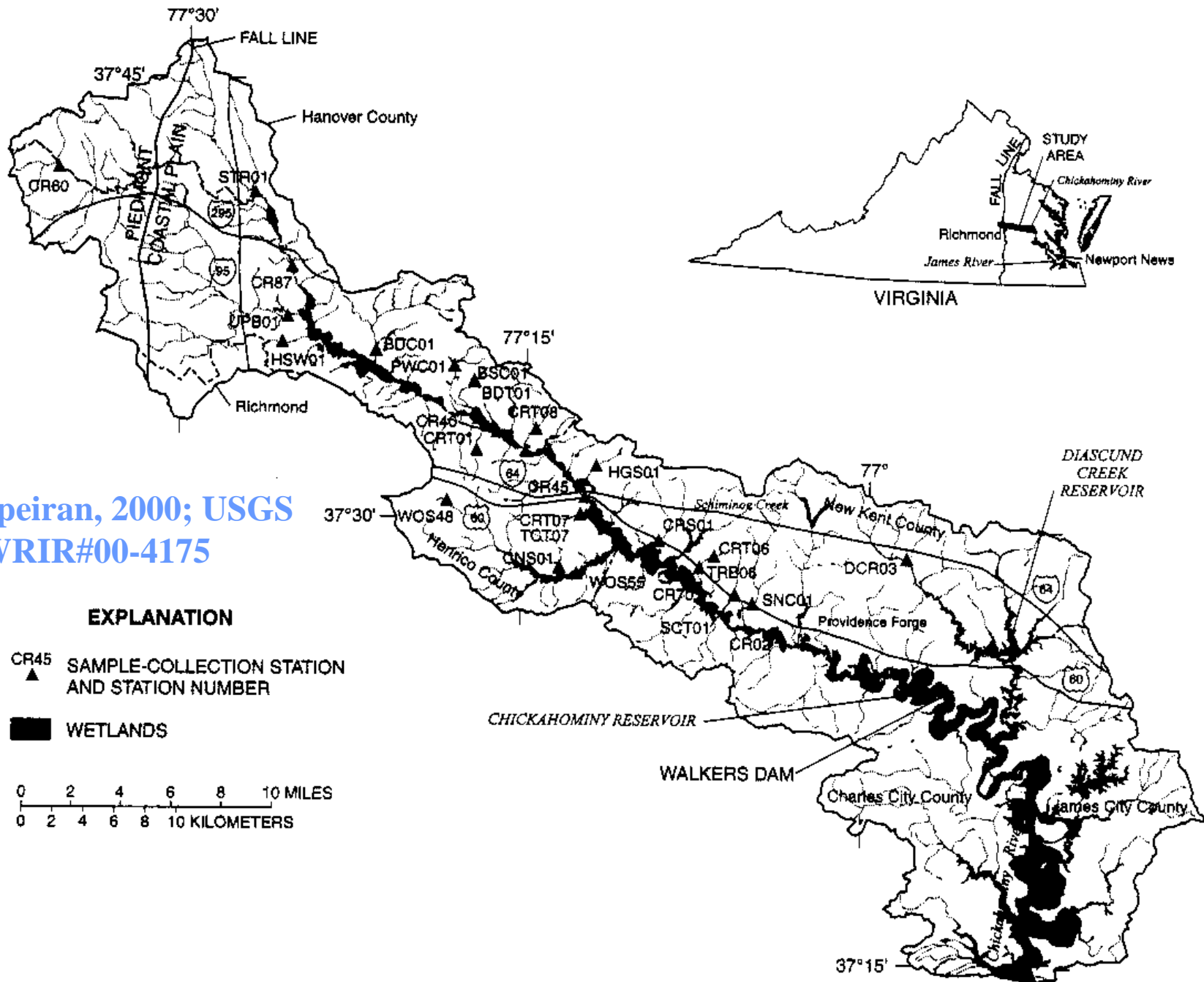


CEE 577: Surface Water Quality Modeling

Lecture #42

TOC & THMFP Models III

Scientific Literature



Speiran, 2000; USGS
WRIR#00-4175

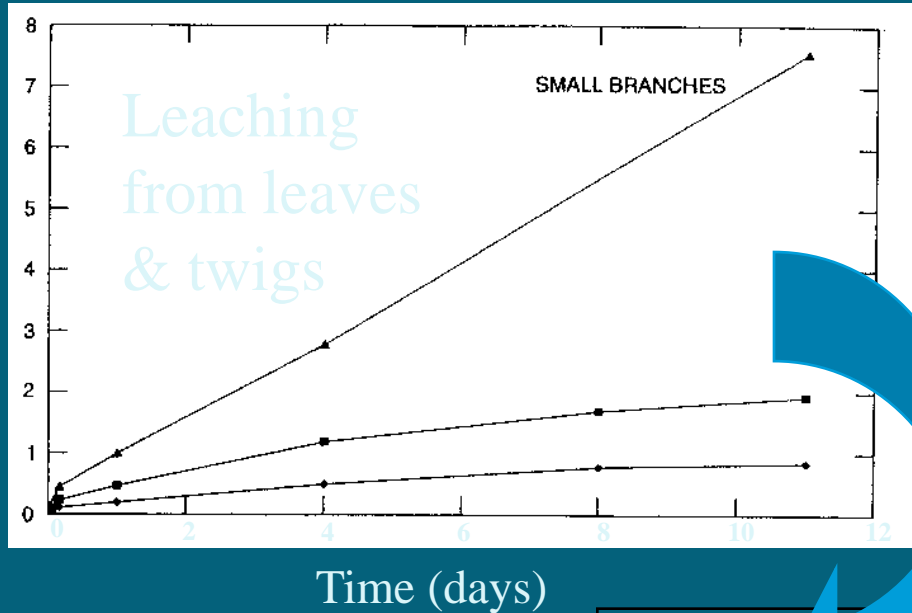
Organics

- Terrestrial origin
 - Lab tests
 - Field studies



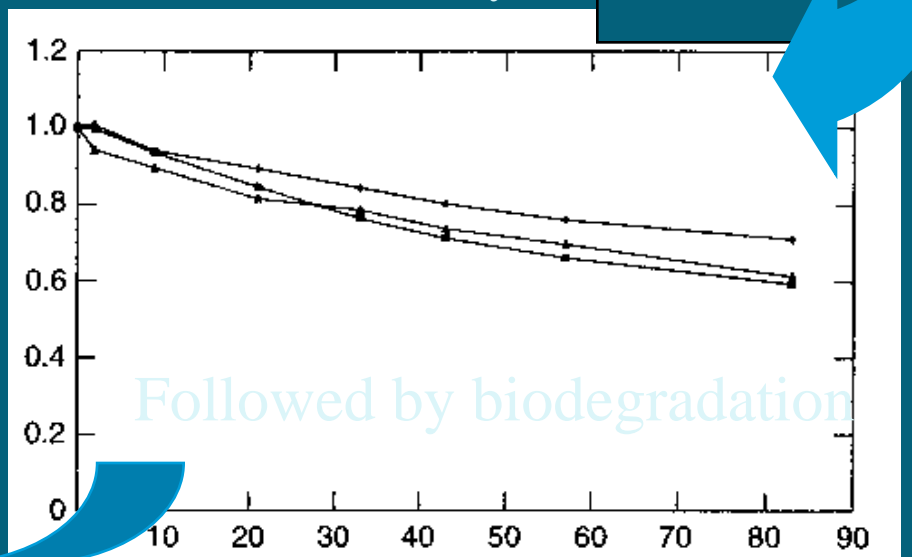
Speiran, 2000; USGS
WRIR#00-4175

Organic Matter
as measured by UV_{254} (cm^{-1})



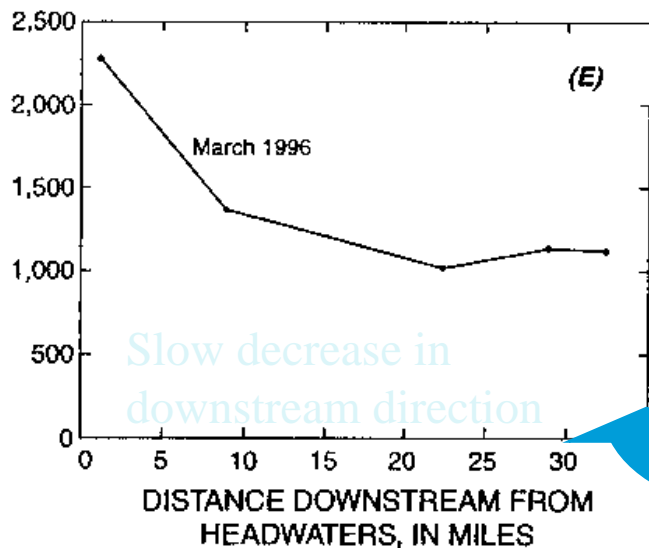
Time (days)

Organic Matter
as measured by UV_{254} (cm^{-1})



Time (days)

TOTAL ORGANIC HALIDE
FORMATION POTENTIAL, IN
MICROGRAMS PER LITER
AS CHLORIDE



DISTANCE DOWNSTREAM FROM
HEADWATERS, IN MILES

Estimating Primary Productivity

- In situ methods are best
 - Direct observation of natural system over short time intervals
 - Measure changes in O_2 , CO_2 , pH, conductance
 - e.g., Dissolved O_2 diurnal variation in a lake
 - Naturally isolated water
 - Hypolimnion vs epilimnion
 - Artificially isolate a volume of water (community) and make measurements
 - Light & dark bottle tests

Wetzel & Likens, 1991, Limnological Analyses, 2nd edition, Springer-Verlag

Primary Productivity (cont.)

- Radiolabel methods
 - $^{14}\text{CO}_2$ uptake ($t_{1/2}=5760$ yr)
 - Add a small, known amount of $\text{NaH}^{14}\text{CO}_3$ to a sample collected at known depth
 - Return sample to collection depth in a headspace-free BOD bottle (light & dark)
 - Bring bottles to surface at the end of ~4 hr
 - Filter (0.45 μm) under weak vacuum
 - Collect particulates (algae)
 - Collect & sparge filtrate (EOM)
 - Concentrate by lyophilization?
 - Analyze samples by scintillation counting

Wetzel & Likens, 1991, Limnological Analyses, 2nd edition, Springer-Verlag

Data for Allochthonous Loading

- Stepczuk, Martin, Longabucco, Bloomfield & Effler, 1998
 - “Allochthonous Contributions of THM Precursors to a Eutrophic Reservoir, J. Lake & Res. Mgmt., 14(2/3)344-355

