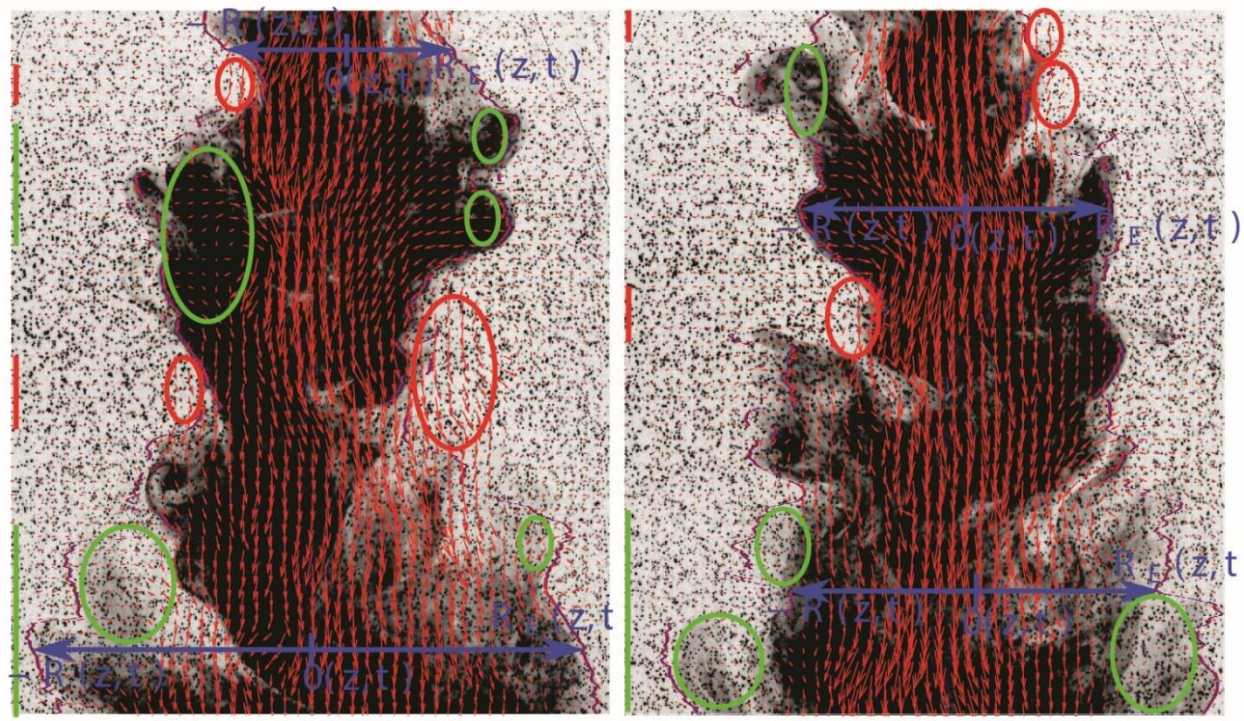
***Taylor Micro-Scale Methods for Estimating Injury and Mortality to Marine Organisms Entrained by a Diffuser at Huntington Beach Desalination Facility (HBDF)***



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7 December 2017

**ABSTRACT:** The objective of this technical note is to conduct a site-specific, hydrodynamic-based, turbulence mortality analysis of the Huntington Beach Desalination Facility (HBDF) diffuser design, and determine how its turbulence impacts align with the 23% of entrainment mass-balance baseline set forth in the *Substitute Environmental Documentation* or (SED), that was adopted by the State Water Resource Control Board (SWRCB) in conjunction with the Ocean Plan Desalination Amendment. The problem of quantifying injury to marine organisms that become entrained in turbulent jets and plumes is not well understood, but two general hypotheses have immerged from the scientific literature: a) injury or mortality occurs when the organism is subjected to strain rates and shear stresses in turbulent flows that exceed the tensile strength or shear strength of the organism or its outer membranes, epidermis or other soft tissues; and b) injury or mortality occurs when entrained organisms are exposed to a specific type of turbulent eddy that is comparable to the size of the organism. Professor Philip Roberts has expanded on hypothesis-b in reports to the California State Water Resources Control Board and for the *CalAm Monterey Peninsula Water Supply Project*. There are two parts to the Roberts interpretation of hypothesis-b. First, Roberts postulates that incremental turbulence impacts due to the action of the diffuser discharge will only occur in regions of the *brine mixing zone* (BMZ) where the turbulent eddies induced by the diffuser are smaller than 1 mm, because the smallest turbulent eddies known to occur naturally in California coastal waters are about 1 mm in size. The operative premise here is that turbulent eddies induced by a diffuser that are smaller than 1 mm would be unnatural occurrences to which ocean ecology has not adapted. This condition also limits injury to 1 mm and sub-millimeter size organisms, which are the most fragile and abundant populations in the receiving waters. Second, the specific type of turbulent eddy used by Roberts to calculate injury is the *Kolmogorov* scale eddy.

This study invokes the Roberts interpretation of hypothesis-b with one modification, namely: the properties of the Taylor micro-scale eddy are used for calculating injury because the highest strain rates occur at that particular size of turbulent eddy. Invoking the Taylor micro-scale also allows the eddy-based injury criteria of hypothesis-b to incorporate the essential concepts of the stress/strain injury relationships of hypothesis-a. Therefore, injury is presumed to occur in the regions of the diffuser discharge plume where the Taylor micro-scale eddy is less than 1 mm. To be conservative, all plankton exposed to injurious Taylor micro-scale turbulence from the diffuser were assumed to suffer lethal injury.

Two sets of operating scenarios (worst-daily and monthly) were evaluated for the Huntington Beach Desalination Facility (HBDF). The Taylor micro-scale turbulence analysis gave similar final answers for harmful diffuser entrainment and *area of production foregone* (APF) as the SED 23% of entrainment mass-balance baseline assessment. The Taylor micro-scale hypothesis gives estimates of harmful entrainment fluxes that are 21.3 MGD greater than the SED 23% of entrainment baseline for monthly operating scenarios, which is the equivalent of 25.5% of the dilution water entrained at the $+\Delta 2\text{ppt}$ over background compliance point under the Ocean Plan, and produces an APF mitigation scaling that is only 3.22 acres greater than what would have otherwise resulted from the SED 23% turbulence impact estimate. The harmful Taylor micro-scale turbulence is confined close to the point of discharge extending only 0.77m (2.53 ft.) from the point of discharge for daily Worst-Case #1 and 0.71 m (2.33 ft.) for daily Worst Case #2. For the monthly scenarios, harmful Taylor micro-scale turbulence is slightly more confined to the immediate vicinity of the discharge.

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**1) Background:**

California Ocean Plan, Section III.M.2 (b), requires that, "*Multiport diffusers shall be engineered to maximize dilution, minimize the size of the brine mixing zone, minimize suspension of benthic sediments, and mortality of all forms of marine life.*" Presently there are no scientifically codified methods for calculating mortality of marine organisms entrained by diffusers. Mortality to marine organisms that are entrained by diffusers has never been a regulated impact in waste water outfalls or power generation in California, (neither under CWA Section 316 a nor b).

The available regulatory guidance for estimating diffuser impacts follows from the Substitute Environmental Documentation or *SED* (see SWRCB, 2014) that was adopted by the State Water Resource Control Board in conjunction with the Ocean Plan Desalination Amendment (SWRCB, 2015). Based on previous work by the SWRCB's Expert Review Panel (ERP; Foster et al., 2013), page 85 of the SED states that, "*larvae in 23 percent of the total entrained volume of dilution water may be exposed to lethal turbulence*". The SED continues on p.85 to give an example of how to implement this guidance, "*If a facility has a 50 percent production efficiency, it takes approximately 20 parts ambient water to dilute 1 part brine to 5 percent above ambient salinity. For example, if a facility is discharging 50 MGD of 66 ppt brine, with a background salinity of 33 ppt, the facility would need approximately 950 MGD of diluent water to get their brine to 35 ppt. Of that 950 MG, organisms in 218 MG could potentially be exposed to lethal turbulence (23 percent of total dilution volume) using the modeling data from Foster et al. (2013)*". Section III. M. 3.b.(1) in the Ocean Plan Amendment (OPA) modified the 5 percent over ambient water quality objective as follows: "*Discharges shall not exceed a daily maximum of 2.0 parts per thousand (ppt) above natural background salinity measured no further than 100 meters (328 ft) horizontally from each discharge point. There is no vertical limit to this zone*." The region within 100 m from the discharge point is referred to herein as the *regulatory brine mixing zone*, (BMZ).

Using the SED guidance, MBC (2016) estimated that potential annual average lethal turbulence entrainment would be $Q_c(SED)$ = 180 MGD, with an associated area of production foregone of 23.46 acres. This calculation is based on what was believed to be an annual average operating condition with the HBDF discharging 56 MGD of brine at 63.4 ppt into receiving waters with natural background salinity = 33.52 ppt using the following simple mass balance equation:

$$Q_c(SED) = 0.23 Q'_E = 0.23 \overline{Q}\, \overline{D}_{\Delta 2\, ppt} \qquad (1)$$

where $Q'_E$ is the flux of dilution water entrained in order to dilute the brine to 2 ppt above natural background salinity, $\overline{Q}$ is the brine discharge rate, and $\overline{D}_{\Delta 2\, ppt}$ is the average (bulk) dilution factor to achieve dilution down to 2 ppt above natural background salinity, which was assumed to be $\overline{D}_{\Delta 2\, ppt}$ = 13.94

Since the MBC (2016) report, the Santa Ana Regional Water Quality Control Board (RWQCB) requested dilution analysis utilize the EPA-certified mixing model (CORMIX 10.0) as well as incorporating additional worst-case daily operating scenarios for the HBDF as opposed to the monthly baseline scenario previously modeled. The two sets of worst-daily and monthly discharge scenarios requested by the RWQCB are summarized below in Table 1, and in greater detail in Appendix-A. Daily Worst-Case #1 intakes up to 116.5 MGD to allow for operational flexibility of higher drinking water production to make up for other days of lower production. Daily Worst-Case#1 includes additional intake flow of approximately 8.5 MGD of backwash and RO membrane cleaning subsequent rinse water. Monthly Case ***#1*** which utilizes an average brine discharge of $\overline{Q}$ = 56.7 mgd that includes approximately 6.7 MGD of backwash and RO membrane cleaning subsequent rinse water. Daily Worst-Case #2 excludes the backwash and the RO membrane cleaning subsequent rinse water, so that the daily worst case intake flow rate is reduced to 108 MGD, and the brine discharge rate is 54 MGD. However, on a average monthly basis, the HBDF is expected intake approximately 106.7 MGD of sea water resulting in a Monthly Case #2 scenario that discharges 50 MGD of brine.

The MBC (2016) analysis was repeated in Table-2, applying equation (1) to the daily worst-case operating parameters in Table-1. The estimates for lethal turbulence entrainment for the SED 23% of entrainment baseline are found to rise to 193 MGD for daily Worst-Case #1 & Monthly Case #1; 195 MGD for daily Worst-Case-2; and 181 MGD for Monthly-Case #2. The corresponding APF mitigation scaling in Table 2 is based on several new factors previously reported to the Santa Ana Regional Water Quality Control Board, namely: a) revised empirical transport model (ETM) parameters based on Tenera (2010 & 2015), and b) calculating the standard error for gobies based on proportional entrainment. This revised APF calculus, following the submission of the MBC (2016) report, finds that the area of production forgone due to HBDF diffuser turbulence impacts is in the range of 29.2 acres to 31.3 acres based on the 23 % of entrainment SED guidance for all anticipated worst case operating conditions of the HBDF.

**Table 1: Worst-Case Operating Conditions for the HBDF**

| | Intake Rate (MGD) | Production Rate (MGD) | Discharge Rate (MGD) | Brine Salinity (ppt) | *Duckbill Cross-Section ($m^2$) | *Duckbill Equivalent Diameter (m) | *Maximum Discharge Velocity (m/s) |
|---|---|---|---|---|---|---|---|
| **Daily Worst-Case 1** | 116.5 | 54.0 | 62.50 | 62.44 | 0.193 | 0.496 | 4.72 |
| **Monthly-Case 1** | 106.7 | 50.0 | 56.7 | 63.1 | 0.184 | 0.484 | 4.50 |
| **Daily Worst-Case 2** | 108 | 54.0 | 54.00 | 67.00 | 0.179 | 0.478 | 4.39 |
| **Monthly-Case 2** | 100.0 | 50.0 | 50.0 | 67.00 | 0.172 | 0.468 | 4.24 |

*Based on Jenkins (2017) dilution report

**Table 2: Diffuser Turbulence Impacts based on SED 23% of Entrainment Baseline**

| | Bulk Dilution Factor @ Compliance Point* | Entrainment Rate @ Compliance Point* | Deleterious Entrainment (at 23%) | Area of Production Foregone, APF(SED)** |
|---|---|---|---|---|
| Daily Worst-Case # 1 | 13.46 | 841 MGD | 193 MGD | 30.97 acres |
| Monthly-Case # 1 | 14.79 | 839 MGD | 193 MGD | 30.97 acres |
| Daily Worst-Case # 2 | 15.74 | 850 MGD | 195 MGD | 31.28 acres |
| Monthly-Case # 2 | 15.74 | 787 MGD | 181 MGD | 29.16 acres |

*Compliance Point where discharge plume salinity = 2 ppt over natural background
= 33.52 ppt + 2 ppt = 35.52 ppt

**Based on Tenera, (2010 & 2015) and MBC, (2017)

The SED guidance for estimating diffuser-induced turbulence impacts is a simple mass balance baseline that takes no accounting of any diffuser design-specific parameters. This mass balance is applied to a control volume consisting of the dilution space inside the 2 ppt over background compliance point; and the 0.23 factor in equation (1) is based on the assumption that all the lethal turbulence is confined inside the compliance point, as illustrated in Figure 1. However, the staffs of the RWQCB and SWRCB have recently indicated that site-specific modeling may be required to determine if the regulatory guidance in the SED is applicable. In a July 26, 2017 comment letter submitted to the California State Lands Commission on their Draft Supplemental Environmental Impact Report, staff of the RWQCB included a request to, "*include a diffuser-specific analysis of shearing-related mortality in the SEIR to determine whether the 23 percent mortality estimate is appropriate.*" Furthermore, SWRCB staff has opined that the context of the SED guidance from Foster et al., (2013), was linear brine diffusers with fixed, uniformly spaced ports discharging upward from the seabed at $60^0$ angles, and the RWQCB questioned whether the 23% of entrainment SED baseline would apply to other diffuser configurations, such as the fanned 3-port duckbill diffuser employed by the HBDF, (Figure 2).

The implementation section of the brine amendment to the California Ocean Plan, Section III.M.2 (b), requires that:

> *Multiport diffusers shall be engineered to maximize dilution, minimize the size of the brine mixing zone, minimize suspension of benthic sediments, and mortality of all forms of marine life*

Addressing these implementation requirements, Poseidon Resources contracted with Alden Research Laboratory (Alden) to develop a high-performance, multiport diffuser that could be retrofitted to the existing discharge structure for the Huntington Beach Generating Station. The Alden-designed HBDF diffuser discharges through three 36-in. duckbill check valves in a fanned arrangement discharging upward at $47^0$, from several meters above the seabed, (Figure 2). The dilution performance of this diffuser was evaluated using the CORMIX v-10.0.3.0 EPA certified mixing-zone model (Jenkins, 2017), and was found to be highly efficient in diluting HBDF brine under both sets of worst-case operating conditions listed in Table 1. The CORMIX dilution curves (Appendix-C-F) show that the new HBDF duckbill diffuser design can reach the 2 ppt over background compliance point within 69.9 m (229 ft.) to 91.8 m (301 ft.) from the point of discharge under daily worst case conditions. Under monthly conditions, the HBDF diffuser can satisfy compliance point requirements at 69.1 m (227 ft.) and 86.3 m (283 ft.) from the point of discharge. With computational fluid dynamics modeling of the diffuser velocity field over the seabed, it was demonstrated that the HBDF diffuser would not cause suspension of even the finest grained sediments found at the discharge site, (Jenkins, 2017). The objective of this technical note is to satisfy the remaining requirement of Section III.M.2 (b) by conducting a site-specific, hydrodynamic-based, turbulence mortality analysis of the Figure-2 diffuser design, and determine how its turbulence impacts align with the 23% of entrainment SED baseline for daily and Monthly-Case #1 & #2 operating conditions in Table 2.

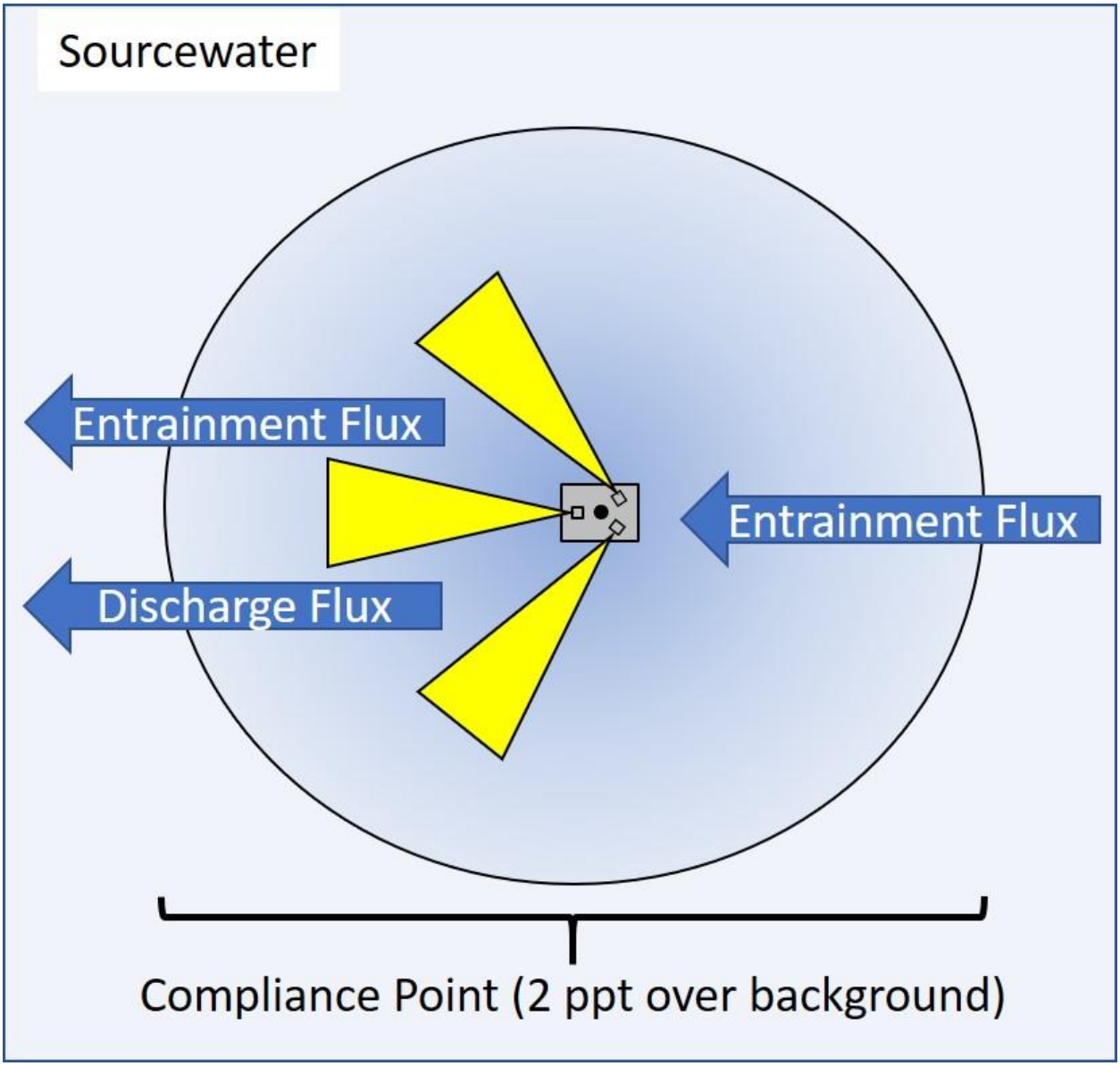



**Figure 1:** Schematic diagram of the control volume used in the SED guidance, as defined by the dilution space inside the 2 ppt over ambient compliance point. The spatial extent of the harmful turbulence zone is depicted in yellow. This is the basis of the 23 % of entrainment SED baseline, whereby all the lethal turbulence is contained inside the compliance point. Entrainment flux is drawn through the control volume by the action of the momentum of the diffuser jets and viscous shearing with the surrounding water mass.

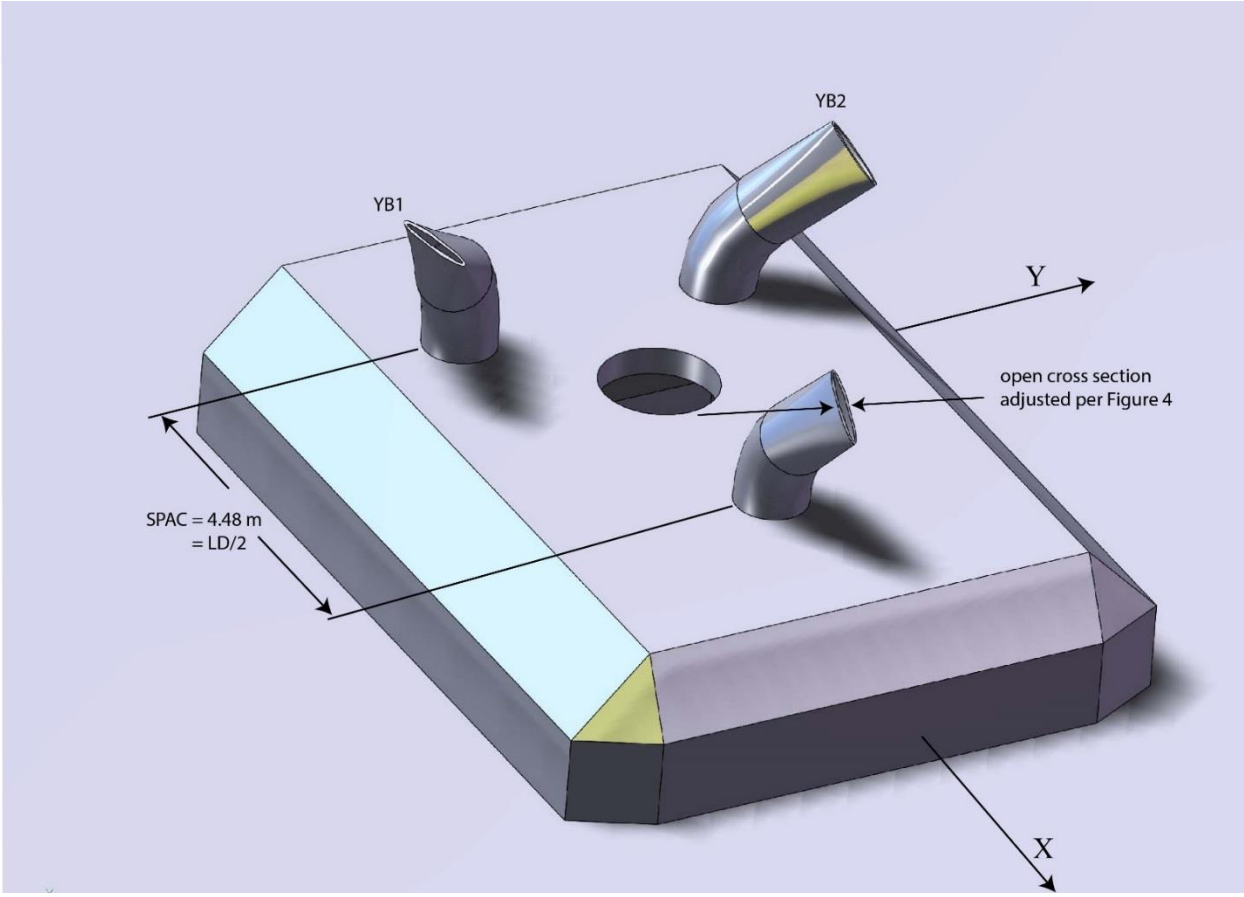



**Figure 2:** Three-dimensional CAD of the Alden-designed *3-Jet Duckbill Diffuser Retrofit* at the Huntington Beach Generating Station (HBGS) discharge tower site located at latitude 33º 38' 19" N, longitude 117º 58' 57" W, approximately 1,500 ft (457 m) offshore. For the dilution analysis in this technical memorandum, the 4.5-ft. diameter port that appears in the center of the diffuser was capped.

**2) Technical Approach:**

We have reviewed the presently-available scientific literature, from which two general hypotheses have emerged for estimating turbulent shear impacts to marine organisms that become entrained by diffuser discharge jets, namely: 1) the critical stress/strain hypothesis, (dating back to Morgan et al., 1974; Ulanowicz, 1976; Marcy et al.,1978; Cada et al., 2006, 2007; Neitzel et al., 2000, 2004), which is based on the premise that marine organisms suffer injury or mortality when subjected to turbulent strain rates and shear stresses that exceed the tensile strength or shear strength of an organism (particularly its outer membranes, epidermis or other soft tissues), and 2) the turbulence length scale hypothesis (after Jessop, 2007; Roberts and Mead-Vetter, 2013; Roberts, 2016); whereby, only those entrained organisms which are comparable to specific turbulent eddy scales will suffer sub-lethal injury or worse. Roberts (2016) correctly postulates that incremental turbulence mortality due to the action of the diffuser discharge will only occur in regions of the BMZ where the turbulent eddies induced by the diffuser are smaller than the turbulent eddies occurring naturally in the ocean water mass surrounding the discharge site. The smallest turbulent eddies occur at the *Kolmogorov eddy scale*, (cf. Kolmogorov, 1941), and the only known measurements of Kolmogorov scale ocean turbulence in California coastal waters were based on turbulent momentum surveys conducted in Monterey Bay by Walter et al., (2014). These measurements suggest the smallest naturally occurring turbulent eddies in the ocean water mass are about 1 mm in size. The operative premise for assigning incremental turbulence mortality impacts to any diffuser-induced eddy smaller than 1 mm is based on principles of natural selection, whereby the ocean ecology has already adapted to ocean turbulence occurring at eddy scales greater than 1mm. (Turbulent eddies induced by a diffuser that are smaller than 1 mm would be unnatural occurrences to which ocean ecology has not adapted). We note that this size-class specific injury threshold has not been empirically verified within the existing body of experimental literature. Therefore, this analysis takes a more conservative approach and assumes all sub-millimeter plankton would be injured within the water volume containing diffuser-induced turbulent eddy scales less than 1 mm.

The decisive issue herein is selecting the appropriate turbulent eddy scale for implementing these injury hypotheses. While the turbulent kinetic energy is ultimately dissipated into heat at the Kolmogorov eddy scales, Kolmogorov scale eddies contain very little energy; (Grant et al., 1962, first showed that while the energy dissipation spectra peaks at Kolmogorov scales, the energy spectra of a turbulent flow peaks at much larger, integral-scale proportional eddies). Consequently, it is difficult to support that a Kolmogorov eddy in a diffuser jet or plume would contain sufficient energy to shear a sub-millimeter sized planktonic organism, (although a Kolmogorov eddy may cause that organism to spin and possibly upset the internal order of that organism). In order for a turbulent eddy to cause injury to an organism of comparable size, the eddy must possess sufficient energy to exert strain rates and shear stresses that exceed the tensile strength or shear strength of the membranes and soft tissues of that organism. Experimental measurements and theoretical work show that almost all the turbulent kinetic energy is concentrated at the large eddy scales, $l$, that are typically some fraction of the half-width (integral length scales) of jets and plumes, (Tennekes and Lumley, 1972). The highest strain rates and shear stresses in turbulent shear flows are found at the Taylor micro-scale, which is the largest turbulent eddy scale at which fluid viscosity still significantly affects the dynamics of turbulent eddies in the flow, (Tennekes and Lumley, 1972; Landahl and E. Mollo-Christensen,

1992). Invoking the Taylor micro-scale also allows the eddy-based injury criteria of hypothesis-b to incorporate the essential concepts of the stress/strain injury relationships of hypothesis-a, notably Neitzel et al., (2000, 2004), showed high correlations between strain rates in a turbulent jet and the percentage of juvenile salmon populations incurring soft tissue injuries. Therefore, we submit that the appropriate turbulent eddy scale for implementing the injury hypotheses should be based on the Taylor micro scale; and that incremental injury and mortality occurs in a diffuser jet or plume when the entrained organisms are exposed to Taylor micro-scale eddies that are equal to or less than 1 mm in size.

To summarize, the aggregate injury mechanism proposed here from hypotheses a & b is based on the following postulates: 1) the entrained organism is exposed to the highest external strain rates and shear stress when the organism is of comparable size to the turbulent eddy, and the Taylor micro-scale eddies exert the highest strain rates, 2) the smallest naturally occurring turbulent eddies in the ocean are 1 mm, so that only man-made eddies that are smaller than 1 mm will do incremental harm to the ocean ecology, 3) postulates (1) and (2) imply that injury is limited to organisms that are in the 1 mm and sub-millimeter size regimes.

From Tennekes and Lumley, (1972), the Taylor microscale is found to be directly proportional to the large, high-energy, integral-scale proportional eddies, $l$, according to:

$$\lambda = l\sqrt{10}\, R_e^{-1/2} \qquad (2)$$

where $R_e = \bar{u}_0\, d / \nu$ is the jet Reynolds number, $\bar{u}_0$ is the jet discharge velocity, $d$ is the jet diameter at the discharge nozzle, $\nu$ is the kinematic viscosity. The Reynolds number in equation (2) is readily calculated from the CORMIX 10.0.3.0 dilution modeling, (Jenkins, 2017); but the size of the high-energy, integral-scale proportional eddies, $l$, must be inferred from the published experimental literature. Using particle image velocimetry, (PIV), measurements, Burridge (2016b) found that the high-energy, integral-scale proportional eddies could be estimated from half width, $b_T$, and the fluctuations in half width, $\delta b_T$, of axisymmetric turbulent jets and plumes, according to:

$$l \cong \delta b_T = 0.44\, b_T \qquad (3)$$

With equation (3) the Taylor micro scale can be calculated from the CORMIX v10.0.3.0 mixing model solutions for the plume half-width, *BH*, in a horizontal plane normal to the trajectory, and from the plume thickness (layer depth), *BV*, in a vertical plane normal to the trajectory, based on the following:

$$\lambda = 0.44\, r_H \sqrt{10}\, R_e^{-1/2} = 0.44\sqrt{10}\, \frac{BH \cdot BV}{BH + BV}\, R_e^{-1/2} \qquad (4)$$

where $r_H$ is the hydraulic radius of the diffuser plume (cf. Appendix B for more details). Equation (4) gives estimates of the growth in the Taylor micro scale with increasing distance from the point of discharge. At the critical distance, $x_c$, where the Taylor micro scale reaches 1 mm, ($\lambda \rightarrow 1$mm @ $x = x_c$), we examine the CORMIX v 10.0.3.0 output (Appendix C-F) to

determine the corresponding centerline dilution factor, $D(x_c)$, from which the average (bulk) dilution factor is calculated as: $\overline{D}(x_c)=1.4D(x_c)$, Fischer et al., (1979). From the bulk dilution factor, the critical entrainment flux of dilution water into the BMZ that is exposed to harmful, sub-millimeter size Taylor micro scale turbulence is readily calculated by:

$$Q_c = \overline{D}(x_c)\overline{Q} \tag{5}$$

The critical entrainment flux, $Q_c$ leads directly to calculation of the area of production foregone, using the EPM/APF calculus after Foster, et al, (2013). Area of production foregone (acres) estimates were provided by Eric Miller of HDR, based on the solutions for the critical entrainment flux, $Q_c$, from equation (5) These estimates, were derived using standard methods described in MBC (2017) and the species-specific Empirical Transport Model parameters presented in Tenera (2010). The proportional mortality (Pm) derived from the Empirical Transport Model for the intake in Tenera (2015) assuming 106 million gallons per day intake water volume. For each scenario, the multiplication factor derived by dividing the discharge shearing scenario by 106 was applied to the Pm106 estimates. This generated a Pm relevant to each discharge shearing scenario. For the example, daily Worst Case #1 operations produced a critical entrainment flux of $Q_c$ = 233.6 million gallons per day. The multiplier in this case was 2.204 or 233.6/106 = 2.204.

**3) Findings Under the Taylor Micro-Scale Injury Hypotheses:**

The results of the Taylor micro scale calculations of the turbulence impacts of the HBDF diffuser are plotted in Figures 3-6 and summarized in Table-3. The first, and perhaps most significant, finding is that the harmful Taylor micro-scale turbulence ($\lambda \leq 1$mm) is confined close to the point of discharge, extending only 0.77 m (2.53 ft.) from the point of discharge for daily Worst-Case #1, and 0.71 m (2.33 ft.) for daily Worst-Case #2 (cf. red curves in Figures 3 & 4 and critical distance in Row 1 of Table 3). For the monthly-case scenarios, harmful Taylor micro-scale turbulence is even more confined to the immediate vicinity of the discharge, reaching only 0.73 m (2.39 ft.) from the point of discharge for Monthly-Case #1, and 0.69 m (2.26 ft.) for Monthly-Case #2 (cf. red curves in Figures 4 & 5 and critical distance in Row 1 of Table 3).

The CORMIX v10.0.3.0 model finds that the dilution factor on the plume centerline at the critical distance ($\lambda \rightarrow 1$mm @ $x = x_c$), reaches $D(x_c)$ = 2.67 for daily Worst-Case #1 and $D(x_c)$ = 2.68 for daily Worst Case #2, corresponding to an average (bulk) dilution of $\overline{D}(x_c)$ = 3.74 for daily Worst-Case#1 and $\overline{D}(x_c)$ = 3.75 for daily Worst Case #2, (cf. black curves in Figures 3 & 4 and Rows 2 & 3 in Table 3). Centerline dilution factors at the critical distance for turbulence impacts are slightly higher for the monthly cases, where: $D(x_c)$ = 2.70 for Monthly-Case #1, and $D(x_c)$ = 2.72 for Monthly-Case #2, corresponding to an average (bulk) dilution of $\overline{D}(x_c)$ = 3.78 for Monthly-Case#1 and $\overline{D}(x_c)$ = 3.81 for Monthly-Case #2, (cf. black curves in Figures 5 & 6 and Rows 2 & 3 in Table 3). With these bulk dilution factors, the total entrainment

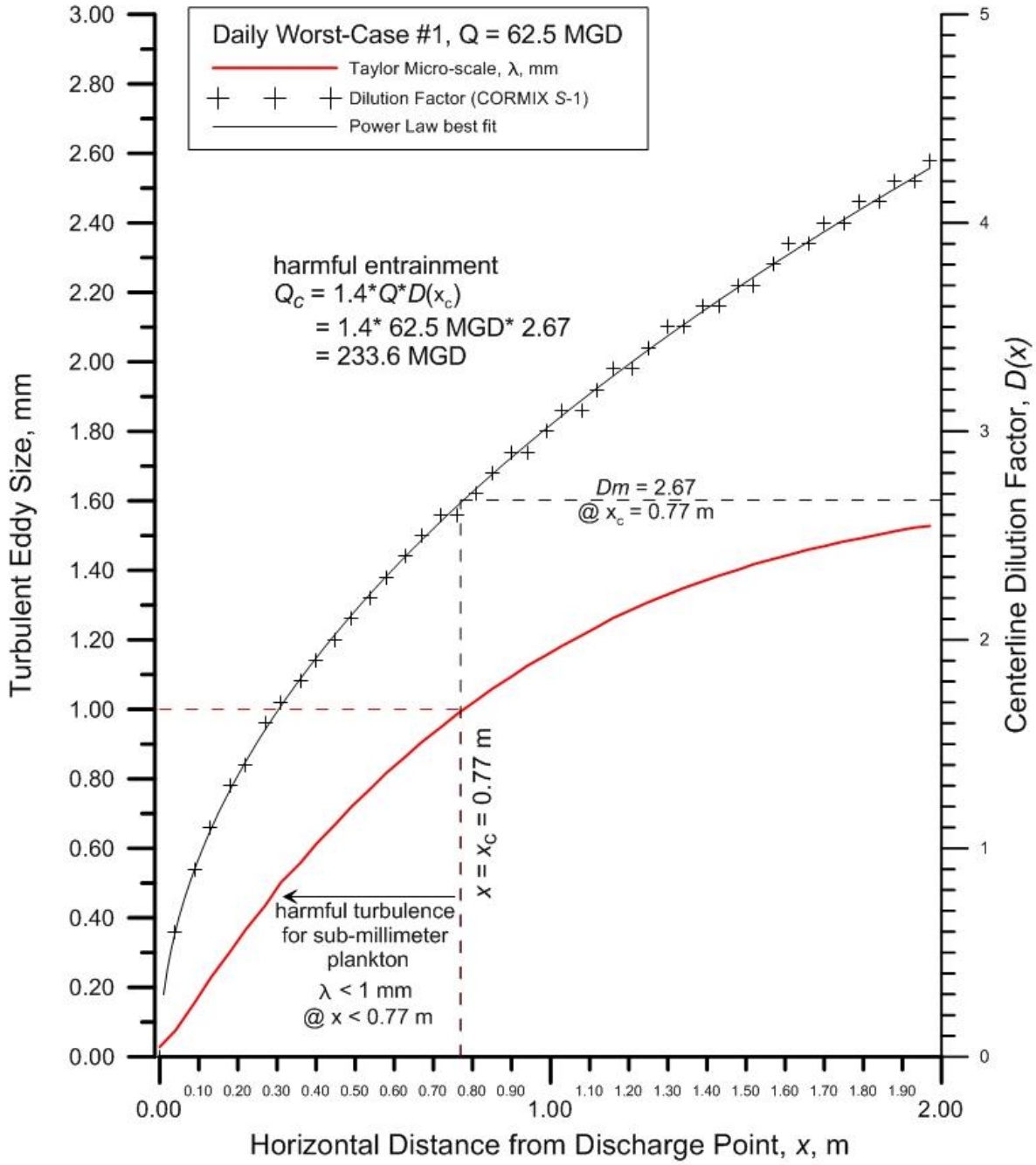



**Figure 3:** Variation of Taylor micro-scale turbulence (red) and centerline dilution factor (black) with distance from discharge point for daily Worst-Case #1

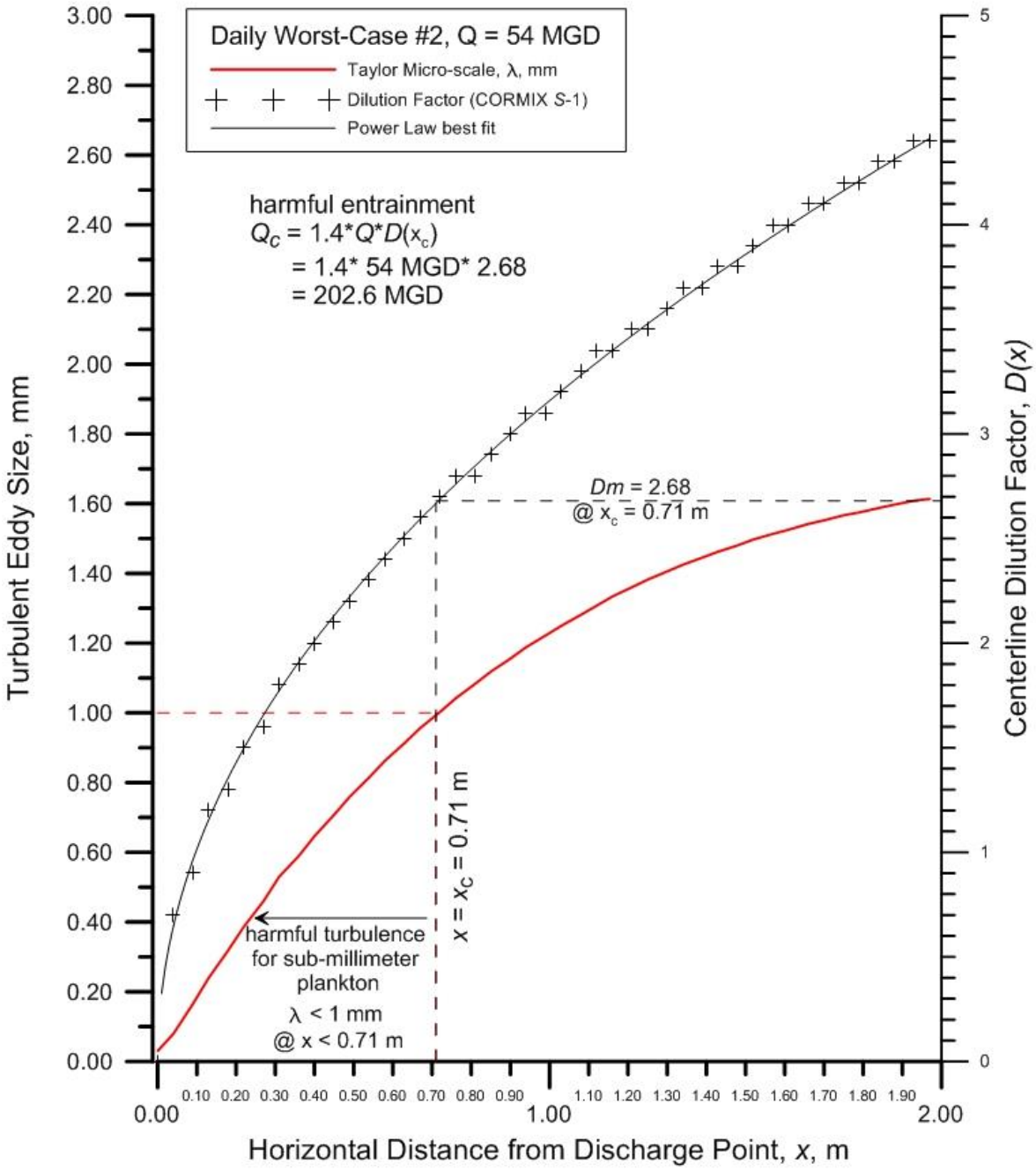



**Figure 4:** Variation of Taylor micro-scale turbulence (red) and centerline dilution factor (black) with distance from discharge point for daily Worst-Case #2

