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**Algal Nutrient Availability & Limitation in Lake Ontario
during IFYGL. Appendices to Part I. Available Phosphorus
in Urban Runoff and Lake Ontario Tributary Waters**

Texas Univ. at Dallas, Richardson. Ctr for Environmental Studies

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**ALGAL NUTRIENT AVAILABILITY AND LIMITATION
IN LAKE ONTARIO DURING IFYGL**

Appendices to

**Part I. Available Phosphorus in Urban Runoff
and Lake Ontario Tributary Waters**

by

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16. ABSTRACT Samples of Madison urban runoff, precipitation from Madison and New York State were analyzed for various forms of phosphorus to estimate the algal-available fraction of each of these P forms. Urban runoff particulate P forms from Madison runoff showed acid extractable inorganic P in the range of 33 to 46% of the particulate P. Ranges for the OH₂ and for exchange resin extractable inorganic P were 22 to 27 and 13 to 17% of particulate P, respectively. Runoff from urban areas in the Genesee R. basin (N.Y.) showed acid, base, and resin extractable inorganic P in the ranges of 30 to 48, 18 to 30, and 11 to 25% of particulate P, respectively, in general agreement with the Madison samples. Inorganic P extracted from particulate P by resin in long-term aerobic dark incubations was similar to that extracted by the resin in short-term tests, indicating that physical and chemical rather than microbial mineralization processes were probably the key factors regulating the release of inorganic P from the runoff particles to the solution phase. This portion of the report includes the appendices for Part I of this study, published as EPA-600/3-76-094a. Appendices in this section include (1) statistical formulae and other special calculations, (b) bioassays of soluble and particulate phosphorus with <i>S. capricornutum</i>, (3) dark incubations of unfiltered runoff and river water samples, and (4) chloroform treatment of New York river water.		
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APPENDIX A

STATISTICAL FORMULAE AND OTHER SPECIAL CALCULATIONS

1. Arithmetic mean

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

2. Variance

$$s^2 = \frac{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}{n(n-1)}$$

3. Standard deviation

$$s = \sqrt{s^2}$$

4. Coefficient of variation

$$cv = \frac{s}{\bar{x}} \cdot 100\%$$

5. Comparison of two mean values for significant difference.
(Miller and Freund, 1965) *

$\bar{x}_1$ = mean of n_1 observations

$\bar{x}_2$ = mean of n_2 observations

and $\bar{x}_1 > \bar{x}_2$; let $\bar{x}_1 - \bar{x}_2 = \delta$ with null hypothesis $\delta = 0$

and one-sided alternative hypothesis $\delta > 0$

$$\text{Compute } t = \frac{\bar{x}_1 - \bar{x}_2}{s_{\bar{x}_1 - \bar{x}_2}}$$

$$\text{where } s_{\bar{x}_1 - \bar{x}_2} = \sqrt{(n_1-1)s_1^2 + (n_2-1)s_2^2} \cdot \sqrt{\frac{n_1 + n_2}{n_1 n_2 (n_1 + n_2 - 2)}}$$

Compare t and $t_{.05}$, where $t_{.05}$ is taken from a table of

* Miller, I., and Freund, J.E. Probability and Statistics for Engineers, Prentice-Hall, Inc., Englewood Cliffs, N.J., 432 p. (1965).

t values, entered at $n_1 + n_2 - 2$ degrees of freedom. If $t > t_{.05}$, the difference, $\delta = \bar{x}_1 - \bar{x}_2$ is judged significant at the 95% confidence level.

6. Coefficient of variation for PP calculated by difference (TP-TSP)

s_1^2 = variance of 3 TP replicate determinations with mean $\bar{x}_1$

s_2^2 = variance of 3 TSP replicate determinations with mean $\bar{x}_2$

$$PP = \bar{x}_1 - \bar{x}_2$$

$$s_{PP} = s_{\bar{x}_1 - \bar{x}_2} = \sqrt{2s_1^2 + 2s_2^2} \cdot \sqrt{\frac{6}{9(4)}}$$

$$cv = \frac{s_{PP}}{PP} \cdot 100\%$$

7. Least-squares estimators, a and b, of α and β in the linear regression equation $y = \alpha + \beta x$ (Miller and Freund, 1965)

Normal equations: (n = no. of x,y pairs observed)

$$n \sum_{i=1}^n y_i = an + b \sum_{i=1}^n x_i$$

$$n \sum_{i=1}^n x_i y_i = a \sum_{i=1}^n x_i + b \sum_{i=1}^n x_i^2$$

8. Sample correlation coefficient (Miller and Freund, 1965)

$$r = \frac{S_{xy}}{\sqrt{S_{xx} \cdot S_{yy}}}, \text{ where } S_{xx} = n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2$$

$$S_{yy} = n \sum_{i=1}^n y_i^2 - (\sum_{i=1}^n y_i)^2$$

$$S_{xy} = n \sum_{i=1}^n x_i y_i - (\sum_{i=1}^n x_i)(\sum_{i=1}^n y_i)$$

$100 r^2$ = percent of the variation of y which is explained by differences in x

9. Calculation of phosphorus available to anion-exchange resin

$$\left(\begin{array}{l} \text{Available P} \\ \text{conc. in} \\ \text{test flask} \end{array} \right) * = \frac{\mu\text{gP/l in 100 ml Na}_2\text{SO}_4 \text{ resin leachate}}{\text{percent recovery of P from resin/100}} + \frac{\text{DRP in flask supernate}}{(\mu\text{gP/l})}$$

(see Figure 6.2)

10. Smallest detectable available P concentration in an algal growth bioassay

Compute C = a constant with units of cells/ml or Absorbance at 750 nm:

$$C = \bar{x}_{\text{blank}} + t_{.05} \cdot s_{\text{blank}}$$

where $t_{.05}$ is found from a table of t values, entered at n-1 degrees of freedom, for a one-sided t statistic at the 95% confidence level

($\bar{x}_{\text{blank}}$ is the mean value of cultures grown with AAP(-P) medium,

and s_{blank} is the corresponding standard deviation of these cultures).

The smallest detectable P concentration is the P concentration corresponding to C on the standard curve of growth vs. P concentration.

11. Critical values for rejection of outliers in algal growth bioassays (EPA, 1971)

Rank order all observations: $x_1 < x_2 < x_3 < \dots < x_n$

If x_n is a suspected outlier, compute the criterion $c = \frac{x_n - x_{n-1}}{x_n - x_1}$

Reject x_n if c exceeds the appropriate critical value listed below:

<u>n</u>	<u>critical value at 95% confidence level</u>
3	0.941
4	0.765
5	0.642
6	0.560
7	0.507

* Test flask volumes were 100 ml.

