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Determination of marina buffer zones using simple mixing and transport models : a report to the Virginia State Dept. of Health, Bureau of Shellfish Sanitation as part of the Chesapeake Bay Initiatives Marine Pollution Abatement Initiative

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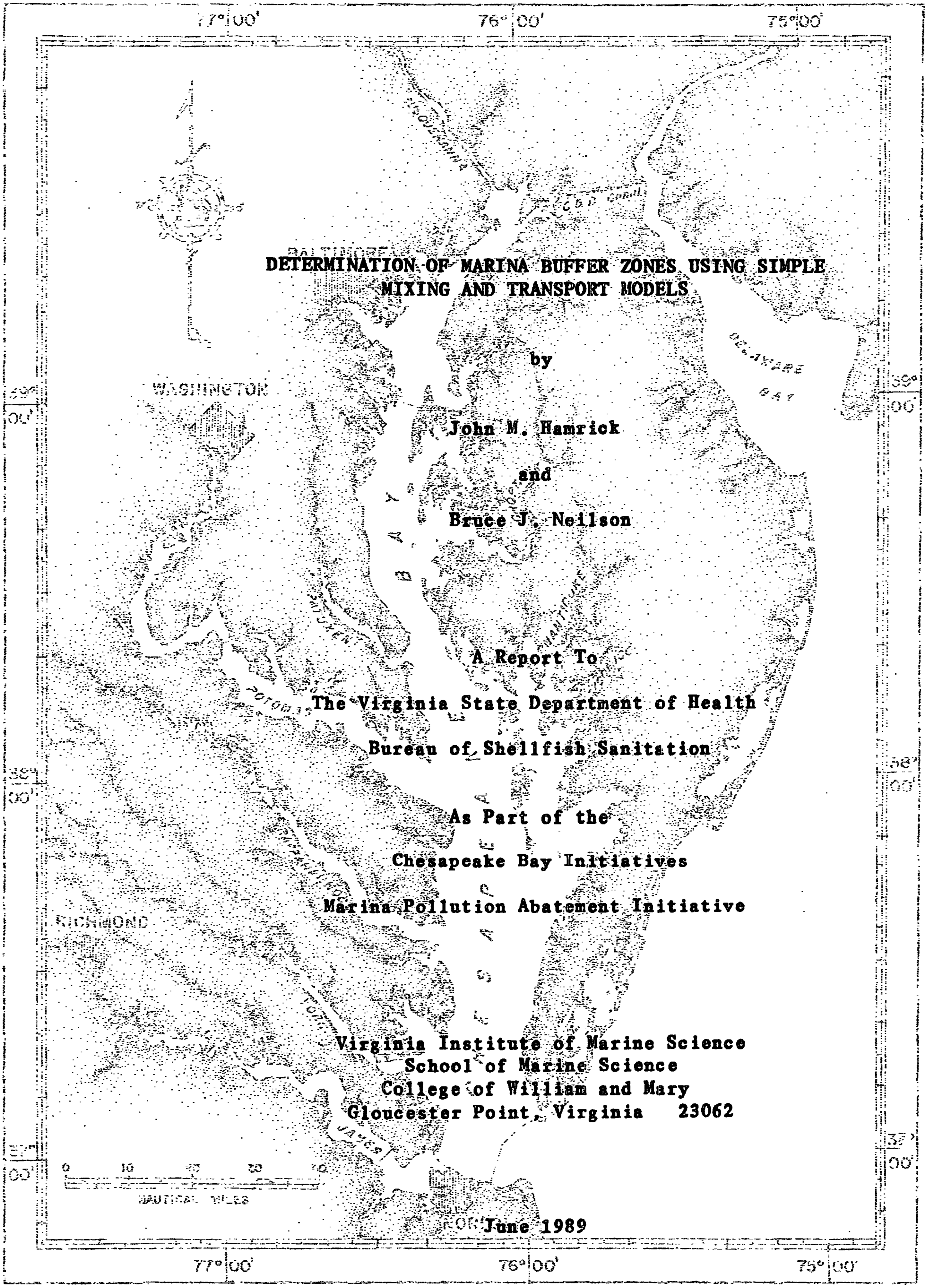

DETERMINATION OF MARINA BUFFER ZONES USING SIMPLE MIXING AND TRANSPORT MODELS

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A Report To

The Virginia State Department of Health

Bureau of Shellfish Sanitation

As Part of the

Chesapeake Bay Initiatives

Marina Pollution Abatement Initiative

Virginia Institute of Marine Science
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ABSTRACT

This report describes the rationale, development and application of simple mixing and transport models for the determination of marina buffer zones and buffer zones for other point source discharges. Included in the report are two computer programs for implementation of the most general two dimensional transport model.

CONTENTS

1. INTRODUCTION

The discharge of sanitary waste from boats in the vicinity of marinas has the potential to contaminate adjacent shellfish beds and pose serious public health risk if the shellfish are harvested for human consumption. To reduce the public health risk posed by potentially contaminated shellfish harvested near marina sites, it is a standard policy to establish buffer zones surrounding marina sites. In the State of Virginia, the policy of the Bureau of Shellfish Sanitation of the State Health Department requires buffer zones around boat mooring facilities within which shellfish cannot be harvested for direct marketing during the months of April through October. The size of the buffer zone for a particular marina is based on the number of docking slips as follows:

0 - 50 slips	1/8 mile in all directions
51 - 100 slips	1/4 mile in all directions
over 100 slips	1/2 mile in all directions

This policy is easy to implement and has provided adequate protection to the public. The policy has, however, come under criticism as lacking a rigorous scientific basis beyond the simple rational concept of more boats, more contamination. An extended scientific basis for establishing buffer zones may be formulated using the concept of indicator organisms to represent potential pathogenic contamination of a water body.

The potential for pathogenic contaminant of shellfish producing water bodies can be represented by the concentration of total coliform or fecal coliform organisms in the water body. In the vicinity of treated sewage discharges, a total coliform concentration exceeding 70 organisms/100mL is a generally accepted criteria for inclusion in a buffer zone. In the vicinity of boat marinas where fresh fecal material may be discharged, a fecal coliform concentration exceeding 14 organisms/100mL is the currently accepted criteria for inclusion in a buffer zone. Using the above indicator organism concentrations to delineate buffer zone boundaries, a rigorous scientific basis for establishing buffer zones would involve the prediction of the indicator organism concentration distribution in the water body in the vicinity of the marina.

Given a reasonable estimate of the discharge rate of indicator organisms from the marina site, the resulting concentrations distribution can, in principle, be determined using soundly established hydrodynamic and transport phenomena theory, as documented in Fischer et al, (1979) and Thomann and Mueller (1987). The level of sophistication involved in implementing this approach may vary considerably, with technical and economic resources being the key determinants. The most sophisticated level of implementation would involve using multidimensional numerical hydrodynamic and transport models to determine the flow and mixing characteristics and resulting contaminant distribution for a site of interest. This approach is time consuming and costly involving the need for extensive field data and computer time and is not feasible when a large number of sites must be evaluated. The least sophisticated level of implementation would involve using simple, but sound, analytical hydrodynamic and transport models. These analytic models would require only readily available site data from tide tables and navigation charts and the necessary calculations could be performed using a handheld calculator. The simplicity and economy of this simple mixing and transport model approach, which has a sound scientific basis, provides a strong recommendation for its use in determining marina buffer zones.

The purpose of this report is to present a consistent and scientifically sound approach for determining marina buffer zones using simple mixing and transport models. The presentation includes discussions of mixing and transport model selection based on marina site characteristics, and use of the transport models for determination of buffer zones. Example calculations for various classes of marina sites are included. Completed details of the transport models are included in an Appendix.

2. SELECTION OF MIXING AND TRANSPORT MODELS

To use the simple mixing and transport models, to be presented in this section, for buffer zone determination, it will be necessary to match specific marina sites to the most appropriate model or models. This can be preliminarily accomplished by adopting a classification scheme for marina sites. Referring to Figures A.1, A.3, and A.4, three classes of sites are identified as: major or wide channel; minor or narrow channel; and semi-enclosed bay or basin. Naturally, these classes are somewhat subjective, but some general features may be identified. Wide channel sites are characterized by the marina being along the shoreline of a wide, typically wider than 100 yds or 100 m, channel which may have measurable net fresh water discharge in addition to tidal driven flow. Narrow channel sites are characterized by the marina being along the shoreline of a narrow channel, typically closed at the upstream, and having an insignificant net fresh water discharge. Semi-enclosed bay and basin sites include marinas located in natural bays having narrow entrances and manmade semi-enclosed boat basins.

Three simple analytical mixing and transport models have been selected for their ability to describe the dominant physical processes responsible for contaminant mixing and transport in the three marina site classes described above. The correspondence between the marina site classes and the models are essentially one to one, however, borderline situations will likely be common and require evaluation of the site using two models with a requirement of conservatism being used to synthesize the final results.

The three models to be used all assume that the contaminant material becomes uniformly mixed over the water depth in a time, T_z,

$$T_z = 120 \frac{h}{q_m} \qquad (2.1, A40)$$

which must be less than the tidal period, T_t (12.4 hrs) and less than the inverse of the contaminant decay rate, K_d, ($K_d \simeq$ 1/day for fecal coliform). In the equation for T_z, h is the mean water depth and q_m is the maximum tidal current velocity obtained from tidal current tables or estimated using equations (A41, A44, or A32) as appropriation, in Appendix A.

The first transport model essentially corresponds to marinas on the shore lines of wide channels and is termed the Two-Dimensional Advection-Dispersion Equation Model, with a detailed description given in Section A.1 of Appendix A. The model solutions are given by Equations (A11) and (A16), Appendix A and represents the two-dimensional along and across channel contaminant distribution for a continuous injection of contaminant at a point on the shoreline or centerline of a channel as shown in Figures A1 and A3, Appendix A. Use of this solution requires estimates of dispersion coefficients, D_x and D_y obtained using equations (A6) and (A7) which are also derived in Section A.4, equations (A46, A48, A49). This model is best suited for use when the condition

$$B^2 \gtrsim 3D_y/K_d \qquad (2.3)$$

or using equation (A7)

$$B^2 \gtrsim q_m h/(20K_d) \qquad (2.3)$$

is satisfied, thus allowing the major channel class to be defined in terms of the channel width, B, the maximum tidal velocity, q_m, and the contaminant decay rate coefficient K_d.

The second transport model essentially corresponds to marinas on the shore lines of narrow channels and is termed the One-Dimensional Advection-Dispersion Equation Model, with a detailed description given in Section A.2 of Appendix A. The model solution is given by equations (A20) and (A21), Appendix A, and represents the one-dimensional along channel contaminant distribution for a continuous injection of contaminant at a point on the shore line of a channel as shown in Figure A.3. Use of this solution requires an estimate of the longitudinal dispersion coefficient D_L which may be estimated using Equation (A6), with the γ_x factor, equation (A49) evaluated with Y_m=B. This model is best suited for use when the condition

$$B^2 \lesssim 3D_y/K_d \qquad (2.3,A14)$$

or

$$B^2 \lesssim q_m h/(20K_d) \qquad (2.4,A17)$$

is satisfied, thus allowing the narrow channel class to be defined. For the range

$$D_y/K_d \lesssim B^2 \lesssim 10D_y/K_d$$

or

$$q_m h/(60K_d) \lesssim B^2 \lesssim q_m h/(6K_d)$$

the distinction between the wide channel, two-dimensional model, equation (A11) and the narrow channel one-dimensional model, equations (A20) and (A21) is not precise and both models should be used to obtain a conservative prediction.

The third model essentially corresponds to marinas located in semi-enclosed bays and basins and is termed the Zero-Dimensional Mixed Basin Model, with a detailed description given in Section A.3 of Appendix A. The model solution is given by Equation (A36) which represents the basin average contaminant concentration for a continuous contaminant release as shown in Figure A.4. Use of this model is limited to basins whose geometric features satisfy

$$\frac{A_e T_t}{4a\ A_s^{1/2}} \leq \frac{1}{K_d} \qquad (2.5,A32)$$

where A_e and A_s are the entrance channel cross sectional area and basin surface area, respectively and 2a is the tidal range. For basins which do not satisfy this condition, but are somewhat elongated in plan shape, the One-Dimensional Advective-Dispersion Equation Model may be appropriate.

3. DETERMINATION OF BUFFER ZONES

The three models for determining marina buffer zones require topographic and hydrodynamic data as discussed in the previous section and also estimates of contaminant loading and decay rates. The contaminant loading rate, M, appearing in Equations (A11, A16), (A20, A21) and (A36) can be estimated from marina size and occupancy information using

$$M = M_p\ N_p\ N_s\ F_o\ F_m \qquad (3.1)$$

where

M_p = Fecal coliform loading per person per day (2 E9 organisms/day or 2.3 E4 organisms/sec)

N_p = Number of persons per boat (assumed as 2)

N_s = Number of boat slips at the marina

F_o = Average fraction of slips occupied.

F_m = Average fraction of marine sanitation devices malfunctioning

The per person loading rate M_p and person per boat N_p are numbers suggested by the Interstate Shellfish Commission. For the fractional parameters F_o and F_m reasonable estimates can be made if conservative default values of one are used. For example, the technical procedures issued by the State of South Carolina specify one-half for both F_o and F_m.

The decay rate coefficient, K_d, for bacteria including fecal coliform depends upon site conditions including temperature, salinity, sunlight, predation, nutrient deficiencies, settling and aftergrowth. (Thomann and Mueller, 1987). The formula

$$K_d = (0.8 + .006S)(1.07)^{(T-20)} \tag{3.2}$$

from Thomann and Mueller gives K_d in days^{-1} and accounts for salinity in parts per thousand and temperature in degrees C, while conservatively neglecting the influences of sunlight and settling.

The actual determination of the buffer zone extent involves the use of the appropriate model solutions, either Equation (A11, A16), (A21, A22), or (A36) to delineate the region in the vicinity of the marina where the indicator or fecal coliform organism concentration exceeds the prescribed value, for example, 14 organisms/100 ml. In the remainder of this section, the determination procedure using the three models will be outlined, with detailed sample calculations given in the following section.