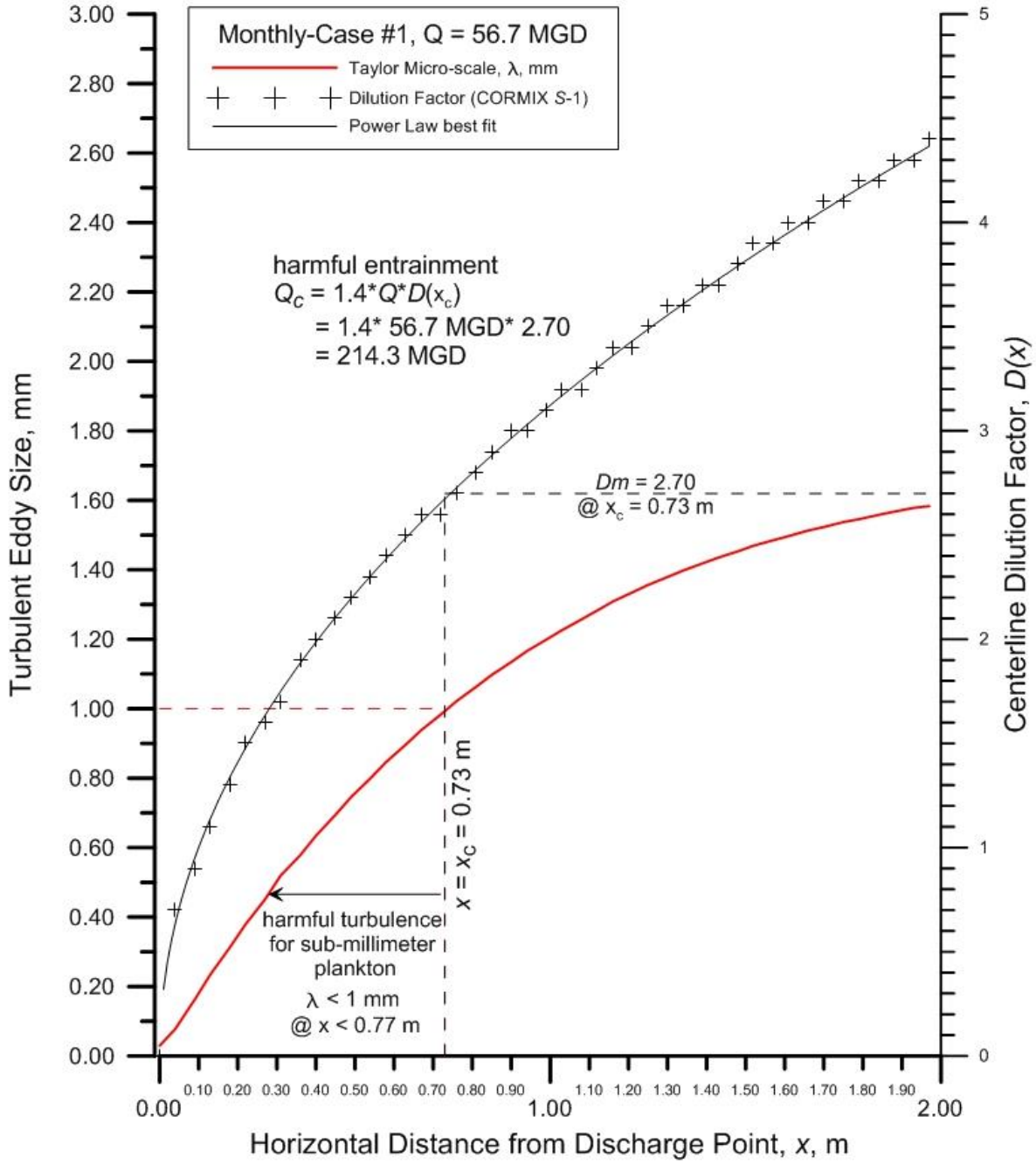



**Figure 5:** Variation of Taylor micro-scale turbulence (red) and centerline dilution factor (black) with distance from discharge point for Monthly-Case #1

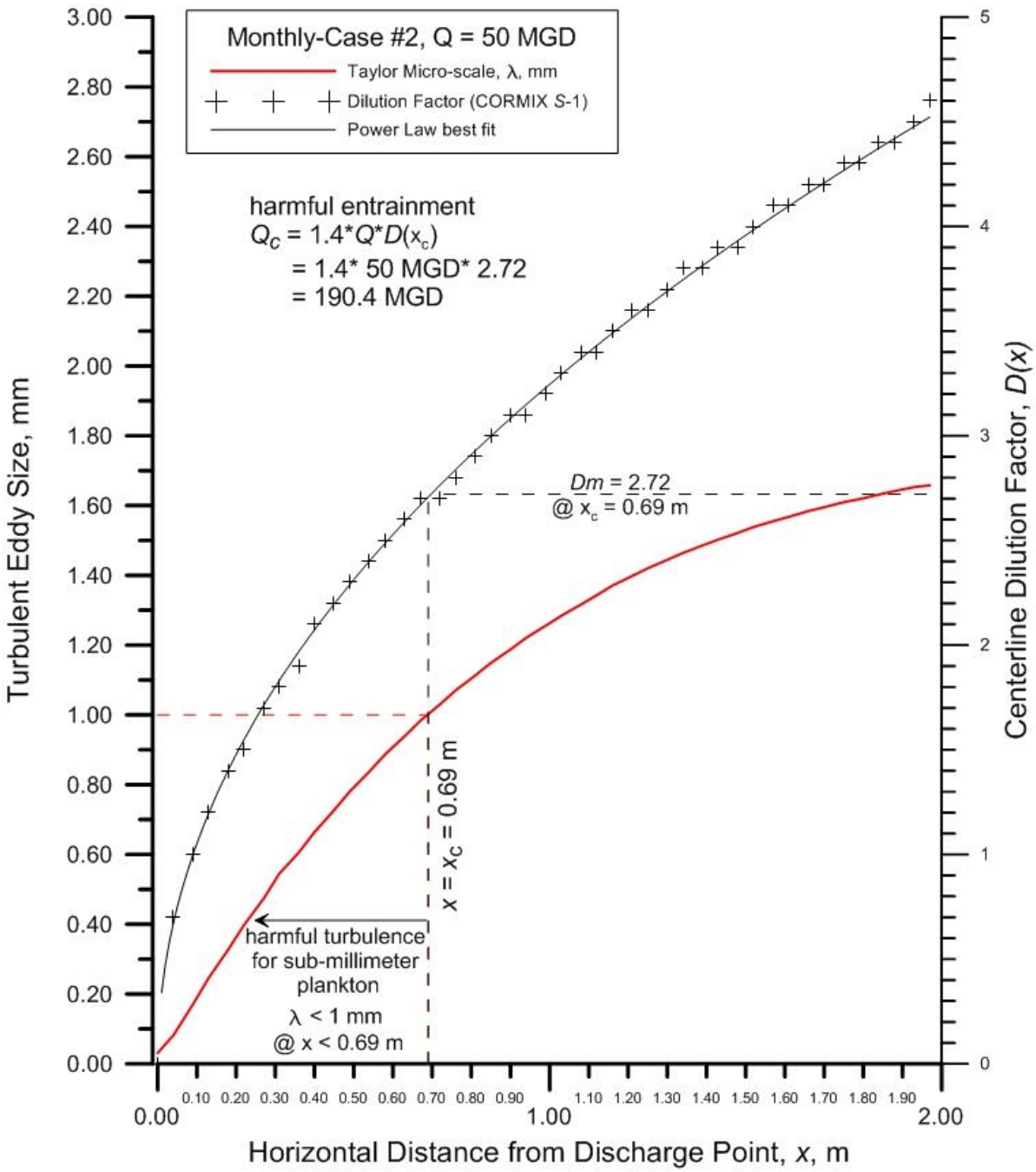



**Figure 6:** Variation of Taylor micro-scale turbulence (red) and centerline dilution factor (black) with distance from discharge point for Monthly-Case #2

**Table 3: Diffuser-Induced Turbulent Shear Impacts by the Taylor Micro-Scale Hypothesis**

| | Daily Worst-Case #1 | *Monthly-Case #1 | Daily Worst-Case #2 | Monthly-Case #2 |
|---|---|---|---|---|
| Critical Distance for Turbulence Impacts, $x_c$ | 0.77 m (2.53 ft.) | 0.73 m (2.39 ft.) | 0.71 m (2.33 ft.) | 0.69 m (2.26 ft.) |
| Centerline Dilution Factor at Critical Distance, $D(x_c)$ | 2.67 | 2.70 | 2.68 | 2.72 |
| Average (Bulk) Dilution Factor at $\overline{D}(x_c)$ | 3.74 | 3.78 | 3.75 | 3.81 |
| Harmful Entrainment Flux, subjected to Taylor micro-scale, $Q_c$ | 233.6 MGD | 214.3 MGD | 202.6 MGD | 190.4 MGD |
| Harmful Entrainment Flux, 23% SED Baseline**, $Q_c(SED)$ | 193 MGD | 193 MGD | 195 MGD | 181 MGD |
| Deviation from the SED 23% Baseline, $Q_c - Q(SED)$ | +40.6 MGD | +21.3 MGD | +7.6 MGD | +9.4 MGD |
| Percent of Dilution Water @ $+\Delta$ 2ppt Compliance Point containing harmful Turbulence | 27.8% | 25.5% | 23.8% | 24.2% |
| Area of Production Foregone, $APF_c$, | 37.10 acres | 34.19 acres | 32.41 acres | 30.57 acres |
| Deviation from the SED 23% Baseline, $APF_c - APF(SED)$ | + 6.13 acres | + 3.22 acres | + 1.13 acres | +1.41 acres |

*Column highlighted in yellow is the monthly worst-case operating scenario that serves as the basis for mitigation scaling.

flux of dilution water subjected to harmful Taylor micro-scale turbulence is $Q_c$ = 233.6 MGD for daily Worst-Case#1 and $Q_c$ = 202.6 MGD for daily Worst Case #2, (cf. Row 4 in Table-3). The critical entrainment flux exposed to harmful turbulence is less for the monthly-case scenarios, declining to $Q_c$ = 214.3 MGD for Monthly-Case#1 and $Q_c$ = 190.4 MGD for Monthly-Case #2, (cf. Row 4 in Table-3). These critical entrainment rates scale to an *area of production foregone* (APF) of 37.10 acres for daily Worst-Case #1 and 32.41 acres for daily Worst Case #2, (cf. Row 8 in Table 3). For the moderately lower critical entrainment rates of the monthly-case scenarios, area of production foregone declines to 34.19 acres for Monthly-Case #1 and 30.57 acres for Monthly-Case #2, (cf. Row 8 in Table 3).

Returning to the SWRCB and RWQCB staffs' question of "*whether the 23 percent mortality estimate is appropriate"*, the hydrodynamic, diffuser-specific analysis in Table-3 resulted in a similar level of harmful diffuser entrainment and APF as the SED 23% turbulence impact estimate. Mitigation for diffuser turbulence impacts (if appropriate) are expected to be based on monthly-case operating conditions. The Taylor micro-scale hypothesis in Table 3 gives harmful entrainment fluxes that are 21.3 MGD greater than the SED 23% of entrainment baseline in Table 2 for Monthly-Case #1 (cf. Row 6 in Table 3), which is the equivalent of 25.5% of the dilution water entrained at the $+\Delta$ 2ppt over background compliance point (cf. Row 7 in Table-3), and produces an APF mitigation scaling that is only 3.22 acres greater than what would have otherwise resulted from the SED 23% turbulence impact estimate (cf. Row 9 Table-3). Similarly, the Taylor micro-scale hypothesis gives harmful entrainment fluxes that are 9.4 MGD less than the SED 23% of entrainment baseline for Monthly-Case #2, (cf. Row 6 in Table 3), representing 24.2% of the dilution water entrained at the $+\Delta$ 2ppt over background compliance point (cf. Row 7 in Table-3), and produces an APF mitigation scaling that is only 1.41 acres greater than what would have otherwise resulted from the SED 23% turbulence impact estimate (cf. Row 9 Table-3). In general, the diffuser-specific Taylor micro-scale analysis gives results quite similar to the generalized SED mass-balance analysis.

**APPENDIX A: Input Data to Turbulence-Induced Injury and Mortality Calculations**

The brine discharge was modeled assuming no ambient currents (per initial dilution requirements under the Ocean Plan) and brine discharges having a $\Delta T = 0\ ^0C$ or $\Delta T = +2\ ^0C$. The CORMIX v10 model results reported in Jenkins (2017) find that the brine dilution is essentially unaffected by a 2-degree difference in the delta-T. Natural background salinity at Huntington Beach is $S_0$ = 33.52 ppt, (SEIR, 2010; Jenkins, 2017). The discharge diffuser consists of 3 ea. 36 in, duck bill check valves in a fanned arrangement at spacings measuring *SPAC* = 4.48, with the horizontal angles between the check valves at 45 degrees that produce a general uni-directional discharge plume (Figure A-1). The port elevation of each check valve is 2.8 m above the seabed where local water depth is *h* = -27.9 ft. MSL, (8.5 m MSL). Each check valve is inclined upward at a $47^0$ discharge angle.

Two discharge scenarios were studied, and the dilution results from the CORMIX v10 model are listed in Appendix C & D of Jenkins, (2017). CORMIX 10.0 uses the symbol *"S"* for what it terms "*the hydrodynamic average centerline dilution*". However, inspection of the CORMIX v-10 User Manual reveals that *S* is the *mixing ratio*, which represents the ratio of the total parts of a water sample per parts effluent contained in that sample. The relevant dilution metric under the Ocean Plan is *dilution factor*, $D(x)$, which is defined as parts seawater per parts effluent, (Appendix-I, SWRCB, 2015). Mixing ratio, *S*, and dilution factor are related by the following:

$$D(x) = \frac{S_b(x=0) - S_b(x)}{S_b(x) - S_0} = S - 1 \qquad (6)$$

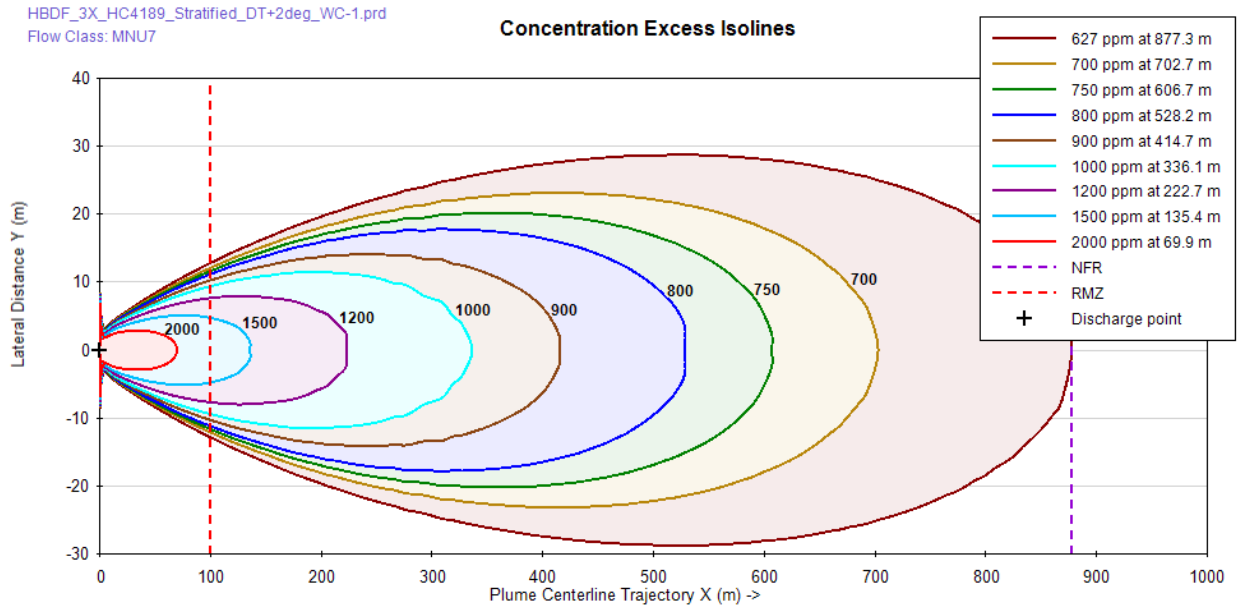
Here: $S_b(x)$ is the effluent salinity at distance, *x* from the point of discharge, where $S_b(x=0)$ represents the salinity at the point of discharge; and $S_0$ is the natural background salinity in the receiving water equal to 33.52 ppt. When $S_b(x)$ =35.52 ppt (2 ppt over ambient) it is equivalent to the water quality objective under the Ocean Plan brine amendment, $S_b(x) = C_o$. In CORMIX vernacular, $S_b(x) = C_o$ is referred to as the *water quality standard* or *CCC*, and is expressed as an excess concentration over natural background in parts per million (ppm). The mixing ratios and salinity outputs from the CORMIX model are evaluated along the centerline of the discharge plume. The dilution factors derived from those mixing ratios using equation 6) can be related to the average (bulk) dilution factor $\overline{D}(x)$ using the following relation from Fischer et al., (1979)

$$\overline{D}(x) = 1.4\,D(x) = 1.4(S-1) \qquad (7)$$

While the average salinity in the plume at any given point can be calculated from equations (6) and (7) by:

$$\overline{S}_b(x) = \frac{\overline{D}(x)\,S_0 + S_b(x=0)}{1 + \overline{D}(x)} \qquad (8)$$

**a)**




**b)**

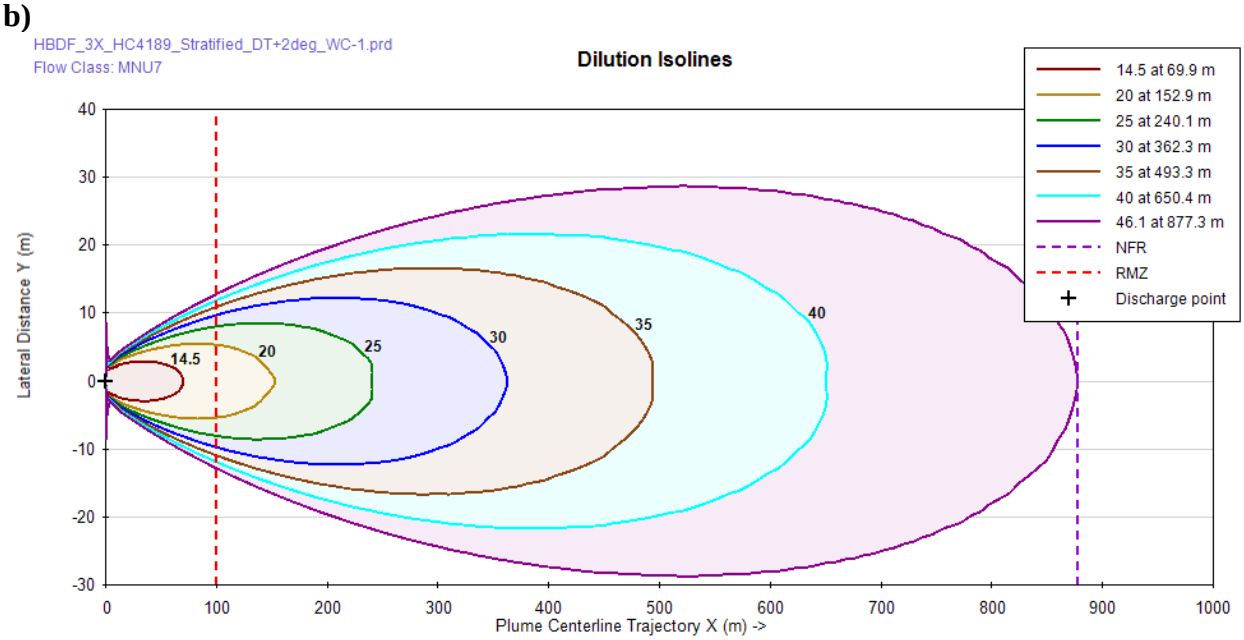



**Figure A-1:** Isolines on the seabed for Daily Worst-Case #1 operating conditions: a) excess salinity (salinity above natural background) in parts per million (ppm); and, b) dilution expressed as mixing ratio, S, where S = Dm + 1. Note, dilution of the brine to within 2 ppt (2,000 ppm) of natural background is achieved at 69.9 m from the point of discharge where the mixing ratio is S = 14.5 and the dilution factor is Dm = 13.5. At the 100 m *regulatory mixing zone* (RMZ), the mixing ratio is S = 16.8 and the dilution factor becomes Dm = 15.8, ultimately reaching Dm = 45.1 at 877 m from the point of discharge which marks the limit of the *zone of initial dilution*, or ZID, (cf Appendix-C for detailed *Prediction File* and additional salinity & dilution figures)

The following is a summary of the relevant diffuser dimensions and CORMIX model results used in the turbulence mortality calculations in Appendix-II:

***Daily Worst-Case #1***: Under Daily Worst-Case-1 conditions, with total discharge $\overline{Q}$ = 62.5 mgd (2.738 $m^3$/s), each check valve provides $A_i$ = 0.193 $m^2$ of equivalent circular cross sectional area with an effective diameter of $d$ = 0.496 m in order to discharge $Q_i = \overline{Q}/3$ = 0.913 $m^3$/s from each check valve. This gives a maximum discharge velocity of $u_0$ = 4.72 m/s, (15.49 ft/s). End-of-pipe discharge salinity $S_b$ = 62.44 ppt. The density of the discharge is $\rho_b = 1/\alpha_b$ = 1,046.8 kg/$m^3$ for T = 0 $^0$C; and $\rho_b = 1/\alpha_b$ = 1,046.4 kg/$m^3$ for ΔT = + 2 $^0$C. The densimetric Froude number is $F_r = u/\sqrt{\Delta\rho g d/\rho}$ = 14.08 and the jet Reynolds number is $R_e = ud/\nu$ = 2.102 x $10^6$.

***Daily Worst-Case #2:*** For Daily Worst-Case-2 conditions, ($\overline{Q}$ = 54 mgd or 2.366 $m^3$/s),each check valve provides $A_i$ = 0.179 $m^2$ of equivalent circular cross sectional area with an effective diameter of $d$ = 0.478 m in order to discharge $Q_i = \overline{Q}/3$ = 0.789 $m^3$/s from each check valve, resulting in a maximum discharge velocity of $u_0$ = 4.39 m/s, (13.48 ft/s).End-of-pipe discharge salinity $S_b$ = 67 ppt. The density of the discharge is $\rho_b = 1/\alpha_b$ = 1,050.7 kg/$m^3$ for T = 0 $^0$C; and $\rho_b = 1/\alpha_b$ = 1,050.3 kg/$m^3$ for ΔT = + 2 $^0$C. The densimetric Froude number is $F_r = u/\sqrt{\Delta\rho g d/\rho}$ = 12.36 and the jet Reynolds number is $R_e = ud/\nu$ = 1.884 x $10^6$.

***Monthly-Case #1:*** Under Monthly-Case-1 conditions, with total discharge $\overline{Q}$ = 56.7 mgd (2.484 $m^3$/s), each Tideflex Series 35-D/HC4189 duckbill check valve check provides $A_i$ = 0.184 $m^2$ of equivalent circular cross sectional area with an effective diameter of $d$ = 0.484 m in order to discharge $Q_i = \overline{Q}/3$ = 0.828 $m^3$/s from each check valve. This gives a maximum discharge velocity of $u_0$ = 4.50 m/s, (14.77 ft/s) and the Densimetric Froude number is: $F_r = u/\sqrt{\Delta\rho g d/\rho}$ = 13.30, and the jet Reynolds number is $R_e = ud/\nu$ = 1.954 x $10^6$.

***Monthly-Case #2:*** For Monthly-Case-2 conditions, ($\overline{Q}$ = 50 mgd or 2.191 $m^3$/s), each check valve provides $A_i$ = 0.172 $m^2$ of equivalent circular cross sectional area with an effective diameter of $d$ = 0.468 m in order to discharge $Q_i = \overline{Q}/3$ = 0.730 $m^3$/s from each check valve, resulting in a maximum discharge velocity of $u_0$ = 4.245 m/s, (13.93 ft/s), and the Densimetric Froude number is: $F_r = u/\sqrt{\Delta\rho g d/\rho}$ = 11.98, and the jet Reynolds number is $R_e = ud/\nu$ = 1.954 x $10^6$.

**APPENDIX B: Empirical Approach to Estimating the Integral-Scale Proportional Turbulent Eddy Size for Diffuser-Induced Injury and Mortality**

In order to calculate the Taylor micro-scale using equation (2) the size of the high-energy, integral-scale proportional eddies, $l$, must be inferred from the published experimental literature. Figure B-1 gives two images of the high-energy, integral scale eddies in a dense plume, as measured in a laboratory by Burridge et al., (2016a). These integral scale eddies are circled in green in Figure B-1, and are clearly a significant fraction of the half-width of the plume, $b_T$. Furthermore, these large eddies produce measurable fluctuations in the half-width of the plume, $\delta b_T$ , as identified by the solid red lines along the boundaries of the plume in Figure B-1. These half-width fluctuations are comparable to the size of the large, high-energy eddies, $\delta b_T \cong l$ . Using particle image velocimetry, (PIV), measurements like those in Figure B-1, Burridge (2016b) found that both the half width and the fluctuations in half width of an axisymmetric turbulent dense plume grow at a nearly constant rate with increasing distance from the point of discharge (Figure B-2), and that this constant rate behavior persists across three orders of magnitude in Richardson number (ratio of inertia to buoyant acceleration). Taking the ratio of the two empirical curves in Figure B-2, the size of the high-energy, integral scale eddies, $l$ can be estimated by:

$$l \cong \delta b_T = 0.44\, b_T \tag{9}$$

With equations (2) & (3) the Taylor micro scale can be calculated from the output of plume dimensions from the CORMIX v10.0.3.0 mixing model for the two sets of worst-case operating conditions in Table -1. These solutions are described in detail in Jenkins (2017). CORMIX Module 271 printouts in the prediction files in Appendices C-F generally show the plume from the HBDF diffuser to progressively increase in width and thickness with increasing distance from an initial jet merging point near the free surface, as a result of the initial slot discharge at a $47^0$ upward angle toward the sea surface. Because of this continuous variation in both plume width and thickness in proximity with the free surface, we will use the hydraulic radius of the CORMIX plume to represent the axisymmetric plume half-width in equation (3), or:

$$b_T \cong r_H = \frac{BH * BV}{BH + BV} \tag{10}$$

Here *BH* is the CORMIX plume half-width, in a horizontal plane normal to the trajectory and *BV* is the CORMIX plume thickness (layer depth) in a vertical plane normal to the trajectory, (cf. CORMIX v10.0.3.0 *prediction files* in Appendix-III).

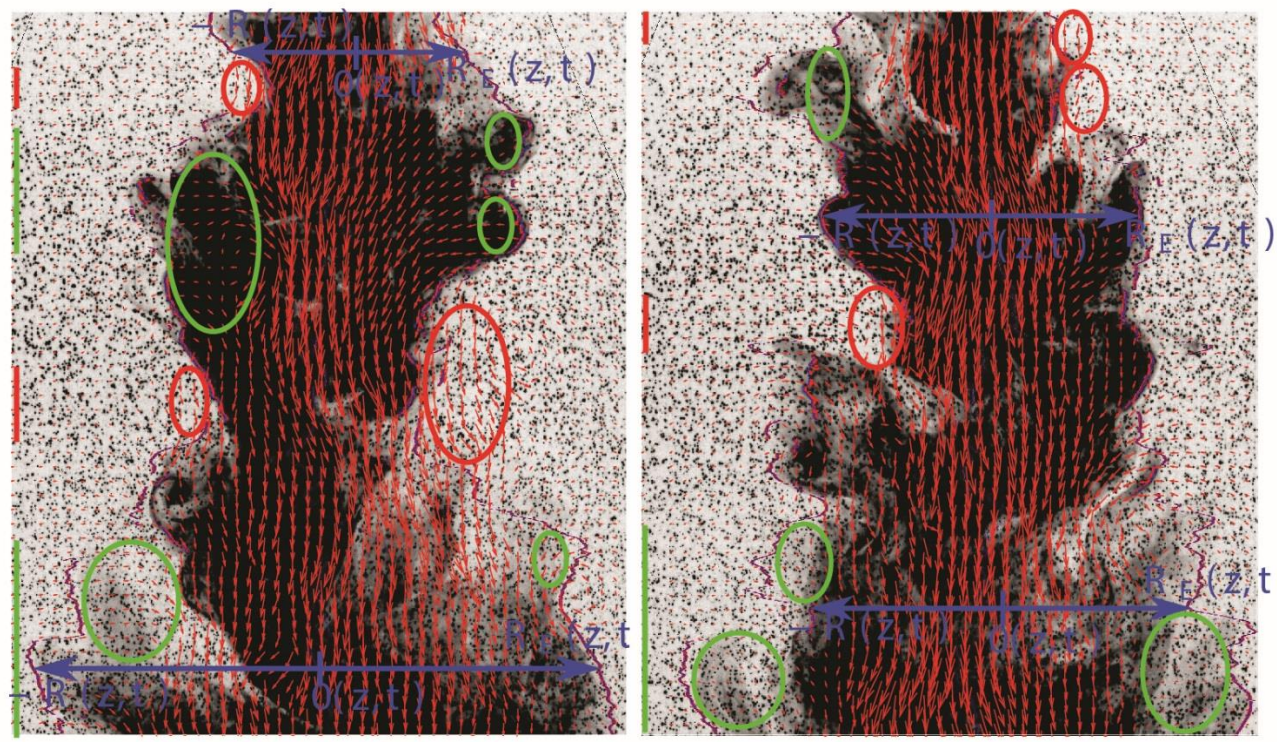


**Figure B-1:** Two typical experimental images of the large integral scale eddies in a turbulent plume. The small dark 'spots' throughout both images are the 50 μm particles used to obtain particle image velocimetry, (PIV), measurements. Dense 'plume fluid', stained by dye, is indicated by dark regions in each image. The edges detected by two independent algorithms are marked by the red solid lines (7 pixels wide) and blue solid lines (3 pixels wide). Velocity vectors (red arrows) indicate the local velocities within the fluid. Notice that large-scale eddies are locally present are circled in green, and are a significant fraction of the overall plume width, $b_T$ . Locations where eddies are locally absent are circled in red. Images from Burridge, et al,(2016a).

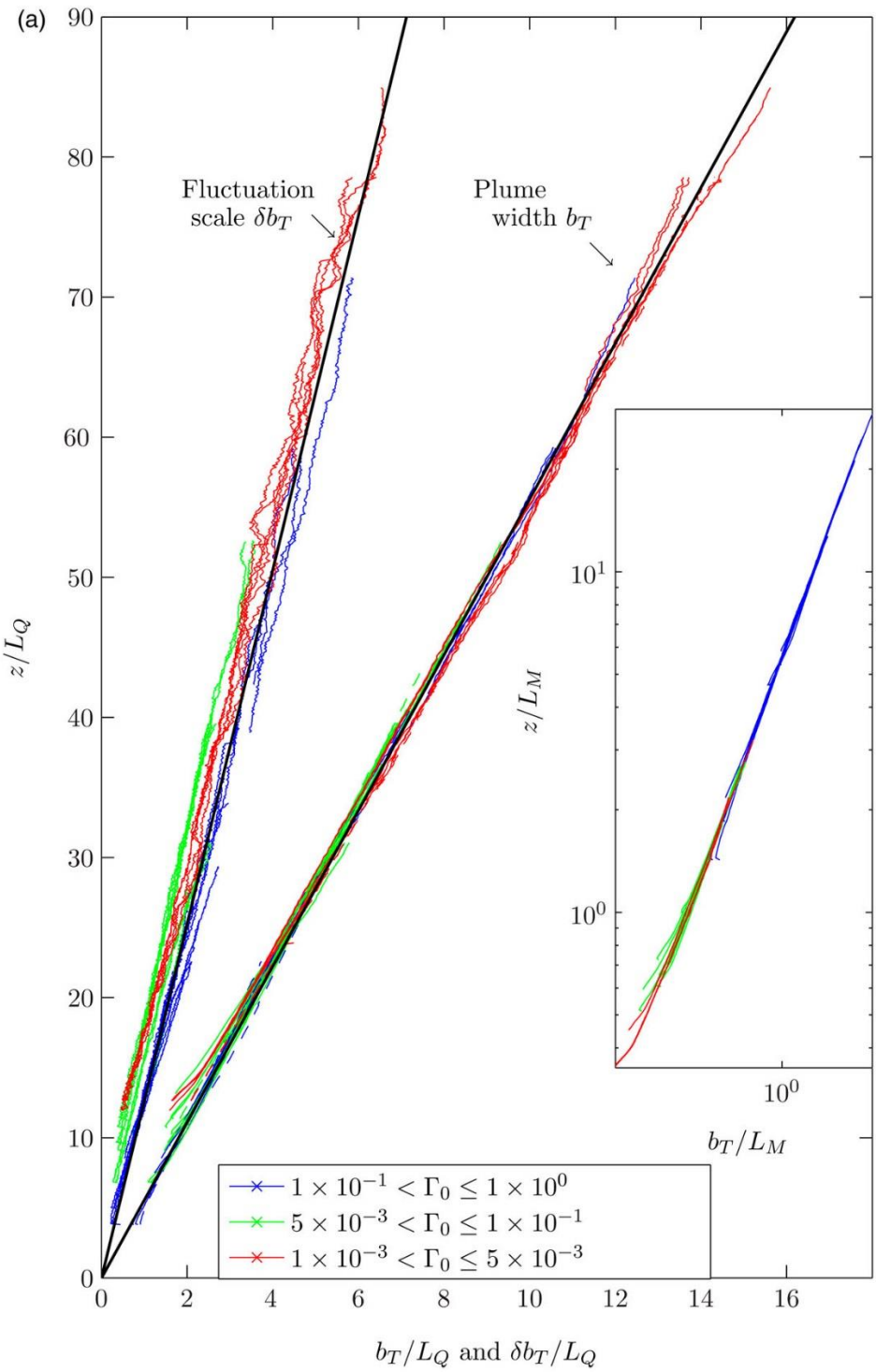



**Figure B-2.** The variation of the plume half-width, $b_T$, and eddy length scale $\delta b_T$ with non-dimensional distance from the point of discharge, $z/L_Q$ where $L_Q = Q_0 / M_0^{1/2}$; $Q_0$ is the volume flux at the point of discharge; $M_0$ is the specific momentum at the point of discharge, and $\Gamma_0$ is the Richardson number (ratio of inertia to buoyant acceleration) at the point of discharge. Data and figure from Burridge, et al.,(2016b).

# Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T = +2^0$ C; Sheet C-1

```
D-CORMIX PREDICTION FILE:
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
               D-CORMIX: CORMIX MIXING ZONE EXPERT SYSTEM
                      BRINE DISCHARGE SUB-SYSTEM
                 Subsystem CORMIX2: Multi Port Discharge
                       CORMIX Version 10.0GTH
                   DHYDRO Version 10.0.3.0 December 2017
----------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   HBDF Huntington Beach
 Design case:       Alden 3- Port Duckbill
 FILE NAME:         C:\...17_fix\HBDF_3X_HC4189_Stratified_DT+2deg_WC-1.prd
 Time stamp:        11/28/2017--13:09:24

COASTAL ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 Single (constant) offshore slope:
 SLOPE =  1.06 deg. UA    =     0.000  F     =      0.020 USTAR =0.5000E-07
 UW    =      0.000 UWSTAR=0.0000E+00
 Density stratified (non-uniform) environment:
 STRCND=  N         RHOAM = 1022.7365  RHOAH0= 1022.7365  RHOAHD= 1023.4730
 LEVDEN=  1         RHOAS = 1022.0000
 SUB1  =      8.50  RHOA1 = 1023.4730  EPS1  =0.1663E-02

DISCHARGE PARAMETERS (metric units) for multi_port_diffuser
 BANK  =  LEFT      DISTB =    461.48  HD    =      8.50  LEVDIS=  1
 Diffuser type:     DITYPE= unidirectional_perpendicular
 LD    =      8.96  NOPEN  =   3       SPAC =      4.48
 YB1   =    457.00  YB2    = 465.96
 Nozzle/port arrangement:   unidirectional_with_fanning
 D0    =      0.496 A0    =      0.193 H0    =      2.80  SUB0 =      5.70
 D0INP =      0.496 CR0   =      1.000
 GAMMA =     90.00  THETA =     47.00  SIGMA =      0.00  BETA  =     90.00
 U0    =      4.724 Q0    =      2.738 Q0A    =0.2738E+01
 RHO0  = 1046.4000  DRHO0 =-.2366E+02  RHOCW = 1046.4000  GP0   =-.2269E+00
 C0    =0.2894E+05  CUNITS=  ppm
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00


FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3056E+00  m0    =0.9625E+00  j0    =-.4623E-01  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.065 lM    =      4.13  lm    =  99999.00
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.2738E+01  M0    =0.8624E+01  J0    =-.4142E+00
 Associated 3-d length scales (meters)
 LQ    =      0.44  LM    =  99999.00  Lm    =  99999.00  Lb    =  99999.00
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     47.75  FRD0  =     14.08  R     =  99999.00  PL    =  140.00
 (slot)             (port/nozzle)

RECOMPUTED SOURCE CONDITIONS FOR RISER GROUPS:
 Properties of riser group with  1 ports/nozzles each:
 U0    =      4.724 D0    =      0.496 A0    =      0.193 THETA =     47.00
 FR0   =     47.75  FRD0  =     14.08  R     =  99999.00
 (slot)             (riser group)

FLOW CLASSIFICATION
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
 D  Flow class (D-CORMIX)     =    MNU7     D
 D  Applicable layer depth HS =     8.50    D
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

## Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +2$^0$ C; Sheet C-2

```
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.2894E+05  CUNITS=  ppm
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2000E+04
 REGMZ =  1
 REGSPC=  1         XREG  =    100.00  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE an at the diffuser mid-point:
       461.48 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =100 display intervals per module
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   Uc = Local centerline excess velocity (above ambient)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH       Uc        TT
      0.00     0.00   -5.70     1.0 0.289E+05   0.03     4.48     4.724   .00000E+00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER

 Because of the FANNED-OUT HORIZONTAL ORIENTATION of the diffuser jets,
   the near-field dilution is slightly improved.