APPENDIX B

BIOASSAYS OF SOLUBLE AND PARTICULATE PHOSPHORUS
WITH S. CAPRICORNUTUM

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Table B.1. BIOASSAY OF RUNOFF PARTICLES IN AAP-P MEDIUM

Assay Begun January 9, 1973

A. Standard Curve (all cultures counted after 22 days)

<u>DRP</u> <u>($\mu\text{gP/l}$)</u>	<u>Selenastrum,</u> <u>cells/ml ($\times 10^{-4}$)</u>
0	3
25	47
50	128
100	269

B. Sample Flasks

<u>Sample--Flask</u>	<u>Selenastrum</u> <u>cells/ml ($\times 10^{-4}$)</u>	<u>Available P</u> <u>($\mu\text{gP/l}$)</u>	<u>Available P</u> <u>mean value</u> <u>($\mu\text{gP/l}$)</u>
A-8	1	157	63
	2	153	62
	3	146	59
	4	139	57
			60
B-8	1	82	36
	2	84	36
	3	100	42
	4	92	40
	5	65	29
			37
D-8	1	112	46
	2	105	44
	3	104	44
	4	87	38
	5	101	43
			43
502-1	1	18	8
	2	39	17
	3	15	6
	4	19	9
			10

Table B.2. COMPUTATION OF PARTICULATE P CONCENTRATIONS IN CULTURE FLASKS

Assay Begun January 9, 1973

Runoff Sample	Sample TP	Sample TSP ^a	Mean sample TP-TSP	ml sample filtered/ml AAP(-P) medium	Culture dilution factor	PP in culture flasks
	(µgP/l)					(µgP/l)
A-8	595	375				
	578	375				
	<u>594</u>	<u>367</u>				
mean value	589	372	217	X 100/100	X 25/27	= 201
B-8	690	414				
	705	412				
	<u>702</u>	<u>425</u>				
mean value	699	417	282	X 50/100	X 25/27	= 130
D-8	680	351				
	712	354				
	<u>695</u>	<u>364</u>				
mean value	696	356	340	X 50/100	X 25/27	= 157
502-1	59	35				
	63	36				
	<u>59</u>	<u>35</u>				
mean value	60	35	25	X 200/100	X 25/27	= 46

^aDetermined on filtrates taken at the time of filtration for collecting sample particles on membrane filters.

Table B.3 BIOASSAY OF RUNOFF PARTICLES IN 3X AAP-P MEDIUM

Assay Begun January 17, 1973

A. Standard Curve^a (all cultures grown 20 days)

DRP ($\mu\text{gP/l}$)	Selenastrum cells/ml ($\times 10^{-4}$)
0	0
25	35
50	90
100	247
<u>200</u>	<u>446</u>

B. Sample Flasks^b

Sample--Flask	Selenastrum cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
A-9	1	132	62
	2	112	55
	3	143	66
	4	131	62
	5	175	77
	6	152	<u>70</u>
	Mean value	65	185
B-9	1	82	44
	2	75	42
	3	72	41
	4	53	34
	5	51	33
	6	73	<u>41</u>
	Mean value	39	97
P-9	1	123	59
	2	103	51
	3	88	47
	4	114	55
	5	96	49
	6	95	<u>48</u>
	Mean value	52	94

^a 25 ml 3X AAP-P medium + one ml cells + one ml (27X) DRP spike; values are average of 6 flasks.

^b Particles from runoff samples in 25 ml 3X AAP-P medium + one ml cells + one ml water

Table B.4. BIOASSAY OF RUNOFF PARTICLES IN AAP-P MEDIUM

Assay Begun February 2, 1973

A. Standard Curve (all cultures grown 19 days)

DRP ($\mu\text{gP/l}$)	Selenastrum cells/ml ($\times 10^{-4}$)
0	7
25	64
50	120
100	248
200	499

B. Sample Flasks

Sample--Flask	Selenastrum cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
D-11	1	143	58
	2	137	56
	3	124	50
	4	112	46
	5	88	37
	Mean value	49	209
E-11	1	51	28
	2	41	18
	3	46	21
	4	45	20
	5	28	12
	Mean value	19	254
H-11	1	357	143
	2	345	138
	3	341	137
	4	370	149
	Mean value	142	469

Table B.5. BIOASSAY OF RUNOFF PARTICLES IN AAP-P MEDIUM

Assay Begun March 7, 1973

A. Standard Curve (all cultures grown 20 days)

DRP ($\mu\text{gP/l}$)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	8
25	64
50	126
100	254
200	516

B. Sample Flasks

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
A-12	1	215	84	
	2	238	93	
	3	203	79	189
	4	206	81	176
	5	162	<u>63</u>	<u>173</u>
		Mean value	80	179
B-12	1	167	65	
	2	168	66	
	3	137	53	186
	4	138	54	189
	5	151	<u>59</u>	<u>192</u>
		Mean value	59	189
D-12	1	74	30	
	2	85	34	
	3	81	32	118
	4	71	28	120
	5	79	<u>31</u>	<u>125</u>
		Mean value	31	121
I-12	1	141	55	
	2	129	50	
	3	153	60	359
	4	152	59	347
	5	163	<u>64</u>	<u>361</u>
		Mean value	58	365

Table B.6. BIOASSAY OF SOLUBLE PHOSPHORUS IN URBAN RUNOFF

Assay Begun January 6, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)
0	0.015
25	0.079
50	0.142
100	0.217

B. Sample Flasks^a

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	Chemical analyses:	
				DRP in Cultures ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
A-8	1	0.199	83		
	2	0.170	64		
	3	0.178	70		
	4	0.190	77		
	5	0.185	<u>73</u>		
		Mean value	73	66	68
B-8	1	0.210	93		
	2	0.203	86		
	3	0.210	93		
	4	0.191	77		
	5	0.190	<u>77</u>		
		Mean value	85	76	81
D-8	1	0.170	64		
	2	0.185	74		
	3	0.195	80		
	4	0.190	77		
	5	0.185	<u>73</u>		
		Mean value	74	61	65

^a Five ml of filtered runoff and 20 ml (5/4X) AAP-P + one ml cells + one ml water; cultures spiked with 1X nitrate (AAP) after 6 days

Table B.7. BIOASSAY OF SOLUBLE PHOSPHORUS IN URBAN RUNOFF
Assay Begun January 19, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)
0	0.007
50	0.118
100	0.215
150	0.289
200	0.361

B. Sample Flasks^a

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	Chemical Analyses: DRP in TSP in Cultures Cultures ($\mu\text{gP/l}$) ($\mu\text{gP/l}$)	
A-9	1	0.495	All > 200	161	181
	2	0.470			
	3	0.480			
	4	0.499			
	5	0.460			
B-9	1	0.460	All > 200	150	167
	2	0.460			
	3	0.460			
	4	0.450			
	5	0.455			
F-9	1	0.269	133		
	2	0.281	141		
	3	0.290	148		
	4	0.272	135		
	5	0.275	<u>137</u>		
Mean value			139	90	102

^a Five ml of filtered runoff sample + 20 ml (5/4X AAP-P) medium + one ml water + one ml cells.

Table B.8. BIOASSAY OF SOLUBLE PHOSPHORUS IN URBAN RUNOFF

Assay Begun March 6, 1973

(See assay of January 19)

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)
0	0.017
100	0.166
200	0.328
300	0.432
400	0.509

B. Sample Flasks^a

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	Chemical analysis: TSP in Culture Flask ($\mu\text{gP/l}$)
B-9	1	0.455	327	167
	2	0.465	342	
	3	0.475	355	
	4	0.470	348	
	5	0.465	342	
		mean value	343	
B-9 + 50 $\mu\text{gP/l}$	1	0.500	391	217
	2	0.530	> 400	
	3	0.522	> 400	
	4	0.525	> 400	
	5	0.510	> 400	
		mean value	> 398	
B-9 + 100 $\mu\text{gP/l}$	1	0.525	> 400	267
	2	0.535	> 400	
	3	0.535	> 400	
	4	0.540	> 400	
	5	0.548	> 400	

^a Five ml of same sample as used in Jan. 19, 1973 assay, + 20 ml (5/4X) AAP-P medium + one ml cells + one ml water + one ml water or DRP (27X) spike

Table B.9. BIOASSAY OF SOLUBLE PHOSPHORUS IN URBAN RUNOFF

Assay Begun February 9, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)
0	0.010
25	0.070
50	0.116
100	0.206
200	0.365

B. Sample Flasks^a

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	DRP in Cultures ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
D-10	1	0.127	59	45	50
	2	0.125	58		
	3	0.121	56		
	4	0.120	56		
	5	0.125	58		
	mean value		57		
E-10	1	0.020	4	24	30
	2	0.023	5		
	3	0.025	5		
	4	0.025	5		
	5	0.025	5		
	mean value		5		
H-10	1	0.113	52	81	98
	2	0.091	41		
	3	0.101	46		
	4	0.100	45		
	5	0.103	47		
	mean value		46		
D-11	1	0.090	40	47	48
	2	0.111	50		
	3	0.105	48		
	4	0.103	47		
	5	0.105	48		
	mean value		47		

