . This finding lends tentative support to the notion that decreased concentrations of ammonia, TKN, and cBOD, presumably emanating from stormwater ponds, facilitated higher scores. However, mIBI scores in tributaries to Salt Creek scored in the poor to fair range across the board, with many scores falling in the lower half of the poor range (i.e., very poor in Figure 56), with Addison

Creek and Spring Brook fairing the worst, generally coincidental with the highest chloride concentrations in the watershed.



*Figure 55. Distributions of mIBI scores by drainage area class for sites sampled in the Salt Creek watershed 2010 and 2007. mIBI scores for drainage classes less than 38 square miles were significantly higher in 2010*

*Table 7. Correlations between mBI scores and environmental variables (habitat and water chemistry) for sites sampled at similar locations in 2010 and 2007 throughout the Salt Creek watershed.*

Environmental Measure	mBI Correlation with Environmental Variables	
	Year	
	2010	2007
QHEI	0.49	0.41
Substrate	0.32	0.27
Cover	0.39	0.35
Channel	0.43	0.21
Riparian	0.48	0.49
Pool	0.49	0.49
Riffle	0.29	0.26
High-Influence Modified	-0.48	-0.37
CBOD	-0.08	-0.03
Chloride	0.04	-0.31
Conductivity	0.05	-0.20
Field D.O.	0.22	-0.13
Nitrate	0.13	0.31
Ammonia	-0.06	-0.15
TKN	-0.11	0.17
Nitrite	0.08	0.27
Field pH	0.09	-0.18
Total Phosphorus	0.03	0.24
TDS	-0.04	-0.22
TSS	0.01	-0.08
Field Temperature	-0.13	-0.31