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =    8.50m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00   -5.70     1.0 0.289E+05   0.03     4.48 .00000E+00
      0.04     0.00   -5.70     1.6 0.176E+05   0.08     4.41 .15573E-01
      0.09     0.00   -5.70     1.9 0.152E+05   0.17     4.35 .36191E-01
      0.13     0.00   -5.70     2.1 0.137E+05   0.25     4.29 .60093E-01
      0.18     0.00   -5.69     2.3 0.127E+05   0.34     4.23 .86651E-01
      0.22     0.00   -5.69     2.4 0.119E+05   0.42     4.17 .11550E+00
      0.27     0.00   -5.69     2.6 0.112E+05   0.51     4.11 .14640E+00
      0.31     0.00   -5.69     2.7 0.107E+05   0.60     4.06 .17917E+00
      0.36     0.00   -5.69     2.8 0.103E+05   0.68     4.00 .21366E+00
      0.40     0.00   -5.69     2.9 0.989E+04   0.76     3.95 .24977E+00
      0.45     0.00   -5.68     3.0 0.955E+04   0.85     3.90 .28740E+00
      0.49     0.00   -5.68     3.1 0.925E+04   0.93     3.85 .32648E+00
      0.54     0.00   -5.68     3.2 0.898E+04   1.02     3.80 .36694E+00
      0.58     0.00   -5.68     3.3 0.873E+04   1.10     3.76 .40872E+00
      0.63     0.00   -5.68     3.4 0.851E+04   1.19     3.71 .45176E+00
      0.67     0.00   -5.68     3.5 0.830E+04   1.27     3.67 .49603E+00
      0.72     0.00   -5.68     3.6 0.811E+04   1.36     3.62 .54147E+00
```

## Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +2$^0$ C; Sheet C-3

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.76 | 0.00 | -5.67 | 3.6 | 0.793E+04 | 1.44 | 3.58 | .58806E+00 |
| 0.81 | 0.00 | -5.67 | 3.7 | 0.777E+04 | 1.53 | 3.54 | .63575E+00 |
| 0.85 | 0.00 | -5.67 | 3.8 | 0.762E+04 | 1.61 | 3.50 | .68452E+00 |
| 0.90 | 0.00 | -5.67 | 3.9 | 0.747E+04 | 1.70 | 3.46 | .73434E+00 |
| 0.94 | 0.00 | -5.67 | 3.9 | 0.734E+04 | 1.78 | 3.43 | .78518E+00 |
| 0.99 | 0.00 | -5.67 | 4.0 | 0.721E+04 | 1.87 | 3.39 | .83702E+00 |
| 1.03 | 0.00 | -5.66 | 4.1 | 0.709E+04 | 1.95 | 3.35 | .88983E+00 |
| 1.08 | 0.00 | -5.66 | 4.1 | 0.698E+04 | 2.04 | 3.32 | .94359E+00 |
| 1.12 | 0.00 | -5.66 | 4.2 | 0.687E+04 | 2.12 | 3.29 | .99829E+00 |
| 1.16 | 0.00 | -5.66 | 4.3 | 0.677E+04 | 2.21 | 3.25 | .10539E+01 |
| 1.21 | 0.00 | -5.66 | 4.3 | 0.667E+04 | 2.30 | 3.22 | .11104E+01 |
| 1.25 | 0.00 | -5.66 | 4.4 | 0.658E+04 | 2.38 | 3.19 | .11678E+01 |
| 1.30 | 0.00 | -5.66 | 4.5 | 0.649E+04 | 2.47 | 3.16 | .12260E+01 |
| 1.34 | 0.00 | -5.65 | 4.5 | 0.641E+04 | 2.55 | 3.13 | .12851E+01 |
| 1.39 | 0.00 | -5.65 | 4.6 | 0.633E+04 | 2.64 | 3.10 | .13451E+01 |
| 1.43 | 0.00 | -5.65 | 4.6 | 0.625E+04 | 2.72 | 3.07 | .14058E+01 |
| 1.48 | 0.00 | -5.65 | 4.7 | 0.617E+04 | 2.81 | 3.04 | .14674E+01 |
| 1.52 | 0.00 | -5.65 | 4.7 | 0.610E+04 | 2.89 | 3.02 | .15297E+01 |
| 1.57 | 0.00 | -5.65 | 4.8 | 0.603E+04 | 2.98 | 2.99 | .15928E+01 |
| 1.61 | 0.00 | -5.64 | 4.9 | 0.596E+04 | 3.06 | 2.96 | .16568E+01 |
| 1.66 | 0.00 | -5.64 | 4.9 | 0.590E+04 | 3.15 | 2.94 | .17214E+01 |
| 1.70 | 0.00 | -5.64 | 5.0 | 0.584E+04 | 3.23 | 2.91 | .17868E+01 |
| 1.75 | 0.00 | -5.64 | 5.0 | 0.578E+04 | 3.32 | 2.89 | .18530E+01 |
| 1.79 | 0.00 | -5.64 | 5.1 | 0.572E+04 | 3.40 | 2.86 | .19199E+01 |
| 1.84 | 0.00 | -5.64 | 5.1 | 0.566E+04 | 3.49 | 2.84 | .19875E+01 |
| 1.88 | 0.00 | -5.64 | 5.2 | 0.561E+04 | 3.57 | 2.82 | .20558E+01 |
| 1.93 | 0.00 | -5.63 | 5.2 | 0.555E+04 | 3.66 | 2.80 | .21249E+01 |
| 1.97 | 0.00 | -5.63 | 5.3 | 0.550E+04 | 3.74 | 2.77 | .21946E+01 |
| 2.02 | 0.00 | -5.63 | 5.3 | 0.545E+04 | 3.83 | 2.75 | .22650E+01 |
| 2.06 | 0.00 | -5.63 | 5.4 | 0.540E+04 | 3.91 | 2.73 | .23361E+01 |
| 2.11 | 0.00 | -5.63 | 5.4 | 0.536E+04 | 4.00 | 2.71 | .24079E+01 |
| 2.15 | 0.00 | -5.63 | 5.4 | 0.531E+04 | 4.08 | 2.69 | .24803E+01 |
| 2.20 | 0.00 | -5.63 | 5.5 | 0.527E+04 | 4.17 | 2.67 | .25534E+01 |
| 2.24 | 0.00 | -5.62 | 5.5 | 0.522E+04 | 4.25 | 2.65 | .26272E+01 |
| 2.28 | 0.00 | -5.62 | 5.6 | 0.518E+04 | 4.34 | 2.64 | .27016E+01 |
| 2.33 | 0.00 | -5.62 | 5.6 | 0.514E+04 | 4.42 | 2.62 | .27766E+01 |
| 2.37 | 0.00 | -5.62 | 5.7 | 0.510E+04 | 4.51 | 2.60 | .28523E+01 |
| 2.42 | 0.00 | -5.62 | 5.7 | 0.506E+04 | 4.59 | 2.58 | .29286E+01 |
| 2.46 | 0.00 | -5.62 | 5.8 | 0.502E+04 | 4.68 | 2.57 | .30055E+01 |
| 2.51 | 0.00 | -5.61 | 5.8 | 0.499E+04 | 4.76 | 2.55 | .30830E+01 |
| 2.55 | 0.00 | -5.61 | 5.8 | 0.495E+04 | 4.85 | 2.54 | .31612E+01 |
| 2.60 | 0.00 | -5.61 | 5.9 | 0.491E+04 | 4.93 | 2.52 | .32399E+01 |
| 2.64 | 0.00 | -5.61 | 5.9 | 0.488E+04 | 5.02 | 2.51 | .33193E+01 |
| 2.69 | 0.00 | -5.61 | 6.0 | 0.484E+04 | 5.10 | 2.49 | .33992E+01 |
| 2.73 | 0.00 | -5.61 | 6.0 | 0.481E+04 | 5.19 | 2.48 | .34797E+01 |
| 2.78 | 0.00 | -5.61 | 6.1 | 0.478E+04 | 5.27 | 2.46 | .35608E+01 |
| 2.82 | 0.00 | -5.60 | 6.1 | 0.475E+04 | 5.36 | 2.45 | .36425E+01 |
| 2.87 | 0.00 | -5.60 | 6.1 | 0.472E+04 | 5.44 | 2.44 | .37248E+01 |
| 2.91 | 0.00 | -5.60 | 6.2 | 0.469E+04 | 5.53 | 2.43 | .38077E+01 |
| 2.96 | 0.00 | -5.60 | 6.2 | 0.466E+04 | 5.61 | 2.42 | .38911E+01 |
| 3.00 | 0.00 | -5.60 | 6.3 | 0.463E+04 | 5.70 | 2.40 | .39750E+01 |
| 3.05 | 0.00 | -5.60 | 6.3 | 0.460E+04 | 5.78 | 2.39 | .40596E+01 |
| 3.09 | 0.00 | -5.59 | 6.3 | 0.457E+04 | 5.87 | 2.38 | .41446E+01 |
| 3.14 | 0.00 | -5.59 | 6.4 | 0.454E+04 | 5.95 | 2.37 | .42303E+01 |
| 3.18 | 0.00 | -5.59 | 6.4 | 0.451E+04 | 6.04 | 2.36 | .43165E+01 |
| 3.23 | 0.00 | -5.59 | 6.4 | 0.449E+04 | 6.12 | 2.36 | .44032E+01 |
| 3.27 | 0.00 | -5.59 | 6.5 | 0.446E+04 | 6.21 | 2.35 | .44904E+01 |
| 3.32 | 0.00 | -5.59 | 6.5 | 0.444E+04 | 6.29 | 2.34 | .45782E+01 |
| 3.36 | 0.00 | -5.59 | 6.6 | 0.441E+04 | 6.38 | 2.33 | .46666E+01 |
| 3.40 | 0.00 | -5.58 | 6.6 | 0.439E+04 | 6.46 | 2.32 | .47554E+01 |
| 3.45 | 0.00 | -5.58 | 6.6 | 0.436E+04 | 6.55 | 2.32 | .48448E+01 |
| 3.49 | 0.00 | -5.58 | 6.7 | 0.434E+04 | 6.63 | 2.31 | .49347E+01 |
| 3.54 | 0.00 | -5.58 | 6.7 | 0.431E+04 | 6.72 | 2.31 | .50251E+01 |
| 3.58 | 0.00 | -5.58 | 6.7 | 0.429E+04 | 6.80 | 2.30 | .51160E+01 |
| 3.63 | 0.00 | -5.58 | 6.8 | 0.427E+04 | 6.89 | 2.29 | .52075E+01 |
| 3.67 | 0.00 | -5.57 | 6.8 | 0.425E+04 | 6.97 | 2.29 | .52994E+01 |
| 3.72 | 0.00 | -5.57 | 6.8 | 0.422E+04 | 7.06 | 2.28 | .53919E+01 |
| 3.76 | 0.00 | -5.57 | 6.9 | 0.420E+04 | 7.14 | 2.28 | .54848E+01 |
| 3.81 | 0.00 | -5.57 | 6.9 | 0.418E+04 | 7.23 | 2.28 | .55783E+01 |

## Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +2$^0$ C; Sheet C-4

```
      3.85     0.00   -5.57     7.0 0.416E+04   7.31     2.27 .56722E+01
      3.90     0.00   -5.57     7.0 0.414E+04   7.40     2.27 .57667E+01
      3.94     0.00   -5.57     7.0 0.412E+04   7.48     2.27 .58616E+01
      3.99     0.00   -5.56     7.1 0.410E+04   7.57     2.26 .59570E+01
      4.03     0.00   -5.56     7.1 0.408E+04   7.65     2.26 .60529E+01
      4.08     0.00   -5.56     7.1 0.406E+04   7.74     2.26 .61493E+01
      4.12     0.00   -5.56     7.2 0.404E+04   7.82     2.26 .62461E+01
      4.17     0.00   -5.56     7.2 0.402E+04   7.91     2.25 .63435E+01
      4.21     0.00   -5.56     7.2 0.401E+04   7.99     2.25 .64413E+01
      4.26     0.00   -5.55     7.3 0.399E+04   8.08     2.25 .65396E+01
      4.30     0.00   -5.55     7.3 0.397E+04   8.16     2.25 .66383E+01
      4.35     0.00   -5.55     7.3 0.395E+04   8.25     2.25 .67375E+01
      4.39     0.00   -5.55     7.4 0.393E+04   8.33     2.25 .68372E+01
      4.44     0.00   -5.55     7.4 0.392E+04   8.42     2.25 .69373E+01
      4.48     0.00   -5.55     7.4 0.390E+04   8.50     2.25 .70379E+01
 Cumulative travel time =           7.0379 sec  (    0.00 hrs)
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------
BEGIN MOD251: DIFFUSER PLUME IN CO-FLOW

 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      4.48     0.00   -8.50     7.4 0.390E+04   8.50     2.52 .70379E+01
     13.21     0.00   -8.50     8.7 0.332E+04   8.50     3.46 .73829E+02
     21.94     0.00   -8.50     9.8 0.295E+04   8.50     4.40 .15050E+03
     30.66     0.00   -8.50    10.8 0.267E+04   8.50     5.34 .23592E+03
     39.39     0.00   -8.50    11.7 0.246E+04   8.50     6.28 .32926E+03
     48.12     0.00   -8.50    12.6 0.230E+04   8.50     7.21 .42990E+03
     56.85     0.00   -8.50    13.4 0.216E+04   8.50     8.15 .53734E+03
     65.58     0.00   -8.50    14.1 0.205E+04   8.50     9.08 .65118E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.200E+04 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     74.30     0.00   -8.50    14.9 0.195E+04   8.50    10.02 .77109E+03
     83.03     0.00   -8.50    15.5 0.186E+04   8.50    10.95 .89675E+03
     91.76     0.00   -8.50    16.2 0.179E+04   8.50    11.88 .10279E+04
 ** REGULATORY MIXING ZONE BOUNDARY is within the Near-Field Region **
  In this prediction interval the plume DOWNSTREAM distance meets or exceeds
  the regulatory value =   100.00 m.
  This is the extent of the REGULATORY MIXING ZONE.
    100.49     0.00   -8.50    16.8 0.172E+04   8.50    12.81 .11644E+04
    109.22     0.00   -8.50    17.4 0.166E+04   8.50    13.74 .13060E+04
    117.94     0.00   -8.50    18.0 0.161E+04   8.50    14.67 .14524E+04
    126.67     0.00   -8.50    18.6 0.156E+04   8.50    15.60 .16037E+04
    135.40     0.00   -8.50    19.1 0.151E+04   8.50    16.53 .17595E+04
    144.13     0.00   -8.50    19.7 0.147E+04   8.50    17.46 .19198E+04
    152.86     0.00   -8.50    20.2 0.143E+04   8.50    18.38 .20845E+04
    161.58     0.00   -8.50    20.7 0.140E+04   8.50    19.31 .22534E+04
    170.31     0.00   -8.50    21.2 0.137E+04   8.50    20.24 .24265E+04
    179.04     0.00   -8.50    21.7 0.134E+04   8.50    21.16 .26036E+04
    187.77     0.00   -8.50    22.1 0.131E+04   8.50    22.08 .27846E+04
```

## Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +2$^0$ C; Sheet C-5

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 196.50 | 0.00 | -8.50 | 22.6 | 0.128E+04 | 8.50 | 23.01 | .29695E+04 |
| 205.22 | 0.00 | -8.50 | 23.1 | 0.126E+04 | 8.50 | 23.93 | .31582E+04 |
| 213.95 | 0.00 | -8.50 | 23.5 | 0.123E+04 | 8.50 | 24.85 | .33507E+04 |
| 222.68 | 0.00 | -8.50 | 23.9 | 0.121E+04 | 8.50 | 25.77 | .35467E+04 |
| 231.41 | 0.00 | -8.50 | 24.4 | 0.119E+04 | 8.50 | 26.70 | .37464E+04 |
| 240.14 | 0.00 | -8.50 | 24.8 | 0.117E+04 | 8.50 | 27.62 | .39495E+04 |
| 248.86 | 0.00 | -8.50 | 25.2 | 0.115E+04 | 8.50 | 28.54 | .41562E+04 |
| 257.59 | 0.00 | -8.50 | 25.6 | 0.113E+04 | 8.50 | 29.46 | .43662E+04 |
| 266.32 | 0.00 | -8.50 | 26.0 | 0.111E+04 | 8.50 | 30.37 | .45795E+04 |
| 275.05 | 0.00 | -8.50 | 26.4 | 0.110E+04 | 8.50 | 31.29 | .47962E+04 |
| 283.78 | 0.00 | -8.50 | 26.8 | 0.108E+04 | 8.50 | 32.21 | .50160E+04 |
| 292.50 | 0.00 | -8.50 | 27.2 | 0.106E+04 | 8.50 | 33.13 | .52391E+04 |
| 301.23 | 0.00 | -8.50 | 27.6 | 0.105E+04 | 8.50 | 34.04 | .54654E+04 |
| 309.96 | 0.00 | -8.50 | 27.9 | 0.104E+04 | 8.50 | 34.96 | .56947E+04 |
| 318.69 | 0.00 | -8.50 | 28.3 | 0.102E+04 | 8.50 | 35.88 | .59271E+04 |
| 327.42 | 0.00 | -8.50 | 28.7 | 0.101E+04 | 8.50 | 36.79 | .61626E+04 |
| 336.14 | 0.00 | -8.50 | 29.0 | 0.997E+03 | 8.50 | 37.71 | .64010E+04 |
| 344.87 | 0.00 | -8.50 | 29.4 | 0.985E+03 | 8.50 | 38.62 | .66423E+04 |
| 353.60 | 0.00 | -8.50 | 29.7 | 0.973E+03 | 8.50 | 39.54 | .68866E+04 |
| 362.33 | 0.00 | -8.50 | 30.1 | 0.962E+03 | 8.50 | 40.45 | .71338E+04 |
| 371.06 | 0.00 | -8.50 | 30.4 | 0.951E+03 | 8.50 | 41.36 | .73838E+04 |
| 379.78 | 0.00 | -8.50 | 30.8 | 0.941E+03 | 8.50 | 42.28 | .76366E+04 |
| 388.51 | 0.00 | -8.50 | 31.1 | 0.931E+03 | 8.50 | 43.19 | .78922E+04 |
| 397.24 | 0.00 | -8.50 | 31.4 | 0.921E+03 | 8.50 | 44.10 | .81506E+04 |
| 405.97 | 0.00 | -8.50 | 31.8 | 0.911E+03 | 8.50 | 45.01 | .84117E+04 |
| 414.70 | 0.00 | -8.50 | 32.1 | 0.902E+03 | 8.50 | 45.92 | .86755E+04 |
| 423.42 | 0.00 | -8.50 | 32.4 | 0.893E+03 | 8.50 | 46.83 | .89420E+04 |
| 432.15 | 0.00 | -8.50 | 32.7 | 0.885E+03 | 8.50 | 47.74 | .92111E+04 |
| 440.88 | 0.00 | -8.50 | 33.0 | 0.876E+03 | 8.50 | 48.65 | .94828E+04 |
| 449.61 | 0.00 | -8.50 | 33.3 | 0.868E+03 | 8.50 | 49.56 | .97571E+04 |
| 458.34 | 0.00 | -8.50 | 33.7 | 0.860E+03 | 8.50 | 50.47 | .10034E+05 |
| 467.06 | 0.00 | -8.50 | 34.0 | 0.852E+03 | 8.50 | 51.38 | .10313E+05 |
| 475.79 | 0.00 | -8.50 | 34.3 | 0.845E+03 | 8.50 | 52.29 | .10595E+05 |
| 484.52 | 0.00 | -8.50 | 34.6 | 0.837E+03 | 8.50 | 53.20 | .10880E+05 |
| 493.25 | 0.00 | -8.50 | 34.9 | 0.830E+03 | 8.50 | 54.11 | .11167E+05 |
| 501.98 | 0.00 | -8.50 | 35.2 | 0.823E+03 | 8.50 | 55.01 | .11456E+05 |
| 510.70 | 0.00 | -8.50 | 35.5 | 0.816E+03 | 8.50 | 55.92 | .11748E+05 |
| 519.43 | 0.00 | -8.50 | 35.7 | 0.810E+03 | 8.50 | 56.83 | .12042E+05 |
| 528.16 | 0.00 | -8.50 | 36.0 | 0.803E+03 | 8.50 | 57.73 | .12339E+05 |
| 536.89 | 0.00 | -8.50 | 36.3 | 0.797E+03 | 8.50 | 58.64 | .12638E+05 |
| 545.62 | 0.00 | -8.50 | 36.6 | 0.791E+03 | 8.50 | 59.54 | .12939E+05 |
| 554.34 | 0.00 | -8.50 | 36.9 | 0.785E+03 | 8.50 | 60.45 | .13243E+05 |
| 563.07 | 0.00 | -8.50 | 37.2 | 0.779E+03 | 8.50 | 61.35 | .13549E+05 |
| 571.80 | 0.00 | -8.50 | 37.4 | 0.773E+03 | 8.50 | 62.26 | .13857E+05 |
| 580.53 | 0.00 | -8.50 | 37.7 | 0.767E+03 | 8.50 | 63.16 | .14168E+05 |
| 589.26 | 0.00 | -8.50 | 38.0 | 0.762E+03 | 8.50 | 64.07 | .14481E+05 |
| 597.98 | 0.00 | -8.50 | 38.3 | 0.756E+03 | 8.50 | 64.97 | .14796E+05 |
| 606.71 | 0.00 | -8.50 | 38.5 | 0.751E+03 | 8.50 | 65.87 | .15113E+05 |
| 615.44 | 0.00 | -8.50 | 38.8 | 0.746E+03 | 8.50 | 66.78 | .15433E+05 |
| 624.17 | 0.00 | -8.50 | 39.1 | 0.741E+03 | 8.50 | 67.68 | .15755E+05 |
| 632.90 | 0.00 | -8.50 | 39.3 | 0.736E+03 | 8.50 | 68.58 | .16079E+05 |
| 641.62 | 0.00 | -8.50 | 39.6 | 0.731E+03 | 8.50 | 69.48 | .16405E+05 |
| 650.35 | 0.00 | -8.50 | 39.9 | 0.726E+03 | 8.50 | 70.38 | .16733E+05 |
| 659.08 | 0.00 | -8.50 | 40.1 | 0.721E+03 | 8.50 | 71.28 | .17064E+05 |
| 667.81 | 0.00 | -8.50 | 40.4 | 0.717E+03 | 8.50 | 72.18 | .17396E+05 |
| 676.54 | 0.00 | -8.50 | 40.6 | 0.712E+03 | 8.50 | 73.08 | .17731E+05 |
| 685.26 | 0.00 | -8.50 | 40.9 | 0.708E+03 | 8.50 | 73.98 | .18068E+05 |
| 693.99 | 0.00 | -8.50 | 41.1 | 0.704E+03 | 8.50 | 74.88 | .18407E+05 |
| 702.72 | 0.00 | -8.50 | 41.4 | 0.699E+03 | 8.50 | 75.78 | .18748E+05 |
| 711.45 | 0.00 | -8.50 | 41.6 | 0.695E+03 | 8.50 | 76.68 | .19091E+05 |
| 720.18 | 0.00 | -8.50 | 41.9 | 0.691E+03 | 8.50 | 77.58 | .19436E+05 |
| 728.90 | 0.00 | -8.50 | 42.1 | 0.687E+03 | 8.50 | 78.48 | .19783E+05 |
| 737.63 | 0.00 | -8.50 | 42.4 | 0.683E+03 | 8.50 | 79.38 | .20132E+05 |
| 746.36 | 0.00 | -8.50 | 42.6 | 0.679E+03 | 8.50 | 80.28 | .20484E+05 |
| 755.09 | 0.00 | -8.50 | 42.9 | 0.675E+03 | 8.50 | 81.17 | .20837E+05 |
| 763.82 | 0.00 | -8.50 | 43.1 | 0.671E+03 | 8.50 | 82.07 | .21192E+05 |
| 772.54 | 0.00 | -8.50 | 43.3 | 0.668E+03 | 8.50 | 82.97 | .21549E+05 |
| 781.27 | 0.00 | -8.50 | 43.6 | 0.664E+03 | 8.50 | 83.87 | .21909E+05 |
| 790.00 | 0.00 | -8.50 | 43.8 | 0.660E+03 | 8.50 | 84.76 | .22270E+05 |

## Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +2$^0$ C; Sheet C-6

```
    798.73     0.00   -8.50    44.1 0.657E+03   8.50    85.66 .22633E+05
    807.46     0.00   -8.50    44.3 0.653E+03   8.50    86.55 .22998E+05
    816.18     0.00   -8.50    44.5 0.650E+03   8.50    87.45 .23365E+05
    824.91     0.00   -8.50    44.8 0.647E+03   8.50    88.34 .23734E+05
    833.64     0.00   -8.50    45.0 0.643E+03   8.50    89.24 .24105E+05
    842.37     0.00   -8.50    45.2 0.640E+03   8.50    90.13 .24478E+05
    851.10     0.00   -8.50    45.4 0.637E+03   8.50    91.03 .24852E+05
    859.83     0.00   -8.50    45.7 0.634E+03   8.50    91.92 .25229E+05
    868.55     0.00   -8.50    45.9 0.631E+03   8.50    92.82 .25607E+05
    877.28     0.00   -8.50    46.1 0.627E+03   8.50    93.71 .25987E+05
 Cumulative travel time =       25987.4316 sec  (    7.22 hrs)

 Entire region is occupied by Phase 1.
   Plume does not re-stratify in this flow region.

END OF MOD251: DIFFUSER PLUME IN CO-FLOW
-----------------------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 SIMULATION STOPS because of STAGNANT AMBIENT conditions.
   All far-field processes will be UNSTEADY.
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
D-CORMIX      End of Prediction File
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

**Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +2$^0$ C; Sheet C-7**

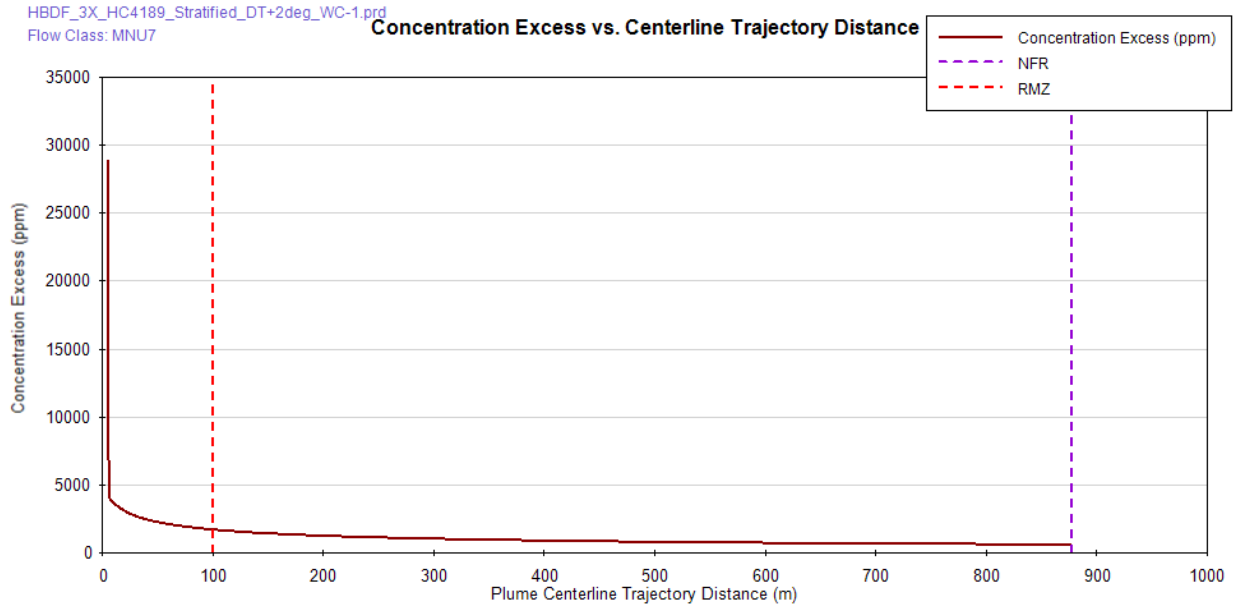



**Figure C-1:** Excess Salinity in ppm as a function of centerline trajectory distance for Worst-Case #1, $\Delta T$ = +2$^0$ C.

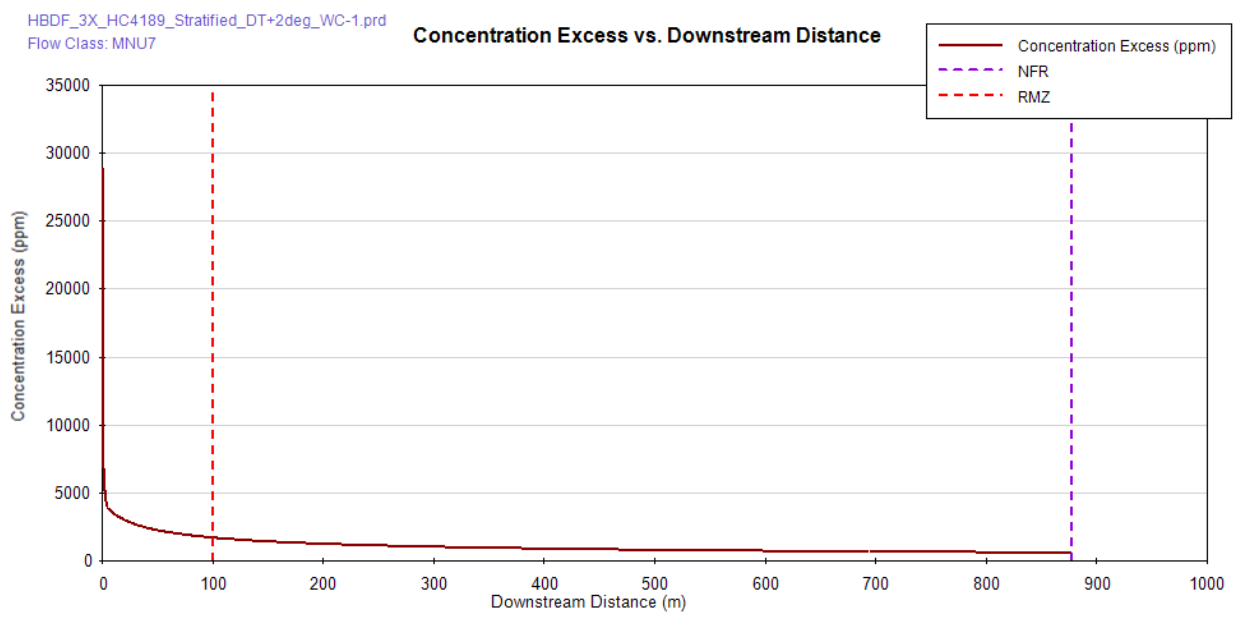



**Figure C-2:** Excess Salinity in ppm as a function of distance downstream for Worst-Case #1, $\Delta T$ = +2$^0$ C

**Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +2$^0$ C; Sheet C-8**

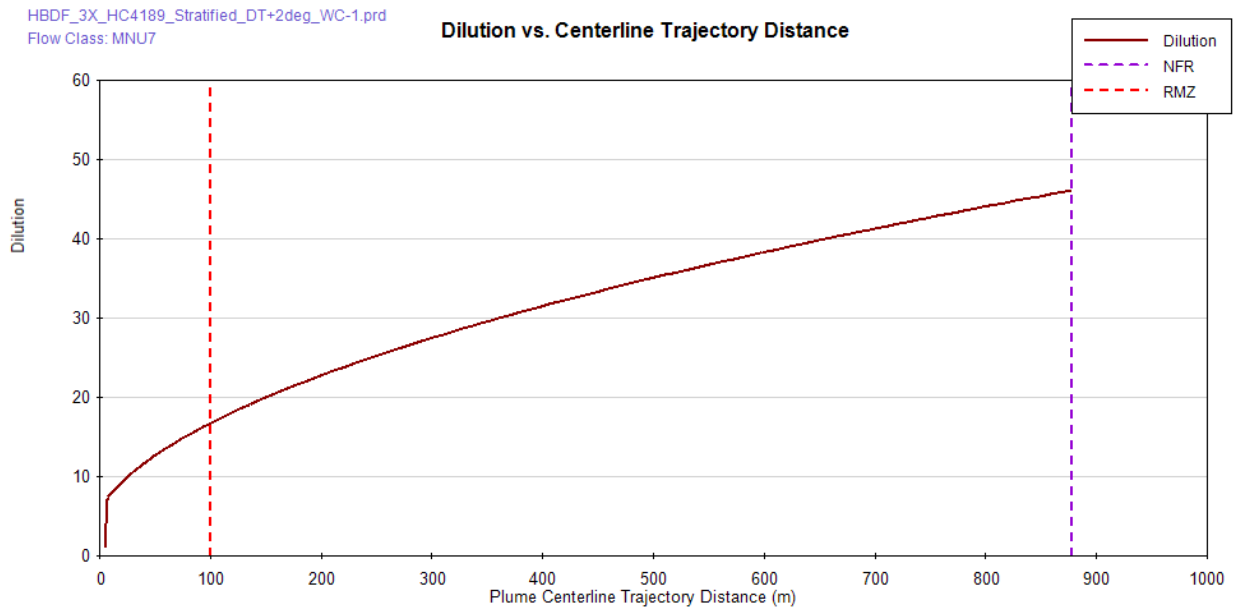



**Figure C-3:** Dilution expressed as mixing ratio, S**,** as a function of centerline trajectory distance for Worst-Case #1, $\Delta T$ = +2$^0$ C. Note S = 1 + Dm

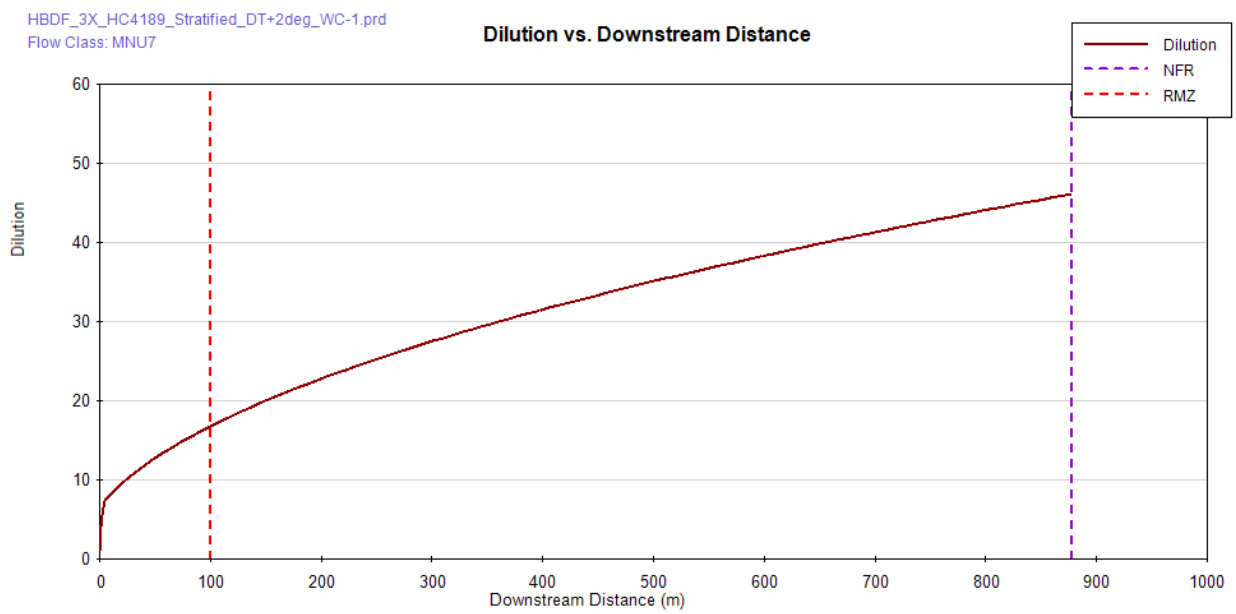



**Figure C-4:** Dilution expressed as mixing ratio, S**,** as a function of distance downstream for Worst-Case #1, $\Delta T$ = +2$^0$ C. Note S = 1 + Dm

## Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T = +0^0$ C; Sheet C-9

```
D-CORMIX PREDICTION FILE:
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
               D-CORMIX: CORMIX MIXING ZONE EXPERT SYSTEM
                      BRINE DISCHARGE SUB-SYSTEM
                 Subsystem CORMIX2: Multi Port Discharge
                       CORMIX Version 10.0GTH
                   DHYDRO Version 10.0.3.0 December 2017
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   HBDF Huntington Beach
 Design case:       Alden 3- Port Duckbill
 FILE NAME:         C:\...17_fix\HBDF_3X_HC4189_Stratified_DT_0deg_WC-1.prd
 Time stamp:        11/28/2017--15:58:12

COASTAL ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 Single (constant) offshore slope:
 SLOPE =  1.06 deg. UA    =     0.000  F     =      0.020 USTAR =0.5000E-07
 UW    =      0.000 UWSTAR=0.0000E+00
 Density stratified (non-uniform) environment:
 STRCND=  N         RHOAM = 1022.7365  RHOAH0= 1022.7365  RHOAHD= 1023.4730
 LEVDEN=  1         RHOAS = 1022.0000
 SUB1  =      8.50  RHOA1 = 1023.4730  EPS1  =0.1663E-02

DISCHARGE PARAMETERS (metric units) for multi_port_diffuser
 BANK  =  LEFT      DISTB =    461.48  HD    =      8.50  LEVDIS=  1
 Diffuser type:     DITYPE= unidirectional_perpendicular
 LD    =      8.96  NOPEN  =   3       SPAC =      4.48
 YB1   =    457.00  YB2    = 465.96
 Nozzle/port arrangement:   unidirectional_with_fanning
 D0    =      0.496 A0    =      0.193 H0    =      2.80  SUB0 =      5.70
 D0INP =      0.496 CR0   =      1.000
 GAMMA =     90.00  THETA =     47.00  SIGMA =      0.00  BETA  =     90.00
 U0    =      4.724 Q0    =      2.738 Q0A    =0.2738E+01
 RHO0  = 1046.8000  DRHO0 =-.2406E+02  RHOCW = 1046.8000  GP0   =-.2307E+00
 C0    =0.2894E+05  CUNITS=  ppm
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00


FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3056E+00  m0    =0.9625E+00  j0    =-.4701E-01  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.065 lM    =      4.08  lm    =  99999.00
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.2738E+01  M0    =0.8624E+01  J0    =-.4212E+00
 Associated 3-d length scales (meters)
 LQ    =      0.44  LM    =  99999.00  Lm    =  99999.00  Lb    =  99999.00
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     47.35  FRD0  =     13.96  R     =  99999.00  PL    =  140.00
 (slot)              (port/nozzle)

RECOMPUTED SOURCE CONDITIONS FOR RISER GROUPS:
 Properties of riser group with  1 ports/nozzles each:
 U0    =      4.724 D0    =      0.496 A0    =      0.193 THETA =     47.00
 FR0   =     47.35  FRD0  =     13.96  R     =  99999.00
 (slot)              (riser group)

FLOW CLASSIFICATION
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
 D  Flow class (D-CORMIX)     =    MNU7     D
 D  Applicable layer depth HS =     8.50    D
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

## Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +0$^0$ C; Sheet C-10

```
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.2894E+05  CUNITS=  ppm
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2000E+04
 REGMZ =  1
 REGSPC=  1         XREG  =    100.00  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE an at the diffuser mid-point:
       461.48 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =100 display intervals per module
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   Uc = Local centerline excess velocity (above ambient)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH       Uc        TT
      0.00     0.00   -5.70     1.0 0.289E+05   0.03     4.48     4.724   .00000E+00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER

 Because of the FANNED-OUT HORIZONTAL ORIENTATION of the diffuser jets,
   the near-field dilution is slightly improved.

