A PRELIMINARY DISCUSSION OF THE LOWER POTOMAC STP (LPSTP) ALLOWABLE EFFLUENT FLOW RATE

June 29, 1973

Norman L. Lovelace

Annapolis Field Office

Environmental Protection Agency

A PRELIMINARY DISCUSSION OF THE LOWER POTOMAC STP (LPSTP) ALLOWABLE EFFLUENT FLOW RATE

I. INTRODUCTION

Before any vigorous analysis is done on the effects of the LPSTP discharge, several things should be discussed. Review of TR 35 and other related reports indicates that conflicts may exist on the subject of embayment discharges. Furthermore, the integrity and veracity of the Potomac Load Allocations, as presented in TR 35, is currently being questioned by Hydroscience, Inc. and other interested parties. The implications of these questions and observations are quite significant when related to the LPSTP investigation. It is beyond the scope of this discussion to fully explore and analyze the validity of the questions being raised about TR 35. However, it should be kept in mind that it was not the primary objective of TR 35 to present loadings for Potomac embayments. Consequently, detailed analyses were not performed on the local effects of embayment discharges.

No definitive answer will be given here concerning an allowable discharge rate for the LPSTP. Instead the criteria within which an analysis is to be made and the probable results of such an analysis will be discussed.

II. GUNSTON COVE

Gunston Cove is a Virginia embayment of the Potomac Estuary, approximately 2 miles upstream of Indian Head, Maryland. The embayment may be characterized as being relatively wide and shallow.

It has an average depth of about 4 feet and a surface area of approximately 8.24×10^7 sq ft. There are two freshwater inflows at the head of the embayment; Pohick Creek and Accotink Creek. The LPSTP discharges into Pohick Creek.

Gunston Cove, and other Potomac embayments, have been described as being ideally suited for high primary productivity. For this reason the proposed nutrient criteria (TR 35) are more stringent for the embayments than for the main channel.

1970 and 1972 AFO data indicates that there are high levels of chlorophyll a present in the embayment throughout the summer months. The data also shows that the TP and TIN standards proposed in TR 35 are contravened a majority of the time. The nitrogen criteria are meet occassionally, however, this is generally during periods of high chlorophyll a levels. Pre and post bloom nutrient levels are always above the desirable levels. Dissolved oxygen is often above saturation during the daylight hours due to photosynthetic production. Although no night time data are available, it is possible that significant DO depressions may exist at night due to algal respiration. 1972 and 1973 Fairfax County data indicates that the inflows of Pohick (before LPSTP) and Accotink Creeks may be a significant source of nutrients.

III. PROBLEM STATEMENT

As understood by AFO, the objective of the LPSTP discharge rate analysis may be stated as follows:

> Determine the maximum allowable effluent flow rate for the LPSTP that will not cause a problem in Gunston Cove. Assume

the LPSTP effluent will have the following characteristics;

BOD_5	$\leq$ 3.0 mg/l
Unoxidized N	$\leq$ 1.0 mg/l
Total P	$\leq$ 0.2 mg/l
Total N (when technology is available)	$\leq$ 1.0 mg/l
UOD	$\leq$ 10.0 mg/l

The problem statement is deficient in some areas. "Problem" in Gunston Cove is not defined, it may be defined in terms of a probable chlorophyll a level, dissolved oxygen standard or a combination of both. The level of oxidized N (NO_3-N) in the effluent is not given. This could be a significant factor until the 1.0 mg/l Total N requirement is feasible. The methods of expression for the nitrogen and phosphorus concentrations are not given; are they expressed at NO_3, N, P, PO_4, etc.? For the purposes of this discussion, the nitrogen concentration will be assumed to be expressed as N and the phosphorus concentration will be considered to be expressed as P.

The statement also implies that the LPSTP will be the cause of a "problem" in Gunston Cove. As will be discussed later, this may not be the case. The LPSTP may be a contributing factor to a possible "problem" in Gunston Cove, however, it may not be the primary factor.

IV. AVAILABLE INFORMATION AND GOVERNING CRITERIA

There are two things that may be viewed as possible governing criteria. One is nutrient levels (N, P) and the other is dissolved

oxygen. DO appears to be the only enforceable standard, however, excessive algal populations caused by high nutrient levels (and/or other factors) can have a detrimental impact on the DO budget. This is particularly true during the night time hours and during the fall die off.

TR 35 sets desirable upper bounds for the nitrogen and phosphorus pre bloom concentrations in Gunston Cove, they are;

Inorganic N as N	$\leq$ 0.3 mg/l
Total Phosphorus as P	$\leq$ 0.03 mg/l

These levels are claimed to be necessary to prevent nuisance algal growths, which are defined as being greater than 25 µg/l of chlorophyll a. TR 35 does not claim that this chlorophyll a level (25 µg/l) is an absolute figure given the above nutrient levels, however, it does imply that nuisance conditions will not exist at these levels.

TR 35 sets allowable mass loading rates for N, P, and UOD into Gunston Cove. If it is assumed that these loadings are based on the above criteria, then a possible conflict arises. The loadings are given in terms of a wastewater flow rate and a corresponding lbs/day mass loading. These figures have been further reduced to include an effluent concentration: The TR 35 figures are:

Waste Flow	TP as P		Total N as N		UOD	
mgd	lbs/day	mg/l	lbs/day	mg/l	lbs/day	mg/l
50	35	0.084	130	0.31	7000	16.8
103	60	0.070	270	0.31	11000	12.8
170	140	0.099	460	0.32	16000	11.3

These figures are based on a warm weather condition. The following observations can be made:

1. The LPSTP proposed effluent concentrations for N and P are above the TR 35 proposed effluent concentrations.
2. The LPSTP effluent UOD concentration is below the TR 35 limits for the flow range shown.
3. The TR 35 allowable P effluent concentrations are substantially higher than the proposed receiving water upper limits.
4. The TR 35 allowable effluent Total N concentrations are at the receiving water upper limit for inorganic N. The reasoning behind this is that the total N will be converted to inorganic N (hydrolysis, oxidation). This seems to be a reasonable assumption because of the warm weather conditions and long retention time of the embayment.

In another section, TR 35 (pp. II-18, XII-9) proposes effluent concentrations for embayment discharges, these are:

UOD	$\leq$ 10.0 mg/l
Total N	$\leq$ 1.0 mg/l
Total P	$\leq$ 0.2 mg/l

These concentrations appear to conflict with the mass loadings presented for Gunston Cove. The UOD concentration is more stringent while the N and P concentrations are less stringent.

The only waters available for the dilution of the LPSTP effluent are:

1. Pohick Creek
2. Accotink Creek
3. Potomac Estuary

Review of the historical data for these 3 waters indicate they have N and P concentrations that are regularly above the proposed limits. The proposed upper limits for TIN and TP in the main Potomac, in this area, are 0.4 mg/l and 0.067 mg/l, respectively. It it is assumed that these constituents act conservatively or nearly conservatively then it appears as though there is virtually no water available for dilution of the LPSTP effluent nutrients, even at a "cleaned up" condition.

The UOD concentration in the LPSTP effluent appears to be well within the limits stated in TR 35. However, the TR 35 UOD loading was determined assuming there was not a large standing crop of

phytoplankton. The question arises; are the TR 35 UOD loadings valid if the nutrient criteria are violated? Unfortunately there is no clear cut answer to this question.

The question of whether the nutrient levels established in TR 35 will, in fact, meet the stated chlorophyll a objective will not be considered here. This is a question of much debate and of great importance. The fact that it is not considered in detail here should not diminish the importance of this question.

V. PRELIMINARY MODEL APPLICATIONS

Some preliminary model runs were made in an attempt to quantify some of the intuitive observations already made in this discussion. Due to the preliminary nature of this analysis, strict adherence to normal verification and calibration procedures was not observed. Therefore, the results cannot be considered as final predictions, but rather as general indications.

The objectives of the model runs are:

1. To demonstrate the effects of the Potomac Estuary on Gunston Cove at various LPSTP flows and Potomac flows.
2. To demonstrate the effects of the LPSTP at various flows.
3. To check the UOD loading for possible DO standard violations.

Five hydraulic conditions were specified for the model runs, they are:

1. Potomac flow above Gunston Cove 6542 cfs.

   Pohick Creek = Accotink Creek = 10 cfs.

   a. LPSTP = 100 mgd

   b. LPSTP = 200 mgd

   c. LPSTP = 300 mgd

2. Potomac flow above Gunston Cove = 820 cfs

   Pohick Creek = Accotink Creek = 10 cfs

   a. LPSTP = 100 mgd

   b. LPSTP = 200 mgd

These Potomac flows correspond to flows at the fall line of roughly 6000 cfs and 300 cfs.

All quality runs were made with a steady state model using net flows computed from a dynamic hydraulic model. Figure 1 shows a portion of the computational network used.

Inorganic nitrogen was treated as a conservative parameter. This assumption was made for the following reasons:

1. No phytoplankton uptake rate was assumed because the objective was to evaluate pre-bloom conditions. To assume a uptake rate could give a false impression because a loss would correspond to an increase in the algal standing crop. It could otherwise be possible to meet nutrient criteria if high enough loss rates were assumed, however, these high loss rates would correspond to large algal populations (blooms).

2. Adsorption and deposition of the various nitrogen forms was assumed to be insignificant.
3. Denitrification to elemental N was assumed to be insignificant.
4. Uptake by rooted aquatics was assumed to be insignificant. This may not be a completely valid assumption, particularly in the marsh areas of the cove. However, since no reliable uptake rates were available they were neglected in the interest of safety.

Phosphorus was not modelled. However, information concerning TP can be deduced from the TIN results if one makes the conservative assumption.

UOD and DO were run with the following conditions:

1. UOD decay rate (deoxygenation rate) = 0.35 (1/day). base e.
2. Sediment uptake rate = 1.0 gr $O_2/m^2/day$.
3. Reaeration rates were computed using the O'Connor-Dobbins formula.
4. The effects of phytoplankton were neglected.
5. The UOD and DO in the Potomac just above Gunston Cove were assumed at 2.0 mg/l and 6.8 mg/l, respectively. These values also correspond to a "cleaned up" condition in the Potomac.
6. UOD and DO in Accotink Creek and Pohick Creek were assigned values of 5.0 mg/l and 7.0 mg/l, respectively.
7. A DO saturation value of 7.8 mg/l was assumed.

8. LPSTP UOD was specified at 10.0 mg/l.

9. LPSTP effluent DO was specified at 5.0 mg/l.

These conditions are similar to the ones used in TR 35.

VI. MODEL RESULTS

The results of the model runs are shown at the end of this discussion.

A. Dissolved Oxygen

The model runs of dissolved oxygen indicate that minimum level of 5.0 mg/l probably can be maintained in the majority of Gunston Cove with LPSTP flows of up to 300 mgd. This prediction is, of course, dependent on the validity of the assumptions made in the DO model. Complete faith should not be put into these DO predictions because of the assumptions made. They should be viewed as indications and not absolutes. The TR 35 figures tend to support the DO predictions made here. However, the predictions are sufficiently close to the 5.0 mg/l DO standard to warrant a more detailed analysis, should the need arise.

B. Nitrogen

The model runs for inorganic nitrogen indicate that the proposed nitrogen criteria in TR 35 are not feasible. The conclusion is based primarily on the observation that intrusion of Potomac water, at the TR 35 proposed TIN level, into Gunston Cove can violate the TIN criteria for Gunston Cove. The fact that the LPSTP effluent will have a TIN concentration of about 1.0 mg/l will act to further exceed the TR 35 proposed levels.

TIN runs were made under the five different flow regimes. The following observations are made:

1. The degree of intrusion of the Potomac water into Gunston Cove is significantly effected by the LPSTP flow.
2. The degree of intrusion of the Potomac water into Gunston Cove does not appear to be greatly affected by the Potomac flow, at least for the two flows that were run (6000 cfs and 300 cfs).

The runs were made by considering only one source of nitrogen at a time. The combined effects of the sources can be obtained by simply adding together the responses to the individual sources. To consider the effect of the Potomac, the Potomac was set at 0.4 mg/l TIN and the LPSTP, Pohick and Accotink inflow concentrations were set at zero. This was done for the various LPSTP flows with the two Potomac flows. The resulting profiles show the effect of the Potomac alone. For the other sources the Potomac concentration was set to zero and the particular inflow was assigned a concentration (1.0 mg/l).

Two sets of curves were developed, from the model runs, to show the effects of the LPSTP and the Potomac on Gunston Cove. The Pohick Creek response is included in the LPSTP curves. The effects of Accotink Creek were not included, however, it was determined that its effect was overshadowed by the LPSTP at the low flow assigned to the creek (10 cfs). One set is for a Potomac flow at the fall line of

300 cfs and the other is for a flow of 6000 cfs. From these curves it is possible to obtain estimates of the TIN concentration at various locations in Gunston Cove under a given set of conditions. Boundary conditions and inflow concentrations other than those run can also be evaluated. This is possible if one recognizes that the principle of linear superposition applies here. The quality response to the specified boundary condition (Potomac concentration) or inflow concentration (LPSTP) is linear with respect to that condition. For instance if one wanted to see the influence of the Potomac when its concentration is 0.2 mg/l rather than 0.4 mg/l, then one would simply reduce the 0.4 mg/l response at the desired location by 50%. This principle does not apply to flows, the response to a LPSTP discharge at 100 mgd is not 1/2 the response at 200 mgd. It must be emphasized that these curves are derived from steady state model runs using the various assumptions already stated and that the model cannot be considered as fully calibrated or verified.