For the Two-dimensional advection-dispersion equation model, the solutions, equations (A11) and (A16), allow concentration contours to be constructed in plan view along and across the water body, thus determining the buffer zone extent. The basic information necessary to use Equations (A11) and (A16) includes

M = loading rate (organisms/sec)
K_d = decay coefficient (1/sec)
h = mean water depth (meters)
L_u = distance upstream to closed end (meters)
L_d = distance downstream to open end (meters)
B = channel width (meters)
q_m = maximum tidal velocity magnitude (m/s) (3.3)
u = tidally averaged mean discharge velocity (m/s)
$2a$ = tidal elevation range (meters)

with h and B readily obtained from navigation or topographic charts, q_m and a obtained from tidal tables or q_m estimated using Equation (A41). The required dispersion coefficient D_x and D_y in m^2/sec are calculated using Equations (A6) and (A7). Evaluating Equations (A11) and (A16) at x,y coordinate pairs, in meters, gives concentrations in organisms per cubic meter. Noting that the buffer zone boundary is defined by

$$C_B = 14 \text{ organisms/100 ml} \tag{3.4a}$$

or

$$C_B = 1.4E5 \text{ organisms/m}^3, \tag{3.4b}$$

concentration contours may be constructed and the buffer zone determined. A certain amount of iteration, as shown in the next section, may be necessary in adjusting the dispersion coefficients.

For the One-dimensional advection-dispersion equation model, the solution, Equations (A20, A21), allows the concentration as a function of along channel distance from the source to be determined. The basic information necessary to use Equations (A20,A21) and the auxiliary equations, (A41 - A44) includes the variables, (4.3), listed for the Two-dimensional advection-dispersion model, however, in this case the procedure outlined by Equations (A36-A39) should be used to determine q_m. If channel end effects are to be included, L_d and L_u, in meters, as defined in Figure A.3 are also required. The longitudinal dispersion coefficient D_L in m^2/sec is assumed equal to D_x and calculated using Equation (A6). The along channel concentration distribution may now be plotted with the buffer zone boundaries defined using C_B, Equation (4.4).

For the Zero-dimensional mixed basin model, the solution, Equation (A37) gives the basin volumetric and tidal cycle averaged concentration. In addition to M and K_d, the required information includes

$$
\begin{aligned}
A_e &= \text{entrance channel cross sectional area } (M^2) \\
A_s &= \text{basin surface area } (M^2) \\
h &= \text{mean depth (m)} \qquad (3.5) \\
2a &= \text{tidal elevation range (m)} \\
T_t &= \text{tidal period (44,712 sec)}
\end{aligned}
$$

Inserting the information into Equation (A36) gives the basin average concentration in organisms per cubic meter. If this concentration is less than C_B, Equation (4.4), the buffer zone should include only the basin. If the basin mean concentration given by Equation (A36) exceeds C_B, the buffer zone extends outside of the basin and the extend outside must be determined using either the Two-dimensional or One-dimensional advection-dispersion equation models. In these cases, the appropriate loading into the region outside the basin is given by

$$\dot{M} = Q_o C \qquad (3.6)$$

with Q_o and C given by Equations (A34) and (A35). The determination of the buffer zone boundary outside of the basin then follows the appropriate previously discussed procedures.

4. EXAMPLE CALCULATIONS

In this section, example calculations of buffer zones for five marinas and two sewage treatment plant outfall sites are presented. Two computer programs, MARINA1 and MARINA2, which implement solutions of the Two-Dimensional Advection-Dispersion Equation model, equations (A11) and (A16) are used. Listings of the programs appear in Appendix B.

4.1 Garrett's Marina (M-21)

Garrett's Marina is located on the south shoreline of the Rappahannock River in Essex County, Virginia. The marina has 40 boat slips and the current buffer zone extends 1/8 mile (200m) in all directions. Since the marina is located on a major estuarine channel, channel end effects are not relevant, and the computer program MARINA1, representing equation (A11) is appropriate. Input data are:

$M = 1.2$ E6 organisms/s

$K_d = 10E\text{-}5/s$

$q_m = 0.57$ m/s

$h = 3.3$ m

$B = 3550$ m

$u = .0002$ m/s

The dispersion coefficients are calculated using equations (A6) and (A7) with γ_x in (A6) initially set equal to 1.0, to give

$D_x = 0.23$ m²/s

$D_y = 0.03$ m²/s

The output from MARINA1 is shown in Figure B.1. The across channel mixing zone width near the source is estimated as

$$Y_m \doteq 0.012B = 43m$$

and γ_x is determined to be 100 using equation (A49), and

$D_x = 23\ m^2/s$

is now used as input with the output shown in Figure B.2. The across channel mixing zone width does not change significantly and another iteration is not necessary.

The above calculations are repeated with

$u = 0\ m/s$

to insure a conservative upstream prediction of the buffer zone, and the outputs are shown in Figures B.3 and B.4. Choosing the largest distances in the upstream, downstream, and across channel directions from Figures B.1 through B.4 gives a 14 organism/100 ml boundary of

$-852\ m \leq x \leq 852\ m$

$0 \leq y \leq 142\ m$

and a zero organism boundary of

$-3621\ m \leq x \leq 3621\ m$

$0 \leq y \leq 249\ m$

Assuming the buffer zones to be elliptical in shape, the corresponding areas are 0.19 sq km (47 ac) and 1.42 sq km (350 ac), respectively. For comparison, the current semicircular buffer zone corresponding to an 1/8 mile radius is 15.7 acres.

4.2 South Hill Banks Marina (M-22)

South Hill Banks Marina is located approximately 2 miles downstream from Garrett's Marina on the Rappahannock River. Hydrodynamic conditions are the same as for Garrett's Marine, but the loading is

$M = 2.1\ E5$ organisms/s

corresponding to 7 boat slips. Output from the MARINA1 program, shown in Figures B.5 through B.87, is used to give a 14 organism/100ml boundary of

$-213 \text{ m} \leq x \leq 213 \text{ m}$

$0 \leq y \leq 71 \text{ m}$

and a zero organism boundary of

$-1704 \text{ m} \leq x \leq 1704 \text{ m}$

$0 \leq y \leq 178 \text{ m}.$

The corresponding buffer zone areas are 0.024 sq km (5.9 ac) and 0.48 sq. km (117 ac), compared with a current area of 15.7 acres.

4.3 Ingram Bay Marina (M-171)

Ingram Bay Marina is located on Towles Creek, an inlet on Ingram Bay in Northumberland County, Virginia. The marina has 49 boat slips and the current buffer zone extends 1/8 mile (200 m) in all directions. since Towles Creek is a relatively short, 765 m (1/2 mile), end effects may be important, and the computer program MARINA2, representing equation (A16) is appropriate. Input data are

$M = 1.47 \text{ E6 organisms/s}$

$K_d = 10E-5/s$

$q_m = 0.0133 \text{ m/s}$

$h = 0.76 \text{ m}$

$B = 107 \text{ m}$

$u = 0$

$L_u = 440 \text{ m}$

$L_d = 325 \text{ m}.$

The dispersion coefficients are calculated using equations (A6) and (A7) with γ_x in (A6) initially set equal to 1.0, to give

$D_x = 0.00126 \text{ m}^2/\text{s}$

$D_y = 0.00017 \text{ m}^2/\text{s}$

The output from MARINA2 is shown in Figure B.9. The across channel mixing zone width near the source is estimated as

$Y_m = 0.09\ B = 9.6\ m$

with γ_x, determined using equation (A49), remaining approximately equal to 1.0. Using the results in Figure B.9 the 14 organism/100 ml boundary is

$$-96\ m \leq x \leq 96\ m$$

$$0 \leq y \leq 37\ m$$

while the zero organism boundary is

$$-122\ m \leq x \leq 122\ m$$

$$0 \leq y \leq 48\ m$$

Assuming the buffer zones to be elliptical, the corresponding areas are 0.006 sq km (1.4 ac) and 0.01 sq km (2.25 ac), respectively. For comparison, the current buffer, corresponding to 1/4 mile along the creek and the complete width, has an area of 10.6 acres.

4.4 Cranes Creek (M-176)

Cranes Creek marina is located near the mouth of Cranes Creek, an inlet on Ingram Bay in Northumberland County, Virginia. The marina has 16 boat slips and the current buffer zone extends 1/8 mile (200 m) in all directions. The length along the main stem plus either branch of this Y shaped inlet is 2400 m (1.5 miles) suggested that end effects may be important, and the computer program MARINA2, representing equation (A16) is appropriate. Input data are

$M = 480{,}000$ organisms/s

$K_d = 1E{-}5/s$

$q_m = 0.025\ m/s$

$h = 1.55\ m$

$B = 610\ m$

$u = 0.$

$L_u = 1200\ m$

$L_d = 1200\ m.$

The dispersion coefficients are calculated using equations (A6) and (A7) with γ_x (A6) initially set equal to 1.0, to give

$$D_x = 0.0049 \text{ m}^2/\text{s}$$
$$D_y = 0.00065 \text{ m}^2/\text{s}$$

The output from MARINA2 is shown in Figure B.10. The across channel mixing zone width near the source is estimated as

$$Y_m = 0.015B = 9.2 \text{ m}$$

with γ_x determined to be 4.2 using equation (A49), and

$$D_x = 0.03 \text{ m}^2/\text{s}$$

is now used as input, with the output shown in Figure B.11. The across channel mixing zone width does not change significantly and another iteration is not necessary.

From Figures B.10 and B.11, the 14 organism/100 ml boundary is

$$-220 \text{ m} \leq x \leq 220 \text{ m}$$
$$0 \leq y \leq 49 \text{ m}$$

while the zero organism boundary is

$$-342 \text{ m} \leq x \leq 342 \text{ m}$$
$$0 \leq y \leq 67 \text{ m}$$

Assuming the buffer zones to be elliptical in shape, the corresponding areas are 0.017 sq km (4.2 ac) and 0.036 sq km (8.9 ac), respectively. For comparison, the current semicircular buffer zone has an area of 15.7 acres.

4.5 A. C. Fisher Marina (M-177)

The A. C. Fisher Marina is located near the end of the north Y subchannel of Cranes Creek. The analysis considers only the subchannel which has a length of 965 (0.6 miles) with MARINA2 being the appropriate computer program. The input data are

M = 240,000 organisms/s
K_d = 1E-5/s
q_m = 0.025 m/s
h = 1.37 m
B = 76 m
u = 0
L_u = 160 m
L_d = 745 m.

The dispersion coefficients are calculated using equations (A6) and (A7) with γ_x in (A6) initially set equal to 1.0, to give

D_x = 0.0043 m²/s
D_y = 0.00057 m²/s

The output from MARINA2 is shown in Figure B.13. The across channel mixing zone near the source is estimated as

Y_m = 0.09B = 6.8 m

with γ_x determined from equation (A49) as 7.4. After a second iteration the mixing zone width converges to

Y_m = 0.05B = 3.8 m

with γ_x equal to 7.7. The final dispersion coefficient is

D_x = 0.033 m²/s

with Figure B.13 showing the MARINA2 output.

From Figures B.12 and B.13, the 14 organism/100 ml boundary is

$-160\ m \leq x \leq 242\ m$

$0 \leq y \leq 38\ m$

and the zero organism boundary is

$-160\ m \leq x \leq 370\ m$

$0 \leq y \leq 56\ m$

It is noted that in both of the above boundary regions, the zone extends to the closed channel end at x = -160 m. The estimated buffer zone areas are 0.0133 sq km (3.3 ac) and 0.0252 sq km (6.24 ac) respectively. The current buffer zone area is approximately 6.24 acres.

4.6 James River STP

The buffer zone for the James River Sewage Treatment Plant outfall may be determined using the computer program MARINA1. Input data are

$M = 1.75\ E6$ organisms/s

$K_d = 1E-5/s$

$q_m = 0.44\ m/s$

$h = 1.52\ m$

$B = 2350\ m$

$u = 0$

The dispersion coefficients are calculated using equations (A6) and (A7) with γ_x in (A6) initially set equal to 1.0, to give

$D_x = 0.083\ m^2/s$

$D_y = 0.011\ m^2/s$

The output from MARINA1 is shown in Figure B.14. The across channel mixing zone width near the source is estimated as

$Y_m = 0.015\ B = 35\ m$

and γ_x is determined to be 88 using equation (A49). After a number of iterations the mixing zone width, γ_x and D_x converge to

$Y_m = 0.009B = 21.2$ m

$\gamma_x = 194$

$D_x = 16$ m²/s

with the MARINA1 output shown in Figure B.15.

The 14 organisms/100 ml boundary is

$-2350 \text{ m} \leq x \leq 2350 \text{ m}$

$0 \leq y \leq 141 \text{ m}$

and the zero organism boundary is

$-4935 \text{ m} \leq x \leq 4935 \text{ m}$

$0 \leq y \leq 235 \text{ m}$

The corresponding elliptical areas are 0.52 sq km (129 ac) and 1.82 sq km (452 ac).

4.7 York River STP

The buffer zone for the York River Sewage Treatment Plant outfall may be determined using the computer program MARINA1. Input data are

M = 2 E6 organisms/s

K_d = 1E-5/s

q_m = 0.51 m/s

h = 6.7 m

B = 3800 m

u = 0

The dispersion coefficients are calculated using equations (A6) and (A7) with γ_x in (A6) initially set equal to 1.0, to give

$D_x = 0.43$ m²/s

$D_y = 0.058\ m^2/s$

The output from MARINA1 is shown in Figure B.16. After a number of iterations the mixing zone width, γ_x and D_x converge to

$Y_m = 0.01B = 38\ m$

$\gamma_x = 32$

$D_x = 14\ m^2/s$

with the MARINA1 output shown in Figure B.17.

Using Figures B.16 and B.17, the 14 organisms/100 ml boundary is

$-380\ m \leq x \leq 380\ m$

$0 \leq y \leq 114\ m$

and the zero organism boundary is

$-2660\ m \leq x \leq 2660\ m$

$0 \leq y \leq 304\ m$

The corresponding areas are 0.068 sq km (16.8 ac) and 1.27 sq km (314 ac).

5. CONCLUSIONS AND RECOMMENDATIONS

This report has demonstrated the ability of simple mixing and transport models to provide a scientifically sound approach for determining marina buffer zones. As indicated by the example calculations in Section 4., the transport models may predict significantly smaller and larger buffer zones for various marinas than the current methodology. This is because of the transport models incorporation of more details of the site specific hydrodynamic and mixing characteristics.