Table B.9. (continued)

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	DRP in Cultures ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
E-11	1	0.034	10	22	25
	2	0.023	4		
	3	0.029	8		
	4	0.030	8		
	5	0.022	4		
		mean value	7		
H-11	1	0.040	13	20	21
	2	0.041	14		
	3	0.032	8		
	4	0.045	16		
	5	0.035	11		
		mean value	12		

^a Samples D-10, D-11, H-11: five ml filtered runoff + 20 ml (5/4X) AAP(-P) medium + one ml cells + one ml of water
 Samples E-10, H-10, E-11: 20 ml filtered runoff + five ml (5X) AAP(-P) medium + one ml cells + one ml water

Table B.10. BIOASSAY OF SOLUBLE PHOSPHORUS IN URBAN RUNOFF
Assay Begun March 13, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)
0	0.010
25	0.042
50	0.081
100	0.141

B. Sample Flasks^a

Sample--flask ^a	Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	DRP in Cultures ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
A-12	1	0.121	85	49
	2	0.099	68	51
	3	0.135	95	
	4	0.122	85	
	5	0.122	85	
		mean value	84	
B-12	1	0.165	120	64
	2	0.160	115	65
	3	0.161	116	
	4	0.160	115	
		Mean value	116	
D-12	1	0.110	76	46
	2	0.110	76	48
	3	0.096	65	
	4	0.108	74	
	5	0.092	62	
		mean value	71	
I-12	1	0.029	14	22
	2	0.028	13	34
	3	0.025	11	
	4	0.028	13	
	5	0.025	11	
		mean value	12	

^aSamples A-12, B-12, D-12: five ml filtered runoff + 20 ml (5/4X) AAP(-P) medium + one ml cells + one ml water. Sample I-12: 20 ml filtered runoff + five ml (5X) AAP(-P) medium + one ml cells + one ml water

Table B.11. BIOASSAY OF PARTICLES FROM MADISON SNOW SAMPLES

Assay Begun April 27, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	9
10	26
25	62
50	167
100	305
200	647

B. Sample Flasks

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
Snow	1	48	20	
Picnic Pt.	2	29	11	
	3	33	12	
	4	31	12	82
	5	41	17	83
		Mean value	14	82
Snow	1	1	< 2	
Roof of	2	0	< 2	
City-County	3	1	< 2	
Bldg.	4	2	< 2	118
	5	2	< 2	118
		Mean value	< 2	118
Snow	1	86	35	
Near Meat	2	68	27	
Packing	3	64	26	135
Plant	4	77	31	127
		Mean value	30	131

**Table B.12. BIOASSAY OF PHOSPHORUS IN UNFILTERED NEW YORK
RAIN GAGE SAMPLES**

Assay Begun July 16, 1973

A. Standard Curve

<u>DRP</u> <u>($\mu\text{gP/l}$)</u>	<u>Selenastrum</u> <u>cells/ml ($\times 10^{-4}$)</u>
0	10
10	38
25	86
50	154

B. Sample Flasks

<u>Sample--Flask</u>	<u>Selenastrum</u> <u>cells/ml ($\times 10^{-4}$)</u>	<u>Available P</u> <u>($\mu\text{gP/l}$)</u>	<u>TP in Cultures</u> <u>($\mu\text{gP/l}$)</u>
May 601	1	111	35
	2	88	27
	3	102	32
	4	93	29
	5	102	32
	mean value	31	311
May 602	1	22	4
	2	19	3
	3	18	3
	4	18	3
	5	17	3
	mean value	3	64
May 606	1	6	< 2
	2	5	< 2
	3	6	< 2
	4	6	< 2
	5	4	< 2
	mean value	< 2	325
June 601	1	78	24
	2	98	31
	3	96	30
	4	98	31
	5	103	32
	mean value	31	53

Table B.12. (continued)

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	TP in Cultures ($\mu\text{gP/l}$)
June 603	1	14	2	
	2	19	3	
	3	18	3	77
	4	22	4	74
	5	19	<u>3</u>	<u>84</u>
		mean value	3	78
June 604	1	117	37	
	2	172	56	
	3	137	44	47
	4	114	36	49
	5	124	<u>40</u>	<u>47</u>
		mean value	43	48

The following samples were quantitated by comparison of their Absorbance at 750 nm (A_{750}), compared to the mean A_{750} of the 10 $\mu\text{gP/l}$ standard = 0.035:

Sample	Average A_{750}	Approximate Available P ($\mu\text{gP/l}$)	Average TP in Cultures ($\mu\text{gP/l}$)
May 603	0.009	< 10	3
May 604	0.011	< 10	4
May 605	0.025	< 10	259
June 602	0.011	< 10	7
June 605	0.012	< 10	7
June 606	0.012	< 10	9
June 608	0.017	< 10	256

Table B.13. BIOASSAY OF RUNOFF PARTICLES IN AAP-P MEDIUM

Assay Begun December 21, 1973

A. Standard Curve^a

DRP ($\mu\text{gP/l}$)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	≤ 1
25	65
50	118
100	193

B. Sample Flasks^b

Sample--Flask	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
502-1 1	29	10	
2	10	3	
3	12	4	
4	24	8	
5	38	14	40
6	36	13	44
	mean value	9	43

^a 25 ml AAP-P + one ml cells + one ml DRP (27X) spike (27 ml volume); values are averages of six flasks

^b Particles from sample 502-1 in 25 ml AAP-P medium + one ml cells (26 ml volume)

Table B.14. BIOASSAY OF AVAILABLE P IN AUTOCLAVED
NEW YORK RIVER WATERS

Assay Begun March 29, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)
0	0.010
25	0.050
50	0.090
100	0.180
200	0.339

B. Sample Flasks

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 27	1	0.010	< 1	
	2	0.010	< 1	
	3	0.010	< 1	
	4	0.010	< 1	4
	5	0.010	< 1	5
		mean value	< 1	4
No. 28	1	0.119	68	
	2	0.115	64	
	3	0.110	60	
	4	0.121	68	47
	5	0.111	60	47
		mean value	64	47
No. 29	1	0.165	95	
	2	0.149	85	
	3	0.155	88	
	4	0.160	91	56
	5	0.178	102	56
		mean value	92	56

Table B.15. BIOASSAY OF 507-7 PARTICLES IN AAP (-P) MEDIUM
Assay Begun March 29, 1973

Sample--Flask		Selenastrum* Cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
507-7	1	0	0	
	2	0	0	
	3	0	0	62
	4	0	0	62
	5	0	<u>0</u>	<u>58</u>
		mean value	0	61

* No cell counts were made for standards since the growth in the samples was negligible.