VII. CONCLUSIONS AND RECOMMENDATIONS

1. The TR 35 receiving water criteria for nitrogen and phosphorus in Gunston Cove are not feasible as presented. This conclusion is based on the fact that the N and P criteria are higher for the main channel than for Gunston Cove and that the proposed LPSTP effluent concentrations are higher than the receiving water standards. In addition the inflows from Pohick and Accotink Creeks have N and P concentrations that are regularly above the standards.

2. A DO standard of 5.0 mg/l appears to be feasible in Gunston Cove with a LPSTP flow rate of up to 300 mgd and an effluent UOD concentration of 10.0 mg/l. This conclusion may be contingent on meeting the nutrient criteria, which are not feasible. Further work is needed to either support or disprove this preliminary conclusion.

3. It appears as though any new discharges and/or expansion of existing facilities will result in contravention of the TR 35 nutrient standards, particularly in the Potomac embayments. Thus the problem of determining allowable loads becomes one of determining the extent to which standards will be violated. Simply the problem becomes one of determining the degree of non compliance as opposed to compliance. Within this framework one has two choices pertaining to allowable effluent flow rates:

a. If the effluent nutrient concentrations are above the receiving water nutrient standards then the effluent flow rate should be kept at a minimum.

b. If the effluent nutrient concentrations are below the receiving water nutrient standards then the effluent flow rate should be kept at a maximum.

The second choice is generally not feasible due to treatment limitations. Both choices are also dependent upon meeting DO standards and other applicable standards, which may dictate the opposite course of action depending on UOD levels and other factors.

With respect to the above conclusions, it is recommended that the TR 35 proposed nutrient standards and allowable loads be reviewed. The entire tidal Potomac should be treated as an integrated system and

standards should be developed with such an approach. A possible result of such a review could possibly be two sets of standards. One set could be an interim planning set which would be used for objective planning and would be feasible at the present time. The other set would be absolute standards which may not be feasible at the present time. In both cases consideration should be given to population projections and the expected levels of BAT. Also consideration should be given to alternative methods of waste disposal (if any) and a policy of zero discharge.

The full impact of either meeting or not meeting the proposed standards should be accessed and quantified. Germane to the process of developing standards is the determination of a water quality objective. In the case of the Potomac this objective could be stated in terms of the extent of the biological response to the various nutrient inputs, and a DO standard. Obviously, toxic substance and other parameters would also be included in the standards.

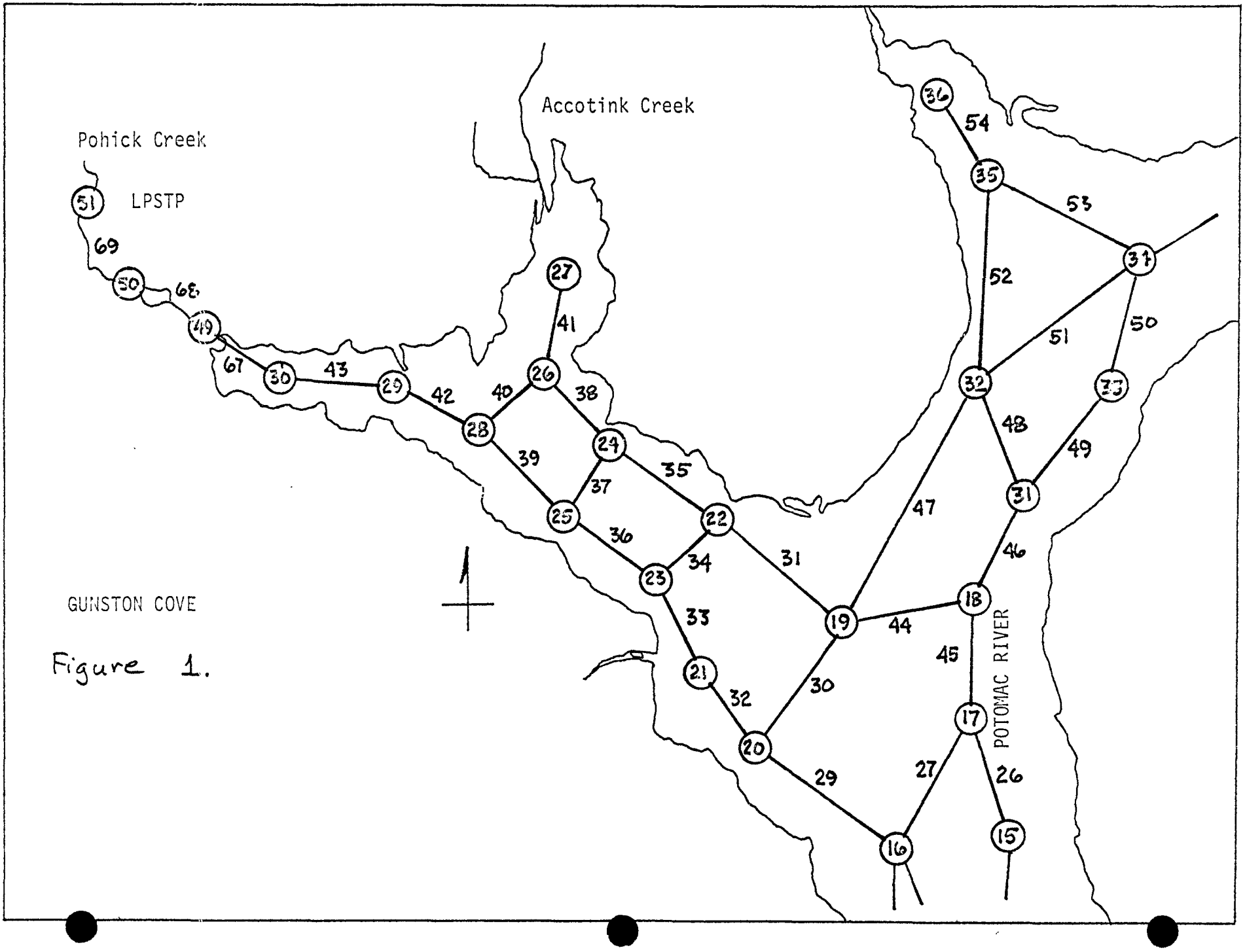
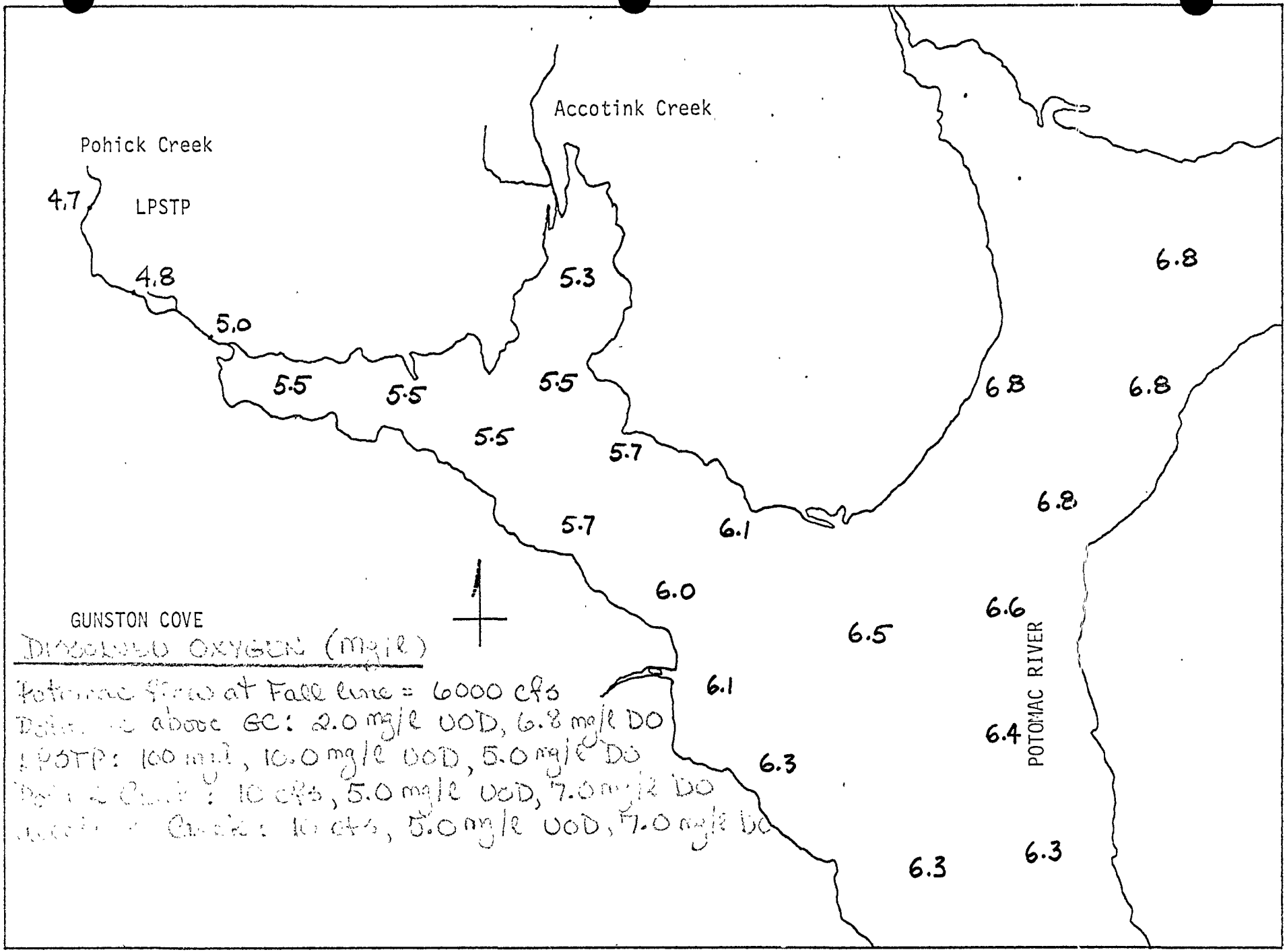
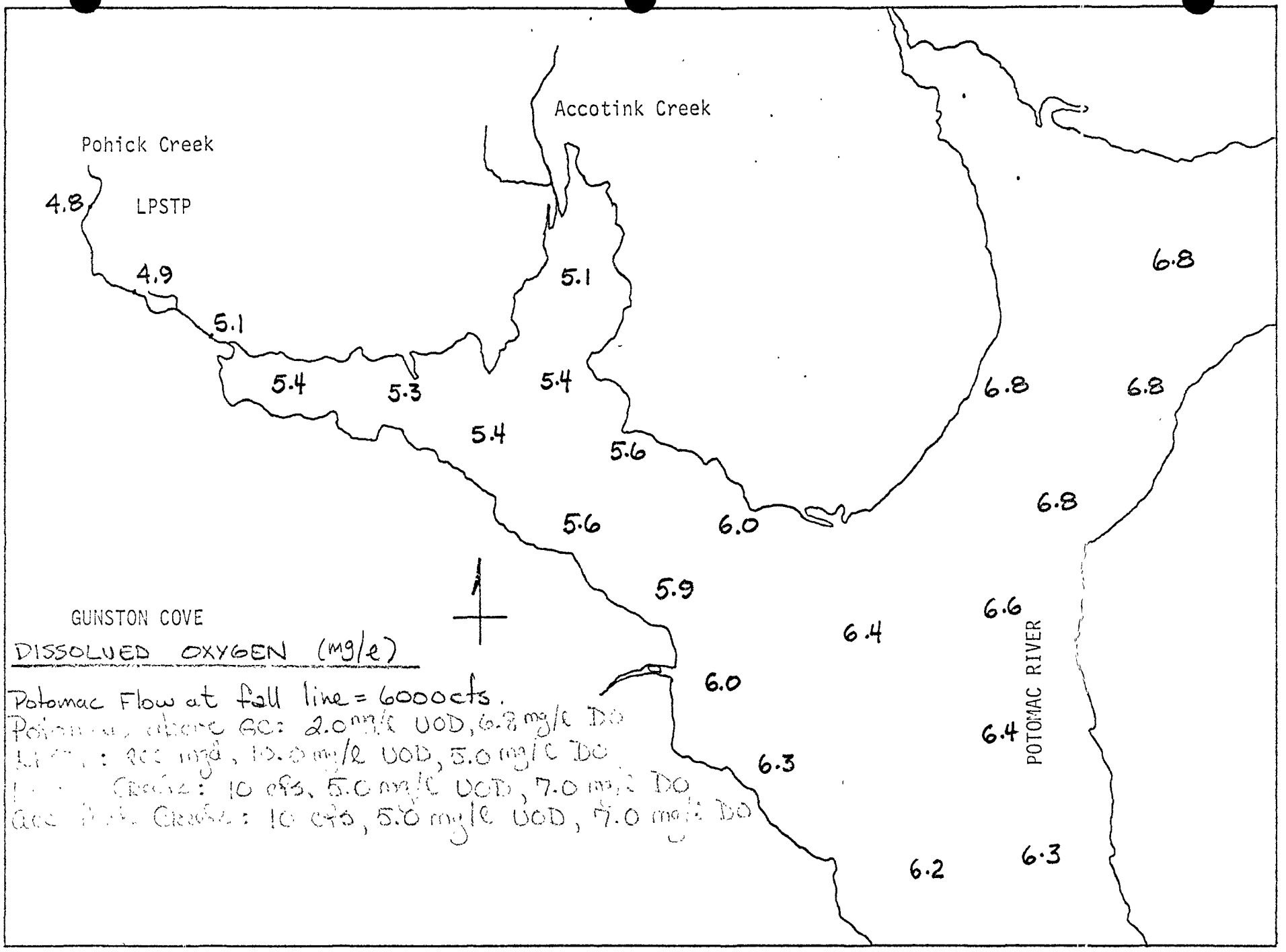