The major weakness of the transport models is the necessity of replacing the actual site conditions with idealized geometry, topography and current fields. While this results in simple analytical solutions to the transport equations, the uncertainty must be incorporated in the dispersion coefficients. Thus the development of more complex models allowing variations in geometry, topography and current is recommended as the direction for future improvement in buffer zone prediction methodology.

REFERENCES

Abramowitz, M. and Stegun, I. 1964. Handbook of Mathematical Functions, U. S. Government Printing Office, Washington, D. C.

Fischer, H. B., et al. 1979. Mixing in Inland and Coastal Waters. Academic Press, New York.

Hamrick, J. M., 1986. Long-Term Dispersion in Unsteady Skewed Free Surface Flow, Estuarine Coastal and Shelf Science. 23, p. 807-845.

Hamrick, J. M., 1987. Time Averaged Estuarine Mass Transport Equations, Proceedings of the National Conference on Hydraulic Engineering, ASCE.

Thomann, R. and Mueller, J. 1987. Principles of Surface Water Quality Modeling and Control, Harper and Row, New York.

APPENDIX A MIXING AND TRANSPORT MODELS

A.1 Two-Dimensional Advection-Dispersion Equation Model

For situations where the concentration of dissolved or suspended material is nearly uniform over the water column and the change in water depth during a tidal cycle is small relative to the mean water depth, a depth averaged, tidal cycle averaged advection-dispersion equation is appropriate to describe the transport of dissolved and suspended material (Hamrick, 1986). The vertical uniformity condition is satisfied if

$$120 \frac{h}{q_m} \leq \frac{1}{K_d} \qquad \text{(A1)}$$

and

$$120 \frac{h}{q_m} \leq T_t \qquad \text{(A2)}$$

where h is the mean water depth, q_m is the maximum tidal velocity magnitude, K_d is the decay rate coefficient for a decaying dissolved or suspended material and T_t is the semi-diurnal tidal period. The expression 120 h/q_m represents the time required for vertical mixing over the water column depth and is derived in Section A.4. The small change in depth condition is satisfied if

$$a \ll h \qquad \text{(A3)}$$

where 2a is the tide range or change in depth between high and low water and h is the mean depth or low water depth plus one half of the tide range. For mean depths greater than 2m (6 ft), tidal current magnitudes greater than 20 cm/s (0.65 ft/s), depth changes less than 1m (3 ft), typical decay coefficients on the order of 1/day and a tidal period of 12.4 hrs equations (A1-A3) are satisfied.

The two-dimensional depth averaged, tidal cycle averaged advection-dispersion equation, which has been rigorously derived by Hamrick (1986, 1987), is

$$\frac{\partial c}{\partial t} + u\frac{\partial c}{\partial x} + v\frac{\partial c}{\partial y} = \frac{1}{h}\frac{\partial}{\partial x}\left(hD_{xx}\frac{\partial c}{\partial x} + h\,D_{xy}\frac{\partial c}{\partial y}\right)$$

$$+ \frac{1}{h}\frac{\partial}{\partial y}\left(hD_{xx}\frac{\partial c}{\partial x} + hD_{yy}\frac{\partial c}{\partial y}\right) - K_dC \qquad \text{(A4)}$$

where C is the depth and tidal cycle averaged concentration, u and v are the depth and tidal averaged mass transport velocities in horizontal x and y coordinates, and D is the dispersion coefficient tensor. If the velocity field is unidirectional and the x coordinate is aligned in that direction, the transverse velocity v and the off-diagonal dispersion coefficients, D_{xy} and D_{yx} may be set to zero. Furthermore, if interest is restricted to the steady state concentration distribution resulting from a continuous steady injection of material into the water body, the time derivative may be neglected. The simplified equation is:

$$hu\frac{\partial c}{\partial x} = \frac{\partial}{\partial x}\left(hD_x\frac{\partial c}{\partial x}\right) + \frac{\partial}{\partial y}\left(hD_y\frac{\partial c}{\partial y}\right) - hK_dC \qquad \text{(A5)}$$

Detailed methods for determining the dispersion coefficients are given in Hamrick (1986), while reasonable estimates for tidally dominated flow are given by the simplified expressions:

$$D_x = \frac{h}{8}q_m\gamma_x \qquad \text{(A6)}$$

$$D_y = \frac{h}{60}q_m \qquad \text{(A7)}$$

derived in Section A.4.

The steady advection-dispersion equation (A5) has closed form analytical solutions only if the coefficients h, u, D_x, D_y and K_d are constant. Although this is seldom true for actual situations, it is possible to choose representative values which will give reasonable results in the immediate vicinity of source sites. Thus the actual situation is idealized by a straight constant depth and width channel having a constant uniform longitudinal mass transport velocity. The effects of nonuniform depth and width, channel curvature, and nonuniform longitudinal velocity are accounted for in the γ_x factor, equation (A49), in the dispersion coefficient D_x. If actual conditions were uniform, this factor would be unity.

The first solution to be presented is for a continuous point injection at x=y=0 on the shoreline of a channel of width, B. In this case x is positive in the direction of net flow (seaward) and y is positive across the channel toward the opposite shore at y=B, as shown in Figure A1. The effects of the channel being possibly closed upstream at $x = -L_u$ and open downstream to another water body at $X = L_d$ are excluded assuming the conditions

$$T_{xu} = \frac{2.4L_u^2}{hq_m \gamma_x} = \geq \frac{1}{K_d} \tag{A8}$$

$$T_{xd} = \frac{2.4L_d^2}{hq_m \gamma_x} \geq \frac{1}{K_d} \tag{A9}$$

$$\frac{L_d}{u} \geq \frac{1}{K_d} \tag{A10}$$

are satisfied, with the longitudinal dispersion time scales defined in section A.4, by equation (A50). The neglect of channel end effects if often termed the infinite channel approximation and essentially is based on the condition that the material will decay long before being transported to either channel end. The solution is

$$C = \frac{M}{\pi h(D_x D_y)^{1/2}} \exp\left[\frac{u}{(4K_d D_x)^{1/2}} \left(\frac{K_d}{D_x}\right)^{1/2} x\right]$$

$$\sum_{i=-\infty}^{\infty} K_0\left[\left(1 + \frac{u^2}{4K_d D_x}\right)^{1/2} \left(\frac{K_d x^2}{D_x} + \frac{K_d}{D_y}(y+2iB)^2\right)^{1/2}\right] \tag{A11}$$

where M is the number of coliform organisms or mass of contaminant injected per unit time, exp () is the natural exponential and $K_o()$ is the modified Bessel function of the second kind of order zero. The behavior of the Bessel function is shown in Figure A.2 taken from Abramowitz and Stegun (1964) which also contains useful polynominal approximations and detailed tables. For very wide major river or estuary channels satisfying

$$B^2 \ggg (D_y/K_d) \text{ or } B^2 > 300\ (D_y/K_d) \tag{A12}$$

the series may be truncated at the i=0 term for hand calculations. For channels of moderate width

$$B^2 >> (D_y/K_d) \text{ or } B^2 \quad 30 \ (D_y/K_d) \tag{A13}$$

use of the three leading terms, i = -1, 0, 1, for hand calculations will often suffice. For narrow channels such that

$$B^2 < 3(D_y/K_d) \tag{A14}$$

a one-dimensional solution will be acceptable and will be presented in the Section A.2. The proper value of u to be used in (A11) would be

$$u = \frac{Q_f}{A} , \tag{A15}$$

the cross section average velocity of the net fresh water discharge through the channel.

The shoreline injection solution, equation (A11), may readily be modified to describe injection at the channel, center line, typical of treated waste water outfalls. The modifications simply involve replacing M and B in equation (A11) with M/2 and B/2 and noting that the y coordinate origin is now along the centerline.

For short channels closed at the upstream end, $x = -L_u$, and open to another water body downstream at, $x = L_d$, as shown in Figure A3, an analytic solution may be obtained for the case of no longitudinal mass transport velocity and complete removal of the dissolved substance at the open end. The solution for a shoreline injection at x = y = 0, is

$$C = \frac{M}{\pi h (D_x D_y)^{1/2}}$$

$$\left(\sum_{i=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} (-1)^j K_o \left(\left[\frac{K_d}{D_x} (x+2L_u+jL_c)^2 + \frac{K_d}{D_y} (y2iB)^2 \right]^{1/2} \right) \right. \tag{A16}$$

$$\left. +(-1)^j K_o \left(\left[\frac{K_d}{D_x} (x + 2jL_c)^2 + \frac{K_d}{D_y} (y + 2iB)^2 \right]^{1/2} \right) \right)$$

The above solution is too cumbersome for hand calculation but can be easily evaluated by a simple computer program. For an injection point along the channel centerline, equation (A16) can be readily modified by replacing M and B by M/2 and B/2 and noting y = 0, along the channel centerline.

A.2 One-Dimensional Advection-Dispersion Equation Model

For narrow channels satisfying

$$\frac{20\ B^2}{q_m h} < \frac{1}{K_d} \qquad \text{(A17)}$$

and

$$\frac{20B^2}{q_m h} \le T_t \qquad \text{(A18)}$$

a one-dimensional advection-dispersion equation model is appropriate. For steady injections, the cross section averaged, tidal cycle averaged equation is

$$u \frac{\partial c}{\partial x} = \frac{1}{A} \frac{\partial}{\partial x} (AD_L \frac{\partial c}{\partial x}) - K_d C \qquad \text{(A19)}$$

where u is the cross section averaged, tidal cycle averaged velocity, A is the mean cross section area and D_L is the longitudinal dispersion coefficient. The longitudinal dispersion coefficient, D_L, can be estimated using equation (A6) for D_x, by appropriate evaluation of the factor, γ_x, equation (A49), as shown in Section A.4. An alternate approach to estimating D_L is from a field dye release or observations of the salinity distribution when u is known and large enough to deduce a longitudinal salinity gradient.

For constant values of u, A and D_L, the solution of equation (A19) for a source at x=0 is

$$c = \frac{M}{A(4K_dD_L)^{1/2}}[c_1 \ \ \exp(r_1(\frac{K_d}{D_L})^{1/2}x) + c_2 \ \ \exp(-r_2(\frac{K_d}{D_L})^{1/2}x)] \qquad \text{(A20)}$$

for $x \geq 0$

$$c = \frac{M}{A(4K_dD_L)^{1/2}} [c_3 \exp(r_1(\frac{K_d}{D_L})^{1/2}x) + c_4 \exp(-r_2(\frac{K_d}{D_L})^{1/2}x)] \quad (A21)$$

for $x \leq 0$

$$r_1 = (1 + \frac{u^2}{4K_dD_L})^{1/2} + \frac{u}{(4K_dD_L)^{1/2}} \quad (A22)$$

$$r_2 = (1 + \frac{u^2}{4K_dD_L})^{1/2} - \frac{u}{(4K_dD_L)^{1/2}} \quad (A23)$$

where M is the number of coliform organisms or mass of contaminant injected per unit time. The four constants, c_1, c_2, c_3 and c_4 are determined by satisfying four boundary conditions. Two conditions are continuity of concentration and mass flux at x = 0, which require

$$c_1 + c_2 - c_3 - c_4 = 0 \quad (A24)$$

$$-r_1c_1 + r_2c_2 + r_1c_3 - r_2c_4 = 2. \quad (A25)$$

The simplest form of the remaining two conditions correspond to the no end effects or infinite channel approximation which is appropriate when equations (A8-A10) are satisfied. In this case, c given by (A20) must approach zero for large positive x, requiring $c_1 = 0$, and c given by (A21) must approach zero for large negative x, requiring $c_4 = 0$. Then using (A24) and (A25), c_2 and c_3 are given by

$$c_2 = c_3 = \frac{2}{r_1+r_2} . \quad (A26)$$

It is noted that if there is no net flow, u = 0, then $r_1 = r_2 = 1$ and $c_2 = c_3 = 1$ with c given by

$$c = \frac{M}{A(4K_dD_L)^{1/2}} \exp(\pm(\frac{K_d}{D_L})^{1/2}x) \quad (A27)$$

where the + and - exp () are chosen for $x \leq 0$ and $x \geq 0$ respectively. Inspection of (A27) immediately reveals that an underestimation of D_L will result in higher predicted concentrations and a more conservative estimation of buffer zone length.

A more realistic approach to formulating the remaining two conditions for use with (A24) and (A25) is to impose boundary conditions on (A20) downstream at $x = L_d$ and on (A21) upstream at $x = -L_u$. For short closed end channels, inlets and tidal creeks, L_d would be the distance downstream to the outlet into a large body of water while L_u would be the distance upstream to the closed end or limit of tidal flow as shown in Figure A.3. For these situations the net flow velocity is zero or very small and difficult to determine and can be neglected resulting in $r_1 = r_2 = 1$. At the downstream boundary, $x = L_d$, c is set to zero corresponding to complete removal of material by flow in the exterior larger water body at the outlet (Fischer et al, 1979). At the upstream boundary, $x = -L_u$ the diffusion flux of material is set to zero. The resulting complete set of four equations obtained for (A20), (A21), (A24), and (A25) is

$$\exp[(\frac{K_d}{D_L})^{1/2} L_d) c_1 + \exp(-(\frac{K_d}{D_L})^{1/2} L_d)] c_2 = 0$$

$$c_1 - c_3 = -1$$

$$c_2 - c_4 = 1$$

$$\exp[-(\frac{K_d}{D_L})^{1/2} L_u) c_3 - \exp((\frac{K_d}{D_L})^{1/2} L_u)] c_4 = 0 \qquad \text{(A28 a,b,c,d)}$$

which has the solution

$$c_1 = c_3 - 1$$

$$c_4 = c_2 - 1$$

$$C_2 = \frac{\exp[(\frac{K_d}{D_L})^{1/2}(L_d+L_u)) + \exp((\frac{K_d}{D_L})^{1/2}(L_d-L_u)]}{\exp[(\frac{K_d}{D_L})^{1/2}(L_d+L_u)) + \exp(-(\frac{K_d}{D_L})^{1/2}(L_d+L_u))]}$$

$$C_s = \frac{\exp[(\frac{K_d}{D_L})^{1/2}(L_d+L_u) - \exp(-(\frac{K_d}{D_L})^{1/2}(L_d-L_u)]}{\exp[(\frac{K_d}{D_L})^{1/2}(L_d+L_u) + \exp(-(\frac{K_d}{D_L})^{1/2}(L_d+L_u)]} \qquad \text{(A29a,b,c,d)}$$

The method illustrated above can be easily applied to other boundary condition at $x = L_d$ and $x = -L_u$.