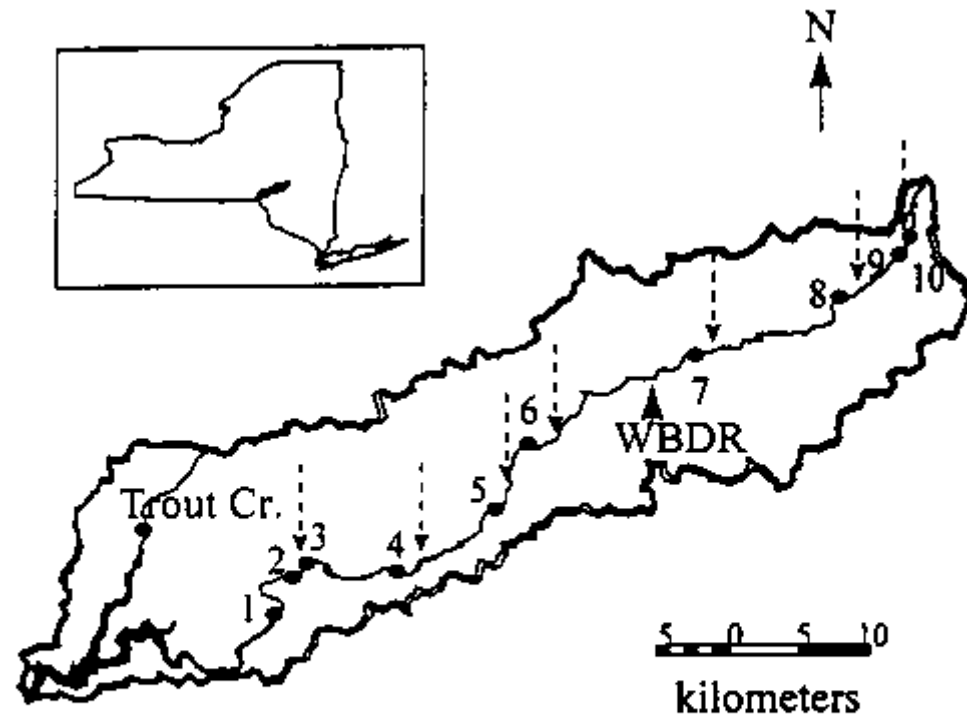
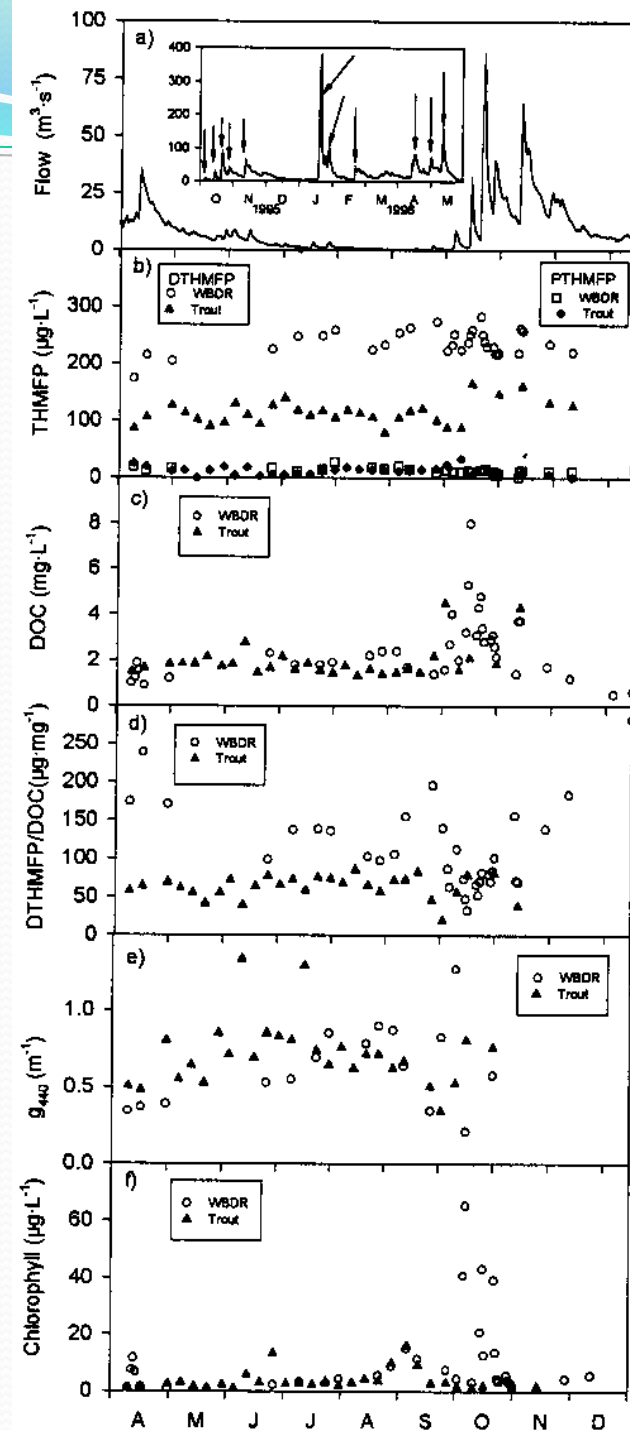


Figure 1.--Cannonsville Reservoir watershed, with two routine monitoring sites [WBDR (1), and Trout Creek]. The 10 synoptic survey sites, including site (1) for WBDR, are also shown. Dashed lines indicate point source locations (see Fig. 3a for point source identification).

Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

Time variability

- Time series data for WBDR and Trout Creek Apr-Dec interval (1995)
 - a) discharge for WBDR at Boerston
 - inset identifies eleven runoff events for the fall 95 – spring 96 interval
 - b) DTHMFP and PTHMFP
 - c) DOC
 - d) DTHMFP/DOC (yield)
 - e) g_{440}
 - f) chlorophyll



Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

Average concentrations

Table 1.—Comparison of selected variables for Trout Creek and WBDR from the routine monitoring program* April-December 1995.

Variables	Units	Trout Cr.			WBDR		
		Avg.	Range	N	Avg.	Range	N
DTHMFP	$\mu\text{g} \cdot \text{L}^{-1}$	114	79-165	31	235	174-275	19
PTHMFP	$\mu\text{g} \cdot \text{L}^{-1}$	13	0-34	31	15	7-28	19
DOC	$\text{mg} \cdot \text{L}^{-1}$	1.9	1.0-4.5	29	2.0	0.9-4.4	19
POC	$\text{mg} \cdot \text{L}^{-1}$	0.5	0.1-1.2	24	0.8	0.2-3.7	19
Yield**	$\mu\text{g} \cdot \text{mg}^{-1}$	60	20-86	29	119	48-239	19
ξ_{440}	m^{-1}	0.7	0.4-1.3	27	0.6	0.2-1.3	16

* Monitoring that was part of the routine program, and not specifically associated with high runoff periods.