Pohick Creek
Accotink Creek
LPSTP
GUNSTON COVE
POTOMAC RIVER
51
50
49
30
29
28
27
26
24
25
23
22
21
20
19
18
17
16
15
36
35
31
32
33
31
69
68
67
43
42
40
41
38
39
37
35
36
34
31
33
47
54
53
52
51
50
48
49
46
44
45
30
32
29
27
26

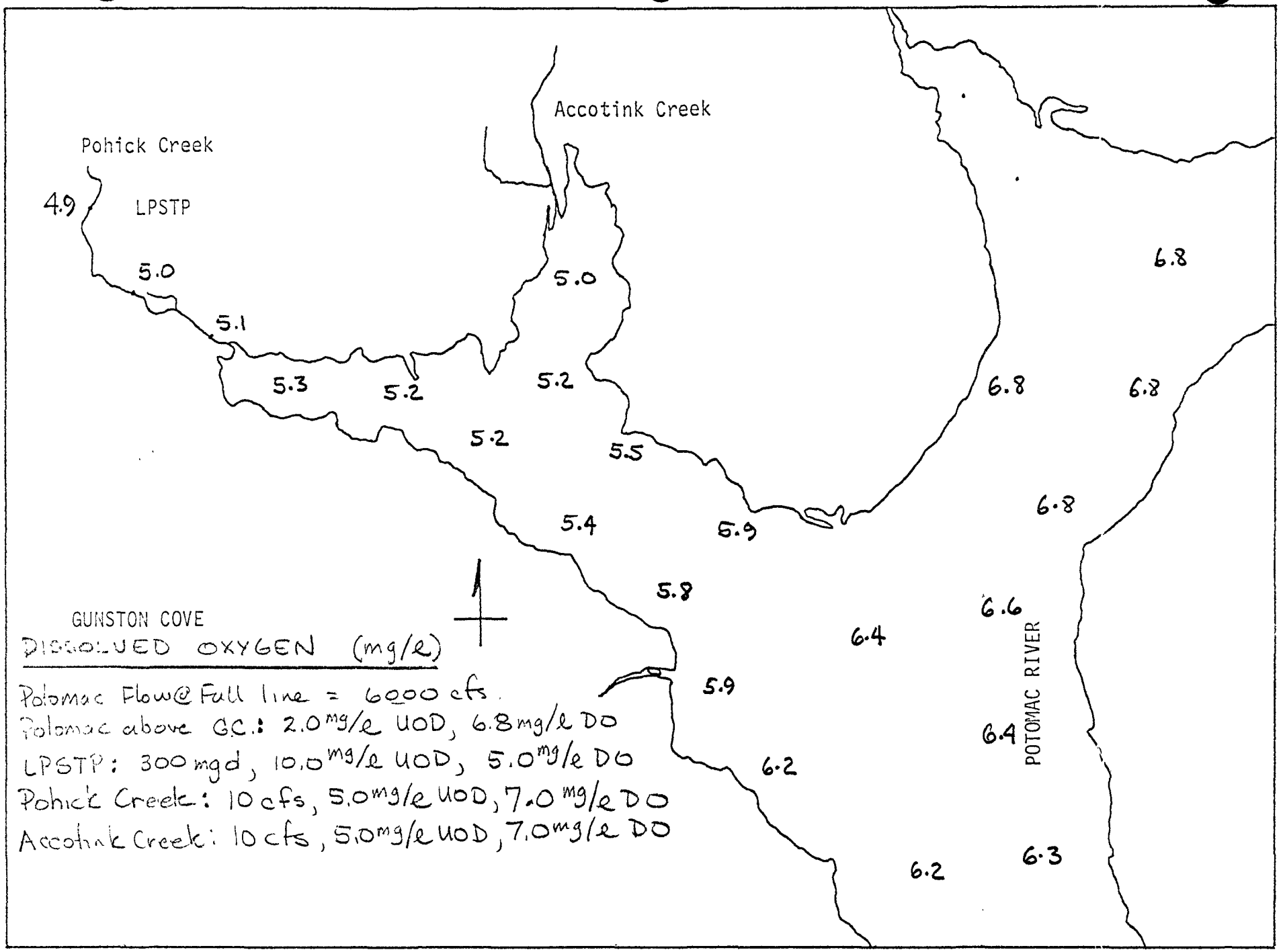
Figure 1.

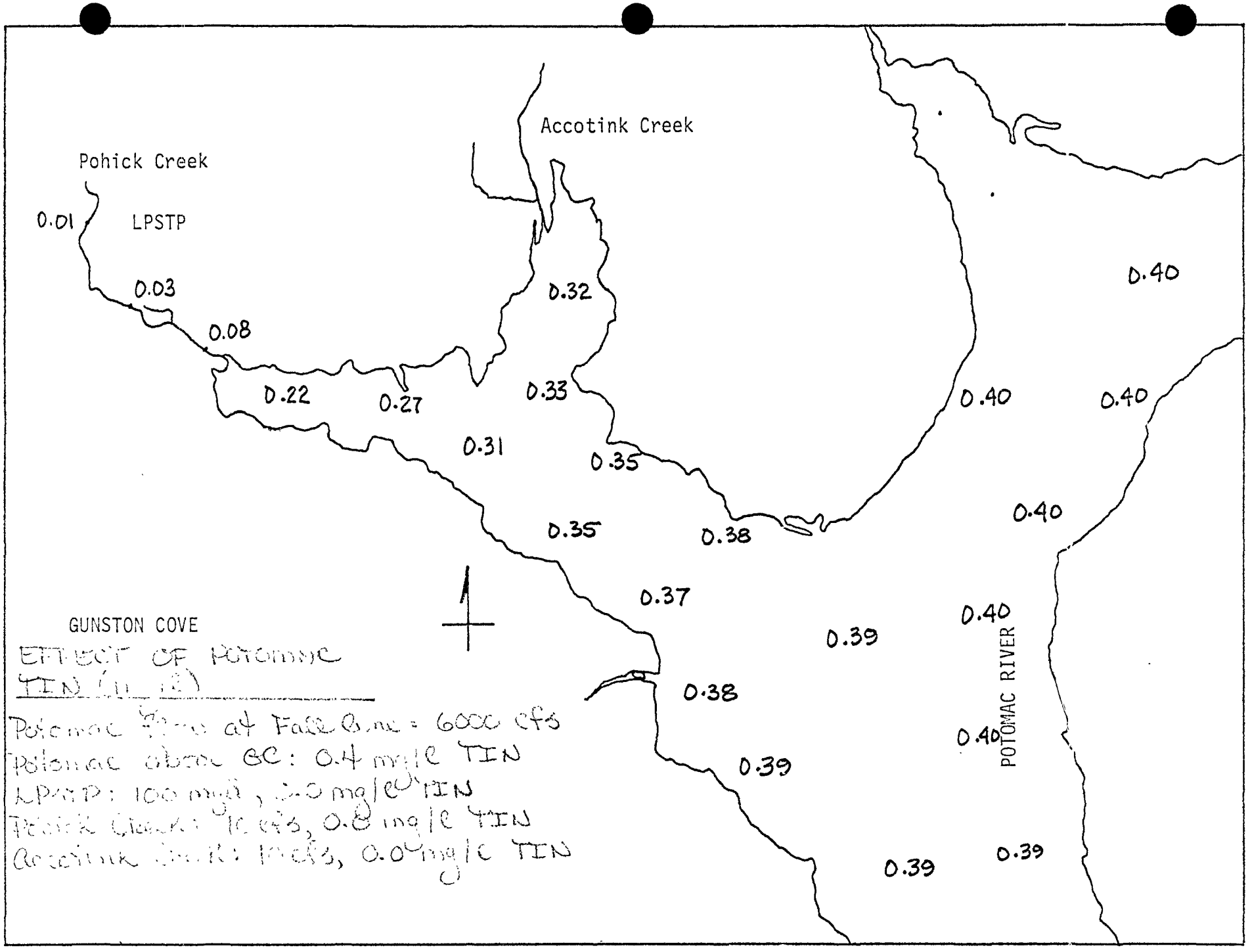
Model Results:

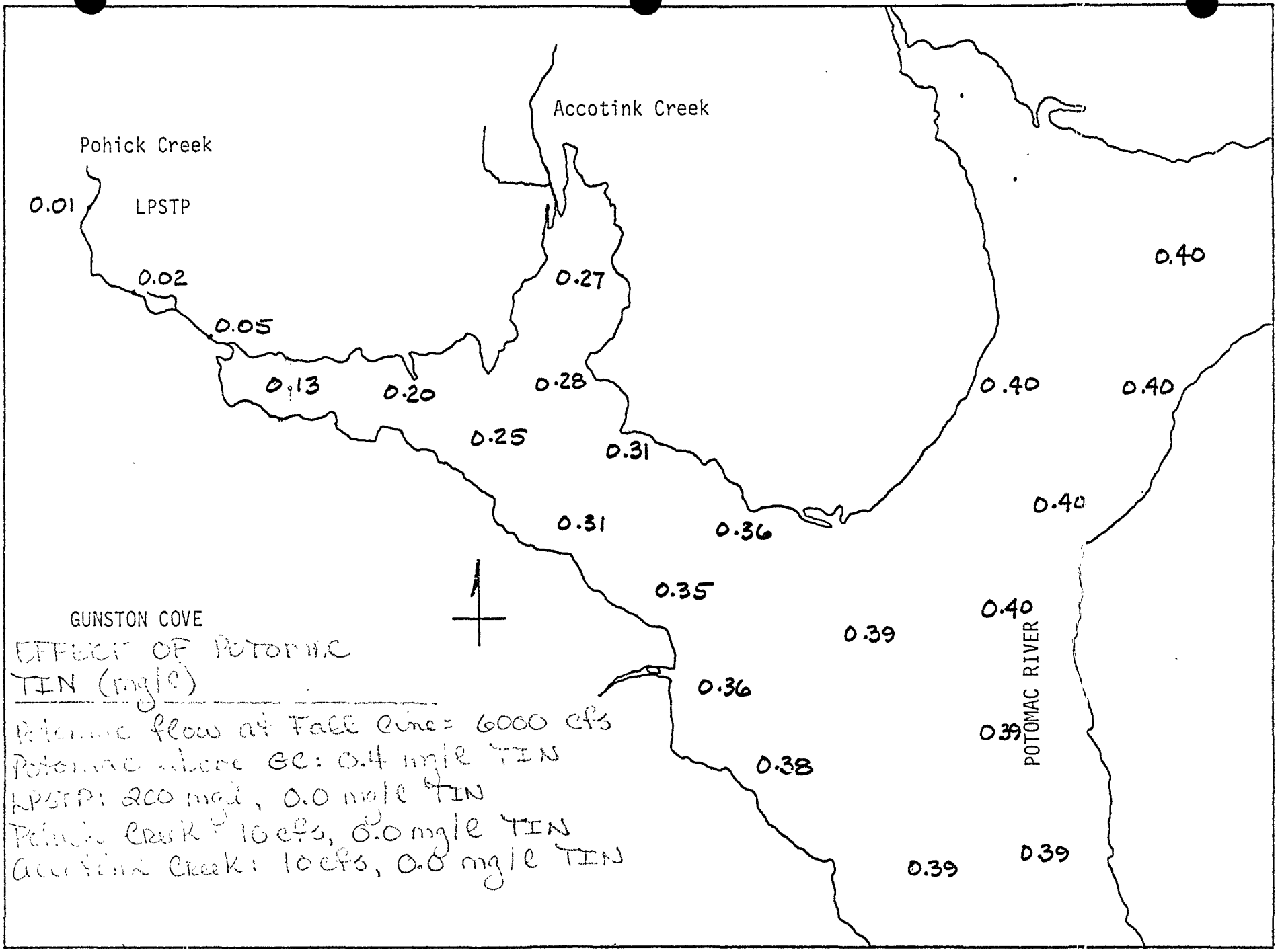
Following are diagrams showing the results of the various model runs that were made.