A.3 Zero-Dimensional Mixed Basin Model

For small semi-enclosed basins, marinas and embayments, as depicted in Figure A4, a zero dimensional mixed basin model may be appropriate. The model requires that

$$\frac{a}{h} << 1 \qquad \text{(A30)}$$

where h is the mean basin depth and 2a is the difference between high and low water depth. If A_s is the surface area of the basin, the assumption of complete mixing requires that

$$\frac{A_s^{1/2}}{q_m} < \frac{1}{K_d} \qquad \text{(A31)}$$

The representative velocity magnitude is estimated by

$$q_m = \frac{4a}{T_t} \frac{A_s}{A_e} \qquad \text{(A32)}$$

where A_e is the mean cross section area of the entrance channel into the basin from the exterior body of water. Combining (A31) and (A32) gives

$$\frac{A_e T_t}{4a A_s^{1/2}} \leq \frac{1}{K_d} \qquad \text{(A33)}$$

For $T_t = 0.5$ day, $K_d = 1$/day, $4a = 1$m, $A_s = 40{,}000\text{m}^2$, which are typical of a semi-enclosed marina, the criteria is satisfied.

The appropriate tidal cycle averaged mass balance equation is

$$hA_s \frac{dc}{dt} = M + Q_i c_i - Q_o c - K_d h A_s c \qquad \text{(A34)}$$

where c is the concentration in the basin, M is the number of coliform organisms or mass of contaminant injected per unit time, Q_i and c_i are volumetric inflow and inflow concentration, and Q_o is volumetric outflow. For steady state injections, the time derivative is zero. Assuming that no material comes into the basin during flooding tide, c_i may be set to zero. The average volumetric outflow during a tidal cycle is simply

$$Q_o = \frac{2a A_s}{T_t} \qquad \text{(A35)}$$

allowing equation (A34) to be solved for c the mean basin and outflow concentration. The solution is:

$$c = \frac{M}{A_s\left(hK_d + \frac{2a}{T_t}\right)} \qquad \text{(A36)}$$

A.4 Estimation of Dispersion Coefficients and Mixing Time Scales

Use of the depth averaged advection-dispersion equation in section A.1 requires that the time scale for the mixing of material by turbulent diffusion over the depth of flow be approximately less than or equal to the decay time for a decaying substance and the dominant semi-diurnal tidal period as indicated by equations (A1) and (A2). The time scale for mixing by turbulent diffusion over a depth h may be estimated as

$$T_z = \frac{.3h^2}{K_z} \qquad \text{(A37)}$$

(Fischer, et al. 1979), where K_z is the depth and tidal cycle averaged vertical turbulent diffusion coefficient given by

$$K_z = 0.067\ hq_* \qquad \text{(A38)}$$

The root mean square tidal shear velocity, q_*, is given by

$$q_*^2 = C_b \frac{1}{T_t} \int_o^T (u^2+v^2)dt = \frac{C_b}{2} q_m^2 \quad \text{(A39)}$$

where C_b is the bottom friction coefficient, u and v are the instantaneous depth average tidal velocity components and q_m is the magnitude of the maximum tidal velocity or current. Taking a representative value of C_b = 0.003, and combining (A37)-(A39) gives

$$T_z = 120 \frac{h}{q_m} \quad \text{(A40)}$$

which appears in equations (A1) and (A2). For major estuarine channels, q_m, may be obtained from NOAA tidal current tables. If published values of q_m in the locality of interest are not available, q_m may be estimated by

$$q_m = \frac{a}{h} (gh)^{1/2} \quad \text{(A41)}$$

where 2a is the change in depth between high and low water, h is the mean depth and g is the acceleration of gravity, (9.8 m/s or 32 ft/s). Equation (A41) is suitable for channels whose length, L_c, exceeds the tidal excursion

$$L_e = q_m \frac{T_t}{\pi} \quad \text{(A42)}$$

by a factor of about 10 or more. For short channels, particularly tidal creeks, the conditions

$$L_c > 10 L_e \quad \text{(A43)}$$

will not be satisfied and q_m can be estimated by

$$q_m = \frac{4a L_c}{hT_t} \quad \text{(A44)}$$

Use of the two-dimensional steady advection-dispersion equation (A5) and its solutions (A11) and (A16) requires estimates of D_x and D_y using equations (A6) and (A7). These two equations are appropriate for use when the x direction coincides with the primary axis of flow. Also if the flows satisfy, $T_z \leq T_t$, Hamrick (1986) has shown that

$$D_x = \frac{5.86}{2} h \left(\frac{C_b}{2}\right)^{1/2} q_m \tag{A45}$$

where h and q_m are local values. Using C_b=.003, gives

$$D_x = \frac{h}{8} q_m \tag{A46}$$

which is also equation (A6), with the factor γ_x=1.

Since it is assumed that there is no velocity component in the y direction, D_y, is essentially a turbulent diffusion coefficient. Using experimental and field data summarized in Fischer, et al. (1979) D_y is estimated by

$$D_y = 0.4hq_* \tag{A47}$$

or using (A39) and C_b = .003

$$D_y = \frac{h}{60} q_m \tag{A48}$$

the equivalent of equation (A7).

Since it will be necessary to idealize an actual channel by a uniform constant width and depth channel and use an average value of q_m, it is necessary to adjust the value of D_x given by equation (A46) by a factor γ_x. The factor accounts for nonuniformity of h and q_m in the across channel, y, direction which can result in enhanced dispersion by transverse shear, Fischer et al (1979). Based on results presented in Fischer et al (1979), the correction factor is given by

$$\gamma_x = \text{Max } (1, \gamma'_x) \tag{A49a}$$

$$\gamma'_x = \text{Min } \left[\left(\frac{Y_m}{h}\right)^2, \left(\frac{T_t q_m}{60Y_m}\right)^2\right] \tag{A49b}$$

where Y_m is the transverse mixing zone width or the distance across the channel to where $C(Y_m) = e^{-1}C(0)$.

Channel end effects may be neglected, as in the two dimensional solution, equation (A11) and the one dimensional solution equation (A27), if the along channel dispersive and advective transport time scales exceed the decay time scale. The decay dispersive time scale for upstream transport is

$$T_{xu} = \frac{.3L_u^2}{D_x} = \frac{2.4L_u^2}{hq_m\gamma_x} \qquad \text{(A50)}$$

where, D_x is evaluated using equation (A47), with a similar expression for T_{xd} obtained using L_d in place of L_u. These time scales are then compared with the decay time scale $1/K_d$ as in equations (A8) and (A9) to evaluate the importance of channel end effects.

Use of the one-dimensional advection-dispersion equation (A19) and its various solutions given in Section A.2 requires that the time scale for the mixing of material by turbulent diffusion and dispersion across the width of a channel be approximately less than or equal to the decay time for a decaying substance and the dominant semi-diurnal tidal period as indicated by equations (A17) and (A18). The time scale for mixing across the channel width, B, may be estimated by

$$T_y = \frac{.3B^2}{D_y} \qquad \text{(A51)}$$

Using D_y given by (A7) or (A8) gives

$$T_y = \frac{20\ B^2}{q_m h} \qquad \text{(A52)}$$

which appears in equations (A17) and (A18). The longitudinal dispersion coefficient, D_L, may be evaluated using equation (A6) with the factor, γ_x, evaluated using equation (A49) with $Y_m = B$.

Mixing in small semi-enclosed basins, discussed in Section A.3 is primarily by the advective stirring of the tidal inflow. The time required for basin-complete mixing to occur is estimated by

$$T_m = \frac{L_p}{q_m} \qquad \text{(A53)}$$

where L_p is a path length through the basin. If the surface area of the basin is A_s, then an estimate of L_p is the square root of A_s. Requiring the mixing time scale to be approximately less than or equal to the decay time scale gives

$$\frac{A_s^{1/2}}{q_m} < \frac{1}{K_d} \qquad \text{(A31)}$$

For the semi-enclosed basin, q_m is estimated as the mean volumetric tidal inflow rate divided by the cross sectional area of the entrance channel into the basin as indicated by equation (A32) in Section A.3. Combining (A31) and (A32) gives the requirement (A33).

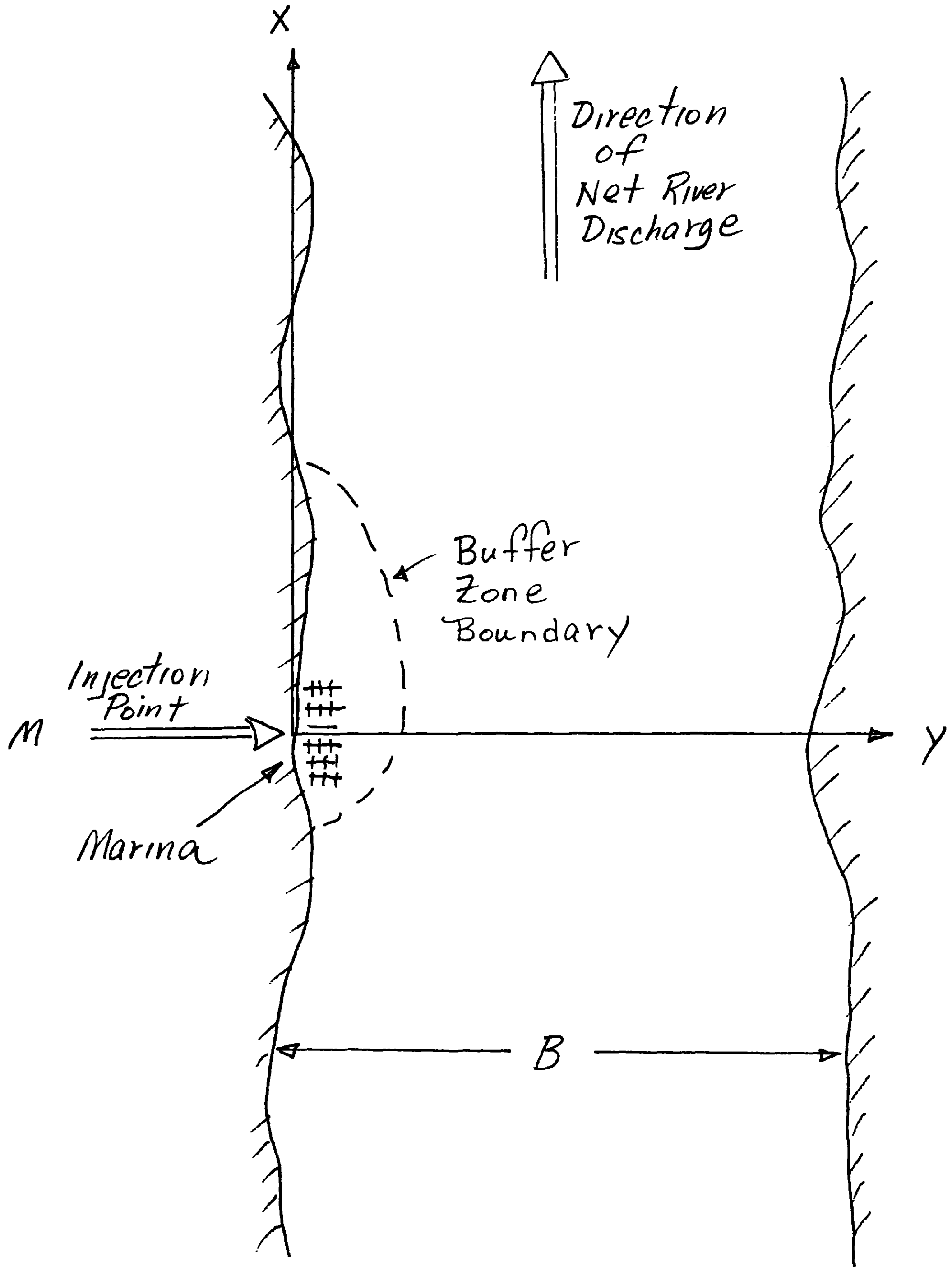
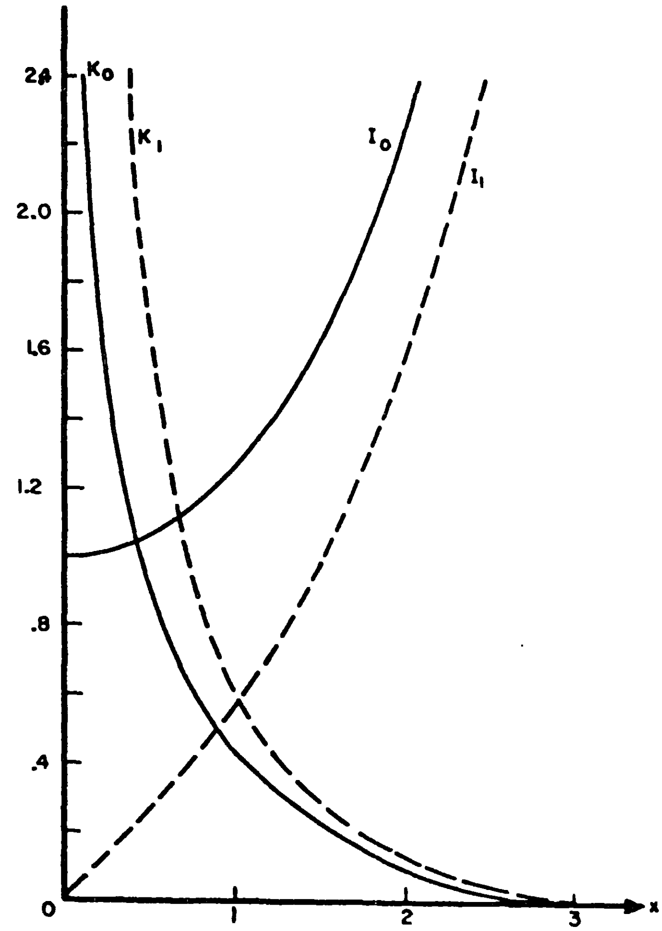
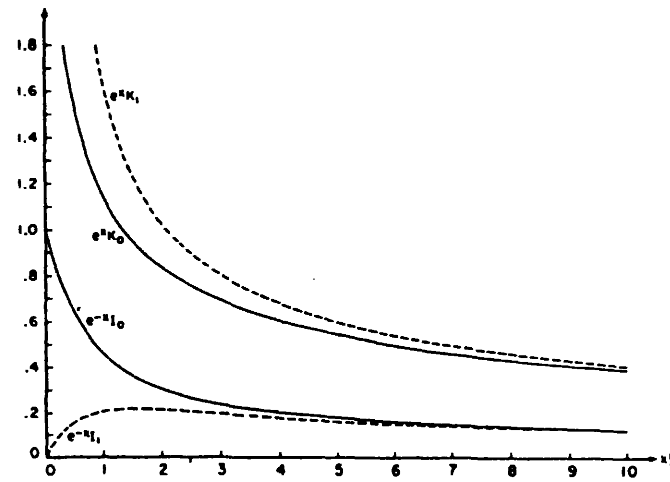


Figure A1. Major River or Estuary Channel



$I_0(x)$, $K_0(x)$, $I_1(x)$ *and* $K_1(x)$.