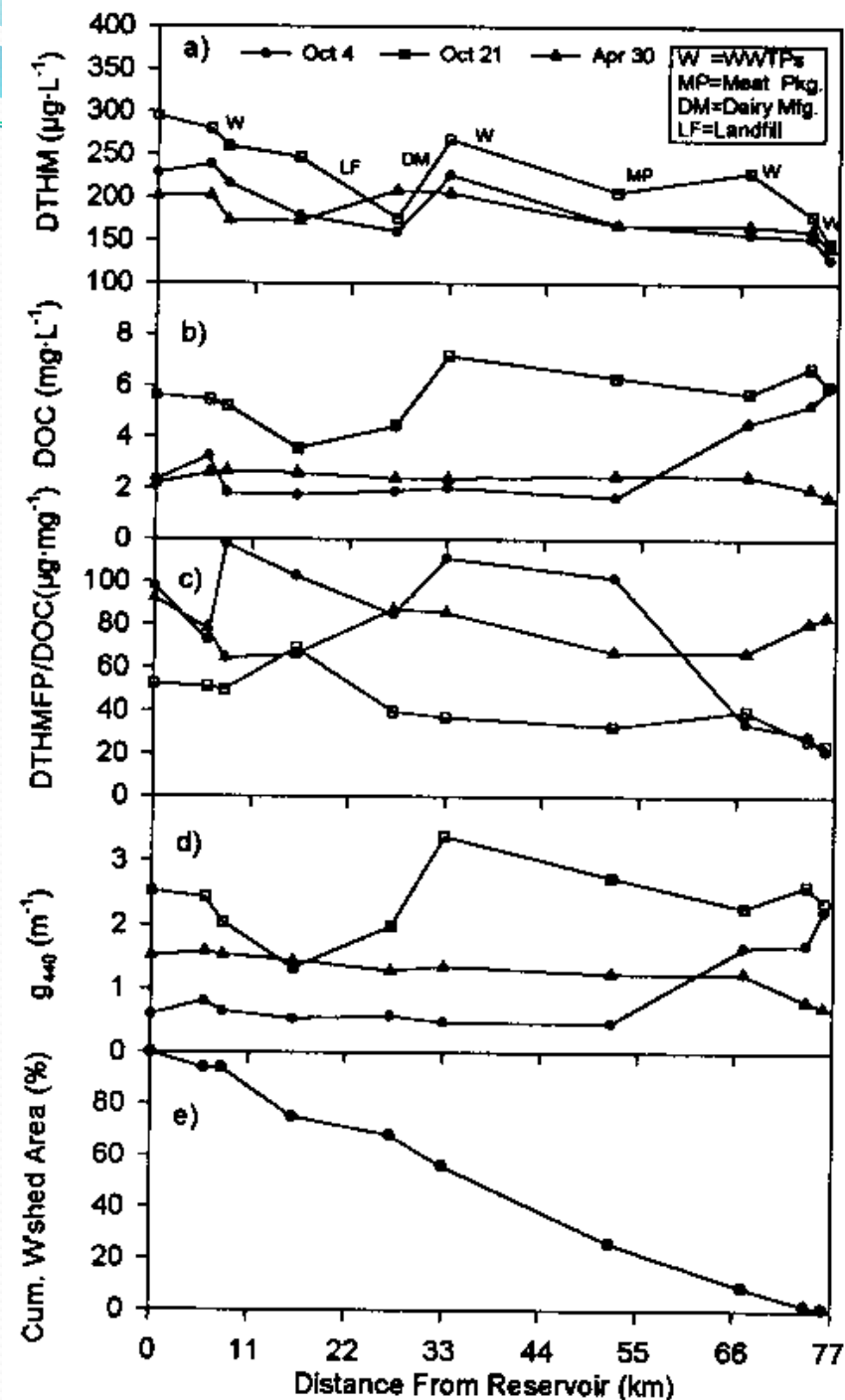
** μg DTHMFP / mg DOC.

Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

Synoptic Surveys

- Detailed data on 3 separate days for the WBDR

Stepczuk et al., 1998, J. Lake & Res. Mgmt.,
14(2/3)344-355



Summary of Synoptic Surveys

Table 2.--Selected data for three synoptic surveys of WBDR. Conditions at the mouth (0-km station at Beerston) and over the stream length are presented.

Date	10/4/95	10/21/95	4/30/96
Mean Daily Flow ($\text{m}^3 \cdot \text{s}^{-1}$)	1	57	55
DTHMFP ($\mu\text{g} \cdot \text{L}^{-1}$)			
@Beerston *	229	295	203
Stream Average	186	229	181
Range	129-239	148-295	142-209
DOC ($\text{mg} \cdot \text{L}^{-1}$)			
@Beerston *	2.8	5.6	2.2
Stream Average	3.1	5.6	2.4
Range	1.8-5.9	3.6-7.2	1.7-2.7
g_{440} (m^{-1})			
@Beerston *	0.6	2.5	1.5
Stream Average	1.0	2.4	1.3
Range	0.5-2.2	1.3-3.4	0.7-1.6

* Mouth of WBDR.

Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

Storm Events

Table 3. Selected hydrologic and water quality data for eleven runoff events for WBDR, October 1995-April 1996.

Runoff Events (1995-1996)	Starting Flow*	Peak Flow	%-ile** Peak Flow	%-ile** Volume	DTHMFP Flow-wtd. Conc.	DTHMFP Range	DOC Flow-wtd. Conc.	DOC Range	Flow-wtd. Avg. Yield
Date	($m^3 \cdot s^{-1}$)	($m^3 \cdot s^{-1}$)	%	%	($\mu g \cdot L^{-1}$)	($\mu g \cdot L^{-1}$)	($mg \cdot L^{-1}$)	($mg \cdot L^{-1}$)	($\mu g \cdot mg^{-1} C$) ‡
10/5	1	11	0	0	243	231-268	3.6	2.0-4.3	68
10/14	2	41	23	10	254	240-275	5.0	3.7-5.8	51
10/21	5	132	85	75	255	249-325	4.2	2.0-5.3	61
10/27	16	55	38	35	223	215-246	2.9	2.0-3.3	76
11/11	12	81	60	55	259	237-279	3.6	1.8-4.1	72
1/18	12	555	100	100	214	169-249	3.7	1.1-4.8	58
1/27	41	166	92	92	163	151-229	2.1	1.5-2.7	78
2/20	6	60	40	37	180	161-233	2.9	1.0-3.6	62
4/12	13	74	47	48	175	161-209	1.9	1.3-2.3	92
4/29	20	88	65	78	225	220-254	2.1	1.2-2.6	107
5/11	32	172	93	97	223	218-258	2.3	1.6-3.3	97
Event Avg.	131	219	3.1	70					
Routine Monitoring	Avg. Flow		Avg. Conc.	Range	Avg. Conc.	Range	Avg. Yield		
Date	($m^3 \cdot s^{-1}$)		($\mu g \cdot L^{-1}$)	($\mu g \cdot L^{-1}$)	($mg \cdot L^{-1}$)	($mg \cdot L^{-1}$)	($\mu g \cdot mg^{-1} C$) ‡		
4/95-12/95	3		235	174-275	2.0	1.0-4.4	119		

* Base flow = ~ 16 ($m^3 \cdot s^{-1}$).