Table B.16. BIOASSAY OF PARTICLES FROM NEW YORK
RIVER WATERS AND GENESEE R. BASIN
SAMPLES IN AAP-P MEDIUM

Assay Begun April 14, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	1
25	64
50	107
100	227
200	572

B. Sample Flasks

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
				124
No. 34	1	8	3	123
	2	6	2	116
	3	9	4	108
	4	11	5	118
	5	6	2	126
		mean value	3	119
No. 502-7	1	76	33	
	2	70	31	
	3	79	35	142
	4	56	25	140
	5	53	24	128
		mean value	30	137
No. 502-8	1	30	13	
	2	43	19	
	3	56	25	99
	4	53	23	99
	5	52	23	103
		mean value	21	100

Table B.16. (continued)

Sample--Flask		Selenastrum cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No.	1	9	4	
504-8	2	9	4	
	3	9	4	57
	4	12	5	55
	5	7	<u>3</u>	<u>60</u>
		mean value	4	57
No.	1	4	1	
507-8	2	7	3	
	3	10	4	68
	4	6	2	65
	5	5	<u>2</u>	<u>59</u>
		mean value	2	64

Table B.17. BIOASSAY OF AVAILABLE P IN AUTOCLAVED
NEW YORK RIVER WATERS

Assay Begun April 14, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)
0	0.000
25	0.052
50	0.071
100	0.131
200	0.228

B. Sample Flasks

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 31	1	0.055	40	
	2	0.058	42	30
	3	0.053	38	28
	4	0.055	40	31
		mean value	40	30
No. 32	1	0.004	1	
	2	0.004	1	
	3	0.004	1	
	4	0.004	1	6
	5	0.004	1	6
		mean value	1	6
No. 33	1	0.010	5	
	2	0.010	5	
	3	0.012	7	
	4	0.011	5	10
	5	0.010	5	10
		mean value	5	10

Table B.17 (continued)

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 34	1	0.047	32	
	2	0.046	32	
	3	0.042	30	30
	4	0.047	32	30
	5	0.045	<u>31</u>	<u>29</u>
		mean value	31	30
No. 35	1	0.125	95	
	2	0.113	85	
	3	0.120	90	53
	4	0.122	92	52
	5	0.129	<u>100</u>	<u>53</u>
		mean value	92	53
No. 36	1	0.013	7	
	2	0.010	5	
	3	0.019	12	14
	4	0.018	11	16
	5	0.019	<u>12</u>	<u>14</u>
		mean value	9	15

Table B.18. BIOASSAY OF PARTICLES FROM NEW YORK RIVER AND
GENESEE R. BASIN SAMPLES IN AAP-P MEDIUM

Assay Begun May 8, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	10
25	77
50	157
100	323
200	625

B. Sample Flasks

Sample--Flask	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 42 1	56	18	
2	83	27	
3	34	10	187
4	9	< 2	190
5	1	< 2	185
	mean value	< 12	187
No. 43 1	4	< 2	
2	5	< 2	
3	0	< 2	
4	0	< 2	306
5	0	< 2	308
	mean value	< 2	309
No. 44 1	17	3	
2	22	5	137
3	18	3	128
4	23	5	133
	mean value	4	133

Table B.18 (continued)

Sample--Flask		Selenastrum cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No.	1	236	73	
502-10	2	282	87	
	3	372	114	333
	4	93	29	320
	5	299	92	331
		mean value	79	328
No.	1	5	< 3	
507-12	2	0	< 3	
	3	1	< 3	207
	4	0	< 3	204
	5	0	< 3	218
		mean value	< 3	210

Table B.19. BIOASSAY OF AVAILABLE P IN AUTOCLAVED
NEW YORK RIVER WATERS

Assay Begun May 8, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)
0	0.010
25	0.046
50	0.092
100	0.183
200	0.281

B. Sample Flasks

Sample--Flask	Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 40 1	0.010	< 1	
2	0.010	< 1	
3	0.010	< 1	
4	0.011	< 1	5
5	0.010	< 1	3
	mean value	< 1	4
No. 41 1	0.010	< 1	
2	0.010	< 1	
3	0.010	< 1	
4	0.010	< 1	5
5	0.010	< 1	4
	mean value	< 1	4
No. 42 1	0.060	31	
2	0.055	28	
3	0.060	31	
4	0.062	32	32
5	0.055	28	32
	mean value	30	32

Table B.19. (continued)

Sample--Flask		Absorbance (750 nm)	Available P (μ gP/l)	TSP in Cultures (μ gP/l)
No. 43	1	0.079	42	
	2	0.079	42	
	3	0.087	48	
	4	0.078	42	39
	5	0.060	<u>32</u>	<u>39</u>
		mean value	41	39

Table B.20. BIOASSAY OF PARTICLES FROM NEW YORK RIVER AND
GENESEE R. BASIN SAMPLES IN AAP-P MEDIUM

Assay Begun May 22, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	5
10	29
25	87
100	347

B. Sample Flasks

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 47	1	25	8	
	2	16	5	
	3	14	4	239
	4	21	6	230
	5	4	< 2	238
		mean value	< 5	236
No. 502-11	1	2	< 2	164
	2	2	< 2	164
	3	2	< 2	164
	4	1	< 2	164
		mean value	< 2	164
No. 507-11	1	5	< 2	
	2	4	< 2	
	3	3	< 2	70
	4	5	< 2	68
	5	5	< 2	66
		mean value	< 2	68

Table B.21. BIOASSAY OF AVAILABLE P IN AUTOCLAVED
NEW YORK RIVER WATERS

Assay Begun May 22, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	0.009	5
10	0.031	29
25	0.075	87
50	0.098	--
100	0.209	341
200	0.308	--
300	0.395	--
400	0.423	--

B. Sample Flasks

Sample--Flask	Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 47 1	0.125	61	
2	0.125	61	
3	0.128	63	56
4	0.122	60	53
5	0.130	67	51
	mean value	61	53

C. Comparison: quantitation by cell counting

Sample--Flask	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 47 1	140	40	
2	141	41	
3	138	40	
4	139	40	
5	147	42	
	mean value	41	53

Table B.22. BIOASSAY OF AVAILABLE P IN AUTOCLAVED
NEW YORK RIVER WATERS

Assay Begun May 31, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	(A) Absorbance (750 nm)	(S) <u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	DRP ($\mu\text{gP/l}$)	(A)	(S)
0	0.008	6	400	0.404	1169
10	0.026	28	500	0.437	1241
25	0.053	74	600	0.459	1365
50	0.097	163			
100	0.186	323			
200	0.301	742			
300	0.363	1002			

B. Sample Flasks

Sample--Flask	Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 49 1	0.011	< 3	
2	0.011	< 3	
3	0.010	< 3	12
4	0.010	< 3	13
5	0.010	< 3	11
	mean value	< 3	12
No. 50 1	0.010	< 3	
2	0.010	< 3	
3	0.010	< 3	13
4	0.011	< 3	10
5	0.010	< 3	12
	mean value	< 3	12
No. 51 1	0.229	126	
2	0.242	137	
3	0.261	150	84
4	0.219	120	85
5	0.274	163	82
	mean value	139	83

Table B.22. (continued)

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 52	1	0.130	68	
	2	0.137	71	52
	3	0.132	69	58
	4	0.133	69	53
		mean value	69	54
No. 53	1	0.031	12	
	2	0.045	21	
	3	0.039	16	28
	4	0.040	17	27
	5	0.041	18	27
		mean value	17	27

C. Comparison: quantitation by cell counting

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 51	1	300	92	
	2	302	92	
	3	296	90	
	4	310	94	
		mean value	92	83
No. 52	1	151	50	
	2	156	51	
	3	150	50	
	4	154	51	
		mean value	50	54

Table B.23. BIOASSAY OF PARTICLES FROM NEW YORK
RIVER AND GENESEE R. BASIN SAMPLES
IN AAP-P MEDIUM

Assay Begun May 31, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Selenastrum cells/ml ($\times 10^{-4}$)	DRP ($\mu\text{gP/l}$)	Selenastrum cells/ml ($\times 10^{-4}$)
0	6	400	1169
10	28	500	1241
25	74	600	1365
50	163		
100	323		
200	742		
300	1002		

B. Sample Flasks

Sample--Flask	Selenastrum cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 50 1	15	4	
2	23	7	
3	1	< 3	79
4	18	5	78
5	11	< 3	79
	mean value	< 4	79
No. 50 1	138	46	
(auto- 2	131	43	
claved) 3	138	46	
4	122	41	
5	156	51	
	mean value	45	79
No. 50 + 1	287	88	
50 $\mu\text{gP/l}$ 2	251	78	
(auto- 3	266	82	
claved) 4	278	85	
	mean value	83	