$e^{-x}I_0(x), e^{-x}I_1(x), e^xK_0(x)$ *and* $e^xK_1(x)$.

Figure A2. Behavior of Modified Bessel Function of Second Kind, Zero Order, K_o

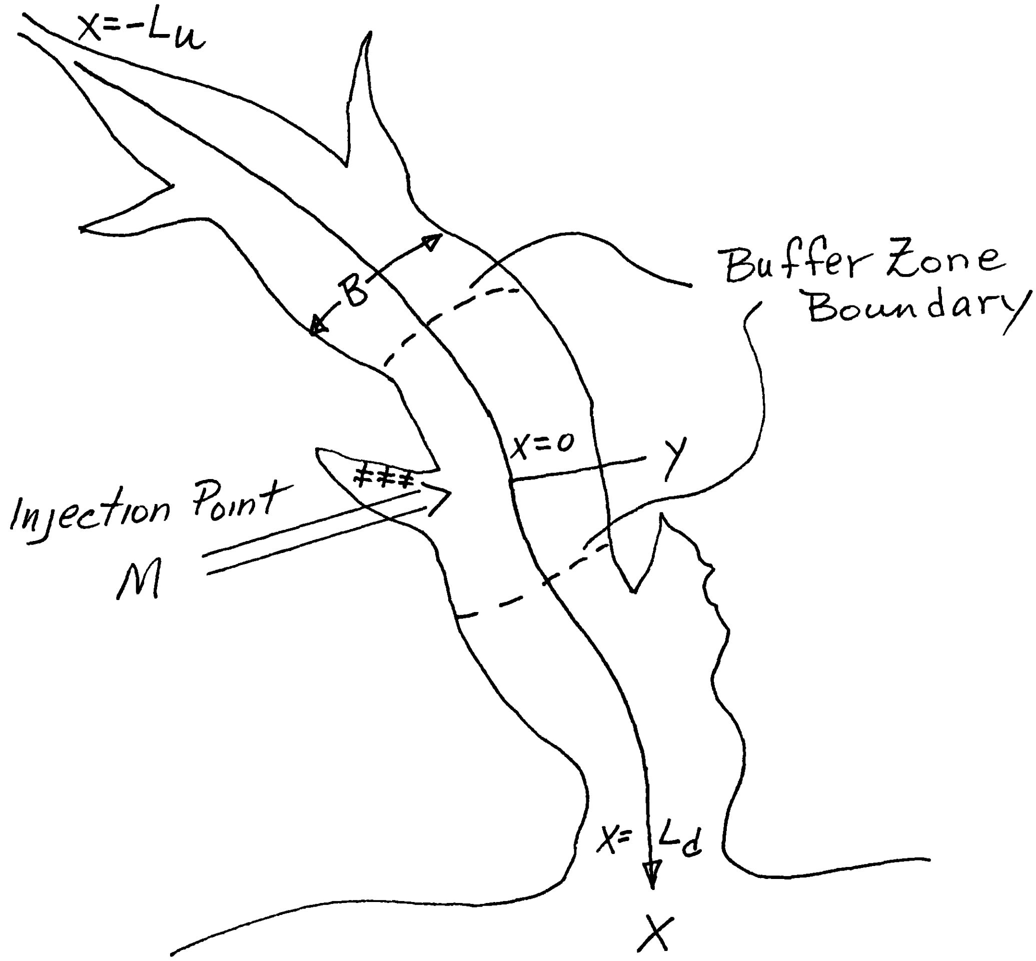


Figure A3. Minor Channel or Tidal Creek

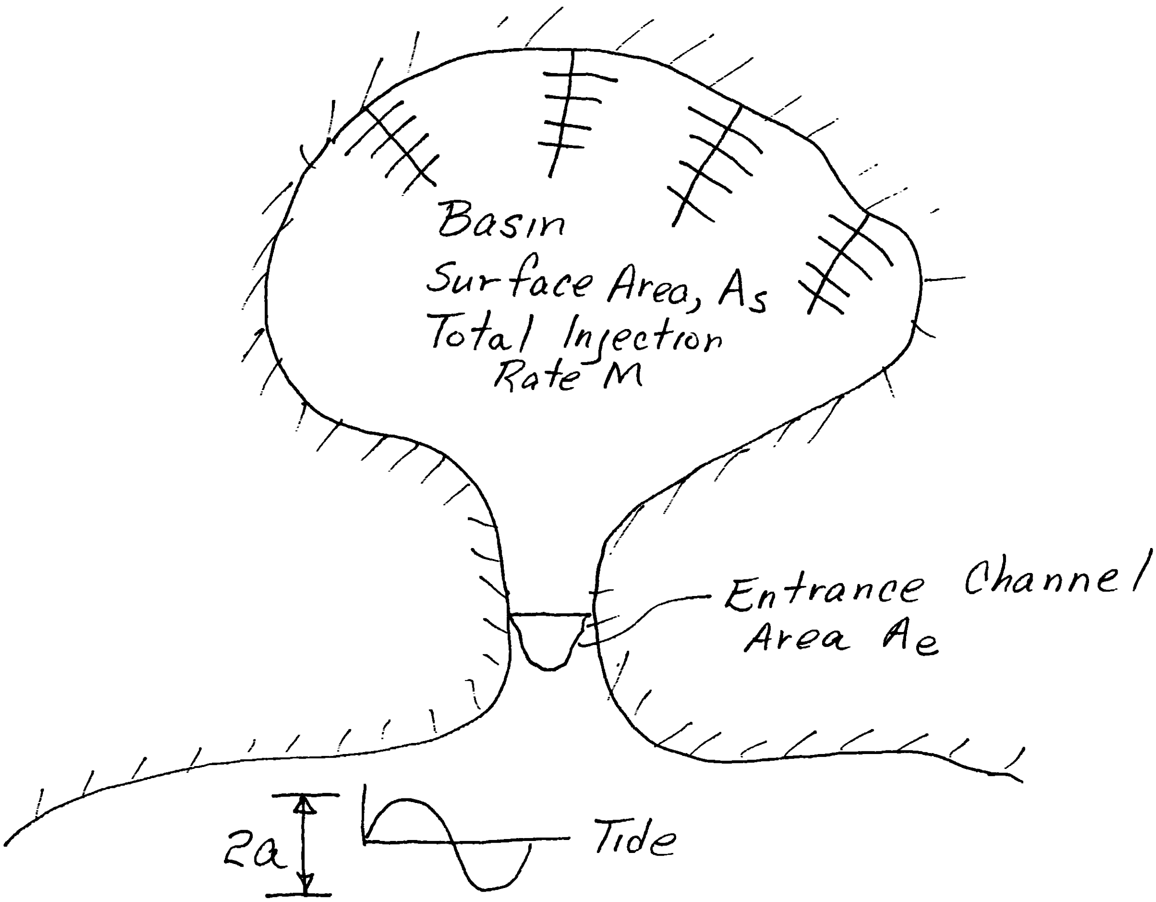


Figure A4. Semi-Enclosed Basin

APPENDIX B

```
10 REM      PROGRAM MARINA1  (GWBASIC)    VA INST. OF MARINE SCIENCE
20 REM              J. M. HAMRICK     MARCH 1989
30 REM
40 DIM XSLB(41),YSLB(21),PHI(11)
50 DIM MI(9),HI(9),DXI(9),DYI(9),UI(9),BI(9),KDI(9)
60 DIM IC(41,21)
70 DIM TEXT$(9)
80 REM  ------------------------------
90 MI(1)=1470000!:  HI(1)=.762:  DXI(1)=.00126:  DYI(1)=.00017
100 UI(1)=0!:         BI(1)=107!:  KDI(1)=.00001
110 MI(2)=480000!:   HI(2)=1.55:   DXI(2)=.00486:  DYI(2)=.00065
120 UI(2)=0!:         BI(2)=610!:   KDI(2)=.00001
130 MI(3)=240000!:   HI(3)=1.37:   DXI(3)=.0043:  DYI(3)=.00057
140 UI(3)=0!:         BI(3)=76!:   KDI(3)=.00001
150 MI(4)=1200000!:  HI(4)=3.29:   DXI(4)=.233:    DYI(4)=.031
160 UI(4)=.0001867: BI(4)=3550!:  KDI(4)=.00001
170 MI(5)=210000!:   HI(5)=3.29:   DXI(5)=.233:    DYI(5)=.031
180 UI(5)=.0001867: BI(5)=3550!:  KDI(5)=.00001
190 MI(6)=2000000!:  HI(6)=6.7:    DXI(6)=.4313:   DYI(6)=.0575
200 UI(6)=.000068:  BI(6)=3799!:  KDI(6)=.00001
210 MI(7)=1752000!: HI(7)=1.52: DXI(7)=8.340001E-02: DYI(7)=.0111
220 UI(7)=0!:         BI(7)=2350!:  KDI(7)=.00001
230 MI(8)=3000000!:  HI(8)=4!:   DXI(8)=.25:    DYI(8)=.033
240 UI(8)=.01:       BI(8)=2000!:   KDI(8)=.00001
250 REM
260 REM      EDIT STATEMENT # 280 & 290 FOR NEW INPUT EXAMPLE
270 REM
280 MI(9)=3000000!:  HI(9)=4!: DXI(9)=.25:   DYI(9)=.033
290 UI(9)=.01:       BI(9)=2000!:    KDI(9)=.00001
300 REM
310 REM
320 TEXT$(1)=" INGRAM BAY MARINA (M-171)      "
330 TEXT$(2)=" CRANES CREEK MARINA (M-176)    "
340 TEXT$(3)=" A. C. FISHER MARINA (M-177)    "
350 TEXT$(4)=" GARETT'S MARINA     (M-21)     "
360 TEXT$(5)=" SOUTH HILL BANKS MAR(M-22)     "
370 TEXT$(6)=" YORK RIVER S.T.P.              "
380 TEXT$(7)=" JAMES RIVER S.T.P.             "
390 TEXT$(8)=" HAMRICK EXAMPLE # 1            "
400 TEXT$(9)=" USER DESIGNATED EXAMPLE        "
410 CA=1.25331414#: CB=7.832358E-02: CC=2.189568E-02: CD=1.062446E-02
420 CE=5.87872E-03:   CF=.0025154:  CG=5.3208E-04
430 CH=.57721566#:   CI=.4227842#:  CJ=.23069756#:  CK=.0348859
440 CL=2.62698E-03:   CM=.0001075:   CN=.0000074
450 CO=1#:     CP=3.5156229#:    CQ=3.0899424#:    CR=1.2067492#
460 CS=.2659732:     CT=.0360768:     CU=.0045813
470 S=.0001
480 PI=3.14159
490 MAXX=21
500 MAXY=11
510 REM
520 REM  SPECIFY IF OUTPUT TO SCREEN OR DISK
```

```
530 REM
540 PRINT "IS OUTPUT TO GO TO SCREEN (S) OR DISK (D) ? "
550 INPUT OUTP$
560 REM
570 IF (OUTP$="D" OR OUTP$="d") THEN MAXX=41
580 IF (OUTP$="D" OR OUTP$="d") THEN MAXY=21
590 REM
600 PRINT "specify desired marina:"
610 PRINT "  "
620 PRINT "enter single digit #:   "
630 PRINT "   "
640 PRINT " 1 - ingram bay marina      (m-171)"
650 PRINT " 2 - cranes creek marina    (m-176)"
660 PRINT " 3 - a. c. fisher marina    (m-177)"
670 PRINT " 4 - garett's marina        (m-21)  "
680 PRINT " 5 - south hill banks       (m-22)  "
690 PRINT " 6 - york river stp                 "
700 PRINT " 7 - james river stp                "
710 PRINT " 8 - hamrick example # 1            "
720 PRINT " 9 - other (will specify input file)"
730 REM
740 INPUT IPICK
750 PRINT "ipick=",IPICK
760 M=MI(IPICK)
770 H=HI(IPICK)
780 DX=DXI(IPICK)
790 DY=DYI(IPICK)
800 U=UI(IPICK)
810 B=BI(IPICK)
820 KD=KDI(IPICK)
830 REM
840 REM  -------------------------------------------------
850 REM   input variable override logic
860 REM
870 PRINT "      var #      var            VALUE"
880 PRINT "      -----      ---            -----"
890 PRINT "        1         m    ",M
900 PRINT "        2         h    ",H
910 PRINT " .      3         dx   ",DX
920 PRINT "        4         dy   ",DY
930 PRINT "        5         u    ",U
940 PRINT "        6         b    ",B
950 PRINT "        7         kd   ",KD
960 PRINT "  "
970 PRINT " enter var # you wish to change or '0' (quit)"
980 INPUT IVAL
990 IF (IVAL=0) GOTO 1100
1000 PRINT "what is new value?"
1010 INPUT VALNEW
1020 IF (IVAL=1) THEN M=VALNEW
1030 IF (IVAL=2) THEN H=VALNEW
1040 IF (IVAL=3) THEN DX=VALNEW
```

```
1050 IF (IVAL=4) THEN DY=VALNEW
1060 IF (IVAL=5) THEN U=VALNEW
1070 IF (IVAL=6) THEN B=VALNEW
1080 IF (IVAL=7) THEN KD=VALNEW
1090 GOTO 870
1100 REM ---------------------------------------
1110 REM zoom feature
1120 REM
1130 YBMAX=1!
1140 XBMAX=1!
1150 XBMIN=-1!
1160 PRINT "do you wish to zoom?"
1170 INPUT ZOOM$
1180 IF (ZOOM$ <> "y" AND ZOOM$ <> "Y") THEN GOTO 1250
1190 PRINT "enter max y/b value:"
1200 INPUT YBMAX
1210 PRINT "enter max x/b value:"
1220 INPUT XBMAX
1230 PRINT "enter min x/b value:"
1240 INPUT XBMIN
1250 RINCY=YBMAX/(MAXY-1)
1260 RINCX=(XBMAX-XBMIN)/(MAXX-1)
1270 REM ----------------------------------
1280 REM     LOOP REDUCTION CODE
1290 LIMIT=5
1300 PRINT "CONCENTRATION IS CURRENTLY DETERMINED BY EVALUATING"
1310 PRINT "THE FUNCTION 'PHI' FROM -5 TO 5"
1320 PRINT "THIS RUN CAN BE SPED UP BY REDUCING THE # OF EVALUATIONS"
1330 PRINT "AT A CORRESPONDING TRADEOFF COST IN ACCURACY"
1340 PRINT
1350 PRINT " DO YOU WISH TO SPEED CALCULATIONS?"
1360 INPUT SPEED$
1370 IF (SPEED$ <> "Y" AND SPEED$ <> "y") THEN GOTO 1460
1380 PRINT " ENTER N, TO EVALUATE FROM -N TO N"
1390 PRINT " EXAMPLES:"
1400 PRINT "      3     (TO EVALUATE FROM -3 TO 3)"
1410 PRINT "      1     (TO EVALUATE FROM -1 TO 1)"
1420 INPUT LIMIT
1430 REM -----------------------------------
1440 REM     main loop
1450 REM
1460 FOR IY = 1 TO MAXY
1470 IYP=CINT(IY*(100!/MAXY))
1480 PRINT "percent completion of run=",IYP," %"
1490 YSLB(IY)=(IY*RINCY)-RINCY
1500 REM
1510 FOR IX = 1 TO MAXX
1520 XSLB(IX)=(IX*RINCX)-RINCX+XBMIN
1530 REM
1540 REM   concentration =term1*term2*term3
1550 REM
1560 REM   evaluate term1
```

```
1570 TERM1=(S*M)/(PI*H*((DX*DY)^.5))
1580 REM
1590 REM   evaluate term2
1600 TERM2=(U/((4!*KD*DX)^.5))*((KD*B*B/DX)^.5)*(XSLB(IX))
1610 REM
1620 REM   evaluate term3
1630 TERM3=0!
1640 C1=(1!+((U*U)/(4!*KD*DX)))^.5
1650 C2=(KD*B*B/DX)*((XSLB(IX))^2!)
1660 C3=KD*B*B/DY
1670 REM
1680 REM     -----------------------------------
1690 FOR N=-LIMIT TO LIMIT
1700 VAR=YSLB(IY) +2!*N
1710 VAR2=VAR*VAR
1720 PHI(N+6)=C1*((C2+C3*VAR2)^.5)
1730 X=PHI(N+6)
1740 GOSUB 2480
1750 TERM3=TERM3+ADD
1760 NEXT N
1770 REM
1780 C=TERM1*TERM3
1790 IF (C >999999!) THEN C=999999!
1800 IC(IX,IY)=C
1810 IF (IC(IX,IY) > 9999) THEN IC(IX,IY)=9999
1820 REM
1830 NEXT IX
1840 NEXT IY
1850 REM ----------------------------------
1860 REM      output
1870 REM
1880 IF (OUTP$="D" OR OUTP$="d") THEN GOTO 2170
1890 REM -----------
1900 REM      SCREEN OUTPUT
1910 PRINT
1920 PRINT " RESULTS FOR ",TEXT$(IPICK)
1930 PRINT " INPUT IN MKS UNITS:  "
1940 PRINT "      M        H         DX        DY        U       B        KD"
1950 PRINT "      -        -         --        --        -       -        --"
1960 PRINT USING "##.##^^^^";M,H,DX,DY,U,B,KD
1970 PRINT
1980 PRINT "  CONCENTRATION IN ORGANISMS PER 100 ML "
1990 PRINT "      VALUES OF Y/B (COLUMNS) & X/B (ROWS)"
2000 PRINT " EVALUATION FROM",-LIMIT," TO",LIMIT
2010 BL$="      "
2020 FOR IY = 1 TO MAXY
2030 IF (IY=1) THEN PRINT BL$;
2040 IF (IY <MAXY) THEN PRINT USING "##.##";YSLB(IY);
2050 IF (IY =MAXY) THEN PRINT USING "###.##";YSLB(IY)
2060 NEXT IY
2070 FOR IX=1 TO MAXX STEP 2
2080 PRINT USING "###.##";XSLB(IX);
```

```
2090 FOR IY=1 TO MAXY
2100 IF (IY<MAXY) THEN PRINT USING "#####";IC(IX,IY);
2110 IF (IY =MAXY) THEN PRINT USING "#####";IC(IX,IY)
2120 NEXT IY
2130 NEXT IX
2140 GOTO 2440
2150 REM  ----------
2160 REM      DISK OUTPUT
2170 OPEN "O",#1,"DATA"
2180 PRINT #1," RESULTS FOR",TEXT$(IPICK)
2190 PRINT #1,"   "
2200 PRINT #1,"INPUT IN MKS UNITS:  "
2210 PRINT #1,"   "
2220 PRINT #1,"    M       H          DX        DY        U       B      KD"
2230 PRINT #1,"    -       -          --        --        -       -      --"
2240 PRINT #1,"   "
2250 PRINT #1,USING "##.##^^^^";M,H,DX,DY,U,B,KD
2260 PRINT #1,"   "
2270 PRINT #1,"  CONCENTRATION IN ORGANISMS PER 100 ML  "
2280 PRINT #1,"  EVALUATION FROM",-LIMIT," TO",LIMIT
2290 PRINT #1,"   VALUES OF Y/B (COLUMNS) & X/B (ROWS) "
2300 BL$="      "
2310 FOR IY=1 TO MAXY
2320 IF (IY=1) THEN PRINT #1,BL$;
2330 IF (IY<MAXY) THEN PRINT #1,USING "##.##";YSLB(IY);
2340 IF (IY=MAXY) THEN PRINT #1,USING "###.##";YSLB(IY)
2350 NEXT IY
2360 FOR IX=1 TO MAXX
2370 PRINT #1,USING "###.##";XSLB(IX);
2380 FOR IY=1 TO MAXY
2390 IF (IY<MAXY) THEN PRINT #1,USING "#####";IC(IX,IY);
2400 IF (IY=MAXY) THEN PRINT #1,USING "#####";IC(IX,IY)
2410 NEXT IY
2420 NEXT IX
2430 CLOSE #1:END
2440 END
2450 REM
2460 REM  --------------------------------
2470 REM      function ko
2480 IF (X <= 0!) THEN ADD=1000000!
2490 IF (X <=0!) THEN RETURN
2500 IF (X >=2!) THEN GOSUB 2560
2510 IF (X >=2!) THEN RETURN
2520 IF (X < 2!) THEN GOSUB 2690
2530 RETURN
2540 REM
2550 REM  --------------------------------
2560 REM      function kog2
2570 XD2=2!/X:          XD22=XD2*XD2:    XD23=XD22*XD2
2580 XDC24=XD23*XD2: XD25=XD24*XD2:  XD26=XD25*XD2
2590 REM
2600 A1=CA-CB*XD2+CC*XD22-CD*XD23
```

```
2610 A2=CE*XD24-CF*XD25+CG*XD26
2620 ADD=A1+A2
2630 ADD=ADD/(X^.5)
2640 ADD=ADD*(EXP(TERM2-X))
2650 REM
2660 RETURN
2670 REM ---------------------------------
2680 REM      function kol2
2690 X2=X/2!
2700 GOSUB 2800
2710 EX=-LOG(X2)*OT
2720 REM
2730 X22=X2*X2:        X24=X22*X22:     X26=X24*X22