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =    8.50m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00   -5.70     1.0 0.289E+05   0.03     4.48 .00000E+00
      0.04     0.00   -5.70     1.6 0.176E+05   0.08     4.41 .15573E-01
      0.09     0.00   -5.70     1.9 0.152E+05   0.17     4.35 .36191E-01
      0.13     0.00   -5.70     2.1 0.137E+05   0.25     4.29 .60093E-01
      0.18     0.00   -5.69     2.3 0.127E+05   0.34     4.23 .86651E-01
      0.22     0.00   -5.69     2.4 0.119E+05   0.42     4.17 .11550E+00
      0.27     0.00   -5.69     2.6 0.112E+05   0.51     4.11 .14640E+00
      0.31     0.00   -5.69     2.7 0.107E+05   0.60     4.06 .17917E+00
      0.36     0.00   -5.69     2.8 0.103E+05   0.68     4.00 .21366E+00
      0.40     0.00   -5.69     2.9 0.989E+04   0.76     3.95 .24977E+00
      0.45     0.00   -5.68     3.0 0.955E+04   0.85     3.90 .28740E+00
      0.49     0.00   -5.68     3.1 0.925E+04   0.93     3.85 .32648E+00
      0.54     0.00   -5.68     3.2 0.898E+04   1.02     3.80 .36694E+00
      0.58     0.00   -5.68     3.3 0.873E+04   1.10     3.76 .40872E+00
      0.63     0.00   -5.68     3.4 0.851E+04   1.19     3.71 .45176E+00
      0.67     0.00   -5.68     3.5 0.830E+04   1.27     3.67 .49603E+00
      0.72     0.00   -5.68     3.6 0.811E+04   1.36     3.62 .54147E+00
```

**Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +0$^0$ C; Sheet C-11**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.76 | 0.00 | -5.67 | 3.6 | 0.793E+04 | 1.44 | 3.58 | .58806E+00 |
| 0.81 | 0.00 | -5.67 | 3.7 | 0.777E+04 | 1.53 | 3.54 | .63575E+00 |
| 0.85 | 0.00 | -5.67 | 3.8 | 0.762E+04 | 1.61 | 3.50 | .68452E+00 |
| 0.90 | 0.00 | -5.67 | 3.9 | 0.747E+04 | 1.70 | 3.46 | .73434E+00 |
| 0.94 | 0.00 | -5.67 | 3.9 | 0.734E+04 | 1.78 | 3.43 | .78518E+00 |
| 0.99 | 0.00 | -5.67 | 4.0 | 0.721E+04 | 1.87 | 3.39 | .83702E+00 |
| 1.03 | 0.00 | -5.66 | 4.1 | 0.709E+04 | 1.95 | 3.35 | .88983E+00 |
| 1.08 | 0.00 | -5.66 | 4.1 | 0.698E+04 | 2.04 | 3.32 | .94359E+00 |
| 1.12 | 0.00 | -5.66 | 4.2 | 0.687E+04 | 2.12 | 3.29 | .99829E+00 |
| 1.16 | 0.00 | -5.66 | 4.3 | 0.677E+04 | 2.21 | 3.25 | .10539E+01 |
| 1.21 | 0.00 | -5.66 | 4.3 | 0.667E+04 | 2.30 | 3.22 | .11104E+01 |
| 1.25 | 0.00 | -5.66 | 4.4 | 0.658E+04 | 2.38 | 3.19 | .11678E+01 |
| 1.30 | 0.00 | -5.66 | 4.5 | 0.649E+04 | 2.47 | 3.16 | .12260E+01 |
| 1.34 | 0.00 | -5.65 | 4.5 | 0.641E+04 | 2.55 | 3.13 | .12851E+01 |
| 1.39 | 0.00 | -5.65 | 4.6 | 0.633E+04 | 2.64 | 3.10 | .13451E+01 |
| 1.43 | 0.00 | -5.65 | 4.6 | 0.625E+04 | 2.72 | 3.07 | .14058E+01 |
| 1.48 | 0.00 | -5.65 | 4.7 | 0.617E+04 | 2.81 | 3.04 | .14674E+01 |
| 1.52 | 0.00 | -5.65 | 4.7 | 0.610E+04 | 2.89 | 3.02 | .15297E+01 |
| 1.57 | 0.00 | -5.65 | 4.8 | 0.603E+04 | 2.98 | 2.99 | .15928E+01 |
| 1.61 | 0.00 | -5.64 | 4.9 | 0.596E+04 | 3.06 | 2.96 | .16568E+01 |
| 1.66 | 0.00 | -5.64 | 4.9 | 0.590E+04 | 3.15 | 2.94 | .17214E+01 |
| 1.70 | 0.00 | -5.64 | 5.0 | 0.584E+04 | 3.23 | 2.91 | .17868E+01 |
| 1.75 | 0.00 | -5.64 | 5.0 | 0.578E+04 | 3.32 | 2.89 | .18530E+01 |
| 1.79 | 0.00 | -5.64 | 5.1 | 0.572E+04 | 3.40 | 2.86 | .19199E+01 |
| 1.84 | 0.00 | -5.64 | 5.1 | 0.566E+04 | 3.49 | 2.84 | .19875E+01 |
| 1.88 | 0.00 | -5.64 | 5.2 | 0.561E+04 | 3.57 | 2.82 | .20558E+01 |
| 1.93 | 0.00 | -5.63 | 5.2 | 0.555E+04 | 3.66 | 2.80 | .21249E+01 |
| 1.97 | 0.00 | -5.63 | 5.3 | 0.550E+04 | 3.74 | 2.77 | .21946E+01 |
| 2.02 | 0.00 | -5.63 | 5.3 | 0.545E+04 | 3.83 | 2.75 | .22650E+01 |
| 2.06 | 0.00 | -5.63 | 5.4 | 0.540E+04 | 3.91 | 2.73 | .23361E+01 |
| 2.11 | 0.00 | -5.63 | 5.4 | 0.536E+04 | 4.00 | 2.71 | .24079E+01 |
| 2.15 | 0.00 | -5.63 | 5.4 | 0.531E+04 | 4.08 | 2.69 | .24803E+01 |
| 2.20 | 0.00 | -5.63 | 5.5 | 0.527E+04 | 4.17 | 2.67 | .25534E+01 |
| 2.24 | 0.00 | -5.62 | 5.5 | 0.522E+04 | 4.25 | 2.65 | .26272E+01 |
| 2.28 | 0.00 | -5.62 | 5.6 | 0.518E+04 | 4.34 | 2.64 | .27016E+01 |
| 2.33 | 0.00 | -5.62 | 5.6 | 0.514E+04 | 4.42 | 2.62 | .27766E+01 |
| 2.37 | 0.00 | -5.62 | 5.7 | 0.510E+04 | 4.51 | 2.60 | .28523E+01 |
| 2.42 | 0.00 | -5.62 | 5.7 | 0.506E+04 | 4.59 | 2.58 | .29286E+01 |
| 2.46 | 0.00 | -5.62 | 5.8 | 0.502E+04 | 4.68 | 2.57 | .30055E+01 |
| 2.51 | 0.00 | -5.61 | 5.8 | 0.499E+04 | 4.76 | 2.55 | .30830E+01 |
| 2.55 | 0.00 | -5.61 | 5.8 | 0.495E+04 | 4.85 | 2.54 | .31612E+01 |
| 2.60 | 0.00 | -5.61 | 5.9 | 0.491E+04 | 4.93 | 2.52 | .32399E+01 |
| 2.64 | 0.00 | -5.61 | 5.9 | 0.488E+04 | 5.02 | 2.51 | .33193E+01 |
| 2.69 | 0.00 | -5.61 | 6.0 | 0.484E+04 | 5.10 | 2.49 | .33992E+01 |
| 2.73 | 0.00 | -5.61 | 6.0 | 0.481E+04 | 5.19 | 2.48 | .34797E+01 |
| 2.78 | 0.00 | -5.61 | 6.1 | 0.478E+04 | 5.27 | 2.46 | .35608E+01 |
| 2.82 | 0.00 | -5.60 | 6.1 | 0.475E+04 | 5.36 | 2.45 | .36425E+01 |
| 2.87 | 0.00 | -5.60 | 6.1 | 0.472E+04 | 5.44 | 2.44 | .37248E+01 |
| 2.91 | 0.00 | -5.60 | 6.2 | 0.469E+04 | 5.53 | 2.43 | .38077E+01 |
| 2.96 | 0.00 | -5.60 | 6.2 | 0.466E+04 | 5.61 | 2.42 | .38911E+01 |
| 3.00 | 0.00 | -5.60 | 6.3 | 0.463E+04 | 5.70 | 2.40 | .39750E+01 |
| 3.05 | 0.00 | -5.60 | 6.3 | 0.460E+04 | 5.78 | 2.39 | .40596E+01 |
| 3.09 | 0.00 | -5.59 | 6.3 | 0.457E+04 | 5.87 | 2.38 | .41446E+01 |
| 3.14 | 0.00 | -5.59 | 6.4 | 0.454E+04 | 5.95 | 2.37 | .42303E+01 |
| 3.18 | 0.00 | -5.59 | 6.4 | 0.451E+04 | 6.04 | 2.36 | .43165E+01 |
| 3.23 | 0.00 | -5.59 | 6.4 | 0.449E+04 | 6.12 | 2.36 | .44032E+01 |
| 3.27 | 0.00 | -5.59 | 6.5 | 0.446E+04 | 6.21 | 2.35 | .44904E+01 |
| 3.32 | 0.00 | -5.59 | 6.5 | 0.444E+04 | 6.29 | 2.34 | .45782E+01 |
| 3.36 | 0.00 | -5.59 | 6.6 | 0.441E+04 | 6.38 | 2.33 | .46666E+01 |
| 3.40 | 0.00 | -5.58 | 6.6 | 0.439E+04 | 6.46 | 2.32 | .47554E+01 |
| 3.45 | 0.00 | -5.58 | 6.6 | 0.436E+04 | 6.55 | 2.32 | .48448E+01 |
| 3.49 | 0.00 | -5.58 | 6.7 | 0.434E+04 | 6.63 | 2.31 | .49347E+01 |
| 3.54 | 0.00 | -5.58 | 6.7 | 0.431E+04 | 6.72 | 2.31 | .50251E+01 |
| 3.58 | 0.00 | -5.58 | 6.7 | 0.429E+04 | 6.80 | 2.30 | .51160E+01 |
| 3.63 | 0.00 | -5.58 | 6.8 | 0.427E+04 | 6.89 | 2.29 | .52075E+01 |
| 3.67 | 0.00 | -5.57 | 6.8 | 0.425E+04 | 6.97 | 2.29 | .52994E+01 |
| 3.72 | 0.00 | -5.57 | 6.8 | 0.422E+04 | 7.06 | 2.28 | .53919E+01 |
| 3.76 | 0.00 | -5.57 | 6.9 | 0.420E+04 | 7.14 | 2.28 | .54848E+01 |
| 3.81 | 0.00 | -5.57 | 6.9 | 0.418E+04 | 7.23 | 2.28 | .55783E+01 |

## Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +0$^0$ C; Sheet C-12

```
      3.85     0.00   -5.57     7.0 0.416E+04   7.31     2.27 .56722E+01
      3.90     0.00   -5.57     7.0 0.414E+04   7.40     2.27 .57667E+01
      3.94     0.00   -5.57     7.0 0.412E+04   7.48     2.27 .58616E+01
      3.99     0.00   -5.56     7.1 0.410E+04   7.57     2.26 .59570E+01
      4.03     0.00   -5.56     7.1 0.408E+04   7.65     2.26 .60529E+01
      4.08     0.00   -5.56     7.1 0.406E+04   7.74     2.26 .61493E+01
      4.12     0.00   -5.56     7.2 0.404E+04   7.82     2.26 .62461E+01
      4.17     0.00   -5.56     7.2 0.402E+04   7.91     2.25 .63435E+01
      4.21     0.00   -5.56     7.2 0.401E+04   7.99     2.25 .64413E+01
      4.26     0.00   -5.55     7.3 0.399E+04   8.08     2.25 .65396E+01
      4.30     0.00   -5.55     7.3 0.397E+04   8.16     2.25 .66383E+01
      4.35     0.00   -5.55     7.3 0.395E+04   8.25     2.25 .67375E+01
      4.39     0.00   -5.55     7.4 0.393E+04   8.33     2.25 .68372E+01
      4.44     0.00   -5.55     7.4 0.392E+04   8.42     2.25 .69373E+01
      4.48     0.00   -5.55     7.4 0.390E+04   8.50     2.25 .70379E+01
 Cumulative travel time =           7.0379 sec  (    0.00 hrs)
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------
BEGIN MOD251: DIFFUSER PLUME IN CO-FLOW

 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      4.48     0.00   -8.50     7.4 0.390E+04   8.50     2.52 .70379E+01
     13.21     0.00   -8.50     8.7 0.332E+04   8.50     3.46 .73829E+02
     21.94     0.00   -8.50     9.8 0.295E+04   8.50     4.40 .15050E+03
     30.66     0.00   -8.50    10.8 0.267E+04   8.50     5.34 .23592E+03
     39.39     0.00   -8.50    11.7 0.246E+04   8.50     6.28 .32926E+03
     48.12     0.00   -8.50    12.6 0.230E+04   8.50     7.21 .42990E+03
     56.85     0.00   -8.50    13.4 0.216E+04   8.50     8.15 .53734E+03
     65.58     0.00   -8.50    14.1 0.205E+04   8.50     9.08 .65118E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.200E+04 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     74.30     0.00   -8.50    14.9 0.195E+04   8.50    10.02 .77109E+03
     83.03     0.00   -8.50    15.5 0.186E+04   8.50    10.95 .89675E+03
     91.76     0.00   -8.50    16.2 0.179E+04   8.50    11.88 .10279E+04
 ** REGULATORY MIXING ZONE BOUNDARY is within the Near-Field Region **
  In this prediction interval the plume DOWNSTREAM distance meets or exceeds
  the regulatory value =   100.00 m.
  This is the extent of the REGULATORY MIXING ZONE.
    100.49     0.00   -8.50    16.8 0.172E+04   8.50    12.81 .11644E+04
    109.22     0.00   -8.50    17.4 0.166E+04   8.50    13.74 .13060E+04
    117.94     0.00   -8.50    18.0 0.161E+04   8.50    14.67 .14524E+04
    126.67     0.00   -8.50    18.6 0.156E+04   8.50    15.60 .16037E+04
    135.40     0.00   -8.50    19.1 0.151E+04   8.50    16.53 .17595E+04
    144.13     0.00   -8.50    19.7 0.147E+04   8.50    17.46 .19198E+04
    152.86     0.00   -8.50    20.2 0.143E+04   8.50    18.38 .20845E+04
    161.58     0.00   -8.50    20.7 0.140E+04   8.50    19.31 .22534E+04
    170.31     0.00   -8.50    21.2 0.137E+04   8.50    20.24 .24265E+04
    179.04     0.00   -8.50    21.7 0.134E+04   8.50    21.16 .26036E+04
    187.77     0.00   -8.50    22.1 0.131E+04   8.50    22.08 .27846E+04
```

**Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +0$^0$ C; Sheet C-13**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 196.50 | 0.00 | -8.50 | 22.6 | 0.128E+04 | 8.50 | 23.01 | .29695E+04 |
| 205.22 | 0.00 | -8.50 | 23.1 | 0.126E+04 | 8.50 | 23.93 | .31582E+04 |
| 213.95 | 0.00 | -8.50 | 23.5 | 0.123E+04 | 8.50 | 24.85 | .33507E+04 |
| 222.68 | 0.00 | -8.50 | 23.9 | 0.121E+04 | 8.50 | 25.77 | .35467E+04 |
| 231.41 | 0.00 | -8.50 | 24.4 | 0.119E+04 | 8.50 | 26.70 | .37464E+04 |
| 240.14 | 0.00 | -8.50 | 24.8 | 0.117E+04 | 8.50 | 27.62 | .39495E+04 |
| 248.86 | 0.00 | -8.50 | 25.2 | 0.115E+04 | 8.50 | 28.54 | .41562E+04 |
| 257.59 | 0.00 | -8.50 | 25.6 | 0.113E+04 | 8.50 | 29.46 | .43662E+04 |
| 266.32 | 0.00 | -8.50 | 26.0 | 0.111E+04 | 8.50 | 30.37 | .45795E+04 |
| 275.05 | 0.00 | -8.50 | 26.4 | 0.110E+04 | 8.50 | 31.29 | .47962E+04 |
| 283.78 | 0.00 | -8.50 | 26.8 | 0.108E+04 | 8.50 | 32.21 | .50160E+04 |
| 292.50 | 0.00 | -8.50 | 27.2 | 0.106E+04 | 8.50 | 33.13 | .52391E+04 |
| 301.23 | 0.00 | -8.50 | 27.6 | 0.105E+04 | 8.50 | 34.04 | .54654E+04 |
| 309.96 | 0.00 | -8.50 | 27.9 | 0.104E+04 | 8.50 | 34.96 | .56947E+04 |
| 318.69 | 0.00 | -8.50 | 28.3 | 0.102E+04 | 8.50 | 35.88 | .59271E+04 |
| 327.42 | 0.00 | -8.50 | 28.7 | 0.101E+04 | 8.50 | 36.79 | .61626E+04 |
| 336.14 | 0.00 | -8.50 | 29.0 | 0.997E+03 | 8.50 | 37.71 | .64010E+04 |
| 344.87 | 0.00 | -8.50 | 29.4 | 0.985E+03 | 8.50 | 38.62 | .66423E+04 |
| 353.60 | 0.00 | -8.50 | 29.7 | 0.973E+03 | 8.50 | 39.54 | .68866E+04 |
| 362.33 | 0.00 | -8.50 | 30.1 | 0.962E+03 | 8.50 | 40.45 | .71338E+04 |
| 371.06 | 0.00 | -8.50 | 30.4 | 0.951E+03 | 8.50 | 41.36 | .73838E+04 |
| 379.78 | 0.00 | -8.50 | 30.8 | 0.941E+03 | 8.50 | 42.28 | .76366E+04 |
| 388.51 | 0.00 | -8.50 | 31.1 | 0.931E+03 | 8.50 | 43.19 | .78922E+04 |
| 397.24 | 0.00 | -8.50 | 31.4 | 0.921E+03 | 8.50 | 44.10 | .81506E+04 |
| 405.97 | 0.00 | -8.50 | 31.8 | 0.911E+03 | 8.50 | 45.01 | .84117E+04 |
| 414.70 | 0.00 | -8.50 | 32.1 | 0.902E+03 | 8.50 | 45.92 | .86755E+04 |
| 423.42 | 0.00 | -8.50 | 32.4 | 0.893E+03 | 8.50 | 46.83 | .89420E+04 |
| 432.15 | 0.00 | -8.50 | 32.7 | 0.885E+03 | 8.50 | 47.74 | .92111E+04 |
| 440.88 | 0.00 | -8.50 | 33.0 | 0.876E+03 | 8.50 | 48.65 | .94828E+04 |
| 449.61 | 0.00 | -8.50 | 33.3 | 0.868E+03 | 8.50 | 49.56 | .97571E+04 |
| 458.34 | 0.00 | -8.50 | 33.7 | 0.860E+03 | 8.50 | 50.47 | .10034E+05 |
| 467.06 | 0.00 | -8.50 | 34.0 | 0.852E+03 | 8.50 | 51.38 | .10313E+05 |
| 475.79 | 0.00 | -8.50 | 34.3 | 0.845E+03 | 8.50 | 52.29 | .10595E+05 |
| 484.52 | 0.00 | -8.50 | 34.6 | 0.837E+03 | 8.50 | 53.20 | .10880E+05 |
| 493.25 | 0.00 | -8.50 | 34.9 | 0.830E+03 | 8.50 | 54.11 | .11167E+05 |
| 501.98 | 0.00 | -8.50 | 35.2 | 0.823E+03 | 8.50 | 55.01 | .11456E+05 |
| 510.70 | 0.00 | -8.50 | 35.5 | 0.816E+03 | 8.50 | 55.92 | .11748E+05 |
| 519.43 | 0.00 | -8.50 | 35.7 | 0.810E+03 | 8.50 | 56.83 | .12042E+05 |
| 528.16 | 0.00 | -8.50 | 36.0 | 0.803E+03 | 8.50 | 57.73 | .12339E+05 |
| 536.89 | 0.00 | -8.50 | 36.3 | 0.797E+03 | 8.50 | 58.64 | .12638E+05 |
| 545.62 | 0.00 | -8.50 | 36.6 | 0.791E+03 | 8.50 | 59.54 | .12939E+05 |
| 554.34 | 0.00 | -8.50 | 36.9 | 0.785E+03 | 8.50 | 60.45 | .13243E+05 |
| 563.07 | 0.00 | -8.50 | 37.2 | 0.779E+03 | 8.50 | 61.35 | .13549E+05 |
| 571.80 | 0.00 | -8.50 | 37.4 | 0.773E+03 | 8.50 | 62.26 | .13857E+05 |
| 580.53 | 0.00 | -8.50 | 37.7 | 0.767E+03 | 8.50 | 63.16 | .14168E+05 |
| 589.26 | 0.00 | -8.50 | 38.0 | 0.762E+03 | 8.50 | 64.07 | .14481E+05 |
| 597.98 | 0.00 | -8.50 | 38.3 | 0.756E+03 | 8.50 | 64.97 | .14796E+05 |
| 606.71 | 0.00 | -8.50 | 38.5 | 0.751E+03 | 8.50 | 65.87 | .15113E+05 |
| 615.44 | 0.00 | -8.50 | 38.8 | 0.746E+03 | 8.50 | 66.78 | .15433E+05 |
| 624.17 | 0.00 | -8.50 | 39.1 | 0.741E+03 | 8.50 | 67.68 | .15755E+05 |
| 632.90 | 0.00 | -8.50 | 39.3 | 0.736E+03 | 8.50 | 68.58 | .16079E+05 |
| 641.62 | 0.00 | -8.50 | 39.6 | 0.731E+03 | 8.50 | 69.48 | .16405E+05 |
| 650.35 | 0.00 | -8.50 | 39.9 | 0.726E+03 | 8.50 | 70.38 | .16733E+05 |
| 659.08 | 0.00 | -8.50 | 40.1 | 0.721E+03 | 8.50 | 71.28 | .17064E+05 |
| 667.81 | 0.00 | -8.50 | 40.4 | 0.717E+03 | 8.50 | 72.18 | .17396E+05 |
| 676.54 | 0.00 | -8.50 | 40.6 | 0.712E+03 | 8.50 | 73.08 | .17731E+05 |
| 685.26 | 0.00 | -8.50 | 40.9 | 0.708E+03 | 8.50 | 73.98 | .18068E+05 |
| 693.99 | 0.00 | -8.50 | 41.1 | 0.704E+03 | 8.50 | 74.88 | .18407E+05 |
| 702.72 | 0.00 | -8.50 | 41.4 | 0.699E+03 | 8.50 | 75.78 | .18748E+05 |
| 711.45 | 0.00 | -8.50 | 41.6 | 0.695E+03 | 8.50 | 76.68 | .19091E+05 |
| 720.18 | 0.00 | -8.50 | 41.9 | 0.691E+03 | 8.50 | 77.58 | .19436E+05 |
| 728.90 | 0.00 | -8.50 | 42.1 | 0.687E+03 | 8.50 | 78.48 | .19783E+05 |
| 737.63 | 0.00 | -8.50 | 42.4 | 0.683E+03 | 8.50 | 79.38 | .20132E+05 |
| 746.36 | 0.00 | -8.50 | 42.6 | 0.679E+03 | 8.50 | 80.28 | .20484E+05 |
| 755.09 | 0.00 | -8.50 | 42.9 | 0.675E+03 | 8.50 | 81.17 | .20837E+05 |
| 763.82 | 0.00 | -8.50 | 43.1 | 0.671E+03 | 8.50 | 82.07 | .21192E+05 |
| 772.54 | 0.00 | -8.50 | 43.3 | 0.668E+03 | 8.50 | 82.97 | .21549E+05 |
| 781.27 | 0.00 | -8.50 | 43.6 | 0.664E+03 | 8.50 | 83.87 | .21909E+05 |
| 790.00 | 0.00 | -8.50 | 43.8 | 0.660E+03 | 8.50 | 84.76 | .22270E+05 |

**Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +0$^0$ C; Sheet C-14**

```
    798.73     0.00   -8.50    44.1 0.657E+03   8.50    85.66 .22633E+05
    807.46     0.00   -8.50    44.3 0.653E+03   8.50    86.55 .22998E+05
    816.18     0.00   -8.50    44.5 0.650E+03   8.50    87.45 .23365E+05
    824.91     0.00   -8.50    44.8 0.647E+03   8.50    88.34 .23734E+05
    833.64     0.00   -8.50    45.0 0.643E+03   8.50    89.24 .24105E+05
    842.37     0.00   -8.50    45.2 0.640E+03   8.50    90.13 .24478E+05
    851.10     0.00   -8.50    45.4 0.637E+03   8.50    91.03 .24852E+05
    859.83     0.00   -8.50    45.7 0.634E+03   8.50    91.92 .25229E+05
    868.55     0.00   -8.50    45.9 0.631E+03   8.50    92.82 .25607E+05
    877.28     0.00   -8.50    46.1 0.627E+03   8.50    93.71 .25987E+05
 Cumulative travel time =       25987.4316 sec  (    7.22 hrs)

 Entire region is occupied by Phase 1.
   Plume does not re-stratify in this flow region.

END OF MOD251: DIFFUSER PLUME IN CO-FLOW
----------------------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 SIMULATION STOPS because of STAGNANT AMBIENT conditions.
   All far-field processes will be UNSTEADY.
----------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------
D-CORMIX      End of Prediction File
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

**Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +0$^0$ C; Sheet C-15**

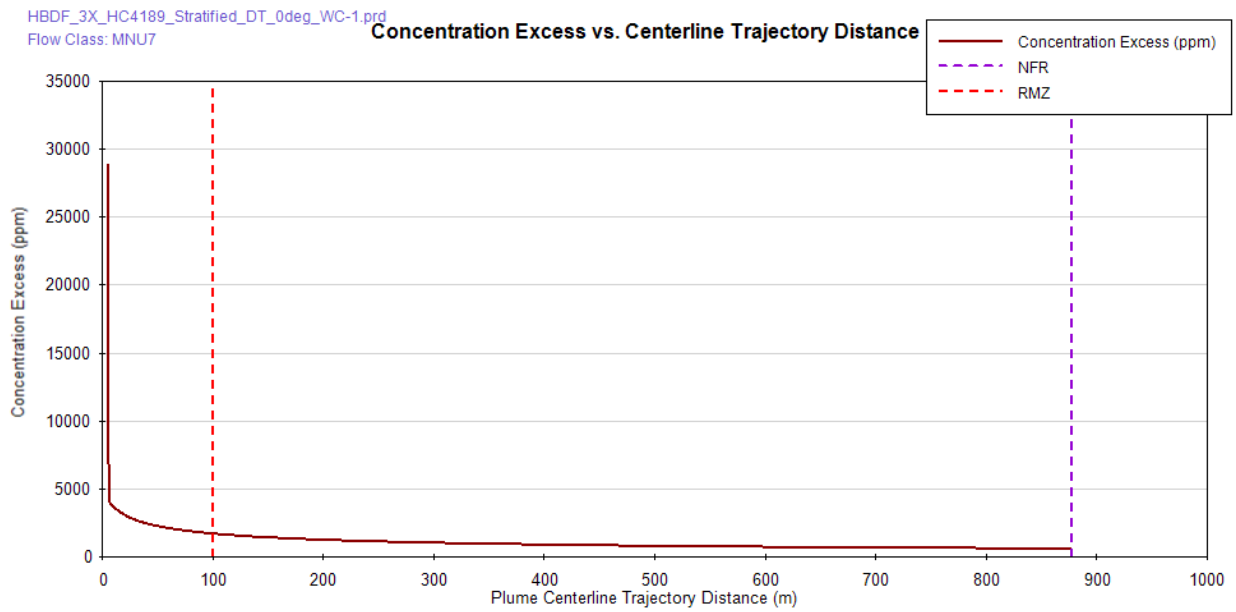



**Figure C-5:** Excess Salinity in ppm as a function of centerline trajectory distance for Worst-Case #1, $\Delta T$ = +0$^0$ C.

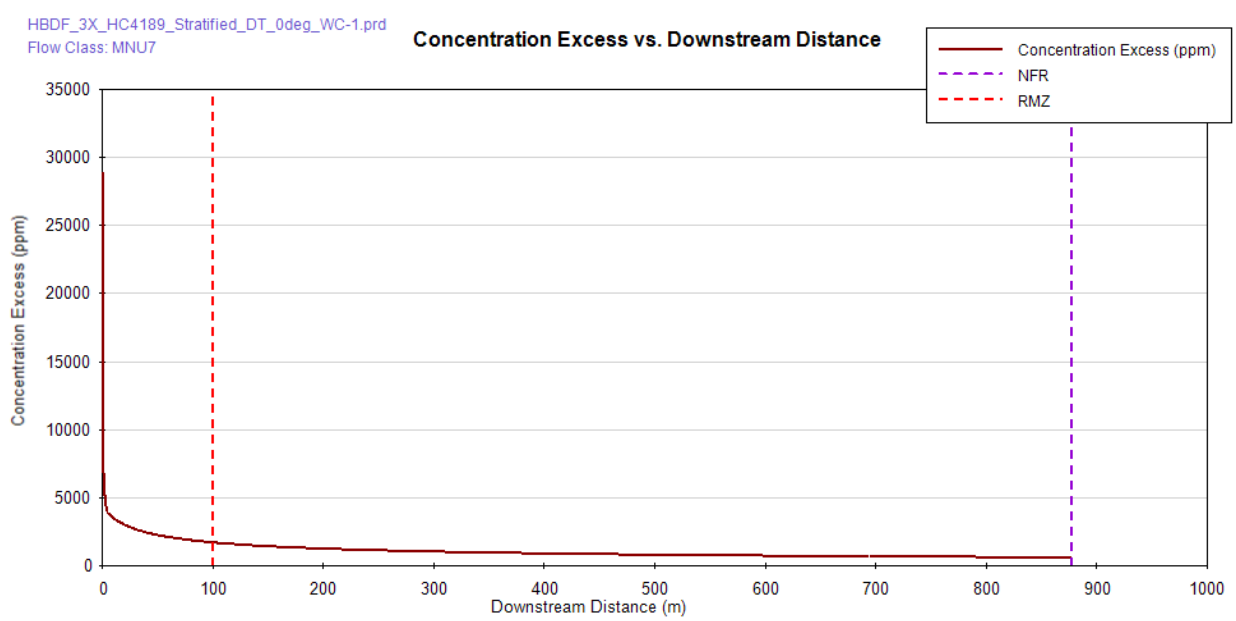



**Figure C-6:** Excess Salinity in ppm as a function of distance downstream for Worst-Case #1, $\Delta T$ = +0$^0$ C

**Appendix-C: CORMIX 10.0.3.0 Prediction File for Worst-Case #1, $\Delta T$ = +0$^0$ C; Sheet C-16**

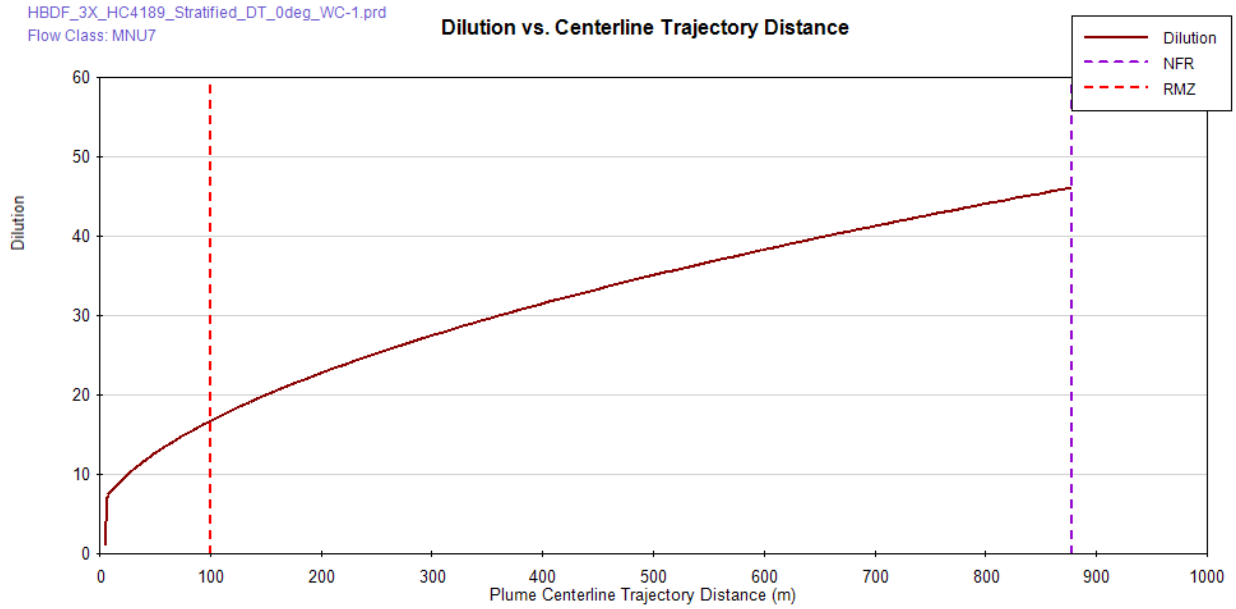



**Figure C-7:** Dilution expressed as mixing ratio, S**,** as a function of centerline trajectory distance for Worst-Case #1, $\Delta T$ = +0$^0$ C. Note S = 1 + Dm

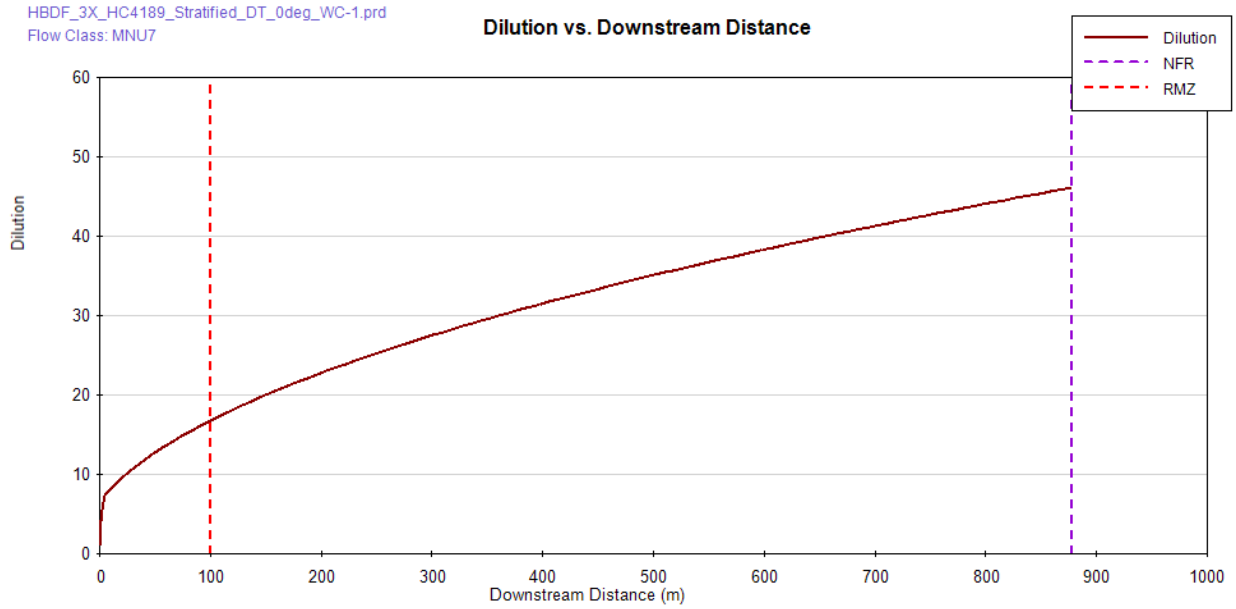



**Figure C-8:** Dilution expressed as mixing ratio, S**,** as a function of distance downstream for Worst-Case #1, $\Delta T$ = +0$^0$ C. Note S = 1 + Dm

# Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +2$^0$ C; Sheet D-1

```
D-CORMIX PREDICTION FILE:
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
               D-CORMIX: CORMIX MIXING ZONE EXPERT SYSTEM
                      BRINE DISCHARGE SUB-SYSTEM
                 Subsystem CORMIX2: Multi Port Discharge
                      CORMIX Version 10.0GTH
                   DHYDRO Version 10.0.3.0 December 2017
---------------------------------------------------------------------------------------------
---------------------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   HBDF Huntington Beach
 Design case:       Alden 3- Port Duckbill
 FILE NAME:         C:\...17_fix\HBDF_3X_HC4189_Stratified_DT+2deg_WC-2.prd
 Time stamp:        11/28/2017--14:28:22

COASTAL ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 Single (constant) offshore slope:
 SLOPE =  1.06 deg. UA    =     0.000  F     =      0.020 USTAR =0.5000E-07
 UW    =      0.000 UWSTAR=0.0000E+00
 Density stratified (non-uniform) environment:
 STRCND=  N         RHOAM = 1022.7365  RHOAH0= 1022.7365  RHOAHD= 1023.4730
 LEVDEN=  1         RHOAS = 1022.0000
 SUB1  =      8.50  RHOA1 = 1023.4730  EPS1  =0.1663E-02

DISCHARGE PARAMETERS (metric units) for multi_port_diffuser
 BANK  =  LEFT      DISTB =    461.48  HD    =      8.50  LEVDIS=  1
 Diffuser type:     DITYPE= unidirectional_perpendicular
 LD    =      8.96  NOPEN  =   3       SPAC =      4.48
 YB1   =    457.00  YB2    = 465.96
 Nozzle/port arrangement:   unidirectional_with_fanning
 D0    =      0.478 A0    =      0.179 H0    =      2.80  SUB0 =      5.70
 D0INP =      0.478 CR0   =      1.000
 GAMMA =     90.00  THETA =     47.00  SIGMA =      0.00  BETA  =     90.00
 U0    =      4.395 Q0    =      2.366 Q0A    =0.2366E+01
 RHO0  = 1050.3000  DRHO0 =-.2756E+02  RHOCW = 1050.3000  GP0   =-.2643E+00
 C0    =0.3350E+05  CUNITS=  ppm
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00


FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.2641E+00  m0    =0.7736E+00  j0    =-.4653E-01  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.060 lM    =      3.30  lm    =  99999.00
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.2366E+01  M0    =0.6932E+01  J0    =-.4169E+00
 Associated 3-d length scales (meters)
 LQ    =      0.42  LM    =  99999.00  Lm    =  99999.00  Lb    =  99999.00
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     42.71  FRD0  =     12.36  R     =  99999.00  PL    =  140.00
 (slot)             (port/nozzle)

RECOMPUTED SOURCE CONDITIONS FOR RISER GROUPS:
 Properties of riser group with  1 ports/nozzles each:
 U0    =      4.395 D0    =      0.478 A0    =      0.179 THETA =     47.00
 FR0   =     42.71  FRD0  =     12.36  R     =  99999.00
 (slot)             (riser group)

FLOW CLASSIFICATION
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
 D  Flow class (D-CORMIX)     =    MNU7     D
 D  Applicable layer depth HS =     8.50    D
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

## Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +2$^0$ C; Sheet D-2

```
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.3350E+05  CUNITS=  ppm
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2000E+04
 REGMZ =  1
 REGSPC=  1         XREG  =    100.00  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE an at the diffuser mid-point:
       461.48 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =100 display intervals per module
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   Uc = Local centerline excess velocity (above ambient)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH       Uc        TT
      0.00     0.00   -5.70     1.0 0.335E+05   0.03     4.48     4.395   .00000E+00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER

 Because of the FANNED-OUT HORIZONTAL ORIENTATION of the diffuser jets,
   the near-field dilution is slightly improved.

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =    8.50m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00   -5.70     1.0 0.335E+05   0.03     4.48 .00000E+00
      0.04     0.00   -5.70     1.7 0.201E+05   0.08     4.41 .17025E-01
      0.09     0.00   -5.70     1.9 0.172E+05   0.17     4.35 .39708E-01
      0.13     0.00   -5.70     2.2 0.155E+05   0.25     4.29 .66076E-01
      0.18     0.00   -5.69     2.3 0.143E+05   0.34     4.23 .95422E-01
      0.22     0.00   -5.69     2.5 0.134E+05   0.42     4.17 .12734E+00
      0.27     0.00   -5.69     2.6 0.127E+05   0.51     4.11 .16155E+00
      0.31     0.00   -5.69     2.8 0.121E+05   0.60     4.06 .19787E+00
      0.36     0.00   -5.69     2.9 0.116E+05   0.68     4.00 .23611E+00
      0.40     0.00   -5.69     3.0 0.111E+05   0.76     3.95 .27618E+00
      0.45     0.00   -5.68     3.1 0.107E+05   0.85     3.90 .31795E+00
      0.49     0.00   -5.68     3.2 0.104E+05   0.93     3.85 .36134E+00
      0.54     0.00   -5.68     3.3 0.101E+05   1.02     3.80 .40628E+00
      0.58     0.00   -5.68     3.4 0.981E+04   1.10     3.76 .45269E+00
      0.63     0.00   -5.68     3.5 0.955E+04   1.19     3.71 .50053E+00
      0.67     0.00   -5.68     3.6 0.932E+04   1.27     3.67 .54974E+00
      0.72     0.00   -5.68     3.7 0.910E+04   1.36     3.62 .60027E+00
```

## Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +2$^0$ C; Sheet D-3

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.76 | 0.00 | -5.67 | 3.8 | 0.890E+04 | 1.44 | 3.58 | .65208E+00 |
| 0.81 | 0.00 | -5.67 | 3.8 | 0.872E+04 | 1.53 | 3.54 | .70514E+00 |
| 0.85 | 0.00 | -5.67 | 3.9 | 0.854E+04 | 1.61 | 3.50 | .75940E+00 |
| 0.90 | 0.00 | -5.67 | 4.0 | 0.838E+04 | 1.70 | 3.46 | .81484E+00 |
| 0.94 | 0.00 | -5.67 | 4.1 | 0.823E+04 | 1.78 | 3.43 | .87142E+00 |
| 0.99 | 0.00 | -5.67 | 4.1 | 0.809E+04 | 1.87 | 3.39 | .92912E+00 |
| 1.03 | 0.00 | -5.66 | 4.2 | 0.795E+04 | 1.95 | 3.35 | .98792E+00 |
| 1.08 | 0.00 | -5.66 | 4.3 | 0.782E+04 | 2.04 | 3.32 | .10478E+01 |
| 1.12 | 0.00 | -5.66 | 4.4 | 0.770E+04 | 2.12 | 3.29 | .11087E+01 |
| 1.16 | 0.00 | -5.66 | 4.4 | 0.758E+04 | 2.21 | 3.25 | .11706E+01 |
| 1.21 | 0.00 | -5.66 | 4.5 | 0.747E+04 | 2.30 | 3.22 | .12336E+01 |
| 1.25 | 0.00 | -5.66 | 4.5 | 0.737E+04 | 2.38 | 3.19 | .12975E+01 |
| 1.30 | 0.00 | -5.66 | 4.6 | 0.727E+04 | 2.47 | 3.16 | .13624E+01 |
| 1.34 | 0.00 | -5.65 | 4.7 | 0.717E+04 | 2.55 | 3.13 | .14282E+01 |
| 1.39 | 0.00 | -5.65 | 4.7 | 0.708E+04 | 2.64 | 3.10 | .14950E+01 |
| 1.43 | 0.00 | -5.65 | 4.8 | 0.699E+04 | 2.72 | 3.07 | .15627E+01 |
| 1.48 | 0.00 | -5.65 | 4.8 | 0.691E+04 | 2.81 | 3.04 | .16313E+01 |
| 1.52 | 0.00 | -5.65 | 4.9 | 0.683E+04 | 2.89 | 3.02 | .17008E+01 |
| 1.57 | 0.00 | -5.65 | 5.0 | 0.675E+04 | 2.98 | 2.99 | .17712E+01 |
| 1.61 | 0.00 | -5.64 | 5.0 | 0.667E+04 | 3.06 | 2.96 | .18424E+01 |
| 1.66 | 0.00 | -5.64 | 5.1 | 0.660E+04 | 3.15 | 2.94 | .19145E+01 |
| 1.70 | 0.00 | -5.64 | 5.1 | 0.653E+04 | 3.23 | 2.91 | .19875E+01 |
| 1.75 | 0.00 | -5.64 | 5.2 | 0.646E+04 | 3.32 | 2.89 | .20612E+01 |
| 1.79 | 0.00 | -5.64 | 5.2 | 0.640E+04 | 3.40 | 2.86 | .21358E+01 |
| 1.84 | 0.00 | -5.64 | 5.3 | 0.633E+04 | 3.49 | 2.84 | .22112E+01 |
| 1.88 | 0.00 | -5.64 | 5.3 | 0.627E+04 | 3.57 | 2.82 | .22874E+01 |
| 1.93 | 0.00 | -5.63 | 5.4 | 0.621E+04 | 3.66 | 2.80 | .23644E+01 |
| 1.97 | 0.00 | -5.63 | 5.4 | 0.615E+04 | 3.74 | 2.77 | .24422E+01 |
| 2.02 | 0.00 | -5.63 | 5.5 | 0.610E+04 | 3.83 | 2.75 | .25207E+01 |
| 2.06 | 0.00 | -5.63 | 5.5 | 0.604E+04 | 3.91 | 2.73 | .26000E+01 |
| 2.11 | 0.00 | -5.63 | 5.6 | 0.599E+04 | 4.00 | 2.71 | .26801E+01 |
| 2.15 | 0.00 | -5.63 | 5.6 | 0.594E+04 | 4.08 | 2.69 | .27609E+01 |
| 2.20 | 0.00 | -5.63 | 5.7 | 0.589E+04 | 4.17 | 2.67 | .28424E+01 |
| 2.24 | 0.00 | -5.62 | 5.7 | 0.584E+04 | 4.25 | 2.65 | .29247E+01 |
| 2.28 | 0.00 | -5.62 | 5.8 | 0.579E+04 | 4.34 | 2.64 | .30077E+01 |
| 2.33 | 0.00 | -5.62 | 5.8 | 0.574E+04 | 4.42 | 2.62 | .30915E+01 |
| 2.37 | 0.00 | -5.62 | 5.9 | 0.570E+04 | 4.51 | 2.60 | .31759E+01 |
| 2.42 | 0.00 | -5.62 | 5.9 | 0.566E+04 | 4.59 | 2.58 | .32610E+01 |
| 2.46 | 0.00 | -5.62 | 6.0 | 0.561E+04 | 4.68 | 2.57 | .33469E+01 |
| 2.51 | 0.00 | -5.61 | 6.0 | 0.557E+04 | 4.76 | 2.55 | .34334E+01 |
| 2.55 | 0.00 | -5.61 | 6.1 | 0.553E+04 | 4.85 | 2.54 | .35206E+01 |
| 2.60 | 0.00 | -5.61 | 6.1 | 0.549E+04 | 4.93 | 2.52 | .36085E+01 |
| 2.64 | 0.00 | -5.61 | 6.1 | 0.545E+04 | 5.02 | 2.51 | .36970E+01 |
| 2.69 | 0.00 | -5.61 | 6.2 | 0.541E+04 | 5.10 | 2.49 | .37863E+01 |
| 2.73 | 0.00 | -5.61 | 6.2 | 0.537E+04 | 5.19 | 2.48 | .38762E+01 |
| 2.78 | 0.00 | -5.61 | 6.3 | 0.534E+04 | 5.27 | 2.46 | .39667E+01 |
| 2.82 | 0.00 | -5.60 | 6.3 | 0.530E+04 | 5.36 | 2.45 | .40579E+01 |
| 2.87 | 0.00 | -5.60 | 6.4 | 0.527E+04 | 5.44 | 2.44 | .41497E+01 |
| 2.91 | 0.00 | -5.60 | 6.4 | 0.523E+04 | 5.53 | 2.43 | .42422E+01 |
| 2.96 | 0.00 | -5.60 | 6.4 | 0.520E+04 | 5.61 | 2.42 | .43353E+01 |
| 3.00 | 0.00 | -5.60 | 6.5 | 0.517E+04 | 5.70 | 2.40 | .44291E+01 |
| 3.05 | 0.00 | -5.60 | 6.5 | 0.513E+04 | 5.78 | 2.39 | .45235E+01 |
| 3.09 | 0.00 | -5.59 | 6.6 | 0.510E+04 | 5.87 | 2.38 | .46185E+01 |
| 3.14 | 0.00 | -5.59 | 6.6 | 0.507E+04 | 5.95 | 2.37 | .47141E+01 |
| 3.18 | 0.00 | -5.59 | 6.6 | 0.504E+04 | 6.04 | 2.36 | .48103E+01 |
| 3.23 | 0.00 | -5.59 | 6.7 | 0.501E+04 | 6.12 | 2.36 | .49071E+01 |
| 3.27 | 0.00 | -5.59 | 6.7 | 0.498E+04 | 6.21 | 2.35 | .50046E+01 |
| 3.32 | 0.00 | -5.59 | 6.8 | 0.495E+04 | 6.29 | 2.34 | .51026E+01 |
| 3.36 | 0.00 | -5.59 | 6.8 | 0.492E+04 | 6.38 | 2.33 | .52012E+01 |
| 3.40 | 0.00 | -5.58 | 6.8 | 0.490E+04 | 6.46 | 2.32 | .53005E+01 |
| 3.45 | 0.00 | -5.58 | 6.9 | 0.487E+04 | 6.55 | 2.32 | .54003E+01 |
| 3.49 | 0.00 | -5.58 | 6.9 | 0.484E+04 | 6.63 | 2.31 | .55007E+01 |
| 3.54 | 0.00 | -5.58 | 7.0 | 0.482E+04 | 6.72 | 2.31 | .56016E+01 |
| 3.58 | 0.00 | -5.58 | 7.0 | 0.479E+04 | 6.80 | 2.30 | .57032E+01 |
| 3.63 | 0.00 | -5.58 | 7.0 | 0.476E+04 | 6.89 | 2.29 | .58053E+01 |
| 3.67 | 0.00 | -5.57 | 7.1 | 0.474E+04 | 6.97 | 2.29 | .59080E+01 |
| 3.72 | 0.00 | -5.57 | 7.1 | 0.472E+04 | 7.06 | 2.28 | .60113E+01 |
| 3.76 | 0.00 | -5.57 | 7.1 | 0.469E+04 | 7.14 | 2.28 | .61151E+01 |
| 3.81 | 0.00 | -5.57 | 7.2 | 0.467E+04 | 7.23 | 2.28 | .62195E+01 |

## Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +2$^0$ C; Sheet D-4