Table B.23. (continued)

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 51	1	9	< 3	
	2	11	< 3	117
	3	2	< 3	116
	4	1	< 3	112
		mean value	< 3	115
No. 51	1	159	52	
	2	155	51	
	3	136	45	
	4	131	43	
	5	132	44	
		mean value	47	115
No. 51 + 50 $\mu\text{gP/l}$ (auto- claved)	1	299	91	
	2	307	93	
	3	279	85	
		mean value	90	
No. 52	1	4	< 3	
	2	2	< 3	
	3	2	< 3	135
	4	0	< 3	137
	5	0	< 3	150
		mean value	< 3	141
No. 52 (auto- claved)	1	169	55	
	2	204	65	
	3	217	69	
	4	202	65	
	5	160	55	
		mean value	62	141
No. 53	1	0	< 3	
	2	4	< 3	
	3	0	< 3	65
	4	1	< 3	69
	5	1	< 3	65
		mean value	< 3	66

Table B. 23 (continued)

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 53 (auto- claved)	1	71	24	
	2	92	31	
	3	107	36	
	4	61	20	
	5	110	<u>37</u>	
		mean value	30	66

**Table B.24. BIOASSAY OF PARTICLES FROM GENESEE R.
BASIN SAMPLES IN AAP-P MEDIUM**

Assay Begun June 5, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Selenastrum cells/ml ($\times 10^{-4}$)
0	5
10	29
25	73
50	173
100	329
200	639
300	994

B. Sample Flasks

Sample--Flask	Selenastrum cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 501-12^a			
1	19	5	
2	4	< 2	
3	12	3	147
4	16	4	136
5	15	4	155
	mean value	< 4	146
No. 502-12			
1	4	< 2	
2	32	9	
3	19	5	79
4	35	10	78
5	19	5	85
	mean value	< 6	81

^aInoculated on June 6, 1967, with same cell suspension used on standards and sample No. 502-12 on June 5, 1973.

Table B.25. BIOASSAY OF AVAILABLE P IN AUTOCLAVED
NEW YORK RIVER WATERS

Assay Begun June 5, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	0.010	5
10	0.027	29
25	0.056	73
50	0.098	173
100	0.202	329
200	0.302	639
300	0.381	994

B. Sample Flasks

Sample--Flask	Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 52 ^a 1	0.152	77	
2	0.150	76	
3	0.149	75	52
4	0.145	73	58
5	0.159	81	53
	mean value	76	54
No. 52 + 1	0.230	125	
25 $\mu\text{gP/l}$ 2	0.205	130	
3	0.238	131	
4	0.235	129	
5	0.227	123	
	mean value	127	79
No. 52 + 1	0.280	171	
50 $\mu\text{gP/l}$ 2	0.290	182	
3	0.280	171	
4	0.240	132	
5	0.255	147	
	mean value	161	104

^a 20 ml of sample No. 52 + one ml cells + one ml of water or 27X ortho-phosphate spike; the sample No. 52 used in these tests was the same as used in the bioassay begun May 31, 1973.

Table B.25 (continued)

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 52 + 100 $\mu\text{gP/l}$	1	0.301	196	
	2	0.302	197	
	3	0.329	230	
	4	0.342	248	
	5	0.320	220	
		mean value	218	54
No. 52 + 200 $\mu\text{gP/l}$	1	0.362	277	
	2	0.321	221	
	3	0.339	243	
	4	0.345	252	
	5	0.340	245	
		mean value	248	254

C. Comparison: quantitation by counting cells

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 52	1	158	48	
	2	151	46	
	3	171	53	
	4	159	49	
	5	169	52	
		mean value	50	54

Table B.26. BIOASSAY OF PARTICLES FROM NEW YORK RIVER
WATERS AND GENESEE RIVER BASIN SAMPLES

Assay Begun June 25, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	2
10	20
25	78
50	172
100	374
200	746

B. Sample Flasks

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 56 (auto- claved)	1	86	27	
	2	97	30	
	3	93	29	87
	4	91	28	84
	5	108	<u>33</u>	<u>90</u>
		mean value	29	87
No. 58 (not auto- claved)	1	competing algae		
	2	present; could		
	3	not count <u>S.</u>		
	4	<u>capricornutum</u>		
	5	accurately		
No. 58 (auto- claved)	1	252	70	
	2	298	82	
	3	385	105	231
	4	380	103	246
	5	235	<u>66</u>	<u>234</u>
		mean value	85	237

Table B.26 (continued)

Sample--Flask		Selenastrum cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 59 (auto- claved)	1	203	58	
	2	183	52	
	3	191	55	163
	4	158	46	163
	5	170	<u>49</u>	<u>162</u>
		mean value	52	163
No. 60 (auto- claved)	1	160	46	
	2	156	45	
	3	155	45	196
	4	198	57	190
	5	178	<u>51</u>	<u>182</u>
		mean value	49	189
No.501-13 (auto- claved)	1	46	16	
	2	48	17	
	3	49	17	99
	4	49	17	106
	5	50	<u>17</u>	<u>103</u>
		mean value	17	103
No.507-13 (auto- claved)	1	45	16	
	2	56	20	
	3	51	18	221
	4	51	18	225
	5	42	<u>15</u>	<u>225</u>
		mean value	17	224

Table B.27. BIOASSAY OF AVAILABLE P IN AUTOCLAVED
NEW YORK RIVER WATERS

Assay Begun June 25, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Absorbance (750 nm)	<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)
0	0.004	2
10	0.025	20
25	0.067	78
50	0.102	172
100	0.225	374
200	0.318	746
300	0.404	-

B. Sample Flasks

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 56	1	0.019	7	
	2	0.018	7	
	3	0.019	7	13
	4	0.020	7	13
		mean value	7	13
No. 56 + 25 $\mu\text{gP/l}$	1	0.100	43	
	2	0.111	48	
	3	0.109	46	
	4	0.105	45	
	5	0.112	48	
		mean value	46	38
No. 57	1	0.011	3	
	2	0.010	3	
	3	0.015	5	
	4	0.011	3	11
	5	0.010	3	11
		mean value	3	11
No. 57 + 25 $\mu\text{gP/l}$	1	0.102	43	
	2	0.102	43	
	3	0.101	42	
	4	0.102	43	
	5	0.105	45	
		mean value	43	36

Table B.27. (continued)

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 58	1	0.140	60	
	2	0.139	60	
	3	0.138	60	
	4	0.142	62	50
	5	0.140	<u>60</u>	<u>50</u>
		mean value	60	50
No. 58 + 25 $\mu\text{gP/l}$	1	0.228	101	
	2	0.211	93	
	3	0.225	100	
	4	0.235	106	
	5	0.230	<u>102</u>	
		mean value	100	75
No. 59	1	0.152	67	
	2	0.160	70	
	3	0.158	69	57
	4	0.162	<u>72</u>	<u>55</u>
		mean value	70	56
No. 59 + 25 $\mu\text{gP/l}$	1	0.241	110	
	2	0.245	112	
	3	0.240	110	
	4	0.245	112	
	5	0.240	<u>110</u>	
		mean value	111	81
No. 59 ($\frac{1}{2}\text{X}$) ^a	1	0.080	33	
	2	0.079	33	
	3	0.080	33	
	4	0.078	<u>32</u>	
		mean value	33	28
No. 59 ($\frac{1}{2}\text{X}$) ^a + 25 $\mu\text{gP/l}$	1	0.180	80	
	2	0.187	82	
	3	0.183	81	
	4	0.185	82	
	5	0.188	<u>83</u>	
		mean value	82	53

^aTen ml of sample No. 59 diluted to 20 ml with glass dist. water before assay.