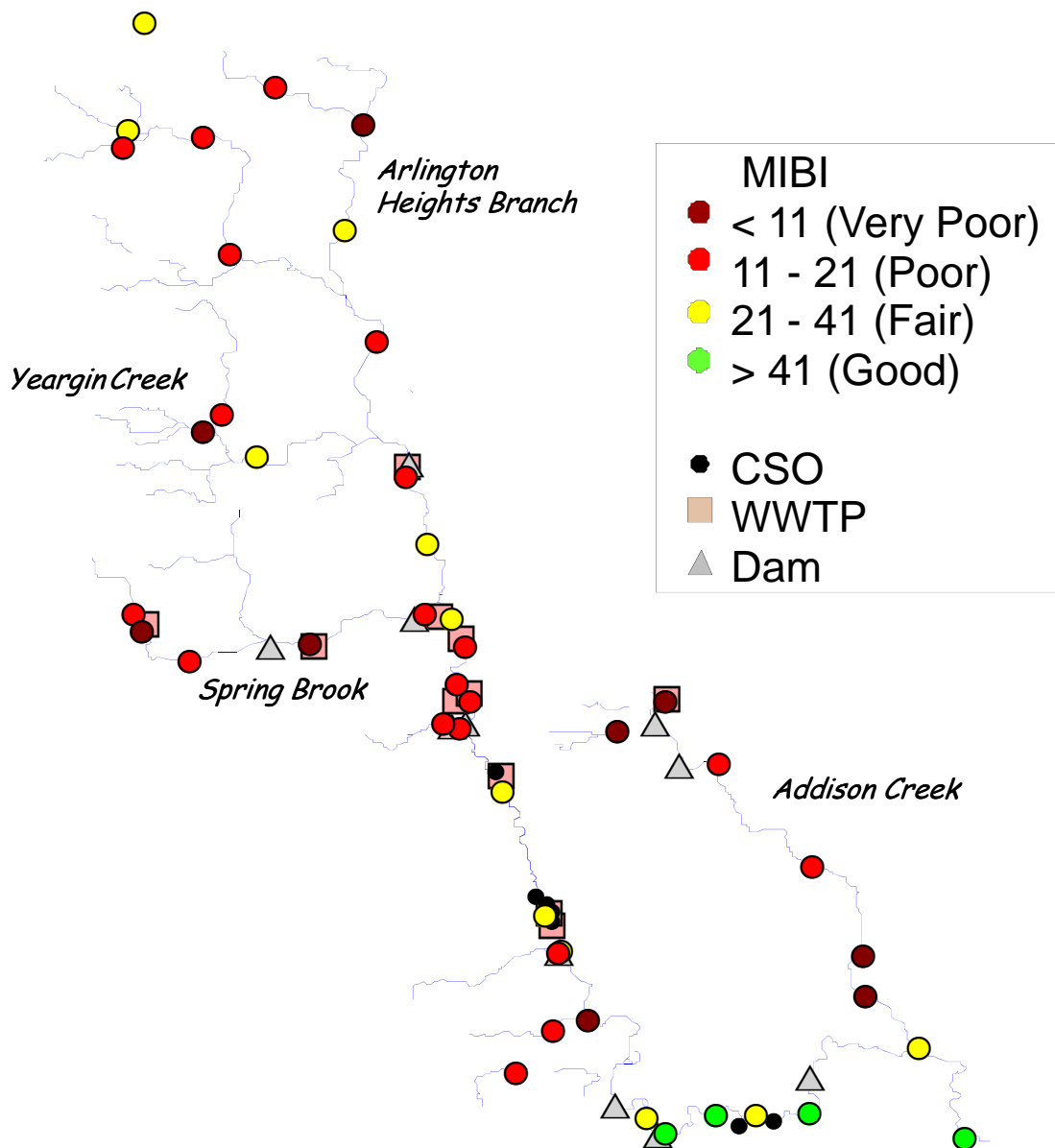


Figure 56. Macroinvertebrate IBI scores plotted by narrative range for sites sampled from the Salt Creek watershed, 2010.

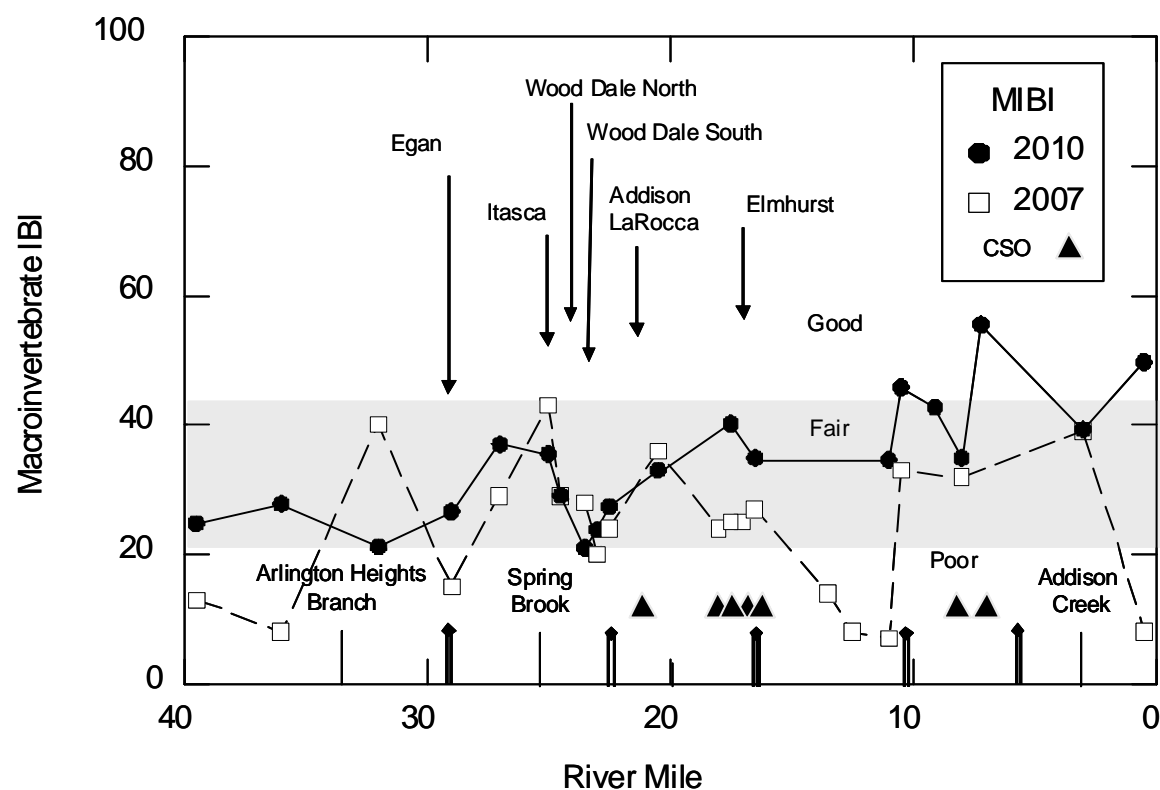


Figure 57. Macroinvertebrate IBI scores for samples collected from the Salt Creek mainstem, 2010 and 2007 in relation to publicly owned treatment works, low head dams (noted by diamond tipped bars adjoining the x-axis), and combined sewer outfalls (CSO). The shaded region demarcates the "fair" narrative range.

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