```
      3.85     0.00   -5.57     7.2 0.464E+04   7.31     2.27 .63244E+01
      3.90     0.00   -5.57     7.2 0.462E+04   7.40     2.27 .64299E+01
      3.94     0.00   -5.57     7.3 0.460E+04   7.48     2.27 .65359E+01
      3.99     0.00   -5.56     7.3 0.458E+04   7.57     2.26 .66425E+01
      4.03     0.00   -5.56     7.4 0.455E+04   7.65     2.26 .67496E+01
      4.08     0.00   -5.56     7.4 0.453E+04   7.74     2.26 .68573E+01
      4.12     0.00   -5.56     7.4 0.451E+04   7.82     2.26 .69655E+01
      4.17     0.00   -5.56     7.5 0.449E+04   7.91     2.25 .70742E+01
      4.21     0.00   -5.56     7.5 0.447E+04   7.99     2.25 .71835E+01
      4.26     0.00   -5.55     7.5 0.445E+04   8.08     2.25 .72933E+01
      4.30     0.00   -5.55     7.6 0.443E+04   8.16     2.25 .74036E+01
      4.35     0.00   -5.55     7.6 0.441E+04   8.25     2.25 .75145E+01
      4.39     0.00   -5.55     7.6 0.439E+04   8.33     2.25 .76258E+01
      4.44     0.00   -5.55     7.7 0.437E+04   8.42     2.25 .77377E+01
      4.48     0.00   -5.55     7.7 0.435E+04   8.50     2.25 .78501E+01
 Cumulative travel time =           7.8501 sec  (    0.00 hrs)
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------
BEGIN MOD251: DIFFUSER PLUME IN CO-FLOW

 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      4.48     0.00   -8.50     7.7 0.435E+04   8.50     2.52 .78501E+01
     13.21     0.00   -8.50     9.0 0.371E+04   8.50     3.46 .82348E+02
     21.94     0.00   -8.50    10.2 0.329E+04   8.50     4.40 .16787E+03
     30.66     0.00   -8.50    11.2 0.298E+04   8.50     5.34 .26314E+03
     39.39     0.00   -8.50    12.2 0.275E+04   8.50     6.28 .36725E+03
     48.12     0.00   -8.50    13.1 0.256E+04   8.50     7.21 .47951E+03
     56.85     0.00   -8.50    13.9 0.241E+04   8.50     8.15 .59935E+03
     65.58     0.00   -8.50    14.7 0.228E+04   8.50     9.08 .72633E+03
     74.30     0.00   -8.50    15.4 0.217E+04   8.50    10.02 .86007E+03
     83.03     0.00   -8.50    16.1 0.208E+04   8.50    10.95 .10002E+04
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.200E+04 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     91.76     0.00   -8.50    16.8 0.199E+04   8.50    11.88 .11466E+04
 ** REGULATORY MIXING ZONE BOUNDARY is within the Near-Field Region **
  In this prediction interval the plume DOWNSTREAM distance meets or exceeds
  the regulatory value =   100.00 m.
  This is the extent of the REGULATORY MIXING ZONE.
    100.49     0.00   -8.50    17.5 0.192E+04   8.50    12.81 .12988E+04
    109.22     0.00   -8.50    18.1 0.185E+04   8.50    13.74 .14567E+04
    117.94     0.00   -8.50    18.7 0.179E+04   8.50    14.67 .16200E+04
    126.67     0.00   -8.50    19.3 0.174E+04   8.50    15.60 .17887E+04
    135.40     0.00   -8.50    19.8 0.169E+04   8.50    16.53 .19626E+04
    144.13     0.00   -8.50    20.4 0.164E+04   8.50    17.46 .21414E+04
    152.86     0.00   -8.50    20.9 0.160E+04   8.50    18.38 .23250E+04
    161.58     0.00   -8.50    21.5 0.156E+04   8.50    19.31 .25135E+04
    170.31     0.00   -8.50    22.0 0.152E+04   8.50    20.24 .27065E+04
    179.04     0.00   -8.50    22.5 0.149E+04   8.50    21.16 .29040E+04
    187.77     0.00   -8.50    23.0 0.146E+04   8.50    22.08 .31060E+04
```

**Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +2$^0$ C; Sheet D-5**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 196.50 | 0.00 | -8.50 | 23.5 | 0.143E+04 | 8.50 | 23.01 | .33122E+04 |
| 205.22 | 0.00 | -8.50 | 23.9 | 0.140E+04 | 8.50 | 23.93 | .35227E+04 |
| 213.95 | 0.00 | -8.50 | 24.4 | 0.137E+04 | 8.50 | 24.85 | .37373E+04 |
| 222.68 | 0.00 | -8.50 | 24.8 | 0.135E+04 | 8.50 | 25.77 | .39560E+04 |
| 231.41 | 0.00 | -8.50 | 25.3 | 0.132E+04 | 8.50 | 26.70 | .41787E+04 |
| 240.14 | 0.00 | -8.50 | 25.7 | 0.130E+04 | 8.50 | 27.62 | .44053E+04 |
| 248.86 | 0.00 | -8.50 | 26.2 | 0.128E+04 | 8.50 | 28.54 | .46358E+04 |
| 257.59 | 0.00 | -8.50 | 26.6 | 0.126E+04 | 8.50 | 29.46 | .48700E+04 |
| 266.32 | 0.00 | -8.50 | 27.0 | 0.124E+04 | 8.50 | 30.37 | .51080E+04 |
| 275.05 | 0.00 | -8.50 | 27.4 | 0.122E+04 | 8.50 | 31.29 | .53496E+04 |
| 283.78 | 0.00 | -8.50 | 27.8 | 0.120E+04 | 8.50 | 32.21 | .55949E+04 |
| 292.50 | 0.00 | -8.50 | 28.2 | 0.119E+04 | 8.50 | 33.13 | .58437E+04 |
| 301.23 | 0.00 | -8.50 | 28.6 | 0.117E+04 | 8.50 | 34.04 | .60961E+04 |
| 309.96 | 0.00 | -8.50 | 29.0 | 0.116E+04 | 8.50 | 34.96 | .63519E+04 |
| 318.69 | 0.00 | -8.50 | 29.4 | 0.114E+04 | 8.50 | 35.88 | .66111E+04 |
| 327.42 | 0.00 | -8.50 | 29.7 | 0.113E+04 | 8.50 | 36.79 | .68737E+04 |
| 336.14 | 0.00 | -8.50 | 30.1 | 0.111E+04 | 8.50 | 37.71 | .71396E+04 |
| 344.87 | 0.00 | -8.50 | 30.5 | 0.110E+04 | 8.50 | 38.62 | .74089E+04 |
| 353.60 | 0.00 | -8.50 | 30.8 | 0.109E+04 | 8.50 | 39.54 | .76814E+04 |
| 362.33 | 0.00 | -8.50 | 31.2 | 0.107E+04 | 8.50 | 40.45 | .79570E+04 |
| 371.06 | 0.00 | -8.50 | 31.6 | 0.106E+04 | 8.50 | 41.36 | .82359E+04 |
| 379.78 | 0.00 | -8.50 | 31.9 | 0.105E+04 | 8.50 | 42.28 | .85179E+04 |
| 388.51 | 0.00 | -8.50 | 32.3 | 0.104E+04 | 8.50 | 43.19 | .88030E+04 |
| 397.24 | 0.00 | -8.50 | 32.6 | 0.103E+04 | 8.50 | 44.10 | .90912E+04 |
| 405.97 | 0.00 | -8.50 | 32.9 | 0.102E+04 | 8.50 | 45.01 | .93824E+04 |
| 414.70 | 0.00 | -8.50 | 33.3 | 0.101E+04 | 8.50 | 45.92 | .96767E+04 |
| 423.42 | 0.00 | -8.50 | 33.6 | 0.996E+03 | 8.50 | 46.83 | .99739E+04 |
| 432.15 | 0.00 | -8.50 | 33.9 | 0.987E+03 | 8.50 | 47.74 | .10274E+05 |
| 440.88 | 0.00 | -8.50 | 34.3 | 0.977E+03 | 8.50 | 48.65 | .10577E+05 |
| 449.61 | 0.00 | -8.50 | 34.6 | 0.968E+03 | 8.50 | 49.56 | .10883E+05 |
| 458.34 | 0.00 | -8.50 | 34.9 | 0.959E+03 | 8.50 | 50.47 | .11192E+05 |
| 467.06 | 0.00 | -8.50 | 35.2 | 0.951E+03 | 8.50 | 51.38 | .11504E+05 |
| 475.79 | 0.00 | -8.50 | 35.6 | 0.942E+03 | 8.50 | 52.29 | .11818E+05 |
| 484.52 | 0.00 | -8.50 | 35.9 | 0.934E+03 | 8.50 | 53.20 | .12135E+05 |
| 493.25 | 0.00 | -8.50 | 36.2 | 0.926E+03 | 8.50 | 54.11 | .12455E+05 |
| 501.98 | 0.00 | -8.50 | 36.5 | 0.918E+03 | 8.50 | 55.01 | .12778E+05 |
| 510.70 | 0.00 | -8.50 | 36.8 | 0.911E+03 | 8.50 | 55.92 | .13104E+05 |
| 519.43 | 0.00 | -8.50 | 37.1 | 0.903E+03 | 8.50 | 56.83 | .13432E+05 |
| 528.16 | 0.00 | -8.50 | 37.4 | 0.896E+03 | 8.50 | 57.73 | .13763E+05 |
| 536.89 | 0.00 | -8.50 | 37.7 | 0.889E+03 | 8.50 | 58.64 | .14096E+05 |
| 545.62 | 0.00 | -8.50 | 38.0 | 0.882E+03 | 8.50 | 59.54 | .14432E+05 |
| 554.34 | 0.00 | -8.50 | 38.3 | 0.875E+03 | 8.50 | 60.45 | .14771E+05 |
| 563.07 | 0.00 | -8.50 | 38.6 | 0.869E+03 | 8.50 | 61.35 | .15112E+05 |
| 571.80 | 0.00 | -8.50 | 38.9 | 0.862E+03 | 8.50 | 62.26 | .15456E+05 |
| 580.53 | 0.00 | -8.50 | 39.1 | 0.856E+03 | 8.50 | 63.16 | .15803E+05 |
| 589.26 | 0.00 | -8.50 | 39.4 | 0.850E+03 | 8.50 | 64.07 | .16152E+05 |
| 597.98 | 0.00 | -8.50 | 39.7 | 0.844E+03 | 8.50 | 64.97 | .16503E+05 |
| 606.71 | 0.00 | -8.50 | 40.0 | 0.838E+03 | 8.50 | 65.87 | .16857E+05 |
| 615.44 | 0.00 | -8.50 | 40.3 | 0.832E+03 | 8.50 | 66.78 | .17214E+05 |
| 624.17 | 0.00 | -8.50 | 40.5 | 0.826E+03 | 8.50 | 67.68 | .17573E+05 |
| 632.90 | 0.00 | -8.50 | 40.8 | 0.821E+03 | 8.50 | 68.58 | .17934E+05 |
| 641.62 | 0.00 | -8.50 | 41.1 | 0.815E+03 | 8.50 | 69.48 | .18298E+05 |
| 650.35 | 0.00 | -8.50 | 41.4 | 0.810E+03 | 8.50 | 70.38 | .18664E+05 |
| 659.08 | 0.00 | -8.50 | 41.6 | 0.805E+03 | 8.50 | 71.28 | .19033E+05 |
| 667.81 | 0.00 | -8.50 | 41.9 | 0.800E+03 | 8.50 | 72.18 | .19404E+05 |
| 676.54 | 0.00 | -8.50 | 42.2 | 0.795E+03 | 8.50 | 73.08 | .19777E+05 |
| 685.26 | 0.00 | -8.50 | 42.4 | 0.790E+03 | 8.50 | 73.98 | .20153E+05 |
| 693.99 | 0.00 | -8.50 | 42.7 | 0.785E+03 | 8.50 | 74.88 | .20531E+05 |
| 702.72 | 0.00 | -8.50 | 42.9 | 0.780E+03 | 8.50 | 75.78 | .20911E+05 |
| 711.45 | 0.00 | -8.50 | 43.2 | 0.775E+03 | 8.50 | 76.68 | .21294E+05 |
| 720.18 | 0.00 | -8.50 | 43.5 | 0.771E+03 | 8.50 | 77.58 | .21679E+05 |
| 728.90 | 0.00 | -8.50 | 43.7 | 0.766E+03 | 8.50 | 78.48 | .22066E+05 |
| 737.63 | 0.00 | -8.50 | 44.0 | 0.762E+03 | 8.50 | 79.38 | .22456E+05 |
| 746.36 | 0.00 | -8.50 | 44.2 | 0.758E+03 | 8.50 | 80.28 | .22847E+05 |
| 755.09 | 0.00 | -8.50 | 44.5 | 0.753E+03 | 8.50 | 81.17 | .23242E+05 |
| 763.82 | 0.00 | -8.50 | 44.7 | 0.749E+03 | 8.50 | 82.07 | .23638E+05 |
| 772.54 | 0.00 | -8.50 | 45.0 | 0.745E+03 | 8.50 | 82.97 | .24036E+05 |
| 781.27 | 0.00 | -8.50 | 45.2 | 0.741E+03 | 8.50 | 83.87 | .24437E+05 |
| 790.00 | 0.00 | -8.50 | 45.5 | 0.737E+03 | 8.50 | 84.76 | .24840E+05 |

## Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +2$^0$ C; Sheet D-6

```
    798.73     0.00   -8.50    45.7 0.733E+03   8.50    85.66 .25245E+05
    807.46     0.00   -8.50    46.0 0.729E+03   8.50    86.55 .25652E+05
    816.18     0.00   -8.50    46.2 0.725E+03   8.50    87.45 .26061E+05
    824.91     0.00   -8.50    46.4 0.721E+03   8.50    88.34 .26473E+05
    833.64     0.00   -8.50    46.7 0.718E+03   8.50    89.24 .26887E+05
    842.37     0.00   -8.50    46.9 0.714E+03   8.50    90.13 .27302E+05
    851.10     0.00   -8.50    47.2 0.710E+03   8.50    91.03 .27720E+05
    859.83     0.00   -8.50    47.4 0.707E+03   8.50    91.92 .28140E+05
    868.55     0.00   -8.50    47.6 0.703E+03   8.50    92.82 .28562E+05
    877.28     0.00   -8.50    47.9 0.700E+03   8.50    93.71 .28986E+05
 Cumulative travel time =       28986.3965 sec  (    8.05 hrs)

 Entire region is occupied by Phase 1.
   Plume does not re-stratify in this flow region.

END OF MOD251: DIFFUSER PLUME IN CO-FLOW
-----------------------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 SIMULATION STOPS because of STAGNANT AMBIENT conditions.
   All far-field processes will be UNSTEADY.
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
D-CORMIX      End of Prediction File
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

**Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +2$^0$ C; Sheet D-7**

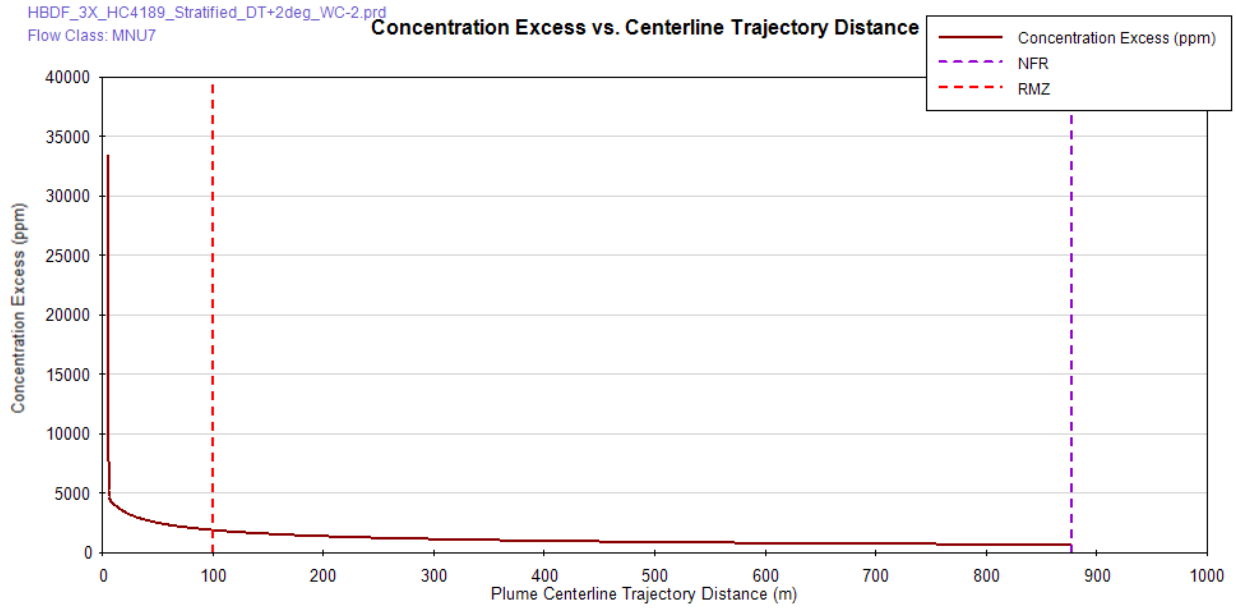



**Figure D-1:** Excess Salinity in ppm as a function of centerline trajectory distance for Worst-Case #2, $\Delta T$ = +2$^0$ C.

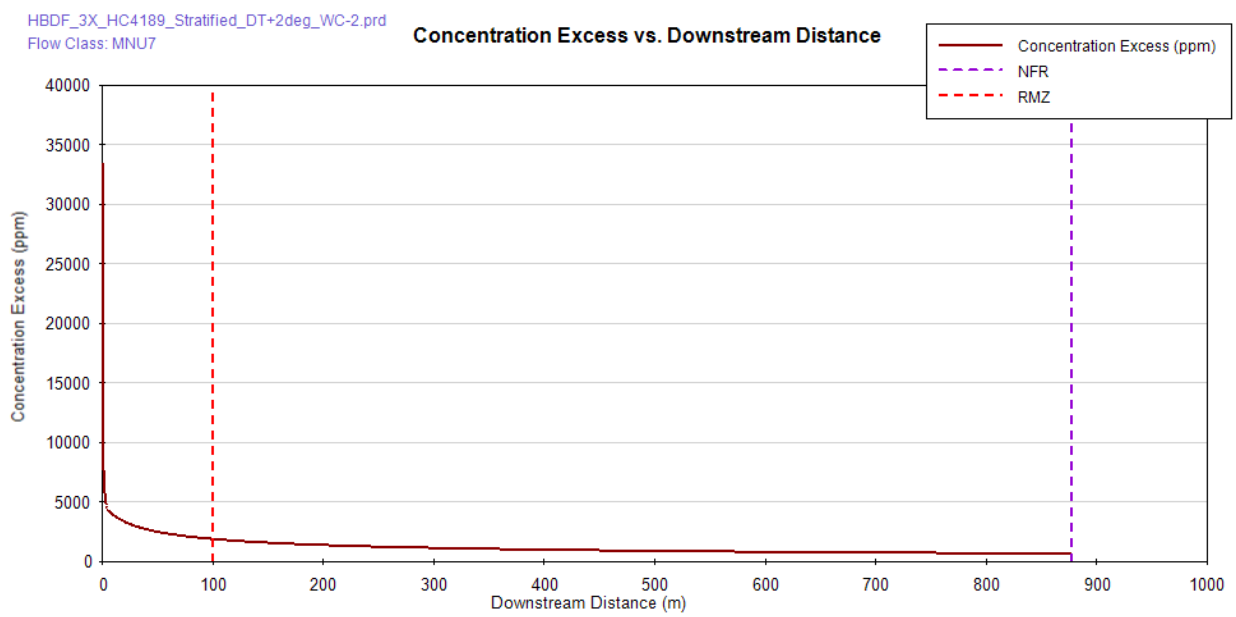



**Figure D-2:** Excess Salinity in ppm as a function of distance downstream for Worst-Case #2, $\Delta T$ = +2$^0$ C

**Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +2$^0$ C; Sheet D-8**

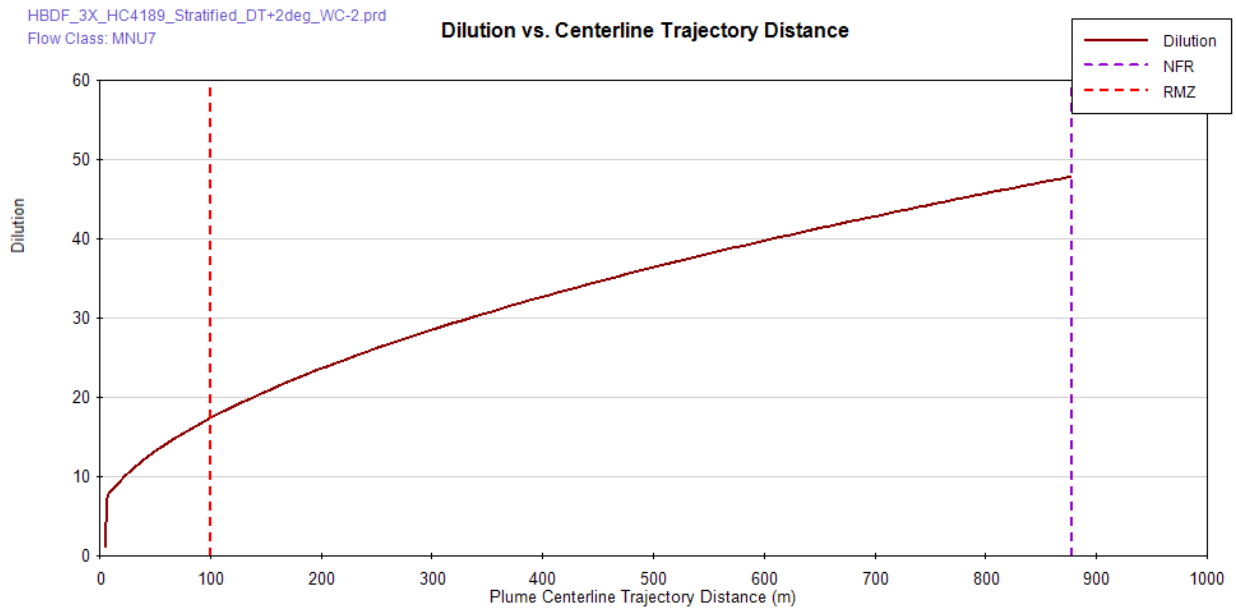



**Figure D-3:** Dilution expressed as mixing ratio, S**,** as a function of centerline trajectory distance for Worst-Case #2, $\Delta T$ = +2$^0$ C. Note S = 1 + Dm

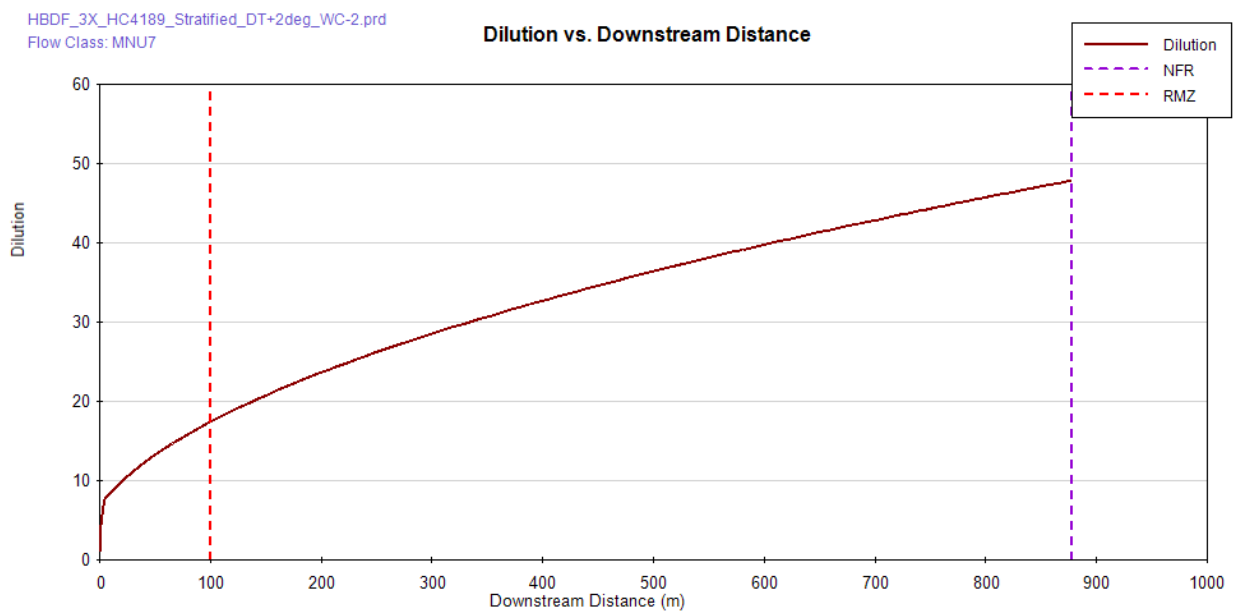



**Figure D-4:** Dilution expressed as mixing ratio, S**,** as a function of distance downstream for Worst-Case #2, $\Delta T$ = +2$^0$ C. Note S = 1 + Dm

## Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T = +0^0$ C; Sheet D-9

```
D-CORMIX PREDICTION FILE:
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
               D-CORMIX: CORMIX MIXING ZONE EXPERT SYSTEM
                      BRINE DISCHARGE SUB-SYSTEM
                 Subsystem CORMIX2: Multi Port Discharge
                      CORMIX Version 10.0GTH
                   DHYDRO Version 10.0.3.0 December 2017
---------------------------------------------------------------------------------------------
---------------------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   HBDF Huntington Beach
 Design case:       Alden 3- Port Duckbill
 FILE NAME:         C:\...17_fix\HBDF_3X_HC4189_Stratified_DT_0deg_WC-2.prd
 Time stamp:        11/28/2017--16:29:00

COASTAL ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 Single (constant) offshore slope:
 SLOPE =  1.06 deg. UA    =     0.000  F     =      0.020 USTAR =0.5000E-07
 UW    =      0.000 UWSTAR=0.0000E+00
 Density stratified (non-uniform) environment:
 STRCND=  N         RHOAM = 1022.7365  RHOAH0= 1022.7365  RHOAHD= 1023.4730
 LEVDEN=  1         RHOAS = 1022.0000
 SUB1  =      8.50  RHOA1 = 1023.4730  EPS1  =0.1663E-02

DISCHARGE PARAMETERS (metric units) for multi_port_diffuser
 BANK  =  LEFT      DISTB =    461.48  HD    =      8.50  LEVDIS=  1
 Diffuser type:     DITYPE= unidirectional_perpendicular
 LD    =      8.96  NOPEN  =   3       SPAC =      4.48
 YB1   =    457.00  YB2    = 465.96
 Nozzle/port arrangement:   unidirectional_with_fanning
 D0    =      0.478 A0    =      0.179 H0    =      2.80  SUB0 =      5.70
 D0INP =      0.478 CR0   =      1.000
 GAMMA =     90.00  THETA =     47.00  SIGMA =      0.00  BETA  =     90.00
 U0    =      4.395 Q0    =      2.366 Q0A    =0.2366E+01
 RHO0  = 1050.7000  DRHO0 =-.2796E+02  RHOCW = 1050.7000  GP0   =-.2681E+00
 C0    =0.3350E+05  CUNITS=  ppm
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00


FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.2641E+00  m0    =0.7736E+00  j0    =-.4720E-01  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.060 lM    =      3.27  lm    =  99999.00
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.2366E+01  M0    =0.6932E+01  J0    =-.4229E+00
 Associated 3-d length scales (meters)
 LQ    =      0.42  LM    =  99999.00  Lm    =  99999.00  Lb    =  99999.00
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     42.41  FRD0  =     12.28  R     =  99999.00  PL    =  140.00
 (slot)             (port/nozzle)

RECOMPUTED SOURCE CONDITIONS FOR RISER GROUPS:
 Properties of riser group with  1 ports/nozzles each:
 U0    =      4.395 D0    =      0.478 A0    =      0.179 THETA =     47.00
 FR0   =     42.41  FRD0  =     12.28  R     =  99999.00
 (slot)             (riser group)

FLOW CLASSIFICATION
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
 D  Flow class (D-CORMIX)     =    MNU7     D
 D  Applicable layer depth HS =     8.50    D
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

## Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +0$^0$ C; Sheet D-10

```
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.3350E+05  CUNITS=  ppm
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2000E+04
 REGMZ =  1
 REGSPC=  1         XREG  =    100.00  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE an at the diffuser mid-point:
       461.48 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =100 display intervals per module
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   Uc = Local centerline excess velocity (above ambient)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH       Uc        TT
      0.00     0.00   -5.70     1.0 0.335E+05   0.03     4.48     4.395   .00000E+00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER

 Because of the FANNED-OUT HORIZONTAL ORIENTATION of the diffuser jets,
   the near-field dilution is slightly improved.

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =    8.50m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00   -5.70     1.0 0.335E+05   0.03     4.48 .00000E+00
      0.04     0.00   -5.70     1.7 0.201E+05   0.08     4.41 .17025E-01
      0.09     0.00   -5.70     1.9 0.172E+05   0.17     4.35 .39708E-01
      0.13     0.00   -5.70     2.2 0.155E+05   0.25     4.29 .66076E-01
      0.18     0.00   -5.69     2.3 0.143E+05   0.34     4.23 .95422E-01
      0.22     0.00   -5.69     2.5 0.134E+05   0.42     4.17 .12734E+00
      0.27     0.00   -5.69     2.6 0.127E+05   0.51     4.11 .16155E+00
      0.31     0.00   -5.69     2.8 0.121E+05   0.60     4.06 .19787E+00
      0.36     0.00   -5.69     2.9 0.116E+05   0.68     4.00 .23611E+00
      0.40     0.00   -5.69     3.0 0.111E+05   0.76     3.95 .27618E+00
      0.45     0.00   -5.68     3.1 0.107E+05   0.85     3.90 .31795E+00
      0.49     0.00   -5.68     3.2 0.104E+05   0.93     3.85 .36134E+00
      0.54     0.00   -5.68     3.3 0.101E+05   1.02     3.80 .40628E+00
      0.58     0.00   -5.68     3.4 0.981E+04   1.10     3.76 .45269E+00
      0.63     0.00   -5.68     3.5 0.955E+04   1.19     3.71 .50053E+00
      0.67     0.00   -5.68     3.6 0.932E+04   1.27     3.67 .54974E+00
      0.72     0.00   -5.68     3.7 0.910E+04   1.36     3.62 .60027E+00
```

**Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +0$^0$ C; Sheet D-11**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.76 | 0.00 | -5.67 | 3.8 | 0.890E+04 | 1.44 | 3.58 | .65208E+00 |
| 0.81 | 0.00 | -5.67 | 3.8 | 0.872E+04 | 1.53 | 3.54 | .70514E+00 |
| 0.85 | 0.00 | -5.67 | 3.9 | 0.854E+04 | 1.61 | 3.50 | .75940E+00 |
| 0.90 | 0.00 | -5.67 | 4.0 | 0.838E+04 | 1.70 | 3.46 | .81484E+00 |
| 0.94 | 0.00 | -5.67 | 4.1 | 0.823E+04 | 1.78 | 3.43 | .87142E+00 |
| 0.99 | 0.00 | -5.67 | 4.1 | 0.809E+04 | 1.87 | 3.39 | .92912E+00 |
| 1.03 | 0.00 | -5.66 | 4.2 | 0.795E+04 | 1.95 | 3.35 | .98792E+00 |
| 1.08 | 0.00 | -5.66 | 4.3 | 0.782E+04 | 2.04 | 3.32 | .10478E+01 |
| 1.12 | 0.00 | -5.66 | 4.4 | 0.770E+04 | 2.12 | 3.29 | .11087E+01 |
| 1.16 | 0.00 | -5.66 | 4.4 | 0.758E+04 | 2.21 | 3.25 | .11706E+01 |
| 1.21 | 0.00 | -5.66 | 4.5 | 0.747E+04 | 2.30 | 3.22 | .12336E+01 |
| 1.25 | 0.00 | -5.66 | 4.5 | 0.737E+04 | 2.38 | 3.19 | .12975E+01 |
| 1.30 | 0.00 | -5.66 | 4.6 | 0.727E+04 | 2.47 | 3.16 | .13624E+01 |
| 1.34 | 0.00 | -5.65 | 4.7 | 0.717E+04 | 2.55 | 3.13 | .14282E+01 |
| 1.39 | 0.00 | -5.65 | 4.7 | 0.708E+04 | 2.64 | 3.10 | .14950E+01 |
| 1.43 | 0.00 | -5.65 | 4.8 | 0.699E+04 | 2.72 | 3.07 | .15627E+01 |
| 1.48 | 0.00 | -5.65 | 4.8 | 0.691E+04 | 2.81 | 3.04 | .16313E+01 |
| 1.52 | 0.00 | -5.65 | 4.9 | 0.683E+04 | 2.89 | 3.02 | .17008E+01 |
| 1.57 | 0.00 | -5.65 | 5.0 | 0.675E+04 | 2.98 | 2.99 | .17712E+01 |
| 1.61 | 0.00 | -5.64 | 5.0 | 0.667E+04 | 3.06 | 2.96 | .18424E+01 |
| 1.66 | 0.00 | -5.64 | 5.1 | 0.660E+04 | 3.15 | 2.94 | .19145E+01 |
| 1.70 | 0.00 | -5.64 | 5.1 | 0.653E+04 | 3.23 | 2.91 | .19875E+01 |
| 1.75 | 0.00 | -5.64 | 5.2 | 0.646E+04 | 3.32 | 2.89 | .20612E+01 |
| 1.79 | 0.00 | -5.64 | 5.2 | 0.640E+04 | 3.40 | 2.86 | .21358E+01 |
| 1.84 | 0.00 | -5.64 | 5.3 | 0.633E+04 | 3.49 | 2.84 | .22112E+01 |
| 1.88 | 0.00 | -5.64 | 5.3 | 0.627E+04 | 3.57 | 2.82 | .22874E+01 |
| 1.93 | 0.00 | -5.63 | 5.4 | 0.621E+04 | 3.66 | 2.80 | .23644E+01 |
| 1.97 | 0.00 | -5.63 | 5.4 | 0.615E+04 | 3.74 | 2.77 | .24422E+01 |
| 2.02 | 0.00 | -5.63 | 5.5 | 0.610E+04 | 3.83 | 2.75 | .25207E+01 |
| 2.06 | 0.00 | -5.63 | 5.5 | 0.604E+04 | 3.91 | 2.73 | .26000E+01 |
| 2.11 | 0.00 | -5.63 | 5.6 | 0.599E+04 | 4.00 | 2.71 | .26801E+01 |
| 2.15 | 0.00 | -5.63 | 5.6 | 0.594E+04 | 4.08 | 2.69 | .27609E+01 |
| 2.20 | 0.00 | -5.63 | 5.7 | 0.589E+04 | 4.17 | 2.67 | .28424E+01 |
| 2.24 | 0.00 | -5.62 | 5.7 | 0.584E+04 | 4.25 | 2.65 | .29247E+01 |
| 2.28 | 0.00 | -5.62 | 5.8 | 0.579E+04 | 4.34 | 2.64 | .30077E+01 |
| 2.33 | 0.00 | -5.62 | 5.8 | 0.574E+04 | 4.42 | 2.62 | .30915E+01 |
| 2.37 | 0.00 | -5.62 | 5.9 | 0.570E+04 | 4.51 | 2.60 | .31759E+01 |
| 2.42 | 0.00 | -5.62 | 5.9 | 0.566E+04 | 4.59 | 2.58 | .32610E+01 |
| 2.46 | 0.00 | -5.62 | 6.0 | 0.561E+04 | 4.68 | 2.57 | .33469E+01 |
| 2.51 | 0.00 | -5.61 | 6.0 | 0.557E+04 | 4.76 | 2.55 | .34334E+01 |
| 2.55 | 0.00 | -5.61 | 6.1 | 0.553E+04 | 4.85 | 2.54 | .35206E+01 |
| 2.60 | 0.00 | -5.61 | 6.1 | 0.549E+04 | 4.93 | 2.52 | .36085E+01 |
| 2.64 | 0.00 | -5.61 | 6.1 | 0.545E+04 | 5.02 | 2.51 | .36970E+01 |
| 2.69 | 0.00 | -5.61 | 6.2 | 0.541E+04 | 5.10 | 2.49 | .37863E+01 |
| 2.73 | 0.00 | -5.61 | 6.2 | 0.537E+04 | 5.19 | 2.48 | .38762E+01 |
| 2.78 | 0.00 | -5.61 | 6.3 | 0.534E+04 | 5.27 | 2.46 | .39667E+01 |
| 2.82 | 0.00 | -5.60 | 6.3 | 0.530E+04 | 5.36 | 2.45 | .40579E+01 |
| 2.87 | 0.00 | -5.60 | 6.4 | 0.527E+04 | 5.44 | 2.44 | .41497E+01 |
| 2.91 | 0.00 | -5.60 | 6.4 | 0.523E+04 | 5.53 | 2.43 | .42422E+01 |
| 2.96 | 0.00 | -5.60 | 6.4 | 0.520E+04 | 5.61 | 2.42 | .43353E+01 |
| 3.00 | 0.00 | -5.60 | 6.5 | 0.517E+04 | 5.70 | 2.40 | .44291E+01 |
| 3.05 | 0.00 | -5.60 | 6.5 | 0.513E+04 | 5.78 | 2.39 | .45235E+01 |
| 3.09 | 0.00 | -5.59 | 6.6 | 0.510E+04 | 5.87 | 2.38 | .46185E+01 |
| 3.14 | 0.00 | -5.59 | 6.6 | 0.507E+04 | 5.95 | 2.37 | .47141E+01 |
| 3.18 | 0.00 | -5.59 | 6.6 | 0.504E+04 | 6.04 | 2.36 | .48103E+01 |
| 3.23 | 0.00 | -5.59 | 6.7 | 0.501E+04 | 6.12 | 2.36 | .49071E+01 |
| 3.27 | 0.00 | -5.59 | 6.7 | 0.498E+04 | 6.21 | 2.35 | .50046E+01 |
| 3.32 | 0.00 | -5.59 | 6.8 | 0.495E+04 | 6.29 | 2.34 | .51026E+01 |
| 3.36 | 0.00 | -5.59 | 6.8 | 0.492E+04 | 6.38 | 2.33 | .52012E+01 |
| 3.40 | 0.00 | -5.58 | 6.8 | 0.490E+04 | 6.46 | 2.32 | .53005E+01 |
| 3.45 | 0.00 | -5.58 | 6.9 | 0.487E+04 | 6.55 | 2.32 | .54003E+01 |
| 3.49 | 0.00 | -5.58 | 6.9 | 0.484E+04 | 6.63 | 2.31 | .55007E+01 |
| 3.54 | 0.00 | -5.58 | 7.0 | 0.482E+04 | 6.72 | 2.31 | .56016E+01 |
| 3.58 | 0.00 | -5.58 | 7.0 | 0.479E+04 | 6.80 | 2.30 | .57032E+01 |
| 3.63 | 0.00 | -5.58 | 7.0 | 0.476E+04 | 6.89 | 2.29 | .58053E+01 |
| 3.67 | 0.00 | -5.57 | 7.1 | 0.474E+04 | 6.97 | 2.29 | .59080E+01 |
| 3.72 | 0.00 | -5.57 | 7.1 | 0.472E+04 | 7.06 | 2.28 | .60113E+01 |
| 3.76 | 0.00 | -5.57 | 7.1 | 0.469E+04 | 7.14 | 2.28 | .61151E+01 |
| 3.81 | 0.00 | -5.57 | 7.2 | 0.467E+04 | 7.23 | 2.28 | .62195E+01 |

## Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +0$^0$ C; Sheet D-12