2740 X28=X24*X24:      X2T=X26*X24:     X2TW=X26*X26
2750 REM
2760 ADD=EX-CH+CI*X22+CJ*X24+CK*X26+CL*X28+CM*X2T+CN*X2TW
2765 ADD=ADD*(EXP(TERM2))
2770 RETURN
2780 REM  ------------------------------------------------
2790 REM      function io
2800 T=X/3.75
2810 T2=T*T
2820 T4=T2*T2
2830 T6=T4*T2
2840 T8=T6*T2
2850 TT=T8*T2
2860 TTW=TT*T2
2870 REM
2880 OT=CO+CP*T2+CQ*T4+CR*T6+CS*T8+CT*TT+CU*TTW
2890 REM
2900 RETURN
```

```
10 REM      PROGRAM MARINA2   (GWBASIC)     VA INST. OF MARINE SCIENCE
20 REM               J. M. HAMRICK     MARCH 1989
30 REM
40 DIM XSLB(41),YSLB(21)
50 DIM MI(4),HI(4),DXI(4),DYI(4),UI(4),BI(4),KDI(4)
60 DIM LCI(4),LUI(4)
70 DIM IC(41,21)
80 DIM TEXT$(4)
90 REM ------------------------------
100 MI(1)=1470000!:  HI(1)=.762:  DXI(1)=.00126:  DYI(1)=.00017
110 UI(1)=0!:        BI(1)=107!:   KDI(1)=.00001
120 LCI(1)=765!:    LUI(1)=440!
130 MI(2)=480000!:   HI(2)=1.55:   DXI(2)=.00486:  DYI(2)=.00065
140 UI(2)=0!:        BI(2)=610!:   KDI(2)=.00001
150 LCI(2)=2400!:   LUI(2)=1200!
160 MI(3)=240000!:   HI(3)=1.37:   DXI(3)=.0043:  DYI(3)=.00057
170 UI(3)=0!:       BI(3)=76!:    KDI(3)=.00001
180 LCI(3)=905!:    LUI(3)=160!
190 REM
200 REM      EDIT STATEMENTS # 220-240 FOR NEW INPUT EXAMPLE
210 REM
220 MI(4)=0!:  HI(4)=0!: DXI(4)=0!:   DYI(4)=0!
230 UI(4)=0!:       BI(4)=0!:     KDI(4)=0!
240 LCI(4)=0!:    LUI(4)=0!
250 REM
260 REM
270 TEXT$(1)=" INGRAM BAY MARINA (M-171)       "
280 TEXT$(2)=" CRANES CREEK MARINA (M-176)     "
290 TEXT$(3)=" A. C. FISHER MARINA (M-177)     "
300 TEXT$(4)=" USER DESIGNATED EXAMPLE         "
310 CA=1.25331414#: CB=7.832358E-02: CC=2.189568E-02: CD=1.062446E-02
320 CE=5.87872E-03:   CF=.0025154:  CG=5.3208E-04
330 CH=.57721566#:   CI=.4227842#:  CJ=.23069756#:  CK=.0348859
340 CL=2.62698E-03:   CM=.0001075:   CN=.0000074
350 CO=1#:     CP=3.5156229#:     CQ=3.0899424#:     CR=1.2067492#
360 CS=.2659732:     CT=.0360768:     CU=.0045813
370 S=.0001
380 PI=3.14159
390 MAXX=21
400 MAXY=11
410 REM
420 REM  SPECIFY IF OUTPUT TO SCREEN OR DISK
430 REM
440 PRINT "IS OUTPUT TO GO TO SCREEN (S) OR DISK (D) ? "
450 INPUT OUTP$
460 REM
470 IF (OUTP$="D" OR OUTP$="d") THEN MAXX=41
480 IF (OUTP$="D" OR OUTP$="d") THEN MAXY=21
490 REM
500 PRINT "specify desired marina:"
510 PRINT "  "
520 PRINT "enter single digit #:   "
```

```
530 PRINT "   "
540 PRINT " 1 - ingram bay marina      (m-171)"
550 PRINT " 2 - cranes creek marina    (m-176)"
560 PRINT " 3 - a. c. fisher marina    (m-177)"
570 PRINT " 4 - other (will specify input file)"
580 REM
590 INPUT IPICK
600 PRINT "ipick=",IPICK
610 M=MI(IPICK)
620 H=HI(IPICK)
630 DX=DXI(IPICK)
640 DY=DYI(IPICK)
650 U=UI(IPICK)
660 B=BI(IPICK)
670 KD=KDI(IPICK)
680 LC=LCI(IPICK)
690 LU=LUI(IPICK)
700 REM
710 REM ------------------------------------------------
720 REM   input variable override logic
730 REM
740 PRINT "     var #     var            VALUE"
750 PRINT "     -----     ---            -----"
760 PRINT "       1        m    ",M
770 PRINT "       2        h    ",H
780 PRINT "       3        dx   ",DX
790 PRINT "       4        dy   ",DY
800 PRINT "       5        u    ",U
810 PRINT "       6        b    ",B
820 PRINT "       7        kd   ",KD
830 PRINT "       8        lc   ",LC
840 PRINT "       9        lu   ",LU
850 PRINT "  "
860 PRINT " enter var # you wish to change or '0' (quit)"
870 INPUT IVAL
880 IF (IVAL=0) GOTO 1010
890 PRINT "what is new value?"
900 INPUT VALNEW
910 IF (IVAL=1) THEN M=VALNEW
920 IF (IVAL=2) THEN H=VALNEW
930 IF (IVAL=3) THEN DX=VALNEW
940 IF (IVAL=4) THEN DY=VALNEW
950 IF (IVAL=5) THEN U=VALNEW
960 IF (IVAL=6) THEN B=VALNEW
970 IF (IVAL=7) THEN KD=VALNEW
980 IF (IVAL=8) THEN LC=VALNEW
990 IF (IVAL=9) THEN LU=VALNEW
1000 GOTO 740
1010 REM ----------------------------------------
1020 REM zoom feature
1030 REM
1040 YBMAX=1!
```

```
1050 XBMAX=1!
1060 XBMIN=-1!
1070 PRINT "do you wish to zoom?"
1080 INPUT ZOOM$
1090 IF (ZOOM$ <> "y" AND ZOOM$ <> "Y") THEN GOTO 1160
1100 PRINT "enter max y/b value:"
1110 INPUT YBMAX
1120 PRINT "enter max x/b value:"
1130 INPUT XBMAX
1140 PRINT "enter min x/b value:"
1150 INPUT XBMIN
1160 RINCY=YBMAX/(MAXY-1)
1170 RINCX=(XBMAX-XBMIN)/(MAXX-1)
1180 REM  -----------------------------------
1190 REM      LOOP REDUCTION CODE
1200 LIMIT=5
1210 PRINT "CONCENTRATION IS CURRENTLY DETERMINED BY EVALUATING"
1220 PRINT "THE FUNCTION 'PHI' FROM -5 TO 5"
1230 PRINT "THIS RUN CAN BE SPED UP BY REDUCING THE # OF EVALUATIONS"
1240 PRINT "AT A CORRESPONDING TRADEOFF COST IN ACCURACY"
1250 PRINT
1260 PRINT " DO YOU WISH TO SPEED CALCULATIONS?"
1270 INPUT SPEED$
1280 IF (SPEED$ <> "Y" AND SPEED$ <> "y") THEN GOTO 1400
1290 PRINT " ENTER N, TO EVALUATE FROM -N TO N"
1300 PRINT " EXAMPLES:"
1310 PRINT "       3      (TO EVALUATE FROM -3 TO 3)"
1320 PRINT "       1      (TO EVALUATE FROM -1 TO 1)"
1330 INPUT LIMIT
1340 REM  ------------------------------------
1350 REM      main loop
1360 REM
1370 LCDB=LC/B
1380 LUDB=LU/B
1390 REM
1400 FOR IY = 1 TO MAXY
1410 IYP=CINT(IY*(100!/MAXY))
1420 PRINT "percent completion of run=",IYP," %"
1430 YSLB(IY)=(IY*RINCY)-RINCY
1440 REM
1450 FOR IX = 1 TO MAXX
1460 XSLB(IX)=(IX*RINCX)-RINCX+XBMIN
1470 REM
1480 REM   concentration =term1*term2*term3
1490 REM
1500 REM   evaluate term1
1510 TERM1=(S*M)/(PI*H*((DX*DY)^.5))
1520 REM
1530 REM   evaluate term2
1540 TERM2=1!
1550 REM
1560 REM   evaluate term3
```

```
1570 TERM3=0!
1580 C1=1!
1590 C2= KD*B*B/DX
1600 C3=KD*B*B/DY
1610 REM
1620 REM     --------------------------------
1630 FOR MM=-LIMIT TO LIMIT
1640 FOR N=-LIMIT TO LIMIT
1650 VARX1=XSLB(IX)+2!*MM*LCDB
1660 VARX2=XSLB(IX)+2!*LUDB+2!*MM*LCDB
1670 VARY=YSLB(IY)+2!*N
1680 VARY2=VARY*VARY
1690 VARX12=VARX1*VARX1
1700 VARX22=VARX2*VARX2
1710 PHI=C1*((C2*VARX12+C3*VARY2)^.5)     <insert:    1711    X=PHI
1720 GOSUB 2510
1730 TERM3=TERM3+ADD*(-1!)^MM
1740 PHI=C1*((C2*VARX22+C3*VARY2)^.5)     < insert    1741    X=PHI
1750 GOSUB 2510
1760 TERM3=TERM3+ADD*(-1!)^MM
1770 NEXT N
1780 NEXT MM
1790 REM
1800 C=TERM1*TERM2*TERM3
1810 IF (C<-999999!) THEN C=-9999!
1820 IF (C >999999!) THEN C=999999!
1830 IC(IX,IY)=C
1840 IF (IC(IX,IY) > 9999) THEN IC(IX,IY)=9999
1850 REM
1860 NEXT IX
1870 NEXT IY
1880 REM  ------------------------------
1890 REM     output
1900 REM
1910 IF (OUTP$="D" OR OUTP$="d") THEN GOTO 2200
1920 REM  ----------
1930 REM     SCREEN OUTPUT
1940 PRINT
1950 PRINT " RESULTS FOR ",TEXT$(IPICK)
1960 PRINT " INPUT IN MKS UNITS:  "
1970 PRINT "    M      H       DX     DY     U     B      KD   LC   LU"
1980 PRINT "    -      -       --     --     -     -      --   --   --"
1990 PRINT USING "##.##^^^^";M,H,DX,DY,U,B,KD,LC,LU
2000 PRINT
2010 PRINT "  CONCENTRATION IN ORGANISMS PER 100 ML "
2020 PRINT "     VALUES OF Y/B (COLUMNS) & X/B (ROWS)"
2030 PRINT " EVALUATION FROM",-LIMIT," TO",LIMIT
2040 BL$="     "
2050 FOR IY = 1 TO MAXY
2060 IF (IY=1) THEN PRINT BL$;
2070 IF (IY <MAXY) THEN PRINT USING "##.##";YSLB(IY);
2080 IF (IY =MAXY) THEN PRINT USING "###.##";YSLB(IY)
```

```
2090 NEXT IY
2100 FOR IX=1 TO MAXX STEP 2
2110 PRINT USING "###.##";XSLB(IX);
2120 FOR IY=1 TO MAXY
2130 IF (IY<MAXY) THEN PRINT USING "#####";IC(IX,IY);
2140 IF (IY =MAXY) THEN PRINT USING "#####";IC(IX,IY)
2150 NEXT IY
2160 NEXT IX
2170 GOTO 2470
2180 REM ----------
2190 REM      DISK OUTPUT
2200 OPEN "O",#1,"DATA"
2210 PRINT #1," RESULTS FOR",TEXT$(IPICK)
2220 PRINT #1,"   "
2230 PRINT #1,"INPUT IN MKS UNITS:  "
2240 PRINT #1,"   "
2250 PRINT #1,"    M        H      DX    DY       U      B    KD    LC    LU"
2260 PRINT #1,"    -        -      --    --       -      -    --    --    --"
2270 PRINT #1,"   "
2280 PRINT #1,USING "##.##^^^^";M,H,DX,DY,U,B,KD,LC,LU
2290 PRINT #1,"   "
2300 PRINT #1,"  CONCENTRATION IN ORGANISMS PER 100 ML  "
2310 PRINT #1,"  EVALUATION FROM",-LIMIT," TO",LIMIT
2320 PRINT #1,"   VALUES OF Y/B (COLUMNS) & X/B (ROWS) "
2330 BL$="       "
2340 FOR IY=1 TO MAXY
2350 IF (IY=1) THEN PRINT #1,BL$;
2360 IF (IY<MAXY) THEN PRINT #1,USING "##.##";YSLB(IY);
2370 IF (IY=MAXY) THEN PRINT #1,USING "###.##";YSLB(IY)
2380 NEXT IY
2390 FOR IX=1 TO MAXX
2400 PRINT #1,USING "###.##";XSLB(IX);
2410 FOR IY=1 TO MAXY
2420 IF (IY<MAXY) THEN PRINT #1,USING "#####";IC(IX,IY);
2430 IF (IY=MAXY) THEN PRINT #1,USING "#####";IC(IX,IY)
2440 NEXT IY
2450 NEXT IX
2460 CLOSE #1:END
2470 END
2480 REM
2490 REM --------------------------------
2500 REM      function ko
2510 IF (X <= 0!) THEN ADD=1000000!
2520 IF (X <=0!) THEN RETURN
2530 IF (X >=2!) THEN GOSUB 2590
2540 IF (X >=2!) THEN RETURN
2550 IF (X < 2!) THEN GOSUB 2720
2560 RETURN
2570 REM
2580 REM --------------------------------
2590 REM      function kog2
2600 XD2=2!/X:       XD22=XD2*XD2:    XD23=XD22*XD2
```

```
2610 XDC24=XD23*XD2: XD25=XD24*XD2:  XD26=XD25*XD2
2620 REM
2630 A1=CA-CB*XD2+CC*XD22-CD*XD23
2640 A2=CE*XD24-CF*XD25+CG*XD26
2650 ADD=A1+A2
2660 ADD=ADD/(X^.5)
2670 ADD=ADD*(EXP(-X))
2680 REM
2690 RETURN
2700 REM --------------------------------
2710 REM      function kol2
2720 X2=X/2!
2730 GOSUB 2830
2740 EX=-LOG(X2)*OT
2750 REM
2760 X22=X2*X2:        X24=X22*X22:     X26=X24*X22
2770 X28=X24*X24:      X2T=X26*X24:     X2TW=X26*X26
2780 REM
2790 ADD=EX-CH+CI*X22+CJ*X24+CK*X26+CL*X28+CM*X2T+CN*X2TW
2800 RETURN
2810 REM  ---------------------------------------------
2820 REM      function io
2830 T=X/3.75
2840 T2=T*T
2850 T4=T2*T2
2860 T6=T4*T2
2870 T8=T6*T2
2880 TT=T8*T2
2890 TTW=TT*T2
2900 REM
2910 OT=CO+CP*T2+CQ*T4+CR*T6+CS*T8+CT*TT+CU*TTW
2920 REM
2930 RETURN
```