** Percent storms exceeded (out of 61 total).

‡ Yield is the quotient of DTHMFP and DOC.

Stepczuk et al., 1998, *J. Lake & Res. Mgmt.*, 14(2/3)344-355

Storm Event Time Series

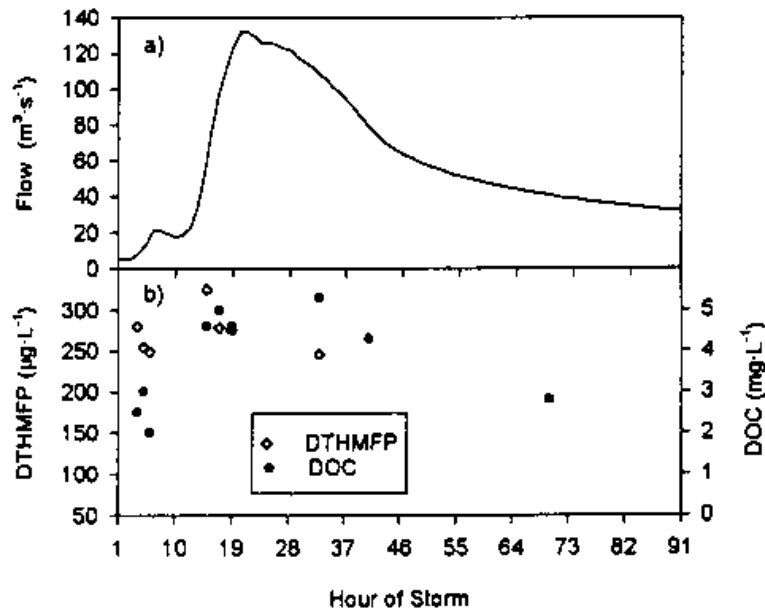


Figure 4.—Time series for runoff event for WBDR starting on October 21, 1995: a) hydrograph, and b) concentrations of DTHMFP and DOC.

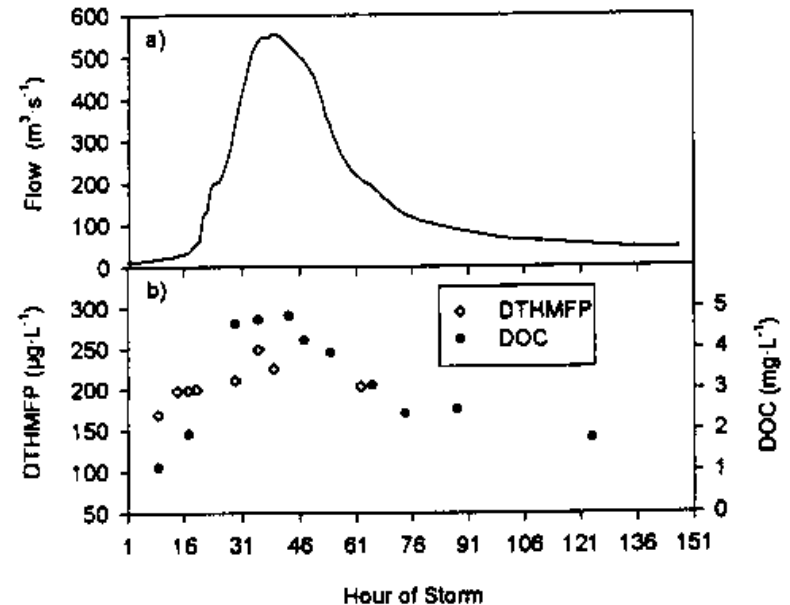


Figure 5.—Time series for runoff event for WBDR starting on January 18, 1996: a) hydrograph, and b) concentrations of DTHMFP and DOC.

Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

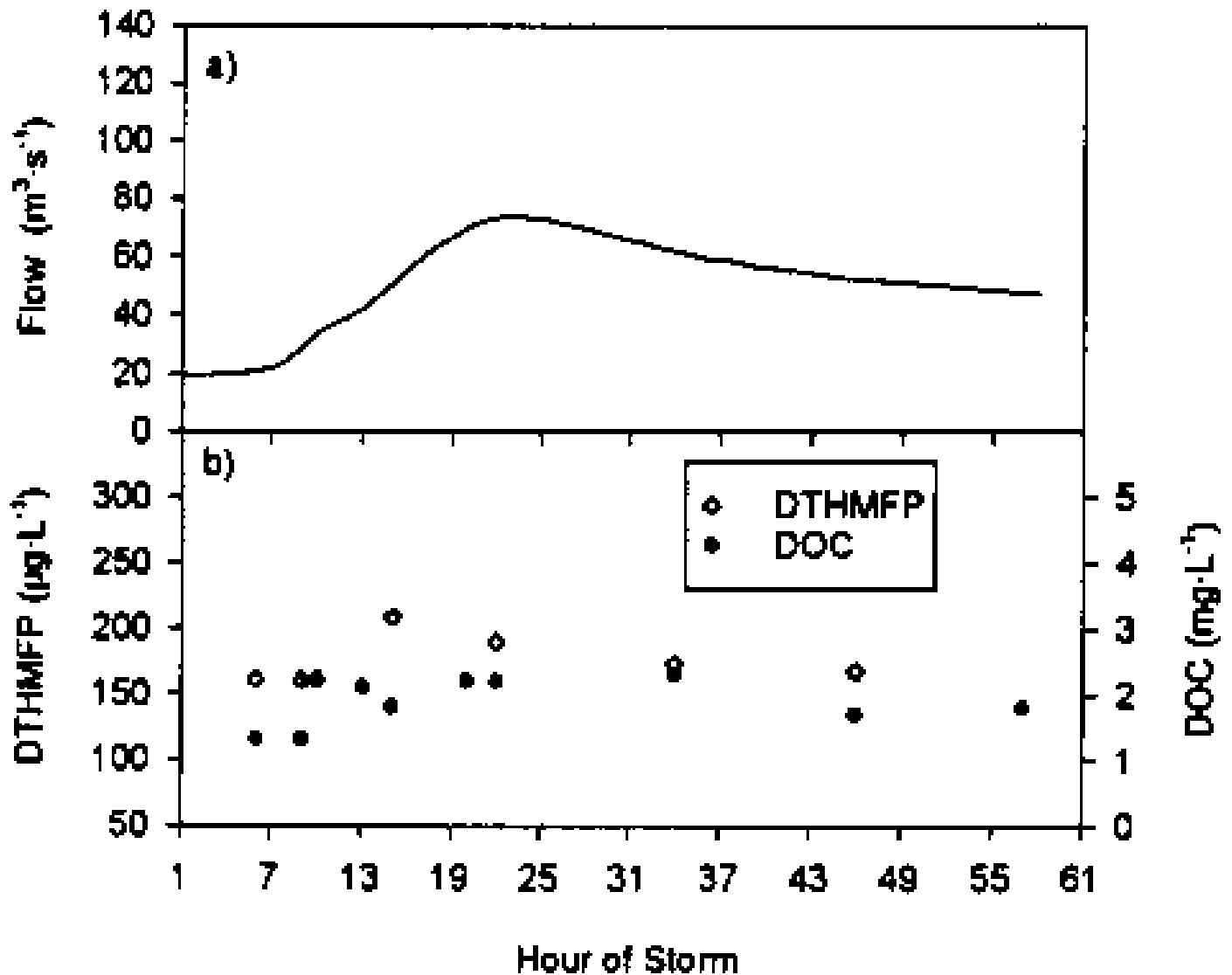


Figure 6.—Time series for runoff event for WBDR starting on April 12, 1996: a) hydrograph, and b) concentrations of DTHMFP and DOC.

Stepczuk et al., 1998, [J. Lake & Res. Mgmt.](#), 14(2/3)344-355

Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

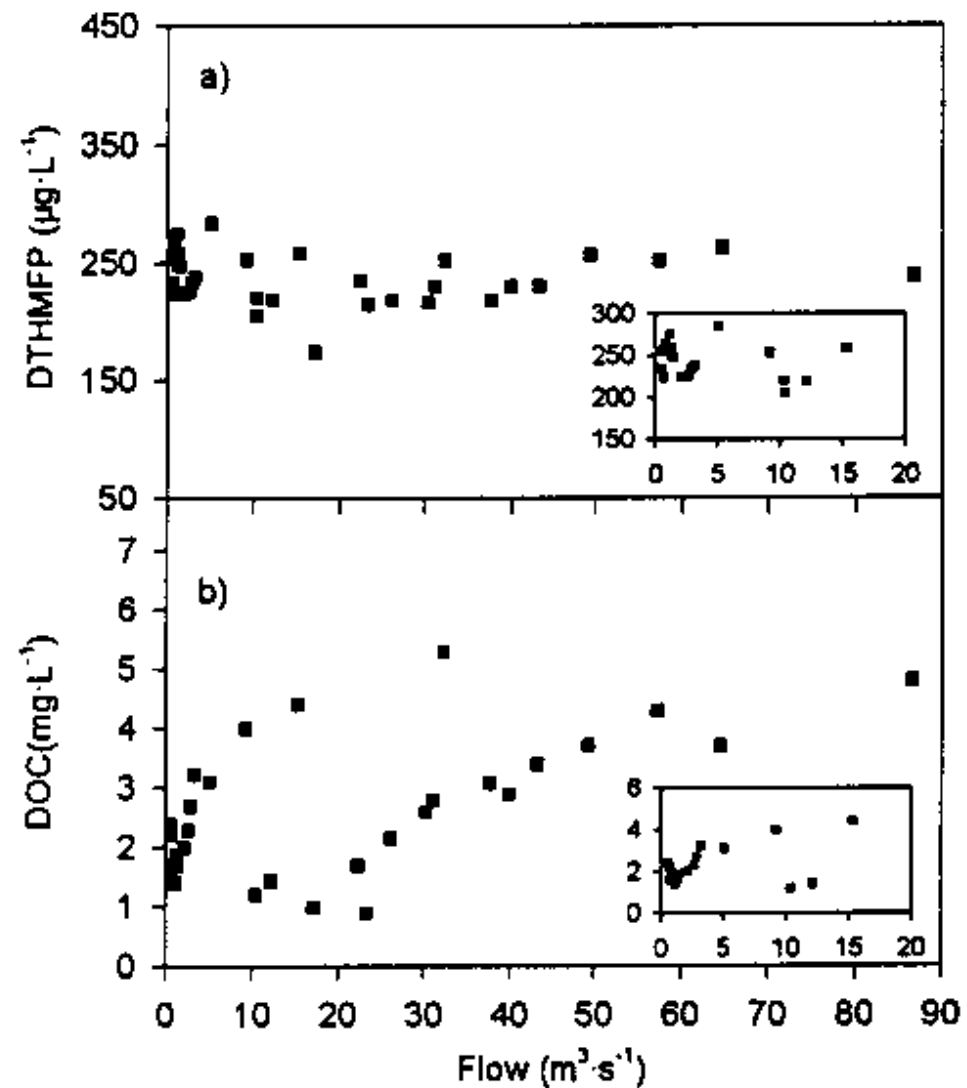


Figure 7.—Evaluation of the relationship between concentration and daily average flow in WBDR: a) DTHMFP (inset for non-event data only), and b) DOC (inset for non-event data only).