```
      3.85     0.00   -5.57     7.2 0.464E+04   7.31     2.27 .63244E+01
      3.90     0.00   -5.57     7.2 0.462E+04   7.40     2.27 .64299E+01
      3.94     0.00   -5.57     7.3 0.460E+04   7.48     2.27 .65359E+01
      3.99     0.00   -5.56     7.3 0.458E+04   7.57     2.26 .66425E+01
      4.03     0.00   -5.56     7.4 0.455E+04   7.65     2.26 .67496E+01
      4.08     0.00   -5.56     7.4 0.453E+04   7.74     2.26 .68573E+01
      4.12     0.00   -5.56     7.4 0.451E+04   7.82     2.26 .69655E+01
      4.17     0.00   -5.56     7.5 0.449E+04   7.91     2.25 .70742E+01
      4.21     0.00   -5.56     7.5 0.447E+04   7.99     2.25 .71835E+01
      4.26     0.00   -5.55     7.5 0.445E+04   8.08     2.25 .72933E+01
      4.30     0.00   -5.55     7.6 0.443E+04   8.16     2.25 .74036E+01
      4.35     0.00   -5.55     7.6 0.441E+04   8.25     2.25 .75145E+01
      4.39     0.00   -5.55     7.6 0.439E+04   8.33     2.25 .76258E+01
      4.44     0.00   -5.55     7.7 0.437E+04   8.42     2.25 .77377E+01
      4.48     0.00   -5.55     7.7 0.435E+04   8.50     2.25 .78501E+01
 Cumulative travel time =           7.8501 sec  (    0.00 hrs)
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------
BEGIN MOD251: DIFFUSER PLUME IN CO-FLOW

 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      4.48     0.00   -8.50     7.7 0.435E+04   8.50     2.52 .78501E+01
     13.21     0.00   -8.50     9.0 0.371E+04   8.50     3.46 .82348E+02
     21.94     0.00   -8.50    10.2 0.329E+04   8.50     4.40 .16787E+03
     30.66     0.00   -8.50    11.2 0.298E+04   8.50     5.34 .26314E+03
     39.39     0.00   -8.50    12.2 0.275E+04   8.50     6.28 .36725E+03
     48.12     0.00   -8.50    13.1 0.256E+04   8.50     7.21 .47951E+03
     56.85     0.00   -8.50    13.9 0.241E+04   8.50     8.15 .59935E+03
     65.58     0.00   -8.50    14.7 0.228E+04   8.50     9.08 .72633E+03
     74.30     0.00   -8.50    15.4 0.217E+04   8.50    10.02 .86007E+03
     83.03     0.00   -8.50    16.1 0.208E+04   8.50    10.95 .10002E+04
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.200E+04 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     91.76     0.00   -8.50    16.8 0.199E+04   8.50    11.88 .11466E+04
 ** REGULATORY MIXING ZONE BOUNDARY is within the Near-Field Region **
  In this prediction interval the plume DOWNSTREAM distance meets or exceeds
  the regulatory value =   100.00 m.
  This is the extent of the REGULATORY MIXING ZONE.
    100.49     0.00   -8.50    17.5 0.192E+04   8.50    12.81 .12988E+04
    109.22     0.00   -8.50    18.1 0.185E+04   8.50    13.74 .14567E+04
    117.94     0.00   -8.50    18.7 0.179E+04   8.50    14.67 .16200E+04
    126.67     0.00   -8.50    19.3 0.174E+04   8.50    15.60 .17887E+04
    135.40     0.00   -8.50    19.8 0.169E+04   8.50    16.53 .19626E+04
    144.13     0.00   -8.50    20.4 0.164E+04   8.50    17.46 .21414E+04
    152.86     0.00   -8.50    20.9 0.160E+04   8.50    18.38 .23250E+04
    161.58     0.00   -8.50    21.5 0.156E+04   8.50    19.31 .25135E+04
    170.31     0.00   -8.50    22.0 0.152E+04   8.50    20.24 .27065E+04
    179.04     0.00   -8.50    22.5 0.149E+04   8.50    21.16 .29040E+04
    187.77     0.00   -8.50    23.0 0.146E+04   8.50    22.08 .31060E+04
```

**Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +0$^0$ C; Sheet D-13**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 196.50 | 0.00 | -8.50 | 23.5 | 0.143E+04 | 8.50 | 23.01 | .33122E+04 |
| 205.22 | 0.00 | -8.50 | 23.9 | 0.140E+04 | 8.50 | 23.93 | .35227E+04 |
| 213.95 | 0.00 | -8.50 | 24.4 | 0.137E+04 | 8.50 | 24.85 | .37373E+04 |
| 222.68 | 0.00 | -8.50 | 24.8 | 0.135E+04 | 8.50 | 25.77 | .39560E+04 |
| 231.41 | 0.00 | -8.50 | 25.3 | 0.132E+04 | 8.50 | 26.70 | .41787E+04 |
| 240.14 | 0.00 | -8.50 | 25.7 | 0.130E+04 | 8.50 | 27.62 | .44053E+04 |
| 248.86 | 0.00 | -8.50 | 26.2 | 0.128E+04 | 8.50 | 28.54 | .46358E+04 |
| 257.59 | 0.00 | -8.50 | 26.6 | 0.126E+04 | 8.50 | 29.46 | .48700E+04 |
| 266.32 | 0.00 | -8.50 | 27.0 | 0.124E+04 | 8.50 | 30.37 | .51080E+04 |
| 275.05 | 0.00 | -8.50 | 27.4 | 0.122E+04 | 8.50 | 31.29 | .53496E+04 |
| 283.78 | 0.00 | -8.50 | 27.8 | 0.120E+04 | 8.50 | 32.21 | .55949E+04 |
| 292.50 | 0.00 | -8.50 | 28.2 | 0.119E+04 | 8.50 | 33.13 | .58437E+04 |
| 301.23 | 0.00 | -8.50 | 28.6 | 0.117E+04 | 8.50 | 34.04 | .60961E+04 |
| 309.96 | 0.00 | -8.50 | 29.0 | 0.116E+04 | 8.50 | 34.96 | .63519E+04 |
| 318.69 | 0.00 | -8.50 | 29.4 | 0.114E+04 | 8.50 | 35.88 | .66111E+04 |
| 327.42 | 0.00 | -8.50 | 29.7 | 0.113E+04 | 8.50 | 36.79 | .68737E+04 |
| 336.14 | 0.00 | -8.50 | 30.1 | 0.111E+04 | 8.50 | 37.71 | .71396E+04 |
| 344.87 | 0.00 | -8.50 | 30.5 | 0.110E+04 | 8.50 | 38.62 | .74089E+04 |
| 353.60 | 0.00 | -8.50 | 30.8 | 0.109E+04 | 8.50 | 39.54 | .76814E+04 |
| 362.33 | 0.00 | -8.50 | 31.2 | 0.107E+04 | 8.50 | 40.45 | .79570E+04 |
| 371.06 | 0.00 | -8.50 | 31.6 | 0.106E+04 | 8.50 | 41.36 | .82359E+04 |
| 379.78 | 0.00 | -8.50 | 31.9 | 0.105E+04 | 8.50 | 42.28 | .85179E+04 |
| 388.51 | 0.00 | -8.50 | 32.3 | 0.104E+04 | 8.50 | 43.19 | .88030E+04 |
| 397.24 | 0.00 | -8.50 | 32.6 | 0.103E+04 | 8.50 | 44.10 | .90912E+04 |
| 405.97 | 0.00 | -8.50 | 32.9 | 0.102E+04 | 8.50 | 45.01 | .93824E+04 |
| 414.70 | 0.00 | -8.50 | 33.3 | 0.101E+04 | 8.50 | 45.92 | .96767E+04 |
| 423.42 | 0.00 | -8.50 | 33.6 | 0.996E+03 | 8.50 | 46.83 | .99739E+04 |
| 432.15 | 0.00 | -8.50 | 33.9 | 0.987E+03 | 8.50 | 47.74 | .10274E+05 |
| 440.88 | 0.00 | -8.50 | 34.3 | 0.977E+03 | 8.50 | 48.65 | .10577E+05 |
| 449.61 | 0.00 | -8.50 | 34.6 | 0.968E+03 | 8.50 | 49.56 | .10883E+05 |
| 458.34 | 0.00 | -8.50 | 34.9 | 0.959E+03 | 8.50 | 50.47 | .11192E+05 |
| 467.06 | 0.00 | -8.50 | 35.2 | 0.951E+03 | 8.50 | 51.38 | .11504E+05 |
| 475.79 | 0.00 | -8.50 | 35.6 | 0.942E+03 | 8.50 | 52.29 | .11818E+05 |
| 484.52 | 0.00 | -8.50 | 35.9 | 0.934E+03 | 8.50 | 53.20 | .12135E+05 |
| 493.25 | 0.00 | -8.50 | 36.2 | 0.926E+03 | 8.50 | 54.11 | .12455E+05 |
| 501.98 | 0.00 | -8.50 | 36.5 | 0.918E+03 | 8.50 | 55.01 | .12778E+05 |
| 510.70 | 0.00 | -8.50 | 36.8 | 0.911E+03 | 8.50 | 55.92 | .13104E+05 |
| 519.43 | 0.00 | -8.50 | 37.1 | 0.903E+03 | 8.50 | 56.83 | .13432E+05 |
| 528.16 | 0.00 | -8.50 | 37.4 | 0.896E+03 | 8.50 | 57.73 | .13763E+05 |
| 536.89 | 0.00 | -8.50 | 37.7 | 0.889E+03 | 8.50 | 58.64 | .14096E+05 |
| 545.62 | 0.00 | -8.50 | 38.0 | 0.882E+03 | 8.50 | 59.54 | .14432E+05 |
| 554.34 | 0.00 | -8.50 | 38.3 | 0.875E+03 | 8.50 | 60.45 | .14771E+05 |
| 563.07 | 0.00 | -8.50 | 38.6 | 0.869E+03 | 8.50 | 61.35 | .15112E+05 |
| 571.80 | 0.00 | -8.50 | 38.9 | 0.862E+03 | 8.50 | 62.26 | .15456E+05 |
| 580.53 | 0.00 | -8.50 | 39.1 | 0.856E+03 | 8.50 | 63.16 | .15803E+05 |
| 589.26 | 0.00 | -8.50 | 39.4 | 0.850E+03 | 8.50 | 64.07 | .16152E+05 |
| 597.98 | 0.00 | -8.50 | 39.7 | 0.844E+03 | 8.50 | 64.97 | .16503E+05 |
| 606.71 | 0.00 | -8.50 | 40.0 | 0.838E+03 | 8.50 | 65.87 | .16857E+05 |
| 615.44 | 0.00 | -8.50 | 40.3 | 0.832E+03 | 8.50 | 66.78 | .17214E+05 |
| 624.17 | 0.00 | -8.50 | 40.5 | 0.826E+03 | 8.50 | 67.68 | .17573E+05 |
| 632.90 | 0.00 | -8.50 | 40.8 | 0.821E+03 | 8.50 | 68.58 | .17934E+05 |
| 641.62 | 0.00 | -8.50 | 41.1 | 0.815E+03 | 8.50 | 69.48 | .18298E+05 |
| 650.35 | 0.00 | -8.50 | 41.4 | 0.810E+03 | 8.50 | 70.38 | .18664E+05 |
| 659.08 | 0.00 | -8.50 | 41.6 | 0.805E+03 | 8.50 | 71.28 | .19033E+05 |
| 667.81 | 0.00 | -8.50 | 41.9 | 0.800E+03 | 8.50 | 72.18 | .19404E+05 |
| 676.54 | 0.00 | -8.50 | 42.2 | 0.795E+03 | 8.50 | 73.08 | .19777E+05 |
| 685.26 | 0.00 | -8.50 | 42.4 | 0.790E+03 | 8.50 | 73.98 | .20153E+05 |
| 693.99 | 0.00 | -8.50 | 42.7 | 0.785E+03 | 8.50 | 74.88 | .20531E+05 |
| 702.72 | 0.00 | -8.50 | 42.9 | 0.780E+03 | 8.50 | 75.78 | .20911E+05 |
| 711.45 | 0.00 | -8.50 | 43.2 | 0.775E+03 | 8.50 | 76.68 | .21294E+05 |
| 720.18 | 0.00 | -8.50 | 43.5 | 0.771E+03 | 8.50 | 77.58 | .21679E+05 |
| 728.90 | 0.00 | -8.50 | 43.7 | 0.766E+03 | 8.50 | 78.48 | .22066E+05 |
| 737.63 | 0.00 | -8.50 | 44.0 | 0.762E+03 | 8.50 | 79.38 | .22456E+05 |
| 746.36 | 0.00 | -8.50 | 44.2 | 0.758E+03 | 8.50 | 80.28 | .22847E+05 |
| 755.09 | 0.00 | -8.50 | 44.5 | 0.753E+03 | 8.50 | 81.17 | .23242E+05 |
| 763.82 | 0.00 | -8.50 | 44.7 | 0.749E+03 | 8.50 | 82.07 | .23638E+05 |
| 772.54 | 0.00 | -8.50 | 45.0 | 0.745E+03 | 8.50 | 82.97 | .24036E+05 |
| 781.27 | 0.00 | -8.50 | 45.2 | 0.741E+03 | 8.50 | 83.87 | .24437E+05 |
| 790.00 | 0.00 | -8.50 | 45.5 | 0.737E+03 | 8.50 | 84.76 | .24840E+05 |

**Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +0$^0$ C; Sheet D-14**

```
    798.73     0.00   -8.50    45.7 0.733E+03   8.50    85.66 .25245E+05
    807.46     0.00   -8.50    46.0 0.729E+03   8.50    86.55 .25652E+05
    816.18     0.00   -8.50    46.2 0.725E+03   8.50    87.45 .26061E+05
    824.91     0.00   -8.50    46.4 0.721E+03   8.50    88.34 .26473E+05
    833.64     0.00   -8.50    46.7 0.718E+03   8.50    89.24 .26887E+05
    842.37     0.00   -8.50    46.9 0.714E+03   8.50    90.13 .27302E+05
    851.10     0.00   -8.50    47.2 0.710E+03   8.50    91.03 .27720E+05
    859.83     0.00   -8.50    47.4 0.707E+03   8.50    91.92 .28140E+05
    868.55     0.00   -8.50    47.6 0.703E+03   8.50    92.82 .28562E+05
    877.28     0.00   -8.50    47.9 0.700E+03   8.50    93.71 .28986E+05
 Cumulative travel time =       28986.3965 sec  (    8.05 hrs)

 Entire region is occupied by Phase 1.
   Plume does not re-stratify in this flow region.

END OF MOD251: DIFFUSER PLUME IN CO-FLOW
-----------------------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 SIMULATION STOPS because of STAGNANT AMBIENT conditions.
   All far-field processes will be UNSTEADY.
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
D-CORMIX      End of Prediction File
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

**Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = +0$^0$ C; Sheet D-15**

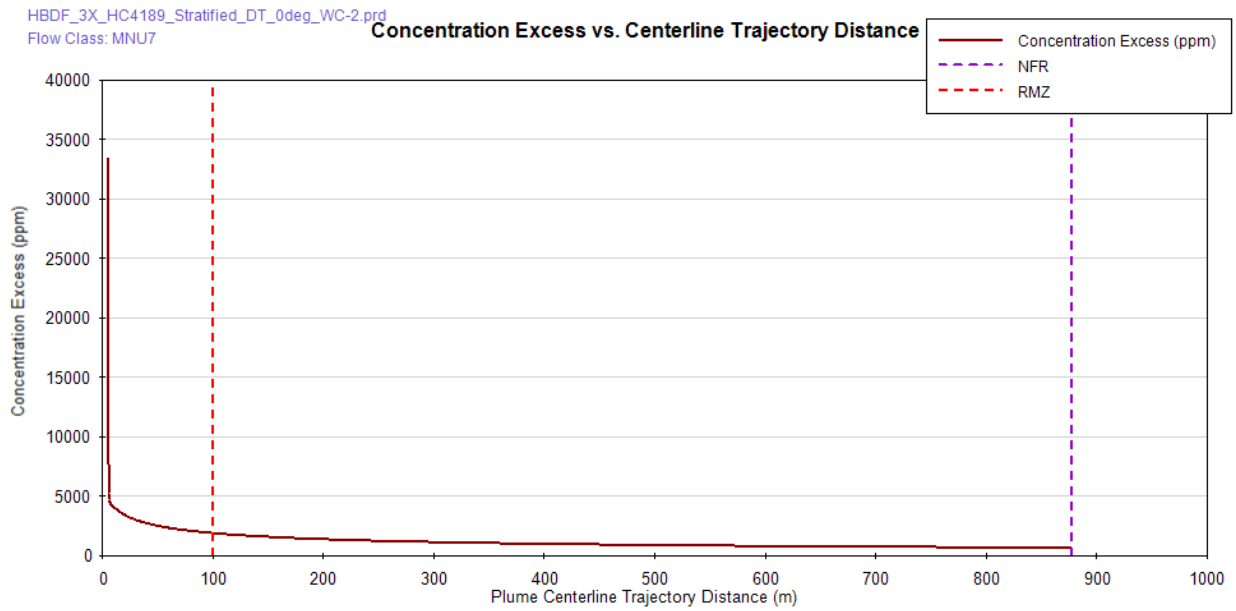



**Figure D-5:** Excess Salinity in ppm as a function of centerline trajectory distance for Worst-Case #2, $\Delta T$ = +0$^0$ C.

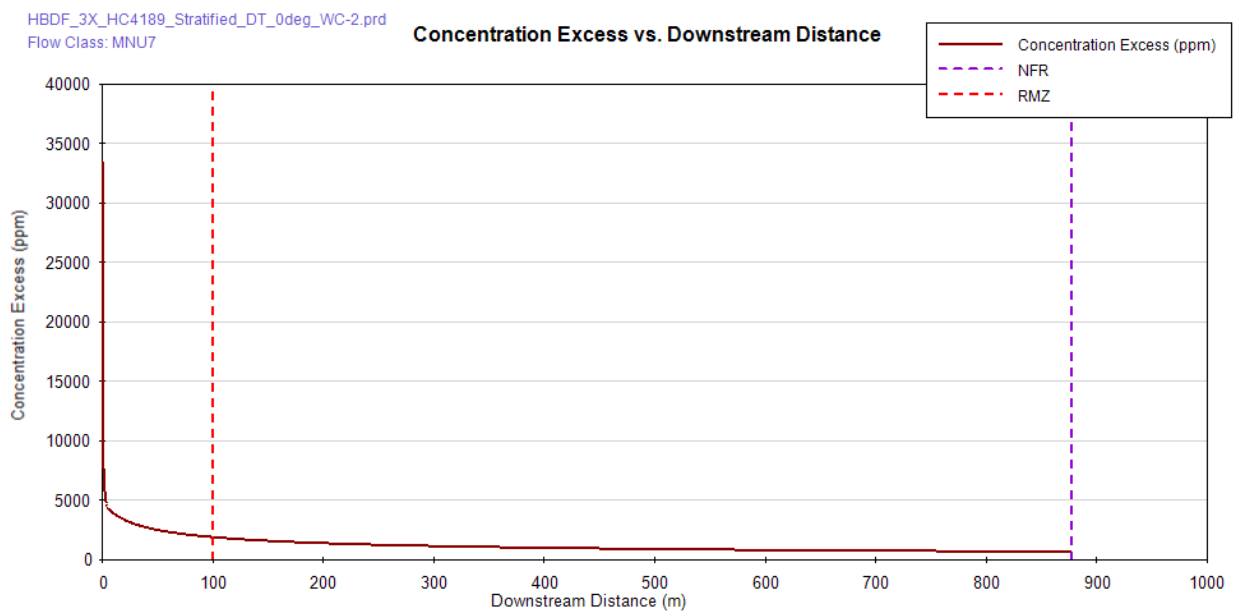



**Figure D-6:** Excess Salinity in ppm as a function of distance downstream for Worst-Case #2, $\Delta T$ = +0$^0$ C

**Appendix-D: CORMIX 10.0.3.0 Prediction File for Worst-Case #2, $\Delta T$ = $0^0$ C; Sheet D-8**

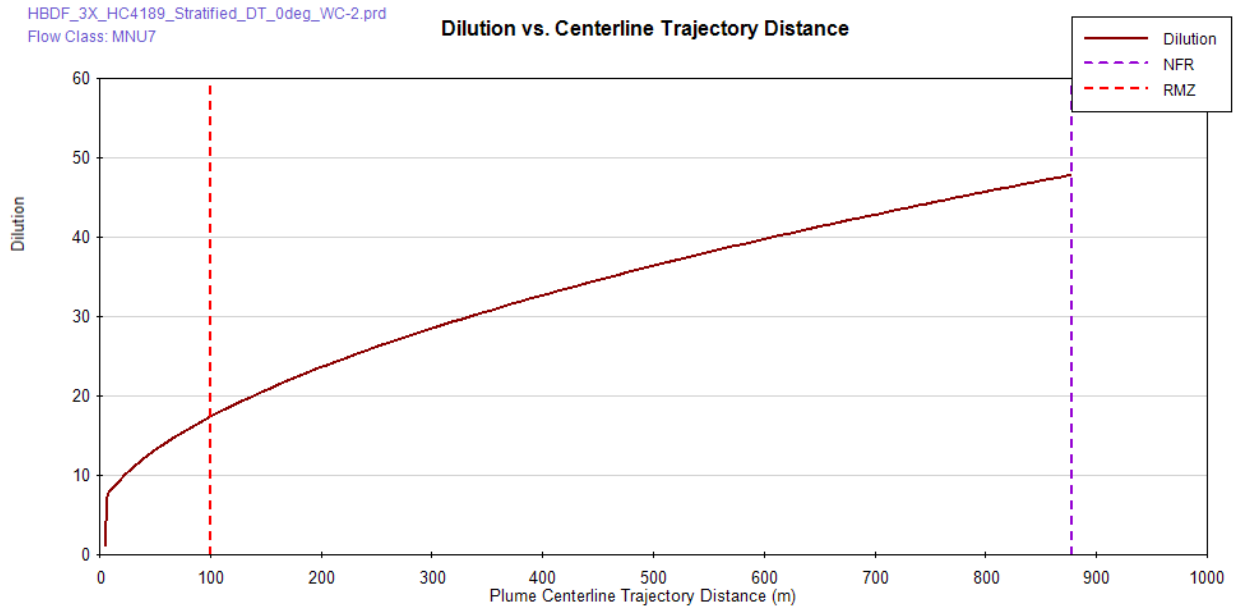



**Figure D-7:** Dilution expressed as mixing ratio, S**,** as a function of centerline trajectory distance for Worst-Case #2, $\Delta T$ = $+0^0$ C. Note S = 1 + Dm

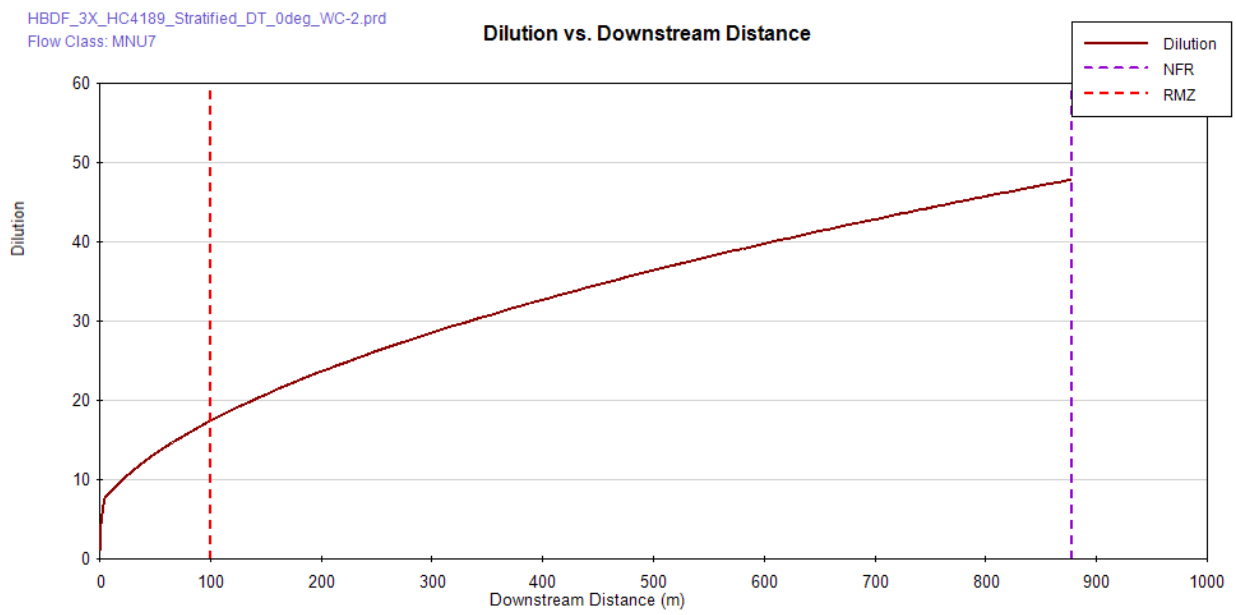



**Figure D-8:** Dilution expressed as mixing ratio, S**,** as a function of distance downstream for Worst-Case #2, $\Delta T$ = $+0^0$ C. Note S = 1 + Dm

# Appendix-E: CORMIX 10.0.3.0 Prediction File for Monthly-Case #1, $\Delta T$ = +0$^0$ C; Sheet E-1

```
D-CORMIX PREDICTION FILE:
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
               D-CORMIX: CORMIX MIXING ZONE EXPERT SYSTEM
                      BRINE DISCHARGE SUB-SYSTEM
                 Subsystem CORMIX2: Multi Port Discharge
                       CORMIX Version 10.0GTH
                   DHYDRO Version 10.0.3.0 December 2017
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   HBDF Huntington Beach
 Design case:       Alden 3- Port Duckbill
 FILE NAME:         C:\...BDF_3X_HC4189_Stratified_DT_0deg_WC-1_monthly.prd
 Time stamp:        11/29/2017--12:15:51

COASTAL ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 Single (constant) offshore slope:
 SLOPE =  1.06 deg. UA    =      0.000  F     =      0.020 USTAR =0.5000E-07
 UW    =      0.000 UWSTAR=0.0000E+00
 Density stratified (non-uniform) environment:
 STRCND=  N         RHOAM = 1022.7350  RHOAH0= 1022.7350  RHOAHD= 1023.4700
 LEVDEN=  1         RHOAS = 1022.0000
 SUB1  =      8.50  RHOA1 = 1023.4700  EPS1  =0.1659E-02

DISCHARGE PARAMETERS (metric units) for multi_port_diffuser
 BANK  =  LEFT      DISTB =    461.48  HD    =      8.50  LEVDIS=  1
 Diffuser type:     DITYPE= unidirectional_perpendicular
 LD    =      8.96  NOPEN  =   3       SPAC =      4.48
 YB1   =    457.00  YB2    = 465.96
 Nozzle/port arrangement:   unidirectional_with_fanning
 D0    =      0.484 A0    =      0.184 H0    =      2.80  SUB0 =      5.70
 D0INP =      0.484 CR0   =      1.000
 GAMMA =     90.00  THETA =     47.00  SIGMA =      0.00  BETA  =     90.00
 U0    =      4.501 Q0    =      2.484 Q0A    =0.2484E+01
 RHO0  = 1047.4000  DRHO0 =-.2467E+02  RHOCW = 1047.4000  GP0   =-.2365E+00
 C0    =0.2960E+05  CUNITS=  ppm
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00


FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.2773E+00  m0    =0.8319E+00  j0    =-.4371E-01  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.062 lM    =      3.70  lm    =  99999.00
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.2484E+01  M0    =0.7454E+01  J0    =-.3917E+00
 Associated 3-d length scales (meters)
 LQ    =      0.43  LM    =  99999.00  Lm    =  99999.00  Lb    =  99999.00
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     45.67  FRD0  =     13.30  R     =  99999.00  PL    =  140.00
 (slot)             (port/nozzle)

RECOMPUTED SOURCE CONDITIONS FOR RISER GROUPS:
 Properties of riser group with  1 ports/nozzles each:
 U0    =      4.501 D0    =      0.484 A0    =      0.184 THETA =     47.00
 FR0   =     45.67  FRD0  =     13.30  R     =  99999.00
 (slot)             (riser group)

FLOW CLASSIFICATION
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
 D  Flow class (D-CORMIX)     =    MNU7     D
 D  Applicable layer depth HS =     8.50    D
```

## Appendix-E: CORMIX 10.0.3.0 Prediction File for Monthly-Case #1, $\Delta T$ = +0$^0$ C; Sheet E-2

```
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.2960E+05  CUNITS=  ppm
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2000E+04
 REGMZ =  1
 REGSPC=  1         XREG  =    100.00  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE an at the diffuser mid-point:
       461.48 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =100 display intervals per module
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   Uc = Local centerline excess velocity (above ambient)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH       Uc        TT
      0.00     0.00   -5.70     1.0 0.296E+05   0.03     4.48     4.501   .00000E+00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER

 Because of the FANNED-OUT HORIZONTAL ORIENTATION of the diffuser jets,
   the near-field dilution is slightly improved.

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =    8.50m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00   -5.70     1.0 0.296E+05   0.03     4.48 .00000E+00
      0.04     0.00   -5.70     1.7 0.178E+05   0.08     4.41 .16529E-01
      0.09     0.00   -5.70     1.9 0.153E+05   0.17     4.35 .38504E-01
      0.13     0.00   -5.70     2.1 0.138E+05   0.25     4.29 .64026E-01
      0.18     0.00   -5.69     2.3 0.128E+05   0.34     4.23 .92414E-01
      0.22     0.00   -5.69     2.5 0.120E+05   0.42     4.17 .12328E+00
      0.27     0.00   -5.69     2.6 0.113E+05   0.51     4.11 .15635E+00
      0.31     0.00   -5.69     2.7 0.108E+05   0.60     4.06 .19145E+00
      0.36     0.00   -5.69     2.9 0.103E+05   0.68     4.00 .22840E+00
      0.40     0.00   -5.69     3.0 0.993E+04   0.76     3.95 .26711E+00
      0.45     0.00   -5.68     3.1 0.958E+04   0.85     3.90 .30745E+00
      0.49     0.00   -5.68     3.2 0.928E+04   0.93     3.85 .34936E+00
      0.54     0.00   -5.68     3.3 0.900E+04   1.02     3.80 .39276E+00
```

**Appendix-E: CORMIX 10.0.3.0 Prediction File for Monthly-Case #1, $\Delta T$ = +0$^0$ C; Sheet E-3**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.58 | 0.00 | -5.68 | 3.4 | 0.875E+04 | 1.10 | 3.76 | .43758E+00 |
| 0.63 | 0.00 | -5.68 | 3.5 | 0.853E+04 | 1.19 | 3.71 | .48376E+00 |
| 0.67 | 0.00 | -5.68 | 3.6 | 0.832E+04 | 1.27 | 3.67 | .53127E+00 |
| 0.72 | 0.00 | -5.68 | 3.6 | 0.813E+04 | 1.36 | 3.62 | .58005E+00 |
| 0.76 | 0.00 | -5.67 | 3.7 | 0.795E+04 | 1.44 | 3.58 | .63006E+00 |
| 0.81 | 0.00 | -5.67 | 3.8 | 0.778E+04 | 1.53 | 3.54 | .68127E+00 |
| 0.85 | 0.00 | -5.67 | 3.9 | 0.763E+04 | 1.61 | 3.50 | .73364E+00 |
| 0.90 | 0.00 | -5.67 | 4.0 | 0.749E+04 | 1.70 | 3.46 | .78715E+00 |
| 0.94 | 0.00 | -5.67 | 4.0 | 0.735E+04 | 1.78 | 3.43 | .84175E+00 |
| 0.99 | 0.00 | -5.67 | 4.1 | 0.722E+04 | 1.87 | 3.39 | .89744E+00 |
| 1.03 | 0.00 | -5.66 | 4.2 | 0.710E+04 | 1.95 | 3.35 | .95417E+00 |
| 1.08 | 0.00 | -5.66 | 4.2 | 0.699E+04 | 2.04 | 3.32 | .10119E+01 |
| 1.12 | 0.00 | -5.66 | 4.3 | 0.688E+04 | 2.12 | 3.29 | .10707E+01 |
| 1.16 | 0.00 | -5.66 | 4.4 | 0.678E+04 | 2.21 | 3.25 | .11305E+01 |
| 1.21 | 0.00 | -5.66 | 4.4 | 0.668E+04 | 2.30 | 3.22 | .11912E+01 |
| 1.25 | 0.00 | -5.66 | 4.5 | 0.658E+04 | 2.38 | 3.19 | .12528E+01 |
| 1.30 | 0.00 | -5.66 | 4.6 | 0.650E+04 | 2.47 | 3.16 | .13155E+01 |
| 1.34 | 0.00 | -5.65 | 4.6 | 0.641E+04 | 2.55 | 3.13 | .13790E+01 |
| 1.39 | 0.00 | -5.65 | 4.7 | 0.633E+04 | 2.64 | 3.10 | .14434E+01 |
| 1.43 | 0.00 | -5.65 | 4.7 | 0.625E+04 | 2.72 | 3.07 | .15087E+01 |
| 1.48 | 0.00 | -5.65 | 4.8 | 0.617E+04 | 2.81 | 3.04 | .15749E+01 |
| 1.52 | 0.00 | -5.65 | 4.9 | 0.610E+04 | 2.89 | 3.02 | .16419E+01 |
| 1.57 | 0.00 | -5.65 | 4.9 | 0.603E+04 | 2.98 | 2.99 | .17098E+01 |
| 1.61 | 0.00 | -5.64 | 5.0 | 0.596E+04 | 3.06 | 2.96 | .17785E+01 |
| 1.66 | 0.00 | -5.64 | 5.0 | 0.590E+04 | 3.15 | 2.94 | .18480E+01 |
| 1.70 | 0.00 | -5.64 | 5.1 | 0.584E+04 | 3.23 | 2.91 | .19184E+01 |
| 1.75 | 0.00 | -5.64 | 5.1 | 0.578E+04 | 3.32 | 2.89 | .19895E+01 |
| 1.79 | 0.00 | -5.64 | 5.2 | 0.572E+04 | 3.40 | 2.86 | .20615E+01 |
| 1.84 | 0.00 | -5.64 | 5.2 | 0.566E+04 | 3.49 | 2.84 | .21342E+01 |
| 1.88 | 0.00 | -5.64 | 5.3 | 0.561E+04 | 3.57 | 2.82 | .22077E+01 |
| 1.93 | 0.00 | -5.63 | 5.3 | 0.555E+04 | 3.66 | 2.80 | .22819E+01 |
| 1.97 | 0.00 | -5.63 | 5.4 | 0.550E+04 | 3.74 | 2.77 | .23569E+01 |
| 2.02 | 0.00 | -5.63 | 5.4 | 0.545E+04 | 3.83 | 2.75 | .24327E+01 |
| 2.06 | 0.00 | -5.63 | 5.5 | 0.540E+04 | 3.91 | 2.73 | .25091E+01 |
| 2.11 | 0.00 | -5.63 | 5.5 | 0.535E+04 | 4.00 | 2.71 | .25863E+01 |
| 2.15 | 0.00 | -5.63 | 5.6 | 0.531E+04 | 4.08 | 2.69 | .26643E+01 |
| 2.20 | 0.00 | -5.63 | 5.6 | 0.526E+04 | 4.17 | 2.67 | .27429E+01 |
| 2.24 | 0.00 | -5.62 | 5.7 | 0.522E+04 | 4.25 | 2.65 | .28222E+01 |
| 2.28 | 0.00 | -5.62 | 5.7 | 0.518E+04 | 4.34 | 2.64 | .29023E+01 |
| 2.33 | 0.00 | -5.62 | 5.8 | 0.514E+04 | 4.42 | 2.62 | .29830E+01 |
| 2.37 | 0.00 | -5.62 | 5.8 | 0.510E+04 | 4.51 | 2.60 | .30644E+01 |
| 2.42 | 0.00 | -5.62 | 5.9 | 0.506E+04 | 4.59 | 2.58 | .31465E+01 |
| 2.46 | 0.00 | -5.62 | 5.9 | 0.502E+04 | 4.68 | 2.57 | .32293E+01 |
| 2.51 | 0.00 | -5.61 | 5.9 | 0.498E+04 | 4.76 | 2.55 | .33127E+01 |
| 2.55 | 0.00 | -5.61 | 6.0 | 0.494E+04 | 4.85 | 2.54 | .33968E+01 |
| 2.60 | 0.00 | -5.61 | 6.0 | 0.491E+04 | 4.93 | 2.52 | .34815E+01 |
| 2.64 | 0.00 | -5.61 | 6.1 | 0.487E+04 | 5.02 | 2.51 | .35669E+01 |
| 2.69 | 0.00 | -5.61 | 6.1 | 0.484E+04 | 5.10 | 2.49 | .36529E+01 |
| 2.73 | 0.00 | -5.61 | 6.2 | 0.481E+04 | 5.19 | 2.48 | .37396E+01 |
| 2.78 | 0.00 | -5.61 | 6.2 | 0.477E+04 | 5.27 | 2.46 | .38269E+01 |
| 2.82 | 0.00 | -5.60 | 6.2 | 0.474E+04 | 5.36 | 2.45 | .39148E+01 |
| 2.87 | 0.00 | -5.60 | 6.3 | 0.471E+04 | 5.44 | 2.44 | .40034E+01 |
| 2.91 | 0.00 | -5.60 | 6.3 | 0.468E+04 | 5.53 | 2.43 | .40925E+01 |
| 2.96 | 0.00 | -5.60 | 6.4 | 0.465E+04 | 5.61 | 2.42 | .41823E+01 |
| 3.00 | 0.00 | -5.60 | 6.4 | 0.462E+04 | 5.70 | 2.40 | .42727E+01 |
| 3.05 | 0.00 | -5.60 | 6.4 | 0.459E+04 | 5.78 | 2.39 | .43636E+01 |
| 3.09 | 0.00 | -5.59 | 6.5 | 0.456E+04 | 5.87 | 2.38 | .44552E+01 |
| 3.14 | 0.00 | -5.59 | 6.5 | 0.454E+04 | 5.95 | 2.37 | .45474E+01 |
| 3.18 | 0.00 | -5.59 | 6.6 | 0.451E+04 | 6.04 | 2.36 | .46402E+01 |
| 3.23 | 0.00 | -5.59 | 6.6 | 0.448E+04 | 6.12 | 2.36 | .47335E+01 |
| 3.27 | 0.00 | -5.59 | 6.6 | 0.446E+04 | 6.21 | 2.35 | .48274E+01 |
| 3.32 | 0.00 | -5.59 | 6.7 | 0.443E+04 | 6.29 | 2.34 | .49219E+01 |
| 3.36 | 0.00 | -5.59 | 6.7 | 0.440E+04 | 6.38 | 2.33 | .50170E+01 |
| 3.40 | 0.00 | -5.58 | 6.8 | 0.438E+04 | 6.46 | 2.32 | .51127E+01 |
| 3.45 | 0.00 | -5.58 | 6.8 | 0.436E+04 | 6.55 | 2.32 | .52089E+01 |
| 3.49 | 0.00 | -5.58 | 6.8 | 0.433E+04 | 6.63 | 2.31 | .53056E+01 |
| 3.54 | 0.00 | -5.58 | 6.9 | 0.431E+04 | 6.72 | 2.31 | .54030E+01 |