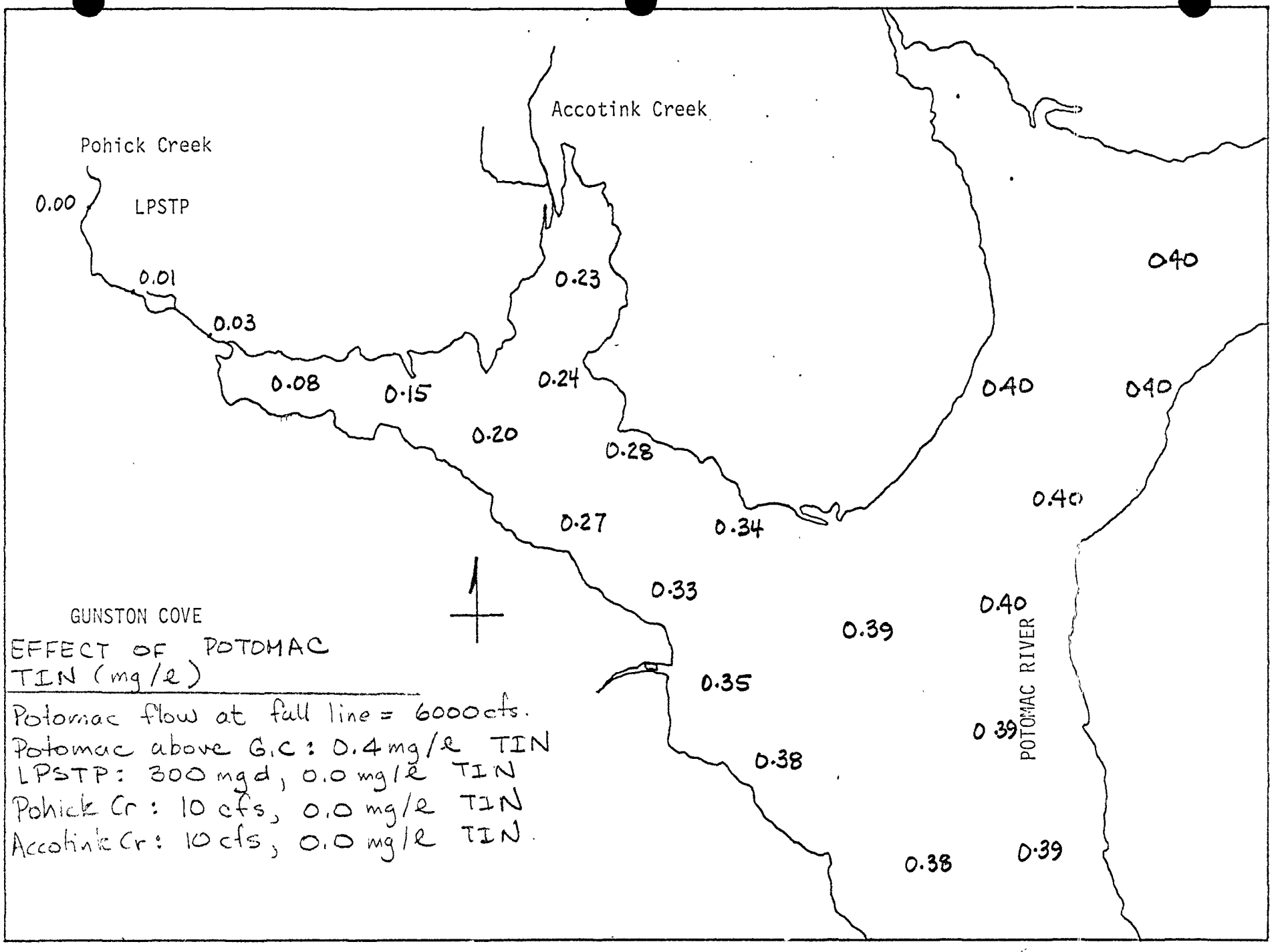

Accotink Creek
Pohick Creek
4.7
LPSTP
4.8
5.0
5.5
5.5
5.3
5.5
5.5
5.7
5.7
6.1
6.8
6.8
6.8
6.0
6.5
6.6
6.1
6.4
6.3
6.3
6.3
POTOMAC RIVER
GUNSTON COVE
DISSOLVED OXYGEN (mg/l)
Potomac flow at Fall line = 6000 cfs
Deficit above GC: 2.0 mg/l UOD, 6.8 mg/l DO
LPSTP: 100 mgd, 10.0 mg/l UOD, 5.0 mg/l DO
Pohick Creek: 10 cfs, 5.0 mg/l UOD, 7.0 mg/l DO
Accotink Creek: 10 cfs, 5.0 mg/l UOD, 7.0 mg/l DO

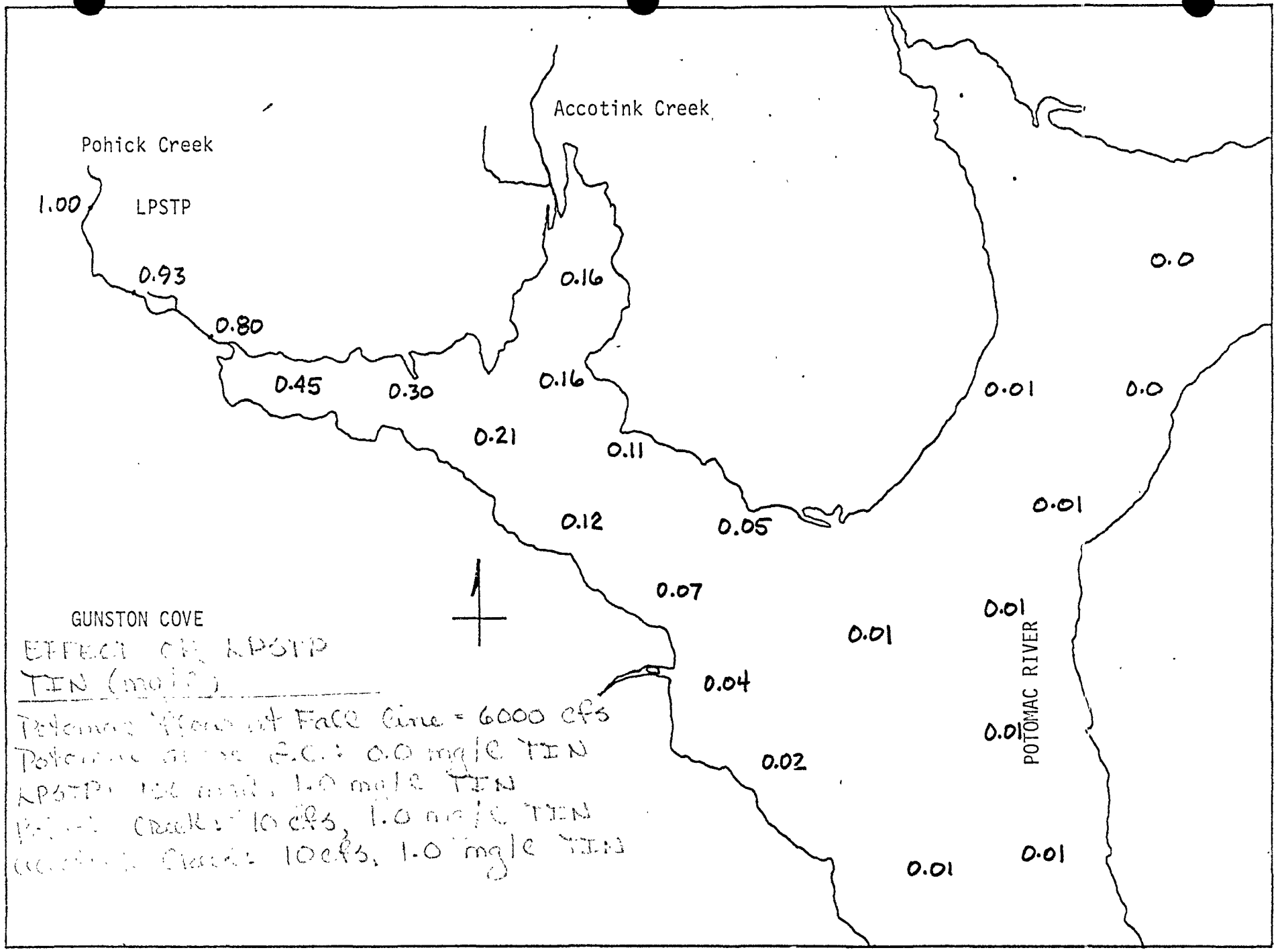

Pohick Creek
Accotink Creek
LPSTP
4.8
4.9
5.1
5.1
5.4
5.3
5.4
5.4
5.6
6.8
6.8
6.8
5.6
6.0
5.9
6.6
6.4
6.0
6.4
6.3
6.2
6.3
POTOMAC RIVER
GUNSTON COVE
DISSOLVED OXYGEN (mg/e)
Potomac Flow at fall line = 6000cfs.
Potomac above GC: 2.0 mg/l UOD, 6.8 mg/l DO
[illegible]: 200 mgd, 10.0 mg/l UOD, 5.0 mg/l DO
[illegible] Creek: 10 cfs, 5.0 mg/l UOD, 7.0 mg/l DO
Accotink Creek: 10 cfs, 5.0 mg/l UOD, 7.0 mg/l DO

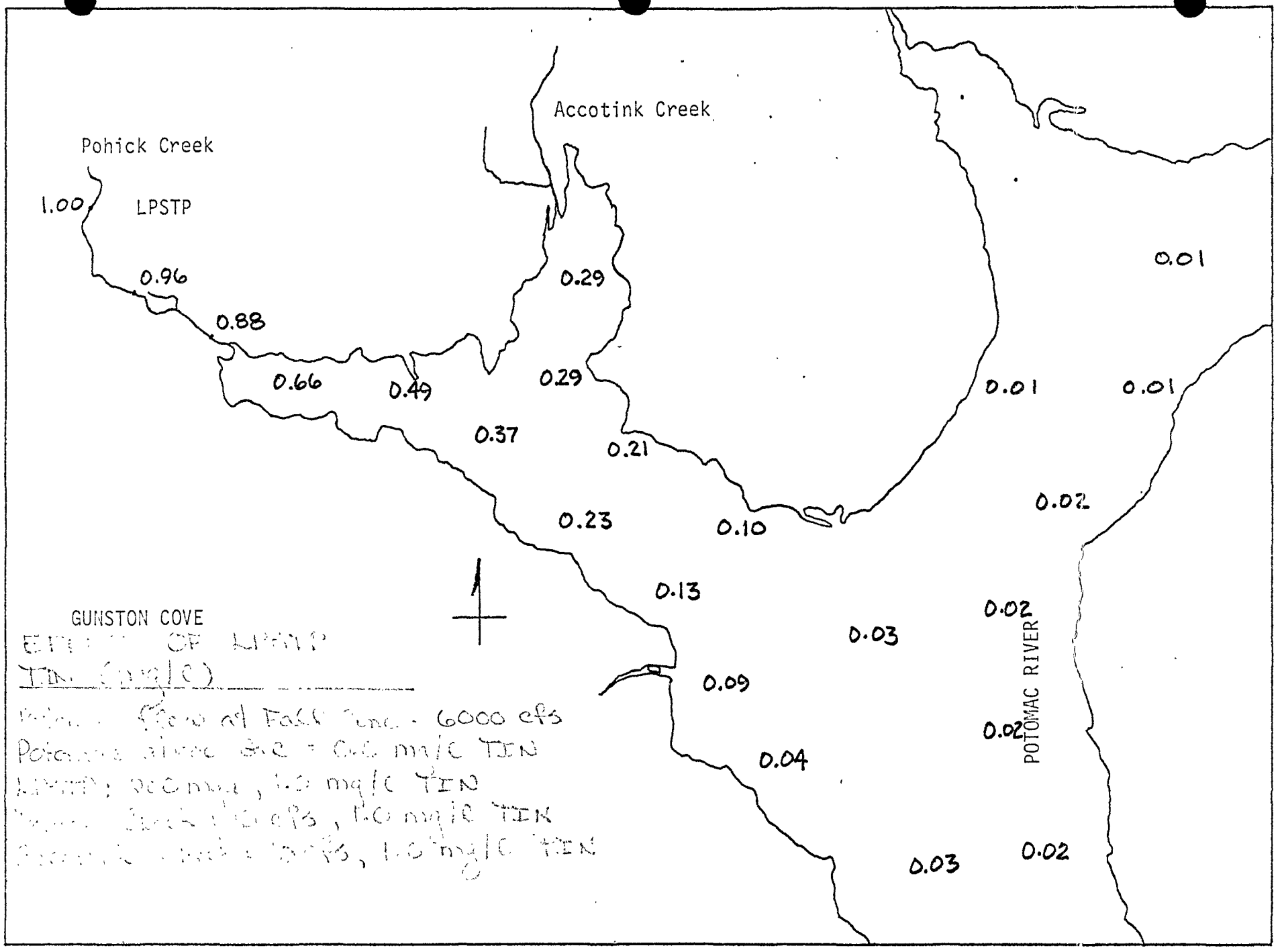

Accotink Creek
Pohick Creek
4.9
LPSTP
5.0
5.1
5.3
5.2
5.0
5.2
5.2
5.5
5.4
5.9
5.8
5.9
6.2
6.2
6.4
6.6
6.8
6.8
6.8
6.8
6.4
6.3
POTOMAC RIVER
GUNSTON COVE
DISSOLVED OXYGEN (mg/ℓ)
Potomac Flow@ Fall line = 6000 cfs.
Potomac above GC.: 2.0 mg/ℓ UOD, 6.8 mg/ℓ DO
LPSTP: 300 mgd, 10.0 mg/ℓ UOD, 5.0 mg/ℓ DO
Pohick Creek: 10 cfs, 5.0 mg/ℓ UOD, 7.0 mg/ℓ DO
Accotink Creek: 10 cfs, 5.0 mg/ℓ UOD, 7.0 mg/ℓ DO