Stepczuk et al., 1998, *J. Lake & Res. Mgmt.*, 14(2/3)344-355

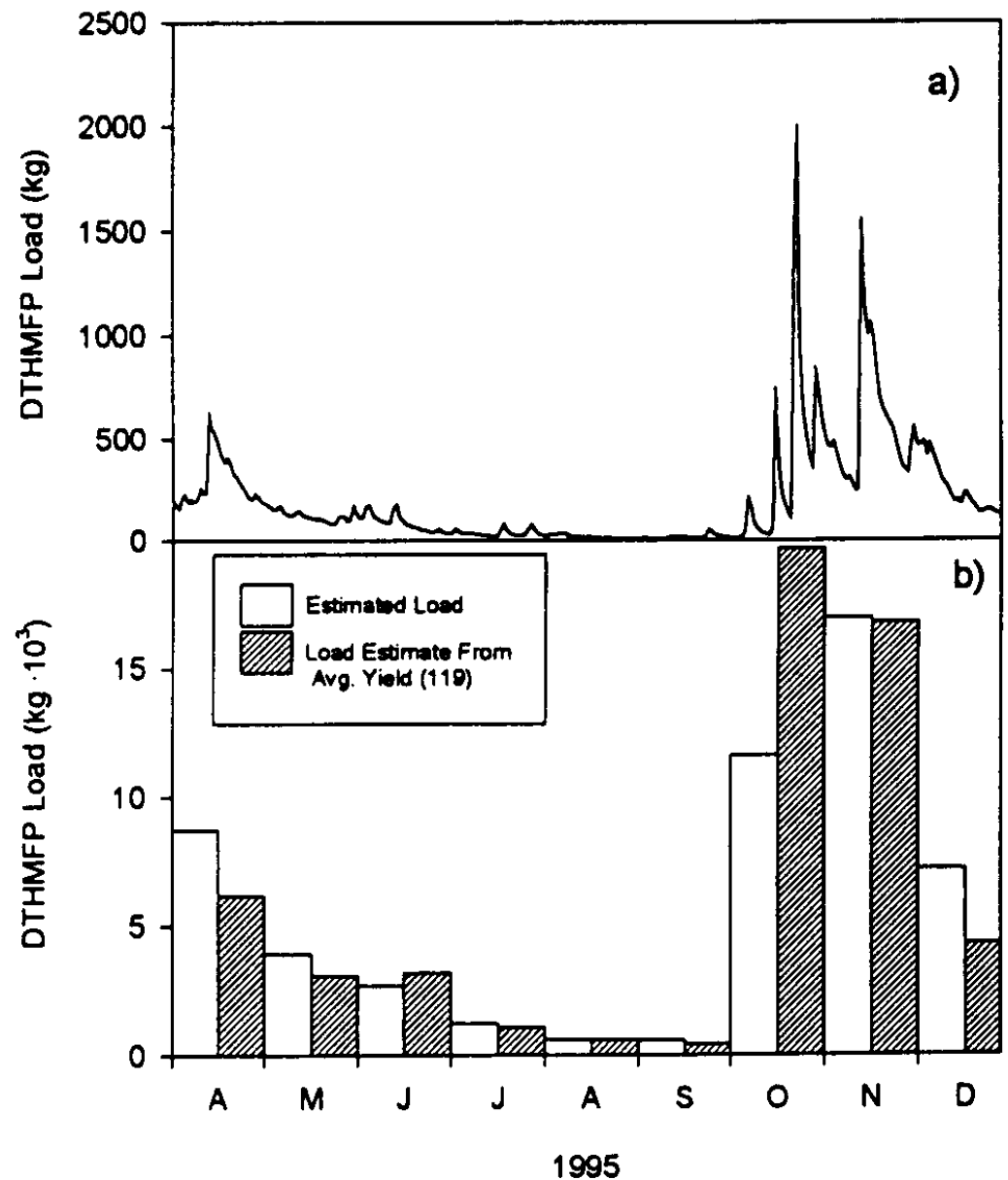
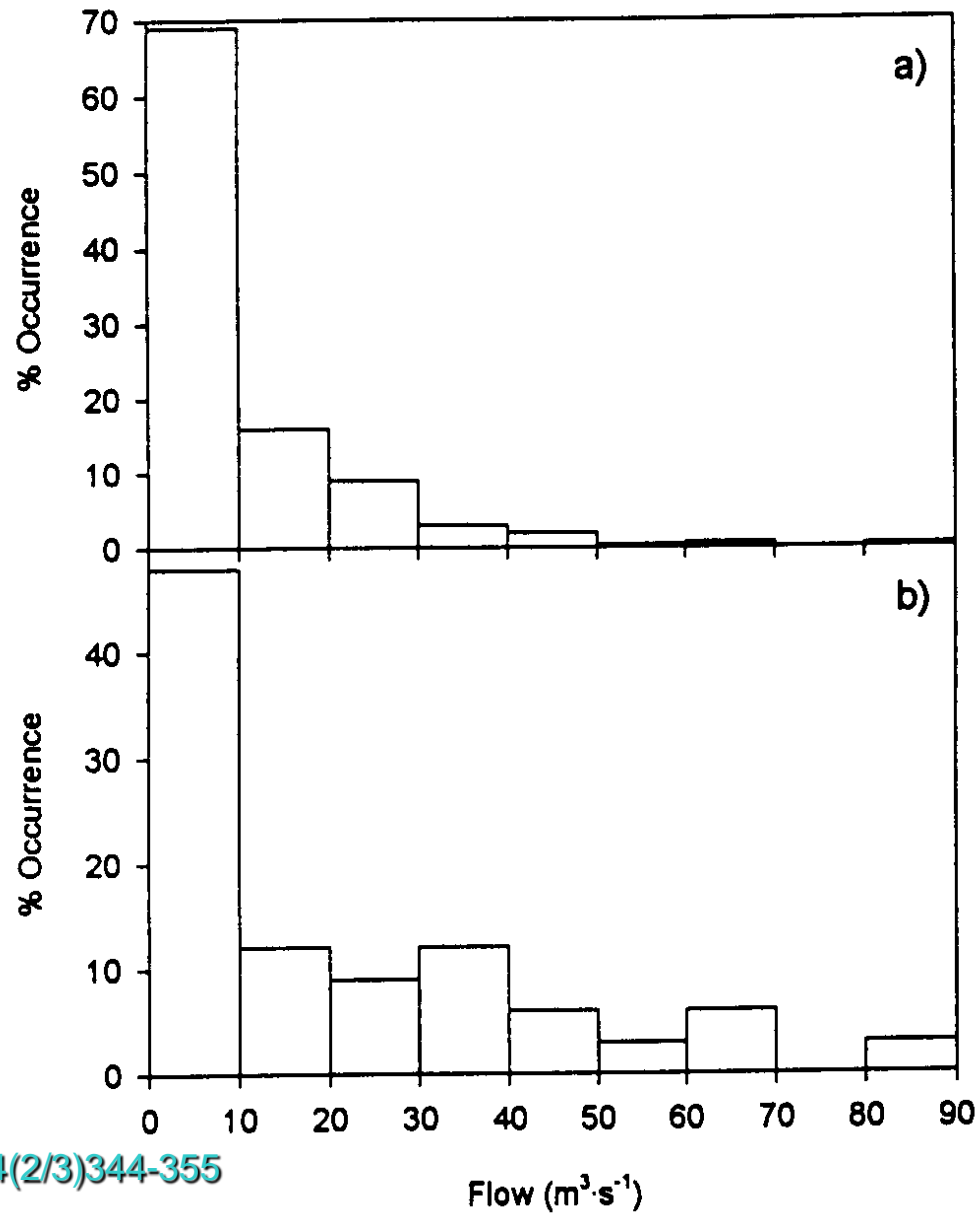