## Appendix-E: CORMIX 10.0.3.0 Prediction File for Monthly-Case #1, $\Delta T$ = +0$^0$ C; Sheet E-4

```
      3.58     0.00   -5.58     6.9 0.428E+04   6.80     2.30 .55009E+01
      3.63     0.00   -5.58     6.9 0.426E+04   6.89     2.29 .55993E+01
      3.67     0.00   -5.57     7.0 0.424E+04   6.97     2.29 .56983E+01
      3.72     0.00   -5.57     7.0 0.422E+04   7.06     2.28 .57978E+01
      3.76     0.00   -5.57     7.1 0.420E+04   7.14     2.28 .58979E+01
      3.81     0.00   -5.57     7.1 0.418E+04   7.23     2.28 .59985E+01
      3.85     0.00   -5.57     7.1 0.415E+04   7.31     2.27 .60997E+01
      3.90     0.00   -5.57     7.2 0.413E+04   7.40     2.27 .62013E+01
      3.94     0.00   -5.57     7.2 0.411E+04   7.48     2.27 .63035E+01
      3.99     0.00   -5.56     7.2 0.409E+04   7.57     2.26 .64063E+01
      4.03     0.00   -5.56     7.3 0.407E+04   7.65     2.26 .65095E+01
      4.08     0.00   -5.56     7.3 0.405E+04   7.74     2.26 .66133E+01
      4.12     0.00   -5.56     7.3 0.404E+04   7.82     2.26 .67176E+01
      4.17     0.00   -5.56     7.4 0.402E+04   7.91     2.25 .68224E+01
      4.21     0.00   -5.56     7.4 0.400E+04   7.99     2.25 .69277E+01
      4.26     0.00   -5.55     7.4 0.398E+04   8.08     2.25 .70335E+01
      4.30     0.00   -5.55     7.5 0.396E+04   8.16     2.25 .71399E+01
      4.35     0.00   -5.55     7.5 0.394E+04   8.25     2.25 .72467E+01
      4.39     0.00   -5.55     7.5 0.393E+04   8.33     2.25 .73540E+01
      4.44     0.00   -5.55     7.6 0.391E+04   8.42     2.25 .74619E+01
      4.48     0.00   -5.55     7.6 0.389E+04   8.50     2.25 .75702E+01
 Cumulative travel time =           7.5702 sec  (    0.00 hrs)
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------
BEGIN MOD251: DIFFUSER PLUME IN CO-FLOW

 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      4.48     0.00   -8.50     7.6 0.389E+04   8.50     2.52 .75702E+01
     13.21     0.00   -8.50     8.9 0.332E+04   8.50     3.46 .79412E+02
     21.94     0.00   -8.50    10.1 0.294E+04   8.50     4.40 .16188E+03
     30.66     0.00   -8.50    11.1 0.267E+04   8.50     5.34 .25376E+03
     39.39     0.00   -8.50    12.0 0.246E+04   8.50     6.28 .35416E+03
     48.12     0.00   -8.50    12.9 0.229E+04   8.50     7.21 .46241E+03
     56.85     0.00   -8.50    13.7 0.216E+04   8.50     8.15 .57798E+03
     65.58     0.00   -8.50    14.5 0.204E+04   8.50     9.08 .70043E+03
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.200E+04 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     74.30     0.00   -8.50    15.2 0.194E+04   8.50    10.02 .82940E+03
     83.03     0.00   -8.50    15.9 0.186E+04   8.50    10.95 .96457E+03
     91.76     0.00   -8.50    16.6 0.178E+04   8.50    11.88 .11057E+04
 ** REGULATORY MIXING ZONE BOUNDARY is within the Near-Field Region **
  In this prediction interval the plume DOWNSTREAM distance meets or exceeds
  the regulatory value =   100.00 m.
  This is the extent of the REGULATORY MIXING ZONE.
    100.49     0.00   -8.50    17.2 0.172E+04   8.50    12.81 .12525E+04
    109.22     0.00   -8.50    17.9 0.166E+04   8.50    13.74 .14047E+04
    117.94     0.00   -8.50    18.5 0.160E+04   8.50    14.67 .15623E+04
```

**Appendix-E: CORMIX 10.0.3.0 Prediction File for Monthly-Case #1, $\Delta T$ = +0$^0$ C; Sheet E-5**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 126.67 | 0.00 | -8.50 | 19.0 | 0.155E+04 | 8.50 | 15.60 | .17249E+04 |
| 135.40 | 0.00 | -8.50 | 19.6 | 0.151E+04 | 8.50 | 16.53 | .18926E+04 |
| 144.13 | 0.00 | -8.50 | 20.1 | 0.147E+04 | 8.50 | 17.46 | .20650E+04 |
| 152.86 | 0.00 | -8.50 | 20.7 | 0.143E+04 | 8.50 | 18.38 | .22421E+04 |
| 161.58 | 0.00 | -8.50 | 21.2 | 0.140E+04 | 8.50 | 19.31 | .24238E+04 |
| 170.31 | 0.00 | -8.50 | 21.7 | 0.136E+04 | 8.50 | 20.24 | .26100E+04 |
| 179.04 | 0.00 | -8.50 | 22.2 | 0.133E+04 | 8.50 | 21.16 | .28005E+04 |
| 187.77 | 0.00 | -8.50 | 22.7 | 0.130E+04 | 8.50 | 22.08 | .29952E+04 |
| 196.50 | 0.00 | -8.50 | 23.2 | 0.128E+04 | 8.50 | 23.01 | .31941E+04 |
| 205.22 | 0.00 | -8.50 | 23.6 | 0.125E+04 | 8.50 | 23.93 | .33971E+04 |
| 213.95 | 0.00 | -8.50 | 24.1 | 0.123E+04 | 8.50 | 24.85 | .36041E+04 |
| 222.68 | 0.00 | -8.50 | 24.5 | 0.121E+04 | 8.50 | 25.77 | .38150E+04 |
| 231.41 | 0.00 | -8.50 | 25.0 | 0.119E+04 | 8.50 | 26.70 | .40297E+04 |
| 240.14 | 0.00 | -8.50 | 25.4 | 0.117E+04 | 8.50 | 27.62 | .42482E+04 |
| 248.86 | 0.00 | -8.50 | 25.8 | 0.115E+04 | 8.50 | 28.54 | .44705E+04 |
| 257.59 | 0.00 | -8.50 | 26.2 | 0.113E+04 | 8.50 | 29.46 | .46964E+04 |
| 266.32 | 0.00 | -8.50 | 26.7 | 0.111E+04 | 8.50 | 30.37 | .49259E+04 |
| 275.05 | 0.00 | -8.50 | 27.1 | 0.109E+04 | 8.50 | 31.29 | .51589E+04 |
| 283.78 | 0.00 | -8.50 | 27.5 | 0.108E+04 | 8.50 | 32.21 | .53954E+04 |
| 292.50 | 0.00 | -8.50 | 27.9 | 0.106E+04 | 8.50 | 33.13 | .56354E+04 |
| 301.23 | 0.00 | -8.50 | 28.2 | 0.105E+04 | 8.50 | 34.04 | .58787E+04 |
| 309.96 | 0.00 | -8.50 | 28.6 | 0.103E+04 | 8.50 | 34.96 | .61254E+04 |
| 318.69 | 0.00 | -8.50 | 29.0 | 0.102E+04 | 8.50 | 35.88 | .63754E+04 |
| 327.42 | 0.00 | -8.50 | 29.4 | 0.101E+04 | 8.50 | 36.79 | .66286E+04 |
| 336.14 | 0.00 | -8.50 | 29.7 | 0.995E+03 | 8.50 | 37.71 | .68851E+04 |
| 344.87 | 0.00 | -8.50 | 30.1 | 0.983E+03 | 8.50 | 38.62 | .71447E+04 |
| 353.60 | 0.00 | -8.50 | 30.5 | 0.972E+03 | 8.50 | 39.54 | .74075E+04 |
| 362.33 | 0.00 | -8.50 | 30.8 | 0.960E+03 | 8.50 | 40.45 | .76733E+04 |
| 371.06 | 0.00 | -8.50 | 31.2 | 0.950E+03 | 8.50 | 41.36 | .79422E+04 |
| 379.78 | 0.00 | -8.50 | 31.5 | 0.939E+03 | 8.50 | 42.28 | .82142E+04 |
| 388.51 | 0.00 | -8.50 | 31.9 | 0.929E+03 | 8.50 | 43.19 | .84891E+04 |
| 397.24 | 0.00 | -8.50 | 32.2 | 0.919E+03 | 8.50 | 44.10 | .87670E+04 |
| 405.97 | 0.00 | -8.50 | 32.5 | 0.910E+03 | 8.50 | 45.01 | .90479E+04 |
| 414.70 | 0.00 | -8.50 | 32.9 | 0.900E+03 | 8.50 | 45.92 | .93316E+04 |
| 423.42 | 0.00 | -8.50 | 33.2 | 0.892E+03 | 8.50 | 46.83 | .96182E+04 |
| 432.15 | 0.00 | -8.50 | 33.5 | 0.883E+03 | 8.50 | 47.74 | .99077E+04 |
| 440.88 | 0.00 | -8.50 | 33.9 | 0.874E+03 | 8.50 | 48.65 | .10200E+05 |
| 449.61 | 0.00 | -8.50 | 34.2 | 0.866E+03 | 8.50 | 49.56 | .10495E+05 |
| 458.34 | 0.00 | -8.50 | 34.5 | 0.858E+03 | 8.50 | 50.47 | .10793E+05 |
| 467.06 | 0.00 | -8.50 | 34.8 | 0.851E+03 | 8.50 | 51.38 | .11093E+05 |
| 475.79 | 0.00 | -8.50 | 35.1 | 0.843E+03 | 8.50 | 52.29 | .11397E+05 |
| 484.52 | 0.00 | -8.50 | 35.4 | 0.836E+03 | 8.50 | 53.20 | .11703E+05 |
| 493.25 | 0.00 | -8.50 | 35.7 | 0.829E+03 | 8.50 | 54.11 | .12011E+05 |
| 501.98 | 0.00 | -8.50 | 36.0 | 0.822E+03 | 8.50 | 55.01 | .12322E+05 |
| 510.70 | 0.00 | -8.50 | 36.3 | 0.815E+03 | 8.50 | 55.92 | .12636E+05 |
| 519.43 | 0.00 | -8.50 | 36.6 | 0.808E+03 | 8.50 | 56.83 | .12953E+05 |
| 528.16 | 0.00 | -8.50 | 36.9 | 0.802E+03 | 8.50 | 57.73 | .13272E+05 |
| 536.89 | 0.00 | -8.50 | 37.2 | 0.795E+03 | 8.50 | 58.64 | .13594E+05 |
| 545.62 | 0.00 | -8.50 | 37.5 | 0.789E+03 | 8.50 | 59.54 | .13918E+05 |
| 554.34 | 0.00 | -8.50 | 37.8 | 0.783E+03 | 8.50 | 60.45 | .14244E+05 |
| 563.07 | 0.00 | -8.50 | 38.1 | 0.777E+03 | 8.50 | 61.35 | .14574E+05 |
| 571.80 | 0.00 | -8.50 | 38.4 | 0.771E+03 | 8.50 | 62.26 | .14905E+05 |
| 580.53 | 0.00 | -8.50 | 38.7 | 0.766E+03 | 8.50 | 63.16 | .15239E+05 |
| 589.26 | 0.00 | -8.50 | 38.9 | 0.760E+03 | 8.50 | 64.07 | .15576E+05 |
| 597.98 | 0.00 | -8.50 | 39.2 | 0.755E+03 | 8.50 | 64.97 | .15915E+05 |
| 606.71 | 0.00 | -8.50 | 39.5 | 0.750E+03 | 8.50 | 65.87 | .16256E+05 |
| 615.44 | 0.00 | -8.50 | 39.8 | 0.744E+03 | 8.50 | 66.78 | .16600E+05 |
| 624.17 | 0.00 | -8.50 | 40.0 | 0.739E+03 | 8.50 | 67.68 | .16946E+05 |
| 632.90 | 0.00 | -8.50 | 40.3 | 0.734E+03 | 8.50 | 68.58 | .17295E+05 |
| 641.62 | 0.00 | -8.50 | 40.6 | 0.730E+03 | 8.50 | 69.48 | .17645E+05 |
| 650.35 | 0.00 | -8.50 | 40.8 | 0.725E+03 | 8.50 | 70.38 | .17999E+05 |
| 659.08 | 0.00 | -8.50 | 41.1 | 0.720E+03 | 8.50 | 71.28 | .18354E+05 |
| 667.81 | 0.00 | -8.50 | 41.4 | 0.715E+03 | 8.50 | 72.18 | .18712E+05 |
| 676.54 | 0.00 | -8.50 | 41.6 | 0.711E+03 | 8.50 | 73.08 | .19072E+05 |
| 685.26 | 0.00 | -8.50 | 41.9 | 0.707E+03 | 8.50 | 73.98 | .19434E+05 |
| 693.99 | 0.00 | -8.50 | 42.2 | 0.702E+03 | 8.50 | 74.88 | .19799E+05 |
| 702.72 | 0.00 | -8.50 | 42.4 | 0.698E+03 | 8.50 | 75.78 | .20166E+05 |

# Appendix-E: CORMIX 10.0.3.0 Prediction File for Monthly-Case #1, $\Delta T$ = +0$^{0}$ C; Sheet E-6

```
    711.45     0.00   -8.50    42.7 0.694E+03   8.50    76.68 .20535E+05
    720.18     0.00   -8.50    42.9 0.690E+03   8.50    77.58 .20906E+05
    728.90     0.00   -8.50    43.2 0.686E+03   8.50    78.48 .21279E+05
    737.63     0.00   -8.50    43.4 0.682E+03   8.50    79.38 .21655E+05
    746.36     0.00   -8.50    43.7 0.678E+03   8.50    80.28 .22033E+05
    755.09     0.00   -8.50    43.9 0.674E+03   8.50    81.17 .22413E+05
    763.82     0.00   -8.50    44.2 0.670E+03   8.50    82.07 .22795E+05
    772.54     0.00   -8.50    44.4 0.666E+03   8.50    82.97 .23179E+05
    781.27     0.00   -8.50    44.7 0.663E+03   8.50    83.87 .23566E+05
    790.00     0.00   -8.50    44.9 0.659E+03   8.50    84.76 .23954E+05
    798.73     0.00   -8.50    45.1 0.656E+03   8.50    85.66 .24345E+05
    807.46     0.00   -8.50    45.4 0.652E+03   8.50    86.55 .24737E+05
    816.18     0.00   -8.50    45.6 0.649E+03   8.50    87.45 .25132E+05
    824.91     0.00   -8.50    45.9 0.645E+03   8.50    88.34 .25529E+05
    833.64     0.00   -8.50    46.1 0.642E+03   8.50    89.24 .25928E+05
    842.37     0.00   -8.50    46.3 0.639E+03   8.50    90.13 .26329E+05
    851.10     0.00   -8.50    46.6 0.636E+03   8.50    91.03 .26732E+05
    859.83     0.00   -8.50    46.8 0.632E+03   8.50    91.92 .27137E+05
    868.55     0.00   -8.50    47.0 0.629E+03   8.50    92.82 .27544E+05
    877.28     0.00   -8.50    47.3 0.626E+03   8.50    93.71 .27953E+05
 Cumulative travel time =       27952.8281 sec  (    7.76 hrs)

 Entire region is occupied by Phase 1.
   Plume does not re-stratify in this flow region.

END OF MOD251: DIFFUSER PLUME IN CO-FLOW
-----------------------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 SIMULATION STOPS because of STAGNANT AMBIENT conditions.
   All far-field processes will be UNSTEADY.
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
D-CORMIX      End of Prediction File
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

**Appendix-E: CORMIX 10.0.3.0 Monthly-Case #1, $\Delta T$ = +0$^0$ C; Sheet E-7**

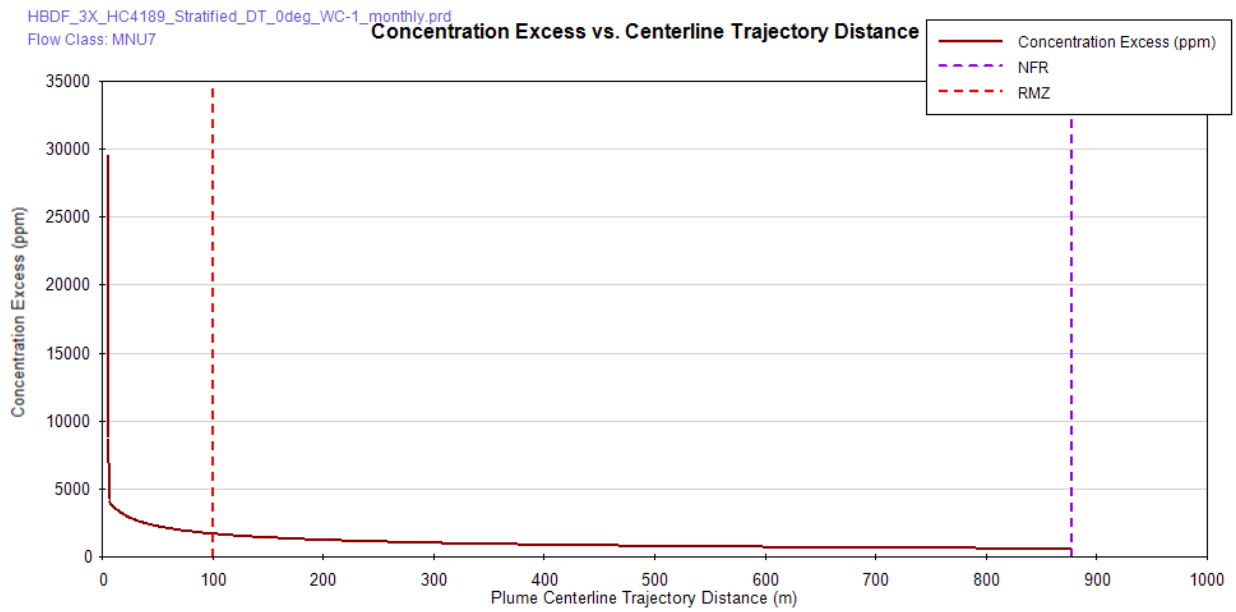



**Figure E-1:** Excess Salinity in ppm as a function of centerline trajectory distance for Monthly-Case #1, $\Delta T$ = +0$^0$ C.

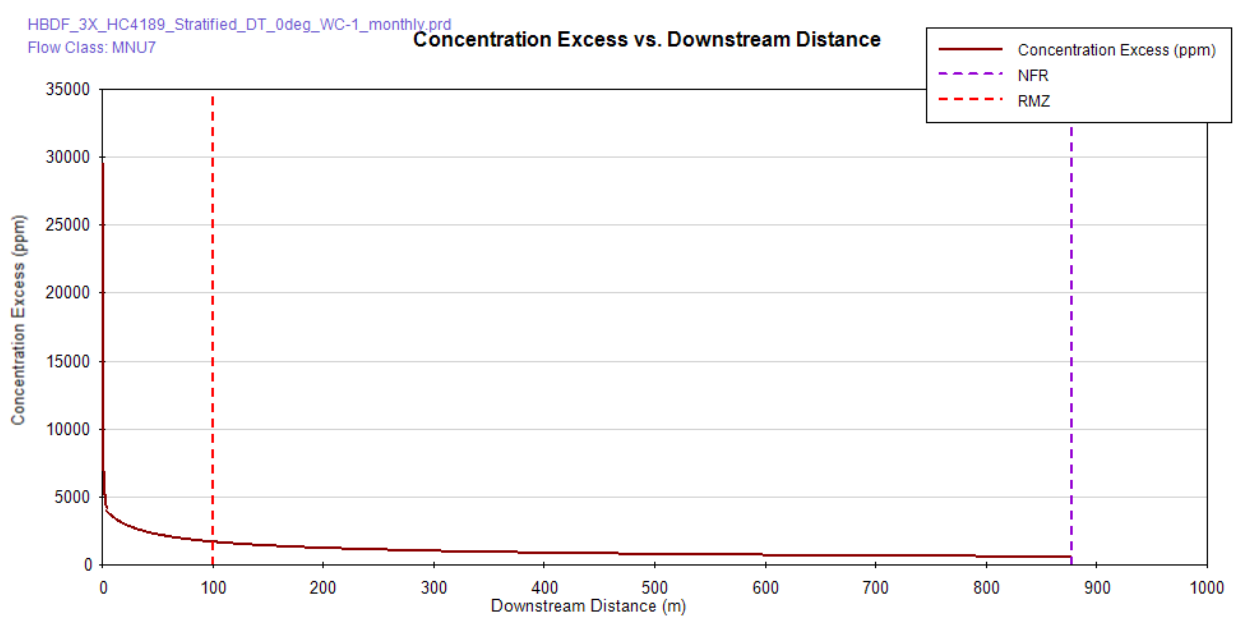



**Figure E-2:** Excess Salinity in ppm as a function of distance downstream for Monthly-Case #1, $\Delta T$ = +0$^0$ C

**Appendix-E: CORMIX 10.0.3.0 Monthly-Case #1, $\Delta T$ = +0$^0$ C; Sheet E-8**

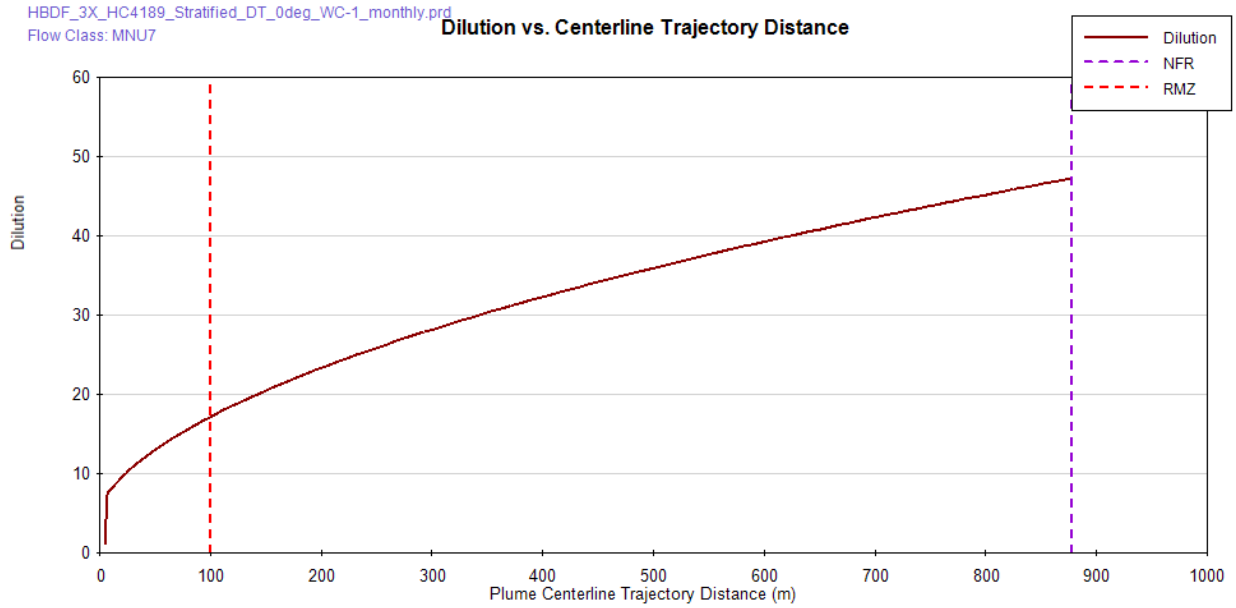



**Figure E-3:** Dilution expressed as mixing ratio, S**,** as a function of centerline trajectory distance for Monthly-Case #1, $\Delta T$ = +0$^0$ C. Note S = 1 + Dm

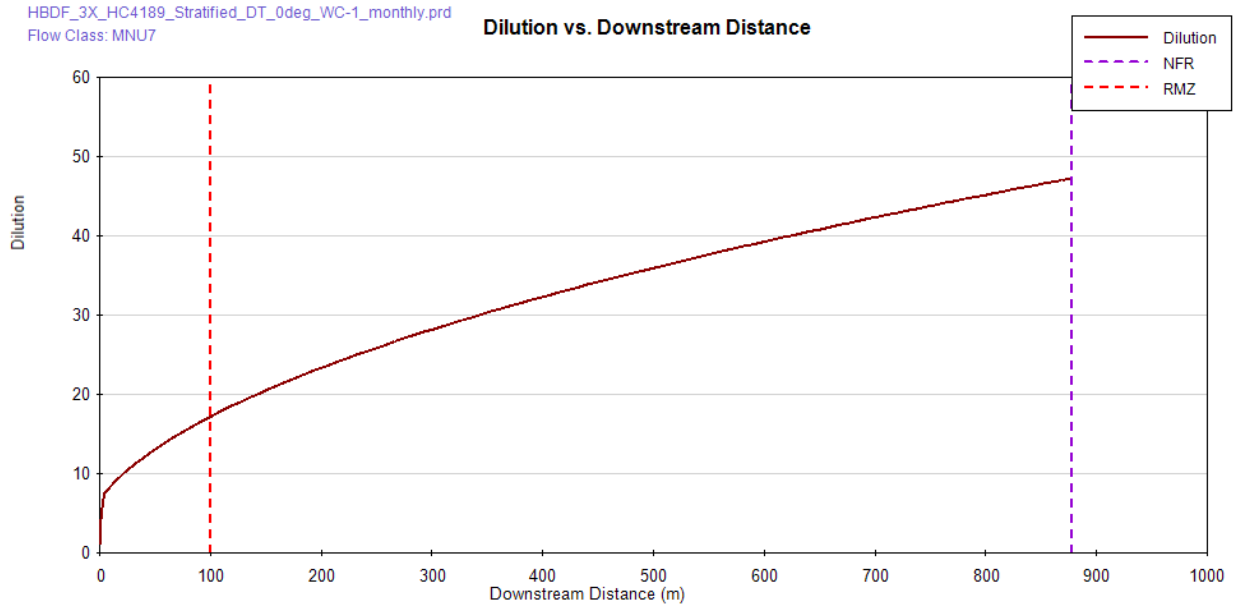



**Figure E-4:** Dilution expressed as mixing ratio, S**,** as a function of distance downstream for Monthly-Case #1, $\Delta T$ = +0$^0$ C. Note S = 1 + Dm

## Appendix-F: CORMIX 10.0.3.0 Session Report for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-1

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                       CORMIX MIXING ZONE EXPERT SYSTEM
                           CORMIX Version 10.0GTH
                        DHYDRO:Version-10.0.3.0  December,2017
SITE NAME/LABEL:                HBDF Huntington Beach
  DESIGN CASE:                  Alden 3- Port Duckbill
  FILE NAME:                    C:\projects\Poseidon HB MichalBaker\CORMIX\CORMIX v10.0GTH
Verification\0deg Delta-T\3-Port Duckbill Worst-Case#2\Worst-Case#2 Monthly 29Nov2017\HBDF 3X
HC4189 Stratified DT 0deg WC-2 monthly.prd
  Using subsystem BCORMIX2:     Multiport Diffuser Brine Discharges
  Start of session:             11/29/2017--13:04:46
******************************************************************************
SUMMARY OF INPUT DATA:
------------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                           = unbounded
  Average depth                   HA      = 8.5 m
  Depth at discharge              HD      = 8.5m
  Bottom slope (single slope only)SLOPE   = 1.06 deg
  Ambient velocity                UA      = 0.0000 m/s
  Darcy-Weisbach friction factor  F       = 0.02
  Wind velocity                   UW      = 0 m/s
  Ambient Density Stratification with 1 subsurface level:
  Surface density                 RHOAS   = 1022 kg/m^3
  Level 1 Submergence             LEVEL1  = 8.5 m
  Density at Level 1              RHOA1   = 1023.47 kg/m^3
------------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Submerged Multiport Diffuser Discharge
  Diffuser type                   DITYPE  = unidirectional perpendicular
  Diffuser length                 LD      = 8.96 m
  Nearest bank                            = left
  Diffuser endpoints              YB1     = 457 m;    YB2 = 465.96 m
  Number of openings              NOPEN   = 3
  Number of Risers                NRISER  = 3
  Ports/Nozzles per Riser         NPPERR   = 1
  Spacing between risers/openings SPAC    = 4.48 m
  Port/Nozzle diameter            D0      = 0.468 m
    with contraction ratio                = 1
  Equivalent slot width           B0      = 0.0384 m
  Total area of openings          TA0     = 0.5161 m^2
  Discharge velocity              U0      = 4.24 m/s
  Total discharge flowrate        Q0      = 2.19063 m^3/s
  Discharge port height           H0      = 2.8 m
  Nozzle arrangement              BETYPE  = unidirectional with fanning
  Diffuser alignment angle        GAMMA   = 90 deg
  Vertical discharge angle        THETA   = 47 deg
  Actual Vertical discharge angle THEAC   = 47 deg
  Horizontal discharge angle      SIGMA   = 0 deg
  Relative orientation angle      BETA    = 90 deg
  Discharge density               RHO0    = 1050.7 kg/m^3
  Density difference              DRHO    = -27.9650 kg/m^3
  Buoyant acceleration            GP0     = -0.2681 m/s^2
  Discharge concentration         C0      = 33500 ppm
  Surface heat exchange coeff.    KS      = 0 m/s
  Coefficient of decay            KD      = 0 /s
------------------------------------------------------------------------------
FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
  Discharge (volume flux)         q0      = 0.244490 m^2/s
  Momentum flux                   m0      = 1.037832 m^3/s^2
  Buoyancy flux                   j0      = -0.195803 m^3/s^3
------------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 0.06 m         Lm  = 99999 m         LM  = 3.08 m
  lm' = 99999 m         Lb' = 99999 m         La  = 99999 m
  (These refer to the actual discharge/environment length scales.)
```

## Appendix-F: CORMIX 10.0.3.0 Session Report for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-2

```
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
Slot Froude number              FR0    = 41.83
  Port/nozzle Froude number       FRD0   = 11.98
  Velocity ratio                  R      = 99999
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                        = no
  Water quality standard specified       = yes
  Water quality standard          CSTD   = 2000 ppm
  Regulatory mixing zone                 = yes
  Regulatory mixing zone specification   = distance
  Regulatory mixing zone value           = 100 m (m^2 if area)
  Region of interest                     = 3500 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS   = MNU7 |
  *------------------------*
  This flow configuration applies to a layer corresponding to the full water
  depth at the discharge site.  The ambient density stratification at the
  discharge site is relatively weak and unimportant so the discharge flow
  penetrates to the surface and/or breaks down the existing stratification
  through vigorous mixing.
  Applicable layer depth = water depth = 8.5 m
*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at the SURFACE:
 1) directly above the port/diffuser center for submerged discharges, OR:
 2) at the point of entry into the water for above surface discharges,
 461.48 m from the left bank/shore.
  Number of display steps NSTEP = 100 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 685.3655 ppm
  Dilution at edge of NFR              s = 48.9
  NFR Location:                        x = 877.28 m
    (centerline coordinates)           y = 0 m
                                       z = -8.5 m
  NFR plume dimensions:  half-width (bh) = 93.71 m
                          thickness (bv) = 8.5 m
Cumulative travel time:       30650.6855 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is greater than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is NEGATIVELY BUOYANT and will tend to sink towards
  the bottom.
-----------------------------------------------------------------------------
Stratification assessment:
  The specified ambient density stratification is weak relative to the
  discharge conditions and is dynamically unimportant. The discharge will
  behave as if the ambient were unstratified.
-----------------------------------------------------------------------------
Near-field instability behavior:
  The diffuser flow will experience instabilities with full vertical mixing
  in the near-field.
  There may be benthic impact of high pollutant concentrations.
-----------------------------------------------------------------------------
```

## Appendix-F: CORMIX 10.0.3.0 Session Report for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-3

```
FAR-FIELD MIXING SUMMARY:
  Because of the specified STAGNANT ambient conditions, there exists
  no steady-state far-field for this discharge.
  Unsteady circulations and pollutant buid-up may result in the far-field.
-------------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in unbounded section does not contact bank in this simulation.
************************ TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.
********************** REGULATORY MIXING ZONE SUMMARY ***********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 1883.060181  ppm
  Corresponding dilution               s = 17.8
  Plume location:                      x = 100 m
    (centerline coordinates)           y = 0 m
                                       z = -8.5 m
  Plume dimensions:      half-width (bh) = 12.76 m
                          thickness (bv) = 8.5 m
Cumulative travel time < 30650.6855 sec. (RMZ is within NFR)

Note:
Plume concentration c and dilution s values are reported based on prediction
file values - assuming linear interpolation between predicted points just
before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account
for this linear interpolation. Step size can be controlled by increasing
(reduces the prediction step size) or decreasing (increases the prediction
step size) the - Output Steps per Module - in CORMIX input.

At this position, the plume is NOT IN CONTACT with any bank.
Furthermore, the specified water quality standard has indeed been met
  within the RMZ. In particular:
The ambient water quality standard was encountered at the following
  plume position:
  Water quality standard                 = 2000  ppm
  Corresponding dilution               s = 16.8
  Plume location:                      x = 86.63 m
    (centerline coordinates)           y = 0 m
                                       z = -8.5 m
  Plume dimensions:      half-width (bh) = 11.33 m
                          thickness (bv) = 8.5 m
-------------------------------------------------------------------------------
Regulatory Mixing Zone Analysis:
  The RMZ specification occurs before the near-field mixing regime (NFR) has
  been completed.  The specification of the RMZ is highly restrictive.
********************* FINAL DESIGN ADVICE AND COMMENTS **********************
CORMIX2 uses the TWO-DIMENSIONAL SLOT DIFFUSER CONCEPT to represent
  the actual three-dimensional diffuser geometry.  Thus, it approximates
  the details of the merging process of the individual jets from each
  port/nozzle.
In the present design, the spacing between adjacent ports/nozzles
  (or riser assemblies) is of the order of, or less than, the local
  water depth so that the slot diffuser approximation holds well.

Nevertheless, if this is a final design, the user is advised to use a
  final CORMIX1 (single port discharge) analysis, with discharge data
  for an individual diffuser jet/plume, in order to compare to
  the present near-field prediction.
-------------------------------------------------------------------------------
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

## Appendix-F: CORMIX 10.0.3.0 Prediction File for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-1

```
D-CORMIX PREDICTION FILE:
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
               D-CORMIX: CORMIX MIXING ZONE EXPERT SYSTEM
                      BRINE DISCHARGE SUB-SYSTEM
                 Subsystem CORMIX2: Multi Port Discharge
                       CORMIX Version 10.0GTH
                   DHYDRO Version 10.0.3.0 December 2017
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   HBDF Huntington Beach
 Design case:       Alden 3- Port Duckbill
 FILE NAME:         C:\...BDF_3X_HC4189_Stratified_DT_0deg_WC-2_monthly.prd
 Time stamp:        11/29/2017--13:04:46

COASTAL ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 Single (constant) offshore slope:
 SLOPE =  1.06 deg. UA    =     0.000  F     =      0.020 USTAR =0.5000E-07
 UW    =      0.000 UWSTAR=0.0000E+00
 Density stratified (non-uniform) environment:
 STRCND=  N         RHOAM = 1022.7350  RHOAH0= 1022.7350  RHOAHD= 1023.4700
 LEVDEN=  1         RHOAS = 1022.0000
 SUB1  =      8.50  RHOA1 = 1023.4700  EPS1  =0.1659E-02

DISCHARGE PARAMETERS (metric units) for multi_port_diffuser
 BANK  =  LEFT      DISTB =    461.48  HD    =      8.50  LEVDIS=  1
 Diffuser type:     DITYPE= unidirectional_perpendicular
 LD    =      8.96  NOPEN  =   3       SPAC =      4.48
 YB1   =    457.00  YB2    = 465.96
 Nozzle/port arrangement:   unidirectional_with_fanning
 D0    =      0.468 A0    =      0.172 H0    =      2.80  SUB0 =      5.70
 D0INP =      0.468 CR0   =      1.000
 GAMMA =     90.00  THETA =     47.00  SIGMA =      0.00  BETA  =     90.00
 U0    =      4.245 Q0    =      2.191 Q0A    =0.2191E+01
 RHO0  = 1050.7000  DRHO0 =-.2796E+02  RHOCW = 1050.7000  GP0   =-.2681E+00
 C0    =0.3350E+05  CUNITS=  ppm
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00


FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.2445E+00  m0    =0.6919E+00  j0    =-.4371E-01  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.058 lM    =      3.08  lm    =  99999.00
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.2191E+01  M0    =0.6199E+01  J0    =-.3916E+00
 Associated 3-d length scales (meters)
 LQ    =      0.41  LM    =  99999.00  Lm    =  99999.00  Lb    =  99999.00
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     41.83  FRD0  =     11.98  R     =  99999.00  PL    =  140.00
 (slot)             (port/nozzle)

RECOMPUTED SOURCE CONDITIONS FOR RISER GROUPS:
 Properties of riser group with  1 ports/nozzles each:
 U0    =      4.245 D0    =      0.468 A0    =      0.172 THETA =     47.00
 FR0   =     41.83  FRD0  =     11.98  R     =  99999.00
 (slot)             (riser group)

FLOW CLASSIFICATION
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
 D  Flow class (D-CORMIX)     =    MNU7     D
 D  Applicable layer depth HS =     8.50    D
 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

## Appendix-F: CORMIX 10.0.3.0 Prediction File for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-2

```
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.3350E+05  CUNITS=  ppm
 NTOX  =  0
 NSTD  =  1         CSTD  =0.2000E+04
 REGMZ =  1
 REGSPC=  1         XREG  =    100.00  WREG  =      0.00  AREG  =      0.00
 XINT  =   3500.00  XMAX  =   3500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE an at the diffuser mid-point:
       461.48 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP =100 display intervals per module
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   Uc = Local centerline excess velocity (above ambient)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH       Uc        TT
      0.00     0.00   -5.70     1.0 0.335E+05   0.03     4.48     4.245   .00000E+00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
BEGIN MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER

 Because of the FANNED-OUT HORIZONTAL ORIENTATION of the diffuser jets,
   the near-field dilution is slightly improved.

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =    8.50m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      0.00     0.00   -5.70     1.0 0.335E+05   0.03     4.48 .00000E+00
      0.04     0.00   -5.70     1.7 0.199E+05   0.08     4.41 .17799E-01
      0.09     0.00   -5.70     2.0 0.170E+05   0.17     4.35 .41601E-01
      0.13     0.00   -5.70     2.2 0.153E+05   0.25     4.29 .69310E-01
      0.18     0.00   -5.69     2.4 0.141E+05   0.34     4.23 .10018E+00
      0.22     0.00   -5.69     2.5 0.132E+05   0.42     4.17 .13378E+00
      0.27     0.00   -5.69     2.7 0.125E+05   0.51     4.11 .16981E+00
      0.31     0.00   -5.69     2.8 0.119E+05   0.60     4.06 .20806E+00
      0.36     0.00   -5.69     2.9 0.114E+05   0.68     4.00 .24838E+00
      0.40     0.00   -5.69     3.1 0.109E+05   0.76     3.95 .29061E+00
      0.45     0.00   -5.68     3.2 0.106E+05   0.85     3.90 .33466E+00
      0.49     0.00   -5.68     3.3 0.102E+05   0.93     3.85 .38043E+00
      0.54     0.00   -5.68     3.4 0.992E+04   1.02     3.80 .42783E+00
      0.58     0.00   -5.68     3.5 0.964E+04   1.10     3.76 .47681E+00
      0.63     0.00   -5.68     3.6 0.939E+04   1.19     3.71 .52729E+00
      0.67     0.00   -5.68     3.7 0.916E+04   1.27     3.67 .57923E+00
```