Table B.27. (continued)

Sample--Flask		Absorbance (750 nm)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 60	1	0.065	27	
	2	0.070	29	
	3	0.065	27	38
	4	0.069	<u>28</u>	<u>38</u>
		mean value	28	38
No. 60 + 25 $\mu\text{gP/l}$	1	0.169	75	
	2	0.170	75	
	3	0.170	75	
	4	0.166	73	
	5	0.173	<u>77</u>	
		mean value	75	63

C. Comparison: quantitation by counting cells

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	TSP in Cultures ($\mu\text{gP/l}$)
No. 56	1	13	7	
	2	12	7	
	3	15	8	
	4	15	8	
	5	9	<u>5</u>	
		mean value	7	13
No. 56 + 25 $\mu\text{gP/l}$	1	101	31	
	2	114	34	
	3	97	30	
	4	115	34	
	5	106	<u>32</u>	
		mean value	32	38

Recovery of 25 $\mu\text{gP/l}$ spike = 100%

**Table 3.28. BIOASSAY OF PARTICLES FROM GENESEE R. BASIN
SAMPLES IN AAP-P MEDIUM**

Assay Begun July 2, 1973

A. Standard Curve

DRP ($\mu\text{gP/l}$)	Selenastrum cells/ml ($\times 10^{-4}$)
0	7
10	23
25	94
50	162
100	336

B. Sample Flasks

Sample--Flask	Selenastrum cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 501-14 1	7	< 2	
2	17	6	
3	15	5	50
4	12	4	54
5	23	8	53
	mean value	< 5	52
No. 501-14 1	38	12	
(auto- 2	34	11	
claved) 3	39	12	54
4	35	11	54
5	33	10	55
	mean value	11	54
No. 502-14 1	13	4	
2	1	< 2	
3	0	< 2	131
4	0	< 2	126
5	1	< 2	124
	mean value	< 2	127
No. 502-14 1	138	42	
(auto- 2	152	45	
claved) 3	160	48	128
4	146	44	127
5	143	43	128
	mean value	44	128

Table B.28. (continued)

Sample--Flask		<u>Selenastrum</u> cells/ml ($\times 10^{-4}$)	Available P ($\mu\text{gP/l}$)	PP in Cultures ($\mu\text{gP/l}$)
No. 507-14	1	38	12	
	2	30	10	
	3	45	14	440
	4	28	9	458
	5	44	<u>14</u>	<u>434</u>
		mean value	12	444
No. 507-14 (auto- claved)	1	162	48	
	2	179	54	
	3	167	50	479
	4	164	49	505
	5	169	<u>51</u>	<u>459</u>
		mean value	50	481

Table B.29. AVAILABLE P IN AUTOCLAVED NEW YORK RIVER
WATERS AS CALCULATED USING CORRECTED
NET A₇₅₀ DATA

Sample No.	Net Mean A ₇₅₀ in Bioassay	Corrected Net Mean A ₇₅₀ ^b	Mean Blank A ₇₅₀	Corrected Net Mean A ₇₅₀ + Mean Blank A ₇₅₀	Available P In Bioassay Flasks (µgP/l)
<u>Niagara R. at Ft. Niagara</u>					
27	0.000	0.000	0.010	0.010	< 1
33	0.011	0.008	0.000	0.008	4
41	0.000	0.000	0.010	0.010	< 1
50	0.002	0.001	0.008	0.009	< 3
56	0.015	0.010	0.004	0.014	5
<u>Niagara R. at Beaver I. Park</u>					
32	0.004	0.003	0.000	0.003	< 1
40	0.000	0.000	0.010	0.010	< 1
49	0.002	0.001	0.008	0.009	< 3
57	0.007	0.005	0.004	0.009	3
<u>Genesee R.</u>					
34	0.045	0.031	0.000	0.031	22
42	0.048	0.034	0.010	0.044	23
51	0.237	0.166	0.008	0.174	92
58	0.136	0.095	0.004	0.099	42
<u>Oswego R.</u>					
28	0.105	0.073	0.019	0.083	45
29	0.151	0.106	0.010	0.116	65
31	0.055	0.039	0.000	0.039	27
35	0.122	0.085	0.000	0.085	65
43	0.067	0.047	0.010	0.057	29
47 ^d	0.117	0.082	0.009	0.091	42
52 ^d	0.125	0.087	0.008	0.095	47
52 ^e	0.141	0.099	0.010	0.109	53
59	0.154	0.108	0.004	0.112	48
59(1/2)	0.075	0.052	0.004	0.056	24

^a Mean A₇₅₀ of sample cultures minus the mean A₇₅₀ of the blank cultures

^b Net mean A₇₅₀ divided by 1.43

^c Found by comparing the corrected net mean A₇₅₀ to a standard curve of A₇₅₀ vs. P concentration for standard AAP cultures

^d Assayed May 31, 1973

^e Assayed June 5, 1973

APPENDIX C

DARK INCUBATIONS OF UNFILTERED RUNOFF AND RIVER WATER SAMPLES

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APPENDIX C
DARK INCUBATIONS OF UNFILTERED
RUNOFF AND RIVER WATER SAMPLES

Table C.1. Dark Incubation Begun September 26, 1972

A. Initial Period of Storage at 4°C

Sample No.	Initial DRP ^a (µgP/l)	Storage Period (days)
23-Oswego R.	49	35
24-Oswego R. Mouth	41	21
25-Black R.	14	21
26-Oswego R.	79	21
B-4 Madison Runoff	240	7

^aDetermined prior to storage

B. Dark Incubation at 17-23°C (Begun Sept. 26, 1973)

Sample No.	DRP (µgP/l) after incubation ^b			
	Sample		Sample + Resin	
	23 days	50 days	23 days	50 days
23	61	73	65	78
mean	<u>69</u>	<u>71</u>	--	<u>74</u>
values	65	72	--	76
24	61	62	64	53
mean	<u>58</u>	<u>59</u>	--	<u>59</u>
values	60	61	--	56
25	25	31	20	22
mean	<u>21</u>	<u>27</u>	--	<u>30</u>
values	23	29	--	26

Table C.1. (continued)

26	112	120	95	114
mean	<u>110</u>	<u>109</u>	--	<u>103</u>
values	111	114	--	108
B-4	274	244	321	322
mean	<u>248</u>	<u>240</u>	--	<u>315</u>
values	261	242	--	318

^b All samples except B-4 were filtered through glass fiber filters for DRP determined during the incubations; B-4 was filtered through 0.45 micron pore size membrane filters.

Table C.2. DARK INCUBATION BEGUN NOVEMBER 9, 1972

Unfiltered Runoff Samples

Runoff Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation		
		<u>Sample Only</u>	<u>Sample + Resin</u>	
		25 Days	25 days	50 days
B-7	576	292	564	641
		293	569	650
		<u>255</u>	<u>595</u>	<u>652</u>
		mean value	280	576
				648
F-7	300	140	391	407
		150	396	393
		<u>155</u>	<u>391</u>	<u>386</u>
		mean value	148	393
				395
402-8	70	45	107	106
		43	106	113
		<u>44</u>	<u>111</u>	<u>108</u>
		mean value	44	108
				109
407-8	27	31	92	107
		32	91	104
		<u>28</u>	<u>92</u>	<u>102</u>
		mean value	30	92
				104

Table C.3. DARK INCUBATION BEGUN JANUARY 8, 1973

Unfiltered Runoff Samples

Runoff Sample	Initial	DRP ($\mu\text{gP/l}$) after incubation			
	DRP ($\mu\text{gP/l}$)	<u>Sample Only</u>		<u>Sample + Resin</u>	
		25 days	50 Days	25 Days	50 Days
A-8	354	347	542	372	430
		348	552	389	391
		<u>365</u>	<u>557</u>	<u>401</u>	<u>409</u>
	mean value	353	550	387	410
B-8	410	410	467	455	458
		422	482	476	464
		<u>425</u>	<u>476</u>	<u>470</u>	<u>472</u>
	mean value	419	475	467	465
D-8	328	380	385	381	434
		364	407	399	419
		<u>381</u>	<u>395</u>	<u>391</u>	<u>414</u>
	mean value	375	396	390	422