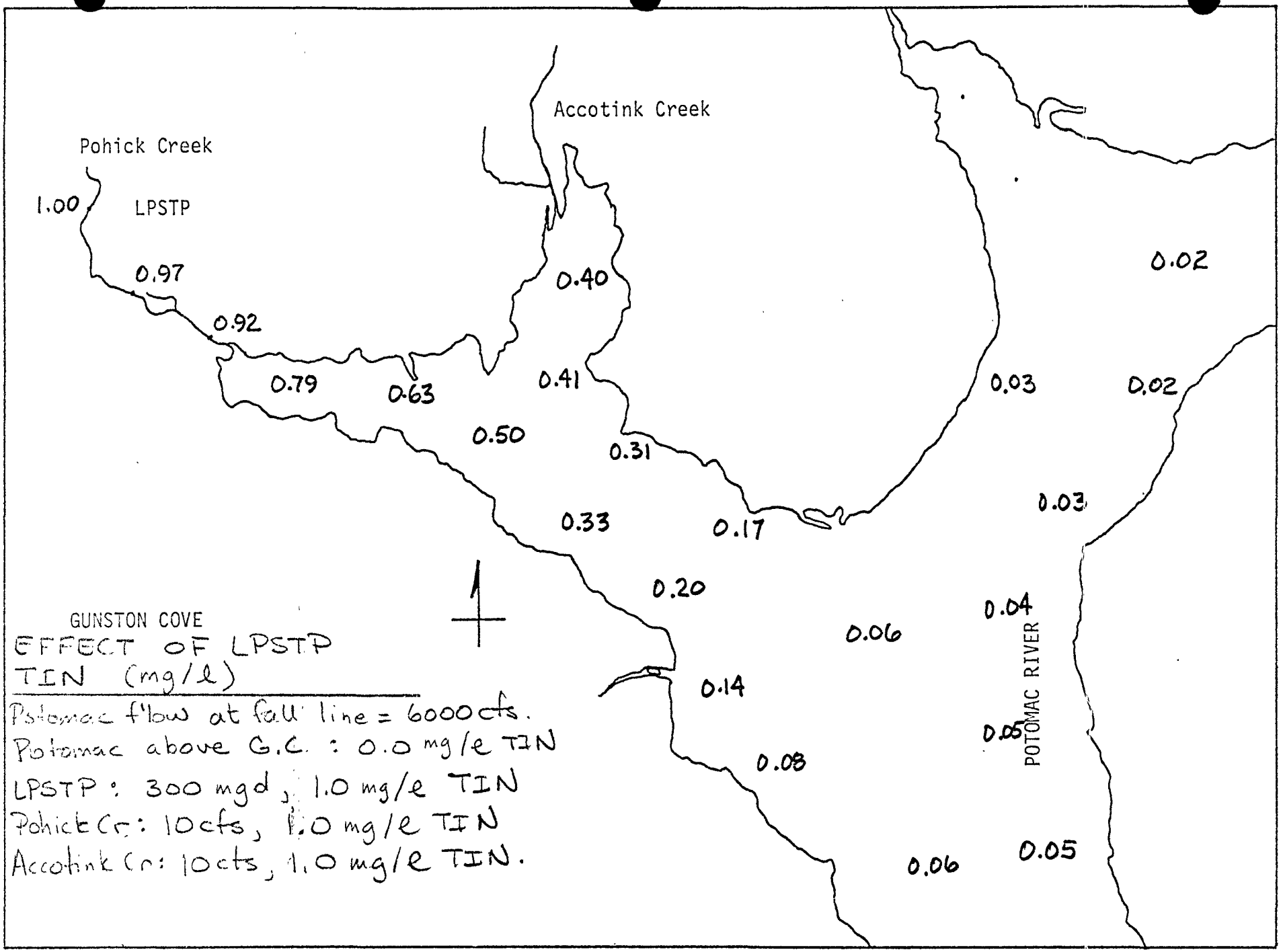

Pohick Creek
Accotink Creek
0.01
LPSTP
0.03
0.08
0.22
0.27
0.32
0.33
0.31
0.35
0.35
0.38
0.37
0.39
0.38
0.39
0.39
0.40
0.40
0.40
0.40
0.40
0.39
POTOMAC RIVER
GUNSTON COVE
EFFECT OF POTOMAC
TIN (1, 8)
Potomac flow at Falls Gage = 6000 cfs
Potomac above GC: 0.4 mg/l TIN
LPSTP: 100 mgd, 2.0 mg/l TIN
Pohick Creek: 10 cfs, 0.8 mg/l TIN
Accotink Creek: 10 cfs, 0.04 mg/l TIN

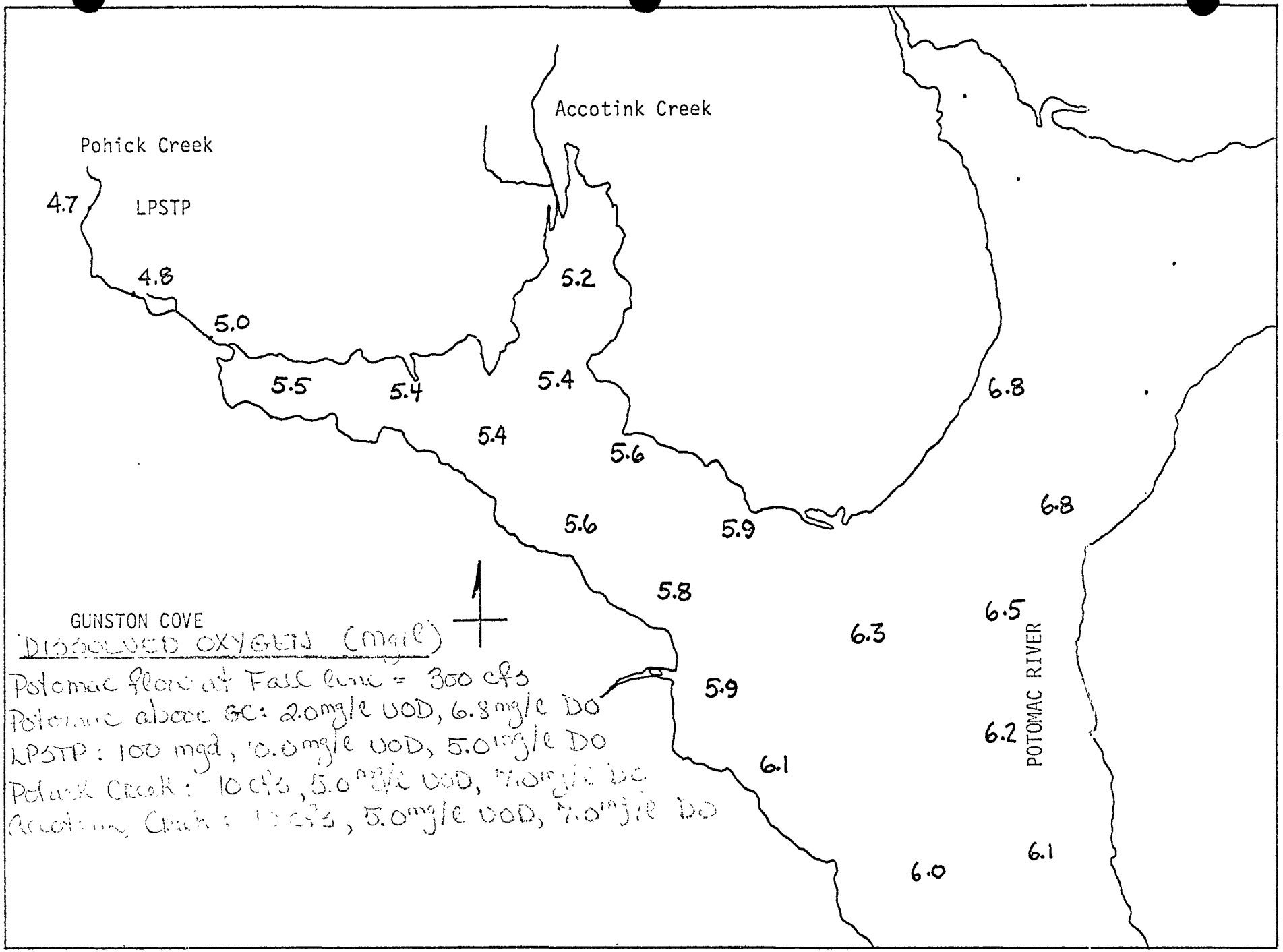

Accotink Creek
Pohick Creek
0.01
LPSTP
0.02
0.05
0.13
0.20
0.27
0.28
0.25
0.31
0.31
0.36
0.35
0.36
0.38
0.39
0.40
0.40
0.40
0.40
0.40
0.39
0.39
POTOMAC RIVER
GUNSTON COVE
EFFECT OF POTOMAC
TIN (mg/l)
Potomac flow at Fall Line = 6000 cfs
Potomac above GC: 0.4 mg/l TIN
LPSTP: 200 mgd, 0.0 mg/l TIN
Pohick Creek: 10 cfs, 0.0 mg/l TIN
Accotink Creek: 10 cfs, 0.0 mg/l TIN

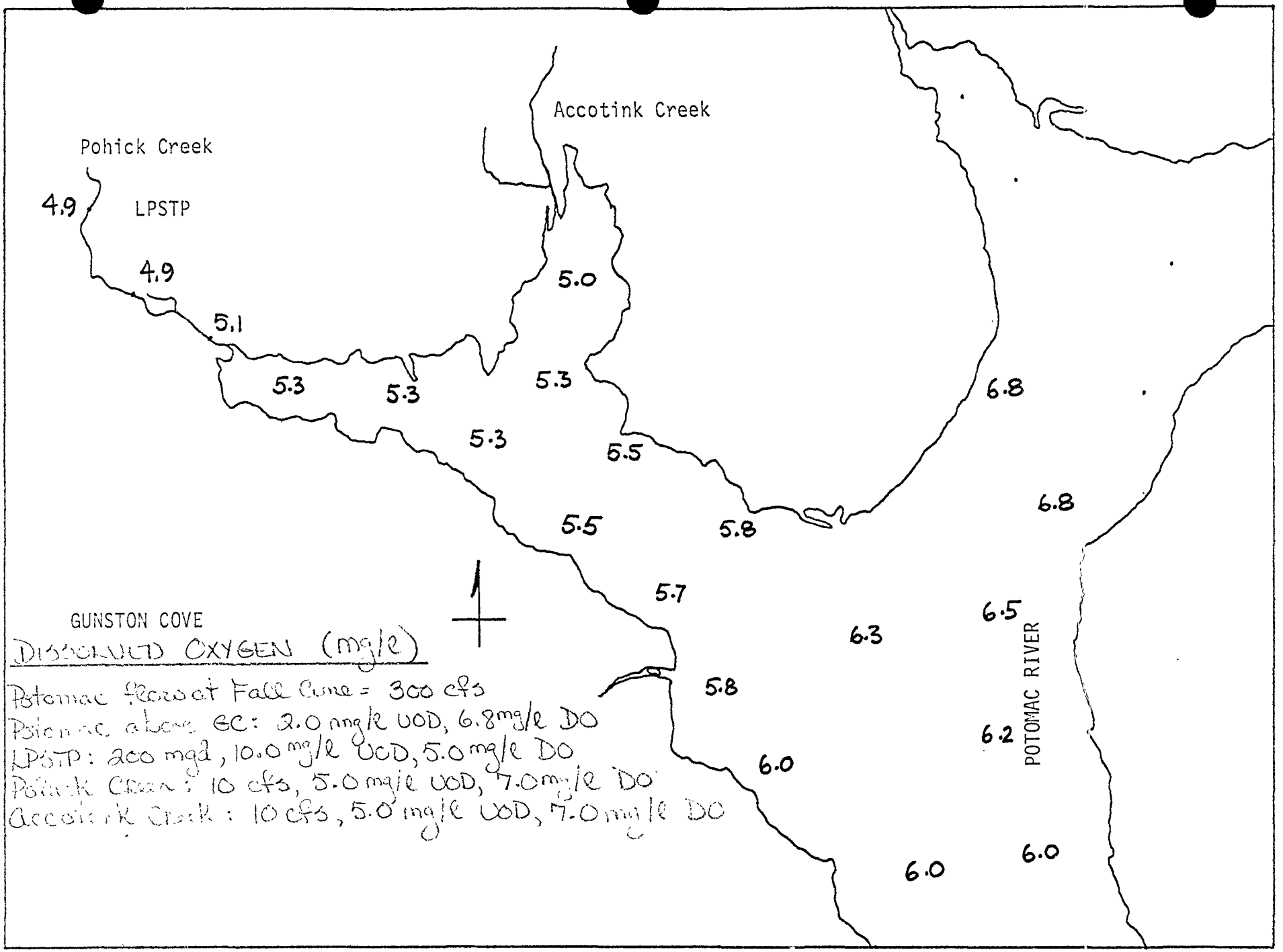

Pohick Creek
Accotink Creek
0.00
LPSTP
0.01
0.03
0.08
0.15
0.20
0.23
0.24
0.28
0.27
0.34
0.33
0.35
0.38
0.38
0.39
0.40
0.40
0.40
0.40
0.40
0 39
POTOMAC RIVER
GUNSTON COVE
EFFECT OF POTOMAC
TIN (mg/ℓ)
Potomac flow at fall line = 6000cfs.
Potomac above G.C: 0.4 mg/ℓ TIN
LPSTP: 300 mgd, 0.0 mg/ℓ TIN
Pohick Cr: 10 cfs, 0.0 mg/ℓ TIN
Accotink Cr: 10 cfs, 0.0 mg/ℓ TIN.