**Appendix-F: CORMIX 10.0.3.0 Prediction File for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-3**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.72 | 0.00 | -5.68 | 3.7 | 0.894E+04 | 1.36 | 3.62 | .63257E+00 |
| 0.76 | 0.00 | -5.67 | 3.8 | 0.875E+04 | 1.44 | 3.58 | .68727E+00 |
| 0.81 | 0.00 | -5.67 | 3.9 | 0.856E+04 | 1.53 | 3.54 | .74329E+00 |
| 0.85 | 0.00 | -5.67 | 4.0 | 0.839E+04 | 1.61 | 3.50 | .80058E+00 |
| 0.90 | 0.00 | -5.67 | 4.1 | 0.823E+04 | 1.70 | 3.46 | .85913E+00 |
| 0.94 | 0.00 | -5.67 | 4.1 | 0.808E+04 | 1.78 | 3.43 | .91889E+00 |
| 0.99 | 0.00 | -5.67 | 4.2 | 0.794E+04 | 1.87 | 3.39 | .97983E+00 |
| 1.03 | 0.00 | -5.66 | 4.3 | 0.780E+04 | 1.95 | 3.35 | .10419E+01 |
| 1.08 | 0.00 | -5.66 | 4.4 | 0.768E+04 | 2.04 | 3.32 | .11052E+01 |
| 1.12 | 0.00 | -5.66 | 4.4 | 0.756E+04 | 2.12 | 3.29 | .11695E+01 |
| 1.16 | 0.00 | -5.66 | 4.5 | 0.744E+04 | 2.21 | 3.25 | .12350E+01 |
| 1.21 | 0.00 | -5.66 | 4.6 | 0.733E+04 | 2.30 | 3.22 | .13015E+01 |
| 1.25 | 0.00 | -5.66 | 4.6 | 0.723E+04 | 2.38 | 3.19 | .13690E+01 |
| 1.30 | 0.00 | -5.66 | 4.7 | 0.713E+04 | 2.47 | 3.16 | .14376E+01 |
| 1.34 | 0.00 | -5.65 | 4.8 | 0.704E+04 | 2.55 | 3.13 | .15072E+01 |
| 1.39 | 0.00 | -5.65 | 4.8 | 0.695E+04 | 2.64 | 3.10 | .15777E+01 |
| 1.43 | 0.00 | -5.65 | 4.9 | 0.686E+04 | 2.72 | 3.07 | .16493E+01 |
| 1.48 | 0.00 | -5.65 | 4.9 | 0.678E+04 | 2.81 | 3.04 | .17218E+01 |
| 1.52 | 0.00 | -5.65 | 5.0 | 0.670E+04 | 2.89 | 3.02 | .17953E+01 |
| 1.57 | 0.00 | -5.65 | 5.1 | 0.662E+04 | 2.98 | 2.99 | .18696E+01 |
| 1.61 | 0.00 | -5.64 | 5.1 | 0.654E+04 | 3.06 | 2.96 | .19450E+01 |
| 1.66 | 0.00 | -5.64 | 5.2 | 0.647E+04 | 3.15 | 2.94 | .20212E+01 |
| 1.70 | 0.00 | -5.64 | 5.2 | 0.640E+04 | 3.23 | 2.91 | .20983E+01 |
| 1.75 | 0.00 | -5.64 | 5.3 | 0.634E+04 | 3.32 | 2.89 | .21763E+01 |
| 1.79 | 0.00 | -5.64 | 5.3 | 0.627E+04 | 3.40 | 2.86 | .22551E+01 |
| 1.84 | 0.00 | -5.64 | 5.4 | 0.621E+04 | 3.49 | 2.84 | .23348E+01 |
| 1.88 | 0.00 | -5.64 | 5.4 | 0.615E+04 | 3.57 | 2.82 | .24154E+01 |
| 1.93 | 0.00 | -5.63 | 5.5 | 0.609E+04 | 3.66 | 2.80 | .24968E+01 |
| 1.97 | 0.00 | -5.63 | 5.6 | 0.603E+04 | 3.74 | 2.77 | .25790E+01 |
| 2.02 | 0.00 | -5.63 | 5.6 | 0.598E+04 | 3.83 | 2.75 | .26621E+01 |
| 2.06 | 0.00 | -5.63 | 5.7 | 0.592E+04 | 3.91 | 2.73 | .27460E+01 |
| 2.11 | 0.00 | -5.63 | 5.7 | 0.587E+04 | 4.00 | 2.71 | .28306E+01 |
| 2.15 | 0.00 | -5.63 | 5.8 | 0.582E+04 | 4.08 | 2.69 | .29161E+01 |
| 2.20 | 0.00 | -5.63 | 5.8 | 0.577E+04 | 4.17 | 2.67 | .30023E+01 |
| 2.24 | 0.00 | -5.62 | 5.9 | 0.572E+04 | 4.25 | 2.65 | .30893E+01 |
| 2.28 | 0.00 | -5.62 | 5.9 | 0.568E+04 | 4.34 | 2.64 | .31771E+01 |
| 2.33 | 0.00 | -5.62 | 6.0 | 0.563E+04 | 4.42 | 2.62 | .32657E+01 |
| 2.37 | 0.00 | -5.62 | 6.0 | 0.559E+04 | 4.51 | 2.60 | .33550E+01 |
| 2.42 | 0.00 | -5.62 | 6.0 | 0.554E+04 | 4.59 | 2.58 | .34450E+01 |
| 2.46 | 0.00 | -5.62 | 6.1 | 0.550E+04 | 4.68 | 2.57 | .35358E+01 |
| 2.51 | 0.00 | -5.61 | 6.1 | 0.546E+04 | 4.76 | 2.55 | .36273E+01 |
| 2.55 | 0.00 | -5.61 | 6.2 | 0.542E+04 | 4.85 | 2.54 | .37196E+01 |
| 2.60 | 0.00 | -5.61 | 6.2 | 0.538E+04 | 4.93 | 2.52 | .38125E+01 |
| 2.64 | 0.00 | -5.61 | 6.3 | 0.534E+04 | 5.02 | 2.51 | .39062E+01 |
| 2.69 | 0.00 | -5.61 | 6.3 | 0.530E+04 | 5.10 | 2.49 | .40006E+01 |
| 2.73 | 0.00 | -5.61 | 6.4 | 0.527E+04 | 5.19 | 2.48 | .40957E+01 |
| 2.78 | 0.00 | -5.61 | 6.4 | 0.523E+04 | 5.27 | 2.46 | .41915E+01 |
| 2.82 | 0.00 | -5.60 | 6.4 | 0.519E+04 | 5.36 | 2.45 | .42880E+01 |
| 2.87 | 0.00 | -5.60 | 6.5 | 0.516E+04 | 5.44 | 2.44 | .43851E+01 |
| 2.91 | 0.00 | -5.60 | 6.5 | 0.513E+04 | 5.53 | 2.43 | .44829E+01 |
| 2.96 | 0.00 | -5.60 | 6.6 | 0.509E+04 | 5.61 | 2.42 | .45815E+01 |
| 3.00 | 0.00 | -5.60 | 6.6 | 0.506E+04 | 5.70 | 2.40 | .46806E+01 |
| 3.05 | 0.00 | -5.60 | 6.7 | 0.503E+04 | 5.78 | 2.39 | .47805E+01 |
| 3.09 | 0.00 | -5.59 | 6.7 | 0.500E+04 | 5.87 | 2.38 | .48810E+01 |
| 3.14 | 0.00 | -5.59 | 6.7 | 0.497E+04 | 5.95 | 2.37 | .49821E+01 |
| 3.18 | 0.00 | -5.59 | 6.8 | 0.494E+04 | 6.04 | 2.36 | .50840E+01 |
| 3.23 | 0.00 | -5.59 | 6.8 | 0.491E+04 | 6.12 | 2.36 | .51864E+01 |
| 3.27 | 0.00 | -5.59 | 6.9 | 0.488E+04 | 6.21 | 2.35 | .52895E+01 |
| 3.32 | 0.00 | -5.59 | 6.9 | 0.485E+04 | 6.29 | 2.34 | .53932E+01 |
| 3.36 | 0.00 | -5.59 | 6.9 | 0.482E+04 | 6.38 | 2.33 | .54976E+01 |
| 3.40 | 0.00 | -5.58 | 7.0 | 0.480E+04 | 6.46 | 2.32 | .56026E+01 |
| 3.45 | 0.00 | -5.58 | 7.0 | 0.477E+04 | 6.55 | 2.32 | .57082E+01 |
| 3.49 | 0.00 | -5.58 | 7.1 | 0.474E+04 | 6.63 | 2.31 | .58144E+01 |
| 3.54 | 0.00 | -5.58 | 7.1 | 0.472E+04 | 6.72 | 2.31 | .59213E+01 |
| 3.58 | 0.00 | -5.58 | 7.1 | 0.469E+04 | 6.80 | 2.30 | .60287E+01 |
| 3.63 | 0.00 | -5.58 | 7.2 | 0.467E+04 | 6.89 | 2.29 | .61368E+01 |
| 3.67 | 0.00 | -5.57 | 7.2 | 0.464E+04 | 6.97 | 2.29 | .62455E+01 |

## Appendix-F: CORMIX 10.0.3.0 Prediction File for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-4

```
      3.72     0.00   -5.57     7.3 0.462E+04   7.06     2.28 .63547E+01
      3.76     0.00   -5.57     7.3 0.459E+04   7.14     2.28 .64646E+01
      3.81     0.00   -5.57     7.3 0.457E+04   7.23     2.28 .65750E+01
      3.85     0.00   -5.57     7.4 0.455E+04   7.31     2.27 .66861E+01
      3.90     0.00   -5.57     7.4 0.452E+04   7.40     2.27 .67977E+01
      3.94     0.00   -5.57     7.4 0.450E+04   7.48     2.27 .69099E+01
      3.99     0.00   -5.56     7.5 0.448E+04   7.57     2.26 .70227E+01
      4.03     0.00   -5.56     7.5 0.446E+04   7.65     2.26 .71361E+01
      4.08     0.00   -5.56     7.5 0.444E+04   7.74     2.26 .72501E+01
      4.12     0.00   -5.56     7.6 0.442E+04   7.82     2.26 .73646E+01
      4.17     0.00   -5.56     7.6 0.440E+04   7.91     2.25 .74796E+01
      4.21     0.00   -5.56     7.7 0.438E+04   7.99     2.25 .75953E+01
      4.26     0.00   -5.55     7.7 0.436E+04   8.08     2.25 .77115E+01
      4.30     0.00   -5.55     7.7 0.434E+04   8.16     2.25 .78283E+01
      4.35     0.00   -5.55     7.8 0.432E+04   8.25     2.25 .79456E+01
      4.39     0.00   -5.55     7.8 0.430E+04   8.33     2.25 .80634E+01
      4.44     0.00   -5.55     7.8 0.428E+04   8.42     2.25 .81819E+01
      4.48     0.00   -5.55     7.9 0.426E+04   8.50     2.25 .83008E+01
 Cumulative travel time =           8.3008 sec  (    0.00 hrs)
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD271: ACCELERATION ZONE OF UNIDIRECTIONAL CO-FLOWING DIFFUSER
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BEGIN MOD251: DIFFUSER PLUME IN CO-FLOW

 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

       X        Y       Z        S       C       BV       BH        TT
      4.48     0.00   -8.50     7.9 0.426E+04   8.50     2.52 .83008E+01
     13.21     0.00   -8.50     9.2 0.363E+04   8.50     3.46 .87077E+02
     21.94     0.00   -8.50    10.4 0.322E+04   8.50     4.40 .17751E+03
     30.66     0.00   -8.50    11.5 0.292E+04   8.50     5.34 .27825E+03
     39.39     0.00   -8.50    12.4 0.269E+04   8.50     6.28 .38834E+03
     48.12     0.00   -8.50    13.4 0.251E+04   8.50     7.21 .50704E+03
     56.85     0.00   -8.50    14.2 0.236E+04   8.50     8.15 .63376E+03
     65.58     0.00   -8.50    15.0 0.223E+04   8.50     9.08 .76803E+03
     74.30     0.00   -8.50    15.7 0.213E+04   8.50    10.02 .90945E+03
     83.03     0.00   -8.50    16.5 0.203E+04   8.50    10.95 .10577E+04
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.200E+04 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     91.76     0.00   -8.50    17.2 0.195E+04   8.50    11.88 .12124E+04
 ** REGULATORY MIXING ZONE BOUNDARY is within the Near-Field Region **
  In this prediction interval the plume DOWNSTREAM distance meets or exceeds
  the regulatory value =   100.00 m.
  This is the extent of the REGULATORY MIXING ZONE.
    100.49     0.00   -8.50    17.8 0.188E+04   8.50    12.81 .13733E+04
    109.22     0.00   -8.50    18.5 0.181E+04   8.50    13.74 .15403E+04
    117.94     0.00   -8.50    19.1 0.175E+04   8.50    14.67 .17131E+04
    126.67     0.00   -8.50    19.7 0.170E+04   8.50    15.60 .18914E+04
    135.40     0.00   -8.50    20.3 0.165E+04   8.50    16.53 .20752E+04
    144.13     0.00   -8.50    20.8 0.161E+04   8.50    17.46 .22643E+04
```

**Appendix-F: CORMIX 10.0.3.0 Prediction File for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-5**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 152.86 | 0.00 | -8.50 | 21.4 | 0.157E+04 | 8.50 | 18.38 | .24585E+04 |
| 161.58 | 0.00 | -8.50 | 21.9 | 0.153E+04 | 8.50 | 19.31 | .26578E+04 |
| 170.31 | 0.00 | -8.50 | 22.5 | 0.149E+04 | 8.50 | 20.24 | .28619E+04 |
| 179.04 | 0.00 | -8.50 | 23.0 | 0.146E+04 | 8.50 | 21.16 | .30708E+04 |
| 187.77 | 0.00 | -8.50 | 23.5 | 0.143E+04 | 8.50 | 22.08 | .32843E+04 |
| 196.50 | 0.00 | -8.50 | 24.0 | 0.140E+04 | 8.50 | 23.01 | .35024E+04 |
| 205.22 | 0.00 | -8.50 | 24.4 | 0.137E+04 | 8.50 | 23.93 | .37250E+04 |
| 213.95 | 0.00 | -8.50 | 24.9 | 0.134E+04 | 8.50 | 24.85 | .39519E+04 |
| 222.68 | 0.00 | -8.50 | 25.4 | 0.132E+04 | 8.50 | 25.77 | .41832E+04 |
| 231.41 | 0.00 | -8.50 | 25.8 | 0.130E+04 | 8.50 | 26.70 | .44186E+04 |
| 240.14 | 0.00 | -8.50 | 26.3 | 0.128E+04 | 8.50 | 27.62 | .46582E+04 |
| 248.86 | 0.00 | -8.50 | 26.7 | 0.125E+04 | 8.50 | 28.54 | .49019E+04 |
| 257.59 | 0.00 | -8.50 | 27.1 | 0.123E+04 | 8.50 | 29.46 | .51496E+04 |
| 266.32 | 0.00 | -8.50 | 27.6 | 0.122E+04 | 8.50 | 30.37 | .54013E+04 |
| 275.05 | 0.00 | -8.50 | 28.0 | 0.120E+04 | 8.50 | 31.29 | .56568E+04 |
| 283.78 | 0.00 | -8.50 | 28.4 | 0.118E+04 | 8.50 | 32.21 | .59161E+04 |
| 292.50 | 0.00 | -8.50 | 28.8 | 0.116E+04 | 8.50 | 33.13 | .61793E+04 |
| 301.23 | 0.00 | -8.50 | 29.2 | 0.115E+04 | 8.50 | 34.04 | .64461E+04 |
| 309.96 | 0.00 | -8.50 | 29.6 | 0.113E+04 | 8.50 | 34.96 | .67166E+04 |
| 318.69 | 0.00 | -8.50 | 30.0 | 0.112E+04 | 8.50 | 35.88 | .69907E+04 |
| 327.42 | 0.00 | -8.50 | 30.4 | 0.110E+04 | 8.50 | 36.79 | .72684E+04 |
| 336.14 | 0.00 | -8.50 | 30.8 | 0.109E+04 | 8.50 | 37.71 | .75496E+04 |
| 344.87 | 0.00 | -8.50 | 31.1 | 0.108E+04 | 8.50 | 38.62 | .78343E+04 |
| 353.60 | 0.00 | -8.50 | 31.5 | 0.106E+04 | 8.50 | 39.54 | .81224E+04 |
| 362.33 | 0.00 | -8.50 | 31.9 | 0.105E+04 | 8.50 | 40.45 | .84139E+04 |
| 371.06 | 0.00 | -8.50 | 32.2 | 0.104E+04 | 8.50 | 41.36 | .87088E+04 |
| 379.78 | 0.00 | -8.50 | 32.6 | 0.103E+04 | 8.50 | 42.28 | .90070E+04 |
| 388.51 | 0.00 | -8.50 | 33.0 | 0.102E+04 | 8.50 | 43.19 | .93084E+04 |
| 397.24 | 0.00 | -8.50 | 33.3 | 0.101E+04 | 8.50 | 44.10 | .96132E+04 |
| 405.97 | 0.00 | -8.50 | 33.7 | 0.996E+03 | 8.50 | 45.01 | .99211E+04 |
| 414.70 | 0.00 | -8.50 | 34.0 | 0.985E+03 | 8.50 | 45.92 | .10232E+05 |
| 423.42 | 0.00 | -8.50 | 34.3 | 0.976E+03 | 8.50 | 46.83 | .10547E+05 |
| 432.15 | 0.00 | -8.50 | 34.7 | 0.966E+03 | 8.50 | 47.74 | .10864E+05 |
| 440.88 | 0.00 | -8.50 | 35.0 | 0.957E+03 | 8.50 | 48.65 | .11184E+05 |
| 449.61 | 0.00 | -8.50 | 35.3 | 0.948E+03 | 8.50 | 49.56 | .11508E+05 |
| 458.34 | 0.00 | -8.50 | 35.7 | 0.939E+03 | 8.50 | 50.47 | .11834E+05 |
| 467.06 | 0.00 | -8.50 | 36.0 | 0.931E+03 | 8.50 | 51.38 | .12164E+05 |
| 475.79 | 0.00 | -8.50 | 36.3 | 0.923E+03 | 8.50 | 52.29 | .12497E+05 |
| 484.52 | 0.00 | -8.50 | 36.6 | 0.915E+03 | 8.50 | 53.20 | .12832E+05 |
| 493.25 | 0.00 | -8.50 | 36.9 | 0.907E+03 | 8.50 | 54.11 | .13170E+05 |
| 501.98 | 0.00 | -8.50 | 37.3 | 0.899E+03 | 8.50 | 55.01 | .13512E+05 |
| 510.70 | 0.00 | -8.50 | 37.6 | 0.892E+03 | 8.50 | 55.92 | .13856E+05 |
| 519.43 | 0.00 | -8.50 | 37.9 | 0.884E+03 | 8.50 | 56.83 | .14203E+05 |
| 528.16 | 0.00 | -8.50 | 38.2 | 0.877E+03 | 8.50 | 57.73 | .14553E+05 |
| 536.89 | 0.00 | -8.50 | 38.5 | 0.870E+03 | 8.50 | 58.64 | .14905E+05 |
| 545.62 | 0.00 | -8.50 | 38.8 | 0.864E+03 | 8.50 | 59.54 | .15261E+05 |
| 554.34 | 0.00 | -8.50 | 39.1 | 0.857E+03 | 8.50 | 60.45 | .15619E+05 |
| 563.07 | 0.00 | -8.50 | 39.4 | 0.851E+03 | 8.50 | 61.35 | .15980E+05 |
| 571.80 | 0.00 | -8.50 | 39.7 | 0.844E+03 | 8.50 | 62.26 | .16344E+05 |
| 580.53 | 0.00 | -8.50 | 40.0 | 0.838E+03 | 8.50 | 63.16 | .16710E+05 |
| 589.26 | 0.00 | -8.50 | 40.3 | 0.832E+03 | 8.50 | 64.07 | .17079E+05 |
| 597.98 | 0.00 | -8.50 | 40.6 | 0.826E+03 | 8.50 | 64.97 | .17451E+05 |
| 606.71 | 0.00 | -8.50 | 40.8 | 0.820E+03 | 8.50 | 65.87 | .17825E+05 |
| 615.44 | 0.00 | -8.50 | 41.1 | 0.815E+03 | 8.50 | 66.78 | .18202E+05 |
| 624.17 | 0.00 | -8.50 | 41.4 | 0.809E+03 | 8.50 | 67.68 | .18582E+05 |
| 632.90 | 0.00 | -8.50 | 41.7 | 0.804E+03 | 8.50 | 68.58 | .18964E+05 |
| 641.62 | 0.00 | -8.50 | 42.0 | 0.798E+03 | 8.50 | 69.48 | .19348E+05 |
| 650.35 | 0.00 | -8.50 | 42.2 | 0.793E+03 | 8.50 | 70.38 | .19736E+05 |
| 659.08 | 0.00 | -8.50 | 42.5 | 0.788E+03 | 8.50 | 71.28 | .20125E+05 |
| 667.81 | 0.00 | -8.50 | 42.8 | 0.783E+03 | 8.50 | 72.18 | .20518E+05 |
| 676.54 | 0.00 | -8.50 | 43.1 | 0.778E+03 | 8.50 | 73.08 | .20913E+05 |
| 685.26 | 0.00 | -8.50 | 43.3 | 0.773E+03 | 8.50 | 73.98 | .21310E+05 |
| 693.99 | 0.00 | -8.50 | 43.6 | 0.768E+03 | 8.50 | 74.88 | .21710E+05 |
| 702.72 | 0.00 | -8.50 | 43.9 | 0.764E+03 | 8.50 | 75.78 | .22112E+05 |
| 711.45 | 0.00 | -8.50 | 44.1 | 0.759E+03 | 8.50 | 76.68 | .22517E+05 |
| 720.18 | 0.00 | -8.50 | 44.4 | 0.755E+03 | 8.50 | 77.58 | .22924E+05 |
| 728.90 | 0.00 | -8.50 | 44.6 | 0.750E+03 | 8.50 | 78.48 | .23333E+05 |

**Appendix-F: CORMIX 10.0.3.0 Prediction File for Monthly-Case #2, $\Delta T = +0^0$ C; Sheet F-6**

```
    737.63     0.00   -8.50    44.9 0.746E+03   8.50    79.38 .23745E+05
    746.36     0.00   -8.50    45.2 0.742E+03   8.50    80.28 .24159E+05
    755.09     0.00   -8.50    45.4 0.737E+03   8.50    81.17 .24576E+05
    763.82     0.00   -8.50    45.7 0.733E+03   8.50    82.07 .24995E+05
    772.54     0.00   -8.50    45.9 0.729E+03   8.50    82.97 .25416E+05
    781.27     0.00   -8.50    46.2 0.725E+03   8.50    83.87 .25840E+05
    790.00     0.00   -8.50    46.4 0.721E+03   8.50    84.76 .26266E+05
    798.73     0.00   -8.50    46.7 0.718E+03   8.50    85.66 .26694E+05
    807.46     0.00   -8.50    46.9 0.714E+03   8.50    86.55 .27125E+05
    816.18     0.00   -8.50    47.2 0.710E+03   8.50    87.45 .27558E+05
    824.91     0.00   -8.50    47.4 0.706E+03   8.50    88.34 .27993E+05
    833.64     0.00   -8.50    47.7 0.703E+03   8.50    89.24 .28430E+05
    842.37     0.00   -8.50    47.9 0.699E+03   8.50    90.13 .28870E+05
    851.10     0.00   -8.50    48.2 0.696E+03   8.50    91.03 .29312E+05
    859.83     0.00   -8.50    48.4 0.692E+03   8.50    91.92 .29756E+05
    868.55     0.00   -8.50    48.6 0.689E+03   8.50    92.82 .30202E+05
    877.28     0.00   -8.50    48.9 0.685E+03   8.50    93.71 .30651E+05
 Cumulative travel time =       30650.6426 sec  (    8.51 hrs)

 Entire region is occupied by Phase 1.
   Plume does not re-stratify in this flow region.

END OF MOD251: DIFFUSER PLUME IN CO-FLOW
-----------------------------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 SIMULATION STOPS because of STAGNANT AMBIENT conditions.
   All far-field processes will be UNSTEADY.
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------
D-CORMIX      End of Prediction File
DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
```

**Appendix-F: CORMIX 10.0.3.0 Prediction File for Monthly-Case #2, $\Delta T$ = +0$^0$ C; Sheet F-7**

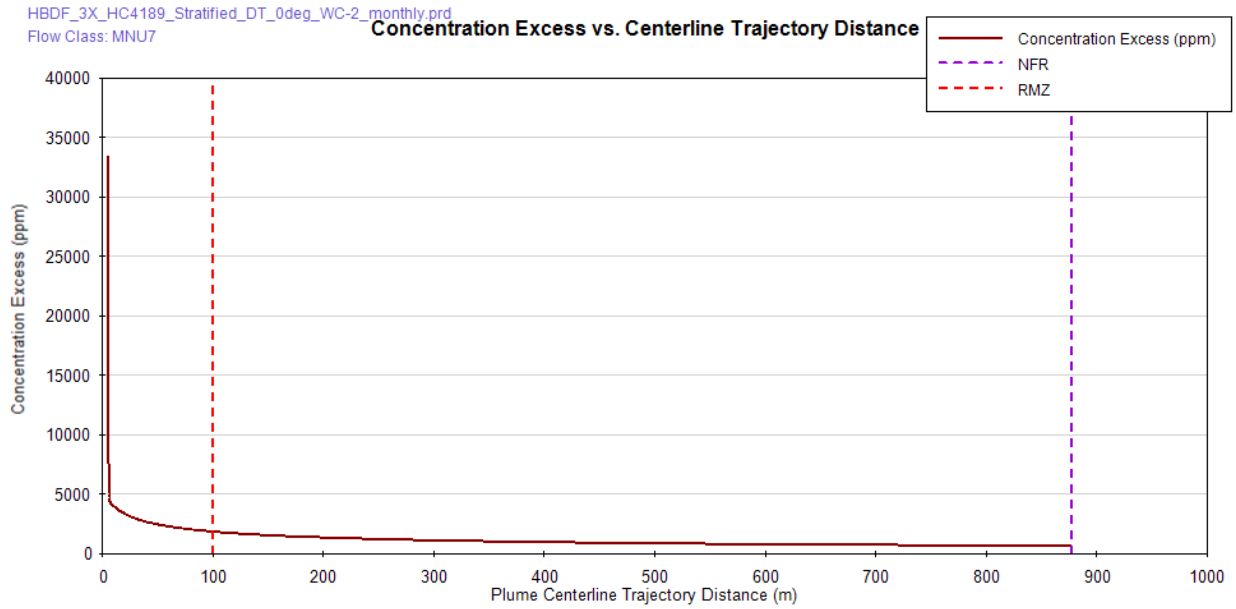


**Figure F-1:** Excess Salinity in ppm as a function of centerline trajectory distance for Monthly-Case #2, $\Delta T$ = +0$^0$ C.

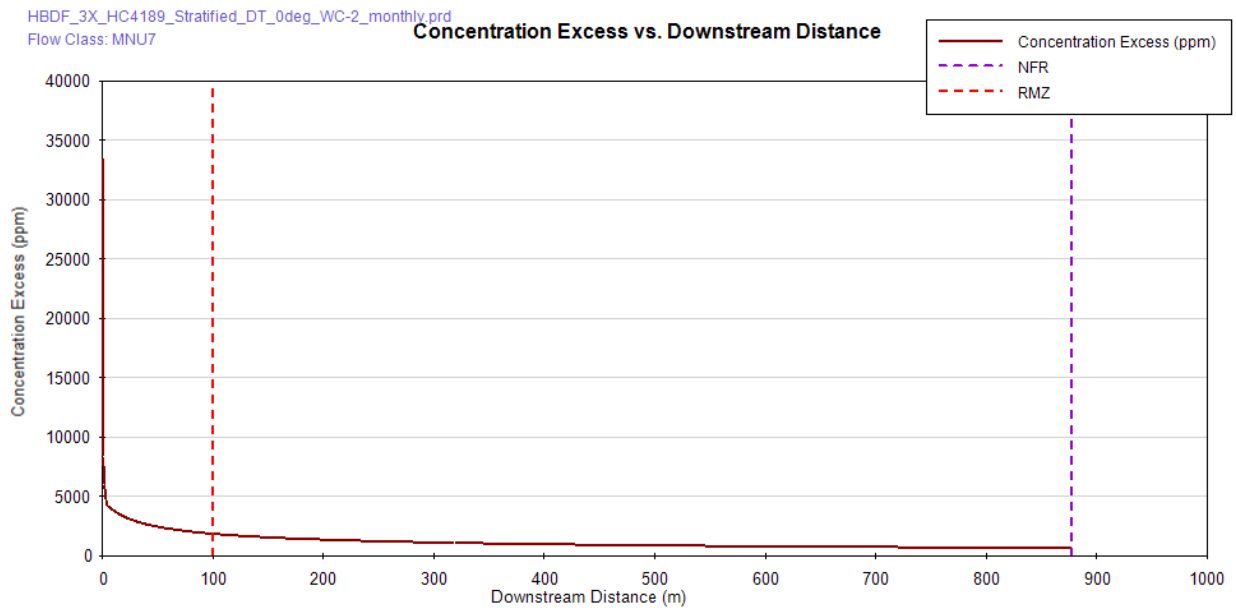


**Figure F-2:** Excess Salinity in ppm as a function of distance downstream for Monthly-Case #2, $\Delta T$ = +0$^0$ C

**Appendix-F: CORMIX 10.0.3.0 Prediction File for Monthly-Case #2, $\Delta T$ = 0$^0$ C; Sheet F-8**

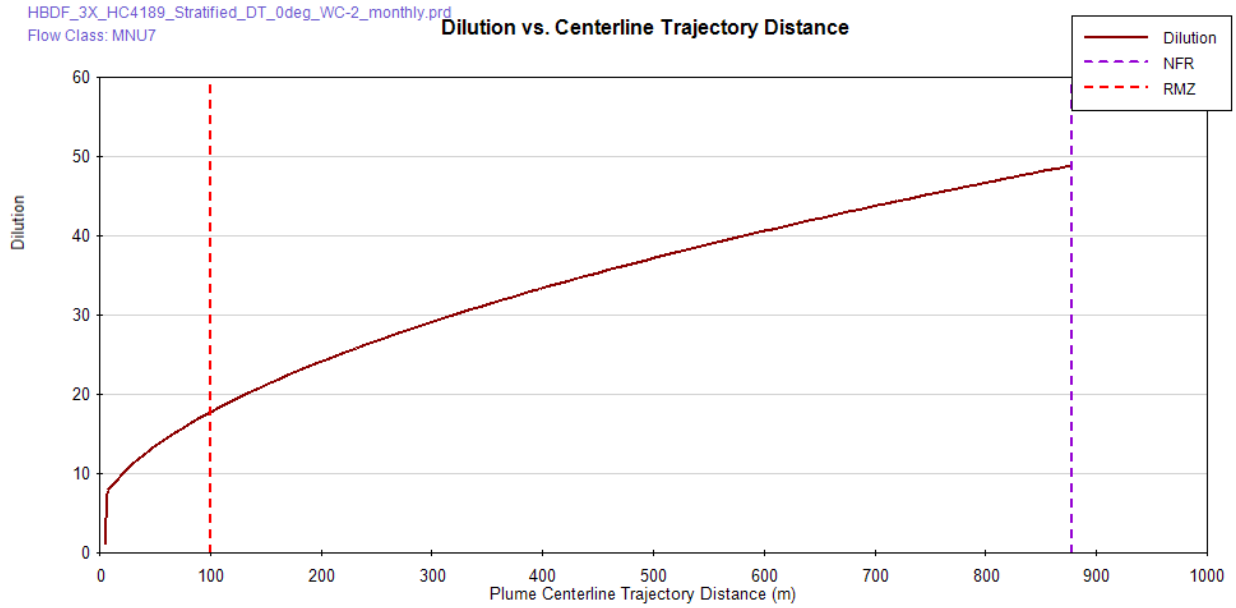


**Figure F-3:** Dilution expressed as mixing ratio, S**,** as a function of centerline trajectory distance for Monthly-Case #2, $\Delta T$ = +0$^0$ C. Note S = 1 + Dm

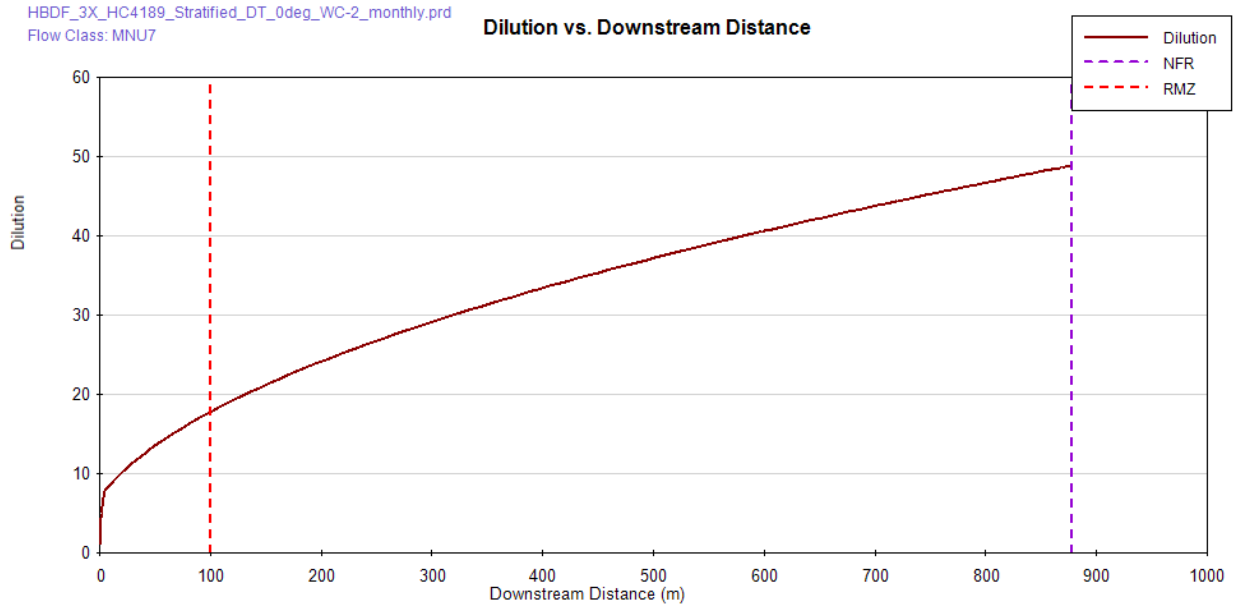


**Figure F-4:** Dilution expressed as mixing ratio, S**,** as a function of distance downstream for Monthly-Case #2, $\Delta T$ = +0$^0$ C. Note S = 1 + Dm

**References:**

Burridge, H.C., Parker, D.A., Kruger, J.L.,Partridge J.L. and P.F. Linden, 2016a, "The significance of engulfment in the process of turbulent entrainment by plumes", VIIIth Int. Symp. on Stratified Flows, San Diego, USA, Aug. 29 - Sept. 1, 2016, 7pp.

Burridge, H.C., Partridge J.L. and P.F. Linden**,** 2016b, "The Fluxes and Behaviour of Plumes Inferred from Measurements of Coherent Structures within Images of the Bulk Flow", *Atmosphere-Ocean* 54 (4) 2016, 403–417 http://dx.doi.org/10.1080/07055900.2016.1175337

Cada, G, T. Carlson, J. Ferguson, M Richmond, and M. Sale. 1999. Exploring the Role of Shear Stress and Severe Turbulence in Downstream Fish Passage. Oak Ridge National Laboratory, Technical report, 11 pp.

Cada, G.F., J.M. Loar, L.A. Garrison, R.K. Fisher, and D. Neitzel. 2006. Efforts to Reduce Mortality to Hydroelectric Turbine-Passed Fish: Locating and Quantifying Damaging Shear Stresses. *Environmental Management* 37(6): 898-906.

Cada, G.F, L.A. Garrison, and R.K. Fisher Jr. 2007. Determining the Effects of Shear Stress on Fish Mortality during Turbine Passage. *Hydro Review*, November 2007, p 52-58.

Fischer, H.B., E.J. List, R.C.Y. Koh and J. Imberger. 1979. *Mixing in Inland and Coastal Waters.* Academic Press., ISBN: 9780122581502, 302 pp.

Foster, M.S., G.M. Cailliet, J. Callaway, P. Raimondi, and J. Steinbeck. 2012. Mitigation and Fees for the Intake of Seawater by Desalination and Power Plants. Report to State Water Resources Control Board, Sacramento.

Foster, M.S., G.M. Cailliet, J. Callaway, K. Mead-Vetter, P. Raimondi, and P. Roberts. 2013. Desalination Plant Entrainment Impacts and Mitigation, Report to State Water Resources Control Board, Sacramento.

Grant, H.L., R.W. Stewart, and A. Moilliet. 1962. Turbulence Spectra from a Tidal Channel. *J. Fluid Mech*. 12: 241-268.

Greenewelt, C.H. 1962. Dimensional Relationships for Flying and Swimming Animals. *Smithsonian Miscellaneous Collections*, no. 144, 28 pp.

Heisenberg, W. 1948. *Proc. Roy. Soc*. A., vol. 195, no. 402.

Hertel, H. 1977. *Structure, Form and Movement*, Reinhold Press, 1966

Jenkins, S.A., S. Aijaz, and J. Wasyl. 1992. Transport of Fine Sediments by Hydrostatic Jets. *Nearshore and Estuarine Cohesive Sediment Transport*, American Geophysical Union, v. 42, 1992, p. 331–347.

Jenkins, S. 2017. "Alternative Hydrodynamic Model Analysis Alden 3-Jet Duckbill Diffuser Retrofit at Huntington Beach Desalination Facility (HBDF)-Version 2". Submitted to Poseidon Resources (Surfside) LLC, 29 November 2017, 114 pp.

Jessop, M.J. 2007. The Quick and the Dead: Larval Mortality Due to Turbulent Tidal Transport. *J. Mar. Biol. Ass*. 87: 675-680.

Kolmogorov, A. N. 1941. *C.R. Acad. Sci., USSR*., vol 30, no.301.

Landahl, M.T. and E. Mollo-Christensen, 1992, *Turbulence and Random Processes in Fluid Mechanics*, Cambridge Press, 2ed, ISBN-13: 978-0521422130

LePage, S., 2004, "Salinity tolerance investigation: supplemental report for the Huntington Beach Desalination Project", submitted to Poseidon Resources, 29 pp.

Marcy, B.C., Jr., A.D. Beck, and R.E. Ulanowicz. 1978. Effects and Impacts of Physical Stress on Entrained Organisms. In: Schubel, J. R. and Marcy, B.C., Jr. (eds.) Power Plant Entrainment: a Biological Assessment. NY, Academic Press, pp. 135-188.

MBC Applied Environmental Sciences and Tenera Environmental (MBC and Tenera). 2005. AES Huntington Beach L.L.C. Generating Station Entrainment and Impingement Study Final Report. Submitted to AES Huntington Beach L.L.C.

MBC. 2016. Huntington Beach Desalination Facility: Diffuser Discharge Analysis. Submitted to Poseidon Resources (Surfside) LLC, March, 2016, 72 pp.

MBC Applied Environmental Sciences (MBC). 2017. Huntington Beach Desalination Facility: intake location entrainment analysis. Prepared for Poseidon Water.

Miller, E., 2017, "Diffuser-Specific Shearing Impact Assessment", Submitted to Poseidon Resources (Surfside) LLC, October, 2017.

Morgan, R.P., R.E. Ulanowicz, V.J. Rasin, L.A. Noe, and G. B. Gray. 1974. Effects of Shear on Eggs and Larvae of Striped Bass, *Morone saxatilis*, and White Perch, *M. americana*. *Transactions of the American Fisheries Society* 105(1): 149-154.

Neitzel, D.A., M.C. Richmond, D.D. Dauble, R.P. Mueller, R.A. Moursund, C.S. Abernethy, G.R. Guensch, and G.F. Cada. 2000. Laboratory Studies on the Effects of Shear on Fish. U. S. Department of Energy, Idaho Operations Office, DOE/ID-10822, Idaho Falls, Idaho.

Neitzel, D.A., D.D. Dauble, G.F. Cada, M.C. Richmond, G.R. Guensch, R.P. Mueller, C. S. Abernethy, and B. Amidan. 2004. Survival Estimates for Juvenile Fish Subjected to a Laboratory-Generated Shear Environment. *Transactions of the American Fisheries Society* 133(2): 447-454. DOI: 10.1577/02-021

Roberts, P.J.W. and K. Mead-Vetter. 2013. The Effects of Turbulence and Turbidity Due to Brine Diffusers on Larval Mortality: A Review. Appendix 1 to Foster et al. 2013. Prepared for the State Water Resources Control Board, Sacramento, CA.

Roberts, P.J.W. 2016. Modeling Brine Disposal into Monterey Bay. Prepared for ESA Environmental Science Associates, San Francisco, CA. July 6, 2016. 62 pp.

Roberts, P.J.W. 2017. Response to Memoranda from TWB Environmental and HDR Concerning Huntington Beach Desalination Plant. Submitted to CA State Lands Commission, 26 July 2017, 4 pp.

SEIR, 2010, "Subsequent Environmental Impact Report Sea Water Desalination Project at Huntington Beach," #2001051092, City of Huntington Beach, prepared by Dudek Consulting, May, 2010, 9 sections + append.

SWRCB, 2014, "DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND THE INCORPORATION OF OTHER NONSUBSTANTIVE CHANGES", Draft Staff Report Including the Draft Substitute Environmental Documentation Amendment to the Water Quality Control Plan For Ocean Waters of California, 206 pp.

SWRCB, 2015, State Water Resources Control Board. Final Staff Report Including the Final Substitute Environmental Documentation, Adopted May 6, 2017. Amendment to the Water Quality Control Plan For Ocean Waters of California Addressing: "DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND THE INCORPORATION OF OTHER NON-SUBSTANTIVE CHANGES", cf. Appendix-A: "Ocean Plan with the May 6, 2015 Final Desalination Amendment", 1303 pp.

Tenera Environmental, Inc. (Tenera). 2010. Entrainment and impingement effects from operation of the Huntington Beach Desalination Facility in standalone mode. Prepared for Poseidon Resources. Appendix M in Dudek. (2010). Draft Substitute Environmental Impact Report for the seawater desalination project at Huntington Beach. State Clearinghouse No. 2001051092. Prepared for the City of Huntington Beach.

Tenera Environmental, Inc. (Tenera). 2015. Memorandum on approach for APF calculations at Huntington Beach. Prepared for Poseidon Resources.

Tennekes, H. and J. Lumley. 1972. *A First Course in Turbulence*, MIT Press, ISBN: 9780262200196, 320 pp.

Trousdale, S. and E. Henderson. 2009. Sydney's Desalination Plant: Addressing Environmental Issues Using Innovative Design, Planning & Monitoring. *IDA World Congress – Atlantis,* The Palm, Dubai, UAE, November 7-12. REF: IDAWC/ DB09-023, 18 pp.

Ulanowicz, R.E. 1976. The Mechanical Effects of Water Flow on Fish Eggs and Larvae. In: Saila, S.B. (ed.) Fisheries and Energy Production: a Symposium. Lexington, MA, D.C. Heath, pp. 77-87.

Walter, R.K., M.E. Squibb, C.B. Woodson, J.R. Koseff, and S.G. Monismith. 2014. Stratified Turbulence in the Nearshore Coastal Ocean: Dynamics and Evolution in the Presence of Internal Bores. *Journal of Geophysical Research: Oceans* 119(12): 8709-8730.

Wygnanski, I. and H.E. Fiedler. 1969. Some Measurements in the Self-Preserving Jet. *Journal of Fluid Mechanics* 38(3): 577-612.