Table C.4. DARK INCUBATION BEGUN JANUARY 24, 1973

Unfiltered Runoff Samples

Runoff Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation			
		Sample Only		Sample + Resin	
		25 Days	50 Days	25 Days	50 Days
A-9	868	942	947	930	983
		952	984	957	967
		<u>925</u>	<u>1020</u>	<u>942</u>	<u>961</u>
		mean value	940	943	970
B-9	812	867	868	880	853
		846	900	875	869
		<u>865</u>	<u>902</u>	<u>893</u>	<u>906</u>
		mean value	859	883	876
F-9	486	545	520	545	562
		530	530	548	545
		<u>537</u>	<u>534</u>	<u>546</u>	<u>561</u>
		mean value	537	546	556
D-10	244	320	287	330	342
		300	285	331	343
		<u>304</u>	<u>280</u>	<u>328</u>	<u>341</u>
		mean value	208	330	342

Table C.5. DARK INCUBATION BEGUN FEBRUARY 7, 1973

Unfiltered Runoff Samples

Runoff Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation			
		Sample Only		Sample + Resin	
		13 Days	26 Days	13 Days	26 Days
D-11	252	233	256	286	315
		233	264	288	329
		<u>238</u>	<u>268</u>	<u>276</u>	<u>304</u>
		mean value	235	263	284
				316	
E-11	30	10	15	35	32
		12	14	39	32
		<u>13</u>	<u>13</u>	<u>36</u>	<u>32</u>
		mean value	12	14	36
				32	
H-11	110	41	55	106	103
		44	54	100	108
		<u>49</u>	<u>53</u>	<u>102</u>	<u>103</u>
		mean value	44	54	103
				105	

Table C.6. DARK INCUBATION BEGUN MARCH 8, 1973
Unfiltered Runoff Samples

Runoff Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation			
		Sample Only		Sample + Resin	
		13 Days	21 Days	13 Days	26 Days
A-12	264	295	293	299	309
		290	305	306	313
		<u>299</u>	<u>309</u>	---	<u>311</u>
		mean value	295	302	311
	347	345	394	337	385
B-12	347	354	406	337	395
		<u>349</u>	<u>397</u>	---	<u>397</u>
		mean value	349	337	392
		349	399	337	392
	247	194	249	287	328
D-12	247	197	257	278	340
		<u>198</u>	<u>250</u>	<u>307</u>	<u>340</u>
		mean value	196	291	336
		196	252	291	336
	30	35	84	84	153
I-12	30	33	84	114	132
		<u>36</u>	<u>82</u>	<u>107</u>	<u>141</u>
		mean value	35	102	142
		35	83	102	142
	30	35	84	84	153

Table C.7. DARK INCUBATION BEGUN DECEMBER 1, 1972

Runoff Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation	
		Sample Only (No Resin)	
		25 Days	50 Days
402-9	55	67	--
		70	64
		69	66
		71	70
		70	70
	mean value	69	68
409-0	13	30	33
		27	32
		29	32
		28	33
		29	31
	mean value	29	32
404-8	175	205	--
		212	214
		216	225
		214	214
		209	215
	mean value	211	217
409-8	< 1	12	15
		11	18
		13	18
		11	14
		12	12
	mean value	12	15

Table C.8. DARK INCUBATION BEGUN APRIL 13, 1973
Unfiltered River Water Samples

Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation					
		Sample Only			Sample + Resin		
		14 Days	27 Days	50 Days	14 Days	27 Days	50 Days
No. 31	43	46	35	28	65	45	33
		47	34	24	<u>64</u>	<u>48</u>	<u>32</u>
		<u>47</u>	<u>30</u>	<u>28</u>			
		47	33	26	64	46	32
	mean value						
No. 32	2	6	0	0	4	1	2
		6	2	0	<u>4</u>	<u>1</u>	<u>2</u>
		<u>6</u>	<u>0</u>	<u>0</u>			
		6	1	0	4	1	2
	mean value						
No. 33	5	11	3	1	8	2	2
		12	1	0	<u>8</u>	<u>1</u>	<u>3</u>
		<u>14</u>	<u>2</u>	<u>0</u>			
		12	2	0	8	2	3
	mean value						
No. 34	26	30	26	14	60	57	53
		32	25	19	<u>67</u>	<u>59</u>	<u>54</u>
		<u>32</u>	<u>29</u>	<u>21</u>			
		31	27	18	63	58	54
	mean value						

Table C.8. (continued)

Sample	Initial	DRP ($\mu\text{gP/l}$) after incubation					
	DRP	Sample Only			Sample + Resin		
	($\mu\text{gP/l}$)	14 Days	27 Days	50 Days	14 Days	27 Days	50 Days
No. 35	47	63	49	37	71	61	61
		66	56	50	<u>74</u>	<u>62</u>	<u>61</u>
		<u>65</u>	<u>62</u>	<u>39</u>			
		64	56	42	73	62	61
	mean value						
No. 36	7	9	1	1	4	0	2
		10	1	0	<u>2</u>	<u>5</u>	<u>9</u>
		<u>11</u>	<u>3</u>	<u>1</u>			
		10	2	1	3	3	5
	mean value						

Table C.9. DARK INCUBATION BEGUN MAY 7, 1973

Unfiltered River Water Samples

Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation			
		Sample Only		Sample + Resin	
		14 Days	50 Days	14 Days	50 Days
No. 40	6	5	0	29	0
		7	0	11	0
		7	0		
	mean value	6	0	20	0
No. 41	4	6	1	5	4
		5	1	4	4
		4	2		2
	mean value	5	1	4	3
No. 42	40	42	44	38	36
		42	43	40	36
		43	40		36
					32
	mean value	42	42	39	35
No. 43	38	58	61	36	41
		62	68	36	36
		61	70		34
					38
	mean value	60	66	36	37
No. 44	9	5	3	5	9
		7	7	5	4
		7	3		7
					7
	mean value	6	4	5	7

Table C.10. DARK INCUBATION BEGUN MAY 31, 1973

Unfiltered River Water Samples

Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation					
		Sample Only			Sample + Resin		
		13 Days	26 Days	50 Days	13 Days	26 Days	50 Days
No. 49	2	9	8	1	5	4	1
		9	9	0	<u>9</u>	<u>2</u>	<u>0</u>
		<u>14</u>	<u>10</u>	<u>4</u>			
	mean value	12	9	2	7	3	1
No. 50	1	7	5	1	6	0	0
		9	7	0	<u>4</u>	<u>3</u>	<u>0</u>
		<u>8</u>	<u>4</u>	<u>1</u>			
	mean value	8	5	1	5	2	0
No. 51	104	108	102	90	110	105	94
		109	110	111	111	98	93
		<u>109</u>	<u>107</u>	<u>104</u>	<u>110</u>	<u>102</u>	<u>94</u>
	Mean value	109	107	104	110	102	94

Table C.10. (continued)

Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation					
		Sample Only			Sample + Resin		
		13 Days	26 Days	50 Days	13 Days	26 Days	50 Days
No. 52	50	63	64	58	57	52	41
		63	62	61	<u>53</u>	<u>41</u>	<u>42</u>
		<u>63</u>	<u>64</u>	<u>60</u>			
	mean value	63	63	60	55	46	41
No. 53	5	7	5	1	9	5	12
		7	2	1	<u>8</u>	<u>4</u>	<u>4</u>
		<u>7</u>	<u>5</u>	<u>1</u>			
	mean value	7	4	1	8	4	8