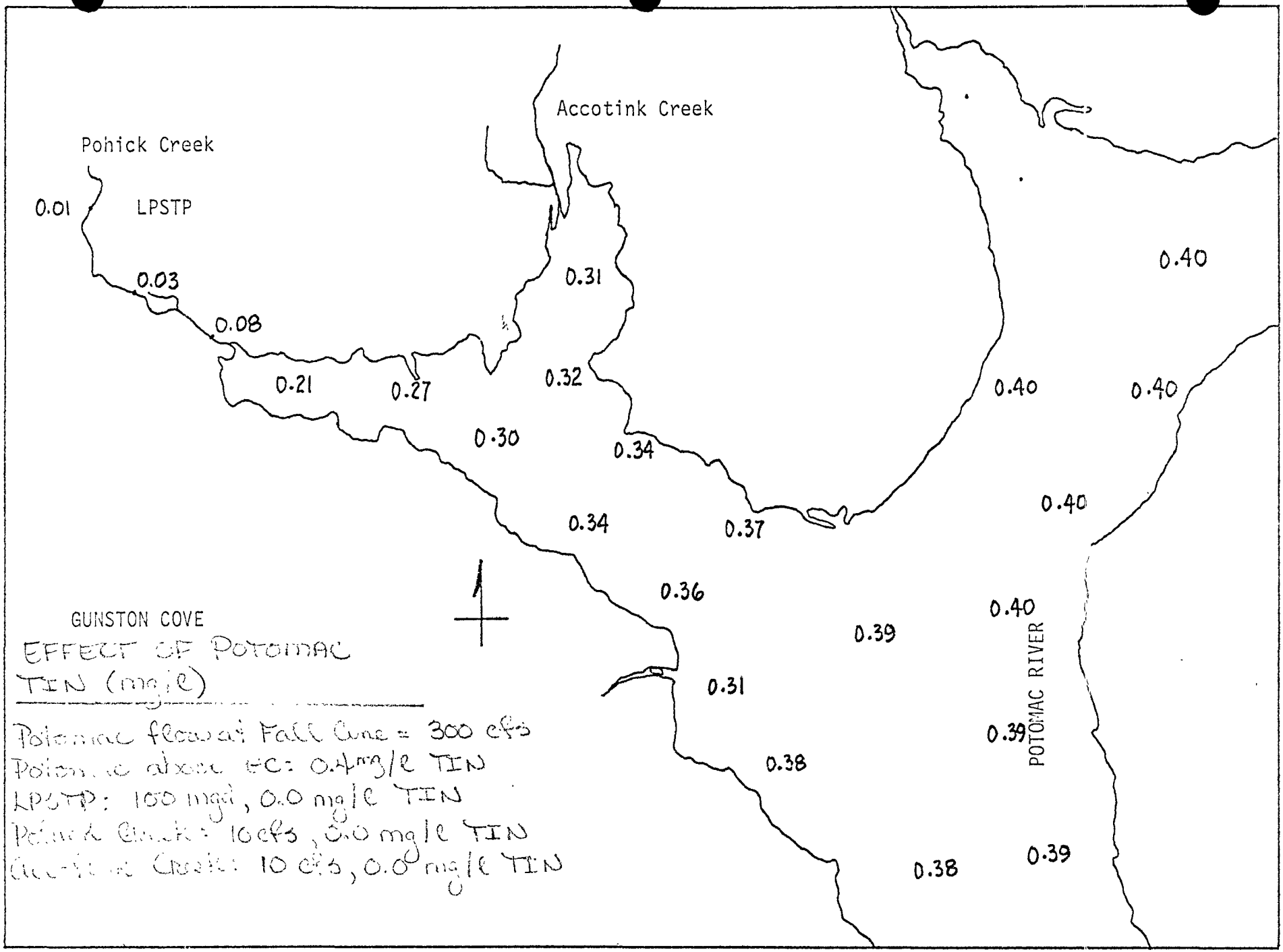

Accotink Creek
Pohick Creek
1.00
LPSTP
0.93
0.80
0.45
0.30
0.16
0.16
0.21
0.11
0.12
0.05
0.07
0.04
0.02
0.01
0.0
0.01
0.0
0.01
0.01
0.01
0.01
0.01
POTOMAC RIVER
GUNSTON COVE
EFFECT OF LPSTP
TIN (mg/l)
Potomac Flow at Face Line = 6000 cfs
Potomac [illegible] C.C.: 0.0 mg/l TIN
LPSTP: [illegible] 1.0 mg/l TIN
[illegible] Creek: 10 cfs, 1.0 mg/l TIN
[illegible] Creek: 10cfs, 1.0 mg/l TIN

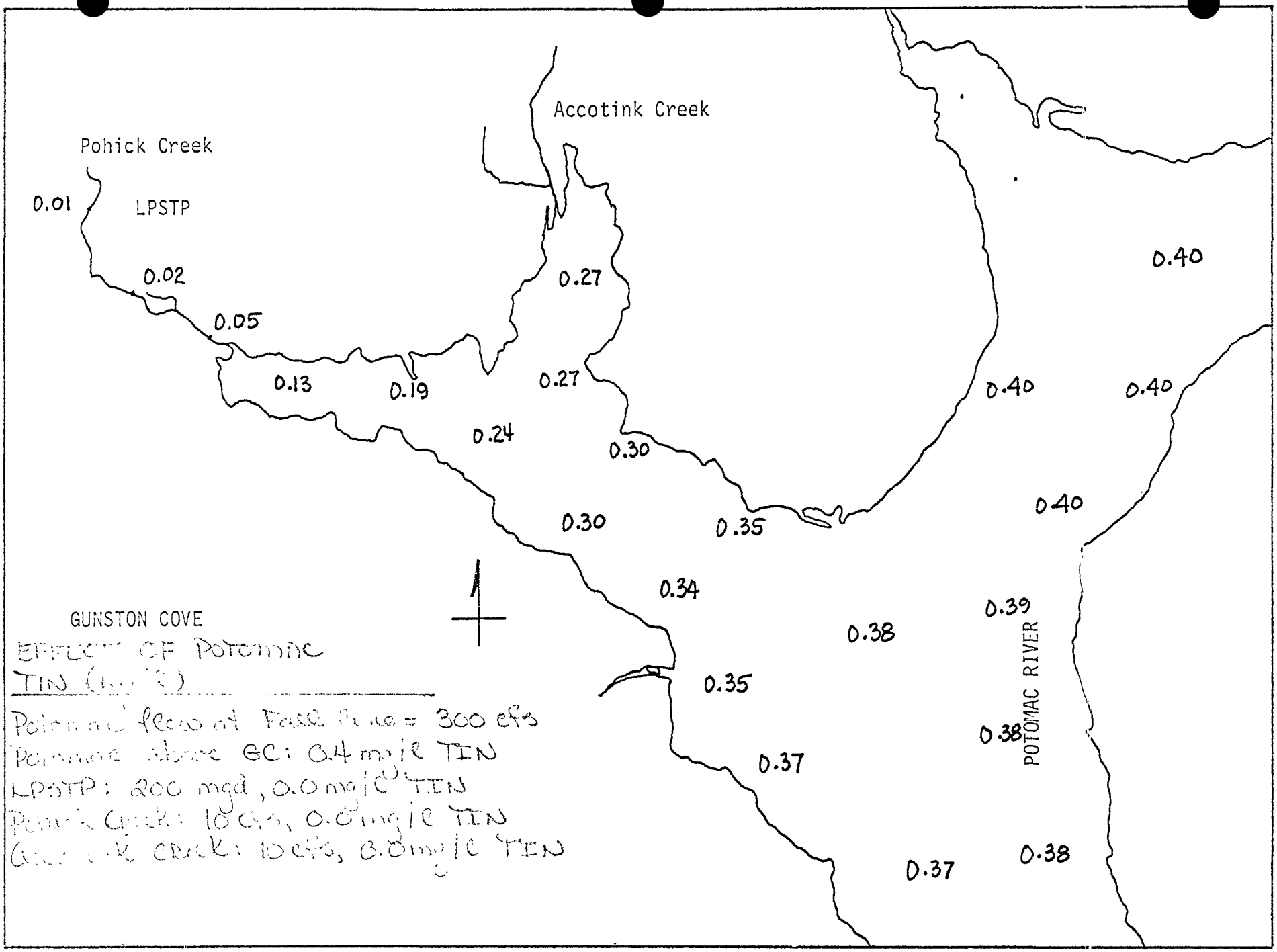

Accotink Creek
Pohick Creek
1.00
LPSTP
0.96
0.88
0.66
0.49
0.29
0.29
0.37
0.21
0.23
0.10
0.13
0.09
0.04
0.03
0.01
0.01
0.01
0.02
0.02
0.02
0.02
POTOMAC RIVER
GUNSTON COVE
EFFECT OF LPSTP
TIN (mg/l)
Potomac flow at Falls Church - 6000 cfs
Potomac above GC = 0.02 mg/l TIN
LPSTP; 36 mgd, 1.0 mg/l TIN
Pohick Creek 0 cfs, 1.0 mg/l TIN
Accotink Creek 0 cfs, 1.0 mg/l TIN

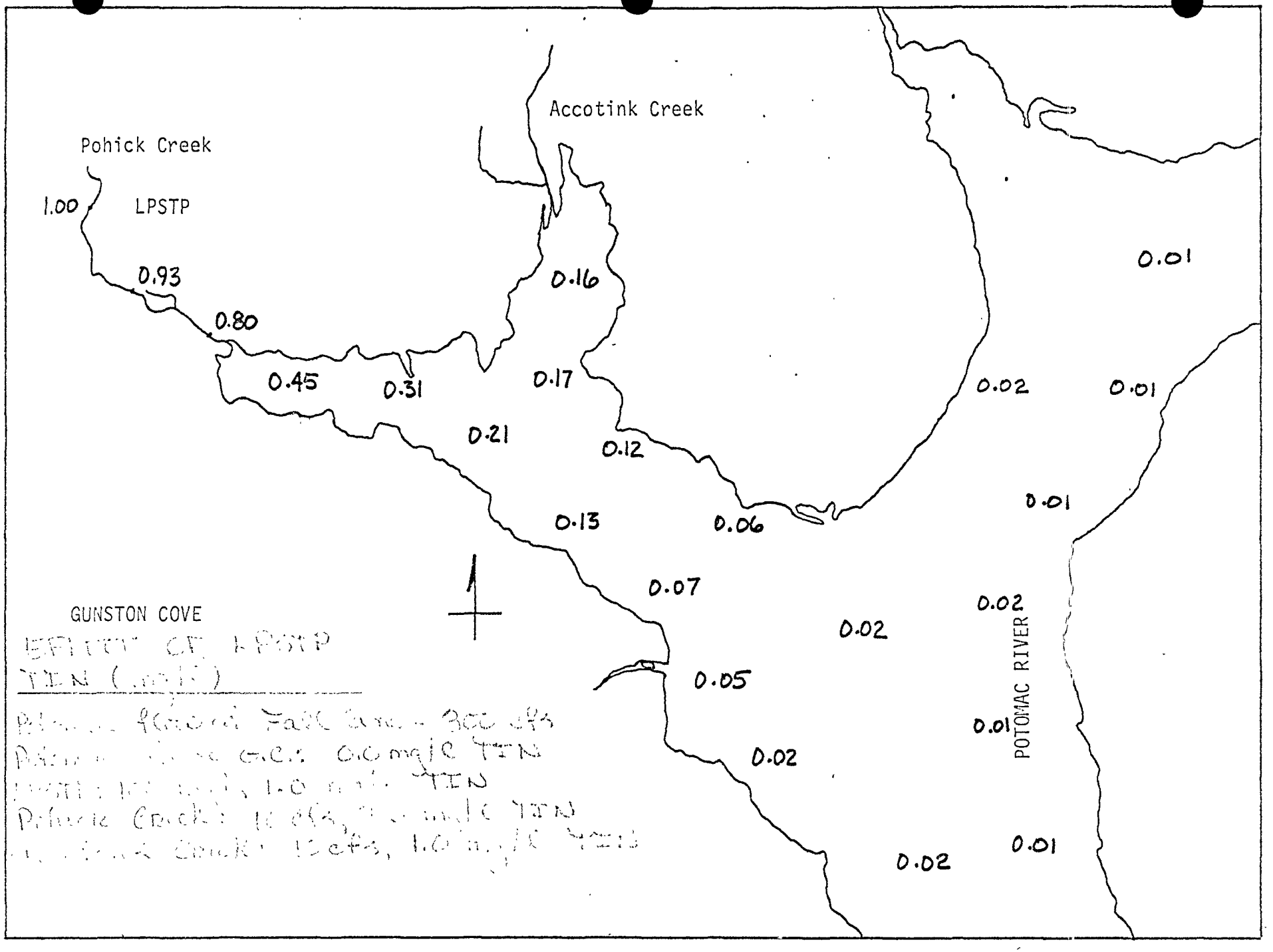

Accotink Creek
Pohick Creek
1.00
LPSTP
0.97
0.92
0.79
0.63
0.40
0.41
0.50
0.31
0.33
0.17
0.20
0.14
0.08
0.06
0.02
0.03
0.02
0.03
0.04
0.05
0.06
0.05
POTOMAC RIVER
GUNSTON COVE
EFFECT OF LPSTP
TIN (mg/l)
Potomac flow at fall line = 6000 cfs.
Potomac above G.C. : 0.0 mg/l TIN
LPSTP : 300 mgd, 1.0 mg/l TIN
Pohick Cr: 10 cfs, 1.0 mg/l TIN
Accotink Cr: 10 cfs, 1.0 mg/l TIN.