Figure 9. Estimates of DTHMFP loads from WBDR to Cannonville Reservoir, April-December 1995: a) daily, and b) comparison of monthly, from DTHMFP (as in a), and DOC (from a yield of $119 \mu\text{g} \cdot \text{mg}^{-1} \text{C}$) concentrations.



Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

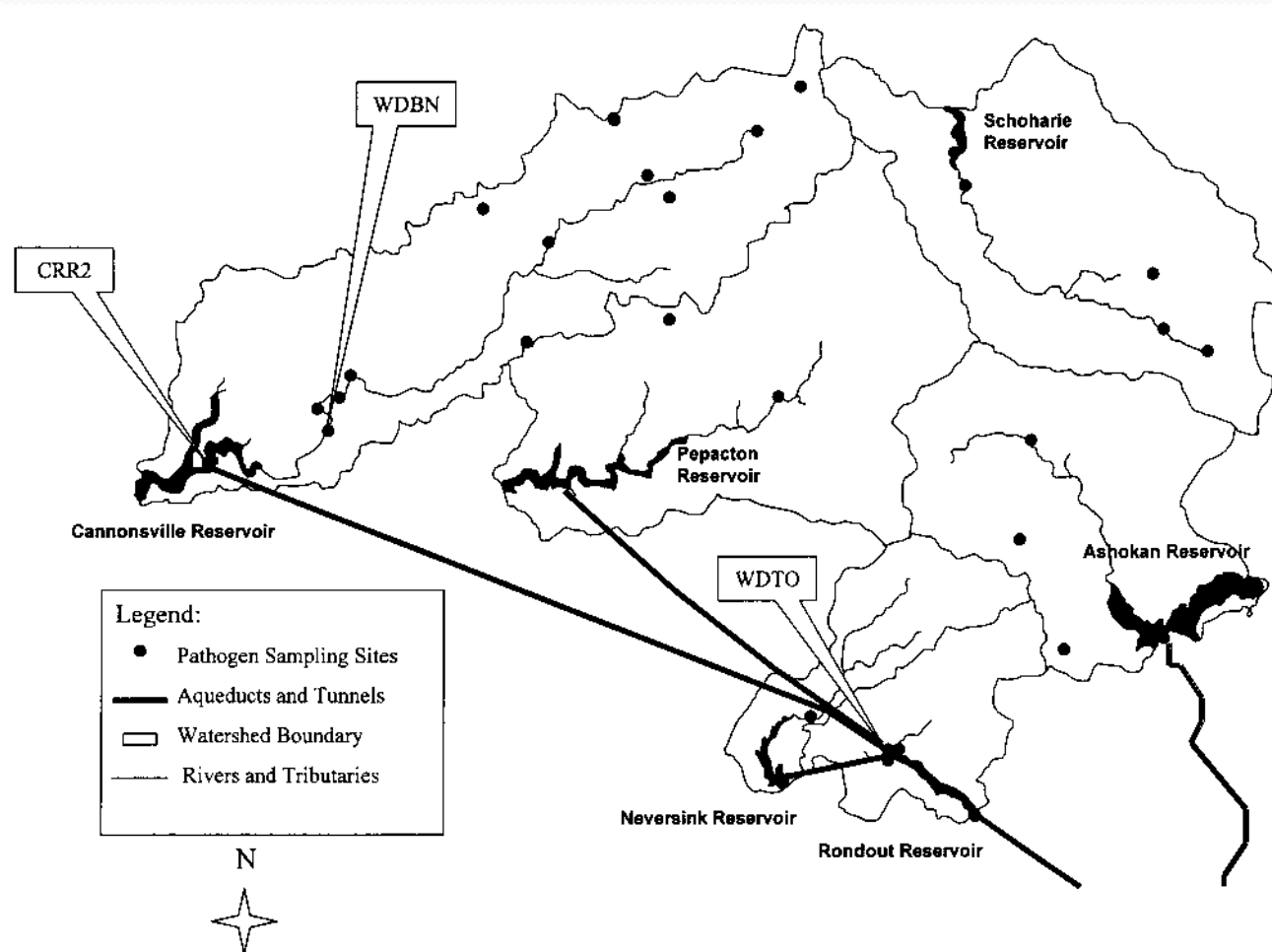


Figure 1.—New York City Department of Environmental Protection pathogen monitoring sites, including sites associated with the Cannonsville Reservoir and watershed.

- The End