Table C.11. DARK INCUBATION BEGUN JUNE 8, 1973
Unfiltered River Water Samples

Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation					
		Sample Only			Sample + Resin		
		13 Days	25 Days	50 Days	13 Days	25 Days	50 Days
No. 54	40	49	50	42	49	49	53
		46	49	40	<u>50</u>	<u>52</u>	<u>47</u>
		<u>48</u>	<u>49</u>	<u>43</u>			
	mean value	48	49	42	50	51	50

Table C.12. DARK INCUBATION BEGUN JUNE 22, 1973

Unfiltered River Water Samples

Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation					
		Sample Only			Sample + Resin		
		13 Days	27 Days	50 Days	13 Days	27 Days	50 Days
No. 56	26	30	28	9	24	29	12
		30	27	13	<u>26</u>	<u>23</u>	<u>11</u>
		<u>30</u>	<u>24</u>	<u>13</u>			
		30	26	12	25	26	12
	mean value						
No. 57	3	10	5	0	5	8	6
		10	2	0	<u>13</u>	<u>6</u>	<u>6</u>
		<u>11</u>	<u>5</u>	<u>0</u>			
		10	4	0	9	7	6
	mean value						
No. 58	49	68	70	53	77	75	58
		73	65	54	<u>77</u>	<u>80</u>	<u>56</u>
		<u>72</u>	<u>70</u>	<u>59</u>			
		71	68	52	77	77	57
	mean value						
No. 59	46	63	66	48	56	58	35
		65	67	51	<u>54</u>	<u>53</u>	<u>31</u>
		<u>72</u>	<u>69</u>	<u>52</u>			
		67	67	52	55	55	33
	mean value						

Table C.12. (continued)

Sample	Initial DRP ($\mu\text{gP/l}$)	DRP ($\mu\text{gP/l}$) after incubation					
		Sample Only			Sample + Resin		
		13 Days	27 Days	50 Days	13 Days	27 Days	50 Days
No. 60	13	21	13	2	20	22	18
		24	19	9	<u>18</u>	<u>22</u>	<u>18</u>
		<u>26</u>	<u>19</u>	<u>4</u>			
		24	17	5	19	22	18
	mean value						
No. 507-13	5	16	10	9	13	23	23
		16	10	4	<u>16</u>	<u>29</u>	<u>18</u>
		<u>15</u>	<u>10</u>	<u>2</u>			
		16	10	5	14	26	20
	mean value						

APPENDIX D

Table D.1. CHLOROFORM TREATMENT OF NEW YORK RIVER WATER SAMPLES

Initial Data, Before Chloroform Treatment				DRP* in Chloroform - treated samples after:		
Sample No.	Initial DRP (µgP/l)	Initial TSP (µgP/l)	TP (µgP/l)	1 Day	7 Days	14 Days
27	4	8	18	9	10	10
				8	8	4
				9	11	10
			mean value	9	10	8 ^c
28	68	71	93	66	44	31
				71	61	31
				71	74	77
			mean value	69	63	46 ^c
29	78	82	106	78	80	83
				81	84	88
				81	83	88
			mean value	80	82	86 ^a
31	43	49	95	44	47	
				47	50	
				47	51	
			mean value	46	49 ^b	
33	5	10	34	10	14	
				11	15	
				11	14	
			mean value	11	14	

^a 15 days ^b 9 days ^c 16 days

* Each value represents one test flask

Table D.1. (continued)

Initial Data, Before Chloroform Treatment				DRP in Chloroform - treated samples after:		
Sample No.	Initial DRP ($\mu\text{gP/l}$)	Initial TSP ($\mu\text{gP/l}$)	TP ($\mu\text{gP/l}$)	1 Day	7 Days	14 Days
34	26	26	386	32	36	
				32	37	
				32	36	
			mean value	32	36 ^b	
35	47	52	105	60	65	
				63	70	
				62	67	
			mean value	62	67 ^b	
36	7	12	34	10	14	
				11	15	
				11	15	
			mean value	11	15 ^b	
49	2	6	51	14	24	28
				13	19	22
				14	22	22
			mean value	14	22	24
50	1	7	26	10	17	20
				12	16	18
				13	16	18
			mean value	12	16	19

^b 9 days

Table D.1. (continued)

Initial Data, Before Chloroform Treatment				DRP in Chloroform - treated samples after:		
Sample No.	Initial DRP ($\mu\text{gP/l}$)	Initial TSP ($\mu\text{gP/l}$)	TP ($\mu\text{gP/l}$)	1 Day	7 Days	14 Days
51	104	111	173	107	119	117
				113	123	125
				114	124	122
				mean value	111	122
52	50	57	104	59	69	69
				62	71	75
				61	70	73
				mean value	61	72
53	5	16	41	15	21	24
				15	19	25
				15	11	15
				mean value	15	21
54	40	51	87	48	55	56
				49	58	59
				49	58	59
				mean value	49	58
56	26	33	59	26	29	30
				27	7	21
				28	30	31
				mean value	27	22 ^d

^d 8 days

Table D.1. (continued)

Initial Data, Before Chloroform Treatment				DRP in Chloroform - treated samples after:		
Sample No.	Initial DRP ($\mu\text{gP/l}$)	Initial TSP ($\mu\text{gP/l}$)	TP ($\mu\text{gP/l}$)	1 Day	8 Days	14 Days
57	3	7	86	15	18	21
				17	18	21
				18	23	25
				mean value	20	22
58	49	58	204	62	75	74
				65	76	80
				62	76	78
				mean value	76	77
59	46	59	147	77	86	103
				77	90	93
				77	27	78
				mean value	68	91
60	13	24	99	25	9	32
				29	35	40
				28	39	37
				mean value	28	37

Table D.1. CHLOROFORM TREATMENT OF NEW YORK RIVER WATERS

Begun May 8, 1973 and August 13, 1973

A. Initial Data, before Chloroform treatment

Sample No.	Initial DRP ($\mu\text{gP/l}$)	Initial TSP ($\mu\text{gP/l}$)	TP ($\mu\text{gP/l}$)
40 Niagara R. (Beaver I.)	6	10	15
41 Niagara R. (Ft. Niagara)	4	8	22
42 Genesee R.	40	45	150
43 Oswego R.	38	46	96
44 Black R.	9	15	34

B. Storage of Samples without Chloroform at 4°C for 96 days (begun May 8, 1973)

Sample No.	DRP ($\mu\text{gP/l}$)		DRP after storage (percent of TP)
	Initial	After Storage*	
40	6	7 7	
	mean value	7	47
41	4	16 16	
	mean value	16	73
42	40	40 40	
	mean value	40	27
43	38	69 69	
	mean value	69	72
44	9	9 9	
	mean value	9	26

* replicate samples from cubitainer used for cold storage of bulk sample

Table D.1. (continued)

C. Chloroform Test at 20°C (begun August 13, 1973)

Sample No.	DRP in Chloroform-Treated Samples			DRP at 14 Days (Percent of TP)
	1 Day	7 Days	14 Days	
40	9	17	10	
	10	10	10	
	10	11	10	
	<u>10</u>	<u>11</u>	<u>10</u>	
mean value	10	12	10	67
41	17	19	18	
	17	19	18	
	19	20	22	
	<u>19</u>	<u>20</u>	<u>18</u>	
mean value	19	20	19	86
42	43	48	50	
	46	51	52	
	44	50	52	
	<u>46</u>	<u>50</u>	<u>50</u>	
mean value	44	50	51	34
43	71	71	73	
	72	75	75	
	74	76	77	
	<u>74</u>	<u>75</u>	<u>78</u>	
mean value	73	74	76	79
44	11	16	17	
	11	16	17	
	11	16	17	
	<u>11</u>	<u>16</u>	<u>18</u>	
mean value	11	16	17	50

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