Accotink Creek
Pohick Creek
4.7
LPSTP
4.8
5.0
5.5
5.4
5.4
5.2
5.4
5.6
5.6
5.9
6.8
6.8
5.8
6.5
6.3
5.9
6.2
6.1
6.1
6.0
POTOMAC RIVER
GUNSTON COVE
DISSOLVED OXYGEN (mg/l)
Potomac flow at Fall line = 300 cfs
Potomac above GC: 2.0mg/l UOD, 6.8 mg/l DO
LPSTP: 100 mgd, 10.0 mg/l UOD, 5.0 mg/l DO
Pohick Creek: 10 cfs, 5.0 mg/l UOD, 7.0 mg/l DO
Accotink Creek: 10 cfs, 5.0 mg/l UOD, 7.0 mg/l DO


Accotink Creek
Pohick Creek
4.9
LPSTP
4.9
5.1
5.0
5.3
5.3
5.3
6.8
5.3
5.5
6.8
5.5
5.8
5.7
GUNSTON COVE
6.5
6.3
5.8
6.2
POTOMAC RIVER
6.0
6.0
6.0
DISSOLVED OXYGEN (mg/l)
Potomac flow at Fall Line = 300 cfs
Potomac above GC: 2.0 mg/l UOD, 6.8 mg/l DO
LPSTP: 200 mgd, 10.0 mg/l UOD, 5.0 mg/l DO
Pohick Creek: 10 cfs, 5.0 mg/l UOD, 7.0 mg/l DO
Accotink Creek: 10 cfs, 5.0 mg/l UOD, 7.0 mg/l DO

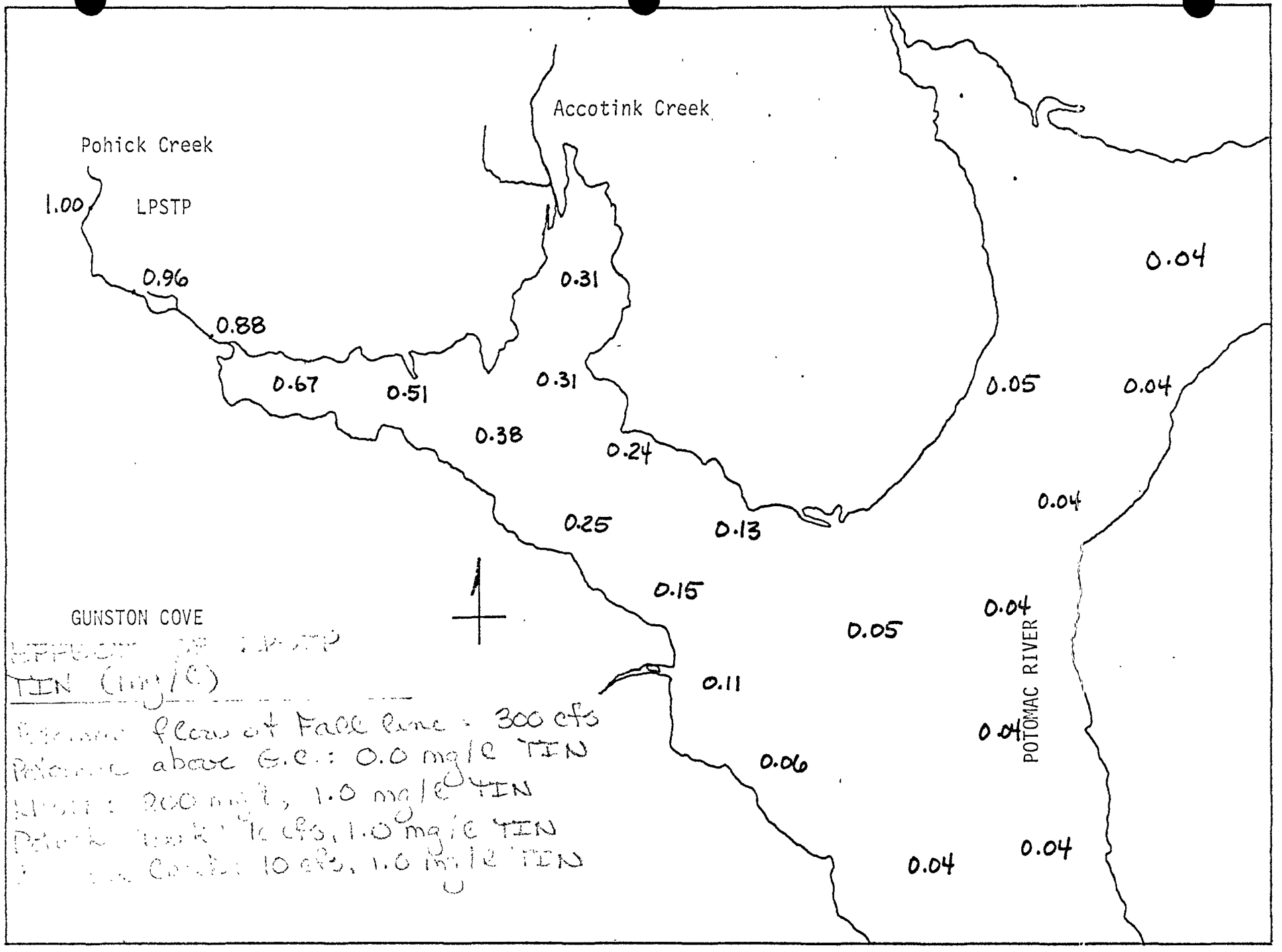

Accotink Creek
Pohick Creek
0.01
LPSTP
0.03
0.08
0.21
0.27
0.31
0.32
0.30
0.34
0.34
0.37
0.36
0.31
0.38
0.40
0.40
0.40
0.40
0.39
0.39
0.38
0.39
POTOMAC RIVER
GUNSTON COVE
EFFECT OF POTOMAC
TIN (mg/l)
Potomac flow at Fall Line = 300 cfs
Potomac above FC: 0.4 mg/l TIN
LPSTP: 100 mgd, 0.0 mg/l TIN
Pohick Creek: 10 cfs, 0.0 mg/l TIN
Accotink Creek: 10 cfs, 0.0 mg/l TIN


Accotink Creek
Pohick Creek
LPSTP
0.01
0.02
0.05
0.13
0.19
0.27
0.27
0.24
0.30
0.30
0.35
0.34
0.35
0.37
0.37
0.38
0.39
0.38
0.40
0.40
0.40
0.40
POTOMAC RIVER
GUNSTON COVE
EFFECT OF POTOMAC
TIN (
Potomac flow at Fall
Potomac above GC: 0.4 mg/l TIN
LPSTP: 200 mgd, 0.0 mg/l TIN
Pohick Creek: 10 cfs, 0.0 mg/l TIN
Accotink Creek: 10 cfs, 0.0 mg/l TIN



EFFECT OF LPSTP
TIN (mg/l)

Potomac Upstream Fall Line - 300 cfs
Potomac [illegible] G.C. 0.0 mg/l TIN
[illegible] 1.0 mg/l TIN
Pohick Creek 10 cfs, 1.0 mg/l TIN
Accotink Creek 10 cfs, 1.0 mg/l TIN


Pohick Creek
Accotink Creek
1.00
LPSTP
0.96
0.88
0.67
0.51
0.31
0.31
0.38
0.24
0.25
0.13
0.15
0.11
0.06
0.04
0.05
0.04
0.04
0.05
0.04
0.04
0.04
POTOMAC RIVER
GUNSTON COVE
TIN (mg/ℓ)

Influence Curves:

Curve I ; Effect of Potomac, Potomac flow at fall line = 6000 cfs.

Curve II ; Effect of LPSTP, Potomac flow at fall line = 6000 cfs.

Curve III; Effect of Potomac, Potomac flow at fall line = 300 cfs.

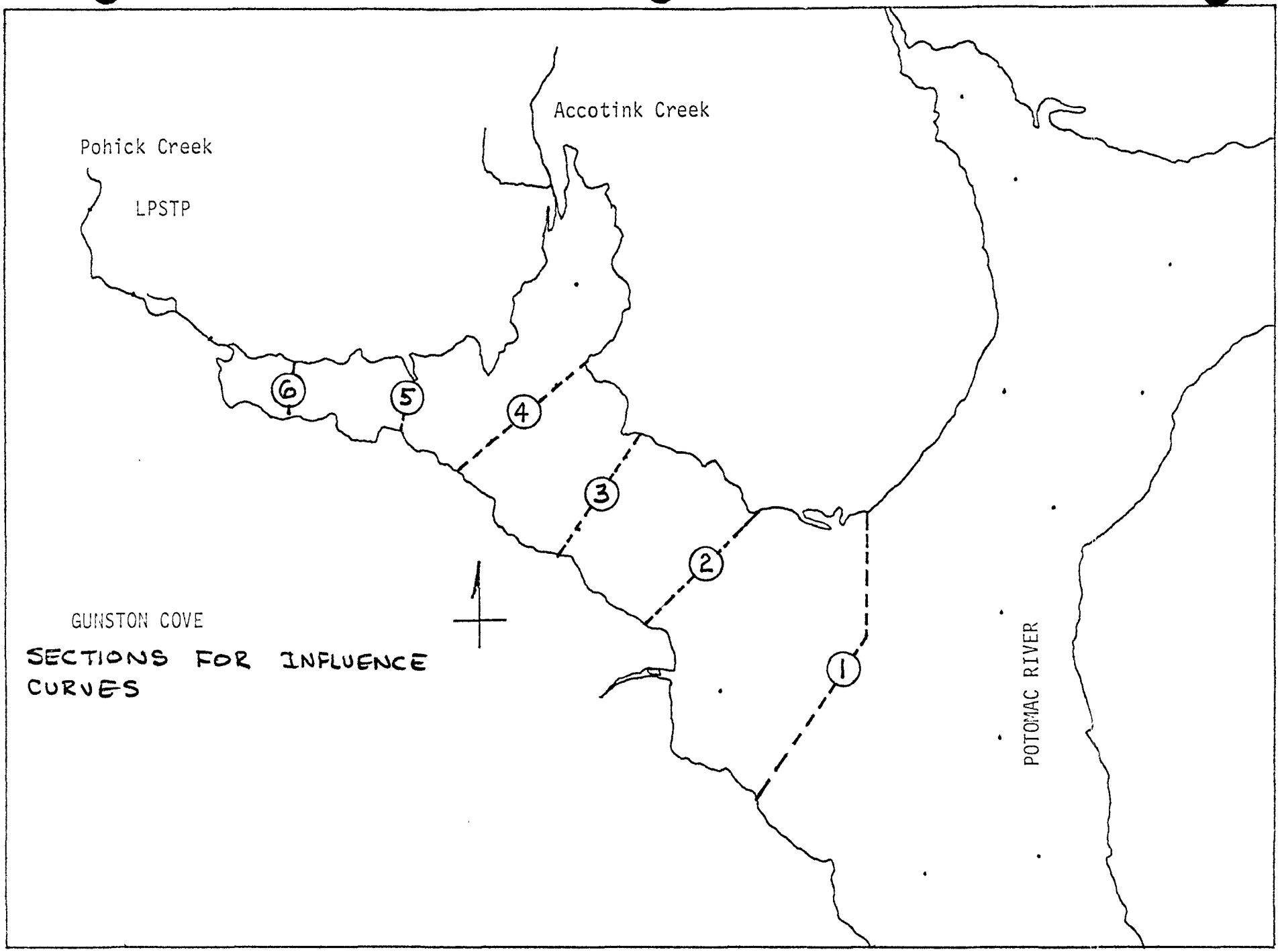
Curve IV ; Effect of LPSTP, Potomac flow at fall line = 300 cfs.

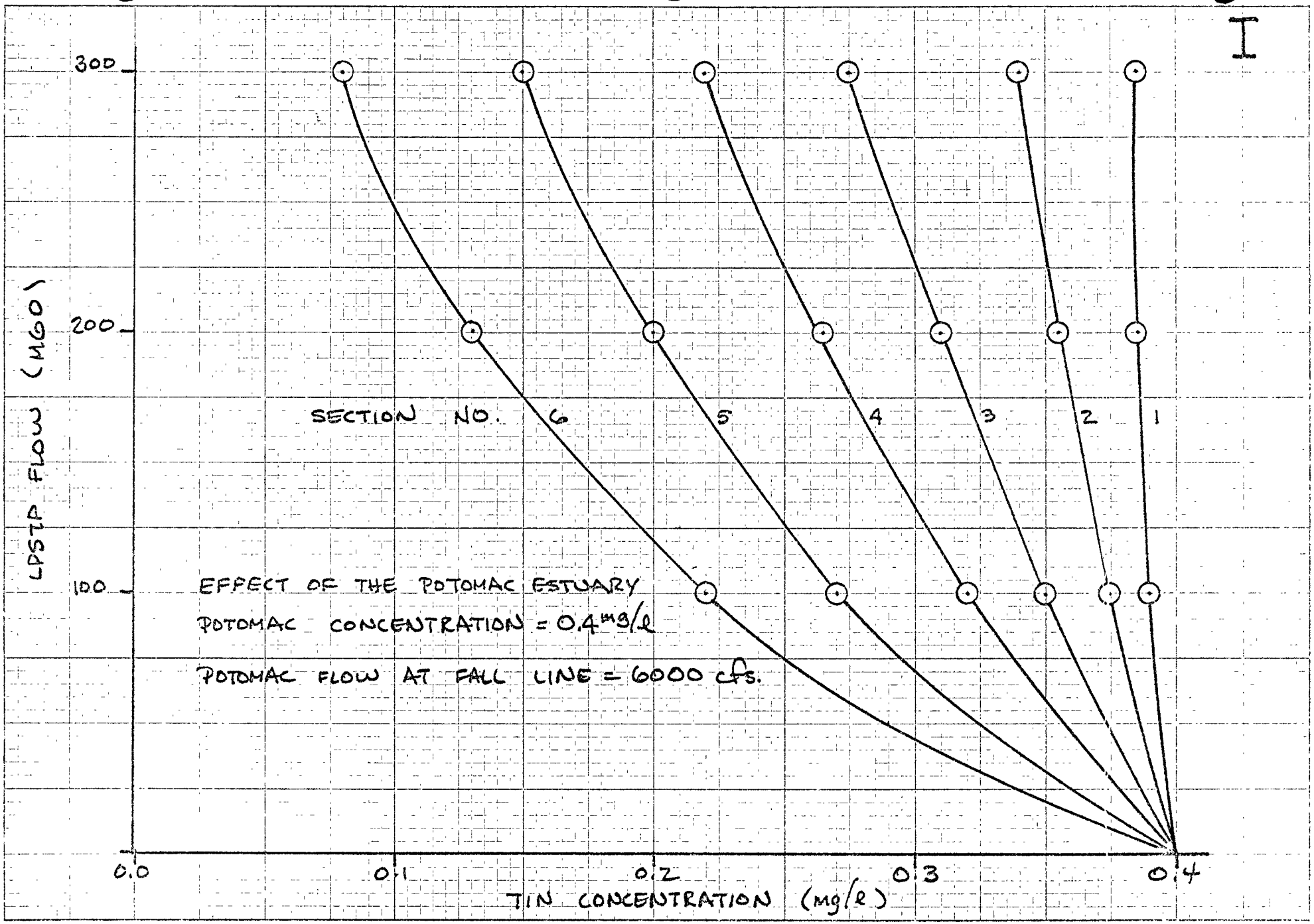
Directions for use:

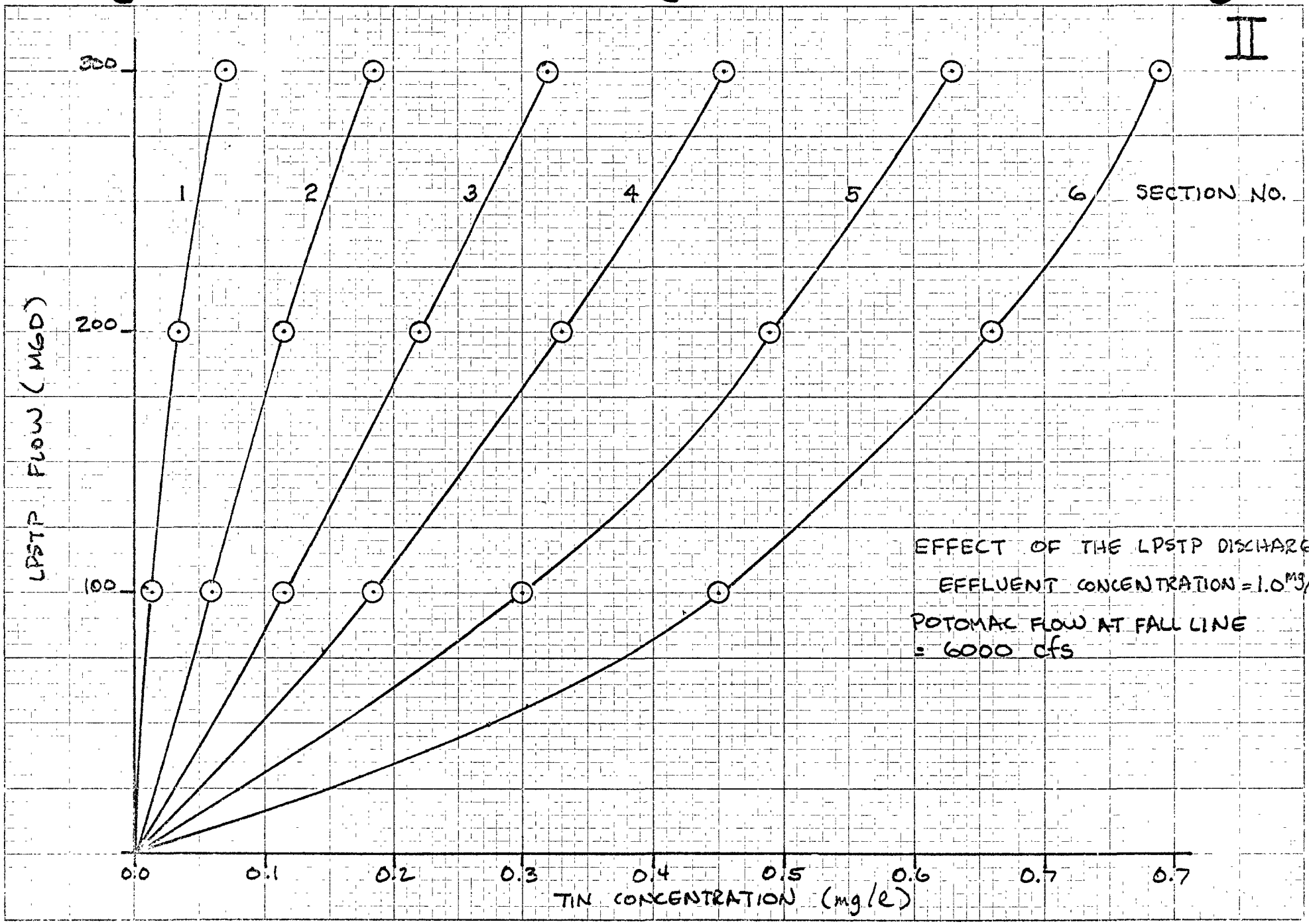
To determine the approximate concentration at a location (section);

1. Determine the Potomac influence from the appropriate curve.
2. Determine the LPSTP influence from the appropriate curve.
3. Add the two influences together to get the final result.

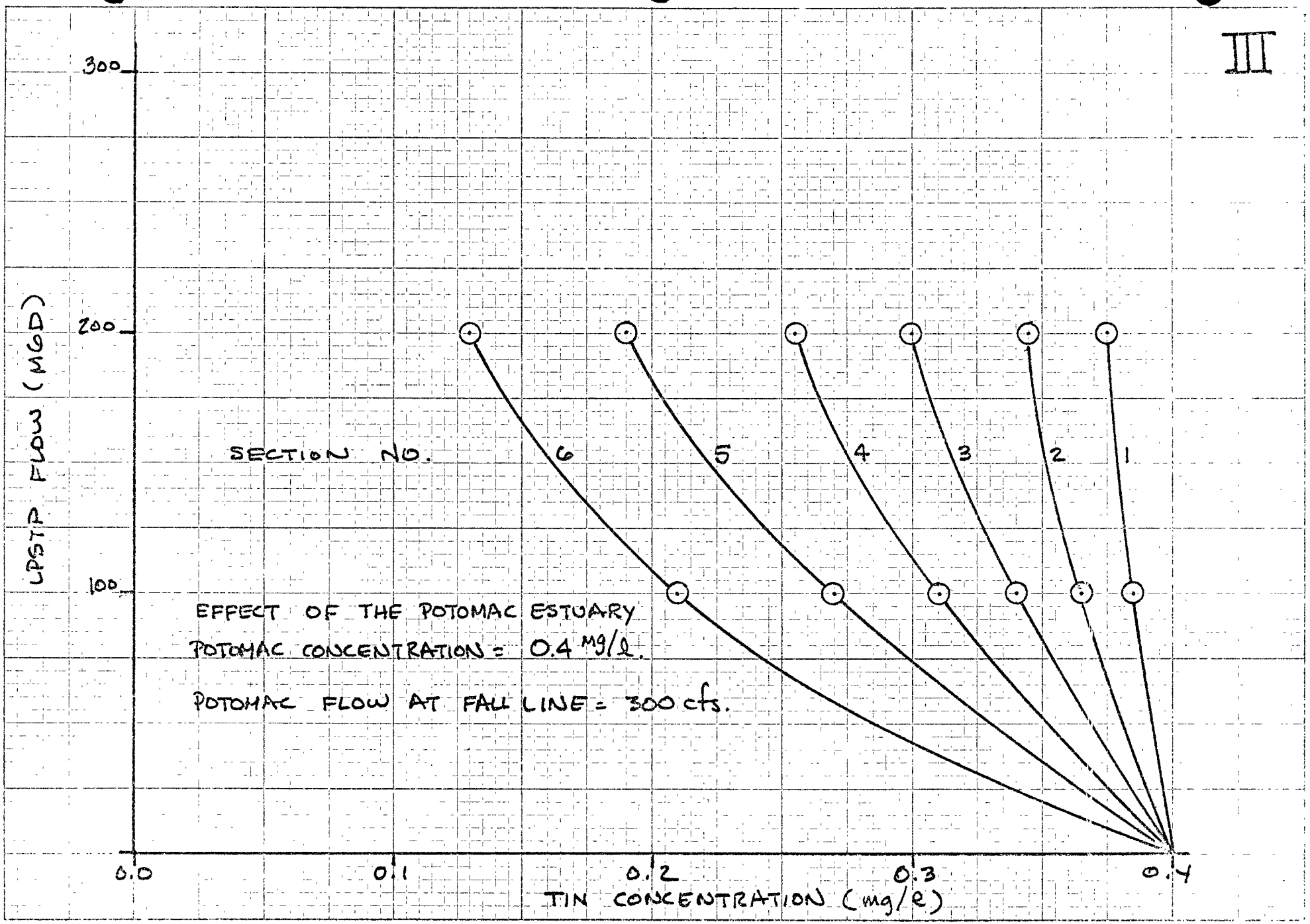
Remember that different LPSTP inflow concentrations and Potomac concentrations can be evaluated by applying a proportionality factor.


Accotink Creek
Pohick Creek
LPSTP
6
5
4
3
2
1
GUNSTON COVE
POTOMAC RIVER
SECTIONS FOR INFLUENCE CURVES

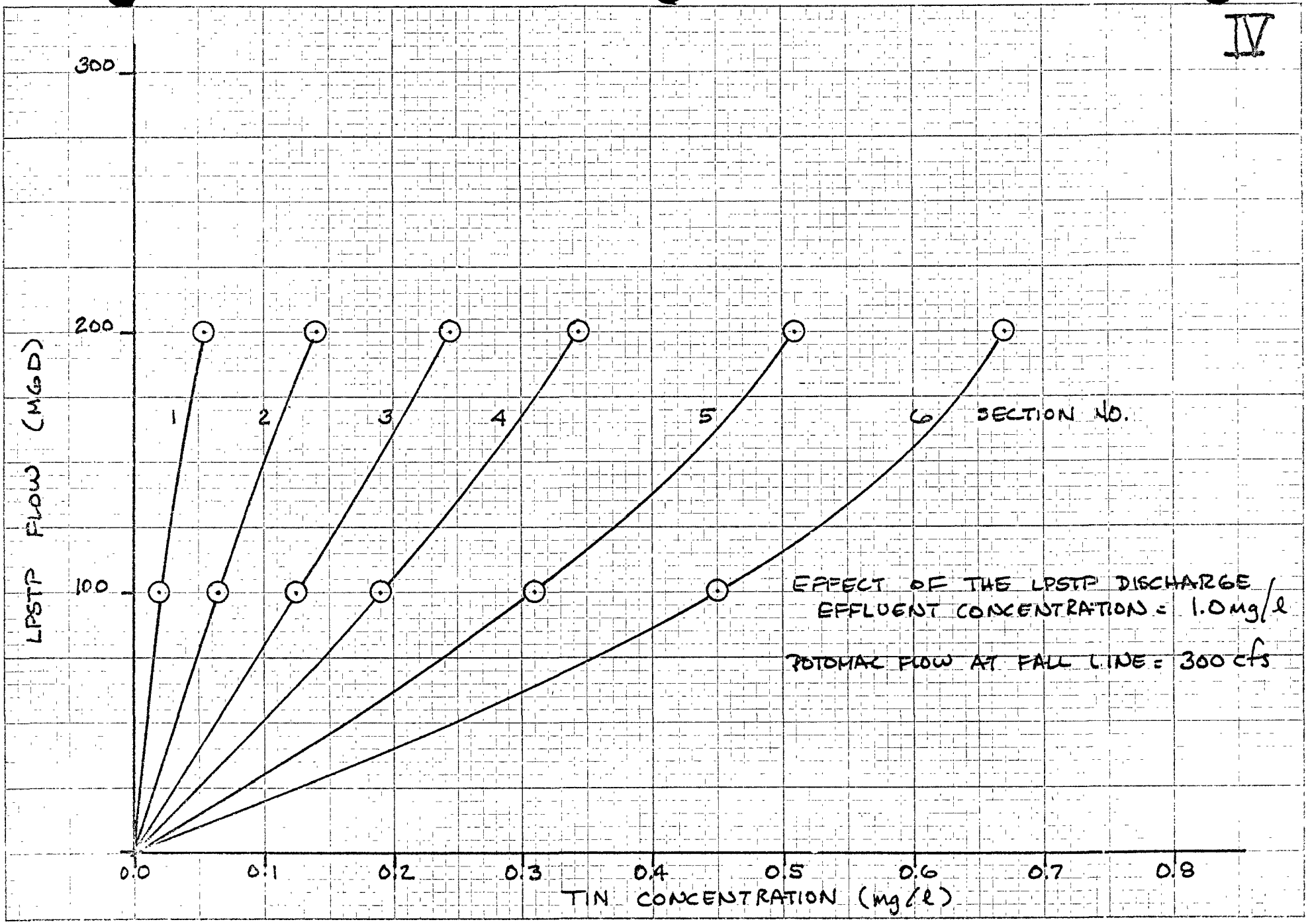

I
300
200
100
LDSTA FLOW (MGD)
SECTION NO.
6
5
4
3
2
1
EFFECT OF THE POTOMAC ESTUARY
POTOMAC CONCENTRATION = 0.4 mg/l
POTOMAC FLOW AT FALL LINE = 6000 cfs.
0.0
0.1
0.2
0.3
0.4
TIN CONCENTRATION (mg/l)


II
300
200
100
LPSTP FLOW (MGD)
1
2
3
4
5
6
SECTION NO.
EFFECT OF THE LPSTP DISCHARGE
EFFLUENT CONCENTRATION = 1.0 MG/L
POTOMAC FLOW AT FALL LINE
= 6000 cfs
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.7
TIN CONCENTRATION (mg/l)

III


300
200
100
LPSTP FLOW (MGD)
SECTION NO.
6
5
4
3
2
1
EFFECT OF THE POTOMAC ESTUARY
POTOMAC CONCENTRATION = 0.4 mg/l.
POTOMAC FLOW AT FALL LINE = 300 cfs.
0.0
0.1
0.2
0.3
0.4
TIN CONCENTRATION (mg/l)

IV


300
200
100
LPSTP FLOW (MGD)
1
2
3
4
5
6
SECTION NO.
EFFECT OF THE LPSTP DISCHARGE
EFFLUENT CONCENTRATION = 1.0 mg/l
POTOMAC FLOW AT FALL LINE = 300 cfs
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
TIN CONCENTRATION (mg/l)