RESULTS FOR GARETTS MARINA (M-21)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.120E+07	0.329E+01	0.233E+00	0.310E-01	0.187E-03	0.355E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.17	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.16	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.15	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.14	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.13	3	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	5	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.11	6	6	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.10	9	8	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.09	12	10	7	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.08	16	14	10	6	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.07	22	19	12	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	30	25	16	9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.05	42	34	20	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.04	59	45	24	12	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.03	86	59	29	14	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.02	130	76	34	15	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.01	216	91	37	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	99	39	17	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.01	222	94	38	17	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.02	138	80	36	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.03	94	64	32	15	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.04	67	50	27	14	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	49	39	23	12	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	36	30	19	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.07	27	23	15	9	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.08	20	18	12	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.09	15	13	10	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.10	12	10	8	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.11	9	8	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	7	6	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.13	5	5	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.14	4	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.15	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.16	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.17	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.19	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.1 Results for Garetts Marina

RESULTS FOR GARETTS MARINA (M-21)

INPUT IN MKS UNITS;

M	H	DX	DY	U	B	KD
0.120E+07	0.329E+01	0.230E+02	0.310E-01	0.187E-03	0.355E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.96	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.90	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.84	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.78	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.72	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.66	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.60	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.54	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.48	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.42	5	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.36	7	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	9	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.24	11	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	14	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	19	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	28	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	10	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	28	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	19	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	14	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.24	11	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.30	9	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.36	7	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.42	5	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.48	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.54	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.60	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.66	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.72	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.78	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.84	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.90	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.96	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.2 Results for Garetts Marina

RESULTS FOR GARETTS MARINA (M-21)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.120E+07	0.329E+01	0.233E+00	0.310E-01	0.000E+00	0.355E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.17	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.16	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.15	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.14	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.13	4	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	6	5	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.11	7	7	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.10	10	9	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.09	13	12	9	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.08	18	16	11	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.07	24	21	14	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	33	27	17	9	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.05	45	36	21	11	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.04	63	48	26	13	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.03	90	62	31	14	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.02	134	78	35	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.01	219	93	38	17	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	99	39	17	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.01	219	93	38	17	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.02	134	78	35	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.03	90	62	31	14	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.04	63	48	26	13	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	45	36	21	11	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	33	27	17	9	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.07	24	21	14	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.08	18	16	11	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.09	13	12	9	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.10	10	9	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.11	7	7	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	6	5	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.13	4	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.14	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.15	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.16	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.17	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.3 Results for Garetts Marina

RESULTS FOR GARETTS MARINA (M-21)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.120E+07	0.329E+01	0.230E+02	0.310E-01	0.000E+00	0.355E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.96	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.90	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.84	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.78	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.72	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.66	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.60	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.54	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.48	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.42	5	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.36	7	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	9	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.24	11	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	14	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	19	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	28	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	10	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	28	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	19	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	14	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.24	11	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.30	9	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.36	7	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.42	5	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.48	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.54	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.60	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.66	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.72	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.78	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.84	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.90	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.96	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.4 Results for Garetts Marina

RESULTS FOR SOUTH HILL BANKS MARINA (M-22)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.210E+06	0.329E+01	0.233E+00	0.310E-01	0.187E-03	0.355E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.10	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.09	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.08	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.07	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	5	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.05	7	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.04	10	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.03	15	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.02	22	13	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.01	37	16	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	17	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.01	38	16	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.02	24	14	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.03	16	11	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.04	11	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	8	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	6	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.07	4	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.08	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.09	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.10	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.11	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.5 Results for South Hill Banks Marina

RESULTS FOR SOUTH HILL BANKS MARINA (M-22)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.210E+06	0.329E+01	0.230E+02	0.310E-01	0.187E-03	0.355E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.42	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.24	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.24	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.30	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.42	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.6 Results for South Hill Banks Marina

RESULTS FOR SOUTH HILL BANKS MARINA (M-22)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.210E+06	0.329E+01	0.233E+00	0.310E-01	0.000E+00	0.355E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.10	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.09	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.08	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.07	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	5	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.05	8	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.04	11	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.03	15	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.02	23	13	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.01	38	16	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	17	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.01	38	16	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.02	23	13	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.03	15	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.04	11	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	8	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	5	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.07	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.08	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.09	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.10	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.7 Results for South Hill Banks Marina

RESULTS FOR SOUTH HILL BANKS MARINA (M-22)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.210E+06	0.329E+01	0.230E+02	0.310E-01	0.000E+00	0.355E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.42	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.24	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.24	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.30	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.42	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.8 Results for South Hill Banks Marina

RESULTS FOR INGRAM BAY MARINA (M-171)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD	LC	LU
1470000.	0.76	0.00126	0.00017	0.00000	107.0	0.00001	765.	440.

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
-1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.08	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.02	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.96	5	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.90	10	9	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.84	19	17	12	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.78	35	31	22	12	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.72	65	57	39	21	10	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.66	120	104	69	36	16	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.60	223	191	121	61	26	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.54	416	349	212	101	40	14	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.48	781	640	368	163	61	20	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.42	1474	1173	629	258	90	28	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.36	2810	2148	1056	398	129	39	11	3	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	5423	3920	1728	590	178	51	14	3	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.24	9999	7094	2722	834	235	64	17	4	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	9999	9999	4055	1115	294	76	20	5	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	9999	9999	5574	1388	347	87	22	5	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	9999	9999	6870	1593	384	94	23	6	1	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	9999	7392	1669	397	97	24	6	1	0	0	0	0	0	0	0	0	0	0	0	0
0.06	9999	9999	6870	1593	384	94	23	6	1	0	0	0	0	0	0	0	0	0	0	0	0
0.12	9999	9999	5574	1388	347	87	22	5	1	0	0	0	0	0	0	0	0	0	0	0	0
0.18	9999	9999	4055	1115	294	76	20	5	1	0	0	0	0	0	0	0	0	0	0	0	0
0.24	9999	7094	2722	834	235	64	17	4	1	0	0	0	0	0	0	0	0	0	0	0	0
0.30	5423	3920	1728	590	178	51	14	3	1	0	0	0	0	0	0	0	0	0	0	0	0
0.36	2810	2148	1056	398	129	39	11	3	0	0	0	0	0	0	0	0	0	0	0	0	0
0.42	1474	1173	629	258	90	28	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0
0.48	781	640	368	163	61	20	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.54	416	349	212	101	40	14	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.60	223	191	121	61	26	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.66	120	104	69	36	16	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.72	65	57	39	21	10	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.78	35	31	22	12	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.84	19	17	12	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.90	10	9	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.96	5	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.02	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.08	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.9 Results for Ingram Bay Marina

RESULTS FOR CRANES CREEK MARINA (M-176)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD	LC	LU
480000.	1.55	0.00486	0.00065	0.00000	610.0	0.00001	2400.	1200.

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.28	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.26	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.24	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.22	6	5	5	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.20	11	10	9	7	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	20	19	16	12	8	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.16	38	35	29	21	13	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.14	71	65	51	35	22	13	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	133	121	91	60	35	19	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0
-0.10	252	224	161	99	55	28	14	7	3	1	0	0	0	0	0	0	0	0	0	0	0
-0.08	487	418	279	158	81	40	19	9	4	1	0	0	0	0	0	0	0	0	0	0	0
-0.06	965	784	468	239	114	53	24	11	5	2	1	0	0	0	0	0	0	0	0	0	0
-0.04	2008	1461	737	335	149	66	29	13	5	2	1	0	0	0	0	0	0	0	0	0	0
-0.02	4667	2555	1027	420	176	75	32	14	6	2	1	0	0	0	0	0	0	0	0	0	0
0.00	9999	3351	1165	455	186	78	34	14	6	2	1	0	0	0	0	0	0	0	0	0	0
0.02	4667	2555	1027	420	176	75	32	14	6	2	1	0	0	0	0	0	0	0	0	0	0
0.04	2008	1461	737	335	149	66	29	13	5	2	1	0	0	0	0	0	0	0	0	0	0
0.06	965	784	468	239	114	53	24	11	5	2	1	0	0	0	0	0	0	0	0	0	0
0.08	487	418	279	158	81	40	19	9	4	1	0	0	0	0	0	0	0	0	0	0	0
0.10	252	224	161	99	55	28	14	7	3	1	0	0	0	0	0	0	0	0	0	0	0
0.12	133	121	91	60	35	19	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0
0.14	71	65	51	35	22	13	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0
0.16	38	35	29	21	13	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0
0.18	20	19	16	12	8	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	11	10	9	7	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.22	6	5	5	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.24	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.26	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.28	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.10 Results for Cranes Creek Marina

RESULTS FOR CRANES CREEK MARINA (M-176)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD	LC	LU
480000.	1.55	0.02000	0.00065	0.00000	610.0	0.00001	2400.	1200.

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.52	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.48	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.44	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.40	6	5	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.36	11	10	8	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.32	20	18	15	11	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.28	37	34	27	18	11	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.24	69	62	47	31	18	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.20	130	115	82	50	28	14	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.16	249	213	141	80	41	20	9	4	2	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	490	397	235	120	57	26	12	5	2	1	0	0	0	0	0	0	0	0	0	0	0
-0.08	1011	732	367	166	73	32	14	6	2	1	0	0	0	0	0	0	0	0	0	0	0
-0.04	2332	1268	508	207	87	37	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	1652	574	224	92	38	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0
0.04	2332	1268	508	207	87	37	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0
0.08	1011	732	367	166	73	32	14	6	2	1	0	0	0	0	0	0	0	0	0	0	0
0.12	490	397	235	120	57	26	12	5	2	1	0	0	0	0	0	0	0	0	0	0	0
0.16	249	213	141	80	41	20	9	4	2	0	0	0	0	0	0	0	0	0	0	0	0
0.20	130	115	82	50	28	14	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0
0.24	69	62	47	31	18	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0
0.28	37	34	27	18	11	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.32	20	18	15	11	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.36	11	10	8	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.40	6	5	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.44	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.48	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.52	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.11 Results for Cranes Creek Marina

RESULTS FOR A. C. FISHER MARINA (M-177)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD	LC	LU
240000.	1.37	0.00430	0.00057	0.00000	76.0	0.00001	905.	160.

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
-2.10	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.98	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.86	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.74	3	3	2	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.62	4	4	4	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
-1.50	7	7	6	6	5	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0
-1.38	12	12	11	9	8	6	5	3	2	1	1	0	0	0	0	0	0	0	0	0	0
-1.26	20	19	17	15	12	9	7	5	3	2	1	1	0	0	0	0	0	0	0	0	0
-1.14	32	31	28	24	19	15	11	7	5	3	2	1	1	0	0	0	0	0	0	0	0
-1.02	53	51	45	38	30	22	16	11	7	5	3	2	1	0	0	0	0	0	0	0	0
-0.90	87	84	73	60	46	33	23	15	10	6	4	2	1	1	0	0	0	0	0	0	0
-0.78	145	138	119	94	70	49	33	21	14	8	5	3	2	1	0	0	0	0	0	0	0
-0.66	244	229	192	146	104	70	46	29	18	11	6	4	2	1	0	0	0	0	0	0	0
-0.54	416	385	310	224	151	98	61	37	23	13	8	5	3	1	1	0	0	0	0	0	0
-0.42	723	652	494	335	213	131	79	47	28	16	9	5	3	2	1	0	0	0	0	0	0
-0.30	1303	1120	770	477	283	166	96	56	32	19	11	6	3	2	1	0	0	0	0	0	0
-0.18	2509	1924	1128	629	350	196	111	63	36	20	12	7	4	2	1	0	0	0	0	0	0
-0.06	5921	3019	1436	736	393	215	119	67	38	21	12	7	4	2	1	0	0	0	0	0	0
0.06	5921	3019	1436	736	393	215	119	67	38	21	12	7	4	2	1	0	0	0	0	0	0
0.18	2509	1924	1128	629	350	196	111	63	36	20	12	7	4	2	1	0	0	0	0	0	0
0.30	1303	1120	770	477	283	166	96	56	32	19	11	6	3	2	1	0	0	0	0	0	0
0.42	723	652	494	335	213	131	79	47	28	16	9	5	3	2	1	0	0	0	0	0	0
0.54	416	385	310	224	151	98	61	37	23	13	8	5	3	1	1	0	0	0	0	0	0
0.66	244	229	192	146	104	70	46	29	18	11	6	4	2	1	0	0	0	0	0	0	0
0.78	145	138	119	94	70	49	33	21	14	8	5	3	2	1	0	0	0	0	0	0	0
0.90	87	84	73	60	46	33	23	15	10	6	4	2	1	1	0	0	0	0	0	0	0
1.02	53	51	45	38	30	22	16	11	7	5	3	2	1	0	0	0	0	0	0	0	0
1.14	32	31	28	24	19	15	11	7	5	3	2	1	1	0	0	0	0	0	0	0	0
1.26	20	19	17	15	12	9	7	5	3	2	1	1	0	0	0	0	0	0	0	0	0
1.38	12	12	11	9	8	6	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0
1.50	7	7	6	6	5	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0
1.62	4	4	4	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1.74	2	2	2	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1.86	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.98	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.12 Results for A. C. Fisher Marina

RESULTS FOR A. C. FISHER MARINA (M-177)

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD	LC	LU
240000.	1.37	0.03200	0.00057	0.00000	76.0	0.00001	905.	160.

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
-2.10	110	105	90	71	52	37	24	16	10	6	4	2	1	0	0	0	0	0	0	0	0
-1.86	119	112	96	75	55	38	25	16	10	6	4	2	1	0	0	0	0	0	0	0	0
-1.62	146	136	114	86	61	41	27	17	11	6	4	2	1	0	0	0	0	0	0	0	0
-1.38	196	181	145	105	71	47	29	18	11	7	4	2	1	0	0	0	0	0	0	0	0
-1.14	280	253	193	133	86	54	33	20	12	7	4	2	1	1	0	0	0	0	0	0	0
-0.90	419	367	261	167	102	62	37	22	13	7	4	2	1	1	0	0	0	0	0	0	0
-0.66	654	540	349	207	120	69	40	23	13	8	4	2	1	1	0	0	0	0	0	0	0
-0.42	1082	793	446	245	135	76	43	25	14	8	4	2	1	1	0	0	0	0	0	0	0
-0.18	2056	1092	525	271	145	80	45	25	14	8	4	2	1	1	0	0	0	0	0	0	0
0.06	3449	1188	543	276	147	80	45	25	14	8	4	2	1	0	0	0	0	0	0	0	0
0.30	1448	944	489	258	140	77	43	24	14	8	4	2	1	0	0	0	0	0	0	0	0
0.54	829	652	394	223	126	71	40	23	13	7	4	2	1	0	0	0	0	0	0	0	0
0.78	514	438	297	182	107	62	36	21	12	7	4	2	1	0	0	0	0	0	0	0	0
1.02	331	294	216	142	88	53	31	18	11	6	3	2	1	0	0	0	0	0	0	0	0
1.26	218	199	154	107	70	43	26	16	9	5	3	2	1	0	0	0	0	0	0	0	0
1.50	146	135	109	79	54	35	22	13	8	5	3	1	1	0	0	0	0	0	0	0	0
1.74	98	92	77	58	41	27	17	11	7	4	2	1	0	0	0	0	0	0	0	0	0
1.98	67	63	54	42	30	21	14	9	5	3	2	1	0	0	0	0	0	0	0	0	0
2.22	46	44	38	30	22	16	11	7	4	3	1	1	0	0	0	0	0	0	0	0	0
2.46	32	30	26	22	16	12	8	5	3	2	1	1	0	0	0	0	0	0	0	0	0
2.70	22	21	19	15	12	9	6	4	3	2	1	0	0	0	0	0	0	0	0	0	0
2.94	15	14	13	11	9	6	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0
3.18	10	10	9	8	6	5	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0
3.42	7	7	6	5	4	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0
3.66	5	5	4	4	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
3.90	3	3	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4.14	2	2	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.38	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.62	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.13 Results for A. C. Fisher Marina

RESULTS FOR JAMES RIVER STP

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.175E+07	0.152E+01	0.834E-01	0.111E-01	0.000E+00	0.235E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.24	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.22	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.20	3	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	6	6	5	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.16	11	11	9	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.14	21	19	15	11	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	37	34	26	17	10	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.10	68	61	45	28	16	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.08	127	110	75	44	23	12	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	243	200	122	65	32	15	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.04	486	359	188	89	41	19	9	4	1	0	0	0	0	0	0	0	0	0	0	0	0
-0.02	1085	610	257	110	48	21	10	4	2	1	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	789	289	119	51	22	10	4	2	1	0	0	0	0	0	0	0	0	0	0	0
0.02	1085	610	257	110	48	21	10	4	2	1	0	0	0	0	0	0	0	0	0	0	0
0.04	486	359	188	89	41	19	9	4	1	0	0	0	0	0	0	0	0	0	0	0	0
0.06	243	200	122	65	32	15	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0
0.08	127	110	75	44	23	12	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0
0.10	68	61	45	28	16	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0
0.12	37	34	26	17	10	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.14	21	19	15	11	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.16	11	11	9	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	6	6	5	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	3	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.22	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.24	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.14 Results for James River STP

RESULTS FOR JAMES RIVER STP

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.175E+07	0.152E+01	0.160E+02	0.111E-01	0.000E+00	0.235E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-2.00	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.90	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.80	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.70	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.60	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.50	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.40	4	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.30	6	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.20	7	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.10	9	8	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.00	11	10	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.90	14	12	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.80	18	15	9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.70	24	19	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.60	31	23	12	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.50	40	29	14	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.40	53	35	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	72	42	18	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.20	102	49	19	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.10	158	54	20	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	57	20	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.10	158	54	20	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	102	49	19	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.30	72	42	18	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.40	53	35	16	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.50	40	29	14	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.60	31	23	12	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.70	24	19	10	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.80	18	15	9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.90	14	12	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.00	11	10	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.10	9	8	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.20	7	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.30	6	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.40	4	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.50	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.60	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.70	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.80	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.90	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.00	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.15 Results for James River STP

RESULTS FOR YORK RIVER STP

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.200E+07	0.670E+01	0.431E+00	0.575E-01	0.000E+00	0.380E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 10 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.19	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.18	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.17	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.16	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.15	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.14	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.13	4	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.12	5	5	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.11	6	6	5	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.10	8	7	6	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.09	10	9	7	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.08	13	12	9	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.07	17	15	10	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.06	22	19	13	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.05	28	23	15	9	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.04	37	29	18	10	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.03	51	37	20	11	6	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.02	71	45	23	12	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.01	110	52	24	12	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	55	25	12	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.01	110	52	24	12	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.02	71	45	23	12	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.03	51	37	20	11	6	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.04	37	29	18	10	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	28	23	15	9	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0.06	22	19	13	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.07	17	15	10	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.08	13	12	9	6	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.09	10	9	7	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.10	8	7	6	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.11	6	6	5	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.12	5	5	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.13	4	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.14	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.15	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.16	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.17	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.18	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.19	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.16 Results for York River STP

RESULTS FOR YORK RIVER STP

INPUT IN MKS UNITS:

M	H	DX	DY	U	B	KD
0.200E+07	0.670E+01	0.140E+02	0.575E-01	0.000E+00	0.380E+04	0.100E-04

*** CONCENTRATION IN ORGANISMS PER 100 ML ***

EVALUATION IS FROM -5 TO 5

VALUES OF Y/B (COLUMNS) & X/B (ROWS):

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.65	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.60	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.55	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.50	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.45	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.40	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.35	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.30	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.25	5	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.20	7	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.15	10	7	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.10	13	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-0.05	20	9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.00	9999	9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.05	20	9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.10	13	8	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.15	10	7	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.20	7	5	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.25	5	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.30	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.35	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.40	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.45	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.50	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.55	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.60	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.65	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure B.17 Results for York River STP